United States
Environmental Protection
Agency

Office of General Enforcement
Washington DC 20460

EPA-340/1-81-001a
February 1981

Stationary Source Enforcement Series

Emission Reduction Study Stationary Sources of Air Pollution (1970-1979)

Final Report

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Final Report

by

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Contract No. 68-01-4141

EPA Project Officer: Robert Marshall

Task No. 35

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of General Enforcement
Division of Stationary Source Enforcement
Washington, DC 20460

February 1981

FOREWORD

This research was performed for the Division of Stationary Source Enforcement (DSSE), U.S. Environmental Protection Agency (EPA), under task order no. 35, contract no. 68-01-4141. Mr. Robert Marshall, DSSE, was the EPA Task Manager. His suggestions and comments during the research were most helpful.

This research documents the progress private business, state, and Federal agencies have made towards meeting the primary ambient air quality standards for criteria air pollutants. These pollutants must be reduced to acceptable levels to ensure reasonably healthy atmospheric conditions.

EMISSION REDUCTION STUDY: STATIONARY SOURCES
OF AIR POLLUTION (1970-1979)

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF TABLES

I. INTRODUCTION

A. Background

Under the Clean Air Act amendments of 1970, the States and the U.S. Environmental Protection Agency (EPA) are charged with the responsibility of reducing the quantity of pollutants in the ambient air to levels adequate to protect public health and welfare. EPA has identified seven pollutants deemed harmful to health and welfare in certain concentrations: total suspended particulates, sulfur oxides, nitrogen oxides, carbon monoxide, photochemical oxidants, hydrocarbons, and lead. National Ambient Air Quality Standards (NAAQS) were established for the first six as levels to be attained and maintained. The lead standard has recently been promulgated. No regulations currently exist.

Under the Clean Air Act amendments of 1977, the States and EPA were charged with the responsibility of revising State Implementation Plans (SIPs) to ensure maintenance of the NAAQS once attained.

B. Scope

This report summarizes the results of 10 years of local, state, Federal, and industry efforts to reduce the amount of particulates, sulfur oxides, nitrogen oxides, and ozone being emitted to the atmosphere by stationary sources. In addition, because the control of ozone and hydrocarbons is simultaneously achieved by removal of volatile organic compounds (VOCs), VOC control is emphasized. However, carbon monoxide is not included in this study because of the small contribution by stationary sources (less than 20 percent).

Data developed in previous studies [1,2], modified and updated, are used as partial bases for analysis of particulates and sulfur oxides emissions. Similar data are developed for nitrogen oxides and VOCs. Modifications to and updates

of previous data include consideration of changes in State Implementation Plan (SIP) requirements prepared or promulgated by the States and EPA, as well as a more detailed analysis, where feasible. For VOCs, the impact of reasonably available control technology (RACT)--as described in the applicable Control Technique Guideline (CTG) document--is also considered.

With some exceptions, source categories included in this study are those accounting for at least 1 percent of all emissions. The current EPA Office of Air Quality Planning and Standards (OAQPS) data file [3] is the basis for selection. Stationary source categories accounting for at least 1 percent of actual emissions are shown in Tables I through IV. Listings of all source categories by pollutant are presented in Appendix A. The following source categories, accounting for at least 1 percent of all emissions, were excluded for the reasons indicated:

Particulate matter

Stone and rock processors
Grain elevators and mills
With few exceptions, state or local emission limitations for these source categories are expressed qualitatively.

Coal mines
Brick and tile plants
Not specifically covered in state or local regulations. Activity data were not available to permit estimates under the general process rate limitations.

Oil-fired electric utility boilers
Uncontrolled emissions estimated using AP42 emission factors are less than compliance emissions.

Sulfur oxides

Residential coal, oil, and gas furnaces
Considered to be an area source.

Nitrogen oxides

Residential coal, oil, and gas furnaces
Considered to be an area source.

Petroleum refineries

Not subject to limitations in practically all state and local regulations.

VOCs

Organic solvents
Includes a large number of small sources.

On site solid waste incineration
Considered to be an area source.

Throughout this study, emissions are referred to as "uncontrolled," "actual," and "compliance." These terms are defined as follows:

- Uncontrolled emissions: Those emissions that would occur if there were not Federally enforceable emission limitations.
- Actual emissions: Those emissions resulting from the use of emission control systems to meet Federally enforceable emission limitations.
- Compliance emissions: Those emissions estimated to result when all sources are in full compliance with Federally enforceable applicable emission limitations.

In some source categories, 1979 uncontrolled emissions are less than those existing in 1970 because of decreased activity. This difference is considered in the analyses. It should also be noted that compliance emissions are based on 1979 data, when they are available, or on 1978 data projected to 1979 on the basis of growth in gross national product (GNP) from 1978 to 1979. Compliance emissions for subsequent years may be different, depending on changes in industrial activity in the year of interest and/or compliance requirements.

C. Methodology

Estimates of nationwide reductions in emissions resulting from state, local, and Federal programs are made by comparing uncontrolled and actual emission estimates for 1979 with those for 1970. Similar estimates for 1975 are included to provide a rudimentary profile of emission estimates over the period 1970 through 1979.

Particulate matter and sulfur oxide uncontrolled and actual emissions data for 1970 and 1975 were obtained from two previous RTI studies [1,2]. The OAQPS Data File of Nationwide Emissions was the source of 1970 and 1975 data for nitrogen oxide and VOC emissions. Where available, compliance emissions data for 1975, based on 1979 emissions limitations, were used. For all other cases, 1975 compliance emissions were estimated assuming the same degree of control as required in 1979.

The following general model for making the 1979 emission estimates was used:

Emissions = Emission factor x Activity factor.

Uncontrolled, actual, and compliance emissions can be estimated with this model and the appropriate emission factor.

Wherever available data permitted, emission estimates were made on an individual plant basis. Industry-wide data were used wherever individual plant data were not available. The following source categories were analyzed on an individual plant basis with generalized emission factors applied to each process point.

- Coal-fired electric utility boilers
- Oil-fired electric utility boilers
- Gas-fired electric utility boilers
- Coal-fired industrial boilers
- Nonferrous smelters
- Petroleum refineries
- Iron and steel plants and coke ovens.

The following source categories were analyzed using plant sizes, expressed as number of employees, as listed in the Department of Commerce Census of Manufacturers.

- Surface coating, paper
- Surface coating, automobile and light-duty trucks
- Surface coating, miscellaneous metal parts and products
- Surface coating, wood furniture
- Plastic manufacturers
- Graphic arts
- Dry cleaning.

Cutback asphalt operations were analyzed state by state. All of these source categories were analyzed in the aggregate at the regional or national level.

Activity factors for individual analyses reflect actual fuel consumption for indirect heat sources and actual production for manufacturing facilities. Individual plant data were used when available. In other cases, national production data prorated to individual plants on the basis of percent of national capacity were used. The 1979 data were used when available; otherwise, 1978 data were projected to 1979 on the basis of data in the Department of Commerce's Survey of Current Businesses.

In the estimates of 1979 actual emissions, compliance emissions were occasionally larger than reported or estimated actual emissions. When this occurred, actual emissions were assumed to be the same as compliance emissions.

Uncontrolled sulfur oxide emissions for 1975 and 1979 were estimated with the 1970 average sulfur content of fuels. The use of low-sulfur fuels is a control option to meet sulfur oxide emission limitations. It was assumed that any switch to low-sulfur content fuels from 1970 to 1979 was the result of state, local, or Federal abatement programs.

D. Overall Results

Based on emission estimates made using the methodology described in Section C above, the following tabulations demonstrate the increase in

air pollution control of stationary sources since the enactment of the Clean Air Act. Even though the uncontrolled emission rate has increased significantly, increased degree of control has resulted in improved air quality--lower actual emissions.

Findings for specific source categories are presented in Chapter II.

PARTICULATE MATTER, STATIONARY SOURCES

Year	Uncontrolled emissions (10^3 tons)	Degree of control	Actual emissions (10^3 tons)
1970	88,516	68%	28,492
1975	101,181	82%	18,015
1979	118,684	89%	13,546
Compliance	-	93%	8,079

SULFUR OXIDES, STATIONARY SOURCES

Year	Uncontrolled emissions (10^3 tons)	Degree of control	Actual emissions (10^3 tons)
1970	38,885	14%	33,569
1975	44,552	28%	32,083
1979	47,592	32%	32,345
Compliance	-	41%	28,148

NITROGEN OXIDES, STATIONARY SOURCES

Year	Uncontrolled emissions (10^3 tons)	Degree of control	Actual emissions (10^3 tons)
1970	13,090	0%	13,090
1975	13,600	0%	13,600
1979	16,360	9%	14,825
Compliance	-	13%	14,221

VOLATILE ORGANIC COMPOUNDS, STATIONARY SOURCES

Year	Uncontrolled emissions (10^3 tons)	Degree of control	Actual emissions (10^3 tons)
1970	18,260	6%	17,160
1975	17,213	8%	15,900
1979	24,269	21%	19,145
Compliance	-	31%	16,687

E. Limitations

The emission estimates that follow in Chapter II are useful in providing a measurement of progress toward attainment and maintenance of the NAAQS. They are also useful in assessing the impact of pollution control programs on the reduction of emissions in specific key industry groups and in identifying those industry groups where relatively less progress has been made toward meeting full compliance. Although a national summary of this type is valuable as an overall indicator of nationwide progress, the nature of the results do NOT lend themselves to direct application to a specific facility or local geographic area.

The compliance emission estimates are based on estimated 1979 activity. Projection of these estimates to some future year should consider changes in industrial activity and changes that may occur in emission limitations prescribed in state, local, or Federal regulations.

Conclusions drawn from the comparison of 1979 emission data with those for 1970 or 1975 must be made considering the different procedures used in estimating emissions. This difference is particularly important for those source categories for which 1979 estimates are based on industrial plant activity while estimates for 1970 and 1975 are based on nationally aggregated activity.

Fugitive particulate matter emissions from roads and other nonprocess sources are not included for any of the selected source categories. Process fugitive particulate matter emissions are included in those source categories for which emission factors are published in AP42. Fugitive emissions from processes indicated are included in the estimates for the following source categories.

Integrated iron and steel plants: storage piles and material handling.

Nonferrous smelters: crushing, materials handling, and process operations. Process fugitive emissions factors for lead and zinc smelters were estimated by using copper smelter fugitive emissions factors as a base.

Fugitive process emissions for other source categories and fugitive emissions from roads and other nonprocess sources are included in the totals to the extent that they are included in the nationwide inventory maintained in the OAQPS data file.

TABLE I. STATIONARY SOURCE CATEGORIES ACCOUNTING FOR 1 PERCENT OR MORE OF 1978 ACTUAL PARTICULATE EMISSIONS

Source category	Percent of total actual emissions
Coal-fired steam electric power plants	19.1
Stone and rock processors	10.9
Portland cement plants	6.3
Coal-fired industrial boilers	5.6
Iron and steel mills and coke plants[a]	6.7
Grain elevators and mills	5.5
Forest fires and prescribed burning	4.2
Solid waste disposal[b]	3.5
Brick and tile plants	2.9
Primary copper smelters	2.6
Kraft pulp and paper mills	1.8
Coal mines	1.4
Lime plants	1.2
Asphalt batching plants	1.2
Grey iron foundries	1.1
Oil-fired electric steam-electric power plants	1.1

[a]Coke ovens account for 1.2 and 0.2 percent of actual and uncontrolled emissions, respectively.
[b]Except municipal incinerators.

TABLE II. STATIONARY SOURCE CATEGORIES ACCOUNTING FOR 1 PERCENT OR MORE OF 1978 ACTUAL SULFUR OXIDE EMISSIONS

Source category	Percent of total actual emissions
Coal-fired steam electric power plants	58.7
Primary smelters	7.1
Coal-fired industrial boilers	7.0
Oil-fired steam electric power plants	6.2
Oil-fired industrial boilers	4.0
Oil-fired commercial/institutional boilers	3.3
Refineries	2.6
Portland cement plants	2.5
Sulfur recovery plants[a]	1.6
Residential coal, oil, and gas furnaces	1.3

[a]Used to purify sour natural gas or coke oven gas, and in petroleum refineries. Emissions have been distributed among these industries.

TABLE III. STATIONARY SOURCE CATEGORIES ACCOUNTING FOR 1 PERCENT OR MORE OF 1978 ACTUAL NITROGEN OXIDE EMISSIONS

Source category	Percent of total actual emissions
Coal-fired steam electric power plants	21.9
Gas pipelines and plants	13.1
Oil-fired steam electric power plants	5.2
Gas-fired steam electric power plants	3.7
Coal-fired industrial boilers	2.6
Gas-fired industrial boilers	2.4
Petroleum refineries	1.7
Residential, coal, oil, and gas furnaces	1.4
Oil-fired industrial boilers	1.3
Oil-fired commercial/institutional furnaces	1.1

TABLE IV. STATIONARY SOURCE CATEGORIES ACCOUNTING FOR 1 PERCENT OR MORE OF 1978 ACTUAL VOC EMISSIONS

Source category	Percent of total actual emissions
Organic solvent[a]	11.1
Refineries	4.9
Bulk gasoline terminals	2.7
Cutback asphalt plants	2.2
Forest fires and prescribed fires	2.1
Degreasers	1.9
Service stations, Stage 1	1.8
Service stations, Stage 2	1.7
Surface coating plants, paper	1.6
Solid waste, open burning	1.3
Graphic arts facilities	1.3
Plastic plants	1.2
Surface coating plants, automobiles	1.2
Dry cleaning plants	1.2
Solid waste, onsite incineration	1.1
Architectural coating	1.1
Surface coating plants, wood furniture	1.0
Surface coating plants, miscellaneous metal products	1.0

[a]Miscellaneous solvent losses estimated by subtracting solvent consumption in individual source categories from total national consumption. These solvent losses are from a large number of small sources and are probably uncontrollable.

II. FINDINGS

The results of this study are presented in four sections: Section A, Particulate Matter Results for the Nation; Section B, Sulfur Oxide Results for the Nation; Section C, Nitrogen Oxide Results for the Nation; and Section D, VOC Results for the Nation.

A. Particulate Results for the Nation

Estimated uncontrolled and actual particulate emissions for 1970, 1975, and 1979 and compliance emissions for 1975 and 1979, based on activity in those years, for attainment of ambient air quality standards are shown in Tables V and VI. Data for stationary sources, only, are shown graphically in Figure 1. Stationary sources accounted for 89 percent of particulate matter emissions in 1979.

Between 1970 and 1979, uncontrolled emissions from stationary sources increased by 34 percent, from 88.5 million tons per year (tpy) to 118.7 million tpy, as a result of growth during the period. This growth made an absolute reduction in emissions more difficult. The 52 percent actual emission reduction in stationary sources achieved (to 13.5 million tons in 1979 from 28.5 million tons in 1970) was possible because abatement programs increased the overall degree of control from 68 percent in 1970 to 89 percent in 1979.

State Implementation Plans (SIPs) were designed to achieve ambient air quality standards by controlling emissions from stationary sources to a level of 8.1 million tpy, based on an estimated 1979 uncontrolled emission level of 118.7 million tons. This is equivalent to an overall degree of control of 93 percent. Emission reductions through 1979 represent 96 percent of the compliance objective for the 10 selected source categories listed in Table V

and 95 percent of the compliance objective for emissions from all stationary sources.

Examination of Table VI shows that the industries requiring the greatest degree of additional control for particulates, in terms of absolute emission reductions, to meet full compliance requirements are integrated iron and steel mills and coke plants, portland cement plants, and coal-fired industrial boilers. Estimated uncontrolled and actual particulate emissions for 1970, 1975, and 1979 and compliance emissions, based on 1979 activity, for each of the 10 selected source categories listed in Table V are shown in Figures 2 through 11.

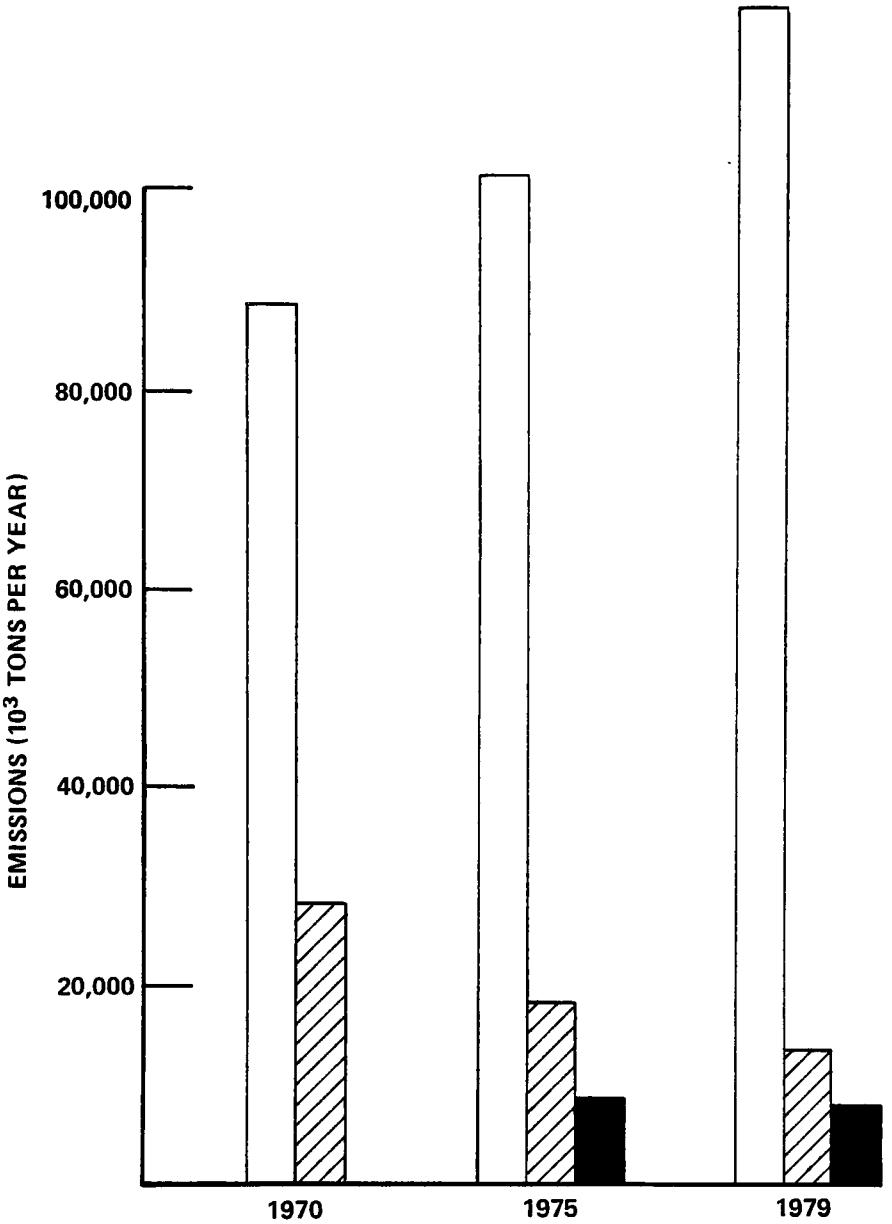
TABLE V. SUMMARY OF NATIONWIDE PARTICULATE MATTER EMISSION ESTIMATES

Source category	Emissions (10^3 tons)							
	1970		1975			1979		
	Uncontrolled	Actual	Uncontrolled	Actual	Compliance	Uncontrolled	Actual	Compliance
Coal-fired electric utility boilers	34,533	4,188	49,352	3,760	758	50,595	966	869
Coal-fired industrial boilers	4,391	2,435	3,817	1,179	323	4,355	831	260
Integrated iron and steel plants and coke ovens[h]	5,733	4,775	5,076	3,768	1,951	5,716	3,388	2,198
Portland cement plants	10,643	906	9,604	365	89	10,572	981	98
Primary nonferrous smelters[a]	602	46	549	33	14	722	142	19
Solid waste disposal plants	469	367	406	233	75	303	196	56
Kraft pulp and paper mills	3,133	288	3,789	146	112	4,096	297	121
Asphalt batching plants	6,998	490	7,089	213	120	8,181	164	138
Lime plants	2,263	1,154	2,198	220	23	2,401	168	25
Grey iron foundries	1,326	156	899	62	46	1,215	134	12
Subtotal for selected source categories	70,091	14,805	82,779	9,979	3,511	88,156	7,267	3,796
Stationary sources[f]	88,516	28,492	101,181	18,015	8,314	118,684	13,546	8,079
Mobile source[e]	1,437	1,437	1,484	1,484	1,484[g]	1,676	1,676	1,676[g]
All sources	89,953[b]	29,929[b]	102,655[b]	19,499[b]	9,798[c]	120,360[c]	15,222[c]	9,755[d]

[a] 1979 estimates include fugitive process emissions and emissions from ore crushing and materials handling.
[b] Reference 1, adjusted for revised iron and steel emission factors.
[c] Reference 3 data adjusted for revised iron and steel emission factors projected to 1979 on basis of GNP growth [9].
[d] Estimated from data in Reference 1 projected to 1979 on basis of GNP growth [9].
[e] Estimated from data in References 10 and 11.
[f] By difference between all sources and mobile sources.
[g] Detailed data not available. Actual emissions in OAQPS data file assumed also to be compliance emissions.
[h] Includes emissions from materials handling and storage piles.

TABLE VI. PROGRESS TOWARD COMPLIANCE FOR PARTICULATE MATTER

Source category	Percent of total 1979 actual stationary source emissions	Average percent control in 1979	Percent of compliance objective	Total reduction remaining	
				(10^3 tons)	(percent)
Coal-fired electric utility boilers	7	98	99	97	1
Coal-fired industrial boilers	6	81	86	571	14
Integrated iron and steel mills, and coke ovens	25	59	66	1,190	34
Portland cement plants	7	91	92	883	8
Primary nonferrous smelters	1	80	83	123	17
Solid waste disposal plants	1	35	43	140	57
Kraft pulp and paper mills	2	93	96	176	4
Asphalt batching plants	1	98	99	26	1
Lime plants	1	93	94	143	6
Grey iron foundries	1	89	90	122	10
Subtotal for selected source categories	54	91	96	3,471	4
All stationary sources	100	89	95	5,467	5



EMISSION SUMMARY

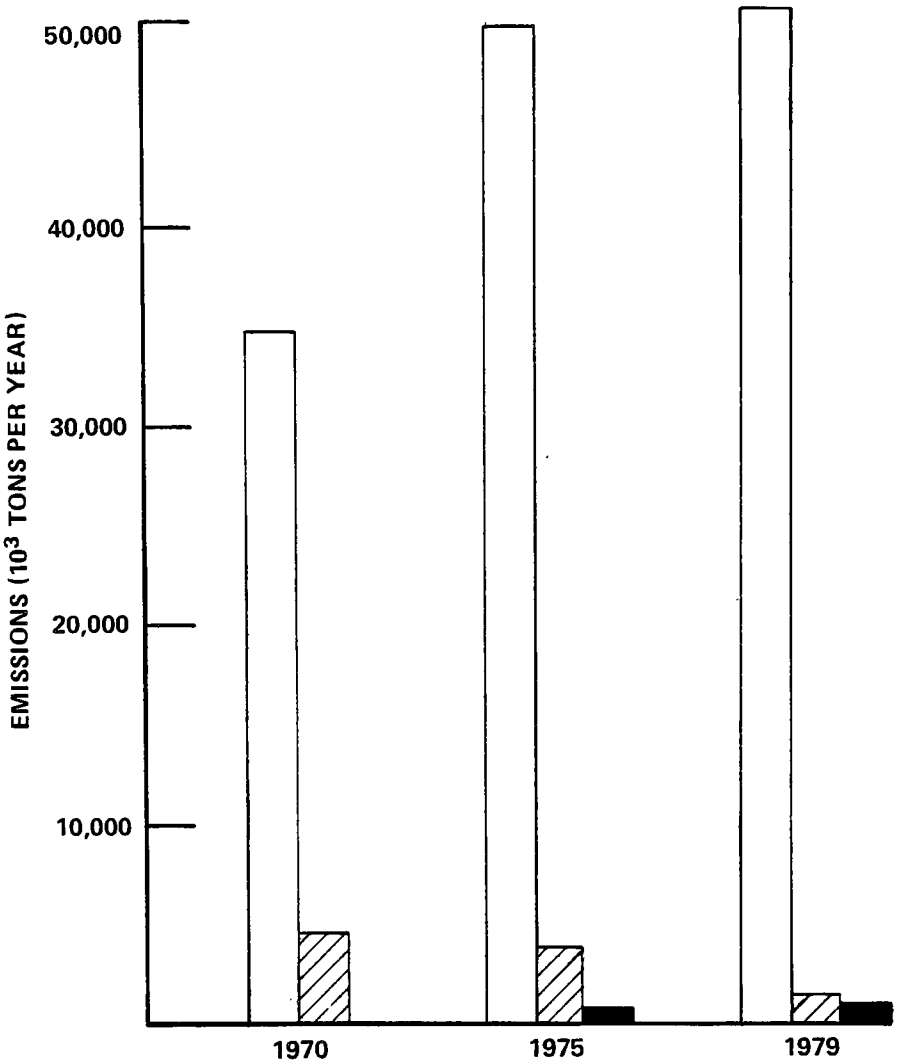
	Particulate Matter Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	88,516	101,181	118,684
Actual	28,492	18,015	13,546
Compliance		8,314	8,079

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 1. Nationwide Particulate Matter Emissions, Stationary Sources.



EMISSION SUMMARY

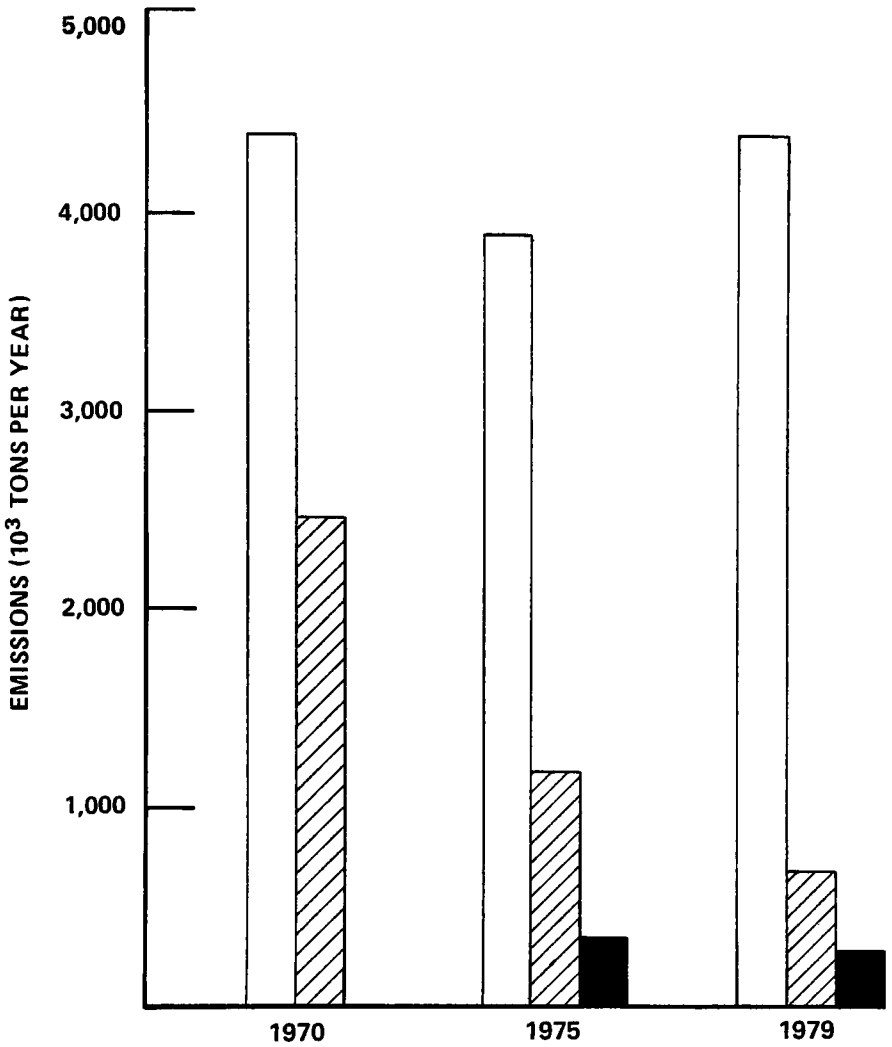
	Particulate Matter Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	34,533	49,352	50,595
Actual	4,188	3,760	966
Compliance		758	869

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 2. Coal-Fired Electric Utility Boilers, Particulate Matter Emissions.



EMISSION SUMMARY

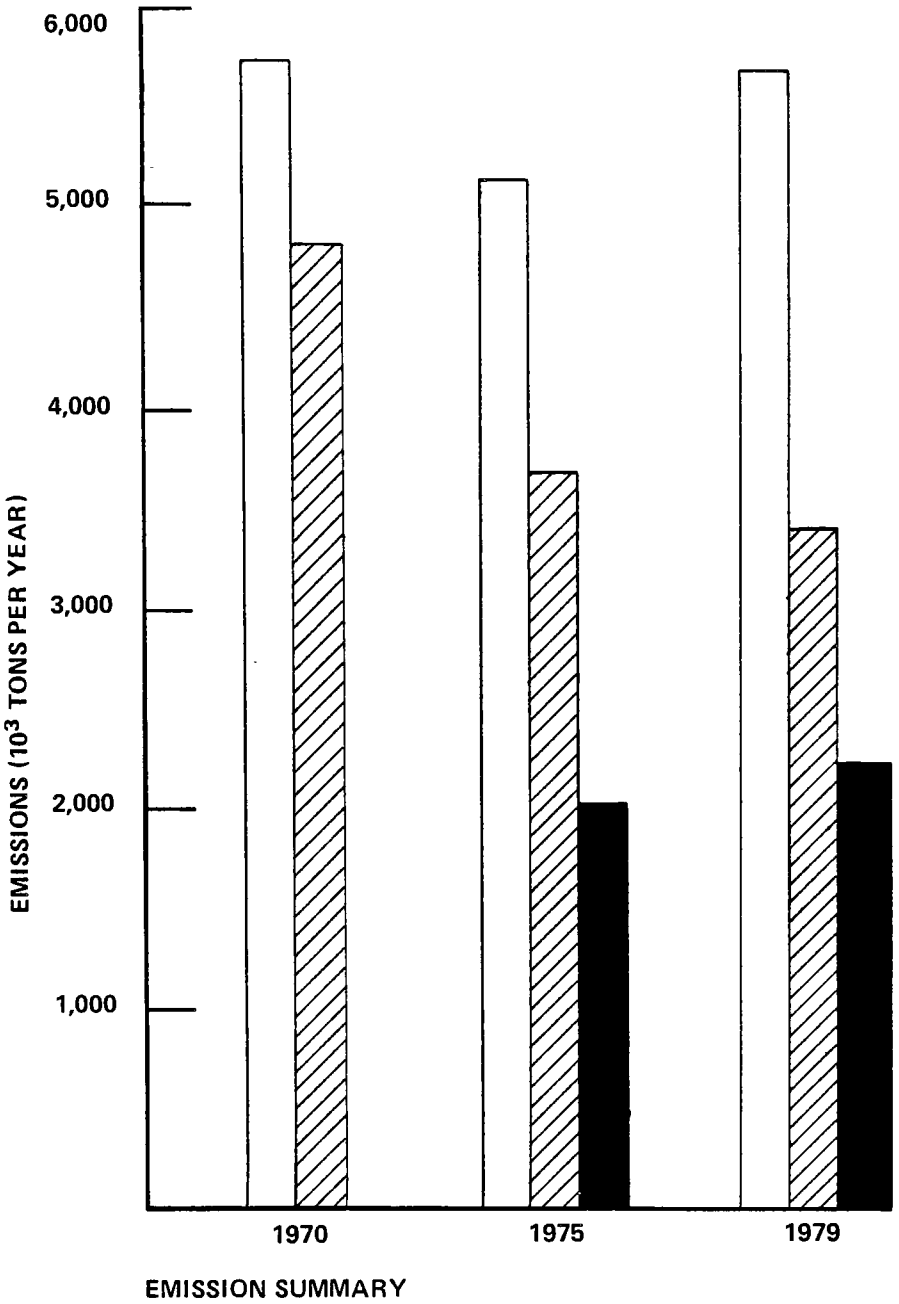
	Particulate Matter Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	4,391	3,817	4,355
Actual	2,435	1,179	831
Compliance		323	260

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 3. Coal-Fired Industrial Boilers, Particulate Matter Emissions.



EMISSION SUMMARY

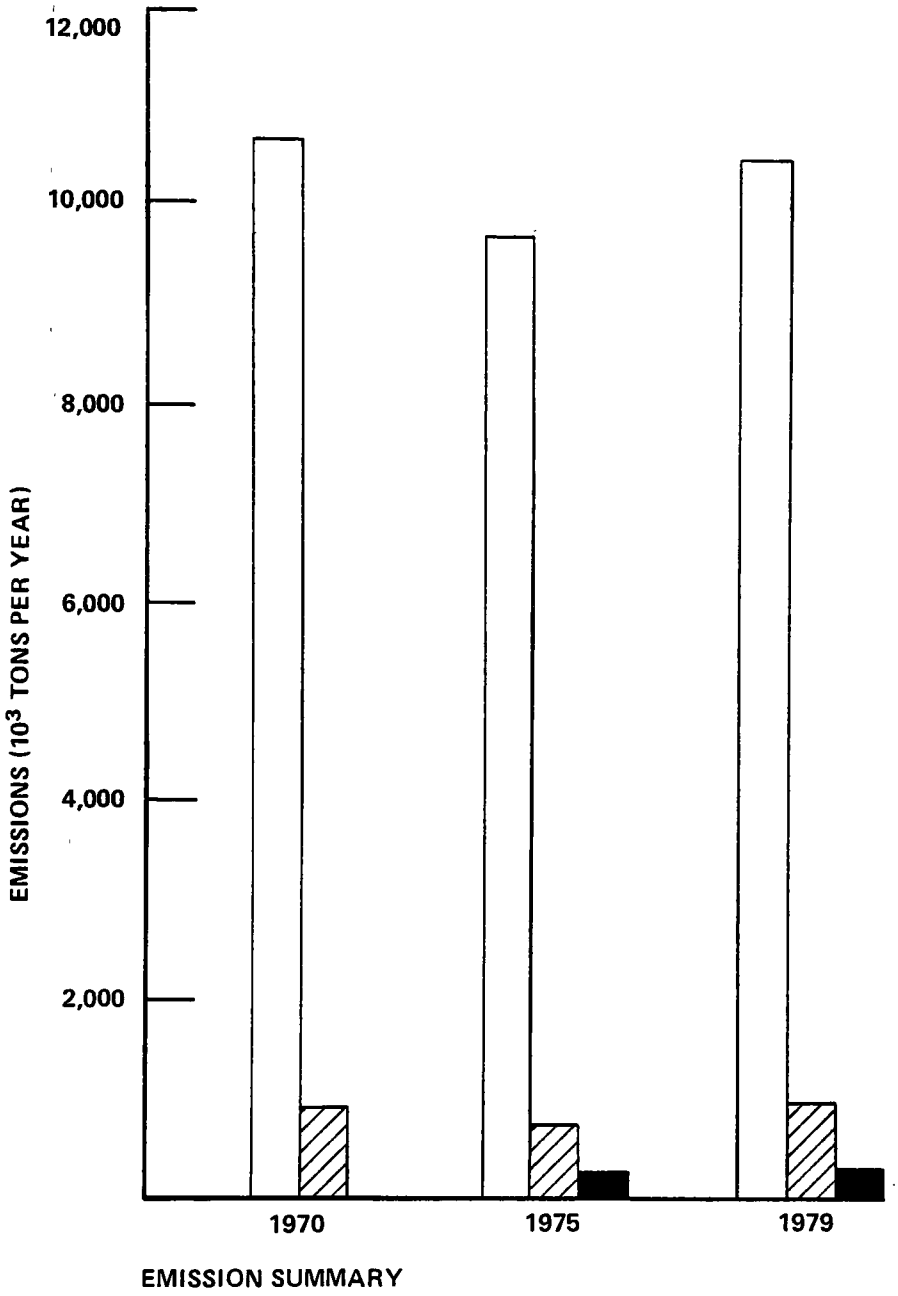
	Particulate Matter Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	5,733	5,076	5,716
Actual	4,775	3,768	3,388
Compliance		1,951	2,198

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 4. Iron and Steel Plants, Particulate Matter Emissions.



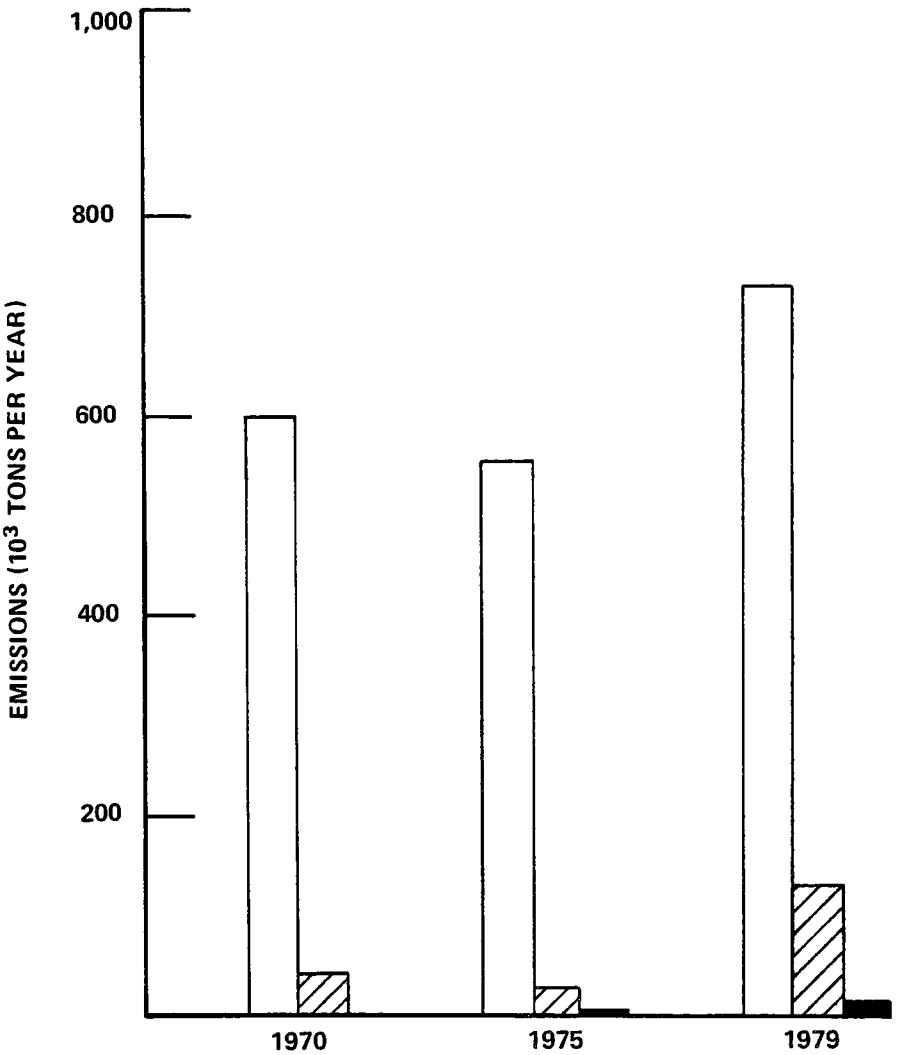
	Particulate Matter Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	10,643	9,604	10,572
Actual	906	365	981
Compliance		89	98

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 5. Portland Cement Plants, Particulate Matter Emissions.



EMISSION SUMMARY

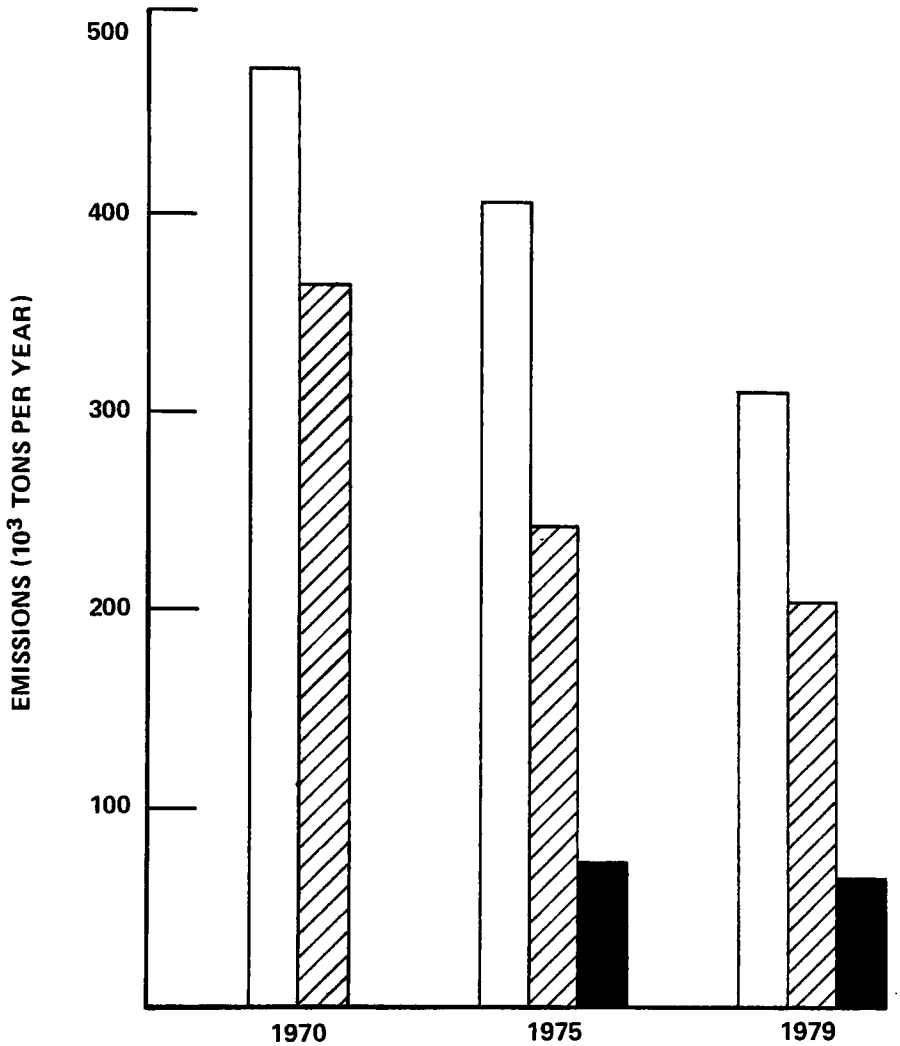
	Particulate Matter Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	602	549	722
Actual	46	33	142
Compliance		14	19

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 6. Primary Nonferrous Smelters, Particulate Matter Emissions.



EMISSION SUMMARY

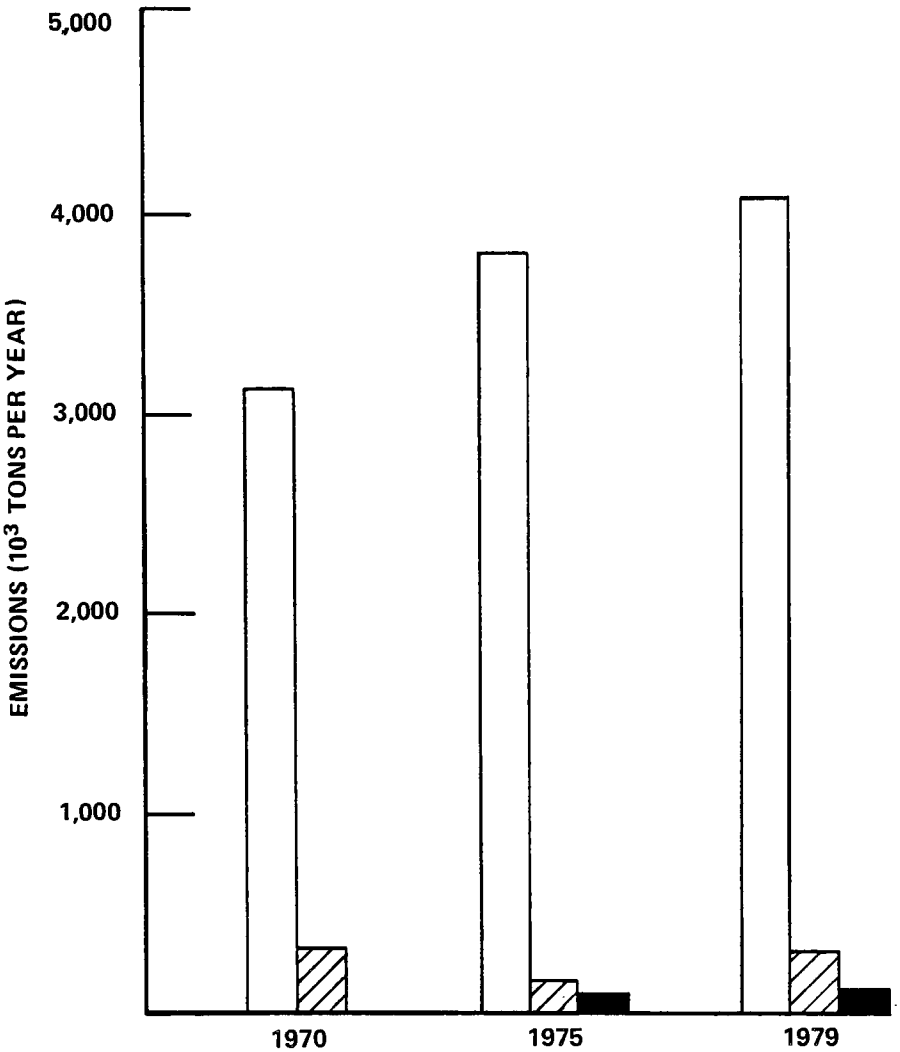
	Particulate Matter Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	469	406	303
Actual	367	233	196
Compliance		75	56

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 7. Solid Waste Disposal, Particulate Matter Emissions.



EMISSION SUMMARY

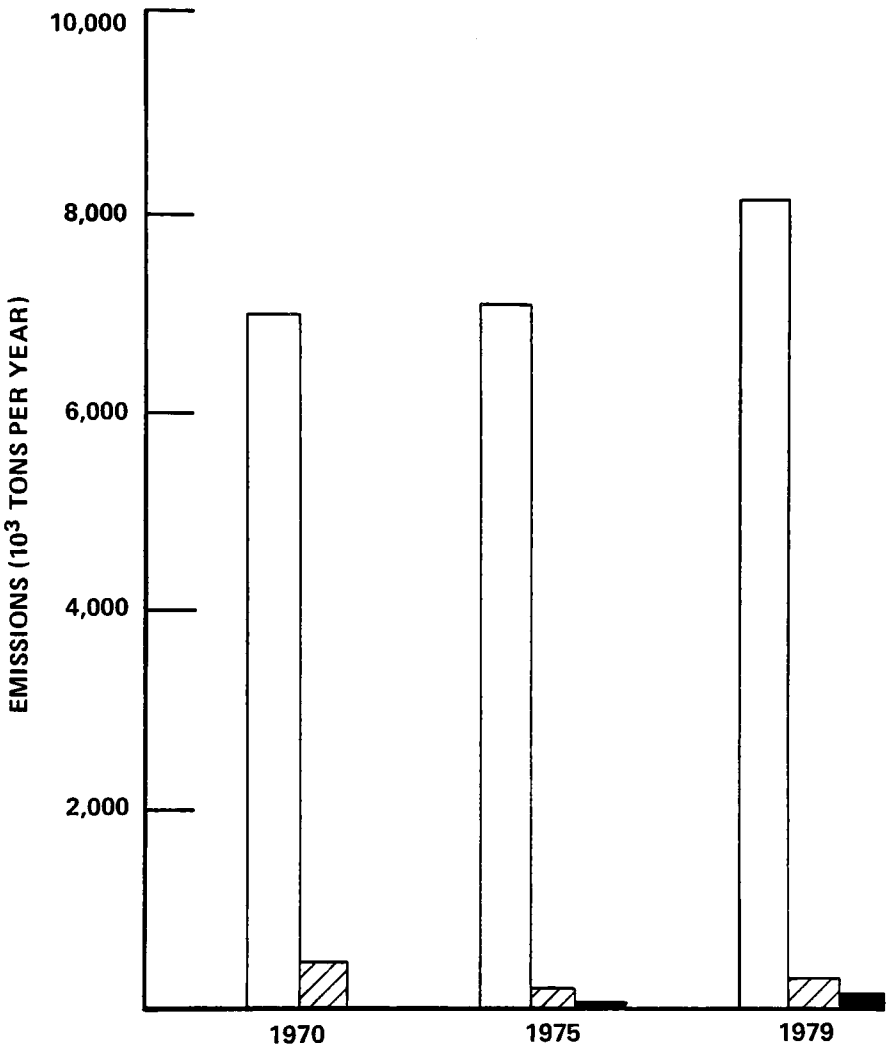
	Particulate Matter Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	3,133	3,789	4,096
Actual	288	146	297
Compliance		112	121

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 8. Kraft Pulp and Paper Mills, Particulate Matter Emissions.



EMISSION SUMMARY

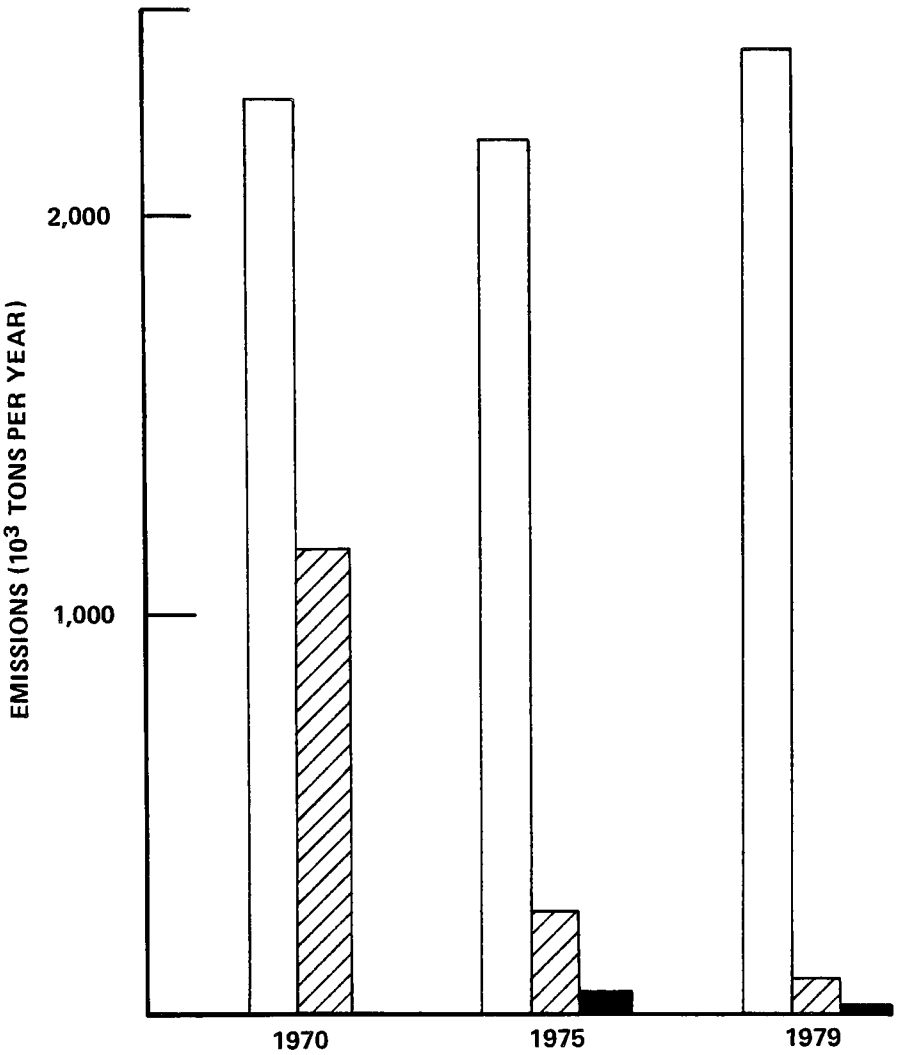
	Particulate Matter Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	6,998	7,089	8,181
Actual	490	213	164
Compliance		120	138

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 9. Asphalt Batching Plants, Particulate Matter Emissions.



EMISSION SUMMARY

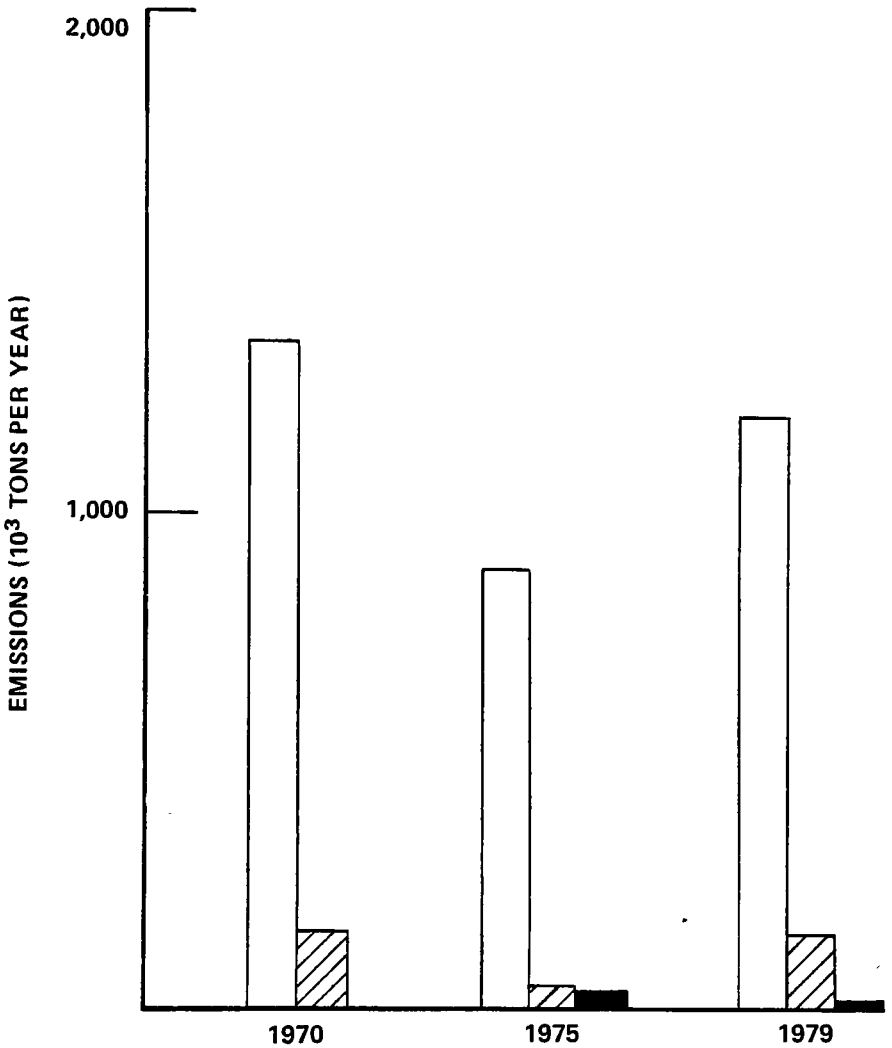
	Particulate Matter Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	2,263	2,198	2,401
Actual	1,154	220	168
Compliance		23	25

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 10. Lime Plants, Particulate Matter Emissions.



EMISSION SUMMARY

	Particulate Matter Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	1,326	899	1,215
Actual	156	62	134
Compliance		46	12

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 11. Grey Iron Foundries, Particulate Matter Emissions.

B. Sulfur Oxide Results for the Nation

Estimated uncontrolled and actual sulfur oxide emissions for 1970, 1975, and 1979 and compliance emissions for 1975 and 1979, based on activity in those years, for attainment of ambient air quality standards are shown in Tables VII and VIII. Data for stationary sources, only, are shown graphically in Figure 12. Stationary sources accounted for 97 percent of sulfur oxide emissions in 1979.

Between 1970 and 1979, uncontrolled emissions stationary sources increased by 22 percent, from 38.9 million tpy to 47.6 million tpy, as a result of growth during the period. This growth made an absolute reduction in emissions in stationary sources more difficult. The 4 percent actual emission reduction achieved (to 32.3 million tons in 1979 from 33.6 million tons in 1970) was possible because abatement programs increased the overall degree of control from 14 percent in 1970 to 32 percent in 1979.

SIPs were designed to achieve ambient air quality standards by controlling emissions from stationary sources to a level of 28.1 million tpy based on an estimated 1979 uncontrolled emission level of 47.6 million tons. This is equated to an overall degree of control of 41 percent. Emission reductions through 1979 represent 74 percent of the compliance objective for the eight selected source categories listed in Table VII and 78 percent of the compliance objective for emissions from all sources.

Examination of Table VIII shows that for sulfur oxides the industries that require the greatest degree of additional control, in terms of absolute emission reductions, to meet full compliance requirements are coal-fired electric utility and primary nonferrous smelters. Uncontrolled and actual emissions for 1970, 1975, and 1979 and compliance emissions, based on 1979 activity, for each of the eight selected source categories listed in Table VII are shown in Figures 13 through 20.

TABLE VII. SUMMARY OF NATIONWIDE SULFUR OXIDE EMISSION ESTIMATES

Source category	Emissions (10^3 tons)							
	1970		1975			1979		
	Uncontrolled	Actual	Uncontrolled	Actual	Compliance	Uncontrolled	Actual	Compliance
Coal-fired electric utility boilers	15,439	15,439	20,971	13,536	11,481	26,536	21,144	19,479
Oil-fired electric utility boilers	1,618	1,618	2,022	1,692	1,555	2,542	2,461	2,407
Coal-fired industrial boilers	4,754	4,754	4,133	2,782	2,175	3,449	2,253	1,561
Oil-fired industrial boilers	1,021	1,021	954	863	863	1,227	1,120	1,120
Oil-fired commerical/ institutional boilers	1,350	1,350	1,076	979	979	1,088	980	980
Primary nonferrous smelters	4,845	3,580	4,629	2,965	603	5,814	1,804	796
Petroleum refineries	1,537	1,537	1,759	1,759	644	2,420	1,458	887
Portland cement plants	733	733	661	661	599	935	929	848
Subtotal for selected source categories	31,297	30,032	36,205	25,237	18,899	44,011	32,149	28,078
Stationary sources[e]	38,855	33,569	44,552	32,083	25,751	47,592	32,345	28,148
Mobile sources[d]	731	731	817	817	817[f]	911	911	911
All sources	39,586[a]	34,300[a]	45,639[a]	32,900[a]	26,568[a]	48,503[b]	33,256[c]	29,059[b]

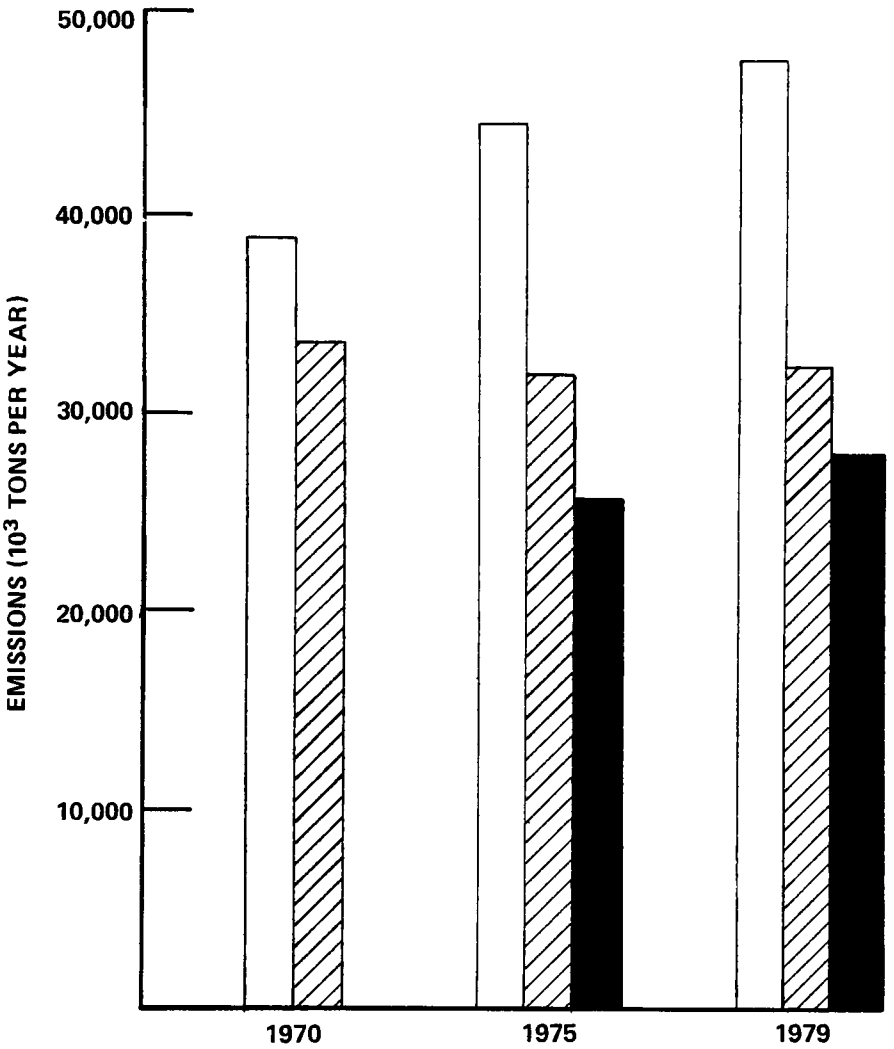
[a] See Reference 1.
[b] Estimated from data in Reference 1 and 3, projected to 1979 using GNP growth [9].
[c] Reference 3 projected to 1979 using GNP growth [9].
[d] Estimated from data in References 10 and 11.
[e] By difference between all sources and mobile sources.
[f] Detailed data not available. Actual emissions in OAQPS data file assumed also to be compliance emissions.

TABLE VIII. PROGRESS TOWARD COMPLIANCE FOR SULFUR OXIDES

Source category	Percent of total 1979 actual stationary source emissions	Average percent control in 1979	Percent of compliance objective	Total reduction remaining	
				(10^3 tons)	(percent)
Coal-fired electric utility boilers	65	20	76	1,665	24
Oil-fired electric utility boilers	8	3	60	54	40
Coal-fired industrial boilers	7	34	63	692	37
Oil-fired industrial boilers	3	a	b	b	b
Oil-fired commercial/ institutional boilers	3	a	b	b	b
Primary nonferrous smelters	6	69	80	1,008	20
Petroleum refineries	5	40	63	571	37
Portland Cement Plants	3	1	7	81	93
Subtotal for selected source categories	99	27	74	4,071	26
All stationary sources	100	32	78	4,197	22

[a] Uncontrolled emissions estimated with 1970 average sulfur control; actual estimated with 1978 average.

[b] The national average emission calculations indicate that no control is required. Specific situations may exist where state/local regulations may require control.



EMISSION SUMMARY

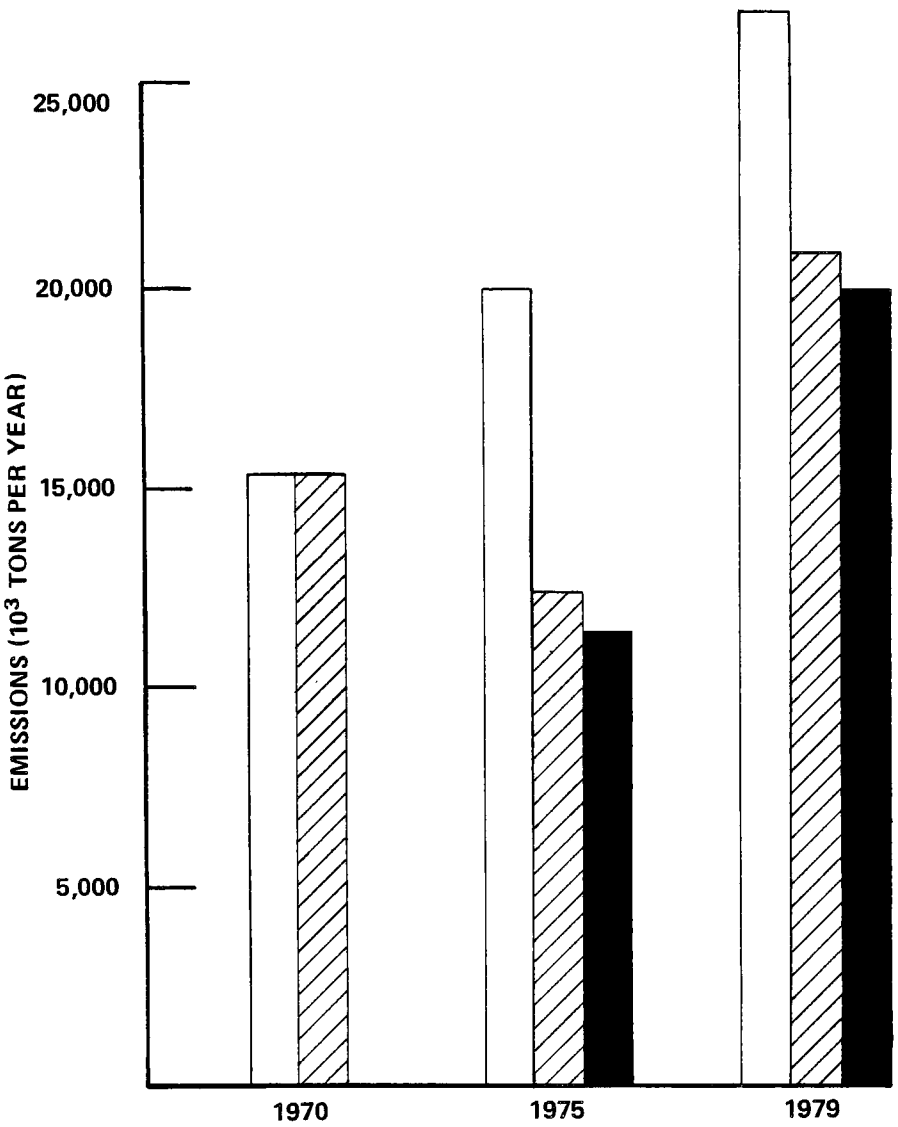
	Sulfur Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	38,855	44,552	47,592
Actual	33,569	32,083	32,345
Compliance		25,751	28,148

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 12. Nationwide Sulfur Oxide Emissions, Stationary Sources.



EMISSION SUMMARY

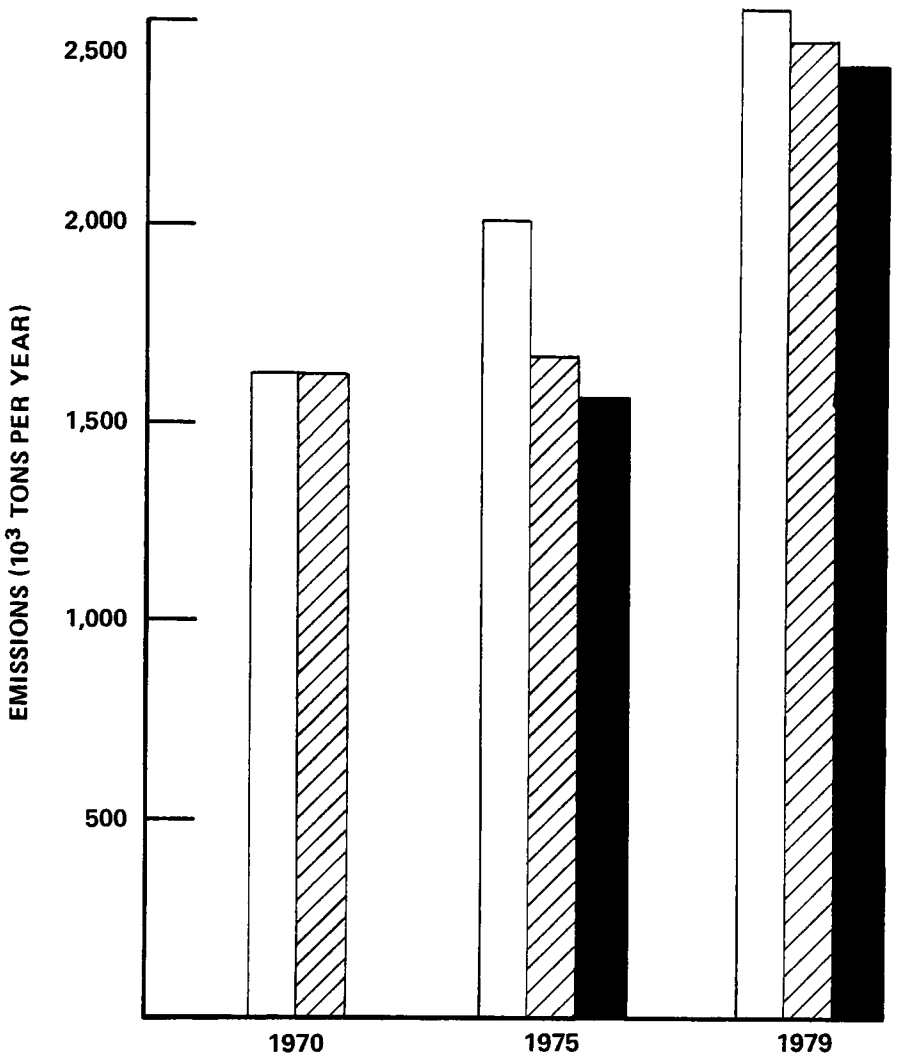
	Sulfur Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	15,439	20,971	26,536
Actual	15,439	13,536	21,144
Compliance		11,481	19,479

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 13. Coal-Fired Electric Utility Boilers, Sulfur Oxide Emissions.



EMISSION SUMMARY

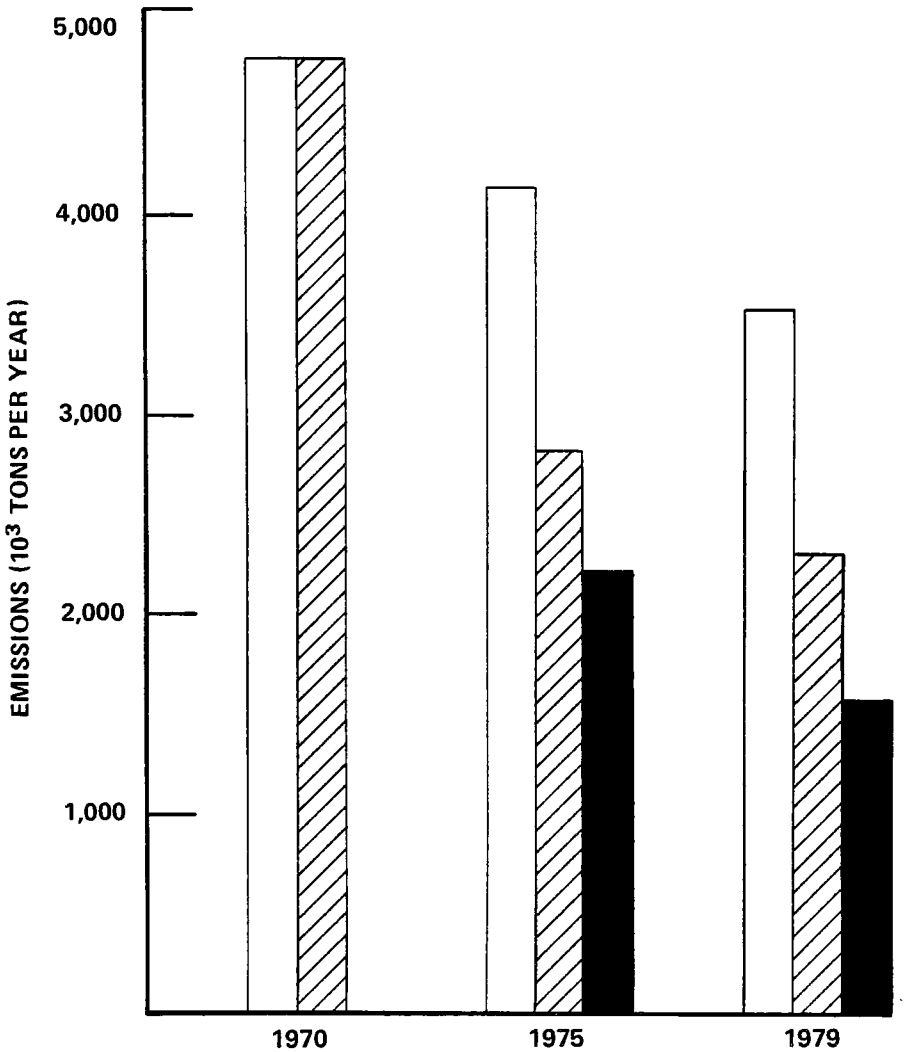
	Sulfur Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	1,618	2,022	2,542
Actual	1,618	1,692	2,461
Compliance		1,555	2,407

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 14. Oil-Fired Electric Utility Boilers, Sulfur Oxide Emissions.



EMISSION SUMMARY

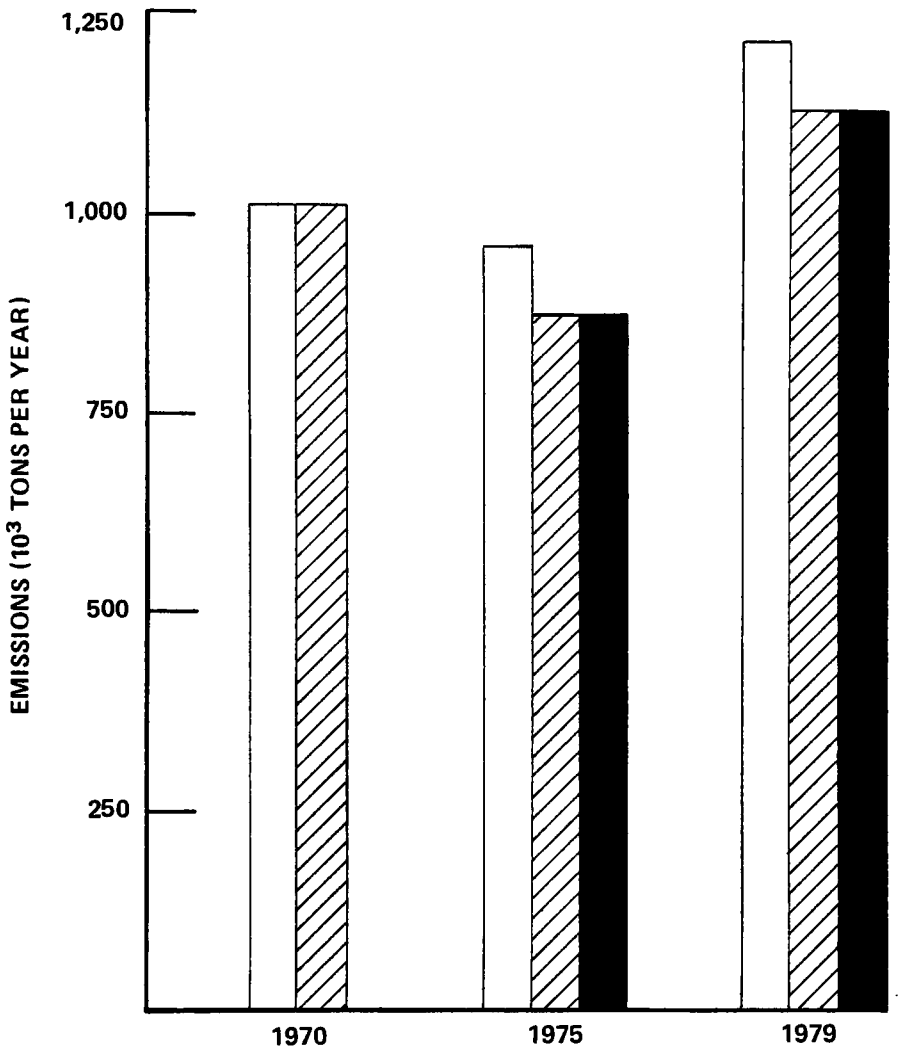
	Sulfur Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	4,754	4,133	3,449
Actual	4,754	2,782	2,253
Compliance		2,175	1,561

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 15. Coal-Fired Industrial Boilers, Sulfur Oxide Emissions.



EMISSION SUMMARY

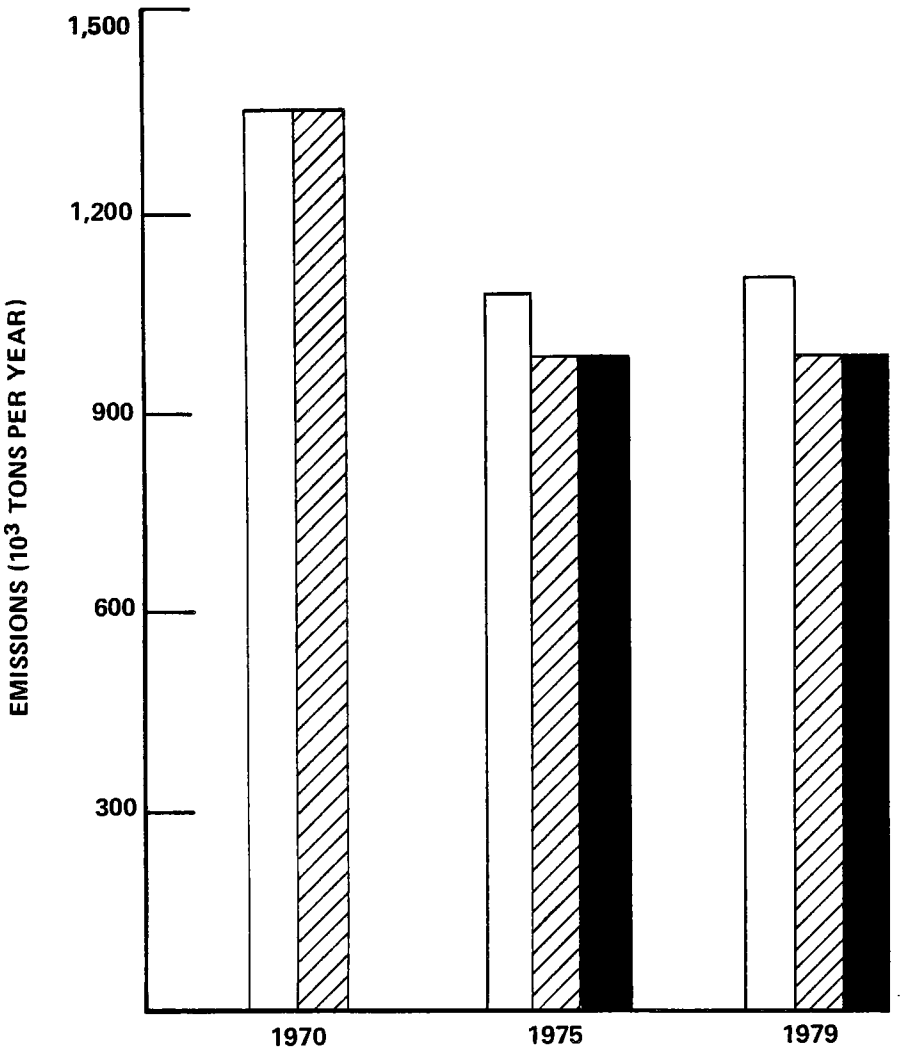
	Sulfur Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	1,021	954	1,227
Actual	1,021	863	1,120
Compliance		863	1,120

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 16. Oil-Fired Industrial Boilers, Sulfur Oxide Emissions.



EMISSION SUMMARY

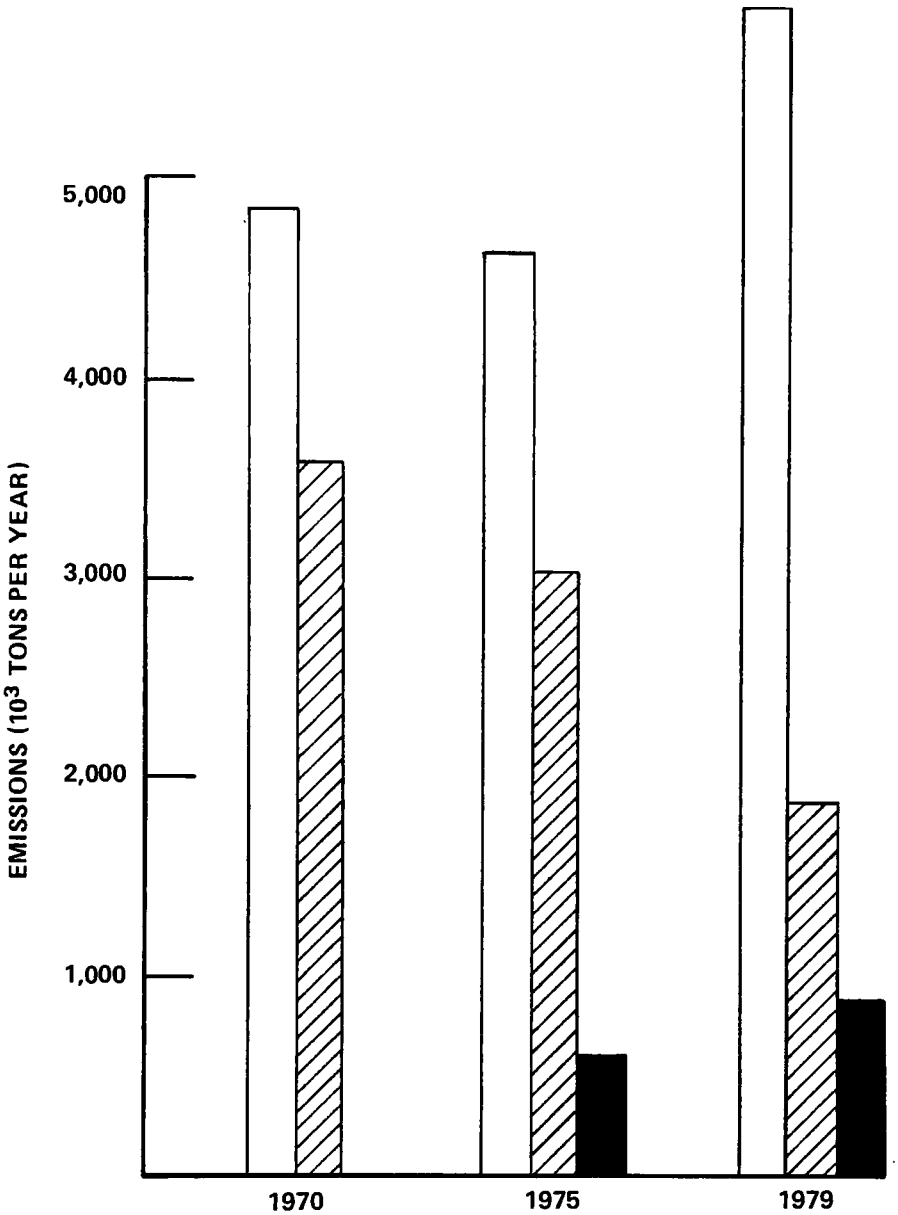
	Sulfur Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	1,350	1,076	1,088
Actual	1,350	979	980
Compliance		979	980

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 17. Oil-Fired Commercial/Institutional Boilers, Sulfur Oxide Emissions.



EMISSION SUMMARY

	Sulfur Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	4,845	4,629	5,814
Actual	3,580	2,965	1,804
Compliance		603	796

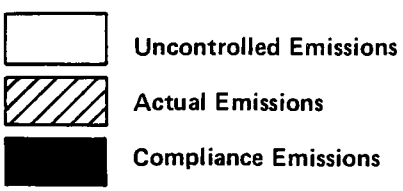
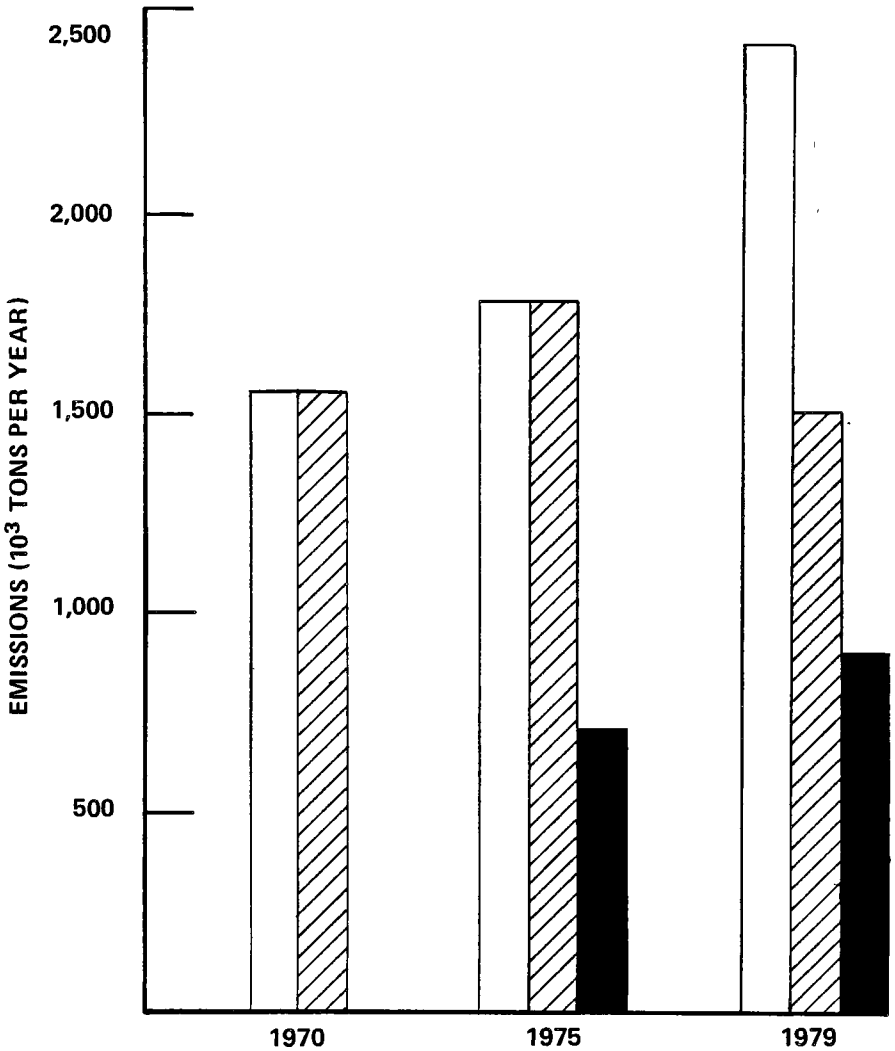


Figure 18. Primary Nonferrous Smelters, Sulfur Oxide Emissions.



EMISSION SUMMARY

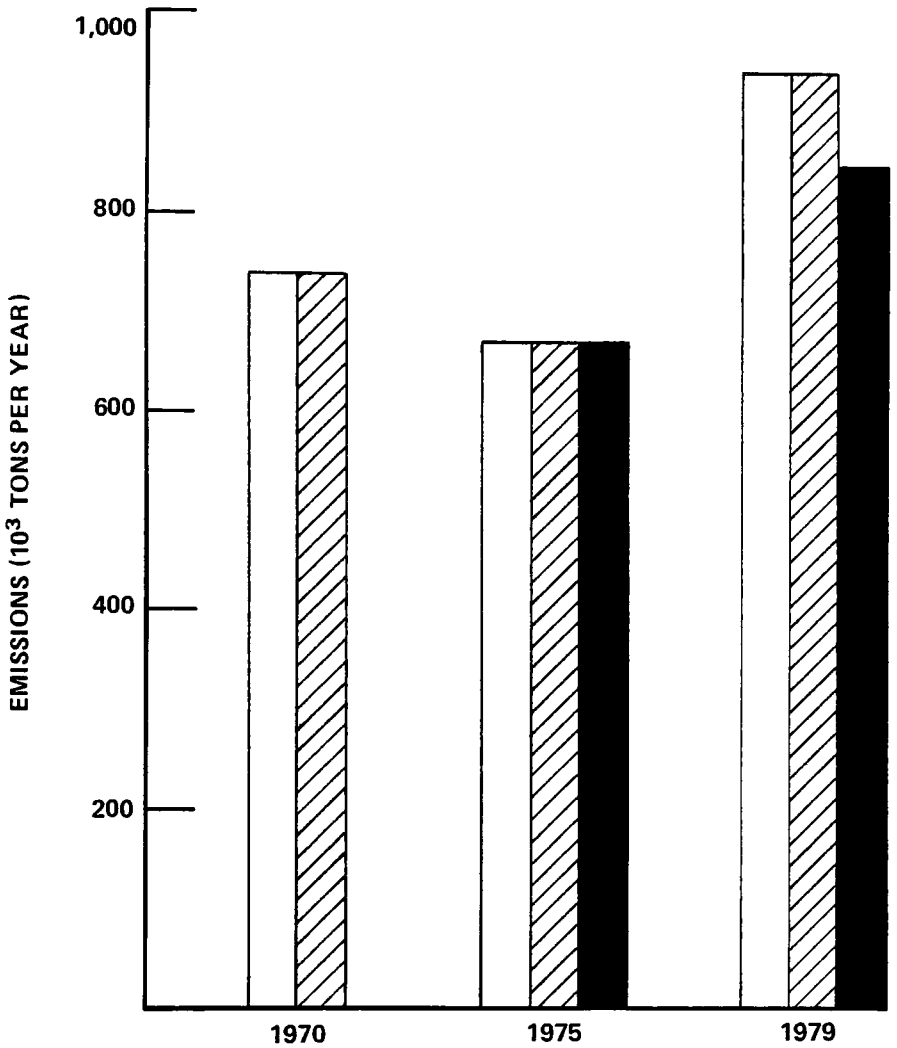
	Sulfur Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	1,537	1,759	2,420
Actual	1,537	1,759	1,458
Compliance		644	887

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 19. Petroleum Refineries, Sulfur Oxide Emissions.



EMISSION SUMMARY

	Sulfur Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	733	661	935
Actual	733	661	929
Compliance		599	848

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 20. Portland Cement Plants, Sulfur Oxide Emissions.

C. Nitrogen Oxide Results for the Nation

Uncontrolled and actual nitrogen oxide emissions for 1970, 1975, and 1979 and compliance emissions for 1975 and 1979, based on activity in those years, for attainment of ambient air quality standards are shown in Tables IX and X. Data for stationary sources, only, are shown graphically in Figure 21. Stationary sources accounted for 62 percent of nitrogen oxide emissions in 1979.

Between 1970 and 1979, uncontrolled emissions from all sources increased by 33 percent, from 20.9 million tpy to 27.7 million tpy, as a result of industrial and transportation growth during the period. Growth from stationary sources resulted in an increase in actual emissions of 13 percent (to 14.8 million tons in 1979 from 13.1 million tons in 1970).

These emission data for all sources shown in Tables IX and X are estimated assuming that only the selected source categories will be subject to state, local, or Federal emission limitations. While some sources other than the selected source categories may be subject to emission limitations, the assumption results in a conservative estimate of emission reductions achieved as the result of state, local, and Federal abatement programs.

SIPs were designed to achieve ambient air quality standards by controlling emissions from stationary sources to a level of 14.2 million tpy based on an estimated 1979 uncontrolled emission level of 16.4 million tons. This is equated to an overall degree of control of 13 percent. Emission reductions through 1979 represent 72 percent of the compliance objective for the eight selected source categories listed in Tables IX and 72 percent of the compliance objective for emissions from all stationary sources.

Examination of Table X shows that, for nitrogen oxides, the industries requiring the greatest degree of additional control in terms of absolute

emission reductions to meet full compliance requirements are coal- and gas-fired electric utility boilers and gas-fired industrial boilers. Estimated uncontrolled and actual emissions for 1970, 1975, and 1979 and compliance emissions, based on 1979 activity, for the eight selected categories listed in Table IX, are shown in Figures 22 through 29.

TABLE IX. SUMMARY OF NATIONWIDE NITROGEN OXIDE EMISSION ESTIMATES

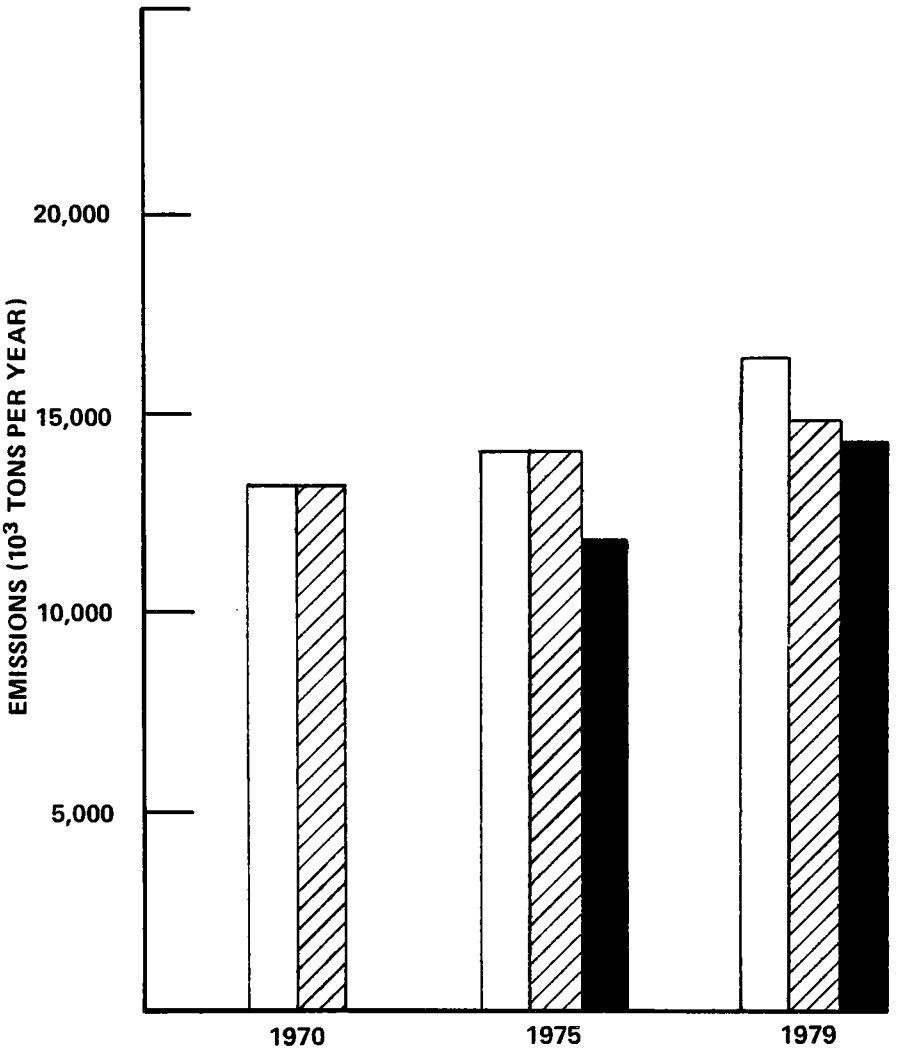
Source category	Emissions (10^3 tons)							
	1970		1975			1979		
	Uncontrolled	Actual	Uncontrolled	Actual	Compliance[a]	Uncontrolled	Actual	Compliance
Coal-fired electric utility boilers	3,779	3,779	4,708	4,708	3,662	6,298	5,134	4,899
Oil-fired electric utility boilers	715	715	1,147	1,147	1,090	1,130	1,130	1,074
Gas-fired electric utility boilers	1,168	1,168	944	944	411	871	500	379
Coal-fired industrial boilers	988	988	799	799	799	722	722	722
Oil-fired industrial boilers	250	250	205	205	190	316	316	293
Gas-fired industrial boilers	710	710	628	628	474	689	689	520
Oil-fired commerical/ institutional boilers	359	359	292	292	292	284	284	284
Gas pipelines and plants	3,067	3,067	3,287	3,287	3,287	3,594	3,594	3,594
Subtotal for selected source categories	11,036	11,036	12,010	12,010	10,205	13,904	12,369	11,765
Stationary sources[b]	13,090	13,090	13,600	13,600	11,795	16,360	14,825	14,221
Mobile sources[c]	7,779	7,779	9,654	9,499	9,499	11,380	10,391	10,391
All sources[d]	20,869	20,869	23,254	23,099	21,294	27,740	25,216	24,612

[a] Assumes same ratio of uncontrolled to compliance for stationary sources as 1979.
[b] OAQPS data files (References 3, 5, and 6).
[c] From data provided by OAQPS (Reference 10) and from Reference 11. Uncontrolled emission data determined by applying ratio of emission factors--1970/1975, 1970/1979--to actual emissions.
[d] By addition of stationary and mobile source emissions.

TABLE X. PROGRESS TOWARD COMPLIANCE FOR NITROGEN OXIDES

Source category	Percent of total 1979 actual stationary source emissions	Average percent control in 1979	Percent of compliance objective	Total reduction remaining	
				(10^3 tons)	(percent)
Coal-fired electric utility boilers	35	18	83	235	17
Oil-fired electric utility boilers	8	0	0	56	100
Gas-fired electric utility boilers	3	43	75	121	25
Coal-fired industrial boilers	5	a	a	a	a
Oil-fired industrial boilers	2	0	0	23	100
Gas-fired industrial boilers	5	0	0	169	100
Oil-fired commercial/ institutional boilers	2	a	a	a	a
Gas pipelines and plants smelters	24	a	a	a	a
Subtotal for selected source categories	83	11	72	604	28
All stationary sources	100	9	72	604	28

[a] The national average emission calculations indicate that no control is required. Specific situations may exist where state/local regulations may require some control.



EMISSION SUMMARY

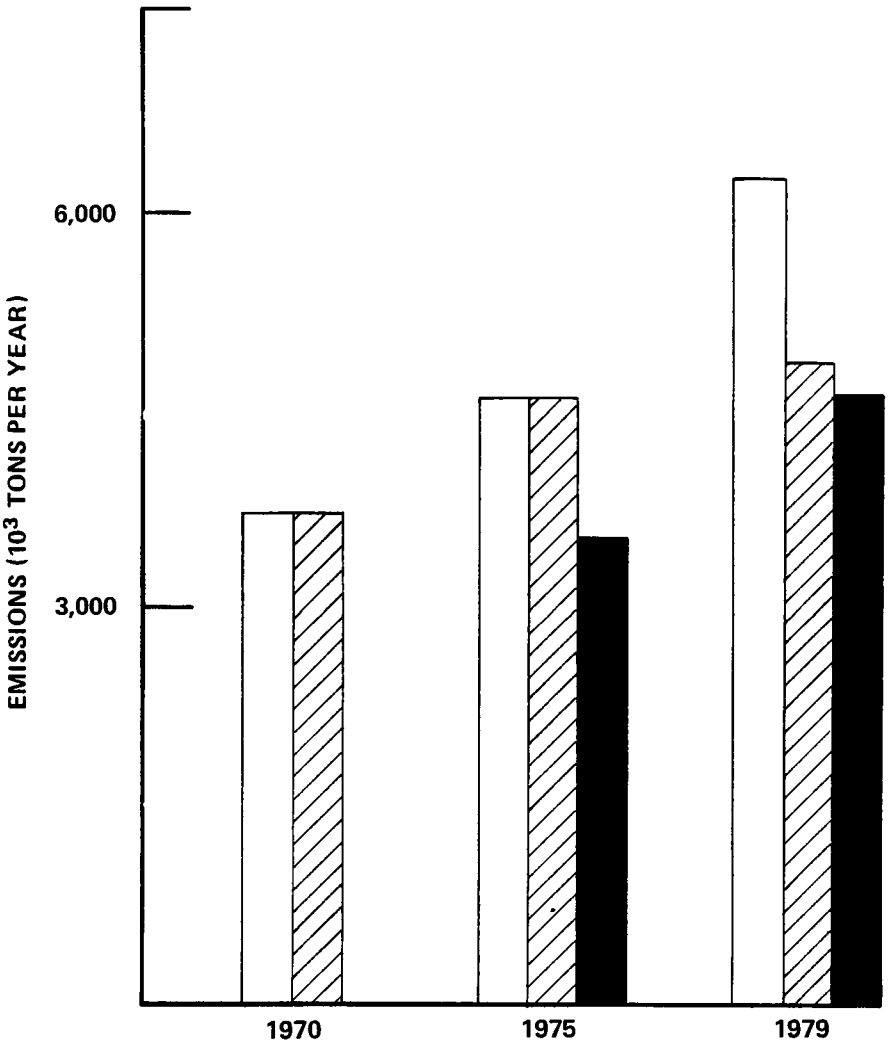
	Nitrogen Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	13,090	13,600	16,360
Actual	13,090	13,600	14,825
Compliance		11,795	14,221

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 21. Nationwide Nitrogen Oxide Emissions, Stationary Sources.



EMISSION SUMMARY

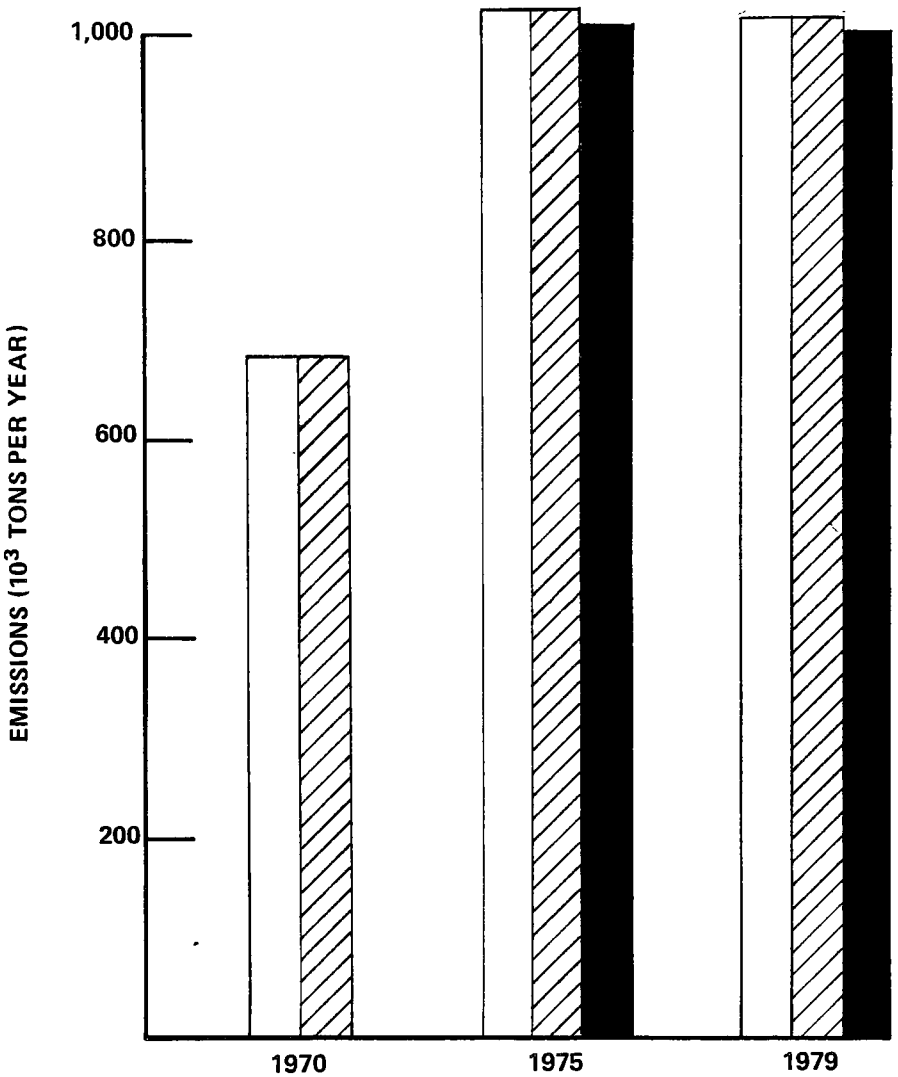
	Nitrogen Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	3,779	4,708	6,298
Actual	3,779	4,708	5,134
Compliance		3,662	4,899

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 22. Coal-Fired Electric Utility Boilers, Nitrogen Oxide Emissions.



EMISSION SUMMARY

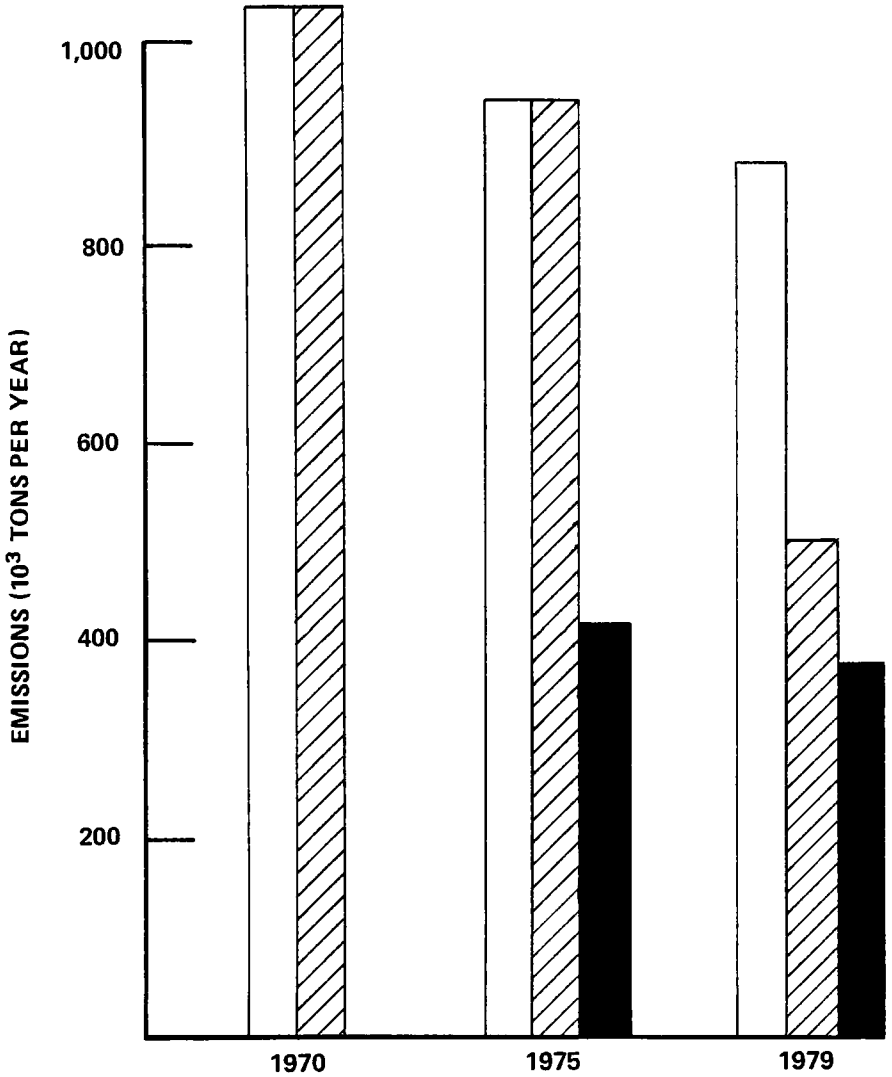
	Nitrogen Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	715	1,147	1,130
Actual	715	1,147	1,130
Compliance		1,090	1,074

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 23. Oil-Fired Electric Utility Boilers, Nitrogen Oxide Emissions.



EMISSION SUMMARY

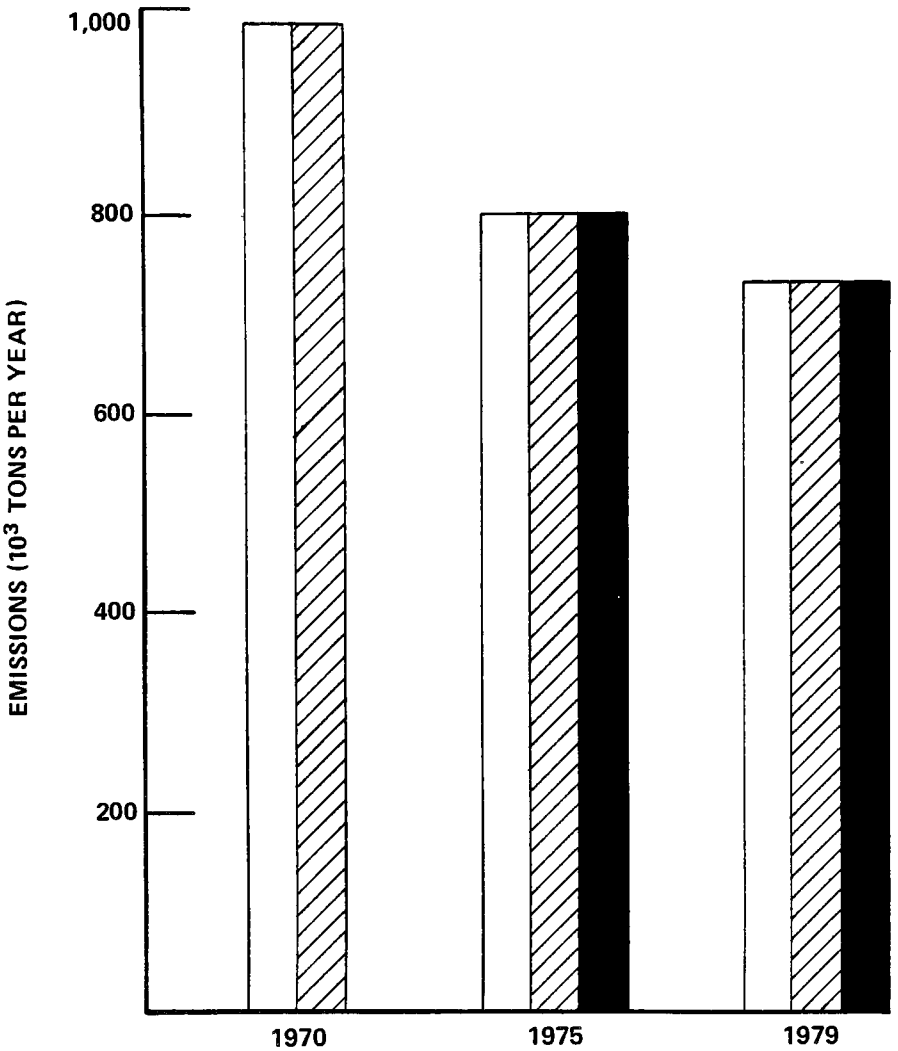
	Nitrogen Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	1,168	944	871
Actual	1,168	944	500
Compliance		411	379

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 24. Gas-Fired Electric Utility Boilers, Nitrogen Oxide Emissions.



EMISSION SUMMARY

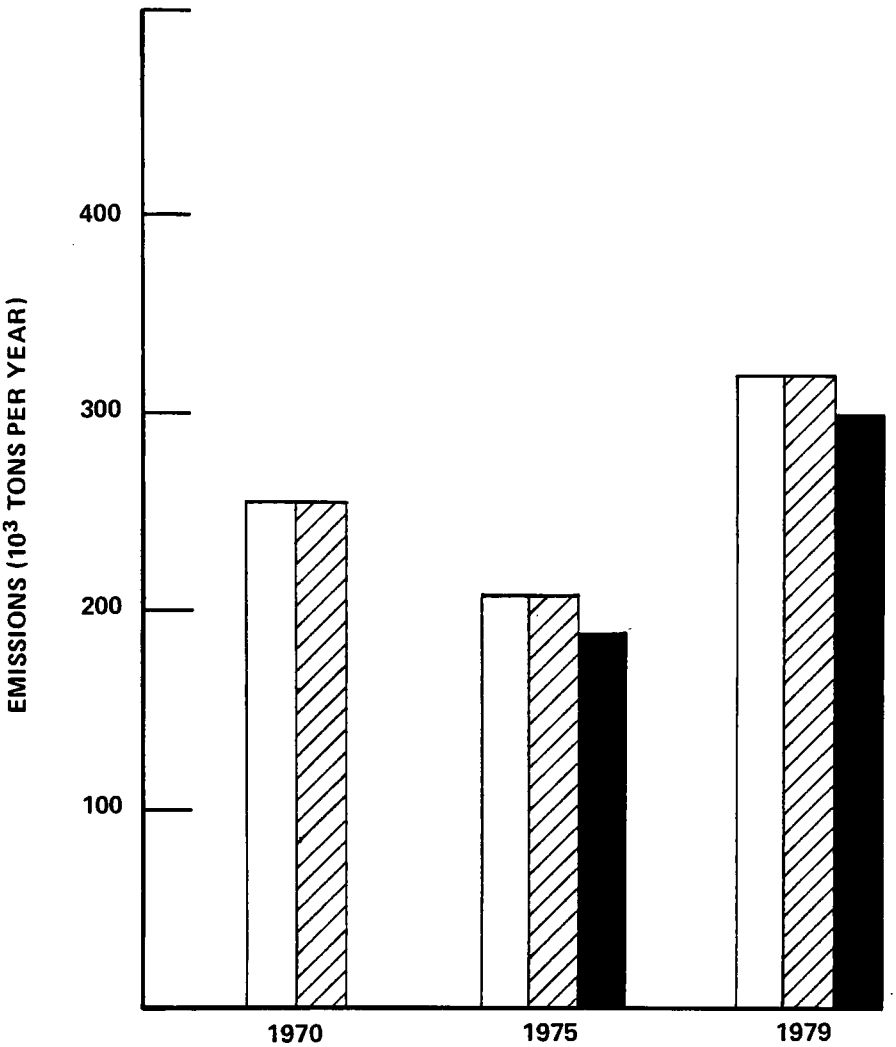
	Nitrogen Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	988	799	722
Actual	988	799	722
Compliance		799	722

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 25. Coal-Fired Industrial Boilers, Nitrogen Oxide Emissions.



EMISSION SUMMARY

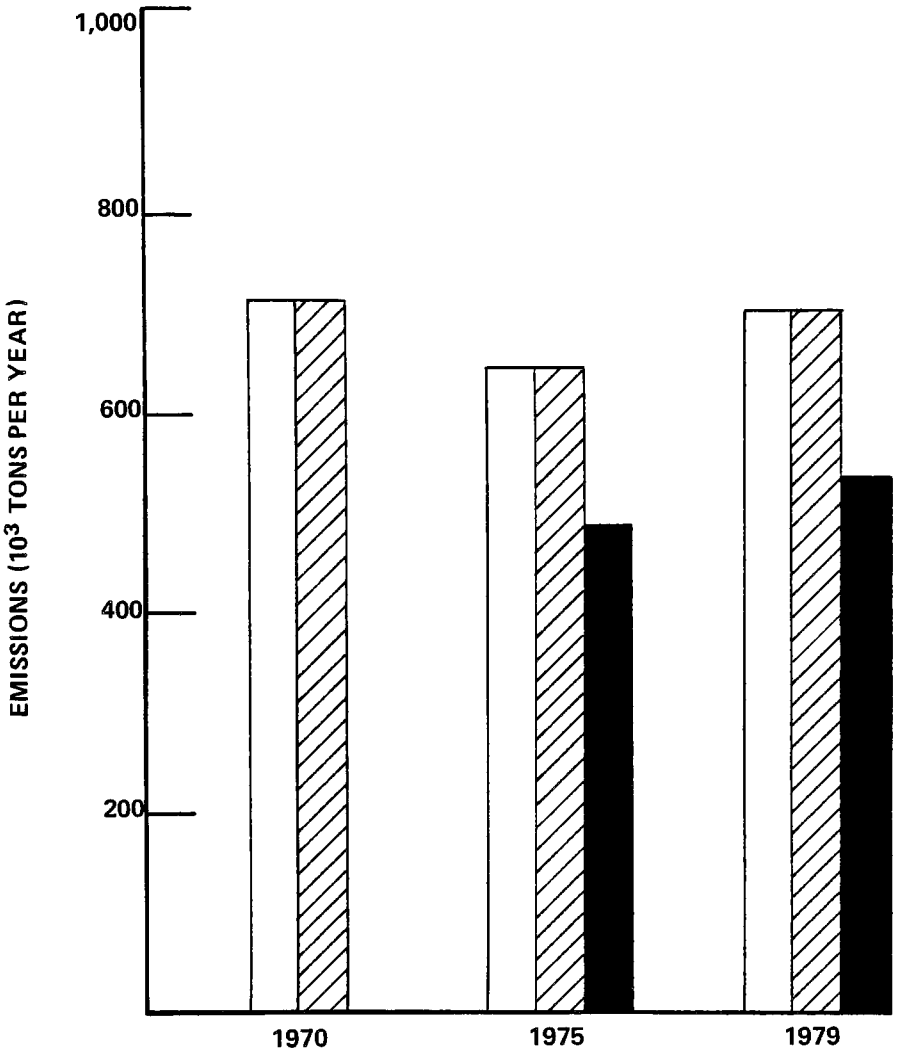
	Nitrogen Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	250	205	316
Actual	250	205	316
Compliance		190	293

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 26. Oil-Fired Industrial Boilers, Nitrogen Oxide Emissions.



EMISSION SUMMARY

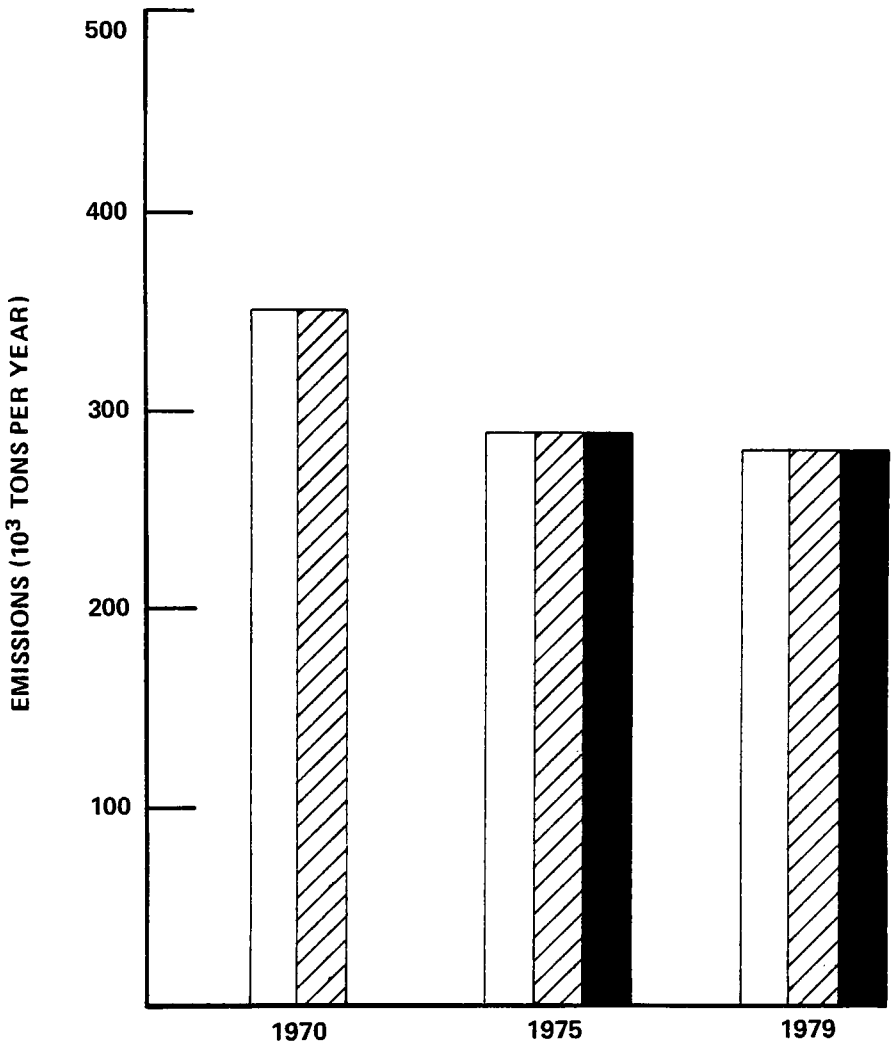
	Nitrogen Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	710	628	689
Actual	710	628	689
Compliance		474	520

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 27. Gas-Fired Industrial Boilers, Nitrogen Oxide Emissions.



EMISSION SUMMARY

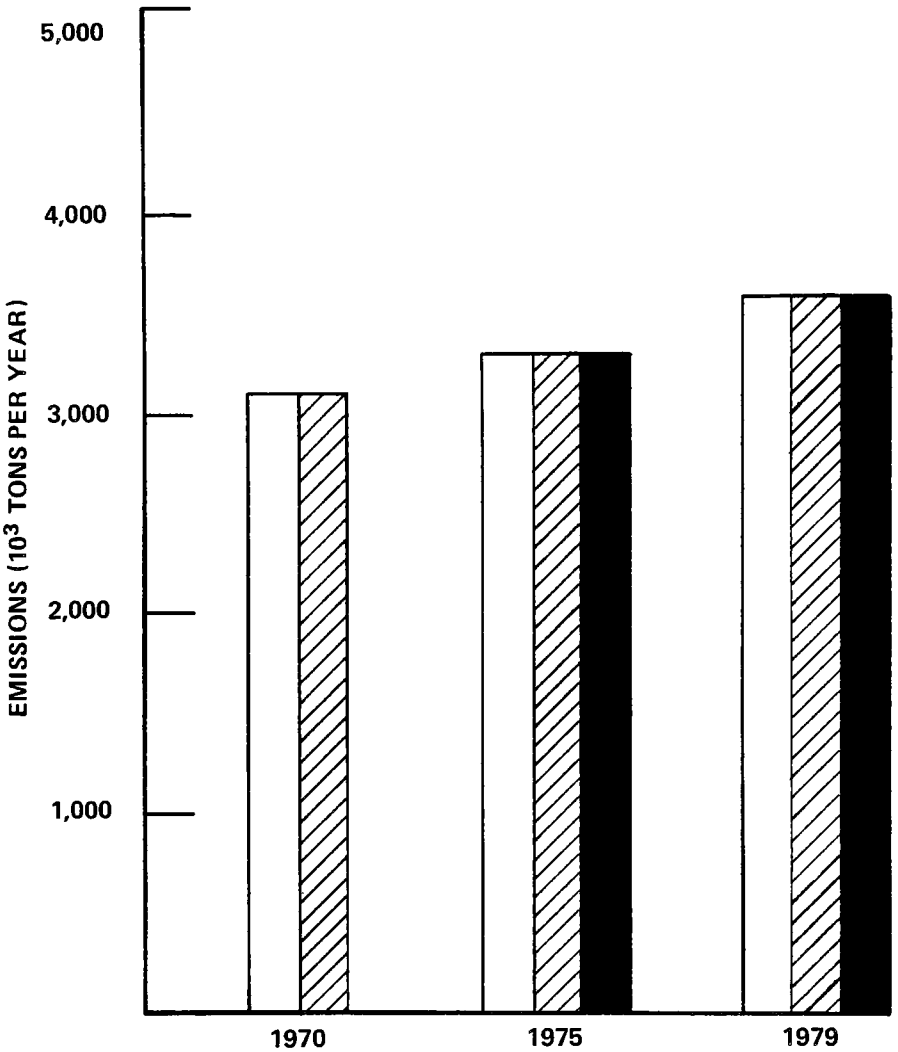
	Nitrogen Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	359	292	284
Actual	359	292	284
Compliance		292	284

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 28. Oil-Fired Commercial Institutional Boilers, Nitrogen Oxide Emissions.



EMISSION SUMMARY

	Nitrogen Oxide Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	3,067	3,287	3,594
Actual	3,067	3,287	3,594
Compliance		3,287	3,594

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 29. Gas Pipeline and Plants, Nitrogen Oxide Emissions.

D. VOC Results for the Nation

Uncontrolled and actual VOC emissions for 1970, 1975, and 1979 and compliance emissions for 1975 and 1979, based on activity in those years, for attainment of ambient air quality standards are shown in Tables XI and XII. Data for stationary sources, only, are shown graphically in Figure 30. Stationary sources accounted for 67 percent of VOC emissions in 1979.

Between 1970 and 1979, uncontrolled emissions from stationary sources increased by 33 percent from 18.3 million tpy to 24.3 million tpy, as a result of growth during this period. This growth made an absolute reduction in emissions more difficult. The 12 percent actual emission increase in stationary sources (to 19.1 million tons in 1979 from 17.1 million tons in 1970) was less than the 33 percent overall increase in uncontrolled emissions because abatement programs increased control from 6 percent in 1970 to 21 percent in 1979.

Full compliance with limitations resulting from SIP revisions to include the application of reasonably available control technology, as stipulated by the 1977 Clean Air Act Amendments, will require an additional reduction of 2.5 million tons of VOC emissions from stationary sources. This represents an overall degree of control of 31 percent, based on an estimated 1979 uncontrolled emission level of 24.3 million tons. Emission reductions through 1979 represent 68 percent of the compliance objective for the 13 selected source categories listed in Table XI and 68 percent of the compliance objectives for emissions from all stationary sources.

Examination of Table XII shows that, for VOCs, the source categories requiring the greatest control in terms of absolute emission reductions to meet full compliance requirements are petroleum refineries, plastics manufacturers, paper surface coating, solvent metal cleaning, and cutback asphalt operations. Estimated uncontrolled and actual emissions for 1970,

1975, and 1979 and compliance emissions, based on 1979 activity, for the 13 selected source categories listed in Table XI, are shown in Figures 31 through 43.

TABLE XI. SUMMARY OF NATIONWIDE VOC EMISSION ESTIMATES

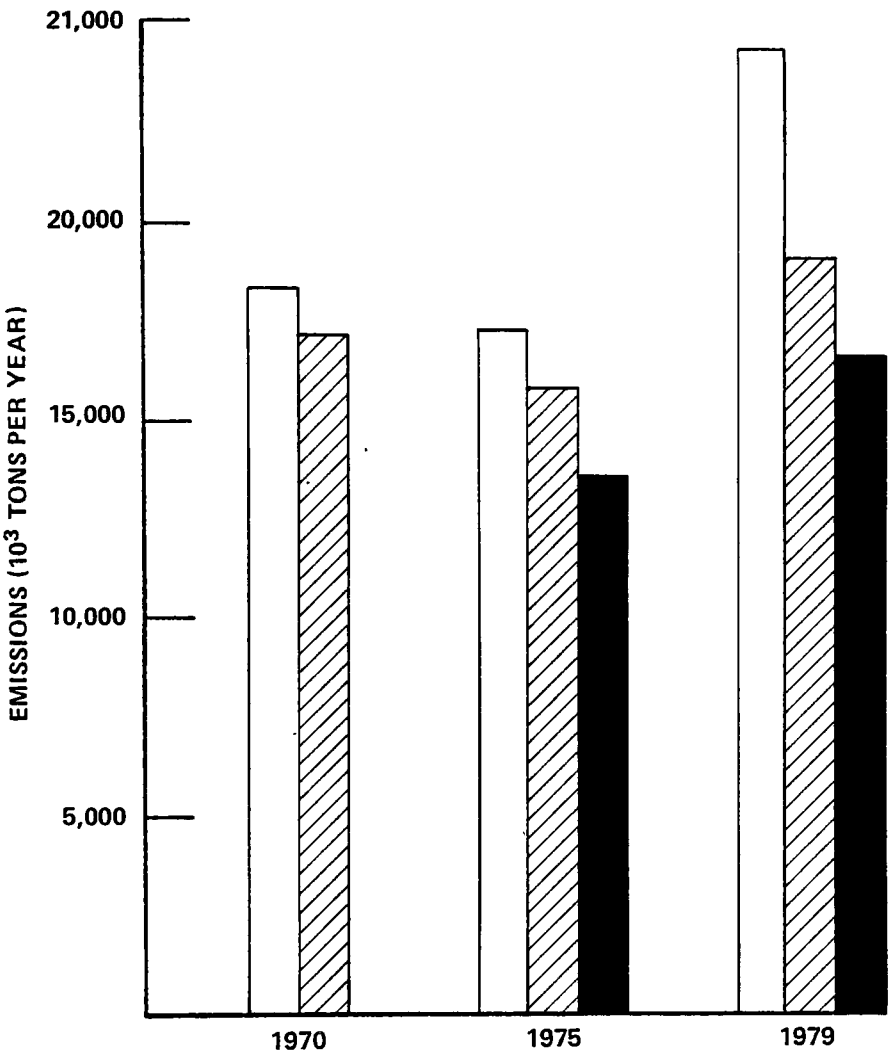
	Emissions (10^3 tons)							
	1970		1975			1979		
Source category	Uncontrolled	Actual	Uncontrolled	Actual	Compliance[a]	Uncontrolled	Actual	Compliance
Petroleum refineries	2,337	1,237	2,753	1,440	475	3,090	1,506	533
Bulk gasoline terminals	737	737	840	840	371	889	476	393
Cutback asphalt operations	e	e	e	e	e	992	421	235
Surface coating, paper	323	323	359	359	120	375	359	125
Surface coating, automobiles and light-duty trucks	e	e	e	e	e	90	90	22
Surface coating, wood furniture	172	172	234	234	187	308	308	246
Surface coating, miscellaneous metal parts and products	e	e	e	e	e	128	111	53
Plastics manufacturers	195	195	238	238	24	403	403	40
Solid waste disposal plants	500	500	370	370	370	343	343	343
Graphic arts	e	e	e	e	e	212	149	88
Dry cleaning plants	e	e	e	e	e	128	111	53
Solvent metal cleaning	e	e	e	e	e	834	726	512
Architectural coatings	e	e	e	e	e	2,970	545	447
Subtotal for selected source categories	4,264	3,164	4,794	3,481.	1,547	10,762	5,548	3,090
Stationary sources[b]	18,260	17,160	17,213	15,900	13,633	24,269	19,145	16,687
Mobile sources[c]	13,252	13,252	14,176	11,140	11,140	17,744	9,450	9,450
All sources[d]	31,512	30,412	31,389	27,040	24,773	42,013	28,595	26,137

[a] Assumes same ratio of uncontrolled to compliance for stationary sources as 1979.
[b] OAQPS data files (References 3, 5, and 6). Decrease in uncontrolled emissions from 1970 to 1975 is primarily due to drastic reduction in open and onsite burning.
[c] From data provided by OAQPS (Reference 10) and from Reference 11. Uncontrolled emission data determined by applying ratio of emission factors--1970/1975, 1970/1979--to actual emissions.
[d] By addition of stationary and mobile source emissions.
[e] Compatible data not available.

TABLE XII. PROGRESS TOWARD COMPLIANCE FOR VOCs

Source category	Percent of total 1979 actual stationary source emissions	Average percent control in 1979	Percent of compliance objective	Total reduction remaining	
				(10^3 tons)	(percent)
Petroleum refineries	8	51	62	973	38
Bulk gasoline terminals	2	46	83	83	17
Cutback asphalt operations	2	58	75	186	25
Surface coating, paper	2	4	6	234	94
Surface coating, automobiles and light-duty trucks	1	0	0	68	100
Surface coating, wood furniture	2	0	0	62	100
Surface coating, miscellaneous metal parts and products	1	13	23	58	77
Plastics manufacturers	2	0	0	363	100
Solid waste disposal plants	2	a	a	a	a
Graphic arts	1	30	51	61	49
Dry cleaning plants	1	13	23	58	77
Solvent metal cleaning	4	13	34	214	66
Architectural coatings	3	82	96	98	4
Subtotal for selected source categories	29	48	68	2,458	32
All stationary sources	100	21	68	2,458	32

[a]The national average emission calculations indicate that no control is required. Specific situations may exist where state/local regulations may require some control.



EMISSION SUMMARY

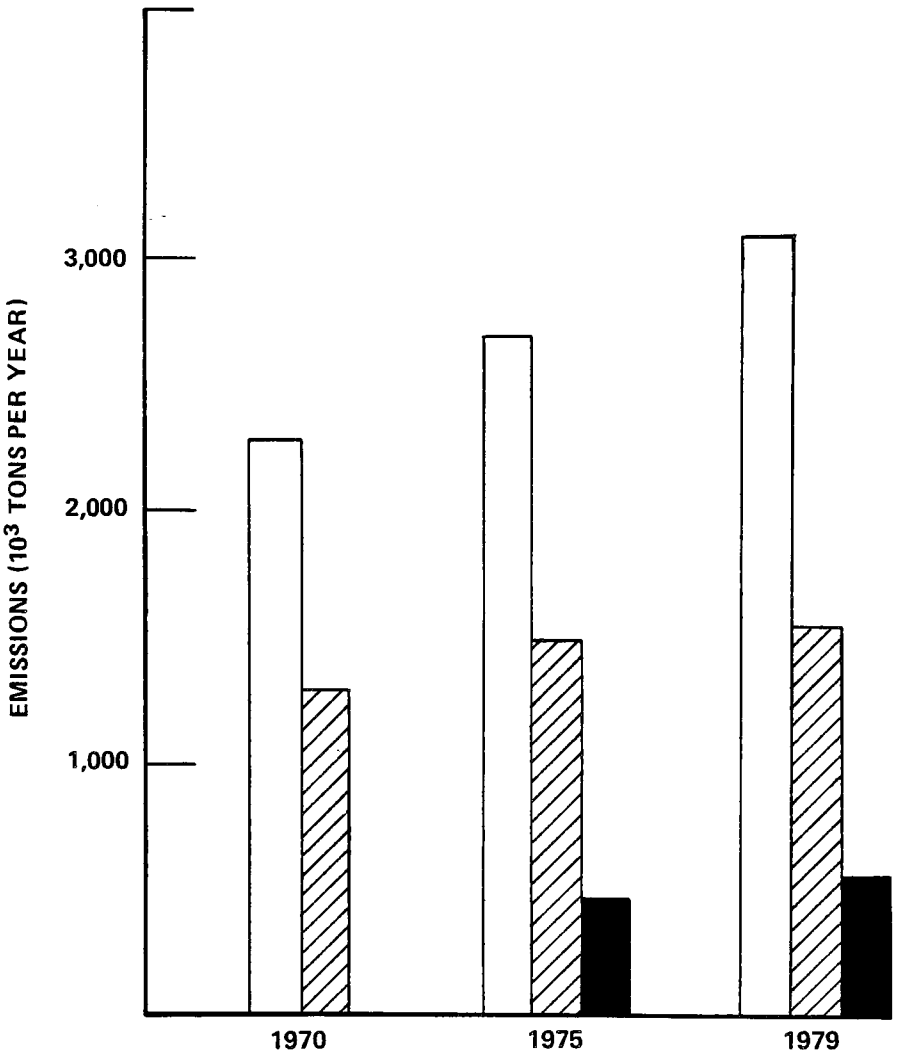
	VOC Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	18,260	17,213	24,269
Actual [A]	17,160	15,900	19,145
Compliance		13,633	16,687

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 30. Nationwide VOC Emissions, Stationary Sources.



EMISSION SUMMARY

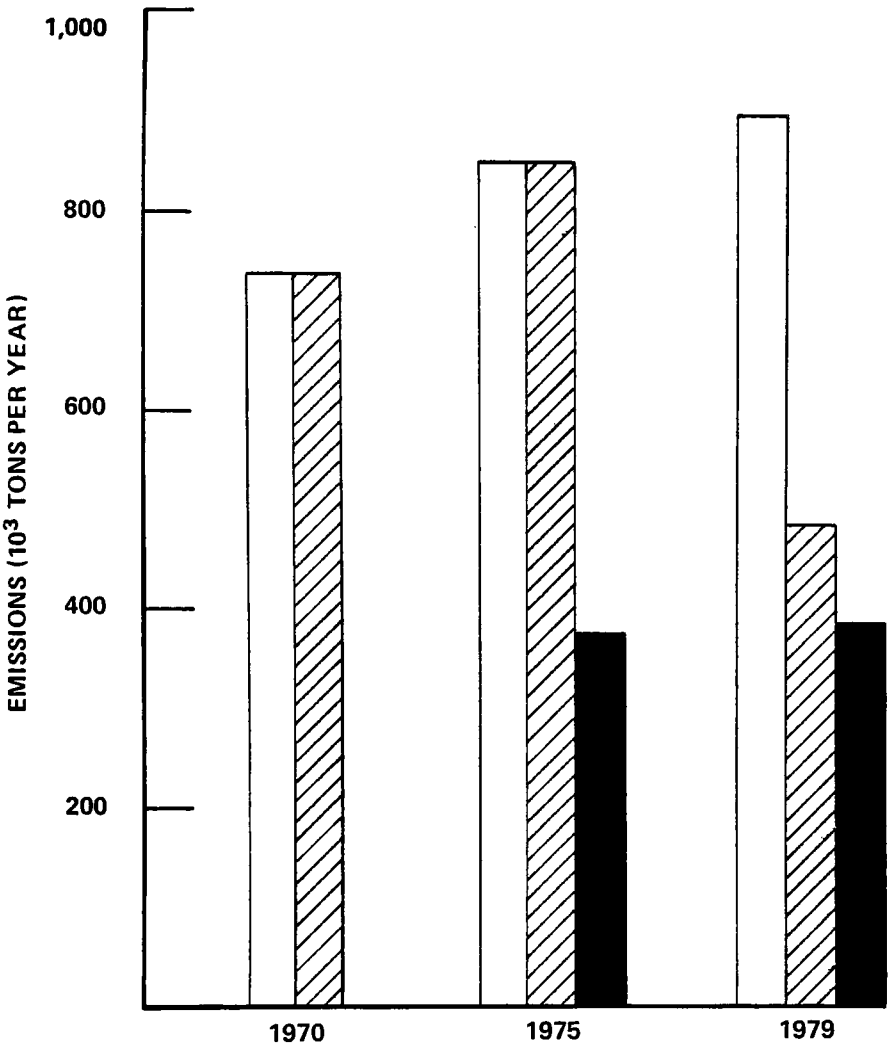
	VOC Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	2,337	2,753	3,090
Actual	1,237	1,440	1,506
Compliance		475	533

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 31. Petroleum Refineries, VOC Emissions.



EMISSION SUMMARY

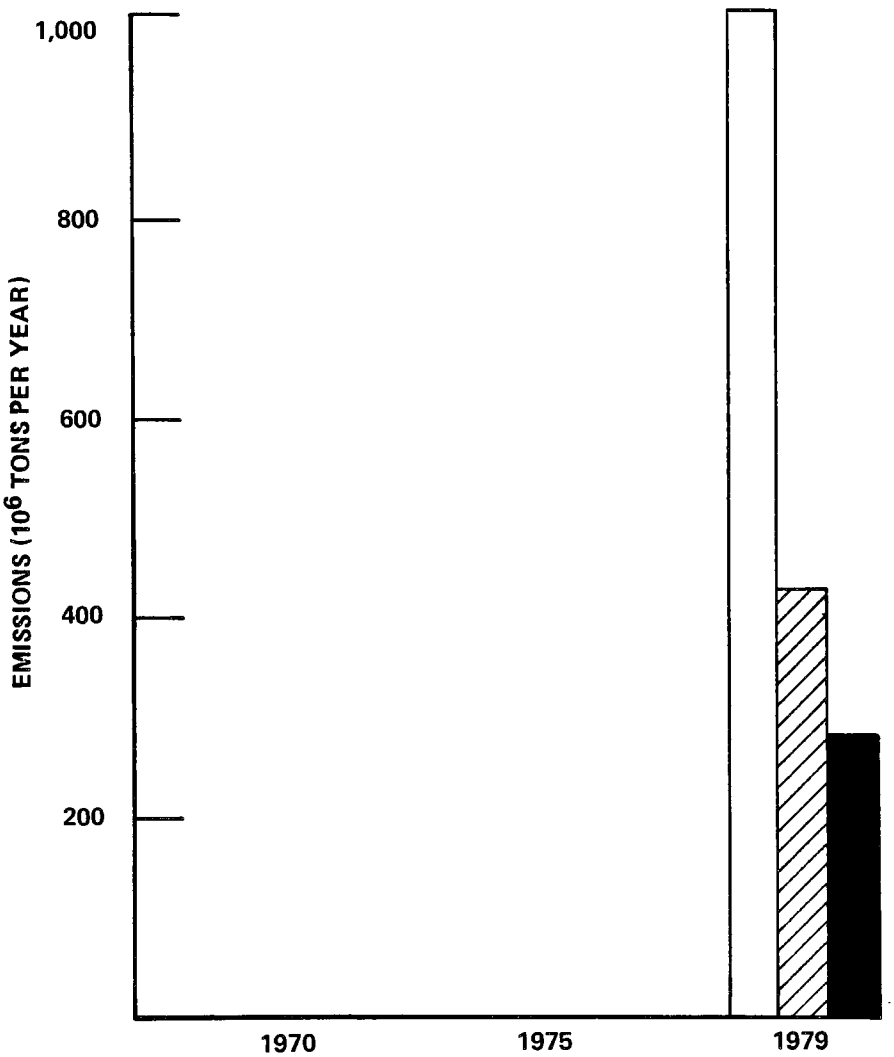
	VOC Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	737	840	889
Actual	737	840	476
Compliance		371	393

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 32. Bulk Gasoline Terminals, VOC Emissions.



EMISSION SUMMARY

	VOC Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	a	a	992
Actual	a	a	421
Compliance	a	a	235

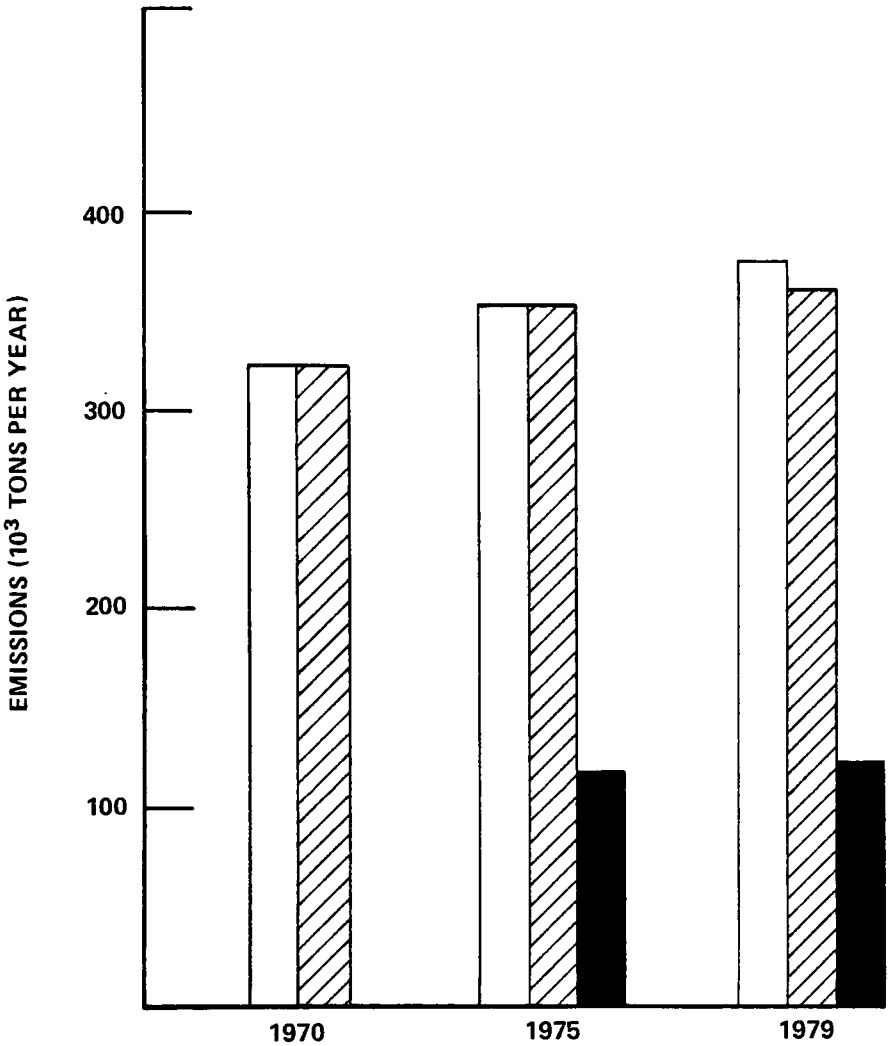
[a]Data not available

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 33. Cutback Asphalt Operations, VOC Emissions.



EMISSION SUMMARY

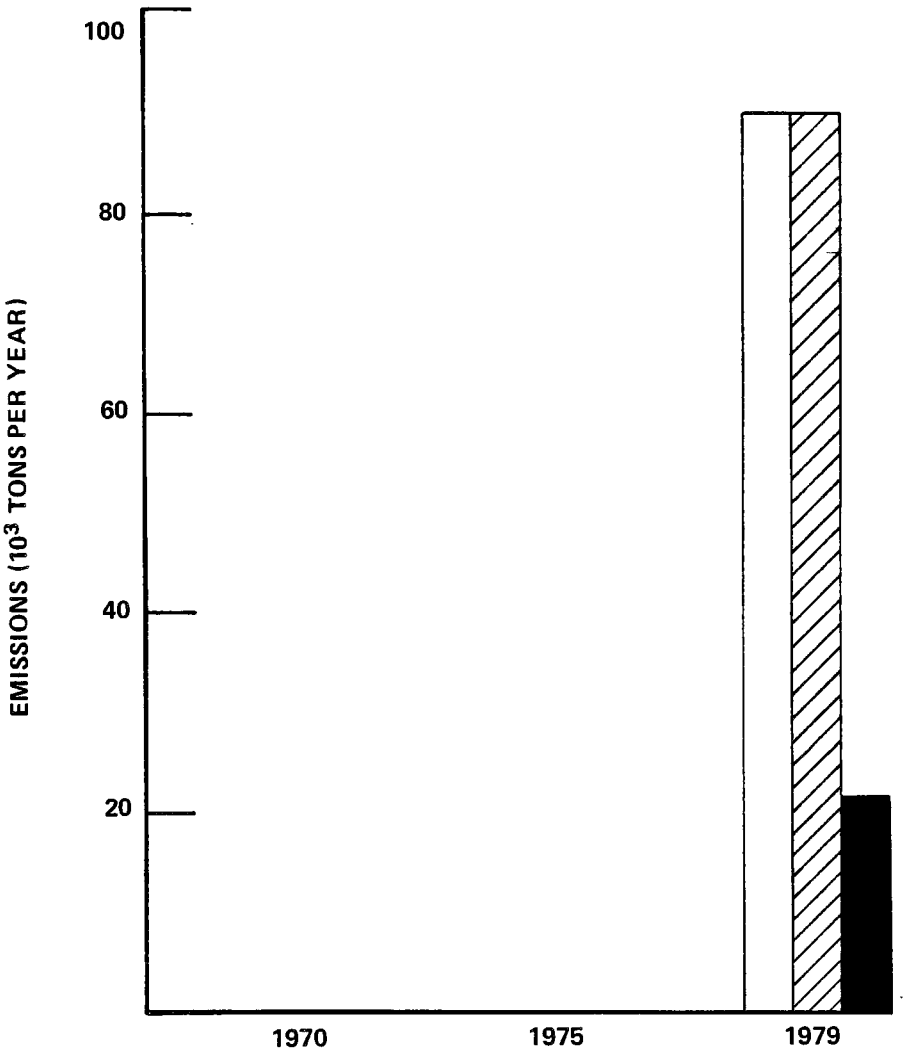
	VOC Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	323	359	375
Actual	323	359	359
Compliance		120	125

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 34. Paper Surface Coating, VOC Emissions.



EMISSION SUMMARY

	VOC Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	a	a	90
Actual	a	a	90
Compliance		a	22

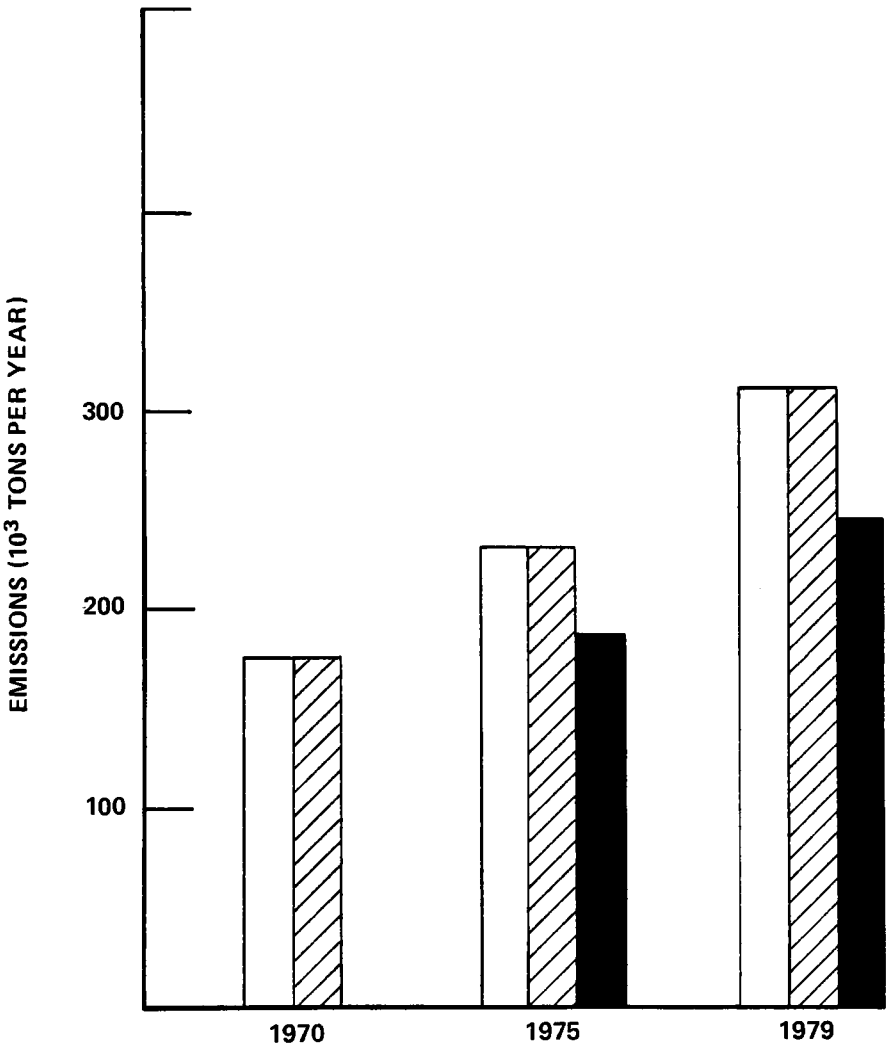
[a]Compatible data not available

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 35. Automobile and Light Duty Trucks Surface Coating, VOC Emissions.



EMISSION SUMMARY

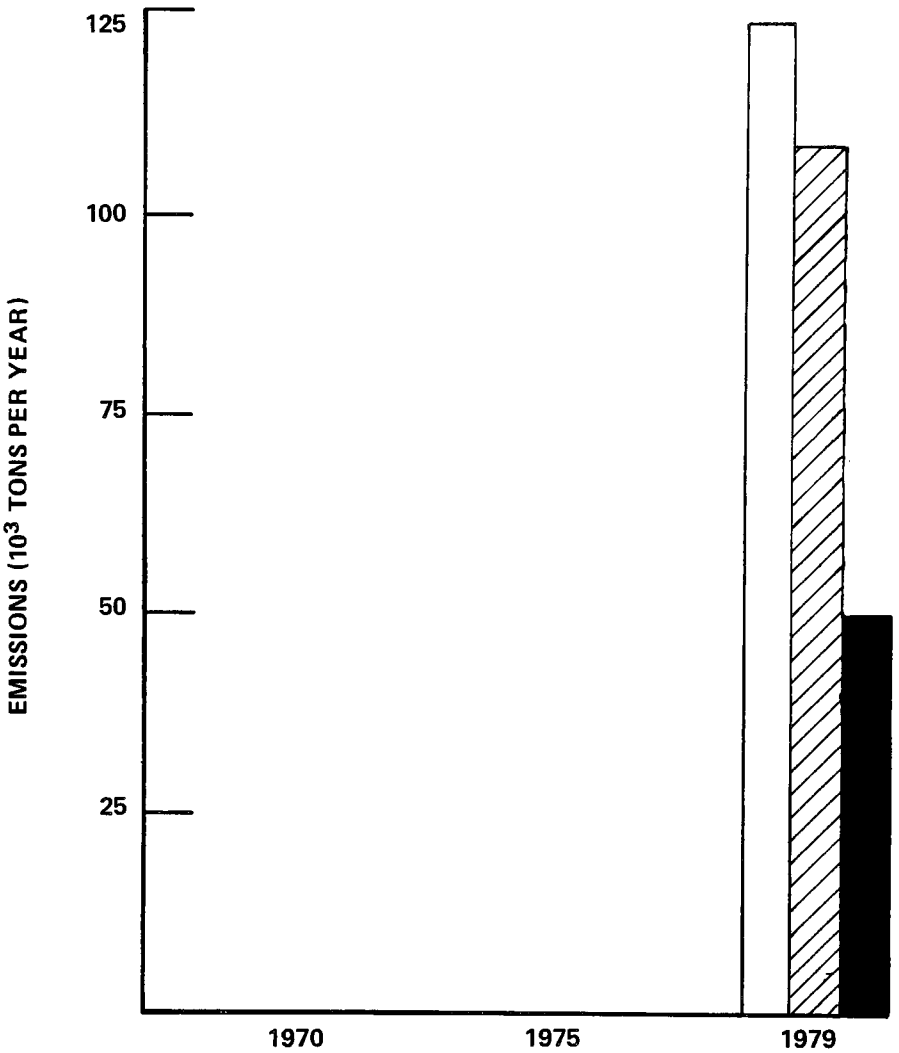
	VOC Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	172	234	308
Actual	172	234	308
Compliance		187	246

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 36. Wood Furniture Surface Coating, VOC Emissions.



EMISSION SUMMARY

	VOC Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	a	a	128
Actual	a	a	111
Compliance		a	53

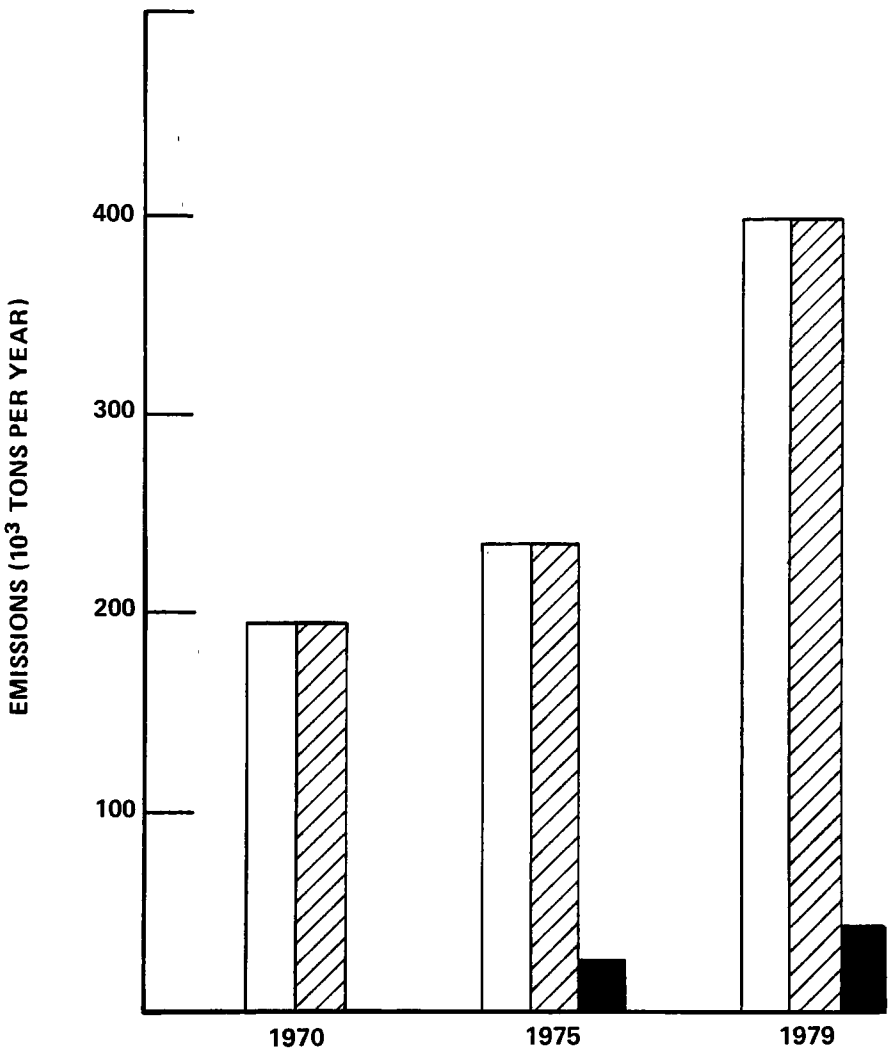
[a]Compatible data not available

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 37. Miscellaneous Metal Parts and Products Surface Coating, VOC Emissions.



EMISSION SUMMARY

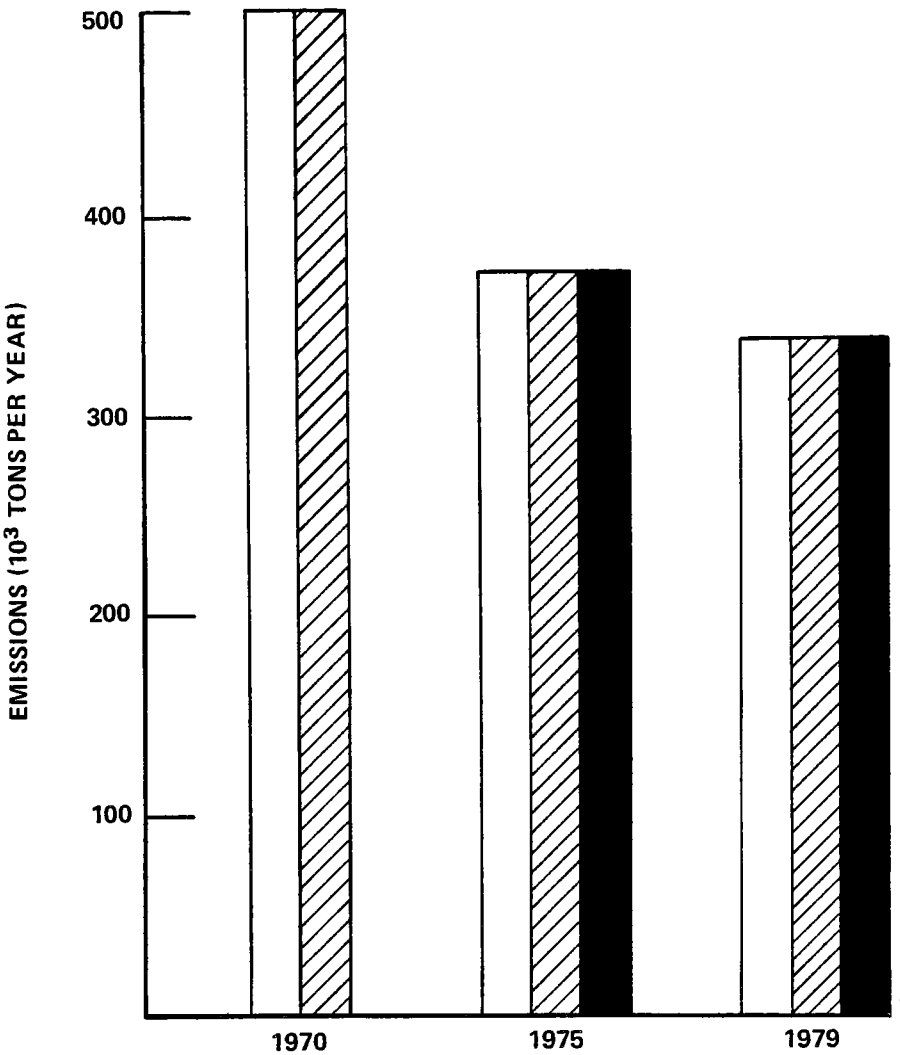
	VOC Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	195	238	403
Actual	195	238	403
Compliance		24	40

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 38. Plastics Manufactures, VOC Emissions.



EMISSION SUMMARY

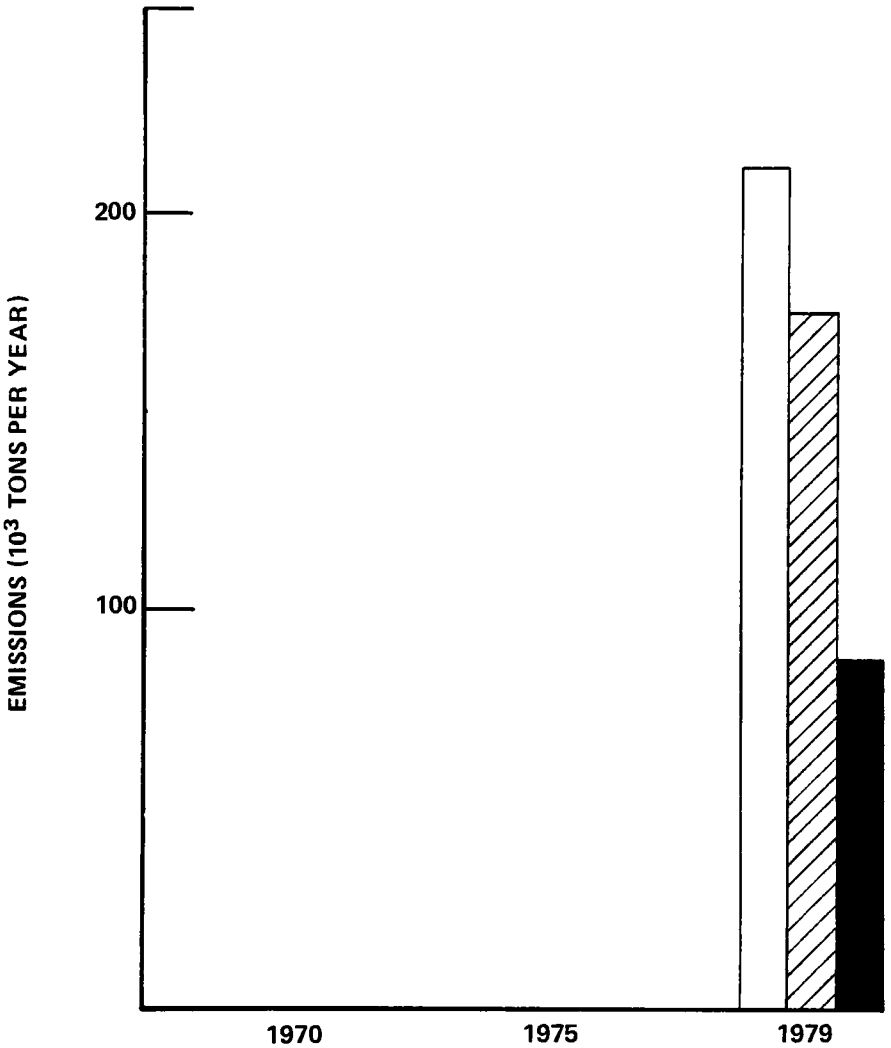
	VOC Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	500	370	343
Actual	500	370	343
Compliance		370	343

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 39. Solid Waste Disposal, VOC Emissions.



EMISSION SUMMARY

	VOC Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	a	a	212
Actual	a	a	149
Compliance		a	88

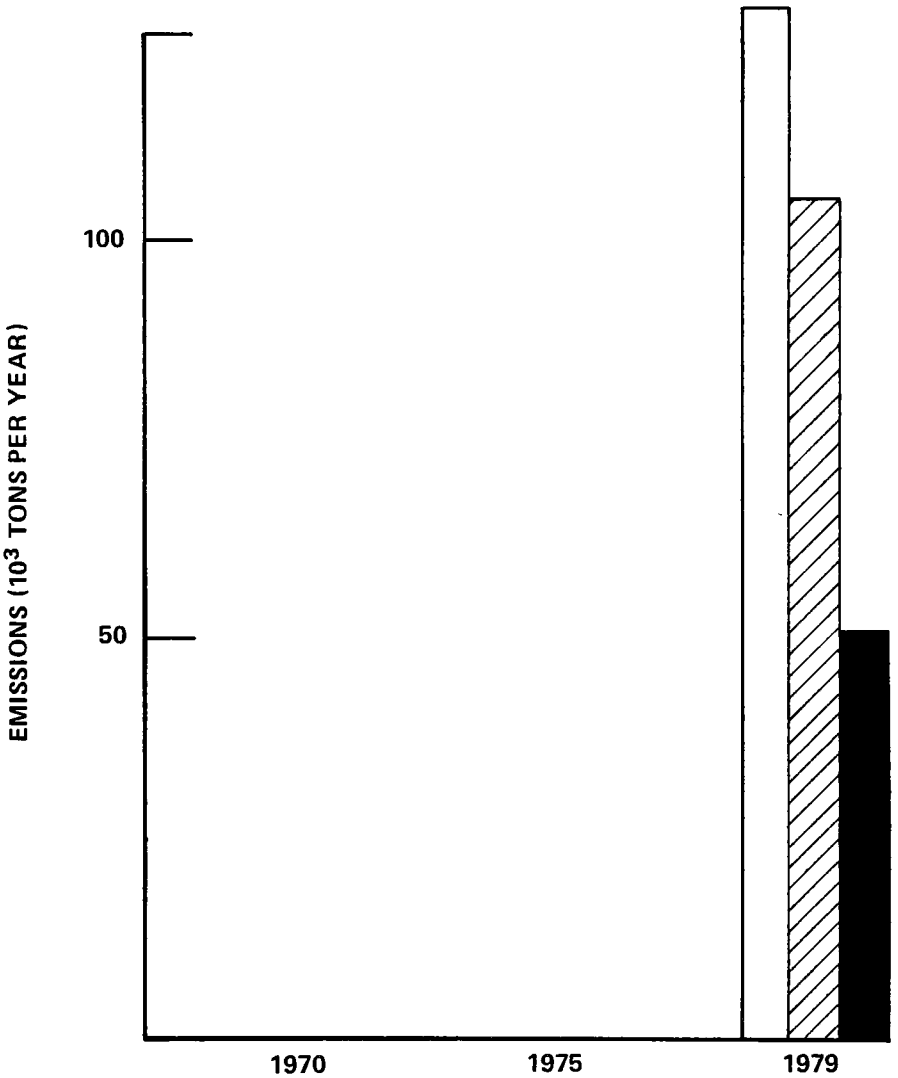
[a]Compatible data not available

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 40. Graphic Arts, VOC Emissions.



EMISSION SUMMARY

	VOC Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	a	a	128
Actual	a	a	111
Compliance		a	53

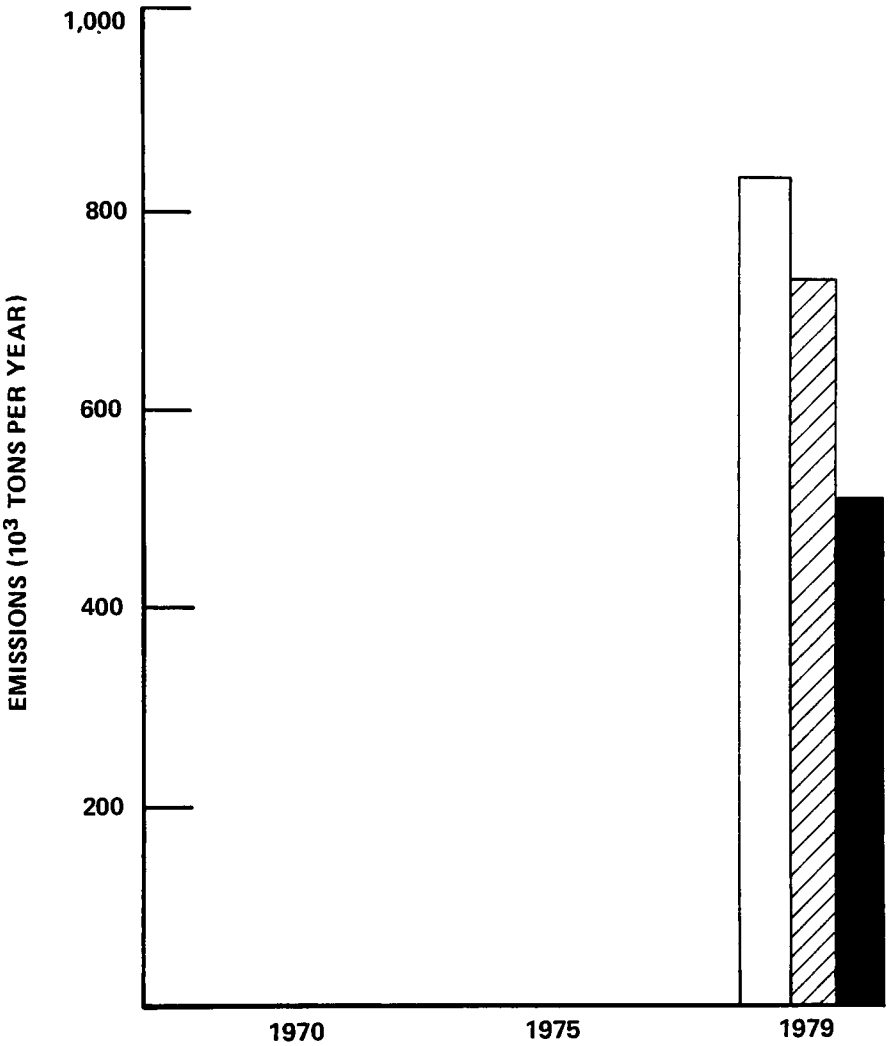
[a]Compatible data not available

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 41. Dry Cleaning, VOC Emissions.



EMISSION SUMMARY

	VOC Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	a	a	834
Actual	a	a	726
Compliance		a	512

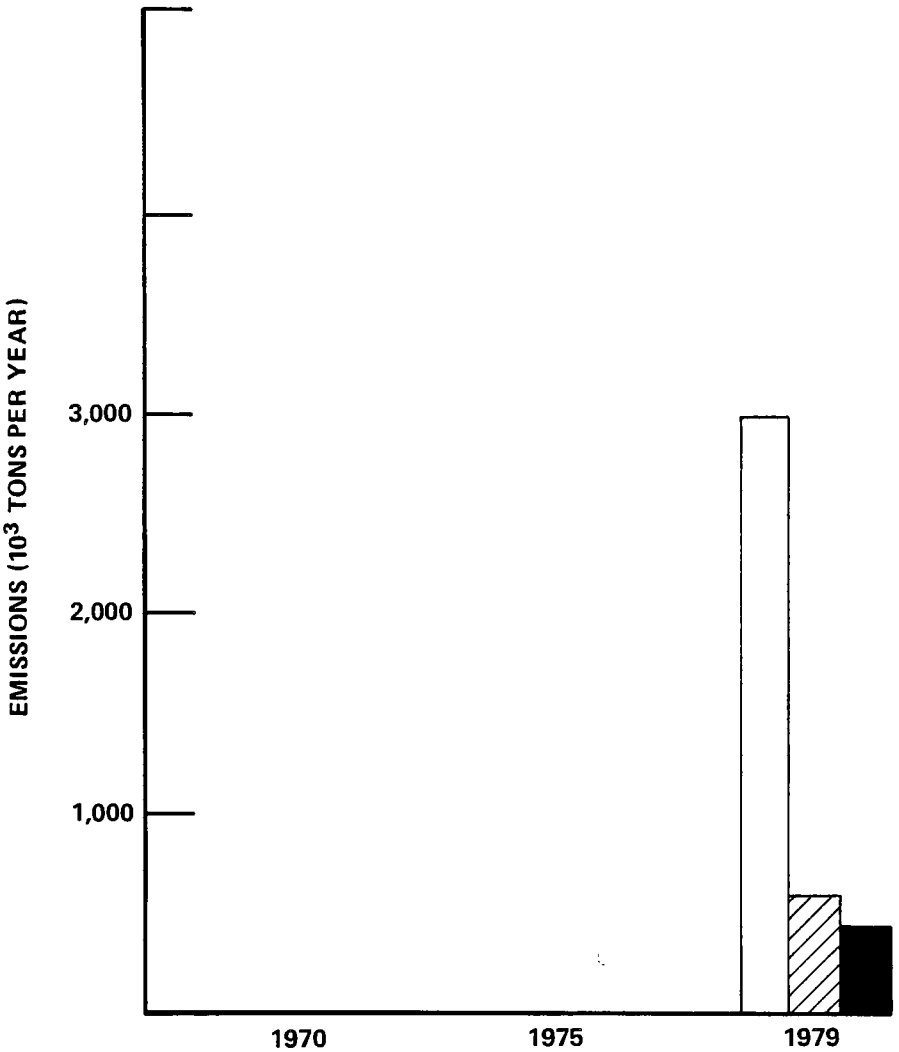
[a]Data not available

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 42. Solvent Metal Cleaning, VOC Emissions.



EMISSION SUMMARY

	VOC Emissions (10^3 tons per year)		
	1970	1975	1979
Uncontrolled	a	a	2,970
Actual	a	a	545
Compliance		a	447

[a] Data not available

Uncontrolled Emissions

Actual Emissions

Compliance Emissions

Figure 43. Architectural Coatings, VOC Emissions.

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APPENDIX A

CONTRIBUTION OF INDIVIDUAL SOURCE CATEGORIES TO NATIONWIDE EMISSIONS

TABLE A-1. CONTRIBUTION OF SELECTED SOURCE CATEGORIES TO NATIONWIDE PARTICULATE EMISSIONS

Source category	Percent of total actual emissions	Percent of total uncontrolled emissions
Coal-fired steam electric power plants	19.1	44.3
Stone and rock processors	10.9	4.5
Transportation	9.5	1.1
Portland cement plants	6.3	9.2
Coal-fired industrial boilers	5.6	3.4
Iron and steel mills and coke plants[a]	6.7	12.4
Grain elevators and mills	5.5	2.0
Forest fires and prescribed burning	4.2	0.5
Solid waste disposal[b]	3.5	0.4
Brick and tile plants	2.9	1.8
Primary copper smelters	2.6	0.6
Kraft pulp and paper mills	1.8	3.0
Coal mines	1.4	0.2
Lime plants	1.2	2.0
Asphalt batching plants	1.2	7.0
Grey iron foundries	1.1	1.2
Oil-fired electric steam-electric power plants	1.1	0.1
Primary aluminum smelters	0.8	0.5
Oil-fired industrial boiler plants	0.7	0.1
Clay processors	0.7	1.1
Residential coal, oil, and gas furnaces	0.5	0.1
Oil-fired commercial/institutional boilers	0.5	0.1
Ferroalloys plants	0.4	0.2
Primary lead smelters	0.3	0.2
Gas-fired industrial boilers	0.3	<0.1
Phosphate rock processors	0.3	1.0
Primary zinc smelters	0.2	0.1
Coal-fired commercial/institutional boilers	0.2	<0.1
Phosphate fertilizer plants	0.2	0.2
Municipal incinerators	0.2	<0.1
Gas-fired steam electric power plants	0.1	<0.1
Gas-fired commercial/institutional boilers	0.1	<0.1
Sulfuric acid plants	<0.1	<0.1
Carbon black plants	<0.1	<0.1
Coal cleaning plants	<0.1	0.3
Gas pipelines and plants	<0.1	<0.1
All other categories[c]		

Source: OAQPS Data File of Nationwide Emissions, 1978, December 28, 1979.

(Footnotes on next page)

TABLE A-1. CONTRIBUTION OF SELECTED SOURCE CATEGORIES TO NATIONWIDE PARTICULATE EMISSIONS (Continued)

[a]Coke ovens account for 1.2 and 0.2 percent of actual and uncontrolled emissions, respectively.
[b]Except municipal incinerators.
[c]Includes fuel combustion other than coal oil and gas, secondary metals--aluminum, lead, zinc, and copper; miscellaneous mineral products--glass, perlite, concrete batching, sand and gravel, gypsum, asphalt roofing, and castable refractories; miscellaneous chemical industry processes--phosphoric acid, calcium carbide, adiponitrile, phthalic anhydride, polyethelene, polyvinyl chloride, charcoal, paint manufacturing, ammonium nitrate, ammonium sulfate, and miscellaneous processes--sulfide pulp and paper, semi-chemical recovery furnaces and fluid bed reactors, plywood, cotton ginning, milling and grain processing, cattle feedlots, fluid bed catalytic crackers, thermal catalytic crackers, oil and gas process heaters; and miscellaneous sources other than forest fires and prescribed fires.

TABLE A-2. CONTRIBUTION OF SELECTED SOURCE CATEGORIES TO NATIONWIDE SULFUR OXIDE EMISSIONS

Source category	Percent of total actual emissions	Percent of total uncontrolled emissions
Coal-fired steam electric power plants	58.7	54.3
Primary copper smelters	7.1	12.1
Coal-fired industrial boilers	7.0	6.4
Oil-fired steam electric power plants	6.2	5.7
Oil-fired industrial boilers	4.0	3.7
Oil-fired commercial/institutional boilers	3.3	3.0
Transportation	3.3	3.1
Refineries	2.6	2.4
Portland cement plants	2.5	2.3
Sulfur recovery plants[a]	1.6	1.5
Residential coal, oil, and gas furnaces	1.3	1.2
Sulfuric acid plants	0.8	0.8
Kraft pulp and paper mills	0.3	0.3
Coal-fired commercial/institutional combustion	0.2	0.1
Solid waste disposal[b]	0.1	0.1
Primary lead and zinc smelters	0.1	2.1
GasfFired commercial/institutional boilers	<0.1	<0.1
Gas pipelines and plants	<0.1	<0.1
Gas-fired industrial boilers	<0.1	<0.1
Gas-fired steam electric power plants	<0.1	<0.1
Municipal incinerators	<0.1	<0.1
All other categories[c]	0.7	0.7

Source: OAQPS Data File of Nationwide Emissions, 1978, December 28, 1979.

[a]Used to purify sour natural gas or coke oven gas, and in petroleum refineries. Emissions will be distributed among these industries.
[b]Except municipal incinerators.
[c]Includes fuel combustion from other coal, oil, and gas; glass manufacturing; forest fires and prescribed burning; and other miscellaneous sources.

TABLE A-3. CONTRIBUTION OF SELECTED SOURCE CATEGORIES TO NATIONWIDE NITROGEN OXIDE EMISSIONS

Source category	Percent of total actual emissions	Percent of total uncontrolled emissions
Transportation	40.2	40.2
Coal-fired steam electric power plants	21.9	21.9
Gas pipelines and plants	13.1	13.1
Oil-fired steam electric power plants	5.2	5.2
Gas-fired steam electric power plants	3.7	3.7
Coal-fired industrial boilers	2.6	2.6
Gas-fired industrial boilers	2.4	2.4
Petroleum refineries	1.7	1.7
Residential, coal, oil, and gas furnaces	1.4	1.4
Oil-fired industrial boilers	1.3	1.3
Oil-fired commercial/institutional furnaces	1.1	1.1
Gas-fired commercial/institutional furnaces	0.6	0.6
Forest fires and prescribed fires	0.5	0.5
Solid waste disposal[a]	0.5	0.5
Portland cement	0.4	0.4
Coal-fired commercial/institutional combustion	<0.1	<0.1
Steel manufacture (coke ovens only)	<0.1	<0.1
Municipal incinerators	<0.1	<0.1
All other categories[b]	3.4	3.4

Source: OAQPS Data File of Nationwide Emissions, 1978, December 28, 1979.

[a]Except municipal incinerators.
[b]Includes fuel combustion other than coal, oil, and gas and industrial processes--acrylonitrite, adipic acid, adeponitrite, ammonium nitrile, TNT, and glass.

TABLE A-4. CONTRIBUTION OF SELECTED SOURCE CATEGORIES TO NATIONWIDE VOC EMISSIONS

Source category	Percent of total actual emissions	Percent of total uncontrolled emissions
Transportation	38.2	35.8
Organic solvent[a]	11.1	10.4
Refineries	4.9	10.6
Bulk gasoline terminals	2.7	2.8
Cutback asphalt plants	2.2	2.1
Forest fires and prescribed fires	2.1	2.0
Degreasers	1.9	1.7
Service stations, Stage 1	1.8	1.7
Service stations, Stage 2	1.7	1.6
Surface coating plants, paper	1.6	1.5
Solid waste, open burning	1.3	1.2
Graphic arts facilities	1.3	1.2
Plastic plants	1.2	1.1
Surface coating plants, automobiles	1.2	1.1
Dry cleaning plants	1.2	1.1
Solid waste, onsite incineration	1.1	1.0
Architectural coating	1.1	1.0
Surface coating plants, wood furniture	1.0	0.9
Surface coating plants, miscellaneous metal products	1.0	0.9
Adhesive manufacturing plants	0.9	0.9
Gasoline bulk plants	0.6	0.5
Pesticides use	0.5	0.4
Carbon black plants (oil and gas)	0.5	0.4
Synthetic rubber plants	0.4	0.4
Gas pipelines and plants	0.2	0.2
Coal-fired steam electric power plants	0.2	0.1
Iron and steel plants (coke ovens only)	0.1	<0.1
Residential, coal, oil, and gas furnaces	<0.1	<0.1
Oil-fired steam electric power plants	<0.1	<0.1
Coal-fired industrial boilers	<0.1	<0.1
Oil-fired industrial boilers	<0.1	<0.1
Oil-fired commercial/institutional boilers	<0.1	<0.1
Gas-fired steam electric power plants	<0.1	<0.1
Coal-fired commercial/institutional boilers	<0.1	<0.1
Gas-fired industrial boilers	<0.1	<0.1
Gas-fired commercial/institutional boilers	<0.1	<0.1
Municipal incineration	<0.1	<0.1
All other categories[b]	18.2	17.2

Source: OAQPS Data File of Nationwide Emissions, 1978, December 28, 1979.

(Footnotes on next page)

TABLE A-4. CONTRIBUTION OF SELECTED SOURCE CATEGORIES TO NATIONWIDE VOC EMISSIONS (Continued)

[a]Miscellaneous solvent losses estimated by subtracting solvent consumption in individual source categories from total national consumption. These solvent losses are from a large number of small sources and are probably uncontrollable.

[b]Includes fuel combustion other than coal, oil, or gas; miscellaneous chemical--textile polymers, pharmaceuticals, paint, ammonia, and charcoal; other processes--beehive coke, fermentation, vegetable oil, bakeries, glass, and miscellaneous sources, petrochemicals--acetic acid, acrylonitrile, dimenthyl terephthalate, ethylbenzene, ethylene, ethylene oxide, formaldehyde, maleic anhydride, methanol, methyl methacrylate, propylene oxide, vinyl chloride, other products, storage and handling, waste disposal, and fugitive emissions; petroleum marketing and distribution--crude oil production; natural gas liquids; crude oil field storage; ship and barge transfer, domestic crude loading, crude unloading, and gasoline transfer; and distillate fuels shortage; other surface coating processes--large appliances, magnet wire, cans, coils, fabric, flatwood products, metal furniture, automobile refinishing, and miscellaneous categories; miscellaneous solid waste disposal; miscellaneous burning; and miscellaneous solvent use.

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
EPA-340/1-81-001a		

4. TITLE AND SUBTITLE	5. REPORT DATE
Emission Reduction Study: Stationary Sources of Air Pollution (1970-1979)	February 1981
	6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT NO.
Martin F. Massoglia John P. Wood Kenneth H. Babb	

9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT NO.
Research Triangle Institute P.O. Box 12194 Research Triangle Park, North Carolina 27709	11. CONTRACT/GRANT NO. Task 35, Contract 68-01-4141

12. SPONSORING AGENCY NAME AND ADDRESS	13. TYPE OF REPORT AND PERIOD COVERED
U.S. Environmental Protection Agency, Office of Enforcement, Division of Stationary Source Enforcement (EN-341) 401 M Street, S.W. Washington, D.C. 20460	Final 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This research documents the progress private business, state, and Federal agencies have made towards meeting the primary ambient air quality standards for criteria air pollutants. These pollutants must be reduced to acceptable levels to ensure reasonably healthy atmospheric conditions.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Abatement program Air pollution Emission reduction Nitrogen oxides Particulates Stationary sources Sulfur oxides Volatile organic compounds	State Implementation Plans	13b

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES
Unlimited	Unclassified	78
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE