United States
Environmental Protection
Agency

Office of Air Quality
Planning and Standards
Research Triangle Park NC 27711

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Air

NATIONAL AIR POLLUTANT EMISSION TRENDS, PROCEDURES DOCUMENT 1900-1996

(Section 4.0: National Criteria Pollutant Estimates, 1985 - 1996 Methodology)

draft

$$E = A * EF * [1 - C/100]$$

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TABLES

FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

AADT	annual average daily traffic
AAMA	American Automotive Manufacturer's Association
AAR	Association of American Railroads
ACT	Alternative Control Technology
ADTV	average daily traffic volume
AIRS	Aerometric Information Retrieval System
AIRS/AMS	AIRS Area and Mobile Source Subsystem
AIRS/FS	AIRS Facility Subsystem
ARD	Acid Rain Division
ASTM	American Society for Testing and Materials
BEA	U.S. Department of Commerce, Bureau of Economic Analysis
BLS	U.S. Bureau of Labor Statistics
CAAA	Clean Air Act Amendments of 1990
CEM	continuous emissions monitor(ing)
CNOI	Census number of inhabitants
CO	carbon monoxide
CTG	Control Techniques Guidelines
CTIC	Conservation Information Technology Center
DOE	U.S. Department of Energy
DOT	Department of Transportation
DVMT	daily vehicle miles traveled
EIA	U.S. DOE, Energy Information Administration
EFIG	EPA, OAQPS, Emission Factors and Inventory Group
EG	earnings growth
EPA	U.S. Environmental Protection Agency
ERCAM/VOC	Emission Reductions and Cost Analysis Model for VOC
ESD	EPA, OAQPS, Emission Standards Division
ETS/CEM	Emissions Tracking System/Continuous Emissions Monitoring
FAA	Federal Aviation Adminstration
FCC	fluid catalytic cracking unit
FGD	flue gas desulfurization
FHWA	U.S. Federal Highway Adminstration
FID	Flame Ionization Detector
FREDS	Flexible Regional Emissions Data System
FTP	Federal Test Procedure
GCVTC	Grand Canyon Visibility Transport Commission
GT	gas turbines
HC	hydrocarbon
HCPREP	FREDS Hydrocarbon Preprocessor
HDV	heavy duty vehicle
hp	horsepower
HPMS	Highway Performance Monitoring System
IC	internal combustion (engine)
I/M	inspection and maintenance
LDT	light duty truck
LDV	light duty vehicle

LTO	landing and takeoff
MACT	maximum available control technology
MRI	Midwest Research Institute
MW	megawatts
NAA	nonattainment area
NADB	National Allowance Data Base
NAPAP	National Acid Precipitation Assessment Program
NEDS	National Emission Data System
NESHAP	National Emission Standards for Hazardous Air Pollutants
NET	National Emissions Trends (inventory)
NH_3	ammonia
NO_x	oxides of nitrogen
NPI	National Particulates Inventory
NSPS	New Source Performance Standards
OAQPS	EPA, Office of Air Quality Standards and Planning
OMS	EPA, Office of Mobile Sources
OSD	ozone season daily
OTAG	Ozone Transport Assessment Group
OTR	ozone transport region
Pb	lead
PCE	personal consumption expenditures
PM	particulate matter
PM-2.5	particulate matter less than 2.5 microns in diameter
PM-10	particulate matter less than 10 microns in diameter
ppm	parts per million
QA	quality assurance
QC	quality control
RACT	Reasonably Available Control Technology
RCRA	Resource Conservation and Recovery Act
ROM	Regional Oxidant Model
RVP	Reid vapor pressure
SCC	source classification code
SEDS	State Energy Data System
SIC	Standard Industrial Classification (code)
SIP	State Implementation Plan
SO_2	sulfur dioxide
SO_4	sulfates
SUPROXA	Super Regional Oxidant A
TOG	total organics
tpy	tons per year
TSDF	hazardous waste treatment, storage, and disposal facility
TSP	total suspended particulate matter
USDA	U.S. Department of Agriculture
USFS	USDA Forest Service
VMT	vehicle miles traveled
VOC	volatile organic compound(s)

SECTION 4.0
NATIONAL CRITERIA POLLUTANT ESTIMATES
1985 - 1996 METHODOLOGY

Each year the U.S. Environmental Protection Agency (EPA) prepares national estimates for assessing trends in criteria pollutant emissions. In the past, the emissions were estimated using consistent top-down methodologies employing national statistics on economic activity, material flows, etc., for the years 1940 to the current year of the report. Although emissions prepared in this way were useful for evaluating changes from year to year, they did not provide a geographically detailed measure of emissions for any given year. Bottom-up inventories, where emissions are derived at the plant or county level, are extremely useful in many applications, such as inputs into atmospheric models. During the past several years, changes have been made to the methodologies in order to produce emissions for the *National Air Pollutant Emission Trends, 1900-1996*[1] *(Trends)* report, starting at the county level, which both represent a bottom-up inventory and allow for an evaluation of changes in emissions from year to year. These methodological changes allowed for the incorporation of even more detailed state data. Starting with this year's *Trends* report (Reference 1), state data including emission estimates have been incorporated.

4.1 INTRODUCTION

The carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), and volatile organic compound (VOC) emissions presented in this report for the years 1985 through 1989 have been estimated using a methodology based on the methodology developed for the *Interim* Inventories, with several exceptions. The *Interim* methodology was developed to produce the inventories for the years 1987 through 1991 and is presented in the *Regional Interim Emission Inventories (1987-1991)*.[2] A similar methodology was developed for the preparation of a national 1990 particulate matter inventory as documented in the *Development of the OPPE Particulate Programs Implementation Evaluation System*.[3] In order to generate the necessary emissions for the *Trends* report, the *Interim* methodology has been expanded to generate CO, NO_x, SO_2, and VOC emissions for the years 1985 and 1986, as well as particulate matter less than 10 microns (PM-10) emissions for the years 1985 through 1989.

The 1990 Interim Inventory has been revised with state emissions when available. The state non-utility point emissions were obtained from the Ozone Transport Assessment Group (OTAG), Grand Canyon Visibility Transport Commission (GCVTC), and Aerometric Information Retrieval System/Facility Subsystem (AIRS/FS). Area source emissions were also obtained from OTAG, California, and Oregon. On-road emissions were calculated by EPA from state-provided emission factor inputs and vehicle miles traveled (VMT). All gaps in emissions were filled with 1990 Interim Inventory emissions. The 1990 state emissions (hereafter referred to as the 1990 National Emission Trends [NET] inventory) is the basis for the 1991 through 1996 emissions.

Two pollutants, particulate matter less than 2.5 microns (PM-2.5) and ammonia (NH_3), have been added to the list of pollutants inventoried by EPA's Emission Factors and Inventory Group (EFIG). Emissions and associated data for these two pollutants are available for the years 1990 through 1996.

4.1.1 Lead Emissions

The lead (Pb) emissions for the years 1985 through 1995 have been estimated using the methodologies presented in section 5.0 of this report. The weighted emission factors and control efficiencies were assumed to be constant from 1990 to 1996. The 1996 preliminary estimates were made by growing the 1992 activity data by one of two methods applied to the appropriate source category. The first of these two methods used a quadratic regression with weighted 20-year specific source category activity data. The second method used a linear regression with weighted 7-year activity data. This second method was applied to source categories where the trend in the activity data has changed significantly over the past 10 years.

A detailed description of the methodologies used to generate the CO, NO_x, VOC, SO_2, and PM-10 emissions for the years 1985 through 1996 and PM-2.5 and NH_3 emissions for the years 1990 through 1996 are presented in this section. The description is divided into subsections based on similar approaches in estimating the emissions. The beginning of each subsection lists the Tier 1 category, and below, if necessary. Table 4.1-1 shows the subsection/tier category relationships. If a Tier 2 category is not listed, it is currently not estimated within the Emission Trends Inventory.

4.1.2 Carbon Monoxide, Nitrogen Oxides, Volatile Organic Compounds, Sulfur Dioxide, Particulate Matter (PM-10 and PM-2.5), and Ammonia Emissions

Emissions were developed at the county and Source Classification Code (SCC) level for most source categories. These emissions are then summed to the Tier level. There are four levels in the Tier categorization. The first and second level, referred to as Tier 1 and Tier 2, respectively, are the same for each of the six criteria pollutants and are listed in Table 4.1-2. The third level, Tier 3, is unique for each of the six pollutants. The fourth level, Tier 4, is the SCC level. Table 4.1-3 lists the Tier 1 and Tier 2 codes and names with the associated SCC and SCC description. Due to space limitations, the SCC descriptions have been truncated.

Although the emissions were derived at the SCC level, the growth indicators for the point sources for 1985 through 1996 were assigned at this SIC level for all sources except the stationary fuel combustion sources. A match-up between two digit SICs and SCCs, as well as Tier category, is impossible, since the SICs are defined at the plant level but the SCCs are defined at the process level. Therefore, the same SIC could be used in two or more Tier 1 categories. For example, Plant A produces and stores adipic acid. This plant would be assigned SIC code 28 (Chemical and Allied Products). The manufacturing section of the plant would be assigned an SCC of 3-01-001-03 and would be included in Tier 1 category 04, Chemical and Allied Product Manufacturing. The section of the plant where the adipic acid is stored would be assigned an SCC of 3-01-001-02 and would be included in Tier 1 category 09, Storage and Transport. As this example shows, in order to use the methodology for the years 1985 to 1996, both the SCC (to determine which Tier category methodology to apply) and the SIC (to know which growth indicator to choose) must be known.

4.1.3 References

1. *National Air Pollutant Emission Trends*, 1900-1996, under development. U.S. Environmental Protection Agency, Research Triangle Park, NC. October 1997.

2. *Regional Interim Emission Inventories (1987-1991), Volume I: Development Methodologies*. EPA-454/R-93-021a. U.S. Environmental Protection Agency, Research Triangle Park, NC. May 1993.

3. *Development of the OPPE Particulate Programs Implementation Evaluation System*, Final, Prepared for the Office of Policy, Planning and Evaluation/Office of Policy Analysis, U.S. Environmental Protection Agency, under EPA Contract No. 68-D3-0035, Work Assignment No. 0-10, Washington, DC. July 1994.

Table 4.1-1. Section 4.0 Structure

Subsection	Tier 1	Tier 2
4.1 Introduction		
4.2 Fuel Combustion - Electric Utility	Fuel Combustion - Electric Utility (01)	Majority of Coal (01), Oil (02), and Gas (03). The point level - steam generated fossil fuel sources.
4.3 Industrial	Fuel Combustion - Electric Utility (01)	Other [(04), mainly gas turbines], Internal Combustion (05), The area source level - steam generated Coal (01), Oil (02), Gas (03).
	Fuel Combustion - Industrial (02)	All
	Chemical & Allied Product Manufacturing (04)	All
	Metals Processing (05)	All
	Petroleum & Related Industries (06)	All
	Other Industrial Processes (07)	All
	Storage & Transport (09)	All
	Waste Disposal & Recycling (10)	All
	Miscellaneous (14)	Health services (05)
4.4 Other Combustion	Other Combustion (03)	All
	Miscellaneous (14)	Other combustion (02)
4.5 Solvents	Solvent Utilization (08)	All
4.6 Highway Vehicles	Highway Vehicles (11)	All
4.7 Off-highwy	Off-highway (12)	All
4.8 Fugitive Dust	Natural Sources (13)	Geogenic [(02), wind erosion only]
	Miscellaneous (14)	Agriculture & Forestry [(01), agricultural crops and livestock only] Fugitive dust (07)

NOTE: Numbers in parentheses after Tier name are the Tier codes.

Table 4.1-2. Major Source Categories

TIER 1	TIER 2
FUEL COMBUSTION-ELECTRIC UTILITIES	
	Coal
	Oil
	Gas
	Other
	Internal Combustion
FUEL COMBUSTION-INDUSTRIAL	
	Coal
	Oil
	Gas
	Other
	Internal Combustion
FUEL COMBUSTION-OTHER	
	Commercial / Institutional Coal
	Commercial / Institutional Oil
	Commercial / Institutional Gas
	Misc. Fuel Combustion (except residential)
	Residential Wood
	Residential Other
CHEMICAL & ALLIED PRODUCT MFG.	
	Organic Chemical Mfg.
	Inorganic Chemical Mfg.
	Polymer & Resin Mfg.
	Agricultural Chemical Mfg.
	Paint, Varnish, Lacquer, Enamel Mfg.
	Pharmaceutical Mfg.
	Other Chemical Mfg.
METALS PROCESSING	
	Nonferrous
	Ferrous
	Not elsewhere classified (NEC)
PETROLEUM & RELATED INDUSTRIES	
	Oil & Gas Production
	Petroleum Refineries & Related Industries
	Asphalt Manufacturing
OTHER INDUSTRIAL PROCESSES	
	Agriculture, Food, & Kindred Products
	Textiles, Leather, & Apparel Products
	Wood, Pulp & Paper, & Publishing Products
	Rubber & Miscellaneous Plastic Products
	Mineral Products
	Machinery Products
	Electronic Equipment
	Transportation Equipment
	Construction
	Miscellaneous Industrial Processes
SOLVENT UTILIZATION	
	Degreasing
	Graphic Arts
	Dry Cleaning

Table 4.1-2. (continued)

TIER 1	TIER 2
	Surface Coating
	Other Industrial
STORAGE & TRANSPORT	
	Bulk Terminals & Plants
	Petroleum & Petroleum Product Storage
	Petroleum & Petroleum Product Transport
	Service Stations: Stage I
	Service Stations: Stage II
	Service Stations: Breathing & Emptying
	Organic Chemical Storage
	Organic Chemical Transport
	Inorganic Chemical Storage
	Inorganic Chemical Transport
	Bulk Materials Storage
	Bulk Materials Transport
WASTE DISPOSAL & RECYCLING	
	Incineration
	Open Burning
	Publicly Owned Treatment Works
	Industrial Waste Water
	Treatment Storage and Disposal Facility
	Landfills
	Other
HIGHWAY VEHICLES	
	Light-Duty Gas Vehicles & Motorcycles
	Light-Duty Gas Trucks
	Heavy-Duty Gas Vehicles
	Diesels
OFF-HIGHWAY	
	Nonroad Gasoline
	Nonroad Diesel
	Aircraft
	Marine Vessels
	Railroads
NATURAL SOURCES	
	Biogenic
	Geogenic
	Miscellaneous (lightning, freshwater, saltwater)
MISCELLANEOUS	
	Agriculture & Forestry
	Other Combustion (forest fires)
	Catastrophic / Accidental Releases
	Repair Shops
	Health Services
	Cooling Towers
	Fugitive Dust

NOTE(S): For the purposes of this report, forest fires are considered anthropogenic sources although many fires do occur naturally.

Table 4.1-3. Tier 1 and Tier 2 Match-up with Source Classification Codes

Tier 1 : 01 FUEL COMB. ELEC. UTIL.

Tier2 : 01 Coal

10100101	- 10100306	External Combustion Boilers Electric Generation
2101001000	- 2101003000	Stationary Source Fuel Combustion Electric Utility

Tier2 : 02 Oil

10100401	- 10100505	External Combustion Boilers Electric Generation
2101004000		Stationary Source Fuel Combustion Electric Utility Distillate Oil Total:
2101004001		Stationary Source Fuel Combustion Electric Utility Distillate Oil All Bo
2101005000		Stationary Source Fuel Combustion Electric Utility Residual Oil Total: A

Tier2 : 03 Gas

10100601	- 10100702	External Combustion Boilers Electric Generation
2101006000		Stationary Source Fuel Combustion Electric Utility Natural Gas Total: Bo
2101006001		Stationary Source Fuel Combustion Electric Utility Natural Gas All Boile
2101010000		Stationary Source Fuel Combustion Electric Utility Process Gas Total: Al

Tier2 : 04 Other

10100801	- 10101302	External Combustion Boilers Electric Generation
2101007000	- 2101009000	Stationary Source Fuel Combustion Electric Utility

Tier2 : 05 Internal Combustion

20100101	- 20101031	Internal Combustion Engines Electric Generation
2101004002		Stationary Source Fuel Combustion Electric Utility Distillate Oil All I.
2101006002		Stationary Source Fuel Combustion Electric Utility Natural Gas All I.C.

Tier 1 : 02 FUEL COMB. INDUSTRIAL

Tier2 : 01 Coal

10200101	Industrial Anthracite Coal Pulverized Coal
10500102	Space Heaters Industrial Coal **
2102001000	Stationary Source Fuel Combustion Industrial Anthracite Coal Total: All
2102002000	Stationary Source Fuel Combustion Industrial Bituminous/Subbituminous Coa
2390001000	Industrial Processes In-Process Fuel Use Anthracite Coal Total
2390002000	Industrial Processes In-Process Fuel Use Bituminous/Subbituminous Coal T
39000189	In-process Fuel Use In-process Fuel Use General

Tier2 : 02 Oil

10200401	Industrial Residual Oil Grade 6 Oil
10201403	Industrial CO Boiler Distillate Oil
10201404	Industrial CO Boiler Residual Oil
10500105	Space Heaters Industrial Distillate Oil
2102004000	Stationary Source Fuel Combustion Industrial Distillate Oil Total: Boile
2102005000	Stationary Source Fuel Combustion Industrial Residual Oil Total: All Boi
2390004000	Industrial Processes In-Process Fuel Use Distillate Oil Total
2390005000	Industrial Processes In-Process Fuel Use Residual Oil Total
30190001	Chemical Manufacturing Fuel Fired Equipment Distillate Oil (No. 2): Distillate Hea
30190002	Chemical Manufacturing Fuel Fired Equipment Residual Oil: Process Heaters
30190011	Chemical Manufacturing Fuel Fired Equipment Distillate Oil (No. 2): Incinerators
30190012	Chemical Manufacturing Fuel Fired Equipment Residual Oil: Incinerators
30290001	Food and Agriculture Fuel Fired Equipment Distillate Oil (No. 2)
30290002	Food and Agriculture Fuel Fired Equipment Residual Oil
30390001	Primary Metal Production Fuel Fired Equipment Distillate Oil (No. 2): Process Heat
30390002	Primary Metal Production Fuel Fired Equipment Residual Oil: Process Heaters
30390011	Primary Metal Production Fuel Fired Equipment Distillate Oil (No. 2): Incinerators
30390012	Primary Metal Production Fuel Fired Equipment Residual Oil: Incinerators
30390021	Primary Metal Production Fuel Fired Equipment Distillate Oil (No. 2): Flares
30390022	Primary Metal Production Fuel Fired Equipment Residual Oil: Flares
30490001	Secondary Metal Production Fuel Fired Equipment Distillate Oil (No. 2): Process He
30490002	Secondary Metal Production Fuel Fired Equipment Residual Oil: Process Heaters
30490011	Secondary Metal Production Fuel Fired Equipment Distillate Oil (No. 2): Incinerato
30490012	Secondary Metal Production Fuel Fired Equipment Residual Oil: Incinerators
30490021	Secondary Metal Production Fuel Fired Equipment Distillate Oil (No.2)
30490022	Secondary Metal Production Fuel Fired Equipment Residual Oil
30490031	Secondary Metal Production Fuel Fired Equipment Distillate Oil: Furnaces
30490032	Secondary Metal Production Fuel Fired Equipment Residual Oil: Furnaces
30500207	Mineral Products Asphalt Concrete Asphalt Heater: Residual Oil (Use 3-05-050-21 fo
30500208	Mineral Products Asphalt Concrete Asphalt Heater: Distillate Oil (Use 3-05-050-22
30590001	Mineral Products Fuel Fired Equipment Distillate Oil (No. 2): Process Heaters
30590002	Mineral Products Fuel Fired Equipment Residual Oil: Process Heaters
30590011	Mineral Products Fuel Fired Equipment Distillate Oil (No. 2): Incinerators
30590012	Mineral Products Fuel Fired Equipment Residual Oil: Incinerators

Table 4.1-3. (continued)

30600101	Petroleum Industry Process Heaters Oil-fired **
30600103	Petroleum Industry Process Heaters Oil-fired
30600111	Petroleum Industry Process Heaters Oil-fired (No. 6 Oil) > 100 Million Btu Capacit
30600901	Petroleum Industry Flares Distillate Oil
30600902	Petroleum Industry Flares Residual Oil
30609901	Petroleum Industry Incinerators Distillate Oil (No. 2)
30609902	Petroleum Industry Incinerators Residual Oil
30790001	Pulp and Paper and Wood Products Fuel Fired Equipment Distillate Oil (No. 2): Proc
30790002	Pulp and Paper and Wood Products Fuel Fired Equipment Residual Oil: Process Heater
30790011	Pulp and Paper and Wood Products Fuel Fired Equipment Distillate Oil (No. 2): Inci
30790012	Pulp and Paper and Wood Products Fuel Fired Equipment Residual Oil: Incinerators
30790021	Pulp and Paper and Wood Products Fuel Fired Equipment Distillate Oil (No. 2)
30790022	Pulp and Paper and Wood Products Fuel Fired Equipment Residual Oil
30890001	Rubber and Miscellaneous Plastics Products Process Heaters Distillate Oil (No. 2)
30890002	Rubber and Miscellaneous Plastics Products Process Heaters Residual Oil
30890011	Rubber and Miscellaneous Plastics Products Process Heaters Distillate Oil (No. 2):
30890012	Rubber and Miscellaneous Plastics Products Process Heaters Residual Oil: Incinerat
30990001	Fabricated Metal Products Fuel Fired Equipment Distillate Oil (No. 2): Process Hea
30990002	Fabricated Metal Products Fuel Fired Equipment Residual Oil: Process Heaters
30990011	Fabricated Metal Products Fuel Fired Equipment Distillate Oil (No. 2): Incinerator
30990012	Fabricated Metal Products Fuel Fired Equipment Residual Oil: Incinerators
31000401	Oil and Gas Production Process Heaters Distillate Oil (No. 2)
31000411	Oil and Gas Production Process Heaters Distillate Oil (No. 2): Steam Generators
31390001	Electrical Equipment Process Heaters Distillate Oil (No. 2)
31390002	Electrical Equipment Process Heaters Residual Oil
39000402	In-process Fuel Use In-process Fuel Use Cement Kiln/Dryer
39990001	Miscellaneous Manufacturing Industries Miscellaneous Manufacturing Industries Dist
39990002	Miscellaneous Manufacturing Industries Miscellaneous Manufacturing Industries Resi
39990011	Miscellaneous Manufacturing Industries Miscellaneous Manufacturing Industries Dist
39990012	Miscellaneous Manufacturing Industries Miscellaneous Manufacturing Industries Resi
39990021	Miscellaneous Manufacturing Industries Miscellaneous Manufacturing Industries Dist
39990022	Miscellaneous Manufacturing Industries Miscellaneous Manufacturing Industries Resi
40201002	Surface Coating Operations Coating Oven Heater Distillate Oil
40201003	Surface Coating Operations Coating Oven Heater Residual Oil
40290011	Surface Coating Operations Fuel Fired Equipment Distillate Oil: Incinerator/Afterb
40290012	Surface Coating Operations Fuel Fired Equipment Residual Oil: Incinerator/Afterbur
49090011	Organic Solvent Evaporation Fuel Fired Equipment Distillate Oil (No. 2): Incinerat
49090012	Organic Solvent Evaporation Fuel Fired Equipment Residual Oil: Incinerators
49090021	Organic Solvent Evaporation Fuel Fired Equipment Distillate Oil (No. 2): Flares
49090022	Organic Solvent Evaporation Fuel Fired Equipment Residual Oil: Flares
50390005	Solid Waste Disposal - Industrial Auxillary Fuel/No Emissions Distillate Oil
Tier2 : 03 Gas	
10200601	Industrial Natural Gas > 100 Million Btu/hr
10201401	Industrial CO Boiler Natural Gas
10201402	Industrial CO Boiler Process Gas
10500106	Space Heaters Industrial Natural Gas
2102006000	Stationary Source Fuel Combustion Industrial Natural Gas Total: Boilers
2102006001	Stationary Source Fuel Combustion Industrial Natural Gas All Boiler Type
2102010000	Stationary Source Fuel Combustion Industrial Process Gas Total: All Boil
2390006000	Industrial Processes In-Process Fuel Use Natural Gas Total
2390010000	Industrial Processes In-Process Fuel Use Process Gas Total
30190003	Chemical Manufacturing Fuel Fired Equipment Natural Gas: Distillate Heaters
30190004	Chemical Manufacturing Fuel Fired Equipment Process Gas
30190013	Chemical Manufacturing Fuel Fired Equipment Natural Gas: Incinerators
30290003	Food and Agriculture Fuel Fired Equipment Natural Gas
30390003	Primary Metal Production Fuel Fired Equipment Natural Gas: Process Heaters
30390004	Primary Metal Production Fuel Fired Equipment Process Gas: Process Heaters
30390013	Primary Metal Production Fuel Fired Equipment Natural Gas: Incinerators
30390014	Primary Metal Production Fuel Fired Equipment Process Gas: Incinerators
30390023	Primary Metal Production Fuel Fired Equipment Natural Gas: Flares
30390024	Primary Metal Production Fuel Fired Equipment Process Gas: Flares
30490003	Secondary Metal Production Fuel Fired Equipment Natural Gas
30490004	Secondary Metal Production Fuel Fired Equipment Process Gas: Process Heaters
30490013	Secondary Metal Production Fuel Fired Equipment Natural Gas: Incinerators

Table 4.1-3. (continued)

30490014		Secondary Metal Production Fuel Fired Equipment Process Gas: Incinerators
30490023		Secondary Metal Production Fuel Fired Equipment Natural Gas
30490024		Secondary Metal Production Fuel Fired Equipment Process Gas: Flares
30490033		Secondary Metal Production Fuel Fired Equipment Natural Gas: Furnaces
30490034		Secondary Metal Production Fuel Fired Equipment Process Gas: Furnaces
30490035		Secondary Metal Production Fuel Fired Equipment Propane
30500206		Mineral Products Asphalt Concrete Asphalt Heater: Natural Gas (Use 3-05-050-20 for
30590003		Mineral Products Fuel Fired Equipment Natural Gas: Process Heaters
30590013		Mineral Products Fuel Fired Equipment Natural Gas: Incinerators
30590023		Mineral Products Fuel Fired Equipment Natural Gas: Flares
30600102		Petroleum Industry Process Heaters Gas-fired **
30600104		Petroleum Industry Process Heaters Gas-fired
30600108		Petroleum Industry Process Heaters Landfill Gas-fired
30600903		Petroleum Industry Flares Natural Gas
30600904		Petroleum Industry Flares Process Gas
30609903		Petroleum Industry Incinerators Natural Gas
30609904		Petroleum Industry Incinerators Process Gas
30790003		Pulp and Paper and Wood Products Fuel Fired Equipment Natural Gas: Process Heaters
30790013		Pulp and Paper and Wood Products Fuel Fired Equipment Natural Gas: Incinerators
30790023		Pulp and Paper and Wood Products Fuel Fired Equipment Natural Gas: Flares
30890003		Rubber and Miscellaneous Plastics Products Process Heaters Natural Gas
30890013		Rubber and Miscellaneous Plastics Products Process Heaters Natural Gas: Incinerato
30890023		Rubber and Miscellaneous Plastics Products Process Heaters Natural Gas: Flares
30990003		Fabricated Metal Products Fuel Fired Equipment Natural Gas: Process Heaters
30990013		Fabricated Metal Products Fuel Fired Equipment Natural Gas: Incinerators
30990023		Fabricated Metal Products Fuel Fired Equipment Natural Gas: Flares
31000205		Oil and Gas Production Natural Gas Production Flares
31000404		Oil and Gas Production Process Heaters Natural Gas
31000405		Oil and Gas Production Process Heaters Process Gas
31000414		Oil and Gas Production Process Heaters Natural Gas: Steam Generators
31000415		Oil and Gas Production Process Heaters Process Gas: Steam Generators
31390003		Electrical Equipment Process Heaters Natural Gas
39000602		In-process Fuel Use In-process Fuel Use Cement Kiln/Dryer
39900601		Miscellaneous Manufacturing Industries Process Heater/Furnace Natural Gas
39990003		Miscellaneous Manufacturing Industries Miscellaneous Manufacturing Industries Natu
39990004		Miscellaneous Manufacturing Industries Miscellaneous Manufacturing Industries Proc
39990013		Miscellaneous Manufacturing Industries Miscellaneous Manufacturing Industries Natu
39990014		Miscellaneous Manufacturing Industries Miscellaneous Manufacturing Industries Proc
39990023		Miscellaneous Manufacturing Industries Miscellaneous Manufacturing Industries Natu
39990024		Miscellaneous Manufacturing Industries Miscellaneous Manufacturing Industries Proc
40201001		Surface Coating Operations Coating Oven Heater Natural Gas
40290013		Surface Coating Operations Fuel Fired Equipment Natural Gas: Incinerator/Afterburn
40290023		Surface Coating Operations Fuel Fired Equipment Natural Gas: Flares
49090013		Organic Solvent Evaporation Fuel Fired Equipment Natural Gas: Incinerators
49090023		Organic Solvent Evaporation Fuel Fired Equipment Natural Gas: Flares
50390006		Solid Waste Disposal - Industrial Auxillary Fuel/No Emissions Natural Gas
Tier2 : 04 Other		
10200801	- 10201302	External Combustion Boilers Industrial
10500110	- 10500114	External Combustion Boilers Space Heaters Industrial
2102007000	- 2102009000	Stationary Source Fuel Combustion Industrial
2390007000	- 2390009000	Industrial Processes In-Process Fuel Use
30290005		Food and Agriculture Fuel Fired Equipment Process Heaters: LPG
30500209		Mineral Products Asphalt Concrete Asphalt Heater: LPG (Use 3-05-050-23 for MACT)
30600107		Petroleum Industry Process Heaters LPG-fired
30600199		Petroleum Industry Process Heaters Other Not Classified
30600905		Petroleum Industry Flares Liquified Petroleum Gas
30600999		Petroleum Industry Flares Not Classified **
30609905		Petroleum Industry Incinerators Liquified Petroleum Gas
30890004		Rubber and Miscellaneous Plastics Products Process Heaters Liquified Petroleum Gas
39000801	- 39001399	In-Process Fuel Use In-Process Fuel Use
40201004		Surface Coating Operations Coating Oven Heater Liquified Petroleum Gas (LPG)
50390010		Solid Waste Disposal - Industrial Auxillary Fuel/No Emissions Liquified Petroleum
Tier2 : 05 Internal Combustion		
20180001		Electric Generation Equipment Leaks Equipment Leaks
20200101	- 20201002	Internal Combustion Engines Industrial
2102006002		Stationary Source Fuel Combustion Industrial Natural Gas All I.C. Engine

Table 4.1-3. (continued)

27501001		Fixed Wing Aircraft L & TO Exhaust Military Piston Engine: Aviation Gas
27501014		Fixed Wing Aircraft L & TO Exhaust Military Jet Engine: JP-4
27501015		Fixed Wing Aircraft L & TO Exhaust Military Jet Engine: JP-5
27502001		Fixed Wing Aircraft L & TO Exhaust Commercial Piston Engine: Aviation Gas
27502011		Fixed Wing Aircraft L & TO Exhaust Commercial Jet Engine: Jet A
27505001		Fixed Wing Aircraft L & TO Exhaust Civil Piston Engine: Aviation Gas
27505011		Fixed Wing Aircraft L & TO Exhaust Civil Jet Engine: Jet A
27601014		Rotary Wing Aircraft L & TO Exhaust Military Jet Engine: JP-4
27601015		Rotary Wing Aircraft L & TO Exhaust Military Jet Engine: JP-5
28000211		Diesel Marine Vessels Commercial Crew Boats: Main Engine Exhaust: Idling
28000212		Diesel Marine Vessels Commercial Crew Boats: Main Engine Exhaust: Maneuvering
28000213		Diesel Marine Vessels Commercial Crew Boats: Auxiliary Generator Exhaust: Hotellin
28000216		Diesel Marine Vessels Commercial Supply Boats: Main Engine Exhaust: Idling
28000217		Diesel Marine Vessels Commercial Supply Boats: Main Engine Exhaust: Maneuvering
28000218		Diesel Marine Vessels Commercial Supply Boats: Auxiliary Generator Exhaust: Hotell
Tier 1 : 03 FUEL COMB. OTHER		
Tier2 : 01 Commercial/Institutional Coal		
10300101	- 10300309	External Combustion Boilers Commercial/Institutional
10500202		Space Heaters Commercial/Institutional Coal **
2103001000		Stationary Source Fuel Combustion Commercial/Institutional Anthracite Coa
2103002000		Stationary Source Fuel Combustion Commercial/Institutional Bituminous/Sub
2199001000	- 2199003000	Stationary Source Fuel Combustion Total Area Source Fuel Combustion
Tier2 : 02 Commercial/Institutional Oil		
10300401	- 10300504	External Combustion Boilers Commercial/Institutional
10500205		Space Heaters Commercial/Institutional Distillate Oil
20300101		Commercial/Institutional Distillate Oil (Diesel) Reciprocating
20300102		Commercial/Institutional Distillate Oil (Diesel) Turbine
20300107		Commercial/Institutional Distillate Oil (Diesel) Reciprocating: Exhaust
2103004000		Stationary Source Fuel Combustion Commercial/Institutional Distillate Oil
2103005000		Stationary Source Fuel Combustion Commercial/Institutional Residual Oil
2199004000	- 2199005000	Stationary Source Fuel Combustion Total Area Source Fuel Combustion
50190005		Solid Waste Disposal - Government Auxillary Fuel/No Emissions Distillate Oil
50290005		Solid Waste Disposal - Commercial/Institutional Auxillary Fuel/No Emissions Distil
Tier2 : 03 Commercial/Institutional Gas		
10300601	- 10300799	External Combustion Boilers Commercial/Institutional
10500206		Space Heaters Commercial/Institutional Natural Gas
20300201	- 20300702	Internal Combustion Engines Commercial/Institutional
2103006000		Stationary Source Fuel Combustion Commercial/Institutional Natural Gas T
2199006000	- 2199006002	Stationary Source Fuel Combustion Total Area Source Fuel Combustion Natural Gas
27300320		Off-highway LPG-fueled Engines Industrial Equipment Industrial Fork Lift: Liquifie
50190006		Solid Waste Disposal - Government Auxillary Fuel/No Emissions Natural Gas
50290006		Solid Waste Disposal - Commercial/Institutional Auxillary Fuel/No Emissions Natura
Tier2 : 04 Misc. Fuel Comb. (Except Residential)		
10300901	- 10301303	External Combustion Boilers Commercial/Institutional
10500209	- 10500214	External Combustion Boilers Space Heaters Commercial-Institutional
20190099		Electric Generation Flares Heavy Water
20301001	- 20400402	Internal Combustion Engines
2103007000	- 2103011010	Stationary Source Fuel Combustion Commercial/Institutional
2199007000		Stationary Source Fuel Combustion Total Area Source Fuel Combustion Liqui
2199009000	- 2199011000	Stationary Source Fuel Combustion Total Area Source Fuel Combustion
28888801	- 28888803	Internal Combustion Engines Fugitive Emissions Other Not ClassifiedSpecify in Co
50190010		Solid Waste Disposal - Government Auxillary Fuel/No Emissions Liquified Petroleum
50290010		Solid Waste Disposal - Commercial/Institutional Auxillary Fuel/No Emissions Liquif
Tier2 : 05 Residential Wood		
2104008000	- 2104008053	Stationary Source Fuel Combustion Residential Wood
2199008000		Stationary Source Fuel Combustion Total Area Source Fuel Combustion Wood
Tier2 : 06 Residential Other		
2104001000	- 2104007000	Stationary Source Fuel Combustion Residential
2104011000		Stationary Source Fuel Combustion Residential Kerosene Total: All Heater
Tier 1 : 04 CHEMICAL & ALLIED PRODUCT MFG		
Tier2 : 01 Organic Chemicals		
2301000000		Industrial Processes Chemical Manufacturing: SIC 28 All Process Total
2301040000		Industrial Processes Chemical Manufacturing: SIC 28
30100101		Chemical Manufacturing Adipic Acid General

Table 4.1-3. (continued)

30100103	- 30100105	Chemical Manufacturing Chemical Manufacturing Adipic Acid
30100107	- 30100199	Chemical Manufacturing Chemical Manufacturing Adipic Acid
30100601	- 30100699	Chemical Manufacturing Chemical Manufacturing Charcoal Manufacture
30101901	- 30101907	Chemical Manufacturing Chemical Manufacturing Phthalic Anhydride
30103101	- 30103104	Chemical Manufacturing Chemical Manufacturing Terephthalic Acid/DimethylTerephth
30103180		Chemical Manufacturing Terephthalic Acid/Dimethyl Terephthalate Fugitive Emissions
30103199		Chemical Manufacturing Terephthalic Acid/Dimethyl Terephthalate Other Not Classifi
30103402	- 30103499	Chemical Manufacturing Chemical Manufacturing
30104201	- 30104203	Chemical Manufacturing Lead Alkyl Mfg. Na/Pb Alloy Process
30104301		Chemical Manufacturing Lead Alkyl Manufacturing (Electrolytic Process) General
30109101	- 30110099	Chemical Manufacturing Chemical Manufacturing
30112001	- 30112780	Chemical Manufacturing Chemical Manufacturing
30113201	- 30121009	Chemical Manufacturing
30121080	- 30130107	Chemical Manufacturing Chemical Manufacturing
30130110	- 30181001	Chemical Manufacturing Chemical Manufacturing
30184001		Chemical Manufacturing General Processes Distillation Units

Tier2 : 02 Inorganic Chemicals

2301010000		Industrial Processes Chemical Manufacturing: SIC 28 Industrial Inorganic
2301010010		Industrial Processes Chemical Manufacturing: SIC 28 Industrial Inorganic
30100801		Chemical Manufacturing Chloro-alkali Production Liquefaction (Diaphragm Cell Proc
30100802		Chemical Manufacturing Chloro-alkali Production Liquefaction (Mercury Cell Proces
30100805		Chemical Manufacturing Chloro-alkali Production Air Blowing of Mercury Cell Brine
30100899		Chemical Manufacturing Chloro-alkali Production Other Not Classified
30101101		Chemical Manufacturing Hydrochloric Acid By-product Process
30101199	- 30101203	Chemical Manufacturing Chemical Manufacturing
30101206		Chemical Manufacturing Hydroflouric Acid Tail Gas Vent
30101299		Chemical Manufacturing Hydroflouric Acid Other Not Classified
30102101	- 30102319	Chemical Manufacturing
30102322		Chemical Manufacturing Sulfuric Acid (Contact Process) Process Equipment Leaks
30102399		Chemical Manufacturing Sulfuric Acid (Contact Process) Other Not Classified
30103201	- 30103299	Chemical Manufacturing Chemical Manufacturing Elemental Sulfur Production
30103501	- 30103553	Chemical Manufacturing Chemical Manufacturing Inorganic Pigments
30103599	- 30103903	Chemical Manufacturing Chemical Manufacturing
30107001		Chemical Manufacturing Inorganic Chemical Manufacturing (General) Fugitive Leaks
30111201	- 30111401	Chemical Manufacturing Chemical Manufacturing

Tier2 : 03 Polymers & Resins

2301020000		Industrial Processes Chemical Manufacturing: SIC 28
30101801	- 30101807	Chemical Manufacturing Plastics Production Specific Products
30101809		Chemical Manufacturing Plastics Production Extruder
30101812	- 30101814	Chemical Manufacturing Plastics Production Specific Products
30101817	- 30101820	Chemical Manufacturing Plastics Production Specific Products
30101822	- 30101839	Chemical Manufacturing Plastics Production Specific Products
30101842	- 30101863	Chemical Manufacturing
30101870	- 30101882	Chemical Manufacturing Chemical Manufacturing
30101885	- 30101892	Chemical Manufacturing
30101899		Chemical Manufacturing Plastics Production Others Not Specified
30102401	- 30102424	Chemical Manufacturing Syn. Org. Fiber Mfg.
30102426		Chemical Manufacturing Synthetic Organic Fiber Manufacturing Equipment Cleanup (Us
30102499	- 30102611	Chemical Manufacturing
30102613	- 30102699	Chemical Manufacturing
64520011		Miscellaneous Resins Alkyd Resin Production, Solvent Process Polymerization Reacti
64630001		Vinyl-based Resins Polyvinyl Chloride and Copolymers Production - Suspension Proce
64630052		Vinyl-based Resins Polyvinyl Chloride and Copolymers Production - Suspension Proce
64920030		Fibers Production Processes Rayon Fiber Production Fiber Finishing

Tier2 : 04 Agricultural Chemicals

30100305	- 30100399	Chemical Manufacturing Chemical Manufacturing Ammonia Production
30101301	- 30101399	Chemical Manufacturing Chemical Manufacturing Nitric Acid
30101601		Chemical Manufacturing Phosphoric Acid: Wet Process Reactor
30101603	- 30101799	Chemical Manufacturing Chemical Manufacturing
30102701	- 30102708	Chemical Manufacturing Chemical Manufacturing Ammonium Nitrate Production
30102710	- 30102801	Chemical Manufacturing Chemical Manufacturing
30102806	- 30102820	Chemical Manufacturing Chemical Manufacturing Normal Superphosphate
30102822	- 30102825	Chemical Manufacturing Chemical Manufacturing Normal Superphosphate
30102906	- 30102920	Chemical Manufacturing Chemical Manufacturing Triple Superphosphate
30102922	- 30103002	Chemical Manufacturing Chemical Manufacturing
30103004	- 30103099	Chemical Manufacturing Chemical Manufacturing Ammonium Phosphates

Table 4.1-3. (continued)

30103301	- 30103399	Chemical Manufacturing Chemical Manufacturing Pesticides
30104001	- 30104006	Chemical Manufacturing Chemical Manufacturing Urea Production
30104008	- 30104013	Chemical Manufacturing Chemical Manufacturing Urea Production
30104501		Chemical Manufacturing Organic Fertilizer General: Mixing/Handling
30113004		Chemical Manufacturing Ammonium Sulfate (Use 3-01-210 for Caprolactum Production)
30113005		Chemical Manufacturing Ammonium Sulfate (Use 3-01-210 for Caprolactum Production)

Tier2 : 05 Paints, Varnishs, Lacquers, Enamels

30101401	- 30101403	Chemical Manufacturing Chemical Manufacturing Paint Manufacture
30101415		Chemical Manufacturing Paint Manufacture Premix/Preassembly
30101430		Chemical Manufacturing Paint Manufacture Pigment Grinding/Milling
30101450		Chemical Manufacturing Paint Manufacture Product Finishing
30101451		Chemical Manufacturing Paint Manufacture Product Finishing, Tinting: Mix Tank and
30101470		Chemical Manufacturing Paint Manufacture Equipment Cleaning
30101498		Chemical Manufacturing Paint Manufacture Other Not Classified
30101499	- 30101599	Chemical Manufacturing Chemical Manufacturing

Tier2 : 06 Pharmaceuticals

2301030000		Industrial Processes Chemical Manufacturing: SIC 28
30106001	- 30106009	Chemical Manufacturing Chemical Manufacturing Pharmaceutical Preparations
30106011	- 30106099	Chemical Manufacturing Chemical Manufacturing Pharmaceutical Preparations

Tier2 : 07 Other Chemicals

30100501	- 30100507	Chemical Manufacturing Chemical Manufacturing Carbon Black Production
30100509		Chemical Manufacturing Carbon Black Production Furnace Process: Fugitive Emissions
30100599		Chemical Manufacturing Carbon Black Production Other Not Classified
30100701	- 30100799	Chemical Manufacturing Chemical Manufacturing
30100901	- 30101014	Chemical Manufacturing
30101021		Chemical Manufacturing Explosives (Trinitrotoluene) Continuous Process: Nitration
30101022		Chemical Manufacturing Explosives (Trinitrotoluene) Continuous Process: Nitration
30101099		Chemical Manufacturing Explosives (Trinitrotoluene) Other Not Classified
30102001	- 30102099	Chemical Manufacturing Chemical Manufacturing Printing Ink Manufacture
30104101	- 30104199	Chemical Manufacturing Chemical Manufacturing Nitrocellulose
30105001		Chemical Manufacturing Adhesives General/Compound Unknown **
30111103		Chemical Manufacturing Asbestos Chemical Brake Line/Grinding **
30111199		Chemical Manufacturing Asbestos Chemical Not Classified **
30188801	- 30188805	Chemical Manufacturing Chemical Manufacturing Fugitive Emissions Specify inComme
30196099		Chemical Manufacturing
30199998		Chemical Manufacturing Other Not Classified Specify in Comments Field
30199999		Chemical Manufacturing Other Not Classified Specify in Comments Field

Tier 1 : 05 METALS PROCESSING

Tier2 : 01 Non-Ferrous Metals Processing

2304050000		Industrial Processes Secondary Metal Production: SIC 33 Nonferrous Foundr
30300001		Primary Metal Production Aluminum Ore (Bauxite) Crushing/Handling
30300002		Primary Metal Production Aluminum Ore (Bauxite) Drying Oven
30300101	- 30300201	Primary Metal Production Primary Metal Production
30300502	- 30300518	Primary Metal Production Primary Metal Production Primary Copper Smelting
30300521	- 30300599	Primary Metal Production Primary Metal Production Primary Copper Smelting
30301001	- 30301010	Primary Metal Production Primary Metal Production Lead Production
30301014		Primary Metal Production Lead Production Sintering Charge Mixing
30301015		Primary Metal Production Lead Production Sinter Crushing/Screening
30301017	- 30301025	Primary Metal Production Primary Metal Production Lead Production
30301099	- 30301499	Primary Metal Production Primary Metal Production
30303002	- 30303008	Primary Metal Production Primary Metal Production Zinc Production
30303010		Primary Metal Production Zinc Production Sinter Breaking and Cooling
30303011		Primary Metal Production Zinc Production Zinc Casting
30303014	- 30303099	Primary Metal Production Primary Metal Production Zinc Production
30400101	- 30400299	Secondary Metal Production
30400401	- 30400699	Secondary Metal Production Secondary Metal Production
30400801	- 30400899	
30401001	- 30401099	Secondary Metal Production Secondary Metal Production Nickel Production
30404001		Secondary Metal Production Lead Cable Coating General
36000101		Printing and Publishing Typesetting (Lead Remelting) Remelting (Lead Emissions Onl

Tier2 : 02 Ferrous Metals Processing

2303020000		Industrial Processes Primary Metal Production: SIC 33 Iron & Steel Foundr
30300302	- 30300304	Primary Metal Production Primary Metal Production By-Product Coke Manufacturing
30300306	- 30300308	Primary Metal Production Primary Metal Production By-Product Coke Manufacturing
30300310	- 30300315	Primary Metal Production Primary Metal Production By-Product Coke Manufacturing

Table 4.1-3. (continued)

30300331	- 30300401	Primary Metal Production Primary Metal Production
30300601	- 30300611	Primary Metal Production Ferroalloy Open Furnace
30300615	- 30300802	Primary Metal Production
30300808		Primary Metal Production Iron Production (See 3-03-015 for Integrated Iron & Steel
30300813	- 30300819	Primary Metal Production Iron Production Sintering
30300824	- 30300826	Primary Metal Production Iron Production Blast Furnaces
30300899	- 30300914	Primary Metal Production
30300916	- 30300999	Primary Metal Production Primary Metal Production Steel Production
30302301	- 30302303	Primary Metal Production Primary Metal Production Taconite Iron Ore Processing
30302306		Primary Metal Production Taconite Iron Ore Processing Dry Grinding/Milling
30302308		Primary Metal Production Taconite Iron Ore Processing Bentonite Blending
30302311	- 30302315	Primary Metal Production Primary Metal Production Taconite Iron Ore Processing
30400301	- 30400355	Secondary Metal Production Secondary Metal Production Gray Iron Foundries
30400358	- 30400399	Secondary Metal Production Secondary Metal Production Gray Iron Foundries
30400701	- 30400720	Secondary Metal Production Secondary Metal Production Steel Foundries
30400722		Secondary Metal Production Steel Foundries Muller
30400724	- 30400799	Secondary Metal Production Secondary Metal Production Steel Foundries
30400901		Secondary Metal Production Malleable Iron Annealing
30400999		Secondary Metal Production Malleable Iron Other Not Classified
30405001		Secondary Metal Production Miscellaneous Casting Fabricating Other Not Classified
30405099		Secondary Metal Production Miscellaneous Casting Fabricating Other Not Classified
Tier2 : 03 Metals Processing NEC		
2303000000		Industrial Processes Primary Metal Production: SIC 33 All Processes Tota
2304000000		Industrial Processes Secondary Metal Production: SIC 33 All Processes To
30302401	- 30302411	Primary Metal Production Metal Mining General Processes
30388801	- 30388805	Primary Metal Production Primary Metal Production Fugitive Emissions SpecifyiCom
30399999		Primary Metal Production Other Not Classified Other Not Classified
30402001	- 30402211	Secondary Metal Production Secondary Metal Production
30404901	- 30404999	Secondary Metal Production Secondary MetalProductsMiscellaneous Castingand
30488801	- 30488805	Secondary Metal Production Secondary Metal Production Fugitive Emissions Specif
30499999		Secondary Metal Production Other Not Classified Specify in Comments Field
Tier 1 : 06 PETROLEUM & RELATED INDUSTRIES		
Tier2 : 01 Oil & Gas Production		
2310000000	- 2310030000	Industrial Processes Oil & Gas Production: SIC 13
31000101	- 31000103	Oil and Gas Production Oil and Gas Production Crude Oil Production
31000160		Oil and Gas Production Crude Oil Production Flares
31000199	- 31000204	Oil and Gas Production Oil and Gas Production
31000206	- 31000299	Oil and Gas Production Oil and Gas Production Natural Gas Production
31000301		Oil and Gas Production Natural Gas Processing Facilities Glycol Dehydrators: Reboi
31000302		Oil and Gas Production Natural Gas Processing Facilities Glycol Dehydrators: Reboi
31000303		Oil and Gas Production Natural Gas Processing Facilities Glycol Dehydrators: Phase
31000304		Oil and Gas Production Natural Gas Processing Facilities Glycol Dehydrators: Ethyl
31000305		Oil and Gas Production Natural Gas Processing Facilities Gas Sweeting: Amine Proce
31000306		Oil and Gas Production Natural Gas Processing Facilities Process Valves
31000309		Oil and Gas Production Natural Gas Processing Facilities Compressor Seals
31000310		Oil and Gas Production Natural Gas Processing Facilities Pump Seals
31000311		Oil and Gas Production Natural Gas Processing Facilities Flanges and Connections
31000406		Oil and Gas Production Process Heaters Propane/Butane
31088801	- 31088805	Oil and Gas Production Oil and Gas ProductionFugitive EmissionsSpecify in Comment
Tier2 : 02 Petroleum Refineries & Related Industries		
2306000000		Industrial Processes Petroleum Refining: SIC 29 All Processes Total
30600201	- 30600822	Petroleum Industry Petroleum Industry
30601001	- 30601599	Petroleum Industry Petroleum Industry
30610001	- 30699999	Petroleum Industry Petroleum Industry
Tier2 : 03 Asphalt Manufacturing		
2306010000		Industrial Processes Petroleum Refining: SIC 29 Asphalt Paving/Roofing Ma
30500101	- 30500202	Mineral Products Mineral Products
30500204		Mineral Products Asphalt Concrete Cold Aggregate Handling
30500205		Mineral Products Asphalt Concrete Drum Dryer: Hot Asphalt Plants
30500211		Mineral Products Asphalt Concrete Rotary Dryer Conventional Plant with Cyclone
30500212		Mineral Products Asphalt Concrete Heated Asphalt Storage Tanks: Drum Mix
30500213		Mineral Products Asphalt Concrete Storage Silo
30500214		Mineral Products Asphalt Concrete Truck Load-out
30500221		Mineral Products Asphalt Concrete Elevators: Continuous Process
30500290		Mineral Products Asphalt Concrete Haul Roads: General

Table 4.1-3. (continued)

30500298		Mineral Products Asphalt Concrete Other Not Classified
30500299		Mineral Products Asphalt Concrete See Comment **
Tier 1 : 07 OTHER INDUSTRIAL PROCESSES		
Tier2 : 01 Agriculture, Food, & Kindred Products		
2302000000	- 2302080000	Industrial Processes Food & Kindred Products: SIC 20
2801600000		Miscellaneous Area Sources Agriculture Production - Crops Country Grain E
30200101	- 30200504	Food and Agriculture Food and Agriculture
30200512	- 30200604	Food and Agriculture Food and Agriculture
30200611	- 30200705	Food and Agriculture Food and Agriculture
30200712	- 30200714	Food and Agriculture Food and Agriculture Durum Milling
30200722	- 30200730	Food and Agriculture Food and Agriculture
30200732	- 30200734	Food and Agriculture Food and Agriculture Wheat Milling
30200740		Food and Agriculture Grain Millings Dry Corn Milling: Silo Storage
30200742	- 30200745	Food and Agriculture Food and Agriculture Corn: Dry Milling
30200748		Food and Agriculture Grain Millings Dry Corn Milling: Grinding
30200752	- 30200754	Food and Agriculture Food and Agriculture Corn: Wet Milling
30200756		Food and Agriculture Grain Millings Wet Corn Milling: Milling
30200760		Food and Agriculture Grain Millings Oat: General
30200763		Food and Agriculture Grain Millings Gluten Feed Drying: Direct-fired Dryer - Produ
30200772	- 30200774	Food and Agriculture Food and Agriculture Rice Milling
30200782	- 30200790	Food and Agriculture Food and Agriculture Soybean Mills
30200799		Food and Agriculture Grain Millings See Comments **
30200801		Food and Agriculture Feed Manufacture General **
30200804	- 30201919	Food and Agriculture
30201945		Food and Agriculture Vegetable Oil Processing Oil Refining: Oil Stripping Column
30201998		Food and Agriculture Vegetable Oil Processing Soybean Oil Production: Complete Pro
30201999	- 30203104	Food and Agriculture
30203201	- 30288805	Food and Agriculture
30299998		Food and Agriculture Other Not Specified Other Not Classified
30299999		Food and Agriculture Other Not Specified Other Not Classified
Tier2 : 02 Textiles, Leather, & Apparel Products		
32099997	- 33088805	Textiles, Leather, & Apparel Products
Tier2 : 03 Wood, Pulp & Paper, & Publishing Products		
2307000000		Industrial Processes Wood Products: SIC 24 All Processes Total
2307020000	- 2307060000	Industrial Processes Wood Products: SIC 24
30700101	- 30702099	Pulp & Paper and Wood Products Pulp & Paper and Wood Products
30703003	- 30788898	Pulp & Paper and Wood Products Pulp & Paper and Wood Products
30799901		Pulp and Paper and Wood Products Other Not Classified Battery Separators
30799998		Pulp and Paper and Wood Products Other Not Classified Other Not Classified
30799999		Pulp and Paper and Wood Products Other Not Classified See Comment **
Tier2 : 04 Rubber & Miscellaneous Plastic Products		
2308000000		Industrial Processes Rubber/Plastics: SIC 30 All Processes Total
30800101	- 30800108	Rubber and Miscellaneous Plastics Products Rubber and Miscellaneous Plastics Prod
30800120	- 30800802	Rubber and Miscellaneous Plastics Products Rubber and Miscellaneous Plastics Prod
30800901		Rubber and Miscellaneous Plastics Products Plastic Miscellaneous Products Polystyr
30899999		Rubber and Miscellaneous Plastics Products Other Not Specified Other Not Classifie
Tier2 : 05 Mineral Products		
2305000000	- 2305080000	Industrial Processes Mineral Processes: SIC 32
30500231		Mineral Products Asphalt Concrete Hot Bins and Screens: Continuous Process
30500301		Mineral Products Brick Manufacture Raw Material Drying
30500302		Mineral Products Brick Manufacture Raw Material Grinding
30500304	- 30500405	Mineral Products Mineral Products
30500499	- 30500606	Mineral Products Mineral Products
30500609	- 30500611	Mineral Products Mineral Products Cement Manufacturing: Dry Process
30500613		Mineral Products Cement Manufacturing (Dry Process) Raw Material Grinding and Dryi
30500614		Mineral Products Cement Manufacturing (Dry Process) Clinker Cooler
30500617		Mineral Products Cement Manufacturing (Dry Process) Clinker Grinding
30500623		Mineral Products Cement Manufacturing (Dry Process) Preheater/Precalciner Kiln
30500624		Mineral Products Cement Manufacturing (Dry Process) Raw Mill Feed Belt
30500626		Mineral Products Cement Manufacturing (Dry Process) Raw Mill Air Separator
30500627		Mineral Products Cement Manufacturing (Dry Process) Finish Grinding Mill Feed Belt
30500629		Mineral Products Cement Manufacturing (Dry Process) Finish Grinding Mill Air Separ
30500699		Mineral Products Cement Manufacturing (Dry Process) Other Not Classified
30500706		Mineral Products Cement Manufacturing (Wet Process) Kilns
30500709	- 30500711	Mineral Products Mineral Products Cement Manufacturing: Wet Process

Table 4.1-3. (continued)

30500714		Mineral Products Cement Manufacturing (Wet Process) Clinker Cooler
30500717		Mineral Products Cement Manufacturing (Wet Process) Clinker Grinding
30500799	- 30500802	Mineral Products Mineral Products
30500806		Mineral Products Ceramic Clay/Tile Manufacture Raw Material Handling and Transfer
30500810	- 30500904	Mineral Products Mineral Products
30500907	- 30500909	Mineral Products Mineral Products Clay & Fly Ash Sintering
30500915	- 30501007	Mineral Products
30501010		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Crushin
30501012		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Screeni
30501013		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Air Tab
30501017		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Seconda
30501022		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Drillin
30501034		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Coal Se
30501035		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Blastin
30501099		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Other N
30501101		Mineral Products Concrete Batching General (Non-fugitive)
30501112		Mineral Products Concrete Batching Mixing: Wet
30501113		Mineral Products Concrete Batching Mixing: Dry
30501120	- 30501215	Mineral Products
30501223	- 30501503	Mineral Products
30501505	- 30501507	Mineral Products Mineral Products Gypsum Manufacture
30501511	- 30501513	Mineral Products Mineral Products Gypsum Manufacture
30501515	- 30501517	Mineral Products Mineral Products Gypsum Manufacture
30501519	- 30501606	Mineral Products Mineral Products
30501609		Mineral Products Lime Manufacture Hydrator: Atmospheric
30501611		Mineral Products Lime Manufacture Product Cooler
30501612		Mineral Products Lime Manufacture Pressure Hydrator
30501616	- 30501902	Mineral Products Mineral Products
30501905	- 30502006	Mineral Products Mineral Products
30502008	- 30502010	Mineral Products Mineral Products Stone Quarrying/Processing
30502012	- 30502105	Mineral Products Mineral Products
30502201	- 30502501	Mineral Products Mineral Products
30502508	- 30503103	Mineral Products Mineral Products
30503108		Mineral Products Asbestos Mining Overburden Stripping
30503109		Mineral Products Asbestos Mining Ventilation of Process Operations
30503199	- 30504010	Mineral Products Mineral Products
30504024		Mineral Products Mining and Quarrying of Nonmetallic Minerals Overburden Stripping
30504030	- 30504034	Mineral Products Mineral Products Mining & Quarrying of Nonmetallic Minerals
30504099	- 30509101	Mineral Products Mineral Products
30515001	- 30588805	Mineral Products Mineral Products
30599999		Mineral Products Other Not Defined Specify in Comments Field
Tier2 : 06 Machinery Products		
2309000000	- 2309100260	Industrial Processes Fabricated Metals: SIC 34
30900198	- 30988805	Fabricated Metal Products Fabricated Metal Products
30988806		Fabricated Metal Products Fugitive Emissions Other Not Classified
30999997	- 30999999	Fabricated Metal Products Fabricated Metal Products Other Not Classified
Tier2 : 07 Electronic Equipment		
31303502		Electrical Equipment Manufacturing - General Processes Cleaning
31306500		Electrical Equipment Semiconductor Manufacturing Integrated Circuit Manufacturing:
31306530		Electrical Equipment Semiconductor Manufacturing Etching Process: Wet Chemical: Sp
31399999		Electrical Equipment Other Not Classified Other Not Classified
Tier2 : 08 Transportation Equipment		
31400901		Transportation Equipment Automobiles/Truck Assembly Operations Solder Joint Grindi
31401101	- 31499999	Transportation Equipment Transportation Equipment
Tier2 : 09 Construction		
2311000020		Industrial Processes Construction: SIC 15 - 17 All Processes Demolition
2311000030		Industrial Processes Construction: SIC 15 - 17 All Processes Blasting
2311000080		Industrial Processes Construction: SIC 15 - 17 All Processes Welding Ope
2311010020		Industrial Processes Construction: SIC 15 - 17 General Building Construct
2311010030		Industrial Processes Construction: SIC 15 - 17 General Building Construct
2311010080		Industrial Processes Construction: SIC 15 - 17 General Building Construct
2311020020		Industrial Processes Construction: SIC 15 - 17 Heavy Construction Demoli
2311020030		Industrial Processes Construction: SIC 15 - 17 Heavy Construction Blasti
2311020080		Industrial Processes Construction: SIC 15 - 17 Heavy Construction Weldin
2311030020		Industrial Processes Construction: SIC 15 - 17 Road Construction Demolit

Table 4.1-3. (continued)

2311030030		Industrial Processes Construction: SIC 15 - 17 Road Construction Blastin
2311030080		Industrial Processes Construction: SIC 15 - 17 Road Construction Welding
2311040080		Industrial Processes Construction: SIC 15 - 17 Special Trade Construction
31100199	- 31100202	Building Construction Building Construction
31100299		Building Construction Demolitions/Special Trade Contracts Other Not Classified: Co
Tier2 : 10 Miscellaneous Industrial Processes		
2312000000		Industrial Processes Machinery: SIC 35 All Processes Total
2312050000		Industrial Processes Machinery: SIC 35 Metalworking Machinery: Tool & Die
2399000000		Industrial Processes Industrial Processes: NEC Industrial Processes: NEC
31299999		Machinery, Miscellaneous Miscellaneous Machinery Other Not Classified
31501002		Photographic Equipment Photocopying Equipment Manufacturing Toner Classification
31501003		Photographic Equipment Photocopying Equipment Manufacturing Toner (Carbon Black) G
39999989	- 39999999	Miscellaneous Manufacturing Industries Miscellaneous Manufacturing Industries
Tier 1 : 08 SOLVENT UTILIZATION		
Tier2 : 01 Degreasing		
2415000000	- 2415365999	Solvent Utilization Degreasing
40100201	- 40100399	Organic Solvent Evaporation Degreasing
40188801	- 40188898	Organic Solvent Evaporation Degreasing Fugitive Emissions Specify in Comments F
Tier2 : 02 Graphic Arts		
2425000000	- 2425040999	Solvent Utilization Graphic Arts
40500101	- 40500601	Printing/Publishing Printing Process
40500801	- 40588805	Printing/Publishing Printing Process
Tier2 : 03 Dry Cleaning		
2420000000	- 2420020999	Solvent Utilization Dry Cleaning
40100101	- 40100199	Organic Solvent Evaporation Dry Cleaning Dry Cleaning
41000102		Dry Cleaning Petroleum Solvent - Industrial Stoddard
41000201		Dry Cleaning Petroleum Solvent - Commercial Stoddard
41000202		Dry Cleaning Petroleum Solvent - Commercial Stoddard
68241030		Miscellaneous Processes Paint Stripper Users - Non-chemical Strippers Media Blasti
Tier2 : 04 Surface Coating		
2401001000	- 2401990999	Solvent Utilization Surface Coating
2440020000		Solvent Utilization Miscellaneous Industrial Adhesive (Industrial) Applic
40200101	- 40200706	Surface Coating Operations Surface Coating Operations Surface Coating Applicatio
40200710	- 40200998	Surface Coating Operations Surface Coating Operations
40201101		Surface Coating Operations Fabric Coating/Printing Coating Operation (Also See Spe
40201103		Surface Coating Operations Fabric Coating/Printing Coating Mixing (Also See Specif
40201105	- 40201303	Surface Coating Operations Surface Coating Operations
40201305	- 40201403	Surface Coating Operations Surface Coating Operations
40201405	- 40201503	Surface Coating Operations Surface Coating Operations
40201505	- 40201603	Surface Coating Operations Surface Coating Operations
40201605	- 40201703	Surface Coating Operations Surface Coating Operations
40201705	- 40201803	Surface Coating Operations Surface Coating Operations
40201805	- 40201903	Surface Coating Operations Surface Coating Operations
40201999	- 40202003	Surface Coating Operations Surface Coating Operations
40202005	- 40202103	Surface Coating Operations Surface Coating Operations
40202105	- 40202203	Surface Coating Operations Surface Coating Operations
40202205	- 40202303	Surface Coating Operations Surface Coating Operations
40202305	- 40202403	Surface Coating Operations Surface Coating Operations
40202405	- 40202503	Surface Coating Operations Surface Coating Operations
40202505	- 40202603	Surface Coating Operations Surface Coating Operations
40202605	- 40288805	Surface Coating Operations
40288822		Surface Coating Operations Fugitive Emissions Coating
40288823		Surface Coating Operations Fugitive Emissions Cleartop Coat
40288824		Surface Coating Operations Fugitive Emissions Clean-up
40299995	- 40299999	Surface Coating Operations Surface Coating Operations Surface Coating - Miscella
Tier2 : 05 Other Industrial		
2430000000	- 2440000999	Solvent Utilization
40100401		Organic Solvent Evaporation Knit Fabric Scouring with Chlorinated Solvent Perchlor
40100499		Organic Solvent Evaporation Knit Fabric Scouring with Chlorinated Solvent Other No
49000101	- 49000199	Organic Solvent Evaporation Miscellaneous Solvent Extraction Processes
49000202		Organic Solvent Evaporation Waste Solvent Recovery Operations Condenser Vent
49000206	- 49000599	Organic Solvent Evaporation Miscellaneous
49099998		Organic Solvent Evaporation Miscellaneous Volatile Organic Compound Evaporation Id
49099999		Organic Solvent Evaporation Miscellaneous Volatile Organic Compound Evaporation Id

Table 4.1-3. (continued)

Tier2 : 06 Nonindustrial		
24u0000000	- 2465900000	Solvent Utilization
Tier2 : 07 Solvent Utilization NEC		
2495000000	- 2495000999	Solvent Utilization All Solvent User Categories All Processes
Tier 1 : 09 STORAGE & TRANSPORT		
Tier2 : 01 Bulk Terminals & Plants		
2501050000	- 2501050900	Storage & Transport Petroleum & Petroleum Product Storage Bulk Stations/Terminal
40400101	- 40400271	Bulk Terminals/Plants Petroleum Storage Tanks
40400272		Bulk Terminals/Plants Bulk Plants Gasoline RVP 10: Standing Loss - Int. Floating R
40400278		Bulk Terminals/Plants Bulk Plants Gasoline RVP 10/13/7: Withdrawal Loss - Int. Flo
40400279		Bulk Terminals/Plants Bulk Plants Specify Liquid: Internal Floating Roof (Primary/
40400401	- 40400498	Bulk Terminals/Plants Petroleum Storage Tanks Underground Tanks
Tier2 : 02 Petroleum & Petroleum Product Storage		
2275900000	- 2275900102	Mobile Sources Aircraft Refueling: All Fuels
2275900201		Mobile Sources Aircraft Refueling: All Fuels Underground Tank: Total
2501000000	- 2501010900	Storage & Transport Petroleum & Petroleum Product Storage
2501060000		Storage & Transport Petroleum & Petroleum Product Storage Gasoline Servic
2501060200		Storage & Transport Petroleum & Petroleum Product Storage Gasoline Servic
2501070000		Storage & Transport Petroleum & Petroleum Product Storage Diesel Service
2501070200		Storage & Transport Petroleum & Petroleum Product Storage Diesel Service
2501995000	- 2501995180	Storage & Transport Petroleum & Petroleum Product Storage All Storage Types: Wor
31000104		Oil and Gas Production Crude Oil Production Crude Oil Sumps
31000105		Oil and Gas Production Crude Oil Production Crude Oil Pits
31000108		Oil and Gas Production Crude Oil Production Evaporation from Liquid Leaks into Oil
31000132		Oil and Gas Production Crude Oil Production Atmospheric Wash Tank (2nd Stage of Ga
40300101	- 40399999	Petroleum Product Storage (Refineries Oil and Gas Fie
40400301	- 40400305	Bulk Terminals/Plants Petroleum Storage Tanks Oil Field Storage of Crude Oil
40400306		Bulk Terminals/Plants Oil Field Storage of Crude External Floating Roof Tank: With
40400307		Bulk Terminals/Plants Oil Field Storage of Crude Internal Floating Roof Tank: With
Tier2 : 03 Petroleum & Petroleum Product Transport		
2505000000	- 2505040180	Storage & Transport Petroleum & Petroleum Product Transport
40600101	- 40600299	Transportation and Marketing of Petroleum Products
40688801	- 40688805	Transportation and Marketing of Petroleum Products Fugitive Emissions Specify in
Tier2 : 04 Service Stations: Stage I		
2501060050	- 2501060053	Storage & Transport Petroleum & Petroleum Product Storage Gasoline Service Stati
2501070050	- 2501070053	Storage & Transport Petroleum & Petroleum Product Storage Diesel Service Station
40600301	- 40600399	Transportation and Marketing of Petroleum Products Gasoline Retail Operations St
40600503		Transportation and Marketing of Petroleum Products Pipeline Petroleum Transport -
40600706		Transportation and Marketing of Petroleum Products Consumer (Corporate) Fleet Refu
Tier2 : 05 Service Stations: Stage II		
2501060100	- 2501060103	Storage & Transport Petroleum & Petroleum Product Storage Gasoline Service Stati
2501070100	- 2501070103	Storage & Transport Petroleum & Petroleum Product Storage Diesel Service Station
40600401	- 40600499	Transportation and Marketing of Petroleum Products Filling Vehicle Gas Tanks Sta
40600501		Transportation and Marketing of Petroleum Products Pipeline Petroleum Transport -
40600601		Transportation and Marketing of Petroleum Products Consumer (Corporate) Fleet Refu
Tier2 : 06 Service Stations: Breathing & Emptying		
2275900202		Mobile Sources Aircraft Refueling: All Fuels Underground Tank: Breathing
2501060201		Storage & Transport Petroleum & Petroleum Product Storage Gasoline Servic
2501070201		Storage & Transport Petroleum & Petroleum Product Storage Diesel Service
42500101		Fixed Roof Tanks (210 Bbl Size) Breathing Loss
42500102		Fixed Roof Tanks (210 Bbl Size) Working Loss
Tier2 : 07 Organic Chemical Storage		
2510000000	- 2510995405	Storage & Transport Organic Chemical Storage
30100102		Chemical Manufacturing Adipic Acid Raw Material Storage
30100106		Chemical Manufacturing Adipic Acid Drying, Loading, and Storage
30100508		Chemical Manufacturing Carbon Black Production Bagging/Loading
30101404		Chemical Manufacturing Paint Manufacture Raw Material Storage
30101602		Chemical Manufacturing Phosphoric Acid: Wet Process Gypsum Pond
30101808		Chemical Manufacturing Plastics Production Monomer and Solvent Storage
30101810		Chemical Manufacturing Plastics Production Conveying
30101811		Chemical Manufacturing Plastics Production Storage
30101815		Chemical Manufacturing Plastics Production Pellet Silo
30101816		Chemical Manufacturing Plastics Production Transferring/Handling/Loading/Packing
30101821		Chemical Manufacturing Plastics Production Extruding/Pelletizing/Conveying/Storage

Table 4.1-3. (continued)

30101840		Chemical Manufacturing Plastics Production Resin Storage Tank ** (Use 6-45-200-23
3C:01864		Chemical Manufacturing Plastics Production Pellet Silo/Storage
30101865		Chemical Manufacturing Plastics Production Transferring/Conveying
30101883		Chemical Manufacturing Plastics Production Transferring/Conveying/Storage (Polyure
30101893		Chemical Manufacturing Plastics Production Raw Material Storage
30101894		Chemical Manufacturing Plastics Production Solvent Storage
30102425		Chemical Manufacturing Synthetic Organic Fiber Manufacturing Fiber Storage (Use 6-
30102427		Chemical Manufacturing Synthetic Organic Fiber Manufacturing Solvent Storage (Use
30102612		Chemical Manufacturing Synthetic Rubber (Manufacturing Only) Pre-storage Tank
30102709		Chemical Manufacturing Ammonium Nitrate Production Bulk Loading (General)
30103003		Chemical Manufacturing Ammonium Phosphates Screening/Transfer
30103105		Chemical Manufacturing Terephthalic Acid/Dimethyl Terephthalate Product Transfer V
30104007		Chemical Manufacturing Urea Production Bulk Loading
30106010		Chemical Manufacturing Pharmaceutical Preparations Storage/Transfer
30130108		Chemical Manufacturing Chlorobenzene DCB Crystal Handling/Loading
30183001		Chemical Manufacturing General Processes Storage/Transfer
30201920		Food and Agriculture Vegetable Oil Processing Solvent Storage (Use 4-07-016-15 & -
30800109		Rubber and Miscellaneous Plastics Products Tire Manufacture Solvent Storage ** (Us
30800110		Rubber and Miscellaneous Plastics Products Tire Manufacture Solvent Storage (Use 4
30800803		Rubber and Miscellaneous Plastics Products Plastic Foam Products Bead Storage
31501001		Photographic Equipment Photocopying Equipment Manufacturing Resin Transfer/Storage
40200707		Surface Coating Operations Surface Coating Application - General Adhesive: Solvent
40201104		Surface Coating Operations Fabric Coating/Printing Coating Storage (Also See Speci
40201304		Surface Coating Operations Paper Coating Coating Storage
40201404		Surface Coating Operations Large Appliances Coating Storage
40201504		Surface Coating Operations Magnet Wire Surface Coating Coating Storage
40201604		Surface Coating Operations Automobiles and Light Trucks Coating Storage
40201704		Surface Coating Operations Metal Can Coating Coating Storage
40201804		Surface Coating Operations Metal Coil Coating Solvent Storage (Use 4-07-004-01 thr
40201904		Surface Coating Operations Wood Furniture Surface Coating Coating Storage
40202004		Surface Coating Operations Metal Furniture Operations Coating Storage
40202104		Surface Coating Operations Flatwood Products Coating Storage
40202204		Surface Coating Operations Plastic Parts Coating Storage
40202304		Surface Coating Operations Large Ships Coating Storage
40202404		Surface Coating Operations Large Aircraft Coating Storage
40202504		Surface Coating Operations Miscellaneous Metal Parts Coating Storage
40202604		Surface Coating Operations Steel Drums Coating Storage
40500701		Printing/Publishing General Solvent Storage
40700401	- 40799998	Organic Chemical Storage
42500201		Fixed Roof Tanks (500 Bbl Size) Breathing Loss
49000201		Organic Solvent Evaporation Waste Solvent Recovery Operations Storage Tank Vent
49000204		Organic Solvent Evaporation Waste Solvent Recovery Operations Solvent Spillage
49000205		Organic Solvent Evaporation Waste Solvent Recovery Operations Solvent Loading
Tier2 : 08	**Organic Chemical Transport**	
2515000000	- 2515040405	Storage & Transport Organic Chemical Transport
30101866		Chemical Manufacturing Plastics Production Packing/Shipping
30101884		Chemical Manufacturing Plastics Production Packing/Shipping (Polyurethane)
40899995	- 40899999	Organic Chemical Transportation Organic Chemical Transportation Specify Liquid
Tier2 : 09	**Inorganic Chemical Storage**	
2520000000	- 2520995040	Storage & Transport Inorganic Chemical Storage
30100804		Chemical Manufacturing Chloro-alkali Production Chlorine Loading: Storage Car Ven
30101198		Chemical Manufacturing Hydrochloric Acid Handling and Storage (99.9% Removal)
30101204		Chemical Manufacturing Hydroflouric Acid Fluorspar Handling Silos
30101205		Chemical Manufacturing Hydroflouric Acid Fluorspar Transfer
30102321		Chemical Manufacturing Sulfuric Acid (Contact Process) Storage Tank Vent
30102803	- 30102805	Chemical Manufacturing Chemical Manufacturing Normal Superphosphate
30102821		Chemical Manufacturing Normal Superphosphates Den
30102903	- 30102905	Chemical Manufacturing Chemical Manufacturing Triple Superphosphate
30102921		Chemical Manufacturing Triple Superphosphate Den
30103554		Chemical Manufacturing Inorganic Pigments Conveying/Storage/Packing
30104204		Chemical Manufacturing Lead Alkyl Manufacturing (Sodium/Lead Alloy Process) Sludge
30107002		Chemical Manufacturing Inorganic Chemical Manufacturing (General) Storage/Transfer
30121010		Chemical Manufacturing Caprolactum (Use 3-01-130 for Ammonium Sulfate By-product P
30187001	- 30188599	Chemical Manufacturing Inorganic Chemical Storage

Table 4.1-3. (continued)

Tier2 : 10 Inorganic Chemical Transport

2525000000	- 2525040040	Storage & Transport Inorganic Chemical Transport
30100803		Chemical Manufacturing Chloro-alkali Production Chlorine Loading: Tank Car Vent
30102320		Chemical Manufacturing Sulfuric Acid (Contact Process) Tank Car and Truck Unloadin

Tier2 : 11 Bulk Materials Storage

2530000000	- 2530050120	Storage & Transport Bulk Materials Storage
2650000004		Waste Disposal, Treatment, & Recovery Scrap & Waste Materials Scrap & Was
30200505	- 30200511	Food and Agriculture Food and Agriculture Feed and Grain Terminal Elevators
30200605	- 30200610	Food and Agriculture Food and Agriculture Feed and Grain Country Elevators
30200751		Food and Agriculture Grain Millings Wet Corn Milling: Grain Receiving
30200755		Food and Agriculture Grain Millings Wet Corn Milling: Bulk Loading
30200771		Food and Agriculture Grain Millings Rice: Grain Receiving
30200781		Food and Agriculture Grain Millings Soybean: Grain Receiving
30200791		Food and Agriculture Grain Millings Soybean: Bulk Loading
30200802		Food and Agriculture Feed Manufacture Grain Receiving
30200803		Food and Agriculture Feed Manufacture Shipping
30203105	- 30203111	Food and Agriculture Food and Agriculture Export Grain Elevators
30300003		Primary Metal Production Aluminum Ore (Bauxite) Fine Ore Storage
30300305		Primary Metal Production By-product Coke Manufacturing Coal Unloading
30300309		Primary Metal Production By-product Coke Manufacturing Coal Conveying
30300316		Primary Metal Production By-product Coke Manufacturing Coal Storage Pile
30300613		Primary Metal Production Ferroalloy, Open Furnace Raw Material Storage
30300614		Primary Metal Production Ferroalloy, Open Furnace Raw Material Transfer
30300804		Primary Metal Production Iron Production (See 3-03-015 for Integrated Iron & Steel
30300805		Primary Metal Production Iron Production (See 3-03-015 for Integrated Iron & Steel
30300809	- 30300812	Primary Metal Production Iron Production
30300820	- 30300823	Primary Metal Production Iron Production
30300827		Primary Metal Production Iron Production (See 3-03-015 for Integrated Iron & Steel
30300841		Primary Metal Production Iron Production (See 3-03-015 for Integrated Iron & Steel
30300842		Primary Metal Production Iron Production (See 3-03-015 for Integrated Iron & Steel
30300915		Primary Metal Production Steel Manufacturing (See 3-03-015 for Integrated Iron & S
30301011	- 30301013	Primary Metal Production Primary Metal Production Lead Production
30301016		Primary Metal Production Lead Production Sinter Transfer
30301026		Primary Metal Production Lead Production Sinter Dump Area
30302304		Primary Metal Production Taconite Iron Ore Processing Ore Transfer
30302305		Primary Metal Production Taconite Iron Ore Processing Ore Storage
30302307		Primary Metal Production Taconite Iron Ore Processing Bentonite Storage
30302309		Primary Metal Production Taconite Iron Ore Processing Traveling Grate Feed
30302310		Primary Metal Production Taconite Iron Ore Processing Traveling Grate Discharge
30302316		Primary Metal Production Taconite Iron Ore Processing Pellet Transfer
30303009		Primary Metal Production Zinc Production Raw Material Handling and Transfer
30303012		Primary Metal Production Zinc Production Raw Material Unloading
30400356		Secondary Metal Production Grey Iron Foundries Sand Silo
30400357		Secondary Metal Production Grey Iron Foundries Conveyors/Elevators
30400721		Secondary Metal Production Steel Foundries Sand Silo
30400723		Secondary Metal Production Steel Foundries Conveyors/Elevators
30500203		Mineral Products Asphalt Concrete Storage Piles
30500303		Mineral Products Brick Manufacture Storage of Raw Materials
30500406		Mineral Products Calcium Carbide Circular Charging: Conveyor
30500607		Mineral Products Cement Manufacturing (Dry Process) Raw Material Unloading
30500608		Mineral Products Cement Manufacturing (Dry Process) Raw Material Piles
30500612		Mineral Products Cement Manufacturing (Dry Process) Raw Material Transfer
30500615		Mineral Products Cement Manufacturing (Dry Process) Clinker Piles
30500616		Mineral Products Cement Manufacturing (Dry Process) Clinker Transfer
30500618		Mineral Products Cement Manufacturing (Dry Process) Cement Silos
30500619		Mineral Products Cement Manufacturing (Dry Process) Cement Load Out
30500707		Mineral Products Cement Manufacturing (Wet Process) Raw Material Unloading
30500708		Mineral Products Cement Manufacturing (Wet Process) Raw Material Piles
30500712		Mineral Products Cement Manufacturing (Wet Process) Raw Material Transfer
30500715		Mineral Products Cement Manufacturing (Wet Process) Clinker Piles
30500716		Mineral Products Cement Manufacturing (Wet Process) Clinker Transfer
30500718		Mineral Products Cement Manufacturing (Wet Process) Cement Silos
30500719		Mineral Products Cement Manufacturing (Wet Process) Cement Load Out
30500803		Mineral Products Ceramic Clay/Tile Manufacture Raw Material Storage
30500905		Mineral Products Clay and Fly Ash Sintering Raw Clay/Shale Transfer/Conveying
30500906		Mineral Products Clay and Fly Ash Sintering Raw Clay/Shale Storage Piles

Table 4.1-3. (continued)

30500910		Mineral Products Clay and Fly Ash Sintering Expanded Shale Storage
30501008		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Unloadi
30501009		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Raw Coa
30501011		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Coal Tr
30501014	- 30501016	Mineral Products Coal Cleaning Material Handling
30501021		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Overbur
30501023		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Loading
30501030		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Topsoil
30501032		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Topsoil
30501033		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Overbur
30501036	- 30501038	Mineral Products Mineral Products Surface Mining Operations
30501040	- 30501043	Mineral Products Mineral Products Surface Mining Operations
30501048		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Overbur
30501106	- 30501111	Mineral Products Mineral Products Concrete Batching
30501114		Mineral Products Concrete Batching Transferring: Conveyors/Elevators
30501115		Mineral Products Concrete Batching Storage: Bins/Hoppers
30501221		Mineral Products Fiberglass Manufacturing Raw Material: Unloading/Conveying
30501222		Mineral Products Fiberglass Manufacturing Raw Material: Storage Bins
30501504		Mineral Products Gypsum Manufacture Conveying
30501508	- 30501510	Mineral Products Mineral Products Gypsum Manufacture
30501514		Mineral Products Gypsum Manufacture Storage Bins: Stucco
30501518		Mineral Products Gypsum Manufacture Mixers/Conveyors
30501607		Mineral Products Lime Manufacture Raw Material Transfer and Conveying
30501608		Mineral Products Lime Manufacture Raw Material Unloading
30501610		Mineral Products Lime Manufacture Raw Material Storage Piles.
30501613	- 30501615	Mineral Products Mineral Products Lime Manufacture
30501903		Mineral Products Phosphate Rock Transfer/Storage
30501904		Mineral Products Phosphate Rock Open Storage
30502007		Mineral Products Stone Quarrying - Processing (See also 305320) Open Storage
30502106		Mineral Products Salt Mining Conveying
30502502		Mineral Products Construction Sand and Gravel Aggregate Storage
30502503		Mineral Products Construction Sand and Gravel Material Transfer and Conveying
30502505	- 30502507	Mineral Products Mineral Products Sand/Gravel
30503104	- 30503107	Mineral Products Mineral Products Asbestos Mining
30503110		Mineral Products Asbestos Mining Stockpiling
30503111		Mineral Products Asbestos Mining Tailing Piles
30504020	- 30504023	Mineral Products Mineral Products Mining & Quarrying of Nonmetallic Minerals
30504025		Mineral Products Mining and Quarrying of Nonmetallic Minerals Stockpiling
30504036		Mineral Products Mining and Quarrying of Nonmetallic Minerals Tailing Piles
30510001	- 30510599	Mineral Products Mineral Products
30510604		Mineral Products Bulk Materials Screening/Size Classification Coke
30703001		Pulp and Paper and Wood Products Miscellaneous Wood Working Operations Wood Waste
30703002		Pulp and Paper and Wood Products Miscellaneous Wood Working Operations Wood Waste
Tier2 : 12 Bulk Materials Transport		
2535000000	- 2535030140	Storage & Transport Bulk Materials Transport
30200711		Food and Agriculture Grain Millings Durum Milling: Grain Receiving
30200721		Food and Agriculture Grain Millings Rye: Grain Receiving
30200731		Food and Agriculture Grain Millings Wheat: Grain Receiving
30200741		Food and Agriculture Grain Millings Dry Corn Milling: Grain Receiving
30501044		Mineral Products Coal Mining, Cleaning, and Material Handling (See 305310) Train L
31100203		Building Construction Demolitions/Special Trade Contracts Debris Loading
31100204		Building Construction Demolitions/Special Trade Contracts Debris Loading
Tier 1 : 10 WASTE DISPOSAL & RECYCLING		
Tier2 : 01 Incineration		
2601000000	- 2601030000	Waste Disposal, Treatment, & Recovery On-Site Incineration
30101015		Chemical Manufacturing Explosives (Trinitrotoluene) Batch Process: Red Water Incin
30101023		Chemical Manufacturing Explosives (Trinitrotoluene) Continuous Process: Red Water
31307001		Electrical Equipment Electrical Windings Reclamation Single Chamber Incinerator/Ov
31307002		Electrical Equipment Electrical Windings Reclamation Multiple Chamber Incinerator/
31401001		Transportation Equipment Brake Shoe Debonding Single Chamber Incinerator
31401002		Transportation Equipment Brake Shoe Debonding Multiple Chamber Incinerator
49000203		Organic Solvent Evaporation Waste Solvent Recovery Operations Incinerator Stack
50100101	- 50100103	Solid Waste Disposal Government Municipal Incineration
50100104		Solid Waste Disposal - Government Municipal Incineration Mass Burn Refractory Wall
50100105		Solid Waste Disposal - Government Municipal Incineration Mass Burn Waterwall Combu

Table 4.1-3. (continued)

50100505	- 50100517	Solid Waste Disposal Government Other Incineration
50200101	- 50200105	Solid Waste Disposal Commercial/Institutional Incineration: General
50200205		Solid Waste Disposal - Commercial/Institutional Open Burning Weeds
50200301	- 50200507	Solid Waste Disposal Commercial/Institutional
50300101	- 50300109	Solid Waste Disposal Industrial Incineration
50300501		Solid Waste Disposal - Industrial Incineration Hazardous Waste
50300503		Solid Waste Disposal - Industrial Incineration Hazardous Waste Incinerators: Liqu
50300505		Solid Waste Disposal - Industrial Incineration Hazardous Waste Incinerators: Mult
50300506		Solid Waste Disposal - Industrial Incineration Sludge
Tier2 : 02 Open Burning		
2610000000	- 2610030000	Waste Disposal, Treatment, & Recovery Open Burning
50100201		Solid Waste Disposal - Government Open Burning Dump General Refuse
50100202		Solid Waste Disposal - Government Open Burning Dump Vegetation Only
50200201		Solid Waste Disposal - Commercial/Institutional Open Burning Wood
50200202		Solid Waste Disposal - Commercial/Institutional Open Burning Refuse
50300201	- 50300205	Solid Waste Disposal Industrial Open Burning
Tier2 : 03 POTW		
2630000000		Waste Disposal, Treatment, & Recovery Wastewater Treatment All Categories
2630020000		Waste Disposal, Treatment, & Recovery Wastewater Treatment Public Owned
50100701	- 50100704	Solid Waste Disposal Government Sewage Treatment
50100793		Solid Waste Disposal - Government Sewage Treatment POTW: Sludge Drying Bed
Tier2 : 04 Industrial Waste Water		
2630010000		Waste Disposal, Treatment, & Recovery Wastewater Treatment Industrial To
30182001	- 30182003	Chemical Manufacturing Chemical Manufacturing General Processes
31000506		Oil and Gas Production Liquid Waste Treatment Oil-Water Separation Wastewater Hold
50300702		Solid Waste Disposal - Industrial Liquid Waste Waste Treatment: General
68182599		Consumer Product Manufacturing Facilities Wastewater, Points of Generation Specify
68282599		Miscellaneous Processes Wastewater, Points of Generation Specify Point of Generati
Tier2 : 05 TSDF		
2640000000	- 2640020004	Waste Disposal, Treatment, & Recovery TSDFs
50300801	- 50300899	Solid Waste Disposal Industrial Treatment, Storage, Disposal Facilities
Tier2 : 06 Landfills		
2620000000	- 2620030000	Waste Disposal, Treatment, & Recovery Landfills
50100401		Solid Waste Disposal - Government Landfill Dump Unpaved Road Traffic
50100410		Solid Waste Disposal - Government Landfill Dump Waste Gas Destruction: Waste Gas
50200601		Solid Waste Disposal - Commercial/Institutional Landfill Dump Waste Gas Flares **
50200602		Solid Waste Disposal - Commercial/Institutional Landfill Dump Municipal: Fugitive
50300601	- 50300603	Solid Waste Disposal Industrial Landfill Dump
Tier2 : 07 Other		
2630030000		Waste Disposal, Treatment, & Recovery Wastewater Treatment Residential/Su
2650000000	- 2650000003	Waste Disposal, Treatment, & Recovery Scrap & Waste Materials Scrap & Waste
2660000000		Waste Disposal, Treatment, & Recovery Leaking Underground Storage Tanks L
50100402		Solid Waste Disposal - Government Landfill Dump Fugitive Emissions
50100601	- 50100604	Solid Waste Disposal Government Fire Fighting
50200901		Solid Waste Disposal - Commercial/Institutional Asbestos Removal General
50282599		Solid Waste Disposal - Commercial/Institutional Wastewater, Points of Generation S
50300701		Solid Waste Disposal - Industrial Liquid Waste General
50300901		Solid Waste Disposal - Industrial Asbestos Removal General
50390002		Solid Waste Disposal - Industrial Auxillary Fuel/No Emissions Coal
50400101		Site Remediation General Processes Fixed Roof Tanks: Breathing Loss
50400102		Site Remediation General Processes Fixed Roof Tanks: Working Loss
50400103		Site Remediation General Processes Float Roof Tanks: Standing Loss
50400104		Site Remediation General Processes Float Roof Tanks: Withdrawal Loss
50400150		Site Remediation General Processes Storage Bins
50400151		Site Remediation General Processes: Liquid Waste: General: Transfer
50400301		Site Remediation General Processes Open Refuse Stockpiles : General
50400320		Site Remediation General Processes Storage Bins - Solid Waste
50410310		Site Remediation In Situ Venting/Venting of Soils Active Aeration
50410311		Site Remediation In Situ Venting/Venting of Soils Active Aeration: Vacuum
50410312		Site Remediation In Situ Venting/Venting of Soils Active Aeration, Vacuum: Vapor
50410313		Site Remediation In Situ Venting/Venting of Soils Active Aeration, Vacuum: Vacuum
50410405		Site Remediation Air Stripping of Groundwater Oil/Water Separator
50410408		Site Remediation Air Stripping of Groundwater Treatment Tanks
50410420		Site Remediation Air Stripping of Groundwater Air Stripping Tower
50410530		Site Remediation Thermal Destruction Combustion Unit

50410562 Site Remediation Thermal Destruction Waste Disposal: Chemical Stabilization
50410610 Site Remediation Thermal Desorption Pretreatment
50410622 Site Remediation Thermal Desorption Thermal Desorber: Kiln
50410645 Site Remediation Thermal Desorption Wastes: Containers
50490004 Site Remediation General Processes Incinerators: Process Gas

Tier 1 : 11 HIGHWAY VEHICLES

Tier2 : 01 Light-Duty Gas Vehicles & Motorcycles

2201001000 - 2201001334 Mobile Sources Highway Vehicles - Gasoline Light Duty Gasoline Vehicles (LDGV)
2201080000 - 2201080334 Mobile Sources Highway Vehicles - Gasoline Motorcycles (MC)

Tier2 : 02 Light-Duty Gas Trucks

2201020000 - 2201060334 Mobile Sources Highway Vehicles - Gasoline

Tier2 : 03 Heavy-Duty Gas Vehicles

2201070000 - 2201070334 Mobile Sources Highway Vehicles - Gasoline (HDGV)

Tier2 : 04 Diesels

2230001000 - 2230070334 Mobile Sources Highway Vehicles - Diesel

Tier 1 : 12 OFF-HIGHWAY

Tier2 : 01 Non-Road Gasoline

2260000000 - 2265008010 Mobile Sources
2282005000 - 2282020025 Mobile Sources Marine Vessels, Recreational
26000320 Off-highway 2-stroke Gasoline Engines Industrial Equipment Industrial Fork Lift: G

Tier2 : 02 Non-Road Diesel

2270000000 - 2270008010 Mobile Sources Off-Highway Vehicle Diesel

Tier2 : 03 Aircraft

2275000000 - 2275070000 Mobile Sources Aircraft

Tier2 : 04 Marine Vessels

2280001000 - 2280004040 Mobile Sources Marine Vessels, Commercial
2283000000 - 2283004020 Mobile Sources Marine Vessels, Military

Tier2 : 05 Railroads

2285002000 - 2285002010 Mobile Sources Railroads Diesel

Tier 1 : 13 NATURAL SOURCES

Tier2 : 01 Biogenic

2701000000 - 2701480000 Natural Sources Biogenic
2740020000 - 2740040010 Natural Sources Miscellaneous

Tier2 : 02 Geogenic

2730001000 - 2730100001 Natural Sources Geogenic

Tier2 : 03 Miscellaneous

2740001000 Natural Sources Miscellaneous Lighting Total

Tier 1 : 14 MISCELLANEOUS

Tier2 : 01 Agriculture & Forestry

2307010000 Industrial Processes Wood Products: SIC 24 Logging Operations Total
2801000001 - 2801000008 Miscellaneous Area Sources Agriculture Production - Crops Agriculture - Crops
2805000000 - 2805015001 Miscellaneous Area Sources Agriculture Production - Livestock

Tier2 : 02 Other Combustion

2801500000 Miscellaneous Area Sources Agriculture Production - Crops Agricultural Fi
2801520000 Miscellaneous Area Sources Agriculture Production - Crops Orchard Heaters
2810001000 - 2810050000 Miscellaneous Area Sources Other Combustion
30101030 Chemical Manufacturing Explosives (Trinitrotoluene) Open Burning: Waste

Tier2 : 03 Catastrophic/Accidental Releases

2275900103 Mobile Sources Aircraft Refueling: All Fuels Spillage
2830000000 - 2830010000 Miscellaneous Area Sources Catastrophic/Accidential Releases

Tier2 : 04 Repair Shops

2840000000 - 2841010050 Miscellaneous Area Sources

Tier2 : 05 Health Services

2850000000 - 2850000030 Miscellaneous Area Sources Health Services Hospitals
31502001 - 31502089 Health Services Health Services Hospitals

Tier2 : 06 Cooling Towers

2820000000 - 2820020000 Miscellaneous Area Sources Cooling Towers
38500101 - 38500210 Cooling Tower Cooling Tower

Tier2 : 07 Fugitive Dust

4.2 FUEL COMBUSTION - ELECTRIC UTILITY

The emissions from the combustion of fuel by electric utilities have been divided into two classifications: (1) steam generated fossil-fuel units (boiler) and (2) nonsteam generated fossil-fuel units such as gas turbines (GT) and internal combustion (IC) engines. Two very different methodologies have been used to estimate the emissions for these two classes; each is described separately in this report. The fossil-fuel steam generated methodology is described in this section; the GT and IC methodology is described in section 4.3.

The emissions from fossil-fuel steam electric utility units for the years 1985 through 1995 have been based on five basic factors: (1) fuel consumption, (2) emission factor, which relates the quantity of fuel consumed to the quantity of pollutant emitted, (3) fuel characteristics, such as sulfur content, ash content, and heating value of fuels, (4) control efficiency, which indicates the percent of pollutant emissions not removed through control methods, and (5) rule effectiveness (which, according to EPA, is the measure of the ability of a regulatory program to achieve all the emissions reductions that could be achieved by full compliance with the applicable regulations at all sources at all times). The fuel consumption characteristics and control efficiencies are obtained at the boiler-level, while the emission factors are specified at the SCC-level. The 1996 emissions and heat input are extrapolated from the 1995 boiler-level emissions based on the ratio of plant-level 1996 fuel consumption to 1995 fuel consumption.

The fossil-fuel steam electric utility emissions that are reported in the Trends Data Bases include VOC, NO_x, CO, SO_2, PM-10, and PM-2.5. Since there are no known utility emission factors for either NH_3 or sulfates (SO_4), they are not estimated. It should also be noted that these estimates do not include emissions from the combustion of anthracite coal because it accounts for a very small percentage (< 1 percent) of the overall emissions from fuel combustion by fossil-fuel steam electric utility units.

4.2.1 1985-1995 Steam Electric Utility Emission Inventories

The Energy Information Administration (EIA) of the Department of Energy (DOE) collects monthly boiler-level data on a yearly basis using Form EIA-767 (*Steam-Electric Plant Operation and Design Report*[1]). The EIA also collects plant-level fossil-fuel steam data from all electric utility plants filing Form EIA-759 (*Monthly Power Plant Report*[2]). Currently, Form EIA-767 data are available for the years 1985 through 1995, while Form EIA-759 data are available through the year 1996. The fossil-fuel steam electric utility component of the Trends emission inventories for 1985 through 1996 includes data derived from these two forms. These steam components include data from fossil-fuel steam boilers and not data from GT or IC engines (which account for a very small share of electric utility fuel use and corresponding emissions) unless they report it to EIA.

The steam emission inventory data for 1985 through 1995 are initially based on the aggregated monthly electric utility steam boiler-level data from Form EIA-767. All plants of at least 10 megawatts (MW) that have at least one operating boiler are required to provide this information to EIA, although the amount of data required from plants with less than 100 MW of steam-electric generating capacity is not as extensive as the amount required by those plants of at least 100 MW. For plants with a nameplate rating from 10 MW to less than 100 MW, only selected pages of the Form EIA-767, with ID, boiler fuel quantity and quality, and flue gas desulfurization (FGD) information, must be completed. Other sources of data for NO_x, SO_2 and heat input are used in place of the EIA/AP-42 calculated data when the data are known to be better; the sources are summarized in Table 4.2-1.

NO_x and SO_2 emissions as well as heat input are also available for affected acid rain utility boilers beginning in 1995 (the data are also available for Phase 1 units for 1994) from the Emissions Tracking System/Continuous Emissions Monitoring (ETS/CEM).[3] These data are also included in the 1994 through 1996 Trends fossil-fuel steam electric utility components.

4.2.1.1 Processing Computerized Raw Data

The basis for the fossil-fuel-fired steam electric utility component of the Emission Trends inventory is the reported primary utility data collected by EIA. The data from these EIA forms are transferred to data tapes that are not initially serviceable to the public. E.H. Pechan & Associates, Inc. (Pechan) has developed customized computer code to process these data and to account for the various characteristics of the data tapes.

4.2.1.1.1 Form EIA-767 —

Form EIA-767 data are reported by the operating utility for each plant with fossil-fuel steam boilers of 10 MW or greater. The written form is designed so that information for each plant is reported on separate pages that relate to different levels of data. The relevant data levels are as follows:

- Plant-level: One page for delineating the plant configuration, which establishes the number of boilers and the IDs for each boiler, as well as the associated generator(s), FGD unit(s) (SO_2 scrubbers), flue gas particulate collectors, flue(s) and stack(s). These do not necessarily have a one-to-one correspondence.

- Boiler-level: One page per boiler for monthly fuel consumption and quality data (for coal, oil, gas, and other), one page for regulatory data, and one page for design parameters.

- Generator-level: One page for generation and capacity data relating to up to five generators.

- FGD-level: One page for up to five FGD units for annual operating data and one page for each FGD unit for design parameter data.

- Flue gas particulate collector-level: One page each for (up to five) collectors with annual operating data and design specifications.

- Flue- and stack-level: One page per flue-stack for design parameter data.

Processing Form EIA-767 is accomplished in a series of steps aimed at converting the computerized data into data base form. Each "page" format is reproduced on the computer file exactly as it appears on the written page of the form. The data from each "page" must be extracted from the computer file, associated with the correct boiler, and combined with all corresponding data from the other pages for that boiler.

For example, fuel-related boiler data — monthly values for each fuel burned, along with the fuel's associated sulfur, ash, and heat content — are reported on page six. However, only coal, oil, and gas data are processed. These data must be aggregated for each fuel in order to produce annual estimates for each boiler before they are combined with the other data (such as control devices and efficiencies, plant location data, associated generator generation, and associated stack parameters).

After SCCs are assigned to each boiler's (possible three) reported fuels in a given plant, the SCC-specific data are then separated so that each data base record is on the plant-boiler-SCC level.

4.2.1.1.2 Form EIA-759 —

Form EIA-759 data are also processed in a series of steps, using a less intricate method, since the data for each plant are not reported at the boiler level, but instead are reported by prime mover (e.g., steam, hydro, IC, GT, combined cycle) and fuel type.

For each plant-prime mover combination (in this case, for the steam prime mover), plant ID data, as well as monthly fuel-specific generation and consumption data, are reported. The monthly plant steam prime mover data are aggregated to annual estimates for each fuel (that has been categorized as coal, residual oil, distillate oil, natural gas, or other) and combined to produce a single annual steam plant-level data observation. (Beginning in 1996, only annual, not monthly data, are collected for small plants, so the intermediate aggregation of monthly data is unnecessary.)

Since no actual 1996 data are presently available, these Form EIA-759 data were used to "grow" the 1995 fuel and emissions data for 1996, as described later in Section 4.2.2.

4.2.1.2 Emissions Algorithms

Data that were not obtained directly from the computerized data files (or converted to other measurement units) were developed by Pechan using algorithms that have been utilized since the 1980s. These variables include boiler capacity, SCC, heat input, pollutant emissions, and NO_x control efficiency.

Although generator nameplate capacity is reported on Form EIA-767, when there is not a one-to-one correspondence between boiler and generator (a multiheader situation -- for example, if one boiler is associated with two or more generators or if several boilers are reciprocally associated with several generators), this information in its present form cannot be used to represent the boiler size. Thus, a boiler design capacity variable (in MMBtu/hr) has been developed based on the reported maximum continuous steam flow at 100 percent load (in thousand pounds per hour) by multiplying the steam flow value by a units conversion of 1.25 to obtain boiler capacity,.

Emission factors from AP-42[4] were used in calculating emissions. The emission factor used depends upon the SCC and pollutant, as explained below.

- The appropriate SCC is assigned to each source based on its fuel and boiler characteristics. For sources using 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 by AP-42. If both coal and oil were burned in the same boiler, it is assumed that the oil is distillate;

otherwise, it is assumed to be residual. Based on the fuel and boiler type, the SCC is assigned. See Table 4.2-2 for a complete list of the relationships among fuel type, firing type, bottom type, and SCC.

Since the control efficiencies for NO_x, PM-10, and PM-2.5 were not available from the EIA-767 form, control efficiencies were derived using the following methods:

- NO_x control efficiency is based on the assumption that the unit would be controlled so that its emission rate would equal its emission limit, expressed on an annual equivalent basis. After calculating the heat input, controlled emissions assuming compliance with the applicable standard is back-calculated. After calculating the uncontrolled NO_x emissions, the presumed net control efficiency is calculated.

- Since only TSP control efficiency is reported on Form EIA-767, the PM-10 Calculator[5] was used to derive PM-10 and PM-2.5 control efficiencies. (The PM-10 Calculator estimates PM-10 and PM-2.5 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, where available).

The SO_2 emissions were computed as controlled emissions assuming 100 percent rule effectiveness and using the sulfur content of the fuel as specified in the EIA-767 data. The PM-10 and PM-2.5 emissions were computed as controlled emissions assuming 100 percent rule effectiveness. The ash content of the fuel used to calculate uncontrolled PM-10 and PM-2.5 emissions was also specified in the EIA-767 data. The NO_x emissions were computed as controlled emissions assuming 80 percent rule effectiveness from 1985-1994; beginning with 1995, NO_x rule effectiveness is assumed to be 100 percent. The CO and VOC emissions were calculated as uncontrolled emissions. The algorithms to compute emissions are presented in Table 4.2-3.

In 1997, PM condensible draft emission factors for utility units based on broad fuel categories, rather than SCC, were developed by EPA, with complete emission factors expected to be finalized in October 1998. Thus, beginning with the 1990 file, PM condensible, as well as total PM-10 and total PM-2.5, emissions were calculated using the following equations:

$$PMCD_{SCC} = HTI_{SCC} \times EF_f \times \frac{1}{2000}$$
$$TOTPM10_{SCC} = PM10 + PMCD$$
$$TOTPM25_{SCC} = PM25 + PMCD$$

where:

where:	PM	=	particulate matter (in tons)
	$PMCD$	=	PM condensible emissions (in tons)
	HTI	=	heat input (in MMBtu)
	EF_f	=	fuel-specific PM condensible emission factor (in lbs/MMBtu): coal = .03, residual oil = .02, distillate oil = .01, natural gas = .003

Since 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, many values are missing for these situations. Most data elements are assigned a default value of zero;

however, 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 types are assigned. In the past, there have been discrepancies in the boiler bottom and firing type data as reported to EIA and EPA/Acid Rain Division (ARD). Based on a coördinated effort in 1996, all differences in bottom and firing types for coal boilers have been resolved and updated in the files for the years beginning with 1990.

4.2.1.3 National Allowance Data Base (NADB) SO_2 Emissions and Heat Input

The 1985 SO_2 emissions and heat input that were calculated from 1985 Form EIA-767 data were replaced by the corresponding boiler-level data (and disaggregated to the SCC level) from the National Allowance Data Base Version 2.11 (NADBV211).[6] These data underwent two public comment periods in 1991 and 1992 and are considered the best available data for 1985. Aggregations at the fuel levels (Tier 3) are approximations only and are based on the methodology described in Section 4.2.1.

4.2.1.4 1990-1994 Acid Rain Division (ARD) NO_x Rates

In 1996, ARD completed research on utility coal boiler-level NO_x rates. Most (about 90 percent) of the rates were based on relative accuracy tests performed in 1993 and 1994 as a requirement for continuous emissions monitor (CEM) certification, while the remaining boilers' rates were obtained from utility stack tests from various years. These coal boiler-specific NO_x rates are considered, on the whole, to be significantly better than those calculated by using EPA's NO_x AP-42 factors, which are SCC-category averages.

Thus, whenever the new NO_x rates were available, NO_x coal emissions were recalculated, at the coal SCC level, using the heat input (EIA's 767 fuel throughput multiplied by the fuel heat content) and adjusting units, according to the following equation:

$$NOXCOAL_{SCC} = NOXRT_{coal} \times HTI_{SCC} \times \frac{1}{2000}$$

where: NOXCOAL = NO_x emissions for the boiler coal SCC (in tons)
NOXRT = ARD's coal NO_x rate for the given boiler (in lbs/MMBtu)
HTI = heat input for the boiler's coal SCC (in MMBtu)

These new NO_x SCC-level coal emissions replaced the AP-42 calculated emissions for most of the coal SCCs in the 1990-1994 data bases.

4.2.1.5 1994 and 1995 ETS/CEM Data

Beginning January 1, 1994, under Title IV (Acid Deposition Control) of the Clean Air Act Amendments of 1990 (CAAA) Phase I affected utility units were required to report heat input, SO_2 and NO_x data to EPA. Beginning January 1, 1995, all affected units were required to report heat input and SO_2 emissions; most also had to report NO_x emissions, although some units received extensions until July 1, 1995 or January 1, 1996 for NO_x reporting.

Since the ETS/CEM data are actual, rather than estimated, data, if there were a complete set of annual SO_2 and/or NO_x emissions and/or heat input data available for 1994 and 1995 from ETS/CEM, those data values replaced the data estimated from EIA-767 data. This process involved the following steps:

- Aggregation of ETS/CEM hourly or quarterly data to annual data.
- Assignment of ETS/CEM data, reported on a monitoring stack or pipe level, to the boiler level.
- Matching the ETS/CEM boiler-level annual data to the processed EIA-767 annual data.
- Disaggregating the boiler-level ETS/CEM data to the boiler SCC level based on each SCC's fractional share of the boiler heat input, SO_2, and NO_x, respectively. The algorithms used are included in Table 4.2-4.

For those records in which the ETS/CEM heat input replaces the EIA-calculated value, the heat input will not equal the product of the EIA-reported fuel throughput and heat content.

4.2.1.6 Ozone Season Daily Emissions Data

The ozone season daily (OSD) emissions for 1990-1995 are estimated by considering the day to be a typical or average summer July day. These emissions for VOC, NO_x, CO, SO_2, PM-10, and PM-2.5 (ammonia and sulfates are zero) are calculated at the SCC level using the ratio of the Form EIA-767 July monthly to annual heat input, dividing it by 31, and then multiplying this value by the already calculated annual emissions, according to the following equation:

$$EOSD_{SCC} = \frac{HTIJUL_{SCC}}{31 \ x \ HTIANN_{SCC}} \ x \ EANN_{SCC}$$

where:	EOSD	=	Ozone season daily emissions for a given pollutant at the SCC level (in tons)
	HTIJUL	=	July monthly Form EIA-767 calculated heat input for the given boiler's SCC (in MMBtu)
	HTIANN	=	annual Form EIA-767 calculated heat input for the given boiler's SCC (in MMBtu)
	EANN	=	Trends annual emissions for a given pollutant at the SCC level (in tons) for that year

For the OSD for 1996, the 1996 projected annual Trends emissions is used, but the Form EIA-767 calculated 1995 July to annual heat input are used in the above equation (since the 1996 data are unknown).

4.2.2 1996 Steam Emission Inventory

The 1996 computerized fossil-fuel plant-level data from Form EIA-759 are used in conjunction with the 1995 fossil-fuel steam electric utility component to develop the 1996 steam emission inventory file, since the 1996 Form EIA-767 data are not available. The fuel quantity, heat input, and emissions values are grown by a factor based on the ratio of the 1996 Form EIA-759 plant-level, fuel-specific data to the data for 1995.

The 1996 steam inventory includes the same records that are in the 1995 file. That is, no new plants are added or subtracted from the 1995 steam inventory to produce the 1996 steam inventory. However, the 1996 Form EIA-759 plant-level data would reflect boiler retirement or additions for plants in 1996 and their fuel data would be incorporated in the growth ratios and would be reflected in the 1996 data for the other boilers in the plant. As a result, the 1996 figures should be considered to be preliminary estimates only.

4.2.3 Augmentation Process

The VOC emissions required an additional adjustment due to the underestimation of aldehydes which are not accounted for in the VOC emission factors for the following SCCs: 10100401, 10100404, 10100501, 10100601, and 10100604. The VOC emissions were augmented according to the methodology used in the Hydrocarbon Preprocessor (HCPREP) of the Flexible Regional Emissions Data System (FREDS).[7] This augmentation was performed on steam emission inventory for the years 1985 through 1995.

4.2.4 Sample Calculation

- 1995 boiler SCC data:

SCC	*thruput*	*heatcon*	*sulfcon*	*coneff4*
10100212	1300000	23.18 (*really* 23.1849046)	3.17 (*really* 3.1716)	89.30 (10.7)

emiss4	*htinpt*	*eiahti*	*eiaso2*	*emf4*	*so2ets*	*htiets*
93325590	31782453.38	30140376.00	8602.9316	39	9332.5590	31782453.38

- algorithm:

$$SO2_{coal} = \frac{coal\ tons * emission\ factor * sulfur\ content * (1 - control\ efficiency)}{2000}$$

- calculation:

$$SO2_{coal} = \frac{(1300000)\ (39)\ (3.1716)\ (1-.893)}{2000}$$

- result:

$$SO2_{coal} = 8602\ to\ nearest\ integer$$

But replace by 1995 *ETS/CEM* 9332.5590

Therefore $EIAS02 = 8603$ *and* $EMISS4\ (SO2_{coal}) = 9333$ *in the Inventory*

4.2.5 References

1. *Monthly Power Plant Report*, Form EIA-759, data files for 1990 - 1996, U.S. Department of Energy, Energy Information Administration, Washington, DC, 1997.

2. *Steam-Electric Plant Operation and Design Report*, Form EIA-767, data files for 1985-1995, U.S. Department of Energy, Energy Information Administration, Washington, DC, 1997.

3. *Acid Rain Program CEMS Submissions Instructions for Monitoring Plans, Certification Test Notifications, and Quarterly Reports*, U.S. Environmental Protection Agency, Washington, DC, May 1995.

4. *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Supplement D*, AP-42, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1991.

5. Dean, T. A. and P. Carlson, *PM-10 Controlled Emissions Calculator*. E.H. Pechan & Associates, Inc. Contract No. 68-D0-0120 Work Assignment No. II-81. Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC. April 27, 1993. (TTN CHIEF BBS)

6. *The National Allowance Data Base Version 2.11: Technical Support Document*, Acid Rain Division, Office of Atmospheric Programs, U.S. Environmental Protection Agency, Washington, DC, March 1993.

7. *The Flexible Regional Emissions Data System (FREDS) Documentation for the 1985 NAPAP Emission Inventory: Preparation for the National Acid Precipitation Assessment Program.* Appendix A. EPA-600/9-89-047. U.S. Environmental Protection Agency, Office of Research and Development, Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, May 1989.

Table 4.2-1. Boiler Emissions Data Sources for NO_x and SO_2 by Year

Year	NO_x	SO_2
1985	Calculated from EIA-767 data	NADBV311 data
1986	Calculated from EIA-767 data	Calculated from EIA-767 data
1987	Calculated from EIA-767 data	Calculated from EIA-767 data
1988	Calculated from EIA-767 data	Calculated from EIA-767 data
1989	Calculated from EIA-767 data	Calculated from EIA-767 data
1990	Overlaid ARD coal NO_x rate calculations when possible	Calculated from EIA-767 data
1991	Overlaid ARD coal NO_x rate calculations when possible	Calculated from EIA-767 data
1992	Overlaid ARD coal NO_x rate calculations when possible	Calculated from EIA-767 data
1993	Overlaid ARD coal NO_x rate calculations when possible	Calculated from EIA-767 data
1994	Overlaid ARD coal NO_x rate calculations when possible; overlaid ETS/CEM data when possible	Calculated from EIA-767 data
1995	Overlaid ETS/CEM data when possible	Overlaid ETS/CEM data when possible
1996	Grew from 1995 data using EIA-759 data	Grew from 1995 data using EIA-759 data

Table 4.2-2. Steam Electric Utility Unit Source Classification Code Relationships

Fossil-Fuel	Firing Type	Bottom Type	SCC
Coal			
Bituminous	No data	No data	10100202
		Wet	10100201
		Dry	10100202
	Wall*	No data	10100202
		Wet	10100201
		Dry	10100202
	Opposed	No data	10100202
		Wet	10100201
		Dry	10100202
	Tangential	No data	10100212
		Wet	10100201
		Dry	10100212
	Stoker	All	10100204
	Cyclone	All	10100203
	Fluidized Bed	N/A	10100217
Subbituminous	No data	No data	10100222
		Wet	10100221
		Dry	10100222
	Wall	No data	10100222
		Wet	10100221
		Dry	10100222
	Opposed	No data	10100222
		Wet	10100221
		Dry	10100222
	Tangential	No data	10100226
		Wet	10100221
		Dry	10100226
	Stoker	All	10100224
	Cyclone	All	10100223
Lignite	No data	All	10100301
	Wall	All	10100301
	Opposed	All	10100301
	Tangential	All	10100302
	Stoker	All	10100306
	Cyclone	All	10100303

Table 4.2-2. (continued)

Fossil-Fuel	Firing Type	Bottom Type	SCC
Residual Oil	No data	All	10100401
	Wall	All	10100401
	Opposed	All	10100401
	Tangential	All	10100404
	Stoker	All	10100401
	Cyclone	All	10100401
Distillate Oil	No data	All	10100501
	Wall	All	10100501
	Opposed	All	10100501
	Tangential	All	10100501
	Stoker	All	10100501
	Cyclone	All	10100501
Natural Gas	No data	All	10100601
	Wall	All	10100601
	Opposed	All	10100601
	Tangential	All	10100604
	Stoker	All	10100601
	Cyclone	All	10100601

*Wall firing includes front, arch, concentric, rear, side, vertical, and duct burner firing.

Table 4.2-3. Algorithms Used to Estimate Emissions from Electric Utility Boilers

$$E_{NO_x,SCC} = FC_{SCC} \times EF_{NO_x,SCC} \times (1 - (RE_{NO_x} * CE_{NO_x,b})) \times UCF$$

$$E_{PM\text{-}10 or PM\text{-}2.5,SCC} = FC_{SCC} \times EF_{PM\text{-}10 or PM\text{-}2.5,SCC} \times A_f \times (1 - CE_{PM\text{-}10 or PM\text{-}2.5,b}) \times UCF$$

$$E_{SO_2,SCC} = FC_{SCC} \times EF_{SO_2,SCC} \times S_f \times (1 - CE_{SO_2,b}) \times UCF$$

where:	E	=	estimated emission (in tons)
	FC	=	fuel consumption (in $unit_f$)
	EF	=	emission factor (in lbs/$unit_f$)
	S	=	sulfur content (expressed as a decimal)
	A	=	ash content (expressed as a decimal)
	RE	=	rule effectiveness (expressed as a decimal)
	CE	=	control efficiency (expressed as a decimal)
	b	=	boiler
	f	=	fuel type (coal, oil, gas)
	UCF	=	units conversion factor (1 ton/2000 lbs)
	$unit_{coal}$	=	tons burned
	$unit_{oil}$	=	1000 gallons burned
	$unit_{gas}$	=	million cubic feet burned

Table 4.2-4. Algorithms Used to Disaggregate ETS/CEM Boiler Data to the Boiler-SCC Level

$$CEMSO2_{SCC} = \left(\frac{767SO2_{SCC,b}}{767SO2_{b}} \right) X\ CEMSO2_{b}$$

$$CEMNOX_{SCC} = \left(\frac{767NOX_{SCC,b}}{767NOX_{b}} \right) X\ CEMNOX_{b}$$

$$CEMHTI_{SCC} = \left(\frac{767HTI_{SCC,b}}{767HTI_{b}} \right) X\ CEMHTI_{b}$$

where: ***b*** = boiler

CEMSO2, CEMNO$_x$, CEMHTI = ETS/CEM annual boiler data for given parameter

767SO2, 767NO$_x$, 767HTI = Form EIA-767-based calculated data for given parameter

4.3 INDUSTRIAL

The source categories under the "Industrial" heading include the following Tier 1 and Tier 2 categories:

Tier 1 Category	Tier 2 Category
FUEL COMBUSTION - INDUSTRIAL	All
CHEMICAL & ALLIED PRODUCT MANUFACTURING	All
METALS PROCESSING	All
PETROLEUM & RELATED INDUSTRIES	All
OTHER INDUSTRIAL PROCESSES	All
STORAGE & TRANSPORT	All
FUEL COMBUSTION - ELECTRIC UTILITY	Gas Turbines and Internal Combustion PM-10 area source
WASTE DISPOSAL & RECYCLING	All
MISCELLANEOUS	Health Services

The 1990 Interim Inventory emissions for these source categories were generated from both the non-utility point source and non-solvent area source portions of the 1985 National Acid Precipitation Assessment Program (NAPAP) Emissions Inventory. These 1990 emissions served as the base year from which the emissions for the years 1985 through 1989 were estimated. The emissions for the years 1985 through 1989 were estimated using historical data compiled by the Bureau of Economic Analysis (BEA)[1] or historic estimates of fuel consumption based on the DOE's State Energy Data System (SEDS).[2]

The 1990 NET emissions were revised to incorporate as much state- supplied data as possible. Sources of state data include the OTAG emission inventory, the GCVTC emission inventory, and AIRS/FS. For most non-utility point and non-mobile sources, these emissions were projected from the revised 1990 NET emission inventory to the years 1991 through 1996 using BEA and SEDS data. States were surveyed to determine whether EPA should project their 1990 non-utility point source emissions or extract them from AIRS/FS. For all states that selected AIRS/FS option, the emissions in the NET inventory reflect their AIRS/FS data for the years 1991 through 1995. Additional controls were added to the projected (or grown) emissions for the years 1995 and 1996.

Note that the sections describing the procedures used for the years 1985 through 1989 are specific to the source categories listed above. For the years 1990 through 1996, section 4.3 describes the methodology for the above listed sources categories as well as the source categories described in sections 4.4 - Other Combustion, 4.5 - Solvent Utilization, and 4.7 - Non-road Mobile. This is being done for the draft report only. In the final version of this document, sections will contain only source category-specific information.

4.3.1 1990 Interim Inventory

The 1985 NAPAP Emission Inventory estimates for the **point** sources have been projected to the year 1990 based on the growth in BEA historic earnings for the appropriate state and industry, as identified by the two-digit SIC code. In order to remove the effects of inflation, the earnings data were converted to 1982 constant dollars using the implicit price deflator for personal consumption expenditures (PCE).[3] State and SIC-level growth factors were calculated as the ratio of the 1990 earnings data to the 1985 earnings data. Additional details on point source growth indicators ares presented in section 4.3.2.1.

The **area** source emissions from the 1985 NAPAP Emission Inventory have been projected to the year 1990 based on BEA historic earnings data, BEA historic population data, DOE SEDS data, or other growth indicators. The specific growth indicator was assigned based on the source category. The BEA earnings data were converted to 1982 dollars as described above. The 1990 SEDS data were extrapolated from data for the years 1985 through 1989. All growth factors were calculated as the ratio of the 1990 data to the 1985 data for the appropriate growth indicator. Additional details on area source growth indicators are presented in section 4.3.2.2.

When creating the 1990 emission inventory, changes were made to emission factors, control efficiencies, and emissions from the 1985 inventory for all sources. The PM-10 control efficiencies were obtained from the *PM-10 Calculator*.[4] In addition, rule effectiveness, which was not applied in the 1985 NAPAP Emission Inventory, was applied to the 1990 emissions estimated for the point sources. The CO, NO_x, and VOC point source controls were assumed to be 80 percent effective; PM-10 and SO_2 controls were assumed to be 100 percent effective.

The 1990 emissions for CO, NO_x, SO_2, and VOC were calculated using the following steps: (1) projected 1985 controlled emissions to 1990 using the appropriate growth factors, (2) calculated the uncontrolled emissions using control efficiencies from the 1985 NAPAP Emission Inventory, and (3) calculated the final 1990 controlled emissions using revised control efficiencies and the appropriate rule effectiveness. The 1990 PM-10 emissions were calculated using the TSP emissions from the 1985 NAPAP Emission Inventory. The 1990 uncontrolled TSP emissions were estimated in the same manner as the other pollutants. The 1990 uncontrolled PM-10 estimates were calculated from these TSP emissions by applying SCC-specific uncontrolled particle size distribution factors.[5] The controlled PM-10 emissions were estimated in the same manner as the other pollutants. Because the majority of area source emissions for all pollutants represented uncontrolled emissions, the second and third steps were not required to estimate the 1990 area source emissions.

4.3.1.1 Control Efficiency Revisions

In the 1985 NAPAP point source estimates, control efficiencies for VOC, NO_x, CO, and SO_2 sources in Texas were judged to be too high for their process/control device combination. These high control efficiencies occurred because Texas did not ask for control efficiency information, and simply applied the maximum efficiency for the reported control device.[6] High control efficiencies lead to high future growth in modeling scenarios based on uncontrolled emissions (which are based on the control efficiency and reported actual emissions). High control efficiencies also lead to extreme increases in emissions when rule effectiveness is incorporated.

Revised VOC control efficiencies were developed for Texas for the Emission Reduction and Cost Analysis Model for VOC (ERCAM-VOC).[7] For this analysis, revised efficiencies were also developed by SCC and control device combination for NO_x, SO_2, and CO using engineering judgement. These revised control efficiencies were applied to sources in Texas. A large number of point sources outside of

Texas had VOC and CO control efficiencies that were also judged to be too high. The VOC and CO control efficiencies used for Texas were also applied to these sources.

Control efficiencies not applied in the 1985 NAPAP Emission Inventory were incorporated in the data files for VOC emissions from gasoline marketing (Stage I and vehicle refueling) were incorporated in the data files for VOC emissions from gasoline marketing (Stage I and vehicle refueling) and bulk gasoline plants and terminals, since many areas already have regulations in place for controlling Stage I and Stage II gasoline marketing emissions. Many current state regulations require the use of Stage I controls (except at small volume service stations) to reduce emissions by 95 percent. Emissions were revised to reflect these controls in areas designated as having these requirements as part of their SIPs.[8] Stage II vapor recovery systems are estimated to reduce emissions by 84 percent.[9] Stage II controls are already in place in the District of Columbia, St. Louis, Missouri, and parts of California. Stage II controls also reduce underground tank breathing/emptying losses. Emissions in these area were revised to reflect these controls.

Gasoline bulk plants and terminals are covered by existing Control Techniques Guidelines (CTGs) and are included in many state regulations. Emissions were revised to reflect these controls in areas with regulations.[8] Control efficiencies assumed for these area source categories were 51 percent for gasoline bulk plants and terminals. NAPAP area source estimates have control levels built into these emissions. These control levels were first backed out of the emissions. In areas with no controls, the emissions remained at uncontrolled levels. In areas with regulation, the uncontrolled emissions were reduced to reflect the above efficiencies.

4.3.1.2 Rule Effectiveness Assumptions

Controlled emissions for each inventory year were recalculated, assuming that reported VOC, NO_x, and CO controls were 80 percent effective. Sulfur dioxide and PM-10 controls were assumed to be 100 percent effective. The 80 percent rule effectiveness assumption was judged to be unreasonable for several VOC and CO source categories. The VOC rule effectiveness was changed to 100 percent for bulk storage tank sources that had VOC control devices codes 90, 91, or 92. These three codes represent conversion to variable vapor space tank, conversion to floating roof tank, and conversion to pressurized tank, respectively. These controls were judged to be irreversible process modifications (there are SCCs which represent these type of tanks), and therefore 100 percent rule effectiveness was applied. VOC and CO rule effectiveness was changed to 100 percent for all Petroleum Industry - Fluid Catalytic Cracking Units (FCCs), SCC 30600201. AP-42 lists CO waste heat boilers as a control for these units with both CO and hydrocarbon emissions reduced to negligible levels. Since these boilers handle VOC and CO as fuels rather than as emissions, they are treated as a process instead of as control device, and therefore are not subject to rule effectiveness.

There is no control device code for CO boilers in NAPAP. To implement this set of revisions, all FCCs were assumed to have CO boilers. In addition, the CO rule effectiveness was changed to 100 percent for sources in five other SCCs that burn CO as a fuel. The CO rule effectiveness was also changed to 100 percent for sources with In-Process Fuel Use SCCs. According to AP-42, there should be no CO emissions from these sources. Emissions were not deleted from the inventory, however applying 80 percent rule effectiveness resulted in CO emissions of up to 36,000 short tons from some In-Process Fuel Use sources. Changing the rule effectiveness to 100 percent for sources in these SCCs retains the emissions, but at more reasonable levels. Table 4.3-1 lists the SCCs for which the CO rule effectiveness was changed to 100 percent.

4.3.1.3 Emission Factor Changes

The VOC emission factors for vehicle refueling were updated to reflect changes in gasoline Reid vapor pressure (RVP). The NAPAP gasoline marketing service station emissions were divided into two components: evaporative losses from underground tanks (Stage I) and Stage II vehicle refueling (including spillage). The NAPAP emissions were derived based on gasoline usage combined with the following uncontrolled emissions factors from AP-42:

Stage I: 7.3 lbs/1,000 gallons
Stage II: 11.0 lbs/1,000 gallons
Spillage: 0.7 lbs/1,000 gallons

These emission factors were used to calculate the fraction of total emissions attributable to each of the components above. The total percentage is 38.4 percent for Stage I emissions and 61.6 percent for Stage II emissions, plus spillage.

The Stage II emissions were also revised to reflect changes in emission factors. Stage II emission factors are a function of gasoline RVP and temperature. Gasoline RVPs have decreased since 1985 in response to the phase I and phase II RVP regulations. MOBILE5 was used to calculate Stage II emission factors for five sample states (Maryland, Illinois, New York, Texas, and North Carolina). Factors for each season were calculated based on the seasonal RVP and temperature (see Tables 4.3-2 to 4.3-4) based on engineering judgement. The national average annual factors for each inventory year are shown in Table 4.3-5. The 1987 value was used to estimate the 1985 and 1986 emissions.

In addition to updating the emission factor for Stage II, underground tank breathing/emptying losses were also added to the inventory. The AP-42 emission factor of 1.0 lbs/1,000 gallons was used to estimate emissions for each inventory year. Gasoline usage was back-calculated from the Stage II VOC emissions and emission factor.

4.3.1.4 Emissions Calculations

A three-step process was used to calculate emissions incorporating rule effectiveness. First, base year controlled emissions are projected to the inventory year using the following formula (Equation 4.3-1):

$$CE_i = CE_{BY} + (CE_{BY} \times EG_i)$$

where: CE_i = controlled emissions for inventory year i
CE_{BY} = controlled emissions for base year
EG_i = earnings growth for inventory year i

Earnings growth (EG) is calculated using Equation 4.3-2:

$$EG_i = 1 - \frac{DAT_i}{DAT_{BY}}$$

where: DAT_i = earnings data for inventory year i
DAT_{BY} = earnings data in the base year

Second, uncontrolled emissions in the inventory year are back-calculated from the controlled emissions based on the.control efficiency with the following formula (Equation 4.3-3):

$$UE_i = \frac{CE_i}{\left(1 - \frac{CEFF}{100}\right)}$$

where: UE_i = uncontrolled emissions for inventory year i
CE_i = controlled emissions for inventory year I
CEFF = control efficiency (%)

Third, controlled emissions are recalculated incorporating rule effectiveness using the following equation (Equation 4.3-4):

$$CER_i = UC_i \times \left(1 - \left(\frac{REFF}{100}\right) \times \left(\frac{CEFF}{100}\right)\right) \times \left(\frac{EF_i}{EF_{BY}}\right)$$

where: CER_i = controlled emissions incorporating rule effectiveness
UC_i = uncontrolled emissions
REFF = rule effectiveness (%)
CEFF = control efficiency (%)
EF_i = emission factor for inventory year i
EF_{BY} = emission factor for base year

In many cases, the PM-10 emissions calculated based on the particle size distribution and PM-10 control efficiency were higher than the total suspended particulate (TSP) emissions. The source problem is inconsistency between the TSP control efficiencies from the 1985 NAPAP inventory and the control efficiencies determined using the PM-10 calculator. This error may have been compounded in the following steps with the values selected for particle size distribution and efficiency. In the instances where the controlled PM-10 emissions were calculated to be higher than the controlled TSP emissions, the controlled PM-10 emissions were replaced with the controlled TSP emissions. The uncontrolled PM-10 was then recalculated using the revised PM-10 emissions and the control efficiency from the PM-10 calculator. In other words, it is assumed that in these instances, virtually all of the particles above 10 microns are being controlled and that particles emitted after the control device are all particles of 10 microns or less.

The basis for replacing the PM-10 emissions with the TSP emissions in these cases is the assumption that the controlled TSP emissions from the 1985 NAPAP inventory are the best data that are available as a measure of point source particulate emissions. If it is assumed that the uncontrolled emissions were the best data available, then an adjustment to the TSP control efficiency (resulting in an increase to actual TSP emissions) would be performed rather than replacing the PM-10 emissions.

4.3.1.5 Revised Emissions

Hazardous waste treatment, storage, and disposal Facility (TSDF) emissions were updated using an April 1989 file from EPA's Emission Standards Division (ESD).[10] This file provided estimates of TSDF emissions with longitude and latitude as the geographical indicator for each facility. The longitude and latitude were used to match each emission to the appropriate state and county.

Area source petroleum refinery fugitive emissions were re-estimated based on a revised estimate of national petroleum refinery emissions. The national petroleum refinery emissions used to estimate area source emission in the 1985 NAPAP were obtained from the Emissions Trends report.[11] The emissions for blowdown systems were revised to reflect the high level of control as shown in the point source inventory.

The area source petroleum refinery fugitive emissions were re-estimated using the revised national emission total by applying the methodology used to develop the 1985 NAPAP estimate.[12] Total county fugitive petroleum refinery emissions were determined by distributing the revised Emission Trends estimate (excluding process heaters and catalytic cracking units) based on 1985 county refinery capacity from the DOE Petroleum Supply Annual.[13] Refinery capacity from this publication was allocated to counties based on the designated location of the refinery. The 1985 NAPAP Emission Inventory was used to aid in the matching of refineries to location.

Total area source petroleum refinery fugitive emissions were then estimated by subtracting the point source emissions (SCCs 3-06-004 through 3-06-888) from the total county-level emissions. Negative values (indicating higher point source emissions than the totals shown for the county), were re-allocated to counties exhibiting positive emission values based on the proportion of total refinery capacity for each county to avoid double-counting of emissions. This resulted in an estimate of 351 thousand short tons for 1985 compared with the earlier 1985 NAPAP estimate of 728 thousand short tons (area source refinery fugitives). This revised 1985 estimate was projected to the inventory years, as described in section 4.3.2.1.

The SO_2 emissions for 1987 through 1989 were adjusted to correct for the permanent closing of the Phelps Dodge copper smelter in Arizona in January 1987. This adjustment was made by subtracting the 1985 emissions for State=04, County=003, and NEDS ID =0013 from the inventory for 1987 through 1989.

4.3.2 Emissions, 1985 to 1989

As described in section 4.3.1.3, the 1990 Interim Inventory controlled emissions were projected from the 1985 NAPAP Emissions Inventory using Equations 4.3-1 through 4.3-4. For all other years (1985 to 1989) the emissions were projected from the 1990 Interim Inventory emissions using Equations 4.3-1 and 4.3-2. Therefore, the 1985 emissions estimated by this method do not match the 1985 NAPAP Emission Inventory due to the changes made in control efficiencies and emission factors and the addition of rule effectiveness when creating the 1990 Interim Inventory. For refueling sources, the emissions were adjusted to account for the updated emission factors for all years as described in section 4.3.1.3.

4.3.2.1 Point Source Growth

The changes in the point source emissions were equated with the changes in historic earnings by state and industry. Emissions from each point source in the 1985 NAPAP Emissions Inventory were projected to the years 1985 through 1991 based on the growth in earnings by industry (two-digit SIC code). Historical annual state and industry earnings data from BEA's Table SA-5[1] were used to represent growth in earnings from 1985 through 1990.

The 1985 through 1990 earnings data in Table SA-5 are expressed in nominal dollars. To be used to estimate growth, these values were converted to constant dollars to remove the effects of inflation. Earnings data for each year were converted to 1982 constant dollars using the implicit price deflator for PCE.[3] The PCE deflators used to convert each year's earnings data to 1982 dollars are:

Year	1982 PCE Deflator
1985	111.6
1987	114.3
1988	124.2
1989	129.6
1990	136.4

Several BEA categories did not contain a complete time series of data for the years 1985 through 1990. Because the SA-5 data must contain 1985 earnings and earnings for each inventory year (1985 through 1990) to be useful for estimating growth, a log linear regression equation was used where possible to fill in missing data elements. This regression procedure was performed on all categories that were missing at least one data point and which contained at least three data points in the time series.

Each record in the point source inventory was matched to the BEA earnings data based on the state and the two-digit SIC. Table 4.3.6 shows the BEA earnings category used to project growth for each of the two-digit SICs found in the 1985 NAPAP Emission Inventory. No growth in emissions was assumed for all point sources for which the matching BEA earnings data were not complete. Table 4.3.6 also shows the national average growth and earnings by industry from Table SA-5.

4.3.2.2 Area Source Growth

Emissions from the 1985 NAPAP Inventory were grown to the Emission Trends years based on historical BEA earnings data (section 4.3.2.1), historical estimates of fuel consumption, or other category-specific growth indicators. Table 4.3-7 shows the growth indicators used for each area source by NAPAP category.

The SEDS data were used as an indicator of emissions growth for the area source fuel combustion categories and for the gasoline marketing categories shown in Table 4.3-8. (SEDS reports fuel consumption by sector and fuel type.) Since fuel consumption was the activity level used to estimate emissions for these categories, fuel consumption was a more accurate predictor of changes in emissions, compared to other surrogate indicators such as earnings or population. SEDS fuel consumption data were available through 1989. The 1990 values were extrapolated from the 1985 through 1989 data using a log linear regression technique. In addition to projecting 1990 data for all fuel consumption categories, the 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.

The last step in the creation of the area source inventory was matching the NAPAP categories to the new Area and Mobile Source Subsystem (AMS) categories. This matching is provided in Table 4.3-9. Note that there is not always a one-to-one correspondence between NAPAP and AMS categories. For example, the gasoline marketing NAPAP category was split into two separate AMS categories representing Stage I and Stage II emissions. In addition, three NAPAP SCCs are not included in the AMS system of codes. Therefore, AMS codes were created for process emissions from pharmaceutical manufacture and synthetic fiber manufacture and for SOCMI fugitive emissions.

4.3.3 1990 National Emission Trends

The 1990 National Emission Trends is based primarily on state data, with the 1990 interim data filling in the gaps. The database houses U.S. annual and average summer day emission estimates for the 50 states and the District of Columbia. Seven pollutants (CO, NO_x, VOC, SO2, PM-10, PM-2.5, and NH_3) were estimated in 1990. The state data were extracted from three sources, the OTAG inventory, the GCVTC inventory, and AIRS/FS. Sections 4.3.3.1, 4.3.3.2, and 4.3.3.3 give brief descriptions of these efforts. Section 4.3.3.4 describes the efforts necessary to supplement the inventory gaps that are either temporal, spacial, or pollutant.

Since EPA did not receive documentation on how these inventories were developed, this section only describes the effort to collect the data and any modifications or additions made to the data.

4.3.3.1 OTAG

The OTAG inventory for 1990 was completed in December 1996. The database houses emission estimates for those states in the Super Regional Oxidant A (SUPROXA) domain. The estimates were developed to represent average summer day emissions for the ozone pollutants (VOC, NO_x, and CO). This section gives a background of the OTAG emission inventory and the data collection process.

4.3.3.1.1 Inventory Components —
The OTAG inventory contains data for all states that are partially or fully in the SUPROXA modeling domain. The SUPROXA domain was developed in the late 1980s as part of the EPA regional oxidant modeling (ROM) applications. EPA had initially used three smaller regional domains (Northeast, Midwest, and Southeast) for ozone modeling, but wanted to model to full effects of transport in the eastern United States without having to deal with estimating boundary conditions along relatively high emission areas. Therefore, these three domains were combined and expanded to form the Super Domain. The western extent of the domain was designed to allow for coverage of the largest urban areas in the eastern United States without extending too far west to encounter terrain difficulties associated with the Rocky Mountains. The Northern boundary was designed to include the major urban areas of eastern Canada. The southern boundary was designed to include as much of the United States as possible, but was limited to latitude 26°N, due to computational limitations of the photochemical models.

The current SUPROXA domain is defined by the following coordinates:

North:	47.00°N	East:	67.00°W
South:	26.00°N	West:	99.00°W

Its eastern boundary is the Atlantic Ocean and its western border runs from north to south through North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas. In total, the OTAG Inventory completely covers 37 states and the District of Columbia.

The OTAG inventory is primarily an ozone precursor inventory. It includes emission estimates of VOC, NO_x, and CO for all applicable source categories throughout the domain. It also includes a small amount of SO_2 and PM-10 emission data that was sent by states along with their ozone precursor data. No quality assurance (QA) was performed on the SO_2 and PM-10 emission estimates for the OTAG inventory effort.

Since the underlying purpose of the OTAG inventory is to support photochemical modeling for ozone, it is primarily an average summer day inventory. Emission estimates that were submitted as annual emission estimates were converted to average summer day estimates using operating schedule data and default temporal profiles. Some preliminary work has been performed on converting the average summer day emission estimates in the OTAG inventory to annual emission estimates. The OTAG inventory files contain the preliminary annual emission estimates. These annual emission estimates, however, have not undergone any QA under the OTAG effort and therefore should not be deemed as complete or as reliable as the average summer day estimates.

The OTAG inventory is made up of three major components: (1) the point source component, which includes segment/pollutant level emission estimates and other relevant data (e.g., stack parameters, geographic coordinates, and base year control information) for all stationary point sources in the domain; (2) the area source component, which includes county level emission estimates for all stationary area sources and non-road engines; and (3) the highway vehicle component, which includes county/roadway functional class/vehicle type estimates of VMT and MOBILE5a input files for the entire domain. Of these three components, the NET inventory extracted all but the utility emissions. (See section 4.2 for a description of the utility NET emissions and section 4.6 for the on-road mobile NET emissions.)

4.3.3.1.2 Interim Emissions Inventory (OTAG Default) —
The primary data sources for the OTAG inventory were the individual states. Where states were unable to provide data, the 1990 Interim Inventory [14] was used for default inventory data. The Interim Inventory is a comprehensive county/source level inventory of VOC, NO_x, CO, and SO_2, and was initially developed in 1992 to serve as the emission inventory for EPA's ROM. Since 1992, EPA has continued to update the Interim Inventory as part of its Emission Trends Report.[15] Originally, the Interim Inventory contained only annual emission estimates. One of the subsequent updates to the Interim Inventory was to add average summer (or ozone season) daily emission estimates. These average summer daily emission estimates were the data used for OTAG in the absence of state data. A more detailed description of the 1990 Interim Inventory is presented in section 4.3.1.

4.3.3.1.3 State Data Collection Prodedures —
Since the completion of the Interim Inventory in 1992, many states had completed 1990 inventories for ozone nonattainment areas as required for preparing SIPs. In addition to these SIP inventories, many states had developed more comprehensive 1990 emission estimates covering their entire state. Since these state inventories were both more recent and more comprehensive than the Interim Inventory, a new inventory was developed based on state inventory data (where available) in an effort to develop the most accurate emission inventory to use in the OTAG modeling.

On May 5, 1995, a letter from John Seitz (Director of EPA's Office of Air Quality Planning and Standards [OAQPS]) and Mary Gade (Vice President of ECOS) to State Air Directors, states were requested to supply available emission inventory data for incorporation into the OTAG inventory.[16] Specifically, states were requested to supply all available point and area source emissions data for VOC, NO_x, CO, SO_2, and PM-10, with the primary focus on emissions of ozone precursors. Some emission inventory data were received from 36 of the 38 states in the OTAG domain. To minimize the burden to the states, there was no specified format for submitting tate data. The majority of the state data was submitted in one of three formats:

1) an Emissions Preprocessor System Version 2.0 (EPS2.0) Workfile
2) an ad hoc report from AIRS/FS
3) data files extracted from a state emission inventory database

The origin of data submitted by each state is described in section 4.3.3.1.4.

4.3.3.1.4. State Data Incorporation Procedures/Guidelines —
The general procedure for incorporating state data into the OTAG Inventory was to take the data "as is" from the state submissions. There were two main exceptions to this policy. First, any inventory data for years other than 1990 was backcast to 1990 using BEA Industrial Earnings data by state and two-digit SIC code.[17] This conversion was required for five states that submitted point source data for the years 1992 through 1994. All other data submitted were for 1990.

Second, any emission inventory data that included annual emission estimates but not average summer day values were temporally allocated to produce average summer day values. This temporal allocation was performed for point and area data supplied by several states. For point sources, the operating schedule data, if supplied, were used to temporally allocate annual emissions to average summer weekday using the following equation:

$$EMISSIONS_{ASD} = EMISSIONS_{ANNUAL} * SUMTHRU * 1/(13 * DPW)$$

where:

$EMISSIONS_{ASD}$	=	average summer day emissions
$EMISSIONS_{ANNUAL}$	=	annual emissions
SUMTHRU	=	summer throughput percentage
DPW	=	days per week in operation

If operating schedule data were not supplied for the point source, annual emissions were temporally allocated to an average summer weekday using EPA's default Temporal Allocation file. This computer file contains default seasonal and daily temporal profiles by SCC. The following equation was used:

$$EMISSIONS_{ASD} = EMISSIONS_{ANNUAL} / (SUMFAC_{SCC} * WDFAC_{SCC})$$

where:

$EMISSIONS_{ASD}$	=	average summer day emissions
$EMISSIONS_{ANNUAL}$	=	annual emissions
$SUMFAC_{SCC}$	=	default summer season temporal factor for SCC
$WDFAC_{SCC}$	=	default summer weekday temporal factor for SCC

There were a small number of SCCs that were not in the Temporal Allocation file. For these SCCs, average summer weekday emissions were assumed to be the same as those for an average day during the year and were calculated using the following equation:

$$EMISSIONS_{ASD} = EMISSIONS_{ANNUAL} / 365$$

where:

$EMISSIONS_{ASD}$	=	average summer day emissions
$EMISSIONS_{ANNUAL}$	=	annual emissions

4.3.3.1.4.1 *Point*. For stationary point sources, 36 of the 38 states in the OTAG domain supplied emission estimates covering the entire state. Data from the Interim Inventory were used for the two states (Iowa and Mississippi) that did not supply data. Most states supplied 1990 point source data, although some states supplied data for later years because the later year data reflected significant improvements over their 1990 data. Inventory data for years other than 1990 were backcast to 1990 using BEA historical estimates of industrial earnings at the two-digit SIC level. Table 4.3-10 provides a brief description of the point source data supplied by each state. Figure 4.3-1 shows the states that supplied point source data and whether the data were for 1990 or a later year.

4.3.3.1.4.2 *Area*. For area sources, 16 of the 38 states in the OTAG domain supplied emission estimates covering the entire state, and an additional nine states supplied emission estimates covering part of their state (partial coverage was mostly in ozone nonattainment areas). Interim Inventory data were the sole data source for 13 states. All states supplied area source data for 1990. Where the area source data supplied included annual emission estimates, the default temporal factors were used to develop average summer daily emission estimates. Table 4.3-11 provides a brief description of the area source data supplied by each state. Figure 4.3-2 shows the states that supplied area source data.

The Interim Inventory area source TSDF emissions used for four states were adjusted to reflect information learned about these sources since the development of the Interim Inventory. The Interim

Inventory contained county-level VOC estimates for TSDF sources in excess of 100 tons per day in several counties where the area source TSDF estimates should have been small or zero. Many of these sources were removed from the OTAG inventory as a result of incorporating state data. After the incorporation of state data five of these large TSDF estimates remained in the inventory. After consultation with the four states where these five remaining TSDF emission sources were located, a decision was made to remove the emissions for these five sources from the inventory. Table 4.3-12 lists the TSDF sources that were removed from the OTAG inventory.

4.3.3.1.4.3 *Rule Effectiveness.* For the OTAG inventory, states were asked to submit their best estimate of 1990 emissions. There was no requirement that state-submitted point source data include rule effectiveness for plants with controls in place in that year. States were instructed to use their judgment about whether to include rule effectiveness in the emission estimates. As a result, some states submitted estimates that were calculated using rule effectiveness, while other states submitted estimates that were calculated without using rule effectiveness.

The use of rule effectiveness in estimating emissions can result in emission estimates that are much higher than estimates for the same source calculated without using rule effectiveness, especially for sources with high control efficiencies (95 percent or above). Because of this problem, there was concern that the OTAG emission estimates for states that used rule effectiveness would be biased to larger estimates relative to states that did not include rule effectiveness in their computations.

To test if this bias existed, county level maps of point source emissions were developed for the OTAG domain. If this bias did exist, one would expect to see sharp differences at state borders between states using rule effectiveness and states not using rule effectiveness. Sharp state boundaries were not evident in any of the maps created. Based on this analysis, it was determined that impact of rule effectiveness inconsistencies was not causing large biases in the inventory.

4.3.3.2 Grand Canyon Visibility Transport Commission Inventory

The GCVTC inventory includes detailed emissions data for eleven states: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.[18] This inventory was developed by compiling and merging existing inventory databases. The primary data sources used were state inventories for California and Oregon, AIRS/FS for VOC, NO_x, and SO_2 point source data for the other nine states, the 1990 Interim Inventory for area source data for the other nine states, and the 1985 NAPAP inventory for NH_3 and TSP data. In addition to these existing data, the GCVTC inventory includes newly developed emission estimates for forest wildfires and prescribed burning.

After a detailed analysis of the GCVTC inventory, it was determined that the following portions of the GCVTC inventory would be incorporated into the PM inventory:

- complete point and area source data for California
- complete point and area source data for Oregon
- forest wildfire data for the entire eleven state region
- prescribed burning data for the entire eleven state region

State data from California and Oregon were incorporated because they are complete inventories developed by the states and are presumably based on more recent, detailed and accurate data than the Interim Inventory (some of which is still based on the 1985 NAPAP inventory). The wildfire data in the GCVTC inventory represent a detailed survey of forest fires in the study area and are clearly more accurate than the wildfire data in the Interim Inventory. The prescribed burning data in the GCVTC inventory are the same as the data in the Interim Inventory at the state level, but contain more detailed county-level data.

Non-utility point source emission estimates in the GCVTC inventory from states other than California and Oregon came from AIRS/FS. Corrections were made to this inventory to the VOC and PM emissions. The organic emissions reported in GCVTC inventory for California are total organics (TOG). These emissions were converted to VOC using the profiles from EPA's SPECIATE database. Since the PM emissions in the GCVTC were reported as both TSP and PM-2.5, EPA estimated PM-10 from the TSP in a similar manner as described in section 4.3.1.

4.3.3.3 AIRS/FS

SO_2 and PM-10 (or PM-10 estimated from TSP) sources of greater than 250 tons per year as reported to AIRS/FS that were not included in either the OTAG or GCVTC inventories were appended to the NET inventory. The data were extracted from AIRS/FS using the data criteria set listed in table 4.3-13. The data elements extracted are also listed in Table 4.3-13. The data were extracted in late November 1996. It is important to note that *estimated* emissions were extracted.

4.3.3.4 Data Gaps

As stated above, the starting point for the 1990 NET inventory is the OTAG, GCVTC, AIRS, and 1990 Interim inventories. Data added to this inventories include estimates of SO2, PM-10, PM-2.5, and NH_3, as well as annual or ozone season daily (depending on the inventory) emission estimates for all pollutants. This section describes the steps taken to fill in the gaps from the other inventories.

4.3.3.4.1 SO_2 and PM Emissions —
For SO_2 and PM-10, state data from OTAG were used where possible. (The GCVTC inventory contained SO_2 and PM annual emissions.) In most cases, there were no OTAG data for these pollutants. For point sources, data for plants over 250 tons per year for SO_2 and PM-10 were added from AIRS/FS. The AIRS/FS data were matched to the OTAG plants and the emissions were attached to existing plants from the OTAG data where a match was found. Where no match was found to the plants in the OTAG data, new plants were added to the inventory. For OTAG plants where there were no matching data in AIRS/FS and for all area sources of SO_2 and PM-10, emissions were calculated based on the emission estimates for other pollutants.

The approach to developing SO_2 and PM-10 emissions from these point and area sources involved using uncontrolled emission factor ratios to calculate uncontrolled emissions. This method used SO_2 or PM-10 ratios to NO_x. NO_x was the pollutant utilized to calculate the ratio because (1) the types of sources likely to be important SO_2 and PM-10 emitters are likely to be similar to important NO_x sources and (2) the generally high quality of the NO_x emissions data. Ratios of SO_2/NO_x and PM-10/NO_x based on uncontrolled emission factors were developed. These ratios were multiplied by uncontrolled NO_x emissions to determine either uncontrolled SO_2 or PM-10 emissions. Once the uncontrolled emissions were calculated, information on VOC, NO_x, and CO control devices was used to determine if they also controlled SO_2 and/or PM-10. If this review determined that the control devices listed did not control SO_2 and/or PM-10, plant matches between the OTAG and Interim inventories were performed to ascertain the SO_2 and PM-10 controls applicable for those sources. The plant matching component of this work involved only simple matching based on information related to the state and county FIPS code, along with the plant and point IDs.

There was one exception to the procedures used to develop the PM-10 point source estimates. For South Carolina, PM-10 emission estimates came from the Interim Inventory. This was because South Carolina had no PM data in AIRS/FS for 1990 and using the emission factor ratios resulted in unrealistically high PM-10 emissions.

There were no PM-2.5 data in either OTAG or AIRS/FS. Therefore, the point and area PM-2.5 emission estimates were developed based on the PM-10 estimates using source-specific uncontrolled particle size distributions and particle size specific control efficiencies for sources with PM-10 controls. To estimate PM-2.5, uncontrolled PM-10 was first estimated by removing the impact of any PM-10 controls on sources in the inventory. Next, the uncontrolled PM-2.5 was calculated by multiplying the uncontrolled PM-10 emission estimates by the ratio of the PM-2.5 particle size multiplier to the PM-10 particle size multiplier. (These particle size multipliers represent the percentage to total particulates below the specified size.) Finally, controls were reapplied to sources with PM-10 controls by multiplying the uncontrolled PM-2.5 by source/control device particle size specific control efficiencies.

4.3.3.4.2 NH3 Emissions —

All NH_3 emission estimates incorporated into the NET Inventory came directly from EPA's National Particulate Inventory (NPI).[19] This methodology is the same as that reported in section 4.3.1 for the 1990 Interim, with the exception of agricultural sources. The NPI contained the only NH_3 emissions inventory available. (Any NH_3 estimates included in the OTAG or AIRS/FS inventory were eliminated due to sparseness of data.) As with SO_2 and PM-10, plant matching was performed for point sources. Emissions were attached to existing plants where there was a match. New plants were added for plants where there was no match.

Due to double counting in the NPI, emissions for the following SCCs were deleted: 2805001000, 2805010000, 2805015000, and 2805005000.

Agricultural sources (i.e., livestock operations and fertilizer application) make up approximately 90 percent of NH_3 emissions in current inventories. Because of the high relative contribution from these sources, efforts were made to use the most recent information available to estimate their emissions. Sections 4.3.3.4.2.1 and 4.3.3.4.2.2 describe the methodology used to estimate NH_3 emissions from livestock operations and fertilizer application, respectively.

4.3.3.4.2.1 *Livestock Operations.* The livestock NH_3 emissions in the inventory were estimated using activity data from the 1992 Census of Agriculture.[20] 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,[21] and are listed in Table 4.3-14.

4.3.3.4.2.2 ***Fertilizer Application.*** NH_3 emissions from fertilizer application may comprise up to ten percent of total NH_3 emissions nationally. The activity data used to estimate emissions were obtained from the Commercial Fertilizers Data Base compiled by TVA and now maintained by Association of American Plant Food Control Officials.[22] This database includes county-level usage of over 100 different types of fertilizers, including those that emit NH_3.

The emission factors used for fertilizer application were also obtained from the Netherlands NH_3 study (Reference 21). This source lists emission factors for ten different types of fertilizers including the following:

- Anhydrous ammonia
- Aqua ammonia
- Nitrogen solutions
- Urea
- Ammonium nitrate
- Ammonium sulfate
- Ammonium thiosulfate
- Other straight nitrogen
- Ammonium phosphates
- N-P-K

4.3.3.4.3 Other Modifications —

Additional data were also used to fill data gaps for residential wood combustion and prescribed burning. Although these categories were in the OTAG inventory, the data from OTAG were not usable since the average summer day emissions were often very small or zero. Therefore, annual and average summer day emission estimates for these two sources were taken from the NET.

Additional QA/quality control (QC) of the inventory resulted in the following changes:

- Emissions with SCCs of fewer than eight digits or starting with a digit greater than the number "6" were deleted because they are invalid codes.
- Area source PM-10 and PM-2.5 utility emissions were deleted.
- A correction was made to a point (state 13/county 313/plant 0084) where the ozone season daily value had been revised but not the annual value.
- Tier assignments were made for all SCCs.
- Checked and fixed sources with PM-2.5 emissions which were greater than their PM-10 emissions.
- Checked and fixed sources with PM-10 emissions greater than zero and PM-2.5 emissions equal to zero.

4.3.4 Emissions, 1991 to 1994

The 1991 through 1994 area source emissions were grown in a similar manner as the 1985 through 1989 estimates, except for using a different base year inventory. The base year for the 1991 through 1994 emissions is the 1990 NET inventory. The point source inventory was also grown for those states that did not want their AIRS/FS data used or give other instructions. (The list of states are detailed in the AIRS/FS subsection.) For those states requesting that EPA extract their data from AIRS/FS, the years 1990 through 1995 were downloaded from the EPA IBM Mainframe. The 1996 emissions were not extracted since states are not required to have the 1996 data uploaded into AIRS/FS until July 1997.

4.3.4.1 Grown Estimates

The 1991 through 1994 point and area source emissions were grown using the 1990 NET inventory as the basis. The algorithm for determining the estimates is detailed in section 4.3.2. The 1990 through 1996 SEDS and BEA data are presented in Tables 4.3-15 and 4.3-16. The 1996 BEA and SEDS data were determined based on linear interpretation of the 1988 through 1995 data. Point sources were projected using the first two digits of the SIC code by state. Area source emissions were projected using either BEA or SEDS. Table 4.3-17 lists the SCC and the source for growth.

The 1990 through 1996 earnings data in BEA Table SA-5 (or estimated from this table) are expressed in nominal dollars. In order to be used to estimate growth, these values were converted to constant dollars to remove the effects of inflation. Earnings data for each year were converted to 1992 constant dollars using the implicit price deflator for PCE.[3] The PCE deflators used to convert each year's earnings data to 1992 dollars are:

Year	1992 PCE Deflator
1990	93.6
1991	97.3
1992	100.0
1993	102.6
1994	104.9
1995	107.6
1996	109.7

4.3.4.2 AIRS/FS

Several states responded to EPA's survey and requested that their 1991 through 1995 estimates reflect their emissions as reported in AIRS/FS. The list of these states, along with the years available in AIRS/FS is given in Table 4.3-18. As described in section 4.3.3.3, default estimated annual and ozone season daily emissions (where available) were extracted from AIRS/FS. Some changes were made to these AIRS/FS files. For example, the default emissions for some states contain rule effectiveness and the emissions were determined to be too high by EPA. The emissions without rule effectiveness were extracted from AIRS/FS and replaced the previously high estimates. The changes made to select state and/or plant AIRS/FS data are listed below.

- Louisiana — All VOC source emissions were re-extracted to obtain emissions without rule effectiveness for the year 1994.
- Colorado - Mastercraft — The VOC emissions were reported as ton/year in the initial download from AIRS. The units were changed to pounds/year in AIRS.

- Wisconsin - Briggs and Stratton — The VOC emissions for two SCCs were changed from with rule effectiveness to with out rule effectiveness for the years 1991, 1993, and 1994.

As noted in Table 4.3-18, several states did not report emissions for all pollutants for all years for the 1990 to 1995 time period. To fill these data gaps, EPA applied linear interpolation or extrapolated the closest two years worth of emissions at the plant level. If only one year of emissions data were available, the emission estimates were held constant for all the years. The segment-SCC level emissions were derived using the average split for all available years. The non-emission data gaps were filled by using the most recent data available for the plant.

As described in section 4.3.3.4.1, many states do not provide PM-10 emissions to AIRS. These states' TSP emissions were converted to PM-10 emissions using uncontrolled particle size distributions and AP-42 derived control efficiencies. The PM-10 emissions are then converted to PM-2.5 in the same manner as described in section 4.3.1.4. The State of South Carolina provided its own conversion factor for estimating PM-10 from TSP.

For all sources that did not report ozone season daily emissions, these emissions were estimated using the algorithm described in section 4.3.3.1.4.

4.3.5 1995 Emissions

The 1995 emission estimates were derived in a similar manner as the 1991 through 1994 emissions. The estimates were either extracted from AIRS/FS for 1995, estimated using AIRS/FS data for the years 1990 through 1994, or projected using the 1990 NET inventory. The method used depended on states' responses to a survey conducted by EPA early in 1997. A description of the AIRS/FS methodology is described in section 4.3.4. The following two subsections describe the projected emissions.

4.3.5.1 Grown Estimate

The 1995 point and area source emissions were grown using the 1990 NET inventory as the basis. The algorithm for determining the estimates is detailed in section 4.3.2. The 1990 through 1996 SEDS and BEA data are presented in Tables 4.3-15 and 4.3-16.

4.3.5.2 NO_x RACT

Major stationary source NO_x emitters in marginal and above nonattainment areas and in ozone transport regions (OTRs) are required to install RACT-level controls under the ozone nonattainment related provisions of Title I of the CAAA. The definition of major stationary source for NO_x differs by the severity of the ozone problem as shown in Table 4.3-19.

NO_x RACT controls for non-utility sources that were modeled for the 1995 NET emissions are shown in Table 4.3-20. These RACT-level controls will be applied to point source emitters with emissions at or above the major source size definition for each area. The application of NO_x RACT controls was only applied to grown sources.

4.3.5.3 Rule Effectiveness

Rule effectiveness was revised in 1995 for all grown sources using the information in the 1990 database file. If the rule effectiveness value was between 0 and 100 percent in 1990 and the control efficiency was greater than 0 percent, the uncontrolled emissions were calculated for 1990. The 1995 emissions were calculated by multiplying the growth factor by the 1990 uncontrolled emissions and the control efficiency and a rule effectiveness of 100 percent. The adjustment for rule effectiveness was only applied to grown sources.

4.3.6 1996 Emissions

The 1996 emission estimates were derived in a similar manner as the 1995 emissions. For the non-utility point sources, the 1995 AIRS/FS emissions and 1995 emissions grown from 1990 emissions were merged. The following three subsections describes the projected 1996 emissions.

4.3.6.1 Grown Estimates

The 1996 point and area source emissions were grown using the 1995 NET inventory as the basis. The algorithm for determining the estimates is detailed in section 4.3.2 and is described by the equation below. The 1990 through 1996 SEDS and BEA data are presented in Tables 4.3-15 and 4.3-16. The 1996 BEA and SEDS data were determined using linear interpretation of the 1988 through 1995 data. Rule effectiveness was updated to 100 percent as described in section 4.3.5.3 for the AIRS/FS sources that reported rule effectiveness of less than 100 percent in 1995.

The following equation describes the calculation used to estimate the 1996 emissions:

$$CER_{1996} = UC_{1990} \times \frac{GS_{1996}}{GS_{1990}} \times \left(1 - \left(\frac{REFF}{100}\right) \times \left(\frac{CEFF}{100}\right) \times \left(\frac{RP}{100}\right)\right)$$

where:

CER_{1996}	=	controlled emissions incorporating rule effectiveness
UC_{1990}	=	uncontrolled emissions
GS	=	growth surrogate (either BEA or SEDS data)
REFF	=	rule effectiveness (percent)
CEFF	=	control efficiency (percent)
RP	=	rule penetration (percent)

The rule effectiveness for 1996 was always assumed to be 100 percent. The control efficiencies and rule penetrations are detailed in the following subsections.

4.3.6.2 1996 VOC Controls

This section discusses VOC stationary source controls (except those for electric utilities). These controls were developed to represent the measures mandated by the CAAA and in place in 1996. Title I (specifically the ozone nonattainment provisions) affects VOC stationary sources. Title III hazardous air pollutant regulations will also affect VOC source categories. The discussion for each source category-specific control measure includes the regulatory authority, CAAA provisions relating to the control measure, and relevant EPA guidance.

Table 4.3-21 list the point source controls by pod. (A pod is a group of SCCs with similar emissions and process characteristics for which common control measures, i.e., cost and emission reductions, can be applied. It is used for control measure application/costing purposes.) Table 4.3-22 lists the POD to SCC match. Table 4.3-23 lists the area source control efficiencies, and rule effectiveness and rule penetration if not 100 percent. A description of the controls is detailed below by measure.

4.3.6.2.1 Hazardous Waste Treatment, Storage, and Disposal Facilities —

Control assumptions for TSDF reflect application of Phase I and Phase II standards, as described below. Regulatory authority for these rules falls under the Resource Conservation and Recovery Act (RCRA). The Phase I rule for hazardous waste TSDFs restricts emissions from equipment leaks and process vents (55 FR 25454, 1990). Process vent emissions must be below 3 lb/hr and 3.1 tons per year (tpy) or control devices must be installed. The control device must reduce emissions by 95 percent from uncontrolled levels or, if enclosed combustion devices are used, reduce the vent stream to 20 parts per million (ppm) by volume. The choice of control is not limited; condensers, absorbers, incinerators, and flares are demonstrated control techniques.

The equipment leak standards apply to emissions from valves, pumps, compressors, pressure relief devices, sampling connection systems, and open-ended valves or lines. Streams with organic concentrations equal to or greater than ten percent by weight are subject to the standards. Record keeping and monitoring are required for affected devices, in addition to the equipment standards, such as dual mechanical seals for compressors.

The Phase II rule will restrict emissions from tanks, containers, and surface impoundments.[23] The rule will affect an estimated 2,300 TSDFs. The proposed rule also requires generators with 90-day accumulation tanks (tanks holding waste for a period of 90 days or more) to install controls in order to retain RCRA permit exempt status. An estimated 7,200 generators will be affected. Controls specified for the Phase II rule are covers vented to a 95 percent destruction device, such as incinerators or carbon absorbers.

4.3.6.2.2 Municipal Solid Waste Landfills —

Emission reductions for landfills reflect the proposed rule and guidelines published in the *Federal Register* (55 FR 24468, 1991). Regulatory authority for this control measure falls under RCRA. The proposed rule requires installation of gas collection systems and combustion (open flare) of the captured gases for all existing landfills emitting greater than 150 mg/year, or 167 tpy, of nonmethane organic compounds. A new source performance standard (NSPS) requires the same controls on all new facilities. The control device efficiency is estimated to be 82 percent. A rule effectiveness of 100 percent will be applied. The penetration rate for existing facilities is estimated at 84 percent. A 100 percent penetration will be applied to new sources.

4.3.6.2.3 New Control Technique Guidelines (CTGs) —

Section 183 of the CAAA mandated EPA to establish 11 new CTGs by November 1993. Controls following these guidelines must be implemented in moderate, serious, severe, and extreme nonattainment areas. The majority of these documents are in draft form or still in the analysis stages.

Clean-up solvents will also be regulated through a negotiated rulemaking; however, implementation is not expected by 1996. Both of these control measures would apply nationwide. Control efficiency information was not available for many of the source categories, so default assumptions have been made.

4.3.6.2.4 Existing CTGs —

EPA has issued three groups of CTG documents to be implemented in ozone nonattainment areas. These controls should already be included in areas designated as nonattainment prior to 1990. These controls, however, must also be implemented in newly designated nonattainment areas and over the entire OTR. Not all CTGs are included in this table because of the difficulty, in some cases, of matching the document to the appropriate sources within the inventory. It is assumed that all existing CTGs are implemented by 1996.

4.3.6.2.5 Reasonably Available Control Technology —

The CAAA direct moderate and above ozone nonattainment areas to require reasonably available control technology (RACT)-level controls to VOC major stationary sources. The definition of major source varies, depending on the severity of the ozone nonattainment classification, as follows:

Classification	Major Source Cutoff
Moderate	100 tpy
Serious	50 tpy
Severe	25 tpy
Extreme	10 tpy
OTR	50 tpy

Point source RACT control assumptions are based on EPA documents, including background documents for New Source Performance Standards (NSPSs) and National Emission Standards for Hazardous Air Pollutants (NESHAPs), Alternative Control Technology (ACT) documents, and other compilations of VOC control techniques.

Area source RACT control information was taken from similar sources. The complicating factor for area source RACT controls is the major stationary source size cutoff. A penetration factor was developed that accounts for the fraction of emissions within the area source category that are expected to be emitted from major stationary sources. The penetration rate will vary according to the major stationary source size cutoff and, therefore, the ozone nonattainment classification.

4.3.6.2.6 Vehicle Refueling Controls-Stage II Vapor Recovery —

The CAAA and Title I General Preamble include the following specifications for Stage II vapor recovery programs.

- Stage II is required in serious and above nonattainment areas. Moderate areas must implement Stage II if onboard is not promulgated, and are also encouraged to implement Stage II (regardless of whether onboard is promulgated) in order to achieve early reductions. (Onboard controls require fleet turnover to become fully effective.)

- Stage II must be installed at facilities that sell more than 10,000 gallons of gasoline per month (the cutoff is 50,000 gallons per month for independent small business marketers). There is nothing to preclude states from adopting lower source size cutoffs (Section 182(b)(3)).

- A study must be conducted to analyze comparable measures in the OTR. Implementation plans for OTRs must be modified within one year after issuance of the comparability study to include Stage II or comparable measures (Section 184(b)(2)).

- States must prescribe the use of Stage II systems that are certified to achieve at least 95 percent control of VOC and that are properly installed and operated (General Preamble).

EPA has issued two guidance documents related to Stage II:

- *Technical Guidance - Stage II Vapor Recovery Systems for Control of Vehicle Refueling Emissions at Gasoline Dispensing Facilities - Volume 1* (EPA-450/3-91-022, November 1991)[24]

- *Enforcement Guidance for Stage II Vehicle Refueling Programs* (December 1991)[25]

Table 4.3-24 list the areas with Stage II programs in place as of January 1996.

4.3.6.2.7 New Source Performance Standards —

For new sources subject to NSPS controls, these standards apply regardless of location (40 CFR Part 60). New sources in nonattainment areas are also subject to New Source Review (NSR)/offsets. A 100 percent rule effectiveness is assumed, consistent with that for other VOC stationary source controls.

4.3.6.2.8 Nonroad Engine Controls-Spark-Ignition Engines < 25 hp —

EPA is currently in the process of developing regulations for spark ignition engines less than 25 horsepower (hp) that are designed to reduce hydrocarbons (HC), NO_x, and CO emissions. Expected to be included under these rules are most general utility equipment (i.e., lawn and garden and light commercial/industrial equipment), as well as farm and construction engines less than 25 hp.

A three percent reduction was applied nationally for all two-stroke gasoline engines (SCC = 2260xxxxxx) and all four-stroke gasoline engines (SCC = 2265xxxxxx). An additional 3.3 percent reduction was added to areas with reformulated gasoline. The counties with reformulated gasoline programs are listed in Table 4.3-25.

4.3.6.2.9 Title III —

The source categories affected by Title III maximum achievable control technology (MACT) standards were identified by using EPA's timetable for regulation development under Title III (58 FR 63941, 1993). Applicability of the anticipated regulations in various projection years was also derived from this draft timetable.

Control technology efficiencies were estimated for the expected MACT standards based on available information. The information used depended on the status of specific standards in their development timetable. For standards that have already been proposed or promulgated, efficiencies were estimated using information presented in preambles to the appropriate regulations.

Rule effectiveness was estimated at 100 percent for all Title III standards, in accordance with current EPA guidelines for rule effectiveness. Rule penetration is not applicable for any of the MACT categories, since it is included in the average "control technology efficiency" parameter.

4.3.6.3 NO_x Controls

Two types of controls were applied to the 1996 emissions. For all non-utility point sources that applied controls resulting from NO_x reasonably available control technology (RACT) requirements, the emissions were reduced by the same amount as that detailed in the section describing the 1995 emissions. Further reductions were made to areas that did not put RACT controls into place until January 1996. The second type of control was applied to the estimates of non-road diesel compression ignition engines.

4.3.6.3.1 RACT —
In 1996, several plants not affected by NO_x RACT in 1995 were added. Area combustion sources were reduced in 1996 according to the control efficiencies and rule penetration values listed in Table 4.3-26.

4.3.6.3.2 Nonroad —
A 37 percent reduction was applied nationally to all diesel compression ignition engines. A rule effectiveness of 100 percent was applied as well as a rule penetration rate of between 0.5 and 1 percent depending on type of equipment was also applied. Table 4.3-25 lists the reductions by SCC.

As an update to some of the NET nonroad inventory numbers, OMS agreed to provide numbers from their models and analyses being used for the Regulatory Impact Analysis (RIA) documents. Categories for which OMS provided data are nonroad diesel engines, nonroad spark-ignition marine engines, and locomotives. For each of these categories OMS provided national/SCC level emission estimates. For the diesel nonroad the pollutants covered included VOC, NO_x, CO, PM-10, and PM-2.5. For the nonroad spark-ignition marine engines only VOC and NO_x were provided. For locomtives only NO_x and PM-10 were provided

These national OMS numbers were used to update the 1995 and 1996 NET emission estimates such that the sum of the county/SCC level NET estimates would equal the national/SCC level OMS estimates. Listed below is the procedure used to incorporate the national OMS emission estimates.

1. 1995 and 1996 county/SCC level emission estimates were developed from the 1990 NET emissions using the normal procedure (i.e., BEA growth factors were applied and applicable credits for control programs were accounted for.)

2. The 1995 and 1996 county/SCC level emission estimates developed in Step 1 were aggregated to national/SCC level emission estimates. This was done at the engine category level (e.g., construction, agriculture, lawn and garden, etc.) rather than the specific engine level; although the OMS data was supplied at the specific engine level, a large portion of the NET emission estimates are at the engine category level.

3. Pollutant specific adjustment factors for each applicable engine category were developed by calculating the ratio of the OMS estimate to the NET estimate.

4. The NET county/SCC level estimates developed in Step 1 were then multiplied by the appropriate adjustment factor resulting in final NET county/SCC level estimates that equal the OMS estimates when aggregated to the national level.

For locomotives the national OMS estimates were close to the national NET estimates prior to any adjustments for all pollutants except PM-10. Therefore, only PM-10 and PM-2.5 (calculated as 92 percent of the revised PM-10) were adjusted for locomotives. For nonroad diesel engines and nonroad spark-ignition marine engines adjustments were made to all pollutants for which OMS provided information (VOC NO_x, CO, PM-10, and PM-2.5 for nonroad diesel, VOC and NO_x for nonroad spark-ignition marine engines.)

Tables 4.3-27 through 4.3-29 show the national NET estimates prior to adjustments and the OMS provided estimates for nonroad diesel engines, nonroad spark-ignition marine engines, and locomotives, respectively.

4.3.7 Cotton Ginning

Cotton ginning estimates for 1995 and 1996 were calculated using the following methodology. Ginning activity occurs from August/September through March, covering parts of two calendar years,[26] with the majority of ginning activity occurring between September and January. Ginning activity occurs in the 16 states where cotton is grown, i.e., Alabama, Arizona, Arkansas, California, Florida, Georgia, Louisiana, Mississippi, Missouri, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia. The majority of the ginning facilities are located in Arkansas, California, Louisiana, Mississippi, and Texas.

The general equation for estimating emissions from this category is given below.

$$E = (P_c * B) * EF_c + (P_f * B) * EF_f$$

Where:
- E = annual county emissions (lbs/year)
- B = number of bales ginned in the county
- P_c = fraction of total bales at gins with conventional controls
- EF_c = emission factor for gins with conventional controls (lbs/bale)
- P_f = fraction of total bales at gins with full controls
- EF_f = emission factor for gins with full controls (lbs/bale)

4.3.7.1 Activity Indicator

The activity factor for this category is the number of bales of cotton ginned. The U.S. Department of Agriculture (USDA) compiles and reports data on the amount of cotton ginned by state, district, and county for each crop year in its *Cotton Ginnings* reports.[27] (A crop year runs from September through March.) These reports are published once or twice per month during the crop year and give the amount of cotton ginned as running totals.

The number of bales ginned in a county can be obtained from Reference 26. However, since these data are reported as running totals for the growing season (which spans parts of two calendar years), the number of bales ginned for a calendar year will need to be determined using data from two crop years. The amount of cotton ginned from January 1 to the end of the season (March) for calendar year *x* (crop year *x*) and the amount of cotton ginned from the beginning of the season (August/ September) for calendar year *x* (crop year *y*) should be summed to get the calendar year *x* total. To determine the amount ginned from January 1 to the end of the season, subtract the amount ginned by January 1 (in the early January *Cotton Ginnings* report) from the total reported in the March or end of season *Cotton Ginnings* report. To determine the amount ginned from the beginning of the season to January 1, use the total recorded by January 1 in the early January *Cotton Ginnings* report.

It should be noted that for confidentiality purposes, the *Cotton Ginnings* report may not show detailed data for a county, but may include those data in the district, state, or U.S. totals. Data for a gin may be considered confidential if (1) there are fewer than three gins operating in the county, or (2) more than 60 percent of the cotton ginned in the county is ginned at one mill. The standard *Cotton Ginnings* report lists the following four footnotes to its table of running bales ginned:

1/ withheld to avoid disclosing individual gins
2/ withheld to avoid disclosing individual gins, but included in state total
3/ excludes some gins' data to avoid disclosing individual gins, but included in the state total
4/ withheld to avoid disclosing individual gins but included in the U.S. total

The following methodology can be used for estimating the number of bales ginned from those counties with confidential data.

(1) If all counties in the district show confidentiality, but there is a district total, divide district total by the number of counties to get individual county estimates.

(2) If some (but not all) counties in a district show confidentiality and there is a district total, subtract county totals from district total and divide the remainder by the number of counties showing confidentiality to get estimates for the "confidential" counties.

(3) If both county and district totals are considered confidential within a state, divide the state total by the number of counties to get individual county estimates.

(4) If some (but not all) districts show confidentiality, subtract recorded district totals from the state total and divide the remainder by the number of counties showing confidentiality to get estimates for the "confidential" counties.

Although this method of apportioning is time consuming, it is preferable to using the ginning distribution from previous years to determine current estimates of number of bales ginned in confidential counties. The variability of the cotton harvest from year to year, the possibility of past claims of confidentiality, and the industry trend from numerous small gins to fewer, large gins makes distribution based on past activity unreliable. In addition, if the estimates generated by the methodology above does not meet with state approval, the state may submit more accurate data for those counties and the apportioning methodology can be revised.

The March report, produced at the end of the crop year, contains the final totals (including revisions and updates) for the crop year. Data in the report may differ from earlier reports for the crop year in both total number of bales ginned and counties where ginning occurred. In fact, for crop year 1995, the January reports showed higher totals for some counties than did the final report. Subtracting the January totals from the March totals for these counties yielded a negative number. In these cases, the activity for the county for that time period was considered zero. For this methodology, in instances where counties are recorded in the March final report, but not in earlier (e.g., January) reports, the activity is assumed to have occurred sometime before January. These counties were then added to the January listing as confidential counties, and distribution of ginning activity was then performed.

Kansas has only one small gin operating in the state, and this gin does not operate every year. Since the amount of cotton ginned at this facility is considered insignificant (less than 0.005 percent of the total cotton ginned in the United States in 1995), no emissions for Kansas were calculated.

4.3.7.2 Emission Factor

AP-42 presents total PM and PM-10 emission factors (in lbs/bale) for gins with high-efficiency cyclones on all exhaust streams (i.e., full controls) and for gins with screened drums or cages on the lint cleaners and battery condenser and high-efficiency cyclones on all other exhaust streams (i.e., conventional controls).[28] PM-2.5 emissions were assumed to be one percent of the total PM emissions, as given in Table B.2.2. in AP-42 for Grain Handling. Table 4.3-30 shows the AP-42 emission factors. Additional information obtained from EPA includes the estimated percent of cotton baled at gins using each type of control by state. These data were developed by the National Cotton Council and are shown in Table 4.3-31.[29] Emission factors are controlled emissions factors as indicated.

4.3.7.3 Sample Calculation

Using the data for Alabama from the 03/25/96 *Cotton Ginnings* report:

- District 10 shows data for three counties, confidential data for two counties and a district total.

(1) Subtract District 10 county data from District 10 total.

144,250 - (35,200 + 59,300 + 25,750) = 24,000 bales

(2) Divide the remaining total by two (two counties claimed confidentiality) to estimate amount for each confidential county.

24,000/2 = 12,000 bales per confidential county

This procedure can also be used for District 40.

- Districts 50 and 60 show district totals only (i.e., all counties within these districts claim confidentiality). To estimate individual county totals, divide each district total by the number of counties within that district.

District 50 | District 60

122,300/4 = 30,575 bales per county   153,650/6 = 25,608 bales per county

- Districts 20 and 30 claim county and district confidentiality. To estimate county totals,

(1) Subtract available district totals from state total.

491,150 - (144,250 + 34,650 + 122,300 + 153,650) = 36,300 bales

(2) Divide remainder by the number of counties claiming confidentiality in the two remaining districts.

36,300/8 = 4,538 bales per confidential county

Using the data in Table 4.3-32 and other data from *Cotton Ginnings* reports, PM-10 emissions can be calculated for Madison County, Alabama, as shown in the following example.

(1) Determine total running bales ginned in Madison County in 1996

(a) For the period January 1, 1996 until the end of the crop season, subtract the running total as of January 1, 1996 from the 01/25/96 *Cotton Ginnings* report from the final crop season total from the 03/25/96 *Cotton Ginnings* report.

25,750 bales - 25,700 bales = 50 bales

(b) For the period from the beginning of the 1996 crop year until the end of calendar year 1996, use the running total as of January 1, 1997 from the 01/24/97 *Cotton Ginnings* report. Add this to the total from (a) above to get calendar year 1996 total.

50 bales + 40,500 bales = 40,550 bales ginned in calendar year 1996

(2) Determine the percent of crop ginned by emission control method using Table 4.3-32.

(3) Use the emission factors from AP-42 as shown in Table 4.3-30, the results of (1) and (2) above, and the general equation to estimate emissions.

$$E = [(P_c * B) * EF_c] + [(P_f * B) * EF_f]$$

Where:
P_c = 0.8
P_f = 0.2
B = 40,550 bales
EF_c = 1.2 lb/bale PM-10
EF_f = 0.82 lb/bale PM-10

Emissions = [(0.8 * 40,550 bales) * 1.2 lb/bale] + [(0.2 * 40,550 bales) * 0.82 lb/bale]

= 38,928 lbs + 6,650 lbs
= 45,578 lbs or 23 tons of PM-10

4.3.8 References

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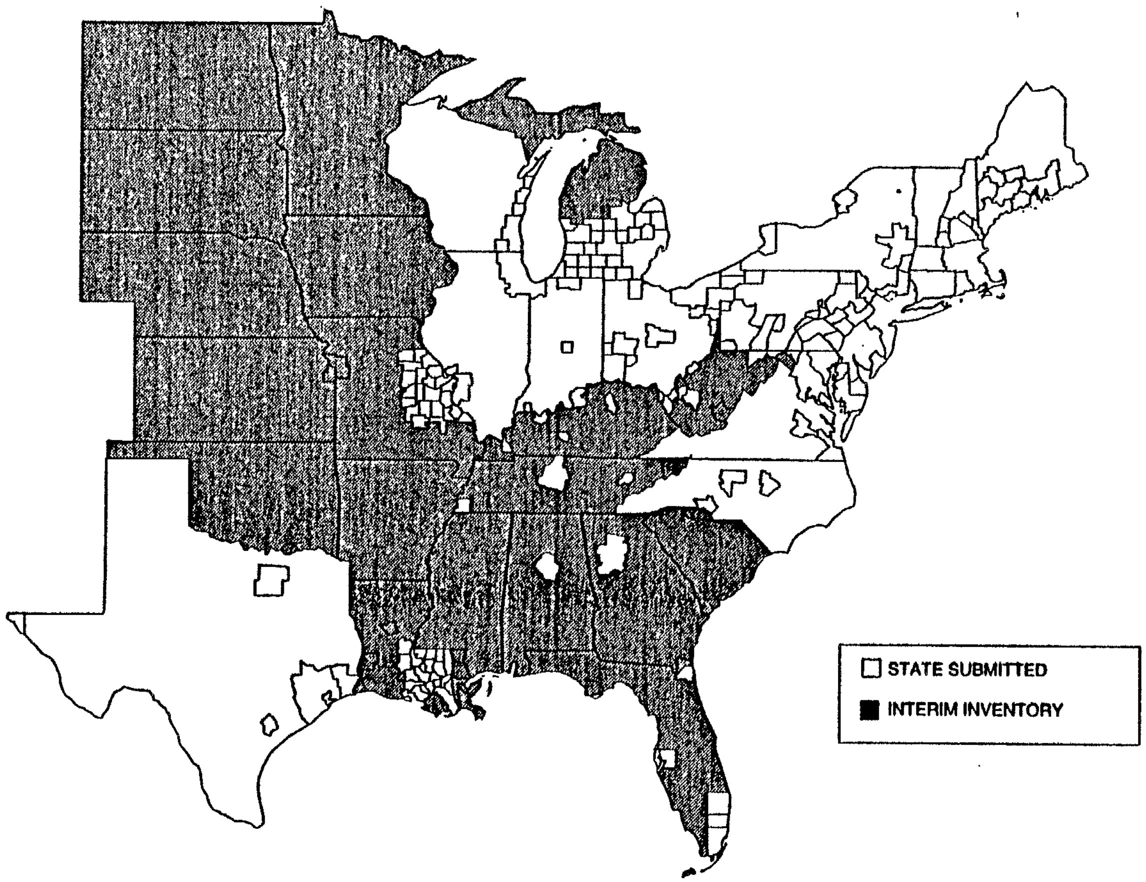
Figure 4.3-2. OTAG Inventory Data Source - Area Sources



4.4 OTHER COMBUSTION

The source categories falling under "Other Combustion" include the following Tier 1 and Tier 2 categories:

TIER 1 CATEGORY	TIER 2 CATEGORY
OTHER COMBUSTION	All
MISCELLANEOUS	Other Combustion

The Tier 1, Other Combustion emissions include residential and commercial/institutional burning of all fuels except solid waste. The emissions for the miscellaneous, other combustion category include agricultural burning, forest fires/wildfires, prescribed/slash and managed burning, and structural fires. The emissions from agricultural burning and structural fires were produced using the methodology described in section 4.4.1. The methodologies used to estimate the emissions for forest fires/wildfires, residential wood combustion, and prescribed/slash and managed burning are described in section 4.4.4.1.

The 1990 emissions for the majority of the source categories were generated from both the non-utility point source and non-solvent area source portions of the 1985 NAPAP inventory, except for emissions from wildfires, residential wood combustion, and prescribed burning. The 1990 Interim Inventory emissions served as the base year from which the emissions for the years 1985 through 1989 were estimated. The emissions for the years 1985 through 1989 were estimated using historical data compiled by the BEA[1] or historic estimates of fuel consumption based on the DOE's SEDS.[2]

4.4.1 1990 Interim Inventory

The 1985 NAPAP inventory estimates for the **point** sources have been projected to the year 1990 based on the growth in BEA historic earnings for the appropriate state and industry,[1] as identified by the two-digit SIC code. To remove the effects of inflation, the earnings data were converted to 1982 constant dollars using the implicit price deflator for personal consumption expenditures.[3] State and SIC-level growth factors were calculated as the ratio of the 1990 earnings data to the 1985 earnings data. Additional information on point source growth indicators is presented in section 4.4.2.1.

The **area** source emissions from the 1985 NAPAP inventory have been projected to the year 1990 based on BEA historic earnings data, BEA historic population data, DOE SEDS data, or other growth indicators. The specific growth indicator was assigned based on the source category. The BEA earnings data were converted to 1982 dollars as described above. The 1990 SEDS data were extrapolated from data for the years 1985 through 1989. All growth factors were calculated as the ratio of the 1990 data to the 1985 data for the appropriate growth indicator. Additional information on area source growth indicators is presented in section 4.4.2.2.

When creating the 1990 emission inventory, changes were made to emission factors, control efficiencies, and emissions from the 1985 inventory for some sources. The PM-10 control efficiencies were obtained from the *PM-10 Calculator*.[4] In addition, rule effectiveness, which was not applied in the 1985 NAPAP inventory, was applied to the 1990 emissions estimated for the point sources. The CO, NO_x, and VOC point source controls were assumed to be 80 percent effective; PM-10 and SO_2 controls were assumed to be 100 percent effective.

The 1990 emissions for CO, NO_x, SO_2, and VOC were calculated using the following steps: (1) projected 1985 controlled emissions to 1990 using the appropriate growth factors, (2) calculated the uncontrolled emissions using control efficiencies from the 1985 NAPAP Emission Inventory, and (3) calculated the final 1990 controlled emissions using revised control efficiencies and the appropriate rule effectiveness. The 1990 PM-10 emissions were calculated using the TSP emissions from the 1985 NAPAP inventory. The 1990 uncontrolled TSP emissions were estimated in the same manner as the other pollutants. The 1990 uncontrolled PM-10 estimates were calculated from these TSP emissions by applying SCC-specific uncontrolled particle size distribution factors.[5] The controlled PM-10 emissions were estimated in the same manner as the other pollutants. Because the majority of area source emissions for all pollutants represented uncontrolled emissions, the second and third steps were not required to estimate the 1990 area source emissions.

4.4.1.1 Control Efficiency Revisions

In the 1985 NAPAP point source estimates, control efficiencies for VOC, NO_x, CO, and SO_2 sources in Texas were judged to be too high for their process/control device combination. These high control efficiencies occurred because Texas did not ask for control efficiency information, and simply applied the maximum efficiency for the reported control device.[6] High control efficiencies lead to high future growth in modeling scenarios based on uncontrolled emissions (which are based on the control efficiency and reported actual emissions). High control efficiencies also lead to extreme increases in emissions when rule effectiveness is incorporated.

Revised VOC control efficiencies were developed for Texas for the ERCAM-VOC.[7] For this analysis, revised efficiencies were also developed by SCC and control device combination for NO_x, SO_2, and CO using engineering judgement. These revised control efficiencies were applied to sources in Texas. A large number of point sources outside of Texas had VOC and CO control efficiencies that were also judged to be too high. The VOC and CO control efficiencies used for Texas were also applied to these sources.

4.4.1.2 Rule Effectiveness Assumptions

Controlled emissions for each inventory year were recalculated, assuming that reported VOC, NO_x, and CO controls were 80 percent effective. Sulfur dioxide and PM-10 controls were assumed to be 100 percent effective.

4.4.1.3 Emissions Calculations

A three-step process was used to calculate emissions incorporating rule effectiveness. First, base year controlled emissions are projected to the inventory year using the following equation (Equation 4.4-1):

$$CE_i = CE_{BY} + (CE_{BY} \times EG_i)$$

where:

CE_i	=	controlled emissions for inventory year i
CE_{BY}	=	controlled emissions for base year
EG_i	=	earnings growth for inventory year i

Earnings growth is calculated using Equation 4.4-2:

$$EG_i = 1 - \frac{DAT_i}{DAT_{BY}}$$

where: EG = earnings growth
DAT_i = earnings data for inventory year i
DAT_{BY} = earnings data in the base year

Second, uncontrolled emissions in the inventory year are back-calculated from the controlled emissions based on the control efficiency with the following equation (Equation 4.4-3):

$$UE_i = \frac{CE_i}{\left(1 - \frac{CEFF}{100}\right)}$$

where: UE_i = uncontrolled emissions for inventory year i
CE_i = controlled emissions for inventory year i
$CEFF$ = control efficiency (percent)

Third, controlled emissions are recalculated incorporating rule effectiveness using Equation 4.4-4:

$$CER_i = UC_i \times \left(1 - \left(\frac{REFF}{100}\right) \times \left(\frac{CEFF}{100}\right)\right) \times \left(\frac{EF_i}{EF_{BY}}\right)$$

where: CER_i = controlled emissions incorporating rule effectiveness
UC_i = uncontrolled emissions
$REFF$ = rule effectiveness (percent)
$CEFF$ = control efficiency (percent)
EF_i = emission factor for inventory year i
EF_{BY} = emission factor for base year

4.2.2 Emissions, 1985 to 1989

As explained in section 4.4.1.1, the 1990 controlled emissions were projected from the 1985 NAPAP inventory using Equations 4.4-1 through 4.4-4. For all other years (1985 to 1989) the emissions were projected from the 1990 emissions using Equations 4.4-1 and 4.4-2. Therefore, the 1985 emissions estimated by this method do not match the 1985 NAPAP inventory due to the changes made in control efficiencies and emission factors and the addition of rule effectiveness when creating the 1990 base year inventory.

4.4.2.1 Point Source Growth

The changes in the point source emissions were equated with the changes in historic earnings by state and industry. Emissions from each point source in the 1985 NAPAP inventory were projected to the years 1985 through 1990 based on the growth in earnings by industry (two-digit SIC code). Historical annual state and industry earnings data from BEA's Table SA-5 (Reference 1) were used to represent growth in earnings from 1985 through 1990.

The 1985 through 1990 earnings data in Table SA-5 are expressed in nominal dollars. To estimate growth, these values were converted to constant dollars to remove the effects of inflation. Earnings data for each year were converted to 1982 constant dollars using the implicit price deflator for PCE.[3] The PCE deflators used to convert each year's earnings data to 1982 dollars are:

Year	1982 PCE Deflator
1985	111.6
1987	114.3
1988	124.2
1989	129.6
1990	136.4

Several BEA categories did not contain a complete time series of data for the years 1985 through 1990. Because the SA-5 data must contain 1985 earnings and earnings for each inventory year (1985 through 1990) to be useful for estimating growth, a log linear regression equation was used where possible to fill in missing data elements. This regression procedure was performed on all categories that were missing at least one data point and which contained at least three data points in the time series.

Each record in the point source inventory was matched to the BEA earnings data based on the state and the two-digit SIC. Table 4.4-1 shows the BEA earnings category used to project growth for each of the two-digit SICs found in the 1985 NAPAP inventory. No growth in emissions was assumed for all point sources for which the matching BEA earnings data were not complete. Table 4.4-1 also shows the national average growth and earnings by industry from Table SA-5.

4.4.2.2 Area Source Growth

Emissions from the 1985 NAPAP inventory were grown to the Emission Trends years based on historical BEA earnings data section 4.4.2.1, historical estimates of fuel consumption (SEDS),[2] or other category-specific growth indicators. Table 4.4-2 shows the growth indicators used for each area source by NAPAP category.

The SEDS data were used as an indicator of emissions growth for the area source fuel combustion categories shown in Table 4.4-3. (SEDS reports fuel consumption by sector and fuel type.) Since fuel consumption was the activity level used to estimate emissions for these categories, fuel consumption was a more accurate predictor of changes in emissions, compared to other surrogate indicators such as earnings or population. SEDS fuel consumption data were available through 1989. The 1990 values were extrapolated from the 1985 through 1989 data using a log linear regression technique. In addition to projecting 1990 data for all fuel consumption categories, the 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.

Due to the year-to-year volatility in the SEDS fuel consumption data for the commercial residual oil fuel use category, the regression technique used above did not yield realistic projections for 1990 for this category. Therefore, a different procedure was used to project 1990 data for commercial residual oil fuel use. State-level sales volumes of residual fuel to the commercial sector were obtained from *Fuel Oil and Kerosene Sales 1990*[8] for 1989 and 1990. Each state's growth in sales of residual fuel to the commercial sector from 1989 to 1990 was applied to that state's 1989 SEDS commercial residual fuel consumption to yield a 1990 consumption estimate. A summary of SEDS national fuel consumption by fuel and sector can be found in Table 4.4-3.

The last step in the creation of the area source inventory was matching the NAPAP categories to the new AMS categories. This matching is provided in Table 4.4-4. Note that there is not always a one-to-one correspondence between NAPAP and AMS categories.

4.4.3 1990 National Emissions Trends

As described in section 4.3.3, the 1990 NET is based primarily on state data, with the Interim data filling in the data gaps. The state data were extracted from three sources: the OTAG inventory, the GCVTC inventory, and AIRS/FS. See sections 4.3.3.1 through 4.3.3.3 for discussions of the data extracting efforts using these sources, and section 4.3.3.4 for information on filling the data gaps. These discussions apply in general to the sources covered in the "Other Combustion" category. Specific exceptions are identified and discussed.

4.4.4 Emissions, 1991 through 1994

The 1991 through 1994 area source emissions were grown in a similar manner as the 1985 through 1989 estimates, except for using a different base year inventory. The base year for the 1991 through 1994 emissions is the 1990 NET inventory. The point source inventory was also grown for those states that did not want their AIRS/FS data used or did not give other instructions. For those states that requested that EPA extract their data from AIRS/FS, the years 1990 through 1995 were downloaded from the EPA IBM Mainframe. The 1996 emissions were not extracted since states are not required to have the 1996 data uploaded to AIRS/FS until July 1997. See section 4.3.4 for further descriptions of the 1991 to 1994 emissions. These descriptions apply in general to the sources in the Other Combustion category. Exceptions are noted at the end of section 4.4.

4.4.5 1995 Emissions

The 1995 emission estimates were derived in a similar manner as the 1991 through 1994 estimates. These estimates were either extracted from AIRS/FS for 1995, estimated using AIRS/FS data for the years 1990 through 1994, or projected using the 1990 NET inventory. The method used depended on the states' responses to a survey conducted by EPA in early 1997. A description of the AIRS/FS methodology is described in section 4.3.4. Section 4.3.5 describes the projected emissions. These descriptions apply in general to the sources in the Other Combustion category. Any exceptions are noted at the end of section 4.4.

4.4.6 1996 Emissions

The 1996 emissions were estimated in a similar manner as the 1995 estimates. For the non-utility point sources, the 1995 AIRS/FS emissions and 1995 emissions grown from 1990 emissions were merged. Sections 4.3.6.1 through 4.3.6.3 described the projected 1996 emissions. These descriptions apply in general to the sources in the Other Combustion category. Exceptions are noted at the end of section 4.4.

4.4.7 Alternative Base Inventory Calculations

For three combustion sources, the 1985 NAPAP inventory was not used as the base year for some or all other years. The 1985 to 1990 wildfire estimates were extracted from the GCVTC inventory.[9] The wildfire emissions for 1985 through 1990 for non-GCVTC states or missing years are based on AP-42 emission factors and fuel loading values. The activity data were derived from the USDA Forest Service and the Department of Interior. The prescribed burning estimates for the years 1985 to 1990 are the same and were obtained from the USDA. Residential wood combustion estimates are also based on AP-42 emission factors and EPA-generated activity.

4.4.7.1 Forest Fires/Wildfires

Forest fire/wildfire emissions were generated for the years 1985 through 1995 using the data on number of acres burned (obtained from the Department of the Interior (DOI)[10, 11] and the USDA Forest Service (USFS)[12, 13]), AP-42 emission factors, and AP-42 fuel loading factors.[14] The following equation summarizes the calculation:

$$E_{state} = Activity \times Fuel\ Loading \times EF \times UCF$$

where: E_{state} = annual state emissions (tons)
Activity = sum of DOI, USFS, and state and private land acres burned (acres)
Fuel Loading = average fuel loading for state (tons/acre)
EF = emission factor (lbs/ton)
UCF = unit conversion factor (1 ton /2,000 lbs)

Table 4.4-5 shows the emission factors and fuel loading for wildfires developed from AP-42. PM-2.5 emissions for 1990 through 1995 were calculated by multiplying the PM-10 emissions by 0.23.[15] Since complete data for 1996 were not available, 1996 emissions were assumed to be the same as 1995 emissions.

4.4.7.1.1 Grand Canyon States —

4.4.7.1.1.1 *Grand Canyon States (1986-1993).* For the years 1986 through 1993, for the states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming, the CO, NO_x, VOC, and PM-10 emissions calculated using the methodology described above were replaced by those included in the GCVTC inventory.[9] The GCVTC inventory provided county level emissions for forest fires in this source category. PM-2.5 emissions for 1990 were also replaced by those in the GCVTC inventory. PM-2.5 emissions for 1991 through 1995 were calculated by multiplying the PM-10 emissions by 0.23.[15] The SO_2 emissions for these states were calculated using the AP-42 emission factor ratio equation shown below. The emission factors are shown in Table 4.4-5.

$$SO_2\ Emissions = \frac{SO_2\ EF}{NO_x\ EF} \times NO_x\ Emissions$$

where: SO_2 Emissions = annual county SO_2 emissions (tons)
SO_2 EF = AP-42 emission factor for SO_x (lbs/ton)
NO_x EF = AP-42 emission factor for NO_x (lbs/ton)
NO_x Emissions = annual NO_x emissions (tons)

4.4.7.1.1.2 *Grand Canyon States (1985, 1994, 1995).* For the years 1985, 1994, and 1995, for the states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming, CO, NO_x, VOC, PM-10 and PM-2.5 emissions were calculated using the following equation:

$$County\ Emissions_{year} = \frac{State\ Activity_{year}}{State\ Activity_{1990}} \times County\ Emissions_{1990}$$

where: County $Emissions_{year}$ = annual county emissions (tons)
State Activity = DOI, state and private, and National Forest Lands burned (acres)
County $Emissions_{1990}$ = annual county emissions provided by the GCVTC (tons)

4.4.7.1.2 Activity —

The activity factor for wildfires is land acres burned. There are three sources of data for this activity: National Forest Service lands burned,[12, 13] state and private acres burned,[12, 13] and U.S. Department of the Interior acres burned.[10, 11] Data from these three sources were summed to get the total acres burned for each state.

4.4.7.1.3 Fuel Loading and Emission Factors —

AP-42 fuel loading and emission factors are shown in Table 4.4-5.[14] An average fuel loading was determined for five regions in the United States. Emission factors for SO_2, NO_x, VOC, CO, and PM-10 were used. PM-2.5 emissions were calculated by multiplying the PM-10 emissions by 0.23.[15]

4.4.7.1.4 County Distribution —

All non-GCVTC states were distributed to the county-level using the same county-level distribution as was used in the 1985 NAPAP Inventory. GCVTC provided county-level emissions for 1986 through 1993. GCVTC emissions were calculated for 1985, 1994, and 1995 using the 1990 GCVTC emissions, as described above.

4.4.7.2 Prescribed/Slash and Managed Burning

The prescribed burning emissions were based on a 1989 USDA Forest Service inventory of particulate matter and air toxics from prescribed burning.[16] The Forest Service inventory contained state-level totals for total particulate matter, PM-10, PM-2.5, CO, carbon dioxide, methane, non-methane, and several air toxics.

The emissions for all pollutants were based on the 1989 Forest Service inventory of particulate matter from prescribed burning.[16] This inventory contains state-level emissions for CO, PM-10, and VOC. The NO_x and SO_2 emissions were calculated by assuming the ratio between the CO emissions to either the NO_x or SO_2 emissions in the Forest Service inventory was equal to the corresponding ratio using the 1985 NAPAP inventory. The following formula was used:

$$FS_{POL} = FS_{CO} \times \left(\frac{NAPAP_{POL}}{NAPAP_{CO}} \right)$$

where:			
	FS_{POL}	=	prescribed burning (NO_x or SO_2) emissions from Forest Service
	FS_{CO}	=	prescribed burning CO emissions from Forest Service
	$NAPAP_{POL}$	=	prescribed burning (NO_x or SO_2) emissions from 1985 NAPAP
	$NAPAP_{CO}$	=	prescribed burning CO emissions from 1985 NAPAP

The resulting 1989 emissions for CO, NO_x, PM-10, SO_2, and VOC have been used for all years between 1985 and 1990. The pollutants were distributed to the county-level using the same county-level distribution as was used in the 1985 NAPAP inventory where forest acreage per county was obtained from local officials and state land usage maps.

4.4.7.3 Residential Wood

Emissions from residential wood combustion were estimated for 1985 through 1996 using annual wood consumption and an emission factor. The following general equation was used to calculate emissions:

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

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.[17] This model was adjusted with heating degree day information,[18] and normalized with annual wood consumption estimates.[19] 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.[20]

4.4.7.3.1 Activity - County Model —

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 northwest 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.

The counties listed below show no residential wood consumption activity. The emissions for these eighteen (18) counties for the years 1985 through 1996 are zero.

State	County
Alaska	Aleutians East Borough
Hawaii	Kalawao
Kansas	Kearny Stanton
Montana	Yellowstone National Park
Texas	Cochran Crockett Crosby Garza Hartley Jim Hogg Loving Moore Reagan Sterling Swisher Terrell Yoakum

4.4.7.3.2 Heating Degree Days —

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. The following equation is used:

$$Adjusted\ Model_{year} = \frac{State\ hdd\ Total_{year}}{State\ hdd\ Total_{1990}} \times County\ Model_{1990}$$

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

4.4.7.3.3 ***National Wood Consumption —***

The Adjusted Model wood consumption estimate was normalized on a national level using the DOE estimate of residential U.S. wood consumption. This value is reported in trillion Btu and is converted to cords by multiplying by 500,000. 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 the normalization of the Adjusted Model:

$$Activity = Adjusted\ Model_{year} \times \frac{DOE_{year}}{\sum Adjusted\ Model_{year}}$$

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

4.4.7.3.4 Emission Factors —

Emission factors were obtained from Table 1.10-1 of AP-42, *Emission Factors for Residential Wood Combustion*, for conventional wood stoves,[14] and are shown here in Table 4.4-6. Table 4.4-6 also shows the emission factors expressed in tons per cord consumed.

4.4.7.3.5 Control Efficiency —

A control efficiency was applied nationally to PM-10 and PM-2.5 residential wood combustion for the years 1991 through 1996.[20] 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. Table 4.4-7 shows the control efficiencies for PM-10 and PM-2.5 for 1991 through 1996.

4.4.8 References

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Table 4.4-1. Bureau of Economic Analysis's SA-5 National Changes in Earnings by Industry

Industry	SIC	Percent Growth from: 1985 to 1987	1987 to 1988	1988 to 1989	1989 to 1990
Wholesale trade	50, 51	5.01	5.87	2.44	-1.02
Retail trade	52 to 59	5.19	4.39	0.65	-0.94
Banking and credit agencies	60, 61	12.44	2.45	-0.33	-0.49
Insurance	63, 64	14.09	4.20	1.52	2.71
Real estate	65, 66	92.14	-6.98	-7.87	-0.48
Holding companies and investment services	67	39.05	-34.86	-12.18	16.91
Hotels and other lodging places	70	12.65	5.59	1.71	2.29
Personal services	72	7.17	2.35	7.44	5.41
Private households	88	-5.68	2.41	0.83	-3.69
Business and miscellaneous repair services	76	17.05	-17.34	5.79	4.34
Auto repair, services, and garages	75	6.65	2.46	3.00	3.93
Amusement and recreation services and motion pictures	78, 79	17.93	16.43	4.06	7.59
Health services	80	15.15	7.08	5.11	6.28
Legal services	81	20.14	9.92	4.09	4.80
Educational services	82	9.35	7.17	3.88	2.60
Social services and membership organizations	83	17.39	8.45	7.95	7.37
Miscellaneous professional services	84	11.28	5.04	7.08	4.12
Federal, civilian	91	-0.54	3.79	1.21	1.96
Federal, military	97	1.96	-1.07	-1.58	-3.19
State and local government	92 to 96	7.88	3.63	3.19	3.04

Table 4.4-2. Area Source Growth Indicators

NAPAP SCC	Category Description	Data Source	Growth Indicator
1	Residential Fuel - Anthracite Coal	SEDS	Res - Anthracite
2	Residential Fuel - Bituminous Coal	SEDS	Res - Bituminous
3	Residential Fuel - Distillate Oil	SEDS	Res - Distillate oil
4	Residential Fuel - Residual Oil		Zero growth
5	Residential Fuel - Natural Gas	SEDS	Res - Natural gas
6	Residential Fuel - Wood	BEA	Population
7	Commercial/Institutional Fuel - Anthracite Coal	SEDS	Comm - Anthracite
8	Commercial/Institutional Fuel - Bituminous Coal	SEDS	Comm - Bituminous
9	Commercial/Institutional - Distillate Oil	SEDS	Comm - Distillate oil
10	Commercial/Institutional - Residual Oil	SEDS	Comm - Residual oil
11	Commercial/Institutional - Natural Gas	SEDS	Comm - Natural gas
12	Commercial/Institutional - Wood	BEA	Services
60	Forest Wild Fires		Zero growth
61	Managed Burning - Prescribed		Zero growth
62	Agricultural Field Burning	BEA	Farm
64	Structural Fires		Zero growth
99	Minor Point Sources	BEA	Population

Table 4.4-3. SEDS National Fuel Consumption

Category	1985	1986	1987	1988	1989	1990
Anthracite Coal (thousand short tons)						
Commercial	524	494	478	430	422	410
Residential	786	740	717	646	633	615
Bituminous Coal (thousand short tons)						
Commercial	4,205	4,182	3,717	3,935	3,323	3,470
Residential	2,264	2,252	2,002	2,119	1,789	1,869
Distillate Fuel (thousand barrels)						
Commercial	107,233	102,246	101,891	98,479	91,891	95,385
Residential	171,339	173,736	176,822	182,475	178,629	184,501
Motor Gasoline (thousand barrels)						
All Sectors	2,493,361	2,567,436	2,630,089	2,685,145	2,674,669	2,760,414
Natural Gas (million cubic feet)						
Commercial	2,432	2,318	2,430	2,670	2,719	2,810
Residential	4,433	4,314	4,315	4,630	4,777	4,805
Residual Fuel (thousand barrels)						
Commercial	30,956	39,480	41,667	42,256	35,406	27,776

Table 4.4-4. AMS to NAPAP Source Category Correspondence

AMS		NAPAP	
SCC	Category	SCC	Category
Stationary Source Fuel Combustion			
2103001000	Commercial/Institutional - Anthracite Coal (Total: All Boiler Types)	7	Commercial/Institutional Fuel - Anthracite Coal
2103002000	Commercial/Institutional - Bituminous/Subbituminous Coal (Total: All Boiler Types)	8	Commercial/Institutional Fuel - Bituminous Coal
2103004000	Commercial/Institutional - Distillate Oil (Total: Boilers & I.C. Engines)	9	Commercial/Institutional - Distillate Oil
2103005000	Commercial/Institutional - Residual Oil (Total: All Boiler Types)	10	Commercial/Institutional - Residual Oil
2103006000	Commercial/Institutional - Natural Gas (Total: Boilers & I.C. Engines)	11	Commercial/Institutional - Natural Gas
2103008000	Commercial/Institutional - Wood (Total: All Boiler Types)	12	Commercial/Institutional - Wood
2104001000	Residential - Anthracite Coal (Total: All Combustor Types)	1	Residential Fuel - Anthracite Coal
2104002000	Residential - Bituminous/Subbituminous Coal (Total: All Combustor Types)	2	Residential Fuel - Bituminous Coal
2104004000	Residential - Distillate Oil (Total: All Combustor Types)	3	Residential Fuel - Distillate Oil
2104005000	Residential - Residual Oil (Total: All Combustor Types)	4	Residential Fuel - Residual Oil
2104006000	Residential - Natural Gas (Total: All Combustor Types)	5	Residential Fuel - Natural Gas
2104008000	Residential - Wood (Total: Woodstoves and Fireplaces)	6	Residential Fuel - Wood
Miscellaneous Area Sources			
2801500000	Agriculture Production - Crops - Agricultural Field Burning (Total)	62	Agricultural Field Burning
2801520000	Agriculture Production - Crops - Orchard Heaters (Total)	63	Frost Control - Orchard Heaters
2810001000	Other Combustion - Forest Wildfires (Total)	60	Forest Wild Fires
2810015000	Other Combustion - Managed (Slash/Prescribed) Burning (Total)	61	Managed Burning - Prescribed
2810030000	Other Combustion - Structure Fires	64	Structural Fires

Table 4.4-5. Wildfires

Region	Fuel loading Tons/Acre Burned
Rocky Mountain	37
Pacific	19
North Central	11
South	9
East	11

Pollutant	Emission Factor lbs/ton
TSP	17
SO_2	0.15
NO_x	4
VOC	19.2
CO	140
PM-10	13

States Comprising Regions

South	East	Rocky Mountain	North Central	Pacific
Alabama	Connecticut	Arizona	Illinois	Alaska
Arkansas	Delaware	Colorado	Indiana	California
Florida	Maine	Idaho	Iowa	Guam
Georgia	Maryland	Kansas	Michigan	Hawaii
Kentucky	Massachusetts	Montana	Minnesota	Oregon
Louisiana	New Hampshire	Nebraska	Missouri	Washington
Mississippi	New Jersey	Nevada	Ohio	
North Carolina	New York	New Mexico	Wisconsin	
Oklahoma	Pennsylvania	North Dakota		
South Carolina	Rhode Island	South Dakota		
Tennessee	Vermont	Utah		
Texas	West Virginia	Wyoming		
Virginia				

Table 4.4-6. Emission Factors for Residential Wood Combustion by Pollutant

Pollutant	Emission Factor (lbs/ton)	Emission Factor (tons/cord)
CO	230.80	1.342 E-1
NO_x	2.80	1.628 E-3
VOC	43.80	2.547 E-2
SO_2	0.40	2.326 E-4
PM-10[a]	30.60	1.779 E-2
PM-2.5[a]	30.60	1.779 E-2

[a]All PM is considered to be less than 2.5 microns.

Table 4.4-7. PM Control Efficiencies for 1991 through 1996

Year	Control Efficiency (%)
1991	1.4
1992	2.8
1993	4.8
1994	6.8
1995	8.8
1996	10.8

4.5 SOLVENT UTILIZATION

Solvent utilization emissions are included as both point and area sources in the Emission Trends inventory. Point source emissions were based on the 1985 NAPAP inventory (see section 4.5.2). The basis for the VOC area source component is a material balance on total nationwide solvent consumption. (There are no area source CO, NO_x, SO_2, and PM emissions in the NET inventory.) Total nationwide solvent emissions by end-use category are estimated from national consumption figures with some adjustments to account for air pollution controls and waste management practices. The nationwide emissions are then apportioned to states and counties using census data and information on state and local regulations pertaining to solvent emissions. County- and category-level point source emissions are then subtracted from the emission totals, and the remaining emissions are included in the area source solvent inventory. Section 4.5.1 describes the development of national solvent emissions, apportionment to states and counties, and short-term projections to the time periods covered by the NET inventory.

4.5.1 Area Source Emissions (VOC only)

Volatile organic compound emissions are estimated for area sources by first estimating national total emissions that are distributed to county and end user, described in this section, and then subtracting the point source emissions, described in section 4.5.2.

4.5.1.1 Overall National Emissions Estimates

The overall national solvents material balance can be summarized as follows:

National solvent emissions (by end-use category) = *National solvent consumption* - *Solvents destroyed by air pollution controls* - *Solvents conveyed to waste management operations*

Note that this overall national material balance yields total solvent emissions, including both point and area sources.

National solvent usage estimates by end-use category were obtained from three main sources. For paints and coatings, the main source was the U.S. Paint Industry Data Base, prepared by SRI International for the National Paint and Coatings Association.[1] Solvent usage estimates for other categories were obtained from industrial solvent marketing reports.[2,3] The base year for this activity data and for the total solvent emissions is 1989.

The solvent emission methodology is designed to incorporate pollution control and waste management information at the source category level. However, the timeframe for the NET inventory effort was too tight to permit development of category-specific information. The mass balance term for waste management was based on the EPA's database[4] for TSDFs, which also forms the basis for the TSDF portion of the NET inventory. (See section 4.3.1.5 for details on TSDF emissions.) In essence, the portion of the TSDF inventory that is attributable to solvents is deducted from the current solvents inventory in order to avoid double-counting. The TSDF deduction was apportioned evenly to all industrial categories, and amounts to about 21 percent of total solvent usage in these categories.

Solvent destruction adjustments in the nationwide material balance were based on the same assumptions used for the 1985 National Emissions Data System (NEDS) and the 1985 NAPAP inventory. According to the data in NEDS and 1985 NAPAP inventory, approximately 16 percent of industrial surface coating emissions are assumed to be destroyed in air pollution controls.

Table 4.5-1 lists the elements in the national solvent material balance by emission source category. As discussed above, these elements are: national solvent consumption, solvent destroyed in air pollution controls, solvent sent to waste management operations, and net solvent emissions. Table 4.5-1 also summarizes the major sources of these data.

4.5.1.2 Distribution of Solvent Emissions to States and Counties

The primary tools used to distribute national solvent emissions to states and counties are 1988 census data bases.[5,6,7] For each of the source categories listed in Table 4.5-1, state- and county-level solvent usage is assumed to be proportional to a particular census measure. For consumer end-use categories, solvent usage was distributed based on population. County-level employment data were used for commercial and industrial end-use categories. Census data on the number of farm acres treated with chemical sprays were used to distribute pesticide solvent usage. Table 4.5-2 lists the specific census data used for each emission category.

State and local regulations covering solvent emissions were also incorporated in the spatial distribution step for the solvent inventories. For an industrial or commercial end-use category, the overall spatial distribution calculation can be summarized as follows:

$$\text{County emissions (by end-use category)} = \text{National emissions} \times \frac{\text{County employment}}{\text{National employment}} \times \frac{\text{Estimated control efficiency for county}}{\text{Nationwide average control efficiency for category}}$$

Quantitative information on state- and county-level control efficiency, rule effectiveness, and rule penetration was obtained primarily from surveys carried out under EPA's ROM modeling effort.[8] For states outside the ROM domain, these parameters were estimated using Bureau of National Affairs regulation summaries.

4.5.1.3 Deduction of Point Source Emissions

The area source inventory is produced by deducting point source emissions from the county-level category emission totals produced in equation 2. The calculation is performed as follows:

$$\text{County-level area source emissions (by end-use category)} = \text{Total county-level emissions (equation 2)} - \text{County-level point source emissions}$$

The AIRS/AMS solvent categories were first matched to the corresponding point source SCCs. Using the 1990 Interim Inventory point source totals by county for each corresponding AMS SCC were calculated. These emissions were then subtracted from the total solvent emissions (the 1989 total solvent emissions were projected to 1990 as described below) to yield the area source emissions. In the cases of negative emissions (higher point source emissions than total estimated solvent emissions), the 1985 NAPAP methodology[9] was followed — area source emissions were set to zero.

Then the non-zero county values were readjusted so that the sum of all county area source emissions equal the difference between the total national emissions and the national point source emissions; otherwise, area source emissions are underestimated.

$$\sum \begin{matrix} \textit{All County} \\ \textit{Area Source} \\ \textit{Emissions} \end{matrix} = \begin{matrix} \textit{National} \\ \textit{Total} \\ \textit{Emissions} \end{matrix} - \begin{matrix} \textit{National} \\ \textit{Point Source} \\ \textit{Emissions} \end{matrix}$$

4.5.1.4 Projecting Solvent Emissions to Other Inventory Years

The total solvent inventory was based on 1989 activity- level data. (Spatial allocations for the solvent area source inventory were based on the 1988 census, which provides the most recent data available at the county level.) Projections to other years (1985 to 1990) are based on state-level earnings data for major industrial categories, which generally correspond to two-digit SICs. The following algorithm is used for the emission projection:

$$\begin{matrix} \text{Projection year emissions} \\ \text{(by county and end-use} \\ \text{category)} \end{matrix} = \begin{matrix} \text{Base year} \\ \text{emissions} \end{matrix} \times \frac{\text{Projection year earnings (by state and 2-digit SIC)}}{\text{Base year earnings}}$$

In this equation, the projection year represents the appropriate calendar year for the Emission Trends inventory (ranging from 1985 to 1990). The total solvent inventory was first projected to 1990 to complete the point source deduction described above. After deducting the point source solvents, this 1990 area source solvent data base was then scaled-back/projected to the other inventory years.

The county/source category emissions predicted using changes in BEA earnings data were then scaled according to expected changes in national solvent emissions. Annual changes in national solvent usage (by end-use category) were taken from the solvent marketing reports.[2,3] All county-level emissions within an end-use category were scaled by a factor so that total national emissions would be equivalent to the national solvent emissions reported in the literature.

4.5.2 Point Source Emissions

The 1990 Interim Inventory emissions for these source categories were generated from the point source portion of the 1985 NAPAP inventory. These 1990 emissions served as the base year from which the emissions for the years 1985 through 1989 were estimated. The emissions for the years 1985 through 1990 were estimated using historical data compiled by the BEA[10] or historic estimates of fuel consumption based on the SEDS.[11]

4.5.2.1 1990 Interim Inventory

The 1985 NAPAP inventory estimates for the point sources have been projected to the year 1990 based on the growth in BEA historic earnings for the appropriate state and industry,[10] as identified by the two-digit SIC code.[10] To remove the effects of inflation, the earnings data were converted to 1982 constant dollars using the implicit price deflator for PCE.[12] State and SIC-level growth factors were calculated as the ratio of the 1990 earnings data to the 1985 earnings data. Additional information on point source growth indicators is presented in section 4.5.2.2.

When creating the 1990 emission inventory, changes were made to emission factors, control efficiencies, and emissions from the 1985 inventory for all sources. The PM-10 control efficiencies were obtained from the *PM-10 Calculator.*[13] In addition, rule effectiveness which was not applied in the 1985 NAPAP inventory, was applied to the 1990 emissions estimated for the point sources. The CO, NO_x, and VOC point source controls were assumed to be 80 percent effective; PM-10 and SO_2 controls were assumed to be 100 percent effective.

The 1990 emissions for CO, NO_x, SO_2, and VOC were calculated using the following steps: (1) projected 1985 controlled emissions to 1990 using the appropriate growth factors, (2) calculated the uncontrolled emissions using control efficiencies from the 1985 NAPAP inventory, and (3) calculated the final 1990 controlled emissions using revised control efficiencies and the appropriate rule effectiveness. The 1990 PM-10 emissions were calculated using the TSP emissions from the 1985 NAPAP inventory. The 1990 uncontrolled TSP emissions were estimated in the same manner as the other pollutants. The 1990 uncontrolled PM-10 estimates were calculated from these TSP emissions by applying SCC-specific uncontrolled particle size distribution factors.[14] The controlled PM-10 emissions were estimated in the same manner as the other pollutants. Because the majority of area source emissions for all pollutants represented uncontrolled emissions, the second and third steps were not required to estimate the 1990 area source emissions.

4.5.2.1.1 Control Efficiency Revisions —

In the 1985 NAPAP point source estimates, control efficiencies for VOC, NO_x, CO, and SO_2 sources in Texas were judged to be too high for their process/control device combination. These high control efficiencies occurred because Texas did not ask for control efficiency information, and simply applied the maximum efficiency for the reported control device. High control efficiencies lead to high future growth in modeling scenarios based on uncontrolled emissions (which are based on the control efficiency and reported actual emissions). High control efficiencies also lead to extreme increases in emissions when rule effectiveness is incorporated.

Revised VOC control efficiencies were developed for Texas for the ERCAM-VOC.[15] For this analysis, revised efficiencies were also developed by SCC and control device combination for NO_x, SO_2, and CO using engineering judgement. These revised control efficiencies were applied to sources in Texas. A large number of point sources outside of Texas had VOC and CO control efficiencies that were also judged to be too high. The VOC and CO control efficiencies used for Texas were also applied to these sources.

4.5.2.1.2 Rule Effectiveness Assumptions —

Controlled emissions for each inventory year were recalculated, assuming that reported VOC, NO_x, and CO controls were 80 percent effective. Sulfur dioxide and PM-10 controls were assumed to be 100 percent effective.

4.5.2.1.3 Emissions Calculations —

A three-step process was used to calculate emissions incorporating rule effectiveness. First, base year controlled emissions are projected to the inventory year using the following equation (Equation 4.5-1):

$$CE_i = CE_{BY} + (CE_{BY} \times EG_i)$$

where:
- CE_i = controlled emissions for inventory year i
- CE_{BY} = controlled emissions for base year
- EG_i = earnings growth for inventory year i

Earnings growth is calculated using Equation 4.5-2:

$$EG_i = 1 - \frac{DAT_i}{DAT_{BY}}$$

where:
- EG_i = earnings growth for year i
- DAT_i = earnings data for inventory year i
- DAT_{BY} = earnings data in the base year

Second, uncontrolled emissions in the inventory year are back-calculated from the controlled emissions based on the control efficiency using Equation 4.5-3:

$$UE_i = \frac{CE_i}{\left(1 - \frac{CEFF}{100}\right)}$$

where:
- UE_i = uncontrolled emissions for inventory year i
- CE_i = controlled emissions for inventory year i
- $CEFF$ = control efficiency (percent)

Third, controlled emissions are recalculated incorporating rule effectiveness using the following equation (Equation 4.5-4):

$$CER_i = UC_i \times \left(1 - \left(\frac{REFF}{100}\right) \times \left(\frac{CEFF}{100}\right)\right)$$

where:
- CER_i = controlled emissions incorporating rule effectiveness
- UC_i = uncontrolled emissions
- $REFF$ = rule effectiveness (percent)
- $CEFF$ = control efficiency (percent)

4.5.2.2 Emissions, 1985 to 1989

As explained in section 4.5.2.1.3, the 1990 controlled emissions were projected from the 1985 NAPAP inventory using Equations 4.5-1 through 4.5-2. For all other years (1985 to 1989), the emissions were projected from the 1990 emissions using Equations 4.5-1 and 4.5-2. Therefore, the 1985 emissions estimated by this method do not match the 1985 NAPAP inventory due to the changes made in control efficiencies and emission factors and the addition of rule effectiveness when creating the 1990 base year inventory. For refueling sources the emissions were adjusted to account for the updated emission factors for all years as described in section 4.5.2.1.3.

The changes in the point source emissions were equated with the changes in historic earnings by state and industry. Emissions from each point source in the 1985 NAPAP inventory were projected to the years 1985 through 1990 based on the growth in earnings by industry (two-digit SIC code). Historical annual state and industrial earnings data from BEA's Table SA-5 (Reference 11) were used to represent growth in earnings from 1985 through 1990.

The 1985 through 1990 earnings data in Table SA-5 are expressed in nominal dollars. To estimate growth, these values were converted to constant dollars to remove the effects of inflation. Earnings data for each year were converted to 1982 constant dollars using the implicit price deflator for PCE.[12] The PCE deflators used to convert each year's earnings data to 1982 dollars are:

Year	1982 PCE Deflator
1985	111.6
1987	114.3
1988	124.2
1989	129.6
1990	136.4

Several BEA categories did not contain a complete time series of data for the years 1985 through 1990. Because the SA-5 data must contain 1985 earnings and earnings for each inventory year (1985 through 1990) to be useful for estimating growth, a log linear regression equation was used where possible to fill in missing data elements. This regression procedure was performed on all categories that were missing at least one data point and which contained at least three data points in the time series.

Each record in the point source inventory was matched to the BEA earnings data based on the state and the two-digit SIC. Table 4.5-3 shows the BEA earnings category used to project growth for each of the two-digit SICs found in the 1985 NAPAP inventory. No growth in emissions was assumed for all point sources for which the matching BEA earnings data were not complete. Table 4.5-3 also shows the national average growth and earnings by industry from Table SA-5.

4.5.3 1990 National Emissions Trends

As described in section 4.3.3, the 1990 NET is based primarily on state data, with the Interim data filling in the data gaps. The state data were extracted from three sources: the OTAG inventory, the GCVTC inventory, and AIRS/FS. See sections 4.3.3.1 through 4.3.3.3 for discussions of the data extracting efforts using these sources, and section 4.3.3.4 for information on filling the data gaps. These discussions apply in general to the sources covered in the Solvent Utilization category. Specific exceptions are identified and discussed.

4.5.4 Emissions, 1991 through 1994

The 1991 through 1994 area source emissions were grown in a similar manner as the 1985 through 1989 estimates, except for using a different base year inventory. The base year for the 1991 through 1994 emissions is the 1990 NET inventory. The point source inventory was also grown for those states that did not want their AIRS/FS data used or did not give other instructions. For those states that requested that EPA extract their data from AIRS/FS, the years 1990 through 1995 were downloaded from the EPA IBM Mainframe. The 1996 emissions were not extracted since states are not required to have the 1996 data uploaded to AIRS/FS until July 1997. See section 4.3.4 for further descriptions of the 1991 to 1994 emissions. These descriptions apply in general to the sources in the Solvent Utilization category. Specific exceptions are noted.

4.5.5 1995 Emissions

The 1995 emission estimates were derived in a similar manner as the 1991 through 1994 estimates. These estimates were either extracted from AIRS/FS for 1995, estimated using AIRS/FS data for the years 1990 through 1994, or projected using the 1990 NET inventory. The method used depended on the states' responses to a survey conducted by EPA in early 1997. A description of the AIRS/FS methodology is described in section 4.3.4. Section 4.3.5 describes the projected emissions. These descriptions apply in general to the sources in the Solvent Utilization category. Specific exceptions are noted.

4.5.6 1996 Emissions

The 1996 emissions were estimated in a similar manner as the 1995 estimates. For the non-utility point sources, the 1995 AIRS/FS emissions and 1995 emissions grown from 1990 emissions were merged. Sections 4.3.6.1 through 4.3.6.3 described the projected 1996 emissions. These descriptions apply in general to the sources in the Solvent Utilization category. Specific exceptions are noted.

4.5.7 References

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15. E.H. Pechan & Associates, Inc., *National Assessment of VOC, CO, and NO_x Controls, Emissions, and Costs*, prepared for U.S. Environmental Protection Agency, Office of Policy Planning and Evaluation, Washington, DC, September 1988.

Table 4.5-1. National Material Balance for Solvent Emissions

Category	Description	Solvent Usage (1,000 tpy)	Percent Destroyed by Air Pollution Controls[1]	Percent Sent to TSDFs[2]	Estimated Emissions (1,000 tpy)	Source
Surface Coating						
2401001	Architectural	503	0	0	503	SRI International/ National Paint and Coatings Institute
2401005	Auto refinishing	133	0	0	133	
2401008	Traffic markings	106	0	0	106	
2401015	Flat wood coating	5	16	21	3	
2401020	Wood furniture	221	16	21	139	
2401025	Metal furniture	70	16	21	44	
2401030	Paper coating	33	16	21	21	
2401040	Can coating	156	16	21	99	
2401045	Coil coating	58	16	21	37	
2401055	Electrical insulation	48	16	21	30	
2401060	Appliances	34	16	21	21	
2401065	Machinery	130	16	21	82	
2401070	Motor vehicles (new)	134	16	21	85	
2401075	Aircraft coating	11	16	21	7	
2401080	Marine paints	29	16	21	18	
2401085	Rail equip. coating	6	16	21	4	
2401090	Misc. manufacturing	210	16	21	132	
2401100	Industrial maintenance	99	0	21	78	
2401200	Aerosols, spec. purpose	173	0	21	137	
Vapor Degreasing (Conveyorized and Open-Top)						
2415105	Furniture	9	0	21	7	Total category number from Frost & Sullivan. Industry breakdowns from EPA BDAT Report for spent solvents.
2415110	Metallurgical proc.	29	0	21	23	
2415120	Fabricated metals	97	0	21	76	
2415125	Industrial machinery	100	0	21	79	
2415130	Electrical equipment	98	0	21	77	
2415135	Transportation equip.	36	0	21	28	
2415140	Instrument mfg.	48	0	21	38	
2415145	Misc. manufacturing	17	0	21	13	
Cold Cleaner Degreasing						
2415305	Furniture	12	0	21	9	Total category number from Frost & Sullivan. Industry breakdowns from EPA BDAT Report for spent solvents.
2415310	Metallurgical proc.	8	0	21	7	
2415320	Fabricated metals	38	0	21	30	
2415325	Industrial machinery	52	0	21	41	
2415330	Electrical equipment	16	0	21	12	
2415335	Transportation equip.	12	0	21	9	
2415340	Instruments	8	0	21	6	
2415345	Misc. manufacturing	19	0	21	15	
2415355	Automobile dealers	191	0	21	151	
2415360	Automobile repair	70	0	21	55	
2415365	Other	5	0	21	4	
Other Categories						
2420010	Drycleaning (perc.)	135	0	21	107	Frost & Sullivan
2420010	Drycleaning (petroleum)	134	0	21	105	Frost & Sullivan
2420020	Coin-op drycleaning	2	0	21	1	Frost & Sullivan
2425000	Graphic arts	276	16	21	174	Frost & Sullivan
2430000	Rubber/plastics	48	16	21	30	Frost & Sullivan
2440020	Adhesives - industrial	460	0	21	363	Freedonia Group
2461021	Cutback asphalt	200	0	0	200	Asphalt Institute
2461800	Pesticides - farm	260	0	0	260	Freedonia Group
2465100	Personal products	228	0	0	228	Frost & Sullivan
2465200	Household products	186	0	0	186	Frost & Sullivan
2465400	Automotive products	650	0	0	650	Freedonia Group
2465600	Adhesives - Comml.	350	0	0	350	Frost & Sullivan

[1]Based on the 1985 NEDS methodology. Does not include solvents that are captured and recycled.
[2]Calculated based on the TSDF sector of the 1985 NAPAP Inventory.

Table 4.5-2. Data Bases Used for County Allocation

AMS Category	Description	Allocation Data (from the Census)
Surface Coating		
2401001	Architectural	Population
2401005	Auto refinishing	Employment in SIC 7532
2401008	Traffic markings	Population
2401015	Flat wood coating	Employment in SIC 2430
2401020	Wood furniture	Employment in SIC 25
2401025	Metal furniture	Employment in SIC 25
2401030	Paper coating	Employment in SIC 26
2401040	Can coating	Employment in SIC 341
2401045	Coil coating	Employment in SIC 344
2401055	Electrical insulation	Employment in SIC 36
2401060	Appliances	Employment in SIC 363
2401065	Machinery	Employment in SIC 35
2401070	Motor vehicles (new)	Employment in SIC 371
2401075	Aircraft coating	Employment in SIC 372
2401080	Marine paints	Employment in SIC 373
2401085	Rail equip. coating	Employment in SIC 374
2401090	Misc. manufacturing	Employment in SIC 20-39
2401100	Industrial maintenance	Employment in SIC 20-39
2401200	Aerosols, spec. purpose	Population
Vapor Degreasing (Conveyorized and Open-Top)		
2415105	Furniture	Employment in SIC 25
2415110	Metallurgical proc.	Employment in SIC 33
2415120	Fabricated metals	Employment in SIC 34
2415125	Industrial machinery	Employment in SIC 35
2415130	Electrical equipment	Employment in SIC 36
2415135	Transportation equip.	Employment in SIC 37
2415140	Instrument mfg.	Employment in SIC 38
2415145	Misc. manufacturing	Employment in SIC 39
Cold Cleaner Degreasing		
2415305	Furniture	Employment in SIC 25
2415310	Metallurgical proc.	Employment in SIC 33
2415320	Fabricated metals	Employment in SIC 34
2415325	Industrial machinery	Employment in SIC 35
2415330	Electrical equipment	Employment in SIC 36
2415335	Transportation equip.	Employment in SIC 37
2415340	Instruments	Employment in SIC 38
2415345	Misc. manufacturing	Employment in SIC 39
2415355	Automobile dealers	Employment in SIC 55
2415360	Automobile repair	Employment in SIC 75
2415365	Other	Employment in SIC 22
Other Categories		
2420010	Drycleaning (perc.)	Employment in SIC 7216
2420010	Drycleaning (petroleum)	Employment in SIC 7216
2420020	Coin-op drycleaning	Employment in SIC 7215
2425000	Graphic arts	Employment in SIC 27
2430000	Rubber/plastics	Employment in SIC 30
2440020	Adhesives - industrial	Employment in SIC 20-39
2461021	Cutback asphalt	Population
2461800	Pesticides - farm	Farm acres treated with sprays
2465100	Personal products	Population
2465200	Household products	Population
2465400	Automotive products	Population
2465600	Adhesives - Comml.	Population

Table 4.5-3. Bureau of Economic Analysis's SA-5 National Changes in Earnings by Industry

Industry	SIC	Percent Growth from: 1985 to 1987	1987 to 1988	1988 to 1989	1989 to 1990
Farm	01, 02	14.67	-2.73	14.58	-3.11
Agricultural services, forestry, fisheries, and other	07, 08, 09	23.58	5.43	1.01	2.48
Coal mining	11	-17.46	-6.37	-4.16	4.53
Metal mining	10	-3.03	18.01	8.94	4.56
Nonmetallic minerals, except fuels	14	2.33	3.74	-2.79	-0.45
Construction	15	7.27	4.81	-1.36	-3.80
Food and kindred products	20	1.67	1.34	-1.20	-0.24
Textile mill products	22	8.50	-0.64	-1.39	-4.97
Apparel and other textile products	23	-1.72	1.25	-1.62	-4.22
Paper and allied products	26	2.62	0.94	-0.14	-0.39
Printing and publishing	27	7.44	5.67	-0.81	0.43
Chemicals and allied products	28	1.75	6.94	0.32	1.61
Petroleum and coal products	29	-10.82	-3.22	-3.02	1.06
Tobacco manufactures	21	-1.97	2.43	-2.43	-5.01
Rubber and miscellaneous plastic products	30	5.27	5.51	0.68	-0.14
Leather and leather products	31	-9.39	-1.64	-3.58	-2.55
Lumber and wood products	24	10.03	5.15	-3.54	-3.71
Furniture and fixtures	25	6.82	2.35	-1.46	-2.98
Primary metal industries	33	-9.09	5.32	-0.34	-3.03
Fabricated metal products	34	-4.52	2.55	-0.86	-1.91
Machinery, except electrical	35	-5.72	6.02	-0.32	-1.92
Electric and electronic equipment	36	-3.17	-18.01	-1.91	-3.22
Transportation equipment, excluding motor vehicles	37	8.44	-1.57	0.55	-1.07
Motor vehicles and equipment	371	-6.45	2.20	-2.96	-5.43
Stone, clay, and glass products	32	-0.23	-1.61	-1.96	-3.19
Instruments and related products	38	-0.04	60.65	-0.82	-2.91
Miscellaneous manufacturing industries	39	1.84	6.92	-2.21	-2.54
Railroad transportation	40	-14.13	-2.53	-3.83	-6.03
Trucking and warehousing	42	5.63	3.26	-0.20	0.99
Water transportation	44	-8.92	0.07	-1.02	2.83
Local and interurban passenger transit	41	13.45	0.51	2.14	1.44
Transportation by air	45	12.01	4.63	4.94	4.36
Pipelines, except natural gas	46	-5.21	3.67	-4.93	3.53
Transportation services	47	15.92	8.52	4.60	4.97
Communication	48	1.94	0.68	-2.81	2.07
Electric, gas, and sanitary services	49	0.07	3.05	0.63	0.39

4.6 HIGHWAY VEHICLES

Highway vehicle emissions were calculated using a consistent methodology for all years from 1970 through 1993. Emissions were calculated by month, county, road type, and vehicle type for each of these years. Emissions of VOC, NO_x, and CO were calculated using monthly state-level emission factors from MOBILE5a by vehicle type while PM-10 and SO_2 emissions were calculated using national annual emission factors by vehicle type. This section of the procedures document discusses the methodology used for calculating highway vehicle emissions.

The activity factor that is used to estimate highway vehicle emissions is VMT. The first section of this chapter discusses the development of the VMT database. The next section of this chapter discusses the development of the inputs used for the MOBILE5a modeling. Estimation of the PM-10 and SO_2 emission factors are discussed next. Finally, the emission calculation procedure is discussed.

4.6.1 VMT

Using state totals for each year, VMT were allocated by county, roadway type, and vehicle type for each year between 1970 and 1993. Each state and county combination in the output files has 96 assigned SCCs representing the 6 rural and 6 urban roadway types, and 8 vehicles types. The methodology used for calculation VMT from (1) 1980 to 1992 differs from the methodology used for calculation mileage totals from (2) 1970 to 1979 and for (3) 1993. Each of the three approaches is described separately below.

4.6.1.1 Background on Highway Performance Monitoring System

The following sections describe the information contained with in Highway Performance Monitoring System (HPMS) and the problems with using this information.

4.6.1.1.1 Description of HPMS —

HPMS[1] is a national data collection and reporting system administered by the U.S. Department of Transportation (DOT), Federal Highway Administration (FHWA) in cooperation with state highway programs. The HPMS contains data on the mileage, extent, and usage of the various functional road systems, the condition and performance of pavements, physical attributes of roads, road capacity and improvement needs, and other data important to the structural integrity and operation of the nation's road systems. The data that make up HPMS are submitted to FHWA annually by each state highway program.

The HPMS has three main data components: (1) the universe data base, (2) the sample data base (a subset of the universe data base), and (3) the areawide data base. The universe data base contains a complete inventory of all mileage for all functional systems, except local roads. The sample data base contains more detailed information for a subset of the highway sections in the universe data base. Each record in the sample data base is part of a sample panel which can be expanded to represent the universe of highway mileage. The areawide data base contains annual state-level summaries of the major components of HPMS. Most of the state-level data in the areawide data base are divided into rural, small urban, and individualized urban area components. Table 4.6-1 illustrates the main data components of HPMS and the type of data they contain.

The travel data in HPMS are of great interest in estimating VMT. HPMS travel data are based on samples of daily traffic counts taken at various points in a state's roadway network. These daily traffic counts are expanded to annual average daily traffic (AADT). To calculate VMT for a specific section of road, the AADT for that section of road is multiplied by the road length[2].

*4.6.1.1.2 **Problems with Using HPMS to Estimate VMT —***

There are several complexities associated with using HPMS data to estimate VMT for this inventory. The county is the basic geographic unit in the 1990 Emission Trends inventory, while all data in HPMS are divided into rural, small urban, and individualized urban geographic areas. In order to use the HPMS data, a mechanism to distribute VMT from a rural, small urban, and individual urban area level to a county level had to be developed. In addition, the level of detail of reporting in the sample data base (the most detailed data base which contained VMT information) varied from state to state. Some states reported data for each individual urban area, some states reported data for all individual urban areas together, and some states reported data separately for some individual urban areas and reported data for the remaining individual urban areas together. This made distributing VMT from the sample data base to counties a difficult task. In the areawide data base, however, all states reported data for individual urban areas separately. Finally, travel data for local road systems were only contained in the areawide data base. Given the problems described above and the limited timeframe of the project, the areawide data base was used to generate county-level VMT estimates. The methodology used to generate county-level VMT estimates is described below.

4.6.1.2 Distribution of HPMS VMT, 1980 to 1992

The FHWA supplied the latest mileage and daily travel summary areawide records that were reported for the HPMS for the period 1980 through 1992. The HPMS files contain state-level summaries of miles of daily travel by functional system and by rural, small urban (population of 5,000 to 49,999), and individual urbanized (population of 50,000 and more) areas. Rural DVMT is provided on a state level for the following six roadway types: Principal arterial-interstate, other principal arterial , minor arterial, major collector, minor collector, and local. Small urban and urban area DVMT are provided for the following six roadway types: principal; arterial - interstate, principal arterial - other freeways and expressways, other principal arterial, minor arterial, collector, and local.

VMT from the HPMS areawide data base was distributed to counties based on each county's rural, small urban, and urbanized area population. Two tables in the Bureau of the Census 1980 Number of Inhabitants (CNOI) documents[3] were used as the source for population data. The 1980 population data had to be used to allocate the VMT because the Census Urbanized Area boundaries were changed for the 1990 census. Although not exactly the same, the large urban area boundaries used in HPMS are based on the 1980 Census Urbanized Area boundaries. Use of the 1990 Census Urbanized Area boundaries would prevent a one-to-one match between HPMS large, urban-area VMT and urbanized area population, making VMT distribution difficult.

The two CNOI tables used to distribute VMT to counties are:

Table 3: **Population of Counties by Urban and Rural Residence.** This table lists the urban population living inside census-defined urbanized areas, the urban population living outside census-defined urbanized areas, and the rural population for each county.

Table 13: **Population of Urban Areas.** This table divides an urbanized area's population among the counties that contain portions of that urbanized area.

County-level rural VMT, small urban VMT, and urbanized area VMT were calculated separately using the following methodology. The methodology described below was performed for each functional road system.

4.6.1.2.1 Rural VMT —

step 1. The percentage of the state's rural population in each county was calculated using county rural population data from CNOI Table 3.

step 2. Each county's rural VMT was calculated by distributing state rural VMT from the HPMS areawide data base, based on the percentage of the state's rural population in each county using the following equation:

$$VMT_{R,C} = VMT_{R,S} \times \frac{POP_{R,C}}{POP_{R,S}}$$

where:
$VMT_{R,C}$ = rural VMT in county C (calculated)
$VMT_{R,S}$ = rural VMT, state total (HPMS)
$POP_{R,C}$ = rural population in county C (CNOI)
$POP_{R,S}$ = rural population, state total (CNOI)

4.6.1.2.2 Small Urban VMT —

step 1. The percentage of the state's small urban population in each county was calculated using county urban population living outside census-defined urbanized areas from CNOI Table 3.

step 2. Each county's small urban VMT was calculated by distributing state small urban VMT from the HPMS areawide data base based on the percentage of the state's small urban population in each county using the following equation:

Table 4.3-1. SCCs With 100 Percent CO Rule Effectiveness

SCC	Process
30300801	Primary Metals Production - Iron Production - Blast Furnaces
30300913	Primary Metals Production -Steel Production - Basic Oxygen Furnace: Open Hood-Stack
30300914	Primary Metals Production -Steel Production - Basic Oxygen Furnace: Closed Hood-Stack
30500401	Mineral Products - Calcium Carbide - Electric Furnace (Hoods and Main Stack)
30600201	Petroleum Industry - Fluid Catalytic Cracking Units
31000205	Oil and Gas Production - Natural Gas Production - Flares
31000299	Oil and Gas Production - Natural Gas Production - Other Not Classified
39000689	In-Process Fuel Use - Natural Gas - General
39000797	In-Process Fuel Use - Process Gas - General

Table 4.3-2. July RVPs Used to Model Motor Vehicle Emission Factors

State	State Reid Vapor Pressure (psi)				
	1987	1988	1989	1990	1991
AL	10.8	10.9	8.9	8.5	8.5
AZ	8.6	8.3	8.2	8.1	8.2
AR	10.2	9.8	9.4	8.7	8.5
CA	8.6	8.5	8.4	8.1	8.2
CO	9.7	9.4	8.7	8.3	8.4
CT	10.9	11.0	8.6	8.3	8.3
DE	11.3	10.8	9.2	8.4	8.3
DC	11.0	10.8	9.1	8.2	8.1
FL	10.2	10.5	9.0	9.1	9.1
GA	10.5	10.7	8.6	8.5	8.3
ID	10.1	9.9	9.5	9.1	9.4
IL	11.1	10.6	9.5	8.6	8.8
IN	11.6	11.1	9.6	8.7	9.0
IA	10.5	10.3	9.7	9.6	9.8
KS	9.8	9.6	9.1	8.5	8.6
KY	11.3	10.9	9.5	8.7	8.8
LA	10.4	11.0	8.6	8.3	8.4
ME	10.8	11.0	8.6	8.3	8.3
MD	11.2	10.8	9.1	8.3	8.2
MA	10.8	11.0	8.6	8.3	8.3
MI	11.7	11.0	9.8	9.1	9.3
MN	10.5	10.3	9.7	9.6	9.8
MS	10.2	9.8	9.4	8.7	8.5
MO	10.0	9.7	9.3	8.6	8.6
MT	9.3	9.5	9.3	8.6	9.2
NE	10.2	9.9	9.4	9.1	9.2
NV	8.6	8.5	8.3	8.2	8.3
NH	10.8	11.0	8.6	8.3	8.3
NJ	11.3	10.9	9.0	8.4	8.3
NM	9.0	8.5	8.2	8.1	8.1
NY	11.2	11.0	8.7	8.3	8.4
NC	10.5	10.7	8.6	8.5	8.3
ND	10.5	10.3	9.7	9.6	9.8
OH	11.6	11.4	9.8	9.6	9.7
OK	9.9	9.7	8.7	8.2	8.4
OR	9.7	9.4	9.1	8.9	9.0
PA	11.4	10.9	9.3	8.6	8.5
RI	10.8	11.0	8.6	8.3	8.3
SC	10.5	10.7	8.6	8.5	8.3
SD	10.5	10.3	9.7	9.6	9.8
TN	10.4	10.5	8.8	8.5	8.3
TX	9.8	9.6	8.4	8.0	8.2
UT	9.7	9.4	8.7	8.3	8.4
VT	10.8	11.0	8.6	8.3	8.3
VA	10.9	10.8	9.0	8.3	8.1
WA	10.8	10.2	9.7	9.6	9.7
WV	11.4	11.2	9.6	9.1	9.1
WI	11.4	10.9	9.6	8.8	9.0
WY	9.5	9.4	9.0	8.4	8.8

Source: *Developed from July MVMA Fuel Volatility Surveys*

Table 4.3-3. 1990 Seasonal RVP (psi) by State

State	Winter	Spring	Summer	Fall
AL	12.8	10.3	9.1	9.7
AZ	10.1	8.5	8.1	8.3
AR	13.4	10.7	8.7	10.9
CA	12.3	10.1	8.1	8.7
CO	11.5	9.6	8.5	9.3
CT	13.2	10.2	8.3	10.2
DE	13.9	10.5	8.4	9.4
DC	12.2	9.1	8.2	9.1
FL	11.9	9.1	9.1	9.1
GA	12.5	10.2	9.1	9.6
ID	12.5	10.5	9.1	9.5
IL	13.7	10.5	8.6	9.6
IN	13.8	10.6	8.7	9.7
IA	13.4	11.2	10.0	11.2
KS	12.5	9.5	8.5	9.0
KY	12.9	9.6	8.7	9.6
LA	12.2	10.0	8.9	9.4
ME	13.1	10.1	8.3	10.1
MD	13.4	10.2	8.3	9.3
MA	13.1	10.1	8.3	10.1
MI	13.8	10.9	9.1	10.9
MN	13.4	11.0	9.6	10.3
MS	13.4	10.7	9.4	10.0
MO	12.4	10.7	8.6	10.2
MT	13.1	10.1	8.6	10.1
NE	13.0	10.5	9.1	9.5
NV	10.9	8.8	8.2	8.5
NH	13.1	10.1	8.3	10.1
NJ	13.8	10.5	8.4	10.5
NM	11.6	9.0	8.1	9.3
NY	13.4	10.2	8.3	10.2
NC	12.5	11.0	9.1	10.4
ND	13.4	11.8	9.6	10.9
OH	13.9	11.2	9.6	10.4
OK	13.1	9.6	8.2	8.9
OR	12.4	10.4	8.8	9.6
PA	13.9	10.6	8.6	10.6
RI	13.1	10.1	8.3	10.1
SC	12.5	11.0	9.1	10.4
SD	13.0	10.9	9.6	10.0
TN	12.7	11.1	9.1	10.5
TX	12.4	9.9	8.0	8.6
UT	11.5	10.0	8.5	9.3
VT	13.1	10.1	8.3	10.1
VA	12.1	9.1	8.2	9.1
WA	13.6	11.1	9.6	10.4
WV	13.5	10.8	9.1	9.9
WI	13.7	10.7	8.8	9.7
WY	12.2	9.8	8.4	8.8

Source: Based on RVPs from the January and July MVMA Fuel Volatility Surveys interpolated to spring and fall.

Table 4.3-4. Seasonal Maximum and Minimum Temperatures (°F) by State

State	Winter Min	Winter Max	Spring Min	Spring Max	Summer Min	Summer Max	Fall Min	Fall Max
AL	42	62	57	78	72	91	58	79
AK	20	31	32	46	46	63	36	47
AZ	41	67	54	83	76	103	59	86
AR	32	53	50	73	70	92	51	75
CA	45	61	50	67	59	78	54	73
CO	18	45	34	61	56	85	37	66
CT	19	36	38	59	60	83	42	63
DE	25	42	42	62	64	84	47	66
DC	29	45	47	66	68	86	51	69
FL	52	72	62	77	73	89	65	82
GA	34	54	50	72	68	87	52	73
HI	66	81	69	83	73	87	71	86
ID	25	40	37	61	56	86	39	64
IL	17	33	39	59	62	83	43	63
IN	21	37	41	62	63	84	44	65
IA	15	31	39	59	64	84	42	63
KS	23	44	44	67	68	91	47	69
KY	27	44	45	66	66	86	47	68
LA	44	64	59	78	73	90	60	79
ME	14	33	33	52	55	76	38	59
MD	26	43	43	64	65	85	47	68
MA	25	38	41	56	63	79	48	62
MI	14	30	33	53	55	77	39	57
MN	5	24	32	51	56	78	36	54
MS	36	59	53	77	70	92	53	78
MO	22	40	44	65	66	87	52	67
MT	14	33	31	54	52	80	35	58
NE	15	35	40	62	64	86	42	65
NV	21	47	31	64	45	87	31	69
NH	12	33	32	56	54	80	36	60
NJ	25	43	41	61	62	82	46	66
NM	24	49	40	70	62	91	43	71
NY	21	36	39	57	61	81	45	62
NC	32	54	48	72	67	88	51	73
ND	1	23	30	53	54	82	31	57
OH	22	38	40	61	61	82	44	64
OK	28	50	48	71	69	91	50	73
OR	35	47	42	61	55	77	45	64
PA	24	39	41	61	62	83	45	65
RI	22	38	38	57	61	80	44	63
SC	34	58	51	76	69	91	52	76
SD	7	27	34	56	59	84	36	60
TN	31	50	50	71	69	89	51	73
TX	37	61	54	78	71	95	55	79
UT	22	40	37	62	58	89	40	66
VT	11	28	33	52	56	78	39	57
VA	31	49	47	68	67	86	51	71
WA	30	42	39	57	53	76	41	59
WV	26	44	43	66	62	84	45	67
WI	15	29	35	53	59	78	41	59
WY	17	40	30	54	52	80	34	60

U.S. NOAA "Climatology of the United States", 1982[12].

Table 4.3-5. Average Annual Service Station Stage II VOC Emission Factors

Year	Emission Factor	
	grams/gallon	lbs/1,000 gallons
1985	4.6	10.0
1986	4.6	10.0
1987	4.6	10.0
1988	4.6	10.0
1989	3.9	8.5
1990	3.6	8.0
1991	3.6	8.0
1992	3.6	8.0
1993	3.6	8.0

Table 4.3-6. Bureau of Economic Analysis's SA-5 National Changes in Earnings by Industry

Industry	SIC	Percent Growth from: 1985 to 1987	1987 to 1988	1988 to 1989	1989 to 1990
Farm	01, 02	14.67	-2.73	14.58	-3.11
Agricultural services, forestry, fisheries, and other	07, 08, 09	23.58	5.43	1.01	2.48
Coal mining	11	-17.46	-6.37	-4.16	4.73
Metal mining	10	-3.03	18.01	8.94	4.56
Nonmetallic minerals, except fuels	14	2.33	3.74	-2.79	-0.45
Construction	15	7.27	4.81	-1.36	-3.80
Food and kindred products	20	1.67	1.34	-1.20	-0.24
Textile mill products	22	8.50	-0.64	-1.39	-4.97
Apparel and other textile products	23	-1.72	1.25	-1.62	-4.22
Paper and allied products	26	2.62	0.94	-0.14	-0.39
Printing and publishing	27	7.44	5.67	-0.81	0.43
Chemicals and allied products	28	1.75	6.94	0.32	1.61
Petroleum and coal products	29	-10.82	-3.22	-3.02	1.06
Tobacco manufactures	21	-1.97	2.43	-2.43	-5.01
Rubber and miscellaneous plastic products	30	5.27	5.51	0.68	-0.14
Leather and leather products	31	-9.39	-1.64	-3.58	-2.55
Lumber and wood products	24	10.03	5.15	-3.54	-3.71
Furniture and fixtures	25	6.82	2.35	-1.46	-2.98
Primary metal industries	33	-9.09	5.32	-0.34	-3.03
Fabricated metal products	34	-4.72	2.55	-0.86	-1.91
Machinery, except electrical	35	-5.72	6.02	-0.32	-1.92
Electric and electronic equipment	36	-3.17	-18.01	-1.91	-3.22
Transportation equipment, excluding motor vehicles	37	8.44	-1.57	0.55	-1.07
Motor vehicles and equipment	371	-6.45	2.20	-2.96	-5.43
Stone, clay, and glass products	32	-0.23	-1.61	-1.96	-3.19
Instruments and related products	38	-0.04	60.65	-0.82	-2.91
Miscellaneous manufacturing industries	39	1.84	6.92	-2.21	-2.54
Railroad transportation	40	-14.13	-2.53	-3.83	-6.03
Trucking and warehousing	42	5.63	3.26	-0.20	0.99
Water transportation	44	-8.92	0.07	-1.02	2.83
Local and interurban passenger transit	41	13.45	0.51	2.14	1.44
Transportation by air	45	12.01	4.63	4.94	4.36
Pipelines, except natural gas	46	-5.21	3.67	-4.93	3.53
Transportation services	47	15.92	8.52	4.60	4.97
Communication	48	1.94	0.68	-2.81	2.07
Electric, gas, and sanitary services	49	0.07	3.05	0.63	0.39

Table 4.3-7. Area Source Growth Indicators

NAPAP SCC	Category Description	Data Source	Growth Indicator
13	Industrial Fuel - Anthracite Coal	SEDS	Ind - Anthracite
14	Industrial Fuel - Bituminous Coal	SEDS	Ind - Bituminous
15	Industrial Fuel - Coke	BEA	Total Manufacturing
16	Industrial Fuel - Distillate Oil	SEDS	Ind - Distillate oil
17	Industrial Fuel - Residual Oil	SEDS	Ind - Residual oil
18	Industrial Fuel - Natural Gas	SEDS	Ind - Natural gas
19	Industrial Fuel - Wood	BEA	Total Manufacturing
20	Industrial Fuel - Process Gas	SEDS	Ind - LPG
21	On-Site Incineration - Residential	BEA	Population
22	On-Site Incineration - Industrial	BEA	Total Manufacturing
23	On-Site Incineration-Commercial/Institutional	BEA	Services
24	Open Burning - Residential	BEA	Population
25	Open Burning - Industrial	BEA	Total Manufacturing
26	Open Burning - Commercial/Institutional	BEA	Services
54	Gasoline Marketed	SEDS	Trans - Motor gasoline
63	Frost Control - Orchard Heaters	BEA	Farm
99	Minor Point Sources	BEA	Population
100	Publicly Owned Treatment Works	BEA	Electric, Gas, and Sanitary Services
102	Fugitive Emissions From Synthetic Organic Chemical Manufacturing	BEA	Mfg - Chemicals and Allied Products
103	Bulk Terminal and Bulk Plants	BEA	Trucking and Warehousing
104	Fugitive Emissions From Petroleum Refinery		Refinery operating cap
105	Process Emissions From Bakeries	BEA	Mfg - Food and Kindred Products
106	Process Emissions From Pharmaceutical Manufacturing	BEA	Mfg - Chemicals and Allied Products
107	Process Emissions From Synthetic Fiber Manufacturing	BEA	Mfg - Textile Mill Products
108	Crude Oil and Natural Gas Production Fields	BEA	Oil and Gas Extraction
109	Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDFs)	BEA	Total Manufacturing

Table 4.3-8. SEDS National Fuel Consumption

Category	1985	1986	1987	1988	1989	1990
Anthracite Coal (thousand short tons)						
Industrial	575	470	437	434	392	387
Bituminous Coal (thousand short tons)						
Industrial	115,854	111,119	111,695	117,729	117,112	118,322
Distillate Fuel (thousand barrels)						
Industrial	203,659	206,108	210,699	209,553	197,035	205,856
Liquefied Petroleum Gases (thousand barrels)						
Industrial	437,964	411,451	447,120	453,599	441,784	457,013
Motor Gasoline (thousand barrels)						
Transportation	2,433,592	2,507,936	2,570,047	2,627,331	2,617,450	2,703,666
All Sectors	2,493,361	2,567,436	2,630,089	2,685,145	2,674,669	2,760,414
Natural Gas (million cubic feet)						
Industrial	6,867	6,502	7,103	7,479	7,887	8,120
Residual Fuel (thousand barrels)						
Industrial	120,002	132,249	107,116	105,448	95,646	118,122

Table 4.3-9. AMS to NAPAP Source Category Correspondence

AMS		NAPAP	
SCC	**Category**	**SCC**	**Category**
Stationary Source Fuel Combustion			
2102001000	Industrial - Anthracite Coal (Total: All Boiler Types)	13	Industrial Fuel - Anthracite Coal
2102002000	Industrial - Bituminous/Subbituminous Coal (Total: All Boiler Types)	14	Industrial Fuel - Bituminous Coal
2102004000	Industrial - Distillate Oil (Total: Boilers & IC Engines)	16	Industrial Fuel - Distillate Oil
2102005000	Industrial - Residual Oil (Total: All Boiler Types)	17	Industrial Fuel - Residual Oil
2102006000	Industrial - Natural Gas (Total: Boilers & IC Engines)	18	Industrial Fuel - Natural Gas
2102008000	Industrial - Wood (Total: All Boiler Types)	19	Industrial Fuel - Wood
2102009000	Industrial - Coke (Total: All Boiler Types)	15	Industrial Fuel - Coke
2102010000	Industrial - Process Gas (Total: All Boiler Types)	20	Industrial Fuel - Process Gas
Industrial Processes			
2301020000	Process Emissions from Pharmaceuticals (PECHAN)	106	Process Emissions from Pharmaceutical Manufacturing
2301030000	Process Emissions from Synthetic Fiber (PECHAN)	107	Process Emissions from Synthetic Fibers Manufacturing
2301040000	SOCMI Fugitives (PECHAN)	102	Fugitive Emissions From Synthetic Organic Chemical Manufacturing
2302050000	Food & Kindred Products: SIC 20 - Bakery Products (Total)	105	Process Emissions From Bakeries
2306000000	Petroleum Refining: SIC 29 - All Processes (Total)	104	Fugitive Emissions From Petroleum Refinery Operations
2310000000	Oil & Gas Production: SIC 13 - All Processes (Total)	108	Crude Oil and Natural Gas Production Fields
2399000000	Industrial Processes: NEC	99	Minor point sources
Storage & Transport			
2501050120	Petroleum & Petroleum Product Storage - Bulk Stations/Terminals: Breathing Loss (Gasoline)	103	Bulk Terminal and Bulk Plants
2501060050	Petroleum & Petroleum Product Storage - Gasoline Service Stations (Stage I: Total)	54	Gasoline Marketed (Stage I)
2501060100	Petroleum & Petroleum Product Storage - Gasoline Service Stations (Stage II: Total)	54	Gasoline Marketed (Stage II)
2501060201	Petroleum & Petroleum Product Storage - Gasoline Service Stations (Underground Tank: Breathing & Emptying)	54	Gasoline Marketed (Breathing & Emptying)

(continued)

Table 4.3-9. (continued)

AMS		NAPAP	
SCC	Category	SCC	Category
Waste Disposal, Treatment, & Recovery			
2601010000	On-Site Incineration - Industrial (Total)	22	On-Site Incineration - Industrial
2601020000	On-Site Incineration - Commercial/Institutional (Total)	23	On-Site Incineration - Commercial/Institutional
2601030000	On-Site Incineration - Residential (Total)	21	On-Site Incineration - Residential
2610010000	Open Burning - Industrial (Total)	25	Open Burning - Industrial
2610020000	Open Burning - Commercial/Institutional (Total)	26	Open Burning - Commercial/Institutional
2610030000	Open Burning - Residential (Total)	24	Open Burning - Residential
2630020000	Wastewater Treatment - Public Owned (Total)	100	Publicly-Owned Treatment Works (POTWs)
2640000000	TSDFs - All TSDF Types (Total: All Processes)	109	Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)

Table 4.3-10. Point Source Data Submitted

State	Data Source/Format	Temporal Resolution	Year of Data	Adjustments to Data
Alabama	AIRS-AFS - Ad hoc retrievals	Annual	1994	Backcast to 1990 using BEA. Average Summer Day estimated using methodology described above.
Arkansas	AIRS-AFS - Ad hoc retrievals	Annual	1990	Average Summer Day estimated using default temporal factors.
Connecticut	State - EPS Workfile	Daily	1990	None
Delaware	State - EPS Workfile	Daily	1990	None
District of Columbia	AIRS-AFS - Ad hoc retrievals	Annual	1990	Average Summer Day estimated using methodology described above.
Florida	AIRS-AFS - Ad hoc retrievals	Annual	1990	Average Summer Day estimated using methodology described above.
Georgia - Atlanta Urban Airshed (47 counties) domain	State - State format	Daily	1990	None
Georgia - Rest of State	AIRS-AFS - Ad hoc retrievals	Annual	1990	Average Summer Day estimated using default temporal factors.
Illinois	State - EPS Workfiles	Daily	1990	None
Indiana	AIRS-AFS - Ad hoc retrievals	Annual	1990	Average Summer Day estimated using methodology described above.
Kansas	AIRS-AFS - Ad hoc retrievals	Annual	1990	Average Summer Day estimated using methodology described above.
Kentucky - Jefferson County	Jefferson County - EPS Workfile	Daily	1990	None
Kentucky - Rest of State	State - EPS Workfile	Daily	1990	None
Louisiana	State - State Format	Annual	1990	Average Summer Day estimated using methodology described above.
Maine	State - EPS Workfile	Daily	1990	None
Maryland	State - EPS Workfile	Daily	1990	None
Massachusetts	State - EPS Workfile	Daily	1990	None
Michigan	State - State Format	Annual	1990	Average Summer Day estimated using methodology described above.
Minnesota	AIRS-AFS - Ad hoc retrievals	Annual	1990	Average Summer Day estimated using methodology described above.
Missouri	AIRS-AFS - Ad hoc retrievals	Annual	1993	Backcast to 1990 using BEA. Average Summer Day estimated using methodology described above.
Nebraska	AIRS-AFS - Ad hoc retrievals	Annual	1990	Average Summer Day estimated using methodology described above.
New Hampshire	State - EPS Workfile	Daily	1990	None
New Jersey	State - EPS Workfile	Daily	1990	None
New York	State - EPS Workfile	Daily	1990	None
North Carolina	State - EPS Workfiles	Daily	1990	None
North Dakota	AIRS-AFS - Ad hoc retrievals	Annual	1990	Average Summer Day estimated using methodology described above.
Ohio	State - State Format	Annual	1990	Average Summer Day estimated using methodology described above.
Oklahoma	State - State Format	Annual	1994	Backcast to 1990 using BEA. Average Summer Day estimated using methodology described above.
Pennsylvania - Allegheny County	Allegheny County - County Format	Daily	1990	None
Pennsylvania - Philadelphia County	Philadelphia County - County Format	Daily	1990	None
Pennsylvania - Rest of State	State - EPS Workfile	Daily	1990	None
Rhode Island	State - EPS Workfile	Daily	1990	None
South Carolina	AIRS-AFS - Ad hoc retrievals	Annual	1991	Average Summer Day estimated using default temporal factors.
South Dakota	AIRS-AFS - Ad hoc retrievals	Annual	1990	Average Summer Day estimated using methodology described above.
Tennessee	AIRS-AFS - Ad hoc retrievals	Annual	1990	Average Summer Day estimated using default temporal factors.

Table 4.3-10 (continued)

State	Data Source/Format	Temporal Resolution	Year of Data	Adjustments to Data
Texas	State - State Format	Daily	1992	Backcast to 1990 using BEA.
Vermont	State - EPS Workfile	Daily	1990	None
Virginia	AIRS-AFS - Ad hoc retrievals	Annual	1990	Average Summer Day estimated using methodology described above.
West Virginia	AIRS-AFS - Ad hoc retrievals	Annual	1990	Average Summer Day estimated using methodology described above.
Wisconsin	State - State Format	Daily	1990	None

Table 4.3-11. Area Source Data Submitted

State	Data Source/Format	Temporal Resolution	Geographic Coverage	Adjustments to Data
Connecticut	State - EPS Workfile	Daily	Entire State	None
Delaware	State - EPS Workfile	Daily	Entire State	None
District of Columbia	State - Hard copy	Daily	Entire State	None
Florida	AIRS-AMS - Ad hoc retrievals	Daily	Jacksonville, Miami/ Ft. Lauderdale, Tampa	Added Nonroad emission estimates from Int. Inventory to Jacksonville (Duval County)
Georgia	State - State format	Daily	Atlanta Urban Airshed (47 Counties)	None
Illinois	State - State format	Daily	Entire State	None
Indiana	State - State format	Daily	Entire State	Nonroad emissions submitted were county totals. Nonroad emissions distributed to specific SCCs based on Int. Inventory
Kentucky	State - State Format	Daily	Kentucky Ozone Nonattainment Areas	None
Louisiana	State - State Format	Daily	Baton Rouge Nonattainment Area (20 Parishes)	None
Maine	State - EPS Workfile	Daily	Entire State	None
Maryland	State - EPS Workfile	Daily	Entire State	None
Michigan	State - State Format	Daily	49 Southern Michigan Counties	None
Missouri	AIRS-AMS- Ad hoc retrievals	Daily	St. Louis area (25 counties)	Only area source combustion data was provided. All other area source data came from Int. Inventory
New Hampshire	State - EPS Workfile	Daily	Entire State	None
New Jersey	State - EPS Workfile	Daily	Entire State	None
New York	State - EPS Workfile	Daily	Entire State	None
North Carolina	State - EPS Workfiles	Annual	Entire State	Average Summer Day estimated using default temporal factors.
Ohio	State - Hard copy	Daily	Canton, Cleveland Columbus, Dayton, Toledo, and Youngstown	Assigned SCCs and converted from kgs to tons. NO_x and CO from Int. Inventory added to Canton, Dayton, and Toledo counties.
Pennsylvania	State - EPS Workfile	Daily	Entire State	Nonroad emissions submitted were county totals. Nonroad emissions distributed to specific SCCs based on Int. Inventory
Rhode Island	State - EPS Workfile	Daily	Entire State	None
Tennessee	State - State format	Daily	42 Counties in Middle Tennessee	No nonroad data submitted. Nonroad emissions added from Int. Inventory
Texas	State - State Format	Annual	Entire State	Average Summer Day estimated using default temporal factors.
Vermont	State - EPS Workfile	Daily	Entire State	None
Virginia	State - EPS Workfile	Daily	Entire State	None
West Virginia	AIRS-AMS - Ad hoc retrievals	Daily	Charleston, Huntington/ Ashland, and Parkersburg (5 counties total)	None
Wisconsin	State - State Format	Daily	Entire State	None

Table 4.3-12. TSDF Emissions Removed from the OTAG Inventory

State	County	Daily VOC Emissions (tons per day)
Alabama	Washington	135
Georgia	Chatham	231
South Carolina	Allendale	1,000
West Virginia	Pleasants	692
West Virginia	Putnam	166

Table 4.3-13. Ad Hoc Report

Critera		Plant Output		Point Output		Stack Output		Segment Output General		Segment Output Pollutant	
Regn	GT 0	YINV	YEAR OF INVENTORY	STTE	STATE FIPS CODE	STTE	STATE FIPS CODE	STTE	STATE FIPS CODE	STTE	STATE FIPS CODE
PLL4	CE VOC	STTE	STATE FIPS CODE	CNTY	COUNTY FIPS CODE	CNTY	COUNTY FIPS CODE	CNTY	COUNTY FIPS CODE	CNTY	COUNTY FIPS CODE
PLL4	CE CO	CNTY	COUNTY FIPS CODE	PNED	NEDS POINT ID	PNED	NEDS POINT ID	PNED	NEDS POINT ID	PNED	NEDS POINT ID
PLL4	CE SO2	CYCD	CITY CODE	PNUM	POINT NUMBER	STNB	STACK NUMBER	STNB	STACK NUMBER	STNB	STACK NUMBER
PLL4	CE NO2	ZIPC	ZIP CODE	CAPC	DESIGN CAPACITY	LAT2	LATITUDE STACK	PNUM	POINT NUMBER	PNUM	POINT NUMBER
PLL4	CE PM-10	PNED	NEDS POINT ID	CAPU	DESIGN CAPACITY UNITS	LON2	LONGITUDE STACK	SEGN	SEGMENT NUMBER	SEGN	SEGMENT NUMBER
PLL4	CE PT	PNME	PLANT NAME	PAT1	WINTER THROUGHPUT	STHT	STACK HEIGHT	SCC8	SCC	SCC8	SCC
DES4	GE 0	LAT1	LATITUDE PLANT	PAT2	SPRING THROUGHPUT	STDM	STACK DIAMETER	HEAT	HEAT CONTENT	PLL4	POLLUTANT CODE
DUE4	ME TY	LON1	LONGITUDE PLANT	PAT3	SUMMER THROUGHPUT	STET	STACK EXIT TEMPERATURE	FPRT	ANNUAL FUEL THROUGHPUT	D034	OSD EMISSIONS
YINV	ME 90	SIC1	STANDARD INDUSTRIAL CODE	PAT4	FALL THROUGHPUT	STEV	STACK EXIT VELOCITY	SULF	SULFUR CONTENT	DU04	OSD EMISSION UNITS
		OPST	OPERATING STATUS	NOHD	NUMBER HOURS/DAY	STFR	STACK FLOW RATE	ASHC	ASH CONTENT	DES4	DEFAULT ESTIMATED EMISSIONS
		STRS	STATE REGISTRATION NUMBER	NODW	NUMBER DAYS/WEEK	PLHT	PLUME HEIGHT	PODP	PEAK OZONE SEASON DAILY PROCESS RATE	DUE4	DEFAULT ESTIMATED EMISSIONS UNITS
				NOHY	NUMBER HOURS/YEAR					CLEE	CONTROL EFFICIENCY
										CLT1	PRIMARY CONTROL DEVICE CODE
										CTL2	SECONDARY CONTROL DEVICE CODE
										REP4	RULE EFFECTIVENESS
										DME4	METHOD CODE
										Emfa	Emission factor

Table 4.3-14. Livestock Operations Ammonia Emission Factors

Category	AMS SCC	Emission Factor ($lb\ NH_3$/Head)
Cattle and Calves	2805020000	50.5
Pigs and Hogs	2805025000	20.3
Poultry	2805030000	0.394
Sheep	2805040000	7.43
Horses	2710020030	26.9
Goats	2805045001	14.1
Mink	2205045002	1.28

Table 4.3-15. SEDS National Fuel Consumption, 1990-1996 (trillion Btu)

Category	1990	1991	1992	1993	1994	1995	1996
Antracite Coal							
Commercial	12	11	11	11	11	11	11
Industrial	10	8	7	11	10	10	10
Residential	19	17	17	16	16	16	16
Bituminous Coal							
Commercial	80	72	75	72	70	69	68
Industrial	2,744	2,592	2,505	2,489	2,434	2,379	2,333
Residential	43	39	40	40	40	39	39
Distillate Fuel							
Commercial	487	482	464	464	450	435	422
Industrial	1,181	1,139	1,144	1,100	1,090	1,080	1,071
Residential	837	832	865	913	887	862	836
Liquefied Petroleum Gases							
Industrial	1,608	1,749	1,860	1,794	1,804	1,813	1,823
Motor Gasoline							
Transportation	13,577	13,503	13,699	14,126	14,201	14,276	14,351
All Sectors	13,872	13,781	13,973	14,335	14,392	14,448	14,505
Natural Gas							
Commercial	2,698	2,808	2,884	2,996	3,035	3,074	3,114
Industrial	8,520	8,637	8,996	9,387	9,635	9,883	10,131
Residential	4,519	4,685	4,821	5,097	5,132	5,166	5,201
Residual Fuel							
Commercial	233	213	191	175	170	168	167
Industrial	417	336	391	452	459	469	481

Table 4.3-16. BEA SA-5 National Earnings by Industry, 1990-1996 (units)

INDUSTRY	LNUM	SIC	1990	1991	1992	1993	1994	1995	1996
Agricultural services, forestry, fisheries, and other	543	46	964265	1008756	1075157	1020685	981240	899890	887668
Amusement and recreation services	480	31	2937092	2663755	2448152	2522678	2587320	2492498	2411880
Apparel and other textile products	210	10	2236519	2765861	2504737	2472439	2311089	2475631	2506157
Auto repair, services, and garages	456	21	2683371	2622813	2659725	2485200	2442973	2554328	2528684
Banking and credit agencies	240	14	4492074	4192648	4153723	3679947	3946221	4108095	4093926
Business and miscellaneous repair services	530	44	6501689	6811447	6700227	6396756	6302258	6276244	6278339
Chemicals and allied products	474	29	9331143	9408424	9839000	9491227	9563394	9337366	9338611
Coal mining	541	41	8010094	8224026	8700331	8870653	9355408	9684972	10055150
Communication	815	88	9806622	9160328	9877000	10173489	10107721	10563196	10714511
Construction	510	40	12475909	12321936	12681893	12210523	11697623	11697964	11552801
Durable goods	220	11,12	16972988	16026036	15165602	12629084	12637872	12300534	11669993
Educational services	444	39	11346157	11071944	11473000	11602340	11910393	12017661	12151962
Electric and electronic equipment	417	25	13142092	12131018	12867336	13300382	13904675	14141260	14341094
Electric, gas, and sanitary services	459	22	16455215	15826060	16741582	16763481	16970038	16684989	16732544
Fabricated metal products	544	47	12264957	13001026	13605000	14257312	15300283	16174723	16956676
Farm	462	23	19635147	19514901	19723459	19451719	19490654	18943464	18821883
Federal, civilian	420	32	20080127	18355601	18628000	18839182	19661583	20101301	20105536
Federal, military	736	62,67	15288460	20970196	27454000	19085768	17607236	19362454	20570242
Food and kindred products	230	13	20023918	21851670	20687858	20695261	21090211	21109035	21364573
Furniture and fixtures	413	24	22274571	20521647	21575065	22245424	23938988	24618032	25086724
Government and government enterprises	465	26	27980768	27477903	28405089	28320985	28537971	28774552	28963492
Health services	542	45	30462607	30197325	30564000	30628655	30632984	31036245	31150973
Holding companies and investment services	477	30	27134887	26402543	27995000	28773589	29986402	30700162	31413217
Hotels and other lodging places	423	33	32751067	30405346	30684000	30484404	31805528	32520448	32474324
Instruments and related products	825	75	29466880	28212745	28402000	29804092	31344139	33071561	33792497
Insurance	805	70	30962609	30861254	32472000	32895714	33489989	34964682	35765097
Leather and leather products	810	72	33034188	32121275	33145000	35507798	35689230	36220265	36857480
Legal services	438	37	54467096	51579378	49765787	45345417	42934833	41800424	39267090
Local and interurban passenger transit	441	38	42602566	42244447	41887294	40349902	39578645	39849442	39298817
Lumber and wood products	920	992	49726499	49560122	51157000	48078948	45113441	43753716	42559159
Machinery, except electrical	855	82	38633551	41180887	42370000	43674461	45005719	46467470	48034254
Manufacturing	426	34	50894228	48212745	48781000	49050681	51327932	52955391	53367624
Metal mining	453	20	50503207	51139774	52032000	52096493	52591995	53272309	53826129
Miscellaneous manufacturing industries	081	1,2	95574782	81662894	91740000	89565300	83870354	62977696	57056700
Miscellaneous professional services	570	49	48760456	51610486	53446000	56055552	56221162	55904274	57333038
Motor vehicles and equipment	880	84,87,89	42249990	43140798	45630000	43719288	5 1245949	54978621	57524347
	468	27	544'2395	53796506	55383000	55561401	56816968	58018592	58739831
Nondurable goods	435	371	40534185	38243276	42349000	45779125	53437201	56430759	59610464
Nonmetallic minerals, except fuels									
Oil and gas extraction	471	28	61160258	62504624	65720000	65462965	65496128	66637475	67740639

Table 4.3-16 (continued)

INDUSTRY	LNUM	SIC	1990	1991	1992	1993	1994	1995	1996
Paper and allied products	432	36	62800551	61864634	61880735	62637955	65131845	67865390	68878883
Personal services	520	42	59408119	58124933	59809000	62399613	66113441	68719329	70581571
Petroleum and coal products	560	48	63211542	62630011	64010000	67492202	70949474	75178437	77571816
Pipelines, except natural gas	835	78,79	58282046	59928056	68382000	66986354	69412780	74884760	78205303
Primary metal industries	100	7,8,9	71298072	71281605	72834000	73131576	76950441	80406129	82227740
Printing and publishing	860	83,86	57869652	61991782	67046000	70933724	75624404	80273238	84753955
Private households	850	81	80478632	80453237	84596000	84175437	84076263	84879183	85759293
Railroad transportation	429	35	86049144	82755303	83278000	83745609	86349853	90047399	90847050
Real estate	734	65,66	55083332	49841726	72100000	86070174	88030504	93540892	101232404
Retail trade	732	63,64	112726504	117109974	122074000	123037038	125599626	126600372	129375146
Rubber and miscellaneous plastic products	710	60,61	164989314	161175740	171538000	177654966	177588180	179719340	182665345
Services	450	997	272849358	272026723	281459000	281561401	285010484	287967471	290991094
Social services and membership organizations	845	80	290082263	304310382	324796000	330498050	341319353	354942380	367914403
State and local	820	73,76	339066242	324306268	350430000	360378172	381334602	425131970	442345116
Stone, clay, and glass products	410	996	437059831	417893114	423337000	423740734	440079122	452446097	455523350
Textile mill products	910	43,91,97	471722228	479284680	492252000	497446400	500579596	493330860	497652586
Tobacco manufactures	610	50,51	472478630	462478932	475642000	469124760	484413724	509234188	516585300
Transportation by air	900	995	585066237	594260020	607223000	613311893	620999045	626458176	634736564
Transportation equipment, excluding motor vehicles	300	15,16,17	655461531	591675219	583884000	597663738	647565291	656082711	656206947
Transportation services	400	998	709909185	689919836	704796000	705302145	725089606	740413570	746514447
Trucking and warehousing	800	995	946288461	951105854	1007747000	1031616956	1065955197	1127747211	1164038961
Water transportation	930	92,93,94,95,96	2087045930	2124393640	2165015000	2204356700	2253703530	2296858730	2338821290
Wholesale trade	620	52 to 59	2734495728	2681249752	2739280000	2773146176	2873677800	2973658000	3021490454

Table 4.3-17. Area Source Listing by SCC and Growth Basis

SCC	SCC Description	Growth Basis
2301000000	Industrial Processes All Manufacturing and Product Types and Operations, All Process Total	BEA
2801000005	Miscellaneous Area Sources Agriculture Production - Crops, All Processes	BEA
2805000000	Miscellaneous Area Sources Agriculture Production - Livestock and Animal Husbandry, All Types	BEA
2830000000	Miscellaneous Area Sources Catastrophic/Accidential Releases All Accidents Total	NO GROWTH
2850000010	Miscellaneous Area Sources Health Services Hospitals Sterilization Operations	NO GROWTH
2810060000	Miscellaneous Area Sources Other Combustion	SEDS
2810003000	Miscellaneous Area Sources Other Combustion [unknown]	SEDS
2810010000	Miscellaneous Area Sources Other Combustion [unknown]	BEA
2810025000	Miscellaneous Area Sources Other Combustion Charcoal Grilling Total	SEDS
2810035000	Miscellaneous Area Sources Other Combustion Firefighting Training Total	SEDS
2810015000	Miscellaneous Area Sources Other Combustion Managed Burning, Prescribed Total	SEDS
2810005000	Miscellaneous Area Sources Other Combustion Managed Burning, Slash Total	BEA
2810050000	Miscellaneous Area Sources Other Combustion Motor Vehicle Fires Total	SEDS
2810030000	Miscellaneous Area Sources Other Combustion Structure Fires Total	SEDS
2275000000	Mobile Sources Aircraft All Aircraft Types & Operations Total	BEA
2280000000	Mobile Sources Marine Vessels, Commercial, All Fuel Types, All Vessel Types	BEA
2283002000	Mobile Sources Marine Vessels, Military Diesel Diesel All Vessels	BEA
2282000000	Mobile Sources Marine Vessels, Recreational, All Fuel Types, All Vessel Types	SEDS
2270000000	Mobile Sources Off-Highway Vehicle Diesel All Off-Highway Vehicle, Recreational, Lawn & Garden Equip: Diesel Total	SEDS
2270002000	Mobile Sources Off-Highway Vehicle Diesel Construction and Industrial Equipment Total	BEA
2270005000	Mobile Sources Off-Highway Vehicle Diesel Farm, Logging, Airport Service, Light Commericial Equipment Total	BEA
2260005000	Mobile Sources Off-Highway Vehicle Gasoline 2 and 4-Stroke Farm, Logging, Airport Service, Light Commericial Equipment Total	BEA
2260000000	Mobile Sources Off-Highway Vehicle Gasoline, 2 and 4-Stroke All Off-Highway Vehicle: Gasoline, Total	SEDS
2260002000	Mobile Sources Off-Highway Vehicle Gasoline, 2 and 4-Stroke Construction and Industrial Equipment Total	BEA
2260004000	Mobile Sources Off-Highway Vehicle Gasoline, 2 and 4-Stroke Lawn & Garden Equipment Total	SEDS
2260001000	Mobile Sources Off-Highway Vehicle Gasoline, 2 and 4-Stroke Recreational Vehicles Total	SEDS
2285000000	Mobile Sources Railroads	BEA
2710020030	Natural Sources Biogenic Horses and Ponies	BEA
2730050000	Natural Sources Geogenic Geyser/Geothermal Total	NO GROWTH
2495000000	Solvent Utilization All Solvent User Categories All Processes Total: All Solvent Types	SEDS
2420000000	Solvent Utilization Dry Cleaning All Processes Total: All Solvent Types	SEDS
2460000000	Solvent Utilization Miscellaneous Non-Industrial: All Classes All Processes Total: All Solvent Types	SEDS
2401000000	Solvent Utilization Surface Coating	SEDS
2401002000	Solvent Utilization Surface Coating [unknown]	NO GROWTH
2401010000	Solvent Utilization Surface Coating All Manufacturing Processes and Industry Total: All Solvent Types	BEA
2401008000	Solvent Utilization Surface Coating Traffic Markings and Architectural Coatings Total: All Solvent Types	SEDS
2103008000	Stationary Source Fuel Combustion Commercial/Institutional Wood Total: All Boiler Types	BEA
2103001000	Stationary Source Fuel Combustion Commerical/Institutional All Coals, Oils, Gas Total: All Combustor Types	SEDS
2101004002	Stationary Source Fuel Combustion Electric Utility All Fuels All I.C. Engine Types	SEDS
2102001000	Stationary Source Fuel Combustion Industrial All Coals, Oils, Gas Total: All Combustor Types	SEDS
2102008000	Stationary Source Fuel Combustion Industrial Wood and Coke Total: All Boiler Types	BEA
2104001000	Stationary Source Fuel Combustion Residential All Coals, Oils, Gas Total: All Combustor Types	SEDS
2104004000	Stationary Source Fuel Combustion Residential Distillate Oil Total: All Combustor Types	NO GROWTH
2104005000	Stationary Source Fuel Combustion Residential Residual Oil Total: All Combustor Types	NO GROWTH
2199004000	Stationary Source Fuel Combustion Total Area Source Fuel Combustion All Fuels, All Combustor Types	SEDS
2501000000	Storage & Transport Petroleum,Petroleum Product,Organic Chemical Storage All Storage Types: Losses Total: All Products	BEA
2500000000	Storage and Transport	NO GROWTH
2601000000	Waste Disposal, Treatment, & Recovery All Types All Categories Total	BEA

Table 4.3-18. Emission Estimates Available from AIRS/FS by State, Year, and Pollutant

State	1990						1991						1992						1993						1994						1995					
	C	N	S	P	T	V	C	N	S	P	T	V	C	N	S	P	T	V	C	N	S	P	T	V	C	N	S	P	T	V	C	N	S	P	T	V
Alabama	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Alaska	✓	✓	✓		✓	✓													✓	✓	✓		✓	✓	✓	✓	✓		✓	✓						
Arizona	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
California	✓	✓	✓	✓	✓	✓													✓						✓	✓		✓	✓	✓						
Colorado	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Connecticut	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Hawaii	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Illinois	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Louisiana	✓	✓	✓		✓	✓													✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓						
Michigan	✓	✓	✓	✓	✓	✓													✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓
Minnesota	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Montana	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Nebraska	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						
Nevada	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
New Hampshire	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
New Mexico	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
North Dakota	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Oregon	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pennsylvania	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
South Carolina																			✓	✓	✓		✓	✓												
South Dakota		✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓		✓		✓	✓	✓		✓		✓	✓	✓		✓		✓	✓	✓		✓
Texas	✓	✓	✓	✓	✓	✓													✓	✓	✓	✓	✓	✓							✓	✓	✓	✓		✓
Utah	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓		✓	✓		✓	✓		✓	✓		✓
Vermont	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Virginia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Washington	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Wisconsin	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						
Wyoming	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes: C = CO N = NO_2 S = SO_2 P = PM-10 T = TSP V = VOC

Pennsylvania only includes Allegheny County (State 42, County 003); New Mexico only includes Albuquerque (State 35, County 001); Washington only includes Puget Sound (State 53, County 033, 053, or 061); Nebraska includes all except Omaha City (State 31, County 055); the CO emissions in NET were maintained for South Dakota (State 46).

Table 4.3-19. NO_x Major Stationary Source Definition

Ozone Nonattainment Status	Major Stationary Source (tons)
Marginal/Moderate	100
Serious	50
Severe	25
Extreme	10
Ozone Transport Region	100

Table 4.3-20. Summary of Revised NO_x Control Efficiencies

Pod ID	Pod Name	Estimated Efficiency	Control	Reference
55	Industrial Process Heat	74	ULNB	ACT (EPA,1993d)
58	Commercial/Institutional - Coal	50	LNB	ACT (EPA,1993e)
59	Commercial/Institutional - Oil	50	LNB	ACT (EPA,1993e)
60	Commercial/Institutional - Gas	50	LNB	ACT (EPA,1993e)
70	Industrial Oil Fired Turbines	70	WI	ACT (EPA,1993f)
71	Industrial Oil Fired Reciprocating Engines	25	IR	ACT (EPA,1993g)
72	Industrial Gas Fired Turbines	84	LNB	ACT (EPA,1993f)
73	Industrial Gas Fired Reciprocating Engines	30	AF + IR	ACT (EPA,1993g)
74	Utility Oil Fired Turbines	70	WI	ACT (EPA,1993f)
75	Utility Oil Fired Reciprocating Engines	25	IR	ACT (EPA,1993g)
76	Utility Gas Fired Turbines	84	LNB	ACT (EPA,1993f)
77	Utility Gas Fired Reciprocating Engines	30	AF + IR	ACT (EPA,1993g)
84	Industrial External Combustion - Coal	50	LNB	ACT (EPA,1993e)
85	Industrial External Combustion - Oil - < 100 MMBtu/hr	50	LNB	ACT (EPA,1993e)
86	Industrial External Combustion - Oil -Cogeneration	50	LNB	ACT (EPA,1993e)
87	Industrial External Combustion - Oil - General	50	LNB	ACT (EPA,1993e)
88	Industrial External Combustion - Gas - < 100 MMBtu/hr	50	LNB	ACT (EPA,1993e)
89	Industrial External Combustion - Gas - Cogeneration	50	LNB	ACT (EPA,1993e)
90	Industrial External Combustion - Gas - General	50	LNB	ACT (EPA,1993e)

Controls:
AF - Air/Fuel Adjustment
IR - Ignition Time Retardation
LNB - Low NO_x Burner
ULNB - Ultra-low NO_x Burner
WI - Water Injection

Table 4.3-21. Point Source Controls by POD and Measure

Spell out

POD	PODNAME	MEASNAME	SOURCE	PTFYCE
4	Fixed roof petroleum product tanks	CTG	Fixed roof petroleum tanks	98
5	Fixed roof gasoline tanks	CTG	Fixed roof gasoline tanks	96
6	EFR petroleum product tanks	CTG	EFR petroleum tanks	90
7	EFR gasoline tanks	CTG	EFR gasoline tanks	95
15	Ethylene oxide manufacture	SOCMI HON	Ethylene oxide manufacture	79
16	Phenol manufacture	SOCMI HON	Phenol manufacture	79
17	Terephthalic acid manufacture	Incineration (RACT)	Terephthalic acid manufacture	98
18	Acrylonitrile manufacture	SOCMI HON	Acrylonitrile manufacture	79
21	Cellulose acetate manufacture	Carbon adsorber (RACT)	Cellulose acetate manufacture	54
23	Polypropylene manufacture	Flare (RACT)	Polypropylene manufacture	98
24	Polyethylene manufacture	Flare (RACT)	Polyethylene manufacture	98
25	Ethylene manufacture	Flare (RACT)	Ethylene manufacture	98
26	Petroleum refinery wastewater treatment	Benzene NESHAP/CTG	Petroleum ref wastewater treatment	95
27	Petroleum refinery vacuum distillation	CTG	Petroleum ref vacuum distillation	100
28	Vegetable oil manufacture	Stripper and equipment (RACT)	Vegetable oil manufacture	42
29	Paint and varnish manufacture	RACT	Paint and varnish manufacture	70
32	Carbon black manufacture	Flare (RACT)	Carbon black manufacture	90
42	Surface coating - thinning solvents	RACT	Surface coating - thinning solvents	90
47	Ferrosilicon production	RACT	Ferrosilicon production	88
48	By-product coke manufacture - other	NESHAP	By-product coke manufacture - other	94
49	By-product coke manufacture - oven charging	NESHAP	By-product coke mfg - oven charging	94
50	Coke ovens - door and topside leaks	NESHAP	Coke ovens - door and topside leaks	94
51	Coke oven by-product plants	NESHAP	Coke oven by-product plants	94
53	Whiskey fermentation - aging	Carbon adsorption (RACT)	Whiskey fermentation - aging	85
54	Charcoal manufacturing	Incineration (RACT)	Charcoal manufacturing	80
56	SOCMI reactor	New CTG	SOCMI reactor	98
57	SOCMI distillation	New CTG	SOCMI distillation	98
61	Open top degreasing	MACT	Open top degreasing	63
62	In-line degreasing	MACT	In-line degreasing	63
63	Cold cleaning	MACT	Cold cleaning	63
65	Open top degreasing - halogenated	MACT	Open top degreasing - halogenated	63
66	In-line degreasing - halogenated	MACT	In-line degreasing - halogenated	63
68	SOCMI fugitives	HON - Equipment Leak and Detec	SOCMI fugitives	79
69	SOCMI wastewater	SOCMI HON	SOCMI wastewater	79
71	SOCMI processes - pharmaceutical	SOCMI HON/Pharmaceuticals	SOCMI processes - pharmaceutical	79
73	SOCMI processes - gum and wood	SOCMI reactor CTG	SOCMI processes - gum and wood	98

Table 4.3-21 (continued)

POD	PODNAME	MEASNAME	SOURCE	PTFYCE
74	SOCMI processes - cyclic crudes	SOCMI HON	SOCMI processes - cyclic crudes	79
75	SOCMI processes - industrial chemicals	SOCMI HON	SOCMI processes - industrial chem	79
77	SOCMI processes - crudes & agricultural	SOCMI reactor CTG	SOCMI processes - crudes & agricul	98
80	SOCMI fugitives - cyclic crudes	SOCMI HON	SOCMI fugitives - cyclic crudes	79
81	SOCMI fugitives - industrial organics	SOCMI HON	SOCMI fugitives - ind organics	79
82	SOCMI - process vents	SOCMI HON	SOCMI - process vents	79
84	VOL storage	SOCMI HON	VOL storage	79
85	Misc organic solvent evaporation	SOCMI HON	Misc organic solvent evaporation	79
86	Single chamber incinerators	RACT	Single chamber incinerators	90
91	Dry cleaning - perchloroethylene	MACT	Dry cleaning - perchloroethylene	44
93	Dry cleaning - other	MACT	Dry cleaning - other	44
95	Bakeries	Incineration (RACT)	Bakeries	95
96	Urea resins - general	RACT	Urea resins - general	90
97	Organic acids manufacture	RACT	Organic acids manufacture	90
98	Leather products	RACT	Leather products	90
114	Petroleum refineries - Blowdown w/o control	RACT/CTG	Petoleum ref - blowdown	98
199	Miscellaneous non-combustion	RACT	Miscellaneous non-combustion	90
401	By-product coke mfg	Benzene NESHAP	By-product coke mfg	85
402	By-product coke - flushing-liquor circulation tank	Benzene NESHAP	By-prod coke - flush-liq circ tank	95
403	By-product coke - excess-ammonia liquor tank	Benzene NESHAP	By-prod coke - ex nh3 liquor tank	98
404	By-product coke mfg - tar storage	Benzene NESHAP	By-product coke mfg - tar storage	98
405	By-product coke mfg - light oil sump	Benzene NESHAP	By-product coke - light oil sum	98
406	By-product coke mfg - light oil dec/cond vents	Benzene NESHAP	By-prod coke - oil dec/cond vents	98
407	By-product coke mfg - tar bottom final cooler	Benzene NESHAP	By-prod coke - tar bottom cooler	81
408	By-product coke mfg - naphthalene processing	Benzene NESHAP	By-prod coke - naphth processing	100
409	By-product coke mfg - equipment leaks	Benzene NESHAP	By-product coke - equipment leaks	83

Table 4.3-22. Point Source SCC to POD Match-up

SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD
30100101	75	30101842	70	30102630	22	30112021	56	30116780	81	30125003	82	30181001	77
30100103	17	30101847	136	30102699	22	30112099	75	30116799	75	30125004	81	30182001	69
30100104	56	30101849	143	30103101	134	30112199	56	30116901	74	30125005	56	30182002	69
30100180	81	30101852	70	30103102	134	30112480	81	30116906	74	30125010	56	30182003	69
30100199	75	30101860	24	30103103	134	30112501	75	30116980	80	30125015	56	30182004	69
30100504	32	30101861	24	30103104	134	30112502	75	30117401	15	30125020	56	30182005	69
30100509	68	30101863	24	30103105	134	30112509	81	30117421	15	30125099	56	30182006	69
30100601	54	30101864	24	30103199	134	30112510	75	30117480	15	30125101	75	30182007	69
30100603	54	30101865	24	30103301	76	30112512	82	30117617	75	30125180	81	30182008	69
30100604	54	30101866	24	30103311	76	30112514	75	30117680	75	30125201	56	30182009	69
30100699	73	30101870	136	30103312	76	30112520	75	30118101	74	30125301	75	30182010	69
30101012	116	30101872	136	30103399	78	30112524	81	30118102	74	30125302	82	30182011	69
30101013	116	30101880	136	30103402	75	30112525	75	30118103	74	30125306	82	30183001	68
30101021	116	30101881	136	30103405	82	30112526	82	30118110	74	30125315	75	30184001	57
30101022	116	30101882	136	30103406	82	30112533	75	30118180	80	30125325	75	30188801	68
30101030	116	30101885	136	30103410	75	30112534	81	30119001	74	30125326	82	30188802	68
30101099	116	30101890	104	30103412	75	30112535	75	30119013	74	30125380	81	30188803	68
30101401	29	30101891	104	30103420	75	30112540	75	30119014	74	30125401	75	30188804	68
30101402	29	30101892	104	30103425	75	30112541	75	30119080	80	30125405	18	30188805	68
30101403	29	30101893	104	30103499	75	30112547	75	30119501	75	30125406	75	30190001	88
30101404	29	30101894	104	30104204	75	30112550	81	30119580	81	30125409	81	30190002	88
30101499	29	30101899	104	30106001	71	30112599	75	30119701	25	30125413	75	30190003	88
30101501	29	30101901	74	30106002	71	30112699	75	30119705	25	30125415	75	30190004	88
30101502	29	30101902	74	30106003	71	30112701	75	30119707	75	30125420	81	30201003	53
30101503	29	30101904	74	30106004	71	30112702	75	30119708	75	30125499	56	30201401	94
30101505	29	30101907	57	30106005	71	30112730	75	30119709	75	30125801	75	30201902	28
30101599	29	30102001	29	30106006	71	30112780	81	30119710	75	30125802	75	30201903	28
30101603	145	30102002	29	30106007	71	30113201	75	30119741	75	30125803	57	30201906	28
30101801	140	30102003	29	30106008	71	30113210	75	30119742	75	30125805	75	30201907	28
30101802	23	30102004	29	30106009	71	30113221	75	30119743	75	30125807	57	30201908	28
30101803	23	30102005	29	30106010	71	30113227	75	30119744	75	30125810	75	30201911	28
30101805	137	30102099	29	30106011	71	30113299	97	30119745	75	30125815	75	30201912	28
30101807	24	30102401	142	30106012	71	30113301	75	30119749	75	30125880	75	30201914	28

Table 4.3-22 (continued)

SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD
30101808	24	30102402	104	30106099	79	30113302	75	30119799	25	30125899	75	30201915	28
30101809	24	30102410	141	30109101	75	30113701	75	30120201	16	30130101	74	30201916	28
30101810	24	30102416	21	30109105	75	30113710	75	30120202	16	30130102	74	30201917	28
30101811	24	30102423	21	30109151	75	30113799	75	30120204	82	30130103	74	30201918	28
30101812	24	30102424	21	30109152	75	30114001	75	30120205	16	30130104	74	30201919	28
30101813	24	30102426	21	30109153	57	30114005	56	30120206	16	30130105	74	30201999	28
30101814	24	30102427	21	30109154	57	30115201	75	30120280	81	30130106	82	30203201	95
30101815	136	30102499	21	30109180	81	30115301	75	30120501	75	30130107	74	30203202	95
30101816	136	30102501	139	30109199	75	30115311	82	30120502	75	30130108	74	30203299	95
30101817	138	30102505	21	30110002	75	30115380	81	30120521	82	30130180	80	30300302	49
30101818	136	30102601	22	30110003	82	30115601	74	30120530	82	30130301	75	30300303	48
30101819	136	30102602	22	30110080	81	30115604	74	30120545	82	30130380	81	30300304	48
30101820	136	30102608	22	30110099	75	30115701	74	30120580	81	30130402	75	30300306	48
30101821	136	30102609	22	30112001	75	30115704	74	30120601	74	30130480	81	30300308	50
30101822	138	30102612	22	30112002	75	30115780	80	30120603	74	30130501	75	30300313	48
30101827	136	30102613	22	30112005	82	30115802	75	30120680	80	30130502	75	30300314	50
30101832	96	30102614	22	30112006	82	30115803	75	30121001	75	30130580	81	30300315	51
30101837	144	30102615	22	30112007	81	30115822	57	30121002	82	30180001	68	30300331	401
30101838	143	30102616	22	30112011	75	30116701	75	30121101	75	30180002	68	30300332	402
30101839	143	30102617	22	30112013	82	30116703	82	30125001	75	30180003	68	30300333	403
30101840	143	30102625	22	30112014	82	30116704	75	30125002	75	30180006	68	30300334	402
30300335	402	30600811	20	30700703	117	31000205	112	40100101	91	40188898	63	40201505	37
30300336	404	30600812	20	30700704	117	31000206	112	40100102	92	40199999	63	40201531	37
30300341	405	30600813	20	30700705	117	31000207	112	40100103	91	40200101	33	40201599	37
30300342	406	30600814	20	30700706	117	31000299	112	40100104	92	40200110	33	40201601	33
30300343	406	30600815	20	30700707	117	31000401	88	40100105	93	40200301	34	40201602	33
30300344	406	30600816	20	30700708	117	31000403	88	40100198	93	40200310	34	40201603	33
30300351	401	30600817	20	30700709	117	31000404	88	40100201	61	40200401	33	40201604	33
30300353	408	30600818	20	30700711	117	31000405	88	40100202	65	40200410	40	40201605	33
30300361	409	30600819	20	30700713	117	31088801	112	40100203	65	40200501	33	40201606	33
30300813	46	30600821	20	30700715	117	31088802	112	40100204	65	40200510	33	40201607	33
30300825	46	30600903	110	30700798	117	31088803	112	40100205	65	40200601	33	40201608	33
30390003	88	30600904	110	30700799	117	31088804	112	40100206	61	40200610	33	40201609	33

Table 4.3-22 (continued)

SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD
30390004	88	30600905	110	30701199	36	31088805	112	40100207	65	40200701	36	40201619	33
30490001	88	30600999	110	30790001	88	32099997	98	40100221	62	40200706	36	40201620	33
30490003	88	30601001	110	30790002	88	32099998	98	40100222	66	40200707	36	40201621	33
30490004	88	30601101	110	30790003	88	32099999	98	40100223	66	40200710	36	40201622	33
30490031	88	30601201	110	30800101	30	39000201	87	40100224	66	40200801	35	40201623	33
30490033	88	30601401	110	30800102	30	39000203	87	40100225	66	40200802	35	40201625	33
30490034	88	30609902	110	30800103	30	39000289	87	40100235	62	40200803	35	40201626	33
30600101	88	30609903	110	30800104	30	39000299	87	40100236	62	40200810	35	40201627	33
30600102	88	30609904	110	30800105	30	39000402	87	40100251	61	40200898	35	40201628	33
30600103	88	30610001	110	30800106	31	39000403	87	40100252	65	40200998	33	40201629	33
30600104	88	30688801	20	30800107	30	39000489	87	40100253	65	40201001	88	40201631	33
30600105	88	30688802	20	30800108	30	39000499	87	40100254	65	40201002	88	40201632	33
30600106	88	30688803	20	30800109	30	39000501	87	40100255	65	40201003	88	40201699	33
30600107	88	30688804	20	30800120	30	39000502	87	40100256	61	40201004	88	40201702	34
30600111	88	30688805	20	30800121	30	39000503	87	40100257	65	40201101	41	40201703	34
30600201	109	30700101	60	30800122	30	39000589	87	40100258	61	40201103	41	40201704	34
30600202	109	30700102	60	30800123	31	39000598	87	40100259	61	40201105	41	40201705	34
30600204	109	30700103	60	30800197	30	39000599	87	40100275	61	40201112	41	40201721	34
30600301	109	30700104	60	30800198	30	39000602	87	40100295	62	40201113	41	40201722	34
30600401	113	30700105	60	30800199	30	39000603	87	40100296	62	40201114	41	40201723	34
30600402	114	30700106	60	30800501	30	39000605	87	40100297	61	40201115	41	40201724	34
30600503	26	30700107	60	30800699	123	39000689	87	40100298	62	40201116	41	40201725	34
30600504	26	30700108	60	30800701	123	39000699	87	40100299	61	40201199	41	40201726	34
30600505	26	30700109	60	30800702	123	39000701	87	40100301	63	40201201	41	40201727	34
30600506	26	30700110	60	30800703	123	39000702	87	40100302	63	40201210	41	40201728	34
30600508	26	30700199	60	30800704	123	39000789	87	40100303	63	40201301	36	40201731	34
30600514	26	30700203	60	30800705	123	39000797	87	40100304	63	40201303	36	40201732	34
30600516	26	30700214	60	30800720	123	39000799	87	40100305	63	40201304	36	40201734	34
30600517	26	30700215	60	30800721	123	39000801	87	40100306	61	40201305	36	40201735	34
30600519	26	30700221	60	30800722	123	39000889	87	40100307	63	40201399	36	40201799	34
30600520	26	30700222	60	30800723	123	39000899	87	40100308	63	40201401	37	40201801	37
30600602	27	30700223	60	30800724	123	39000989	87	40100309	63	40201404	37	40201803	37
30600603	27	30700234	60	30800799	123	39000999	87	40100310	63	40201405	37	40201805	37

Table 4.3-22 (continued)

SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD
30600701	111	30700299	60	30800901	123	39001089	87	40100335	63	40201406	37	40201806	37
30600702	111	30700301	60	30901601	108	39001099	87	40100336	63	40201431	37	40201899	37
30600801	20	30700303	60	31000104	112	39001299	98	40100398	63	40201432	37	40201901	39
30600802	20	30700401	60	31000105	112	39001389	87	40100399	63	40201433	37	40201903	39
30600803	20	30700402	60	31000199	112	39001399	87	40100499	63	40201435	37	40201904	39
30600804	20	30700501	115	31000201	112	39990001	88	40100550	63	40201499	37	40201999	39
30600805	20	30700597	115	31000202	112	39990002	88	40188801	63	40201501	37	40202001	37
30600806	20	30700599	115	31000203	112	39990003	88	40188802	63	40201502	37	40202002	37
30600807	20	30700701	117	31000204	112	39990004	88	40188805	63	40201503	37	40202005	37
40202031	37	40300106	4	40301068	4	40388802	110	40400240	173	40500510	186	40600243	55
40202033	37	40300107	4	40301078	4	40388803	110	40400241	173	40500511	183	40600244	55
40202099	37	40300108	4	40301097	4	40388804	110	40400250	155	40500512	183	40600245	55
40202101	40	40300109	4	40301098	4	40388805	110	40400251	155	40500513	183	40600246	55
40202103	40	40300111	4	40301099	4	40399999	110	40400254	155	40500514	183	40600248	55
40202104	40	40300112	4	40301101	7	40400101	150	40400260	174	40500598	183	40600249	55
40202105	40	40300115	4	40301102	7	40400102	150	40400261	174	40500599	183	40600250	55
40202106	40	40300116	4	40301103	7	40400103	150	40400271	174	40500601	184	40600251	55
40202107	40	40300150	4	40301104	7	40400104	150	40400301	156	40500701	187	40600253	55
40202108	40	40300151	4	40301105	7	40400105	150	40400302	157	40500801	188	40600257	55
40202109	40	40300152	4	40301106	7	40400106	150	40400303	158	40500811	188	40600259	55
40202131	40	40300153	4	40301107	7	40400107	151	40400304	158	40500812	188	40600298	55
40202132	40	40300154	4	40301108	7	40400108	151	40400305	158	40588801	188	40600299	55
40202133	40	40300156	4	40301109	6	40400109	151	40400401	159	40588802	188	40600301	168
40202199	40	40300157	4	40301110	6	40400110	152	40400402	160	40588803	188	40600302	169
40202201	38	40300159	4	40301111	6	40400111	152	40400403	159	40588804	188	40600306	170
40202202	38	40300160	4	40301112	6	40400112	152	40400404	160	40588805	188	40600307	171
40202203	38	40300161	4	40301113	6	40400113	152	40400406	160	40600101	161	40600399	170
40202205	38	40300198	4	40301114	6	40400114	152	40400408	160	40600126	163	40700401	84
40202299	38	40300199	4	40301115	6	40400115	152	40400410	160	40600130	166	40700402	84
40202301	132	40300201	7	40301116	6	40400116	153	40400412	160	40600131	163	40700497	84
40202302	132	40300202	7	40301117	6	40400117	153	40400413	159	40600132	166	40700498	84
40202305	132	40300203	6	40301118	6	40400118	154	40400414	160	40600133	166	40700801	84
40202306	132	40300204	6	40301119	6	40400119	154	40400497	159	40600134	166	40700802	84

Table 4.3-22 (continued)

SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD
40202399	132	40300205	6	40301120	6	40400120	154	40400498	160	40600135	166	40700803	84
40202401	52	40300207	6	40301130	6	40400130	173	40500101	189	40600136	161	40700805	84
40202402	52	40300208	6	40301131	7	40400131	173	40500199	189	40600137	164	40700806	84
40202403	52	40300209	6	40301132	6	40400140	173	40500201	180	40600138	164	40700807	84
40202405	52	40300210	6	40301133	6	40400141	173	40500202	186	40600139	164	40700808	84
40202406	52	40300212	6	40301134	6	40400150	155	40500203	186	40600140	164	40700809	84
40202499	52	40300216	6	40301135	6	40400151	155	40500211	180	40600141	162	40700810	84
40202501	37	40300299	6	40301140	8	40400152	155	40500212	180	40600143	165	40700811	84
40202502	37	40300302	6	40301141	9	40400153	155	40500299	180	40600144	165	40700812	84
40202503	37	40301001	5	40301142	8	40400154	155	40500301	181	40600145	165	40700813	84
40202504	37	40301002	5	40301143	8	40400160	174	40500303	186	40600146	165	40700814	84
40202505	37	40301003	5	40301144	8	40400161	174	40500304	186	40600147	163	40700815	84
40202531	37	40301004	5	40301145	8	40400170	174	40500305	186	40600148	166	40700816	84
40202532	37	40301005	5	40301150	8	40400171	174	40500306	186	40600149	166	40700817	84
40202533	37	40301006	5	40301151	9	40400178	174	40500307	186	40600161	166	40700818	84
40202534	37	40301007	5	40301152	8	40400199	155	40500311	181	40600162	167	40700897	84
40202537	37	40301008	5	40301153	8	40400201	150	40500312	181	40600163	167	40700898	84
40202598	37	40301009	5	40301154	8	40400202	150	40500314	181	40600197	172	40701605	84
40202599	37	40301010	4	40301155	8	40400203	150	40500401	182	40600198	172	40701606	84
40202601	37	40301011	4	40301197	6	40400204	151	40500411	182	40600199	172	40701608	84
40202605	37	40301012	4	40301198	6	40400205	151	40500412	182	40600231	55	40701611	84
40202606	37	40301013	4	40301199	6	40400206	151	40500413	182	40600232	55	40701612	84
40202607	37	40301014	4	40301201	7	40400207	152	40500414	182	40600233	55	40701613	84
40202699	37	40301015	4	40301202	7	40400208	152	40500416	182	40600234	55	40701614	84
40290013	88	40301016	4	40301203	7	40400209	152	40500418	182	40600235	55	40701697	84
40300101	5	40301017	4	40301204	6	40400210	154	40500501	183	40600236	55	40701698	84
40300102	4	40301018	4	40301205	6	40400211	154	40500502	183	40600237	55	40702003	84
40300103	5	40301019	4	40301206	6	40400212	154	40500503	186	40600238	55	40702097	84
40300104	4	40301020	4	40301299	6	40400230	173	40500506	186	40600239	55	40702098	84
40300105	4	40301021	4	40388801	110	40400231	173	40500507	186	40600240	55	40703201	84
40703202	84	40704498	84	40707698	84	40787201	84	50200301	89				
40703203	84	40704801	84	40708097	84	40787299	84	50200302	89				
40703204	84	40704802	84	40708098	84	40799997	84	50200505	89				

Table 4.3-22 (continued)

SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD
40703205	84	40704897	84	40708401	84	40799998	84	50200506	89				
40703206	84	40704898	84	40708403	84	40899995	85	50200601	128				
40703297	84	40705203	84	40708404	84	40899997	55	50200602	128				
40703298	84	40705208	84	40708497	84	40899999	85	50290005	88				
40703601	84	40705210	84	40708498	84	49000101	85	50290006	88				
40703602	84	40705211	84	40715809	84	49000103	85	50290099	88				
40703603	84	40705213	84	40717205	84	49000105	85	50300101	89				
40703605	84	40705216	84	40717206	84	49000199	85	50300102	89				
40703606	84	40705297	84	40717207	84	49000201	85	50300103	89				
40703608	84	40705298	84	40717208	84	49000202	85	50300104	89				
40703609	84	40705603	84	40717209	84	49000203	85	50300105	89				
40703610	84	40705604	84	40717211	84	49000204	85	50300106	89				
40703613	84	40705605	84	40717297	84	49000205	85	50300201	89				
40703614	84	40705606	84	40717298	84	49000206	85	50300202	89				
40703615	84	40705607	84	40717601	84	49000299	85	50300204	89				
40703616	84	40705609	84	40717602	84	49000399	85	50300501	89				
40703617	84	40705610	84	40717603	84	49000401	85	50300506	89				
40703618	84	40705697	84	40717604	84	49000499	85	50300599	89				
40703619	84	40705698	84	40717697	84	49000501	85	50300601	128				
40703620	84	40706005	84	40717698	84	49000599	85	50300602	128				
40703622	84	40706006	84	40718097	84	49090013	85	50300603	128				
40703623	84	40706007	84	40720801	84	49090023	85	50300701	89				
40703624	84	40706008	84	40720897	84	49099998	85	50300801	129				
40703697	84	40706009	84	40720898	84	49099999	85	50300810	129				
40703698	84	40706010	84	40722001	84	50100101	89	50300820	129				
40704001	84	40706011	84	40722003	84	50100103	89	50300830	129				
40704002	84	40706012	84	40722005	84	50100201	89	50300899	129				
40704003	84	40706013	84	40722009	84	50100401	89	50390005	89				
40704004	84	40706015	84	40722010	84	50100505	89	50390006	89				
40704008	84	40706017	84	40722097	84	50100506	89	50390010	89				
40704009	84	40706018	84	40722098	84	50100507	89	62540010	138				
40704097	84	40706019	84	40722801	84	50100510	89	62540020	138				
40704098	84	40706020	84	40722802	84	50100515	89	62540022	138				

Table 4.3-22 (continued)

SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD	SCC	POD
40704401	84	40706021	84	40722803	84	50100516	89	64630016	138				
40704402	84	40706022	84	40722804	84	50100601	88	64630040	138				
40704403	84	40706023	84	40722805	84	50100603	89						
40704404	84	40706024	84	40722806	84	50100701	127						
40704405	84	40706097	84	40722897	84	50100702	127						
40704406	84	40706098	84	40722898	84	50100703	127						
40704407	84	40706401	84	40781602	84	50100704	127						
40704408	84	40706402	84	40781605	84	50190005	87						
40704411	84	40706403	84	40781699	84	50190006	87						
40704412	84	40706497	84	40782001	84	50200101	89						
40704414	84	40706801	84	40782003	84	50200103	89						
40704416	84	40706802	84	40782006	84	50200104	89						
40704418	84	40706814	84	40782009	84	50200105	89						
40704419	84	40706897	84	40782099	84	50200106	89						
40704420	84	40706898	84	40783203	84	50200116	89						
40704421	84	40707601	84	40784899	84	50200117	89						
40704422	84	40707602	84	40786004	84	50200201	89						
40704497	84	40707697	84	40786099	84	50200202	89						

Table 4.3-23. Area Source VOC Controls by SCC and POD

POD	SCC	SOURCE	MEASURE	PCTRD96
211	2420010055	Dry Cleaning - perchloroethylene	MACT	44.0
211	2420000055	Dry Cleaning - perchloroethylene	MACT	44.0
217	2501050120	Bulk Terminals	RACT	51.0
217	2501050000	Bulk Terminals	RACT	51.0
217	2501995000	Bulk Terminals	RACT	51.0
241	2415305000	Cold cleaning	MACT	35.0
241	2415310000	Cold cleaning	MACT	35.0
241	2415320000	Cold cleaning	MACT	35.0
241	2415325000	Cold cleaning	MACT	35.0
241	2415330000	Cold cleaning	MACT	35.0
241	2415335000	Cold cleaning	MACT	35.0
241	2415340000	Cold cleaning	MACT	35.0
241	2415345000	Cold cleaning	MACT	35.0
241	2415355000	Cold cleaning	MACT	35.0
241	2415360000	Cold cleaning	MACT	35.0
241	2415365000	Cold cleaning	MACT	35.0
250	2401075000	Aircraft surface coating	MACT	0.0
251	2401080000	marine surface coating	MACT	0.0
259	2301040001	SOCMI batch reactor processes	New CTG	78.0
270	2640000000	TSDFs	Phase I & II rules	94.0
270	2640000004	TSDFs	Phase I & II rules	94.0
272	2461021000	Cutback Asphalt	Switch to emulsified (CTG)	100.0
272	2461020000	Cutback Asphalt	Switch to emulsified (CTG)	100.0
274	2301040000	SOCMI fugitives	RACT	37.0
276	2306000000	Petroleum refinery fugitives	RACT	43.0
277	2301030000	Pharmaceutical manufacture	RACT	37.0
278	2301020000	Synthetic fiber manufacture	RACT (adsorber)	54.0
279	2310000000	Oil & natural gas fields	RACT (equipment/maintenance)	37.0
279	2310010000	Oil & natural gas fields	RACT (equipment/maintenance)	37.0
279	2310020000	Oil & natural gas fields	RACT (equipment/maintenance)	37.0
279	2310030000	Oil & natural gas fields	RACT (equipment/maintenance)	37.0
280	2501060050	Service stations - stage I	Vapor balance (CTG)	95.0
281	2501060101	Service stations - stage II	Vapor balance (stage II)	70.0
281	2501060103	Service stations - stage II	Vapor balance (stage II)	70.0
283	2501060201	Service stations - underground tank	Vapor balance (stage II)	84.0
283	2501060201	Service stations - underground tank	Vapor balance (stage II)	86.0
284	2620000000	Municipal solid waste landfills	RCRA standards	82.0
284	2620030000	Municipal solid waste landfills	RCRA standards	82.0

POD_VOC	PODNAME	APPLICABLE
211	Dry Cleaning - perchloroethylene	National
217	Bulk Terminals	National
241	Cold cleaning	National
250	Aircraft surface coating	National
251	marine surface coating	National
259	SOCMI batch reactor processes	Moderate+
270	Treatment, stroage and disposal facilities	National
272	Cutback Asphalt	Marginal+
274	SOCMI fugitives	National
276	Petroleum refinery fugitives	National
277	Pharmaceutical manufacture	National
278	Synthetic fiber manufacture	National
279	Oil and natural gas production fields	Moderate+
280	Service stations - stage I-truck unloading	National
284	Municipal solid waste landfills	National

Table 4.3-24. Counties in the United States that use Reformulated Gasoline

State		County		State		County		State		County	
6	California	19	Fresno Co	24	Maryland	510	Baltimore	42	Pennsylvania	91	Montgomery Co
6	California	29	Kern Co	25	Massachusetts	1	Barnstable Co	42	Pennsylvania	101	Philadelphia Co
6	California	37	Los Angeles Co	25	Massachusetts	3	Berkshire Co	44	Rhode Island	1	Bristol Co
6	California	55	Napa Co	25	Massachusetts	5	Bristol Co	44	Rhode Island	3	Kent Co
6	California	67	Sacramento Co	25	Massachusetts	7	Dukes Co	44	Rhode Island	5	Newport Co
6	California	73	San Diego Co	25	Massachusetts	9	Essex Co	44	Rhode Island	7	Providence Co
6	California	75	San Francisco Co	25	Massachusetts	11	Franklin Co	44	Rhode Island	9	Washington Co
9	Connecticut	1	Fairfield Co	25	Massachusetts	13	Hampden Co	48	Texas	39	Brazoria Co
9	Connecticut	3	Hartford Co	25	Massachusetts	15	Hampshire Co	48	Texas	71	Chambers Co
9	Connecticut	5	Litchfield Co	25	Massachusetts	17	Middlesex Co	48	Texas	85	Collin Co
9	Connecticut	7	Middlesex Co	25	Massachusetts	19	Nantucket Co	48	Texas	113	Dallas Co
9	Connecticut	9	New Haven Co	25	Massachusetts	21	Norfolk Co	48	Texas	121	Denton Co
9	Connecticut	11	New London Co	25	Massachusetts	23	Plymouth Co	48	Texas	157	Fort Bend Co
9	Connecticut	13	Tolland Co	25	Massachusetts	25	Suffolk Co	48	Texas	167	Galveston Co
9	Connecticut	15	Windham Co	25	Massachusetts	27	Worcester Co	48	Texas	201	Harris Co
10	Delaware	1	Kent Co	33	New Hampshire	11	Hillsborough Co	48	Texas	291	Liberty Co
10	Delaware	3	New Castle Co	33	New Hampshire	13	Merrimack Co	48	Texas	339	Montgomery Co
10	Delaware	5	Sussex Co	33	New Hampshire	15	Rockingham Co	48	Texas	439	Tarrant Co
11	Dist. Columbia	1	Washington	33	New Hampshire	17	Strafford Co	48	Texas	473	Waller Co
17	Illinois	31	Cook Co	34	New Jersey	1	Atlantic Co	51	Virginia	13	Arlington Co
17	Illinois	43	Du Page Co	34	New Jersey	3	Bergen Co	51	Virginia	36	Charles City Co
17	Illinois	63	Grundy Co	34	New Jersey	5	Burlington Co	51	Virginia	41	Chesterfield Co
17	Illinois	89	Kane Co	34	New Jersey	7	Camden Co	51	Virginia	85	Hanover Co
17	Illinois	93	Kendall Co	34	New Jersey	9	Cape May Co	51	Virginia	87	Henrico Co
17	Illinois	97	Lake Co	34	New Jersey	11	Cumberland Co	51	Virginia	95	James City Co
17	Illinois	111	McHenry Co	34	New Jersey	13	Essex Co	51	Virginia	107	Loudoun Co
17	Illinois	197	Will Co	34	New Jersey	15	Gloucester Co	51	Virginia	153	Prince William Co
18	Indiana	89	Lake Co	34	New Jersey	17	Hudson Co	51	Virginia	159	Richmond Co
18	Indiana	127	Porter Co	34	New Jersey	19	Hunterdon Co	51	Virginia	179	Stafford Co
21	Kentucky	15	Boone Co	34	New Jersey	21	Mercer Co	51	Virginia	199	York Co
21	Kentucky	29	Bullitt Co	34	New Jersey	23	Middlesex Co	51	Virginia	510	Alexandria
21	Kentucky	37	Campbell Co	34	New Jersey	25	Monmouth Co	51	Virginia	550	Chesapeake
21	Kentucky	111	Jefferson Co	34	New Jersey	27	Morris Co	51	Virginia	570	Colonial Heights
21	Kentucky	117	Kenton Co	34	New Jersey	29	Ocean Co	51	Virginia	600	Fairfax
21	Kentucky	185	Oldham Co	34	New Jersey	31	Passaic Co	51	Virginia	610	Falls Church
23	Maine	1	Androscoggin Co	34	New Jersey	33	Salem Co	51	Virginia	650	Hampton
23	Maine	5	Cumberland Co	34	New Jersey	35	Somerset Co	51	Virginia	670	Hopewell
23	Maine	11	Kennebec Co	34	New Jersey	37	Sussex Co	51	Virginia	683	Manassas
23	Maine	13	KNO_x Co	34	New Jersey	39	Union Co	51	Virginia	685	Manassas Park
23	Maine	15	Lincoln Co	34	New Jersey	41	Warren Co	51	Virginia	700	Newport News
23	Maine	23	Sagadahoc Co	36	New York	5	Bronx Co	51	Virginia	710	Norfolk
23	Maine	31	York Co	36	New York	27	Dutchess Co	51	Virginia	735	Poquoson
24	Maryland	3	Anne Arundel Co	36	New York	47	Kings Co	51	Virginia	740	Portsmouth
24	Maryland	5	Baltimore Co	36	New York	59	Nassau Co	51	Virginia	760	Richmond
24	Maryland	9	Calvert Co	36	New York	61	New York Co	51	Virginia	800	Suffolk
24	Maryland	13	Carroll Co	36	New York	71	Orange Co	51	Virginia	810	Virginia Beach
24	Maryland	15	Cecil Co	36	New York	79	Putnam Co	51	Virginia	830	Williamsburg
24	Maryland	17	Charles Co	36	New York	81	Queens Co	55	Wisconsin	59	Kenosha Co
24	Maryland	21	Frederick Co	36	New York	85	Richmond Co	55	Wisconsin	79	Milwaukee Co
24	Maryland	25	Harford Co	36	New York	87	Rockland Co	55	Wisconsin	89	Ozaukee Co
24	Maryland	27	Howard Co	36	New York	103	Suffolk Co	55	Wisconsin	101	Racine Co
24	Maryland	29	Kent Co	36	New York	119	Westchester Co	55	Wisconsin	131	Washington Co
24	Maryland	31	Montgomery Co	42	Pennsylvania	17	Bucks Co	55	Wisconsin	133	Waukesha Co
24	Maryland	33	Prince George's Co	42	Pennsylvania	29	Chester Co				
24	Maryland	35	Queen Annes Co	42	Pennsylvania	45	Delaware Co				

Table 4.3-25. NO_x Nonroad Control Efficiencies by SCC

SCC	POD	PODNAME	ATTAINMENT	CONTROL	RULPEN96	CONEFF96
2270002xxx	48	Construction Equipment - Diesel	Attainment	Phase 1 compression ign. std	1.0	37
2270003xxx	48	Industrial Equipment - Diesel	Attainment	Phase 1 compression ign. std	0.9	37
2270004xxx	48	Lawn And Garden - Diesel	Attainment	Phase 1 compression ign. std	0.5	37
2270005xxx	48	Farm Equipment - Diesel	Attainment	Phase 1 compression ign. std	1.0	37
2270006xxx	48	Commercial Equipment - Diesel	Attainment	Phase 1 compression ign. std	1.0	37
2270007xxx	48	Logging Equipment - Diesel	Attainment	Phase 1 compression ign. std	1.0	37
2270008xxx	48	Airport Service Equipment - Diesel	Attainment	Phase 1 compression ign. std	1.0	37

Table 4.3-26. NO_x Area Source RACT

SCC	POD	PODNAME	ATTAINMENT	RULPEN96	CONEFF96
2102001000	22	Industrial Bituminous Coal Combustion	Moderate	23	21
2102001000	22	Industrial Bituminous Coal Combustion	Serious	45	21
2102001000	22	Industrial Bituminous Coal Combustion	Severe	45	21
2102001000	22	Industrial Bituminous Coal Combustion	Extreme	45	21
2102002000	22	Industrial Anthracite Coal Combustion	Moderate	23	21
2102002000	22	Industrial Anthracite Coal Combustion	Serious	45	21
2102002000	22	Industrial Anthracite Coal Combustion	Severe	45	21
2102002000	22	Industrial Anthracite Coal Combustion	Extreme	45	21
2102004000	23	Industrial Distillate Oil Combustion	Moderate	8	36
2102004000	23	Industrial Distillate Oil Combustion	Serious	16	36
2102004000	23	Industrial Distillate Oil Combustion	Severe	16	36
2102004000	23	Industrial Distillate Oil Combustion	Extreme	16	36
2102005000	23	Industrial Residual Oil Combustion	Moderate	8	42
2102005000	23	Industrial Residual Oil Combustion	Serious	16	42
2102005000	23	Industrial Residual Oil Combustion	Severe	16	42
2102005000	23	Industrial Residual Oil Combustion	Extreme	16	42
2102006000	24	Industrial Natural Gas Combustion	Moderate	11	31
2102006000	24	Industrial Natural Gas Combustion	Serious	22	31
2102006000	24	Industrial Natural Gas Combustion	Severe	22	31
2102006000	24	Industrial Natural Gas Combustion	Extreme	22	31

Table 4.3-27. National Nonroad Diesel Emissions (tons)

		1995		1996	
		NET	OMS	NET	OMS
Rec. Veh.	VOC	1	1,160	1	1,170
	NO_x	547	7,672	547	7,747
	CO	7	4,795	7	4,876
	PM-10	0	959	0	945
	PM-2.5	0	882	0	869
Construction	VOC	98,658	166,439	100,161	167,115
	NO_x	794,859	1,389,600	804,137	1,385,862
	CO	477,757	767,523	484,772	775,071
	PM-10	145,900	163,983	148,235	162,388
	PM-2.5	134,228	150,865	136,376	149,397
Industrial	VOC	233,948	32,255	23,797	32,667
	NO_x	216,66	260,134	214,30`	262,874
	CO	98,727	126,916	98,080	129,074
	PM-10	24,866	30,527	24,921	30,788
	PM-2.5	22,877	28,085	22,929	28,325
Lawn and Garden	VOC	723	9,568	730	9,706
	NO_x	5,946	63,250	5,983	64,184
	CO	3,351	39,532	3,380	40,174
	PM-10	898	7,906	906	7,987
	PM-2.5	827	7,273	834	7,348
Agricultural	VOC	23,691	219,496	32,625	219,594
	NO_x	118,414	1,105,995	164,323	1,111,779
	CO	113,801	830,206	149,409	842,638
	PM-10	20,076	204,237	21,158	203,100
	PM-2.5	18,470	187,898	19,466	186,852
Light Comm.	VOC	2,284	14,393	2,314	14,609
	NO_x	15,386	95,148	15,532	96,607
	CO	9,884	59,467	10,011	60,478
	PM-10	2,953	11,893	2,989	12,009
	PM-2.5	2,717	10,941	2,750	11,048
Logging	VOC	654	12,002	670	11,652
	NO_x	8,665	74,186	8,844	72,616
	CO	3,999	29,365	4,095	29,688
	PM-10	1.165	7,727	1,180	7,494
	PM-2.5	1,072	7,109	1,086	6,895
Airport Service	VOC	12,045	10,273	12,201	10,001
	NO_x	100,442	90,835	101,350	86,672
	CO	46,446	39,318	46,959	39,987
	PM-10	17,971	10,381	18,316	9,804
	PM-2.5	16,534	9,550	16,851	9,020

1165?

Table 4.3-28. National Spark Ignition Marine Engine Emissions (tons)

	1995		1996	
	NET	OMS	NET	OMS
VOC	492,248	434,174	495,491	459,114
NO_x	27,731	41,756	27,945	41,968

Table 4.3-29. National Locomotive Emissions (tons)

	1995 NET	1995 OMS
NO_x	990,000	1,075,400
PM-10	50,000	26,900

Table 4.3-30. Cotton Ginning Emission Factors[28]

Control Type	Total PM (lb/bale)	PM-10 (lb/bale)	PM-2.5 (lb/bale)
Full controls (high-efficiency cyclone)	2.4	0.82	0.024
Conventional controls (screened drums or cages)	3.1	1.2	0.031

Table 4.3-31. Estimated Percentage of Crop By Emission Control Method (By State and U.S. Average)[29]

State	Percent Crop - Full Controls	Percent Crop - Conventional Controls
Alabama	20	80
Arizona	50	50
Arkansas	30	70
California	72	28
Florida	20	80
Georgia	30	70
Louisiana	20	80
Mississippi	20	80
Missouri	20	80
New Mexico	20	80
North Carolina	30	70
Oklahoma	20	80
South Carolina	20	80
Tennessee	20	80
Texas	30	70
Virginia	20	80
U.S. Average[a]	**35**	**65**

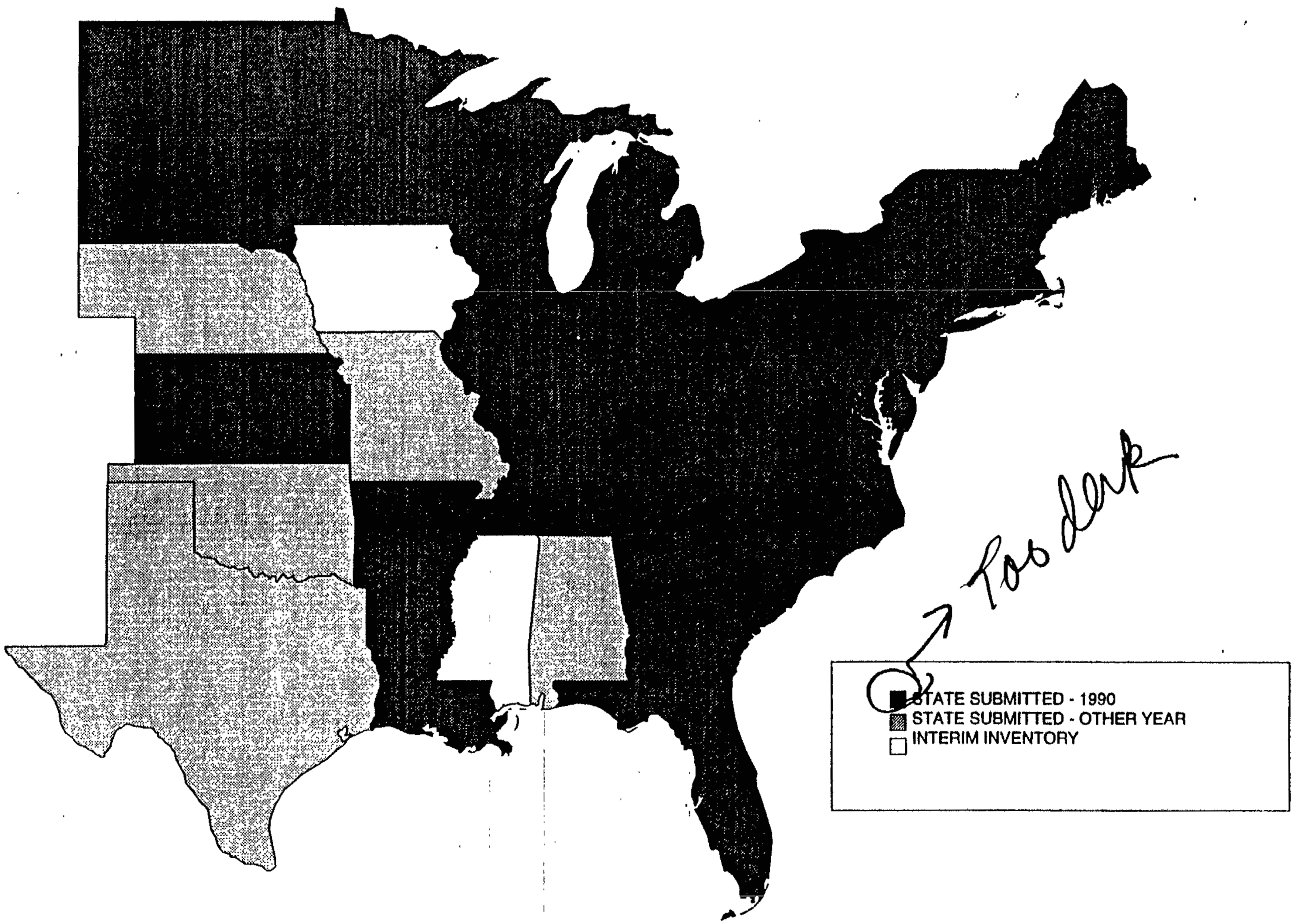
[a]Average is based on the average crop (average total bales ginned per year) from 1991 to 1995 for these states.

Table 4.3-32. Cotton Ginnings: Running Bales Ginned By County, District, State, and United States[a]

State/County/ District		Running Bales Ginned	State/County/ District		Running Bales Ginned
UNITED STATES		17,498,800			
Alabama			Alabama (Cont'd)		
Colbert	1/	*12,000*	Baldwin	1/	*30,575*
Lauderdale	1/	*12,000*	Escambia	1/	*30,575*
Lawrence		35,200	Mobile	1/	*30,575*
Limestone		59,300	Monroe	1/	*30,575*
Madison		25,750			
			District 50		122,300
District 10		144,250			
			Covington	1/	*25,608*
Blount	1/	*4,538*	Crenshaw	1/	*25,608*
Cherokee	1/	*4,538*	Geneva	1/	*25,608*
			Henry	1/	*25,608*
District 20			Houston	1/	*25,608*
			Russell	1/	*25,608*
Chilton	1/	*4,538*			
Fayette	1/	*4,538*	District 60		153,650
Pickens	1/	*4,538*			
Shelby	1/	*4,538*	AL Total		491,150
Tallapoosa	1/	*4,538*			
Tuscaloosa	1/	*4,538*			
			Arizona		
District 30	2/				
			Mohave	1/	
Autauga	1/	*4,079*			
Dallas	1/	*4,079*	District 20	2/	
Elmore		6,100			
Greene	1/	*4,079*	Maricopa		354,050
Hale	1/	*4,079*	Pinal		266,900
Lowndes	1/	*4,079*			
Macon	1/	*4,079*	District 50		620,950
Marengo	1/	*4,079*			
			La Paz	1/	
District 40		34,650	Yuma		74,100

[a]The data in and format of this table were taken from the 03/25/96 *Cotton Ginnings* report.
1/ Withheld to avoid disclosing individual gins.
2/ Withheld to avoid disclosing individual gins, but included in state total.
3/ Excludes some gins' data to avoid disclosing individual gins, but included in state total.
4/ Withheld to avoid disclosing individual gins, but included in U.S. total.

Figure 4.3-1. OTAG Inventory Data Source - Point Sources



$$VMT_{SU,C} = VMT_{SU,S} \times \frac{POP_{SU,C}}{POP_{SU,S}}$$

where: $VMT_{SU,C}$ = Small urban VMT in county C (calculated)
$VMT_{SU,S}$ = Small urban VMT, state total (HPMS)
$POP_{SU,C}$ = Small urban population in county C (CNOI)
$POP_{SU,S}$ = small urban population, state total (CNOI)

The approach for allocation HPMS daily VMT (DVMT) reported for individual urban area was slightly different than the approach used to allocate rural and small urban DVMT. Each urbanized area in the HPMS file is assigned a unique 3-digit code. In order to allocate DVMT totals by road type for each individual urbanize area, an urban area population file was used which provides a linkage between a given urban area code, and the corresponding population in each component county. The percentage or urban DVMT totals to obtain a total urban DVMT by roadway category for each county. Because the boundaries of urbanized and small urban areas changed from year to year, there were urban areas in the HPMS input files for which the population for component counties was not available. In these cases, the VMT for this urban area was added to the HPMS small urban VMT total by road category and allocated by small urban population ratios.

4.6.1.2.3 Urban Area VMT —

step 1. For each urbanized area, the percentage of its population in each county containing a portion of the urbanized area using data from CNOI Table 13.

step 2. Each county's share of an urban area's VMT was calculated by distributing urban area VMT from the HPMS areawide data base based on the percentage of the urban area's population in each county using the following equation:

$$VMT_{UA,C} = VMT_{UA,S} \times \frac{POP_{UA,C}}{POP_{UA,S}}$$

where: $VMT_{UA,C}$ = Urban area's VMT in county C (calculated)
$VMT_{UA,S}$ = Urban area's VMT, state total (HPMS)
$POP_{UA,C}$ = Urban area's population in county C (CNOI)
$POP_{UA,S}$ = Urban area's population, state total (CNOI)

In a few cases, a single county contained parts of more than one urban area. For those counties, urban VMT was calculated as the sum of the county's proportion of VMT from each of the large urban areas in the county and the county's small urban VMT.

The next step in calculation was to allocate the DVMT totals in twelve rural and urban roadway categories among the eight vehicle type categories. For each year between 1980 and 1992, a percentage distribution was calculated for each vehicle type for both the rural and urban classifications. The first step in the development of this percentage distribution was to obtain the most recent VMT totals by vehicle type and by year from FHWA's Highway Statistics.[4] Rural and urban VMT in this publication are provided for the following vehicles types: Passenger cars, motorcycles, buses, two-axle/four-tire single-unit trucks, other single-unit trucks, and combination trucks. (In the years prior to 1990, a VMT breakdown between passenger cars and motorcycles was not provided. A total VMT for Personal Passenger Vehicles is provided. It was assumed that the division between passenger car VMT and motor cycle VMT is the same in earlier years as was reported for 1990.) For each of the six vehicle type categories for which VMT is reported in Highway Statistics, a percentage of the total was calculated for both rural and urban VMT. In order to convert these percentages for the six HPMS categories to the eight MOBILE5a vehicle type categories, a breakdown provided by EPA was used which reconciles the vehicle class categories used in the HPMS to those used in EPA's MOBILE model.[5] This method of conversion form HPMS categories to MOBILE5a categories is based on a matching scheme that allows states to apportion VMT as it is reported in HPMS categories to the eight MOBILE model vehicles class categories. The apportionment percentages supplied by EPA are shown in Table 4.6-2.

After allocating HPMS DVMT totals by county, roadway category, and vehicle type, the values were converted to millions of annual VMT. Quality assurance was performed on the output files for each of the years by comparing state totals to the HPMS data provided by state. It is important to note that for certain years, slight discrepancies exist between the HPMS totals and the totals reported in Highway statistics.

4.6.1.3 Distribution of VMT, 1970 to 1979 and 1993

The methodology for allocating VMT totals for 1970 through 1979 was based on state totals which were published in FHWA's Highway Statistics 1985. For each year, state totals were allocated by county, roadway type, and vehicle type using a ration from the 1980 VMT file for each state/county/SCC combination expressed as a percentage of the 1980 state total. Quality assurance was performed by comparing statewide totals for each year's output to the FHWA's state totals.

The input for the 1993 VMT files were rural and urban VMT totals by state which were obtained from FHWA.[6] The allocation of 1993 VMT by county, roadway category, and vehicle type was accomplished using the 1992 output file. To allocate rural VMT by county, the population file used to allocate rural VMT for the years 1980 to 1992 was used. For urban VMT, the two population files used for earlier years which contained small urban and urban population were combined into one files. After allocating the rural VMT and urban VMT by county, percentages by each of the 12 roadway types were calculated using 1992 output. Lastly, 1993 VMT was divided among the 8 vehicles types using the same vehicles distribution that was used in the allocation of the 1992 VMT.

The resulting annual county-level vehicle and roadway type specific VMT data were temporally allocated to months. Seasonal 1985 NAPAP temporal allocation factors[7] were used to apportion the VMT to the four seasons. Monthly VMT data were obtained using a ratio between the number of days in a month and the number of days in the corresponding season.

4.6.2 Development of VOC, NO_x, and CO Emission Factors

EPA's MOBILE5a mobile source emission factor model was used to calculate all emission factors.[19] The March 26, 1993, version of MOBILE5a was used for this inventory. The pollutants modeled were exhaust VOC, evaporative VOC (which includes resting loss, running loss, and evaporative emissions), exhaust NO_x, and exhaust CO. VOC emissions include aldehydes and hydrocarbons measured by Flame Ionization Detector (FID) testing.

4.6.2.1 Temperature

The temperature data used for Emission Trends inventory included an average daily maximum and minimum temperature for each state for each month for each year from 1970 to 1993. The data were obtained on diskette from the National Climatic Data Center.[9] A single city was selected from each state to represent the state's temperature conditions. The cities were selected to be the most representative of the average conditions within the state, generally either centrally located cities or in states with a majority of VMT clustered in one area, the most populous cities. Because of the great variations of temperature and the wide distribution of VMT throughout California, EPA suggested that California should be broken into two geographic regions, with Los Angeles representing the southern and interior portions of the state and San Francisco representing the northern coastal region of the state. It was also suggested that Texas be broken into two regions, with Houston representing the coastal and southern portions of the state and Dallas representing the interior and northern portions of the state. After investigating the differences in the actual temperature data for these two cities, however, it was determined that there was not enough variation in the temperatures for these two cities to warrant dividing the state into two regions. Table 4.6-3 shows the cities that were used to represent each state's temperature conditions. As noted in Table 4.6-3, data were missing for some years for some states. In these cases, 30-year average monthly maximum and minimum temperature values were used from Statistical Abstracts.[10] The allowable temperature range for input to MOBILE5a is 0°F to 100°F for the minimum daily temperatures and 10°F to 110°F for the maximum daily temperatures. In the few cases where the temperatures fell outside of these ranges, the endpoint of the range was substituted for the actual temperatures.

4.6.2.2 RVP

This section describes the methodology used to apportion RVP values to each state by month. The steps involved in making these calculations were as follows: (1) assigning a January and July RVP to each state, and (2) estimating the RVP for the other months for each state.

4.6.2.2.1 Apportioning RVP Data to Each State —
The first step in the process of determining monthly RVP values for each state was to assign a weighted January and July RVP for each year to every state. EPA's Office of Mobile Sources (OMS) provided spreadsheets of historic RVP data that included the average January and July RVP values weighted by the market share of each type of gasoline (regular unleaded, intermediate unleaded, premium unleaded, etc.) from each of the 23 cities included in the American Automobile Manufacturer's Association (AAMA) fuel surveys.[11] These data were provided for each year from 1970 through 1993. Using these data, January and July RVP values were assigned to each state for each year. This was done using a listing, provided by OMS, matching each nonattainment area throughout the United States which with the corresponding AAMA survey city whose RVP should be used to represent that nonattainment area. These assignments were based on pipeline distribution maps. The corresponding January and July weighted RVP values were then assigned to each of these nonattainment areas. The January or July RVP values for a given year for all nonattainment areas within a state were then averaged to estimate a single statewide January or July RVP value. Several states had no nonattainment areas and therefore

were not included in the OMS cross reference listing. Survey cities were assigned to these states based on a combination of location and pipeline maps. These assignments were as follows:

State	Survey City
Idaho	Billings, MT and Seattle, WA
Iowa	Minneapolis, MN
Nebraska	Kansas City, MO and Minneapolis, MN
North Dakota	Minneapolis, MN
South Dakota	Minneapolis, MN
Wyoming	Billings, MT and Denver, CO

For states where two survey cities are listed, the average of the RVP values for the two survey cities was used. Alaska and Hawaii were not matched with survey cities but were assigned winter and summer RVP values based on guidance from OMS. Alaska was assigned a winter RVP value of 14.5 psi and a summer RVP value of 12.5 psi while Hawaii was assigned a winter RVP value of 10.0 psi and a summer RVP value of 9.5 psi. These assignments applied for each year from 1970 through 1993.

4.6.2.2.2 Estimating Monthly RVP for Each State —

The next step was to estimate statewide RVP values for the remaining months based on the January and July RVP values. The ASTM schedule of seasonal and geographical volatility classes was used as the basis for the RVP allocation by month.[12] This schedule assigns one or two volatility classes to each state for each month of the year. Volatility classes are designated by a letter (A through E), with A being the least volatile. Several states are divided into two or more regions, with each region having its own set of volatility class guidelines. The MOBILE4 *User's Guide*[13] provides guidance on which ASTM class to assign to each state for each month when more than one region is included for a state, or when two ASTM classes are listed for a given state in a given month. This guidance was followed here to select a single ASTM class for each state and month. The MOBILE4 *User's Guide* also lists RVP limits that correspond to each ASTM class (EPA, 1989). These RVP limits are as follows:

- ASTM class A = 9.0 psi
- ASTM class B = 10.0 psi
- ASTM class C = 11.5 psi
- ASTM class D = 13.5 psi
- ASTM class E = 15.0 psi

The January ASTM class designation was assigned to the January RVP value calculated for each state (as determined in step 2 above) and the July ASTM class designation was assigned to the July RVP value calculated for each state. Other months with the same ASTM class designation as either January or July were assigned the January or July RVP value for that state. The RVP values for months with intermediate ASTM class designations were calculated by interpolation using the January and July RVP values and the ASTM class RVP limits. The equation used for this interpolation is shown below.

$$IM = [(IA - SA) \times (WM - SM) / (WA - SA)] + SM$$

where:

IM	=	Intermediate month's (not January or July) RVP value
WM	=	Winter (January) RVP value
SM	=	Summer (July) RVP value
IA	=	Intermediate month's (non-January or July) ASTM RVP limit
WA	=	Winter (January) ASTM RVP limit
SA	=	Summer (July) ASTM RVP limit

Calculations were made for each intermediate month for each state. Starting in 1989, summer RVP values were limited by EPA's Phase I RVP limits and in 1992 by the Phase II RVP limits. After the May through September RVP values were calculated for each state using the procedure above, the values were replaced by the state-specific monthly Phase I (for 1989 to 1991) or the Phase II (for 1992 and 1993) limit if the corresponding limit was lower than the calculated monthly RVP value.

4.6.2.3 Speed

Nine speeds were modeled for each state. The nine speeds used in the model were derived from the average overall speed output from the HPMS impact analysis. Average overall speed data were obtained for the years 1987 through 1990.[1] The average overall speed for each vehicle type varied less than one mile per hour (MPH) over the four-year span. Therefore, the same speeds (from 1990) were used for all years from 1970 to 1993. Table 4.6-4 lists the average overall speed output for 1990 from the HPMS impact analysis. To determine the actual speeds to use in modeling the emission factors, HPMS vehicle types were chosen to represent the speeds for each AMS vehicle type:

- passenger cars — used for light-duty vehicles (LDVs) and motorcycles (speeds for small and large cars were the same)
- pickup trucks and vans — used for light-duty trucks (LDTs)
- multi-trailer trucks with five or more axles — used for heavy-duty vehicles (HDVs)

To reduce the number of speeds to be modeled, the HPMS speeds were rounded to the nearest five miles per hour. Local speeds, which were not included in the HPMS impact analysis output, were assumed to be the same as minor collector speeds for rural roads and collector speeds for urban roads. Table 4.6-5 lists the average speed used for each road type/vehicle type combination.

4.6.2.4 Operating Mode

All MOBILE5a runs at all speeds were made using the operating mode assumptions of the Federal Test Procedure (FTP). With the FTP, 20.6 percent of all VMT is accumulated in the cold start mode (or Bag 1 of the FTP), 27.3 percent of all VMT is accumulated in the hot start mode (or Bag 3 of the FTP), and 52.1 percent of all VMT is accumulated in the hot stabilized mode (or Bag 2 of the FTP).

4.6.2.5 Altitude

The entire states of Colorado, Nevada, New Mexico, and Utah were modeled as high altitude areas. All other states were modeled as low altitude areas.

4.6.2.6 Registration Distribution/Month

A national registration distribution was included in all of the MOBILE5a input files. These registration distributions varied by calendar year and show the fraction of vehicles registered in the given calendar year by model year. Separate registration distributions are developed for each vehicle type (with a single registration distribution for light duty gasoline and diesel vehicles and a single registration distribution for light duty gasoline trucks I and light duty diesel trucks). Registration distributions developed under earlier Emission Trends work assignments were used for calendar years 1970 through 1990. New registration distributions were developed under this assignment for 1991, 1992, and 1993.

The main difference between the 1991 registration distribution and those of previous years is the expansion from a 20-year distribution to a 25-year distribution. In addition to the development of the 1991 distribution, data used in the development of the 1990 registration distribution were updated with more current vehicle sales figures. All registration distributions for the years 1980 through 1990 were also expanded to a 25-year range.

The specific procedures used in each of the steps outlined above are discussed in detail in the following sections. In some cases, the methods used for this version of Emission Trends inventory correspond to procedures used in previous years, while in other cases, improvements have been made to the estimation procedure. Both old and new methods are documented below.

Vehicle registration distributions for 1991, 1992, and 1993 were developed using a dBase computer program. (This program was developed to perform the computations that had been done for earlier Emission Trends inventory in a spreadsheet model.) This registration distribution program estimates the distribution of vehicles operating by model year in 1991, 1992, and 1993 for each of the eight MOBILE vehicle types. For automobiles, the registration distribution is based on the number of cars in operation by model year as reported in AAMA's *Facts and Figures 1993*[11] and sales data from Automotive News' *Market Data Book 1993*.[14] For each of the five MOBILE truck classes, the distribution is based on sales figures from AAMA and Automotive News, as well as the number of trucks in operation by model year from AAMA. For motorcycles, the registration distribution for these three years did not change from previous years; this distribution was taken from the default distribution from the previous Emission Trends procedures manual, which covered a 12-model-year range. The specific procedure used to calculate the registration distribution for automobiles and trucks is discussed below.

4.6.2.6.1 Automobiles —
AAMA's *Facts and Figures 1993* lists the number of cars in operation by model year. The most recent calendar year for which data are available from this source is 1992. The number of cars in operation in 1992 for each model year from 1977 through 1992 was used as a preliminary estimate of the number of cars from these model years operating in 1992 (These will be updated in the next version of Emission Trends inventory by AAMA's actual estimates for the 1993 calendar year).

The earliest model year for which data were given on the number of cars operating in 1992 was the 1977 model year. The figure given for the number of model year 1977 cars operating in 1992 is actually an aggregate figure of the number of cars from 1977 and all earlier model years still operating in 1992. A methodology was developed to distribute the cars operating from model year 1977 and earlier years over the remaining nine years required for developing a 25-year registration distribution. In order to do this, a formula was derived using automobile survival rates to project estimates of operation for these older cars by model year to 1993.[15] Based on AAMA data for previous years, the number of cars from each model year from 1969 through 1977 still in operation in 1993 was estimated using the following formula:

$$\textit{Model Year}_N \textit{ Cars in Operation in Year}_{1993} = A \times \frac{C}{B}$$

where:	A	=	AAMA number of Model Year_N Cars Operating in Year_Y
	B	=	Survival rate for age_{Y-N}
	C	=	Survival rate for age_{1993-N}
	Year	=	Last calendar year for which an estimate is available for this particular model year (as of July 1)
	N	=	Most current model year for which '*Number of Automobiles in Operation*' are available

AAMA's estimate of model year 1992 automobiles operating in 1992 appeared to be low in comparison to historical data. Therefore, a rate of change was calculated for automobile sales from the years 1991 to 1992 (*Automotive News*, 1993). The rate was then multiplied by AAMA's estimate of model year 1991 cars in operation in 1992. To develop an estimate of the number of 1993 model year cars operating in 1993, the number of 1992 registrations of model year 1992 automobiles was multiplied by 0.75, since by July 1, three-quarters of the car model year had passed (new model year automobiles are generally released in October).

Using this complete set of automobile registrations by model year for the 25-year period from 1969 to 1993, the registration distribution was calculated by dividing the number of cars in operation by model year by the total number of cars operating over the 25-year period. This process was repeated to develop a registration distribution for 1991 and 1992. The only difference for these years is that the number of cars in operation in the most recent model year was available from AAMA for these previous years and therefore, no projections of the number of cars in operation were made for the latest model year.

4.6.2.6.2 Trucks —

For each truck type, the 1993 registration distribution was calculated with truck sales figures by type and model year, which were weighted by the distribution of truck registrations (the total over all truck types) from AAMA's *Facts and Figures 1993*. The basic methodology for calculating this distribution is outlined here and closely follows that used in previous years (with a few modifications).

The first step was to determine 1993 truck sales by MOBILE truck category. (Sales figures for years prior to 1992 were not changed from those used in calculating previous years' registration distributions.) AAMA and Automotive News were the sources of sales data.[11,14] Because AAMA's truck categories do not exactly correspond to the categories used in MOBILE, the previous version of the Emission Trends procedures manual outlined a method for allocating sales from AAMA's weight class categories to the MOBILE truck categories. The formulas used for the 1991, 1992, and 1993 distribution are as follows:

$$LDGT1 = Retail Sales(domestic + import)_{(0-6,000 lbs)} - Diesel Factory Sales_{(0-6,000 lbs)}$$

$$LDGT2 = \left(\begin{matrix} Retail \\ Sales \end{matrix} - VCC - M - (0.05 \times CP) - \begin{matrix} Diesel \\ Factory \\ Sales \end{matrix} \right)_{(6,000-10,000 lbs)}$$

where: VCC = Retail sales of van cutaway chassis
M = Retail sales of multi-stops
CP = Retail sales of conventional pickups

$$HDGT = (VCC + M + [0.05 \times CP])_{(6,000-10,000 lbs)} - \begin{pmatrix} Heavy\text{-}Duty \\ Diesel Trucks \end{pmatrix} + \begin{pmatrix} Retail \\ Sales \end{pmatrix}_{(>10,000 lbs)}$$

$$LDDT = Diesel Factory Sales_{(0-6,000 lbs)} + (0.10 \times Diesel Factory Sales)_{(6,000-10,000 lbs)}$$

$$HDDT = [0.9 \times (Diesel Factory Sales)_{(6,000-10,000 lbs)}] + \Sigma \, (Diesel Factory Sales)_{(>10K lbs)}$$

Since the most current year for which data were available was 1992, the formulas above were used to determine 1992 truck sales; 1993 sales were then based on 1992 estimates. However, because the 1992 sales calculated with the formulas above seemed unusually low, the ratio of 1991 truck sales to 1992 truck sales[14] was multiplied by AAMA's 1991 sales[11] to obtain comparable figures for 1992 sales. Sales for 1993 were then estimated by using 50 percent of the 1992 figures for each of the truck categories. (The truck model year is assumed to start in January, so half of the model year trucks would be sold by July 1.)

Once AAMA sales data for 1992 and 1993 were converted into MOBILE categories, a distribution of truck registrations by model year was needed to determine the percentage of trucks operating for each model year as of July 1, 1993.

The AAMA list of trucks in operation by model year covered a range of 17 model years (the last year representing an aggregate figure of all previous years). The total number of trucks in operation was distributed over the remaining eight years in a method consistent with that described for automobiles. Again, 1993 registrations were estimated based on those in 1992, although in the case of trucks, 1992 registrations were multiplied by 50 percent, rather than 75 percent, since half of the truck model year had passed as of July 1. The total number of trucks operating in 1991 reported by AAMA[11] was multiplied by the rate of change in registrations from 1991 to 1992.[14]

Because registration data are not available for each of the five MOBILE truck categories, a method was developed and used in past years of the Emission Trends procedures document to estimate the number of trucks operating by MOBILE category. Following this procedure, the 1993 sales figure for each truck type was multiplied by the ratio of the total number of trucks operating from each model year to the total number of truck sales (comparable to AAMA's data on cars in operation from the previous section). For example, the formula used to calculate Model $Year_N$ light-duty gasoline truck 1 (LDGT1s) operating in 1993 is as follows:

$$\frac{Model\,Year_N LDGT1s}{Operating\,in\,1993} = \frac{Model\,Year_N LGT1s}{Sold\,in\,1993} \times \frac{\begin{matrix}Total\,Model\,Year_N Trucks\\ Operating\,in\,1993\end{matrix}}{Total\,Trucks\,Sold\,in\,1993}$$

This formula was applied to all five truck types for model years 1969 through 1993. To estimate the registration distribution for each truck type, the number of trucks operating per model year, as estimated above, was divided by the total of all trucks operating for that particular truck category.

The sales and registration data used in the development of registration distribution data for 1991 was updated to be comparable to the 1993 data. To estimate 1991 sales in a manner similar to the estimation procedure used in estimating 1992 sales, AAMA's 1988 sales were multiplied by the ratio of sales of automobiles and trucks for 1990 to 1991.[16] These estimates of 1991 sales were then used to derive 1992 sales by multiplying the 1991 car sales figure by 75 percent and the 1991 truck sales figure by 50 percent. The methodology used in the 1993 distribution is exactly the same procedure used for 1992.

Registration distributions input to MOBILE5a should be expressed as a July 1 registration distribution. Internally, the model can than adjust this registration distribution to represent either a January 1 or a July 1 registration distribution, depending on the user selected setting of the month flag. When modeling months from January through June, the month flag within the MOBILE5a input files was set to "1" to simulate January registration distributions. For months from July through December, the flag was set to "2" to model July registration distribution.

4.6.2.7 I/M Programs

For states that had an inspection and maintenance (I/M) program in place in one or more counties in the year being modeled, at least one additional MOBILE5a input file was created that modeled the characteristics of the I/M program in that state. All other inputs (such as temperature, RVP, speeds, etc.) were identical to the no I/M input file modeled for the state in the year being analyzed. The determination of whether or not a county had an I/M program in place in a given year was based on a series of I/M program summaries released by OMS. Emission factors calculated with I/M benefits in a given inventory year were applied only to counties having an I/M program in place in December of the prior year. I/M program characteristics were also included in the I/M program summaries. These program characteristics vary by state and in some cases by nonattainment area or county within a particular state. The effectiveness statistics used as MOBILE5 inputs varied by state based on the characteristics of representative I/M programs in that state. For states where I/M programs varied within a given state, a single set of effectiveness statistics, based on a combination of characteristics of all the I/M programs within the state, was used as an I/M input to the model. In some cases, the characteristics of the different programs within a specific state could not be adequately modeled using some average of the I/M program characteristics. In these cases, multiple I/M programs were modeled for these states, with the appropriate I/M programs applied to the corresponding counties.

4.6.2.8 Oxygenated Fuels

The oxygenated fuel requirements of the 1990 CAAA took effect beginning in late 1992. Therefore, oxygenated fuel was modeled in the areas indicated by OMS, using the oxygenated fuel flag and the oxygenated fuel market share and oxygen content inputs in MOBILE5a. OMS provided a listing of areas participating in the oxygenated fuel program, the months that each area used oxygenated fuel, and market share data indicating the percentage of ether blends versus alcohol blends in each oxygenated fuel area. The average oxygen content of ether blend fuels for all areas, except California, was assumed to be 2.7 percent while alcohol blend fuels were assumed to have an oxygen content of 3.5 percent. For California, the oxygen content of both ether blends and alcohol blends was modeled as 2 percent, based on documentation from OMS on how to model reformulated and oxygenated fuels in the CALI5 model.

4.6.2.9 California

California's highway vehicle fleet has been subject to different emission standards than the rest of the country. To account for these differences in basic emission rates, an EPA-modified version of MOBILE5a was used for California. This model is referred to as CALI5. Input files used with this model are essentially identical to MOBILE5a input files. The model internally handles the different emission standards. Temperature, RVP, speed, registration distribution, and operating mode inputs were developed for California in the same manner as they were for the rest of the nation. The primary difference in inputs is the earlier start date (1992) of the reformulated gasoline program in California. Using CALI5, this was modeled in the summer months for 1992 and 1993 by setting the reformulated gasoline flag to "4" and the RVP to 7.8 psi. As mentioned above, California was also divided into two regions to account for the differences in climate throughout the state.

4.6.3 Development of PM and SO_2 Emission Factors

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.[P1] It calculates particle emission factors in grams per mile from on-road automobiles, trucks, and motorcycles, for particle sizes up to 10 microns.

4.6.3.1 Use of the Part5 Model

The EPA's particulate matter emission factor model, PART5, was used to calculate highway vehicle PM (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. These are listed below:

- 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.

4.6.3.1.1 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 heavy duty diesel vehicle (HDDV) class is broken into five subclasses in PART5. Table 4.6-p1 lists each vehicle class in PART5 along with its FHWA class and gross vehicle weight.

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 for the years 1985-? 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.

4.6.3.1.2 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 for the years 1985-?, 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*[p2] and FHWA's *Highway Statistics*.[p3]

4.6.3.1.3 Emission Factor Mapping —
The VMT data developed for the NET Inventory and used in emission calculations here are at the monthly, county, road type, and vehicle type level. Road type and vehicle type combine to determine the vehicle speed modeled and SCC. The speeds modeled by vehicle type and road type are shown in Table 4.6-p2. These speeds were developed for use in the MOBILE modeling done for the NET Inventory. 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.

4.6.3.2 Exhaust PM Emissions

Monthly, county-level, SCC-specific PM emissions from highway 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. None of the inputs affecting the calculation of the PM exhaust emission factors vary by month, so 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.

4.6.3.3 *Exhaust SO_2 Emissions*

National annual SO_2 highway 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.

4.6.3.4 *PM Brake Wear Emissions*

The PART5 PM emission factors for brake wear are 0.013 grams per mile for PM-10 and ? grams per mile for PM-2.5. This value was applied to estimate brake wear emissions for all vehicle types.

4.6.3.5 *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 ? 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*.[p2] 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.

4.6.4 Calculation of Emissions

Once the highway vehicle emission factors and VMT were developed, a computer program was used to map the corresponding VMT and emission factors to calculate monthly, county-level emissions estimates for each vehicle type and road type. Although emission factors were developed for VOC, NO_x, and CO at the state level, the factors could vary by county depending on the presence or absence of I/M programs and oxygenated fuel program.

4.6.5 References

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Table 4.6-1. Data Components of HPMS

Universe - All Road Mileage	
Identification	Contains state, county, and rural/small urbanized codes and a unique identification of location reference. Optionally, the latitude and longitude coordinates for the beginning and ending points of universe and sample sections are provided.
System	Provides for coding of functional system and federal-aid system.
Jurisdiction	Provides for coding of state or local highway system and special funding category.
Operation	Includes type of facility, truck prohibition, and toll.
Other	Contains length of highway section and fields for the coding of AADT and the number of through lanes.
Sample - Statistical Sample of Universe	
Identification	Contains unique identification for the sample section portion of the record.
Computational Elements	Provides data items used to expand sample information to universe values.
Pavement Attributes	Contains data items used to evaluate the physical characteristics of pavement, pavement performance, and the need for pavement overlays.
Improvements	Describes the improvement type for the year of the improvement completion.
Geometrics/ Configuration	Describes the physical attributes used to evaluate the capacity and operating characteristics of the facility.
Traffic/Capacity	Provides operational data items used to calculate the capacity of a section and the need for improvements.
Environment	Contains items that marginally affect the operation of a facility but are important to its structural integrity.
Supplemental Data	Provides linkage to existing structure and railroad crossing information systems.
Areawide - State Summaries	
Mileage	Road mileage
Travel	Vehicle miles traveled, percent travel by vehicle type
Accidents	Number of accidents
Injuries	Number of injuries
Population	Area population

Table 4.6-2. Apportionment Percentages for Conversion of HPMS Vehicle Type Categories to MOBILE5a Categories

HPMS Vehicle Type Category	MOBILE5a Vehicle Type Category and Apportionment Percentages	
Motorcycle	MC	1.0000
Passenger Car	LDGV	0.9864
	LDDV	0.0136
Other 2-Axle, 4-tire	LDGT1	0.6571
	LDGT2	0.3347
	LDDT	0.0082
Buses	HDGV	0.1028
	HDDV	0.8972
Other Single Unit Trucks	HDGV	0.7994
	HDDV	0.2006
Combination Trucks	HDDV	1.0000

Table 4.6-3. Cities Used for Temperature Data Modeling from 1970 through 1993

State	City
Alabama	Birmingham
Alaska	Anchorage
Arizona	Phoenix
Arkansas	Little Rock
California	Los Angeles
California	San Francisco
Colorado	Denver
Connecticut	Hartford
Delaware	Dover
District of Columbia	Washington
Florida	Orlando (1974-1993)
Georgia	Atlanta
Hawaii	Honolulu
Idaho	Boise
Illinois	Springfield
Indiana	Indianapolis
Iowa	Des Moines
Kansas	Topeka
Kentucky	Louisville
Louisiana	Baton Rouge
Maine	Portland
Maryland	Baltimore
Massachusetts	Boston
Michigan	Detroit
Minnesota	Minneapolis
Mississippi	Jackson
Missouri	Springfield
Montana	Billings
Nebraska	Lincoln
Nevada	Las Vegas
New Hampshire	Concord
New Jersey	Newark
New Mexico	Albuquerque
New York	New York City
North Carolina	Greensboro
North Dakota	Bismarck
Ohio	Columbus
Oklahoma	Oklahoma City
Oregon	Eugene
Pennsylvania	Harrisburg (1970-1991), Middletown (1991-1993)
Rhode Island	Providence
South Carolina	Columbia
South Dakota	Pierre
Tennessee	Nashville
Texas	Dallas/Fort Worth (1974-1993)
Utah	Salt Lake City
Vermont	Montpelier
Virginia	Richmond
Washington	Seattle
West Virginia	Charleston
Wisconsin	Milwaukee
Wyoming	Casper

Table 4.6-4. HPMS Average Overall Travel Speeds for 1990 (MPH)

	Rural					Urban				
Vehicle Type	Interstate	Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Interstate	Other Freeways Expressways	Principal Arterial	Minor Arterial	Collector
Small Pass. Cars	58.4	46.5	40.1	35.4	30.3	46.3	42.4	18.7	19.3	19.5
Large Pass. Cars	58.4	46.5	40.1	35.4	30.3	46.3	42.4	18.7	19.3	19.5
Pickups & Vans	56.7	45.6	39.7	35.3	30.5	45.4	41.9	19.5	20.1	20.3
Single 2 Axle	55.7	44.5	38.8	32.6	24.1	47.1	42.9	18.1	18.2	18.0
Single 3+ Axle	53.3	43.0	37.6	33.1	29.8	45.4	41.5	18.0	18.1	18.1
Multi 4+ Axle	43.0	34.0	30.7	27.9	25.7	37.2	34.4	14.7	14.6	14.5
Multi 5+ Axle	41.8	33.4	30.2	26.9	22.5	36.4	33.8	14.6	14.5	14.3

Table 4.6-5. Average Speeds by Road Type and Vehicle Type (MPH)

Rural

	Interstate	Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local
LDV	60	45	40	35	30	30
LDT	55	45	40	35	30	30
HDV	40	35	30	25	25	25

Urban

	Interstate	Other Freeways & Expressways	Principal Arterial	Minor Arterial	Collector	Local
LDV	45	45	20	20	20	20
LDT	45	45	20	20	20	20
HDV	35	35	15	15	15	15

Table 4.6-6. PM-10 Emission Factors used in the Emission Trends Inventory

	Emission Factor (grams per mile)							
Year	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
1970	0.070	0.069	0.070	0.062	0.615	0.615	2.367	0.070
1971	0.066	0.066	0.067	0.062	0.615	0.615	2.367	0.066
1972	0.063	0.063	0.064	0.062	0.615	0.615	2.367	0.063
1973	0.060	0.060	0.062	0.062	0.615	0.615	2.367	0.060
1974	0.057	0.057	0.059	0.062	0.615	0.615	2.351	0.057
1975	0.054	0.054	0.057	0.062	0.615	0.615	2.335	0.054
1976	0.051	0.051	0.054	0.062	0.615	0.615	2.319	0.051
1977	0.048	0.049	0.052	0.062	0.585	0.583	2.303	0.048
1978	0.045	0.046	0.049	0.062	0.555	0.552	2.287	0.045
1979	0.042	0.043	0.047	0.062	0.525	0.520	2.271	0.042
1980	0.039	0.040	0.044	0.062	0.495	0.489	2.255	0.039
1981	0.036	0.037	0.042	0.062	0.465	0.457	2.239	0.036
1982	0.033	0.034	0.039	0.062	0.435	0.426	2.223	0.033
1983	0.030	0.032	0.037	0.062	0.405	0.395	2.207	0.030
1984	0.026	0.029	0.034	0.062	0.375	0.363	2.191	0.026
1985	0.026	0.028	0.033	0.065	0.368	0.361	2.068	0.026
1986	0.025	0.026	0.031	0.068	0.361	0.360	1.945	0.025
1987	0.024	0.025	0.029	0.071	0.355	0.358	1.822	0.024
1988	0.023	0.024	0.028	0.074	0.348	0.356	1.699	0.023
1989	0.022	0.023	0.026	0.077	0.342	0.354	1.576	0.022
1990	0.021	0.022	0.025	0.080	0.335	0.353	1.453	0.021
1991	0.020	0.021	0.023	0.083	0.329	0.351	1.330	0.020
1992	0.019	0.020	0.022	0.086	0.322	0.349	1.207	0.019
1993	0.018	0.018	0.020	0.089	0.316	0.347	1.084	0.018

Table 4.6-7. Fuel Economy Values Used in Calculation of SO_2 Emission Factors for the Emission Trends Inventory

	Fuel Economy (miles/gallon)						
Year	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
1970	12.68	10.18	6.79	12.68	10.18	5.05	50.00
1971	12.70	10.39	6.85	12.70	10.39	5.17	50.00
1972	12.57	10.51	6.86	12.57	10.51	5.27	50.00
1973	12.48	10.69	6.90	12.48	10.69	5.32	50.00
1974	12.59	11.15	7.11	12.59	11.15	5.47	50.00
1975	12.68	11.40	7.16	12.68	11.40	5.62	50.00
1976	12.69	11.39	7.05	12.69	11.39	5.47	50.00
1977	12.94	11.63	7.05	12.94	11.63	5.47	50.00
1978	13.17	11.81	6.97	13.17	11.81	5.45	50.00
1979	13.52	12.00	6.94	13.52	12.00	5.45	50.00
1980	14.50	12.54	7.13	14.50	12.54	5.64	50.00
1981	14.95	12.72	7.07	14.95	12.72	5.56	50.00
1982	15.49	12.96	7.65	24.90	24.59	5.30	50.00
1983	16.13	13.42	7.96	25.10	24.85	5.44	50.00
1984	16.78	13.90	8.15	25.21	24.96	5.57	50.00
1985	17.46	14.33	8.39	25.31	25.00	5.71	50.00
1986	18.18	14.79	8.49	25.37	25.08	5.82	50.00
1987	18.95	15.24	8.66	25.50	25.15	5.93	50.00
1988	19.63	15.60	8.76	25.55	25.09	6.01	50.00
1989	20.25	15.87	8.90	25.48	24.93	6.11	50.00
1990	20.77	16.06	9.03	25.43	24.65	6.19	50.00
1991	21.23	16.30	9.15	25.41	24.57	6.27	50.00
1992	21.62	16.52	9.27	25.43	24.66	6.34	50.00
1993	21.93	16.70	9.37	25.52	24.77	6.41	50.00

Table 4.6-8. SO_2 Emission Factors used in the Emission Trends Inventory

Year	Emission Factor (grams per mile)							
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
1970	0.147	0.183	0.183	0.274	0.989	1.231	2.482	0.037
1971	0.146	0.179	0.179	0.272	0.987	1.207	2.425	0.037
1972	0.148	0.177	0.177	0.271	0.997	1.193	2.379	0.037
1973	0.149	0.174	0.174	0.270	1.004	1.173	2.356	0.037
1974	0.148	0.167	0.167	0.262	0.996	1.124	2.292	0.037
1975	0.147	0.163	0.163	0.260	0.989	1.100	2.231	0.037
1976	0.147	0.163	0.163	0.264	0.988	1.101	2.292	0.037
1977	0.144	0.160	0.160	0.264	0.969	1.078	2.292	0.037
1978	0.141	0.158	0.158	0.267	0.952	1.061	2.300	0.037
1979	0.138	0.155	0.155	0.268	0.927	1.045	2.300	0.037
1980	0.128	0.148	0.148	0.261	0.865	1.000	2.223	0.037
1981	0.124	0.146	0.146	0.263	0.839	0.986	2.255	0.037
1982	0.120	0.144	0.144	0.243	0.503	0.510	2.365	0.037
1983	0.115	0.139	0.139	0.234	0.499	0.504	2.304	0.037
1984	0.111	0.134	0.134	0.228	0.497	0.502	2.251	0.037
1985	0.107	0.130	0.130	0.222	0.495	0.501	2.195	0.037
1986	0.102	0.126	0.126	0.219	0.494	0.500	2.154	0.037
1987	0.098	0.122	0.122	0.215	0.492	0.498	2.114	0.037
1988	0.095	0.119	0.119	0.212	0.491	0.500	2.086	0.037
1989	0.092	0.117	0.117	0.209	0.492	0.503	2.052	0.037
1990	0.090	0.116	0.116	0.206	0.493	0.509	2.025	0.037
1991	0.088	0.114	0.114	0.203	0.493	0.510	1.999	0.037
1992	0.086	0.113	0.113	0.201	0.493	0.508	1.977	0.037
1993	0.085	0.111	0.111	0.199	0.399	0.411	1.589	0.037

Table 4.6-p1 PART5 Vehicle Classes

Vehicle Class		FHWA Class	Gross Vehicle Weight (lbs)
LDGV	light-duty gasoline vehicles		
LDGT1	light-duty gasoline trucks, I	1	<6,000
LDGT2	light-duty gasoline trucks, II	2A	6,001-8,500
HDGV	heavy-duty gasoline trucks	2B - 8B	>8,500
MC	motorcycles		
LDDV	light-duty diesel vehicles	1	<6,000
LDDT	light-duty diesel trucks	2A	6,001-8,500
2BHDDV	class 2B heavy-duty diesel vehicles	2B	8,501-10,000
LHDDV	light heavy-duty diesel vehicles	3,4,5	10,001-19,500
MHDDV	medium heavy-duty diesel vehicles	6,7,8A	19,501-33,000
HHDDV	heavy heavy-duty diesel vehicles	8B	33,000+
BUSES	buses		

Table 4.6-p2 Average Speeds by Road Type and Vehicle Type

	Rural Road Speeds (mph)					
Vehicle Type	Interstate	Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local
LDV	60	45	40	35	30	30
LDT	55	45	40	35	30	30
HDV	40	35	30	25	25	25

	Urban Road Speeds (mph)					
Vehicle Type	Interstate	Other Freeways & Expressways	Princip al Arterial	Minor Arterial	Collector	Local
LDV	45	45	20	20	20	20
LDT	45	45	20	20	20	20
HDV	35	35	15	15	15	15

4.7 OFF-HIGHWAY

This category includes the estimated emissions from aircraft, commercial marine vessels, railroads, and all other nonroad vehicles and equipment. The methodology used to generate the emissions for these sources is described in this section.

4.7.1 1990 Interim Inventory

The 1990 emissions from aircraft, commercial marine vessels, and railroads have been estimated from the area source portion of the 1985 NAPAP inventory by the process described in section 4.7.1.2. The bases for the 1990 Interim Inventory nonroad emissions were emission inventories[1] prepared by OMS for 27 nonattainment areas (NAAs). These inventories were combined and used to create national county-level emissions. These emissions are detailed in section 4.7.1.1.

4.7.1.1 Nonroad Mobile Source Emissions

Nonroad sources include motorized vehicles and equipment that are not normally operated on public roadways to provide transportation. The nonroad mobile source emissions in the NET inventory are based on 1990 nonroad emissions[2] compiled by EPA's EFIG. The EFIG nonroad data contains total emissions for non-road sources at the county level. These emissions include all nonroad sources except aircraft, commercial marine vessels, and railroads. The EFIG nonroad emissions were developed from nonroad emission inventories for 27 ozone NAAs by OMS. The OMS inventories contained 1990 emissions at the SCC-level for each county within one of the 27 NAAs. These nonroad data ***do not include*** emissions for SO_2. The SO_2 emissions in the 1985 NAPAP inventory from the nonroad sources were approximately 92,000 short tons and are not included in the NET inventory.

A two step process was used to convert the OMS NAA emissions to county-SCC-level emissions needed for the NET inventory. The first step, performed by EFIG, used the OMS 1990 nonroad emissions for the 27 ozone NAAs to estimate nonroad emissions for the rest of the country. The second step used the EFIG total nonroad emissions for each county to create 1990 county-SCC-level nonroad emissions.

Step 1. Creation of National County-Level 1990 Nonroad Emissions

OMS 1990 nonroad emission inventories prepared for 27 ozone and six CO NAAs. (Data from the CO NAAs were not used because it did not include VOC and NO_x emissions). Table 4.7-1 lists the 27 ozone NAAs for which nonroad inventories were compiled. Each NAA inventory contained county-level emissions for 279 different equipment/engine type combinations for each county in the NAA. For this information to be useful for the NET inventory, nonroad emissions were needed for the entire country (excluding Alaska and Hawaii). The following methodology was used to create 1990 nonroad emissions for the entire country:

(a) VOC, NO_x, and CO per capita emission factors were developed for each NAA by summing each pollutant's emissions for all equipment/engine categories for all counties within the NAA and dividing by the NAA population

(b) for counties entirely within one of the 27 NAAs, the emissions in the OMS inventories were used

(c) for counties partially in one of the 27 NAAs, emissions were calculated by multiplying the NAA per capita emission factor by the total county population

(d) all other counties were assigned a "surrogate NAA" based on geography and climate, emissions were calculated by multiplying the surrogate NAA per capita emission factors by the total county population. Figure 4.7-1 shows the surrogate NAA each area of the country was assigned.

Step 2. Distribution of Total Nonroad Emissions to SCCs

The resulting emissions from step 1 above, represent total county nonroad emissions. To be incorporated into the NET inventory, these emissions must be distributed to the appropriate SCCs. The following methodology was used to distribute total nonroad emissions to SCCs:

(a) an SCC was assigned to each of the 279 equipment/engine type combinations in the OMS inventories; the 27 SCCs used are listed in Table 4.7-2

(b) for each of the 27 OMS inventories, the percentage of emissions from sources assigned to each of the 27 SCCs was calculated

(c) each county's total nonroad emissions were distributed to the 27 SCCs using the SCC percentages from its surrogate NAA.

4.7.1.2 Aircraft, Marine Vessels and Railroads

The area source emissions from the 1985 NAPAP inventory have been projected to the year 1990 based on BEA historic earnings data or other growth indicators. The specific growth indicator was assigned based on the source category. The BEA earnings data were converted to 1982 dollars as described in section 4.7.1.2.2. All growth factors were calculated as the ratio of the 1990 data to the 1985 data for the appropriate growth indicator.

When creating the 1990 emissions inventory, changes were made to emission factors from the 1985 inventory for some sources. The 1990 emissions for CO, NO_x, SO_2, and VOC were calculated using the following steps: (1) projected 1985 controlled emissions to 1990 using the appropriate growth factors, (2) calculated the uncontrolled emissions using control efficiencies from the 1985 NAPAP inventory, and (3) calculated the final 1990 controlled emissions using revised emission factors. The 1990 PM-10 emissions were calculated using the TSP emissions from the 1985 NAPAP inventory. The 1990 uncontrolled TSP emissions were estimated in the same manner as the other pollutants. The 1990 uncontrolled PM-10 estimates were calculated from these TSP emissions by applying SCC-specific uncontrolled particle size distribution factors.[3] The controlled PM-10 emissions were estimated in the same manner as the other pollutants.

4.7.1.2.1 Emission Factor Changes —

Emission factors for several sources were updated to reflect recent technical improvements in AP-42 and other emission inventory guidance documents. Emission factors for all four pollutants were updated for railroads. The SO_2 emission factors for aircraft were also updated.

Railroad emission factors in NAPAP were derived from data in AP-42. Improved emission factors for railroad locomotives have recently been developed in a revision to EPA's mobile source emission inventory guidance.[4] These updated emission factors were incorporated into the NET estimates. Railroad emission factors are summarized in Table 4.7-3 for line-haul locomotives and yard (switch) locomotives. Because only one set of emission factors is required for railroads, the separate emission factors for line-haul and yard locomotives were weighted by fuel usage. The Association of American Railroads (AAR) provided data on fuel consumption by line-haul and yard locomotives for Class I railroads for 1985 through 1990, as shown in Table 4.7-4.

AP-42 SO_2 emission rates were compared with emission rates published in EPA's emission inventory guidance.[5] SO_2 rates were on average 54 percent lower, due to changes in fuel sulfur content. This change was incorporated into the aircraft emissions for the NET inventory. (Although new data were available only for civil aircraft, the emission factor change was incorporated for all aircraft). Aircraft emission factors for VOC, NO_x, and CO have not changed. Table 4.7-5 compares SO_2 emission rates from aircraft.

4.7.1.2.2 1990 Growth Indicators for Aircraft, Marine Vessels, and Railroads —

Emissions from the 1985 NAPAP inventory were grown to the NET years based on historical BEA earnings data or other category-specific growth indicators. Table 4.7-6 shows the growth indicators used for each area source by NAPAP category.

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 is derived from by summing the air carrier and air taxi regional totals of LTOs from FAA-operated control towers and FAA traffic control centers.[6] Since these data are compiled on a regional basis, 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.[7] Since military aircraft LTO totals were not available, BEA data were used.

The changes in the military aircraft emissions were equated with the changes in historic earnings by state and industry. Emissions in the 1985 NAPAP inventory were projected to the years 1985 through 1991 based on the growth in earnings by industry (two-digit SIC code). Historical annual state and industry earnings data from BEA's Table SA-5 (Reference 8) were used to represent growth in earnings from 1985 through 1990.

The 1985 through 1990 earnings data in Table SA-5 are expressed in nominal dollars. To estimate growth, these values were converted to constant dollars to remove the effects of inflation. Earnings data for each year were converted to 1982 constant dollars using the implicit price deflator for PCE.[9] The PCE deflators used to convert each year's earnings data to 1982 dollars are:

Year	1982 PCE Deflator
1985	111.6
1987	114.3
1988	124.2
1989	129.6
1990	136.4

Several BEA categories did not contain a complete time series of data for the years 1985 through 1990. Because the SA-5 data must contain 1985 earnings and earnings for each inventory year (1985 through 1990) to be useful for estimating growth, a log linear regression equation was used where possible to fill in missing data elements. This regression procedure was performed on all categories that were missing at least one data point and which contained at least three data points in the time series.

Each record in the point source inventory was matched to the BEA earnings data based on the state and the two-digit SIC. Table 4.7-7 shows the BEA earnings category used to project growth for each of the two-digit SICs found in the 1985 NAPAP inventory. No growth in emissions was assumed for all point sources for which the matching BEA earnings data were not complete. Table 4.7-7 also shows the national average growth and earnings by industry from BEA Table SA-5.

Railroad data are provided by the Association of American Railroads (AAR). National totals of revenue-ton-miles for the years 1985 through 1990 are used to estimate changes in activity during this period. The national growth is therefore applied to each state and county.[10]

Marine vessel activity is recorded annually by the U.S. Army Corp of Engineers. Cargo tonnage national totals are used to determine growth in diesel- and residual-fueled vessel use through the year 1989.[11] Since gasoline-powered vessels are used predominantly for recreation, growth for this category is therefore based on population.

4.7.1.2.3 Emissions Calculations —

A four-step process was used to calculate emissions incorporating rule effectiveness. First, base year controlled emissions are projected to the inventory year using the following equation (Equation 4.7-1):

$$CE_i = CE_{BY} + (CE_{BY} \times EG_i)$$

where:

CE_i = Controlled Emissions for inventory year i

CE_{BY} = Controlled Emissions for base year

EG_i = Earnings Growth for inventory year i

Earnings growth is calculated using Equation 4.7-2:

$$EG_i = 1 - \frac{DAT_i}{DAT_{BY}}$$

where: EG_i = Earnings growth for year i
DAT_i = Earnings data for inventory year i
DAT_{BY} = Earnings data in the base year

Second, uncontrolled emissions in the inventory year are back-calculated from the controlled emissions based on the control efficiency using Equation 4.7-3:

$$UE_i = \frac{CE_i}{\left(1 - \frac{CEFF}{100}\right)}$$

where: UE_i = Uncontrolled Emissions for inventory year i
CE_i = Controlled Emissions for inventory year i
CEFF = Control Efficiency (percent)

For aircraft, marine vessels, and railroads this equation reduces to Equation 4.7-4 since the control efficiency is equal to zero.

$$UE_i = CE_i$$

Third, controlled emissions are recalculated incorporating revised emission factors using the following equation (Equation 4.7-5):

$$CER_i = UC_i \times \left(\frac{EF_i}{EF_{BY}}\right)$$

where: CER_i = Controlled Emissions Incorporating Rule Effectiveness
UC_i = Uncontrolled Emissions
EF_i = Emission factor for inventory year i
EF_{BY} = Emission factor for base year

The last step in the creation of the inventory was matching the NAPAP categories to the new AMS categories. This matching is provided in Table 4.7-8. Note that there is not always a one-to-one correspondence between NAPAP and AMS categories.

4.7.2 Emissions, 1970 through 1989

The nonroad emissions for the years 1970 through 1989 have been based on the 1990 estimates. Historic E-GAS growth factors[12] were obtained by representative NAA and rest of state counties and by Bureau of Labor Statistics (BLS) codes and then correlated to the nonroad SCCs and counties.

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

4.7.3 1990 National Emissions Trends

As described in section 4.3.3, the 1990 NET is based primarily on state data, with the Interim data filling in the data gaps. The state data were extracted from three sources: the OTAG inventory, the GCVTC inventory, and AIRS. See sections 4.3.3.1 through 4.3.3.3 for discussions of the data extracting efforts using these sources, and section 4.3.3.4 for information on filling the data gaps. These discussions apply in general to the sources covered in the Off-highway category. Specific exceptions are identified and discussed.

4.7.4 Emissions, 1991 through 1994

The 1991 through 1994 area source emissions were grown in a similar manner as the 1985 through 1989 estimates, except for using a different base year inventory. The base year for the 1991 through 1994 emissions is the 1990 NET inventory. See section 4.3.4 for further descriptions of the 1991 to 1994 emissions. These descriptions apply in general to the sources in the Off-Highway category. Specific exceptions are noted.

4.7.5 1995 Emissions

The 1995 emission estimates were derived in a similar manner as the 1991 through 1994 estimates. Section 4.3.5 describes the procedures used to develop the 1995 projected emissions. See also the section 4.3 discussion of nonroad emissions estimates. These descriptions apply in general to the sources in the Off-Highway category. Specific exceptions are noted.

4.7.6 1996 Emissions

The 1996 emissions were estimated in a similar manner as the 1995 estimates. Section 4.3.6 describes the projected 1996 emissions. See also the section 4.3 discussion of nonroad emissions estimates. These descriptions apply in general to the sources in the Off-Highway category. Specific exceptions are noted.

4.7.7 References

1. *Documentation for Estimation of Nonroad Emission Estimates for the United States*, U.S. Environmental Protection Agency, Research Triangle Park, NC, November 1992.

2. *Nonroad Engine Emission Inventories for CO and Ozone Nonattainment Boundaries*, U.S. Environmental Protection Agency, Ann Arbor, MI, October 1992.

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4. *Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources*, Draft revision, Chapter 6, U.S. Environmental Protection Agency, Office of Mobile Sources, Ann Arbor, MI, 1991.

5. *Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources*, Draft revision, Chapter 5, U.S. Environmental Protection Agency, Office of Mobile Sources, Ann Arbor, MI, November 1991.

6. *Air Traffic Activity*, U.S. Department of Transportation, Federal Aviation Administration, Washington, DC, 1991.

7. *Terminal Area Forecasts, FY 1991-2005*, FAA-APO-91-5, U.S. Department of Transportation, Federal Aviation Administration, Washington, DC, July 1991.

8. *Table SA-5 — Total Personal Income by Major Sources 1969-1990*, data files, U.S. Department of Commerce, Bureau of Economic Analysis, Washington, DC, September 1991.

9. *Survey of Current Business*, U.S. Department of Commerce, Bureau of Economic Analysis, Washington, DC, July 1986, July 1987, July 1988, July 1989, July 1990, July 1991.

10. *Railroad Ten-Year Trends 1981-1990*, Association of American Railroads, Washington, DC, 1991.

11. *Waterborne Commerce of the United States, Calendar Year 1989*, WRSC-WCUS-89, Part 5, U.S. Army Corp of Engineers, New Orleans, LA, June 1991.

12. *E-GAS Growth Factors and BLS to SCC Cross Reference*. Computer PC model and files received by E.H. Pechan & Associates, Inc. from TRC Environmental Corporation, Chapel Hill, NC. June 1994.

Table 4.7-1. Ozone Nonattainment Areas with OMS-Prepared Nonroad Emissions

Atlanta, GA	Hartford, CT	Providence, RI
Baltimore, MD	Houston, TX	San Diego, CA
Baton Rouge, LA	Miami, FL	San Joaquin, CA
Beaumont, TX	Milwaukee, WI	Seattle, WA
Boston, MA	Muskegon, MI	Sheboygan, WI
Chicago, IL	New York, NY	South Coast, CA
Cleveland, OH	Philadelphia, PA	Springfield, MA
Denver, CO	Phoenix, AZ	St. Louis, MO
El Paso, TX	Portsmouth, NH	Washington, DC

Figure 4.7-1. Assignment of Surrogate Nonattainment Areas

Table 4.7-2. Source Categories Used for Nonroad Emissions

AMS SCC	Category Description
2260001000	Recreational Vehicles: Gasoline, 2-Stroke
2260002000	Construction Equipment: Gasoline, 2-Stroke
2260003000	Industrial Equipment: Gasoline, 2-Stroke
2260004000	Lawn & Garden Equipment: Gasoline, 2-Stroke
2260005000	Farm Equipment: Gasoline, 2-Stroke
2260006000	Light Commercial: Gasoline, 2-Stroke
2260007000	Logging Equipment: Gasoline, 2-Stroke
2260008000	Airport Service Equipment: Gasoline, 2-Stroke
2265001000	Recreational Vehicles: Gasoline, 4-Stroke
2265002000	Construction Equipment: Gasoline, 4-Stroke
2265003000	Industrial Equipment: Gasoline, 4-Stroke
2265004000	Lawn & Garden Equipment: Gasoline, 4-Stroke
2265005000	Farm Equipment: Gasoline, 4-Stroke
2265006000	Light Commercial: Gasoline, 4-Stroke
2265007000	Logging Equipment: Gasoline, 4-Stroke
2265008000	Airport Service Equipment: Gasoline, 4-Stroke
2270001000	Recreational Vehicles: Diesel
2270002000	Construction Equipment: Diesel
2270003000	Industrial Equipment: Diesel
2270004000	Lawn & Garden Equipment: Diesel
2270005000	Farm Equipment: Diesel
2270006000	Light Commercial: Diesel
2270007000	Logging Equipment: Diesel
2270008000	Airport Service Equipment: Diesel
2282005000	Recreational Marine Vessels: Gasoline, 2-Stroke
2282010000	Recreational Marine Vessels: Gasoline, 4-Stroke
2282020000	Recreational Marine Vessels: Diesel

Table 4.7-3. Railroad Locomotives Diesel Fuel Consumption, 1985 to 1990 (million gallons)

Year	Line-Haul	Switch
1985	2,889	255
1990	2,876	258

Source: "Railroad Ten-Year Trends 1981-1990," Association of American Railroads, Washington, DC, 1991.

Table 4.7-4. Railroad Emission Factors (lbs/1,000 gallons)

	Wtg. Factor	NO_x	CO	HC	SO_2
NAPAP		370	130	90	57
Revised					
Line-haul	2,876	493.1	62.6	20.1	36.0
Yard	258	504.4	89.4	48.2	36.0
New Wtd. Avg.		494	65	22	36

Source: "Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources," Draft revision, Chapter 5, Office of Mobile Sources, U.S. Environmental Protection Agency, Ann Arbor, MI, November 1991.

Table 4.7-5. Civil Aircraft SO_2 Emission Factors

Engine Type	Fuel Rate (lbs/hr)	AP-42 SO_2 Emission Factor (lbs/hr)	New SO_2 Emission Factor (lbs/hr)	Engine Type	Fuel Rate (lbs/hr)	AP-42 SO_2 Emission Factor (lbs/hr)	New SO_2 Emission Factor (lbs/hr)
250B17B	63	0.06	0.03	PT6A-41	147	0.15	0.08
	265	0.27	0.14		510	0.51	0.28
	245	0.25	0.13		473	0.47	0.26
	85	0.09	0.05		273	0.27	0.15
501D22A	610	0.61	0.33	Dart RDa7	411	0.41	0.22
	2376	2.38	1.28		1409	1.41	0.76
	2198	2.2	1.19		1248	1.25	0.67
	1140	1.14	0.62		645	0.65	0.35
TPE-331-3	112	0.11	0.06	0-200	8.24	0	0.00
	458	0.46	0.25		45.17	0.01	0.00
	409	0.41	0.22		45.17	0.01	0.00
	250	0.25	0.14		25.5	0.01	0.00
JT3D-7	1013	1.01	0.55	TSIO-360C	11.5	0	0.00
	9956	9.96	5.38		133	0.03	0.01
	8188	8.19	4.39		99.5	0.02	0.01
	3084	3.08	1.67		61	0.01	0.01
JT9D-7	1849	1.85	1.00	O-320	9.48	0	0.00
	16142	16.14	8.72		89.1	0.02	0.01
	13193	13.19	7.12		66.7	0.01	0.01
	4648	4.65	2.51		46.5	0.01	0.01
PT6A-27	115	0.12	0.06				
	425	0.43	0.23				
	400	0.4	0.22				
	215	0.22	0.12				

Source: "Supplement D to Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources," AP-42, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1991.

Table 4.7-6. Area Source Growth Indicators

NAPAP SCC	Category Description	Data Source	Growth Indicator
45	Railroad Locomotives	AAR	Railroad ton-miles (national)
46	Aircraft LTOs - Military	BEA	Military
47	Aircraft LTOs - Civil	FAA	Aircraft - civil
48	Aircraft LTOs - Commercial	FAA	Aircraft - commercial
49	Vessels - Coal	Corp of Engineers	Cargo tonnage (national)
50	Vessels - Diesel Oil		Cargo tonnage (national)
51	Vessels - Residual Oil		Cargo tonnage (national)

Table 4.7-7. Bureau of Economic Analysis's SA-5 National Changes in Earnings by Industry

Industry	SIC	Percent Growth			
		1985 to 1987	1987 to 1988	1988 to 1989	1989 to 1990
Federal, military	97	1.96	- 1.07	- 1.58	-3.19

Table 4.7-8. AMS to NAPAP Source Category Correspondence

AMS SCC	AMS Category	NAPAP SCC	NAPAP Category
Mobile Sources			
2275001001	Aircraft - Military Aircraft (LTOs)	46	Aircraft LTOs - Military
2275020000	Aircraft - Commercial Aircraft (LTOs)	48	Aircraft LTOs - Commercial
2275050000	Aircraft - Civil Aircraft (LTOs)	47	Aircraft LTOs - Civil
2280001000	Marine Vessels - Coal	49	Vessels - Coal
2280002000	Marine Vessels - Diesel	50	Vessels - Diesel Oil
2280003000	Marine Vessels - Residual Oil	51	Vessels - Residual Oil
2285002000	Railroads - Diesel	45	Railroad Locomotives
2260001000	Recreational Vehicles: Gasoline, 2-Stroke	39	Off-Highway Gasoline Vehicles
2260002000	Construction Equipment: Gasoline, 2-Stroke	39	Off-Highway Gasoline Vehicles
2260003000	Industrial Equipment: Gasoline, 2-Stroke	39	Off-Highway Gasoline Vehicles
2260004000	Lawn & Garden Equipment: Gasoline, 2-Stroke	39	Off-Highway Gasoline Vehicles
2260005000	Farm Equipment: Gasoline, 2-Stroke	39	Off-Highway Gasoline Vehicles
2260006000	Light Commercial: Gasoline, 2-Stroke	39	Off-Highway Gasoline Vehicles
2260007000	Logging Equipment: Gasoline, 2-Stroke	39	Off-Highway Gasoline Vehicles
2260008000	Airport Service Equipment: Gasoline, 2-Stroke	39	Off-Highway Gasoline Vehicles
2265001000	Recreational Vehicles: Gasoline, 4-Stroke	39	Off-Highway Gasoline Vehicles
2265002000	Construction Equipment: Gasoline, 4-Stroke	39	Off-Highway Gasoline Vehicles
2265003000	Industrial Equipment: Gasoline, 4-Stroke	39	Off-Highway Gasoline Vehicles
2265004000	Lawn & Garden Equipment: Gasoline, 4-Stroke	39	Off-Highway Gasoline Vehicles
2265005000	Farm Equipment: Gasoline, 4-Stroke	39	Off-Highway Gasoline Vehicles
2265006000	Light Commercial: Gasoline, 4-Stroke	39	Off-Highway Gasoline Vehicles
2265007000	Logging Equipment: Gasoline, 4-Stroke	39	Off-Highway Gasoline Vehicles
2265008000	Airport Service Equipment: Gasoline, 4-Stroke	39	Off-Highway Gasoline Vehicles
2270001000	Recreational Vehicles: Diesel	44	Off-Highway Diesel Vehicles
2270002000	Construction Equipment: Diesel	44	Off-Highway Diesel Vehicles
2270003000	Industrial Equipment: Diesel	44	Off-Highway Diesel Vehicles
2270004000	Lawn & Garden Equipment: Diesel	44	Off-Highway Diesel Vehicles
2270005000	Farm Equipment: Diesel	44	Off-Highway Diesel Vehicles
2270006000	Light Commercial: Diesel	44	Off-Highway Diesel Vehicles
2270007000	Logging Equipment: Diesel	44	Off-Highway Diesel Vehicles
2270008000	Airport Service Equipment: Diesel	44	Off-Highway Diesel Vehicles
2282005000	Recreational Marine Vessels: Gasoline, 2-Stroke	52	Marine Vessels - Gasoline
2282010000	Recreational Marine Vessels: Gasoline, 4-Stroke	52	Marine Vessels - Gasoline
2282020000	Recreational Marine Vessels: Diesel	N/A	

4.8 FUGITIVE DUST

The "Fugitive Dust" grouping includes the estimated emissions for several Tier 2 source categories. These Tier 2 source categories are components of two Tier I source categories: Natural Sources and Miscellaneous sources. The PM-10 and PM-2.5 emissions from the Natural Sources category discussed here are from geogenically derived wind erosion. PM-10 and PM-2.5 emissions in the Miscellaneous Category are divided into two Tier 2 subcategories: agriculture and forestry, and fugitive dust. This section presents a description of the methodology used to estimate the emissions for the following tier categories:

- Natural Sources
  - Geogenic
    - wind erosion
- Miscellaneous
  - Agriculture and Forestry
    - agricultural crops
    - agricultural livestock
  - Fugitive dust
    - wind erosion
    - unpaved roads
    - paved roads
    - other (construction and mining and quarrying)

PM-2.5 emissions were calculated only for the years 1990 through 1996. Although several of the source categories listed above have information concerning the PM-2.5 particle size multiplier that should be applied to the AP-42 emission factor to calculate PM-2.5 emissions, much of that data is fairly old. As a consequence, EPA, Pechan, and Midwest Research Institute (MRI) performed an evaluation of more recent particle size distribution information.[1] That review indicated that the PM-2.5/PM-10 ratio for several of the source categories listed above should be reduced. Table 4.8-1 shows the particle size ratios used to calculate PM-2.5 particle size multipliers from the PM-10 particles size multipliers used to develop PM-10 emissions for each fugitive dust category in this section.

Table 4.8-1. Particle Size Ratios

Source Category	Ratio of PM-2.5 to PM-10
Wind Erosion - Agricultural Land	0.15
Agricultural Crops	0.20
Agricultural Livestock	0.15
Wind Erosion - Non-Agricultural Land	0.15
Paved Roads	0.25
Unpaved Roads	0.15
Construction Activities	0.20
Mining and Quarrying	0.20

4.8.1 Natural Sources, Geogenic, Wind Erosion

The wind erosion emissions were estimated for the years 1985 through 1996 using the following methodology. PM-10 and PM-2.5 wind erosion emissions estimates for agricultural lands were made using a modification of the methodology used by Gillette and Passi[2] to develop wind erosion emissions for 1985 NAPAP. Several simplifying assumptions were made in order to perform the calculations using a spreadsheet model.[3]

The NAPAP methodology and the method used to develop the wind erosion estimates presented here both develop an expectation of the 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:

$$I = k \times C_2 \times C_d^2 \times \left(\frac{u^4}{0.886^4} \right) \times \Gamma(3,x)$$

where:	I	=	dust flux ($gm/cm^2/sec$)
	k	=	PM-10 particle size multiplier (= 0.9)
			PM-2.5 particle size multiplier (= 0.135)
	C	=	constant (= 4×10^{-14} $gm/cm^2/sec$)
	C_d	=	drag coefficient
	u	=	mean wind speed (cm/sec)
	$\Gamma(3,x)$	=	incomplete gamma function

To evaluate $\Gamma(3,x)$, x must be determined from the following equation:

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

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:

$$u_t = \frac{u_{*t}}{C_d^{0.5}}$$

Values of the threshold friction velocity for different soil types both before and after rain to account for crusting of the soil surface have been reported by Gillette and Passi.[2]

4.8.1.1 Determination of Correction Parameters

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 for the wind speed was necessary. Values for monthly wind speed, total monthly precipitation and anemometer height were obtained from the Local Climatological Data[4] 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 utilized to determine the drag coefficient (C_d) from the following equation:

$$C_d = \left(\frac{0.23}{\ln z_s} \right)^2$$

where: z_s = anemometer height

Information concerning the average soil type for each state was determined from the USDA surface soil map.[5] A single soil type was assigned to each state in order to determine a single value for the threshold friction velocity (u_{*t}). The threshold friction velocity (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 utilized for all succeeding months until the time of a significant tillage operation or plant emergence. The value of u_t was then calculated using the value of u_{*t} determined and C_d. Once u_t was determined, then x could be calculated and the incomplete gamma function could be evaluated using an asymptotic expansion. Following evaluation of the incomplete gamma function, the flux for each month was determined.

Wind erosion was assumed to be zero from the time of plant emergence until harvest. 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.[2] For the years 1985 through 1989, 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.

4.8.1.2 1990-1996 Modification

The method for estimating 1990 through 1996 emissions from geogenic wind erosion is similar to the above wind erosion methodology with the exception that previous years rain data for September through December was used. This data was used to determine whether or not any month between September and December of the previous year had more than 5.08 cm of precipitation. Gillette and Passi utilized previous year precipitation information to assign the threshold friction velocity to an area.

4.8.1.3 Activity Data

Once the emission flux potential for each month for each crop type (fall or spring planted) for each state was calculated, then the acres of spring or fall planted crops in each state were required (and the number of seconds per month) to determine the emissions. The acres of crops planted in each state was obtained for each of the 11 years from the USDA.[6] Evaluation of which crops were spring planted or fall planted for each state was made using information available from the USDA.[7] The emissions calculated were then estimated for each state.

4.8.1.4 County Distribution (1985-1989)

State-level PM-10 estimates were distributed to the county-level using estimates of county rural land area from the U.S. Census Bureau.[8] The following formula was used:

$$County\ Emissions = \left(\frac{County\ Rural\ Land}{State\ Rural\ Land}\right) \times State\ Emissions$$

4.8.1.5 County Distribution (1990-1996)

State-level PM-10 estimates were distributed to the county-level using estimates of acres of land tilled from the Conservation Information Technology Center.[9] The following formula was used:

$$County\ Emissions = \left(\frac{County\ Cropland\ Tilled}{State\ Croplant\ Tilled}\right) \times State\ Emissions$$

4.8.2 Miscellaneous Sources

The methodology used to estimate the emissions from agricultural crops, agricultural livestock, and fugitive dust are described in this section. The PM-10 and PM-2.5 emissions arise from construction activities, mining and quarrying, paved road resuspension, and unpaved roads. The general methodology used for these categories estimated the emissions by using an activity indicator and an emission factor with one or more correction factors. The activity indicator for a given category varied from year to year as may the correction factors.

4.8.2.1 Agricultural Crops (1985-1989)

The PM-10 emissions for the years 1985 through 1989 were estimated using the AP-42 emission factor equation for agricultural tilling.[10] The activity data for this calculation were the acres of land planted. The emission factor, developed to estimate of the mass of TSP produced per acre-tilled was adjusted to estimate PM-10 using the following constant parameters: the silt content of the surface soil, a particle size multiplier, and the number of tillings per year.

The following AP-42 particulate emission factor equation was used to determine state PM-10 emissions from agricultural tilling for 1985 through 1989:

$$E = c \times k \times s^{0.6} \times p \times a$$

where:

E = PM-10 emissions
c = constant 4.8 lbs/acre-pass

k	=	dimensionless particle size multiplier (PM-10=0.21)
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 (%)
p	=	number of passes or tillings in a year (assumed to be 3 passes)
a	=	acres of land planted

4.8.2.1.1 Determination of Correction Parameters —

4.8.2.1.1.1 . *Silt content (s).* By comparing the USDA[5] surface soil map with the USDA[11] county map, soil types were assigned to all counties of the continental United States. Silt percentages were determined by using a soil texture classification triangle.[12] For those counties with organic material as its soil type, Pechan used the previous silt percentages presented by Cowherd.[13] The weighted mean state silt values were determined by weighing the county value by the number of hectares within the county and summing across the entire state. Table 4.8-2 shows the silt percentages used for 1985 through1989. These silt values were assumed constant for the five- year period examined.

Table 4.8-2. Silt Content by Soil Type

Soil Type	Silt Content (%)
Silt Loam	78
Sandy Loam	33
Sand	12
Loamy Sand	12
Clay	75
Clay Loam	75
Organic Material	10-82
Loam	60

4.8.2.1.1.2 *Number of Tillings per year (p).* Cowherd et al.[13] reported that crops are tilled three times each year, on average, and this value was used for p.

4.8.2.1.2 Activity Data —

The acres of crops planted (a) in each state was obtained for each of the 5 years from the USDA.[6]

4.8.2.1.3 County Distribution —

State-level PM-10 estimates were distributed to the county-level using county estimates of cropland harvested from the 1987 Census of Agriculture.[14] The following formula was used:

$$County\ Emissions = \left(\frac{County\ Cropland\ Harvested}{State\ Croplant\ Harvested} \right) \times State\ Emissions$$

4.8.2.2 Agricultural Crops (1990-1996)

The methodology to determine agricultural crop emissions for the years 1990 through 1996 was similar to the methodology for the years 1985 through 1989, with several exceptions. The PM-10 and

PM-2.5 emissions for the years 1990 through 1996 were also estimated using the AP-42 emission factor equation for agricultural tilling.[10] The activity data for this calculation were the acres of land tilled. The emission factor, developed to estimate the mass of TSP produced per acre-tilled was adjusted to estimate PM-10 and PM-2.5 using the following constant parameters: the silt content of the surface soil, a particle size multiplier, and the number of tillings per year.

The following AP-42 particulate emission factor equation was used to determine regional PM-10 emissions from agricultural tilling for 1990 through 1996:

$$E = c \times k \times s^{0.6} \times p \times a$$

where:	E	=	PM emissions
	c	=	constant 4.8 lbs/acre-pass
	k	=	dimensionless particle size multiplier (PM-10=0.21; 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 (%)
	p	=	number of passes or tillings in a year
	a	=	acres of land tilled

4.8.2.2.1 Determination of Correction Parameters —

4.8.2.2.1.1 *Silt content (s).* By comparing the USDA[5] surface soil map with the USDA[11] 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.[12] For those counties with organic material as its soil type, Pechan used the previous silt percentages presented by Cowherd.[13] These silt factors were then corrected using information from Spatial Distribution of PM-10 emissions from Agricultural Tilling in the San Joaquin Valley.[15] 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 disaggregate 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. Table 4.8-3 shows the percent silt used for each soil type for 1990 through 1996. 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.

Table 4.8-3. Silt Content by Soil Type

Soil Type	Silt Content (%)
Silt Loam	52
Sandy Loam	33
Sand	12
Loamy Sand	12
Clay	29
Clay Loam	29
Organic Material	10-82
Loam	40

4.8.2.2.1.2 Number of Tillings per year (p). 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.[16] 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.[17] Where there were data from more than one region for a single crop, an average value was used. Information for both conservation and convention 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. Table 4.8-4 shows the number of tilling used for each crop type, and for conservational and conventional use included in the database provided by the Conservation Information Technology Center (CTIC).[9] The number of tillings for categories not included in Agricultural Activities Influencing Fine Particulate Matter Emissions were determined by contact with the CTIC.[18]

Rice and spring wheat are included in the category "spring-seeded small grain" in the database provided by the CTIC.[9] 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.[6] 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.

Table 4.8-4. Number of Tillings by Crop Type

Crop	Number of Tillings Conservational Use	Conventional Use
Corn	2	6
Spring Wheat	1	4
Rice	5	5
Fall-Seeded Small Grain	3	5
Soybeans	1	6
Cotton	5	8
Sorghum	1	6
Forage	3	3
Permanent Pasture	1	1
Other Crops	3	3
Fallow	1	1
Annual Conservation Use	(No method, not used after 1995; number of tillings = 1)	

4.8.2.2.2 Activity Data —

The acres of crops tilled (a) in each county for each crop type and tilling method was obtained for each of the 6 years from the CTIC.[9]

4.8.2.2.3 County Distribution —

All emissions for agricultural crops for 1990-1996 were calculated on a county basis.

4.8.2.3 Agricultural Livestock

The 1990 emissions from agricultural livestock were determined from activity data, expressed in terms of the number of heads of cattle[14] and a national PM-10 emission factor.[19] The following formula was used:

$$\text{County Emissions} = \left(\frac{\text{County Head of Cattle}}{1{,}000}\right) \times 17$$

The emissions for the years 1985 through 1991 were produced using the methodology described in section 4.8.2.6. The emissions for the years 1992 through 1996 were produced using E-GAS growth factors as also described in section 4.8.2.6. The PM-2.5 emissions for agricultual livestock for the years 1990 through 1996 were determined by multiplying the PM-10 emission for that year by the size adjustment factor of 0.15, shown in Table 1.

4.8.2.4 PM Emissions from Reentrained Road Dust from Unpaved Roads

Estimates of PM emissions from Reentrained road dust on unpaved roads were developed for each county. PART5 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.

4.8.2.4.1 PM Emission Factor Calculation —

The equation used in PART5 to calculate PM emission factors from Reentrained road dust on unpaved roads is based on an empirical formula from AP-42. This equation is shown below:[f1]

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

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 (0.36for PM-10 and ? 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.

4.8.2.4.1.1 *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.[f2] 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.

4.8.2.4.1.2 *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[F9] showing the number of days per month with more than 0.01 inches of rain were used. These monthly rain data were multiplied by 12 before being input to PART5 so that the inputs would represent an annual number of rain days, as required by the equation. Precipitation event accumulation data were collected for several meteorological stations within each state.

4.8.2.4.1.3 ***Vehicle Wheel, Weight, and Speed Inputs***. The speeds shown in Table 4.8-f1 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. These speeds are shown in Table 4.8-f1. 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*,[f3] *MVMA Motor Vehicle Facts and Figures '91*,[f4] and the *1991 Market Data Book*.[f5] Using these data sources, a fleet average vehicle weight of 6,358 pounds was modeled with a fleet average number of wheels per vehicle of five.

4.8.2.4.2 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 equation used to calculate unpaved road VMT is:

$$VMTUP = ADTV * FSRM * DPY$$

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

4.8.2.4.2.1 ***Estimating Local Unpaved VMT***. Unpaved roadway mileage estimates were retrieved from the FHWA's annual *Highway Statistics*[f6] 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 were derived for the volume and population categories listed in Table 4.8-f2. This was done by first assigning an average daily traffic volume (ADTV) to each volume category, as shown in Table 4.8-f2.

The above equation was then used to calculate state-level unpaved road VMT estimates for the volume and population categories listed in Table 4.8-f2. These detailed VMT data were then summed to develop state-level, county-maintained unpaved roadway VMT.

4.8.2.4.2.2 ***Estimation of Federal and State-Maintained Unpaved Roadway 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, as shown in the following equation:

$$ADTV = VMT / MILEAGE$$

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[F6] by the state-level ADTV values calculated as discussed above for locally-maintained roadways. The following equation illustrates:

$$VMT = ADTV * RM * 365$$

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)

4.8.2.4.2.3 *Unpaved 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 in the following equation:

$$UnpavedVMT_{Roadtype} = Mileage_{Roadtype} * ADTV * DPY$$

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 Administrations Highway Statistics.[F6] 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 redistribute within the ADTV categories based on the average distributions found in Alabama, Georgia, and Louisiana.

4.8.2.4.3 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.

4.8.2.4.4 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[f7] for the years 1985 through 1989. The following formula was used for this allocation:

$$PM_{X,Y} = (CNTYLAND_{URB,X}/STATLAND_{URB}) * PM_{ST,URB,Y} + (CNTYLAND_{RUR,X}/STATLAND_{RUR}) * PM_{ST,RUR,Y}$$

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.

4.8.2.4.5 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. The control assumed was vacuum sweeping on both urban and rural roads twice per month to achieve an control level of 79 percent. The penetration factor used varied by road type and NAA classification (serious or moderate).

4.8.2.5 PM Emissions from Reentrained Road Dust from 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. This equation is shown below:[f8]

$$PAVED = PSDPVD * (PVSILT/2)^{0.65} * (WEIGHT/3)^{1.5}$$

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 ? 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 were 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) were 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. This calculation is slightly modified given that emissions were calculated at the monthly level, in actuality, monthly rain data was annualized (multiplied by twelve).

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 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 formula illustrates this allocation:

$$PVDEMIS_{X,Y} = PVDEMIS_{ST,Y} * VMT_{X,Y}/VMT_{ST,Y}$$

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 both urban and rural roads twice per month to achieve an control level of 79 percent. The penetration factor used varied by road type and NAA classification (serious or moderate).

4.8.2.6 Other Fugitive Dust Sources

The other fugitive dust sources are from construction and mining and quarrying activies. Construction sources are explained in section 4.8.2.6.1 and mining and quarrying methodology is detailed in section 4.8.2.6.2.

4.8.2.6.1 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.[27] The acres of land under construction were estimated from the dollars spent on construction.[28] The PM-10 emission factor for the years 1985 through1989 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.[19] The PM-10 emission factor for the years 1990 through 1995 was obtained from Improvement of Specific Emission Factors.[29] 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.[22] A control efficiency was applied to emissions for 1995 and 1996 for counties classified as PM nonattainment areas.[30]

4.8.2.6.1.1 ***1985-1989 Emission Factor Equation.*** The following AP-42 particulate emission factor equation for heavy construction was used to determine regional PM-10 emissions from construction activities for 1985 through 1989:

$$E = T \times \$ \times f \times m \times P$$

where:
- E = PM-10 emissions
- 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 (varies by type of construction)
- P = dimensionless PM-10/TSP ratio (0.22).

4.8.2.6.1.2 ***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, shown in Table 4.8-1. A control efficiency was applied to PM nonattainment areas for 1995 and 1996.

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

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)

4.8.2.6.1.2.1 ***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.[31] 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[28] 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) follows:

$$\$_{1988,Region\,I,\,SIC_{1521}} = \frac{\$_{1987,Nation,Census}}{\$_{1987,Nation,Dodge}} \times \$_{1988,Nation,Dodge} \times \frac{\$_{1987,Region\,1,Census,\,SIC_{1521}}}{\$_{1987,Nation,Census,\,SIC_{1521}}}$$

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

4.8.2.6.1.2.2 ***Determination of construction acres (f).*** Information developed by Cowherd et al.[21] 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 using the method developed by Heisler[32]) was utilized along with total construction receipts to determine the total number of acres of each construction type.

4.8.2.6.1.2.3 ***Months of construction (m).*** Estimates of the duration (in months) for each type construction were derived from Cowherd et al.[27]

4.8.2.6.1.2.4 ***PM-10/TSP Ratio (P) (1985-1989).*** The PM-10/TSP ratio for construction activities was derived from Midwest Research Institute [MRI].[19] In MRI's report, the data in Table 9," Net Particulate Concentrations and Ratios" is cited from Kinsey et al.[33] That table included the ratios of PM-10/TSP for 19 test sites for three different construction activities. MRI suggests averaging the ratios for the construction activity of interest. Since Pechan was looking at total construction emissions from all sources, Pechan averaged the PM-10/TSP ratios for all test sites and construction activities.

4.8.2.6.1.2.5 ***PM-10 and PM-2.5 Ratio (P) (1990-1995).*** The PM-10 emission factor used for the years 1990 through 1995 for construction activities was obtained from Improvement of Specific Emission Factors.[29] This study reported an emission factor of 0.11 ton PM-10/acre-month. This value is the geometric mean of emission factors for 7 different sites considered in the study. Emission inventories for the sites were prepared for the construction activities observed at each site. The PM-2.5 emission factor used for the years 1990-1995 was the PM-10 emission factor (0.11 ton PM-10/acre-month) multiplied by the particle size adjustment factor of 0.2, shown in Table 1.

4.8.2.6.1.2.6 ***Control Efficiency (1990-1996).*** A control efficiency was applied to emissions for 1995 and 1996 for counties classified as PM nonattainment areas.[30] Therefore, the control efficiency for the years 1990 through 1994 is zero for all counties. The PM-10 control efficiency used for 1995 and 1996 PM nonattainment areas is 62.5. The PM-2.5 control efficiency for these years and areas is 37.5.

4.8.2.6.1.2.7 ***County Distribution.*** 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.[34] The following formula was used:

$$County\ Emissions = \frac{County\ Construction\ Payroll}{Regional\ Construction\ Payroll} \times Regional\ Emissions$$

4.8.2.6.2 Mining and Quarrying —

The PM-10 emissions for the years 1985 through 1995 were the sum of the emissions from metallic ore, nonmetallic ore, and coal mining operations. The 1996 PM-10 emissions were produced through a linear projection of the emissions for the years 1990 through 1995.The PM-2.5 emissions for the years 1990 through 1996 were determined by multiplying the PM-10 emissions for that year by the particle size adjustment factor of 0.2, represented in Table 4.8-1.

PM-10 emissions estimates from mining and quarrying operations include only the following sources of emissions: 1) overburden removal, 2) drilling and blasting, 3) loading and unloading and 4) overburden replacement. Transfer and conveyance operations, crushing and screening operations and storage were not included. Travel on haul roads was also omitted. These operations were not included in order to be consistent with previous TSP emissions estimates from these sources (i.e., Evans and Cooper[35]), because they represent activities necessary for ore processing, but not necessary for actual extraction of ore from the earth, and because these activities are the most likely to have some type of control implemented.

Pechan's emissions of mining and quarrying operations is a summation of three types of mining (metallic, non-metallic and coal) which are expressed in the following equation.

$$E = E_m + E_n + E_c$$

where:

	E	=	PM-10 emissions from mining and quarrying operations
	E_m	=	PM-10 emissions from metallic mining operations
	E_n	=	PM-10 emissions from non-metallic mining operations
	E_c	=	PM-10 emissions from coal mining operations

4.8.2.6.2.1 ***Determination of Correction Parameters.*** It was assumed that, for the four operations listed above, the TSP emission factors utilized in developing copper ore processing Emission Trends estimates applied to all metallic minerals. PM-10 emission factors were determined for each of the four operations listed above by making the following assumptions. Table 11.2.3-2 of AP-42[10] was used to determine that 35 percent of overburden removal TSP emissions were PM-10. For drilling and blasting and truck dumping, 81 percent of the TSP emissions were assumed to be PM-10.[36] For loading operations, 43 percent of TSP emissions were assumed to be PM-10.[36]

Non-metallic mineral emissions were calculated by assuming that the PM-10 emission factors for western surface coal mining[37] applied to all non-metallic minerals.

Coal mining includes two additional sources of PM-10 emissions compared to the sources considered for metallic and non-metallic minerals. The two additional sources are overburden replacement and truck loading and unloading of that overburden. Pechan assumed that tons of overburden was equal to ten times the tons of coal mined.[35]

4.8.2.6.2.2 *Activity Data*. The regional metallic and non-metallic crude ore handled at surface mines for 1985 through 1995 were obtained from the U.S. Geological Survey.[38] Some state level estimates are withheld by the U.S. Geological Survey to avoid disclosing proprietory data. Known distributions from past years were used to estimate these withheld data.

The regional production figures for surface coal mining operations were obtained from the Coal Industry Annual[39] for 1985 through 1995.

4.8.2.6.2.2.1 *Metallic Mining Operations*. The following PM-10 emissions estimate equation calculates the emissions from overburden removal, drilling and blasting, and loading and unloading during metallic mining operations.

$$E_m = A_m \times EF_o + B \times EF_b + EF_l + EF_d$$

where:
- A_m = metallic crude ore handled at surface mines (1000 short tons)
- EF_o = PM-10 open pit overburden removal emission factor for copper ore processing (lbs/ton)
- B = fraction of total ore production that is obtained by blasting at metallic mines
- EF_b = PM-10 drilling/blasting emission factor for copper ore processing (lbs/ton)
- EF_l = PM-10 loading emission factor for copper ore processing (lbs/ton)
- EF_d = PM-10 truck dumping emission factor for copper ore processing (lbs/ton)

4.8.2.6.2.2.2 *Non-metallic Mining Operations*. The following PM-10 emissions estimate equation calculates the emissions from overburden removal, drilling and blasting, and loading and unloading during non-metallic mining operations.

$$E_n = A_n \times \left(EF_v + D \times EF_r + EF_a + ½ \times \left(EF_e + EF_t\right)\right)$$

where:
- A_n = non-metallic crude ore handled at surface mines (1000 short tons)
- EF_v = PM-10 open pit overburden removal emission factor at western surface coal mining operations (lbs/ton)
- D = fraction of total ore production that is obtained by blasting at non-metallic mines
- EF_r = PM-10 drilling/blasting emission factor at western surface coal mining operations (lbs/ton)
- EF_a = PM-10 loading emission factor at western surface coal mining operations (lbs/ton)

EF_e	=	PM-10 truck unloading: end dump-coal emission factor at western surface coal mining operations (lbs/ton)
EF_t	=	PM-10 truck unloading: bottom dump-coal emission factor at western surface coal mining operations (lbs/ton)

4.8.2.6.2.2.3 *Coal Mining*. The following PM-10 emissions estimate equation calculates the emissions from overburden removal, drilling and blasting, loading and unloading and overburden replacement during coal mining operations.

$$E_c = A_c \times \left(10 \times \left(EF_{to} + EF_{or} + EF_{dt}\right) + EF_v + EF_r + EF_a + ½ \times \left(EF_e + EF_t\right)\right)$$

where:			
	A_c	=	coal production at surface mines (1000 short tons)
	Ef_{to}	=	PM-10 emission factor for truck loading overburden at western surface coal mining operations (lbs/ton of overburden)
	Ef_{or}	=	PM-10 emission factor for overburden replacement at western surface coal mining operations (lbs/ton of overburden)
	Ef_{dt}	=	PM-10 emission factors for truck unloading: bottom dump-overburden at western surface coal mining operations (lbs/ton of overburden)
	EF_v	=	PM-10 open pit overburden removal emission factor at western surface coal mining operations (lbs/ton)
	EF_r	=	PM-10 drilling/blasting emission factor at western surface coal mining operations (lbs/ton)
	EF_a	=	PM-10 loading emission factor at western surface coal mining operations (lbs/ton)
	EF_e	=	PM-10 truck unloading: end dump-coal emission factor at western surface coal mining operations (lbs/ton)
	EF_t	=	PM-10 truck unloading: bottom dump-coal emission factor at western surface coal mining operations (lbs/ton)

4.8.2.6.2.3 *1996 Emissions Methodology*. For the year 1996 PM-10 emissions from mining and quarrying operations were projected based on linear regression of the previous 5 years. Pechan was unable to obtain regional metallic and non-metallic crude ore handled at surface mines for 1996. The U.S. Geological Survey publishes summary statistics on mining and quarrying with a one year delay.

4.8.2.6.2.4 *County Distribution*. Regional-level emissions were distributed equally among counties within each region.

$$County\ Emissions = \frac{1}{Number of Counties in Region} \times Regional\ Emissions$$

4.8.2.7 Grown Emissions

Point source fugitive dust sources in the 1990 NET inventory were wind erosion, unpaved roads, and paved roads. Emissions from these sources were grown from the 1990 NET inventory based on BEA earnings. The cattle feedlot emissions estimated above were also grown from year to year.

4.8.2.7.1 Emissions Calculations —
Base year controlled emissions are projected to the inventory year using the following formula:

$$CE_i = CE_{BY} + (CE_{BY} \times EG_i)$$

where:
CE_i = Controlled Emissions for inventory year i
CE_{BY} = Controlled Emissions for base year
EG_i = Earnings Growth for inventory year i

Earnings growth (EG) is calculated as:

$$EG_i = 1 - \frac{DAT_i}{DAT_{BY}}$$

where:
DAT_i = Earnings data for inventory year i
DAT_{BY} = Earnings data in the base year

4.8.2.7.2 Growth Indicators, 1985-1989 —
The changes in the point and area source emissions were equated with the changes in historic earnings by state and industry. Emissions from each point source in the 1985 NAPAP inventory were projected to the years 1985 through 1990 based on the growth in earnings by industry (two-digit SIC code). Historical annual state and industry earnings data from BEA's Table SA-5[32] were used to represent growth in earnings from 1985 through 1990.

The 1985 through 1990 earnings data in Table SA-5 are expressed in nominal dollars. To estimate growth, these values were converted to constant dollars to remove the effects of inflation. Earnings data for each year were converted to 1982 constant dollars using the implicit price deflator for PCE.[33] The PCE deflators used to convert each year's earnings data to 1982 dollars are:

Year	1982 PCE Deflator
1985	111.6
1987	114.8
1988	124.2
1989	129.6
1990	136.4

Several BEA categories did not contain a complete time series of data for the years 1985 through 1990. Because the SA-5 data must contain 1985 earnings and earnings for each inventory year (1985 through 1990) to be useful for estimating growth, a log linear regression equation was used where possible to fill in missing data elements. This regression procedure was performed on all categories that were missing at least one data point and which contained at least three data points in the time series.

Each record in the inventory was matched to the BEA earnings data based on the state and the two-digit SIC. Table 4.8-1 shows the BEA earnings category used to project growth for each of the two-digit SICs found in the 1985 NAPAP Emission Inventory. No growth in emissions was assumed for all point sources for which the matching BEA earnings data were not complete. Table 4.8-1 also shows the national average growth and earnings by industry from Table SA-5.

4.8.2.7.3 Growth Indicators, 1992 and 1993 —

See section 4.3 for details on growth factors.

4.8.3 References

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Table 4.8-1. Bureau of Economic Analysis's SA-5 National Changes in Earnings by Industry

		Percent Growth from:			
Industry	**SIC**	**1985 to 1987**	**1987 to 1988**	**1988 to 1989**	**1989 to 1990**
Farm	01, 02	14.67	-2.73	14.58	-3.11
Agricultural services, forestry, fisheries, and other	07, 08, 09	23.58	5.43	1.01	2.48
Coal mining	11, 12	-17.46	-6.37	-4.16	4.73
Metal mining	10	-3.03	18.01	8.94	4.56
Nonmetallic minerals, except fuels	14	2.33	3.74	-2.79	-0.45
Construction	15, 16, 17	7.27	4.81	-1.36	-3.80

Table 4.8-2. BEA SQ-5 National Growth In Earnings By Industry

Industry	Percent Growth from 1990 to 1991
Farm	-18.38
Agricultural services, forestry, fisheries, and other	-5.06
Coal mining	-0.75
Construction	-10.37

Table 4.8-f1 Speeds Modeled for Unpaved Roads

Rural Roads	Speed (mph)	Urban Roads	Speed (mph)
Minor Arterial	39	Other Principal Arterial	20
Major Collector	34	Minor Arterial	20
Minor Collector	30	Collector	20
Local	30	Local	20

Table 4.8-f2 Assumed Values for Average Daily Traffic Volume by Volume Group

	Vehicles Per Day Per Mile			
Volume Category for Rural Roads	**Less than 50**	**50 - 199**	**200 - 499**	**500 and over**
Assumed ADTV Value for Rural Roads	5*	125**	350**	550***
Volume Category for Urban Roads	**Less than 200**	**200 - 499**	**500 - 1999**	**2000 and over**
Assumed ADTV Value for Urban Roads	20*	350**	1250**	2200***

NOTE(S): *10% of volume group's maximum range endpoint.
**Average of volume group's range endpoints.
***110% of volume group's minimum.