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Part III

Environmental Protection Agency

40 CFR Parts 80, 85 and 86

Air Pollution; Tier 2 Motor Vehicle Emission Standards and Gasoline Sulphur Control Requirements; Diesel Fuel Quality Controls; Proposed Rules

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 80, 85 and 86

[AMS–FRL–6337–3]

RIN 2060–AI23

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

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice of proposed rulemaking.

SUMMARY: Today's document proposes a major program designed to significantly reduce the emissions from new passenger cars and light trucks, including pickup trucks, minivans, and sport-utility vehicles. These reductions would provide for cleaner air and greater public health protection, by reducing ozone and PM pollution. The proposed 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 proposed program appears at the beginning of **SUPPLEMENTARY INFORMATION.**

For the first time, through a phase-in, we propose to apply a single average exhaust emission standard that would cover both passenger cars and all light trucks operated on any fuel. The proposed emission levels (''Tier 2 standards'') are feasible for both types of vehicles and are appropriate since the miles traveled in light trucks are increasing and the emissions from these vehicles are thus an increasing problem. This approach will 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.

To enable the vehicle technology and generate emission reductions from current vehicles we propose to significantly reduce average gasoline sulfur levels nationwide. Refiners would generally install refining equipment to remove sulfur in their refining processes, while importers would be required to market only gasoline meeting the proposed sulfur standards. The proposal outlines an averaging, banking, and trading program to provide flexibility for refiners and ease implementation.

This 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 from these vehicles will represent 30–40 percent of nitrogen oxides and volatile organic compound emissions in some cities, and almost 20 percent nationwide, by the year 2020.

Our proposal would bring about major reductions in annual emissions of these pollutants and also reduce the emissions of sulfur compounds coming from the sulfur in gasoline. For example, we project a reduction in oxides of nitrogen emissions of nearly 800,000 tons per year by 2007 and 1,200,000 by 2010, the time frame when many states will have to demonstrate compliance with air quality standards. Emission reductions would continue increasing for many years, reaching almost 2,200,000 tons per year in 2020. In addition, the proposed program would reduce the contribution of vehicles to other serious public health and environmental problems, including regional visibility problems, toxic air pollutants, acid rain, and nitrogen loading of estuaries.

Furthermore, we project that these reductions, and their resulting environmental benefits, would come at an average cost increase of less than $100 per passenger car, less than $200 per light truck, and an increase of less than 2 cents per gallon of gasoline (or about $100 over the life of an average vehicle).

DATES: *Comments:* We must receive your comments by August 2, 1999.

Hearings: We will hold four public hearings, on June 9–10, June 11, June 15, and June 17, 1999. EPA requests that parties who want to testify notify the contact person listed in the **ADDRESSES** section of this document two weeks before the date of the hearing.

ADDRESSES: *Comments:* You may send written comments in paper form or by E-mail. We must receive them by the date indicated under ''DATES'' above (August 2, 1999). Send paper copies of written comments (in duplicate if possible) to 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, SW, Washington, DC 20460. If possible, we also encourage you to send an electronic copy of your comments (in ASCII format) to the docket by e-mail to A-and-R-Docket@epa.gov or on a 3.5 inch diskette accompanying your paper copy. If you wish, you may send your comments by E-mail to the docket at the address listed above without the submission of a paper copy, but a paper copy will ensure the clarity of your comments.

Please also send a separate paper copy to the contact person listed below. If you send comments by E-mail alone, we ask that you send a copy of the E-mail message that contains the comments to the contact person listed below.

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.

Hearings: We will hold four public hearings at the following locations:

June 9–10, 1999, Top of the Tower, 1717 Arch Street, 51st Floor, Philadelphia, PA 19103, telephone: 215–567–8787, fax: 215–557–5171

June 11, 1999, Renaissance Atlanta Hotel, 590 West Peachtree Street, Atlanta, GA, 30308, telephone: 404–881–6000, fax: 404–815–5010

June 15, 1999, Doubletree Hotel, 3203 Quebec Street, Denver, CO, 80207, telephone: 303–321–3333, fax: 303–329–5233

June 17, 1999, Holiday Inn Lakeside City Center, 1111 Lakeside Avenue, Cleveland, OH 44144, telephone: 216–241–5100, fax: 216–241–7437

Additional information on the comment procedure and public hearings can be found in **SUPPLEMENTARY INFORMATION** under Section VII, ''Public Participation.''

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 Tier 2/ Gasoline Sulfur Proposal

For cars and light trucks, the proposed program would:

- Through a phase-in, apply for the first time a single average exhaust emission standard that would cover both passenger cars and all light trucks. The proposed emission levels (''Tier 2 standards'') are feasible for both types of vehicles and are appropriate since the miles traveled in light trucks is increasing and the emissions from these vehicles are thus an increasing problem.
- During the phase-in, apply interim 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 proposed new standards in a flexible way while ensuring that the expected 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, primarily affecting diesel powered vehicles.

• Set more stringent evaporative emission standards.

For commercial gasoline, the proposed program would:

• Significantly reduce average gasoline sulfur levels nationwide. Refiners would generally install refining equipment to remove sulfur in their refining processes. Importers of gasoline would be required to import and market only gasoline meeting the proposed sulfur limits.

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

• Apply temporary, less stringent gasoline sulfur standards to certain small refiners.

• Enable the new Tier 2 vehicles to meet the proposed emission standards, since sulfur in gasoline degrades a vehicle's emission control performance. Lower sulfur gasoline is also important in order to enable 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 proposed action would 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 would also affect you if you produce, distribute, or sell gasoline motor fuel.

The table below gives some examples of entities that may have to follow the proposed regulations. But because these are only examples, you should carefully examine the proposed and existing regulations in 40 CFR parts 80, 85 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 document is available electronically on the day of publication from the Environmental Protection Agency Internet Web site listed below. Electronic copies of the preamble, regulatory language, Draft Regulatory Impact Analysis, and other documents associated with today's proposal 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.

Environomental Protection Agency 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/omswww/

(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 significant progress has been made 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 will continue to help reduce car and truck emissions into the near future.

Nonetheless, due to increasing vehicle population and vehicle miles traveled, passenger cars and light trucks will be significant contributors to air pollution inventories into the indefinite future. In fact, the emission contribution of light trucks and sport utility vehicles will likely surpass that of passenger cars within the next year. (This is occurring because of the combination of growth in miles traveled by light trucks and their less stringent emission standards compared to passenger cars). The program we describe below builds on the NLEV and RFG Phase II programs to develop a strong national program to protect public health and the environment well into the next century. The program while reducing VOC 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 proposal:

- Design a strong national program to assist states in every region of the country in meeting their air quality objectives.
- View vehicles and fuels as an integrated system. Define a program that continues to ensure that car and truck emission reductions are part of the solution to our nation's air quality problems.
- Establish a single set of emission standards that apply regardless of the fuel used and regardless of whether the vehicle is a car or a light truck.
- Provide compliance flexibilities that allow vehicle manufacturers and oil refiners to adjust to future market trends and honor consumer preferences.
- Encourage the development of advanced low emission, fuel efficient technologies such as lean-burn engines.
- 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 proposal. Sections I and II of this preamble will give you a brief overview of our proposal and the basics of our rationale for proposing it. Subsequent sections will expand on the air quality need, the economic impacts, and provide a more detailed description of the specifics of the proposal. The final sections deal with several subjects, including opportunities for public participation that you may wish to take advantage of. You may also want to review our Draft Regulatory Impact Analysis (RIA), found in the docket and on the Internet, where we present more detailed analyses and discussions of many topics raised in this preamble.

A. What Are the Basic Components of Today's Proposal?

The nation's air quality, while certainly better than in the past, will 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 proposing a major, comprehensive program designed to significantly reduce emissions from passenger cars and light trucks (including sport-utility vehicles, minivans, and pickup trucks) and reduce sulfur in gasoline. Under the proposed program, automakers would produce vehicles designed to have very low emissions when operated on low-sulfur gasoline, and oil refiners would provide that cleaner gasoline nationwide. In this preamble, we refer to the proposed comprehensive program as the ''Tier 2/Gasoline Sulfur Control Program'' or simply as the ''Tier 2 Program.''

1. Vehicle Emission Standards

Today's action proposes new federal emission standards (''Tier 2 standards'') for passenger cars and light trucks. 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 would also, for the first time, apply the same federal standards to passenger cars and all light trucks (''light light-duty trucks'' (or LLDTs), rated at less than 6000 pounds gross vehicle weight and ''heavy light-duty trucks'' (HLDTs), rated at more than 6000 pounds gross vehicle weight).

The proposed Tier 2 standards would 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 would phase in beginning in 2004, with the standards to be fully phased in by 2007.[1] For heavy LDTs, the proposed Tier 2 standards would 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 Tier 2 standards would have to meet an interim average standard of 0.30 g/mi NO_X, equivalent to the current NLEV standards for LDVs.[2] During the period 2004–2008, heavy LDTs not certified to Tier 2 standards would phase in an average standard of 0.20 g/mi NO_X. Those not covered by the phase-in would be required to meet a traditional (non-averaging) standard of 0.60 g/mi NO_X.

Manufacturers would be allowed to comply with the very stringent proposed new standards in a flexible way, assuring that the average emissions of a company's production met the target emission levels while allowing the manufacturer to choose from several more- and less-stringent emission categories for certification. The proposed requirements also include more stringent PM standards, which primarily affect diesel vehicles, and more stringent hydrocarbon controls (exhaust NMOG and evaporative emissions standards).

We are also proposing stringent particulate matter standards that would be especially important if there were substantial future growth in diesel sales. Even under an assumed scenario where diesel sales grew to represent 50 percent of all light-duty trucks by 2010, the PM standards being proposed today would result in a steady decrease in total direct $PM_{2.5}$ from cars and light trucks. For this scenario of a 50 percent share for diesel light trucks, direct PM emissions in 2020 with today's proposal would be less than they are at present. Therefore, we believe that today's proposal accommodates environmental concerns about such vehicles in a way that insures positive environmental results.

2. Gasoline Sulfur Standards

The other major part of today's proposal would significantly reduce average gasoline sulfur levels nationwide. These reductions could begin to phase in as early as 2000, with full compliance by 2006. Refiners would generally install advanced refining equipment to remove sulfur during the production of gasoline. Importers of gasoline would be required to import and market only gasoline meeting the proposed sulfur limits. Temporary, less stringent standards would apply to a few small refiners.

EPA is proposing that gasoline produced by refiners and sold by gasoline importers generally meet an average sulfur standard of 30 ppm and a cap of 80 ppm in 2004. The proposed program builds upon the existing regulations covering gasoline content 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 the proposed 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 to as late as 2006. As proposed, the program would achieve expected environmental benefits while providing substantial flexibility to refiners. The effect of the credit program is that those refiners that participate would have the opportunity for more overall leadtime to reach the final sulfur levels.

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

1. Light-Duty Vehicles and Trucks

We are proposing the 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[3] are appropriate beginning in the 2004 model year.[4] 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 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 proposal considers and proposes affirmative responses to the three questions above (see section II below) and sets forth new proposed standards that are more

[1] 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. For further comparison, the standards met by today's Tier 1 vehicles range from 0.60 g/mi to 1.53 g/mi.

[2] 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.

[3] LDTs with a loaded vehicle weight less than or equal to 3750 pounds.

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

stringent than the default standards in the Act.

EPA is also proposing standards for larger light-duty trucks under the general authority of section 202(a)(1) 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 [5] 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.

2. Gasoline Sulfur Controls

We are proposing gasoline sulfur controls pursuant to our authority under section 211(c)(1) of the Clean Air Act.[6] 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 would be in general use were the fuel control to be adopted.

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

[5] 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.

[6] 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 directly or indirectly control sulfur levels in gasoline. See the Draft RIA for more details.

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.[7] 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 would become fully effective, a number of areas would still be in nonattainment for ozone and PM even after the implementation of existing emission controls. EPA also found ample evidence that technologies would 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.

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 is a catalyst poison and that high sulfur levels in commercial gasoline could affect the ability of future automobiles to meet more stringent standards in use. It also pointed out that sulfur control would provide additional benefits by lowering emissions from the current fleet of vehicles.

II. Proposed Tier 2 Determination

Based on the statutory requirements described above and the evidence provided in the Tier 2 Study, as updated in this document, EPA proposes its determination that new, more stringent emission standards are indeed needed, technologically feasible, and cost effective.

[7] 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

We believe 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, our modeling shows that in 2007 approximately 80 million Americans will be living in areas that are in nonattainment for the 8-hour ozone NAAQS, even with all other expected controls in place. Another 49 million people will live in attainment areas that are within 15% of being reclassified as nonattainment areas. This is a total of nearly 130 million people, which represents about 48 percent of the population of the United States.

In addition to these ozone concerns, our models indicate that by 2010, 45 areas, with 18 million people, will be in nonattainment for the original PM_{10} NAAQS and 11 areas with 10 million people will be in nonattainment for the revised PM_{10} NAAQS. While not a specific driving factor in today's findings, our models also project that 102 areas with about 55 million people will be in nonattainment with the new $PM_{2.5}$ NAAQS by 2010. We also must 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.

Clearly there is a critical need for reductions in the emissions being projected for future years. Furthermore, mobile sources are important contributors to the emission problem. As we will explain more fully later in this preamble, in the year 2007, the cars and light trucks that are the subject of today's proposal are projected to contribute nearly 40 percent of the total NO_X and VOC inventory in some cities, and 20 percent of nationwide NO_X and VOC emissions. This situation would have been considerably worse without the NLEV program created by vehicle manufacturers, EPA, the Northeastern states, and others. We therefore believe that reductions in these source categories are an essential part of the reductions needed to attain and maintain the NAAQS. As we explain below, we propose to find that major reductions in future emissions from light-duty vehicles and trucks are both feasible and cost effective compared to available alternatives.

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

We believe that emission standards more stringent than current Tier 1 and National Low Emission Vehicle (NLEV) levels are technologically feasible. We believe this to be true both for the LDVs and LDTs specifically covered in section 202(i) and for the heavier LDTs also included in today's proposal. 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 and are building durable vehicles and trucks, including heavy light-duty trucks, which have very low emission levels.[8]

For light duty vehicles, certified NO_X levels for 1999 reveal that NO_X levels representing full-life, deteriorated emissions in the 0.01 to 0.10 g/mi range are already being seen on some production vehicles. Similarly, light-duty trucks up to 8500 lbs. GVWR, also included in today's proposal, have some very low 1999 certification levels for NO_X, with NO_X levels of as low as 0.04 g/mi for some of the largest LDTs. These levels are well below Tier 1 and NLEV standards. Manufacturers have also certified LDVs and LDTs to NMOG and CO levels as much as 80 percent below Tier 1 standards.

As discussed in more detail below and in the Draft RIA, we believe that, by the 2004–2009 time frame proposed for the Tier 2 standards, manufacturers would be fully able to comply with the proposed new standard levels. In addition, to facilitate manufacturers' efforts to meet these new standards, the Tier 2 regulations would include a corporate fleet average, which would allow manufacturers to optimize the deployment of technology across their product lines. Our analysis of the available technology improvements and the very low emission levels already being realized on these vehicles leads us to propose a finding that today's proposed standards 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 document, we propose that Tier 2 motor vehicle standards are both necessary and cost effective. We have already described our belief that substantial further reductions in emissions are needed to help reduce the levels of unhealthy air pollution that millions of people are being exposed to. (We describe this further below and in the Draft RIA.) In its analyses supporting the new ozone and PM NAAQS, the Agency identified those methods that were reasonably cost effective, and showed that substantial progress toward attainment could be made. However, we also concluded that methods beyond those that could be identified as cost effective at the time were needed and we assumed they would be identified in the future.

We believe that the Tier 2/gasoline sulfur proposal is one of those methods. This proposal would 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, if all of the controls identified for the NAAQS analysis costing less than $10,000/ton (the limit on cost effectiveness used in that analysis) were implemented nationwide, they would produce NO_X emission reductions of about 2.9 million tons per year. That is, to achieve significant further reductions using control approaches other than the proposed Tier 2/Gasoline Sulfur program could mean adopting measures costing well beyond $10,000 per ton.

Further emission reductions are needed. Without Tier 2 and gasoline sulfur controls, we project that in 2007 at least 8 metropolitan areas and 2 rural counties with a combined population of 39 million will exceed the 1-hour ozone NAAQS and 28 metropolitan areas and 4 rural counties with a combined population of 80 million will exceed the 8-hour ozone NAAQS. We project that cars and light trucks will contribute 17 percent of the nationwide NO_X inventory by 2007 and 20 to 40 percent in some cities with air quality problems. The NO_X reductions from today's proposal range from 19 to 48 percent of the reductions we estimate are needed for areas to achieve attainment. We believe that the proposed program, as well as the technologies assumed for the NAAQS analysis mentioned above, are clearly cost effective approaches for attaining and maintaining the NAAQS.

The magnitude of emission reductions that can be achieved by a comprehensive national Tier 2/gasoline sulfur program would be difficult to achieve from any other source category. Given the contribution that light-duty mobile source emissions make to the national emissions inventory and the range of control programs ozone-affected areas already have in place or would be expected to implement, we believe it will be very difficult, if not impossible, to attain and maintain the ozone NAAQS in a cost-effective manner without reducing emissions from LDVs and LDTs. In addition, we project that the Tier 2/gasoline sulfur program would reduce direct and secondary particulate matter coming from LDVs and LDTs by over 70 percent, providing reductions of almost 240,000 tons annually by 2010.

We believe, then, that today's proposal is a major and attractive source of ozone and PM precursor emission reductions when compared to other available options. It would represent a degree of emission reduction beyond those programs identified in the NAAQS analysis that we believe is currently unavailable from any other reasonable program. We also believe that it would be a cost effective program, costing approximately $2,000 per ton of NO_X plus hydrocarbon reduced according to our estimates, which is quite attractive compared to other alternatives. The discussion of cost and cost effectiveness later in this preamble explains the derivation of these numbers and compares them to other alternatives. That discussion indicates that today's proposal would be as cost effective as both the Tier 1 and NLEV standards and cost effective when compared to non-mobile source programs as well.

III. Air Quality Need for and Impact of Today's Proposal

In the absence of significant new controls on emissions, 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 proposal would significantly reduce emissions from cars and light trucks and hence would significantly reduce the health risks posed by air pollution. This section summarizes the results of the analyses we performed to arrive at our proposed 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 being proposed today would improve air quality and mitigate other environmental problems.

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[8] The Draft RIA contains an extended analysis, Section IV.A. below has more discussion of the technological feasibility of our proposed standards including detailed discussions of the various technology options that we believe manufacturers may use to meet these standards.

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.[9] 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 these continued improvements in air quality, however, tens of millions of Americans are still exposed to unhealthy levels of ozone and PM. 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 so exposed.

Ambient ozone is formed in the 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, particles can penetrate deep into the lungs and are linked with premature death, 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.

Under EPA's proposed policy for implementing the new 8-hour ozone, revised PM_{10}, and new $PM_{2.5}$ ambient standards (63 FR 65593, November 27, 1998), states must prepare and submit SIP revisions to demonstrate attainment of the 8-hour ozone standard between 2000 and 2003, depending on ozone classification under the 8-hour standard. The earlier submittal date applies to "transitional" areas, which are areas that are in attainment with the 1-hour standard and can attain the 8-hour standard through local measures adopted prior to classification (under the 8-hour standard) and the regional emission reductions to be achieved under the Regional Ozone Transport Rule (63 FR 57356, October 27, 1998). In general, EPA expects these areas to demonstrate attainment by 2007. Other 8-hour nonattainment areas will be classified as "traditional" under the 8-hour standard, and we believe that these areas will have attainment dates of 2007, 2009, or 2010 depending on their 1-hour classification status and 1-hour attainment date.

Because it takes three "clean" years to qualify an area to be redesignated as attainment for the ozone standard, the deadline for each area to achieve the VOC and NO_X emission reductions needed to meet the ozone standard generally should be two years earlier than its attainment date. For example, 8-hour ozone nonattainment areas for which we would establish an attainment date of 2009 would need to implement emission reductions by the start of the 2007 ozone season in order to have three "clean" years by their 8-hour attainment deadline of 2009.

The SIP revisions to demonstrate attainment with the revised PM_{10} standard must be prepared by 2002, with attainment by 2006, unless this date is not practicable. 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 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 do not 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 affects tens of millions of Americans. Without new standards, steady annual increases in fleet size and miles of travel will outstrip the benefits of current emission controls, and will cause ozone-forming emissions from cars and trucks to grow each year starting about 2014. The contribution of these vehicles to PM exposure and PM nonattainment would also remain significant, and could increase considerably if diesel engines are used in more cars or light trucks. For ozone in particular, the contribution of cars and light trucks—in terms of both local emissions and transported pollution—will be so significant to those areas expected to be in nonattainment in the 2007 to 2010 time frame, and the expected emission reduction shortfall in these areas will be so large, that further reductions from cars and light trucks are an inescapable element of any attainment strategy.

The standards we are proposing would cut the contribution of ozone and PM precursors from cars and light trucks greatly. Even with this cut, 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. However, their task would be easier and the economic impact on their industries and citizens would be lighter as a result of the actions proposed today. This would be a critical benefit of today's proposal. Following implementation of the Regional Ozone Transport Rule, states

[9] 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/).

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 will therefore have to consider their other alternatives. In fact, however, many of the alternatives states will have to consider are very costly, with a small impact from each additional category subjected to new emission controls. The emission reductions from today's proposed standards for gasoline, cars, and light trucks would 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. They would also reduce the need for states to seek even deeper reductions from large and small sources already subject to emission controls.

In our meetings and correspondence with state and local officials, they asked us to reduce the emissions from cars and trucks, so that their charge of protecting the public against air pollution is one they can accomplish on schedule and without adverse economic impacts. We heard from the Northeast States for Coordinated Air Use Management, the Ozone Transport Commission, the State and Territorial Air Program Administrators, and the Association of Local Air Pollution Control Officers. They consistently told us that it would be very difficult and costly for the states to obtain comparable reductions from other sources as substitutes for reductions from cars and light trucks, especially on top of the additional reductions needed to reach ozone attainment even with the reductions from today's proposal.

We project that today's proposal would also have important benefits for regional visibility, acid rain, and coastal water quality.

For these and other reasons discussed in this document, we are proposing to determine 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 can be obtained by reducing emissions from cars and light trucks. We believe that such reductions are in fact necessary (since cars and light trucks are such large contributors to current and projected ozone problems) and reasonable (since these reductions could 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 proposal would help mitigate and the expected health and environmental benefits of this proposal. 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 Draft Regulatory Impact Analysis for today's proposal.

B. Ozone

1. Ozone Levels Have Declined, but Unhealthy Levels of Ozone Persist

Ground-level ozone is the main harmful ingredient in smog.[10] It is produced by complex chemical reactions when its precursors, VOC and NO_X, react in the presence of sunlight. The chemical reactions that create ozone take place while the wind is carrying the pollutants, which means that ozone can be more severe many miles away from the source of ozone-forming emissions than it is at the source. The movement of ozone and its precursors is called ''ozone transport'' and suggests two complementary approaches to reduce ozone levels in areas affected by ozone transport:

(1) Reduce ozone precursor emissions in the area itself.

(2) Reduce ozone precursor emissions in upwind areas to reduce incoming ozone and ozone precursor levels.

Within a nonattainment area itself, both VOC and NO_X reductions are generally beneficial. Especially in the eastern portion of the U.S., the second approach of controlling upwind emissions can play an important part in efforts to reduce ozone levels in nonattainment areas. Because individual states cannot control upwind sources of air pollution that lie outside their borders, EPA has a special role in managing transport impacts. Vehicle and fuel standards should play a part in doing so.

Since NO_X affects downwind ozone levels in the eastern U.S. over greater distances than VOC does, reductions in upwind NO_X emissions are particularly important in reducing ozone levels downwind. Modeling conducted by the Ozone Transport Assessment Group, discussed below, indicates that VOC reductions substantially upwind from nonattainment areas have little benefit in those nonattainment areas across the eastern region of the U.S. By contrast, VOC reductions in or near nonattainment areas do provide air quality benefits. Since cars and light trucks meeting today's proposed standards would operate everywhere, today's proposal would reduce VOC and NO_X emissions in both nonattainment areas and in upwind areas.

The new standards being proposed today would have their largest effect on NO_X emissions. Sulfur in gasoline has been found to increase NO_X emissions more than VOC emissions, and reducing sulfur would therefore yield larger NO_X reductions than VOC reductions. Similarly, the vehicle standards proposed today represent a greater reduction from current NO_X standards than is the case for VOC. We have taken this approach because air quality modeling conducted for OTAG, and subsequent modeling we have conducted, indicates that NO_X reductions would have larger ozone benefits than would VOC reductions. In addition, we believe that individual nonattainment areas have a wider range of alternative control opportunities for VOC than they have for NO_X.

Ozone levels have decreased significantly over the past 20 years as VOC and NO_X emissions have been reduced. However, ozone levels in much of the country remain a major concern. Outside of California, the 1990 census showed 72 million people living in areas that were formally designated as non-attainment for the 1-hour standard as of August 10, 1998. Measured ozone design values from 1995 to 1997 in the region analyzed by the Ozone Transport Assessment Group (OTAG)[11] indicate that in this region alone, 26 metropolitan areas and 8 rural counties together containing 75 million people experienced ozone levels in excess of the 1-hour ozone standard.

The 8-hour ozone standard is more stringent and protective than the 1-hour standard, and more areas have exceeded it in the recent past. In 1995 to 1997, at least one county in each of 81 metropolitan areas and an additional 30 rural counties together containing 110 million people had ozone values in excess of the 8-hour ozone standard. Additional areas in the OTAG region had ozone levels within 15 percent of the 8-hour standard and hence faced potentially significant maintenance challenges: 52 metropolitan areas and 44 rural counties together containing 26 million people.

For several reasons, we expect to see substantial additional progress in

[10] Ozone also occurs naturally in the stratosphere and provides a protective layer high above the earth.

[11] OTAG evaluated a region that included all or part of the easternmost 37 states.

reducing ozone levels over the next ten years despite continued growth in electric power generation, industrial output, nonroad activity levels, and vehicle miles traveled. NO_X and VOC emissions from mobile sources will continue to decline as older, higher-emitting vehicles and nonroad engines are retired from service and replaced with newer vehicles and nonroad engines that must meet more stringent federal emission standards. Other federal regulations that will reduce ozone precursor emissions will take effect, such as regulations that will reduce VOC emissions from paints and other architectural coatings. Beginning in 2000, areas of the country participating in the federal reformulated gasoline program will receive lower-emitting Phase 2 reformulated gasoline. States are expected to implement additional measures to reduce NO_X and VOC emissions in 1-hour ozone nonattainment areas. In addition, the final Regional Ozone Transport Rule (ROTR) (63 FR 57356, October 27, 1998) requires the District of Columbia and 22 states in the eastern U.S. to reduce their NO_X emissions substantially by 2003 to reduce ozone levels in downwind states.

Using the most recent improvements to the OTAG emission inventories and the OTAG ozone model, we project that in the OTAG region, these combined emission reductions will bring 18 of the aforementioned 26 metropolitan areas and 6 of the 8 rural counties, with 36 million residents, into attainment with the 1-hour ozone standard by 2007. The same emission reductions are projected to bring ozone design values below the 8-hour standard in 53 out of 81 metropolitan areas and 26 out of 30 rural counties, with a combined 1990 population of 30 million people.[12]

However, we still project many areas in the OTAG region to have ozone design values in 2007 in excess of the 1-hour and 8-hour standards. Eight metropolitan areas and two counties with a combined 1990 population of 39 million are projected to experience ozone design values in excess of the 1-hour ozone standard in 2007.[13] Twenty-eight areas and 4 rural counties, with a combined 1990 population of 80 million, are projected to experience ozone design values at levels in excess of the 8-hour standard in 2007.

Additional areas outside the OTAG modeling region may also experience high ozone levels, even with the additional emission controls that will be implemented by 2007. The most recent assessment for these areas was made in the Regulatory Impact Analysis for the revised NAAQS (NAAQS RIA).[14] That assessment predicted that many areas in California will require substantial additional reductions to attain the 1-hour and 8-hour ozone standards. Although the vehicle and fuel standards being proposed today would not apply to vehicles and fuel sold in California, we project that today's proposals would lead to emission reductions within California. According to the State of California, about 7 to 10 percent of all car and light truck travel in California takes place in vehicles originally sold outside California. These vehicles operate in California during visits and after relocation of households from other states. Today's proposal would cause those vehicles to be cleaner, assisting California's nonattainment areas to meet the ozone standards. In addition, this proposal requires that gasoline in all states (except California, which has its own low-sulfur gasoline program) have a low sulfur content, in order to maintain catalyst effectiveness. This would ensure that vehicles belonging to California residents get clean gasoline when they travel outside of California, so that they return to California with fully functioning catalysts.

Outside of California and the OTAG region, the NAAQS RIA modeling indicated that all areas would attain the 1-hour standard by 2010. One area (Phoenix, AZ) was projected not to attain the 8-hour standard. Eleven other areas were projected to have ozone levels within 15 percent of the 8-hour standard and hence face potential challenges in maintaining their attainment status.

Furthermore, even an area now in attainment or that reaches attainment by 2007 can be at risk of becoming nonattainment in the face of continued growth in its population, economy, vehicle traffic, and nonroad equipment activity levels. Also, an area that we have estimated will reach attainment in 2007 may fail to do so if growth is higher than we project, if emission controls are less effective, or if the modeling is otherwise in error. Our modeling for the OTAG region has estimated that of the 1-hour nonattainment areas projected to reach attainment by 2007 with the benefits of the Regional Ozone Transport Rule (ROTR) and other already committed measures, 17 metropolitan areas and 5 rural counties, with a combined 1990 population of 35 million people, will remain within 15 percent of the 1-hour standard. These areas would benefit from additional reductions to help ensure that they will attain.

With respect to the 8-hour standard, we estimate that 80 metropolitan areas and 39 rural counties with a 1990 population of 49 million people will have design values within 15 percent of the 8-hour standard. These areas have some risk of not actually being in attainment in 2007, and will face potentially significant challenges maintaining their attainment status in future years. Today's proposed standards would help ensure these areas do attain, and help these areas accommodate continued population and economic growth while staying in attainment with the 8-hour ozone standard by further reducing levels of ozone precursors.

EPA's best ozone projections at the current time for the OTAG region are summarized in Tables III–1 and III–2, where "ROTR" refers to the Regional Ozone Transport Rule. It should be noted that the results for the OTAG regions discussed above and summarized in the following tables apply to only a portion of the area that would benefit from today's proposal.

TABLE III–1.—EXTENT OF POTENTIAL 1-HOUR OZONE PROBLEM AREAS IN 2007 IN THE OTAG REGION.[a]

	2007 projections with ROTR
Design values in excess of the 1-Hour NAAQS (≥125 ppb)	
Number of Metropolitan Areas	8
Number of Rural Counties	2
1990 Population of Metropolitan Areas and Rural Counties (millions)	39

[a] Additional potential problem areas in California.

[12] The design value is the calculated ozone level, based on ozone measurements in the area, that is compared to the NAAQS to determine compliance with the standard.

[13] Various states have submitted SIPs to meet a requirement that they demonstrate attainment with the 1-hour ozone standard by 2005 or 2007 (the exact date is state-specific, depending on the severity of their violation of the 1-hour standard). These plans were submitted to EPA in the first half of 1998, and we are still reviewing them for their completeness and approvability. We have not fully evaluated the impact of the measures contained in these plans on future ozone levels. As a result, they are not included in the baseline emission inventory.

[14] "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, NC, July 17, 1997.

TABLE III–2.—EXTENT OF POTENTIAL 8-HOUR OZONE PROBLEM AREAS IN 2007 IN THE OTAG REGION [a]

	2007 projections with ROTR
Design values in excess of the 8-Hour NAAQS (≥85 ppb)	
Number of Metropolitan Areas	28
Number of Rural Counties	4
1990 Population of Metropolitan Areas and Rural Counties (millions)	80
Design values within 15 percent of the 8-Hour NAAQS (72–84 ppb)	
Number of Metropolitan Areas	80
Number of Rural Counties	39
1990 Population of Metropolitan Areas and Rural Counties (millions)	49

[a] Phoenix, Arizona and multiple areas in California are also potential problem areas.

It should be noted that the areas included in Table III–2 have not been designated to be in nonattainment with the 8-hour ozone NAAQS. Such designations will not be made by EPA until 2000, and these designations will be based on the data that are most recently available at that time.[15] Instead, the areas included in Table III–2 have been projected to have design values that would place them in nonattainment in 2007, using an approach described in the Draft RIA.[16] This approach enabled EPA to estimate the extent of the 8-hour nonattainment problem after implementing the reductions set forth in the Regional Ozone Transport Rule and the measures states have adopted or are specifically required by the Clean Air Act to adopt for their existing 1-hour nonattainment areas. (The modeling did not consider the impact of additional measures that may appear in the SIP revisions submitted by some states in the first half of 1998.)

We believe the large reductions called for in today's action would substantially reduce ozone levels nationwide and would therefore reduce ozone levels and design values in the areas projected to otherwise exceed the 8-hour standard as well as in those areas facing potentially significant maintenance challenges.

2. Cars and Light-Duty Trucks Are a Big Part of the NO_X and VOC Inventory, and Today's Proposal Would Reduce This Contribution Substantially

Emissions of VOCs and NO_X come from a variety of sources, both natural and from human activity. 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. Human-caused 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 human 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.[17] The contribution in metropolitan areas was generally larger.

Motor vehicle emission controls have led to significant improvements in emission levels in the air (the ''emission inventory'') and will continue to do so in the near term. As a result of 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, total emissions from the car and light truck fleet are projected to continue to decline through the next decade, reaching a low point for NO_X in 2013 (Figure III–1) and for VOC in 2015.[18] On a per mile basis, average VOC and NO_X emissions from cars and light trucks combined will continue to decline well beyond 2015, reflecting the continuing effect of 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 will increase starting in 2013 and 2015, respectively, so that by 2030 they will have returned to levels nearly the same as they will be in 2000. In cities experiencing rapid growth, such as Charlotte, North Carolina, the near-term trend toward lower emissions tends to reverse sooner.

Figure III–1 illustrates this expected trend in car and light truck NO_X emissions in the absence of today's proposed standards for vehicles and gasoline. 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 trucks will produce about 50 percent of combined car and light truck NO_X emissions. We project that truck emissions will actually increase after 2000, and over the next 30 years, trucks will grow to dominate light-duty NO_X emissions. By 2007, we project trucks will make up two-thirds of light-duty NO_X emissions; by 2020, nearly three-quarters of all light-duty NO_X emissions will be produced by trucks.

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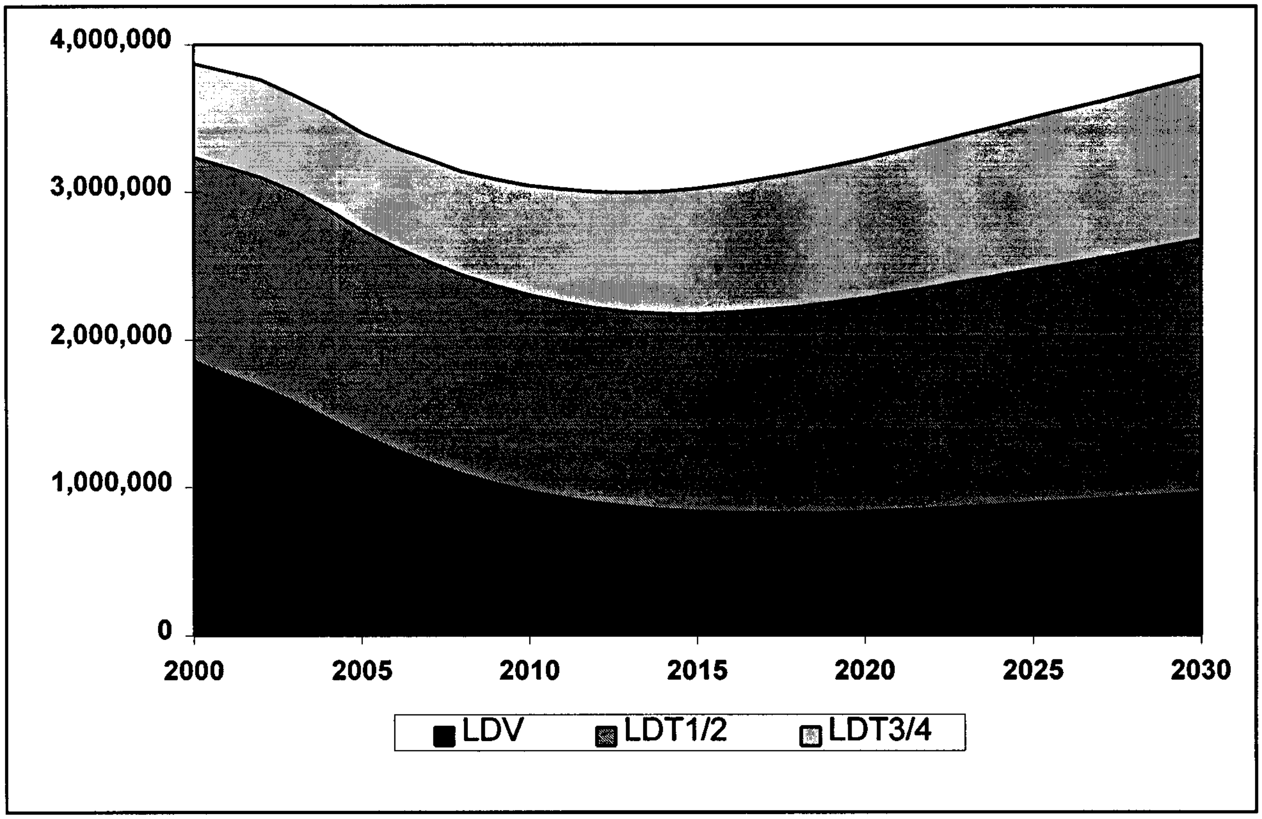
[15] It should also be noted that the number and 1990 population of metropolitan areas projected to be near or above the 8-hour ozone standard in Table III–2 are based on the boundaries of ozone nonattainment areas as currently defined under the 1-hour ozone standard. These boundaries will be reevaluated as 8-hour ozone nonattainment areas are designated and may change from those used above, affecting the count and population of the potential problem areas.

[16] The approach uses a combination of ambient monitoring data and regional ozone photochemical grid modeling for specific ozone episodes to develop statistical correlations between modeled ozone levels and projected future monitoring results. The approach does not reflect any further emission reductions that may have been included in revisions to State Implementation Plans (SIPs) for ozone that EPA received from some states in the first half of 1998. These SIP revisions are still under review by EPA for completeness and approvability.

[17] Emission Trend Report, 1997.

[18] 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 proposal assumes for the base scenario a continuation of the NLEV program past 2004. It also includes all other control measures assumed to be implemented for the purposes of the proposed state-level NO_X budgets in the Regional Ozone Transport Rule, such as reformulated gasoline in all required and opt-in areas and enhanced I/M where required.

Figure III-1.
Light-duty NOx emissions without Tier 2 (annual tons)[a]



[a] Estimates exclude California, Alaska, and Hawaii, although reductions would occur in all three. For all cases, this figure reflects implementation of ROTR and other measures assumed in the ROTR. The estimates reflect continuation of NLEV beyond 2004.

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Today's action would significantly decrease NO_X and VOC emissions from cars and light trucks, and would delay the date by which NO_X and VOC emissions would begin to increase due to continued VMT growth. With Tier 2/Sulfur control, light-duty vehicle NO_X and VOC emissions are projected to continue their downward trend past 2020. Table III–3 shows the annual tons of NO_X that we project would be reduced if today's proposal were adopted.[19] These projections include the benefits of low sulfur fuel and the introduction of Tier 2 car and light truck standards.

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

Year	Light-duty tons without tier 2	Light-duty percent of total without tier 2 (percent)	Light-duty tons reduced by tier 2 [b]
2007	3,218,530	17	795,734
2010	3,041,639	17	1,182,323
2015	3,020,806	17	1,778,881
2020	3,221,151	18	2,198,113

[a] Estimates exclude California, Alaska, and Hawaii, although reductions would occur in all three. For all cases, this table reflects implementation of ROTR and other measures assumed in the ROTR. For the "Without Tier 2" case, the estimates reflect continuation of NLEV beyond 2004.

[b] Does not include emission reductions from heavy-duty gasoline vehicles.

The lower sulfur levels proposed today would 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 would be achieved from vehicles that 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 would meet the new sulfur limit and when large numbers of 2004 and newer vehicles meeting the proposed standards would be in use, the combined NO_X emission reduction from vehicles and fuels would be nearly 800,000 tons per year. After 2007, emissions would be reduced further as the fleet turned over to Tier 2 vehicles operating on low sulfur fuel. By 2020, NO_X emissions would be reduced by two-thirds from the levels that would occur if today's proposal were not adopted. This reduction equals the NO_X emissions from over 166 million pre-Tier 2/Sulfur cars and light trucks. This reduction would represent a 12 percent NO_X reduction in emissions from all manmade sources.

VOC emissions would also be reduced by today's proposal, with reductions increasing as the fleet turns over. The reductions as a percent of emissions from cars and light trucks would be 5 percent in 2007 and grow to 16 percent in 2020.

As discussed earlier, in California, smaller but still substantial reductions in both NO_X and VOC would be achieved because vehicles visiting and relocating to California would be designed to meet today's proposed standards. Also, vehicles from California visiting other states would not be exposed to high sulfur fuel.

These estimates of emission reductions reflect a mixture of urban, suburban, and rural areas. As we noted in the Tier 2 Study, 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–4. Inventory shares in 2010 are about the same.

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 17 percent, it is estimated to be about 38 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 33 percent. In metropolitan areas with high car and light truck contributions, today's proposal would represent a larger step toward attainment since it would have a larger effect on total emissions.

TABLE III–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 [a]	17	18
New York urban area	29	15
Atlanta urban area	38	33
Charlotte urban area	18	15

[a] For all cases, this table reflects implementation of ROTR and other measures assumed in the ROTR. 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 8-hour ozone standard. For this analysis, we included the implementation of the Regional Ozone Transport Rule but assumed that today's proposal was not implemented. In the previously referenced NAAQS RIA we estimated additional NO_X emission reductions that, along with specific accompanying VOC reductions, would bring each residual nonattainment area into attainment with the 8-hour ozone

[19] Today's proposed standards for both vehicles and fuels would apply in 49 states and the U.S. territories, excluding only California. If today's proposal is adopted, there would also be emissions reductions in California from vehicles that relocate or visit from other states. However, much of the emissions inventory analysis for this proposal was made for a 47-state region that excludes California, Alaska, and Hawaii, since these states were not included in the scope of ozone modeling.

standard by 2010. We have used these estimated reductions as the basis for Table III–5, which shows the NO_X reductions needed to reach attainment in 2007 for six metropolitan areas.[20] These are areas for which both the NAAQS RIA and the ozone modeling for this proposal forecasted continued 8-hour nonattainment in that year, even with the emission reductions from the Regional Ozone Transport Rule.

Table III–5 also shows the NO_X emission reductions in those same six areas that we project would result if today's proposal were implemented. Although the two analyses differ in some emission modeling estimates, the comparison is valid as a general indication of the contribution today's proposal can make to attainment. Cars and light trucks contribute about 20 to 40 percent of the NO_X inventory in these six areas. The NO_X reductions estimated for today's proposal range from 19 to 50 percent of the reductions that are estimated to be needed for attainment. 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; as described in the next section, we project that about 20 other areas in the eastern U.S. would also need reductions beyond those of today's proposed program to attain the NAAQS for NO_X.

TABLE III–5.—COMPARISON OF TIER 2/SULFUR NO_X REDUCTIONS TO NO_X REDUCTIONS ESTIMATED TO PRODUCE 8-HOUR OZONE ATTAINMENT IN 2007

Metro area	NO_X reductions estimated to produce attainment (tons/year)	NO_X reductions from proposed tier 2/sulfur standards (tons/year)	Tier 2/sulfur NO_X reductions as percent of reductions to produce attainment
Atlanta	69,802	17,271	25
Dallas	41,283	14,761	36
Memphis	7,343	3,683	50
NY–NJ–CT	186,880	35,906	19
Philadelphia	63,456	19,942	31
Washington, DC-Baltimore	62,519	22,673	36

3. Tier 2/Sulfur Ozone Benefits and the Post-Tier 2/Sulfur Ozone Problem

By reducing ozone precursor emissions from cars and light trucks in areas where ozone levels are near or above the ozone standard, today's proposal would reduce local ozone levels. And by reducing ozone precursor emissions in upwind areas, today's proposal would reduce ozone and ozone precursor levels in the air flowing into areas where ozone levels are high. EPA's analysis of the ozone impact of today's proposal suggests that it would yield large reductions in ozone, particularly in areas where ozone transport plays a significant role in local nonattainment problems. There are uncertainties associated with the modeling we have used to estimate these reductions, but we are certain that the emission reductions would be large.

Ozone levels in a few locations in the centers of large metropolitan areas are VOC-limited; that is, the atmospheric chemistry is such that ozone levels tend to respond to VOC reductions rather than to NO_X reductions. Some of these areas may experience essentially no change or a slight ozone increase on some days, if one considers only the isolated effect of the emission reductions due to today's proposal. However, it has long been recognized that metropolitan areas containing such locations will need to implement additional VOC reductions from local sources to reach attainment. If these reductions and the reductions from today's proposal were combined, the net effect would be a progressive drop in ozone levels until attainment is reached.

To examine the impact of today's proposal on ozone levels, we estimated the ozone effects of the emission reductions that would occur in 2007 and 2010 for the area covered by the OTAG ozone model. The 1-hour ozone reductions in 2007 are relevant to the several 1-hour nonattainment areas required to reach attainment in that year. The 8-hour reductions in 2007 and 2010 are of great relevance to the efforts of states to achieve attainment with the 8-hour ozone standard, since for many areas these dates bracket the three ''clean'' years required to show attainment by their actual deadline.

The estimated emission reductions from our proposal in 2007 and 2010 would be substantial due to the effect of low sulfur fuel on the entire in-use fleet of gasoline vehicles and trucks of all sizes, especially those designed to meet NLEV standards, and due to the fact that many cleaner 2004 and newer vehicles would be on the road. Table III–6 provides a summary of the 1-hour ozone results for the OTAG modeling area for 2007. Table III–7 provides a summary of the 2007 and 2010 results for the 8-hour standard. According to our best modeling, the reductions in 2007 would make the difference between nonattainment and attainment for four metropolitan areas with a combined 1990 population of 15 million people. In 2010, we estimate that the Tier2/Sulfur reductions would be enough by themselves to bring eight metropolitan areas with 13 million people into attainment with the 8-hour standard.

Tables III–6 and III–7 indicate that we project that some areas would not attain with only the emission reductions from the Tier 2/Sulfur proposal. However, we do project that those areas would experience reductions in ozone levels. These reductions would mean that even the areas that are not brought all the way to attainment would not need to reduce emissions from other sources as much as would be required without today's proposal, as previously explained. Of the 18 areas that we projected would not be brought to attainment with the 8-hour standard in 2010, we project that 10 areas would

[20] We calculated the estimated reductions needed for attainment in 2007 by adding the reductions due to NLEV vehicles entering the fleet between 2007 and 2010 to the estimated reductions needed for attainment in 2010.

have design values within 5 percent of the standard.

Today's proposal would also benefit ozone nonattainment areas outside of the OTAG modeling region, including the one area (Phoenix, Arizona) projected to be in nonattainment for ozone in 2010 in the absence of Tier 2/Sulfur controls. The Tier 2/Sulfur controls being proposed today would help Phoenix attain the ozone standard, particularly since cars and light trucks are a relatively large part of the Phoenix emission inventory. These controls also would help the 11 areas projected to face potential maintenance challenges stay in attainment as their economies and populations grow. And as already mentioned, because about 7 to 10 percent of travel in California is by non-California vehicles, there would be a substantial benefit in that state also.

TABLE III–6.—PROJECTED TIER 2/SULFUR IMPACT ON POTENTIAL 1-HOUR OZONE PROBLEM AREAS IN THE OTAG REGION IN 2007 [a]

	2007 without tier 2/sulfur	2007 with tier 2/sulfur	Change due to tier 2/sulfur
Design values projected to be in excess of the 1-Hour NAAQS (≥125 ppb)			
Number of Metropolitan Areas	8	4	−4
Number of Rural Counties	2	2	0
1990 Population of Metropolitan Areas and Rural Counties (millions)	39	24	−15

[a] For all cases, this table reflects implementation of ROTR and other measures assumed in the ROTR. For the "Without Tier 2/Sulfur" case, the estimates reflect continuation of NLEV beyond 2004.

TABLE III–7.—PROJECTED TIER 2/SULFUR IMPACT ON POTENTIAL 8-HOUR OZONE PROBLEM AREAS IN THE OTAG REGION IN 2007 AND 2010 [a]

	Without tier 2/sulfur	With tier 2/sulfur	Change due to tier 2/sulfur
Design values projected to be in excess of the 8-Hour NAAQS (≥85 ppb) in 2007			
Number of Metropolitan Areas	28	25	−3
Number of Rural Counties	4	3	−1
1990 Population of Metropolitan Areas and Rural Counties (millions)	80	72	−8
Design values projected to be in excess of the 8-Hour NAAQS (≥85 ppb) in 2010			
Number of Metropolitan Areas	26	[b] 18	−8
Number of Rural Counties	3	3	0
1990 Population of Metropolitan Areas and Rural Counties (millions)	78	65	−13

[a] For all cases, this table reflects implementation of ROTR and other measures assumed in the ROTR. For the "Without Tier 2/Sulfur" case, the estimates reflect continuation of NLEV beyond 2004.
[b] Of these 18 areas predicted to remain nonattainment, 10 would be within 5 percent of the 8-hour ozone standard.

Much larger VOC and NO_X emission reductions would occur in 2020, when the vehicle fleet would be almost fully turned over to Tier 2 vehicles. The 2020 scenario is designed to help evaluate the long-term impact of today's proposal on ozone levels, when the majority of the vehicle fleet would consist of vehicles that meet the standards being proposed today.

We present three indicators of the benefits of today's proposed program in 2020. First, as shown in Table III–3, that today's proposal would reduce NO_X emissions in 2020 by over 2,000,000 tons per year, not counting reductions in California, Hawaii, and Alaska. The reduction in each nonattainment area would also be very substantial. Second, we have estimated how much design values in 2020 would change due to today's proposal. For all counties projected to need emission reductions beyond the ROTR, the average reduction in 2020 design value was 6 ppb, or almost 8 percent of the 8-hour standard itself. The range of design value reductions was 3 to 12 ppb. These results included only the region covered by the OTAG ozone model. Third, when we analyzed the 2020 scenario to take into account the duration, severity, and geographic extent of high ozone levels, we found that projected excessive 8-hour ozone levels, defined as grid cell-days above 85 ppm ozone, were reduced by 43 percent.

The baseline scenario against which the ozone effects of today's proposed standards in 2020 were compared assumes that no emission control efforts beyond those assumed in the ROTR are implemented. We believe this approximation is reasonable because our inventory modeling shows that in 2020, total human-caused emissions in the absence of today's proposed program change very little from their 2007 levels. We subtracted the emission benefits of today's proposed program in 2020 from those baseline emissions to approximate the emissions that would result in 2020.

We expect the requirement to achieve attainment with the 8-hour standard will cause states with residual nonattainment areas to adopt additional controls in pursuit of their attainment obligations. The increasingly large emission reductions from today's proposal that would occur over time would be of great value to those areas since these areas would not need to implement as extensive or stringent additional controls as would otherwise be the case. Furthermore, once an area reaches attainment, it must adopt a SIP revision containing a strategy to maintain the standard thereafter. The reductions from today's proposal would help such areas overcome any loss of reductions due to less-than-expected effectiveness from other controls, provide a safety margin against the chance of new ozone violations, provide room for population and economic growth to cause increases in emissions from other sources with less need for the maintenance plan to increase the stringency of controls on those other sources, and possibly even allow selective relaxation of other control programs.

Because the ozone modeling for 2020 did not account for the additional measures that states will adopt to attain and maintain the ozone standard, an attainment vs. nonattainment distinction does not apply in 2020. Instead, the changes that today's proposal would achieve in 2020 precursor emissions and in predicted ozone concentrations are more appropriate indicators of the benefits of the Tier2/Sulfur program than would be a count of the areas that have design values move from above to below the ozone standard.

These ozone results for 2007, 2010, and 2020 represent the best modeling currently available to us, but should be considered approximate. The Regulatory Impact Analysis documents all the methods and assumptions used. The results presented are estimates of the future that only apply to the OTAG region rather than the entire area that would be subject to today's proposal. As previously mentioned, there would also be ozone benefits outside this region, particularly for nonattainment areas in California and for Phoenix, Arizona. We expect to revise our ozone effects estimates prior to the final rule to reflect further improvements in estimates of emissions from both mobile and stationary sources.

In addition to the emission-reduction and ozone-reduction benefits discussed above that we expect will result from the proposed rule, we have done a separate analysis of economic benefits (and costs) associated with the expected ozone reductions from today's proposed program (see Section IV.D.5. below and the RIA).

C. Particulate Matter

1. Particulate Matter Presents Substantial Public Health Risks

Particulate matter (PM) is produced as a direct result of human activity and natural processes, and it is also formed through chemical and physical processes in the atmosphere. Natural sources include windblown dust, salt from dried sea spray, fires, and volcanoes, as well as so-called secondary particles formed from the transformation of natural emissions of SO_X, NO_X, and VOCs. Human sources include industrial activities, agriculture, road dust, and soot, as well as secondary particles produced from gases such as SO_X, NO_X, and VOCs that are emitted primarily from combustion processes. PM includes fine particles with a diameter smaller than 2.5 microns (also called $PM_{2.5}$) and coarse particles with larger diameters. Coarse particles are predominantly from non-combustion sources and are dominated by soil dust and sea salt. They remain in the atmosphere a relatively short period of time. Fine particulate includes carbon-based particles emitted directly from combustion processes but consists predominantly of secondary particles, such as sulfate-based particles (produced from SO_X), nitrate-based particles (produced from NO_X), and carbon-based particles created through transformation of VOC emissions. Mobile sources can reasonably be estimated to contribute to ambient secondary nitrate, sulfate and carbonaceous PM in proportion to their contribution to total NO_X, SO, and VOC emissions.

In 1997, 8 million Americans were living in 13 counties that exceeded the recently revised PM_{10} standard, and PM_{10} problems are projected to persist in the absence of further actions to control PM_{10} levels. Table III–8 presents estimates of the extent of PM_{10} and $PM_{2.5}$ nonattainment in the future. In the NAAQS RIA, we projected that in 2010, eleven counties with a combined 1990 population of about 10 million people would not be in attainment with the revised PM_{10} standards.[21] About half of the affected population lives outside of California. In the same analysis, 102 counties were projected to violate the new $PM_{2.5}$ NAAQS, with a combined 1990 population of about 55 million people. About 75 percent of the affected population lives outside of California. (More information about this analysis and its uncertainties may be found in the NAAQS RIA and the Tier 2 Report to Congress.) Ambient PM reductions from more stringent motor vehicle or fuel standards would primarily affect areas outside of California, because California has its own motor vehicle emission control program. California areas would also benefit, however, through the temporary travel and permanent migration of out-of-state vehicles into California, as discussed above.

[21] The methods used to project PM concentrations in 2010 from 1990 emissions and ambient concentration data introduce several sources of uncertainty. Also, the $PM_{2.5}$ values are predicted from a regression model and hence are subject to the uncertainty associated with this model. Other uncertainties exist regarding emission inventory estimates from human and natural sources, monitoring data, and the models used to account for physical and chemical processes in the atmosphere. Even with the anticipated delivery of more comprehensive modeling techniques, the scarcity of speciated ambient PM data in both urban and rural areas to evaluate model behavior will continue to compromise the certainty of the best model-derived conclusions.

TABLE III–8.—PROJECTED 2010 PM_{10}/$PM_{2.5}$ NONATTAINMENT COUNTIES AND POPULATIONS

	Outside California	California
Violating Original PM_{10} NAAQS		
Number of Counties	33	12
1990 Population (millions)	11	7
Violating Revised PM_{10} NAAQS		
Number of Counties	5	6
1990 Population (millions)	5	5
Violating New $PM_{2.5}$ NAAQS		
Number of Counties	92	10
1990 Population (millions)	42	13

A significant number of areas are projected to exceed the PM_{10} NAAQS in 2010 with existing emission controls, indicating that further PM and PM-precursor emission reductions will be needed. Because the bulk of PM emissions from motor vehicles are fine particles, any reduction in particulate emissions from motor vehicles aimed at reducing PM_{10} levels would also reduce ambient levels of $PM_{2.5}$. As mentioned above, the number of counties projected to violate the new $PM_{2.5}$ NAAQS is much larger than that for the revised PM_{10} standards. Tier 2/Sulfur standards that reduce particulate emissions for the purposes of facilitating attainment with the PM_{10} NAAQS could also benefit areas with elevated $PM_{2.5}$ levels.

2. Reducing Emissions From Cars and Light Trucks Would Reduce Ambient Levels

Today's proposal would reduce PM levels by reducing direct PM emissions from cars and light trucks, and by reducing emissions of sulfur and nitrogen oxides that are converted to PM in the atmosphere. Direct PM emissions would be reduced in two ways. First, reductions in gasoline sulfur levels would reduce PM emissions from gasoline vehicles. Second, the more stringent PM standard included in today's proposal would reduce PM emissions from cars and light trucks equipped with diesel engines. Diesel engines are used in a small fraction of current cars and light trucks, but this fraction could grow as discussed in III.C.3. below.

With no growth in diesel sales, we project today's action would reduce direct PM emissions from cars and light trucks mainly due to the introduction of low-sulfur gasoline. Sulfur-based particles account for a substantial portion of the particulate matter emitted by gasoline-powered vehicles. More stringent PM emission standards are not anticipated to alter PM emissions from gasoline vehicles but would result in reductions in diesel PM emissions. The overall effect of today's proposal under this assumption would be to reduce direct exhaust PM emissions from cars and light trucks by 60 percent in 2007 and by 62–63 percent in 2015 and beyond. Tables III–9 and III–10 show the contribution of cars and light trucks to total PM_{10} and $PM_{2.5}$ emissions, and the reductions that would be obtained from today's proposal. The contribution of cars and light trucks to either PM inventory will generally be higher in urban areas than on a nationwide basis, and will vary from area to area. In 2007, for example, cars and light trucks contribute 1.3 percent to the nationwide PM_{10} inventory (excluding natural sources and fugitive dust). For comparison, this percentage is estimated to be 4.4 percent in Atlanta and 1.9 percent in the New York City metropolitan area.

Later in this section we discuss the possibility that sales of diesel-powered vehicles might increase from current levels, making the effect of the more stringent PM standard in this proposal larger.

TABLE III–9.—DIRECT EXHAUST PM_{10} EMISSIONS FROM CARS AND LIGHT TRUCKS AS PERCENT OF TOTAL EMISSIONS, AND REDUCTIONS DUE TO TIER 2/SULFUR CONTROL[a,b]

Year	Light-duty tons without tier 2	Light-duty percent of total without tier 2	Light-duty tons reduced by tier 2
2007	39,209	1.3	23,379
2010	41,412	1.4	25,239
2015	46,064	1.4	28,674
2020	51,102	1.5	32,031

[a] For all cases, this table reflects continuation of current diesel engine usage in the light truck fleet and implementation of ROTR and other measures assumed in the ROTR.
[b] The emission estimates shown exclude natural sources of PM and fugitive dust. They also do not include California (which has its own vehicle and fuel standards), Alaska, or Hawaii. Today's proposal would have additional emission benefits in these states.

TABLE III–10.—DIRECT EXHAUST $PM_{2.5}$ EMISSIONS FROM CARS AND LIGHT TRUCKS AS PERCENT OF TOTAL EMISSIONS, AND REDUCTIONS DUE TO TIER 2/SULFUR CONTROL [a,b]

Year	Light-duty tons without tier 2	Light-duty percent of total without tier 2	Light-duty tons reduced by tier 2
2007	36,365	1.7	21,687
2010	38,409	1.8	23,410
2015	42,724	1.9	26,595
2020	47,397	2.0	29,707

[a] For all cases, this table reflects continuation of current diesel engine usage in the light truck fleet and implementation of ROTR and other measures assumed in the ROTR.
[b] The emission estimates shown exclude natural sources of PM and fugitive dust. They also do not include California (which has its own vehicle and fuel standards), Alaska, or Hawaii. Today's proposal would have additional emission benefits in these states.

Even larger PM reductions would result from the reductions in the sulfur oxides (SO_X), NO_X, and VOC emissions that give rise to secondary PM that would result from today's proposal. The reduction in ambient PM levels that would come from the proposed reductions in these precursor emissions is about 6 to 7 times as large as the reduction from lower emissions of direct PM. Essentially all secondary PM is fine PM and hence is included in estimates of both PM_{10} and $PM_{2.5}$.

We described the effect of today's proposal on VOC and NO_X emissions above in Section III.B. Today's proposal also would reduce SO_X emissions from cars and light trucks by dramatically lowering the level of sulfur in gasoline, since gaseous SO_X emissions are dependent entirely on fuel sulfur level. In the absence of today's proposal, we project that SO_X emissions from cars and light trucks will increase steadily in conjunction with VMT growth, from approximately 216,000 tons in 2005 to 300,000 tons in 2020—an increase of almost 40 percent (total nationwide SO_X emissions from all sources was 20,000,000 tons in 1997). Today's proposal would reduce SO_X emissions from all gasoline-powered engines, including cars, light trucks, heavy-duty gasoline vehicles, and gasoline-powered nonroad engines, in any year by 90 percent, once all gasoline meets the proposed sulfur limit. The same percentage reductions in SO_X emissions would occur in subsequent years. The absolute emission reduction increases with time, however, due to growth in VMT and nonroad engine use. Table III–11 shows the impact of today's proposal on SO_X emissions.

TABLE III–11.—SO_x EMISSIONS FROM CARS AND LIGHT TRUCKS AS PERCENT OF TOTAL EMISSIONS, AND REDUCTIONS DUE TO TIER 2/SULFUR CONTROL [a]

Year	Light-duty tons without tier 2	Light-duty percent of total without tier 2	Light-duty tons reduced by tier 2
2007	225,673	1.2	202,748
2010	240,694	1.3	216,437
2015	270,174	1.4	242,964
2020	299,959	1.6	269,756

[a] The emission estimates shown do not include California (which has its own vehicle and fuel standards), Alaska, or Hawaii. Today's proposal would have additional emission benefits in these states.

3. Today's Proposal Would Limit the Potential Health Risks From Increased Diesel Engine Use in Cars and Light Trucks

Of particular concern from a PM perspective is the possibility that diesels will become more prevalent in the light-duty truck fleet. This development is a reasonable possibility since vehicle and engine manufacturers have indicated their intent to sell more diesel-powered light-duty trucks and in some cases have made capital investments to implement these plans. The Partnership for a New Generation of Vehicles (PNGV), a public-private research and development effort that has been pursuing several promising technologies for greatly improved vehicle fuel economy combined with low emissions, has identified improved diesel engines as a technology likely to be able to deliver large fuel economy improvements in the near future, by about 2004. In order to assess the potential impact of increased diesel sales penetration on $PM_{2.5}$ emissions, we analyzed benefits from our proposed Tier 2 PM standards under a scenario in which the use of diesel engines in light trucks increases rapidly, by five percentage points per year from 2001 through 2010, when diesels would account for 50 percent of light-duty truck sales; beyond 2010, diesel sales were assumed to be stable at 50 percent of the light-truck market. Table III–12 presents the results of our analysis of this scenario.

This scenario of increased diesels would result in dramatic increases in direct $PM_{2.5}$ emissions from cars and light trucks, if there is no change in the PM standards for light trucks. The increase in diesel exhaust $PM_{2.5}$ emissions would more than overcome the reduction in direct $PM_{2.5}$ attributable to the sulfur reduction in gasoline. Assuming no change in the existing PM standards for light trucks, our analysis of this scenario shows that direct $PM_{2.5}$ emissions in 2020 would be approximately 140,000 tons, nearly three times the 47,000 tons projected in the base diesel sales case from Table III–10. The portion of the $PM_{2.5}$ inventory attributable to cars and light trucks would climb steadily, reaching almost 6 percent in 2020 instead of the 2 percent shown in Table III–10 for a scenario where diesel engines do not increase their presence in the light truck fleet. In some cities with relatively high vehicle use and lower industrial emissions, the car and truck contribution would be even higher.

This increase would be accompanied by increases in the mortality and morbidity associated with $PM_{2.5}$ exposure. Fortunately, the standards being proposed today would result in a steady decrease in total direct $PM_{2.5}$ from cars and light trucks despite a possible increase in diesel engines in light trucks. Direct PM emissions in 2020 with today's proposal would be about 25,000 tons per year, less than at present.

If this scenario for increased diesel engines in light trucks were to occur, today's proposal would reduce diesel $PM_{2.5}$ by over 90 percent in 2020. Stated differently, by 2020 today's proposal would reduce over 113,000 tons of the potential increase in PM emissions from passenger cars and light trucks. The result would be less direct $PM_{2.5}$ than is emitted today, because the increase in diesel PM would be more than offset by the reduction in gasoline PM.

TABLE III–12.—DIRECT EXHAUST $PM_{2.5}$ EMISSIONS FROM LIGHT DUTY VEHICLES AND REDUCTIONS DUE TO TIER 2/ SULFUR CONTROL, WITH GREATER DIESEL ENGINE SALES [a,b]

Year	Light-duty exhaust tons without tier 2	Light-duty exhaust tons with tier 2	Light-duty tons reduced
2007	52,907	22,478	30,429
2010	72,626	22,542	50,084
2015	109,622	23,275	86,347
2020	138,177	24,754	113,424

[a] For all cases, this table reflects implementation of ROTR and other measures assumed in the ROTR and an increase in diesel-powered light truck market share from 5 percent of light truck sales in 2001 to 50 percent in 2010 and beyond.
[b] The emission estimates shown exclude natural sources of PM and fugitive dust. They also do not include California (which has its own vehicle and fuel standards), Alaska, or Hawaii. Today's proposal would have additional emission benefits in these states.

4. Today's Proposal Would Have Substantial PM Benefits

In general, we project that today's proposal would reduce both direct and secondary PM from cars and light trucks substantially, regardless of the future market share for diesel engines in the light-duty fleet. The larger part of the reduction is due to large reductions in VOC, NO_X, and SO_X emissions, with corresponding reductions in secondary PM formation.

Low sulfur fuel would greatly reduce direct PM emissions and sulfate-based secondary PM formation from SO_X emissions from gasoline vehicles, while tailpipe PM standards are projected to mitigate excess PM emissions from diesel vehicles, even at very aggressive rates of diesel vehicle sales growth. Substantial reductions in NO_X

emissions would carry over to reductions in indirect PM. These reductions would help reduce the number of areas with PM_{10} and $PM_{2.5}$ levels in excess of national standards, reduce the severity of PM nonattainment in other areas, and help areas facing PM maintenance challenges stay in attainment.

The magnitude of the PM reductions from today's proposal in a given area depends on conditions such as the contribution of light-duty vehicles to the local PM, SO_X, NO_X, and VOC inventory; the contribution of light-duty vehicles to the PM, SO_X, NO_X, and VOC inventories in upwind areas; local and upwind ammonia inventories (involved in secondary PM formation); control measures being implemented on both local and upwind sources of PM and its precursors, and local meteorology. We have incorporated these factors into the air quality modeling used to develop the benefit/cost analysis presented in Section IV.D.5., which includes the economic benefits of the direct and secondary PM reductions expected to result from today's proposal.

The PM modeling results from that analysis suggest that if all cars and trucks used in 2010 met the emission standards being proposed today, significant PM reductions would result in urban and substantial PM reductions would result in much of the continental U.S. The annual average level of both PM_{10} and $PM_{2.5}$ was projected to decline by 0.25 to 0.64 micrograms per cubic meter (μ/m^3) in many cities; average levels were projected to decline by 0.1 to 0.25 μ/m^3 throughout most of the country east of the Great Plains, Nebraska, and parts of Colorado, Arizona, and other western states. Similarly, daily maximum PM levels[22] were projected to decline substantially, with many cities projected to see declines of 0.75 to 4.5 μ/m^3 and over half the continental U.S. projected to experience declines of 0.25 to 0.75 μ/m^3. Note that this analysis assumed no growth in sales of diesel-powered light trucks. It also did not account for the direct PM reductions that would be achieved when the small number of diesel-powered trucks already being sold now will reduce their PM emissions to meet the lower proposed PM standard.

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

This proposal would help reduce levels of three other pollutants for which NAAQS have been established: carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2). The extent of nonattainment for these three pollutants is small, so the primary effect of today's proposal would be to provide areas concerned with maintaining their attainment status a greater margin of safety. As of 1998, every area in the United States has been designated to be in attainment with the NO_2 NAAQS. As of 1997, only one area (Buchanan County, Missouri) did not meet the primary SO_2 short-term standard, due to emissions from the local power plant. In 1997, only 6 of 537 monitoring sites reported ambient CO levels in excess of the CO NAAQS; all six sites were located in California, which has established its own vehicle and fuel emission standards.

The reductions in SO_2 precursor emissions from today's proposal are essentially equal to the SO_X reductions described in Section III.B. and III.C., respectively. The impact of today's proposal on NO_2 emissions depends on the specific emission control technologies used to meet the standards being proposed today. 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 proposal would substantially reduce ambient NO_2 levels by the same proportion. Today's proposal also would require light trucks to meet more stringent CO standards; we will evaluate the impact of these standards more fully before publishing our final rule. 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.[23]

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 proposed that states be required to adopt and implement effective plans for protecting and improving visibility in Class I federal areas (including 156 major national parks and wilderness areas), integrated with plans to achieve the revised ozone and PM standards.

Today's proposal should 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[24] found that

[22] Daily maximum PM levels are the PM levels (averaged over 24 hours) for days that are projected to be in the 98th or 99th percentile when ranked by their $PM_{2.5}$ and PM_{10} levels, respectively.

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

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

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/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.

As an indication of how important car and light truck emissions can be to fine PM and visibility, the recent Northern Front Range Air Quality Study has 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.

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 proposal.

F. Air Toxics

Emissions from cars and light trucks include a number of air pollutants that are known or suspected human or animal carcinogens such as benzene, formaldehyde, acetaldehyde, 1,3-butadiene, and diesel particulate matter, or that are known or suspected to have other, non-cancer health impacts. 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 are of particular relevance to this rulemaking, because of the possibility for increased diesel-powered truck sales and our proposal for a more stringent PM standard that would apply to these trucks. While we have not finalized our decision about the carcinogenicity of diesel exhaust particulate, we are in the process of addressing this question. Several other agencies and international organizations have already made such a determination, including the California Air Resources Board (ARB). Our own quantitative risk assessment for diesel particulate is still in draft form,[25] and is presently being revised to address the comments of a peer review panel of the Clean Air Science Advisory Committee.

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

If these projections are valid and the proportion of light-duty trucks powered by diesel engines increases, the potential health risks from diesel PM could increase substantially. Light trucks could become a larger source of diesel PM than heavy-duty diesel trucks. We estimate that if the percentage of light duty diesel truck sales were to increase to 50 percent of light-duty truck sales by 2010, the increased presence of light duty diesel trucks on the nation's roads could increase the potential cancer risks associated with PM emissions from all diesel-powered highway vehicles (including heavy-duty diesel trucks, diesel buses, and light-duty diesel vehicles) by approximately 130 percent as of 2020, under the current light-duty diesel PM standards. Though the actual levels of diesel engine use may be considerably different than the projections used in both analyses, the analyses are useful in illustrating the potential impact of increased diesel engine use in light trucks.

Today's proposal would limit the increase in the potential cancer risks from cars and light trucks associated with any potential increase in light-duty diesel sales. We have estimated that in 2020, today's proposal would limit the increase in total highway diesel PM emissions due to growth in light truck diesels to 24 percent, in contrast to the more than doubling that would occur without our proposal for a tighter PM standard for light trucks. The comparison in terms of potential cancer risk from car and light truck diesel PM likely would closely follow this emissions comparison.

The VOC emission reductions resulting from today's proposal would further 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. 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 proposal, because we have not yet completed our study of this issue or 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 proposal. Therefore, the estimates included in the Draft RIA should be considered preliminary. A peer-reviewed assessment is planned and may be completed in time to be available for incorporation into the impact analysis for the final rule. EPA will place this document in the docket as soon as it is available for public review.

Section 202(l)(2) of the Clean Air Act requires EPA to establish regulations for the control of hazardous air pollutants, or air toxics, from motor vehicles. The regulations may address vehicle emissions or fuel properties that influence emissions, or both. We will issue a proposal to address this requirement in September of this year, and a final rule in July 2000.

G. Acid Deposition [26]

Acid deposition, or acid rain as it is commonly known, occurs when SO_2

[25] EPA's diesel health assessment (Health Assessment Document for Diesel Emissions, SAB Review Draft, U.S. Environmental Protection Agency, Washington, DC. EPA/600/8–90/057C, February 1998.) can be found at the following EPA website: *http://www.epa.gov/ncea/diesel.htm*. The Clean Air Science Advisory Committee's review of that assessment (CASAC Review of the Draft Diesel Health Assessment Document, U.S. Environmental Protection Agency Science Advisory Board, Washington, DC EPA–SAB–CASC–99–001.) can be found at the following SAB website: http://www.epa.gov/sab/.

[26] 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 20460, November 1995.

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 Draft 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 proposal would help reduce acid rain and acid deposition, thereby helping to reduce acidity levels in lakes and streams throughout the U.S. These reductions would help accelerate the recovery of acidified lakes and streams and the revival of ecosystems adversely affected by acid deposition. Reduced acid deposition levels would 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 would be reduced, and the costs borne to prevent acid-related damage may also decline.

While the reduction in sulfur and nitrogen acid deposition would be roughly proportional to the reduction in SO_X and NO_X emissions, respectively, the precise impact of today's proposal would 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 proposal on SO_X and NO_X emission inventories provides a rough indicator of the likely effect of today's proposal on acid deposition. As discussed in Section III.D. above, today's proposal would reduce SOx emissions by 1.6 percent and NO_X emissions by 12.5 percent in 2020.

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

H. Eutrophication/Nitrification

Nitrogen deposition into bodies of water can cause problems beyond those associated with acid rain. Elevated levels of nitrate in drinking water pose significant health risks, especially to infants. 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.[27] 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.[28] 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. [29] Research suggests that nitrogen fertilization can alter growth patterns and change the balance of species in an ecosystem. In

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

[28] Much of this information was taken from the following EPA document: *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.

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

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 proposal would reduce total NO_X emissions by 12.5 percent in 2020. These reductions should reduce drinking water nitrate levels by reducing the amount of nitrate deposited from the atmosphere onto drinking water sources or onto the watersheds of drinking water sources by similar amounts. The NO_X reductions would also 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 12.5 percent reduction in NO_X from today's proposal are projected to reduce nitrogen loadings by 1.5–5.5 percent. To put these reductions in perspective, the reductions expected in the Chesapeake Bay area would amount to about 6 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 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 drinking water nitrate levels and reduced terrestrial nitrogen deposition expected to result from today's proposal, if implemented. The analysis does, however, account for the economic benefits of reduced eutrophication.

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

Despite continued progress in reducing emissions from cars and light trucks, these vehicles 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. 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 proposal would reduce NO_X, VOC, CO, PM, and SO_X emissions from these vehicles substantially. These reductions would help reduce ozone levels nationwide and reduce the extent and severity of violations of both the 1-hour and 8-hour ozone standards. These reductions would also help reduce PM levels, both by reducing direct PM emissions and by reducing emissions that give rise to secondary PM. The NO_X and SO_X reductions would help reduce acidification problems, and the NO_X reductions would help reduce eutrophication problems and drinking water nitrate levels. The PM standards proposed today would help improve visibility and would help mitigate the adverse health effects due to possible increases in light-duty diesel engine sales.

Section IV.D.5. of this preamble describes the comprehensive analysis EPA has made of the net economic benefit of the requirements we are proposing today. In that analysis, we have quantified many of the public health and environmental benefits of the actions on an annual, national scale. Estimates of the economic value of these effects have been made for as many of the effects as possible, and compared to the cost of compliance. This rulemaking is the first instance in which EPA has conducted such a cost-benefit analysis for a set of proposed vehicle emission standards.

IV. What Are We Proposing and Why?

In the previous section, we showed why many states need as much emission reduction as is reasonably possible from LDVs and LDTs—plus reductions from other sources—if they are to reach and maintain compliance with the 1-hour and 8-hour ozone NAAQS. We also pointed out that these reductions would also be important in addressing PM and other air quality and environmental problems in every major region of the country.

In this section, we describe the comprehensive vehicle/fuel program we are proposing to respond to these serious air quality needs. Specifically, we discuss:

- Our reasons for proposing a comprehensive vehicle and fuel program, including why stringent LDV and LDT standards are feasible in conjunction with low sulfur gasoline.
- Our proposed vehicle-related requirements and our rationales for proposing them.
- Our proposed fuel-related requirements and our rationales.
- Our projections of the economic impacts, cost effectiveness, and monetized environmental and health benefits of the proposed program.
- Other program design options we have considered.

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 proposed today for gasoline-fueled vehicles are well within the reach of existing control technology. Our proposed 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 proposed new Tier 2 requirements. All of the certification and research testing discussed below was performed on low-sulfur test fuel (nominally 30 ppm).

Certainly, larger vehicles and trucks, which are heavier and have larger frontal areas, will face the biggest challenges. 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 proposing to change 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. The proposed change more accurately reflects how these vehicles are used and makes heavy LDT testing consistent with passenger car and light LDT testing. This change will make it substantially easier for the heavier trucks to meet our proposed standards.

Emission control technology has evolved rapidly in recent years. Emission standards applicable to 1990 model year vehicles required roughly 90% reductions in exhaust HC and CO emissions and a 75% reduction in NO_X emissions compared to uncontrolled emissions. Today, some vehicles currently in production are well below these levels, showing 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) 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 Draft 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 proposed standards. The Draft 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 proposed new standards by looking at current full-life certification data. There are at least 48 engine family-control systems combinations 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 proposed 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.

All of the above vehicles are already able, or close to being able, to certify to our proposed standards. The further reductions needed are those to provide an ample safety 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 1999 certification data reflects compliance cushions from as little as 20 percent below the standard to as high as 80 percent below the standard.

The cushion to be expected for Tier 2 vehicles is difficult to establish, although some manufacturers claim a cushion of 50 percent below the standard would be needed. We believe that manufacturers would strive to use the smallest cushions possible in order to minimize the impacts of the standards on their vehicles. Looking at 1999 certification data from this perspective and using a threshold of 0.04 g/mi NO_X, there are fully 22 engine family-control system configurations at or below the 0.04 g/mi level (one of which is a LDT4). Thus, even at such low levels, current technology is already demonstrating the performance that would be necessary to meet the proposed standards.

Since the most difficult compliance effort would be faced by the larger LDTs, we have undertaken a technology demonstration program aimed at lowering the emissions of a large 1999 LDT3 vehicle. This vehicle has a high horsepower engine, four wheel drive, and a curb weight of 4,500 pounds (GVWR[30] of 6,100 lbs). The exhaust system of the vehicle was modified to incorporate two close-coupled and two underfloor catalytic converters. The catalytic converters were aged to full useful life conditions using the accelerated aging methods described by Theiss.[31] For further details of the modifications to this vehicle, please refer to the draft RIA.

In our initial work we made no attempts to alter the calibration of the electronic engine controls. In this configuration, the vehicle achieved emissions levels of 0.060 ± 0.002 g/mi NO_X and 0.09 ± 0.01 g/mi NMHC. Thus, by these straightforward modifications to the catalyst system based upon existing catalyst hardware, this vehicle was able to reach the proposed Tier 2 levels. In order to achieve additional reductions in the test vehicle's emissions, we are planning further work consisting largely of elimination of fuel cut-offs during decelerations, slight increases in EGR, and a minor degree of air injection during cold-start. However, given the amount of leadtime before any of the proposed Tier 2 standards would begin, we believe that the work already done clearly shows the feasibility of our proposal, even for large light-duty trucks.

Figure IV.A.–1 shows the results of our testing in comparison to the California LEV–1 standards applicable to this vehicle, and the proposed Tier 2 standards.

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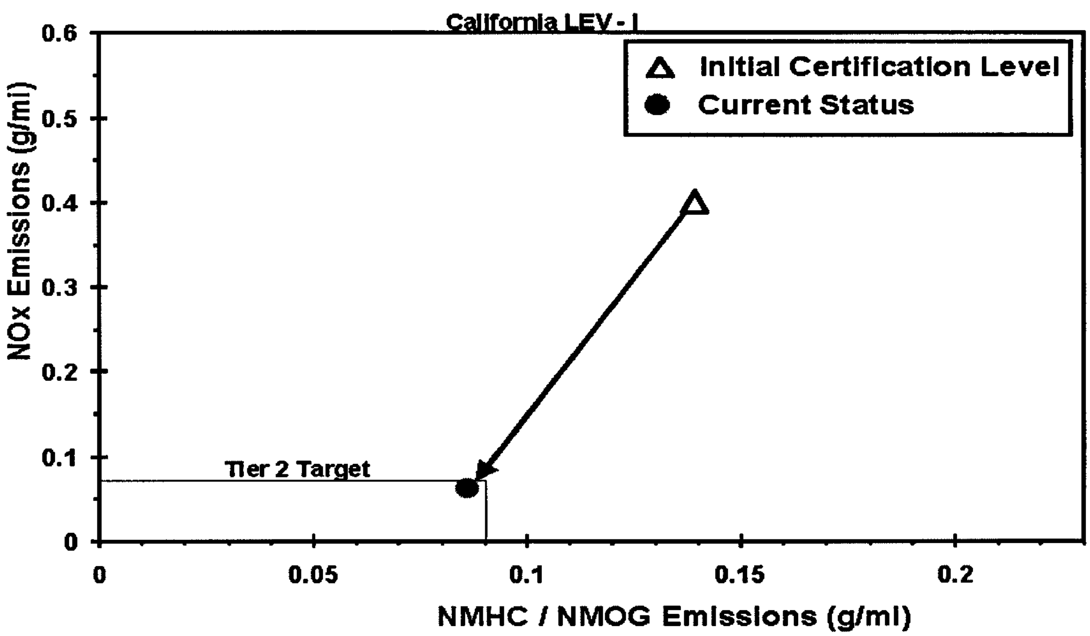
[30] Gross Vehicle Weight Rating. The curb weight of the vehicle plus its maximum recommended load of passengers and cargo.

[31] Theiss, J.R., ''Catalytic Converter Diagnosis Using the Catalyst Exotherm,'' SAE Technical Paper Series, Paper No. 942058, SAE Fuels and Lubricants Meeting and Exposition, Baltimore, MD, October 17–20, 1994.

Figure IV.A.-1

Emission Results - 1999 Light-Duty Truck as Modified by EPA



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One of the challenges facing larger truck catalyst systems is overtemperature protection. Because of this, our work on this vehicle included temperature evaluation of the catalyst under maximum load conditions. We found that the original fuel calibration for the truck provided sufficient enrichment under wide-open-throttle conditions to prevent exceeding the catalyst bed temperature limits (~950 to 1000°C) specified by the manufacturer of the catalytic converters. We conducted chassis dynamometer testing over the aggressive US06 cycle with the dynamometer inertia greatly increased to simulate full GVWR load conditions (6,100 lbs) for the pickup. Catalyst bed temperatures did not exceed 850°C at any point during the testing.

In addition to the EPA work, others have conducted several test programs recently that help demonstrate the feasibility of our proposed levels. The Coordinating Research Council (CRC), automobile manufacturers, and the American Petroleum Institute (API) all tested a number of light-duty vehicles capable of complying with the California LEV or ULEV standards as part of an evaluation of the effects of sulfur levels on emissions. Of the vehicles tested, seven met or nearly met the Tier 2 design targets, and all were below the proposed 0.07 g/mi NO_X and 0.09 g/mi NMOG standards.

Another program sponsored by MECA 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 converters with more advanced catalytic converters, thermally aged to roughly 50,000 miles. With these systems and some related emission control modifications, all three vehicles' emissions were well below our proposed 50,000 mile standards (0.05 g/mi NO_X, 0.075 g/mi NMOG), and the Buick and the Toyota LDT2 met our estimated design targets for those standards.

Finally, the California Air Resources Board (ARB) tested six different production LEV light-duty vehicle models. Two of the six models met the proposed Tier 2 design targets for NMOG and NO_X. After installing low mileage advanced catalytic converters and making some minor adjustments, all of the vehicles had emission levels well below the proposed Tier 2 NMOG and NO_X design targets. 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.

Neither the MECA nor the ARB test programs modified the basic engine calibrations of the vehicles tested. It is very likely that such recalibration could reduce emissions even further. Therefore, we consider these actual test results to be a conservative estimate of the capability of these advanced catalytic converters. This is especially true for the Ford Expedition testing by ARB, where the engine software appeared to modify its own calibration with the new catalyst, counteracting some of the advantages of the new catalyst.

A more expanded analysis of the feasibility of the proposed standards for gasoline fueled vehicles can be found in the Draft 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 proposed CO, formaldehyde and evaporative emission standards. The conclusion of all of our analyses is that the proposed standards would be feasible for gasoline-fueled vehicles operated on low-sulfur gasoline. As gasoline-fueled vehicles represent the overwhelming majority of the light-duty vehicle and truck population, EPA proposes to find that the proposed standards would be feasible overall for LDVs and LDTs.

b. *Diesel Vehicles.* As outlined above, we have decided to propose standards that are intended to be ''fuel neutral.'' In today's document, we propose to find that the Tier 2 standards are technologically feasible and cost-effective for light-duty vehicles and light-duty trucks overall, based on the discussion in Section IV.A.1.a. above. Under the principal of fuel neutrality, all cars and light trucks, including those using diesel engines, would be required to meet the proposed Tier 2 standards. EPA believes that the proposed program, including the phase-in periods, would facilitate the advancement of clean diesel engine technologies. EPA further believes that in the long term the standards would be within reach for diesel-fueled vehicles in combination with appropriate changes to diesel fuel to facilitate aftertreatment technologies.

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. NO_X emissions from heavy trucks and buses sold starting in 2002 will also reflect deep reductions from emission levels typical of engines produced in the mid-1980's. Indeed, emissions and performance of lighter diesel engines 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.[32]

While reductions in ''engine-out'' emissions, including incorporation of EGR strategies, will continue to be made, increasing emphasis is being placed on various aftertreatment devices for diesels. This is because further reductions in engine-out emissions will be unlikely, by themselves, to allow diesels to comply with the proposed Tier 2 standards for NO_X and PM. Rather, diesels would require the use of highly effective aftertreatment devices.

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 proposed Tier 2 standards, but it could be used to meet the interim standards that would begin in 2004.

NO_X adsorbers appear to be up to 90% efficient at removing NO_X from the exhaust. 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

[32] We generally expect that manufacturers would take advantage of the flexibilities in today's proposal to delay the need for diesel vehicles to meet the final Tier 2 levels until late in the phase-in period. Because diesel vehicles represent a very small percentage of the LDV/LDT market, diesels would not fall under the final Tier 2 standards until 2009, giving manufacturers a relatively large amount of leadtime. As discussed below, we are issuing an Advance Notice of Proposed Rulemaking intended to solicit comment on the need for reduced sulfur in diesel fuel in order to meet these standards. We also believe that the proposed interim standards would be feasible for diesels by 2004, with or without the fuel change, given the flexibilities associated with those standards.

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 still be available by the time it would be needed for the proposed 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 Tier 2 levels, low sulfur diesel fuel would also be required to mitigate or prevent this poisoning problem. One solution would be to reduce sulfur to very low levels. Another solution would be to reduce sulfur somewhere below current levels and develop a way to periodically remove the sulfur from the adsorber. In any event, this technique, if used, would also require low sulfur diesel fuel.

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. As the engine and vehicle will 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.

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.

Since we have noted that some of the options for diesel aftertreatment may require lower sulfur diesel fuel than is currently available, the question of diesel fuel quality improvement arises. Manufacturers have argued that low sulfur diesel fuel will be required to permit diesels to meet the proposed new standards. While we believe that low sulfur diesel fuel would likely be required to enable diesel engines to meet the proposed Tier 2 standards, this proposal does not include provisions for such fuel. We need additional information about the specific aftertreatment solutions that could be used to meet the standards, the effectiveness of these approaches in reducing PM and NO_X emissions and their sensitivity to diesel sulfur, and improvements or alternatives that might reduce the impacts of fuel sulfur.

To deal more thoroughly with this matter, we are issuing an Advanced Notice of Proposed Rulemaking on a parallel path with today's Tier 2 proposal. As a part of that process, EPA will assess the effect of low-sulfur fuel on the ability of diesels to meet Tier 2 standards for LDVs and LDTs. It will also consider the issue of the relation of diesel fuel quality to future standards for heavy-duty on-highway diesel engines and nonroad diesel engines. Our plans for this Advanced Notice are discussed further in section IV.C. below. In any case, we believe that the standards proposed today are appropriate and feasible overall for LDVs and LDTs.

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 we propose are needed to meet air quality goals 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 like those proposed today.

This is the reason EPA has decided to propose 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. (We discuss the related fact that the sulfur impact on catalyst performance is not fully reversible in Section IV.C. below, in the context of EPA's preference for a nationwide versus a regional gasoline sulfur control program, and in the Draft RIA.)

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 proposed Tier 2 standards, require catalysts to be extremely efficient to adequately reduce emissions over the full useful life of the vehicle. Recent test programs conducted by the automotive and oil industries show that LEV and ULEV vehicles can experience, on average, a 40% increase in NMHC and 134% increase in NO_X emissions when operated on 330 ppm sulfur fuel (approximately the current national average sulfur level) compared to 30 ppm sulfur fuel.

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

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.

Other implications of continued use of high-sulfur gasoline include the following:

• Other important potential air quality benefits would not be realized throughout the country, including reduction in direct emissions of sulfur dioxide, secondary formation of nitrate PM from NO_X emissions, reductions in regional haze, reductions in air toxics emissions and other pollution problems described in Section III above.

• The immediate and very significant improvements that lower sulfur gasoline would bring in the emissions performance of vehicles already on the road would not occur.

• Advanced emission control technologies now being developed, all of which appear equally or even more sensitive to gasoline sulfur levels than current technologies, would not be available to the U.S. vehicle market (for example, very fuel efficient technologies like gasoline direct injection technology and fuel cells).

• Finally, any interference with onboard emission control system diagnostic (OBD) systems that high-sulfur gasoline causes would remain in the absence of a low-sulfur gasoline program.

3. A Comprehensive Vehicle/Fuel Approach Is Therefore Necessary

Based on this information, we have concluded that sulfur levels in gasoline must be reduced to enable these catalysts to operate properly and for the needed air quality benefits of this program to be achieved. In today's action, therefore, we are proposing a comprehensive, integrated program of stringent vehicle emission standards in combination with stringent gasoline sulfur standards. The proposal is carefully designed to address the need for refiners to make low-sulfur gasoline available at very nearly the same time as auto makers begin selling large numbers of Tier 2 vehicles. We have tried to take into account all potential areas of interaction between the vehicle and gasoline sulfur parts of the proposal, and as a result we believe that the overall proposed program would achieve the expected environmental goals while minimizing the economic and administrative burdens on the affected industries. We encourage all commenters to consider and discuss the interrelationships among the elements of the program when they comment on individual provisions.

B. Our Proposed Program for Vehicles

We have held a series of meetings with the various stakeholders impacted by this action. We have seriously considered their input in developing our proposal and believe the program laid out below and the areas upon which we are seeking comment are responsive to their concerns. One part of this input was provided by a broad representation of the LDV/LDT manufacturing industry, represented by the Alliance of Automobile Manufacturers, and offered constructive recommendations on a number of elements of a vehicle emission control program. We have considered many of their ideas and issues in the design of the proposed program and we are seeking comment on a number of others. The ''Alliance'' proposal is documented in the docket in a letter to EPA dated March 26, 1999.

The next sections of the preamble describe our proposal in detail.

1. Overview of the Proposed Vehicle Program

The vehicle-related part of today's proposal covers a wide range of standards, concepts, and provisions that affect how vehicle manufacturers would 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 proposal. 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 proposed 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 proposed requirements.

a. *Introduction.* Today's proposal for Tier 2 vehicle standards incorporates concepts from the federal NLEV program. The program takes the corporate averaging concept and other provisions from NLEV but changes the focus from NMOG to NO_X. The emission standard ''bins'' used for this average calculation are different in several respects from those of the California LEV II program, yet we have designed them to allow harmonization of federal and California vehicle technology. As discussed below, 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 what fuel is used.

In the discussions below, we propose different Tier 2 phase-in schedules for two different groups of vehicles as well as two different sets of interim standards for 2004 and later model year vehicles not yet phased-in to the Tier 2 standards. To understand how the program would work, it is necessary first to understand EPA's classification system for light-duty vehicles and trucks.

The light duty category of motor vehicles includes all vehicles and trucks under 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. 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.

TABLE IV.B.–1.—Light Duty Vehicles and Trucks; 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, but not more than 8,500 lbs GVWR. Includes LDT3 and LDT4.

As discussed below, the Tier 2 program would 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 would meet interim requirements that would also employ a bins system, but with less stringent corporate average NO_X standards.

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. Some of those documents have now been modified as a result of changes to the proposed program made at the hearing and due to comments received after the hearing.

However, when this NPRM was assembled for signature, the documents related to the LEV II program had still not been finalized. In fact, a 15 day public review of the program was scheduled for April 15–30, 1999. After that review, ARB expected to be able to formally adopt the program and issue final documents without significant change.

We have placed copies of the latest available documents, some of which we used in the preparation of this NPRM, 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 propose to incorporate by reference a number of documents related to LEVII and California test procedures under LEVII. ARB expects to finalize the LEV II program without significant changes before we issue a final rule. We will review any changes to the final version of the LEV II program and its supporting documents and consider them for inclusion in the federal program when we prepare our final rule.

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

The value of a corporate average standard is that the program's air quality goals would be met while allowing manufacturers the flexibility to certify some models above and some models below the standard. Each manufacturer would determine its year-end corporate average NO_X level by computing a sales-weighted average of the NO_X standards from the various bins to which it certified any Tier 2 vehicles. The manufacturer would be in compliance with the standard if its corporate average NO_X emissions for its Tier 2 vehicles met the 0.07 g/mi level.

c. *Tier 2 Emission Standard ''Bins''*. We are proposing seven emission standard bins, each one a set of standards to which manufacturers could certify their vehicles. (Table IV.B.–2. in Section IV.B.–4.a. below shows all the standards associated with each bin.) Several bins have the same values as the California LEV II program. Further, we added three bins that are not a part of the California program to increase the flexibility of the program for manufacturers. As further discussed in Section IV.B.4. below, we believe these extra bins would help provide incentives for manufacturers to produce vehicles with emissions below 0.07 g/mi NO_X.

The corporate average concept using the seven bins would provide a program that gets 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 would 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 emissions to ''float'' in that the fleet NMOG emission rate depends on the mix of bins used to meet the NO_X standard. However, you can see by examining the bins we are proposing, that any combination of vehicles meeting the 0.07 g/mi average NO_X standard would have average NMOG levels at or below 0.09 g/mi. In addition, there will be overall improvements in NMOG since Tier 2 incorporates HLDTs, which are not covered by the NLEV program.

d. *Schedules for Implementation*. We recognize that the Tier 2 standards pose greater technological challenges for larger light duty trucks than for LDVs and smaller trucks. We believe that additional leadtime is appropriate for HLDTs. HLDTs have historically been subject to the least stringent vehicle-based standards. Also, HLDTs were not subject to the voluntary emission reductions implemented for LDVs, LDT1s and LDT2s in the NLEV program. Consequently we have designed separate phase-in programs for the two groups. Our phase-in approach would provide HLDTs with extra time before they would need to begin phase-in to the Tier 2 standards and also provide two additional years for them to fully comply. Figure IV.B–1 provides a graphical representation of how the phase-in of the Tier 2 program would work for all vehicles. This figure shows several aspects of the proposed program:

- Phase-in/phase-out requirements of the interim programs;

• Phase-in requirements of new evaporative standards;

• Years that could be included in alternative phase-in schedules;

• Years in which manufacturers could bank NO_X credits through ''early banking''; and

• ''Boundaries'' on averaging sets in the Tier 2 and interim programs.

We discuss each of these topics in detail below and make numerous references to Figure IV.B–1.

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Figure IV.B-1

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)	b	b	b	*early banking* b	b	b	b	50	100	0.07 avg
HLDT (INTERIM)	TIER 1 b	TIER 1 b	TIER 1 b	25	50	75	100	50 max		0.20[a] avg

[a] 0.60 NOx cap applies to balance of vehicles 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.

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i. Implementation Schedule for LDVs and LLDTs

We are proposing that the Tier 2 standards take effect beginning with the 2004 model year for light duty vehicles and trucks at or below 6000 pounds GVWR (LDV/LLDTs). We are proposing that manufacturers would phase their vehicles into the Tier 2 program beginning with 25 percent of LDV/LLDT sales that year, 50 percent in 2005, 75 percent in 2006, and 100 percent in 2007. Manufacturers would be free to choose which vehicles were 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 would have to meet the 0.07 g/mi corporate average standard. This phase-in schedule would provide between five and eight years of leadtime for the manufacturers to bring all of their LDV/LLDT production into compliance. These vehicles constitute nearly 90 percent of the light duty fleet.

To increase manufacturer flexibility and provide incentives for early introduction of Tier 2 vehicles, we are proposing that manufacturers could use alternative phase-in schedules that would require 100 percent phase-in by 2007, but would 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.

ii. Implementation Schedule for HLDTs

To provide greater leadtime for HLDTs we are proposing that the Tier 2 phase-in schedule would start later and end later than that for LDVs and LLDTs. In our proposal 50 percent of each manufacturer's HLDTs would be required to meet Tier 2 standards in 2008, and 100 percent would have to meet Tier 2 standards in 2009. As with the LDV/LLDTs, the Tier 2 HLDTs would have to meet a corporate average NO_X standard of 0.07 g/mi. This delayed phase-in schedule would provide manufacturers with nine years of lead time before they would need to bring any HLDTs into compliance with Tier 2 standards. As for the LDV/LLDTs above, to encourage early introduction of Tier 2 HLDTs and to provide manufacturers with greater flexibility, we are proposing that manufacturers could use alternative phase-in schedules that would still result in 100% phase-in by 2009.

We request comment on the appropriateness of this separate schedule for HLDTs.

e. *LDVs and LDTs Not Covered by Tier 2.* 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[33], 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 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 are proposing separate sets of interim standards for the two vehicle groups during the phase-in period. The provisions described below would 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 Figure IV.B–1.

i. Interim Standards for LDV/LLDTs

Beginning with the 2004 model year, all new LDVs and LLDTs not incorporated under the Tier 2 phase-in would be subject to an interim corporate average NO_X standard of 0.30 g/mi. This is the nominal LEV NO_X emission standard for LDVs and LDT1s under the NLEV program. This interim program would hold LDVs and LLDTs not covered by the Tier 2 standards during the phase-in to NLEV levels and bring about NO_X emission reductions from LDT2s . By implementing these interim standards for LDVs and LLDTs we will ensure that the accomplishments of the NLEV programs are continued. 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. Figure IV.B–1 shows the maximum percentage of LDVs and LLDTs that would normally be subject to the interim standards each year.

As the interim program for LDV/LLDTs is designed to hold these vehicles to NLEV levels, it employs bins derived from the NLEV program. These bins are shown in Tables IV.B.–6 and –7.

ii. Interim Standards for HLDTs.

Our interim standards for HLDTs would begin in 2004. The Interim Program for HLDTs would set a corporate average NO_X standard of 0.20 g/mi that would be phased in between 2004 and 2007. The interim HLDT standards, like those for LDV/LLDTs would be built around a set of bins (See Tables IV.B.–8 and –9).

As shown in Figure IV.B.–1, the phase-in would be 25 percent in the 2004 model year, 50 percent in 2005, 75 percent in 2006, and 100 percent in 2007. The program would remain in effect through 2008 to cover those HLDTs not yet phased into the Tier 2 standards (a maximum of 50%). Vehicles not subject to the interim corporate average NO_X standard during the 2004–2006 phase-in years would be subject to the least stringent bin (Bin 5) so their NO_X emissions would be effectively capped at 0.60 g/mi. These vehicles would be excluded from the calculation to determine compliance with the interim 0.20 g/mi average NO_X standard.

This proposed approach would implement standards significantly lower than the Tier 1 NO_X standards currently applicable to these vehicles. While manufacturers already certify many HLDTs at or below these levels, we believe these interim standards represent a reasonable step toward the Tier 2 standards and would provide meaningful control in the near term relative to current levels and Tier 1. This approach would 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.

iii. Interim Programs Would Provide Reductions over Previous Standards

As was the case with the primary Tier 2 bin structure, the bin structure for the interim programs would focus on NO_X and yet should provide further reductions in NMOG beyond the NLEV program (See Tables IV.B.–6,7,8 and 9). This is because the interim programs would reduce emissions from LDT2s and HLDTs compared to their previous standards. Without the interim standards, HLDTs could be certified as high as 0.46 g/mi or 0.56 g/mi, the Tier 1 NMHC levels. With the interim standards, however, exhaust NMOG should average approximately 0.09 g/mi for all non-Tier 2 LDV/LLDTs. and 0.25 g/mi or less for HLDTs.

iv. Alternative Approach for Interim Standards

An alternative flexible approach for reducing the emissions from vehicles and trucks prior to their phase-in to Tier 2 standards would be to employ a declining NO_X average, or perhaps separate declining NO_X averages for LDV/LLDTs and HLDTs. In this approach, manufacturers would certify vehicles to their choice of bins, but

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

would have to meet an average NO_X standard (or standards) that became lower each year. Manufacturers could bank NO_X credits in early years of such a program for use in later years when the standard tightened. We request comment on the benefits, implications and drawbacks of such an approach. Commenters should address the issues of (1) what added flexibility does this approach provide beyond that provided by the bins and phase-in approach proposed above, (2) how to handle potential windfall credits that could arise in the early years under such an approach, (3) how a standard that changes each year would impact technology phase-in and phase-out, and (4) whether such an approach would require the implementation of declining average standards for the other exhaust pollutants.

f. *Generating, Banking, and Trading NO_X* Credits. As described above, we are proposing that manufacturers average the NO_X emissions of their Tier 2 vehicles and comply with a corporate average NO_X standard. In addition, we are proposing that when a manufacturer's average NO_X emissions fall below the corporate average NO_X standard, it could generate NO_X credits that it could save for later use (banking) or sell to another manufacturer (trading). NO_X credits would 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 would facilitate compliance with the fleet average NO_X standards and would 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 would generate Tier 2 NO_X credits that it could use in a future model year when its average NO_X might exceed the 0.07 standard. Manufacturers would calculate their corporate average NO_X emissions and then compute credits based on how far below 0.07 g/mi the corporate average fell.

Manufacturers would be free to retain any credits they generate for future use or to trade (sell) those credits to other manufacturers. Credits retained or purchased could be used by manufacturers with corporate average Tier 2 NO_X levels above 0.07 g/mi. Manufacturers could certify LDVs and LLDTs to Tier 2 standards as early as the 2001 model year and receive NO_X credits for their efforts. They could use credits generated under these ''early banking'' provisions after the Tier 2 phase-in begins in 2004 (2008 for HLDTs).

Banking and trading of NO_X credits under the interim non-Tier 2 standards would be similar, except that a manufacturer would 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. There would be no provisions for early banking under the interim standards and manufacturers would not be allowed to use interim credits to address the Tier 2 NO_X average standard. Interim credits from LDVs/LLDTs and interim credits from HLDTs could not be used interchangeably due to the differences in the interim corporate average NO_X standards. We seek comment on allowing exchanges of credits between the LDV/LLDT interim program and the HLDT interim program.

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 Proposing the Same Set of Standards for Tier 2 LDVs and LDTs?

Before we provide a more detailed description of the proposed vehicle program, two overarching principles of today's proposal are worth explaining in some detail. The first of these is our proposal 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 and there are more annual vehicle miles of travel as a result.

As vehicle preferences have increasingly shifted from passenger cars to light trucks there has been an accompanying increase in emissions over what otherwise would have occurred, because of the increase in miles traveled 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 proposed Tier 2 bin structure, we are proposing to equalize the regulatory useful life periods for LDVs and LDTs and to apply the same Tier 2 exhaust emission standard bins to all of them.

Once the phase in periods end for all vehicles in 2009, manufacturers would include all LDVs and LDTs together in calculating their corporate average NO_X levels.[34] As mentioned above and described in more detail in Section IV.B.–4. below, manufacturers could choose the emission bin for any test group of vehicles provided that on a sales weighted average basis, the manufacturer met the average NO_X standard of 0.07 g/mi for its Tier 2 vehicles that year.

Some have suggested that a program with different requirements would be 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 would 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 would have achieved Tier 2 standards in substantial numbers. We believe this phase-in and other provisions of this proposal respond to these concerns. However, we request comments on the need for different standards for these vehicles. Specifically, we request comment on different levels for NMOG standards for these vehicles, including how NMOG standards less stringent than our proposed standards might affect the technological challenges presented by the proposed NO_X standards.

Considerations for a 2004 Technology Review

EPA is seeking comment on whether it should conduct a technology review of the Tier 2 standards in the future. As part of the input received from stakeholders while developing this proposal, the Alliance of Automobile Manufacturers suggested that the proposal include consideration of a technology review, principally designed to assess the status of Tier 2 technology development. As discussed above, we recognize that HLDTs will face the greatest technological challenge in complying with our proposed standards. Some manufacturers have suggested that the approach of applying the same standard to cars and light-duty trucks presents sufficient challenge as to raise serious uncertainty about compliance for the larger vehicles, even in the 2008

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

time frame. In addition to the concerns expressed regarding the time frame for implementation of the more stringent standards for HLDTs in 2008, manufacturers have indicated that there are questions of feasibility for introduction of advanced technologies for improved fuel economy, such as lean burn, fuel cell, and hybrid electric technology.

The review could assess the feasibility of the standards relative to the state of technology development for HLDTs. Further, the review could consider gasoline and diesel fuel quality and its impact on the effectiveness of aftertreatment, and whether lower sulfur levels are necessary for HLDTs to meet the Tier 2 standards. We may also examine the feasibility of the standards for vehicles using technologies to advance fuel economy. In addition, the review could consider whether additional air quality improvements are necessary and the feasibility of additional reductions of vehicle emissions to achieve such air quality improvements. EPA believes that serious consideration of this concept is warranted and if it determines such a review to be appropriate, the best time to conduct such a review may be in the 2004 time frame, before the final Tier 2 standards go into effect for HLDTs.

EPA could conduct such a review to assess the feasibility, timing and stringency of the standards relative to the state of technology development. In doing so, EPA would determine whether or not there was a need to formally consider a change in the final Tier 2 standards. If such a change were determined to be necessary, EPA would conduct a formal rulemaking, including conducting public hearings.

As part of the technology review, EPA would seek advice from all appropriate stakeholders and could engage a peer review process. In addition, such a process, if undertaken, could include public notice and opportunity for comment on the review, including the holding of public hearings by EPA. One way to structure the process would include the establishment of an advisory panel under the Clean Air Act Advisory Committee to provide assessment of the state of technology and the feasibility of the standards. The Committee could recommend appropriate action for the Administrator based on their findings. The Administrator would then determine if any changes were needed to adjust the Tier 2 standards for HLDTs, advanced technologies, or the fuel parameters. We request comment on the need for a technology review, scope of the review and on the design of the process and its timing.

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

The second overarching principle of our vehicle proposal is to apply the same Tier 2 standards to all light vehicles, regardless of the fuel they are designed to use. The same exhaust emission standards and useful life periods we are proposing today would 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 engines used in LDVs and LDTs tend to be used in the same applications as their gasoline counterparts, and thus we believe they should meet the same or very similar standards.

Manufacturers have expressed concerns that diesel-fueled vehicles would have difficulty meeting NO_X and particulate matter levels like those contained in today's proposal. Clearly, these standards would be challenging. As discussed in Section IV.A.–1. above, we expect that the proposed Tier 2 NO_X and NMOG standards would be challenging for gasoline vehicles, but that major technological innovations would not be required. For diesels, however, the proposed NO_X and PM standards would likely require applications of new types of aftertreatment with, perhaps, changes in diesel fuel. We anticipate that manufacturers that chose to build diesel vehicles would adopt aftertreatment technologies such as NO_X storage catalysts and continuously regenerating particulate traps to meet Tier 2 requirements.

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 ago years 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 for 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 Proposed Vehicle Program

The previous subsections IV.B.–1., 2., and 3. provided an overview of today's proposed vehicle program and the two overarching principles that it is built on. This subsection elaborates on the major vehicle-related elements of today's proposal. Later in this preamble, Section V.A. discusses the rest of the proposed vehicle provisions.

a. *Basic Exhaust Emission Standards and ''Bin'' Structure.* The program we are proposing today 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 would have the flexibility to choose the set of standards that a particular test group [35] of vehicles must meet. For a given test group of LDVs or LDTs, manufacturers would select a set of full useful life [36] standards from the same row (''emission bin'' or simply ''bin'') in Table IV.B.–1. below. Each bin contains a set of individual NMOG, CO, HCHO, NO_X, and PM standards. The vehicles would have to comply with each of those standards and would also be subject to the corresponding bin of intermediate useful life standards, if applicable, found in Table IV.B–2. For technology harmonization purposes, our proposed

[35] A ''test group'' is the basic classification unit proposed for certification of light-duty vehicles and trucks under EPA certification procedures for the CAP2000 program. This preamble assumes that manufacturers will be certifying under the provisions of 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.

[36] The regulatory ''useful life'' value for Tier 2 vehicles is specifically addressed in Section V.A.2. of this preamble. Full useful life is proposed to 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.

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

emission bins include all of those adopted in California's LEV II program.[37]

adopted in California's LEV II program.[37]

TABLE IV.B.–2.—TIER 2 LIGHT-DUTY FULL USEFUL LIFE (120,000 MILE) EXHAUST EMISSION STANDARDS
[Grams per mile]

Bin No.	NO_X	NMOG	CO	HCHO	PM
7	0.20	0.125	4.2	0.018	0.02
6	0.15	0.090	4.2	0.018	0.02
5	0.07	0.090	4.2	0.018	0.01
4	0.07	0.055	2.1	0.011	0.01
3	0.04	0.070	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

TABLE IV.B.–3.—LIGHT-DUTY INTERMEDIATE USEFUL LIFE (50,000 MILE) EXHAUST EMISSION STANDARDS
[Grams per mile]

Bin No.	NO_X	NMOG	CO	HCHO	PM
7	0.14	0.100	3.4	0.015	....
6	0.11	0.075	3.4	0.015	....
5	0.05	0.075	3.4	0.015	....
4	0.05	0.040	1.7	0.008	

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 proposing interim standards derived from the LDV/LDT1 NLEV standards to cover all non-Tier 2 LDVs and LLDTs during the Tier 2 phase-in. We are proposing separate interim standards for HLDTs. (We describe the interim standards in detail in Section IV.B.4.e. below.)

i. Why Are We Proposing Extra Bins?

Compared to the CalLEV II program, our Tier 2 proposal includes additional bins. The California program contains no bins that would allow NO_X levels above the 0.07 g/mi level of LEVs. Therefore, under the California program, no engine family can be certified above LEV levels, even with the application of offsetting credits. We propose to add two bins above the LEV bin (Bins 6 and 7) and another below the LEV bin (Bin 3) to provide manufacturers with additional flexibility to reduce costs and to account for greater technological challenges faced in getting certain vehicles to levels of 0.07 g/mi NO_X or less.

During the Tier 2 phase-in years (through 2006 for LDV/LLDTs and 2008 for HLDTs), we are also proposing that the bins from the applicable interim program would be available. Vehicles certified to these levels could, at the manufacturer's option, be included in calculating the Tier 2 corporate average NO_X level. This would enhance the flexibility of the program by providing manufacturers with three additional bins having NO_X standards above 0.07 g/mi. Since a manufacturer could elect these bins under the interim program anyway, there would be no impact on air quality. The interim program and the interim bins for non-Tier 2 vehicles are described in detail in section IV.B.4.e.

The additional bins would also provide an incentive for manufacturers to produce vehicles below 0.07 g/mi of NO_X. We believe this incentive would exist because manufacturers would 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 would have to offset those vehicles in our NO_X averaging system with vehicles certified below 0.07 g/mi, and the 0.04 g/mi bin would provide greater opportunity to do this. Thus, the extra bins would serve two purposes; they would provide additional flexibility to manufacturers to address technological differences and costs, and they would provide those manufacturers with incentives to produce cleaner vehicles and thus advance emission control technology.

We are proposing a bins approach and the proposed bins because we believe they would provide adequate and appropriate emission reductions and manufacturer flexibility. In addition, this structure will help to accelerate technological innovation. We request comment on the appropriateness of the proposed bin structure and whether the levels proposed are appropriate. Also, we request comment on whether we should include up to two additional bins between bin 5 (NO_X = 0.07) and bin 6 (NO_X = 0.15). Our proposed bin structure is intended to assure that nearly all vehicles comply with a NO_X standard of 0.07 g/mi. These additional bins would provide greater flexibility for manufacturers who may find it more cost-effective to produce some vehicles slightly above 0.07 but would have difficulties meeting a 0.07 g/mi average NO_X standard if they had to certify them to a NO_X level of 0.15 g/mi. We request specific comment on whether we should

[35] A ''test group'' is the basic classification unit proposed for certification of light-duty vehicles and trucks under EPA certification procedures for the CAP2000 program. This preamble assumes that manufacturers will be certifying under the provisions of 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.

establish these bins and if so what standards for each pollutant we should include. As we indicated above, we believe that the existence of bins above 0.07 g/mi NO_X provide an incentive for technological advancement. We request comment as to whether these additional bins would limit this incentive in any way.

On the other hand, Bin 7 is intended primarily to aid manufacturers during the transition to Tier 2 standards. We request comment on whether this bin should be eliminated when the Tier 2 phase-in is completed (after 2007 for LDV/LLDTs and after 2009 for HLDTs).

b. *The Proposed Program Would Phase in the Tier 2 Vehicle Standards over Several Years*

i. Primary Phase-In Schedule

We are proposing to phase in the Tier 2 standards for LDVs/LLDTs over a four year period beginning in 2004 and we are proposing a delayed two year phase-in beginning in 2008 for HLDTs. These phase-in schedules are shown in Tables IV.B.–2 and are also shown separately in Tables IV.B.–4 and 5. We believe the flexibility of this dual phase-in approach is appropriate because the proposed Tier 2 program would encompass all light-duty vehicles and trucks and would result in widespread applications of upgraded and improved technology across the fleet. The program would require research, development, proveout, and certification of all light-duty models, and manufacturers would need longer lead time for some vehicles, especially HLDTs. Also, manufacturers might 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 a practical but aggressive phase-in schedule like the one we are proposing effectively balances air quality, technology, and cost considerations.

In each year, manufacturers would have to ensure that the specified fraction of their U.S. sales [38] met Tier 2 standards for evaporative emissions (discussed in Section IV.B.–4.f. below) and exhaust emissions, including Supplemental Federal Test Procedure (SFTP) standards (discussed in Section V.A.–3. below), as well as the corporate average Tier 2 NO_X standard. Manufacturers would 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) would 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 could 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 would generally address the Tier 2 evaporative phase-in with the same vehicles that they used 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 would 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 were 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.–4.—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
2004	25
2005	50
2006	75
2007	100

TABLE IV.B.–5.—PRIMARY PHASE-IN SCHEDULE FOR SALES OF TIER 2 HLDTS

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

According to the proposed phase-in approach, vehicle sales would 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 had adopted the California LEV II program would 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.

ii. Alternative Phase-In Schedule

While our primary proposal is based upon a phase-in of 25%, 50%, 75% and 100% of sales over the 2004, 2005, 2006 and 2007 model years, respectively (or 50% and 100% in 2008 and 2009 for HLDTs), we are proposing to permit alternative phase-in schedules as an option to provide additional flexibility to manufacturers. The alternative phase-in schedule provisions are structured to provide incentive to manufacturers to introduce Tier 2 vehicles before 2004 (or 2008 for HLDTs).

Under this alternative, manufacturers that introduced vehicles earlier than required could earn the flexibility to make offsetting adjustments, on a one-for-one basis, to the phase-in percentages in later years. However, they would still need to reach 100% of sales in the 2007 model year (2009 for HLDTs). Manufacturers would have the option to use this alternative to meet phase-in requirements for LDV/LLDTs and/or HLDTs. They could 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%) schedule for the other.

An alternative phase-in schedule would be acceptable if it passed 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 would be introduced during each year of the alternative phase-in schedule. To test an alternative schedule, a manufacturer would sum its yearly percentages of Tier 2 vehicles beginning with model year 2001 and compare the resulting sum to the sum that results from the primary phase-in schedule. If an alternative schedule scored as high or higher than the base

[36] The regulatory ''useful life'' value for Tier 2 vehicles is specifically addressed in Section V.A.2. of this preamble. Full useful life is proposed to 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.

option, then the alternative schedule would be acceptable.

For LDV/LLDTs, the final sum of percentages would have to 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 began in 2003 would have a sum of 250 percent and would be acceptable. In this example, each Tier 2 vehicle sold early (i.e. in 2003) would 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 began the same year would have a sum of 240 percent and would not be acceptable. For HLDTs, the sum would have to equal or exceed 150 percent.

To ensure that significant numbers of Tier 2 vehicles are introduced in the 2004 time frame, manufacturers would not be permitted to use alternative phase-in schedules that delayed the implementation of the Tier 2 LDV/LLDT requirements, even if the sum of the phase-in percentages met or exceeded 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 proposing that in any alternate phase-in schedule, a manufacturer's phase-in percentages from the 2004 and earlier model years sum to at least 25%.

The mathematical technique to evaluate alternative phase-in schemes is somewhat similar to that used in our NLEV rule and in California rules. We request comment on its appropriateness for this application. We also request comment on other approaches that might serve to provide incentive to manufacturers to introduce Tier 2 vehicles early, and to provide additional flexibility, while at the same time assuring that environmental gains equivalent to or greater than those of the primary phase-in option are produced. We have considered whether it would be appropriate to provide a ''multiplier'' that would serve to increase the value of the percentage of vehicles introduced before 2004 (2008 for HLDTs) in the mathematical test described above. Such a multiplier might start at 1 for 2004–2007 vehicles and increase for each year prior to 2004 (2008 for HLDTs). We request comment as to whether such a multiplier would be appropriate and whether it would produce real environmental gains by speeding the introduction of Tier 2 vehicles into the fleet.

All of the discussion on alternative phase-in schedules to this point has been premised on 100% compliance in 2007 (2009 for HLDTs). We request comment as to whether alternative phase-in schedules should be structured in such a way that, if a manufacturer introduced Tier 2 vehicles in excess of the minimum required during the phase-in years, that manufacturer could extend its phase-in beyond 2007 or 2009. Commenters should address the time period beyond 2007 or 2009 that would be appropriate as well as how EPA would determine the fraction of vehicles that could be delayed until that time.

Phase-in schedules, in general, add little flexibility for manufacturers with limited product offerings. 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. However for manufacturers that meet EPA's definition of ''small volume manufacturer,'' we are proposing elsewhere in this preamble that those manufacturers be exempt from the phase-in schedules and would simply have to comply with the final 100% compliance requirement. Still, we request comment on how alternative phase-in schedules might be structured to provide flexibility and incentive for early introduction to smaller manufacturers.

Later in this preamble (in Section V) we request specific comment on whether we should include a scheme to provide extra NO_X credits for manufacturers that introduce Tier 2 vehicles early. Commenters to the above discussion on alternate phase-in schedules should address whether a provision for extra NO_X credits might be a more appropriate way to provide inducements to smaller manufacturers to introduce Tier 2 vehicles early. Commenters should consider the interactions such extra credits might have with alternate phase-in schedules, particularly in situations where a ''multiplier,'' as described above, might be applied.

c. *Manufacturers Would Meet a ''Corporate Average'' NO_X* Standard. While the manufacturer would be free to certify a test group to any bin of standards in Table IV.B.–2, it would have to ensure that the sales-weighted average of NO_X standards from all of its test groups of Tier 2 vehicles met a full useful life standard of 0.07 g/mi. Using a calculation similar to that for the NMOG corporate average standard in the California and NLEV programs, manufacturers would 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 would use the following formula:

Corporate Average NO_X = Σ(Tier 2 NO_X std for each bin) ×(sales for each bin) total Tier 2 sales

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

The corporate average NO_X standards of the primary Tier 2 program and the interim programs for LDVs/LLDTs and HLDTs would 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 could generate, use, and buy or sell NO_X credits under the proposed program 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 would automatically bring the NMOG fleet average to approximately LEV levels. However, we request comment on the need for such a corporate average NMOG standard, as well as suggestions and rationales for what that standard, if any, should be. Commenters are encouraged to address any interactions with the bin structure, if appropriate.

d. *Manufacturers Could Generate, Bank, and Trade NO_X Credits.*

i. General Provisions

As mentioned in the Overview above, we are proposing that manufacturers with year-end corporate average NO_X emissions for their Tier 2 vehicles below 0.07 g/mi could generate Tier 2 NO_X credits. Credits could be saved (banked) for use in a future model year or for trading (sale) to another manufacturer. Manufacturers would consume credits if their corporate average NO_X emissions were above 0.07 g/mi.

We are proposing the Tier 2 standards to apply regardless of the fuel the vehicle is designed for, and there would 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 NO_X 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.

Because of the split phase-in and the different interim programs we are proposing for the two different groups of vehicles (LDV/LLDTs and HLDTs), we are also proposing to require that manufacturers compute their corporate Tier 2 NO_X averages separately for LDV/LLDTs and HLDTs through 2008. Credit exchanges between LDVs/LLDTs and HLDTs would not be allowed nor would credit exchanges across the interim program and Tier 2 program be allowed. These restrictions would end with the 2009 model year at which time both phase-ins and all interim standards will have ended and the program would permit free averaging across all Tier 2 vehicles. In the context of the whole program we are proposing, we are concerned that allowing cross-trading between interim and Tier 2 vehicles would reduce the expected benefits of the program and delay fleet turnover to Tier 2 emission levels. For this reason we are not proposing to allow such exchanges. We seek comment on this issue.

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

There are several reasons why we believe the proposed provisions for averaging, banking, and trading of NO_X credits (ABT) would be valuable.

- 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, helping to ensure that the standard would be attainable earlier than would otherwise be possible.
- ABT would provide manufacturers with additional product planning flexibility and the opportunity for a more cost effective introduction of product lines meeting the new standard.
- ABT would create an incentive for early introduction of new technology, allowing certain engine families to act as trail blazers for new technology. This could help provide valuable information to manufacturers on the technology prior to manufacturers needing to apply the technology throughout their product line. The early introduction of new technology would also further improve the feasibility of achieving the standard and could also provide valuable information for use in other regulatory programs that may benefit from similar technologies (e.g., heavy-duty vehicle standards).

EPA views the proposed ABT provisions as environmentally neutral because the use of credits by some vehicles would be offset by the generation of an equal number of credits generated by other vehicles. However, when coupled with the new standards, ABT could have environmental benefits because it could allow the new standards to be implemented earlier than would otherwise be appropriate under the Act.

iii. How Manufacturers Would Generate and Use NO_X Credits

As described in the previous subsection, and subject to the phase-in restrictions described in that subsection, manufacturers would 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 certified any LDVs or LDTs. The manufacturer would round this average to one more decimal place than in the corporate average NO_X standard. Tier 2 NO_X credits would be generated when a manufacturer's average was 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) × Sales

The manufacturer could then use these NO_X credits in future years when its corporate NO_X average was above 0.07, or it could trade (sell) the credits to other manufacturers. The use of NO_X credits would not be permitted to address Selective Enforcement Auditing or in-use testing failures.

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

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

To provide manufacturers with greater flexibility and with incentives to certify, produce and sell Tier 2 vehicles as early as possible, we are proposing that manufacturers could utilize alternative phase in schedules. (See IV.B.4.b.ii above.) Under such schedules, a manufacturer could certify vehicles to bins having NO_X standards 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 would still lead to 100% compliance by 2007 (2009 for HLDTs). To the extent that 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. Manufacturers would 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.

These credits would have all the same properties as credits generated by vehicles subject to the primary phase-in schedule. These credits could not be used in the NLEV, Tier 1 or interim program for non-Tier 2 vehicles in any way. However, the NMOG emissions of these vehicles (LDVs and LLDTs only) could 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 are proposing that manufacturers could 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 would have to be prorated by 100,000/120,000 (5/6) so that they could be properly applied to 120,000 mile Tier 2 vehicles in 2004 or later.

We are proposing that early banking of HLDT NO_X credits could not begin until the 2004 model year. This provides a four year period during which early credits could be generated for use in the 2008/2009 HLDT Tier 2 phase-in. We are concerned that allowing generation of early HLDT credits in years prior to 2004 could result in credits that are largely windfall credits. Still, we recognize that vehicles that meet the Tier 2 standards early represent an environmental benefit and we request comment on the need for and appropriateness of allowing early banking of HLDT credits before the 2004 model year.

We recognize that vehicles generating early 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. 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). We request comment on all aspects of early introduction of Tier 2 vehicles and the proposed provisions for early NO_X credits.

v. NO_X Credits Would Have Unlimited Life

We are not proposing to apply the California schedule of discounting unused credits that was 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. Because of the declining corporate average NMOG standards in that program, California has decided, and we agree, that it is prudent to limit the lives of credits to prevent manufacturers from being able to accumulate credits and then apply them in such a way as to delay the impact of declining standards. But in this proposed federal program, once the proposed phase-in period ends in model year 2009, all light duty vehicles and trucks would comply on average with a fixed Tier 2 NO_X standard.

Credits would allow manufacturers a way to address unexpected shifts in their sales mix and yet would prevent the program from being abused to allow emission increases by design, since emissions would be capped by the levels in the least stringent bin. The NO_X emission standards in the Tier 2 and interim programs are quite stringent and do not present easy opportunities to generate credits. The degree to which manufacturers invest the resources to achieve extra NO_X reductions provides true value to the manufacturer and the environment. 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 proposing that Tier 2 NO_X credits would have unlimited lives. We request comment on the need for discounting of credits or limits on credit life and what those discount rates or limits, if any, should be.

vi. NO_X Deficits Could 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 are proposing that the manufacturer be allowed to 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, 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.[39] We believe that it is reasonable to provide this flexibility to carry a deficit for one year given the uncertainties that light duty vehicle and truck manufacturers face with changing market forces and consumer preferences, especially during the introduction of new technologies. These uncertainties can make it hard for manufacturers to accurately predict sales trends of different vehicle models. We request comment on this provision.

e. *Interim Standards.*

i. Interim 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). Currently, 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 2003 and can run through model year 2005.

Given the Tier 2 phase-in we are proposing, not all LDV/LLDTs covered under NLEV will be subject to Tier 2 standards in the 2004 to 2006 period. Unless EPA adopts a program for full Tier 2 compliance in 2004 (i.e., without a 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 proposing interim standards for all non-Tier 2 LDV/LLDTs for the 2004–2006 model years. Our interim standards would replace the NLEV program, which would then terminate at the end of 2003. The transition from NLEV to Tier 2 should be smooth because the interim standards are derived from the NLEV standards for LDVs and LDT1s and would 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 as NLEV levels. The standards would also arguments prebring the emission standards for LDT2s into line with those for the LDVs and LDT1s. We propose to align the useful life periods for interim standards with those of the Tier 2 standards (full useful life of 120,000 miles, intermediate useful life of 50,000 miles, as discussed in Section V.A.-2 below)

Tables IV.B.-6 and IV.B.-7 below present interim standards we are proposing for LDVs and LLDTs not covered by Tier 2 standards during the phase in period.

[39] Because of the limited duration of the interim programs, we are proposing 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 see little risk of prolonged deficits.

TABLE IV.B.–6.—FULL USEFUL LIFE (120,000 MILE) INTERIM EXHAUST EMISSION STANDARDS FOR LDV/LLDTS

[Grams per mile]

Bin No.	NO_X	NMOG	CO	HCHO	PM
5	0.60	0.156	4.2	0.018	0.06
4	0.30	0.090	4.2	0.018	0.06
3	0.30	0.055	2.1	0.011	0.04
2	0.07	0.090	4.2	0.018	0.01
1	0.00	0.00	0.0	0.000	0.0

TABLE IV.B.–7.—INTERMEDIATE USEFUL LIFE (50,000 MILE) INTERIM EXHAUST EMISSION STANDARDS FOR LDV/LLDTS

[Grams per mile]

Bin No.	NO_X	NMOG	CO	HCHO	PM
5	0.40	0.125	3.4	0.015	....
4	0.20	0.075	3.4	0.015	....
3	0.20	0.040	1.7	0.008	....
2	0.05	0.075	3.4	0.015	....

We are proposing a corporate average full useful life NO_X standard of 0.30 g/mi for this interim program. LDV/LLDTs, which will already be at NLEV levels, should readily be able to meet this average NO_X standard. Although we have not shown it in the tables of interim standards above, we are also proposing that all of the bins shown for the Tier 2 program (see Tables IV.B.–2 and –3) could be used in the interim program. Thus if a manufacturer had vehicles certified to Tier 2 bins that it did not need to comply with the Tier 2 NO_X average standard and phase in percentage, it would have the additional option to use them in the interim program. We request comment as to whether the number of bins provided in the interim program and their emission levels are appropriate.

The 0.30 g/mi corporate average NO_X standard (and the bins of standards in the above two tables) would apply only to non-Tier 2 LDV/LLDTs and only for the 2004–2006 model years. Manufacturers would compute, bank, average, trade, account for, and report NO_X credits via the same processes and equations described in this preamble for Tier 2 vehicles, substituting the 0.30 g/mi corporate average standard for the 0.07 g/mi corporate average standard in the basic program. Also, EPA would condition the certificates of conformity on compliance with the corporate average standard, as described for Tier 2 vehicles. These NO_X credits would be good only for the 2004–2006 model years and would only apply to the interim non-Tier 2 LDV/LLDTs. Credits would not be subject to any discounts, and credit deficits from the 2004 and 2005 model year could be carried forward, provided they were covered with appropriate credits by the end of the 2006 model year. NMOG credits from the NLEV program could not be used in this interim program in any way. Credits generated under this interim program would not be applicable to the Tier 2 NO_X average standard of 0.07 g/mi because of our concern that a windfall credit situation could occur. This could happen because credits are relatively easy to generate under a 0.30 g/mi standard compared to generating credits under a 0.07 g/mi standard. The application of credits earned under the interim standard to the Tier 2 standards could significantly delay the fleet turnover to Tier 2 vehicles. The requirements of the interim program would be monitored and enforced in the same fashion as for Tier 2 vehicles.

For the reasons cited above, we believe it is appropriate to extend interim, NLEV-like standards beyond 2003 as a mandatory program and to bring all LDVs and LLDTs within its scope. Manufacturers have already demonstrated their ability to make LDVs and LLDTs that comply at levels well below these standards, and, as the interim standards for LDV/LLDTs are essentially ‘‘phase-out’’ standards, we are not proposing any alternative phase-in schedules or early banking provisions for NO_X credits from the interim LDV/LLDTs.

We request comment on all aspects of the interim standards for LDVs and LLDTs.

ii. *Interim Standards for HLDTs.*

We are also proposing interim standards to begin in 2004 for HLDTs. These vehicles are not included in the NLEV program and will be subject only to the Tier 1 standards prior to model year 2004. Tier 1 standards permit NO_X emissions of 0.98 g/mi for LDT3s and 1.53 g/mi for LDT4s.

The interim standards for HLDTs would apply beginning in the 2004 model year and would phase-in through the 2007 model year, as shown in Figure IV.B.–1. The proposed interim program is based on a corporate average full-life NO_X standard of 0.20 g/mi. Manufacturers would comply with the corporate average HLDT NO_X standard by certifying their interim HLDTs to any of the full useful life bins shown in Table IV.B.–8. Where applicable, manufacturers would also comply with the intermediate useful life standards shown in Table IV.B.–9. Interim HLDTs not needed to meet the phase-in percentages during model years 2004–2006 would have to be certified to the standards of one of the bins in Table IV.B.–8 (and –9), but would not be included in the calculation to demonstrate compliance with the 0.20 g/mi average. Thus, the emissions of all interim HLDTs would be capped at a NO_X value of 0.60 g/mi.

As with LDV/LLDTs, manufacturers would also have the flexibility to use any of the Tier 2 bins shown in Tables IV.B.–2 and IV.B.–3 as additional bins for interim HLDTs. At the end of each model year, manufacturers would determine their compliance with the 0.20 NO_X standard by calculating a sales weighted average of all the bins to which they certified any interim HLDTs, excluding those not needed to meet the phase-in requirements during 2004–2006.

We believe these interim standards are necessary and reasonable for HLDTs. While these trucks make up a fairly small portion of the light-duty fleet (about 11%), their current standards under Tier 1 are far less stringent than the NLEV standards that apply to current model year LDVs and LLDTs.

Given the delayed phase-in we are proposing for HLDTs, we believe it is appropriate to bring about some interim reductions from these vehicles. Further, manufacturers have already demonstrated their ability to meet these interim standards with HLDTs. These standards are a reasonable first step toward the Tier 2 program and would provide meaningful reductions in the near term relative to current certification levels under the Tier 1 emission standards.

TABLE IV.B.–8.—FULL USEFUL LIFE (120,000 MILE) INTERIM EXHAUST EMISSION STANDARDS FOR HLDTS

[Grams per mile]

Bin No.	NO_X	NMOG	CO	HCHO	PM
5	0.60	0.230	4.2	0.018	0.06
4	0.30	0.180	4.2	0.018	0.06
3	0.20	0.156	4.2	0.018	0.02
2	0.07	0.090	4.2	0.018	0.01
1	0.0	0.0	00.0	0.000	0.0

TABLE IV.B.–9.—INTERMEDIATE USEFUL LIFE (50,000 MILE) INTERIM EXHAUST EMISSION STANDARDS FOR HLDTS

[Grams per mile]

Bin No.	NO_X	NMOG	CO	HCHO	PM
5	0.40	0.160	3.4	0.015	....
4	0.20	0.140	3.4	0.015	....
3	0.14	0.125	3.4	0.015	....
2	0.05	0.075	3.4	0.015	....

Given that the interim HLDT standards are ''phase-in'' standards through 2007 (as opposed to the interim LDV/LLDT standards, which are ''phase-out'' standards), we are proposing that manufacturers could employ alternative phase-in schedules as proposed for the Tier 2 standards and described in detail in section IV.B.4.b.ii. of this preamble. These schedules provide manufacturers with greater flexibility and we believe they also provide incentive for manufacturers to introduce advanced emission control technology at an earlier date. Alternative phase-in schedules would have to provide 100% phase-in by the same year as the primary phase-in schedule (2007). Because we are concerned about the possibility of windfall credits from some vehicles that might easily meet the 0.20 corporate average NO_X standard, we are not proposing to permit the generation of credits from interim HLDTs prior to the 2004 model year, although we request comment on this issue.

f. *More Stringent Proposed Light-Duty Evaporative Emission Standards.* We are proposing to adopt a set of more stringent evaporative emission standards for all Tier 2 light-duty vehicles and light-duty trucks. The standards we are proposing in Table IV.B.–10 represent, for most vehicles, more than a 50% reduction in diurnal plus hot soak standards from those that will be in effect in the years immediately preceding Tier 2 implementation. The higher standards for HLDTs provide allowance for greater non-fuel emissions related to larger vehicle size.

TABLE IV.B.–10.—PROPOSED EVAPORATIVE EMISSION STANDARDS [GRAMS PER TEST]

Vehicle class	3 day diurnal + hot soak	Supplemental 2 day diurnal + hot soak
LDVs and LLDTs	0.95	1.2
HLDTs	1.2	1.5

Evaporative emissions from light-duty vehicles and trucks represent nearly half of the light duty VOC inventory projected for the 2007–2010 time frame, according to MOBILE5 projections. We are proposing today to reduce the light-duty evaporative emission standards applicable to diurnal and hot soak emissions by more than 50 percent for most vehicles. Manufacturers are currently certifying to levels that are, on average, about half of the current standards, and in many cases, much less than half the standards. Thus, meeting these proposed standards appears readily feasible. Even though manufacturers are already certifying at levels much below the current standard, we believe that reducing the standards will result in emission reductions as all manufacturers seek to certify with adequate margins to allow for in-use deterioration. Further, we believe that tighter standards will prevent ''backsliding'' toward the current standards as manufacturers pursue cost reductions.

As mentioned in section IV.B.–4.b above, we are proposing to phase in the Tier 2 evaporative standards by the same mechanism as the Tier 2 exhaust standards; e.g., 25/50/75/100 percent beginning in 2004 for LDV/LLDTs and 50/100 percent beginning in 2008 for HLDTs. (as shown in Figure IV.B.–1) As for the proposed exhaust standards, alternative phase-in plans would also be available.

The evaporative emissions standards we are proposing are the same as those that manufacturers' associations proposed during the development of California's LEV II proposal; California ultimately did not adopt these standards. We request comment on all aspects of these proposed evaporative standards and their likely impact on in-use evaporative emission levels. We also request comment on adopting the evaporative emissions standards and phase-in schedule that California adopted (representing about a 75 percent reduction from the standards that will otherwise be in place).

C. Our Proposed Program for Controlling Gasoline Sulfur

When we discussed gasoline sulfur control with the American Petroleum Institute, the National Petrochemical and Refiners Association, and other representatives of the oil industry, they laid out several major points for us to consider in development of our proposal:

- A regional approach to gasoline sulfur control would be more appropriate than a nationwide program. Gasoline sulfur control should be targeted primarily at the areas of greatest environmental need.
- Within the regions, gasoline sulfur standards should be uniform. State fuel initiatives different from any federal regional standards could result in supply disruption and price volatility and should be avoided.
- Adequate lead time would be critical to a successful implementation. Implementing gasoline sulfur control over the next few years involves a number of demands and uncertainties. For example, the technology that is the lowest cost and more cost effective requires sufficient time to develop.
- Permitting and construction of all of these refineries in just four years would be a major challenge. Therefore, streamlining of the permitting process could help address lead time concerns.
- If sulfur levels in diesel fuel were also going to be reduced (or any other changes to gasoline or diesel fuel required) industry would need to know soon so investment discussions could be coordinated.

We have seriously considered the oil industry's input in developing our proposal. While we are not proposing a regionally-based program, as discussed below, we believe the nationwide program we are proposing would provide flexibility in response to many of these concerns about uncertainty and would provide uniformity on a national basis.

The next section of the preamble describes in more detail the industry proposal and our response to their approach, including the concepts of national versus regional scope and the level of the standard. We recognize that refineries face many uncertainties and constraints, including potential future regulation of diesel sulfur that would affect the timing of their ability to meet the proposed gasoline sulfur levels. Consequently, also in this section we propose and request comment on two provisions, a sulfur averaging, banking and trading program and permit streamlining, designed to provide flexibility, to increase lead time, and to ease concern about how other uncertainties would affect decision making concerning gasoline sulfur control.

1. Oil Industry Proposal

During the development of this proposal, a large part of the oil refining industry, represented by the American Petroleum Institute (API) and the National Petrochemical and Refiners Association (NPRA), offered a series of constructive recommendations for the design of a gasoline sulfur control program. These proposals, which have progressively addressed more and more of the concerns we had raised about such a program, have a key element in common—the suggestion that different levels of gasoline sulfur control be applied to different regions of the country. These industry representatives observe that some areas of the country need the emission reductions to be achieved from Tier 2 LDVs and LDTs more than others, and that the gasoline distribution system can supply different gasolines to different geographical regions.

The most recent proposal from these members of the oil industry would provide gasoline meeting an average sulfur level of 150 ppm (capped at 300 ppm) to a large region of the U.S. This proposal would cover all states east of the Mississippi river, plus Missouri, Louisiana, and the eastern half of Texas (and any RFG areas in the West), and would begin in 2004.[40, 41] The remainder of the country (excluding California) would receive gasoline meeting a 300 ppm average (450 ppm cap). Further reductions in sulfur levels in eastern states, to a 30 ppm average/80 ppm cap, would be required starting in 2010, unless a study performed in 2004–06 demonstrated no air quality need for further sulfur reductions. If this study found an air quality need for additional reductions, EPA would make recommendations about the appropriate sulfur levels (if different from the proposed 30/80 ppm levels) and the area to receive this lower sulfur gasoline (if different from the region receiving the 150 ppm average in 2004). The industry representatives thus characterized the 2010 standards as ''rebuttable,'' standards because EPA could have to initiate additional regulatory actions to implement the final 2010 standards.

The arguments presented by the members of the oil industry for why this regional program would be reasonable include a consideration of the technical needs of the vehicles and the ability of refining industry to meet the requirements. Based on testing and analyses performed by oil companies and their trade associations, they concluded:

- Automakers can select from a range of design factors to reduce sulfur sensitivity, including engine design, catalyst size, catalyst location, control of air/fuel mixtures, the types and amounts of precious metals used in the catalyst;
- Vehicles can be designed to fully reverse the sulfur effect while meeting both Tier 2 and SFTP emission standards, even if operated for a long time (1,000 miles) on high sulfur fuel;
- This division of the country into two sulfur regions ''matches cost to consumers with benefits,'' since the areas with the greatest air quality need would get the lower sulfur gasoline, while consumers and refiners located in areas without substantial air quality need would not have to pay the higher costs resulting from the lower levels; and
- The regions, as defined, would optimize gasoline distribution based on the existing distribution system, thus reducing the potential for supply shortfalls or other difficulties.

Following the same methodology we used to estimate the future emissions and emissions reductions that would result from our combined Tier 2/gasoline sulfur proposal (presented above in Section III), we estimated the emissions that would occur from a program that combined our proposed Tier 2 vehicle standards with the gasoline sulfur program proposed by the oil industry.[42] As explained below, we believe vehicles meeting the proposed Tier 2 standards that consistently use the higher sulfur gasoline would emit at higher levels than those that consistently use 30 ppm sulfur gasoline, and that vehicles that travel between the East and West (as defined by the oil industry proposal) would experience an irreversible (permanent) loss in as much as 50 percent of the emissions performance after being exposed to high sulfur levels. As a result, our analysis shows somewhat higher total emissions for the program incorporating the oil industry's proposal than would occur if this sulfur effect did not occur. Since the ''rebuttable standard'' leaves open the possibility that the eastern region will not receive 30 ppm sulfur levels in 2010 and beyond (upon a finding of no air quality need for further reductions), we analyzed that scenario as well. Table IV.C.–1 shows the NO_X emissions we

[40] The industry representatives offered to meet these standards earlier if Tier 2 vehicles were introduced before 2004.

[41] While a majority of oil companies have approved this proposal, not every U.S. refiner supports all of the provisions summarized here.

[42] As explained in this section, because of sulfur's effect on emissions, we do not believe we could finalize the proposed Tier 2 vehicle standards with sulfur levels averaging significantly above 30 ppm. However, for the purposes of this analysis we did not change the modeled Tier 2 vehicle standards.

calculated for select years for these two scenarios, compared to our proposal.

TABLE IV.C.–1.—NATIONWIDE NO_X Emissions from Tier 2 Standards and Oil Industry Proposed Gasoline Sulfur Program

Year	Total NO_X tons		
	EPA proposal	Oil industry proposal 2004: 150/300[a] 2010: 30/300	Oil industry proposal, 2010 standard re-butted 2004: 150/300[a] 2010: 150/300
2007	2,423,000	2,821,000	2,821,000
2010	1,859,000	2,021,000	2,292,000
2015	1,242,000	1,424,000	1,701,000
2020	1,023,000	1,221,000	1,508,000

[a] Sulfur average in East/sulfur average in West.

The industry's proposals have been valuable in helping EPA and all the major stakeholders focus on key issues of the design of gasoline sulfur control options. We have seriously considered these proposals as well as the responses of others to the proposals. We have paid particularly close attention to the issue of the reversibility of gasoline sulfur's emissions impacts, since the environmental benefits to be gained from a regional sulfur program in combination with national Tier 2 vehicle standards hinge on the degree to which the negative impact of high sulfur levels can be reversed when a vehicle is operated later on low sulfur gasoline. We encourage comments on the appropriateness and feasibility of a regional gasoline sulfur program such as the one recommended by the oil industry (in combination with national Tier 2 vehicle standards as proposed today). We are particularly interested in analyses of the environmental and economic consequences of such a proposal.

In addition, others have raised the idea of an alternative temporary regional gasoline sulfur control program. Under this program, which would last from 2004 through 2008, gasoline refined in PADD IV (generally covering the Rocky Mountain states and representing about 5 percent of U.S. gasoline production) would meet an average sulfur standard of 150 ppm with a 300 ppm cap while the remainder of the country would meet a 30 ppm average beginning in 2004. Gasoline refined in PADD IV would have to comply with the 30 ppm average/80 ppm cap beginning in 2009.

This approach would provide the smaller refineries in this region with additional time to make the significant capital investments to desulfurize gasoline. In part because of the smaller scale of the PADD IV refineries, we estimate that the cost of desulfurization would be larger for these refineries than the estimated average cost of meeting a 30 ppm standard.

While the Rocky Mountain region's air quality problems are generally less severe than those in many other parts of the country, we believe that the emission reductions provided by today's proposed program would still be important, for several reasons.

- The Denver and Salt Lake City areas will have ozone levels in the 2007 time frame within 15 percent of the national ambient standards and would benefit from the lowest possible gasoline sulfur levels to assist their efforts to maintain their ozone attainment status.
- Other benefits of the proposed program would also be forgone during the interim period, as discussed above, including the lower secondary PM emissions, improved visibility, and reduced toxic emissions.
- Irreversible damage to vehicle emission control systems in those vehicles that have been fueled in this region at any time during their life would occur.
- PADD IV gasoline is marketed outside the borders of PADD IV.
- The vehicle emission standards would be more difficult to enforce if there were an extended period when vehicles were exposed to gasolines of more than one sulfur level.

We seek comment on the appropriateness of this approach, including consideration of the cost, air quality, and public health impacts as compared to our proposal.

As discussed below, however, we are not proposing a gasoline sulfur control program that incorporates a regional element. We have not been able to satisfy our concerns with the irreversibility of the sulfur effect, since it is not clear that vehicle or catalyst design changes will solve the problem and since we do not believe that the effect is negligible. Without a national low sulfur gasoline program, the air quality benefits of our program would be reduced, particularly in the initial years when the emissions reductions will be most required to help many states achieve attainment with the National Ambient Air Quality Standards. A national program providing low sulfur gasoline everywhere could ensure that the vehicles designed to meet the proposed Tier 2 standards achieved the desired emissions performance, that the investments made by car buyers in cleaner technology would be justified, and that the needed emissions reductions occurred beginning as early as 2004.

2. Why EPA Believes Gasoline Sulfur Program Must be Nationwide

As explained in Section IV.C.3. below, we are proposing that our gasoline sulfur control program apply throughout the country, rather than in a more limited geographic area along the lines of what the oil industry has proposed. In determining the appropriate geographic scope for our proposed program, we considered the implications for the emission control hardware of Tier 2 vehicles, based on the degree to which the sulfur impact on catalysts may be reversible. We considered the degree to which sulfur will impact advanced technology engines and aftertreatment systems. We weighed the impact that sulfur has on onboard diagnostic systems, and what that may mean for state inspection and maintenance programs. We evaluated the environmental implications beyond the ozone benefits to be realized. We also considered the ability of the entire refining industry to control gasoline sulfur at essentially the same time. After review of all of these issues, it is our judgement that a national program is appropriate and reasonable. The following sections explore these issues in more detail.

a. *Sulfur's Negative Impact on Tier 2 Catalysts Is Irreversible.* We have reviewed data from several test programs designed to characterize both the effect of high sulfur levels on vehicle emissions and the ease and completeness with which this effect was eliminated or ''reversed'' once the vehicle was operated on low sulfur gasoline. These test programs were performed by auto manufacturers, oil companies, emission control equipment manufacturers and their various associations. All of the vehicles included in these test programs met either EPA Tier 1 or California LEV emission standards and were not designed to comply with either EPA or California supplemental federal test procedure (SFTP) standards. 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 reversibility, because in contrast to the vehicles that have been tested to date, Tier 2 vehicles would have to meet more stringent exhaust emission standards and would have to meet these standards over the wider variety of operating conditions included in the SFTP provisions. Hence, they would have to be designed to meet the emission standards under all such operating conditions; these design changes may influence the ease with which the sulfur effect is reversed, as explained below.

The vehicles tested exhibited a wide range of reversibility, for reasons that are not fully understood. The LEVs tested in these programs showed, on average, that the effect of operation on high sulfur fuel was reversed after operation on low sulfur fuel if aggressive driving conditions occurred once the vehicle was switched to low sulfur fuel. Roughly 85% of the increase in NMOG and NO_X emissions resulting from high sulfur levels was reversible after operation on low sulfur fuel coupled with more moderate urban driving. (CO emissions were somewhat less reversible under these conditions.) Individual vehicles showed a wide range of responses, however. For example, many vehicles showed substantial irreversibility for one pollutant (NO_X or NMOG) while very high reversibility for the other. In some cases, only half of the initial emission increase due to high sulfur could be removed by driving on low sulfur fuel. Catalyst temperature, the mixture of air and fuel in the engine and the design of the catalyst are all believed to be important factors that affect the reversibility of the sulfur impact. However, to date, no one has been able to demonstrate the specific contributions of these various factors. Also, no one has been able to design a catalyst with both high conversion efficiencies and no or very low sensitivity to sulfur.

These data indicate that the effect of high sulfur levels on emissions from current LEV models driven over a wide variety of operating conditions appears to be partially reversible, particularly if the vehicle is periodically driven aggressively. However, were these vehicles required to meet the SFTP standards, we believe that the degree of reversibility would have been substantially worse.

Studies of the adsorption and removal of sulfur on catalysts have demonstrated that wide variations in the mixture of air and fuel entering the engine (alternating between having a shortage to having an excess of oxygen) directionally help to remove sulfur from the catalytic surface. When driven aggressively, the mixture of air and fuel in the engines of most current vehicles (those not certified to SFTP standards) is quite variable, because precise control of the mixture of air and fuel is primarily done to control emissions. Meeting the SFTP standards will ensure that manufacturers carefully control the mixture of air and fuel over essentially all in-use driving conditions. This absence of widely varying mixtures of air and fuel could therefore inhibit the removal of sulfur from the catalyst once operation on high sulfur fuel ceased. Thus, we project that the sulfur effect on vehicles meeting both the LEV and SFTP standards (vehicles sold after 2000) and vehicles meeting the Tier 2 standards (which will include low exhaust emissions and low SFTP emission standards, too) will be less reversible than the effect shown on the vehicles included in the test programs discussed here.

Another factor that may substantially influence sulfur reversibility is the amount of time the catalyst is exposed to high sulfur fuel. With only a few exceptions, the vehicles in the test programs mentioned above were only driven on high sulfur fuel for a few miles (well under 100) before low sulfur fuel was reintroduced. This appears to limit the extent to which sulfur could permanently disable the effectiveness of the catalyst. However, one vehicle was tested with an aged catalyst system (to simulate a vehicle near the end of the useful life of 100,000+ miles) and driven for extended mileage (more than 1,000 miles) on high sulfur fuel before being retested on low sulfur fuel. (As with the other vehicles, this test vehicle was not designed to be SFTP-compliant; SFTP compliance could further complicate the ability of a vehicle to reverse the sulfur effect.) For this vehicle, only 50% of the NO_X emission effect of high sulfur fuel was reversed upon operation on low sulfur fuel. This is much less than the 85–100% reversibility found with short term exposure to sulfur. Thus, we project that in-use emissions performance of Tier 2 vehicles operated for some time on high sulfur fuel (as would occur if a regional sulfur control program permitted high sulfur levels in a large geographic area) might be substantially compromised. For example, in-use emissions of passenger cars designed to meet the 0.07 g/mi NO_X standard and operate on 30 ppm gasoline would actually be increased by about 50 percent if they were operated on 300 ppm gasoline at any point in their life. Such vehicles might only recover half of the emissions performance otherwise expected, perhaps even less once SFTP compliant designs are incorporated. Furthermore, we believe this effect would be essentially permanent; continued operation with low sulfur gasoline would be unlikely to improve the emissions performance.

The Draft RIA presents our complete evaluation of sulfur irreversibility, based on the data we have obtained to date. We encourage comments on this analysis. Furthermore, we are seeking comment on and will be considering the studies described in Appendix B of the Draft RIA, plus any new information developed or received before a final decision. We welcome any additional data characterizing the irreversibility of the sulfur effect, including what vehicle or catalyst design factors may make exposure to sulfur more or less reversible.

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 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.

b. *Sulfur Has Negative Impacts on OBD Systems and I/M Programs.* 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 proposed 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.[43] 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 be 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 NLEV program provides manufacturers the opportunity to request extra preconditioning of vehicles that they believe may be negatively impacted by high sulfur levels, when such vehicles may be included in in-use testing by EPA. We consider such requests on a case-by-case basis. One manufacturer has already requested, and received approval for, a special preconditioning cycle to remove any sulfur from the catalyst of a specific vehicle model, should that vehicle model be included in any in-use testing. We are concerned that a regional gasoline sulfur program would increase the likelihood that manufacturers would be compelled to request special preconditioning cycles for test programs, and believe that the one request we have granted already is indicative of the potential problems that would arise under a regional gasoline sulfur program. While the use of a special preconditioning cycle can protect the manufacturer from liability for high in-use emissions resulting purely from exposure to high sulfur, the in-use emissions from these vehicles would still be higher than expected based on the certified design.

To the extent that future catalysts are more sensitive to sulfur as emission standards become more stringent, the impact of sulfur on catalysts and catalyst monitors becomes proportionately more critical. The more stringent the Tier 2 vehicle emission standards are, the more stringent the OBD malfunction thresholds will be, because those thresholds are expressed as multiples of the applicable hydrocarbon emission standard. Therefore, even if the sulfur effect on future technology vehicles were equivalent in absolute terms to the effect on current technology vehicles, would become more significant in relative terms on those future technology vehicles. Because of this (and our concern about how reversible the effect of sulfur may be), we are concerned that a regional sulfur program could create widespread problems with OBD catalyst monitors for vehicles traveling outside of the low sulfur region. A regional sulfur program would likely result in higher emissions from Tier 2 vehicles in high sulfur regions, and may also result in more OBD-identified catalyst failures in those areas. We are not aware of a technical solution to this problem.

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

The geographic scope of a sulfur control program also has implications for inspection and maintenance (I/M) programs. A regional sulfur control program could affect I/M programs located outside of the sulfur control region. The emissions measured in these I/M programs would likely be higher than those measured in the low sulfur region, possibly necessitating the use of unique emission cut points for Tier 2 vehicles registered in the higher sulfur region. I/M programs located outside of the sulfur control area would need to consider the possibility that the presence of OBD failure codes may be caused primarily by the use of high sulfur fuels, and may have to provide for a catalyst regeneration procedure to try to reverse the sulfur buildup to get a reading of how the catalyst is operating. This could lead to unequal treatment of vehicles located in different regions of the country based solely on their exposure to sulfur, unnecessarily complicating I/M programs. Furthermore, many I/M areas intend to rely heavily on OBD checks rather than emission checks in the future, making the correlation of OBD checks to the emissions from the vehicles very important. Therefore, the potential scenario of increased emissions without OBD detections (due to sulfur-fouled catalyst monitors) would make OBD a less attractive I/M tool in areas with high sulfur fuel. A national program, even one providing limited, temporary exemptions for small refiners, would avoid many of these concerns.

c. *Sulfur Reductions Would Ensure Lower Emissions of Many Pollutants.* One of the major arguments supporting a regional program is that such a program could be targeted at the majority of areas needing ozone controls by getting the NO_X and VOC reductions in the areas with the greatest ozone pollution problems. However, as our estimates of the total emission reductions to be achieved through the combined Tier 2/gasoline sulfur program show (presented above in Section III), there are substantial NO_X and VOC reductions to be attained nationwide with our proposal. In Table IV.C.–1 above, we estimated that our national sulfur control proposal would result in 9–22% fewer NO_X emissions compared to the regional sulfur program proposed by the oil industry, presuming that we implemented Tier 2 vehicle standards consistent with today's proposal and depending on the year in which the emissions reduction is evaluated. The higher emissions from a regional program would be due to the reduced emissions performance of vehicles (Tier 2 and others) located in the West where higher sulfur levels would be permitted and the loss of emissions performance for vehicles located in the East that travel to the West (or are relocated from the West) and are expected to suffer irreversible catalyst damage due to the higher sulfur levels in the West. Even in 2010 and beyond, when the oil industry's proposed program would result in sulfur levels consistent with our proposal in the East, Tier 2 vehicles located in the West or traveling from West to East would see substantial reductions in emissions performance. Furthermore, if the oil industry's proposed 2010 standard were not implemented (on the basis of the findings of the study they propose for 2004–06), the difference in emissions reductions between our proposal and the oil industry proposal climbs to 16–47% fewer NO_X emissions. Hence, the ozone benefits of this proposal would be somewhat smaller if a regional gasoline sulfur program were adopted.[44]

While the benefits of reducing ozone precursors through gasoline sulfur reductions are generally limited to a nonattainment area (as well as areas trying to maintain their attainment status, including those within 15% of the NAAQS standard and upwind locations that contribute transported ozone precursors into those areas), reductions in emissions of other pollutants have broader geographic benefits, as discussed in Section III. For example, sulfur reductions would 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 areas 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 the emissions performance of the vehicles already on the road, will lead to fewer NMOG emissions, since, as explained in the Draft 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. Thus, a national sulfur reduction program would achieve larger benefits than a regional program, and people living in the region with higher-sulfur gasoline would not get the full benefits of reduced air toxics emissions and could suffer adverse health consequences.

d. *The Refining Industry Can Control Gasoline Sulfur.* While evaluating the merits of a national gasoline sulfur program, in addition to considering the technical requirements for vehicles to meet the proposed Tier 2 standards and the potential air quality benefits that could be realized, we also considered the ability of refiners to reduce gasoline sulfur in essentially every gallon of gasoline by 2004. Based on this evaluation, we believe it is technically feasible for refiners to meet the proposed standards and that it is possible for them to do so in the proposed time frame. A summary of our analysis is presented here; we refer the reader to the Draft RIA for more details.

Technologies that enable refiners to significantly reduce the level of sulfur in gasoline have been available for many years. California began requiring low sulfur gasoline (30 ppm average/80 ppm cap) in 1996.[45] Refiners in California are currently producing gasoline that averages around 20 ppm sulfur. In addition, low sulfur gasoline standards similar to our proposal are, or soon will be, implemented by countries in Asia and Europe, and by Canada. These programs provide additional evidence that desulfurization technologies are available to meet a low sulfur gasoline standard, and that the majority of refiners in the industry can reasonably be expected to install and operate these technologies if given a reasonable amount of lead time.

When considering the implications of a sulfur standard, U.S. refiners can be grouped into two major groups: those already producing gasoline that meets, or nearly meets, the proposed requirements, and those that would have to make processing changes to comply. The majority of refiners currently producing relatively low sulfur gasoline today (roughly 15 percent of domestic production) could meet the proposed gasoline sulfur standard with no or very little additional capital investment, and at most a small increase in operating cost. These refiners have achieved their current sulfur levels using traditional sulfur removal technologies, or, in some cases, with refinery configurations that can accommodate very low sulfur crude oils.

Two examples of these traditional technologies are hydrotreating or hydrocracking the feed to the fluidized catalytic cracker unit (FCC), the unit in

[44] See the Draft RIA for information on the evaluation of this and other alternatives.

[45] Prior to that date, gasoline in California was capped at 300 ppm sulfur.

the refinery that produces the largest fraction of gasoline blendstock. These processes are capital intensive and demand large amounts of hydrogen and other utilities, resulting in high operating expenses. Another example is desulfurization of the gasoline stream coming from the FCC unit. Treating the FCC gasoline stream has the advantage of lower capital and operating costs than treating the FCC feed. The major concern with this approach is that the octane value of this gasoline blendstock is reduced at the same time that sulfur is reduced, particularly when the sulfur is being reduced to low levels. This lost octane must be made up by increasing the production of high-octane blendstocks from other units of the refinery, or by the addition of oxygenates. Making up this octane loss adds significantly to the cost of desulfurizing FCC gasoline. We seek comment on any implications of this proposal of recent activities in California relating to the oxygenate MTBE, and of refiners' possible use of oxygenates other than MTBE to make up any octane loss.

Based on current sulfur levels, we believe the majority of U.S. refiners would have to install at least one desulfurization processing unit to lower gasoline sulfur to the proposed levels. Since installation of traditional desulfurization technologies could be quite costly for most refiners, we have been very encouraged to see the recent development of several improved desulfurization processes that are now available at reduced capital investment and operating costs (and which avoid the octane loss that increases the costs of traditional technologies). Examples of these technologies are CDHydro and CDHDS (licensed by the company CDTECH) and OCTGAIN 220 (licensed by Mobil Oil).[46] These technologies use conventional refining processes combined in new ways, with improved catalysts and other design changes that minimize the undesirable impacts (such as the substantial loss in octane) and maximize the effectiveness of the desulfurization approach. Since these processes provide less costly ways to reduce gasoline sulfur, we presume that they would be used by most refiners to meet the proposed gasoline sulfur standard, and have based our economic assessment (summarized in Section IV.D. below) on that presumption.

Some in the refining industry have told us that since there have not been long-term commercial demonstrations of these newer technologies, they would not consider these technologies to be viable and, if faced with our proposed requirements in 2004, they might select the more traditional sulfur reduction processes, resulting in a higher cost to produce low sulfur gasoline. While we understand the hesitation on the part of some in the oil industry to invest in these improved sulfur reduction technologies, we believe many, if not all, of their concerns would be addressed in the next few years. The industry would have four years to prepare to meet our proposed gasoline sulfur requirements. Refiners have been provided a similar amount of time to comply with fuel programs in the past (highway diesel fuel sulfur control, reformulated gasoline under the complex model) and some have told us that three to four years is adequate to allow them to meet gasoline sulfur standards similar to those proposed today. Refiners would have time to grow more comfortable with the improved processes after they have obtained additional data and information from the vendors that license these technologies. Refiners would be able to have their FCC gasolines tested in vendors' pilot plant facilities, which would provide each refiner with more specific information on how the process would function in their particular refineries. Furthermore, we have been informed that there will soon be demonstrations of at least two of the improved desulfurization technologies in existing refineries; the entire industry will benefit from these efforts.

We have heard concerns that small refiners, particularly those in the Rocky Mountain region, would bear proportionately higher economic burdens if they were required to produce gasoline meeting the same sulfur levels as larger refineries located in the Gulf Coast and East. The severity of these economic impacts could result in unreasonably high gasoline prices, potential refinery closures, and supply shortages, according to those raising the concerns. Our analysis, presented here and in the Draft RIA, leads us to conclude that these severe events would not occur. Furthermore, we have recently received a study that suggests that, in fact, small refiners in the Rocky Mountain region will incur costs only slightly higher than the national average.[47] This study concludes that the potential for refinery closures in this region in response to a gasoline sulfur regulation is small, and that even if ten percent of gasoline were negatively impacted there would not be a significant supply shortfall in the region. We have not yet reviewed this study in detail, and we encourage comments on the analysis presented in it. However, having considered the concerns raised about small refiners in general, including those in the Rocky Mountain region, we are proposing special provisions for small refiners to address their unique challenges.

The advent of the improved desulfurization technologies creates an opportunity for a stringent, nationwide, and yet relatively low-cost, sulfur control program. Such a program would still likely be challenging for many if not most refiners. In the program proposed today, we have built in a number of flexibilities that would ease the task of compliance for refiners while maintaining the level of air quality improvements of a less flexible program. In particular, Section IV.C.–3 below presents a sulfur averaging, banking, and trading program that effectively extends the final compliance date by two years. In consideration of all these factors, we believe that under the proposed program, all refiners nationwide should be able to produce very low sulfur gasoline without suffering severe financial consequences.

e. *Other Stakeholders Support National Gasoline Sulfur Control.* In addition to our technical arguments for concluding that gasoline sulfur should be controlled nationwide, we have considered the positions of other parties. Many stakeholders to our decision have expressed to us their support for a national sulfur control program. Automakers, represented by the American Automobile Manufacturers Association (AAMA) and the Association of International Automotive Manufacturers (AIAM), have petitioned the Agency to implement a national, low sulfur gasoline program ''as soon as possible.'' State organizations such as STAPPA/ALAPCO and the Ozone Transport Commission (OTC) have made similar resolutions, and many individual states have also voiced support for a national program. Environmental organizations, such as the American Lung Association

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[46] In addition to these technologies, other companies have told us that they are working on developing their own desulfurization technologies. Furthermore, there have been recent advances in an approach called biodesulfurization, which employs bacteria that selectively desulfurizes petroleum. We believe refiners will have an increasing number of technology options to meet our proposed standards.

[47] MathPro, Inc., ''Likely Effects on Gasoline Supply in PADD 4 of a National Standard for Gasoline Sulfur Content,'' Prepared for Association of International Automobile Manufacturers, DaimlerChrysler Corporation, Ford Motor Company, and General Motors Corporation, March 19, 1999.

and the American Council for an Energy Efficient Economy, favor a national sulfur control program, as well. The arguments for a national program presented by these parties include:

- High sulfur levels significantly impair the performance of today's emission control technologies, reducing the emissions benefits of current and advanced vehicles,
- Gasoline sulfur contributes to air quality problems not directly benefitted by vehicle emission standards (PM, SO_X, hazardous air pollutants),
- The sulfur impact on emission controls is largely irreversible, and
- If sulfur levels are not controlled, new, more fuel-efficient vehicle technologies that are as or more sulfur-sensitive than today's vehicles will not be introduced in the U.S.

3. Proposed Gasoline Sulfur Standards

We are proposing to require substantial reductions in gasoline sulfur levels nationwide. Not only would these standards enable the stringent tailpipe emission standards we're proposing for Tier 2 vehicles and ensure that these low emission levels would be realized throughout the life of the vehicle, but they would also help to reduce emissions of pollutants that endanger public health and welfare from vehicles already on the road, including NLEV vehicles. The following sections summarize the proposed requirements for gasoline refiners and importers, special provisions for small refiners, and possible changes to construction permitting requirements that would enable refiners to install gasoline desulfurization technology in a timely manner. We also raise the potential need for changes to diesel fuel to enable diesel technologies to meet the proposed Tier 2 standards. Section VI. provides additional information about the compliance and enforcement provisions that would accompany these proposed requirements. More detailed information in support of the conclusions presented in this section of the proposal is found in the draft Regulatory Impact Analysis.

a. *Standards for Refiners and Importers.* Our proposed gasoline sulfur program balances the goal of enabling Tier 2 emission control technologies with the goal of lowering sulfur as early as the refining industry can practically achieve the required levels. To accomplish both of these goals, we are proposing a set of standards combined with a sulfur averaging, banking, and trading (ABT) program. This proposed overall program would achieve the desired sulfur levels, on average, beginning in 2004—the first year Tier 2 vehicles will be sold—while proposing to allow the use of credits towards compliance with refinery average standards indefinitely (within the limits of per-gallon caps). These requirements would apply to all gasoline sold in the U.S.,[48] based on our belief that emissions must be reduced nationwide to adequately protect public health and the environment and that Tier 2 vehicles operated everywhere in the U.S. require protection from the harmful impacts of gasoline sulfur.

Table IV.C.–2. presents the proposed standards for gasoline refiners and importers. The proposal would require all gasoline refiners and importers to produce gasoline that meets an average standard of 30 ppm sulfur at the refinery gate on an annual basis, beginning in 2004. These requirements would apply to all gasoline, reformulated as well as conventional. In 2004 and beyond this standard could be met through the use of credits generated as early as 2000 by refiners who substantially reduce sulfur levels from current (1997–1998) levels, under the provisions of the proposed sulfur ABT program discussed below in Section IV.C.3.c. Hence, the actual average sulfur levels for gasoline in use could be somewhat higher than 30 ppm. However, to ensure that sulfur levels are being reduced significantly (for the benefit of Tier 2 vehicles and to achieve the other emissions benefits of reducing gasoline sulfur), these in-use sulfur levels would be constrained by maximum corporate pool average standards of 120 ppm in 2004 and 90 ppm in 2005. These standards would represent the maximum allowable average sulfur levels for each refiner, measured across all refineries owned and operated by that refiner, rather than at each refinery. In 2006 and beyond, there would be no corporate pool average standard. Every refinery would have to meet the 30 ppm average refinery gate standard, although refiners could use any banked/purchased credits to meet this standard (as explained in the ABT discussion below). Thus, in 2006 and beyond, the majority of gasoline would average 30 ppm, although some individual refineries could average slightly more or less.

TABLE IV.C.–2.—PROPOSED GASOLINE SULFUR STANDARDS FOR REFINERS AND IMPORTERS [EXCLUDING SMALL REFINERS]

Compliance as of:	January 1, 2004	January 1, 2005	January 1, 2006+
Refinery Average, ppm	[a]30	[a]30	[a]30
Corporate Pool Average, ppm	120	90	not applicable
Per-Gallon Cap, ppm	[b]300	180	80

a This standard can be met through the use of credits as long as the applicable corporate pool average and per-gallon caps are not exceeded, as explained in the text.
b This initial per-gallon cap standard begins October 1, 2003.

To ensure that, even as average sulfur levels are reduced in 2004–2006, gasoline sulfur levels do not exceed a maximum level that we believe is particularly harmful to Tier 2 vehicles, we are also proposing "caps" on the sulfur content of every batch of gasoline produced or imported into the country. As shown in Table IV.C.–2, these caps decline over time, ultimately resulting in a per-gallon limit of 80 ppm in 2006 and beyond. Since Tier 2 vehicles would be sold prior to the start of calendar year 2004, the actual date when the initial sulfur cap standard would take effect at the refinery is October 1, 2003. We are also proposing caps on the sulfur content of gasoline sold at the retail level or otherwise distributed downstream of the refinery, as explained in Section VI.B.

For purposes of compliance, we propose that a joint venture, in which two or more refiners own and operate one or more refineries, be treated as separate refining corporations under the proposed gasoline sulfur requirements.

[48] Gasoline sold in California that meets California's standards would be exempt from meeting the proposed standards, due to our belief tht California gasoline already meets or exceeds these requirements. See Section VI.B.

Hence, a refinery owned by a joint venture would be included in the corporate pool calculations of the joint venture, and would not be allowed to be included with other refineries owned by one of the parties to the joint venture in the corporate pool calculations for that party. Given the large number of joint ventures that have been announced recently in the oil industry, we believe this would be an equitable way to handle compliance for joint venture refineries. Furthermore, this approach would increase the number of companies that can generate and trade sulfur credits; a more limited number of multi-refinery companies would tend to bank and trade credits within rather than across corporations. We welcome comments on alternatives to this approach, such as requiring the majority owner in a joint venture to include the jointly owned refinery in his compliance calculations. If you recommend such an approach, please discuss how joint ventures that have (nearly) equal ownership among the parties should be treated for compliance and aggregation purposes.

i. *Why Begin the Program In 2004?*

The primary reason for our proposal to begin the gasoline sulfur standards in 2004 is that this is the first year that Tier 2 vehicles would be required to be sold, and these lower sulfur levels would be needed to avoid significant impairment of the Tier 2 emissions control technology. Furthermore, vehicles already in the fleet would benefit and we would like to maximize that benefit by starting the program as soon as is reasonable. States need the emission reductions that sulfur control would bring as soon as possible due to their SIP requirements in 2007 and 2010. This is reinforced by the fact that several states have already taken the initiative to develop state gasoline sulfur standards. In fact, since model year 2004 vehicles will likely be on the market in the fall of 2003, we are proposing to implement the caps on sulfur levels beginning October 1, 2003. This would help to ensure that sulfur levels are reduced coincidentally with the sale of Tier 2 vehicles, and would also ensure that sulfur levels throughout the gasoline distribution system have been reduced by the start of 2004.

We request comment on the feasibility of the compliance dates summarized in Table IV.C.–2. If these dates are not feasible, what date(s) would be more appropriate, given that Tier 2 vehicles will be introduced no later than model year 2004 and our conclusion that gasoline sulfur reductions must coincide with the introduction of these vehicles? For example, we request comment on the implications of implementing the 30 ppm average standard beginning later than 2004, including potential implication on cost, air quality, and implementation of the proposed Tier 2 vehicle standards. What other factors should we consider if you believe that the proposed implementation dates are not feasible and should be postponed?

We also seek comment on the implications of implementing an average sulfur standard different than the proposed 30 ppm average standard, including levels higher and lower than 30 ppm. Specifically, commenters should address the feasibility of different standards they support, the time frame in which different average standards could be implemented (i.e., in 2003, 2004, or 2005), the potential air quality impacts of such standards, and how such standards would affect the implementation of the proposed Tier 2 vehicle standards.

ii. *How Did We Arrive At the 80 ppm Cap and 30 ppm Average Standards?*

We believe a 30 ppm averaging standard is important and necessary to enable the emission reductions needed from Tier 2 vehicles. The test data we have reviewed, referenced in previous sections of this notice and in the Draft RIA, show that even very low levels of sulfur have some negative impact on catalyst performance. Most of the data available to us were generated through testing with minimum sulfur levels near 30 ppm. We have used this data to conclude that sulfur levels need to be reduced, and to assess, as part of our analysis, the technical feasibility of the proposed Tier 2 vehicle standards. The non-linear relationship between sulfur level and emissions impact (the lower the sulfur level, the greater the incremental increase in emissions) suggests that emission reductions would be ensured by sulfur levels at or near 30 ppm. We believe that requiring the 30 ppm average standard would be necessary to ensure that vehicles regularly use gasoline containing very low amounts of sulfur, regardless of where the vehicles were driven, what time of year it was, or how gasoline production varied from batch-to-batch in a given refinery.

We also believe that an 80 ppm cap standard would be required to provide appropriate insurance for maintaining Tier 2 standards in use and to give automakers an indication of the maximum sulfur levels for which they would need to design their vehicles. The test data we have reviewed show that the greatest increase in emissions comes as the sulfur level is increased from the lowest levels (i.e., 30 ppm). At higher sulfur levels (i.e., above 100 ppm), the catalyst performance is impaired to the extent that an additional increase in sulfur content has a smaller additional impact on emissions. Since the factors that influence sulfur sensitivity vary from vehicle to vehicle, different vehicles will experience different impacts from exposure to specific sulfur levels. None of the data that we have reviewed indicates that a vehicle can be designed to be completely insensitive to sulfur for all types of emissions. Furthermore, as discussed in Section IV.C.2., our concern that roughly half of the sulfur impact on the catalyst would be irreversible for Tier 2 vehicles (with other vehicles being negatively affected as well) provides additional arguments for trying to keep the sulfur cap as close to the average as possible. Hence, to ensure that Tier 2 vehicles maintain the designed emission performance over the life of the vehicle, we believe a cap on gasoline sulfur levels would be necessary, and that 80 ppm would be the appropriate level for this cap.

Setting a cap also would enhance enforcement of sulfur standards by setting a maximum level of sulfur that could be checked at all points in the gasoline distribution process. A sulfur cap significantly lower than 80 ppm could have the unintended consequence of forcing a sulfur average lower than the 30 ppm standard, increasing the overall costs of the program. The proposed level of 80 ppm sulfur for the cap reflects our balancing of several factors, including the potential air quality benefits, economic impacts, compliance flexibility, and the irreversibility of the effects of gasoline sulfur on vehicle emission controls.

As explained in Section IV.D. below, we believe that the combination of our proposed gasoline sulfur standards and the proposed Tier 2 standards would be cost-effective. This judgement about cost-effectiveness reflects what we believe would be an appropriate balance between the costs to be borne by the affected industries and the emissions reductions to be gained. Even though few refiners currently produce gasoline at or near these levels, as explained in Section IV.C.2 above there appear to be no significant obstacles to refiners achieving this level of sulfur control by 2004 (or 2006 if they were to take advantage of the sulfur ABT program). Unless a substantially higher average sulfur standard were set or a substantially smaller fraction of gasoline were affected by our regulations, refiners would have to make a significant investment in technology to desulfurize gasoline. Hence the cost to refiners would not be substantially reduced if we selected a less stringent average standard. Furthermore, we believe that a lesser reduction in gasoline sulfur levels could require us to reduce the stringency of the proposed Tier 2 standards. A higher average sulfur level would require less stringent standards or more vehicle hardware costs; either would reduce the effectiveness of our proposed combined program.

At the same time, we recognize the need to provide some flexibilities to refiners in meeting our proposed standards, to ensure that the program is implemented in an orderly manner, without severe consequences in the initial months (for example, supply shortages or substantial spikes). Hence, we have proposed to allow less stringent caps in 2004 and 2005 (through 2007 under the small refiner provisions discussed below) to balance the needs of the technology with the regulatory burden, economic impact, and ability of the refining industry to reduce sulfur levels in this time frame. Given that Tier 2 vehicles would be phased in over several years and that the vast majority of gasoline would be capped at 80 ppm by 2006 (when 75% of new LDV, LDT1, and LDT2 sales would be required to meet the proposed Tier 2 standards), we believe that the potential damage to Tier 2 catalysts would be minimized. Furthermore, since the gasoline distribution system is fungible (i.e., gasoline from multiple refiners may be mixed together, and gasoline produced at one company's refinery may be sold at another company's retail station), any gasoline that approached the higher caps in 2004 and 2005 would be highly likely to be diluted by lower sulfur gasoline, further limiting the potential negative impact on Tier 2 vehicles.

We have also proposed to permit compliance with the 30 ppm refinery average with the use of credits indefinitely, not just in the years during which the corporate average is reduced, as long as the applicable per-gallon caps are not exceeded. We would like comments on whether this provision should end, and if so, what date would be appropriate to require every refinery to meet the 30 ppm standard with actual production. We also encourage comments on whether corporate averaging (aggregation of refineries owned by a single entity) should be allowed for compliance with the 30 ppm standard, in 2004 and 2005 (in addition to corporate averaging to the pool standard) and/or beginning in 2006.

In light of our technical conclusions about the need for these standards, and our concerns about the irreversibility of the sulfur effect, we believe the 30 ppm average/80 ppm cap is the appropriate sulfur level to enable vehicles to meet the proposed Tier 2 standards and to maximize the emissions reductions to be achieved from this program in a cost-effective way. We welcome comments on these conclusions. We are also interested in any information on the reversibility of the sulfur impact on NLEV and Tier 2 catalysts that may supplement our understanding of how reversibility may differ with exposure to different sulfur levels and how this difference would impact our selection of the 30/80 standards. We also solicit information about what, if any engine or catalyst design modifications could minimize the irreversibility of the sulfur impact and about how compliance with the SFTP standards could impact irreversibility (for either NLEV or Tier 2 vehicles).

iii. *Should a Near-Zero Gasoline Sulfur Standard Be Considered?*

The auto industry, represented by the Alliance of Automobile Manufacturers, have supported a gasoline sulfur control program that would require 30 ppm gasoline in 2004 with a further reduction to ''near-zero'' levels (less than 5 ppm) by 2007. They believe that near-zero sulfur levels would enable the emission control technology that would ultimately be necessary to meet standards similar to those we are proposing today. They also believe that very low sulfur gasoline would significantly increase the emission reductions of the program as compared to a 30 ppm sulfur program.

We are also aware of concerns that advanced emission control and fuel efficient technologies, such as gasoline direct injection engines and automotive fuel cells, may require zero or near-zero sulfur levels to achieve Tier 2 emission levels over their full useful life (or in some cases, even to operate for a significant length of time). At the same time, we're aware that there may be technological solutions to these problems that may allow these technologies to operate on gasoline averaging 30 ppm sulfur. For example, it may be possible to regenerate (remove the sulfur from) the emission control technologies used by gasoline direct injection engines on an ongoing basis. Similarly, it may be possible to prevent sulfur from entering a fuel cell through the use of a sulfur ''guard'' made, for example, of zinc oxide, that might need to be replaced periodically.

We believe at this time that our proposed Tier 2 standards could be met with conventional technology if gasoline averaging 30 ppm is available. Nonetheless, for the reasons put forward by the auto industry and others, we also believe that it may be desirable in the long term for all gasoline in the U.S. to average substantially below 30 ppm sulfur. We encourage you to comment on the question of requiring gasoline sulfur levels under 5 ppm in the 2007 and later time frame. If you are commenting on this issue, we encourage you to take a broad view and to discuss all of the following questions in your comments:

- What technological options would be opened to manufacturers of vehicles and emission control hardware if near-zero sulfur fuel were available?
- What additional air quality benefits would be achieved?
- What changes in vehicle engines and emission control technology would be needed to achieve these emission benefits, absent reductions in gasoline sulfur levels beyond our proposed 30 ppm standard? What would these changes cost?
- What is the maximum sulfur level that advanced technologies, including gasoline direct injection and automotive fuel cells, could be designed to withstand if they are to be commercialized under the proposed Tier 2 standards? In what time frame might substantial commercialization of these technologies occur?
- How feasible is production of near-zero sulfur gasoline for the refining industry? What technologies would be required? How would this vary from refinery to refinery? What additional costs, beyond those expected for a 30 ppm sulfur program, would be incurred? How would the timing of a near-zero sulfur requirement affect refining costs?
- Would equipment used to make 30 ppm have to be modified or replaced to make near-zero sulfur gasoline? If so, how would this affect the time frame in which a near-zero sulfur level in gasoline could be achieved? Would the time frame for achieving these levels be different if refiners were not required to meet a 30 ppm standard? Is there another sulfur concentration that could be easily achieved as an intermediate level before achieving near-zero levels?
- What other issues should we consider in evaluation of further reductions in gasoline sulfur levels?

iv. *Why Are We Proposing Less Stringent Standards for 2004 and 2005?*

We are proposing to permit corporate average sulfur levels to be somewhat higher than 30 ppm, and maximum sulfur levels to be higher than 80 ppm, under the ABT program in 2004 and 2005. This proposal is meant to provide greater flexibility for refiners to meet