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U.S. House of Representatives
Committee on Energy and Commerce
Room 2125, Rayburn House Office Building
Washington, DC 20515

February 11, 1988

The Honorable Lee M. Thomas
Administrator
Environmental Protection Agency
Waterside Mall -- West Tower
401 M Street, S.W.
Washington, D.C. 20640

Dear Mr. Thomas:

Since writing to you on January 8, 1988 concerning the motor vehicle and other mobile source provisions of H.R. 3054 and Senate and House companion bills, the American Lung Association (ALA) has released a Clean Air report (prepared by a consultant, Mr. Michael P. Walsh, who reportedly has provided technical advice in developing the mobile source provisions of these bills. The report which is enclosed for your review and comment to this Committee is entitled:

> The Need for More Stringent Controls on Hydrocarbons and Nitrogen Oxides to Attain Healthy Air Quality Levels Across the United States.

The beauty of this report is that it confirms your agency's comments of November 18, 1987 to the Oversight and Investigations Subcommittee and the General Accounting Office's conclusions of a few days ago in its ozone report, that the statutory nonattainment deadlines in H.R. 3054 and S. 1894 are totally unrealistic. That is refreshing because the ALA is a member of the environmental umbrella group called the "National Clean Air Coalition" which heretofore has asserted that, in fact, the deadlines in H.R. 3054, at least, were too generous. Unfortunately, the ALA, possibly because it is not as strident as other groups, does not seem to have the capability to convince its colleagues in the Coalition of this fact of life. Perhaps this report will help.

Nevertheless, the ALA report ignores the results of the enclosed EPA tables for ozone which begin to show (based on your assumptions and your policy which does not call for tighter

mobile source standards) a significant increase in areas reaching attainment status beginning in 1995. Indeed, over 40 of the areas reach this status by the year 2000 and all but two of the areas achieve it by the year 2010. Unless I misunderstand your September 22 and November 18, 1987* responses to the Subcommittee, EPA presumably would not agree with the ALA's report that to achieve these results tighter mobile source controls are needed. Is that correct? Please explain.

In comparing your projection with those of the ALA, I note your cautions which I presume the ALA would also agree are applicable in the case of its projections as well. You said:

> Especially for ozone, predicting air quality levels and the future attainment status of areas is extremely difficult. Because ozone is a secondarily formed pollutant that results from complex chemical reductions in the atmosphere, ozone concentrations can fluctuate depending on the emission characteristics of the areas, volatile organic/nitrogen oxide ratios, and a variety of meteorological factors. To "forecast" air quality changes for ozone with any confidence, therefore, requires a detailed planning, data-gathering, and analytical exercise similar to the process which would take place as part of a State's development of an ozone SIP revision.
>
> For the purpose of national strategy development, EPA has used broad, generalized assumptions to estimate the reductions that various areas would need to attain the ozone standard. The crude nature of these estimates cannot be overstated, as they were generated using approximate emissions data (in some cases outdated or estimated from national averages) default modeling assumptions for such critical variables as non-methane organic compound/nitrogen oxide (NMOC/NOx) ratios and 1983-85 air quality data. Given these rough estimates of needed emissions reductions, projections were then made at the rate at which the necessary reductions would be achieved, assuming the continuation and expansion of currently required SIP control measures as well as continued emission reductions from the Federal Motor Vehicle Control Program and future reductions in the mid-1990's, such as Reid gasoline volatility controls and on-board technology on new cars. In essence, the analysis assumed that the net rate of reduction in each area including growth would be approximately 3% per year, beginning in 1988. This rate would continue until all necessary VOC reductions have been achieved. This exercise does not attempt to take into account any benefits which might be achieved by reduction in nitrogen oxides; it also assumes standard values for hydrocarbon reactivity and NMOC/NOx ratios as VOC reductions occur. These estimates also do not attempt any regional analysis of the effect of long-range transport.

> The resulting estimates appear in Table III. Given the assumptions and analytical limitations outlined above and in the attached tables of assumptions (IIIa), they must be viewed with extreme caution. The EPA does not regard them as adequate for statutory or regulation development, but rather solely as one indication of the long-term nature and difficult extent of the ozone non-attainment problems. The analysis needed to produce more reliable data and projections more properly belong to State and local governments as part of the overall process of preparing revised State implementation plans for ozone. (Underlining supplied.)

In commenting on the report, I would appreciate your addressing particularly the following questions (without intending to limit you to these questions:

1. The report states that while "substantial progress" has been made in meeting the National Ambient Air Quality Standards for Ozone and Carbon Monoxide, "the nation's air pollution problem is far from solved." I agree. The ALA points out that nearly "40 states contain at least one nonattainment area" and many have "several." Indeed, according to the ALA of this 40, California has 10 and New Jersey 6. The ALA then states:

> -- that for the ozone areas "adoption of the legislation [H.R. 3054 and S. 1894] will significantly lower emissions over the current requirements" (the word "legislation" appears to cover more than the mobile source provisions, making the statement difficult to quarrel about); and
>
> -- without more controls, "beyond those already adopted for stationary and mobile sources, virtually all the areas studied will be in nonattainment in the future." (Of course, no one is reasonably suggesting the absence of more "controls").
>
> The ALA then states:
>
> If stationary source emissions continue to increase, as EPA recently estimated they would, and mobile sources follow the trends estimated in this study for the current set of mobile source requirements, the ozone air quality situation will be just as severe in the future as it is today. Conversely if available stationary and mobile source controls are introduced, most areas could achieve healthy air. Table B summarizes future attainment status under these alternatives.
>
> If the stationary source controls are introduced without the mobile source controls there will continue to be a substantial shortfall. The only options then available

would be to introduce the legislated mobile source controls, find additional stationary source controls which no one has been able to identify at this time, or drastically reduce the use of vehicles in the nonattainment areas. To put this into perspective, the study found that the mobile source emissions reductions which would result from the legislation reflect 38 percent of the additional reductions needed to attain the standards after the stationary controls are introduced along with all currently mandated mobile source controls.

(a) When and what were the estimates that ALA mentions?

(b) Do you agree with the shortfall projection (taking into consideration the increasingly better in use performance shown in the enclosed table prepared by General Motors for vehicles over average lifetimes under existing model year 1981 standards)? Is the "only" option more mobile source controls?

2. At page 5 and 6 of the ALA report, there is a discussion of emission reductions "from <u>all</u> transportation sources." This includes more than motor vehicles. Please provide an up-to-date table for all transportation sources and for just motor vehicles.

3. At page 25, the report refers specifically to S. 1894 and the new motor vehicle standards established in that bill. It states:

> Many vehicles already achieve these levels; for most others, either EPA or the California Air Resources Board have adopted the requirements after finding that they are technologically feasible. In a few cases, while not adopted by either EPA or CARB, one or the other or both agencies have found them to be feasible.

At page 26, the report continues:

> Passenger car and light truck control to the degree recommended in the proposed legislation -- 0.25 HC, NOx, while retaining 3.4 CO -- is actually being achieved by many individual vehicles today <u>in Certification</u>. This is illustrated by analysis of 1987 certification data which shows that the average gasoline fueled car emits only about 0.2 gpm HC, 1.91 CO and 0.37 NOx, compared to standards of 0.41, 3.4 and 1.0, respectively. <u>Approximately half the vehicles certified for 1987 already meet the standards in the House and Senate bills</u>.
>
> Based <u>in part</u> on these data and the critical need for more NOx control, the California Air Resources Board in 1986 determined that 0.4 g/m NOx for passenger cars was necessary and feasible and cost effective. It adopted this standard, to be phased in starting in 1989 and estimated the costs to be about $25 to $30 per vehicle.

> California has also testified before the Senate Environment Committee that 0.25 g/m is feasible and cost effective for HC. They estimated a total cost per vehicle of approximately $25 per vehicle and an overall cost effectiveness of about 80 cents per pound (or about $1600 per ton) for this control. (Underlining supplied.)

(a) It is my understanding that not all passenger car vehicle engines have achieved these levels consistently through certification and that under existing law and S. 1894, the vehicles must achieve the standard for "in-use" purposes, as well as certification purposes, which under existing law is for 50,000 miles/five years and under the bill is 100,000 miles/10 years. The comparison of "certification" to "in-use" is like a sprinter dashing 100 yards in 9 seconds and trying to do the mile in 2.5 minutes. The stamina and capabilities extended for one event are not necessarily transferable to the second event. In reading your responses to my earlier letters, I presume that you agree. Am I correct? Please explain.

(b) In the case of the hydrocarbon standard in S. 1894, I understand that California has not yet adopted the proposed standard and, unlike the Senate bill, it is in California a "non-methane HC standard." In an undated letter which the Subcommittee received December 18, 1987, EPA said "California's current 0.39 non-methane HC standard is arguably less stringent than the federal 0.41 total HC standard, which would increase the cost increment to meet 0.25." A March 1987 EPA staff document (cited by ALA) entitled "Implications of Federal Implementation Plans," states:

> According to the California Air Resources Board and OMS, a 0.25/mi hydrocarbon standard is possible.

Does the word "possible" mean it can be fully achieved as required by the bill and the law for certification and in-use within the time specified and does this mean a "total HC" or "non-methane" standard? What is the basis for your response? What other differences between the California and the Federal standards exist?

Incidentally, the March 1987 "Draft" study, is called a "brainstorming" document. How reliable is it, particularly pages V-7 through V-64?

4. At pages 26-27 of the ALA report, there is a discussion about light duty diesel particulates and a statement that "trap technology has also been coming along (as indicated by the first generation Mercedes systems)." Am I correct in my understanding that after Mercedes introduced the traps, Mercedes recalled those vehicles? What is the status of this technology?

5. The ALA report (pages 29 - 31) states that a "key element" in H.R. 3054 and S. 1894 are the provisions for "enhanced and expanded Inspection and Maintenance (I/M) programs. In your September 22, 1987 letter, you said "no State now meets all" of the I/M requirements of H.R. 3054. Further, that bill fails to specify when the States must actually implement these I/M requirements. Your letter states that "History suggests that there will be resistance to all-new I/M programs, particularly in areas with marginal nonattainment problems." I think that is an understatement, considering the history in Maryland, New Mexico, Colorado, Michigan and California. State legislatures simply have not shared the ALA view. Yet the ALA report does not even mention this issue. If I/M is "key," what is the likelihood to its implementation and effectiveness under the deadlines for serious and severe areas in H.R. 3054? Do you agree, considering history and experience, with the ALA comments regarding the importance and effectiveness of I/M?

6. I request your comments on the ALA's methodology and conclusions, with special attention to the comment that the ALA study "found that the mobile source emissions reductions which would result" from S.1894 or H.R. 3054 "reflect 38% of the additional reductions needed to attain after stationary source controls are introduced along with all currently mandated mobile source controls." From your early letters, indicating no plans for tighter mobile source controls which you can require without legislation, I do not understand that you reach the same conclusions as the ALA. But I request your comments.

7. In the third paragraph of the "Executive Summary" there are some percentage reductions, do you agree these will be achieved by the legislation over present law? Please explain. What portion of these are due to I/M?

8. Taking into consideration your Senate testimony, what are the incremental benefits of these tighter standards? What are the problems?

9. At page 61, the ALA states "NOx control is also necessary in many areas." What are the areas? Are there some, where that is not true and where they could be harmful?

I request your reply within 30 days after receipt of this letter.

With best wishes.

Sincerely,

JOHN D. DINGELL
CHAIRMAN

Enclosures

cc: Members, Committee on Energy and Commerce

The Honorable Francis S. Blake, General Counsel
Environmental Protection Agency

The Honorable George P. Shultz, Secretary
Department of State

The Honorable John S. Herrington, Secretary
Department of Energy

The Honorable Charles A. Bowsher, Comptroller General
General Accounting Office

Mr. Thomas Hanna, President
Motor Vehicle Manufacturers Association

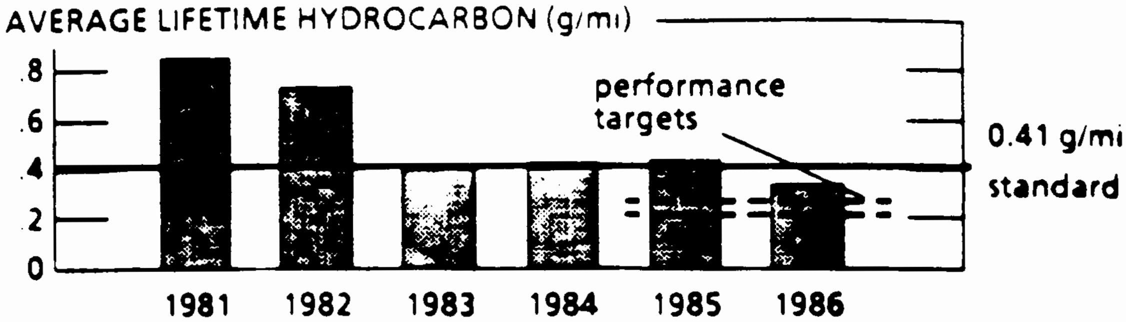
Mr. George C. Nield, President
Automobile Importers of America

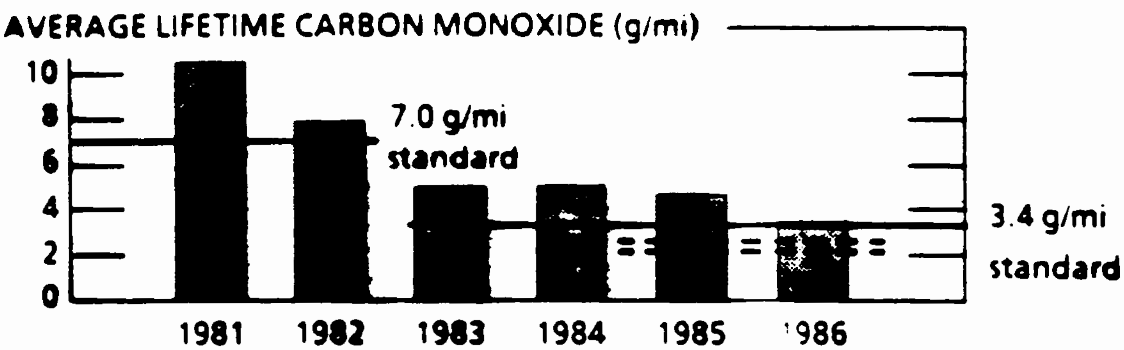
Mr. Owen Bieber, President
United Automobile Workers of America

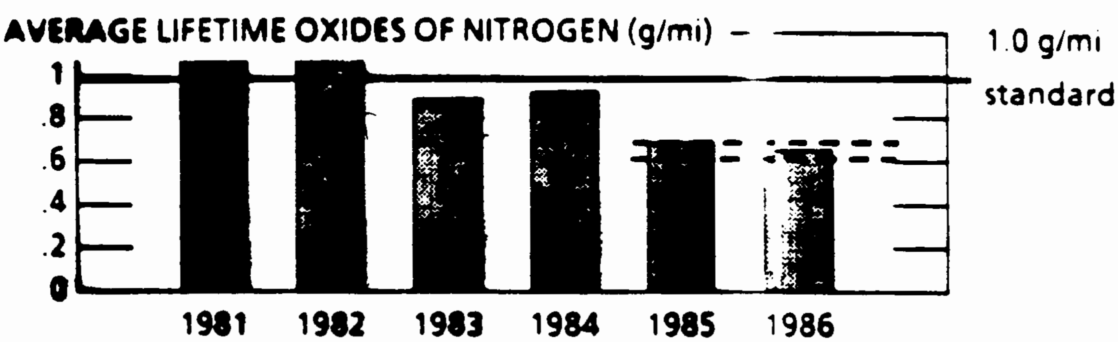
Ms. Fran DuMelle, Director
Office of Governmental Affairs
American Lung Association

GENERAL MOTORS VEHICLES

EPA and GM DATA COMBINED
FEDERAL LOW-ALTITUDE CUSTOMER CARS







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POLLUTION ON WHEELS

The Need for More Stringent Controls on Hydrocarbons and Nitrogen Oxides To Attain Healthy Air Quality Levels Across the United States

A report to the

American Lung Association

Prepared by

Michael P. Walsh
Technical Consultant

February 11, 1988

EXECUTIVE SUMMARY

It has been over ten years since the Clean Air Act was amended. This law was designed in 1970 and modified in 1977 to provide an overall structure to facilitate achievement of the health based National Ambient Air Quality Standards (NAAQS) as quickly as possible, but in no case later than December 31, 1987. While substantial progress has occurred -- a 10 percent decline in ozone levels between 1979 and 1985, 15 percent fewer ozone nonattainment areas since 1980, 38 percent fewer violations of the ozone standard -- the nation's air pollution problem is far from solved. Nearly 40 states contain at least one nonattainment area, and many states contain several. Almost 100 million Americans still live in areas which exceed healthy air levels.

To address these continuing nonattainment problems, comprehensive legislation to reauthorize the Clean Air Act has been introduced in both the House and Senate. The American Lung Association commissioned an analysis of the mobile source provisions of these proposals which lower emissions from both gasoline and diesel powered vehicles, to assess the impact on future air quality. Table A summarizes the most stringent standards contained in either proposal.

The American Lung Association's analysis found that significant nationwide emissions reductions per mile driven are possible based on the standards and extended durability requirements contained in the legislative proposals compared to current levels. For example, it is estimated that the proposed legislation would reduce in use auto hydrocarbon (HC) emissions by 47 percent; for light trucks, the reductions would be 43 percent. The improvements for nitrogen oxides (NOx) are even greater, dropping by 58 percent and 46 percent, for cars and light trucks respectively.

Beyond the NOx and HC emissions reductions, the technologies fostered by the higher standards should also bring about reductions in carbon monoxide (CO) emissions. As recently noted by the state of California Air Resources Board, "We expect that nearly all passenger cars will emit CO emissions at a rate approaching 3.4 grams per mile <u>in use</u> as a result of further NMHC (non methane hydrocarbon) control."

With regard to air quality, the study found that for the 79 ozone nonattainment areas investigated, adoption of the legislation will significantly lower emissions over the current requirements. Without additional controls, beyond those already adopted for stationary and mobile sources, virtually all the areas studied will be in nonattainment in the future. If stationary source emissions continue to increase, as EPA recently estimated they would, and mobile sources follow the

TABLE A: MOTOR VEHICLE STANDARDS CONTAINED IN LEGISLATIVE PROPOSALS

	Current	Revised
Automobiles (Light Duty Vehicles)[1]	grams/mile	grams/mile
Carbon Monoxide (CO)	3.4	3.4[2]
Hydrocarbons (HC)	0.41	0.25 (1992)
Oxides of Nitrogen (NOx)	1.0	0.4 (1990)
Particulates	0.2	0.08 (1990)
Light Duty Trucks (Above 6000 lbs. GVW)	grams/mile	grams/mile
Carbon Monoxide (CO)	10.0	5.0 (1990)
Hydrocarbons (HC)	0.8	0.50 (1992)
Oxides of Nitrogen (NOx)	2.3	
	1.7 (1990)	0.5 (1990)
Particulates	0.26[3]	0.08 (1990)
Heavy Duty Trucks	grams/brake horsepower hour	
Oxides of Nitrogen (NOx)	10.6	
	6.0 (1990)	
	5.0 (1991)	4.0 (1991)
		1.7
Particulates [4]	0.25 (1991)	0.25 (1991)[5]
	0.10 (1994)	0.10 (1994)[5]
Motorcycles	grams/mile	grams/mile
Carbon Monoxide (CO)	19.2	3.4
Hydrocarbons (HC)	8	0.25

Notes:

1. The definition of light duty vehicles is modified to include most light duty trucks with a gross vehicle weight of less than 6000 lbs. GVW. Current standards for these vehicles are 10 gpm CO, 0.8 HC and 2.3 NOx, with the NOx level reduced to 1.2 gpm in 1988. Particulate standards for these vehicles are 0.26 gpm.

2. The current California 7.0 gpm CO standard will be reduced to the nationwide 3.4 gpm level.

3. In the Federal Register of June 4, 1987, EPA proposed a relaxation of this standard for a few years followed by a tightening. Specifically, EPA proposed 0.5 in 1987, 0.45 in 1988 through 1990 and 0.13 in 1991.

4. Buses are required to meet the 0.1 standard in 1991 rather than 1994.

5. These standards do not differ from the current regulatory requirements but incorporate them specifically in the statute.

In addition to tighter emission standards, either or both sets of legislation would:

- Require enhanced I&M programs including anti-tampering emission control equipment inspections;
- Require fleet operators to make increasing use of alternative fueled vehicles;
- Require off-road vehicles beginning in 1990 to meet the emission standards of highway vehicles of comparable horse power;
- Ban lead in gasoline beginning in 1990;
- Eliminate the use of averaging;
- Require a 90% pass rate on EPA's assembly line testing program;
- Establish an idle test for light duty vehicles;
- Expand the class of vehicles eligible for recall;
- Extend the tampering prohibition to individuals; and
- Prohibit the manufacture and sale of emission control defeat devices.

trends estimated in this study for the current set of mobile source requirements, the ozone air quality situation will be just as severe in the future as it is today. Conversely if available stationary and mobile source controls are introduced, most areas could achieve healthy air. Table B summarizes future attainment status under these alternatives.

If the stationary source controls are introduced without the mobile source controls there will continue to be a substantial shortfall. The only options then available would be to introduce the legislated mobile source controls, find additional stationary source controls which no one has been able to identify at this time, or drastically reduce the use of vehicles in the nonattainment areas. To put this into perspective, the study found that the mobile source emissions reductions which would result from the legislation reflect 38 percent of the additional reductions needed to attain the standards after the stationary controls are introduced along with all currently mandated mobile source controls.

Photochemical smog results from chemical reactions involving both hydrocarbons and nitrogen oxides in the presence of sunlight. Motor vehicles are major sources of both of these precursor pollutants. While historically the major strategy for reducing smog has focused on tight restrictions on hydrocarbon emissions, NOx control is also necessary in many areas.

Therefore, it is important in assessing future air quality to consider NOx emissions trends. This study also finds that NOx emissions will increase in the future unless additional controls are introduced. The legislative proposals for mobile sources, on the other hand, will significantly lower these emissions. Including stationary NOx sources which are also increasing under current requirements, the situation will clearly deteriorate without additional controls. Mobile source controls alone will not substantially lower NOx emissions from current levels but they will offset the growth that would otherwise occur.

An assessment of the carbon monoxide problem was also carried out. Since it has now been established that most CO air quality problems across the United States tend to be concentrated in winter months and are most severe in congested central business districts, the analysis was carried out under those conditions (20 degrees F, 10 M.P.H. average speed). The analysis indicates that the current air quality situation will continue to improve for several years, but will then start to degrade during the late 1990's unless additionall controls are introduced. With controls as contained in the legislative proposals, CO can be virtually eliminated; without them, we will likely have almost as serious a CO problem in the future as we do now.

TABLE B: OZONE NONATTAINMENT STATUS FOR SELECTED AREAS

MSA NAME	ST	OZONE LEVEL (1985)	ATTAINMENT STATUS IN THE FUTURE UNDER VARIOUS ALTERNATIVES: BASE CASE 2000	BASE CASE 2010	MAXIMUM CURRENT 2010	ADDITIONAL CONTROLS STATIONARY & MOBILE 2010
Los Angeles CA	CA	0.36	1	1	1	1
Riverside CA	CA	0.33	1	1	1	0
Anaheim CA	CA	0.28	1	1	1	0
Houston TX	TX	0.25	1	1	1	0
New London CT	CT	0.23	1	1	1	0
New York NY	NY	0.22	1	1	0	0
Bridgeport CT	CT	0.22	1	1	1	0
New Haven CT	CT	0.22	1	1	1	0
San Diego CA	CA	0.21	1	1	1	0
Chicago IL	IL	0.20	1	1	0	0
Middlesex NJ	NJ	0.20	1	1	1	0
Oxnard CA	CA	0.19	1	1	1	0
Atlantic City NJ	NJ	0.19	1	1	1	0
Galveston TX	TX	0.19	1	1	0	0
Philadelphia PA	PA	0.18	1	1	0	0
Sacramento CA	CA	0.18	1	1	1	0
Providence RI	RI	0.18	1	1	0	0
Trenton NJ	NJ	0.18	1	1	0	0
Baltimore MD	MD	0.17	1	1	0	0
Milwaukee WI	WI	0.17	1	1	0	0
Hartford CT	CT	0.17	1	1	0	0
Monmouth NJ	NJ	0.17	1	1	1	0
Fresno CA	CA	0.17	1	1	0	0
Boston MA	MA	0.16	1	1	0	0
Washington DC	DC	0.16	1	1	0	0
Nassau NY	NY	0.16	1	1	0	0
Atlanta GA	GA	0.16	1	1	0	0
St Louis MO	MO	0.16	1	1	0	0
Dallas TX	TX	0.16	1	1	0	0
Newark NJ	NJ	0.16	1	1	0	0
Phoenix AZ	AZ	0.16	1	1	0	0
Bergen NJ	NJ	0.16	1	1	0	0
Fort Worth TX	TX	0.16	1	1	0	0
Jersey City NJ	NJ	0.16	1	1	0	0
Baton Rouge LA	LA	0.16	1	1	0	0
El Paso TX	TX	0.16	1	1	0	0
New Bedford MA	MA	0.16	1	1	0	0
Bakersfield CA	CA	0.16	1	1	0	0

1 = nonattainment; 0 = attainment

MSA NAME	ST	OZONE LEVEL (1985)	ATTAINMENT STATUS IN THE FUTURE UNDER VARIOUS ALTERNATIVES: BASE CASE 2000	BASE CASE 2010	MAXIMUM CURRENT 2010	ADDITIONAL CONTROLS STATIONARY & MOBILE 2010
Santa Barbara CA	CA	0.16	1	1	0	0
Portland ME	ME	0.16	1	1	0	0
Springfield/WOR	MA	0.15	1	1	0	0
Salt Lake City	UT	0.15	1	1	0	0
Louisville KY	KY	0.15	1	1	0	0
Memphis TN	TN	0.15	1	1	0	0
Modesto CA	CA	0.15	1	1	0	0
Cleveland OH	OH	0.14	1	1	0	0
Kansas City MO	MO	0.14	1	1	0	0
Nashville TN	TN	0.14	1	1	0	0
Allentown PA	PA	0.14	1	1	0	0
Huntington WV	WV	0.14	1	1	0	0
Brazoria TX	TX	0.14	1	1	0	0
Lake Charles LA	LA	0.14	1	1	0	0
Detroit MI	MI	0.13	1	1	0	0
Tampa FL	FL	0.13	1	1	0	0
Miami FL	FL	0.13	1	1	0	0
Denver CO	CO	0.13	1	1	0	0
Indianapolis IN	IN	0.13	1	1	0	0
Dayton OH	OH	0.13	1	1	0	0
Birmingham AL	AL	0.13	1	1	0	0
Richmond VA	VA	0.13	1	1	0	0
Tulsa OK	OK	0.13	1	1	0	0
Akron OH	OH	0.13	1	1	0	0
Grand Rapids Mi	MI	0.13	1	1	0	0
Harrisburg PA	PA	0.13	1	1	0	0
York PA	P	0.13	1	1	0	0
Lancaster PA	PA	0.13	1	1	0	0
Vallejo CA	CA	0.13	1	1	0	0
Reading PA	PA	0.13	1	1	0	0
Portsmouth NH	NH	0.13	1	1	0	0
Erie PA	PA	0.13	1	1	0	0
Visalia CA	CA	0.13	1	1	0	0
Boulder CO	CO	0.13	1	1	0	0
Vineland NJ	NJ	0.13	1	1	0	0
Cincinnati OH	OH	0.12	1	1	0	0
New Orleans LA	LA	0.12	1	1	0	0
Norfolk VA	VA	0.12	1	1	0	0
San Antonio TX	TX	0.12	1	1	0	0
Canton OH	OH	0.12	1	1	0	0
Hagerstown MD	MD	0.12	1	1	0	0

1 = nonattainment; 0 = attainment

I. BACKGROUND

In late 1970, frustrated by the country's pollution problems, Congress amended the Clean Air Act, setting up a new regulatory structure which has served as a blueprint for progress since that time. The cornerstone of the Act is the health-based National Ambient Air Quality Standards. To meet these standards, in part, the United States knowingly imposed emission standards for new cars which could not then be achieved. To comply with the law, auto manufacturers were required to develop and commercialize technologies which existed only in research laboratories or on prototypes. The adoption of these "technology forcing" emissions standards for carbon monoxide, hydrocarbons and nitrogen oxides was complemented by a comprehensive regulatory structure for assuring compliance with these standards. Standards adopted to date for automobiles are listed below:

Standard (grams per mile)

Model Year	Hydrocarbons	Carbon Monoxide	Nitrogen Oxides
Pre-1968	8.2	90.0	3.4
1968-1971	4.1 (50)	34.0 (62)	none
1972-1974	3.0 (63)	28.0 (69)	3.1 (9)
1975-1976	1.5 (82)	15.0 (83)	3.1 (9)
1977-1979	1.5 (82)	15.0 (83)	2.0 (41)
1980	0.41 (96)	7.0 (92)	2.0 (41)
1981+	0.41 (96)	3.4 (96)	1.0 (76)

( ) percent reduction from uncontrolled levels.

* not standards but approximate levels prior to adoption of standards

While specific numbers were not spelled out in the law, the Clean Air Act also authorized EPA to set standards for all other categories of motor vehicles.

The technology necessary to meet the standards has been developed sufficiently that all 1983 and later model gasoline fueled cars have been "certified" to the most stringent levels. Without exception, all new gasoline automobiles sold in the United States today and for the last several years are equipped with catalytic converters and required the use of lead free fuel.

In addition to the standards themselves, EPA has completed implementation of the full set of enforcement tools which Congress provided to assure compliance with those standards -- most notably, Certification, Assembly Line Testing, Recall and Warranty.

In spite of the progress made to date in reducing vehicle pollution, the problems of poor air quality persist. Many areas in the United States (as well as other parts of the world) still have not achieved healthy air; in addition, new environmental problems are emerging. Finally, excess energy consumption is leading to the growing global environmental concern -- the build up of CO_2 and other gases which are increasing the risk of global climate change. (1)

The purpose of this study is to review the reasons why motor vehicle pollution control is important, to determine the future prospects for attainment of the ozone air quality standard if the Clean Air Act is not amended, and to assess the potential benefits of the currently proposed legislation.

II. TECHNOLOGICAL DEVELOPMENTS

Before emission reductions were mandated, gasoline vehicles emitted pollutants at the following approximate rates:

Uncontrolled Vehicle Emissions*

Pollutant	Emission (grams per mile)
Hydrocarbons	
Exhaust	8.2
Crankcase	4.1
Evaporative	2.9
Carbon Monoxide	90
Oxides of Nitrogen	3.5

* Exhaust emissions as determined by the 1975 U.S. Federal Test Procedure

A. INITIAL CONTROLS

To meet the relatively lenient HC and CO standards that applied in the early 1970s, auto manufacturers generally relied on enleanment of the air/fuel mixture and modification of spark timing. In addition, newer combustion chamber designs were introduced to reduce hydrocarbon emissions, and with faster flames to limit the increased nitrogen oxides. Even when HC and CO standards were tightened, the engine modification approach continued to predominate, with the addition of certain new wrinkles such as transmission controlled spark timing and anti-dieseling throttle control. Attainment of initial HC and CO standards with limitations on NOx increases was generally possible without significant fuel consumption penalties. However, as emissions standards were tightened (especially in 1972 through 1974) it became more and more difficult for domestic cars employing conventional engine designs to achieve low levels of CO, HC and NOx without undesirable compromises in performance or fuel economy. As a result there was a fundamental shift in the technology to the catalytic converter.

B. CATALYSTS

Two basic types of catalysts have been developed -- oxidation and three-way.

An oxidation catalyst is a device that is placed on the tailpipe of a car and which, when the chemistry and exhaust temperature are properly maintained, will oxidize almost all the HC and CO in the exhaust stream to form carbon dioxide and water.

Three-way catalysts (so called because of their ability to lower HC, CO and NOx levels simultaneously) were first introduced in the United States in 1977 by Volvo and have subsequently become widely used as the NOx emission standard has become more stringent. To work effectively, air-fuel mixtures must be controlled much more precisely than is needed for oxidation catalyst systems. As a result, three-way catalysts are responsible for fostering improved air-fuel management systems such as advanced carburetors and throttle body fuel injection systems as well as spurring development of electronic controls. (Ironically, as a result, General Motors has effectively become the world's leading producer of computers.)

Virtually all new cars and light trucks sold today are equipped with catalysts, the vast majority with either three-way or three-way plus oxidation systems. Fuel injection has increased from miniscule proportions during the 1970's to approximately three out of four new light duty vehicles today.

III. ENVIRONMENTAL TRENDS

A. EMISSIONS REDUCTIONS

Figures 1, 2 and 3 show the automobile emissions standards for HC, CO and NOx, respectively, along with the average in use performance of these same model year cars. These data indicate several important facts:

1. As Congress mandated, automobile standards have been lowered significantly over the last 20 years, exceeding 90 percent per mile driven for HC and CO and 65 percent for NOx, compared to uncontrolled vehicles.

2. As a result, the in use emissions performance of vehicles has also been lowered although not to as great a degree.

3. Average in use emissions have generally been higher than the respective standards, especially for CO and HC. In use NOx performance is much closer to the standards than either CO or HC.

4. In absolute terms, the shortfall between the standards and the in use vehicle performance has tended to be narrowed as the standards have been tightened.

Lead usage in gasoline has also dropped over 75 percent since 1975, with positive impacts on health. Based on data collected in more than 60 United States cities by the Centers for Disease Control, mean blood lead levels in children declined by 36.7 percent from 1976 to 1980 -- roughly in proportion with the reduction in the amount of lead added to gasoline.

Emissions reductions from other vehicle categories have been significantly less than from autos. For example, even though many light trucks are used as personal vehicles in much the same manner as cars the vast majority of time, their emissions standards are more lenient. Heavy trucks, especially diesels, are much less controlled than cars at present. HC and CO requirements for gasoline trucks have only recently been significantly tightened and NOx requirements for all heavy trucks will only start toward significant control in 1990 under current requirements.

According to the latest EPA estimates (2), as illustrated in Figure 4, the overall reductions in emissions from <u>all</u> transportation sources across the United States during the last decade were 88 percent for lead, 25 percent for CO, and 30 percent for HC. These reductions occurred despite a 26 percent increase in vehicle miles travelled during this same time period. However overall reductions have been only 1 percent for NOx and there has been no reduction in particulate. In fact, during the last two years, NOx emissions from transportation increased by 300,000 tons.

Figure 5 shows that during 1985, transportation sources were responsible for 73 percent of nationwide lead emissions, 70 percent of the CO, 34 percent of the volatile organic compounds (HC), 45 percent of the NOx, and 18 percent of the particulate. In some cities, the mobile source contribution is even higher. In effect, the percentage contribution from mobile sources to total emissions, with the exception of lead, has not changed appreciably in spite of significant passenger car controls. Growth in vehicle miles travelled and less stringent controls on other mobile sources are offsetting the overall gains from automobile standards. Therefore, significant additional reductions of these pollutants from mobile sources have the potential to result in substantial overall improvements.

Emissions by Model Year

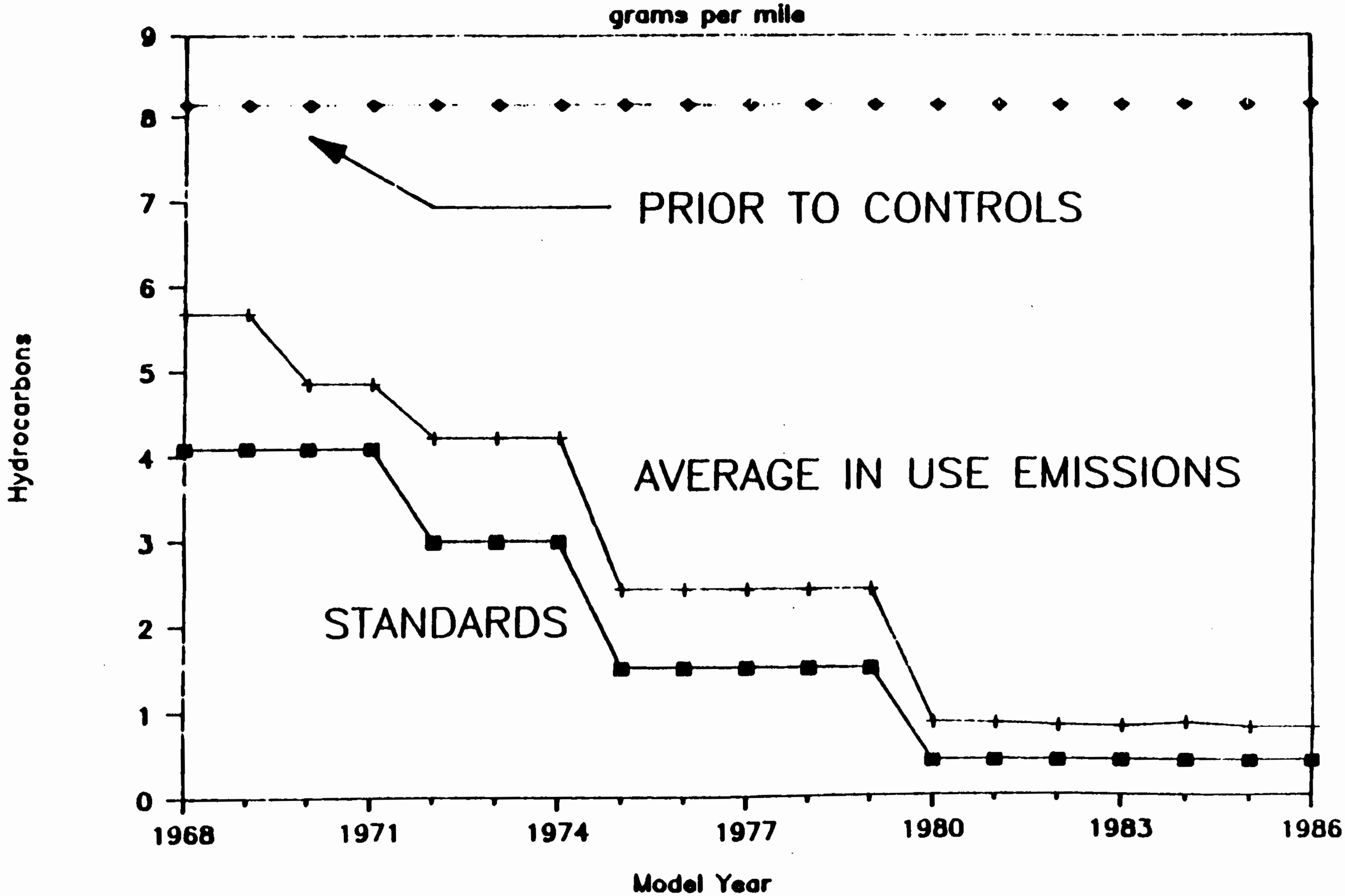

Figure 1

Emissions by Model Year

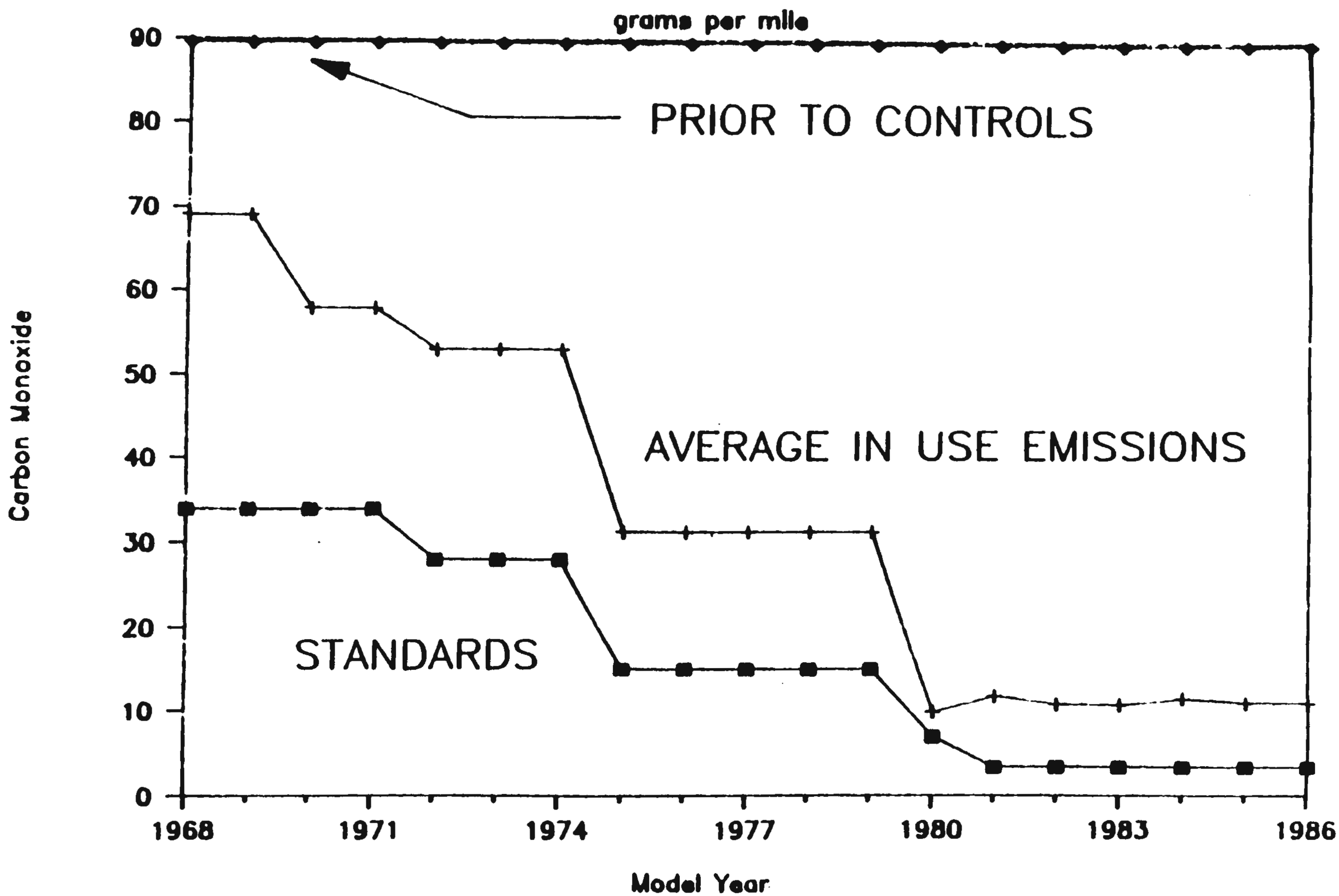

Figure 2

Emissions by Model Year

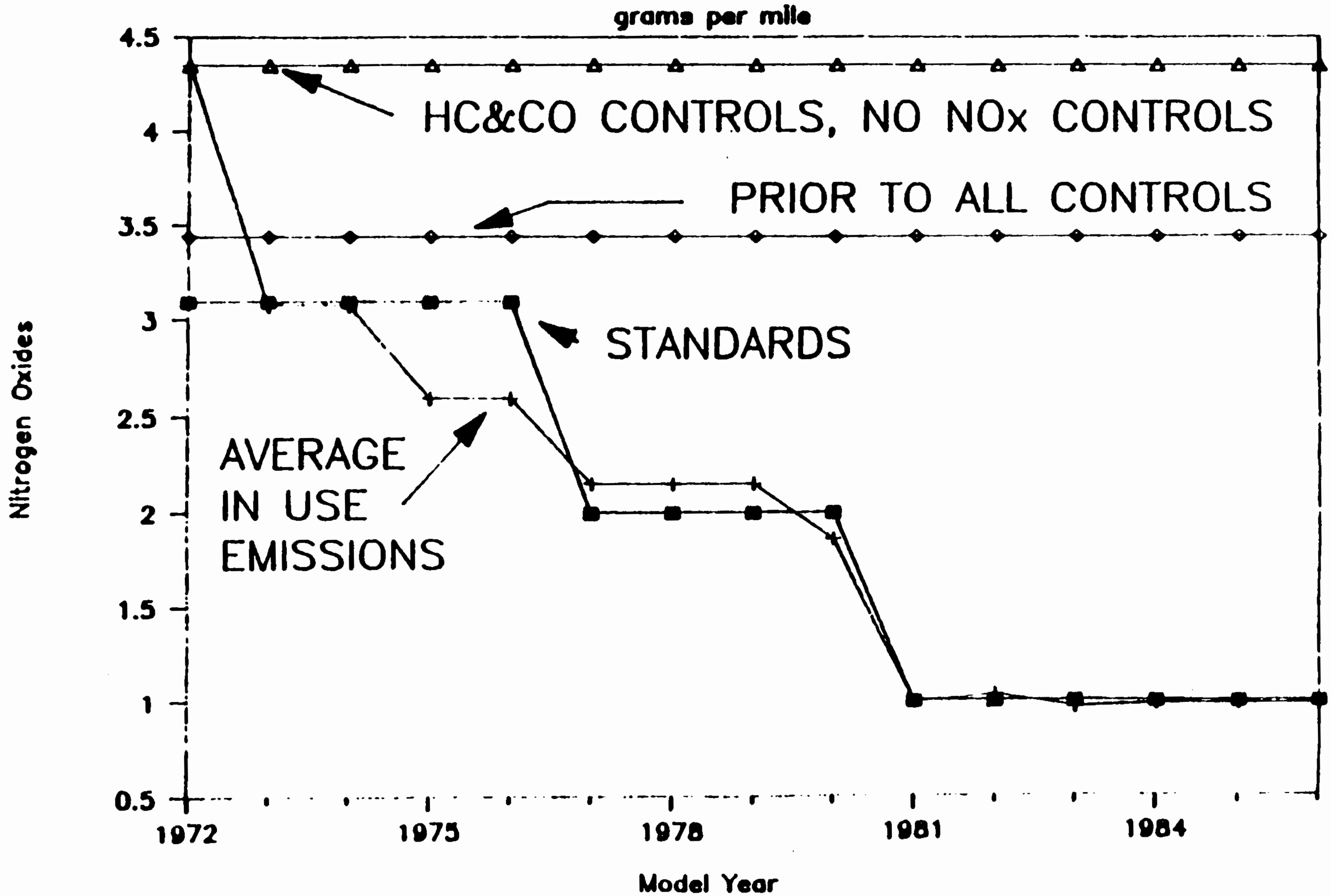

Figure 3

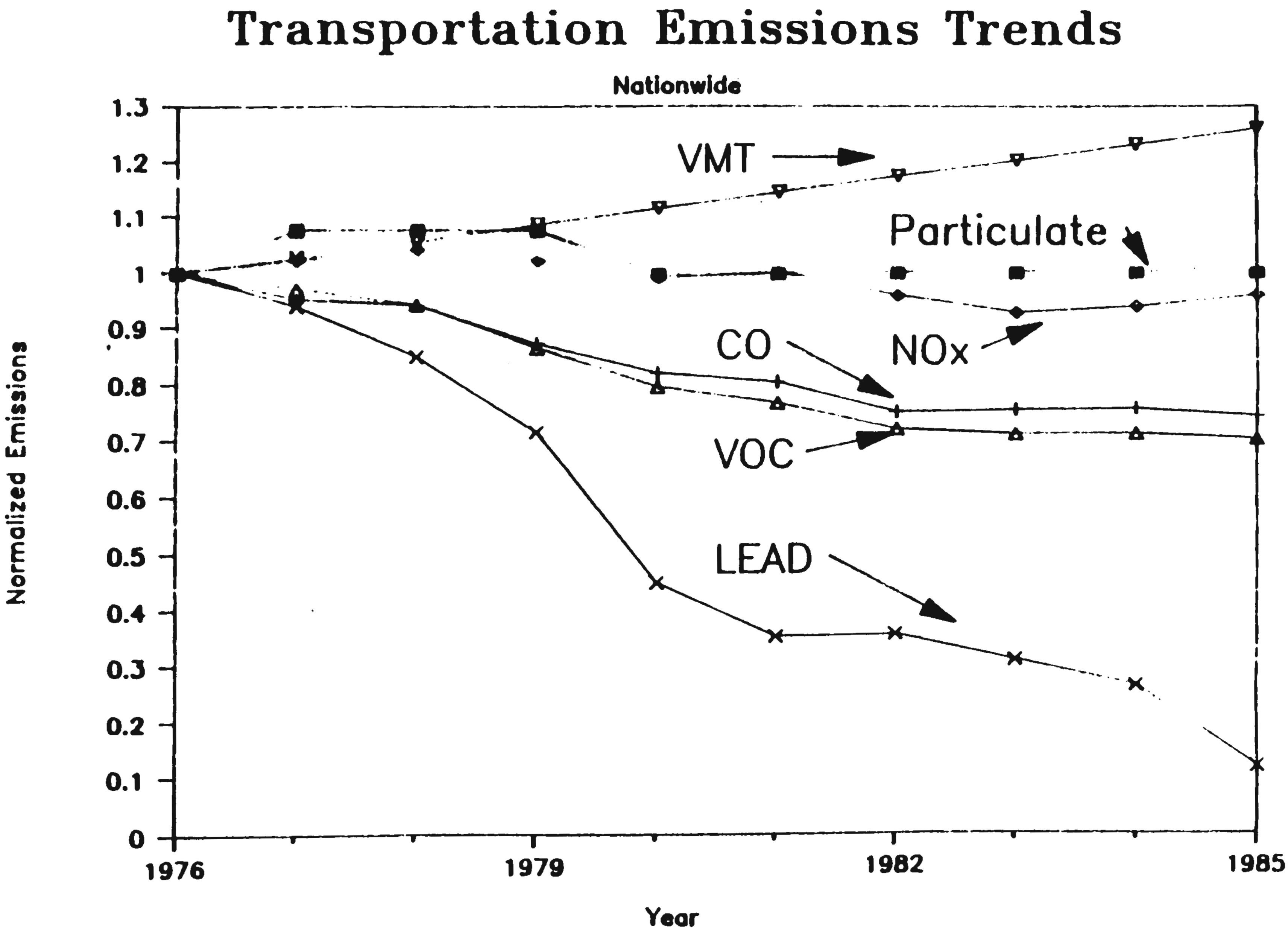
Transportation Emissions Trends
Nationwide
VMT
Particulate
CO
NOx
VOC
LEAD
Normalized Emissions
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1976
1979
1982
1985
Year

Figure 4

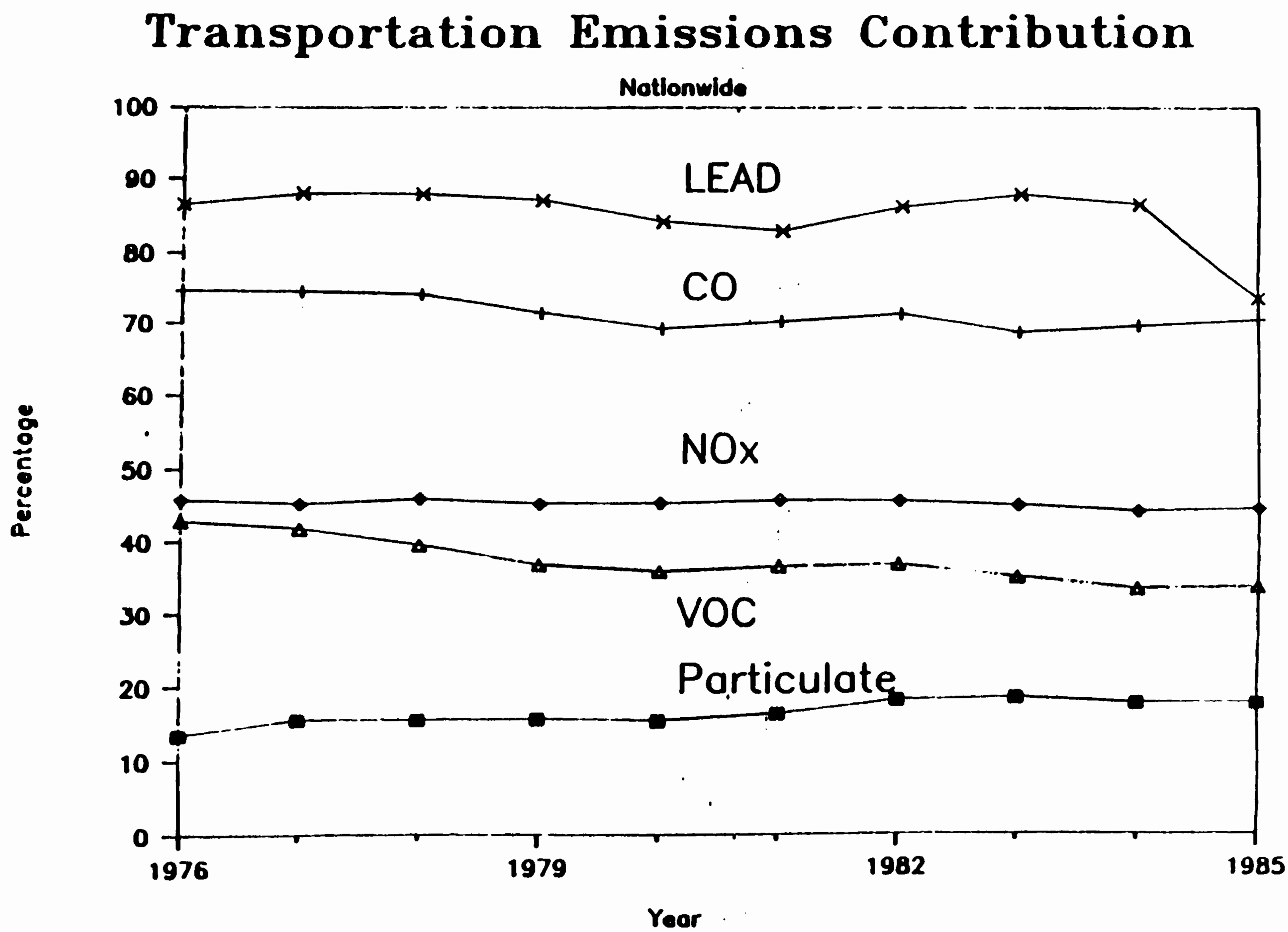
Transportation Emissions Contribution
Nationwide
LEAD
CO
NOx
VOC
Particulate
Percentage
100
90
80
70
60
50
40
30
20
10
0
1976
1979
1982
1985
Year

Figure 5

B. IMPROVEMENTS IN AIR QUALITY

Carbon Monoxide

Carbon monoxide air quality levels across the United States have improved over the last decade, although they have been relatively stable in recent years. According to the latest EPA estimates (2), nationwide improvements have averaged about 5 percent per year, with an overall reduction of 30 percent between 1976 and 1985. Viewed in terms of the actual number of times the health-based air quality standard was violated the improvement has been even more dramatic -- about a 92 percent reduction. This improvement is directly attributed to reduction in CO emitted by motor vehicles, since motor vehicles account for virtually all the CO in these areas.

Nitrogen Dioxide

Overall United States NOx emissions have only recently started to decline after many years of increases; in some areas emissions are still increasing. Annual average NO_2 levels measured at 108 sites increased from 1976 to 1979 then decreased through 1985. (2) The 1985 composite average NO_2 level is 11 percent lower than the 1976 level. The data indicate that air quality is better than it would have been absent motor vehicle controls but that overall gains are less than they could have been, due to the increased miles travelled and growing emissions from many stationary sources that are significant sources of NOx. Primarily because of stationary source growth, total United States NOx emissions are expected to increase sharply by the turn of the century. (3)

Ozone

Nationally, the composite average of the second-highest daily maximum 1 hour ozone values recorded at 183 sites decreased 10 percent between 1976 and 1985. (2) As with CO, the improvement in the number of times the air quality standard was exceeded was even greater, about 38 percent. Certainly control of HC and NOx from motor vehicles has played a significant role in bringing about these reductions.

Lead

Ambient lead levels have also declined substantially; the composite maximum quarterly average of ambient lead levels, recorded at 53 urban sites across the country, decreased 79 percent between 1976 and 1985. (2)

IV. ENVIRONMENTAL CONCERNS REMAIN

The United States is at a critical juncture in its efforts to achieve healthy air. Overall emissions trends from all sources continue to be a concern, especially for those pollutants related to photochemical smog. For example, Figure 6 shows that the nationwide reductions in NOx and VOC's from all sources have been modest over the last decade. In a longer timeframe, it can be seen in Figure 7 that both of these pollutants are substantially higher than they were just a few decades ago. Further, the latest projections from NAPAP, as shown in Figure 8, indicate that overall emissions of these smog precursors will increase substantially in coming decades without significantly more control than is already on the books.

Further, beyond attaining the existing national ambient air quality standards, new air pollution problems such as "acid rain" and global warming are emerging which not only involve new technological challenges but require more international cooperation than was necessary in the past.

It has been over ten years since the Clean Air Act was amended. This law was designed in 1970 and modified in 1977 to provide an overall structure to facilitate achievement of the health based National Ambient Air Quality Standards (NAAQS) as quickly as possible, but in no case later than December 31, 1987. While as noted above, substantial progress has occurred -- a 10 percent decline in ozone levels between 1979 and 1985, 15 percent fewer ozone nonattainment areas since 1980, 38 percent fewer violations of the ozone standard -- the nation's air pollution problem is far from solved. Nearly 40 states contain at least one nonattainment area, and many states contain several. Millions of Americans still live in areas which exceed healthy air levels.

A. OZONE

The ozone problem is a special concern. First, the problem is widespread and pervasive and appears likely to be a long term problem in many of our largest metropolitan areas unless significant further controls are implemented. Figure 9 shows a cross section of major urban areas which exceed the ozone air quality standard; over 80 million Americans currently reside in these areas. (6) Many of these individuals suffer eye irritation, cough and chest discomfort, headaches, upper respiratory illness, increased asthma attacks and reduced pulmonary function as a result of this problem.

Nationwide Emissions Trends

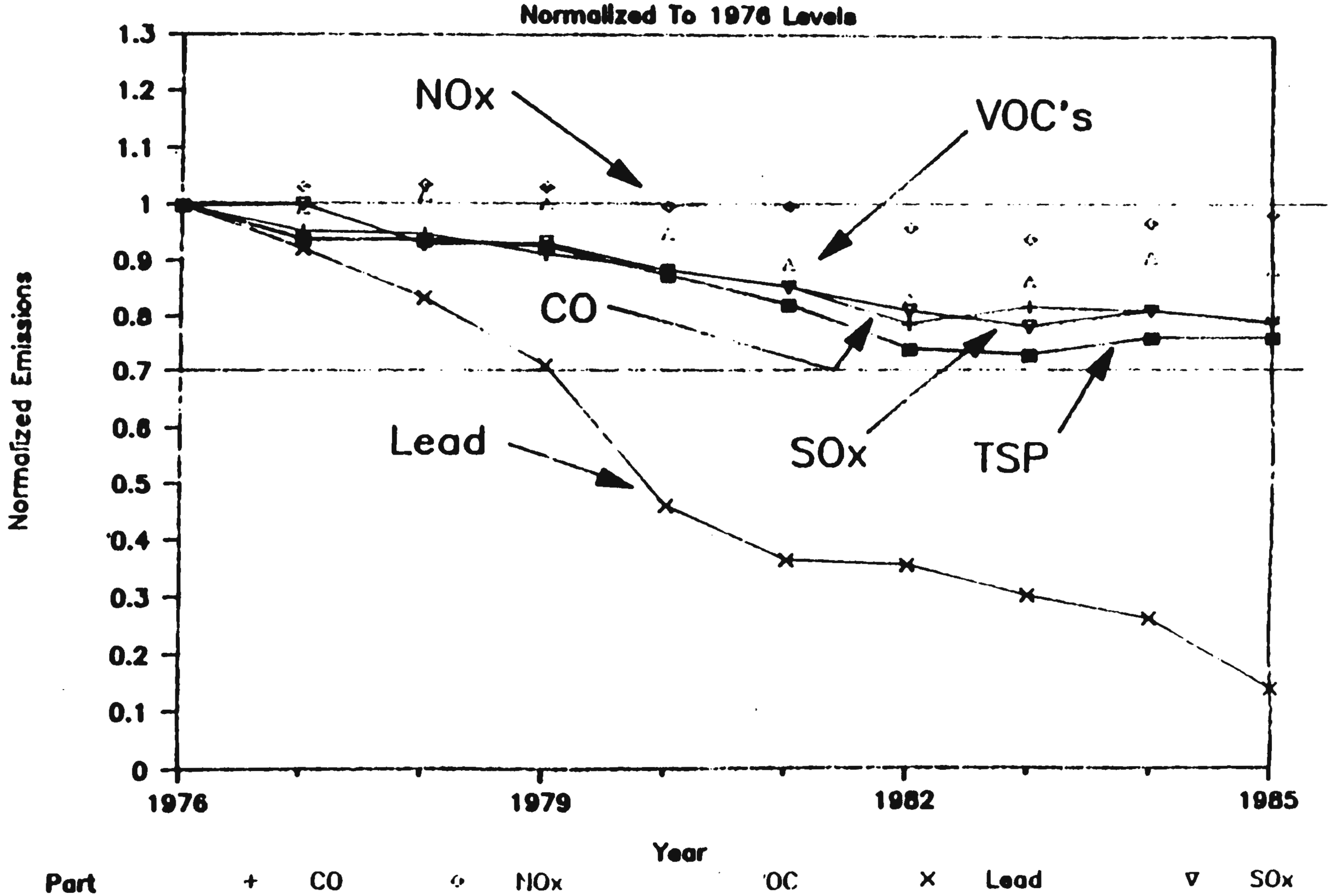

Figure 6

US EMISSIONS TRENDS

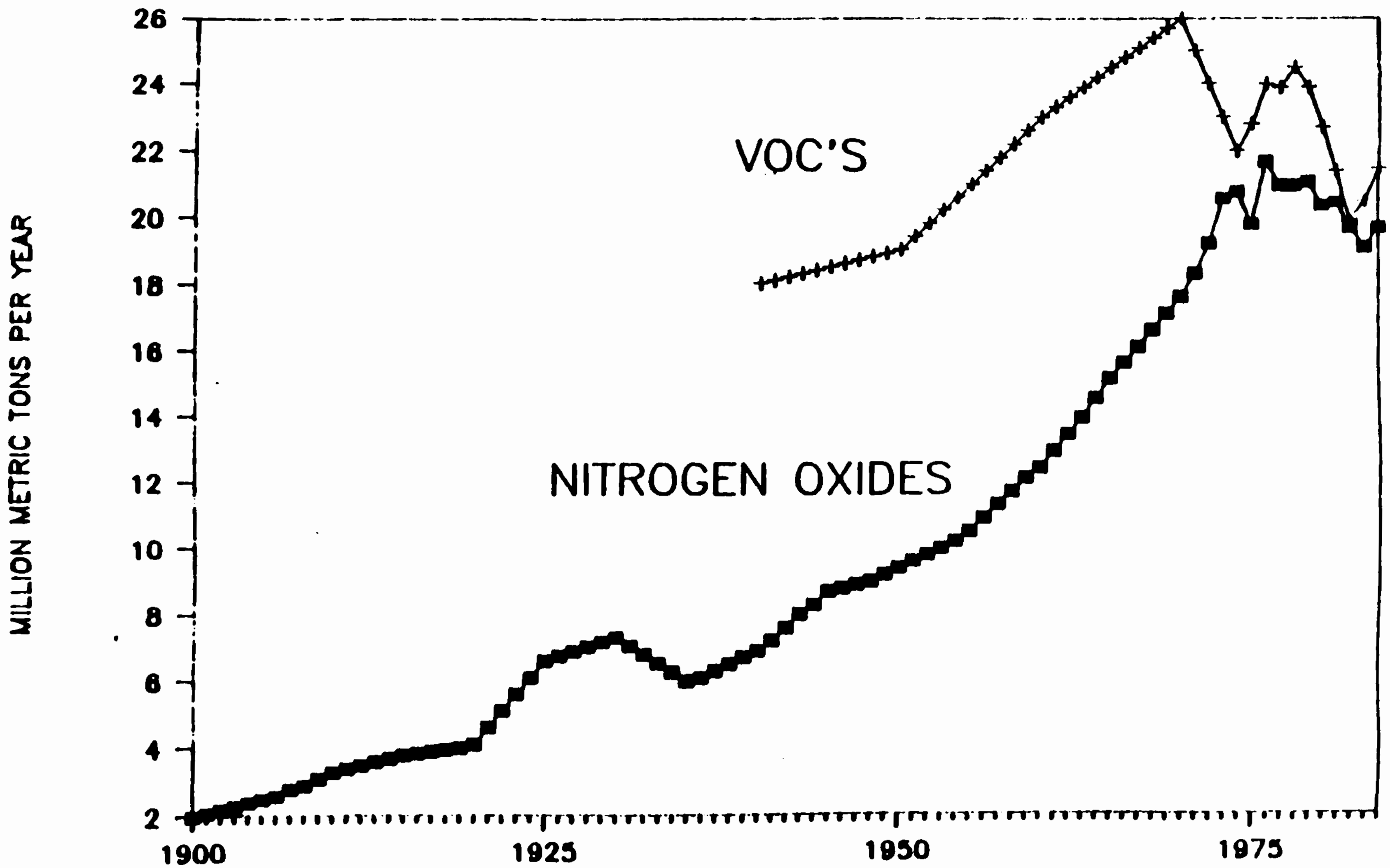

Figure 7

US EMISSIONS TRENDS

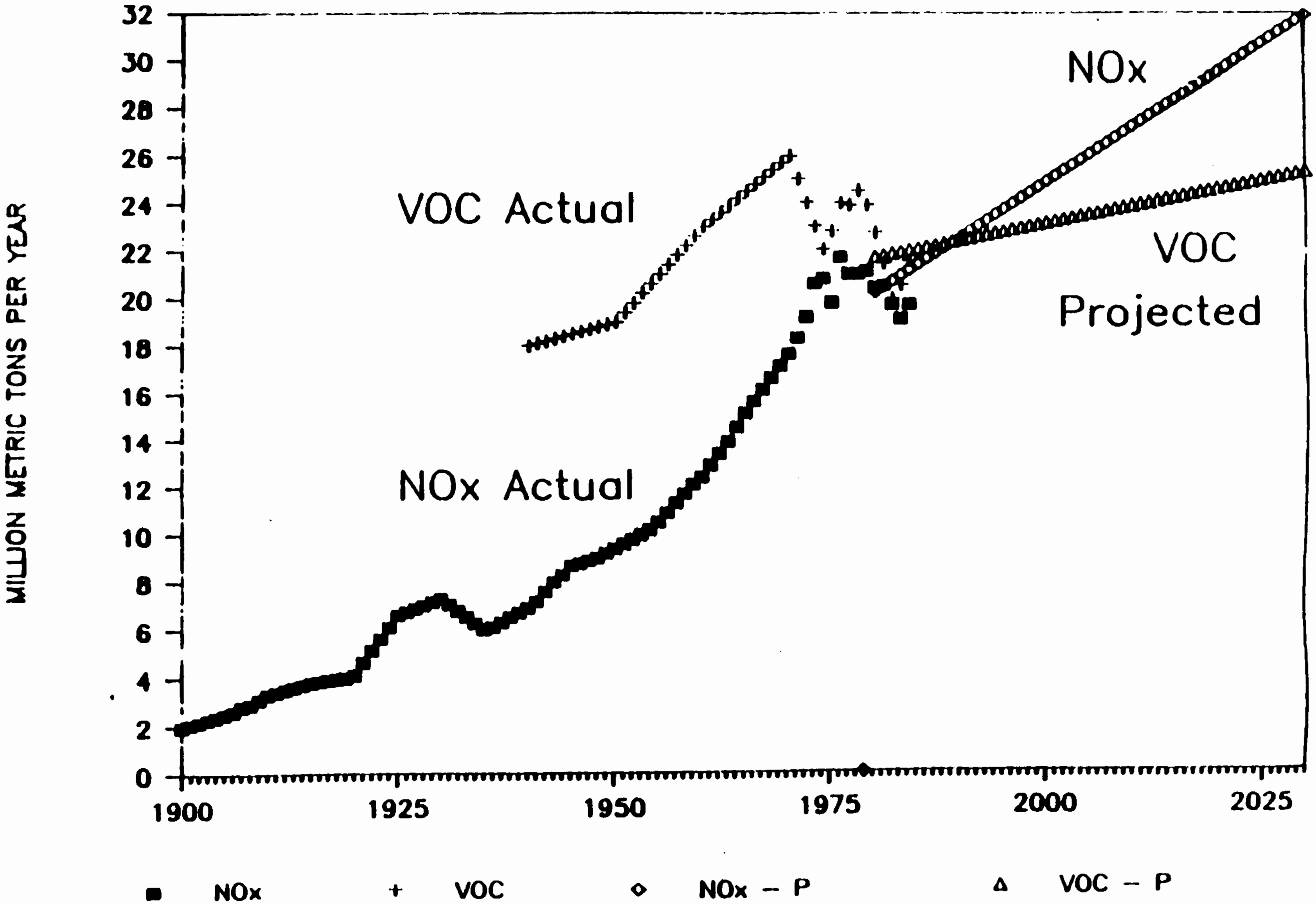

Figure 8

SAMPLING OF OZONE NONATTAINMENT AREAS

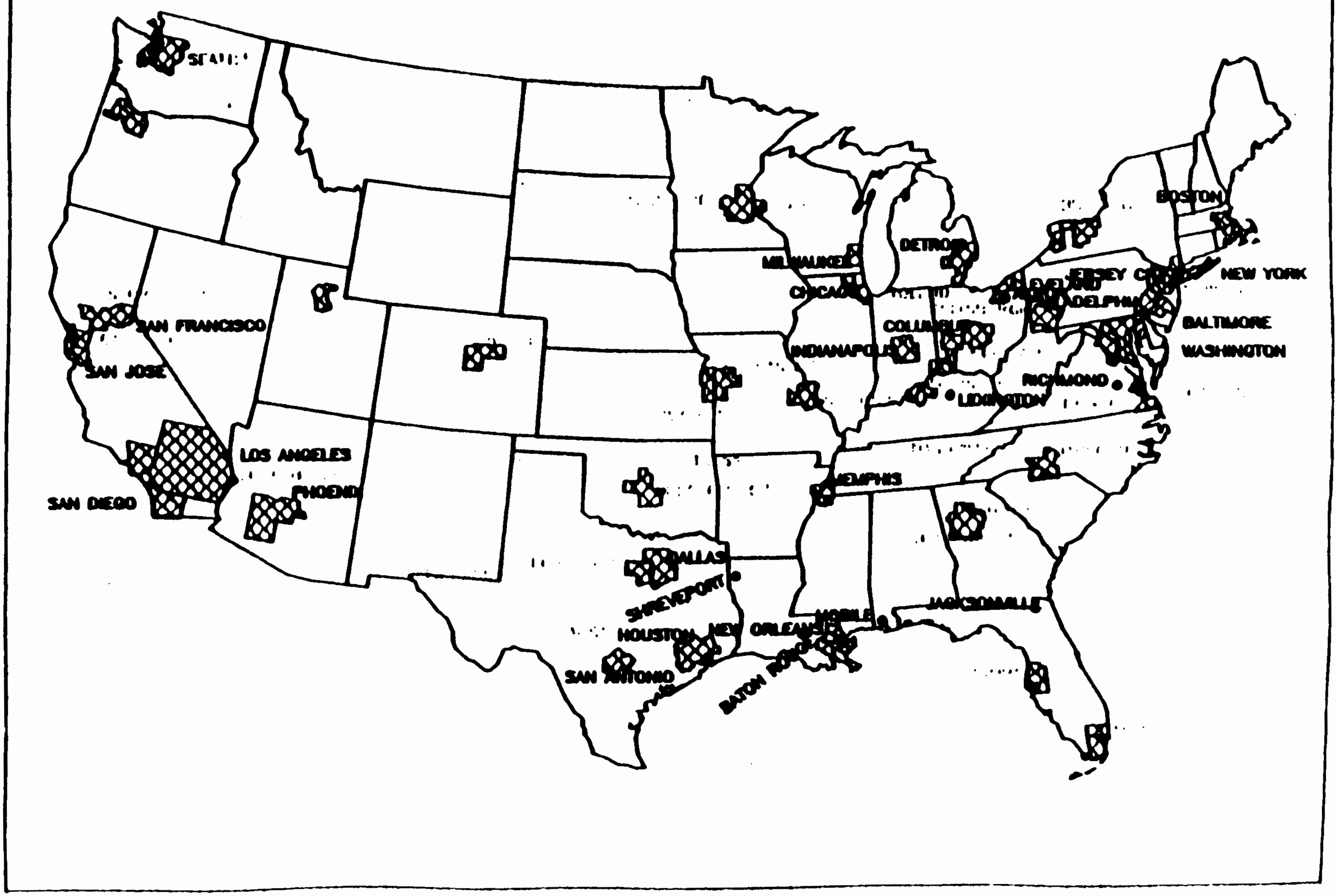

Figure 9

In addition, as noted in testimony before the Congress last year by EPA Administrator Thomas, new studies indicate;

> "that elevated ozone concentrations occurring on some days during the hot summers in many of our urban areas may reduce lung function, not only for people with preexisting respiratory problems, but even for people in good health. This reduction in lung function may be accompanied by symptomatic effects such as chest pain and shortness of breath. Observed effects from exposures of 1 to 2 hours with heavy exercise include measurable reductions in normal lung function in a portion (15 - 30 percent) of the healthy population that is particularly sensitive to ozone." (6)

The ozone problem has become so ubiquitous that background levels in rural areas frequently approach levels where adverse effects have been observed. Further, in terms of impact on the overall quality of life, it is important to note that ozone is generally formed on the "best" days, when the sun is shining and people would normally be enjoying the outdoors.

Numerous studies have also demonstrated that photochemical pollutants seriously impair the growth of certain crops. For example, the Congressional Research Service of the United States Library of Congress found that, in the United States alone, "the short-run or immediate impacts of ozone are evident in annual crop yield decreases estimated at $1.9 to $4.3 billion." (7) In the longer term, CRS points out that "ozone damage has resulted in disappearance of high yielding crops from localities and even from the genetic base." Other negative impacts include seed yield reduction of 10 to 22 percent in field corn, up to 33 percent reductions in wheat yields and from 24 to 50 percent reductions in soybean yields.

B. CARBON MONOXIDE

Carbon monoxide results almost entirely from motor vehicle emissions. While great progress has occurred in reducing ambient CO levels across the United States -- during the last ten years, the national composite average decreased by 36 percent and the average number of exceedences decreased by 92 percent -- the problem is far from solved. About 85 of our major metropolitan areas with a population approaching 30 million currently exceed the carbon monoxide air quality standard.

EPA Administrator Thomas also indicated that as many as 15 areas in the United States may have intermittent carbon monoxide (CO) problems that could prevent attainment for many years. (6) The importance of CO control has been reinforced by a recent study of tunnel workers in New York City. As noted by the authors:

"Given the magnitude of the effect that we have observed for a very prevalent cause of death, exposure to vehicular exhaust, more specifically to CO, in combination with underlying heart disease or other cardiovascular risk factors could be responsible for a very large number of preventable deaths." (11)

C. DIESEL PARTICULATE

Diesel particles are small and respirable (less than 2.5 microns) and consist of a solid carbonaceous core on which a myriad of compounds adsorb. These include:

- o unburned hydrocarbons
- o oxygenated hydrocarbons
- o polynuclear aromatic hydrocarbons
- o inorganic species such as sulfur dioxide, nitrogen dioxide and sulfuric acid.

Very recent studies indicate that these emissions can cause cancer and exacerbate mortality and morbidity from respiratory disease. For example, the Harvard University Health Effects Project recently concluded that "particulate pollution should be a public health concern because, even at current ambient concentrations, it may be contributing to excess mortality and morbidity. Furthermore, our recent analyses...indicate that <u>fine particles (FP)</u> and sulfates (SO_4) <u>are among the most harmful particles to public health</u>." (12) (emphasis added) The greater concern with small particles has motivated EPA to modify the ambient Total Suspended Particulate (TSP) standard to a standard focusing on particles of 10 microns or less in size, the so called PM 10 standard.

Many areas already experience unhealthy air quality levels for particulate (PM10) matter. Estimates are that from 70 to as many as 160 areas are in violation of this air quality standard. PM10 comes from many sources but diesel powered vehicles contribute a significant percentage in urban areas. (It is important to note that diesel NOx and sulfate emissions also contribute to ambient PM10 levels as well as to acid rain.)

With regard to cancer, a pilot study of United States railroad workers, conducted by researchers at Harvard, indicated that the risk ratio for respiratory cancer in diesel exposed subjects relative to unexposed subjects could be as great as 1.42, i.e., the possibility of developing cancer may be up to 42 percent greater in individuals exposed to diesels than in individuals who are not exposed. (13) The follow up study appears to be equally alarming -- "Using multiple logistic regression to adjust for smoking and asbestos exposure, workers age 64 or less at the time of death with lung cancer had increased relative odds (1.2-1.4; p less than 0.05) of having worked in diesel exhaust exposed jobs." (14) Further, during late 1985 and 1986, the results of several new animal studies were released which reinforced these concerns regarding adverse health effects from diesel particulate emissions. (15) In particular, a study conducted under the auspices of the European automobile manufacturers, the CCMC, and conducted by Battelle-Geneva reported that unfiltered diesel exhaust produced an increase in lung tumor incidence from 1 percent to 40 percent; gasoline emissions reportedly showed no effect. (16)

Beyond the adverse health effects, diesel particles are a nuisance. They degrade aesthetics and material usage through soiling and may contribute directly, or in conjunction with other pollutants, to structural damage by means of corrosion or erosion.

They also contribute to impaired visibility. Because of their composition (primarily carbon based) and size (averaging about 0.2 microns), they are very high light absorbers and scatterers and therefore have the potential to be especially harmful to visibility.

Finally, exhaust odor from diesel buses has been a significant public concern for many years. Problems associated with diesel odor include "nausea, headache, and coughing; upsetting of sleep, irritation of eyes, nose and throat; and destruction of the sense of well-being and enjoyment of food, home, and external environment."

D. TOXICS

Other toxic air pollutants, such as benzene, have over recent years become an important focus of air pollution control efforts. (17) Often referred to as "non-criteria pollutants" because air quality criteria have not been published by the EPA to support promulgation of NAAQS, so called "air toxics" have increasingly been the focus of federal, state, and local study and regulation. Activities have been centered on identifying pollutants of concern, evaluating sources and resulting ambient concentrations, and characterizing the health impacts associated with those concentrations.

Historically, stationary industrial sources of toxic air pollutants have been the first subject of regulations and guidelines, in part because of existing permitting authorities at the state and local level. However, in many area of the United States, area sources, especially mobile sources, appear to be a substantial contributor to the overall health risks associated with air toxics. A variety of studies have found that in individual metropolitan areas mobile sources are one of the most important and possibly the most important source category in terms of contributions to health risks associated with air toxics. As recently noted by EPA, mobile sources may be responsible for between 400 and 1850 cancer cases per year.

E. DIRECT NO_2 HEALTH EFFECTS

Nitrogen dioxide (NO_2) is linked with increased susceptibility to respiratory infection, increased airway resistance in asthmatics, and decreased pulmonary function. (18) Even short term exposures to NO_2 have resulted in a wide ranging group of respiratory problems in school children -- cough, runny nose and sore throat are among the most common -- as well as increased sensitivity to bronchoconstrictors by asthmatics. (19,20)

The World Health Organization concluded that a maximum 1 hour exposure of 190-320 micrograms per cubic meter (0.10-0.17 ppm) should be consistent with the protection of public health and that this exposure should not be exceeded more than once per month. The State of California has also adopted a short term NO_2 standard, 0.24 ppm averaged over one hour, to protect public health.

While nitrogen dioxide alone does not significantly reduce visual range, it is responsible for a portion of the brownish colorations observed in polluted air. In addition, nitrogen dioxide and particulate nitrates also contribute to pollutant haze.

Oxides of nitrogen have also been shown to effect vegetation adversely. Some scientists believe that NOx is a significant contributor to the dying forests throughout central Europe. (21) This effect is even more pronounced when nitrogen dioxide and sulfur dioxide occur simultaneously. Further, nitrogen dioxide has been found to cause deleterious effects on a wide variety of textile dyes and fabrics, plastics and rubber.

Lest it appear that the various concerns related to NOx are going away, it is important to note that NOx emissions have approximately tripled in the United States since 1950. According to the latest EPA air quality and emissions trends report, national nitrogen oxide emissions increased by 900,000 metric tons per year from 1983 to 1985; from transportation sources alone, they increased by about 300,000 tons. (2)

F. LEAD

The extremely serious health hazard associated with lead is no longer debatable. Unfortunately, recent studies suggest that lead causes health risks at exposure levels even lower than previously believed. For example, a recent study concluded that fetuses are adversely affected by exposure to lead at concentrations well below the current United States limit of 25 micrograms per deciliter of blood. (22) In tests of 249 children studied between birth and age two, the researchers found that children born with lead levels of at least 10 mg/dl scored nearly seven percent lower on developmental tests than children with little or no lead in their blood.

G. ACID RAIN

Beyond national boundaries, new environmental problems are emerging, most notably acid rain. (21,23,24,25) Acid rain reduces visibility, and in sensitive aquatic systems such as small lakes and streams can destroy fish and other forms of life. Many experts conclude that acid deposition has a significant role in the destruction of some areas of the forests throughout central Europe and North America.

Acid deposition results from the chemical transformation and transport of sulfur dioxide and nitrogen oxides. The major strategy for addressing the acid rain problem should be reductions of sulfur emissions; however NOx controls are important and will be increasingly so over the next ten to fifteen years. There are several reasons:

1. NOx emissions are responsible for about one third of the acidity in rainfall.

2. While emissions of SOx are expected to stabilize or hopefully even decline in the future, NOx emissions are projected to increase. In fact, the 1981 NAS Report indicated that NOx emissions could exceed sulfur emissions by the end of the century.

3. Under certain circumstances, such as the Spring snow melt, nitric acid is disproportionately responsible for fish kills in lakes and streams.

It therefore seems prudent to focus control efforts on both NOx and SOx.

At the 1982 International Conference on Acidification of the Environment in Stockholm, it was concluded that the "acidification problem is serious and, even if deposition remains stable, deterioration of soil and water will continue and may increase unless additional control measures are implemented and existing control policies are strengthened." Therefore, the assembled experts from around the world continued:

> "we know enough to be able to say: Unless we reduce our emissions of sulfur and nitrogen oxides, more lakes and streams, more groundwater, more soils and forests will become acidified and we will be adding to the economic and aesthetic damage we have already done...Best available technology which is economically feasible should also be applied to reduce NOx emissions from both stationary and mobile sources." (24)

This conclusion was reinforced during the International Conference of Ministers on Acid Rain which took place in Ottawa, Canada during March of 1985. The final declaration of the 10 participating countries commits each to "take measures to decrease effectively the total annual emissions of nitrogen oxides from stationary and mobile sources as soon as possible." (25)

H. GLOBAL WARMING

As shown in Figure 10, a gradual build up of CO_2 is occurring, raising the specter of significant global warming in the next century unless the rate of increase can be slowed. (26) As a major consumer of fossil fuels, especially oil, transportation must be singled out as one of the major contributors to global CO_2 emissions, as well as some of the other gases, e.g. ozone, which play a role in global warming.

Some evidence indicates that carbon monoxide may indirectly contribute to global warming. As pointed out by Dr. Gordon MacDonald at a recent World Resources Institute Symposium, "Carbon monoxide could thus be indirectly responsible for increasing greenhouse warming by 20 percent to 40 percent through raising the levels of methane and ozone...Carbon monoxide participates in the formation of ozone, and also in the destruction of hydroxyl radicals, which are principal sinks for ozone and methane greenhouse gases. Because carbon monoxide reacts rapidly with hydroxyl, increased levels of carbon monoxide will lead to higher regional concentrations of ozone and methane. Measures to reduce carbon monoxide emissions will assist in controlling greenhouse warming." (27)

Further, the class of compounds known as chlorofluorocarbons (CFC's) are increasingly implicated in depleting the stratospheric ozone. Almost 40 percent of the CFC-12 produced in the United States goes for charging and servicing motor vehicle air conditioning systems. (28) Other CFC's are used in vehicle seat cushions and padding and in producing electronic components.

Extensive and severe heat waves throughout the Northern Hemisphere in recent years suggest that we may already be experiencing the effects of global warming. (29, 30)

SUMMARY

In order to protect public health and the environment greater control of HC, CO, NOx and particulate emissions from motor vehicles and other sources is necessary. In addition, global warming is increasingly recognized as a genuine and serious problem; to address this will require lower CO_2 emissions as well.

CARBON DIOXIDE CONCENTRATIONS

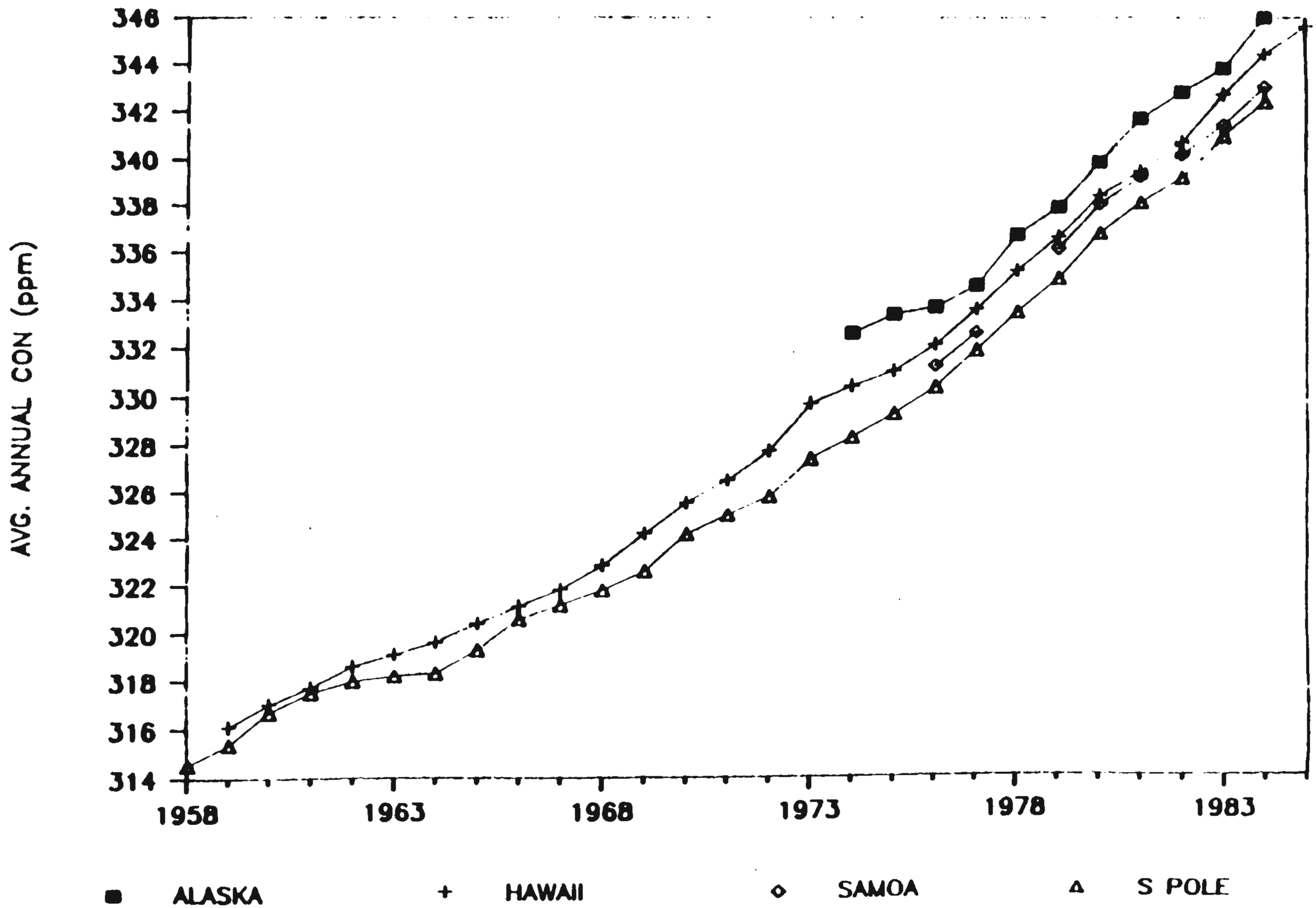

Figure 10

V. LEGISLATIVE EFFORTS TO REDUCE EMISSIONS

Because of the public health and environmental problems noted previously, legislation has been introduced in the Congress to lower emissions from both gasoline and diesel powered vehicles. The most aggressive set of proposals are contained in the Senate Bill (S.1894) introduced by Senator Mitchell and adopted by the full Senate Environment and Public Works Committee late last year. The standards contained in this bill are summarized in Table A. Many vehicles already achieve these levels; for most others, either EPA or the California Air Resources Board have adopted the requirements after finding that they are technologically feasible. In a few cases, while not adopted by either EPA or CARB, one or the other or both agencies have found them to be feasible.

VI. DISCUSSION OF FEASIBILITY OF STRICTER CONTROLS

A. PASSENGER CARS - LDV

Passenger car and light truck control to the degree recommended in the proposed legislation -- 0.25 HC, 0.40 NOx, while retaining 3.4 CO -- is actually being achieved by many individual vehicles today in Certification. This is illustrated by analysis of 1987 certification data which shows that the average gasoline fueled car emits only about 0.2 gpm HC, 1.91 CO and 0.37 NOx, compared to standards of 0.41, 3.4 and 1.0, respectively. Approximately half the vehicles certified for 1987 already meet the standards in the House and Senate bills.

Based in part on these data and the critical need for more NOx control, the California Air Resources Board in 1986 determined that 0.4 g/m NOx for passenger cars was necessary and feasible and cost effective. It adopted this standard, to be phased in starting in 1989 and estimated the costs to be about $25 to $30 per vehicle.

California has also testified before the Senate Environment Committee that 0.25 g/m is feasible and cost effective for HC. They estimated a total cost per vehicle of approximately $25 per vehicle and an overall cost effectiveness of about 80 cents per pound (or about $1600 per ton) for this control.

B. LIGHT TRUCKS UP TO 8500 LBS. - LDT

Light trucks are in most characteristics very similar if not identical to cars, usually equipped with identical engines and drive trains, etc., and are usually driven in much the same fashion; therefore, they should be able to apply the same technology. The lighter category of these trucks (those under 6000 lbs.) should be able to achieve the same emissions levels as those achieved by cars. Heavier light trucks between 6000 and 8500 lbs. GVW should have no difficulty achieving the standards in the legislative proposals which are adjusted to compensate for their additional weight.

C. LIGHT DUTY DIESEL PARTICULATE

The State of California has adopted a standard of 0.08 grams per mile to go into effect in 1989, one year earlier than required by this bill. When EPA first adopted the 0.2 gram per mile particulate standard in 1980, it expected that most vehicles would require the use of particulate trap oxidizers to meet the standard. Engine controls have exceeded EPA's expectations (as well as the levels the auto industry testified to EPA it could achieve), indicating once again how well auto industry engineers are able to respond when faced with a difficult challenge. However, trap technology has also been coming along (as indicated by the first generation Mercedes systems). It is important to note that further progress is needed for these traps, however.

D. HEAVY DUTY TRUCKS

Many medium trucks (8500-14,000 lbs. GVW) are still gasoline fueled and these will need to be equipped with oxidation catalysts to achieve EPA's current HC and CO standards. It is possible to further lower the NOx standard to 1.7 grams per brake horsepower hour for this class of vehicles. Adoption of a 1.7 NOx standard will require the use of the already proven three way catalyst technology to these engines instead of oxidation catalysts. As noted by EPA in 1981, "It is the staffs judgement that achievement of the full 75 percent reduction, i.e., a reduction to the level of the 1.01 g/BHP-hr emission target level, is technologically feasible through the application of three way catalyst technology...Additional NOx control, if necessary, could also be provided by EGR." (see page 59 of EPA's 1981 Regulatory Analysis,)

The diesel truck NOx standard can also be reduced below the current requirements. Some trucks are already certifying below 4 grams per brake horsepower hour (g/BHP-hr), the proposed 1991 standard, and with the use of methanol, levels close to 2 g/BHP-hr have already been demonstrated.

The Senate bill would codify the 1991 and 1994 heavy duty vehicle particulate standards already adopted by EPA.

E. INDUSTRY RESPONSE

Manufacturers have raised two principal problems regarding the feasibility of the standards - the trade off between NOx and CO control, and the difficulty of achieving standards in use.

With regard to the CO versus NOx trade off, the manufacturers argue that while California vehicles achieve very low NOx levels, this is because the California CO standard is 7.0 rather than the federal standard of 3.4.

The data do not support the manufacturers conclusion. For example, a regression analysis was carried out to determine the potential correlation between CO and NOx emission rates. The results show that no conflict exists between controlling the two pollutants; in fact, the data suggest that the technologies used to achieve lower NOx should also lead to slightly lower CO. An independent analysis carried out by the CARB tends to reach the same conclusion. CARB found that 109 out of 120 engine families that had certification levels below 0.4 NOx in California also had CO levels below 3.4 CO.

A regression analysis of each of the gaseous pollutants versus vehicle test weight indicates that there is very little linkage between emissions and weight.

The second auto industry argument is that even if they could certify vehicles to these low levels, the standards are not achievable in use, especially with a 100,000 mile useful life requirement. While recognizing that low certification levels are far from a guarantee of equally low in use performance, they do establish the fundamental capability of a design. To achieve good in use performance, this design must be carefully translated to large numbers of vehicles on the assembly lines using high quality components. Greater quality control efforts which no doubt would result from the tighter assembly line compliance requirements as contained in the legislation should help in this regard. In addition, lower trace lead levels in unleaded gasoline and more advanced emissions control components, particularly more durable catalysts, better air fuel management systems, and electronics should also help. As recently noted in a letter to Senator Chafee by the CARB, "the technology, which manufacturers are expected to utilize for lowering NMHC (non methane hydrocarbons) emissions, includes more durable and efficient close coupled catalytic converters. These single bed converters are located in, or close to, the engine exhaust manifold and "light off" quickly to very effectively lower cold start HC [and CO] emissions." In other words, the advanced technology fostered by the tighter standards contained in the Senate and House bills should make it easier to achieve low in use emission levels.

VII. INSPECTION AND MAINTENANCE

As noted previously, a key element of both the House and Senate proposals is enhanced and expanded Inspection and Maintenance (I/M) programs. This is important because these programs are intended to detect and bring about the repair of vehicles with excessive emissions levels. (31,32) They help to maximize the benefits the public realizes from the emission controls installed on their vehicles by encouraging proper vehicle maintenance. I/M has been required as a part of the State Implementation Plans (SIPs) pursuant to Sections 110 and 172 of the Clean Air Act for those states unable to achieve compliance with the CO or ozone air quality standards by the end of 1982.

Inspection and maintenance has a prominent role in many of the most important components of the United States Motor Control Program. To the extent that I/M identifies, relatively rapidly, vehicles which may be out of compliance this information can be fed back to the Recall and Assembly Line Test programs thereby allowing the EPA to focus investigations and test orders on the most appropriate vehicles. I/M is key to the Warranty program by which individuals can identify equipment defects and it is a requisite for the Warranty against performance defects which are detected by a federally prescribed short inspection test. It is also the major ingredient in the anti-tampering, anti-misfueling effort, as the threat of inspection failure is considered a strong deterrent to tampering and misfueling. For example, within the same geographic region, without I/M, 14 percent of all passenger cars have been subjected to fuel switching (using leaded gasoline in cars which are equipped with catalysts, thereby reducing their effectiveness); this drops to 10 percent with I/M, and 6 percent with I/M and anti tampering checks. Without I/M, therefore, it seems clear that all elements of the in use emissions performance of vehicles are significantly weakened. Overall emissions reductions of approximately 25 percent of mobile source HC and CO emissions are feasible through implementation of I/M; recent indications are that significant NOx and diesel particulate reductions are also possible but such improvements have not yet been demonstrated in actual operating programs.

While most I/M programs in effect in the United States have been adopted in response to Federal requirements, they differ significantly in terms of implementation details. This is because EPA, in specifying the program requirements, recognized the wide variety of local conditions (e.g., labor and land costs, local - state interrelationships, existence of or lack of a safety inspection program, etc.). In this environment, three main mechanisms for implementing I/M programs have evolved. First is the so-called private garage system in which the inspection is conducted by a local gas station or repair facility which is licensed for this purpose by the government after meeting certain requirements. The most successful of these types of programs include sealed, computerized analyzers which provide increased confidence to all concerned that the inspection test is run correctly and objectively. Alternatively, state operated lanes have been installed solely to conduct inspections (often including safety as well as emissions). Finally, to avoid the expense to the state associated with building centralized facilities, private contractors can be hired to build and operate such a system at no capital cost to the government; the complete expense is paid for over time by fees charged to owners of inspected vehicles. Administrative costs for the government can also be provided by these fees.

Recently EPA has audited some of these programs to see which are working best and which are falling short of their potential. While many programs are working very well, it is clear that many programs need to be improved. The major problems are related to low failure rates (substantially fewer vehicles failing the program than anticipated based upon the test standards adopted) in decentralized I/M programs with manual analyzers. Two of the major problems are poor instrument quality control and the abuse of repair cost limits which allow repairs to be waived if the cost of repairing these vehicles is estimated to be greater than a predetermined value. The proposed legislation will help to solve these problems by requiring computerized, better quality analyzers and raising the cut off for repair cost waivers. Better enforcement, especially with sticker based programs, and a lack of commitment in some cases to try to maximize program effectiveness are also problems.

VIII. POTENTIAL EMISSIONS IMPACT OF THE LEGISLATION

Figures 11 through 16 show that significant nationwide emissions reductions per mile driven are possible based on the standards and extended durability contained in the legislative proposals compared to current levels. For example, Figure 11 shows that even without inspection and maintenance programs, in use auto HC emissions can be reduced from 1.05 to 0.71 grams per mile, a 32 percent reduction. For light trucks, the reductions would be from 1.76 to 1.45 grams per mile, an 18 percent improvement. Including the enhanced I/M provisions in the proposed legislation compared to current requirements, the HC reductions increase to 47 percent and 43 percent for cars and light trucks, respectively. Figure 17 shows that for the country as a whole, HC exhaust emissions would be substantially improved with the more stringent standards and enhanced I/M.

Figures 18 through 23 indicate similar improvements would result for NOx, if more stringent standards were adopted. Per mile driven, auto NOx would drop from 1.41 grams to 0.66; for light trucks, the improvement would be from 2.23 to 1.31 grams. In percentage terms, the NOx reductions for cars and light trucks, respectively, would be 53 percent and 41 percent Including I/M, as with HC, the NOx levels are lowered and the percent improvement compared to today's requirements rises to 58 percent and 46 percent, for cars and light trucks respectively. Looking at the trends for the entire country, it can be observed as illustrated in Figure 24 that NOx emissions will likely get worse under the current program but could be substantially improved with adoption of the legislative package.

Beyond the NOx and HC emissions reductions, the technologies fostered by the tighter standards should also bring about reductions in CO emissions. As recently noted by the state of California Air Resources Board, "We expect that nearly all passenger cars will emit CO emissions at a rate approaching 3.4 grams per mile <u>in use</u> as a result of further NMHC (non methane hydrocarbon) control."

Focusing on a portion of the existing nonattainment areas across the country, an analysis was performed to estimate the potential impact of these legislated improvements on overall air quality.

AUTOMOBILE EMISSIONS IN USE

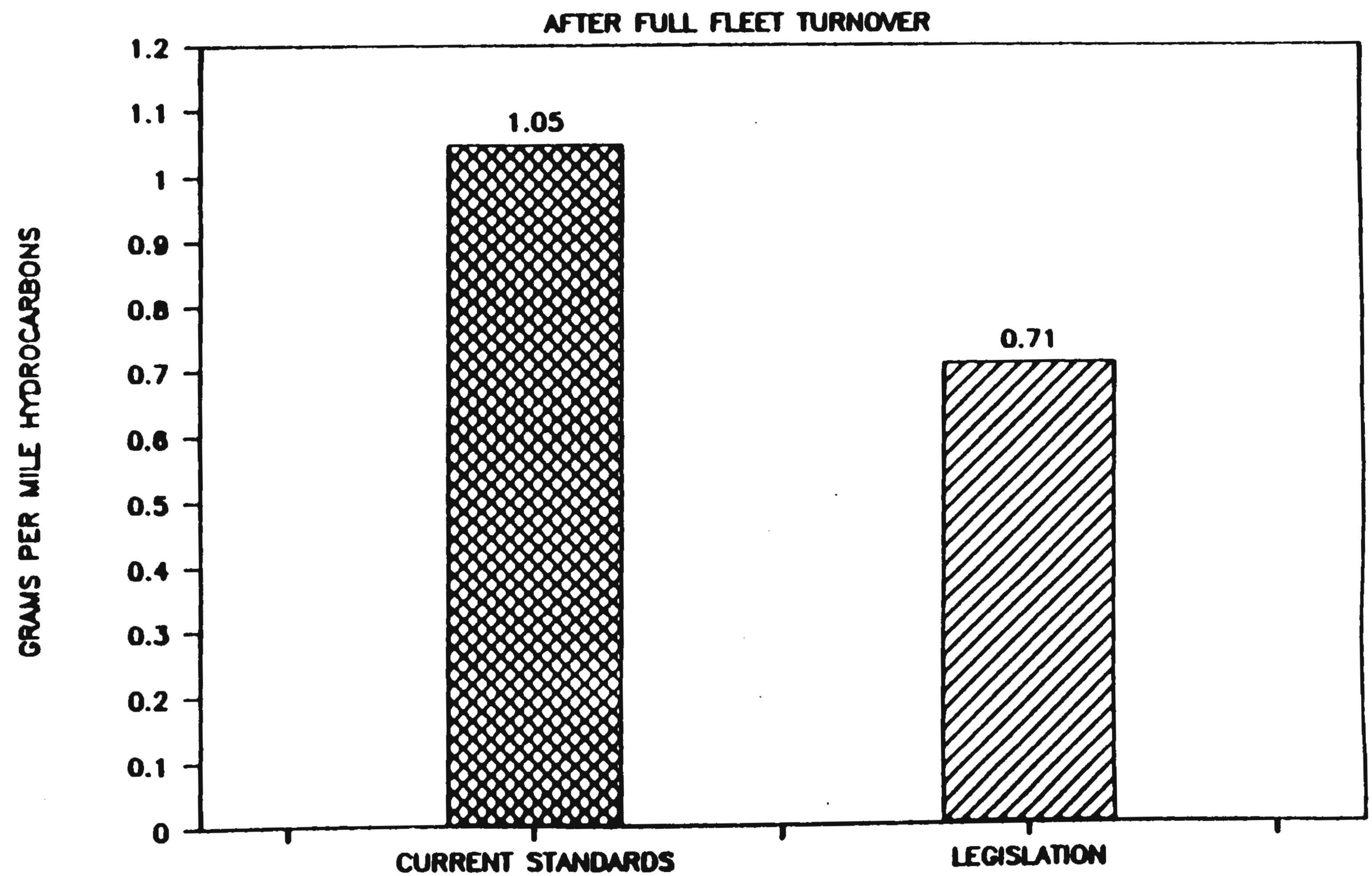

Figure 11

LIGHT TRUCK EMISSIONS IN USE

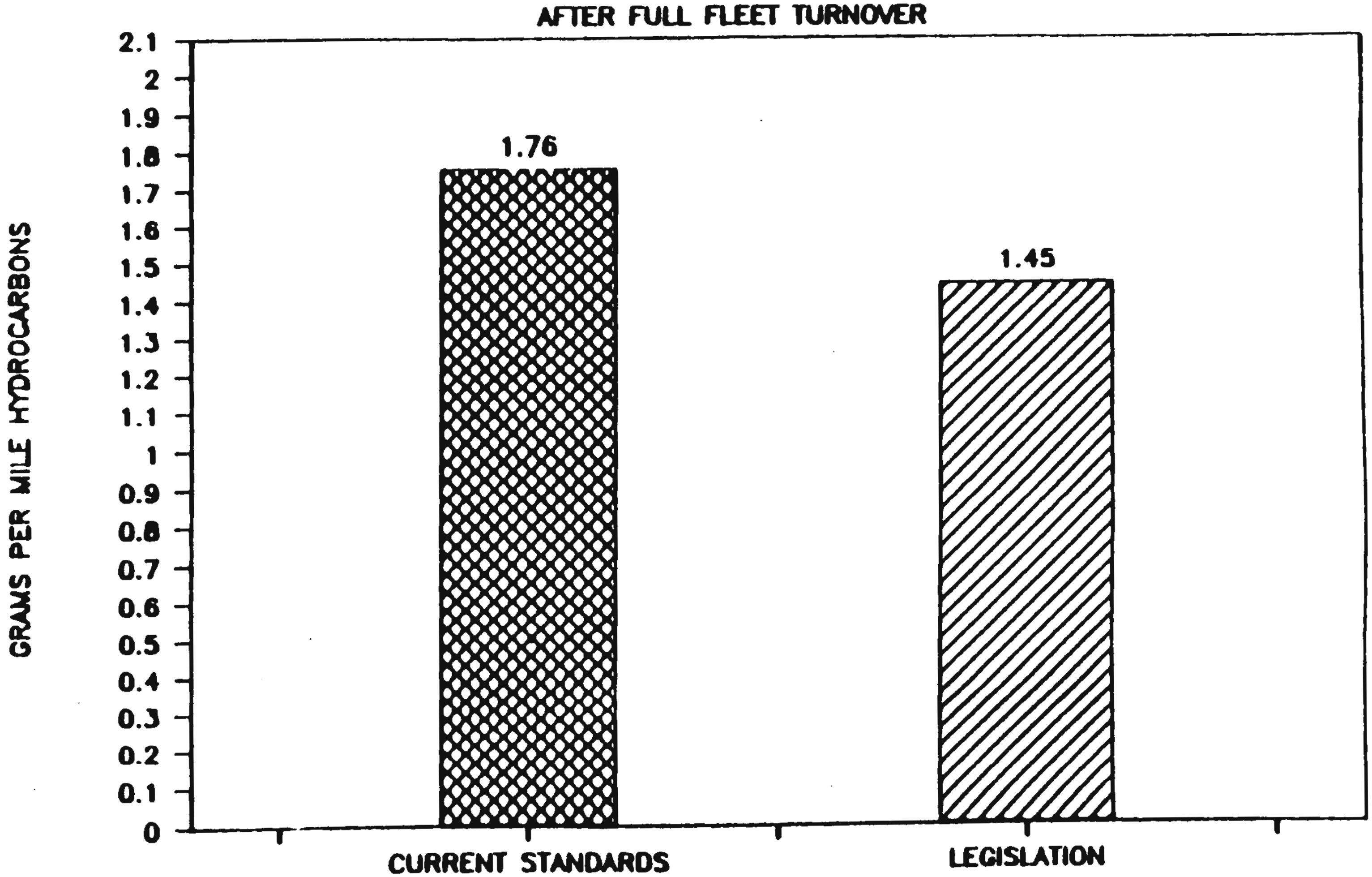

Figure 12

LEGISLATION REDUCTION BENEFITS

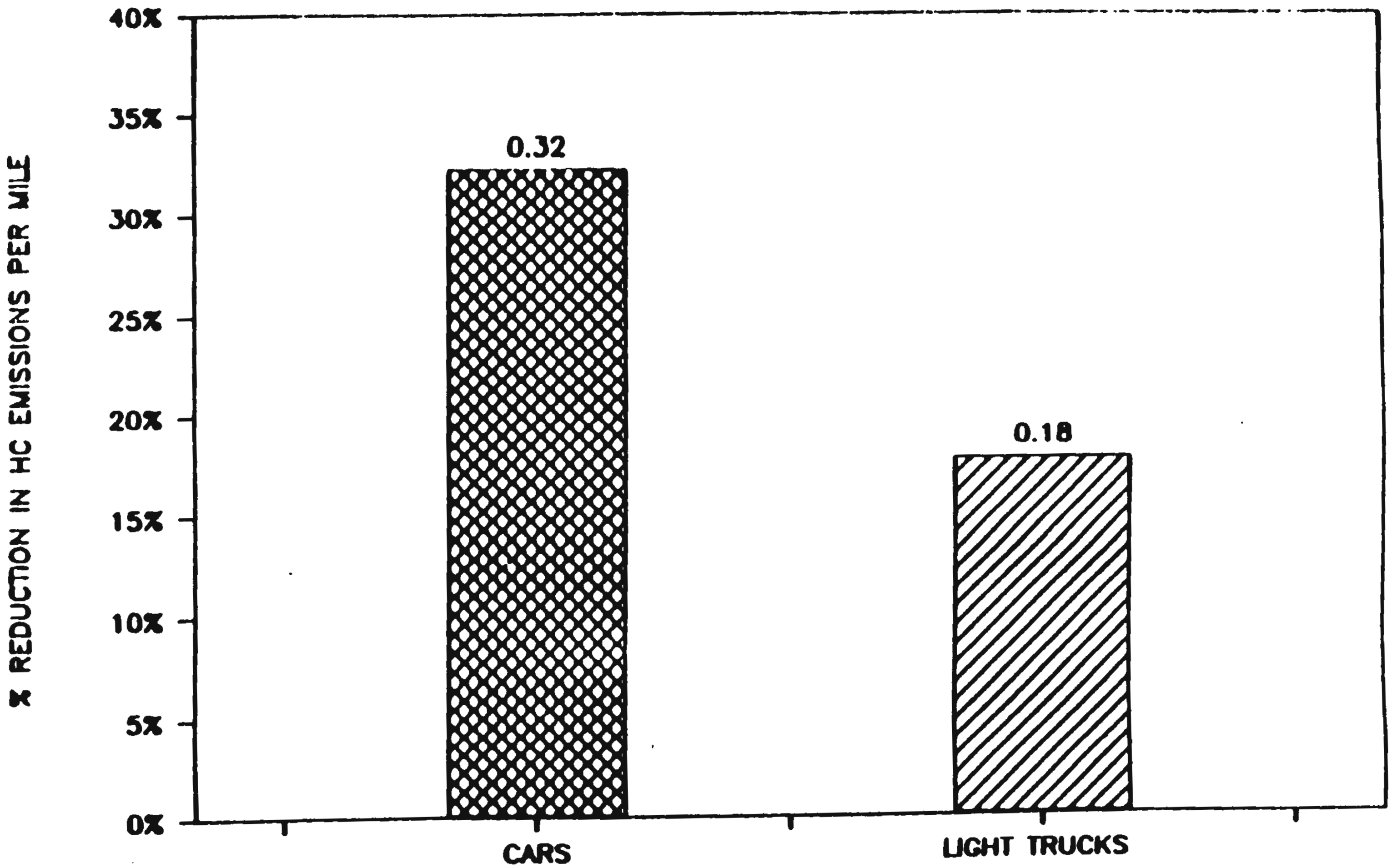

Figure 13

AUTOMOBILE EMISSIONS IN USE

WITH I/M, AFTER FULL FLEET TURNOVER

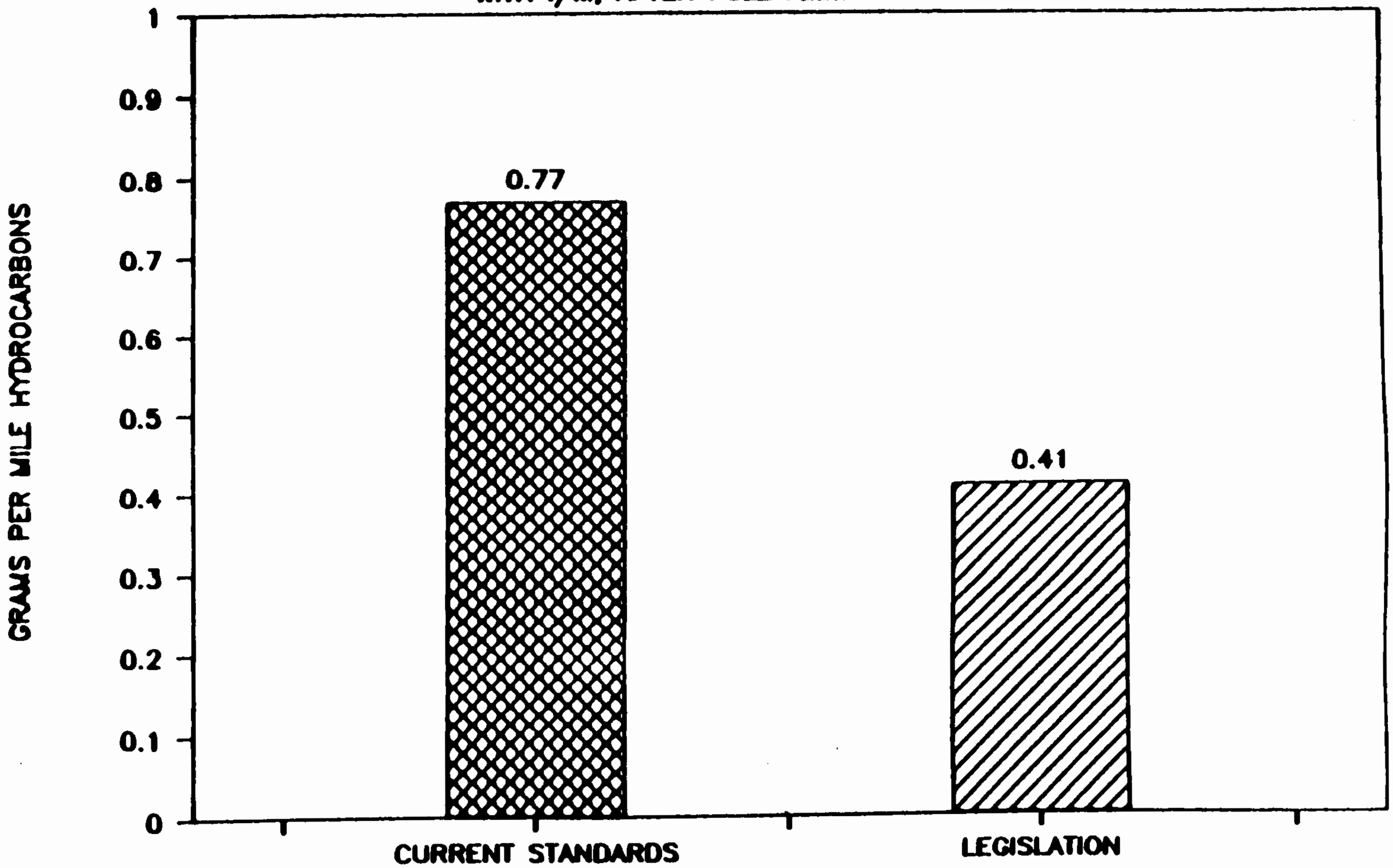

Figure 14

LIGHT TRUCK EMISSIONS IN USE

WITH I/M, AFTER FULL FLEET TURNOVER

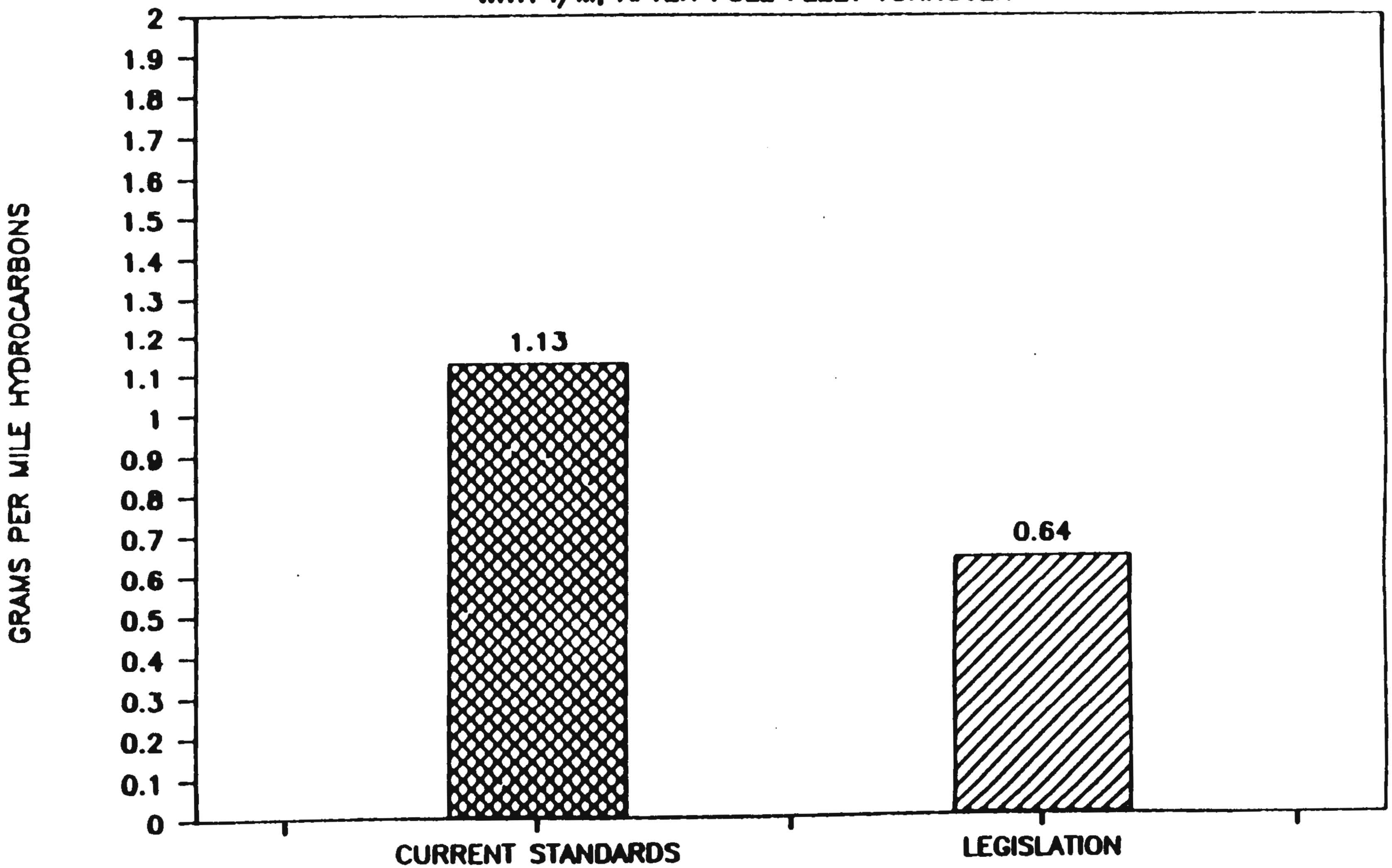

Figure 15