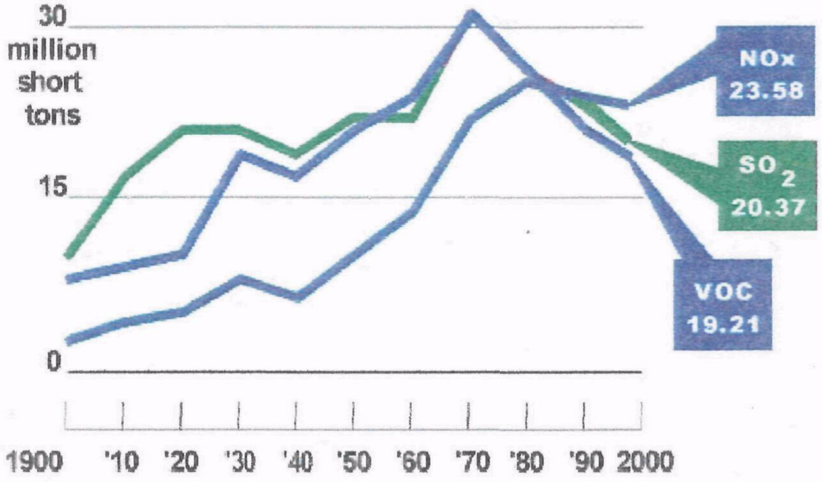
United States Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park NC 27711
EPA-454/E-98-007
December 1998
AIR

EPA NATIONAL AIR POLLUTANT EMISSION TRENDS UPDATE, 1970 - 1997



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National Air Pollutant Emission Trends Update

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The 1998 National Air Pollutant Emission Trends Database Developments for fiscal year 1998:

This year, the US EPA did not publish the National Air Pollutant Emission Trends Report. Instead, we have prepared this brief Update, with widespread distribution through our Website at:

http://www.epa.gov/ttn/chief/trends97/emtrnd.html

Look for a full report in October, 1999. US EPA did update the National Emission Trends database (hereinafter referred to as the NET), however; making improvements to some previous estimates and adding 1997 values. In addition, a 1996 National Toxics Inventory was developed.

This update is comprised of a discussion of new methodologies, a brief discussion of the greenhouse gas inventory, new toxics data, an appendix (A) listing summary tables that includes biogenic emissions, and an appendix (B) listing particulate matter and ammonia methods.

METHODOLOGIES THAT ARE NEW:

Changes in emission estimation methods occurred for a few source categories. For the non-road category, changes have resulted in a net decrease overall, but several tier 3 categories have increased. Other increases for 1996 compared to last year's database are a result of revised activity data for categories such as fuel combustion, utilities, and miscellaneous fugitive dust.

Method changes are described below. For a brief discussion of methodologies for categories not mentioned below, please refer to the 1900-1996 report located at www.epa.gov/oar/emtrnd96. And for a more detailed discussion, refer to the National Air Pollutant Emission Trends Procedures Document located at www.epa.gov/ttn/chief/ei_data.html#ETDP.

MOBILE SOURCES

NON-ROAD VEHICLE ESTIMATES

Diesel, revised Trend Lines: For most nonroad diesel equipment types (i.e., 7-digit Source Classification Codes, or SCC) emission estimates for 1986 to 1997 were obtained from the Office of Mobile Sources (OMS) draft NONROAD Model. (This draft model is an updated version of the earlier draft model used for the nonroad diesel numbers in the December 1997 Trends Report.) A trend line back to 1970 was then obtained by normalizing the nonroad emission estimate using a ratio of 1986 model output to the existing estimate for each equipment category.

Large increases were seen in PM10 and NOx diesel estimates for the 1996 database year (refer to the *National Air Pollutant Emission Trends Report*, October 1996). This was due to the use of the draft NONROAD model. However, further refinements were developed on the new draft of the model for this database year, and results are reflected in Appendix A of this update. About half of the nonroad diesel categories show an increase over last year's (December 1997 *Report*) estimates. However, there is a **NET** total *decrease* in the nonroad diesel category. This is due to the large decrease seen in the "farm" category. PM-10 and NOx are the two most important pollutants generated from nonroad diesel sources.

The increases for the two most recent Trends inventories are, in general, due to more accurate equipment populations, changes in other parameters (hours annual usage), and the addition of new equipment types (i.e., 10-digit SCCs) within these categories. These equipment types include:

1) Industrial, AC/Refrigeration;
2) Industrial, Other Oil Field Equipment;
3) Farm, Irrigation Sets;
4) Construction and Mining, Other Underground Mining Equipment; and
5) Railroad, Railway Maintenance.

The newer draft NONROAD model generated SO2 emissions which were, in general, not calculated previously for nonroad diesel.

(For information on the NONROAD model, refer to the website http://www.epa.gov/oms/nonrdmdl.htm).

Airport service: This category was not estimated with the NONROAD Model, since the methodology for this category is still under review. Refer to Sections 4.7.3 through 4.7.6 of the *Procedures Document (link can be found on the main Update webpage)* for information on airport service estimation methods.

FUGITIVE DUST SOURCES

The estimate for "geogenic wind erosion" was carried over from 1996, since methods for estimating this category are under review. The **1999** Trends Report is expected to include revised values for this category along with an explanation of methods.

MISCELLANEOUS SOURCES

OTHER COMBUSTION

Structural fires: Structural fire emission methods for 1996 were revised for 42 states and the District of Columbia. The "National Fire Incident Reporting System" (NFIRS) was used to compile the number of fires per state. For those States that reported, the percentage of fire stations reporting relative to the total number of fire stations within each State was calculated (since typically only a percentage of the fire stations report data to NFIRS). Then the number of fires were scaled up to estimate the actual number (i.e., reported and unreported) of fires occurring within a State for 1996. Using these data, along with State populations, a State-specific per capita factor was developed to allocate activity to the county level. If a State did not report to NFIRS, a default per capita factor based on the national estimate of structural fires from the National Fire Protection Agency was used. The activity was then multiplied by the appropriate loading factor and emission factor. 1997 structural fire emissions were then estimated by growing 1996 emissions using population as a surrogate.

The remaining states supplied actual 1990 structural fire data for their States through the Ozone Transport and Assessment Group (OTAG) process. These data were extrapolated, using population surrogates, to 1996 last year, and again this year to 1997. A table of these OTAG states can be found in the Procedures Document referred to above.

METHODOLOGIES FOR PM2.5 AND NH_3:

Methods for PM2.5 and NH_3 are listed in Appendix B of this report. However, please note the following:

Information published by the EPA in Chapter 4 of the Air Quality and Emission Trends Report, December 1998, EPA-454/R-98-016, suggests that the presence of PM2.5 crustal materials in the ambient air is much lower than is suggested by the magnitude of the the emissions as presented in this Trends update. (Crustal material emissions are generally those associated with the fugitive dust and geogenic materials and they comprise over ½ of the PM2.5 inventory). Preliminary investigation indicates that many of these emissions are removed very close to the source owing to their low release height, interaction with their surroundings (e.g., impaction, vegetative filtration) and lack of inherent thermal buoyancy. Thus, the crustal materials emission estimates contained herein should not be used to infer their contribution to PM2.5 ambient concentrations unless appropriate adjustments or accommodation in transport models are made to account for the near source removal of these particles. Emission mechanisms for many sources of ammonia are not well understood and much research is ongoing to improve methods for estimating ammonia emissions.

UNITED STATES GREENHOUSE GAS INVENTORY (GHG)

Methodology

Figures 29 through 32 present carbon dioxide emissions data by industry sector for the entire US in the year 1994. This analysis was based on data contained in several Environmental Protection Agency (EPA) and Energy Information Administration (EIA) reports: the Manufacturing Consumption of Energy 1994, DOE/EIA-0512(94); The Annual Energy Review 1997, DOE/EIA-0384(97); Emissions of Greenhouse Gases in the United States 1997, DOE/EIA-0573(97); and the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-1996, EPA 236-

R-98-006.

The Annual Energy Review, EIA and the Emissions of Greenhouse Gases, EPA were used to develop national estimates of CO_2 for the year 1994. Both of these inventories report data on CO_2 emissions caused by both fuel combustion and industrial processes, and both were included in this analysis. Typically, fossil fuel combustion represents 81% of total US GHG emissions and 99% of total US CO_2 emissions, although there is some year-to-year variance. Cement manufacture is the largest remaining source of industrial CO_2 emissions, and has been estimated to contribute about 10 million metric tons of carbon equivalents (MMTCE) to the annual US emissions. For more information on industrial sources of CO_2 or other GHG emission data, the reader is referred to the EPA inventory document or web site at www.epa.gov/globalwarming/inventory.

The Manufacturing Consumption of Energy (known as MECS) data were used to develop the detailed estimates for the industry sector. The MECS data are prepared once every 4 years, thus 1994 is presented as the most recent year for which the MECS data were available. The MECS data contains rich detail on manufacturing industries, but no information on the non-manufacturing industries, such as agricultural activity, mining, and construction. The MECS data were merged with estimates of total industrial energy use to develop these results. Emission estimates were developed using carbon coefficients for various fuel types, and for a quality assurance check, were compared with national inventory data. Refer to Annex A of the EPA Inventory document for more detail on carbon coefficients for fuel types. The table below presents the actual carbon coefficients used in this analysis.

CARBON COEFFICIENTS, MMTCU/qBTU(Q=E15)

	Electricity	Resid Oil	Dist. Oil	NG	LPG	Coal	Coke
1994	50	21.49	19.95	14	17.01	25	25
1996	50	21.49	19.95	14	16.99	25	25

Figures 29 through 32 present total national CO_2 emissions for the U.S., broken out by sector. The utility sector, which represents 36% of total CO_2 emissions in 1994, supplies energy to industry. Emissions resulting from electricity production can thus be prorated to industry on the basis of electricity consumption. Ideally, this would be done on a regional basis in order to best capture the complexity of our nation's energy supply system and to account for variations in carbon emissions per kilowatt hour. However, this analysis uses national averages to develop the carbon emissions embedded in electricity consumption and attributes these emissions to the industries on the basis of their electricity demand.

Results

Figure 29 shows total US CO_2 emissions in 1994. Utilities contribute 36% of that total, with transportation the second largest sector at 31% of total CO_2 emissions. Emissions from utilities were estimated at 495 MMTCE in 1994, with 87% of that total resulting from coal consumption, 9% from natural gas, and 4% from petroleum fuels.

Figure 30 presents all industrial emissions of CO_2 - both manufacturing and non-manufacturing, and the graph was developed to account for both "on-site" and "off-site" emissions. In this case, on-site emissions are process-related emissions such as CO_2 flux from lime calcination, and off-site emissions refer to the emissions that result from fossil fuel consumption at power plants supplying electricity to industry.

Figure 31 presents CO_2 emissions for the entire US, and differs from Figure 29 in that utility sector has been "mapped" into the various end-use sectors that consume the electricity generated at utilities.

Figure 32 presents the CO_2 emissions data in tabular form.

THE NATIONAL TOXICS INVENTORY (NTI)

There were approximately 8.1 million tons of air toxics released to the air in 1993 according to EPA's National Toxics Inventory (NTI). Air toxics are emitted from all types of manmade sources, including large industrial sources, small stationary sources, and mobile sources. As shown in Figure 33, the 1993 NTI estimates of the major source (sources of hazardous air pollutants (HAPs) emitting more than 10 tons per year of an individual HAP or 25 tons per year of aggregate emissions of HAPs) are approximately 61 percent of the national total of all HAP emissions. Area sources contribute approximately 18 percent to the 1993 national emissions of HAPs, and mobile sources contribute 21 percent. Figure 34 illustrates the range in percent contributions of point, area, and mobile source emissions for selected states. Point source contributions ranged from 81 percent (Alabama) to 16% (Hawaii). Area source contributions ranged from 48 percent (Idaho) to 9 percent (Alabama), and mobile source contributions ranged from 55 percent (Hawaii) to 10 percent (Alabama). Figure 35 presents the geographic distribution of 1993 emissions of HAPs by mass. This figure shows total emissions of HAPs for each state and does not necessarily imply relative health risk by exposure to HAPs by state. The categorization of pollutant emissions as high, medium, and low provides a rough sense of the distribution of emissions. In addition, some states may show relatively high emissions as a result of very large emissions from a few facilities, or show relatively high emissions as a result of very small emissions from a large number of smaller point sources.

The 1993 NTI includes emissions information for 166 of the 188 HAPs from 958 point-, area-, and mobile-source categories. Emissions data from the Toxic Release Inventory (TRI) were used as the foundation of the 1993 NTI. The TRI data, however, are significantly limited in several key aspects as a tool for comprehensively characterizing the scope of the air toxics issue.

For example, TRI does not include estimates of air toxics emissions from mobile and area sources. The 1993 NTI suggests that the TRI data alone represent less than 10 percent (760,000 tons/year) of the total NTI emissions. Therefore, the NTI has incorporated other data to create a more complete inventory, as discussed below.

Data from EPA studies, such as the Mercury Report, inventories for Clean Air Act sections 112c(6) and 112(k), and data collected during development of Maximum Achievable Control Technology (MACT) Standards under section 112(d), supplement the TRI data in the NTI. The use of non-TRI data is particularly important for providing estimates of area- and mobile-source contributions to total HAP emissions.

THE 1996 NTI

The EPA updated the 1993 NTI and is currently compiling the 1996 NTI. The 1993 and 1996 NTIs incorporate state data and local HAP inventories. In the 1996 NTI, thirty-eight state and local agencies (representing 34 states) submitted a HAP inventory for inclusion in the NTI. Figure 36 shows the states that submitted a 1996 HAP inventory to EPA. Thus, the state and local HAP inventories are the foundation of the 1996 NTI. The 1993 NTI data are allocated at the county level, whereas, the 1996 NTI data are allocated at the facility level for point (major) sources.

Draft estimates of mobile on-road and point (major) source emissions are available in the 1996 NTI. Area and non-road mobile emissions estimates will be available in spring, 1999. Development of the 1996 NTI is continuing and additional information concerning emissions from sources regulated under the MACT program will be added, as well as additional state and local emissions data submitted as part of Title V operating permit surveys of the Act.

Table 1 compares 1993 and 1996 mobile on-road source emissions. Mobile on-road emissions decreased by 258,000 tons as a result of regulations requiring the use of reformulated fuels and other mobile source programs. Table 2 lists HAPs emitted from on-road gasoline vehicles that have emission estimates in the 1993 and 1996 NTIs. Although the EPA addresses stationary and mobile sources under separate regulatory authorities and through separate offices, these emissions are being evaluated together in EPA's air toxics strategies. Section 202(l) requires EPA to regulate the emissions of hazardous air pollutants from motor vehicles. EPA's reformulated gasoline program requires a 15% year round reduction in the total mass of toxic emissions. EPA's Office of Mobile Sources has provided estimation methodologies for the mobile source-emitted HAPs included in the NTI.

Point source emissions are projected to decrease by 660,000 tons from 1993 to 1998 as a result of MACT standards. Table 3 presents a summary of emission reductions from full implementation of MACT standards.

The EPA is compiling the NTI every three years (1993, 1996, 1999, etc.) The emissions estimates in the NTI, regardless of base year, have several caveats. The NTI is a repository of HAP emissions data from various sources, and it varies in quality and completeness among source categories, geographic location, and estimation methods. As the process of compiling this data is evolving, estimates will likely improve. However, as new base year inventories are compiled and source category and emissions calculation methods change, emissions totals are likely to change.

Table 1. Comparison of 1993 to 1996 Emission Reductions for Mobile On-Road Gasoline Vehicles

1993 Total HAP Emissions (tons per year)	1996 Total HAP Emissions (tons per year)	Emissions Reduction (tons per year)
1,571,000	1,313,000	258,000 = 16%

Table 2. HAPs Emitted From On-Road Gasoline Vehicles

Acetaldehyde
Acrolein
Arsenic and compounds
Benzene
1,3-Butadiene
Chromium and compounds
Dioxins/Furans (defined as TEQ)
Ethylbenzene
Formaldehyde
n-Hexane
Lead and compounds
Manganese and compounds
Mercury and compounds
Methyl tert-butyl ether[a]
Nickel and compounds
Polycyclic Organic Matter (defined as 16-PAH)
Propionaldehyde
Styrene
Toluene
Xylenes (o,m,p)

[a] not available for the 1993 inventory year

Table 3. Emission Reductions from Full Implementation of MACT Standards

Compliance Date	MACT Source Category	HAPs Emitted	Total Baseline Pre-MACT Emissions[a]	Emissions Reduction[b]	Total Post-MACT Emissions[b]
10/27/93	Coke Ovens: Charging, Top side, and Door leaks[c]	Benzene Coke oven gases Polycyclic Organic Matter	1,760 tpy	80 % = 1,408 tpy	352 tpy
9/23/96	Perchloroethylene Dry Cleaning Facilities	Perchloroethylene	95,700 tpy	56 % = 53,592 tpy	42,108 tpy
3/8/96	Industrial Process Cooling Towers	Chromium & compounds	25 tpy	>99 %	0
12/15/96 (w/o new control device), 12/15/97 (w/ new control device)	Magnetic Tape Manufacturing	Methyl ethyl ketone Methyl isobutyl ketone Toluene	4,470 tpy	51 % = 2,300 tpy	2,170 tpy
1/25/96 (decorative) 1/25/97 (hard & anodizing)	Chrome Electroplating: Decorative Hard Anodizing	Chromium & compounds	 11.5 160 3.9 = 175.4 tpy	99 % = 173 tpy	2 tpy
4/22/97	HON	Total unspeciated HAPs	573,000 tpy	90 %= 515,700 tpy	57,300 tpy
11/21/97	Wood Furniture Manufacturing Operations	Glycol ethers Methyl ethyl ketone Methyl isobutyl ketone Toluene Xylenes (o,m,p)	170 tpy	60 % = 102 tpy	68 tpy
12/2/97	Halogenated Solvent Cleaning	Methyl chloroform Methylene chloride Tetrachloroethylene Trichloroethylene	142,000 tpy	60 % = 85,200 tpy	56,800 tpy
12/15/97	Gasoline Distribution	Benzene Cumene Ethyl benzene Ethylene dichloride Hexane Lead & compounds Methyl tert-butyl ether Polycylic Organic Matter Toluene 2,2,4-Trimethylpentane Xylenes (o,m,p)	44,200 tpy	5 % = 2,210 tpy	41,990 tpy

Table 3- Continued. Emission Reductions from Full Implementation of MACT Standards

Compliance Date	MACT Source Category	HAPs Emitted	Total Baseline Pre-MACT Emissions[b]	Emissions Reduction[b]	Total Post-MACT Emissions[b]
12/16/97	Shipbuilding and Ship Repair Facilities	Acrylonitrile Chlorine Chromium & compounds Diethanolamine Ethylbenzene Ethylene dichloride Ethylene glycol Glycol ethers Lead & compounds Manganese & compounds Methyl chloroform Methyl ethyl ketone Methyl isobutyl ketone Methylene chloride Nickel & compounds Polycyclic Organic Matter Toluene Trichloroethylene Xylenes (o,m,p)	7,890 tpy	24 % = 1,894 tpy	5,996 tpy
12/23/97	Secondary Lead Smelting	Acetaldehyde Acetophenone Acrolein Acrylonitrile Antimony & compounds Arsenic & compounds Benzene Biphenyl Bis (2-ethylhexyl)phthalate 1,3-Butadiene Cadmium & compounds Carbon disulfide Chlorobenzene Chloroform Chromium & compounds Cumene Dibutyl phthalate 1,3-Dichloropropene Dioxins/Furans Ethyl carbamate Ethylbenzene Formaldehyde Hexane Lead & compounds Manganese & compounds Mercury & compounds Methyl bromide Methyl chloride Methyl ethyl ketone Methyl iodide Methylene chloride Nickel & compounds Phenol Polycyclic Organic Matter Propionaldehyde Styrene 1,1,2,2-Tetrachloroethane Toluene Trichloroethylene Xylenes(o,m,p)	2,030 tpy	72 % = 1,421 tpy	609 tpy

[a] Due to the various criteria for implementation dates for coke ovens, the date shown here is the Effective Date.
[b] tons per year is abbreviated as tpy.

Figure 1. Density Map of 1997 Carbon Monoxide Emissions by County

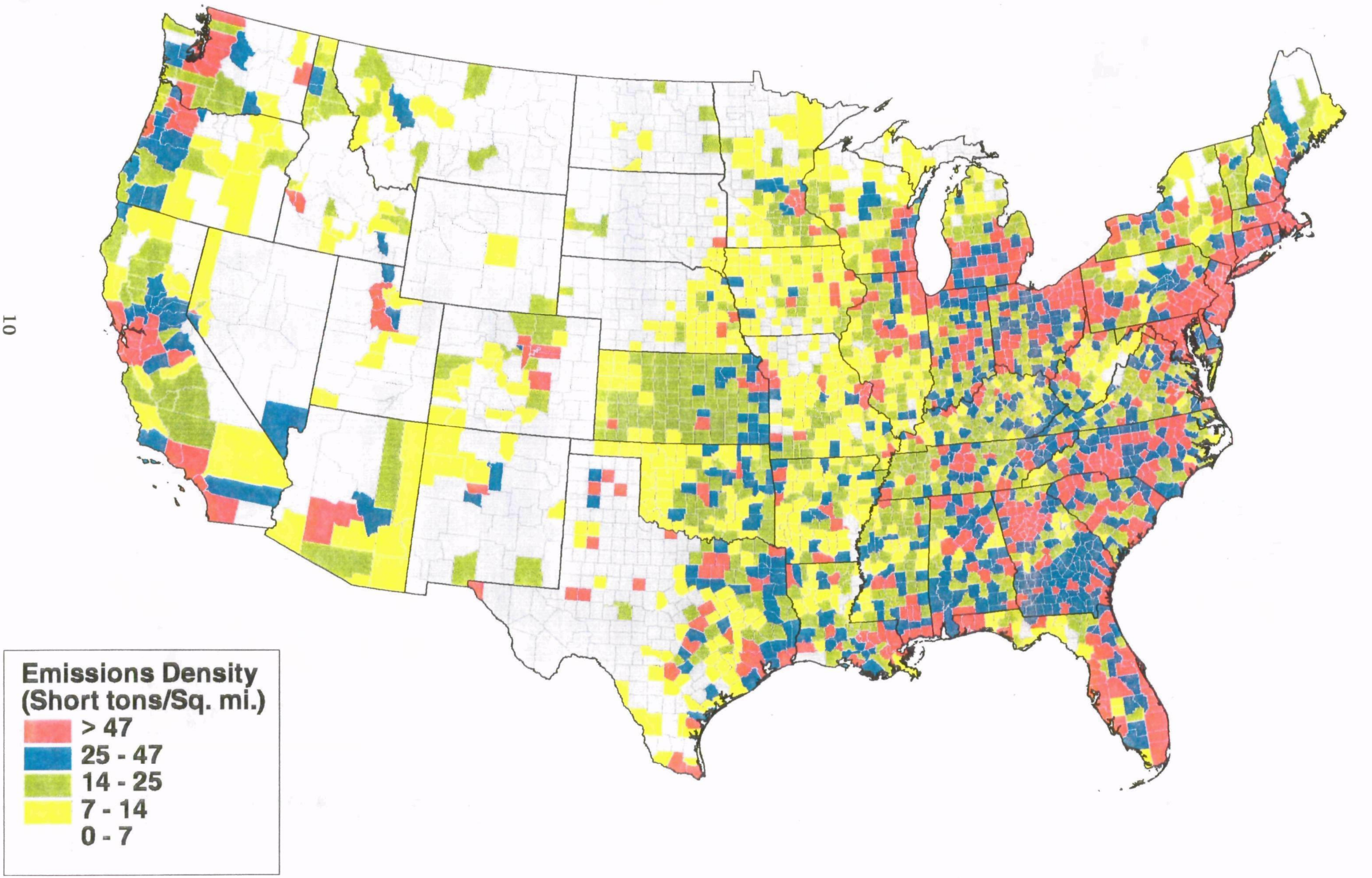

Figure 2. Density Map of 1997 Nitrogen Oxide Emissions by County

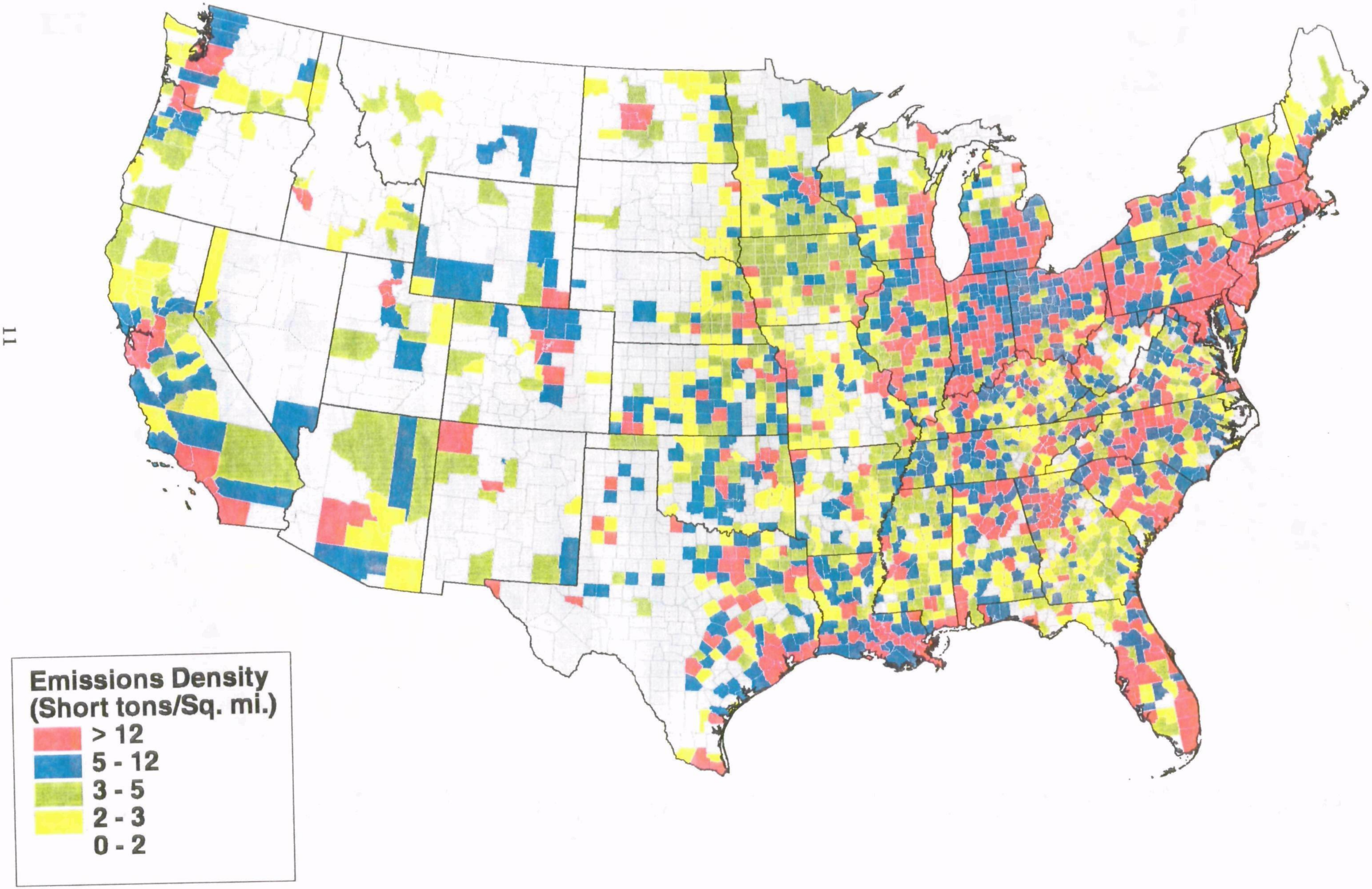

Figure 3. Density Map of 1997 Volatile Organic Compound Emissions by County

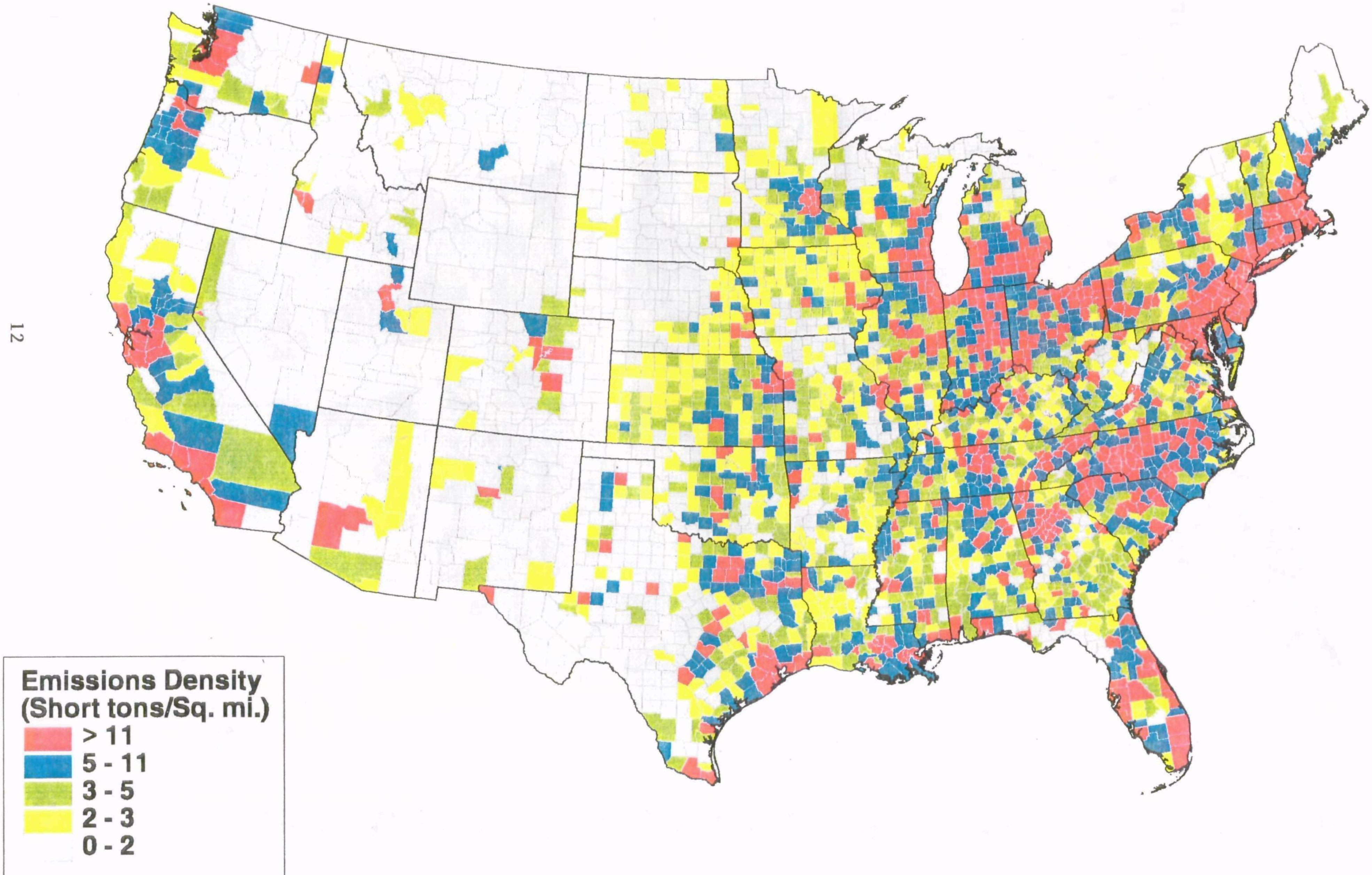

Figure 4. Density Map of 1997 Sulfur Dioxide Emissions by County

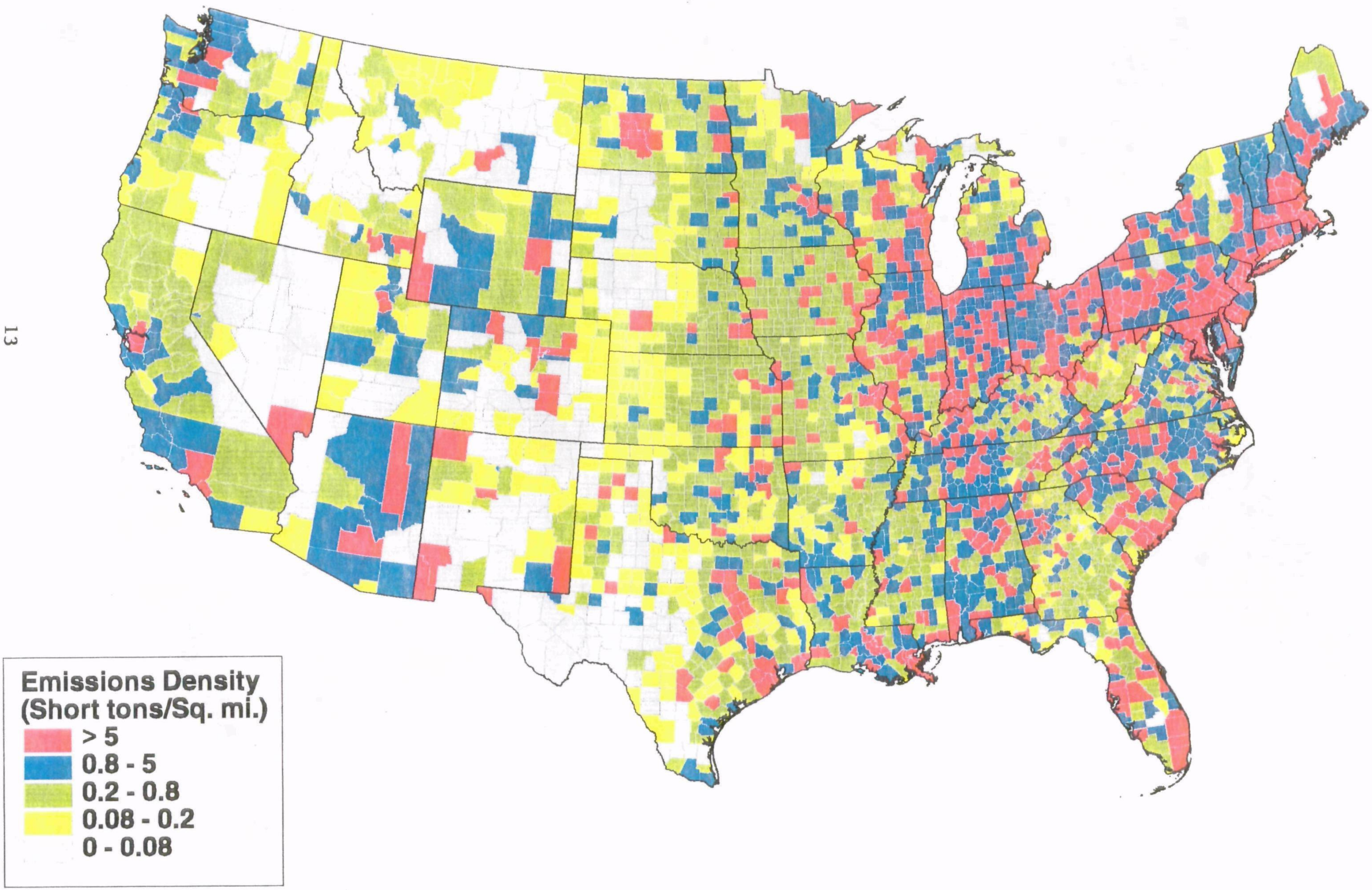

Figure 5. Density Map of 1997 Particulte Matter (PM-10) Emissions by County

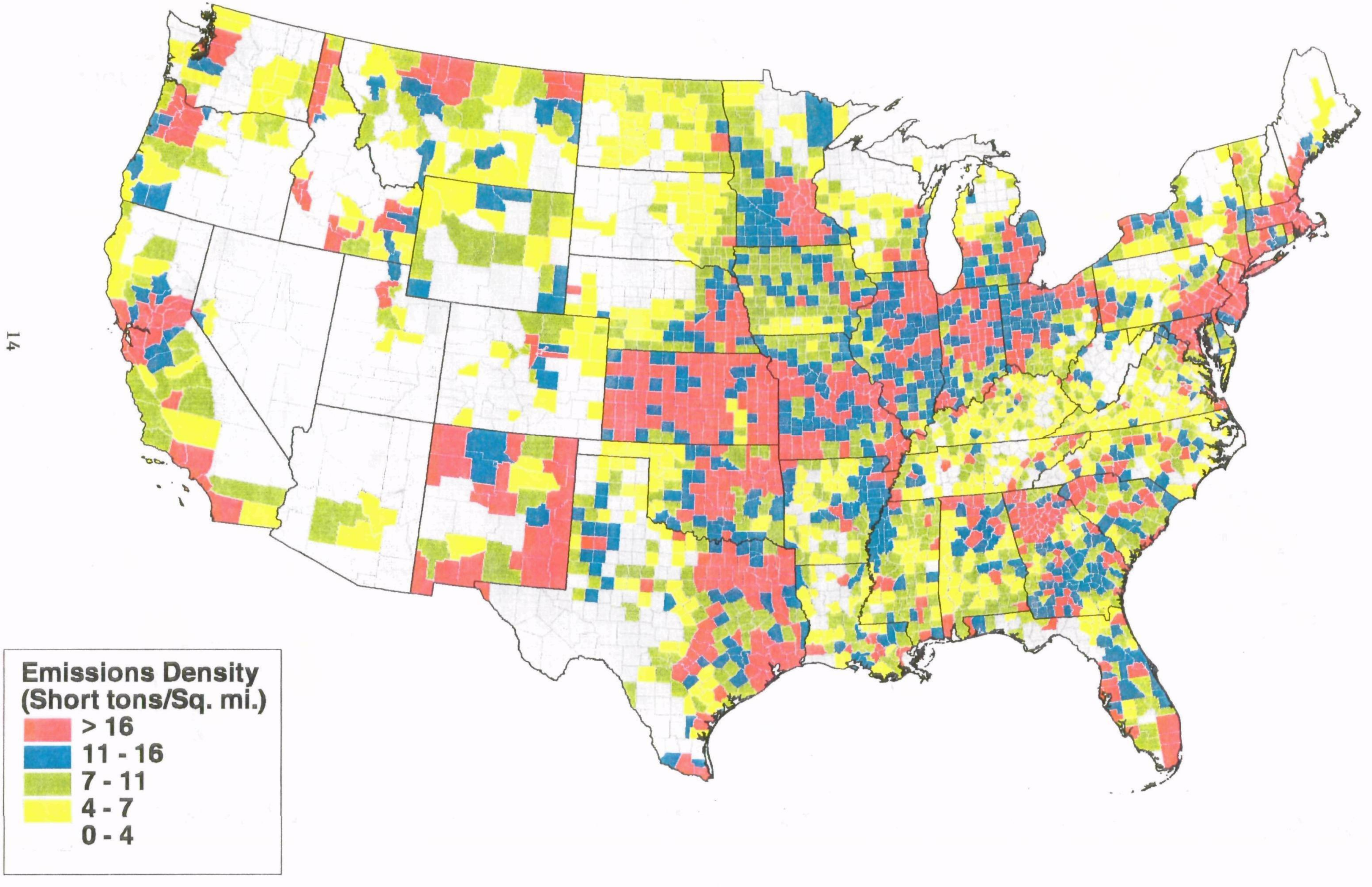

Figure 6. Density Map of 1997 Fine Particulate Matter (PM-2.5) Emissions by County

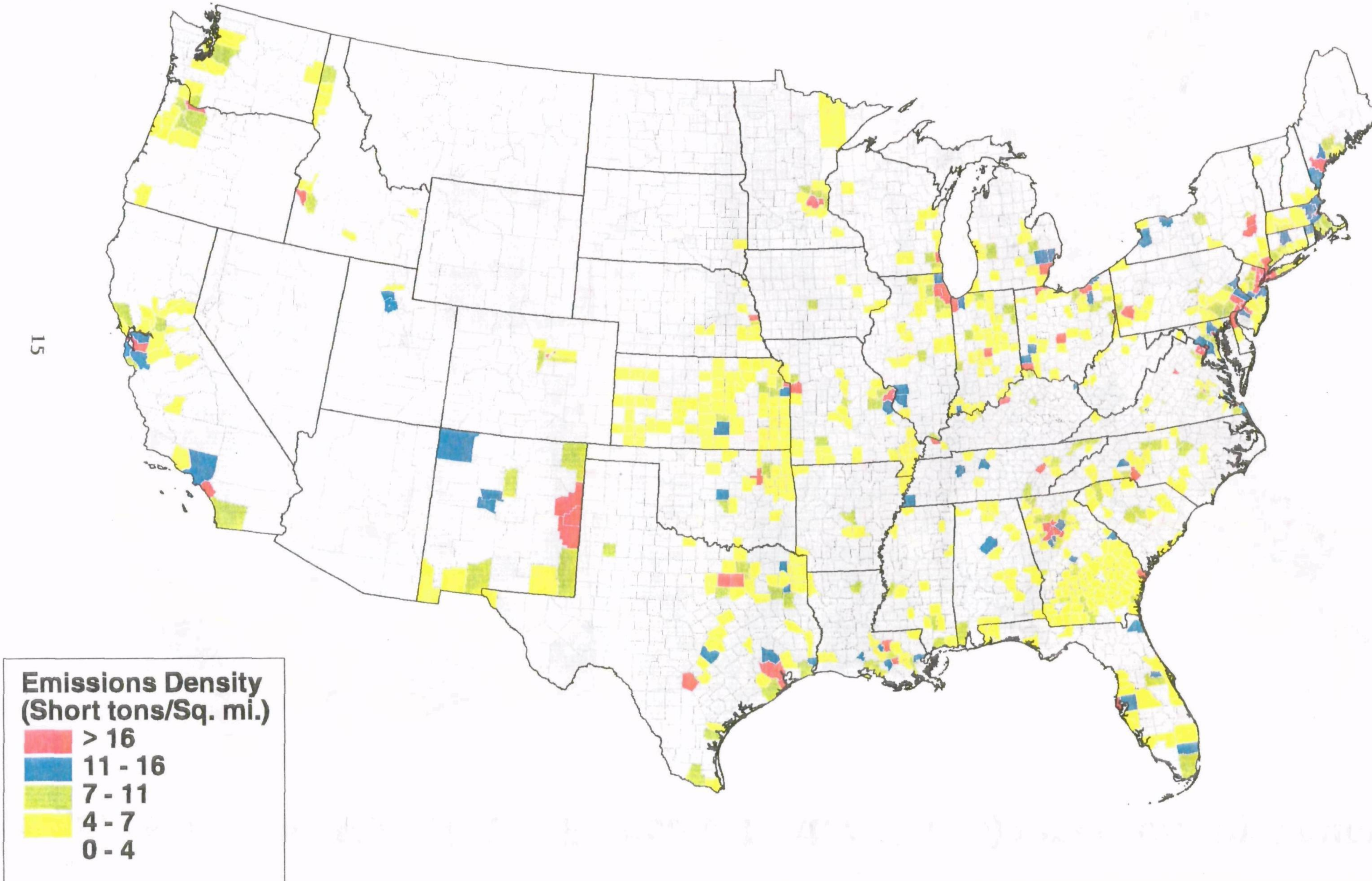

Figure 7. Density Map of 1997 Ammonia Emissions by County

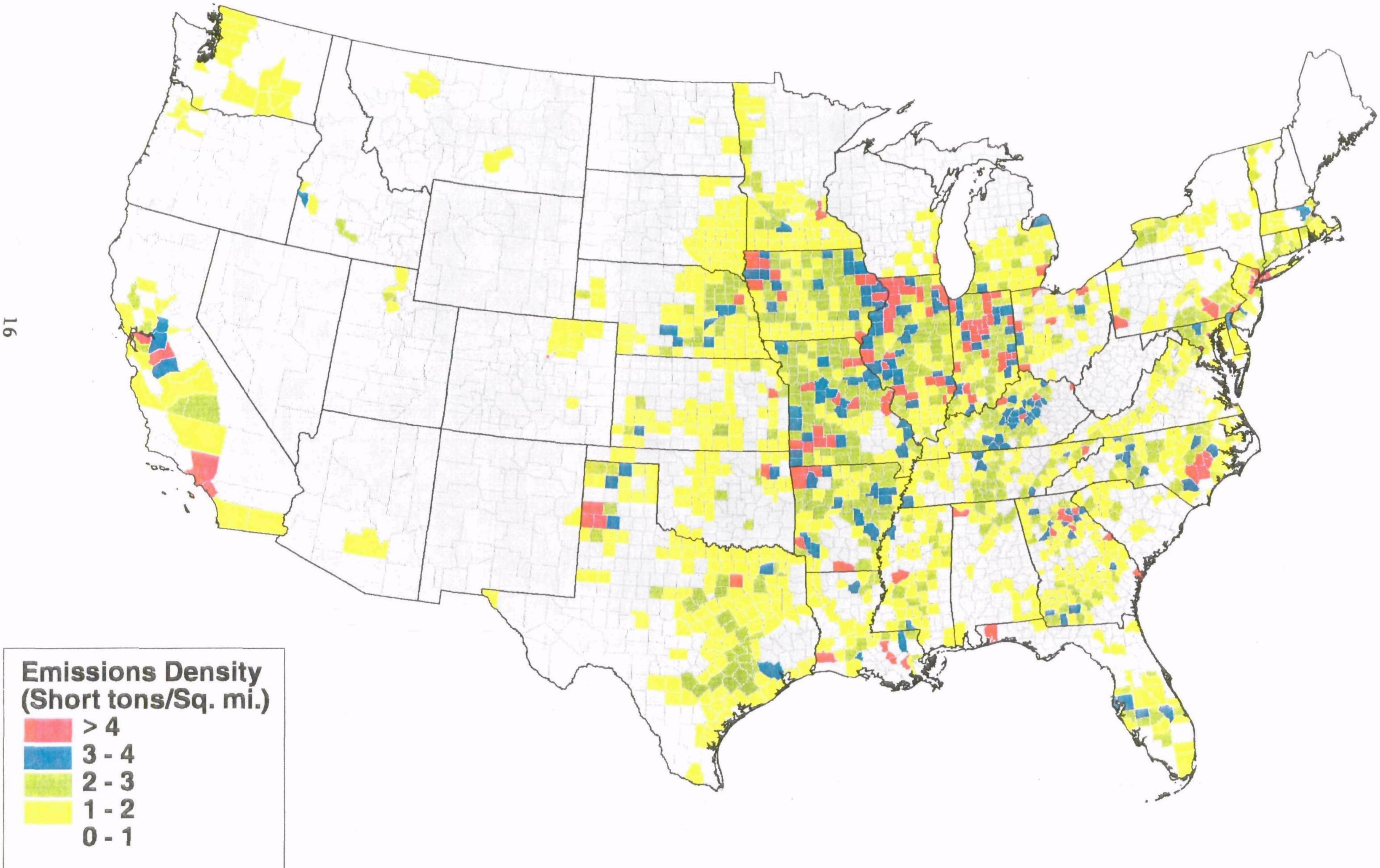

Figure 8. 1997 National CARBON MONOXIDE Emissions by Principal Source Category

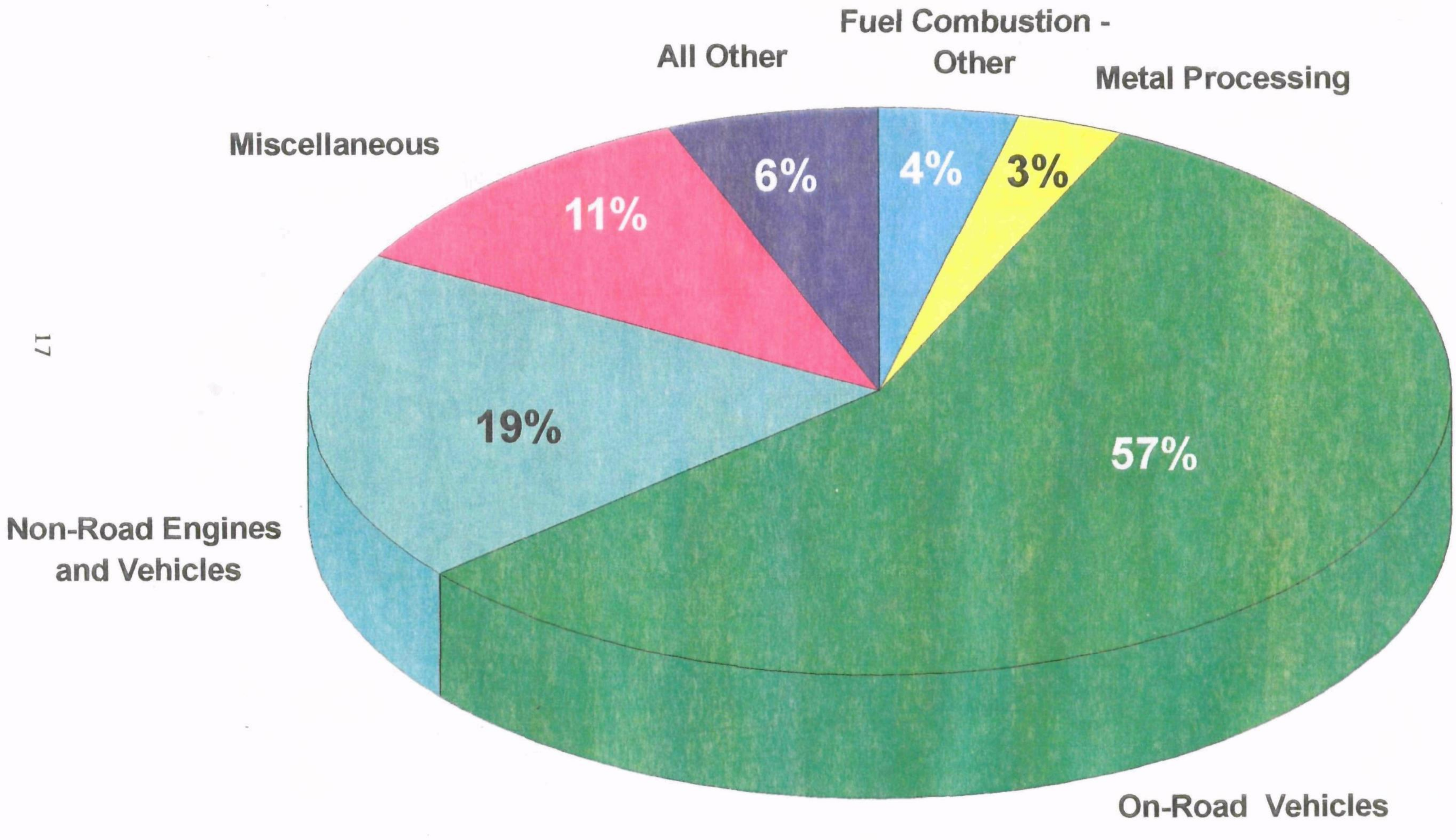

Figure 9. 1997 National NITROGEN OXIDE (NO_X) Emissions by Principal Source Category

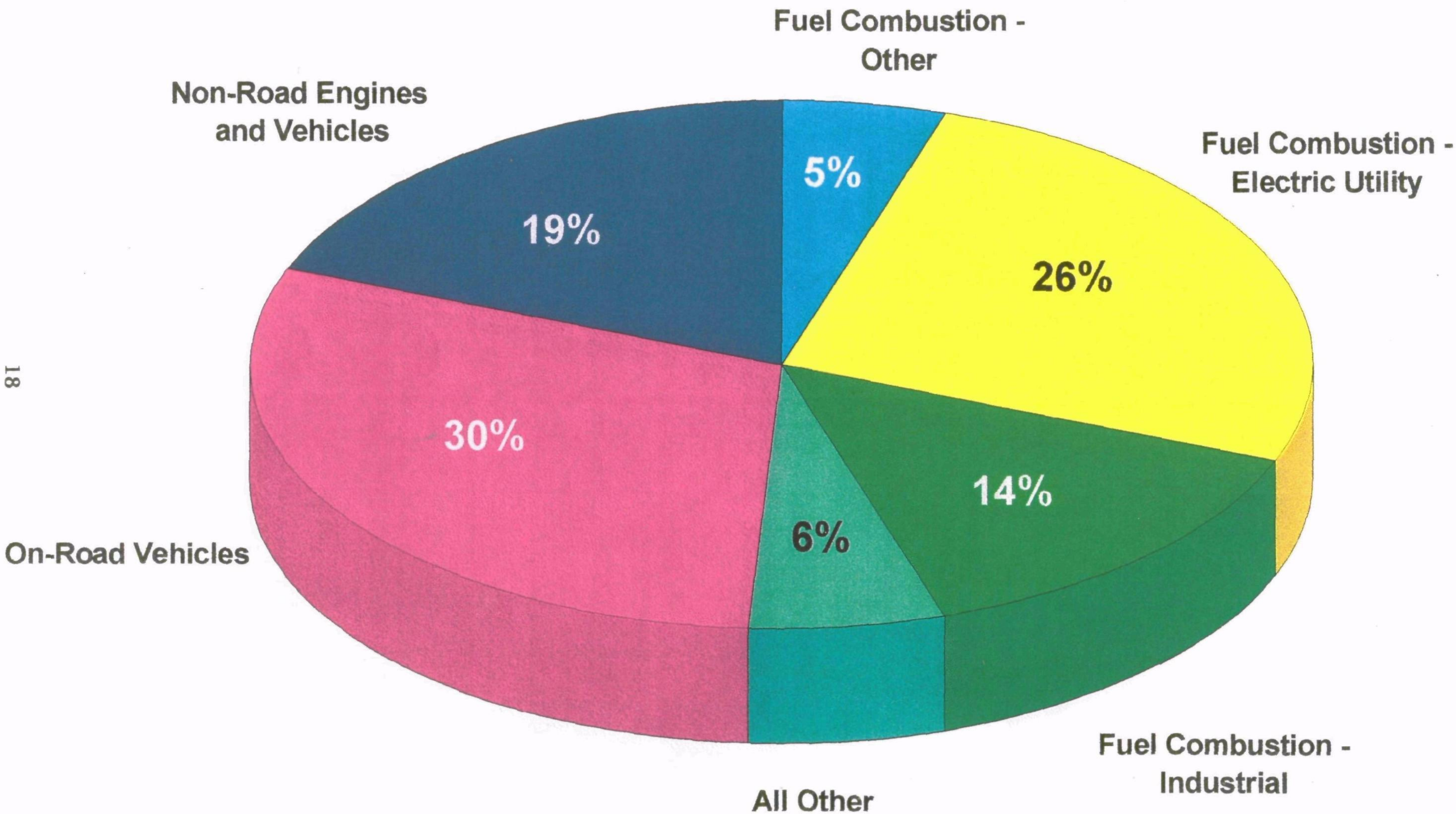

Figure 10. 1997 National VOLATILE ORGANIC COMPOUND Emissions by Principal Source Category

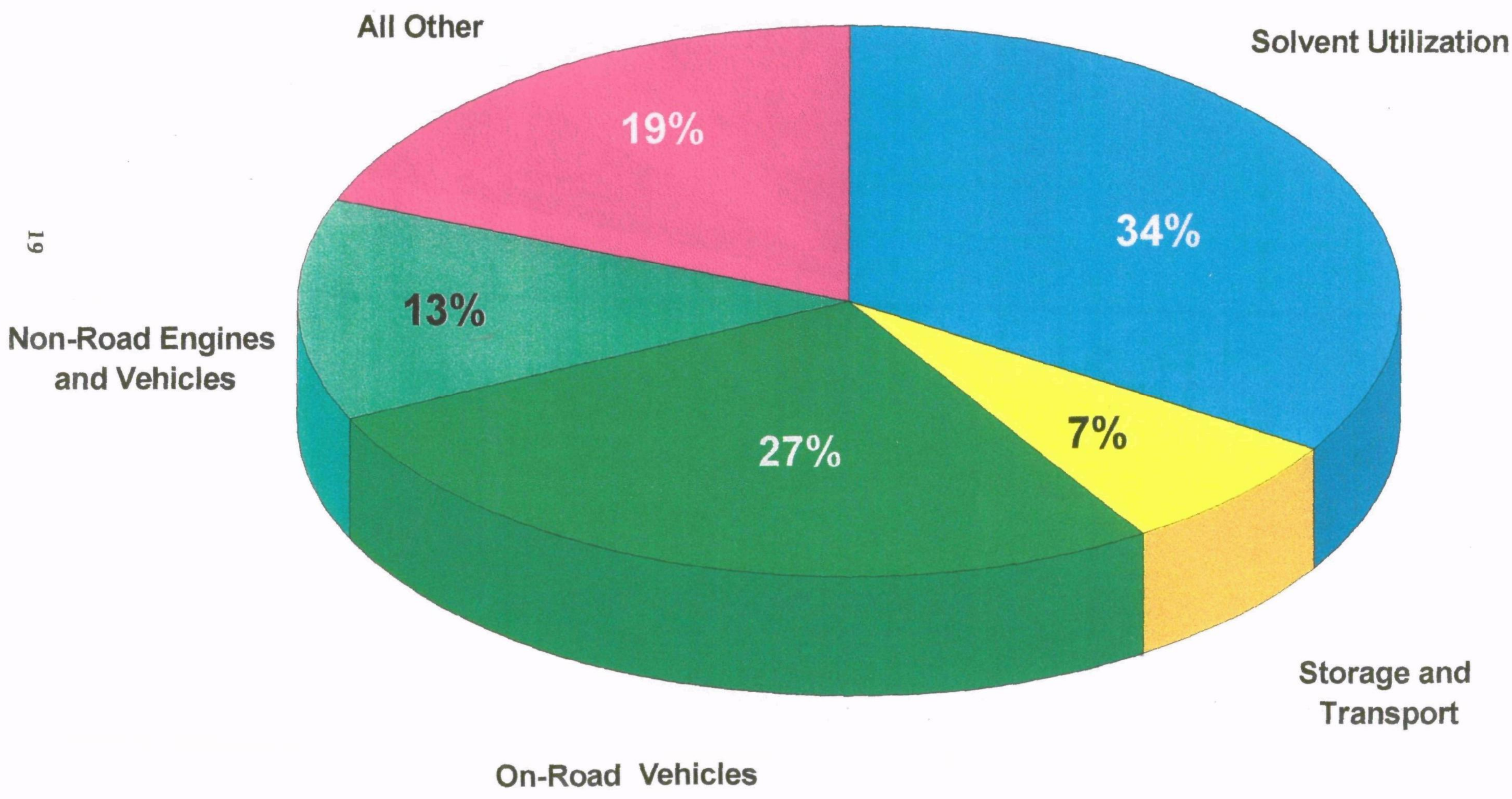

Figure 11. 1997 National SULFUR DIOXIDE Emissions by Principal Source Category

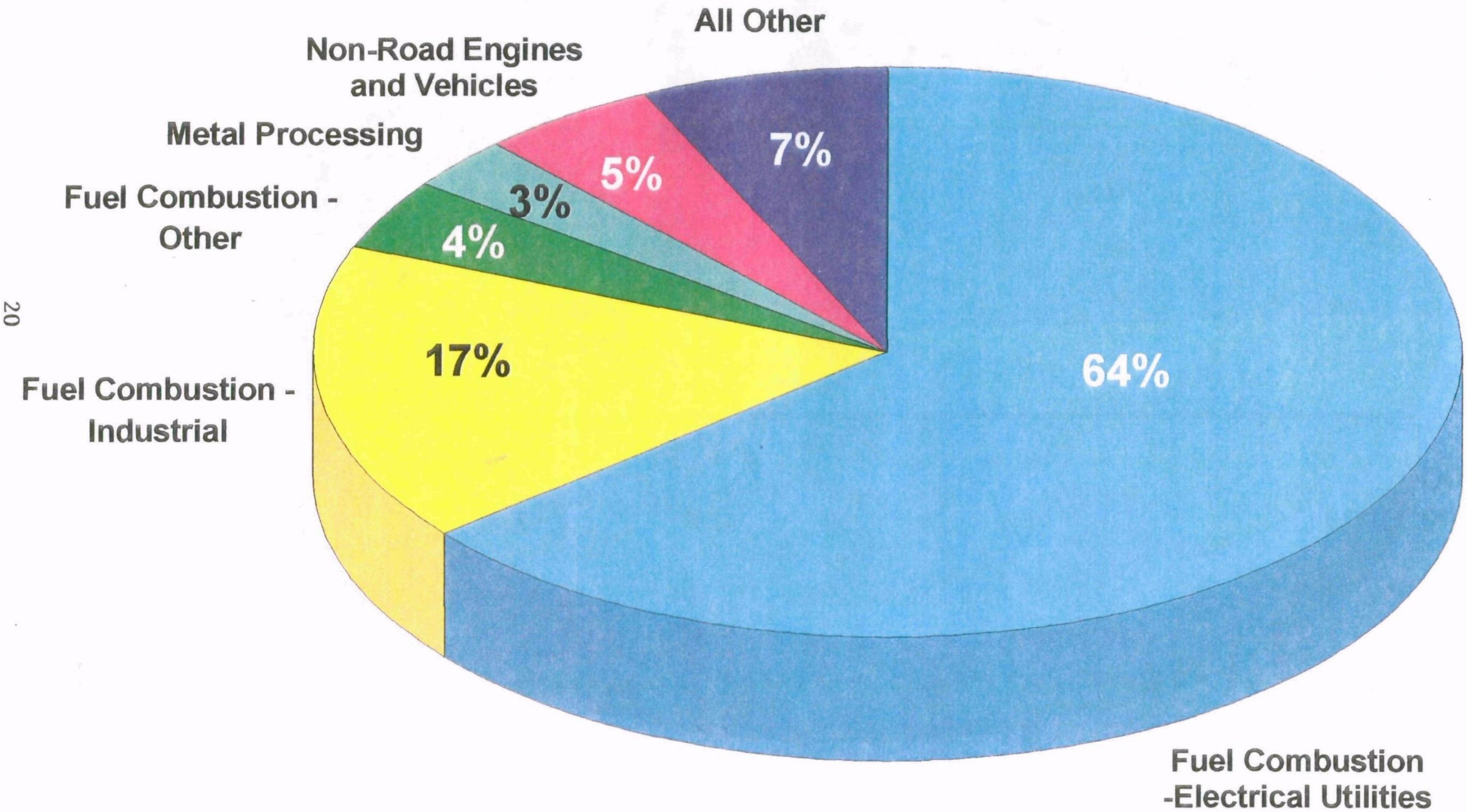

Figure 12. 1997 National PARTICULATE MATTER (PM_{10}) Emissions by Principal Source Category for Non-Fugitive Dust Sources

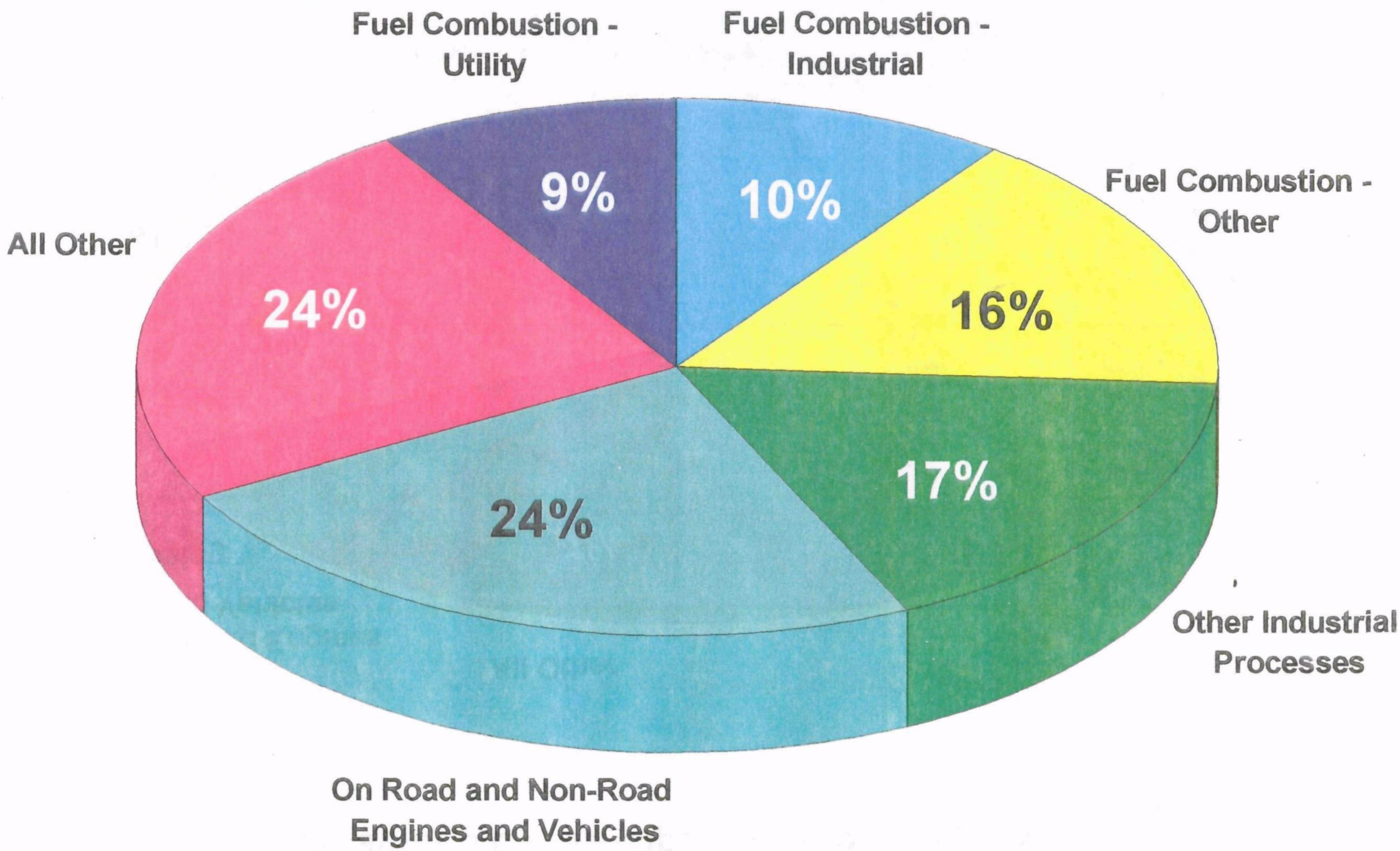

Figure 13. 1997 National PARTICULATE MATTER (PM_{10}) Emissions by Miscellaneous and Natural Sources

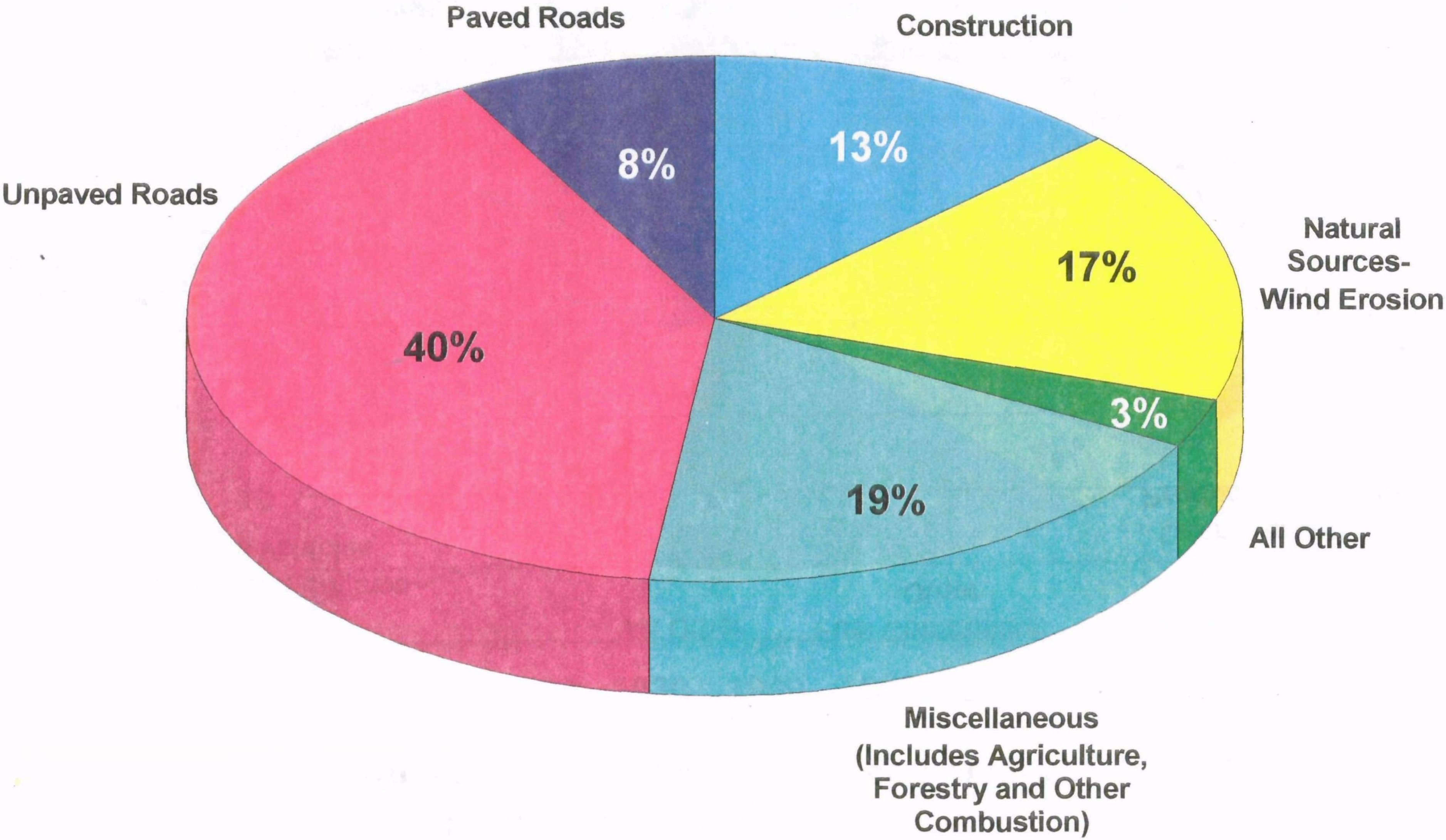

Figure 14. 1997 National LEAD Emissions by Principal Source Category

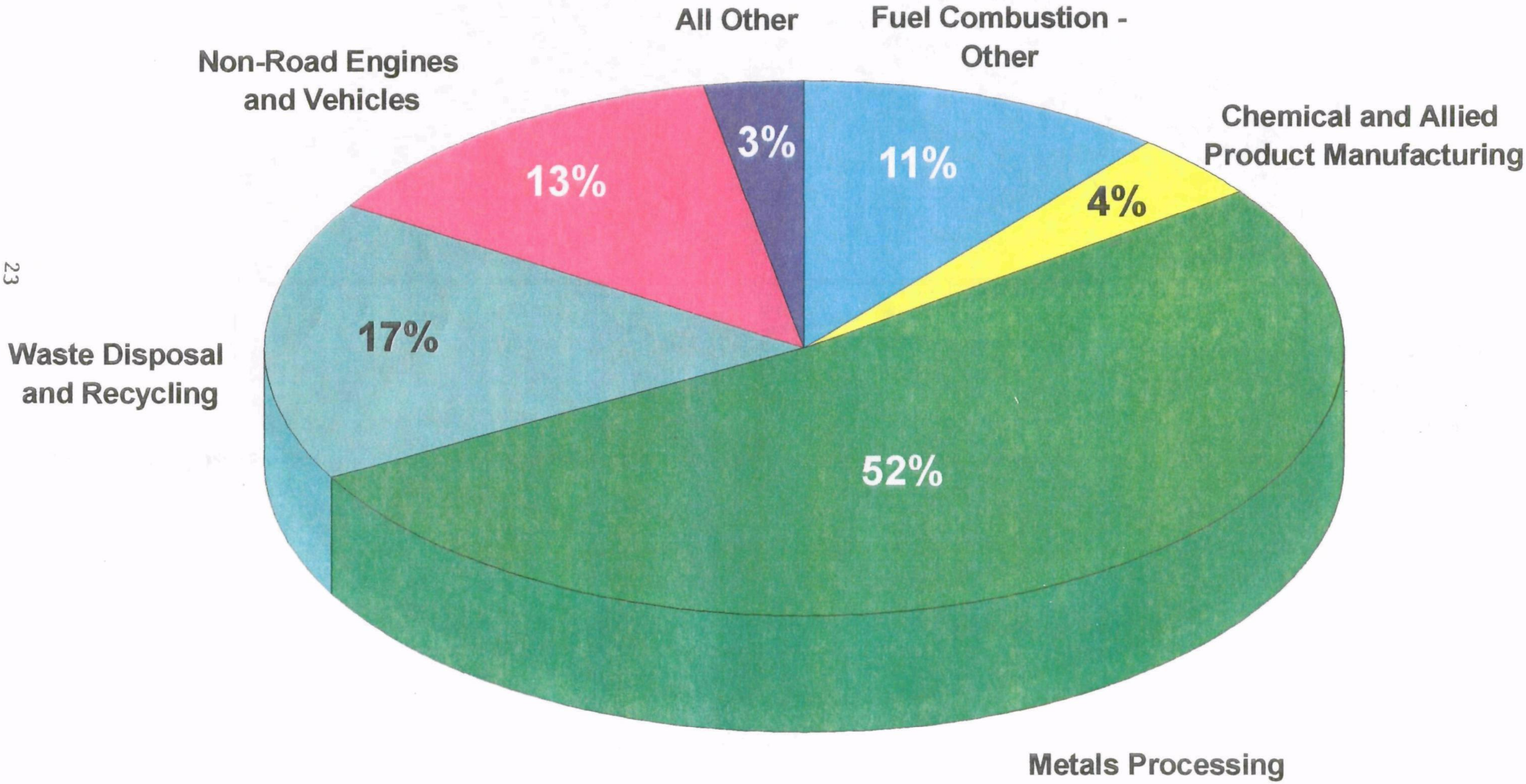

Figure 15. Trend in National Emissions, SULFUR DIOXIDE, VOLATILE ORGANIC COMPOUNDS, and NITROGEN OXIDES (1900 to 1997)

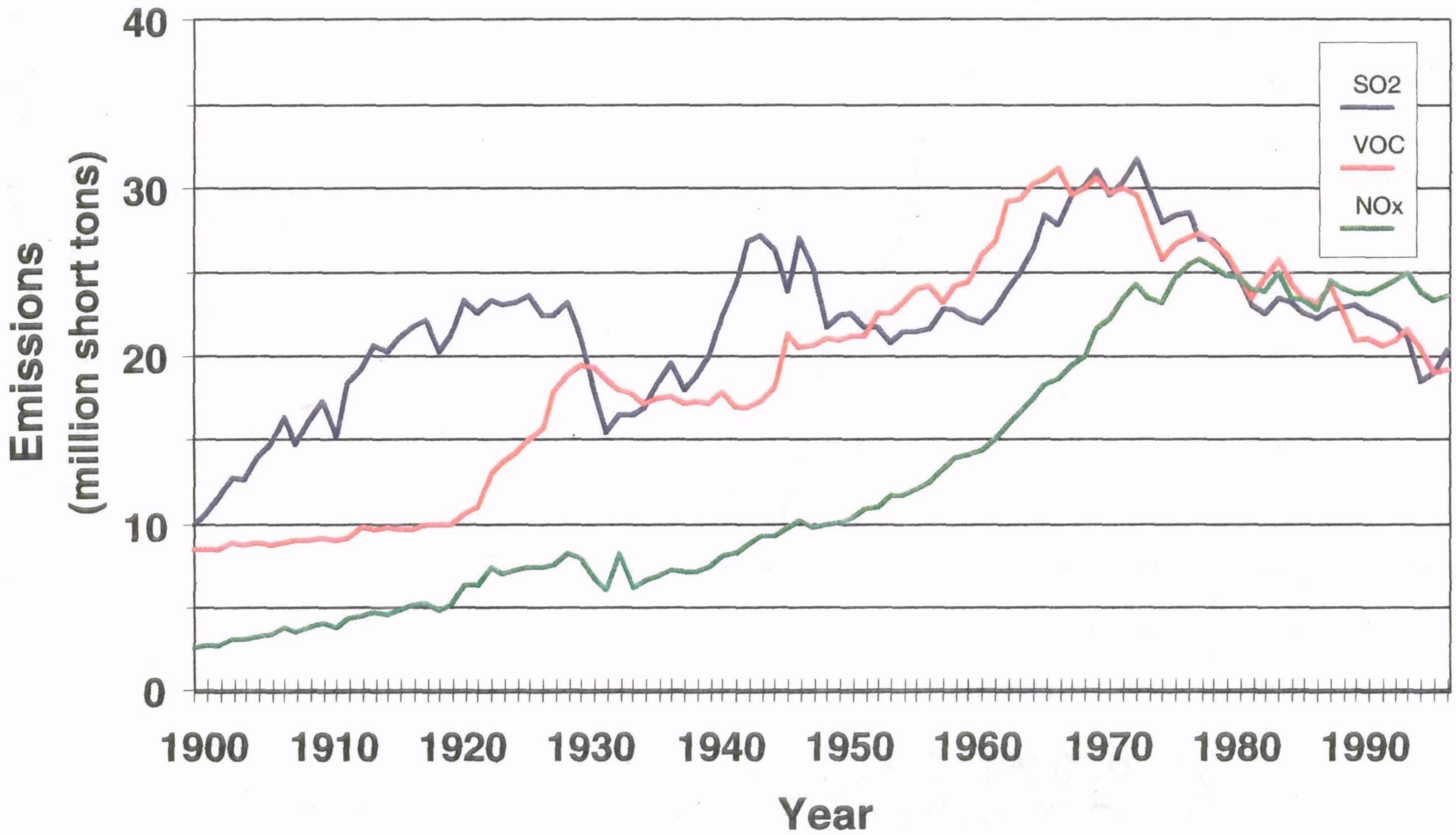

Figure 16. Trend in National Emissions, CARBON MONOXIDE (1940 to 1997), LEAD (1970 to 1997)

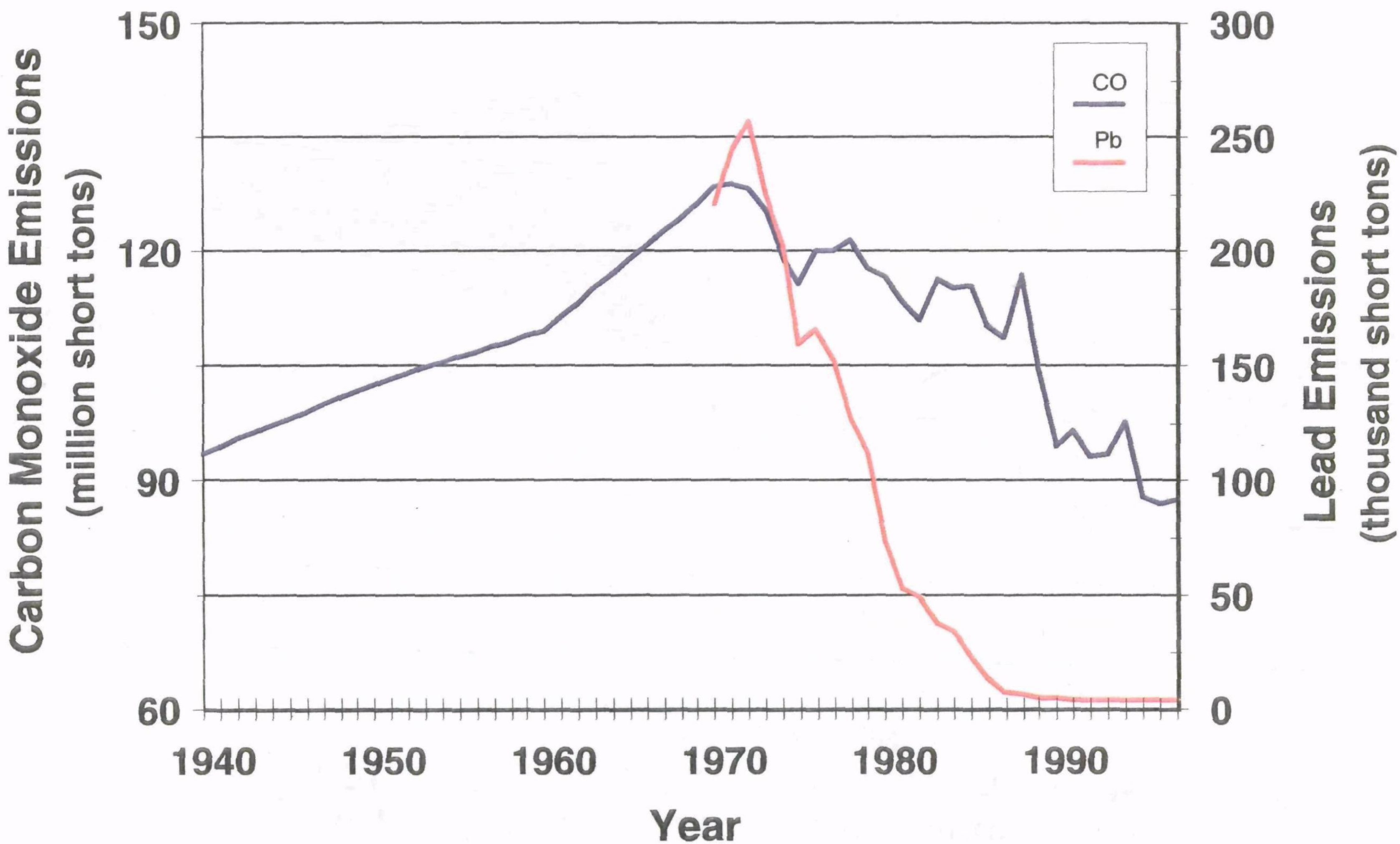

Figure 17. Trend in National Emissions, PARTICULATE MATTER (non-fugitive dust sources), PM-10 (1940 to 1997), and PM-2.5 and AMMONIA (1990 to 1997)

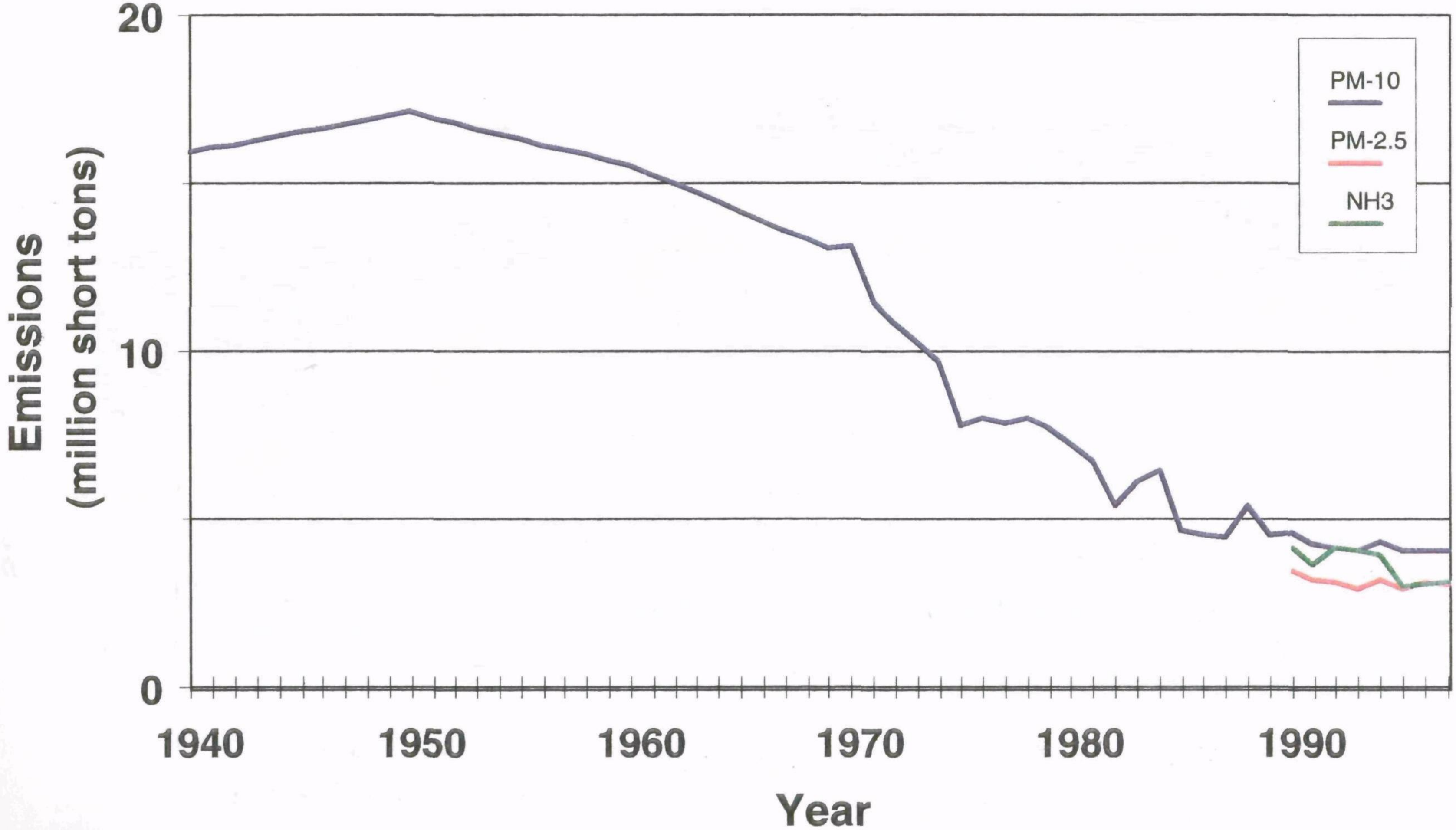

Figure 18. Trend in National Emissions, FUGITIVE DUST PM-10 (1985 to 1997), and FUGITIVE DUST PM-2.5 (1990 to 1997)

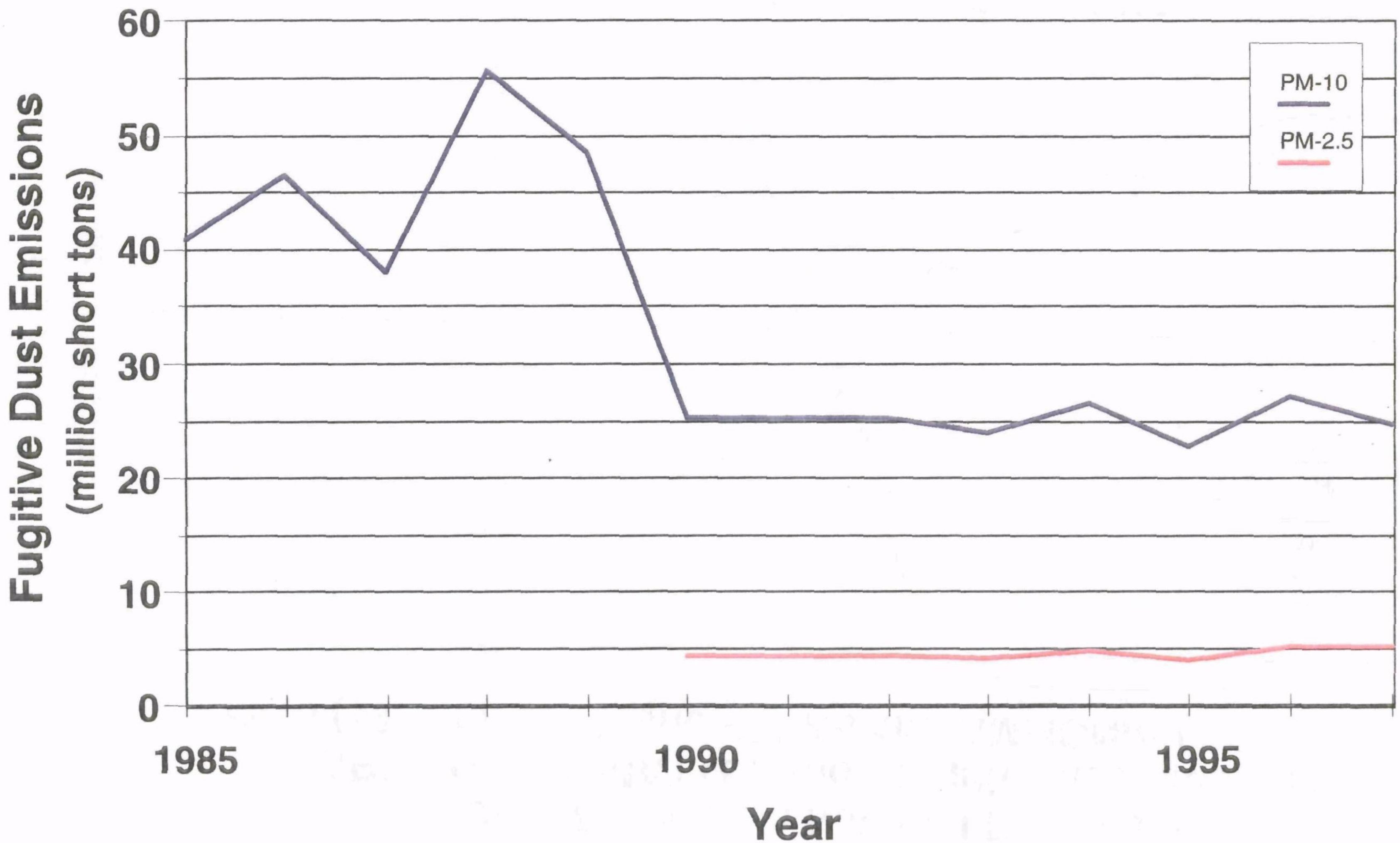

Figure 19. Trend in CARBON MONOXIDE Emissions by 7 Principal Source Categories, 1940 to 1997
(reading legend left to right corresponds to plotted series from top to bottom)

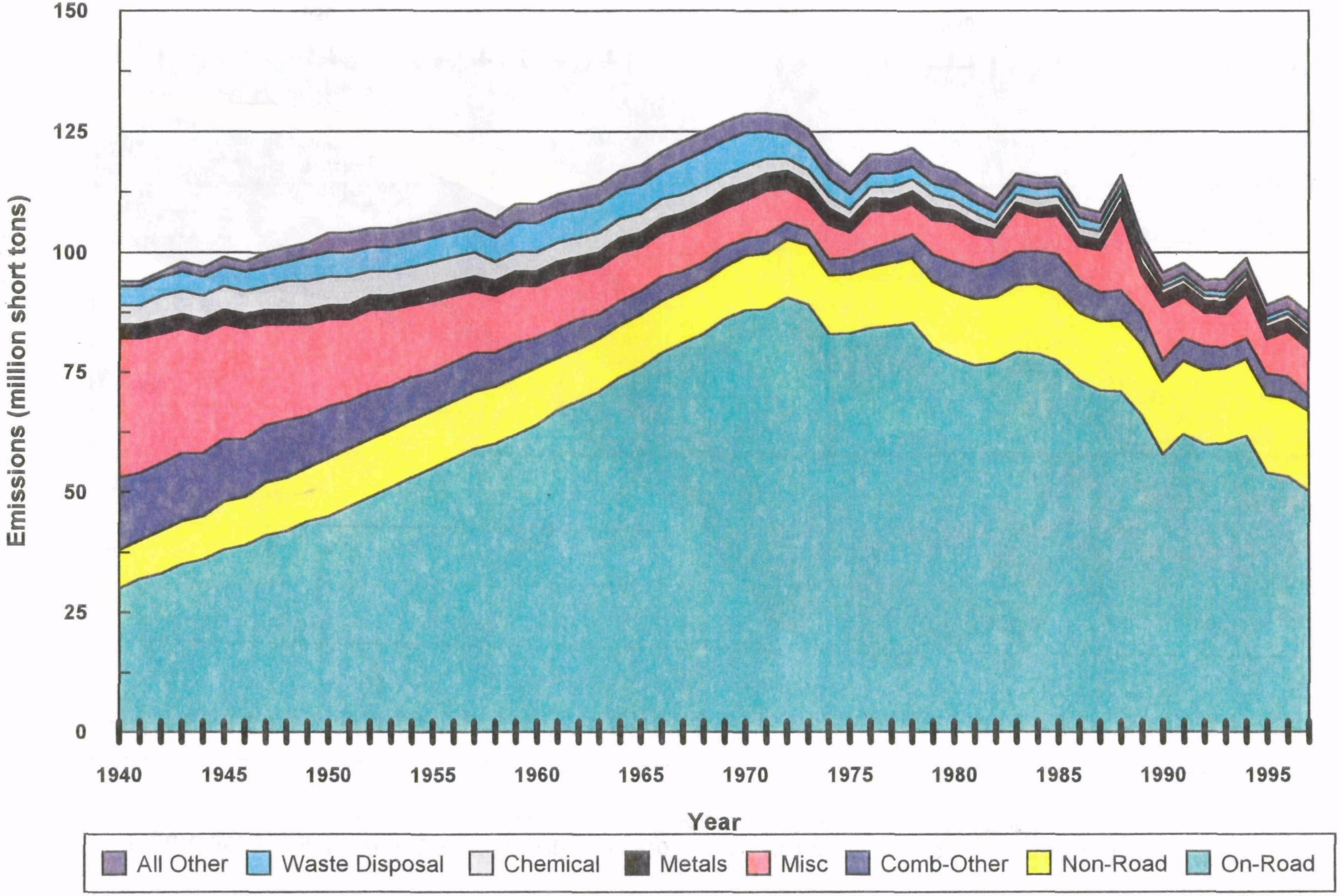

Figure 20. Trend in NITROGEN OXIDE Emissions by 7 Principal Source Categories, 1940 to 1997
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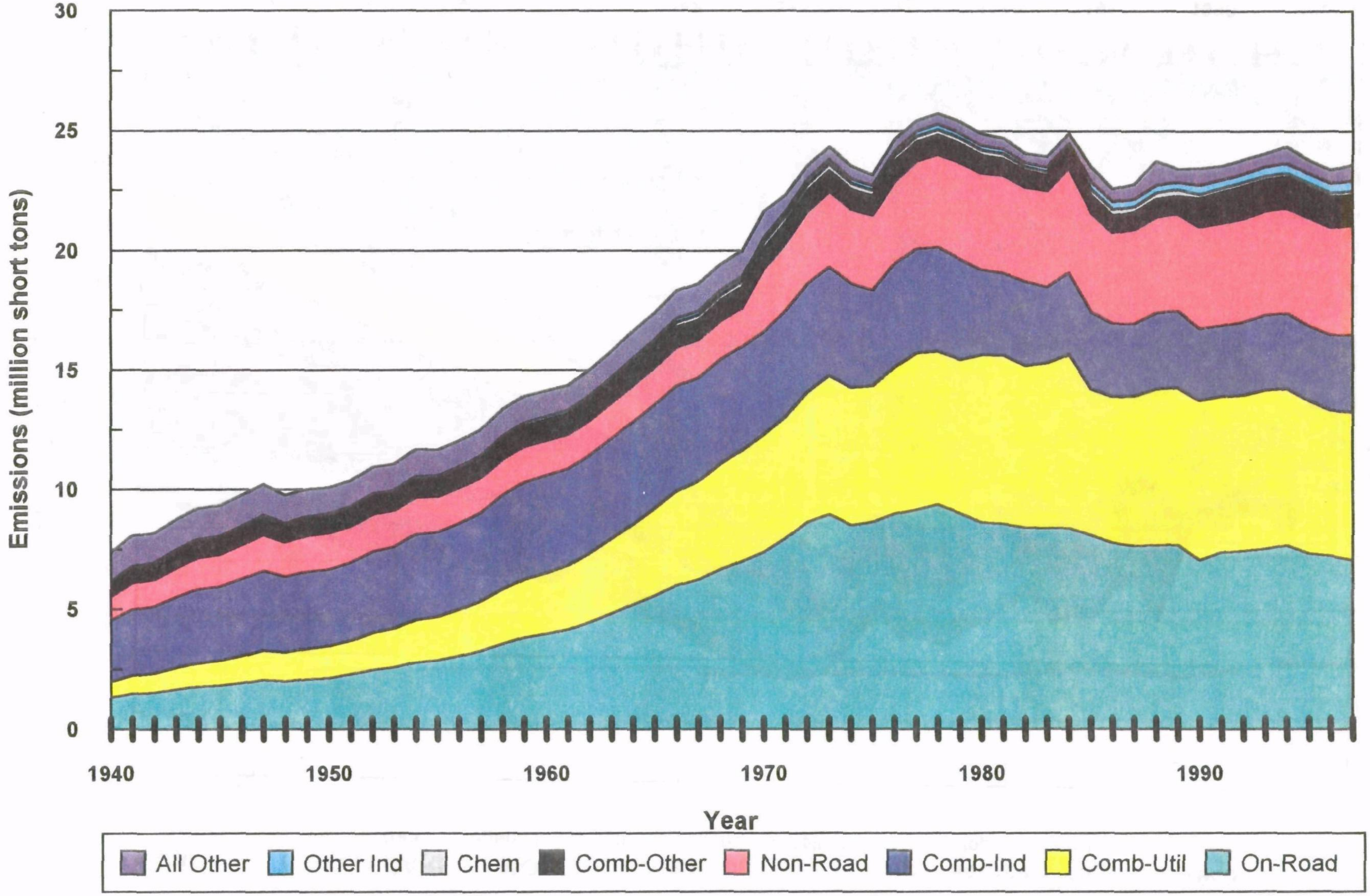


Figure 21. Trend in VOLATILE ORGANIC COMPOUND Emissions by 7 Principal Categories, 1940 to 1997
(reading legend left to right corresponds to plotted series from top to bottom)

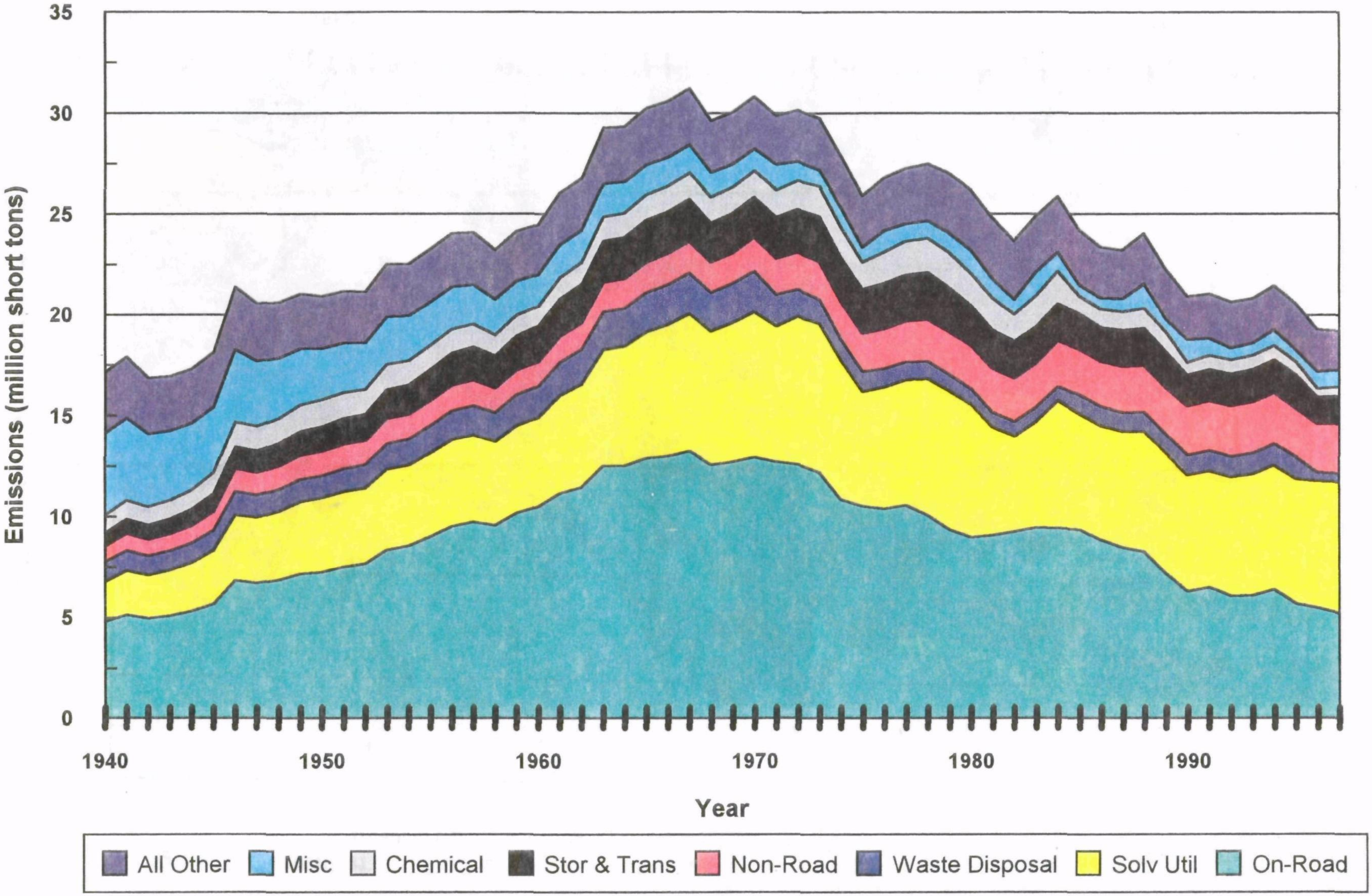


Figure 22. Trend in SULFUR DIOXIDE Emissions by 6 Principal Source Categories, 1940 to 1997
(reading legend left to right corresponds to plotted series from top to bottom)

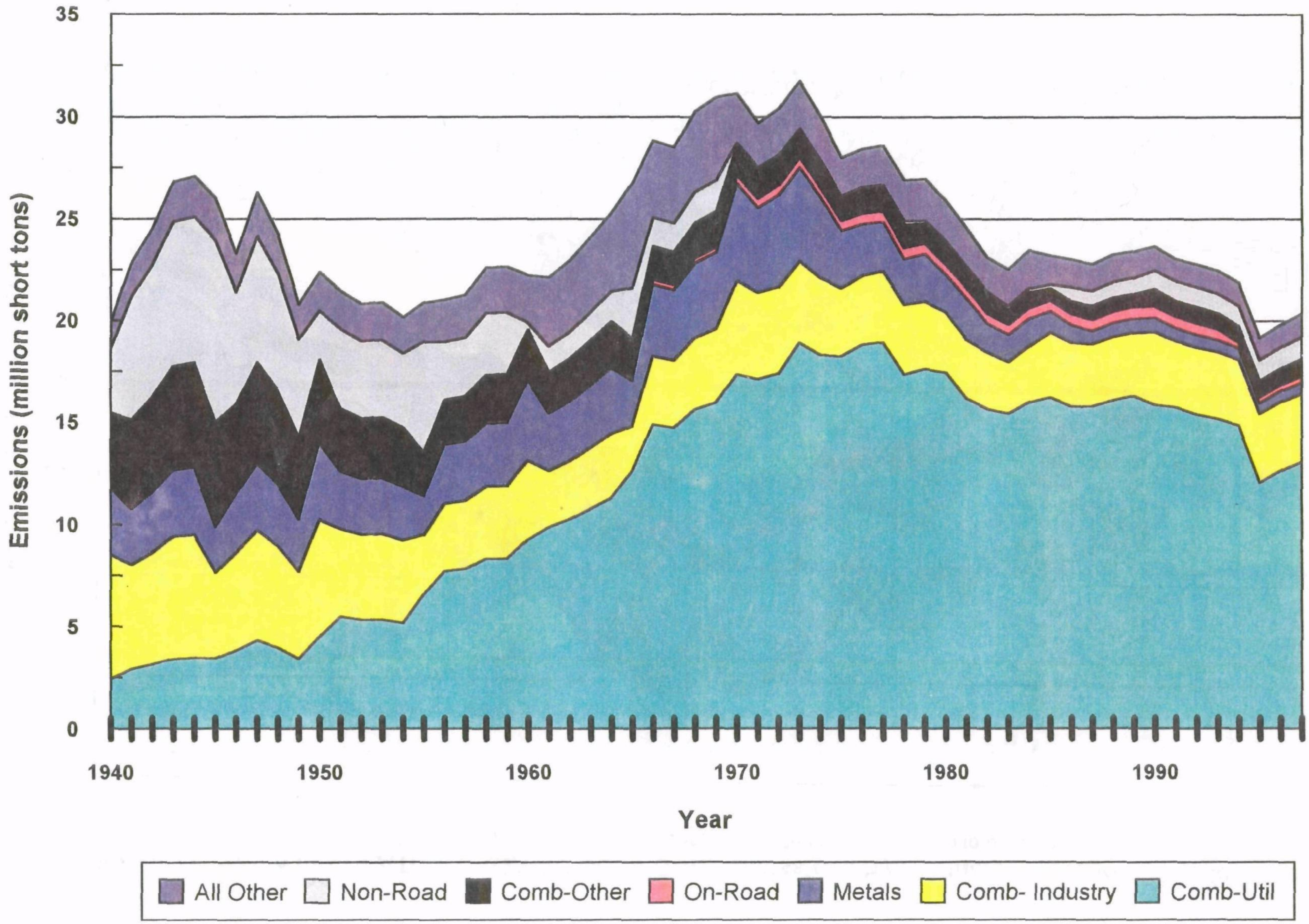


Figure 23. Trend in PARTICULATE MATTER (PM-10) Emissions by 7 Principal Source Categories Excluding Fugitive Dust Sources, 1940-1997

(reading legend left to right corresponds to plotted series from top to bottom)

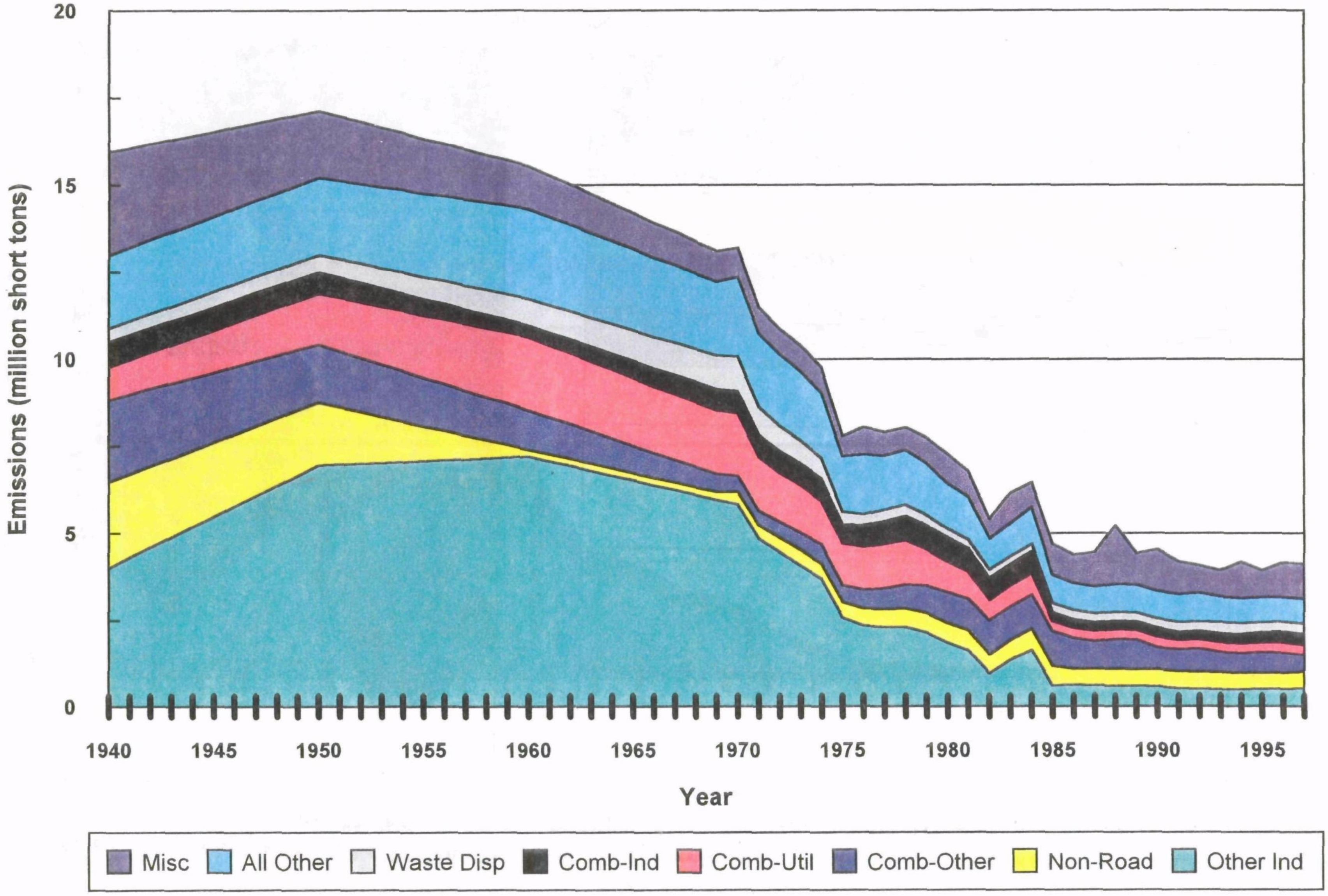
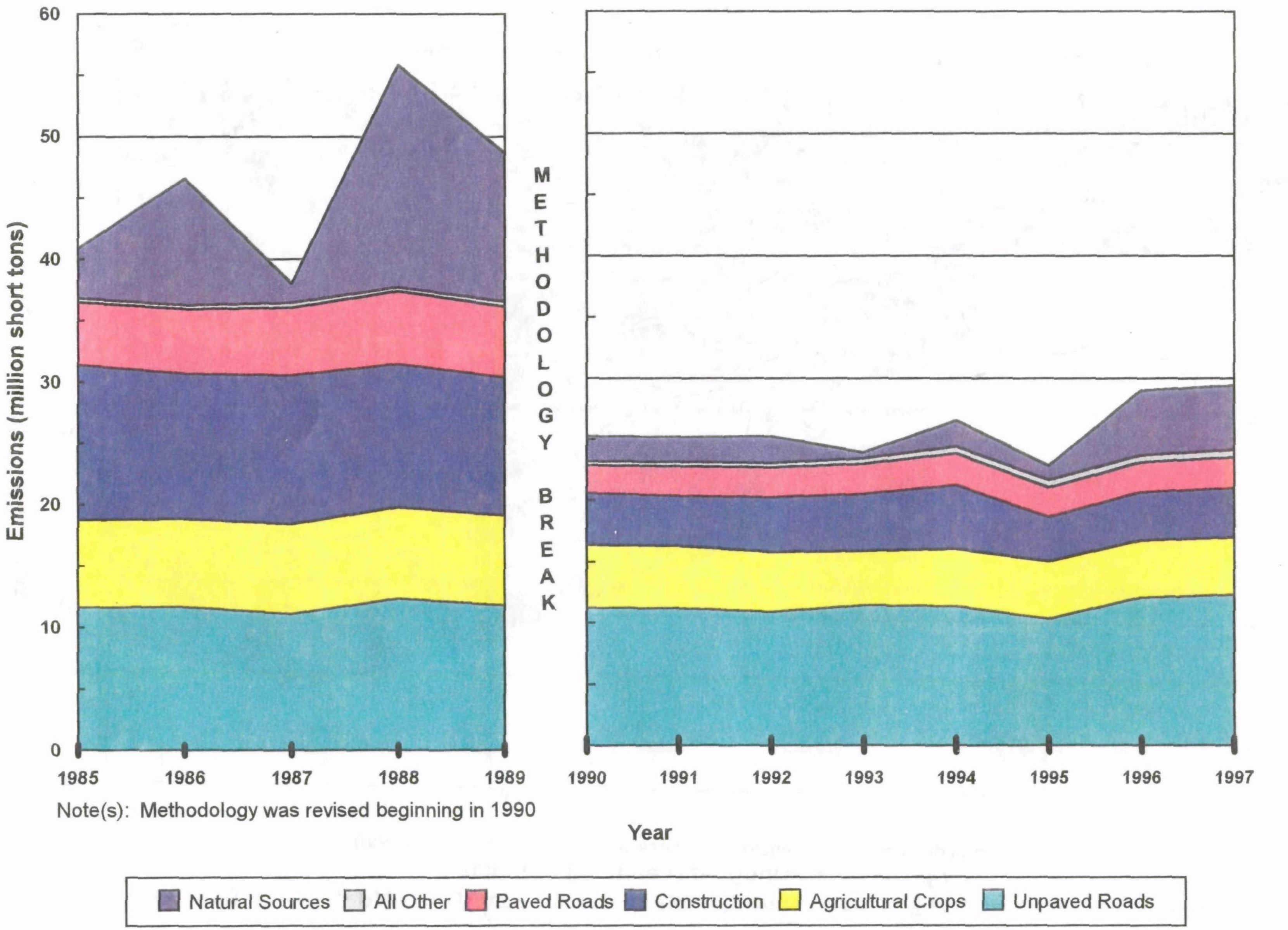


Figure 24. Trend in PARTICULATE MATTER (PM-10) Emissions by Fugitive Dust Source Category, 1985-1997

(reading legend left to right corresponds to plotted series from top to bottom)



Note(s): Methodology was revised beginning in 1990

Figure 25. Trend in LEAD Emissions by 5 Principal Source Categories, 1970-1997

(reading legend left to right corresponds to plotted series from top to bottom)

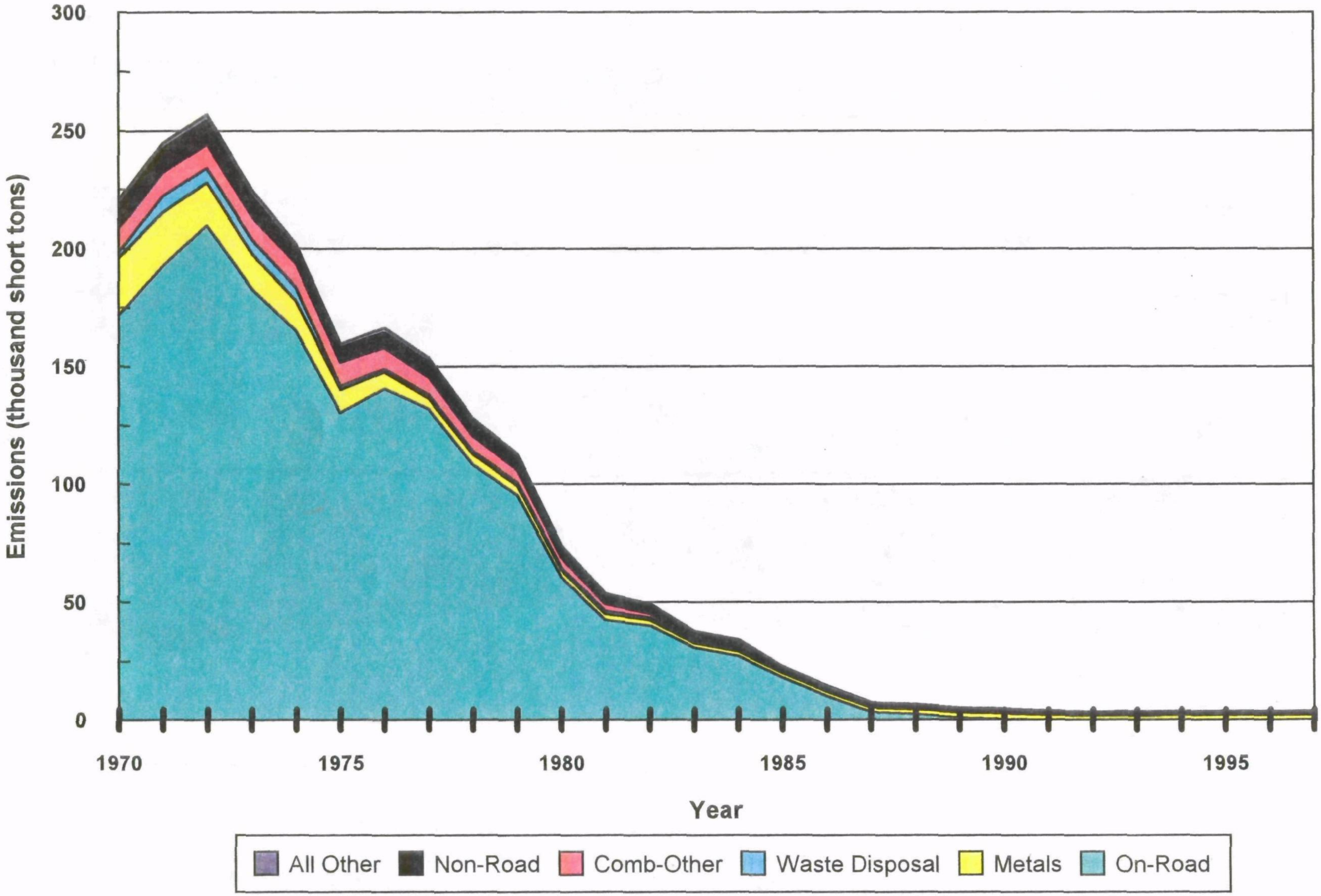


Figure 26. Trend in PARTICULATE MATTER (PM-2.5) Emissions by 7 Principal Source Categories Excluding Fugitive Dust Sources, 1990-1997

(reading legend left to right corresponds to plotted series from top to bottom)

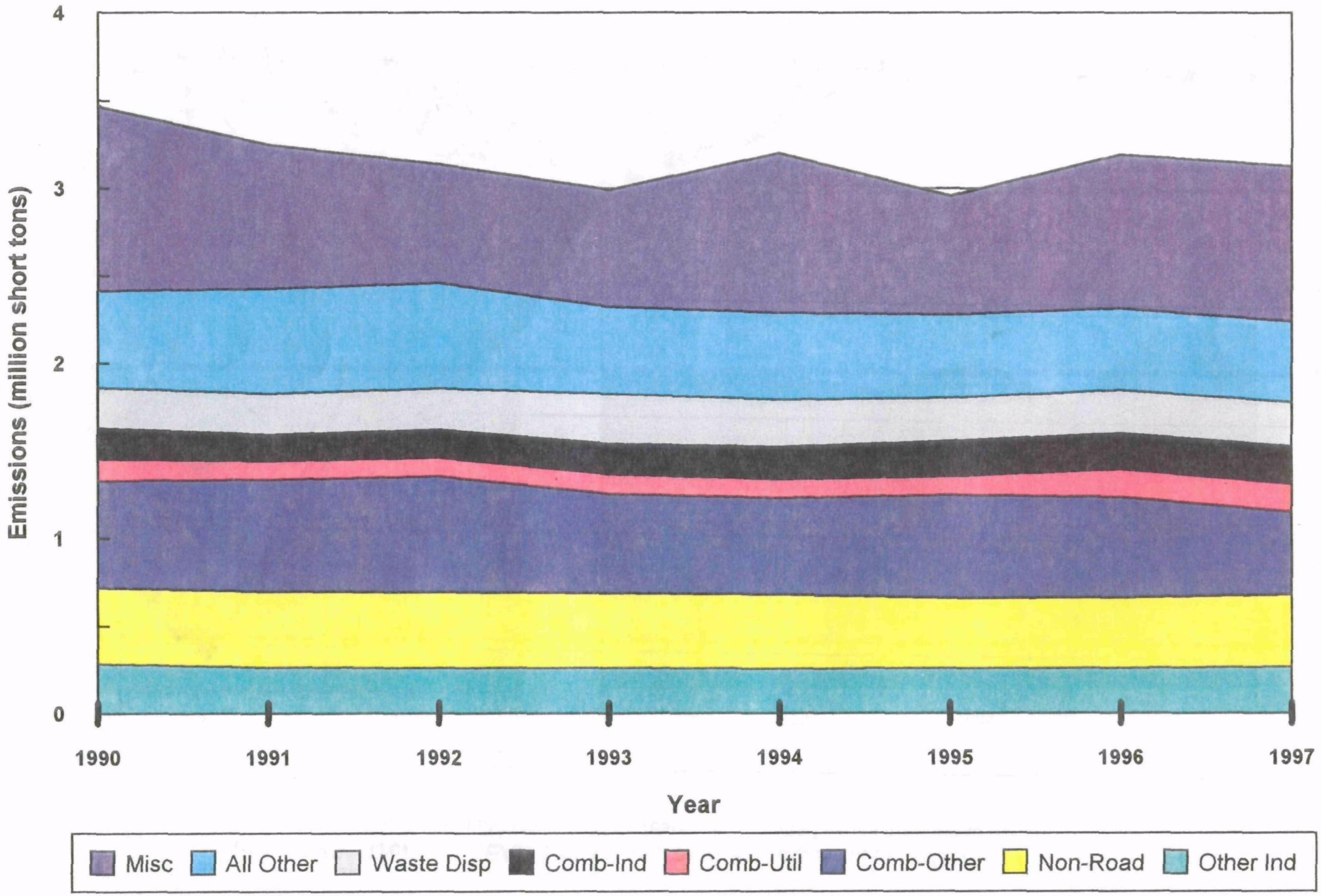


Figure 27. Trend in PARTICULATE MATTER (PM-2.5) Emissions Fugitive Dust Source Category, 1990-1997
(reading legend left to right corresponds to plotted series from top to bottom)

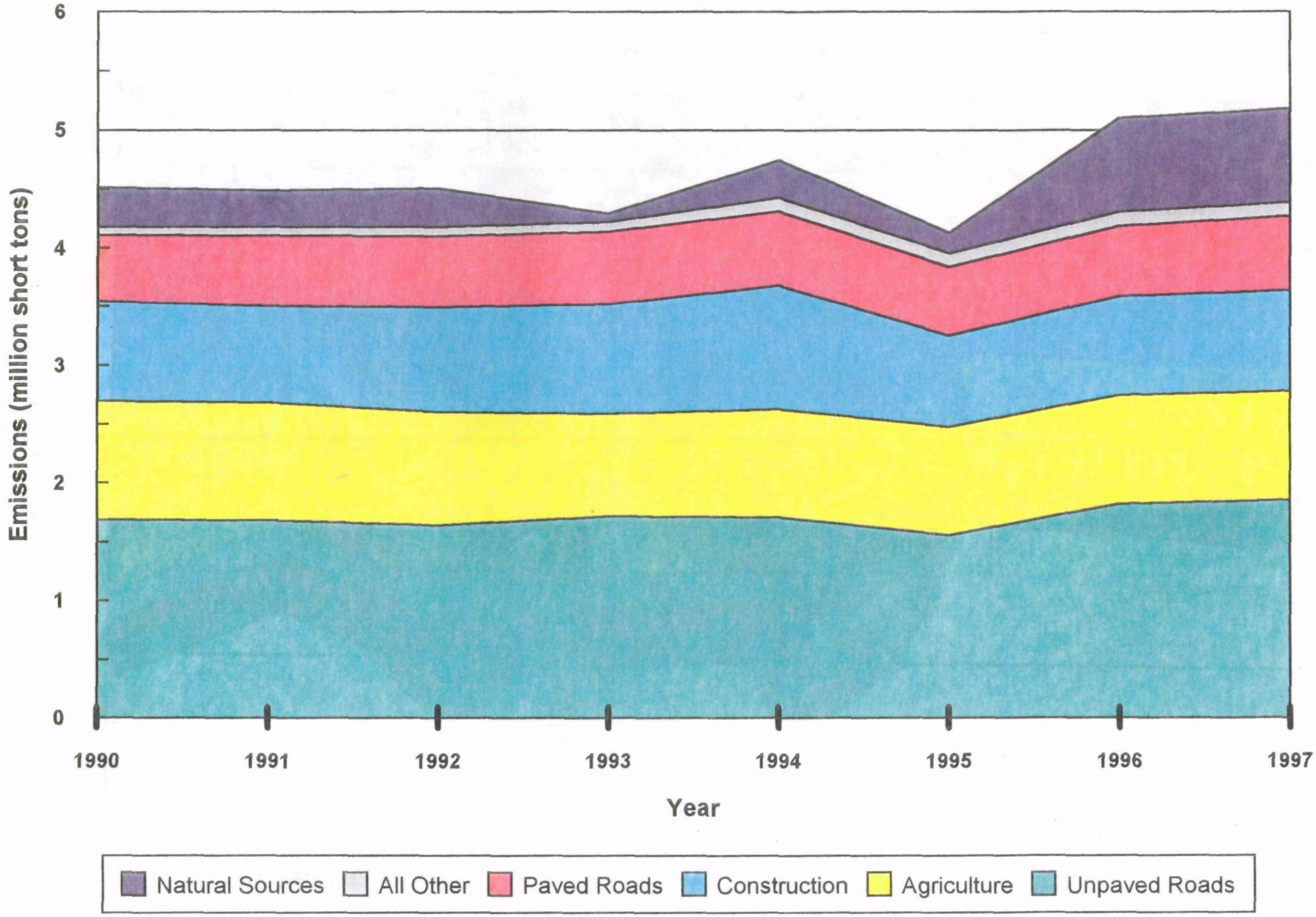


Figure 28. Trend in AMMONIA Emissions by 5 Principal Source Categories, 1990-1997
(reading legend left to right corresponds to plotted series from top to bottom)

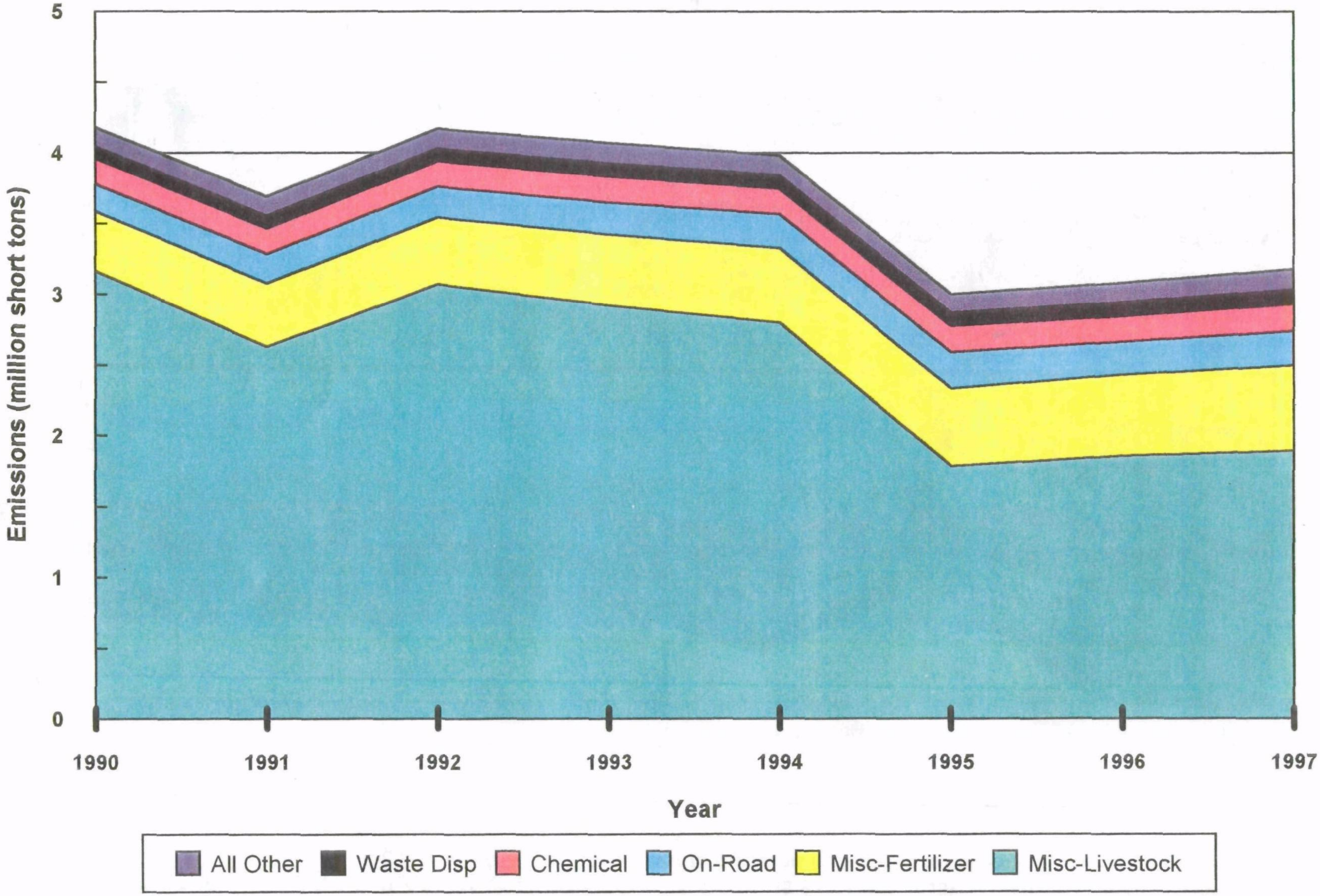


Figure 29. US Carbon Dioxide Emissions by Sector (1994)

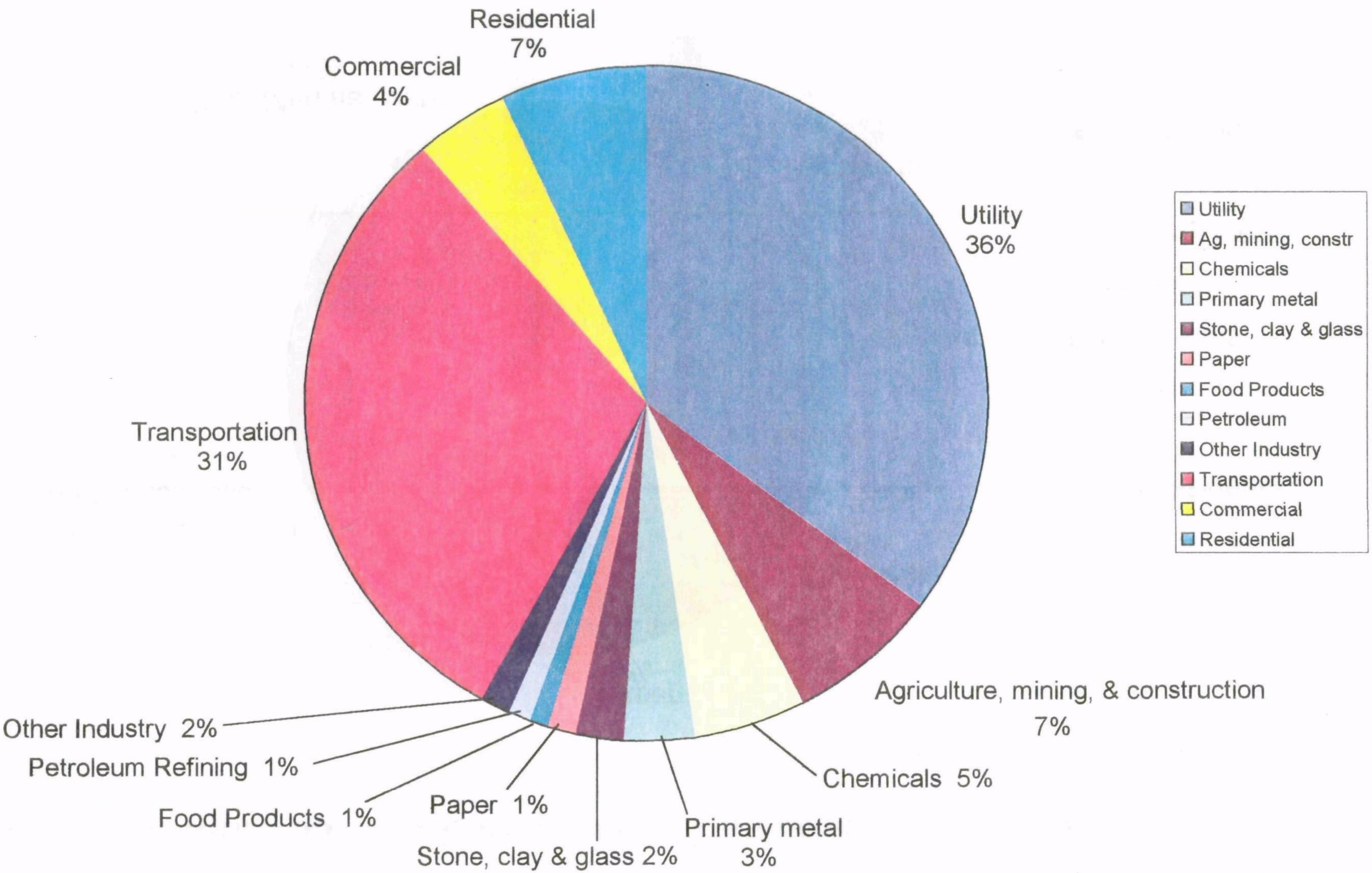
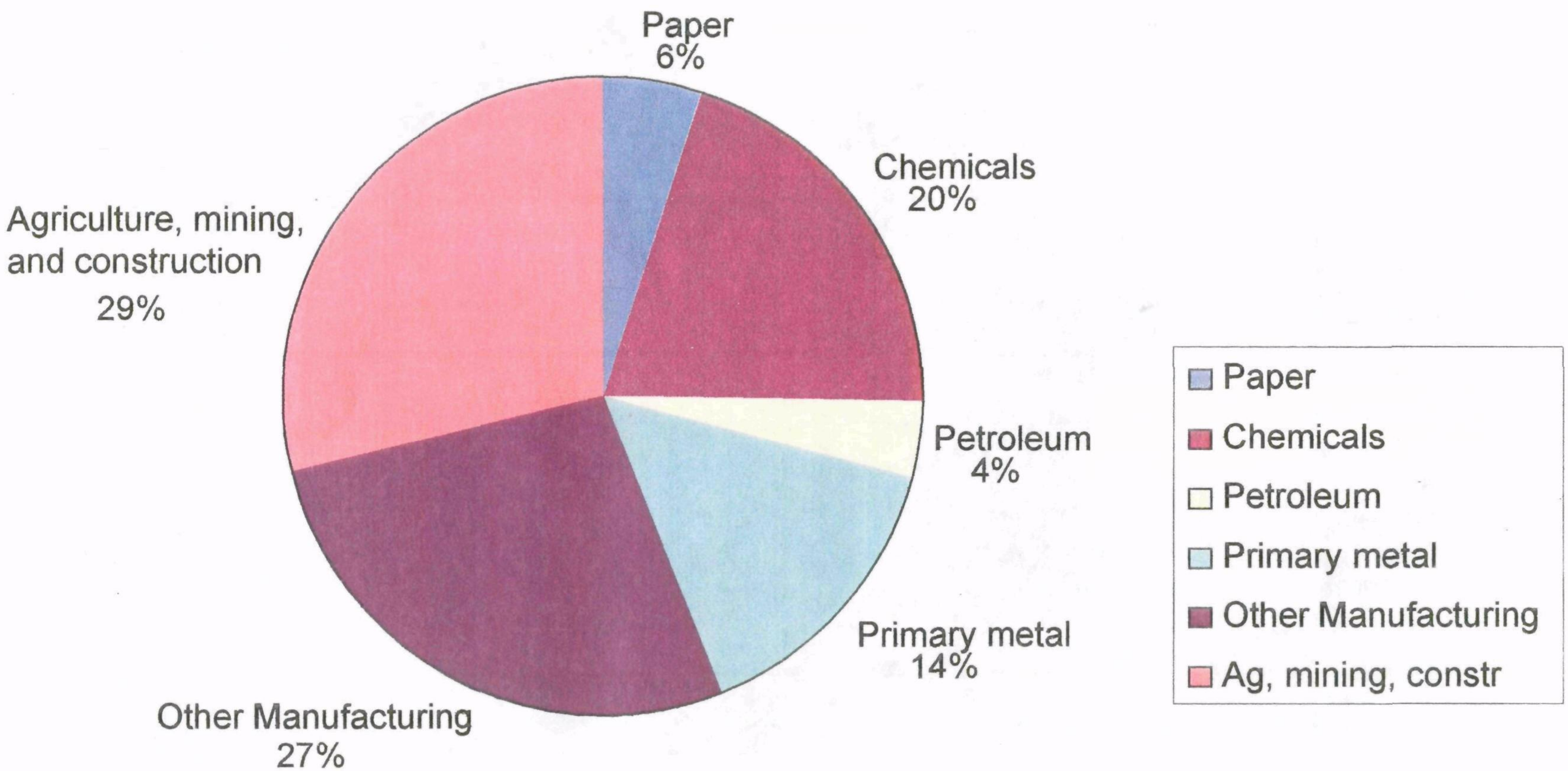
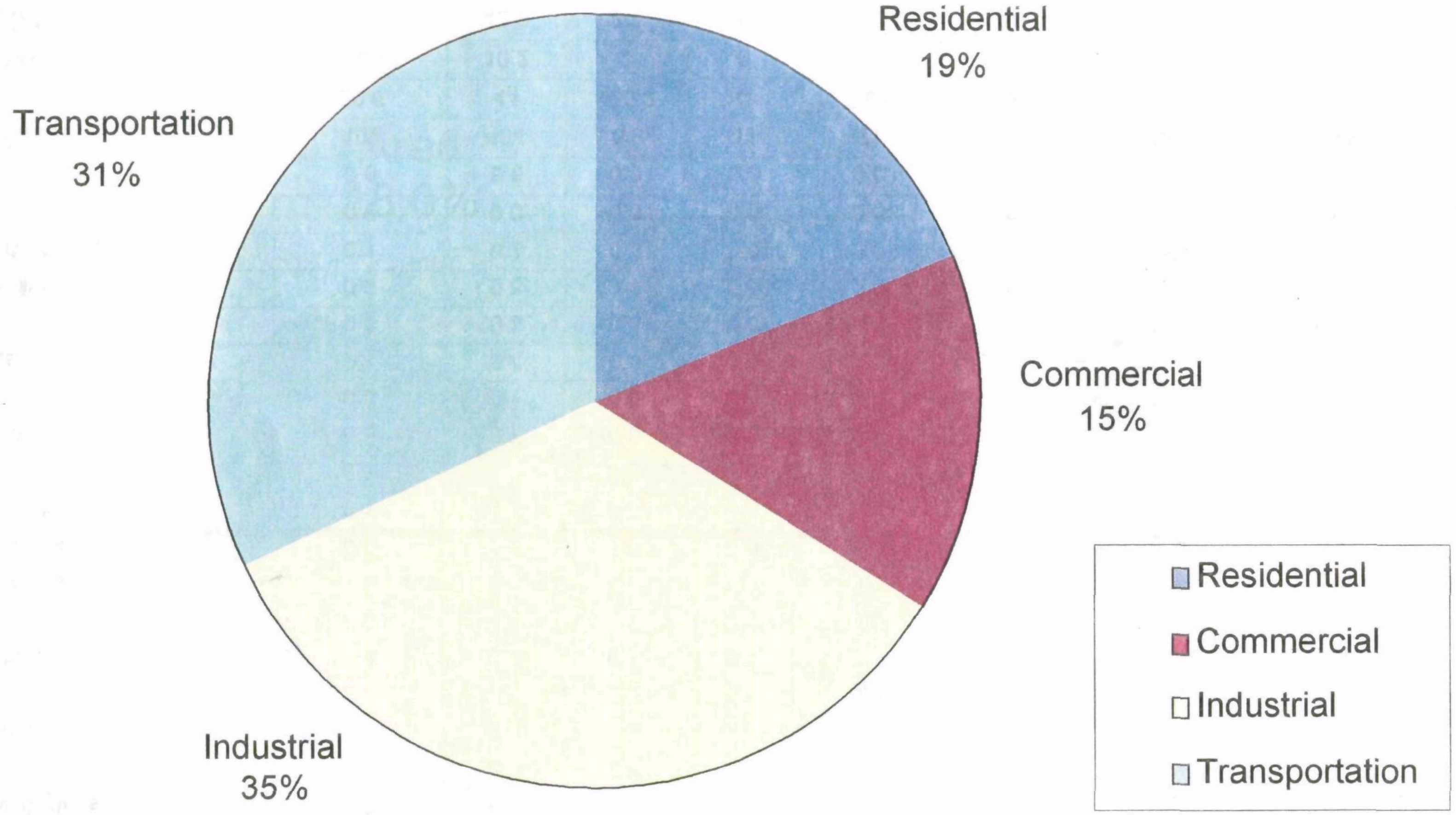


Figure 30. Carbon Dioxide Emissions from Industry



Industry CO2 emissions (491 MMTCE) represented about 35% of total US CO2 emissions (1410) in 1994. This includes emissions from onsite fuel combustion, process related emissions, and carbon emissions attributable to power generated offsite.

Figure 31. US Carbon Dioxide Emissions by End-Use Sector in 1994



Total CO2 emissions in 1994 were 1410 MMTCE. Carbon emissions from the utility sector have been apportioned to the appropriate end-use sector. The Industry Sector, as defined by EIA, includes manufacturing, agriculture, fisheries, forestry, construction, and mining operations.

Figure 32. Carbon Dioxide Emissions in the US, MMTCE

Sector/Source category	Petroleum	NG	Coal	Coke	Process	Total	% of Total CO2	% of Total GHG
Ag, mining, constr	61.5	38.8	0.6	0.0	3.0	104	7%	6%
Chemicals	28.5	35.8	7.3	0.3	0.0	72	5%	4%
Primary metal	1.3	11.3	22.8	10.5	0.0	46	3%	3%
Stone, clay & glass	0.7	6.0	6.8	0.0	17.5	31	2%	2%
Paper	3.9	8.0	7.6	0.0	0.0	20	1%	1%
Food Products	1.0	8.8	4.1	0.0	0.0	14	1%	1%
Petroleum	2.7	11.3	0.0	0.0	0.0	14	1%	1%
Transportation equip	0.4	2.2	0.7	0.1	0.0	3	0%	0%
Rubber	0.3	1.5	0.1	0.0	0.0	2	0%	0%
Fabricated metal	0.2	3.1	0.0	0.0	0.0	3	0%	0%
Textile Products	0.6	1.6	1.0	0.0	0.0	3	0%	0%
Industrial machinery	0.1	1.5	0.3	0.0	0.0	2	0%	0%
Electronic equip	0.1	1.2	0.0	0.0	0.0	1	0%	0%
Lumber & wood	0.5	0.7	0.0	0.0	0.0	1	0%	0%
Printing	0.0	0.7	0.0	0.0	0.0	1	0%	0%
Instruments	0.1	0.4	0.0	0.0	0.0	1	0%	0%
Apparel	0.0	0.3	0.0	0.0	0.0	0	0%	0%
Furniture & fixtures	0.0	0.3	0.1	0.0	0.0	0	0%	0%
Misc manufacturing	0.1	0.3	0.0	0.0	0.0	0	0%	0%
Leather	0.0	0.0	0.0	0.0	0.0	0	0%	0%
Tobacco Products	0.0	0.0	0.0	0.0	0.0	0	0%	0%
Industry Total	102	134	51	11	21	319	22%	19%
Utility	20.6	44	430.2	0	0.05	495	35%	30%
Transportation	416.6	10.2	0	0	0	427	30%	26%
Commercial	14.9	42.9	2.1	0	-	60	4%	4%
Residential	25.3	71.8	1.4	0	-	99	7%	6%
Territories	11.2	NA	0.26	-	-	11	1%	1%
Total	591	303	485	11	21	1410	100%	85%

Emissions in this table do not include methane and nitrous oxide emissions. The % of total GHG emissions is based on total US GHG emissions of 1,657 MMTCE in 1994. Zeros in the percent columns indicate less than one half a percent of total.

Figure 33. National Toxic Emissions for 1993 NTI by Source Type

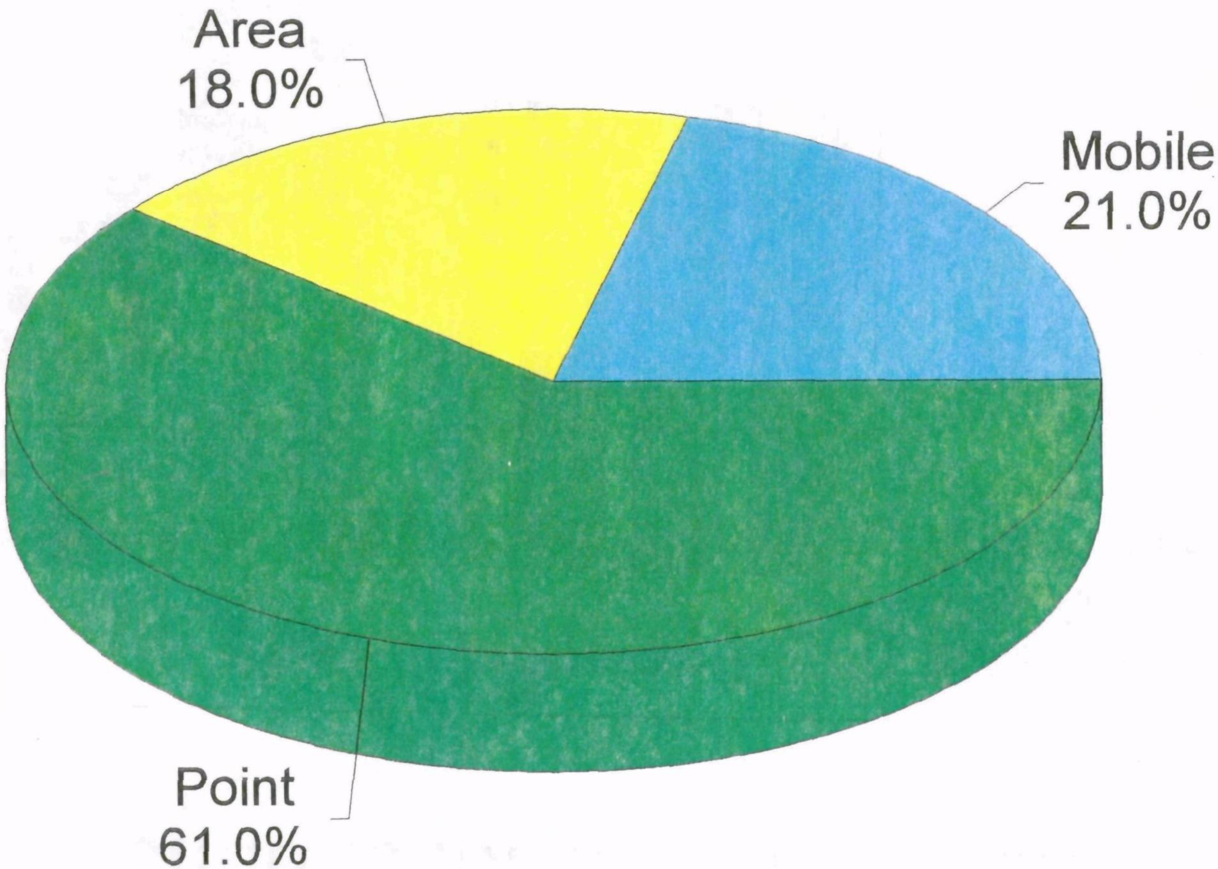


Figure 34. 1993 NTI Source Category Contributions for Selected States

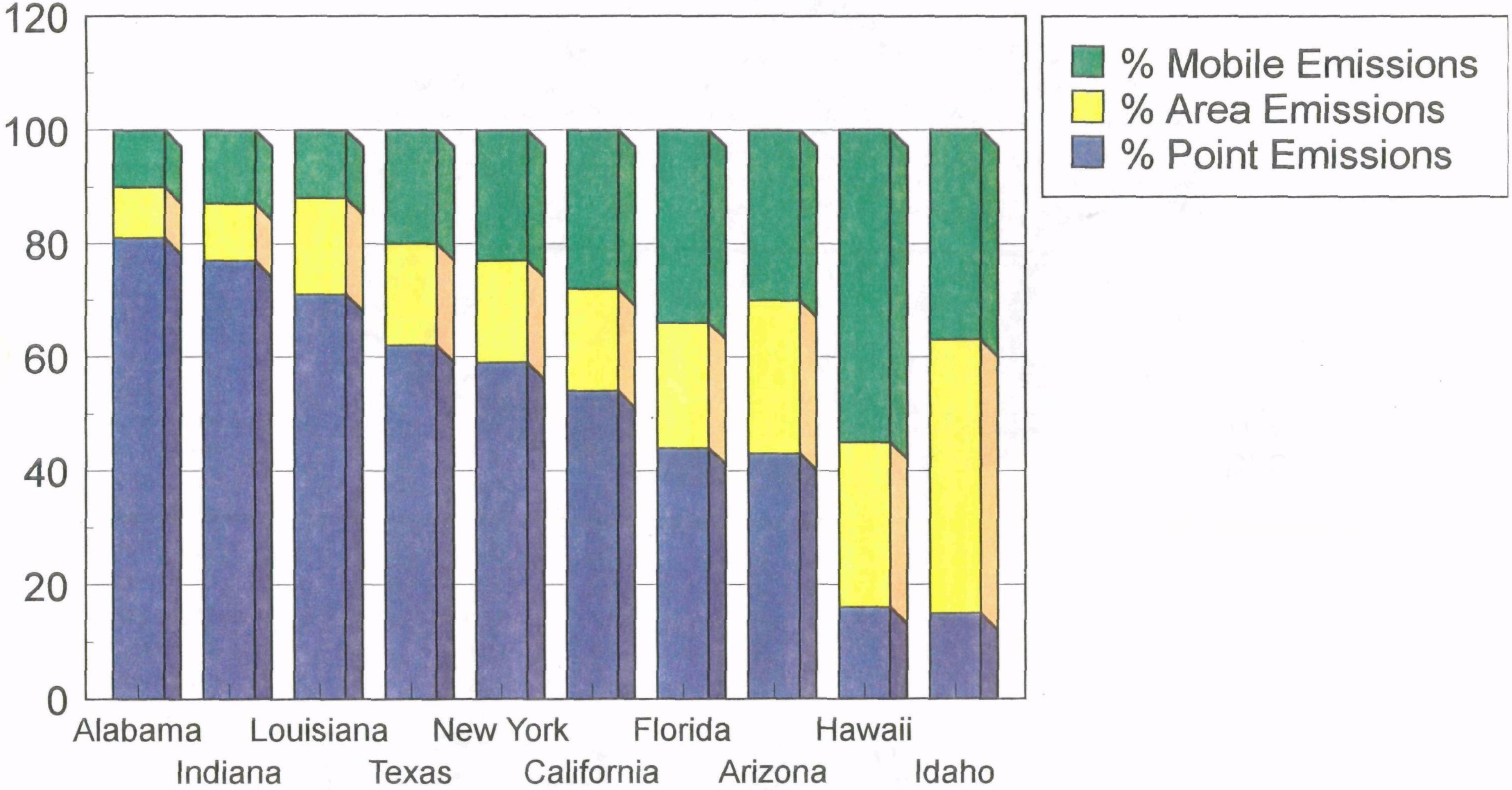


Figure 35. 1993 NTI State Emissions

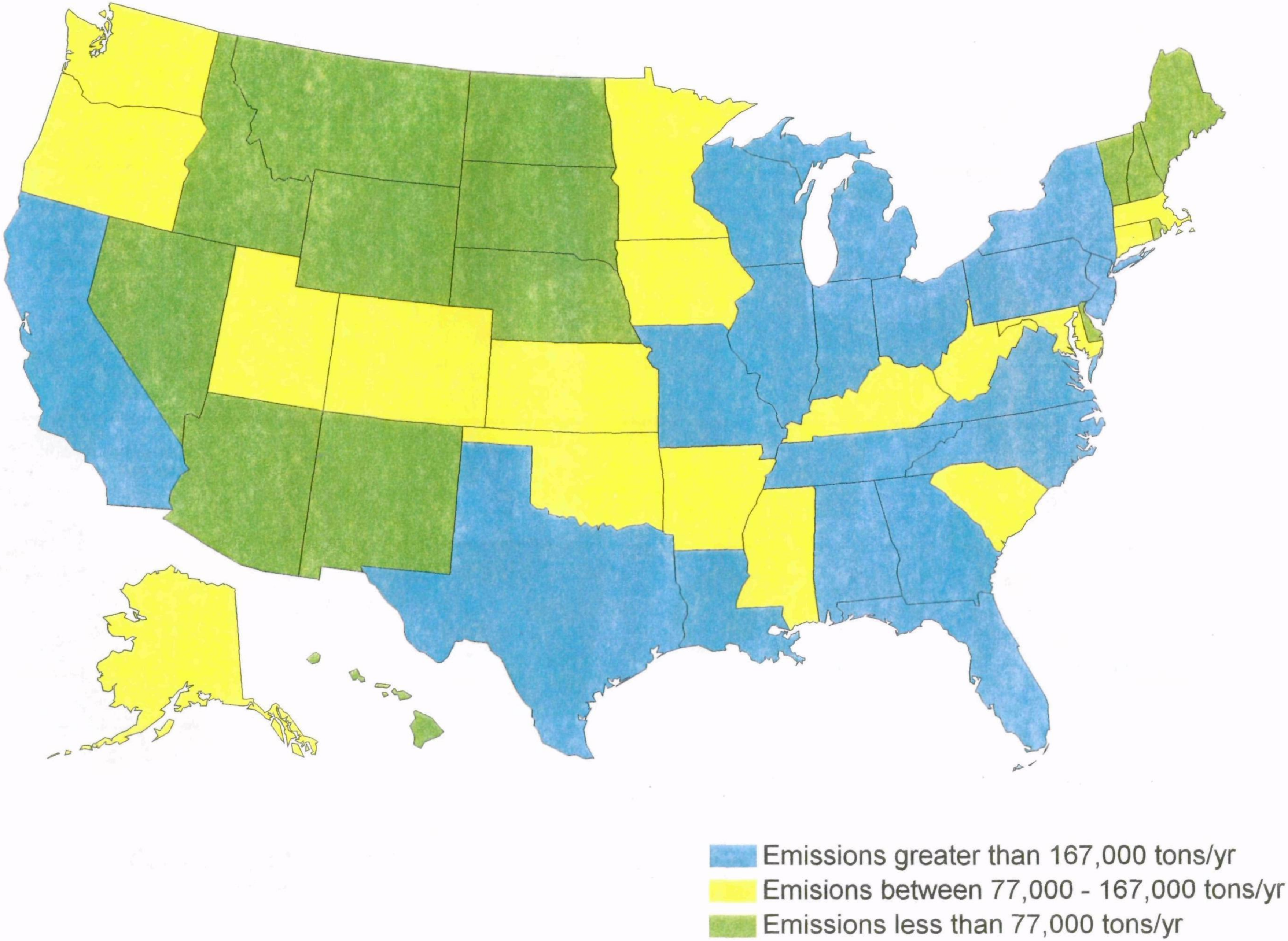


Figure 36. 1996 NTI State Data Summary

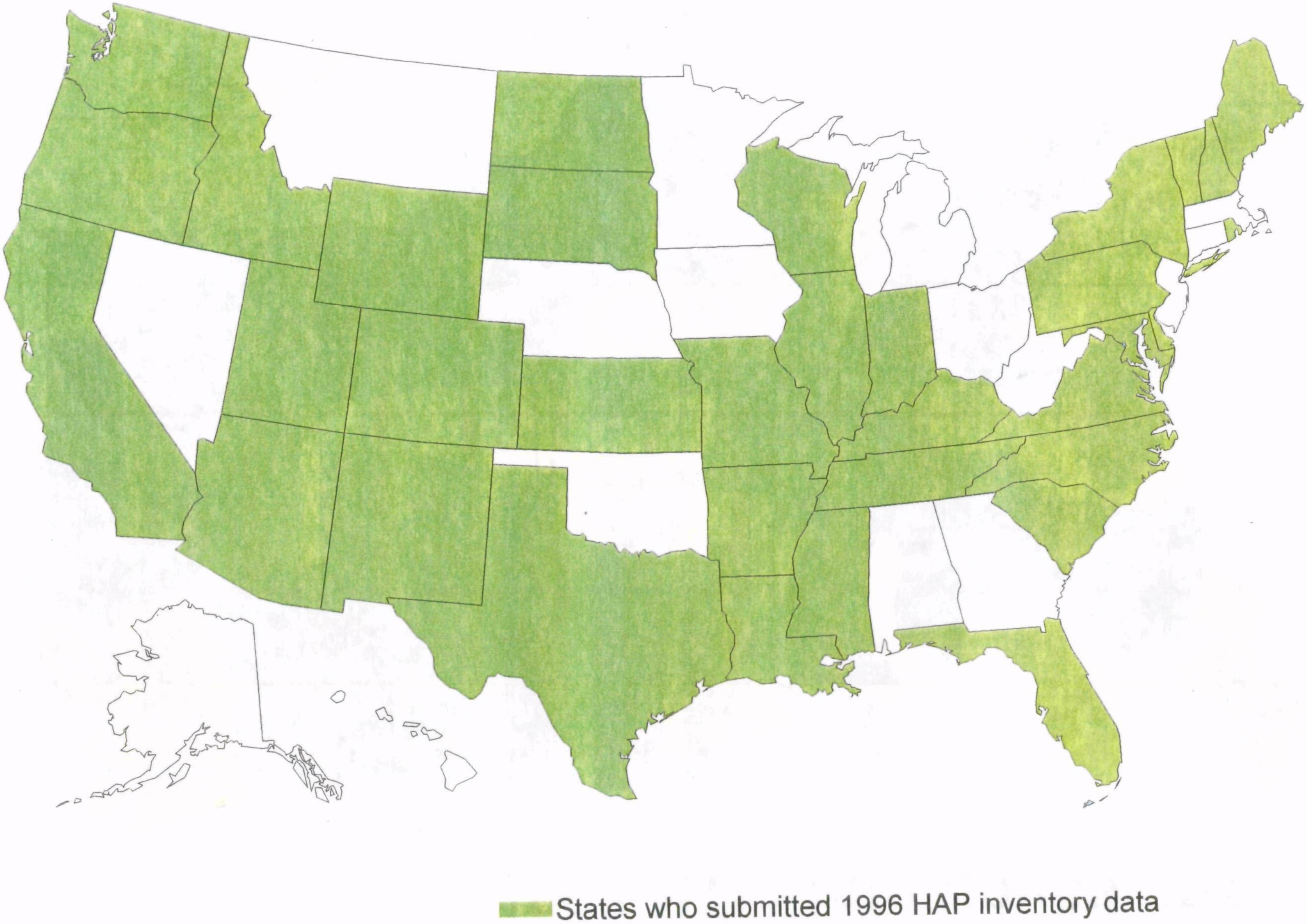


Table A-1. Carbon Monoxide Emissions
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FUEL COMB. ELEC. UTIL.	***237***	***276***	***322***	***291***	***301***	***314***	***321***	***363***	***349***	***350***	***363***	***370***	***372***	***394***	***406***
Coal	106	134	188	207	218	230	233	234	234	236	246	247	250	248	254
Oil	41	69	48	18	20	25	26	20	19	15	16	15	10	11	12
Gas	90	73	85	56	53	48	51	51	51	51	49	53	55	76	79
Internal Combustion	NA	NA	NA	10	10	11	11	57	45	47	51	55	58	59	62
FUEL COMB. INDUSTRIAL	***770***	***763***	***750***	***670***	***649***	***669***	***672***	***879***	***920***	***955***	***1,043***	***1,041***	***1,056***	***1,072***	***1,110***
Coal	100	67	58	86	85	87	87	105	101	102	101	100	98	99	100
Oil	44	49	35	47	46	46	46	74	60	64	66	66	71	72	73
Gas	462	463	418	257	252	265	271	226	284	300	322	337	345	348	362
Other	164	184	239	167	171	173	173	279	267	264	286	287	297	305	318
Internal Combustion	NA	NA	NA	113	96	98	96	195	208	227	268	251	245	247	257
FUEL COMB. OTHER	***3,625***	***3,441***	***6,230***	***7,525***	***6,011***	***6,390***	***6,450***	***4,269***	***4,587***	***4,849***	***4,181***	***4,108***	***4,506***	***4,513***	***3,301***
Commercial/Institutional Coal	12	17	13	14	14	15	15	14	14	15	15	15	15	15	16
Commercial/Institutional Oil	27	23	21	18	19	18	17	18	17	18	18	18	19	19	19
Commercial/Institutional Gas	24	25	26	42	43	47	49	44	44	51	53	54	54	54	56
Misc. Fuel Comb. (Except Resi	NA	NA	NA	57	59	55	55	149	141	141	143	147	145	163	168
Residential Wood	2,932	3,114	5,992	7,232	5,719	6,086	6,161	3,781	4,090	4,332	3,679	3,607	3,999	3,993	2,778
fireplaces	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
woodstoves	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
Residential Other	630	262	178	162	157	168	153	262	281	292	274	268	273	269	264
CHEMICAL & ALLIED PRODUC	***3,397***	***2,204***	***2,151***	***1,845***	***1,798***	***1,917***	***1,925***	***1,183***	***1,127***	***1,112***	***1,093***	***1,171***	***1,223***	***1,223***	***1,287***
Organic Chemical Mfg	340	483	543	251	260	278	285	149	128	131	132	130	127	128	134
ethylene dichloride	*11*	*12*	*17*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
maleic anhydride	*73*	*147*	*103*	*16*	*15*	*16*	*16*	*3*	*3*	*4*	*4*	*4*	*4*	*4*	*4*
cyclohexanol	*36*	*39*	*37*	*5*	*5*	*6*	*6*	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*1*
other	*220*	*286*	*386*	*230*	*240*	*256*	*264*	*146*	*125*	*127*	*128*	*125*	*123*	*123*	*130*
Inorganic Chemical Mfg	190	153	191	89	89	95	95	133	129	130	131	135	134	134	141
pigments; TiO2 chloride proc	*18*	*22*	*34*	*77*	*77*	*83*	*84*	*119*	*119*	*119*	*119*	*119*	*119*	*119*	*125*
other	*172*	*131*	*157*	*12*	*11*	*12*	*12*	*14*	*11*	*12*	*13*	*16*	*15*	*15*	*16*
Polymer & Resin Mfg	NA	NA	NA	19	18	18	18	3	6	5	5	5	5	5	5
Agricultural Chemical Mfg	NA	NA	NA	16	16	17	17	44	19	19	18	17	17	17	18
Paint, Varnish, Lacquer, Ename	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Pharmaceutical Mfg	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Other Chemical Mfg	2,866	1,567	1,417	1,471	1,415	1,509	1,510	854	844	827	805	885	939	939	989
carbon black mfg	*2,866*	*1,567*	*1,417*	*1,078*	*1,034*	*1,098*	*1,112*	*798*	*756*	*736*	*715*	*793*	*845*	*845*	*889*
carbon black furnace: fugitiv	*NA*	*NA*	*NA*	*155*	*161*	*185*	*180*	*17*	*54*	*57*	*60*	*63*	*65*	*65*	*70*
other	*NA*	*NA*	*NA*	*238*	*219*	*226*	*219*	*39*	*35*	*34*	*30*	*30*	*29*	*29*	*30*

Table A-1. Carbon Monoxide Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
METALS PROCESSING	***3,644***	***2,496***	***2,246***	***2,223***	***1,984***	***2,101***	***2,132***	***2,640***	***2,571***	***2,496***	***2,536***	***2,475***	***2,380***	***2,378***	***2,465***
Nonferrous Metals Processing	652	636	842	694	614	656	677	436	438	432	423	421	424	424	440
aluminum anode baking	*326*	*318*	*421*	*41*	*38*	*40*	*41*	*41*	*47*	*41*	*41*	*41*	*41*	*41*	*43*
prebake aluminum cell	*326*	*318*	*421*	*257*	*232*	*248*	*254*	*260*	*260*	*260*	*260*	*260*	*260*	*260*	*271*
other	*NA*	*NA*	*NA*	*396*	*344*	*368*	*382*	*135*	*131*	*131*	*122*	*120*	*123*	*123*	*127*
Ferrous Metals Processing	2,991	1,859	1,404	1,523	1,365	1,439	1,449	2,163	2,108	2,038	2,089	2,029	1,930	1,929	1,999
basic oxygen furnace	*440*	*125*	*80*	*694*	*617*	*650*	*662*	*594*	*731*	*767*	*768*	*677*	*561*	*561*	*580*
carbon steel electric arc furn	*181*	*204*	*280*	*19*	*17*	*18*	*18*	*45*	*54*	*49*	*58*	*61*	*65*	*65*	*67*
coke oven charging	*62*	*53*	*43*	*9*	*8*	*9*	*9*	*14*	*16*	*17*	*7*	*7*	*8*	*8*	*8*
gray iron cupola	*1,203*	*649*	*340*	*302*	*281*	*288*	*280*	*124*	*118*	*114*	*121*	*128*	*120*	*118*	*123*
iron ore sinter plant windbox	*1,025*	*759*	*600*	*304*	*266*	*287*	*293*	*211*	*211*	*211*	*211*	*211*	*211*	*211*	*220*
other	*81*	*70*	*61*	*194*	*176*	*188*	*187*	*1,174*	*979*	*880*	*924*	*945*	*966*	*966*	*1,001*
Metals Processing NEC	NA	NA	NA	6	6	6	6	40	25	26	25	25	25	25	26
PETROLEUM & RELATED INDU	***2,179***	***2,211***	***1,723***	***462***	***455***	***441***	***436***	***333***	***345***	***371***	***371***	***338***	***348***	***348***	***364***
Oil & Gas Production	NA	NA	NA	11	8	8	8	38	18	21	22	35	34	34	36
Petroleum Refineries & Related	2,168	2,211	1,723	449	445	431	427	291	324	345	344	299	309	308	323
fcc units	*1,820*	*2,032*	*1,680*	*403*	*408*	*393*	*390*	*284*	*315*	*333*	*328*	*286*	*299*	*299*	*313*
other	*348*	*179*	*44*	*46*	*37*	*38*	*37*	*7*	*9*	*13*	*17*	*13*	*10*	*10*	*10*
Asphalt Manufacturing	11	NA	NA	2	2	2	2	3	4	5	5	5	5	5	5
OTHER INDUSTRIAL PROCESS	***620***	***630***	***830***	***694***	***713***	***711***	***716***	***537***	***548***	***544***	***594***	***600***	***624***	***635***	***663***
Agriculture, Food, & Kindred Pr	NA	NA	NA	0	0	0	0	3	3	3	3	2	6	7	7
Textiles, Leather, & Apparel Pro	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Wood, Pulp & Paper, & Publish	610	602	798	627	646	649	655	473	461	449	453	461	484	494	515
sulfate pulping: rec. furnace/	*NA*	*NA*	*NA*	*475*	*489*	*491*	*497*	*370*	*360*	*348*	*350*	*355*	*370*	*377*	*394*
sulfate (kraft) pulping: lime k	*610*	*602*	*798*	*140*	*144*	*145*	*146*	*87*	*81*	*75*	*78*	*76*	*82*	*84*	*87*
other	*NA*	*NA*	*NA*	*12*	*13*	*13*	*13*	*16*	*21*	*25*	*24*	*30*	*32*	*33*	*34*
Rubber & Miscellaneous Plastic	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Mineral Products	10	27	32	43	44	44	43	54	77	85	131	131	127	129	135
Machinery Products	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Electronic Equipment	NA	NA	NA	18	18	13	12	2	2	2	2	2	2	2	2
Transportation Equipment	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous Industrial Proces	NA	NA	NA	6	5	5	5	5	5	6	4	4	4	4	4
SOLVENT UTILIZATION	***NA***	***NA***	***NA***	***2***	***2***	***2***	***2***	***5***	***5***	***5***	***5***	***5***	***6***	***6***	***6***
Degreasing	NA	NA	NA	1	1	1	1	0	0	0	0	0	0	0	0
Graphic Arts	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Dry Cleaning	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	1	1	1	1
Surface Coating	NA	NA	NA	0	0	1	1	0	1	1	1	1	1	1	1
Other Industrial	NA	NA	NA	0	0	0	0	4	4	4	4	4	4	4	4
Nonindustrial	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0

Table A-1. Carbon Monoxide Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
STORAGE & TRANSPORT	***NA***	***NA***	***NA***	***49***	***50***	***56***	***55***	***76***	***28***	***17***	***51***	***24***	***25***	***25***	***26***
Bulk Terminals & Plants	NA	NA	NA	0	0	0	0	0	2	0	4	4	4	4	4
Petroleum & Petroleum Product	NA	NA	NA	0	0	0	0	0	12	0	32	4	4	4	4
Petroleum & Petroleum Product	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Service Stations: Stage II	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0
Organic Chemical Storage	NA	NA	NA	42	44	51	49	74	13	13	13	13	13	13	14
Organic Chemical Transport	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Inorganic Chemical Storage	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Inorganic Chemical Transport	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Bulk Materials Storage	NA	NA	NA	6	5	5	5	1	1	3	2	3	3	3	3
WASTE DISPOSAL & RECYCLI	***7,059***	***3,230***	***2,300***	***1,941***	***1,850***	***1,806***	***1,747***	***1,079***	***1,116***	***1,138***	***1,248***	***1,225***	***1,185***	***1,203***	***1,242***
Incineration	2,979	1,764	1,246	958	920	903	876	372	392	404	497	467	432	443	467
conical wood burner	*1,431*	*579*	228	*17*	*18*	*19*	*19*	*6*	*7*	*6*	*6*	*6*	*6*	*6*	*6*
municipal incinerator	*333*	*23*	*13*	*34*	*34*	*35*	*35*	*16*	*17*	*15*	*14*	*14*	*15*	*15*	*16*
industrial	*NA*	*NA*	NA	*9*	*9*	*10*	*9*	*9*	*10*	*10*	*87*	*48*	*10*	*10*	*11*
commmercial/institutional	*108*	*68*	*60*	*32*	*35*	*38*	*39*	*19*	*20*	*21*	*21*	*21*	*21*	*22*	*23*
residential	*1,107*	*1,094*	*945*	*865*	*822*	*800*	*773*	*294*	*312*	*324*	*340*	*347*	*351*	*360*	*380*
other	*NA*	*NA*	*NA*	*2*	*2*	*2*	*2*	*27*	*26*	*28*	*29*	*30*	*29*	*30*	*31*
Open Burning	4,080	1,466	1,054	982	930	903	870	706	722	731	749	755	750	757	772
industrial	*1,932*	*1,254*	*1,007*	*20*	*21*	*21*	*21*	*14*	*14*	*15*	*15*	*15*	*15*	*16*	*16*
commmercial/institutional	*2,148*	*212*	*47*	*4*	*4*	*4*	*5*	*46*	*48*	*50*	*52*	*54*	*52*	*53*	*55*
residential	*NA*	*NA*	NA	*958*	*905*	*877*	*845*	*509*	*516*	*523*	*529*	*533*	*536*	*539*	*545*
other	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*137*	*144*	*144*	*153*	*153*	*147*	*149*	*156*
POTW	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Industrial Waste Water	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
TSDF	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Landfills	NA	NA	NA	0	0	0	0	1	1	2	2	2	2	2	2
Other	NA	NA	NA	0	0	0	0	0	0	0	1	1	1	1	1
ON-ROAD VEHICLES	***88,034***	***83,134***	***78,049***	***77,387***	***71,250***	***71,081***	***66,050***	***57,848***	***62,074***	***59,859***	***60,202***	***61,833***	***54,106***	***53,262***	***50,257***
Light-Duty Gas Vehicles & Mot	64,031	59,281	53,561	49,451	45,340	45,553	42,234	37,407	40,267	39,370	39,163	37,507	33,701	28,732	27,036
light-duty gas vehicles	*63,846*	*59,061*	53,342	*49,273*	*45,161*	*45,367*	*42,047*	*37,198*	*40,089*	*39,190*	*38,973*	*37,312*	*33,500*	*28,543*	*26,847*
motorcycles	*185*	*220*	219	*178*	*179*	*186*	*187*	*209*	*177*	*180*	*190*	*195*	*200*	*189*	*189*
Light-Duty Gas Trucks	16,570	15,767	16,137	18,960	17,274	17,133	15,940	13,816	15,014	14,567	15,196	17,350	14,829	19,271	18,364
light-duty gas trucks 1	*10,102*	*9,611*	10,395	*11,834*	*10,187*	*9,890*	*9,034*	*8,415*	*8,450*	*8,161*	*8,430*	*9,534*	*8,415*	*11,060*	*10,564*
light-duty gas trucks 2	*6,468*	*6,156*	5,742	*7,126*	*7,087*	*7,244*	*6,906*	*5,402*	*6,565*	*6,407*	*6,766*	*7,815*	*6,414*	*8,211*	*7,800*
Heavy-Duty Gas Vehicles	6,712	7,140	7,189	7,716	7,347	7,072	6,506	5,360	5,459	4,569	4,476	5,525	4,123	3,766	3,349
Diesels	721	945	1,161	1,261	1,289	1,322	1,369	1,265	1,334	1,352	1,367	1,451	1,453	1,493	1,508
heavy-duty diesel vehicles	*721*	*915*	*1,139*	*1,235*	*1,260*	*1,290*	*1,336*	*1,229*	*1,298*	*1,315*	*1,328*	*1,411*	*1,412*	*1,453*	*1,468*
light-duty diesel trucks	*NA*	*NA*	*4*	*4*	*5*	*5*	*6*	*5*	*6*	*6*	*7*	*8*	*8*	*11*	*11*
light-duty diesel vehicles	*NA*	*30*	19	*22*	*24*	*26*	*28*	*31*	*30*	*31*	*33*	*32*	*33*	*29*	*30*

Table A-1. Carbon Monoxide Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
NON-ROAD ENGINES AND VEH	**10,702**	**12,319**	**13,757**	**14,624**	**14,439**	**14,698**	**14,820**	**15,376**	**15,368**	**15,652**	**15,828**	**16,050**	**16,271**	**16,409**	**16,755**
Non-Road Gasoline	9,476	10,144	11,002	11,813	12,284	12,464	12,537	13,088	13,065	13,305	13,454	13,638	13,805	13,935	14,242
recreational	268	283	299	312	316	318	321	359	365	370	374	378	382	386	389
construction	250	274	368	421	402	401	398	355	329	334	348	382	393	400	423
industrial	732	803	970	1,104	1,164	1,207	1,227	1,387	1,350	1,374	1,371	1,404	1,436	1,446	1,510
lawn & garden	4,679	5,017	5,366	5,685	5,808	5,866	5,929	6,501	6,599	6,684	6,770	6,823	6,895	6,949	7,009
farm	46	60	77	84	47	92	63	213	170	199	209	175	145	150	152
light commercial	2,437	2,554	2,680	2,894	3,203	3,219	3,223	2,428	2,385	2,453	2,472	2,551	2,621	2,658	2,787
logging	9	21	25	28	33	31	33	32	33	34	34	36	40	41	44
airport service	80	94	116	129	137	144	147	116	114	118	119	121	129	131	141
recreational marine vessels	976	1,037	1,102	1,157	1,175	1,185	1,195	1,698	1,720	1,739	1,757	1,769	1,763	1,775	1,788
Non-Road Diesel	641	1,481	1,879	1,830	1,106	1,129	1,149	1,180	1,207	1,236	1,268	1,300	1,329	1,330	1,301
recreational	2	3	3	4	3	3	3	3	3	3	3	3	4	3	3
construction	362	516	682	761	614	634	655	677	699	721	744	766	788	789	768
industrial	99	78	94	119	153	150	148	146	146	147	149	152	155	156	154
lawn & garden	16	30	33	36	22	23	25	27	30	32	35	38	41	44	47
farm	91	771	972	792	175	176	177	178	179	180	181	183	184	182	176
light commercial	32	43	45	54	42	44	45	46	48	49	51	53	54	56	56
logging	19	17	21	27	58	58	58	58	58	57	57	56	56	52	45
airport service	19	23	28	36	33	35	31	38	38	38	40	41	39	40	43
railway maintenance	NA	UA	UA	UA	2	2	2	2	2	2	3	3	3	3	3
recreational marine vessels	NA	UA	UA	UA	4	4	4	4	4	5	5	5	5	5	5
Aircraft	506	600	743	831	887	931	955	904	888	901	905	915	942	949	1,012
Marine Vessels	14	17	37	44	50	56	59	83	87	85	81	82	82	82	85
coal	2	2	4	5	6	6	7	4	4	4	4	5	4	4	4
diesel	12	14	32	39	44	48	52	46	47	45	43	44	44	44	45
residual oil	0	0	1	1	1	1	1	7	7	7	7	7	6	6	6
gasoline	NA	NA	NA	NA	NA	NA	NA	2	2	2	2	2	2	2	2
other	NA	NA	NA	NA	NA	NA	NA	24	27	27	25	25	26	26	27
Railroads	65	77	96	106	112	118	121	121	120	125	120	114	114	112	115

Table A-1. Carbon Monoxide Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
MISCELLANEOUS	***7,909***	***5,263***	***8,344***	***7,927***	***8,852***	***15,895***	***8,153***	***11,208***	***8,751***	***7,052***	***7,013***	***9,614***	***7,050***	***9,463***	***9,568***
Other Combustion	7,909	5,263	8,344	7,927	8,852	15,895	8,153	11,207	8,751	7,052	7,013	9,613	7,049	9,462	9,568
structural fires	*101*	*258*	*217*	*242*	*242*	*242*	*242*	*164*	*166*	*168*	*169*	*170*	*171*	*142*	*143*
agricultural fires	*873*	*539*	*501*	*396*	*483*	*612*	*571*	*415*	*413*	*421*	*415*	*441*	*465*	*475*	*501*
slash/prescribed burning	*1,146*	*2,268*	*2,226*	*4,332*	*4,332*	*4,332*	*4,332*	*4,668*	*4,713*	*4,760*	*4,810*	*4,860*	*4,916*	*4,955*	*5,033*
forest wildfires	*5,620*	*2,165*	*5,396*	*2,957*	*3,795*	*10,709*	*3,009*	*5,928*	*3,430*	*1,674*	*1,586*	*4,114*	*1,469*	*3,863*	*3,863*
other	*169*	*34*	*4*	*NA*	*NA*	*NA*	*NA*	*32*	*28*	*30*	*34*	*28*	*28*	*27*	*28*
Health Services	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA	NA
Cooling Towers	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	0	0	0	0
Fugitive Dust	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
TOTAL ALL SOURCES	**128,176**	**115,967**	**116,701**	**115,639**	**108,353**	**116,081**	**103,480**	**95,794**	**97,790**	**94,400**	**94,526**	**98,854**	**89,151**	**90,929**	**87,451**

Note(s): NA = not available. For several source categories, emissions either prior to or beginning with 1985 are not available at the more detailed level but are contained in the more aggregate estimate.

"Other" categories may contain emissions that could not be accurately allocated to specific source categories.

Zero values represent less than 500 short tons/year.

In order to convert emissions to gigagrams (thousand metric tons), multiply the above values by 0.9072.

Table A-2. Nitrogen Oxide Emissions
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FUEL COMB. ELEC. UTIL.	***4,900***	***5,694***	***7,024***	***6,127***	***6,246***	***6,545***	***6,593***	***6,663***	***6,519***	***6,504***	***6,651***	***6,565***	***6,384***	***6,060***	***6,178***
Coal	3,888	4,828	6,123	5,240	5,376	5,666	5,676	5,642	5,559	5,579	5,744	5,636	5,579	5,542	5,599
bituminous	*2,112*	*2,590*	*3,439*	*4,378*	*4,465*	*4,542*	*4,595*	*4,532*	*4,435*	*4,456*	*4,403*	*4,207*	*3,830*	*3,748*	*3,802*
subbituminous	*1,041*	*1,276*	*1,694*	*668*	*702*	*867*	*837*	*857*	*874*	*868*	*1,087*	*1,167*	*1,475*	*1,565*	*1,580*
anthracite & lignite	*344*	*414*	*542*	*194*	*209*	*256*	*245*	*254*	*250*	*255*	*255*	*262*	*273*	*229*	*217*
other	*391*	*548*	*447*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
Oil	1,012	866	901	193	217	273	285	221	212	170	180	163	96	103	132
residual	*40*	*101*	*39*	*178*	*201*	*256*	*268*	*207*	*198*	*158*	*166*	*149*	*94*	*101*	*127*
distillate	*972*	*765*	*862*	*15*	*16*	*16*	*17*	*14*	*14*	*13*	*14*	*14*	*2*	*2*	*5*
other	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*0*	*NA*	*NA*	*NA*	*NA*	*NA*	*UA*	*UA*
Gas	NA	NA	NA	646	605	557	582	565	580	579	551	591	562	264	288
natural	*NA*	*NA*	*NA*	*646*	*605*	*557*	*582*	*565*	*580*	*579*	*551*	*591*	*562*	*264*	*288*
Internal Combustion	NA	NA	NA	48	48	50	49	235	168	175	176	175	148	151	159
FUEL COMB. INDUSTRIAL	***4,325***	***4,007***	***3,555***	***3,209***	***3,063***	***3,187***	***3,209***	***3,035***	***2,979***	***3,071***	***3,151***	***3,147***	***3,144***	***3,170***	***3,270***
Coal	771	520	444	608	596	617	615	585	570	574	589	602	597	599	614
bituminous	*532*	*359*	*306*	*430*	*435*	*447*	*446*	*399*	*387*	*405*	*413*	*420*	*412*	*411*	*429*
subbituminous	*164*	*111*	*94*	*14*	*14*	*15*	*14*	*18*	*20*	*21*	*28*	*38*	*46*	*47*	*50*
anthracite & lignite	*75*	*51*	*44*	*33*	*27*	*29*	*30*	*26*	*26*	*26*	*26*	*27*	*26*	*26*	*28*
other	*NA*	*NA*	*NA*	*131*	*119*	*126*	*124*	*141*	*137*	*122*	*122*	*117*	*112*	*114*	*107*
Oil	332	354	286	309	292	296	294	265	237	244	245	241	247	246	240
residual	*228*	*186*	*179*	*191*	*172*	*175*	*176*	*180*	*146*	*154*	*153*	*149*	*156*	*157*	*149*
distillate	*104*	*112*	*63*	*89*	*89*	*91*	*88*	*71*	*73*	*73*	*75*	*76*	*73*	*72*	*73*
other	*NA*	*56*	*44*	*29*	*31*	*31*	*29*	*14*	*18*	*17*	*17*	*17*	*17*	*17*	*18*
Gas	3,060	2,983	2,619	1,520	1,505	1,584	1,625	1,182	1,250	1,301	1,330	1,333	1,324	1,336	1,385
natural	*3,053*	*2,837*	*2,469*	*1,282*	*1,285*	*1,360*	*1,405*	*967*	*1,025*	*1,068*	*1,095*	*1,103*	*1,102*	*1,114*	*1,152*
process	*8*	*5*	*5*	*227*	*210*	*214*	*209*	*211*	*222*	*230*	*233*	*228*	*220*	*220*	*230*
other	*NA*	*140*	*145*	*11*	*10*	*10*	*10*	*3*	*3*	*3*	*2*	*2*	*2*	*2*	*2*
Other	162	149	205	118	119	121	120	131	129	126	124	124	123	125	130
wood/bark waste	*102*	*108*	*138*	*89*	*92*	*93*	*92*	*89*	*82*	*82*	*83*	*83*	*84*	*85*	*89*
liquid waste	*NA*	*NA*	*NA*	*12*	*12*	*12*	*12*	*8*	*11*	*10*	*11*	*11*	*11*	*11*	*11*
other	*60*	*41*	*67*	*17*	*15*	*16*	*16*	*34*	*36*	*34*	*30*	*30*	*28*	*28*	*29*
Internal Combustion	NA	NA	NA	655	552	569	556	874	793	825	863	846	854	864	902
FUEL COMB. OTHER	***836***	***785***	***741***	***712***	***706***	***740***	***736***	***1,196***	***1,281***	***1,353***	***1,308***	***1,303***	***1,298***	***1,289***	***1,276***
Commercial/Institutional Coa	23	33	25	37	37	39	38	40	36	38	40	40	38	38	40
Commercial/Institutional Oil	210	176	155	106	121	117	106	97	88	93	93	95	103	102	107

Table A-2. Nitrogen Oxide Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FUEL COMB. OTHER (continued)															
Commercial/Institutional Gas	120	125	131	145	144	157	159	200	210	225	232	237	231	234	241
Misc. Fuel Comb. (Except R	NA	NA	NA	11	11	11	11	34	32	28	31	31	30	29	30
Residential Wood	44	39	74	88	69	74	75	46	50	53	45	44	49	48	34
Residential Other	439	412	356	326	323	343	347	780	865	916	867	857	847	838	825
distillate oil	*118*	*113*	*85*	*75*	*79*	*80*	*78*	*209*	*211*	*210*	*210*	*210*	*210*	*209*	*208*
natural gas	*242*	*246*	*238*	*248*	*241*	*259*	*267*	*449*	*469*	*489*	*513*	*516*	*519*	*523*	*531*
other	*79*	*54*	*33*	*3*	*3*	*3*	*3*	*121*	*185*	*218*	*144*	*131*	*118*	*106*	*86*
CHEMICAL & ALLIED PROD	***271***	***221***	***213***	***262***	***255***	***274***	***273***	***168***	***165***	***163***	***155***	***160***	***158***	***159***	***167***
Organic Chemical Mfg	70	53	54	37	38	42	42	18	22	22	19	20	20	20	21
Inorganic Chemical Mfg	201	168	159	22	17	18	18	12	12	10	5	6	7	7	7
Polymer & Resin Mfg	NA	NA	NA	22	22	23	23	6	6	6	5	5	4	4	4
Agricultural Chemical Mfg	NA	NA	NA	143	141	151	152	80	77	76	74	76	74	74	78
Paint, Varnish, Lacquer, Ena	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Pharmaceutical Mfg	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Other Chemical Mfg	NA	NA	NA	38	37	40	39	52	48	50	51	54	54	54	56
METALS PROCESSING	***77***	***73***	***65***	***87***	***75***	***82***	***83***	***97***	***76***	***81***	***83***	***91***	***98***	***98***	***102***
Nonferrous Metals Processi	NA	NA	NA	16	14	15	15	14	15	13	12	12	12	12	13
Ferrous Metals Processing	77	73	65	58	48	53	54	78	56	62	67	75	83	83	86
Metals Processing NEC	NA	NA	NA	13	13	13	14	6	5	6	4	4	4	4	4
PETROLEUM & RELATED IN	***240***	***63***	***72***	***124***	***101***	***100***	***97***	***153***	***121***	***148***	***123***	***117***	***110***	***110***	***115***
Oil & Gas Production	NA	NA	NA	69	48	48	47	104	65	68	70	63	58	58	60
Petroleum Refineries & Rela	240	63	72	55	52	51	49	47	52	76	49	49	48	48	50
Asphalt Manufacturing	NA	NA	NA	1	1	1	1	3	4	4	5	5	5	5	5
OTHER INDUSTRIAL PROCE	***187***	***182***	***205***	***327***	***320***	***315***	***311***	***378***	***352***	***361***	***370***	***389***	***399***	***403***	***421***
Agriculture, Food, & Kindred	NA	NA	NA	5	5	5	5	3	3	3	4	3	6	6	6
Textiles, Leather, & Apparel	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Wood, Pulp & Paper, & Publ	18	18	24	73	76	76	77	91	88	86	86	89	89	90	94
Rubber & Miscellaneous Pla	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Mineral Products	169	164	181	239	230	225	220	270	249	259	267	281	287	290	303
cement mfg	*97*	*89*	*98*	*137*	*130*	*126*	*124*	*151*	*131*	*139*	*143*	*150*	*153*	*155*	*162*
glass mfg	*48*	*53*	*60*	*48*	*47*	*46*	*45*	*59*	*59*	*61*	*64*	*66*	*67*	*68*	*71*
other	*24*	*23*	*23*	*54*	*53*	*53*	*51*	*61*	*59*	*60*	*60*	*64*	*66*	*67*	*70*

Table A-2. Nitrogen Oxide Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
OTHER INDUSTRIAL PROCESSES (continued)															
Machinery Products	NA	NA	NA	2	2	2	2	3	2	2	3	6	7	7	7
Electronic Equipment	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Transportation Equipment	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous Industrial Pro	NA	NA	NA	8	7	7	7	10	10	10	9	9	10	10	10
SOLVENT UTILIZATION	***NA***	***NA***	***NA***	***2***	***3***	***3***	***3***	***1***	***2***	***3***	***3***	***3***	***3***	***3***	***3***
Degreasing	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Graphic Arts	NA	NA	NA	0	0	0	0	0	1	1	1	1	1	1	1
Dry Cleaning	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Surface Coating	NA	NA	NA	2	2	2	2	1	2	2	2	2	2	2	2
Other Industrial	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Nonindustrial	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Solvent Utilization NEC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0
STORAGE & TRANSPORT	***NA***	***NA***	***NA***	***2***	***2***	***2***	***2***	***3***	***6***	***5***	***5***	***5***	***6***	***6***	***6***
Bulk Terminals & Plants	NA	NA	NA	NA	NA	NA	NA	0	1	1	1	1	1	1	1
Petroleum & Petroleum Prod	NA	NA	NA	1	1	1	1	2	2	0	0	0	0	0	0
Petroleum & Petroleum Prod	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Service Stations: Stage II	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0
Organic Chemical Storage	NA	NA	NA	1	1	1	1	0	2	3	3	3	4	4	4
Organic Chemical Transport	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Inorganic Chemical Storage	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Inorganic Chemical Transpo	NA	NA	NA	NA	NA	NA	NA	1	0	0	0	0	0	0	0
Bulk Materials Storage	NA	NA	NA	0	0	1	1	0	0	0	0	0	1	1	1
WASTE DISPOSAL & RECYC	***440***	***159***	***111***	***87***	***85***	***85***	***84***	***91***	***95***	***96***	***123***	***114***	***99***	***100***	***103***
Incineration	110	56	37	27	29	31	31	49	51	51	74	65	53	54	56
Open Burning	330	103	74	59	56	54	52	42	43	43	44	44	44	45	46
POTW	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Industrial Waste Water	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
TSDF	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Landfills	NA	NA	NA	0	0	0	0	0	0	1	1	1	1	1	1
Other	NA	NA	NA	0	0	0	0	0	1	1	4	3	1	1	1

Table A-2. Nitrogen Oxide Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
ON-ROAD VEHICLES	***7,390***	***8,645***	***8,621***	***8,089***	***7,651***	***7,661***	***7,682***	***7,040***	***7,373***	***7,440***	***7,510***	***7,672***	***7,323***	***7,245***	***7,035***
Light-Duty Gas Vehicles &	4,158	4,725	4,421	3,806	3,492	3,500	3,494	3,220	3,464	3,614	3,680	3,573	3,444	2,979	2,875
light-duty gas vehicles	*4,156*	*4,722*	*4,416*	*3,797*	*3,482*	*3,489*	*3,483*	*3,208*	*3,453*	*3,602*	*3,668*	*3,560*	*3,431*	*2,967*	*2,863*
motorcycles	*2*	*3*	*5*	*9*	*10*	*11*	*11*	*12*	*11*	*12*	*12*	*13*	*13*	*12*	*12*
Light-Duty Gas Trucks	1,278	1,461	1,408	1,530	1,436	1,419	1,386	1,256	1,339	1,356	1,420	1,657	1,520	1,950	1,901
light-duty gas trucks 1	*725*	*819*	*864*	*926*	*842*	*824*	*803*	*784*	*782*	*792*	*828*	*960*	*902*	*1,156*	*1,122*
light-duty gas trucks 2	*553*	*642*	*544*	*603*	*594*	*595*	*584*	*472*	*557*	*564*	*592*	*697*	*617*	*794*	*780*
Heavy-Duty Gas Vehicles	278	319	300	330	332	336	343	326	326	308	315	351	332	329	326
Diesels	1,676	2,141	2,493	2,423	2,390	2,406	2,458	2,238	2,244	2,163	2,094	2,091	2,028	1,988	1,932
heavy-duty diesel vehicle	*1,676*	*2,118*	*2,463*	*2,389*	*2,352*	*2,366*	*2,416*	*2,192*	*2,199*	*2,116*	*2,047*	*2,043*	*1,979*	*1,941*	*1,886*
light-duty diesel trucks	*NA*	*NA*	*5*	*6*	*6*	*7*	*7*	*7*	*8*	*8*	*8*	*10*	*10*	*13*	*12*
light-duty diesel vehicles	*NA*	*23*	*25*	*28*	*31*	*33*	*35*	*39*	*37*	*39*	*39*	*38*	*39*	*35*	*35*
NON-ROAD ENGINES AND V	***2,182***	***3,135***	***4,011***	***4,143***	***3,908***	***3,998***	***4,049***	***4,237***	***4,265***	***4,310***	***4,339***	***4,397***	***4,507***	***4,478***	***4,560***
Non-Road Gasoline	75	82	96	107	111	115	116	190	187	189	189	190	204	205	211
recreational	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
construction	*2*	*2*	*3*	*4*	*3*	*3*	*3*	*4*	*4*	*4*	*4*	*4*	*5*	*5*	*5*
industrial	*46*	*51*	*61*	*70*	*74*	*76*	*78*	*118*	*115*	*116*	*114*	*116*	*121*	*122*	*127*
lawn & garden	*5*	*6*	*6*	*6*	*6*	*7*	*7*	*17*	*17*	*17*	*18*	*18*	*17*	*18*	*18*
farm	*0*	*1*	*1*	*1*	*0*	*1*	*1*	*6*	*5*	*5*	*6*	*5*	*4*	*4*	*4*
light commercial	*3*	*4*	*4*	*4*	*4*	*4*	*4*	*5*	*5*	*5*	*5*	*6*	*6*	*6*	*6*
logging	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
airport service	*2*	*2*	*2*	*3*	*3*	*3*	*3*	*2*	*2*	*2*	*2*	*3*	*3*	*3*	*3*
recreational marine vess	*16*	*17*	*18*	*19*	*19*	*19*	*19*	*32*	*32*	*33*	*33*	*33*	*42*	*42*	*42*
Non-Road Diesel	1,500	2,329	2,969	2,978	2,667	2,688	2,697	2,731	2,754	2,787	2,827	2,874	2,921	2,958	2,987
recreational	*2*	*5*	*6*	*7*	*2*	*2*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
construction	*636*	*933*	*1,232*	*1,377*	*1,079*	*1,090*	*1,102*	*1,114*	*1,127*	*1,142*	*1,158*	*1,177*	*1,201*	*1,219*	*1,230*
industrial	*218*	*160*	*193*	*244*	*338*	*330*	*322*	*314*	*306*	*303*	*302*	*302*	*303*	*305*	*309*
lawn & garden	*23*	*48*	*52*	*58*	*32*	*36*	*39*	*43*	*47*	*52*	*57*	*62*	*68*	*74*	*81*
farm	*489*	*1,018*	*1,295*	*1,055*	*940*	*953*	*966*	*979*	*993*	*1,006*	*1,020*	*1,034*	*1,049*	*1,059*	*1,056*
light commercial	*51*	*69*	*72*	*87*	*66*	*70*	*74*	*78*	*83*	*87*	*92*	*98*	*103*	*109*	*114*
logging	*37*	*42*	*54*	*67*	*112*	*105*	*98*	*92*	*86*	*82*	*80*	*78*	*77*	*74*	*71*
airport service	*45*	*53*	*65*	*83*	*77*	*81*	*72*	*86*	*86*	*88*	*91*	*95*	*91*	*87*	*93*
railway maintenance	*NA*	*UA*	*UA*	*UA*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*
recreational marine vess	*NA*	*UA*	*UA*	*UA*	*16*	*17*	*18*	*18*	*19*	*20*	*20*	*21*	*22*	*23*	*24*

Table A-2. Nitrogen Oxide Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
NON-ROAD ENGINES AND VEHICLES (continued)															
Aircraft	72	85	106	119	128	134	138	158	155	156	156	161	165	167	178
Marine Vessels	40	48	110	131	149	165	175	229	241	233	222	225	227	227	235
coal	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
diesel	*34*	*41*	*93*	*110*	*125*	*138*	*147*	*147*	*152*	*146*	*139*	*141*	*144*	*143*	*148*
residual oil	*6*	*7*	*17*	*20*	*24*	*26*	*28*	*27*	*27*	*27*	*27*	*27*	*25*	*24*	*25*
gasoline	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*10*	*10*	*9*	*9*	*9*	*10*	*10*	*10*
other	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*45*	*52*	*51*	*48*	*48*	*49*	*49*	*52*
Railroads	495	589	731	808	854	897	923	929	929	946	945	947	990	922	949
MISCELLANEOUS	***330***	***165***	***248***	***310***	***352***	***727***	***293***	***371***	***286***	***254***	***225***	***383***	***237***	***343***	***346***
Other Combustion	330	165	248	310	352	727	293	370	285	253	224	381	236	341	344
Health Services	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0
Cooling Towers	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	0	0	0	0
Fugitive Dust	NA	NA	NA	NA	NA	NA	NA	1	1	1	1	1	1	1	1
TOTAL ALL SOURCES	**21,179**	**23,128**	**24,866**	**23,482**	**22,767**	**23,718**	**23,414**	**23,436**	**23,520**	**23,789**	**24,046**	**24,345**	**23,768**	**23,465**	**23,582**

Note(s): NA = not available. For several source categories, emissions either prior to or beginning with 1985 are not available at the more detailed level but are contained in the more aggregate estimate.

"Other" categories may contain emissions that could not be accurately allocated to specific source categories.

Zero values represent less than 500 short tons/year.

In order to convert emissions to gigagrams (thousand metric tons), multiply the above values by 0.9072.

Table A-3. Volatile Organic Compound Emissions
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FUEL COMB. ELEC. UTIL.	30	40	45	32	34	37	37	47	44	44	45	45	44	49	51
Coal	18	22	31	24	25	27	27	27	27	27	29	29	29	28	29
Oil	7	14	9	5	6	7	7	6	5	4	4	4	3	3	3
Gas	5	4	5	2	2	2	2	2	2	2	2	2	2	8	8
Internal Combustion	NA	NA	NA	1	1	1	1	12	10	10	10	10	10	10	10
FUEL COMB. INDUSTRIAL	150	150	157	134	131	136	134	182	196	187	186	196	206	208	217
Coal	4	3	3	7	7	7	7	7	6	7	6	8	6	6	6
Oil	4	5	3	17	16	16	16	12	11	12	12	12	12	12	12
Gas	77	71	62	57	57	61	61	58	60	52	51	63	73	73	77
Other	65	71	89	35	36	36	36	51	51	49	51	50	50	51	53
Internal Combustion	NA	NA	NA	18	15	15	15	54	68	66	66	64	65	66	69
FUEL COMB. OTHER	541	470	848	1,403	1,117	1,188	1,200	776	835	884	762	748	823	822	593
Commercial/Institutional Coal	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Commercial/Institutional Oil	4	3	3	4	4	4	4	3	3	3	3	3	3	3	3
Commercial/Institutional Gas	6	7	7	6	6	6	7	8	8	10	11	11	11	11	11
Misc. Fuel Comb. (Except Resi	NA	NA	NA	4	4	4	4	8	8	8	9	9	8	8	9
Residential Wood	460	420	809	1,372	1,085	1,155	1,169	718	776	822	698	684	759	758	527
fireplaces	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	758	527
woodstoves	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Residential Other	70	38	28	16	16	17	15	38	39	40	40	40	41	41	41
CHEMICAL & ALLIED PRODU	1,341	1,351	1,595	881	923	982	980	634	710	715	701	691	660	436	458
Organic Chemical Mfg	629	751	884	349	356	387	387	192	216	211	215	217	210	113	119
ethylene oxide mfg	8	9	10	2	2	2	2	0	1	1	1	1	1	0	0
phenol mfg	NA	NA	NA	0	0	0	0	4	4	4	4	4	2	1	1
terephthalic acid mfg	29	46	60	24	24	26	27	20	23	17	19	21	17	15	16
ethylene mfg	70	79	111	28	29	33	33	9	11	10	10	9	10	3	3
charcoal mfg	48	29	40	37	40	43	45	33	33	33	33	34	33	33	35
socmi reactor	81	96	118	43	45	49	49	26	30	30	32	33	33	14	15
socmi distillation	NA	NA	NA	7	7	7	7	8	9	8	8	8	8	2	2
socmi air oxidation process	NA	NA	NA	0	0	1	1	2	2	2	2	2	2	1	1
socmi fugitives	194	235	254	179	180	194	193	61	67	69	70	70	70	37	39
other	199	257	291	27	28	31	30	29	38	37	36	35	34	8	8
Inorganic Chemical Mfg	65	78	93	3	3	3	3	2	3	3	2	2	3	3	3
Polymer & Resin Mfg	271	299	384	343	376	392	389	242	268	283	269	257	222	135	142
polypropylene mfg	0	0	1	12	12	13	13	2	2	2	2	2	2	1	1
polyethylene mfg	17	18	22	51	52	58	57	39	44	45	46	46	35	22	24
polystyrene resins	10	11	15	6	6	7	7	4	5	5	5	5	5	5	5

Table A-3. Volatile Organic Compound Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
CHEMICAL & ALLIED PRODUCT MFG (continued)															
Polymer & Resin Mfg (continued)															
synthetic fiber	112	149	199	217	247	250	250	144	161	173	157	143	142	73	76
styrene/butadiene rubber	77	68	70	45	46	50	50	15	15	16	17	18	16	16	17
other	55	54	77	12	12	14	13	37	41	42	42	43	22	18	19
Agricultural Chemical Mfg	NA	NA	NA	11	11	12	12	6	7	8	7	6	5	5	6
Paint, Varnish, Lacquer, Enam	61	66	65	8	8	8	8	14	16	17	18	17	18	10	10
paint & varnish mfg	61	66	65	8	8	8	8	13	15	16	16	16	16	8	9
other	NA	NA	NA	0	0	0	0	1	1	1	1	1	2	1	2
Pharmaceutical Mfg	40	55	77	43	45	48	48	20	21	24	23	24	38	32	34
Other Chemical Mfg	275	102	92	125	124	132	132	158	179	169	166	168	164	138	145
carbon black mfg	275	102	92	26	24	26	26	9	17	16	16	21	24	24	25
printing ink mfg	NA	NA	NA	2	3	3	3	1	1	1	1	2	2	0	0
fugitives unclassified	NA	NA	NA	12	11	13	12	23	23	21	20	27	30	6	7
carbon black furnace: fugiti	NA	NA	NA	4	4	5	5	0	1	1	1	1	1	0	0
other	NA	NA	NA	81	81	86	87	125	136	129	127	117	107	107	112
METALS PROCESSING	394	336	273	76	70	74	74	122	123	124	124	126	125	70	73
Nonferrous Metals Processing	NA	NA	NA	18	18	19	19	18	19	17	18	20	21	21	22
Ferrous Metals Processing	394	336	273	57	51	54	54	98	99	100	98	97	96	42	43
coke oven door & topside le	216	187	152	12	11	12	12	19	22	27	27	26	26	3	3
coke oven by-product plant	NA	NA	NA	3	3	3	3	7	9	9	9	9	9	1	1
other	177	149	121	41	37	39	39	71	68	63	62	62	61	38	39
Metals Processing NEC	NA	NA	NA	1	1	1	1	7	6	8	8	8	8	8	8
PETROLEUM & RELATED IND	1,194	1,342	1,440	703	655	645	639	612	640	632	649	647	642	517	538
Oil & Gas Production	411	378	379	107	70	71	68	301	301	297	310	305	299	272	282
Petroleum Refineries & Relate	773	951	1,045	592	582	571	568	308	337	332	336	339	339	242	252
vaccuum distillation	24	31	32	15	14	13	13	7	7	7	7	7	6	4	4
cracking units	27	27	21	34	33	32	31	15	17	16	15	16	16	16	16
process unit turnarounds	NA	NA	NA	15	14	13	13	11	11	11	11	10	12	9	9
petroleum refinery fugitives	NA	NA	NA	76	69	66	65	99	105	103	109	109	111	111	115
other	721	893	992	454	452	447	446	177	196	195	194	198	194	103	108
Asphalt Manufacturing	11	13	16	3	3	3	3	3	3	3	3	3	4	4	4

Table A-3. Volatile Organic Compound Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
OTHER INDUSTRIAL PROCES	***270***	***235***	***237***	***390***	***394***	***408***	***403***	***401***	***391***	***414***	***442***	***438***	***450***	***439***	***458***
Agriculture, Food, & Kindred P	208	182	191	169	175	177	175	138	130	127	146	145	147	135	141
vegetable oil mfg	*59*	*61*	*81*	*46*	*49*	*50*	*49*	*16*	*18*	*19*	*19*	*16*	*16*	*15*	*16*
whiskey fermentation: aging	*105*	*77*	*64*	*24*	*24*	*24*	*23*	*24*	*16*	*12*	*24*	*24*	*25*	*18*	*19*
bakeries	*45*	*44*	*46*	*51*	*51*	*52*	*51*	*43*	*44*	*44*	*46*	*46*	*47*	*44*	*46*
other	*NA*	*NA*	*NA*	*49*	*51*	*52*	*52*	*55*	*52*	*51*	*58*	*58*	*60*	*58*	*60*
Textiles, Leather, & Apparel Pr	NA	NA	NA	10	10	10	10	20	18	19	19	19	19	18	18
Wood, Pulp & Paper, & Publis	NA	NA	NA	42	44	44	44	96	92	101	112	105	122	123	129
Rubber & Miscellaneous Plasti	60	51	44	41	43	46	46	58	59	64	62	61	60	60	62
rubber tire mfg	*60*	*51*	*44*	*10*	*10*	*11*	*11*	*5*	*5*	*5*	*5*	*6*	*6*	*6*	*6*
green tire spray	*NA*	*NA*	*NA*	*5*	*5*	*6*	*6*	*3*	*4*	*3*	*3*	*3*	*3*	*3*	*3*
other	*NA*	*NA*	*NA*	*26*	*28*	*29*	*29*	*50*	*50*	*55*	*53*	*52*	*51*	*51*	*53*
Mineral Products	2	2	2	15	15	14	14	18	17	27	28	30	31	32	33
Machinery Products	NA	NA	NA	4	4	4	4	7	8	10	8	11	11	11	11
Electronic Equipment	NA	NA	NA	0	0	0	0	2	2	3	3	3	2	2	2
Transportation Equipment	NA	NA	NA	1	1	0	0	2	2	2	3	3	2	2	2
Construction	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Miscellaneous Industrial Proce	NA	NA	NA	108	103	112	109	59	62	62	62	62	57	57	60
SOLVENT UTILIZATION	***7,174***	***5,651***	***6,584***	***5,699***	***5,743***	***5,945***	***5,964***	***5,750***	***5,782***	***5,901***	***6,016***	***6,162***	***6,183***	***6,273***	***6,483***
Degreasing	707	448	513	756	681	754	757	744	718	737	753	775	789	661	692
open top	*NA*	*NA*	*NA*	*28*	*28*	*29*	*29*	*18*	*25*	*26*	*26*	*27*	*24*	*10*	*10*
conveyorized	*NA*	*NA*	*NA*	*5*	*5*	*5*	*4*	*5*	*6*	*6*	*6*	*6*	*5*	*2*	*2*
cold cleaning	*NA*	*NA*	*NA*	*31*	*31*	*34*	*35*	*30*	*23*	*24*	*24*	*22*	*23*	*9*	*9*
other	*707*	*448*	*513*	*691*	*618*	*687*	*689*	*691*	*664*	*680*	*697*	*719*	*737*	*640*	*670*
Graphic Arts	319	254	373	317	340	362	363	274	301	308	322	333	339	389	412
letterpress	*NA*	*NA*	*NA*	*2*	*2*	*2*	*2*	*4*	*8*	*8*	*8*	*8*	*8*	*8*	*8*
flexographic	*NA*	*NA*	*NA*	*18*	*19*	*20*	*20*	*20*	*24*	*26*	*26*	*25*	*24*	*23*	*24*
lithographic	*NA*	*NA*	*NA*	*4*	*4*	*4*	*4*	*14*	*17*	*18*	*21*	*22*	*20*	*20*	*21*
gravure	*NA*	*NA*	*NA*	*131*	*140*	*148*	*150*	*75*	*82*	*81*	*87*	*93*	*91*	*90*	*94*
other	*319*	*254*	*373*	*162*	*174*	*188*	*187*	*162*	*171*	*175*	*180*	*185*	*196*	*248*	*264*
Dry Cleaning	263	229	320	169	216	216	212	215	218	224	225	228	230	190	191
perchloroethylene	*NA*	*NA*	*NA*	*85*	*110*	*109*	*107*	*110*	*112*	*115*	*116*	*117*	*118*	*71*	*71*
petroleum solvent	*NA*	*NA*	*NA*	*84*	*106*	*106*	*105*	*104*	*106*	*109*	*110*	*111*	*112*	*119*	*120*
other	*263*	*229*	*320*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*1*

Table A-3. Volatile Organic Compound Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
SOLVENT UTILIZATION (continued)															
Surface Coating	3,570	2,977	3,685	2,549	2,606	2,646	2,635	2,523	2,521	2,577	2,632	2,716	2,681	2,881	2,990
industrial adhesives	*52*	*41*	*55*	*381*	*353*	*366*	*375*	*390*	*374*	*386*	*400*	*419*	*410*	*454*	*475*
fabrics	*161*	*177*	*186*	*34*	*35*	*35*	*35*	*14*	*14*	*16*	*16*	*15*	*15*	*14*	*15*
paper	*652*	*548*	*626*	*106*	*110*	*114*	*114*	*75*	*64*	*61*	*59*	*59*	*52*	*53*	*56*
large appliances	*49*	*43*	*36*	*22*	*19*	*19*	*18*	*21*	*20*	*20*	*21*	*22*	*21*	*23*	*24*
magnet wire	*7*	*6*	*5*	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
autos & light trucks	*165*	*204*	*165*	*85*	*88*	*87*	*87*	*92*	*90*	*93*	*92*	*96*	*96*	*123*	*132*
metal cans	*49*	*57*	*73*	*97*	*95*	*96*	*95*	*94*	*91*	*93*	*96*	*98*	*102*	*106*	*111*
metal coil	*18*	*19*	*21*	*50*	*49*	*50*	*50*	*45*	*49*	*47*	*49*	*48*	*47*	*49*	*52*
wood furniture	*211*	*231*	*231*	*132*	*142*	*143*	*140*	*158*	*154*	*159*	*171*	*185*	*179*	*193*	*202*
metal furniture	*35*	*42*	*52*	*41*	*44*	*44*	*44*	*48*	*47*	*49*	*52*	*56*	*53*	*58*	*61*
flatwood products	*64*	*76*	*82*	*4*	*4*	*4*	*4*	*9*	*10*	*10*	*11*	*12*	*13*	*13*	*14*
plastic parts	*17*	*18*	*25*	*11*	*11*	*11*	*11*	*27*	*22*	*23*	*22*	*22*	*18*	*18*	*19*
large ships	*21*	*20*	*20*	*15*	*15*	*16*	*15*	*15*	*14*	*15*	*15*	*15*	*13*	*12*	*13*
aircraft	*1*	*1*	*2*	*27*	*26*	*31*	*34*	*7*	*7*	*7*	*7*	*7*	*6*	*6*	*6*
misc. metal parts	*NA*	*NA*	*NA*	*14*	*14*	*14*	*14*	*59*	*87*	*90*	*92*	*93*	*92*	*92*	*96*
steel drums	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*3*	*3*	*3*	*3*	*4*	*4*	*4*	*4*
architectural	*442*	*407*	*477*	*473*	*503*	*504*	*500*	*495*	*500*	*505*	*510*	*515*	*522*	*554*	*558*
traffic markings	*NA*	*NA*	*NA*	*100*	*106*	*107*	*106*	*105*	*106*	*107*	*108*	*109*	*111*	*117*	*118*
maintenance coatings	*108*	*125*	*106*	*79*	*80*	*80*	*80*	*79*	*76*	*78*	*81*	*85*	*84*	*89*	*93*
railroad	*5*	*7*	*9*	*4*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*4*	*4*	*3*	*3*
auto refinishing	*83*	*143*	*186*	*111*	*132*	*133*	*132*	*130*	*132*	*137*	*140*	*144*	*142*	*164*	*172*
machinery	*39*	*51*	*62*	*37*	*28*	*29*	*28*	*28*	*26*	*26*	*27*	*27*	*25*	*26*	*28*
electronic & other electrical	*NA*	*NA*	*NA*	*79*	*79*	*80*	*79*	*78*	*75*	*77*	*80*	*85*	*85*	*95*	*100*
general	*79*	*61*	*52*	*146*	*148*	*158*	*154*	*121*	*127*	*129*	*133*	*140*	*138*	*138*	*145*
miscellaneous	*942*	*392*	*799*	*104*	*108*	*105*	*103*	*32*	*37*	*42*	*39*	*38*	*35*	*35*	*36*
thinning solvents	*NA*	*NA*	*NA*	*90*	*94*	*97*	*96*	*96*	*97*	*100*	*94*	*96*	*99*	*99*	*104*
other	*372*	*309*	*415*	*306*	*318*	*320*	*317*	*297*	*295*	*302*	*310*	*321*	*314*	*338*	*354*
Other Industrial	640	499	690	125	132	133	131	94	98	102	102	99	96	53	56
miscellaneous	*39*	*30*	*44*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
rubber & plastics mfg	*309*	*245*	*327*	*25*	*29*	*29*	*29*	*28*	*28*	*28*	*29*	*31*	*31*	*37*	*39*
other	*292*	*224*	*319*	*100*	*103*	*104*	*102*	*66*	*71*	*74*	*73*	*68*	*64*	*16*	*17*

Table A-3. Volatile Organic Compound Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
SOLVENT UTILIZATION (continued)															
Nonindustrial	1,674	1,243	1,002	1,783	1,768	1,834	1,867	1,900	1,925	1,952	1,982	2,011	2,048	2,100	2,142
cutback asphalt	*1,045*	*723*	*323*	*191*	*186*	*199*	*199*	*199*	*202*	*207*	*214*	*221*	*227*	*128*	*135*
other asphalt	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
pesticide application	*241*	*195*	*241*	*212*	*262*	*262*	*260*	*258*	*264*	*272*	*280*	*289*	*299*	*360*	*382*
adhesives	*NA*	*NA*	*NA*	*345*	*332*	*345*	*353*	*361*	*365*	*368*	*372*	*375*	*380*	*403*	*406*
consumer solvents	*NA*	*NA*	*NA*	*1,035*	*988*	*1,030*	*1,056*	*1,083*	*1,095*	*1,105*	*1,116*	*1,126*	*1,142*	*1,210*	*1,219*
other	*387*	*325*	*437*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
Other	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	0	0	0	0	0
STORAGE & TRANSPORT	***1,954***	***2,181***	***1,975***	***1,747***	***1,801***	***1,842***	***1,753***	***1,495***	***1,532***	***1,583***	***1,600***	***1,629***	***1,652***	***1,312***	***1,377***
Bulk Terminals & Plants	599	668	517	606	632	652	651	359	369	384	395	403	406	243	255
fixed roof	*14*	*15*	*12*	*14*	*14*	*15*	*15*	*9*	*11*	*12*	*13*	*16*	*16*	*16*	*17*
floating roof	*45*	*50*	*39*	*46*	*48*	*50*	*50*	*26*	*29*	*30*	*34*	*29*	*19*	*19*	*20*
variable vapor space	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*2*	*2*	*1*	*1*	*1*	*0*	*0*	*0*
efr with seals	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*2*	*3*	*3*	*4*	*4*	*3*	*3*	*3*
ifr with seals	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*2*	*2*	*3*	*5*	*3*	*3*	*3*	*3*
underground tanks	*NA*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*2*	*2*	*2*	*2*	*2*	*2*	*2*
area source: gasoline	*509*	*569*	*440*	*512*	*537*	*554*	*553*	*282*	*281*	*292*	*292*	*305*	*322*	*162*	*171*
other	*30*	*33*	*26*	*32*	*32*	*33*	*33*	*36*	*40*	*42*	*44*	*43*	*41*	*38*	*40*
Petroleum & Petroleum Produc	300	315	306	223	214	215	210	157	195	204	205	194	191	133	138
fixed roof gasoline	*47*	*52*	*43*	*26*	*25*	*24*	*23*	*13*	*17*	*17*	*16*	*16*	*16*	*14*	*14*
fixed roof crude	*135*	*141*	*148*	*26*	*22*	*21*	*21*	*21*	*25*	*26*	*28*	*24*	*21*	*19*	*20*
floating roof gasoline	*49*	*54*	*45*	*27*	*26*	*25*	*24*	*15*	*25*	*24*	*24*	*22*	*22*	*7*	*7*
floating roof crude	*32*	*34*	*36*	*5*	*5*	*5*	*5*	*2*	*7*	*7*	*8*	*6*	*6*	*2*	*2*
efr / seal gasoline	*3*	*4*	*3*	*2*	*2*	*2*	*2*	*7*	*11*	*13*	*14*	*14*	*15*	*12*	*12*
efr / seal crude	*1*	*2*	*2*	*0*	*0*	*0*	*0*	*3*	*3*	*3*	*3*	*3*	*2*	*2*	*2*
ifr / seal gasoline	*1*	*2*	*1*	*1*	*1*	*1*	*1*	*1*	*2*	*2*	*2*	*2*	*2*	*2*	*2*
ifr / seal crude	*2*	*2*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
variable vapor space gasoli	*3*	*3*	*3*	*1*	*1*	*1*	*2*	*1*	*2*	*5*	*6*	*3*	*0*	*0*	*0*
area source: crude	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
other	*25*	*22*	*23*	*133*	*131*	*135*	*132*	*92*	*102*	*106*	*103*	*103*	*106*	*73*	*77*
Petroleum & Petroleum Produc	92	84	61	126	123	125	125	151	146	149	142	139	134	131	136
gasoline loading: normal / s	*3*	*2*	*0*	*3*	*3*	*3*	*3*	*3*	*2*	*2*	*2*	*3*	*2*	*2*	*3*
gasoline loading: balanced /	*20*	*13*	*2*	*21*	*21*	*21*	*22*	*15*	*17*	*15*	*13*	*11*	*10*	*8*	*8*
gasoline loading: normal / s	*39*	*26*	*3*	*41*	*40*	*41*	*42*	*26*	*25*	*26*	*24*	*25*	*23*	*22*	*23*
gasoline loading: clean / su	*2*	*1*	*0*	*2*	*2*	*2*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
marine vessel loading: gaso	26	38	50	24	23	23	22	31	30	30	29	28	29	29	30
other	2	4	6	35	34	35	35	76	73	75	73	72	70	69	72
Service Stations: Stage I	416	481	461	207	219	223	223	300	295	303	309	322	334	341	359
Service Stations: Stage II	521	602	583	485	511	522	441	433	430	442	449	467	484	406	427
Service Stations: Breathing &	NA	NA	NA	49	51	52	52	52	51	52	53	55	57	37	39
Organic Chemical Storage	26	31	46	34	34	37	36	30	35	38	39	39	37	16	16
Organic Chemical Transport	NA	NA	NA	17	16	16	15	10	8	8	7	7	7	5	5

Table A-3. Volatile Organic Compound Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
STORAGE & TRANSPORT (continued)															
Inorganic Chemical Storage	NA	NA	NA	0	0	0	0	0	1	1	1	1	1	1	1
Inorganic Chemical Transport	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Bulk Materials Storage	NA	NA	NA	0	0	0	0	2	2	2	1	1	1	1	1
WASTE DISPOSAL & RECYCLI	***1,984***	***984***	***758***	***979***	***950***	***959***	***941***	***986***	***999***	***1,010***	***1,046***	***1,046***	***1,067***	***433***	***449***
Incineration	548	453	366	64	61	60	59	48	50	51	76	65	54	55	58
Open Burning	1,424	517	372	309	292	284	274	196	200	203	207	208	208	210	213
industrial	*NA*	*NA*	*NA*	*6*	*6*	*6*	*6*	*4*	*4*	*4*	*5*	*5*	*5*	*5*	*5*
commmercial/institutional	*NA*	*NA*	*NA*	*1*	*1*	*2*	*2*	*9*	*9*	*10*	*10*	*10*	*10*	*10*	*11*
residential	*NA*	*NA*	*NA*	*302*	*285*	*277*	*266*	*165*	*167*	*169*	*171*	*172*	*173*	*175*	*176*
other	*1,424*	*517*	*372*	*NA*	*NA*	*NA*	*NA*	*19*	*20*	*20*	*21*	*21*	*20*	*20*	*21*
POTW	NA	NA	NA	10	11	11	11	49	47	48	50	52	51	52	54
Industrial Waste Water	NA	NA	NA	1	1	2	2	14	18	19	19	19	16	12	13
TSDF	NA	NA	NA	594	584	602	595	589	591	589	588	587	628	45	47
Landfills	NA	NA	NA	0	0	0	0	64	66	69	74	80	75	22	24
Other	11	14	20	0	0	0	0	26	28	31	33	35	36	37	40
ON-ROAD VEHICLES	***12,972***	***10,545***	***8,979***	***9,376***	***8,477***	***8,290***	***7,192***	***6,313***	***6,499***	***6,072***	***6,103***	***6,401***	***5,701***	***5,490***	***5,230***
Light-Duty Gas Vehicles & Mot	9,193	7,248	5,907	5,864	5,281	5,189	4,462	3,947	4,069	3,832	3,812	3,748	3,426	2,875	2,755
light-duty gas vehicles	*9,133*	*7,177*	*5,843*	*5,810*	*5,227*	*5,136*	*4,412*	*3,885*	*4,033*	*3,799*	*3,777*	*3,711*	*3,385*	*2,839*	*2,719*
motorcycles	*60*	*71*	*64*	*54*	*53*	*53*	*50*	*62*	*37*	*33*	*34*	*37*	*41*	*36*	*36*
Light-Duty Gas Trucks	2,770	2,289	2,059	2,425	2,185	2,129	1,867	1,622	1,688	1,588	1,647	1,909	1,629	2,060	1,968
light-duty gas trucks 1	*1,564*	*1,251*	*1,229*	*1,437*	*1,227*	*1,173*	*1,018*	*960*	*906*	*849*	*875*	*1,003*	*895*	*1,143*	*1,098*
light-duty gas trucks 2	*1,206*	*1,038*	*830*	*988*	*958*	*956*	*849*	*662*	*781*	*739*	*772*	*906*	*735*	*917*	*870*
Heavy-Duty Gas Vehicles	743	657	611	716	662	626	517	432	423	334	326	414	327	293	268
Diesels	266	351	402	370	350	345	346	312	319	318	318	331	319	263	239
heavy-duty diesel vehicles	*266*	*335*	*392*	*360*	*338*	*332*	*332*	*297*	*304*	*302*	*301*	*313*	*302*	*245*	*221*
light-duty diesel trucks	*NA*	*NA*	*2*	*2*	*2*	*2*	*3*	*3*	*3*	*3*	*3*	*4*	*4*	*5*	*5*
light-duty diesel vehicles	*NA*	*15*	*8*	*8*	*9*	*10*	*11*	*13*	*12*	*13*	*13*	*13*	*14*	*12*	*12*
NON-ROAD ENGINES AND VE	***1,644***	***1,892***	***2,141***	***2,239***	***2,257***	***2,293***	***2,314***	***2,452***	***2,466***	***2,498***	***2,516***	***2,538***	***2,405***	***2,397***	***2,430***
Non-Road Gasoline	1,283	1,372	1,473	1,560	1,600	1,619	1,630	1,754	1,765	1,792	1,812	1,832	1,692	1,685	1,711
recreational	*138*	*145*	*151*	*156*	*158*	*159*	*160*	*129*	*131*	*133*	*135*	*136*	*138*	*135*	*136*
construction	*22*	*24*	*32*	*37*	*36*	*35*	*35*	*33*	*31*	*31*	*33*	*36*	*37*	*36*	*38*
industrial	*46*	*50*	*61*	*69*	*73*	*75*	*77*	*82*	*80*	*81*	*81*	*83*	*85*	*82*	*86*
lawn & garden	*574*	*614*	*655*	*691*	*706*	*713*	*720*	*774*	*785*	*795*	*806*	*812*	*823*	*799*	*806*
farm	*4*	*6*	*7*	*8*	*4*	*9*	*6*	*13*	*10*	*12*	*13*	*11*	*8*	*9*	*9*
light commercial	*142*	*151*	*158*	*171*	*188*	*189*	*190*	*140*	*137*	*141*	*142*	*147*	*152*	*148*	*155*
logging	*3*	*6*	*7*	*8*	*10*	*9*	*10*	*9*	*9*	*9*	*10*	*10*	*11*	*11*	*12*
airport service	*4*	*5*	*6*	*6*	*7*	*7*	*7*	*5*	*5*	*6*	*6*	*6*	*6*	*6*	*6*
recreational marine vessels	*350*	*372*	*395*	*413*	*419*	*422*	*425*	*568*	*575*	*582*	*588*	*591*	*432*	*459*	*463*

Table A-3. Volatile Organic Compound Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
NON-ROAD ENGINES AND VEHICLES (continued)															
Non-Road Diesel	232	366	464	448	408	411	412	417	420	424	428	433	438	438	433
recreational	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
construction	103	112	148	165	174	177	180	184	188	191	195	200	204	206	204
industrial	32	20	24	30	50	48	47	46	46	46	46	46	47	47	47
lawn & garden	5	7	8	9	7	8	9	9	10	11	12	13	14	15	17
farm	73	203	257	209	139	138	137	135	134	132	130	128	127	124	119
light commercial	9	10	11	13	12	12	13	13	14	14	15	16	16	17	17
logging	4	7	9	11	14	14	14	14	15	15	15	15	14	14	12
airport service	5	6	7	9	9	9	8	10	10	10	10	11	10	10	11
railway maintenance	NA	UA	UA	UA	1	1	1	1	1	1	1	1	1	1	1
recreational marine vessels	NA	UA	UA	UA	3	3	3	3	3	3	3	3	3	4	4
Aircraft	97	116	146	165	176	185	190	180	177	179	176	176	178	177	187
Marine Vessels	9	11	25	30	34	38	40	49	51	50	48	49	49	48	50
coal	0	0	0	1	1	1	1	0	0	0	0	1	0	0	0
diesel	8	10	23	28	31	35	37	28	29	28	26	27	27	27	28
residual oil	1	1	2	2	2	2	3	4	4	4	4	4	3	3	3
gasoline	NA	NA	NA	NA	NA	NA	NA	1	1	1	1	1	1	1	1
other	NA	NA	NA	NA	NA	NA	NA	16	17	17	17	17	17	17	17
Railroads	22	27	33	37	39	41	42	52	52	54	52	49	49	48	50
NATURAL SOURCES	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***14***	***14***	***14***	***14***	***14***	***14***	***14***	***14***
Geogenic	NA	NA	NA	NA	NA	NA	NA	14	14	14	14	14	14	14	14
MISCELLANEOUS	***1,101***	***716***	***1,134***	***566***	***655***	***1,230***	***642***	***1,150***	***831***	***565***	***627***	***784***	***586***	***832***	***844***
Agriculture & Forestry	NA	NA	NA	NA	NA	NA	NA	81	69	73	86	67	67	64	66
Other Combustion	1,101	716	1,134	565	655	1,230	641	1,064	756	485	535	710	511	760	770
structural fires	19	47	40	44	44	44	44	29	30	30	30	30	31	26	26
agricultural fires	131	75	70	55	67	85	79	48	48	49	48	51	54	55	58
slash/prescribed burning	147	290	285	182	182	182	182	234	236	239	241	246	252	256	262
forest wildfires	770	297	739	283	361	918	335	749	439	164	212	379	171	421	421
other	34	7	1	NA	NA	NA	NA	3	3	3	3	3	3	3	3
Catastrophic/Accidental Relea	NA	NA	NA	NA	NA	NA	NA	4	4	4	4	4	4	4	4
Health Services	NA	NA	NA	0	0	1	1	1	0	1	1	1	1	1	1
Cooling Towers	NA	NA	NA	NA	NA	NA	NA	0	2	2	1	2	2	2	2
Fugitive Dust	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	1	1
TOTAL ALL SOURCES	**30,748**	**25,894**	**26,166**	**24,225**	**23,206**	**24,027**	**22,274**	**20,935**	**21,063**	**20,642**	**20,786**	**21,465**	**20,568**	**19,293**	**19,214**

Note(s): NA = not available. For several source categories, emissions either prior to or beginning with 1985 are not available at the more detailed level but are contained in the more aggregate estimate.
"Other" categories may contain emissions that could not be accurately allocated to specific source categories.
Zero values represent less than 500 short tons/year.
No data was available after 1984 to weigh the emissions from residential wood burning devices.
In order to convert emissions to gigagrams (thousand metric tons), multiply the above values by 0.9072.

Table A-4. Sulfur Dioxide Emissions
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FUEL COMB. ELEC. UTIL.	***17,398***	***18,268***	***17,469***	***16,272***	***15,701***	***15,987***	***16,215***	***15,909***	***15,784***	***15,416***	***15,189***	***14,889***	***12,080***	***12,632***	***13,082***
Coal	15,799	16,756	16,073	15,630	15,020	15,221	15,404	15,220	15,087	14,824	14,527	14,313	11,603	12,137	12,531
bituminous	*9,574*	*10,161*	*NA*	*14,029*	*13,502*	*13,548*	*13,579*	*13,371*	*13,215*	*12,914*	*12,212*	*11,841*	*8,609*	*8,931*	*9,312*
subbituminous	*4,716*	*5,005*	*NA*	*1,292*	*1,182*	*1,310*	*1,422*	*1,415*	*1,381*	*1,455*	*1,796*	*1,988*	*2,345*	*2,630*	*2,640*
anthracite & lignite	*1,509*	*1,590*	*NA*	*309*	*336*	*364*	*404*	*434*	*491*	*455*	*519*	*484*	*649*	*576*	*578*
Oil	1,598	1,511	1,395	612	651	734	779	639	652	546	612	522	413	436	486
residual	*1,578*	*1,462*	*NA*	*604*	*640*	*722*	*765*	*629*	*642*	*537*	*601*	*512*	*408*	*430*	*481*
distillate	*20*	*49*	*NA*	*8*	*11*	*12*	*14*	*10*	*10*	*9*	*10*	*10*	*5*	*6*	*5*
Gas	1	1	1	1	1	1	1	1	1	1	1	1	9	2	4
Internal Combustion	NA	NA	NA	30	29	31	30	49	45	46	49	53	55	57	61
FUEL COMB. INDUSTRIAL	***4,568***	***3,310***	***2,951***	***3,169***	***3,068***	***3,111***	***3,086***	***3,550***	***3,256***	***3,292***	***3,284***	***3,218***	***3,357***	***3,399***	***3,365***
Coal	3,129	1,870	1,527	1,818	1,817	1,856	1,840	1,914	1,805	1,783	1,763	1,740	1,728	1,762	1,769
bituminous	*2,171*	*1,297*	*1,058*	*1,347*	*1,374*	*1,395*	*1,384*	*1,050*	*949*	*1,005*	*991*	*988*	*1,003*	*1,005*	*1,050*
subbituminous	*669*	*399*	*326*	*28*	*29*	*29*	*29*	*50*	*53*	*60*	*67*	*77*	*81*	*83*	*88*
anthracite & lignite	*289*	*174*	*144*	*90*	*73*	*79*	*79*	*67*	*68*	*67*	*68*	*68*	*68*	*68*	*71*
other	*NA*	*NA*	*NA*	*353*	*341*	*353*	*348*	*746*	*735*	*650*	*636*	*606*	*576*	*606*	*559*
Oil	1,229	1,139	1,065	862	807	806	812	927	779	801	809	777	912	918	847
residual	*956*	*825*	*851*	*671*	*617*	*614*	*625*	*687*	*550*	*591*	*597*	*564*	*701*	*708*	*634*
distillate	*98*	*144*	*85*	*111*	*106*	*108*	*107*	*198*	*190*	*191*	*193*	*193*	*191*	*191*	*192*
other	*175*	*171*	*129*	*80*	*84*	*84*	*80*	*42*	*39*	*20*	*20*	*20*	*20*	*20*	*21*
Gas	140	263	299	397	356	360	346	543	516	552	555	542	548	548	572
Other	70	38	60	86	82	83	82	158	142	140	140	141	147	147	153
Internal Combustion	NA	NA	NA	7	6	6	6	9	14	16	17	19	23	23	24
FUEL COMB. OTHER	***1,490***	***1,082***	***971***	***579***	***662***	***660***	***624***	***831***	***755***	***784***	***772***	***780***	***793***	***782***	***813***
Commercial/Institutional Coal	109	147	110	158	164	172	169	212	184	190	193	192	200	200	206
Commercial/Institutional Oil	883	638	637	239	310	295	274	425	376	396	381	391	397	389	414
Commercial/Institutional Gas	1	1	1	2	2	2	2	7	7	7	8	8	8	8	8
Misc. Fuel Comb. (Except Res	NA	NA	NA	1	1	1	1	6	6	6	6	6	5	5	6
Residential Wood	6	7	13	13	10	11	11	7	7	8	6	6	7	7	5
Residential Other	492	290	211	167	175	180	167	175	176	177	178	177	176	173	174
distillate oil	*212*	*196*	*157*	*128*	*134*	*137*	*132*	*137*	*141*	*144*	*145*	*145*	*144*	*145*	*146*
bituminous/subbituminous	*260*	*76*	*43*	*29*	*32*	*33*	*27*	*30*	*26*	*26*	*25*	*25*	*24*	*21*	*20*
other	*20*	*18*	*11*	*10*	*10*	*10*	*8*	*9*	*8*	*8*	*8*	*8*	*8*	*8*	*8*

Table A-4. Sulfur Dioxide Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
CHEMICAL & ALLIED PRODU	***591***	***367***	***280***	***456***	***425***	***449***	***440***	***297***	***280***	***278***	***269***	***275***	***286***	***287***	***301***
Organic Chemical Mfg	NA	NA	NA	16	17	19	17	10	9	9	9	8	8	8	9
Inorganic Chemical Mfg	591	358	271	354	322	341	334	214	208	203	191	194	199	199	208
sulfur compounds	*591*	*358*	*271*	*346*	*314*	*333*	*326*	*211*	*205*	*199*	*187*	*189*	*195*	*195*	*204*
other	*NA*	*NA*	*NA*	*8*	*8*	*8*	*8*	*2*	*3*	*4*	*4*	*4*	*4*	*4*	*4*
Polymer & Resin Mfg	NA	NA	NA	7	6	7	7	1	1	1	1	1	0	0	0
Agricultural Chemical Mfg	NA	NA	NA	4	4	4	4	5	4	4	4	4	5	5	5
Paint, Varnish, Lacquer, Enam	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0
Pharmaceutical Mfg	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Other Chemical Mfg	NA	8	10	76	75	78	77	67	57	60	64	68	74	74	78
METALS PROCESSING	***4,775***	***2,849***	***1,842***	***1,042***	***648***	***707***	***695***	***726***	***612***	***615***	***603***	***562***	***530***	***530***	***552***
Nonferrous Metals Processing	4,060	2,165	1,279	853	479	529	513	517	435	438	431	391	361	362	378
copper	*3,507*	*1,946*	*1,080*	*655*	*298*	*343*	*327*	*323*	*234*	*247*	*250*	*206*	*177*	*177*	*185*
lead	*77*	*34*	*34*	*121*	*111*	*113*	*113*	*129*	*135*	*131*	*122*	*128*	*126*	*126*	*131*
aluminum	*80*	*72*	*95*	*62*	*57*	*59*	*60*	*60*	*61*	*55*	*53*	*51*	*53*	*53*	*55*
other	*396*	*113*	*71*	*14*	*13*	*14*	*13*	*4*	*5*	*5*	*6*	*6*	*6*	*6*	*7*
Ferrous Metals Processing	715	684	562	172	153	162	165	186	159	158	153	153	151	151	156
Metals Processing NEC	NA	NA	NA	18	15	16	17	22	18	18	19	19	18	18	19
PETROLEUM & RELATED IND	***881***	***727***	***734***	***505***	***445***	***443***	***429***	***430***	***378***	***416***	***383***	***379***	***369***	***368***	***385***
Oil & Gas Production	111	173	157	204	155	159	156	122	98	93	98	95	89	89	93
natural gas	*111*	*173*	*157*	*202*	*154*	*157*	*155*	*120*	*96*	*92*	*96*	*93*	*88*	*88*	*91*
other	*NA*	*NA*	*NA*	*2*	*1*	*1*	*1*	*2*	*2*	*2*	*2*	*2*	*1*	*1*	*1*
Petroleum Refineries & Relate	770	554	577	300	289	283	272	304	274	315	278	276	271	271	283
fluid catalytic cracking units	*480*	*318*	*330*	*212*	*207*	*202*	*195*	*183*	*182*	*185*	*183*	*188*	*188*	*188*	*196*
other	*290*	*236*	*247*	*88*	*82*	*81*	*77*	*121*	*92*	*130*	*95*	*88*	*83*	*83*	*86*
Asphalt Manufacturing	NA	NA	NA	1	1	1	1	4	7	7	7	8	9	9	9
OTHER INDUSTRIAL PROCES	***846***	***740***	***918***	***425***	***418***	***411***	***405***	***399***	***396***	***396***	***392***	***398***	***403***	***409***	***427***
Agriculture, Food, & Kindred P	NA	NA	NA	3	3	3	3	3	3	3	3	3	3	3	3
Textiles, Leather, & Apparel Pr	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Wood, Pulp & Paper, & Publis	169	168	223	131	135	135	136	116	123	119	113	109	114	117	122
Rubber & Miscellaneous Plasti	NA	NA	NA	1	1	1	1	0	0	0	0	0	0	0	0
Mineral Products	677	571	694	286	276	268	261	275	267	270	272	282	282	285	297
cement mfg	*618*	*511*	*630*	*192*	*183*	*177*	*172*	181	165	168	170	167	171	172	180
other	*59*	*60*	*64*	*95*	*93*	*91*	*89*	94	102	102	102	114	111	112	117
Machinery Products	NA	NA	NA	0	0	0	0	0	0	1	0	1	1	1	1
Electronic Equipment	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous Industrial Proce	NA	NA	NA	3	3	3	3	5	3	3	3	3	4	4	4

Table A-4. Sulfur Dioxide Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
SOLVENT UTILIZATION	NA	NA	NA	1	1	1	1	0	0	1	1	1	1	1	1
Degreasing	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Graphic Arts	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Dry Cleaning	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	0	0	0	0
Surface Coating	NA	NA	NA	1	1	1	1	0	0	0	0	0	0	0	0
Other Industrial	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
STORAGE & TRANSPORT	NA	NA	NA	4	4	5	5	7	10	9	5	2	2	2	2
Bulk Terminals & Plants	NA	NA	NA	NA	NA	NA	NA	0	1	1	0	0	0	0	0
Petroleum & Petroleum Produ	NA	NA	NA	0	0	0	0	5	7	0	0	0	0	0	0
Petroleum & Petroleum Produ	NA	NA	NA	1	1	1	1	0	0	0	0	0	0	0	0
Service Stations: Stage II	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0
Organic Chemical Storage	NA	NA	NA	1	1	1	1	0	0	0	0	0	0	0	0
Organic Chemical Transport	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Inorganic Chemical Storage	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Inorganic Chemical Transport	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Bulk Materials Storage	NA	NA	NA	1	2	2	2	1	1	7	4	1	1	1	1
WASTE DISPOSAL & RECYCLI	8	46	33	34	35	36	36	42	44	44	71	60	47	48	50
Incineration	4	29	21	25	26	28	28	32	32	32	51	42	35	35	37
industrial	NA	NA	NA	10	10	11	10	5	4	5	25	17	8	8	9
other	4	29	21	15	16	17	18	26	28	27	26	26	27	27	28
Open Burning	4	17	12	9	8	8	8	11	11	11	11	11	11	11	11
industrial	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
other	4	17	12	8	8	8	7	10	10	11	11	11	11	11	11
POTW	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Industrial Waste Water	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	1
TSDF	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Landfills	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
industrial	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
other	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Other	NA	NA	NA	0	0	0	0	0	1	1	8	6	0	0	1
ON-ROAD VEHICLES	411	503	521	522	538	553	570	542	570	578	517	301	304	316	320
Light-Duty Gas Vehicles & Mot	132	158	159	146	142	144	145	138	143	146	147	141	143	127	129
light-duty gas vehicles	132	158	158	145	142	144	145	NA	NA	NA	NA	NA	NA	127	128
motorcycles	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	0	0
Light-Duty Gas Trucks	40	48	50	55	56	58	58	57	59	59	60	70	71	95	96
light-duty gas trucks 1	26	32	33	36	36	37	38	NA	NA	NA	NA	NA	NA	62	63
light-duty gas trucks 2	13	16	16	19	20	21	21	NA	NA	NA	NA	NA	NA	33	33
Heavy-Duty Gas Vehicles	8	9	10	11	11	11	11	11	10	10	11	12	11	11	11
Diesels	231	288	303	311	328	340	356	337	358	363	299	79	80	83	84

Table A-4. Sulfur Dioxide Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
NON-ROAD ENGINES AND VE	***83***	***99***	***175***	***208***	***728***	***764***	***794***	***934***	***958***	***980***	***982***	***1,000***	***1,008***	***1,026***	***1,060***
Non-Road Gasoline	NA	NA	NA	NA	NA	NA	NA	7	7	7	7	7	7	7	7
Non-Road Diesel	NA	NA	NA	NA	495	510	526	543	560	579	597	617	638	659	682
Aircraft	4	4	6	6	7	7	7	11	11	11	11	11	11	11	12
Marine Vessels	43	52	117	143	164	181	193	251	259	258	249	252	239	237	245
Railroads	36	43	53	59	62	65	67	122	120	125	117	113	113	111	114
MISCELLANEOUS	***110***	***20***	***11***	***11***	***13***	***27***	***11***	***12***	***11***	***10***	***9***	***15***	***9***	***13***	***13***
Other Combustion	110	20	11	11	13	27	11	12	11	9	8	14	9	13	13
Fugitive Dust	NA	NA	NA	NA	NA	NA	NA	0	0	0	1	0	0	0	0
TOTAL ALL SOURCES	**31,161**	**28,011**	**25,905**	**23,229**	**22,685**	**23,154**	**23,308**	**23,678**	**23,056**	**22,818**	**22,476**	**21,879**	**19,189**	**19,812**	**20,369**

Note(s): NA = not available. For several source categories, emissions either prior to or beginning with 1985 are not available at the more detailed level but are contained in the more aggregate estimate.

"Other" categories may contain emissions that could not be accurately allocated to specific source categories.

Zero values represent less than 500 short tons/year.

The 1985 fuel combustion, electric utility category is based on the National Allowance Data Base Version 2.11, Acid Rain Division, U.S. EPA, released March 23, 1993. Allocations at the Tier 3 levels are approximations only and are based on the methodology described in section 6.0, paragraph 6.2.1.1.

In order to convert emissions to gigagrams (thousand metric tons), multiply the above values by 0.9072.

Table A-5. Particulate Matter (PM-10) Emissions
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FUEL COMB. ELEC. UTIL.	***1,775***	***1,191***	***879***	***280***	***281***	***276***	***271***	***295***	***257***	***257***	***279***	***273***	***268***	***288***	***290***
Coal	1,680	1,091	796	268	267	261	255	265	232	234	253	246	244	264	265
bituminous	*1,041*	*661*	*483*	*217*	*212*	*190*	*193*	*188*	*169*	*167*	*185*	*181*	*174*	*195*	*194*
subbituminous	*513*	*326*	*238*	*35*	*34*	*49*	*39*	*37*	*39*	*43*	*46*	*44*	*48*	*50*	*51*
anthracite & lignite	*126*	*104*	*75*	*16*	*20*	*22*	*22*	*41*	*23*	*23*	*22*	*21*	*21*	*19*	*19*
other	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
Oil	89	93	76	8	9	11	12	9	10	7	9	8	5	5	6
residual	*85*	*87*	*74*	*8*	*9*	*10*	*11*	*9*	*10*	*7*	*9*	*8*	*5*	*5*	*6*
distillate	*3*	*6*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Gas	7	6	7	1	1	1	1	1	1	0	1	1	1	0	0
Internal Combustion	NA	NA	NA	3	3	3	3	20	15	16	17	17	18	18	19
FUEL COMB. INDUSTRIAL	***641***	***564***	***679***	***247***	***239***	***244***	***243***	***270***	***233***	***243***	***257***	***270***	***302***	***306***	***314***
Coal	83	23	18	71	67	70	70	84	72	74	71	70	70	71	72
bituminous	*52*	*14*	*12*	*48*	*48*	*49*	*49*	*59*	*48*	*53*	*51*	*49*	*49*	*49*	*51*
subbituminous	*16*	*4*	*4*	*1*	*1*	*1*	*1*	*5*	*3*	*3*	*3*	*5*	*5*	*5*	*5*
anthracite & lignite	*.15*	*4*	*2*	*7*	*6*	*6*	*6*	*2*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
other	*NA*	*NA*	*NA*	*15*	*13*	*14*	*14*	*19*	*19*	*17*	*16*	*16*	*15*	*16*	*14*
Oil	89	69	67	52	48	48	48	52	44	45	45	44	49	50	48
residual	*83*	*62*	*63*	*43*	*38*	*38*	*39*	*44*	*36*	*37*	*38*	*37*	*42*	*42*	*40*
distillate	*6*	*7*	*4*	*5*	*5*	*5*	*5*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*
other	*0*	*0*	*0*	*4*	*4*	*4*	*4*	*2*	*2*	*1*	*1*	*1*	*1*	*1*	*1*
Gas	27	25	23	47	44	45	44	41	34	40	43	43	45	45	47
natural	*24*	*22*	*20*	*24*	*23*	*24*	*24*	*30*	*24*	*26*	*29*	*30*	*30*	*30*	*31*
process	*4*	*3*	*3*	*22*	*20*	*20*	*20*	*11*	*10*	*13*	*13*	*14*	*15*	*15*	*16*
other	*NA*	*NA*	*NA*	*1*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other	441	447	571	75	78	79	78	87	72	74	86	74	73	75	78
wood/bark waste	*415*	*444*	*566*	*67*	*70*	*71*	*71*	*80*	*67*	*67*	*71*	*68*	*68*	*69*	*71*
liquid waste	*NA*	*NA*	*NA*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
other	*26*	*3*	*5*	*6*	*6*	*6*	*6*	*6*	*5*	*6*	*14*	*6*	*5*	*6*	*6*
Internal Combustion	NA	NA	NA	3	3	3	3	6	10	11	12	38	64	65	68
FUEL COMB. OTHER	***455***	***492***	***887***	***1,009***	***812***	***862***	***869***	***631***	***657***	***683***	***588***	***570***	***610***	***598***	***497***
Commercial/Institutional Co	13	10	8	13	13	14	13	15	14	15	15	15	16	16	16
Commercial/Institutional Oil	52	34	30	12	16	15	13	13	11	12	11	12	12	12	13
Commercial/Institutional Ga	4	4	4	4	4	5	5	5	6	6	6	7	6	7	7
Misc. Fuel Comb. (Except R	NA	NA	NA	3	3	3	3	79	73	73	72	73	73	72	74

Table A-5. Particulate Matter (PM-10) Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FUEL COMB. OTHER (continued)															
Residential Wood	384	407	818	959	758	807	817	501	535	558	464	446	484	472	368
fireplaces	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*472*	*368*
woodstoves	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
Residential Other	3	37	27	18	18	19	18	18	18	18	18	18	18	19	20
CHEMICAL & ALLIED PROD	***235***	***127***	***148***	***58***	***58***	***62***	***63***	***77***	***68***	***71***	***66***	***76***	***67***	***67***	***70***
Organic Chemical Mfg	43	21	19	19	20	21	22	26	28	28	28	29	29	29	31
Inorganic Chemical Mfg	61	31	25	7	7	8	8	19	4	5	5	5	5	5	5
Polymer & Resin Mfg	NA	NA	NA	4	4	5	5	5	4	5	4	4	4	4	4
Agricultural Chemical Mfg	46	38	61	9	9	9	10	11	11	11	11	10	10	10	11
Paint, Varnish, Lacquer, En	NA	NA	NA	0	0	0	0	1	1	1	1	1	1	1	1
Pharmaceutical Mfg	NA	NA	NA	0	0	0	0	1	0	0	0	0	0	0	0
Other Chemical Mfg	86	37	42	18	17	18	18	14	20	20	18	27	18	18	19
METALS PROCESSING	***1,316***	***825***	***622***	***220***	***194***	***208***	***211***	***214***	***251***	***250***	***181***	***184***	***212***	***211***	***220***
Nonferrous Metals Processi	593	229	130	46	42	45	45	50	46	47	40	39	41	40	42
copper	*343*	*66*	*32*	*3*	*3*	*3*	*3*	*14*	*14*	*15*	*12*	*11*	*12*	*11*	*12*
lead	*53*	*31*	*18*	*4*	*3*	*3*	*3*	*3*	*2*	*2*	*2*	*2*	*3*	*3*	*3*
zinc	*20*	*11*	*3*	*3*	*2*	*3*	*3*	*6*	*6*	*6*	*1*	*2*	*2*	*2*	*2*
other	*177*	*121*	*77*	*36*	*33*	*36*	*36*	*27*	*23*	*23*	*25*	*25*	*25*	*25*	*26*
Ferrous Metals Processing	198	275	322	164	142	153	156	155	123	115	121	125	149	149	155
primary	*31*	*198*	*271*	*136*	*116*	*126*	*129*	*128*	*99*	*92*	*97*	*100*	*123*	*123*	*128*
secondary	*167*	*77*	*51*	*26*	*24*	*26*	*26*	*25*	*24*	*23*	*24*	*25*	*26*	*26*	*27*
other	*NA*	*NA*	*NA*	*2*	*2*	*2*	*2*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Metals Processing NEC	525	321	170	10	9	10	10	9	82	88	20	20	22	22	23
PETROLEUM & RELATED IN	***286***	***179***	***138***	***63***	***62***	***60***	***58***	***55***	***43***	***43***	***38***	***38***	***40***	***40***	***41***
Oil & Gas Production	NA	NA	NA	0	0	0	0	2	2	2	2	2	2	2	2
Petroleum Refineries & Rela	69	56	41	28	26	25	24	20	20	21	20	19	20	20	21
fluid catalytic cracking un	*69*	*56*	*41*	*24*	*23*	*22*	*21*	*17*	*17*	*18*	*17*	*16*	*18*	*18*	*18*
other	*NA*	*NA*	*NA*	*4*	*4*	*4*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Asphalt Manufacturing	217	123	97	35	35	35	34	33	21	20	17	17	18	18	19
OTHER INDUSTRIAL PROCE	***5,832***	***2,572***	***1,846***	***611***	***606***	***601***	***591***	***583***	***520***	***506***	***501***	***495***	***511***	***510***	***530***
Agriculture, Food, & Kindred	485	429	402	68	71	73	72	73	80	69	73	73	80	80	83
country elevators	*257*	*247*	*258*	*7*	*8*	*9*	*9*	*9*	*10*	*10*	*10*	*9*	*9*	*9*	*10*
terminal elevators	*147*	*111*	*86*	*6*	*6*	*6*	*6*	*6*	*7*	*8*	*8*	*7*	*7*	*7*	*7*
feed mills	*5*	*3*	*3*	*6*	*7*	*7*	*7*	*7*	*4*	*5*	*5*	*5*	*5*	*4*	*5*
soybean mills	*25*	*27*	*22*	*13*	*14*	*14*	*14*	*14*	*15*	*11*	*12*	*12*	*12*	*12*	*13*

Table A-5. Particulate Matter (PM-10) Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
OTHER INDUSTRIAL PROCESSES (continued)															
Agriculture, Food, & Kindred Products (continued)															
wheat mills	*5*	*1*	*1*	*3*	*3*	*4*	*3*	*3*	*4*	*4*	*4*	*4*	*4*	*4*	*4*
other grain mills	*9*	*8*	*6*	*7*	*7*	*8*	*8*	*8*	*6*	*5*	*6*	*6*	*7*	*7*	*7*
other	*38*	*32*	*26*	*25*	*26*	*26*	*25*	*25*	*34*	*26*	*28*	*30*	*37*	*37*	*38*
Textiles, Leather, & Apparel	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Wood, Pulp & Paper, & Publ	727	274	183	101	106	108	106	105	81	79	78	76	81	82	85
sulfate (kraft) pulping	*668*	*228*	*142*	*71*	*73*	*73*	*74*	*73*	*53*	*50*	*49*	*50*	*53*	*54*	*57*
other	*59*	*46*	*41*	*30*	*33*	*34*	*33*	*32*	*27*	*29*	*29*	*26*	*28*	*28*	*29*
Rubber & Miscellaneous Pla	NA	NA	NA	3	3	4	4	4	4	4	3	3	3	3	3
Mineral Products	4,620	1,869	1,261	401	391	382	374	367	320	318	316	313	317	314	326
cement mfg	*1,731*	*703*	*417*	*213*	*206*	*198*	*193*	*190*	*147*	*145*	*140*	*139*	*140*	*137*	*142*
surface mining	*134*	*111*	*127*	*20*	*16*	*16*	*15*	*15*	*14*	*15*	*17*	*17*	*17*	*17*	*17*
stone quarrying/processi	*957*	*508*	*421*	*52*	*55*	*56*	*54*	*54*	*59*	*60*	*60*	*58*	*58*	*58*	*60*
other	*1,798*	*547*	*296*	*116*	*114*	*113*	*111*	*108*	*99*	*98*	*99*	*100*	*102*	*102*	*107*
Machinery Products	NA	NA	NA	8	8	9	9	9	8	9	7	7	7	7	7
Electronic Equipment	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	NA	NA	NA	2	2	2	2	2	2	2	0	0	0	0	0
Construction	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Miscellaneous Industrial Pro	NA	NA	NA	28	24	24	23	23	25	24	22	22	23	23	24
SOLVENT UTILIZATION	***NA***	***NA***	***NA***	***2***	***2***	***2***	***2***	***4***	***5***	***5***	***6***	***6***	***6***	***6***	***6***
Degreasing	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Graphic Arts	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Dry Cleaning	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Surface Coating	NA	NA	NA	2	2	2	2	3	4	4	5	5	5	5	5
Other Industrial	NA	NA	NA	0	0	0	0	1	1	1	1	1	1	1	1
STORAGE & TRANSPORT	***NA***	***NA***	***NA***	***107***	***100***	***101***	***101***	***102***	***101***	***117***	***114***	***106***	***109***	***109***	***114***
Bulk Terminals & Plants	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Petroleum & Petroleum Prod	NA	NA	NA	0	0	0	0	0	1	1	1	0	0	0	0
Petroleum & Petroleum Prod	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Service Stations: Stage II	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0
Organic Chemical Storage	NA	NA	NA	1	1	1	1	1	1	1	1	1	1	1	1
Organic Chemical Transport	NA	NA	NA	0	0	0	0	0	0	0	0	0	0	0	0
Inorganic Chemical Storage	NA	NA	NA	0	0	0	0	1	1	1	1	1	1	1	1
Inorganic Chemical Transpo	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Bulk Materials Storage	NA	NA	NA	105	99	99	99	100	99	115	111	104	107	107	112
storage	*NA*	*NA*	*NA*	*33*	*32*	*32*	*31*	*31*	*27*	*30*	*32*	*31*	*30*	*30*	*31*
transfer	*NA*	*NA*	*NA*	*72*	*66*	*66*	*67*	*69*	*71*	*85*	*79*	*73*	*76*	*77*	*80*
combined	*NA*	*NA*	*NA*	*1*	*1*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
other	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*0*	*0*	*NA*	*0*	*0*	*0*	*0*
Bulk Materials Transport	NA	NA	NA	0	0	0	0	1	0	0	0	0	0	0	0

Table A-5. Particulate Matter (PM-10) Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
WASTE DISPOSAL & RECYC	***999***	***371***	***273***	***278***	***265***	***259***	***251***	***271***	***276***	***278***	***334***	***313***	***287***	***290***	***296***
Incineration	229	95	75	52	51	51	50	65	66	65	119	96	69	71	74
residential	*51*	*49*	*42*	*39*	*37*	*36*	*35*	*39*	*41*	*43*	*44*	*45*	*45*	*46*	*48*
other	*178*	*46*	*32*	*13*	*14*	*15*	*15*	*26*	*25*	*23*	*74*	*52*	*25*	*25*	*26*
Open Burning	770	276	198	225	214	208	200	206	209	211	214	216	217	218	220
residential	*770*	*276*	*198*	*221*	*209*	*203*	*195*	*195*	*197*	*199*	*202*	*203*	*204*	*205*	*207*
other	*NA*	*NA*	*NA*	*4*	*4*	*5*	*5*	*11*	*12*	*12*	*13*	*13*	*13*	*13*	*13*
POTW	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Industrial Waste Water	NA	NA	NA	0	0	0	0	NA	0	0	0	0	0	0	0
TSDF	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	0
Landfills	NA	NA	NA	0	0	0	0	0	0	1	1	1	0	0	0
Other	NA	NA	NA	0	0	0	0	0	0	0	0	1	1	1	1
ON-ROAD VEHICLES	***443***	***471***	***397***	***363***	***360***	***369***	***367***	***336***	***349***	***343***	***321***	***320***	***293***	***282***	***268***
Light-Duty Gas Vehicles &	225	207	120	77	66	66	65	61	63	64	65	62	62	55	56
light-duty gas vehicles	*224*	*206*	*119*	*77*	*65*	*66*	*64*	*61*	*63*	*63*	*64*	*61*	*62*	*55*	*56*
motorcycles	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Light-Duty Gas Trucks	70	72	55	43	37	37	34	30	32	31	31	35	32	41	40
light-duty gas trucks 1	*41*	*39*	*25*	*19*	*17*	*16*	*16*	*16*	*15*	*15*	*15*	*17*	*17*	*23*	*23*
light-duty gas trucks 2	*29*	*34*	*29*	*24*	*21*	*20*	*19*	*14*	*17*	*17*	*16*	*18*	*14*	*18*	*17*
Heavy-Duty Gas Vehicles	13	15	15	14	12	12	11	10	10	9	10	10	9	9	9
Diesels	136	177	208	229	245	254	257	235	245	239	215	213	190	177	163
heavy-duty diesel vehicl	*136*	*166*	*194*	*219*	*235*	*244*	*247*	*224*	*234*	*228*	*205*	*204*	*181*	*168*	*154*
light-duty diesel trucks	*NA*	*NA*	*2*	*1*	*2*	*2*	*2*	*1*	*2*	*2*	*2*	*2*	*2*	*2*	*2*
light-duty diesel vehicles	*NA*	*10*	*12*	*8*	*8*	*9*	*9*	*9*	*9*	*9*	*8*	*8*	*8*	*7*	*6*
NON-ROAD ENGINES AND V	***255***	***441***	***566***	***561***	***481***	***483***	***482***	***495***	***491***	***492***	***485***	***481***	***457***	***459***	***466***
Non-Road Gasoline	14	38	41	43	43	43	44	48	48	49	49	50	50	51	51
recreational	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
construction	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*
industrial	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
lawn & garden	*10*	*11*	*11*	*12*	*12*	*13*	*13*	*13*	*13*	*13*	*13*	*13*	*13*	*14*	*14*
farm	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
light commercial	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*2*
logging	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*
airport service	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
recreational marine vess	*UA*	*23*	*24*	*25*	*25*	*25*	*25*	*28*	*29*	*29*	*29*	*30*	*30*	*30*	*30*

Table A-5. Particulate Matter (PM-10) Emissions (continued)
(thousand short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
NON-ROAD ENGINES AND VEHICLES (continued)															
Non-Road Diesel	189	341	439	420	332	327	321	318	314	312	310	310	310	312	316
recreational	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
construction	*90*	*111*	*148*	*161*	*153*	*152*	*151*	*149*	*148*	*147*	*146*	*146*	*146*	*147*	*149*
industrial	*30*	*19*	*23*	*29*	*47*	*45*	*43*	*42*	*41*	*41*	*40*	*41*	*41*	*41*	*43*
lawn & garden	*4*	*6*	*7*	*7*	*6*	*7*	*7*	*8*	*9*	*9*	*10*	*11*	*12*	*13*	*14*
farm	*44*	*185*	*239*	*195*	*86*	*85*	*84*	*83*	*81*	*80*	*79*	*77*	*76*	*75*	*73*
light commercial	*8*	*9*	*9*	*11*	*10*	*11*	*11*	*12*	*12*	*12*	*13*	*13*	*14*	*14*	*15*
logging	*6*	*4*	*6*	*7*	*18*	*16*	*14*	*12*	*11*	*10*	*9*	*9*	*8*	*8*	*8*
airport service	*5*	*6*	*7*	*9*	*9*	*9*	*8*	*10*	*10*	*10*	*10*	*11*	*10*	*11*	*11*
railway maintenance	*NA*	*UA*	*UA*	*UA*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
recreational marine vess	*NA*	*UA*	*UA*	*UA*	*1*	*1*	*1*	*1*	*1*	*2*	*2*	*2*	*2*	*2*	*2*
No Aircraft	21	26	33	37	40	42	43	44	44	45		41	40	40	41
Marine Vessels	6	7	17	20	23	25	27	31	33	32	31	31	30	30	31
coal	*1*	*1*	*2*	*2*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
diesel	*4*	*4*	*10*	*12*	*13*	*15*	*16*	*18*	*19*	*19*	*18*	*18*	*18*	*18*	*18*
residual oil	*2*	*2*	*5*	*6*	*7*	*7*	*8*	*9*	*10*	*10*	*9*	*9*	*9*	*9*	*9*
gasoline	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*1*	*1*	*1*	*1*	*1*	*1*	1	*1*
Railroads	25	30	37	41	43	45	47	53	53	54	52	50	27	27	27
NATURAL SOURCES	***NA***	***NA***	***NA***	***4,047***	***1,577***	***18,110***	***12,101***	***2,092***	***2,077***	***2,227***	***509***	***2,160***	***1,146***	***5,316***	***5,316***
Geogenic	NA	NA	NA	4,047	1,577	18,110	12,101	2,092	2,077	2,227	509	2,160	1,146	5,316	5,316
wind erosion	*NA*	*NA*	*NA*	*4,047*	*1,577*	*18,110*	*12,101*	2,092	2,077	2,227	509	2,160	1,146	5,316	5,316
MISCELLANEOUS	***839***	***569***	***852***	***37,736***	***37,453***	***39,444***	***37,461***	***24,419***	***24,122***	***23,865***	***24,198***	***25,461***	***22,454***	***24,716***	***25,153***
Agriculture & Forestry	NA	NA	NA	7,108	7,326	7,453	7,320	5,146	5,106	4,909	4,475	4,690	4,661	4,708	4,707
agricultural crops	*NA*	*NA*	*NA*	*6,833*	*6,996*	*7,077*	*6,923*	4,745	4,684	4,464	4,016	4,281	4,334	4,395	4,385
agricultural livestock	*NA*	*NA*	*NA*	*275*	*330*	*376*	*396*	402	422	446	458	409	328	313	322
Other Combustion	839	569	852	894	988	1,704	912	1,203	941	785	768	1,048	778	1,004	1,015
wildfires	*385*	*206*	*514*	*308*	*389*	*1,086*	*300*	*601*	*332*	*171*	*152*	*424*	*145*	*387*	*387*
managed burning	*390*	*325*	*315*	*527*	*540*	*559*	*553*	*558*	*563*	*568*	*570*	*578*	*586*	*591*	*602*
other	*64*	*37*	*23*	*59*	*59*	*59*	*59*	*45*	*45*	*46*	*46*	*46*	*46*	*26*	*26*
Cooling Towers	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	1	1	1
Fugitive Dust	NA	NA	NA	29,734	29,139	30,287	29,229	18,069	18,076	18,171	18,954	19,722	17,013	19,002	19,429
wind erosion	*NA*	*NA*	*NA*	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
unpaved roads	*NA*	*NA*	*NA*	*11,644*	*11,110*	*12,379*	*11,798*	*11,234*	*11,206*	*10,918*	*11,430*	*11,370*	*10,362*	*12,060*	*12,305*
paved roads	*NA*	*NA*	*NA*	*5,080*	*5,530*	*5,900*	*5,769*	*2,248*	*2,399*	*2,423*	*2,462*	*2,538*	*2,409*	*2,390*	*2,515*
construction	*NA*	*NA*	*NA*	*12,670*	*12,121*	*11,662*	*11,269*	*4,249*	*4,092*	*4,460*	*4,651*	*5,245*	*3,654*	*3,950*	*4,022*
other	*NA*	*NA*	*NA*	*339*	*377*	*346*	*392*	*336*	*377*	*369*	*409*	*569*	*586*	*602*	*587*
TOTAL ALL SOURCES	**13,077**	**7,803**	**7,287**	**45,582**	**42,490**	**61,082**	**53,069**	**29,844**	**29,451**	**29,380**	**27,833**	**30,755**	**26,760**	**33,197**	**33,581**

Note(s): NA = not available. For several source categories, emissions either prior to or beginning with 1985 are not available at the more detailed level but are contained in the more aggregate estimate.

"Other" categories may contain emissions that could not be accurately allocated to specific source categories.
Zero values represent less than 500 short tons/year.
No data was available after 1984 to weigh the emissions from residential wood burning devices.
In order to convert emissions to gigagrams (thousand metric tons), multiply the above values by 0.9072.

Table A-6. Particulate Matter (PM-2.5) Emissions (thousand short tons)

SOURCE CATEGORY	1990	1991	1992	1993	1994	1995	1996	1997
FUEL COMB. ELEC. UTIL.	***121***	***105***	***106***	***112***	***108***	***107***	***156***	***158***
Coal	97	85	87	90	86	86	133	134
bituminous	*59*	*53*	*53*	*57*	*54*	*52*	*88*	*88*
subbituminous	*14*	*16*	*18*	*18*	*17*	*20*	*32*	*33*
anthracite & lignite	*23*	*16*	*16*	*15*	*15*	*15*	*13*	*13*
Oil	5	5	4	5	5	3	4	5
Gas	NA	NA	NA	NA	NA	NA	0	0
Internal Combustion	20	15	16	17	17	18	18	19
FUEL COMB. INDUSTRIAL	***177***	***151***	***159***	***172***	***183***	***203***	***205***	***213***
Coal	29	23	25	24	25	25	25	25
bituminous	23	*18*	*20*	*20*	*19*	*19*	*19*	20
subbituminous	2	*1*	*1*	2	*3*	*3*	*3*	3
anthracite & lignite	*1*	*1*	*0*	*0*	*0*	*1*	*1*	*1*
other	*3*	*3*	3	3	2	2	2	2
Oil	31	26	26	27	26	28	28	28
residual	26	22	22	23	22	*24*	*24*	24
distillate	*4*	*3*	3	*4*	*4*	*4*	*4*	*4*
other	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Gas	39	34	39	41	42	44	44	46
natural	*29*	*23*	*26*	*28*	*29*	*29*	*29*	30
process	*11*	*10*	*13*	*13*	*14*	*15*	*15*	*16*
other	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other	73	58	59	69	60	59	60	62
wood/bark waste	*68*	*55*	*54*	*58*	*55*	*55*	*56*	58
liquid waste	*1*	*0*	*0*	*1*	*0*	*0*	*0*	0
other	*4*	*3*	*4*	*10*	*4*	*3*	*4*	*4*
Internal Combustion	5	10	10	11	29	48	49	51
FUEL COMB. OTHER	***611***	***638***	***662***	***568***	***550***	***589***	***577***	***476***
Commercial/Institutional Coal	6	6	6	6	6	6	6	6
Commercial/Institutional Oil	5	5	5	5	5	5	5	6
Commercial/Institutional Gas	5	5	6	6	6	6	6	6
Misc. Fuel Comb. (Except Residential)	78	73	72	72	72	73	72	73
Residential Wood - woodstoves	501	535	558	464	446	484	472	368
Residential Other	15	15	15	15	15	15	16	16
CHEMICAL & ALLIED PRODUCT MFG	***47***	***43***	***45***	***41***	***49***	***42***	***42***	***44***
Organic Chemical Mfg	10	10	11	10	11	11	11	12
Inorganic Chemical Mfg	12	3	4	4	4	3	3	4
Polymer & Resin Mfg	4	3	4	3	3	3	3	3
Agricultural Chemical Mfg	8	8	8	8	8	8	8	8
Paint, Varnish, Lacquer, Enamel Mfg	0	0	0	0	0	0	0	0
Pharmaceutical Mfg	0	0	0	0	0	0	0	0
Other Chemical Mfg	13	17	17	15	23	16	16	17

Table A-6. Particulate Matter (PM-2.5) Emissions (continued)
(thousand short tons)

SOURCE CATEGORY	1990	1991	1992	1993	1994	1995	1996	1997
METALS PROCESSING	***157***	***197***	***198***	***125***	***125***	***134***	***134***	***139***
Non-Ferrous Metals Processing	31	29	29	25	25	25	25	26
copper	*9*	*9*	*9*	*8*	*8*	*8*	*8*	*8*
lead	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*
zinc	*5*	*5*	*5*	*1*	*1*	*1*	*1*	*1*
other	*14*	*13*	*13*	*14*	*14*	*14*	*14*	14
Ferrous Metals Processing	121	89	83	86	86	92	92	96
primary	*103*	*72*	*66*	*68*	*68*	*74*	*74*	76
secondary	*17*	*16*	*16*	*17*	*18*	*19*	*19*	19
other	*1*	*0*	*0*	*0*	*0*	*0*	*0*	0
Metals Processing NEC	5	80	85	14	14	16	16	17
PETROLEUM & RELATED INDUSTRIES	***27***	***24***	***24***	***22***	***22***	***22***	***22***	***23***
Oil & Gas Production	2	2	2	2	2	2	1	2
Petroleum Refineries & Related Industrie	13	14	14	13	13	13	13	14
fluid catalytic cracking units	*11*	*12*	*12*	*11*	*11*	*11*	*11*	12
other	*2*	*2*	*2*	*2*	*2*	*2*	*2*	2
Asphalt Manufacturing	12	9	8	7	7	8	8	8
OTHER INDUSTRIAL PROCESSES	***284***	***264***	***259***	***260***	***256***	***256***	***257***	***267***
Agriculture, Food, & Kindred Products	39	46	40	44	43	40	41	42
country elevators	*6*	*6*	*7*	*6*	*6*	*6*	*6*	6
terminal elevators	*3*	*3*	*4*	*5*	*4*	*4*	*4*	4
feed mills	*2*	*2*	*2*	*2*	*2*	*2*	*2*	2
soybean mills	*5*	*4*	*4*	*5*	*5*	*5*	*5*	5
wheat mills	*1*	*1*	*1*	*1*	*1*	*1*	*1*	1
other grain mills	*4*	*3*	*3*	*3*	*3*	*3*	*3*	3
other	*17*	*26*	*19*	*21*	*22*	*20*	*20*	21
Textiles, Leather, & Apparel Products	0	0	0	0	0	0	0	0
Wood, Pulp & Paper, & Publishing Prod	77	61	59	59	57	60	61	64
sulfate (kraft) pulping	*57*	*40*	*38*	*38*	*38*	*40*	*41*	43
other	*21*	*21*	*21*	*21*	*19*	*20*	*20*	21
Rubber & Miscellaneous Plastic Product	3	3	3	3	3	3	3	3
Mineral Products	144	134	135	136	133	134	133	138
cement mfg	*54*	*40*	*39*	*38*	*38*	*38*	*37*	38
surface mining	*6*	*6*	*7*	*7*	*7*	*6*	*6*	7
stone quarrying/processing	*24*	*28*	*28*	*28*	*26*	*26*	*26*	27
other	*61*	*60*	*61*	*62*	*63*	*63*	*63*	66

Table A-6. Particulate Matter (PM-2.5) Emissions (continued)
(thousand short tons)

SOURCE CATEGORY	1990	1991	1992	1993	1994	1995	1996	1997
OTHER INDUSTRIAL PROCESSES (continued)								
Machinery Products	3	3	3	3	3	3	3	3
Electronic Equipment	0	0	0	0	0	0	0	0
Transportation Equipment	1	1	1	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0
Miscellaneous Industrial Processes	16	16	17	15	16	16	16	17
SOLVENT UTILIZATION	***4***	***4***	***5***	***6***	***6***	***5***	***5***	***6***
Degreasing	0	0	0	0	0	0	0	0
Graphic Arts	0	0	0	0	0	0	0	0
Dry Cleaning	0	0	0	0	0	0	0	0
Surface Coating	3	3	4	4	4	4	4	4
Other Industrial	1	1	1	1	1	1	1	1
STORAGE & TRANSPORT	***42***	***42***	***50***	***46***	***43***	***42***	***42***	***44***
Bulk Terminals & Plants	0	0	0	0	0	0	0	0
Petroleum & Petroleum Product Storage	0	1	1	1	0	0	0	0
Petroleum & Petroleum Product Transpo	0	0	0	0	0	0	0	0
Service Stations: Stage II	0	0	0	0	0	0	0	0
Organic Chemical Storage	0	0	0	0	0	0	0	1
Organic Chemical Transport	0	0	0	0	0	0	0	0
Inorganic Chemical Storage	0	0	0	0	0	0	0	0
Inorganic Chemical Transport	0	0	0	0	0	0	0	0
Bulk Materials Storage	41	41	48	44	41	41	41	43
storage	*13*	*11*	*12*	*13*	*13*	*12*	*12*	13
transfer	*28*	*29*	*36*	*31*	*28*	*29*	*29*	30
combined	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
other	NA	*0*	*0*	NA	*0*	*0*	*0*	*0*
Bulk Materials Transport	0	0	0	0	0	0	0	0
WASTE DISPOSAL & RECYCLING	***234***	***238***	***239***	***288***	***271***	***247***	***250***	***254***
Incineration	46	47	46	93	73	50	51	53
residential	*27*	*28*	*30*	*31*	*31*	*31*	*32*	33
other	*19*	*18*	*16*	*62*	*42*	*19*	*19*	20
Open Burning	187	190	192	195	196	197	198	200
residential	*177*	*179*	*181*	*183*	*184*	*185*	*187*	188
other	*10*	*11*	*11*	*11*	*12*	*11*	*12*	12
POTW	0	0	0	0	0	0	0	0
Industrial Waste Water	0	0	0	0	0	0	0	0
TSDF	0	0	0	0	0	0	0	0
Landfills	0	0	1	1	1	0	0	0
Other	0	0	0	0	1	0	0	1

Table A-6. Particulate Matter (PM-2.5) Emissions (continued) (thousand short tons)

SOURCE CATEGORY	1990	1991	1992	1993	1994	1995	1996	1997
ON-ROAD VEHICLES	***275***	***286***	***280***	***257***	***256***	***231***	***221***	***207***
Light-Duty Gas Vehicles & Motorcycles	37	38	38	38	36	36	32	32
ldgv	*37*	*38*	*37*	*38*	*36*	*36*	*32*	*32*
motorcycles	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Light-Duty Gas Trucks	19	21	20	20	23	20	25	25
ldgt1	*10*	*10*	*9*	*9*	*11*	*11*	*14*	*14*
ldgt2	*9*	*11*	*11*	*10*	*12*	*9*	*11*	*11*
Heavy-Duty Gas Vehicles	7	6	6	7	7	6	6	6
Diesels	212	221	216	192	190	169	157	144
hddv	*203*	*212*	*206*	*183*	*182*	*161*	*149*	*136*
lddt	*1*	*1*	*2*	*1*	*2*	*2*	*2*	*2*
lddv	*8*	*8*	*8*	*7*	*7*	*7*	*6*	*6*
NON-ROAD ENGINES AND VEHICLES	***435***	***432***	***432***	***427***	***423***	***402***	***403***	***409***
Non-Road Gasoline	40	41	41	42	42	42	43	43
recreational	*2*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
construction	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
industrial	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
lawn & garden	*11*	*11*	*11*	*11*	*11*	*11*	*11*	*12*
farm	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
light commercial	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
logging	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
airport service	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
recreational marine vessels	*24*	*24*	*24*	*25*	*25*	*25*	*25*	*25*
Non-Road Diesel	293	289	287	285	285	285	287	290
recreational	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
construction	*138*	*136*	*135*	*135*	*134*	*134*	*135*	*137*
industrial	*39*	*38*	*37*	*37*	*37*	*38*	*38*	*39*
lawn & garden	*7*	*8*	*9*	*9*	*10*	*11*	*12*	*13*
farm	*76*	*75*	*74*	*72*	*71*	*70*	*69*	*67*
light commercial	*11*	*11*	*11*	*12*	*12*	*13*	*13*	*14*
logging	*11*	*10*	*9*	*8*	*8*	*8*	*8*	*7*
airport service	*9*	*9*	*9*	*9*	*10*	*10*	*10*	*10*
railway maintenance	*1*	*1*	*1*	*1*	*1*	*1*	*0*	*1*
recreational marine vessels	*1*	*1*	*1*	*1*	*2*	*2*	*2*	*2*

Table A-6. Particulate Matter (PM-2.5) Emissions (continued)
(thousand short tons)

SOURCE CATEGORY	1990	1991	1992	1993	1994	1995	1996	1997
NON-ROAD ENGINES AND VEHICLES (continued)								
Aircraft	31	31	32	30	29	28	28	29
Marine Vessels	22	23	22	21	22	21	21	22
coal	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
diesel	*17*	*18*	*17*	*16*	*17*	*17*	*17*	*17*
residual oil	*3*	*4*	*4*	*3*	*4*	*3*	*3*	*3*
gasoline	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Railroads	49	48	50	48	46	25	24	25
NATURAL SOURCES	***314***	***312***	***334***	***76***	***324***	***172***	***797***	***797***
Geogenic - wind erosion	314	312	334	76	324	172	797	797
MISCELLANEOUS	***5,232***	***5,000***	***4,852***	***4,885***	***5,334***	***4,630***	***5,180***	***5,272***
Agriculture & Forestry	1,009	1,000	960	872	918	916	926	925
agricultural crops	*949*	*937*	*893*	*803*	*856*	*867*	*879*	*877*
agricultural livestock	*60*	*63*	*67*	*69*	*61*	*49*	*47*	*48*
Other Combustion	1,057	822	679	667	910	675	875	885
wildfires	*538*	*299*	*151*	*137*	*372*	*130*	*344*	*344*
managed burning	*479*	*483*	*487*	*488*	*496*	*503*	*507*	*517*
other	*40*	*41*	*41*	*42*	*42*	*42*	*24*	*24*
Cooling Towers	0	0	0	0	0	1	1	1
Fugitive Dust	3,166	3,178	3,213	3,346	3,506	3,038	3,378	3,461
wind erosion	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
unpaved roads	*1,687*	*1,684*	*1,642*	*1,718*	*1,709*	*1,559*	*1,820*	*1,857*
paved roads	*562*	*600*	*606*	*616*	*634*	*585*	*598*	*629*
construction	*850*	*818*	*892*	*930*	*1,049*	*777*	*840*	*857*
other	*67*	*75*	*73*	*81*	*113*	*117*	*120*	*117*
TOTAL ALL SOURCES	**7,959**	**7,735**	**7,644**	**7,286**	**7,949**	**7,083**	**8,293**	**8,311**

Note(s): NA = not available.
"Other" categories may contain emissions that could not be accurately allocated to specific source categories.
Zero values represent less than 500 short tons/year.
In order to convert emissions to gigagrams (thousand metric tons), multiply the above values by 0.9072.

Table A-7. Ammonia (NH3) Emissions
(thousand short tons)

SOURCE CATEGORY	1990	1991	1992	1993	1994	1995	1996	1997
FUEL COMB. ELEC. UTIL.	***0***	***0***	***0***	***0***	***0***	***0***	***6***	***6***
Coal	NA	NA	NA	NA	NA	NA	0	0
Oil	NA	NA	NA	NA	NA	NA	2	2
Gas	NA	NA	NA	NA	NA	NA	4	4
Internal Combustion	0	0	0	0	0	0	0	0
FUEL COMB. INDUSTRIAL	***17***	***17***	***17***	***18***	***18***	***18***	***18***	***18***
Coal	0	0	0	0	0	0	0	0
Oil	4	4	4	4	4	4	4	4
Gas	13	13	13	14	14	13	13	14
Other	0	0	0	0	0	0	0	0
Internal Combustion	0	0	0	0	0	0	0	0
FUEL COMB. OTHER	***8***	***8***	***8***	***8***	***8***	***8***	***8***	***8***
Commercial/Institutional Coal	0	0	0	0	0	0	0	0
Commercial/Institutional Oil	2	2	2	2	2	2	2	2
Commercial/Institutional Gas	1	1	1	1	1	1	1	1
Residential Other	5	5	5	5	5	5	5	5
CHEMICAL & ALLIED PRODUCT MFG	***183***	***183***	***183***	***183***	***183***	***183***	***183***	***193***
Agricultural Chemicals	183	183	183	183	183	183	183	193
ammonium nitrate/urea mfg.	*111*	*111*	*111*	*111*	*111*	*111*	*111*	*118*
other	*71*	*71*	*71*	*71*	*71*	*71*	*71*	*75*
METALS PROCESSING	***6***	***6***	***6***	***6***	***6***	***6***	***6***	***6***
Non-Ferrous Metals Processing	0	0	0	0	0	0	0	0
Ferrous Metals Processing	6	6	6	6	6	6	6	6
Metals Processing NEC	0	0	0	0	0	0	0	0
PETROLEUM & RELATED INDUSTRIES	***43***	***43***	***43***	***43***	***43***	***43***	***43***	***45***
Oil & Gas Production	0	0	0	0	0	0	0	0
Petroleum Refineries & Related Industri	43	43	43	43	43	43	43	45
catalytic cracking	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*45*
other	0	0	0	0	0	0	0	0
OTHER INDUSTRIAL PROCESSES	***38***	***38***	***39***	***39***	***40***	***40***	***41***	***43***
Agriculture, Food, & Kindred Products	2	2	3	3	2	2	2	2
Mineral Products	0	0	0	0	0	0	0	0
Miscellaneous Industrial Processes	35	35	36	37	38	38	39	41
STORAGE & TRANSPORT	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
Bulk Materials Storage	0	0	0	0	0	0	0	0
WASTE DISPOSAL & RECYCLING	***82***	***86***	***89***	***93***	***93***	***93***	***95***	***100***
POTW	82	86	89	93	93	93	95	100
wastewater treatment	*82*	*86*	*89*	*93*	*93*	*93*	*95*	*100*

Table A-7. Ammonia (NH3) Emissions (continued)
(thousand short tons)

SOURCE CATEGORY	1990	1991	1992	1993	1994	1995	1996	1997
ON-ROAD VEHICLES	***192***	***205***	***217***	***227***	***239***	***259***	***231***	***240***
Light-Duty Gas Vehicles & Motorcycles	159	171	181	188	190	204	156	161
Light-Duty Gas Trucks	32	34	35	39	48	54	69	73
Heavy-Duty Gas Vehicles	0	0	1	1	1	1	3	3
Diesels	0	0	0	0	0	0	4	4
NON-ROAD ENGINES AND VEHICLES	***3***	***3***	***3***	***3***	***3***	***3***	***3***	***3***
Marine Vessels	1	1	1	1	1	1	1	1
Railroads	2	2	2	2	2	2	2	2
NATURAL SOURCES	***28***	***24***	***27***	***28***	***24***	***18***	***18***	***18***
Biogenic	28	24	27	28	24	18	18	18
MISCELLANEOUS	***3,586***	***3,076***	***3,539***	***3,422***	***3,327***	***2,336***	***2,433***	***2,498***
Agriculture & Forestry	3,586	3,076	3,539	3,422	3,327	2,336	2,433	2,498
livestock agriculture	*3,166*	*2,630*	*3,067*	*2,923*	*2,801*	*1,784*	*1,855*	*1,894*
fertilizer application	*420*	*446*	*473*	*499*	*525*	*551*	*578*	*604*
Fugitive Dust	0	0	0	0	0	0	0	0
TOTAL ALL SOURCES	4,184	3,688	4,171	4,071	3,983	3,005	3,084	3,178

Note(s): NA = not available.
"Other" categories may contain emissions that could not be accurately allocated to specific source categories.
Zero values represent less than 500 short tons/year.
In order to convert emissions to gigagrams (thousand metric tons), multiply the above values by 0.9072.

Table A-8. Lead Emissions
(short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FUEL COMB. ELEC. UTIL.	***327***	***230***	***129***	***64***	***64***	***66***	***67***	***64***	***61***	***59***	***61***	***61***	***57***	***61***	***64***
Coal	300	189	95	51	48	46	46	46	46	47	49	49	50	52	53
bituminous	*181*	*114*	*57*	*31*	*29*	*28*	*28*	*28*	*28*	*28*	*30*	*30*	*30*	*32*	*32*
subbituminous	*89*	*56*	*28*	*15*	*14*	*14*	*14*	*14*	*14*	*14*	*15*	*15*	*15*	*16*	*16*
anthracite & lignite	*30*	*19*	*9*	*5*	*5*	*4*	*4*	*4*	*4*	*4*	*5*	*5*	*5*	*5*	*5*
Oil	28	41	34	13	16	20	21	18	15	12	12	12	7	8	11
residual	*27*	*40*	*34*	*13*	*16*	*20*	*21*	*18*	*15*	*12*	*12*	*12*	*7*	*8*	*11*
distillate	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
FUEL COMB. INDUSTRIAL	***237***	***75***	***60***	***30***	***22***	***19***	***18***	***18***	***18***	***18***	***19***	***18***	***17***	***16***	***17***
Coal	218	60	45	22	14	14	14	14	15	14	14	14	14	13	13
bituminous	*146*	*40*	*31*	*15*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*9*	*9*
subbituminous	*45*	*12*	*10*	*5*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
anthracite & lignite	*27*	*7*	*4*	*2*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Oil	19	16	14	8	8	5	4	3	3	4	5	4	3	3	4
residual	*17*	*14*	*14*	*7*	*7*	*5*	*3*	*3*	*2*	*3*	*4*	*4*	*3*	*2*	*3*
distillate	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
FUEL COMB. OTHER	***10,052***	***10,042***	***4,111***	***421***	***425***	***426***	***420***	***418***	***416***	***414***	***415***	***415***	***414***	***416***	***415***
Commercial/Institutional C	1	16	12	6	5	5	4	4	3	4	4	3	4	5	5
bituminous	*1*	*6*	*6*	*4*	*3*	*3*	*3*	*3*	*2*	*2*	*2*	*2*	*2*	*3*	*3*
subbituminous	*NA*	*2*	*2*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
anthracite, lignite	*NA*	*7*	*4*	*1*	*1*	*1*	*1*	*0*	*0*	*0*	*1*	*0*	*1*	*1*	*1*
Commercial/Institutional O	4	11	10	4	5	5	4	4	4	4	3	3	3	3	4
residual	*3*	*10*	*9*	*3*	*4*	*4*	*3*	*3*	*3*	*3*	*3*	*3*	*2*	*2*	*3*
distillate	*NA*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
other	*1*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
Misc. Fuel Comb. (Except	10,000	10,000	4,080	400	400	400	400	400	400	400	400	400	400	400	400
Residential Other	47	16	9	11	14	16	12	10	9	7	8	8	8	7	7
CHEMICAL & ALLIED PRO	***103***	***120***	***104***	***118***	***123***	***136***	***136***	***136***	***132***	***93***	***92***	***96***	***163***	***167***	***159***
Inorganic Chemical Mfg	103	120	104	118	123	136	136	136	132	93	92	96	163	167	159
lead oxide and pigments	*103*	*120*	*104*	*118*	*123*	*136*	*136*	*136*	*132*	*93*	*92*	*96*	*163*	*167*	*159*

(continued)

Table A-8. Lead Emissions (continued)
(short tons)

Source Category	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
METALS PROCESSING	***24,224***	***9,923***	***3,026***	***2,097***	***1,835***	***1,965***	***2,088***	***2,169***	***1,975***	***1,773***	***1,899***	***2,027***	***2,048***	***2,052***	***2,038***
Nonferrous Metals Proces	15,869	7,192	1,826	1,376	1,204	1,248	1,337	1,409	1,258	1,111	1,211	1,288	1,337	1,331	1,320
primary lead production	*12,134*	*5,640*	*1,075*	*874*	*673*	*684*	*715*	*728*	*623*	*550*	*637*	*633*	*674*	*588*	*605*
primary copper producti	*242*	*171*	*20*	*19*	*16*	*17*	*19*	*19*	*19*	*20*	*21*	*22*	*21*	*22*	*23*
primary zinc production	*1,019*	*224*	*24*	*16*	*7*	*8*	*9*	*9*	*11*	*11*	*13*	*12*	*12*	*13*	*13*
secondary lead producti	*1,894*	*821*	*481*	*288*	*347*	*353*	*433*	*449*	*414*	*336*	*341*	*405*	*432*	*514*	*479*
secondary copper produ	*374*	*200*	*116*	*70*	*31*	*61*	*37*	*75*	*65*	*73*	*70*	*76*	*79*	*76*	*79*
lead battery manufactur	*41*	*49*	*50*	*65*	*73*	*73*	*74*	*78*	*77*	*77*	*81*	*94*	*102*	*103*	*110*
lead cable coating	*127*	*55*	*37*	*43*	*56*	*50*	*50*	*50*	*48*	*44*	*47*	*44*	*16*	*16*	*11*
other	*38*	*32*	*24*	*3*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Ferrous Metals Processing	7,395	2,196	911	577	499	554	582	576	517	461	495	540	528	529	527
coke manufacturing	*11*	*8*	*6*	*3*	*3*	*4*	*4*	*4*	*3*	*3*	*2*	*0*	*0*	*0*	*0*
ferroalloy production	*219*	*104*	*13*	*7*	*14*	*14*	*20*	*18*	*14*	*14*	*12*	*13*	*8*	*8*	*6*
iron production	*266*	*93*	*38*	*21*	*17*	*18*	*19*	*18*	*16*	*17*	*18*	*18*	*19*	*18*	*19*
steel production	*3,125*	*1,082*	*481*	*209*	*128*	*157*	*138*	*138*	*145*	*139*	*145*	*160*	*159*	*160*	*169*
gray iron production	*3,773*	*910*	*373*	*336*	*337*	*361*	*401*	*397*	*339*	*288*	*319*	*349*	*342*	*343*	*334*
Metals Processing NEC	960	535	289	144	132	164	169	184	199	201	193	200	183	192	191
metal mining	*353*	*268*	*207*	*141*	*131*	*163*	*169*	*184*	*198*	*201*	*193*	*199*	*183*	*192*	*190*
other	*606*	*268*	*82*	*3*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
OTHER INDUSTRIAL PRO	***2,028***	***1,337***	***808***	***316***	***202***	***172***	***173***	***169***	***167***	***56***	***54***	***53***	***58***	***51***	***54***
Mineral Products	540	217	93	43	28	23	23	26	24	26	27	28	29	29	30
cement manufacturing	*540*	*217*	*93*	*43*	*28*	*23*	*23*	*26*	*24*	*26*	*27*	*28*	*29*	*29*	*30*
Miscellaneous Industrial P	1,488	1,120	715	273	174	149	150	143	143	30	28	26	30	22	24
WASTE DISPOSAL & REC	***2,200***	***1,595***	***1,210***	***871***	***844***	***817***	***765***	***804***	***807***	***812***	***824***	***829***	***604***	***622***	***646***
Incineration	2,200	1,595	1,210	871	844	817	765	804	807	812	824	829	604	622	646
municipal waste	*581*	*396*	*161*	*79*	*52*	*49*	*45*	*67*	*70*	*68*	*69*	*68*	*70*	*76*	*70*
other	*1,619*	*1,199*	*1,049*	*792*	*792*	*768*	*720*	*738*	*738*	*744*	*756*	*762*	*534*	*546*	*576*
ON-ROAD VEHICLES	***171,961***	***130,206***	***60,501***	***18,052***	***3,317***	***2,566***	***982***	***421***	***18***	***18***	***19***	***19***	***19***	***20***	***19***
Light-Duty Gas Vehicles &	142,918	106,868	47,184	13,637	2,471	1,919	733	314	13	14	14	14	14	12	12
Light-Duty Gas Trucks	22,683	19,440	11,671	4,061	795	605	232	100	4	4	5	5	5	7	7
Heavy-Duty Gas Vehicles	6,361	3,898	1,646	354	51	42	16	7	0	0	0	0	0	0	0
NON-ROAD ENGINES AND	***9,737***	***6,130***	***4,205***	***921***	***850***	***885***	***820***	***776***	***574***	***565***	***529***	***525***	***544***	***505***	***503***
Non-Road Gasoline	8,340	5,012	3,320	229	222	211	166	158	0	0	0	0	0	0	0
Aircraft	1,397	1,118	885	692	628	674	655	619	574	565	528	525	544	505	503
TOTAL ALL SOURCES	**220,869**	**159,659**	**74,153**	**22,890**	**7,681**	**7,053**	**5,468**	**4,975**	**4,168**	**3,808**	**3,911**	**4,043**	**3,924**	**3,910**	**3,915**

Note(s): NA=not available
In order to convert emissions to megagrams (metric tons), multiply the above values by 0.9072.

Table A-9. Biogenic Volatile Organic Compound Emissions by State (thousand short tons)

State	1988	1990	1991	1995	1996	1997
Alabama	1,826	2,114	1,852	1,937	1,597	1,579
Arizona	535	542	517	548	591	545
Arkansas	1,837	1,852	1,476	1,741	1,472	1,517
California	1,815	1,778	1,711	1,794	2,125	1,623
Colorado	889	748	817	826	878	786
Connecticut	81	68	74	81	63	68
Delaware	25	19	24	26	20	21
District of Columbia	1	1	1	1	0	1
Florida	1,352	1,513	1,246	1,436	1,255	1,307
Georgia	1,666	1,958	1,609	1,721	1,454	1,405
Idaho	854	810	764	706	726	726
Illinois	283	227	257	244	191	187
Indiana	237	185	227	218	165	157
Iowa	141	95	103	112	89	93
Kansas	154	140	133	118	116	119
Kentucky	677	575	648	636	496	464
Louisiana	1,291	1,403	1,043	1,367	1,125	1,187
Maine	599	567	621	622	531	453
Maryland	164	132	155	169	127	135
Massachusetts	140	107	129	140	109	119
Michigan	581	422	548	533	394	408
Minnesota	729	519	612	636	533	502
Mississippi	1,662	1,801	1,450	1,642	1,402	1,419
Missouri	1,472	1,222	1,298	1,267	1,056	1,045
Montana	912	729	781	666	716	680
Nebraska	95	79	81	78	72	77
Nevada	152	140	142	135	158	126
New Hampshire	168	147	163	171	137	286
New Jersey	130	115	124	132	103	107
New Mexico	505	533	499	531	544	440
New York	350	303	328	361	280	290
North Carolina	1,072	1,194	1,002	1,110	908	882
North Dakota	69	49	51	48	46	50
Ohio	270	211	243	259	197	183
Oklahoma	1,013	1,016	864	887	836	811
Oregon	1,066	1,118	1,002	1,114	1,087	1,075
Pennsylvania	594	510	560	642	460	473
Rhode Island	24	18	21	24	18	20
South Carolina	738	886	652	755	626	632
South Dakota	142	103	113	104	102	102
Tennessee	1,063	1,022	1,010	997	817	781
Texas	2,711	2,864	2,244	2,649	2,481	2,431
Utah	407	374	353	345	410	324
Vermont	102	91	100	106	88	90
Virginia	911	886	850	917	728	714
Washington	685	780	650	801	735	763
West Virginia	510	420	473	492	383	368
Wisconsin	648	450	516	541	412	398
Wyoming	505	387	397	358	396	223
National	**33,852**	**33,224**	**30,536**	**32,742**	**29,254**	**28,194**

NOTE: The sums of States may not equal National total due to rounding

Table A-10. Biogenic Nitric Oxide Emissions by State (thousand short tons)

State	1988	1990	1991	1995	1996	1997
Alabama	14	19	14	14	14	14
Arizona	55	51	53	55	58	55
Arkansas	19	21	19	19	18	18
California	42	40	42	42	44	41
Colorado	39	35	38	38	39	35
Connecticut	1	1	1	1	1	1
Delaware	2	2	2	2	2	2
District of Columbia	0	0	0	0	0	0
Florida	22	29	22	22	22	22
Georgia	19	29	20	20	19	19
Idaho	25	23	24	24	24	24
Illinois	90	84	90	86	81	82
Indiana	49	48	51	49	46	46
Iowa	93	82	90	87	81	85
Kansas	91	87	91	85	83	85
Kentucky	19	20	20	19	18	18
Louisiana	19	20	19	19	19	19
Maine	3	3	3	3	2	2
Maryland	6	6	6	6	6	6
Massachusetts	1	1	1	1	1	1
Michigan	25	25	26	25	23	24
Minnesota	58	52	56	54	50	53
Mississippi	19	22	19	19	19	18
Missouri	44	42	44	42	40	40
Montana	60	49	57	53	52	50
Nebraska	91	83	90	86	80	85
Nevada	46	38	44	44	47	41
New Hampshire	1	1	1	1	1	2
New Jersey	2	2	2	2	2	2
New Mexico	62	59	61	64	65	56
New York	17	19	18	18	17	17
North Carolina	21	26	22	21	20	20
North Dakota	51	42	48	44	43	47
Ohio	36	36	37	35	33	33
Oklahoma	35	37	35	34	34	33
Oregon	24	22	23	23	23	23
Pennsylvania	19	21	20	20	18	19
Rhode Island	0	0	0	0	0	0
South Carolina	10	16	11	11	10	10
South Dakota	62	53	60	56	52	56
Tennessee	17	18	18	17	16	16
Texas	199	203	199	202	206	195
Utah	28	25	27	28	29	23
Vermont	2	2	2	2	2	2
Virginia	10	12	10	10	9	9
Washington	15	15	14	15	15	15
West Virginia	4	4	4	4	3	3
Wisconsin	36	34	35	35	32	33
Wyoming	39	40	36	35	35	28
National	**1,638**	**1,596**	**1,628**	**1,591**	**1,553**	**1,529**

NOTE: The sums of States may not equal National total due to rounding

Table A-11. 1997 State-level Emissions and Rank for CO, NOx, VOC, SO2, and Particulate Matter (PM-10)

(thousand short tons)

	Carbon Monoxide		Nitrogen Oxides *		Volatile Organic Compounds *		Sulfur Dioxide		Particulate Matter (PM-10)	
State	Rank	Emissions	Rank	Emissions	Rank	Emissions	Rank	Emissions	Rank	Emissions
Alabama	11	2,392	15	627	17	427	8	811	20	585
Alaska	42	486	49	42	46	64	51	5	41	183
Arizona	21	1,627	23	453	26	297	24	256	37	302
Arkansas	31	1,141	34	257	32	240	36	138	23	500
California	2	6,000	2	1,236	2	1,494	29	200	4	1,600
Colorado	28	1,259	25	414	28	293	35	141	26	476
Connecticut	39	747	40	153	35	165	40	90	45	101
District of Columbia	51	111	51	19	51	21	50	9	51	4
Delaware	49	207	46	68	47	53	39	98	48	38
Florida	3	4,610	6	916	3	859	6	879	12	764
Georgia	4	3,917	11	691	11	595	13	639	7	1,017
Hawaii	48	212	47	49	50	30	47	34	49	33
Idaho	36	811	43	114	38	116	46	41	13	690
Illinois	8	3,046	4	1,129	4	851	4	1,190	8	1,007
Indiana	13	2,384	7	912	12	567	2	1,370	16	660
Iowa	33	997	29	329	30	257	22	273	21	580
Kansas	15	2,127	17	528	20	414	30	180	3	1,639
Kentucky	26	1,412	12	690	21	406	9	806	34	336
Louisiana	14	2,316	10	758	15	437	17	414	28	440
Maine	41	529	44	95	40	109	38	101	43	156
Maryland	30	1,160	28	331	31	243	19	387	40	208
Massachusetts	29	1,212	32	275	27	294	25	255	38	285
Michigan	9	2,996	8	839	7	705	12	653	22	530
Minnesota	25	1,476	22	463	22	398	32	168	10	962
Mississippi	23	1,565	27	351	25	339	27	235	25	479
Missouri	18	2,002	18	523	14	444	15	506	5	1,350
Montana	38	768	39	183	39	110	42	67	6	1,143
Nebraska	37	785	35	252	33	205	37	102	18	632
Nevada	40	545	41	135	42	98	43	65	44	150
New Hampshire	44	359	45	80	44	77	33	164	47	54
New Jersey	27	1,362	24	435	18	425	23	265	36	303
New Mexico	34	938	31	297	37	152	28	207	1	4,948
New York	7	3,116	13	667	5	767	11	663	11	818
North Carolina	10	2,759	14	643	8	685	14	610	24	480
North Dakota	46	317	36	239	41	99	20	308	29	412
Ohio	5	3,812	3	1,185	6	709	1	1,966	14	663
Oklahoma	20	1,733	20	470	23	350	26	239	9	999
Oregon	19	1,758	38	215	29	258	45	44	15	661
Pennsylvania	6	3,332	5	935	9	674	3	1,349	19	593
Rhode Island	50	203	50	31	48	50	49	13	50	27
South Carolina	22	1,606	26	364	24	340	21	299	30	410
South Dakota	45	317	42	120	43	78	44	57	35	311
Tennessee	12	2,391	9	797	10	610	7	840	32	384
Texas	1	6,479	1	1,843	1	1,615	5	1,151	2	3,307
Utah	32	1,029	37	233	34	170	41	83	39	248
Vermont	47	232	48	43	49	48	48	17	46	79
Virginia	16	2,082	16	564	13	492	16	486	27	445
Washington	17	2,062	30	325	16	431	34	150	31	392
West Virginia	35	843	19	516	36	157	10	759	42	158
Wisconsin	24	1,517	21	469	19	418	18	408	33	381
Wyoming	43	363	33	275	45	68	31	179	17	659
National		**87,450**		**23,582**		**19,214**		**20,369**		**33,581**

Note: The sums of States may not equal National due to rounding.

* Excluding Biogenics

APPENDIX B
OVERVIEW OF PRIMARY AND SECONDARY EMISSIONS

The following methods are described in more detail, including references, in the Procedures Document, at epa.gov/ttn/chief/ei_data.html#ETDP.

INTRODUCTION

Emission estimates for particulate matter less than 2.5 microns ($PM_{2.5}$) were developed originally under the National Particulate Inventory Study (NPI). The NPI was a 1990 air emissions inventory for the U.S. (excluding Alaska and Hawaii), Canada and Mexico. In addition to $PM_{2.5}$, the inventory included the following pollutants:

- PM_{10} (particles $\leq$ 10 u
- Sulfur dioxide (SO_2)
- Oxides of nitrogen (NO_x)
- Ammonia (NH_3)
- Volatile organic compounds (VOC)
- Secondary organic aerosols (SOA)

Primary PM emissions may be inventoried as PM_{10} or as $PM_{2.5}$. Emissions of SO_2 and NO_x, assisted by NH_3 that acts as a neutralizing agent, form secondary PM in the atmosphere. The majority of secondary particles are in the $PM_{2.5}$ category. Also, certain VOC species, based on reactivity of the organic compound with atmosphere oxidants, form SOA. Thus, it is necessary to develop a complete inventory of all primarily emitted and secondarily formed PM in order to provide the basis for comprehensive ambient modeling.

For the most part, emissions of SO_2, NO_x, VOC, PM_{10}, $PM_{2.5}$, and NH_3 are based on new methods prepared during the early 1990's. Current estimates are based on VOC, SO_2, and NO_x emissions and/or estimation methodology developed for some source categories from the 1990 Interim Inventory. Also, the current estimates rely on emissions/methods developed for fugitive dust sources in 1996. New or revised emissions/methods were developed for utility, highway, and non-road sources.

The following discussion provides details on both the Trends methods and any new methods developed since 1995.

1. ELECTRIC UTILITY SOURCES

$PM_{2.5}$ and NH_3 emissions for utilities were developed similar to the other pollutants (based on the boiler-level data collected from Form EIA-767). Emission factors for NH_3 were not widely available, and therefore AP-42 factors for uncontrolled emissions were utilized.

The appropriate source classification code (SCC) was assigned to each fuel based on its characteristics. For coal, the SCC is based on the American Society for Testing and Materials (ASTM) criteria for moisture, mineral-free matter basis (if greater than 11,500 Btu/lb, coal type is designated to be bituminous; if between 8,300 and 11,500 Btu/lb, coal type is designated to be subbituminous; and if less than 8,300 Btu/lb, coal type is designated to be lignite) and the boiler type (firing configuration and bottom type) as specified in AP-42. If both coal and oil were burned in the same boiler, it was assumed that the oil is distillate; if only oil was burned, it was assumed to be residual. Then, based on the fuel and boiler type, the SCC is assigned. For natural gas, the SCC is based on fuel and boiler type.

PM_{10} control efficiency was used to calculate both PM_{10} and $PM_{2.5}$ emissions. Since only TSP (Total Suspended Particulate, $\leq \sim 35u$) control efficiency is reported on Form EIA-767, the PM_{10} calculator program was used to derive PM_{10} efficiencies. (The PM-10 calculator estimates PM_{10} control efficiencies based on the SCC and the primary and secondary control devices. The control efficiencies from the PM_{10} calculator are based on data from AP-42 for specific SCCs.) (Refer to the PM Calculator website at epa.gov/ttn/chief/software.html#pm).

The following equation was used to compute controlled PM_{10} and $PM_{2.5}$ emissions:

$$PM_{10} \text{ or } PM_{2.5} = \frac{fuel}{burned} \times \frac{AP\text{-}42}{emf} \times (1 - PM_{10} \text{ or } PM_{2.5} \text{ } eff) \times \frac{1}{2000} \qquad (1)$$

The following equation was used to compute heat input:

$$\frac{heat\ input}{(MMBtu)} = \frac{fuel}{burned} \times \frac{heat}{content} \qquad (2)$$

Although Form EIA-767 data are collected from plants with a total plant capacity of at least 10 MW, there are fewer required data elements (identification data, boiler fuel quantity and quality data, and FGD data, if applicable) for those plants with a total capacity between 10 MW and 100 MW. Thus, missing values are introduced in these situations. Because of time constraints, most data elements were not assigned a default value other than zero. If variables for boiler firing and bottom type were missing (these are needed in the SCC assignment) the default values for wall-fired and dry bottom type were assigned. For ambient modeling purposes, it is necessary to know the location (latitude and longitude) of each boiler. If the latitude and longitude for a specific boiler were missing, they were replaced whenever possible with either (1) the latitude and longitude from other boilers in that same plant or (2) county centroid coordinates.

2. NON-UTILITY POINT SOURCES

The PM_{10}, and $PM_{2.5}$ emissions were calculated using a methodology consistent with emission estimates in the 1990 Interim Inventory/Trends Inventory. This means non-utility point source emissions are calculated based on emission estimates from the 1985 NAPAP Inventory projected to 1990 using Bureau of Economic Analysis (BEA) Industrial Earnings data. Because annual PM_{10} and $PM_{2.5}$ emission estimates are not available from the NAPAP files, annual TSP emissions were used as the starting point for estimating PM_{10} and $PM_{2.5}$ emissions. The procedure used to estimate 1990 PM_{10}, $PM_{2.5}$ and NH_3 emissions from the 1985 NAPAP TSP emissions is described below.

1) projected 1985 controlled TSP emissions to 1990 using appropriate BEA growth factors; 2) calculated 1990 uncontrolled TSP emissions from controlled emissions and the control efficiency from the 1985 NAPAP inventory; 3) 1990 uncontrolled PM_{10} emissions were estimated by applying SCC-specific uncontrolled particle-size distribution factors to the uncontrolled TSP emissions; 4) controlled PM_{10} emissions were estimated using revised control efficiencies from the PM_{10} calculator.

For $PM_{2.5}$, 1990 uncontrolled $PM_{2.5}$ emissions were estimated by applying SCC-specific uncontrolled particle-size distribution factors to the 1990 uncontrolled PM_{10} emissions. As with PM_{10}, controlled $PM_{2.5}$ emissions were estimated using revised control efficiencies from the PM_{10} calculator.

Calculation of NH_3 Emissions. Ammonia emissions were calculated by growing the 1985 NAPAP emissions using the BEA growth factors, and the following formula:

$$CNH_{3(90)} = (CNH_{3(85)} \times EG_{85-90}) \qquad (3)$$

Where:

$CNH_{3(90)}$	=	Controlled NH_3 Emissions for 1990
$CNH_{3(85)}$	=	Controlled NH_3 Emissions for 1985 NAPAP
EG_{85-90}	=	Earnings growth from 1985 to 1990

3. AREA SOURCES:

3.a. <u>Fertilizer applications</u>: NH_3 emissions created from the application of fertilizers were updated for the period 1991-1997, and summary tables are published in Appendix A of this update. New data on fertilizer usage were obtained from the Association of American Plant Food

Control Officials, Inc. and the Fertilizer Institute. These groups jointly produce the Commercial Fertilizers data base. Actual data from the Association was used for 1990 and 1996; the intervening years and 1997 were developed using a linear trends analysis based on the Association's data.

3.b. Agricultural Tilling: The following AP-42 particulate emission factor equation was used to determine regional PM_{10} and $PM_{2.5}$ emissions from agricultural tilling:

$$E = c \; x \; k \; x \; s^{0.6} \; x \; p \; x \; a \qquad (4)$$

Where:

E	= PM_{10} emissions (lbs/yr)
c	= constant 4.8 lbs/acre-pass
k	= dimensionless particle size multiplier (PM_{10}=0.21, and $PM_{2.5}$= 0.042)
s	= silt content of surface soil, defined as the mass fraction of particles smaller than 75 μm diameter found in soil to a depth of 10 cm (percent)
p	= number of passes or tillings in a year (assumed to be 3 passes)
a	= acres of land planted

By comparing the USDA surface soil map with the USDA county map, soil types were assigned to all counties of the continental U.S. Silt percentages were determined by using a soil texture classification triangle.. Silt factors were updated from previous methods by using information from "Spatial Distribution of PM_{10} emissions from Agricultural Tilling in the San Joaquin Valley." (Refer to Reference 15, Chapter 4, of the Procedures Document). Information in that report indicates that silt contents determined from the classification triangle are typically based on wet sieving techniques. The AP-42 silt content is based on dry sieving techniques. Wet sieving tends to desegregate finer materials thus leading to a higher than expected silt content based on the soil triangle estimates. The overestimation is dependent upon the soil type. As a consequence, the values for silt loam and loam were reduced by a factor of 1.5. The values for clay loam and clay were reduced by a factor of 2.6. The values for sand, loamy sand, sandy loam and organic material remained the same. These silt values were assumed constant for the 6-year period examined. This differs from the 1989 through 1985 methodology in that the silt factors are applied on the county level, and are corrected values.

The number of tillings for 1990 through 1996 were determined for each crop type, and for conservational and conventional use using information from Agricultural Activities Influencing Fine Particulate Matter Emissions. (Refer to Reference 16, Chapter 4, of the Procedures Document). The tillage emission factor ratio column in the tables in that report were totaled by crop type when the agricultural implement code was not blank. Harvesting was not included in this total. When the tilling instrument was felt to deeply disturb the soil, the value of the tillage emission factor ratio was equal to one. However, other field instruments were not felt to disturb the soil to the extent of the instruments used to develop the original AP-42 emission factor and thus had an emission factor ratio of less than one. Discussions with the organization that developed the original emission factor and the report referenced above indicated that these values should be used to calculate the number of tillings rather than a single value for each implement usage. Where there were data from more than one region for a single crop, an average value was used. Information for both conservation and conventional tillage methods were developed. The tallies were rounded to the nearest whole number, since it is not physically possible to have a partial tillage event.

These totals were tallied for corn, cotton, rice, sorghum, soybeans, spring wheat, and winter wheat. The number of tillings for categories not included in Agricultural Activities Influencing Fine Particulate Matter Emissions were determined by contact with the Conservation Information Technology Center (CTIC) (Refer to Reference 18, Chapter 4, of the Procedures Document).

Rice and spring wheat are included in the category "spring-seeded small grain" in the database provided by the CTIC. Winter wheat was assumed to prevail in all states except Arkansas, Louisiana, Mississippi, and Texas. Rice was assumed to prevail in these four states, and the number of tillings for rice were applied to the acres harvested in these states. Both rice and winter wheat are grown in California. A ratio of rice to winter wheat acres harvested for 1990 through 1996 was obtained from the U.S. Land Use Summary. This ratio was used to calculate a modified number of tillings for spring-seeded small grain in California for each year.

Acres reported in the CTIC database for no till, mulch till, and ridge till were considered conservation tillage. Those with 0 to 15 percent residue, and 15 to 30 percent residue were considered conventional tillage.

3.c. Livestock Operations. The livestock NH_3 emissions in the inventory were estimated using activity data from the 1992 Census of Agriculture. These data included county-level estimates of number of head for the following livestock: cattle and calves, hogs and pigs, poultry, sheep, horses, goats, and minks. The emission factors used to calculate emissions were taken from a study of NH_3 emissions conducted in the Netherlands.

3.d. Construction Activities. The PM_{10} emissions for the years 1985 through 1995, and the $PM_{2.5}$ emission for the years 1990 through 1995 were calculated from an emission factor, an estimate of the acres of land under construction, and the average duration of construction activity. The acres of land under construction were estimated from the dollars spent on construction. The PM_{10} emission factor for the years 1985 through 1989 was calculated from the TSP emission factor for construction obtained from AP-42 and data on the PM_{10}/TSP ratio for various construction activities. The PM_{10} emission factor for the years 1990 through 1995 was obtained from Improvement of Specific Emission Factors. The 1996 emissions were extrapolated from the 1995 emissions using the ratio between the number of residential construction permits issued in 1996 and the number issued in 1995. A control efficiency was applied to emissions for 1995 and

1996 for counties classified as PM nonattainment areas. (For sources of data, please refer to references 31 through 34, Chapter 4, of the Procedures Document).

1990 through 1995 Emission Factor Equation. The equation below is a variation of the AP-42 particulate emission factor equation for heavy construction and was used to determine regional PM_{10} and $PM_{2.5}$ emissions from construction activities for 1990 through 1995. The $PM_{2.5}$ emission factor used for the years 1990 through 1995 was the PM_{10} emission factor multiplied by the particle size adjustment factor of 0.2. A control efficiency was applied to PM nonattainment areas for 1995 and 1996.

$$E = P \times \$ \times f \times m \times \left(1 - \frac{CE}{100}\right) \qquad (5)$$

where:

E	=	PM emissions
P	=	PM emission factor (ton/acre of construction/month of activity) (PM_{10} = 0.11; $PM_{2.5}$ = 0.022)
\$	=	dollars spent on construction (\$ million)
f	=	factor for converting dollars spent on construction to acres of construction (varies by type of construction, acres/\$ million)
m	=	months of activity (varies by type of construction)
CE	=	control efficiency (percent)

Dollars spent on construction (\$). Estimates of the dollars spent on the various types of construction by EPA region for 1987 were obtained from the Census Bureau. The fraction of total U.S. dollars spent in 1987 for each region for each construction type was calculated. Since values from the Census Bureau are only available every five years, the Census dollars spent for the United States for construction were normalized using estimates of the dollars spent on construction for the United States as estimated by the F.W. Dodge corporation for the other years. This normalized Census value was distributed by region and construction type using the above calculated fractions. An example of how this procedure was applied for SIC 1521 (general contractor, residential building: single family) is shown below.

$$\$_{1988,RegionI,SIC_{1521}} = \frac{\$_{1987,Nation,Census}}{\$_{1987,Nation,Dodge}} \times \$_{1988,Nation,Dodge} \times \frac{\$_{1987,Region1,Census,SIC_{1521}}}{\$_{1987,Nation,Census,SIC_{1521}}} \qquad (6)$$

where:

\$	=	dollar amount of construction spent
1988	=	year 1988
1987	=	year 1987
Region I	=	U.S. EPA Region I

SIC 1521	=	Standard Industrial Code for general contractor, residential building; single family
Nation	=	United States
Census	=	Census Bureau
Dodge	=	F.W. Dodge

Determination of construction acres. Information developed by Cowherd et al. determined that for different types of construction, the number of acres was proportional to dollars spent on that type construction. The following AP-42 particulate emission factor equation for heavy construction was used to determine regional PM_{10} emissions from construction activities for 1990:

$$E = T \times \$ \times f \times m \times P \tag{7}$$

Where:

E	=	PM_{10} emissions tons per year (tpy)
T	=	TSP emission factor (1.2 ton/acre of construction/month of activity)
$	=	dollars spent on construction (million $)
f	=	factor for converting dollars spent on construction to acres of construction (varies by type of construction, acres/million $)
m	=	months of activity per year (varies by type of construction)
P	=	dimensionless PM_{10}/TSP ratio (0.22)

Estimates of the dollars spent on the various types of construction by EPA region for 1987 were obtained from the Census Bureau. The fraction of total U.S. dollars spent in 1987 for each region for each construction type was calculated. Since values from the Census Bureau are only available every five years, the Census dollars spent in the U.S. for construction were normalized for 1990 using estimates of the dollars spent on construction in the U.S. as estimated by the F.W. Dodge corporation. This normalized Census value was distributed by region and construction type using the above calculated fractions.

EPA determined that for different types of construction, the number of acres was proportional to dollars spent on that type construction. This information (proportioned to constant dollars) was utilized along with total construction receipts to determine the total number of acres of each construction type. Estimates of the duration (in months) for each type construction were derived from EPA PM_{10}/TSP ratios for 19 test sites for 3 different construction activities were averaged to derive the PM_{10} fraction used in the emission estimates.

Regional-level PM_{10} estimates were distributed to the county-level using county estimates of payroll for construction (SICs 15, 16, 17) from County Business Patterns (BOC, 1992). The following formula was used:

$PM_{2.5}$ emissions were then calculated using the county-level PM_{10} emissions by applying the particle size ratio of 0.2.

$$County\ Emissions = \frac{County\ Construction\ Payroll}{Regional\ Construction\ Payroll} \times Regional\ Emissions \quad (8)$$

3.e. Unpaved Roads: Estimates of PM emissions from reentrained road dust on unpaved roads were developed for each county. The OMS PART5 model was utilized to obtain the emission factors (refer to Section 4.c. On-Road Vehicles, later in this update). Reentrained road dust emission factors depend on the average weight, speed, and number of wheels of the vehicles traveling on the unpaved roadways, the silt content of the roadway surface material, and the percentage of days in the year with minimal (less than 0.01 inches) or no precipitation. Emissions were calculated by month at the state/road type level for the average vehicle fleet and then allocated to the county/road type level by land area. The activity factor for calculating reentrained road dust emissions on unpaved roads is the VMT accumulated on these roads. The specifics of the emission estimates for reentrained road dust from unpaved roads are discussed in more detail below.

The following equation was used in PART5 to calculate PM emission factors from reentrained road dust on unpaved roads, is based on an empirical formula from AP-42.

$$UNPVD = PSUNP_{PS} \times 5.9 \times (SILT/12) \times (SPD/30) \times (WEIGHT/3)^{0.7} \times (WHEELS/4)^{0.5} \times (365 - IPDAYS)/365 \times 453.392 \quad (9)$$

where:

UNPVD	=	unpaved road dust emission factor for all vehicle classes combined (grams per mile)
$PSUNP_{PS}$	=	fraction of particles less than 10 or 2.5 microns from unpaved road dust (0.36 for PM_{10} and 0.05 for $PM_{2.5}$)
SILT	=	percentage silt content of the surface material
SPD	=	average speed of all vehicle types combined (miles per hour [mph])
WEIGHT	=	average weight of all vehicle types combined (tons)
WHEELS	=	average number of wheels per vehicle for all vehicle types combined
IPDAYS	=	number of precipitation days per year with greater than 0.01 inches of rain
493.592	=	number of grams per pound

The above equation is based on roadside measurements of ambient particulate matter, and is therefore representative of a fleet average emission factor rather than a vehicle-specific emission factor. In addition, because this equation is based on ambient measurements, it includes particulate matter from tailpipe exhaust, brake wear, tire wear, and ambient background particulate concentrations. Therefore, the PART5 fleet average PM emission factors for the tailpipe, tire wear, and brake wear components were subtracted from the unpaved road fugitive dust emission factors before calculating emissions from Reentrained road dust on unpaved roads.

Silt Content Inputs: Average state-level, unpaved road silt content values developed as part of the 1985 NAPAP Inventory, were obtained from the Illinois State Water Survey. Silt contents of over 200 unpaved roads from over 30 states were obtained. Average silt contents of unpaved roads were calculated for each state that had three or more samples for that state. For states that did not have three or more samples, the average for all samples from all states was substituted.

Precipitation Inputs. Rain data input to the emission factor equation above is in the form of the total number of rain days in the year. However, the equation uses the number of days simply to calculate a percentage of rain days. Therefore, to calculate unpaved road dust emission factors that represent monthly conditions, data from the National Climatic Data Center showing the number of days per month with more than 0.01 inches of rain were used. Precipitation event accumulation data were collected for several meteorological stations within each state.

Vehicle Wheel, Weight, and Speed Inputs: The speeds for light duty vehicles and trucks were also assumed to be the average unpaved road speeds for the corresponding unpaved road classification. However, because the fugitive dust emission factors are representative of the entire vehicle fleet, these speeds for each road type were weighted by vehicle-specific VMT to obtain road type-specific speeds. Estimates of average vehicle weight and average number of wheels per vehicle over the entire vehicle fleet were based on data provided in the *Truck Inventory and Use Survey*, *MVMA Motor Vehicle Facts and Figures '91*, and the *1991 Market Data Book*. Using these data sources, a fleet average vehicle weight of 6,358 pounds was modeled.

Unpaved road VMT. The calculation of unpaved road VMT was performed in two parts. Separate calculations were performed for county and noncounty (state or federally) maintained roadways. The 1995 unpaved VMT was also used for 1996, as unpaved growth is very uncertain, but expected to be minimum. The equation used is:

$$VMTUP = ADTV \times FSRM \times DPY \tag{10}$$

where: VMTUP = VMT on unpaved roads (miles/year)
ADTV = average daily traffic volume (vehicles/day/mile)
FSRM = functional system roadway mileage (miles)
DPY = number of days in a year

Estimation of Local Unpaved-Road VMT. Unpaved roadway mileage estimates were retrieved from the FHWA's annual *Highway Statistics* report. State-level, county-maintained roadway mileage estimates are organized by surface type, traffic volume, and population category. From these data, state-level unpaved roadway mileage estimates are derived. This was done by first assigning an average daily traffic volume (ADTV) to each volume category.

The above equation was then used to calculate state-level unpaved road VMT estimates for volume and population categories. These detailed VMT data were then summed to develop state-level, county-maintained unpaved roadway VMT.

Estimation of Federal and State-Maintained Unpaved Road VMT: The calculation of noncounty (state or federally) maintained unpaved road VMT differed from the calculation of county-maintained unpaved road VMT. This was required since noncounty unpaved road mileage was categorized by arterial classification, not roadway traffic volume.

To calculate noncounty, unpaved road VMT, state-level ADTV values for urban and rural roads were multiplied by state-level, rural and urban roadway mileage estimates. Assuming the ADTV does not vary by roadway maintenance responsibility, the county-maintained ADTV values were assumed to apply to noncounty-maintained roadways as well. To develop noncounty unpaved road ADTV estimates, county-maintained roadway VMT was divided by county-maintained roadway mileage estimates.

$$ADTV = VMT \,/\, MILEAGE \qquad (11)$$

where:	ADTV	=	average daily traffic volume for state and federally maintained roadways
	VMT	=	VMT on county-maintained roadways (miles/year)
	MILEAGE	=	state-level roadway mileage of county-maintained roadways (miles)

Federal and state-maintained roadway VMT was calculated by multiplying the state-level roadway mileage of federal and state-maintained unpaved roads by the state-level ADTV values calculated as discussed above for locally-maintained roadways, as follows:

$$VMT = ADTV \times RM \times 365 \qquad (12)$$

where:	VMT	=	VMT at the state level for federally and state-maintained unpaved roadways (miles/year)
	ADTV	=	average daily traffic volume derived from local roadway data
	RM	=	state-level federally and state-maintained roadway mileage (mi)

Unpaved-Road VMT For 1993 and Later Years: The calculation of unpaved VMT differs for years before 1993 and for the year 1993 and later years. This split in methodology is due a difference in the data reported by states in the annual Highway Statistics. In both instances the calculation was performed in two stages.

Unpaved VMT for 1993 and later years was calculated by multiplying the total number of miles of unpaved road by state and functional class by the annualized traffic volume, where the annualized traffic volume is calculated as the average daily traffic volume multiplied by the total number of days per year. This calculation is illustrated as follows:

$$UnpavedVMT_{Roadtype} = Mileage_{Roadtype} \times ADTV \times DPY \tag{13}$$

where: Unpaved VMT = road type specific unpaved Vehicle Miles Traveled (miles/year)

Mileage = total number of miles of unpaved roads by functional class (miles)

ADTV = Average daily traffic volume (vehicle/day)

DPY = number of days per year

The total number of unpaved road miles by state and functional class was retrieved from the Federal Highway Administration's Highway Statistics. In Highway Statistics, state level Local functional class unpaved mileage is broken out by ADTV category. The ADTV categories differed for urban and rural areas. Table MV-1 of Highway Statistics shows the ADTV categories for rural and urban local functional classes and the assumed traffic volume for each category. Local functional class unpaved VMT was calculated for each of these ADTV categories using the equation illustrated above.

Unpaved road mileage for functional classes other than Local (rural minor collector, rural major collector, rural minor arterial, rural other principal arterial, urban collector, urban minor arterial, urban other principal arterial) are not broken out by ADTV in Highway Statistics. An average ADTV was calculated for these functional classes by dividing state level unpaved Local VMT by the total number of miles of Local unpaved road. Separate calculations were preformed for urban and rural areas. The resulting state level urban and rural ADTV was then multiplied by the total number of unpaved miles in each of the non-local functional classes.

One modification was made to the Local functional class mileage reported in Highway Statistics. The distribution of mileage between the ADTV categories for Mississippi resulted in unrealistic emissions. Total unpaved road mileage in Mississippi was redistributed within the ADTV categories based on the average distributions found in Alabama, Georgia, and Louisiana.

Calculation of State-Level Emissions. The state and federally maintained unpaved road VMT were added to the county- maintained VMT for each state and road type to determine each state's total unpaved road VMT by road type. The state-level unpaved road VMT by road type were then temporally allocated by month using the same NAPAP temporal allocation factors used to allocate total VMT. These monthly state-level, road type-specific VMT were then multiplied by the corresponding monthly, state-level, road type-specific emission factors developed as discussed above. These state-level emission values were then allocated to the county level using the procedure discussed below.

Allocation of State-Level Emissions to Counties. The state/road type-level unpaved road PM emission estimates were then allocated to each county in the state using estimates of county rural and urban land area from the U.S. Census Bureau for the years 1985 through 1989.

$$PM_{X,Y} = (CNTYLAND_{URB,X}/STATLAND_{URB}) \times PM_{ST,URB,Y} + (CNTYLAND_{RUR,X}/STATLAND_{RUR}) \times PM_{ST,RUR,Y} \quad (14)$$

where: $Pm_{x,y}$ = unpaved road PM emissions (tons) for county x and road type y

$CNTYLAND_{URB,X}$	=	urban land area in county x
$STATLAND_{URB}$	=	urban land area in entire state
$PM_{ST,URB,Y}$	=	unpaved road PM emissions in entire state for urban road type y
$CNTYLAND_{RUR,X}$	=	rural land area in county x
$STATLAND_{RUR}$	=	rural land area in entire state
$PM_{ST,RUR,Y}$	=	unpaved road PM emissions in entire state for rural road type y

For the years 1990 through 1996, 1990 county-level rural and urban population was used to distribution the state-level emissions instead of land area.

Nonattainment Area 1995 and 1996 Unpaved-Road Controls. PM control measures were applied to the unpaved road emission estimates for the years 1995 and 1996 and for the projection years. The level of control assumed varied by PM nonattainment area classification and by rural and urban areas. On urban unpaved roads in moderate PM nonattainment areas, the assumed control was paving the unpaved roads. This control was applied with a 96 percent control efficiency and a 50 percent penetration rate. On rural roads in serious PM nonattainment areas, chemical stabilization was the assumed control. This control was applied with a 75 percent control efficiency and a 50 percent penetration rate. On urban unpaved roads in serious PM nonattainment areas, paving and chemical stabilization were the controls assumed to be applied. This combination of controls was applied with an overall control efficiency of 90 percent and a penetration rate of 75 percent.

3.f. Paved Roads: Estimates of PM emissions from reentrained road dust on paved roads were developed at the county level in a manner similar to that for unpaved roads. PART5 reentrained road dust emission factors for paved roads depend on the road surface silt loading and the average weight of all of the vehicles traveling on the paved roadways. The equation used in PART5 to calculate PM emission factors from reentrained road dust on paved roads is a generic paved road dust calculation formula from AP-42.

$$PAVED = PSDPVD \times (PVSILT/2)^{0.65} \times (WEIGHT/3)^{1.5} \quad (15)$$

where: PAVED = paved road dust emission factor for all vehicle classes combined (grams per mile)

PSDPVD = base emission factor for particles of less than 10 or 2.5 microns in diameter from paved road dust (7.3 g/mi for PM_{10} and 1.825 g/mi for $PM_{2.5}$)

PVSILT = road surface silt loading (g/m^2)

WEIGHT = average weight of all vehicle types combined (tons)

Paved road silt loadings were assigned to each of the twelve functional roadway classifications (six urban and six rural) based on the average annual traffic volume of each functional system by state. One of three values was assigned to each of these road classes, 1 (gm/m^2) was assigned Local functional class roads, and either 0.20 (gm/m^2) or 0.04 (gm/m^2) was assigned to each of the other functional class roads. A silt loading of 0.20 (gm/m^2) was assigned to a road types that had an ADTV less than 5000 and 0.04 (gm/m^2) was assigned to road types that had an ADTV greater than or equal to 5000. ADTV was calculated by dividing annual VMT by state and functional class by state specific functional class roadway mileage.

As with the PART5 emission factor equation for unpaved roads, the above PM emission factor equation for paved roads is representative of a fleet average emission factor rather than a vehicle-specific emission factor and it includes particulate matter from tailpipe exhaust, brake wear, tire wear, and ambient background particulate concentrations. Therefore, the PART5 fleet average PM emission factors for the tailpipe, tire wear, and brake wear components were subtracted from the paved road fugitive dust emission factors before calculating emissions from reentrained road dust on paved roads.

The emission factors obtained from PART5 were modified to account for the number of days with a sufficient amount of precipitation to prevent road dust resuspension. The PART5 emission factors were multiplied by the fraction of days in a month with less than 0.01 inches of precipitation. This was done by subtracting data from the National Climatic Data Center showing the number of days per month with more than 0.01 inches of precipitation from the number of days in each month and dividing by the total number of days in the month. These emission factors were developed by month at the state and road type level for the average vehicle fleet.

For the years 1990 to 1996 the rain correction factor applied to the paved road fugitive dust emission factors was reduced by 50 percent.

VMT from paved roads was calculated at the state/road type level by subtracting the state/road type-level unpaved road VMT from total state/road type-level VMT. Because there are differences in methodology between the calculation of total and unpaved VMT there are instances where unpaved VMT is higher than total VMT. For these instances, unpaved VMT was reduced to total VMT and paved road VMT was assigned a value of zero. The paved road VMT were then temporally allocated by month using the NAPAP temporal allocation factors for VMT. These monthly/state/road type-level VMT were then multiplied by the corresponding paved road emission factors developed at the same level.

These paved road emissions were allocated to the county level according to the fraction of total VMT in each county for the specific road type. The following equation illustrates this allocation.

$$PVDEMIS_{X,Y} = PVDEMIS_{ST,Y} \ x \ VMT_{X,Y}/VMT_{ST,Y} \tag{16}$$

where: $PVDEMIS_{X,Y}$ = paved road PM emissions (tons) for county x and road type y

$PVDEMIS_{ST,Y}$ = paved road PM emissions (tons) for the entire state for road type y

$VMT_{X,Y}$ = total VMT (million miles) in county x and road type y

$VMT_{ST,Y}$ = total VMT (million miles) in entire state for road type y

PM control measures were applied to the paved road emission estimates for the years 1995 and 1996. The control assumed was vacuum sweeping on paved roads twice per month to achieve an control level of 79 percent. This control was applied to urban and rural roads in serious PM nonattainment areas and to urban roads in moderate PM nonattainment areas. The penetration factor used varied by road type and NAA classification (serious or moderate).

3.g. <u>Wind Erosion</u>: PM_{10} wind erosion emission estimates for agricultural lands were calculated using a modification of the methodology used by Gillette and Passi to develop wind erosion emission estimates for the 1985 NAPAP Inventory. Several simplifying assumptions were made in order to perform the calculations using a spreadsheet model. The NAPAP methodology and the method used to develop the wind erosion estimates in this study both determine expected dust flux based on the probability distribution of wind energy. The methodology uses the mean wind speed coupled with information concerning the threshold friction velocity for the soil and information on precipitation to predict the wind erosion flux potential for soils.

The basic equation used to determine the expected dust flux is given by the following equation:

$$I = k \ x \ C \ x \ C_d \ x \left(\frac{u}{0.886}\right)^4 x \ \Gamma(3,x) \tag{17}$$

Where:

I = dust flux ($gm/cm^2/sec$)

k = PM_{10} particle size multiplier (0.9)

C	= constant (4 x 10^{-14} gm/cm^2/sec)
C_d	= coefficient of drag
u	= mean wind speed (cm/sec)
Γ(3,x)	= incomplete gamma function (i.e., probability distribution)

In order to evaluate (3,x), x must be determined from the following equation:

$$x = \left(u_t \, x \, \frac{0.886}{u} \right)^2 \tag{18}$$

The threshold velocity (u_t) can be determined from the threshold friction velocity (u_{*t}, which is a function of soil type and precipitation) from the following equation:

$$u_t = \frac{u_{xt}}{C_d^{\,0.5}} \tag{19}$$

In order to calculate the flux of emissions from wind erosion using the above equation, information concerning the average monthly wind speed, total monthly precipitation, and anemometer height used to measure the wind speed was necessary. Values for monthly wind speed, total monthly precipitation, and anemometer height were obtained from the local climatological data for several meteorological stations within each State. For most States, several meteorological stations' data were obtained and an overall average was determined for the State. The anemometer height was used to determine the coefficient of drag (C_d) from the following equation:

$$C_d = \left(\frac{0.23}{\ln z_a} \right)^2 \tag{20}$$

Where:

z_a	= anemometer height

Information concerning the average soil type for each State was determined from the USDA surface soil map. A single soil type was assigned to each State in order to determine a single value for the threshold friction velocity (u_{*t}). The u_{*t} utilized represented either a before or after rain value, depending upon whether or not precipitation exceeded 5.08 cm during a month. If precipitation exceeded this amount, the "after-rain" u_{*t} value was used for all succeeding months until the time of a significant tillage operation or plant emergence. Values of the threshold friction velocity for different soil types both before and after rain have been reported by

Gillette and Passi. The value of u_t was then calculated using the value of u_{*t} determined and C_d. Once u_t is determined, then x is calculated and the incomplete gamma function is evaluated. Following determination of the incomplete gamma function, the flux for each month was calculated.

Wind erosion was assumed to be zero from the time of plant emergence until harvest (i.e., the percent of time when the ground is planted). Separate flux estimates were made for fall-planted crops and spring-planted crops. This meant that flux estimates were only calculated from July to October (for fall-planted crops) and from September until May (for spring-planted crops). This approach is consistent with the methodology utilized by Gillette and Passi. However, because they were evaluating the erosion potential over a multi-year time frame, Gillette and Passi utilized previous year precipitation information to assign the threshold friction velocity to an area. In this work, the before rain u_{*t} value was always utilized for January for spring planted crops rather than evaluating whether or not any month between September and December of the previous year had more than 5.08 cm of precipitation.

Once the emission flux potential for each month for each crop type (fall- or spring-planted) for each State was calculated, then information on the number of acres of spring- or fall-planted crops in each State were required (and the number of seconds per month) to determine the emissions. The number of acres of crops planted in each State was obtained for each of the six years from the USDA. Evaluation of which crops were spring-planted or fall-planted for each State was made using information available from the USDA.

State-level PM_{10} estimates were distributed to the county-level using estimates of county rural land area from the U.S. Census Bureau. The following formula was used:

$$County\ Emissions = \frac{Actual\ tillage\ acres/county}{Total\ State\ tillage\ acreage} \times State\ Emissions \qquad (21)$$

$PM_{2.5}$ emissions were then calculated from the county-level PM_{10} emissions by applying the AP-42 particle size multiplier for industrial wind erosion of 0.2 (or 0.40 of PM_{10}), as no other particle size data were available.

3.h. **<u>Cattle Feed Lots</u>**: County-level PM_{10} emission estimates for cattle feed lots were estimated using activity data from the Census of Agriculture (head of cattle per county) and a PM_{10} emission factor of 17 tons per 1,000 head. The following formula was used:

$$County\ Emissions = \frac{County\ Head\ of\ Cattle}{1{,}000} \times 17 \qquad (22)$$

$PM_{2.5}$ emissions were then calculated from the county-level PM_{10} emissions by applying the AP-42 particle size multiplier for agricultural tilling of 0.10 or (0.476 of PM_{10}).

The National Particulates Inventory also includes NH_3 emissions for cattle feet lots, which were estimated based on the 1985 NAPAP Inventory estimates.

4. Other Area and Mobile Sources

The basis for the emission estimates for most (non- fugitive dust) area source categories was the 1985 NAPAP Area Source Emissions Inventory, with the exception of non-road mobile sources, and prescribed burning. This section discusses area source emission estimates performed for this study other than those for fugitive dust. The methodology used to estimate emissions for 1990, including the sources for growth indicators and updated emission factors, are discussed. Non-road gasoline, mobile source emission estimates are based on a 1990 non-road emission inventory compiled by EPA. Non-road diesel emission estimates are derived by using the Non-road model as described in "Methodologies that are New" earlier in this document.

As with the point sources, the 1985 NAPAP Inventory contained total suspended particulate (TSP) emissions. Except where noted, these TSP emissions were grown to 1990 and then particle size multipliers were applied to estimate PM_{10} and $PM_{2.5}$ emissions. Ammonia emissions were estimated by growing NH_3 emissions taken from the 1985 NAPAP Inventory.

4.a. Growth Indicators: Emission estimates from the 1985 NAPAP Inventory were grown to 1990 based on historical BEA earnings data (refer to page 4-37 of the Procedures Document), historical estimates of fuel consumption, or other category-specific growth indicators.

The State Energy Data System (SEDS) data were used as an indicator of emissions growth for the area source fuel combustion categories and for the gasoline marketing categories. (Refer to Table 4.3-9, page 4-70 of the Procedures Document). SEDS reports fuel consumption by sector and fuel type. Since fuel consumption is the activity level used to estimate emissions for these categories, fuel consumption is a more accurate predictor of changes in emissions, compared to other surrogate indicators such as earnings or population. A log linear regression procedure was used to fill in missing data points for fuel consumption categories if at least three data points in the time series (1985 to 1989) were available.

Additional data were gathered for several categories for use in the emission projections. Growth indicators, other than BEA or SEDS data, were developed for petroleum refinery fugitives and several non-road vehicle source categories, including aircraft (commercial and civil), railroads, and marine vessels (other than gasoline-powered).

4.b. <u>Residential Wood Combustion:</u> Residential Wood Emissions from residential wood combustion were estimated for 1985 through 1997 using annual wood consumption and an emission factor. The following general equation) was used to calculate emissions:

$$E_{year} = Activity \times EF \times \left(1 - \frac{CE}{100}\right) \qquad (23)$$

where: E_{year}	=	county emissions (tons)
Activity	=	wood consumption (cords)
EF	=	emission factor (tons/cord)
CE	=	control efficiency (percent)

Activity was based on EPA's County Wood Consumption Estimation Model. This model was adjusted with heating degree day information, and normalized with annual wood consumption estimates. AP-42 emission factors for CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2 and VOC were used. A control efficiency was applied nationally to PM_{10} and $PM_{2.5}$ emissions for the years 1991 through 1996.

EPA's County Wood Consumption Estimation Model is based on 1990 data and provides county level estimates of wood consumption, in cords. Model F of the overall Model was used to estimate the amount of residential wood consumed per county, using a sample set of 91 counties in the northeast and northwestern United States. Model F calculates estimates of cords of wood consumed per household as a function of the number of homes heating primarily with wood with a forced intercept of zero. Using the Model F results, the percentage of the population heating with wood, the number of households in a county, land area per county, and heating degree days, county-level wood consumption for 1990 was estimated.

<u>Heating Degree Days</u>: A heating degree day is the number of degrees per day the daily average temperature is below 65 degrees Fahrenheit. These data were collected for one site in all states (except Texas and California where data were collected for two sites) for each month and summed for the year. An average of the two sites was used for Texas and California. This information is used to adjust the model, which is partially based on 1990 heating degree days, to the appropriate year's heating degree data.

$$Adjusted\ Model_{year} = \frac{State\ hdd\ Total_{year}}{State\ hdd\ Total_{1990}} \times County\ Model_{1990} \qquad (24)$$

where:	Adjusted Model	=	county wood consumption (cords)
	State hdd Total	=	total heating degree days (degrees Fahrenheit)
	County Model	=	EPA model consumption (cords)

National Wood Consumption: The Adjusted Model wood consumption estimate was normalized on a national level using the U.S. Department of Energy (DOE) estimate of residential U.S. wood consumption. This value in 1997 was reported as 414 trillion British thermal units (Btu). Dividing by 20 million Btu/cord yields an account of cords over the nation consumed per year. Consumption for the years 1985, 1986, and 1988 were unavailable from the DOE. Known year's consumption and heating degree days were used to estimate these years. The 1985 DOE estimate was calculated using the ratio of 1985 total heating degree days to 1984 total heating degree days multiplied by the 1984 DOE wood consumption estimate. The 1986 DOE estimate was calculated using the ratio of 1986 total heating degree days to 1985 total heating degree days multiplied by the "calculated" 1985 DOE wood consumption estimate. The 1988 DOE estimate was calculated using the ratio of 1988 total heating degree days to 1987 total heating degree days multiplied by the 1987 DOE wood consumption estimate. The following equation shows normalization of the Adjusted Model:

$$Activity = Adjusted\ Model_{year} \times \frac{DOE_{year}}{\sum Adjusted\ Model_{year}} \qquad (25)$$

where: Activity	=	normalized county consumption (cords)
Adjusted Model	=	county wood consumption (cords)
DOE	=	DOE national estimate of residential wood consumption (cords)

Emission Factors: Emission factors were obtained from Table 1.10-1 of AP-42, Emission Factors for Residential Wood Combustion, for conventional wood stoves.

Control Efficiency: A control efficiency was applied nationally to PM_{10} and $PM_{2.5}$ residential wood combustion for the years 1991 through 1996. The control efficiency for all pollutants for the years 1985 through 1990, and for VOC, NO_x, CO, and SO_2 for 1991 through 1996 is zero.

4.c. Residential Nonwood Combustion: The 1990 SO_2 and PM NET emissions are the same as the 1990 Interim Inventory emissions. The 1991 through 1994 emissions were estimated by applying growth factors to the 1990 Interim Inventory emissions. The growth factors were obtained from the prereleased E-GAS, version 2.0. The E-GAS generates growth factors at the SCC-level for counties representative of all counties within each ozone nonattainment area classified as serious and above and for counties representative of all counties within both the attainment portions and the marginal and moderate nonattainment areas within each state. The appropriate growth factors were applied by county and SCC to the 1990 emissions as shown:

$$Emissions_{(county,SCC,year)} = Growth_{(county,SCC,year)} \times Emissions_{(county,SCC,1990)} \qquad (26)$$

There are approximately 150 representative counties in E-GAS and 2000 SCCs present in the base year inventory. This yields a matrix of 300,000 growth factors generated to determine a single year's inventory. To list all combinations would be inappropriate.

4.d. __Highway Vehicles:__ In 1994, EPA released a computer model, with the acronym PART5, that can be used to estimate particulate emission rates from in-use gasoline and diesel-fueled motor vehicles (refer to Reference 20, page 4-200 of the Procedures Document). It calculates particle emission factors in grams per mile from on-road automobiles, trucks, and motorcycles, for particle sizes up to 10 microns. PART5 was used to calculate on-road vehicle PM_{10} and $PM_{2.5}$ ($PM_{2.5}$ for the years 1990-1996 only) emission factors from vehicle exhaust, brake wear, tire wear, and reentrained road dust from paved and unpaved roads (see sections 4.8.2.3 and 4.8.2.4 for details on road dust emissions), and SO_2 vehicle exhaust emission factors.

Basic assumptions regarding inputs to PART5 were made that apply to all PART5 model runs, and include the following:

- The transient speed cycle was used.
- Any county with an existing I/M program was given I/M credit from PART5, regardless of the details of the I/M program. PART5 gives credit based on the assumption that high emitting vehicles will be forced to make emission reducing repairs and that an existing I/M program will deter tampering. This only affects lead and sulfate emissions from gasoline-powered vehicles.
- Using the input parameter BUSFLG, bus emission factors for all rural road types, urban interstates, and other freeways and expressways road types were modeled using the PART5 transit bus emission factors, while bus emission factors for all other urban road types were modeled using the PART5 Central Business District bus emission factors.

__Registration Distribution__. The vehicle registration distribution used was also common to all PART5 model runs. PART5 uses the same vehicle classifications as the MOBILE model, except that the MOBILE HDDV class is broken into five subclasses in PART5.

To maintain consistency with the NET Inventory, the year specific vehicle registration distribution used in the MOBILE modeling for the NET Inventory was adapted for this analysis. This registration distribution was modified by distributing the MOBILE HDDV vehicle class distribution among the five PART5 HDDV subclasses (2BHDDV, LHDDV, MHDDV, HHDDV, and BUSES). This was accomplished using HDDV subclass-specific sales, survival rates, and diesel market shares.

Speed. The speed inputs documented in the procedures document were used in the PART5 modeling as well, with the exception that the maximum allowable speed in PART5 is 55 mph, so the rural interstate speed was changed from 60 mph to 55 mph for the PART5 modeling (see table 4.6-22 in the Procedures Document). Emission factors were calculated for each combination of state, I/M status, month, vehicle type, and speed. VMT data for each county/month/vehicle type/road type were mapped to the appropriate emission factor.

HDDV Vehicle Class Weighting. After PART5 emission factors are generated, the PART5 HDDV subclass emission factors (2BHDDV, LHDDV, MHDDV, HHDDV, and BUSES) are weighted together to develop a single HDDV emission factor, to correspond with the VMT data already developed for the NET Inventory. These weighting factors are based on truck VMT by weight and truck class from the Truck Inventory and Use Survey and FHWA's *Highway Statistics.*

Exhaust PM Emissions. Monthly, county-level, SCC-specific PM emissions from on-road vehicle exhaust components were calculated by multiplying year specific monthly county-level, SCC-specific VMT by year specific state-level, SCC-specific exhaust PM emission factors generated using PART5. Since none of the inputs affecting the calculation of the PM exhaust emission factors vary by month, only annual PM exhaust emission factors were calculated. PART5 total exhaust emission factors are the sum of lead, soluble organic fraction, remaining carbon portion, and direct SO_4 (sulfates) emission factors.

Exhaust SO_2 Emissions. National annual SO_2 on-road vehicle exhaust emission factors by vehicle type and speed were calculated using PART5. These emission factors calculated within PART5 vary according to fuel density, the weight percent of sulfur in the fuel, and the fuel economy of the vehicle (which varies by speed). None of these parameters vary by month or state. Monthly/county/SCC-specific SO_2 emissions were then calculated by multiplying each county's monthly VMT at the road type and vehicle type level by the SO_2 emission factor (calculated for each vehicle type and speed) that corresponds to the vehicle type and road type.

PM Brake Wear Emissions. The PART5 PM emission factors for brake wear are 0.0125 grams per mile for PM_{10} and 0.005 grams per mile for $PM_{2.5}$. This value was applied to estimate brake wear emissions for all vehicle types.

PM Tire Wear Emissions. PART5 emission factors for tire wear are proportional to the average number of wheels per vehicle. The emission factor is 0.002 grams per mile per wheel for PM_{10} and 0.0005 grams per mile per wheel for $PM_{2.5}$. Therefore, separate tire wear emission factors were calculated for each vehicle type. Estimates of the average number of wheels per vehicle by vehicle class were developed using information from the *Truck Inventory and Use Survey*. Tire wear PM emissions were then calculated at the monthly/county/SCC level by multiplying the monthly/county/SCC level VMT by the tire wear emission factor for the appropriate vehicle type.

Pre-1996 Calculation of Ammonia (NH_3) Emission Factors. Little research has been done to date on ammonia (NH_3) emission factors from motor vehicles. The most comprehensive vehicle testing including NH_3 emission factors available for use in this analysis is summarized in a report by Volkswagen AG (refer to Reference 19, page 4-200, of the Procedures Document). In the testing program described in this report, 18 different Volkswagen/Audi vehicles from the 1978 through 1986 model years were tested. The vehicles were selected to represent a cross-section of the Volkswagen/Audi passenger car production program. The vehicles all had either 4 or 5 cylinder gasoline or diesel engines. Seven of the gasoline vehicles were equipped with 3-way catalysts with oxygen sensors, seven of the vehicles were diesel-fueled, and the remaining four vehicles were gasoline vehicles with no catalysts.

Emissions from each of these vehicles were measured using a chassis dynamometer over three different test procedures: the U.S. FTP, the U.S. Sulfate Emission Test (SET), and the U.S. Highway Driving Test. The FTP includes both cold and hot engine starts with a cumulative mileage of 11.1 miles over 505 seconds. The SET simulates 13.5 miles of travel on a freeway in Los Angeles with heavy traffic over a time of 1,398 seconds. The Highway Driving Test, also known as the Highway Fuel Economy Test (HFET), results in an average speed of 48.1 mph over 10.2 miles with a maximum speed of 59.9 mph. Both the SET and the HFET are hot start tests (no cold starts are included). Each vehicle was tested on all three test cycles on the same day, with three to five repeated measurements carried out for each vehicle on consecutive days.

The mean results of Volkswagen's emission testing program were reported for each of the 18 vehicles tested and for each of the test cycles. The report also shows the total mean value over all three tests by engine type (gasoline with catalyst, gasoline without catalyst, and diesel). These values accounting for all three test cycles were used in this analysis to calculate NH_3 emission since most types of driving would be included in one of the three test cycles (i.e., urban driving would be represented by the FTP; stop and go driving on expressways would be represented by the SET; and freeway driving would be represented by the HFET). These mean emission factors are shown below.

Engine Type	Mean NH_3 Emission Factor (grams/mile)
Gasoline Engine without Catalyst	0.00352
Gasoline Engine with 3-Way Catalyst	0.13743
Diesel Engine	0.00188

Using the NH_3 emission factors listed above, emission factors by vehicle type and model year were calculated using MOBILE5b data listing the fraction of vehicles with 3-way catalysts by vehicle type and travel fractions from MOBILE5b output by model year and vehicle type. For the Trends analysis, motorcycles were assigned the non-catalyst gasoline engine emission factor while all diesel vehicle types were assigned the diesel engine emission factor listed above.

To calculate the LDGV emission factor for 1995, a MOBILE5b run was made to produce by-model-year output for LDGVs in 1995. The by-model-year travel fractions were extracted from the resulting MOBILE5b output file. Then, for each of the 25 model years included in the by-model-year output, a weighted emission factor was calculated by multiplying the fraction of LDGVs with 3-way catalysts in that model year by the emission factor listed above for gasoline engines with 3-way catalysts (i.e., 0.13743 g/mi) and adding to this the product of the fraction of LDGVs without 3-way catalysts in that model year and the emission factor for gasoline engines without 3-way catalysts (i.e., 0.00352 g/mi). This weighted emission factor was then multiplied by the LDGV travel fraction for that model year, giving a model year-weighted emission factor. This procedure was repeated for each of the 25 model years included in the by-model-year output for 1995 and the 25 model-year weighted emission factors were then summed to give the composite 1995 LDGV NH_3 emission factor.

The above procedure was repeated for 1995, 1996, and each projection year for LDGVs, LDGT1s, LDGT2s, and HDGVs. Note that the NH_3 emission factors for each gasoline vehicle type increase with time as the fraction of vehicles with 3-way catalysts increases, since the Volkswagen study showed that NH_3 emission factors for gasoline vehicles with catalysts are significantly higher than those for vehicles without catalysts.

Calculation of Emissions: Once the emission factors for all pollutants and VMT were calculated at the level of detail described above for 1995, 1996, and each of the projection years, emissions were calculated by multiplying the appropriate emission factors by the corresponding VMT values. Emissions for the MOBILE5b pollutants (VOC, NO_x, and CO) were calculated with emission factors and VMT at the month, county, roadway type, and vehicle type (for the eight MOBILE5b vehicle types) level of detail. The emission factors for the PART5 pollutants (PM_{10}, $PM_{2.5}$, and SO_2) did not vary by month, so the same emission factors were multiplied by the monthly VMT at the county, roadway type, and vehicle type (for the 12 PART5 vehicle types) level of detail. Ammonia emission factors varied only by vehicle type, so the eight emission factors by vehicle type were multiplied by VMT representing the same vehicle type at the monthly, county, and roadway type level of detail. Emissions for all pollutants were calculated by multiplying the appropriate emission factor in grams per mile by the corresponding VMT in millions of miles, and then converting the answer to units of tons of emissions.

Emission factors were not calculated separately for each county. To determine the emission factor sets to be modeled in each State, a county-level database was prepared for each year modeled. For each county, the control programs applicable in that year were indicated. The data base also included information on non-default inputs to be modeled, such as registration distributions and other State-supplied data from OTAG, for each county. Next, for each State, all unique combinations of control programs and other non-default inputs were determined for each modeled year. MOBILE5b model runs were then made modeling each of these unique combinations. Each combination was identified using the county code of one of the counties with this combination of controls and inputs. To apply the emission factors to the appropriate counties, a county correspondence file was developed which mapped all counties with the same unique set of input data and control programs to the MOBILE5b emission factors modeled for the county representing that unique combination of inputs and control programs. In some States, a single set of emission factors was applied to all counties in the State, while in other States, a separate set of emission factors was calculated for each county. Most States, however, fell in between these two extremes with several sets of emission factors calculated for the State, with each set applying to one or more counties within the State. A similar process was followed in mapping the PART5 emission factors to the appropriate counties.

1996 and 1997 Ammonia emission factors: NH_3 emission factors used in estimating 1996 and 1997 values are new. The pre-1996 values are based on a European Volkswagen study (Volkswagen AG Research and Development, "Unregulated Motor Vehicle Exhaust Gas Components," Wolfsburg, Germany, March 1989). Emission factors for 1996 and beyond were estimated using the Office of Mobile Sources (OMS) NH_3 emission factors, to capture the impact of catalytic converters on American vehicles.

4.e. Non-Road Gasoline Vehicles: Non-road sources include motorized vehicles and equipment that are not normally operated on public roadways. The non-road mobile source emission estimates in the NET Inventory are based on 1990 non-road emission estimates compiled by EPA. The non-road data contains a total emission estimate for non-road sources at the county level. These emission estimates include all non-road sources except aircraft, commercial marine vessels, railroads, and fugitive road dust. Three of these categories are discussed below. The non-road sources not included in the estimates were determined by growing the applicable NAPAP source categories. The non-road emission estimates were developed from non-road emission inventories for 27 ozone nonattainment areas (NAAs) by EPA's OMS. The OMS inventories contained 1990 emission estimates at the SCC-level for each county within the 27 NAAs. (Refer to Reference 1, page 4-255, of the Procedures Document).

EPA performed a two step process to convert the OMS emission estimates to county/ SCC-level emission estimates from the NAA level. The first step was to use the OMS 1990 non-road emission estimates for the 27 ozone NAAs to estimate non-road emissions for the rest of the country. In the second step, total non-road emission estimates for each county were used to create 1990 county/SCC-level non-road emission estimates. Aircraft, railroads, and marine vessel estimates were derived differently, as discussed below.

Aircraft. Activity levels for aircraft are measured by the number of landing-takeoff operations (LTOs). Annual LTO totals are compiled by the Federal Aviation Administration (FAA) on a regional basis. Commercial aircraft growth was derived from the summation of air carrier and air taxi regional totals of LTOs from FAA-operated control towers and FAA traffic control centers. These data were compiled on a regional basis, so the regional trends were applied to each State. Civil aircraft growth indicators were also developed from regional LTO totals. Civil aircraft activity levels were determined from terminal area activity for the years 1985 through 1989, and from a 1990 forecast of terminal area activity. Military aircraft LTO totals were not available; consequently, BEA data on military sector economic growth were used.

Railroads. Railroad data are provided by the Association of American Railroads (AAR). National totals of revenue-ton-miles for the years 1985 through 1990 were used to estimate changes in activity during this period. The national growth was applied to each State and county.

Marine Vessels. Marine vessel activity is recorded annually by the U.S. Army Corp of Engineers (COE). Cargo tonnage national totals are used to determine growth in diesel- and residual-fueled vessel use through the year 1989. Gasoline-powered vessels are used predominantly for recreation, so growth for this category is therefore based on population.

Diesel: Refer to "Methodologies that are New" on the first page of this update.

We continue to upgrade the emission estimates for $PM_{2.5}$ and NH_3, and expect more significant changes to the 1990 through 1997 estimates in the **1999** Trends Report.

TECHNICAL REPORT DATA

(PLEASE READ INSTRUCTIONS ON THE REVERSE BEFORE COMPLETING)

1. REPORT NO. EPA-454/C-98-007	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE NATIONAL AIR POLLUTANT EMISSION TRENDS UPDATE 1970-1997		5. REPORT DATE 12/30/98
		6. PERFORMING ORGANIZATION CODE USEPA/OAQPS/EMAD/EFIG
7. AUTHOR(S) SHARON V. NIZICH, ANNE POPE, PECHAN-AVANTI GROUP		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. ENVIRONMENTAL PROTECTION AGENCY OFFICE OF AIR QUALITY PLANNING AND STANDARDS EMISSION FACTOR AND INVENTORY GROUP (MD-14) RESEARCH TRIANGLE PARK, NC 27711		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO. 68-D7-0067
12. SPONSORING AGENCY NAME AND ADDRESS DIRECTOR, OFFICE OF AIR QUALITY PLANNING AND STANDARDS OFFICE OF AIR AND RADIATION US ENVIRONMENTAL PROTECTION AGENCY RESEARCH TRIANGLE PARK, NC 27711		13. TYPE OF REPORT AND PERIOD COVERED TECHNICAL 1970-1997
		14. SPONSORING AGENCY CODE EPA/200/04
15. SUPPLEMENTARY NOTES		

16. ABSTRACT

The Emission Factor and Inventory Group (EFIG) annually produces a publication on the trends in emissions of criteria pollutants. These publications are needed by the States to evaluate emission trends in each State and to compare emission trends among the States. The latest such report, entitled, **National Air Pollutant Emission Trends Update 1970-1997 (EPA-E-98-007)** is an update only. A full report will again be generated in December, 1999.

Data from this report has also been used for the National Air Quality Trends report. The emission estimates developed and included in the Emission Trends database have been utilized to support development of the National Particulates Inventory, in support of recent evaluations of the particulate matter and ozone NAAQS, in support of the FACA process, and in support of the CAA Section 812 retrospective analysis.

KEY WORDS/DESCRIPTORS: CRITERIA AIR POLLUTANT, EMISSIONS TRENDS

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI FIELD/GROUP
AIR EMISSION TRENDS AIR POLLUTION AMMONIA BIOGENICS CANADA CARBON MONOXIDE NITROGEN DIOXIDE NITROGEN OXIDES OZONE PARTICULATE MATTER SULFUR DIOXIDE TOTAL SUSPENDED PARTICULATE VOLATILE ORGANIC COMPOUNDS	AIR POLLUTION CONTROL AIR POLLUTION RESEARCH AIR POLLUTION TRENDS	

18. DISTRIBUTION STATEMENT UNLIMITED	UNCLASSIFIED	21. NO. OF PAGES
	UNCLASSIFIED	22. PRICE