



Procedures for Developing Base Year and Future Year Mass and Modeling Inventories for The Heavy- Duty Engine and Vehicle Standards and Highway Diesel Fuel (HDD) Rulemaking

Procedures for Developing Base Year and Future Year Mass and Modeling Inventories for The Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel (HDD) Rulemaking

Mr. Gregory Stella (MD-14)
Office of Air Quality Planning and Standards
U.S. Environmental Protection Agency

Prepared for EPA by
E.H. Pechan & Associates, Inc.
3622 Lyckan Parkway, Suite 2002
Durham, NC 27707
and
5528-B Hempstead Way
Springfield, VA 22151

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ACRONYMS AND ABBREVIATIONS

AAMA	American Automobile Manufacturers Association
ASTM	American Society for Testing and Materials
BEA	Bureau of Economic Analysis
CAA	Clean Air Act
CI	compression-ignition
CNG	compressed natural gas
CO	carbon monoxide
DOE	U.S. Department of Energy
EGU	electric generating unit
EIA	Energy Information Administration
EMS	Emissions Modeling System
EPA	U.S. Environmental Protection Agency
EPS	Emissions Preprocessor System
F	Fahrenheit
FAA	Federal Aviation Administration
FCM	Fuel Consumption Model
FIPS	Federal Information Processing Standard
ft	feet
ft/min	feet per minute
g/bhp-hr	grams per brake horsepower-hour
GSP	Gross State Product
HC	hydrocarbon
HDD	heavy-duty diesel
HDDV	heavy-duty diesel vehicle
HDGV	heavy-duty gasoline vehicle
HON	Hazardous Organic NESHAP
hp	horsepower
HPMS	Highway Performance Monitoring System
I/M	Inspection and Maintenance
IPM	Integrated Planning Model
LDDT	light-duty diesel truck
LDDV	light-duty diesel vehicle
LDGT1	light-duty gasoline truck (less than 6,000 pounds in weight)
LDGT2	light-duty gasoline truck (6,000 to 8,500 pounds in weight)
LDGV	light-duty gasoline vehicle
LEV	Low-Emission Vehicle
LNB	low-NO _x burner
LPG	liquid petroleum gas
LTOs	Landing-Takeoff Operations
m	meter
MACT	maximum achievable control technology

ACRONYMS AND ABBREVIATIONS (continued)

MC	motorcycle
MMBtu	million British thermal units
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NET	National Emission Trends
NH ₃	ammonia
NLEV	National Low Emission Vehicle
NMHC	nonmethane hydrocarbon
NMOG	Nonmethane Organic Gas
NO _x	oxides of nitrogen
OBD	on-board diagnostic
OTAG	Ozone Transport Assessment Group
OTAQ	Office of Transportation and Air Quality
OTC	Ozone Transport Commission
OTR	Ozone Transport Region
PM	particulate matter
PM ₁₀	primary particulate matter with an aerodynamic diameter less than or equal to 10 micrometers
PM _{2.5}	primary particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers
POTWs	Publicly-Owned Treatment Works
ppm	parts per million
psi	pounds per square inch
RACT	reasonably available control technology
REMSAD	Regulatory Modeling System for Aerosols and Deposition
RFG	reformulated gasoline
RSD	Regulatory Support Document
RVP	Reid vapor pressure
SCCs	Source Classification Codes
SCR	selective catalytic reduction
SI	spark-ignition
SIC	Standard Industrial Classification
SIP	State Implementation Plan
SNCR	Selective Noncatalytic Reduction
SO ₂	sulfur dioxide
SOA	secondary organic aerosols
SOCMI	Synthetic Organic Chemical Manufacturing Industry
SO _x	oxides of sulfur
SSD	summer season daily
TLEV	transitional LEV

ACRONYMS AND ABBREVIATIONS (continued)

tpd	tons per day
tpy	tons per year
TSDFs	treatment, storage, and disposal facilities
UAM-V	Urban Airshed Model
ULEV	Ultra-Low Emission Vehicle
U.S.	United States
USDA	U.S. Department of Agriculture
UTM	Universal Transverse Mercator
VMT	vehicle miles traveled
VOC	volatile organic compound

CHAPTER I BACKGROUND

To assist future State and Federal implementation of the Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel (HDD) mobile source emission standards, the United States (U.S.) Environmental Protection Agency (EPA) is developing national annual and temporal emission inventories and applying the Urban Airshed Model (UAM-V) and Regulatory Modeling System for Aerosols and Deposition (REMSAD) to examine the regional ozone and particulate matter (PM) concentration response to a series of emission control strategies. The purpose of this report is to describe the procedures and assumptions used to develop the mass emissions inventories and the emissions input files for the Emissions Modeling System (EMS-95) and Emissions Preprocessor System (EPS 2.5) air quality model preprocessors.

The emission inventories developed to support the HDD rulemaking include the following:

- 1996 Base Year;
- 2007 Base Case;
- 2007 Control Case;
- 2020 Base Case;
- 2020 Control Case;
- 2030 Base Case; and
- 2030 Control Case.

These national inventories were prepared for all 50 States at the county level for mobile highway and mobile nonroad sources. They were prepared for the 48 contiguous States (48 State) at the county-level for electric generating unit (EGU), non-EGU point, and stationary area sources. The inventories contain annual and typical summer season day (SSD) emissions for the following pollutants: oxides of nitrogen (NO_x), volatile organic compounds (VOC), carbon monoxide (CO), oxides of sulfur (SO_x), primary particulate matter with an aerodynamic diameter less than or equal to 10 micrometers and 2.5 micrometers (PM_{10} and $\text{PM}_{2.5}$), ammonia (NH_3), and secondary organic aerosols (SOA). The 2007, 2020, and 2030 Base Case inventories are prepared by applying growth and control assumptions to the 1996 Base Year inventory. The 2007, 2020, and 2030 Control Case inventories are developed from the 2007, 2020, and 2030 Base Case inventories, respectively, by applying HDD control assumptions to the on-highway vehicle and nonroad emission source sectors. The growth and control assumptions used to prepare the 2007, 2020, and 2030 inventories are documented in this report.

Chapters II through VI of this report document the inventories for the EGU, non-EGU point, stationary area, nonroad, and on-highway vehicle source sectors. The chapter for each sector

documents the procedures and assumptions applied to prepare the mass emissions inventories for the 1996 Base Year; 2007, 2020, and 2030 Base Cases; and 2007, 2020, and 2030 Control Cases. Each chapter also discusses the procedures and assumptions applied to prepare the emissions input files for the EMS-95 and EPS 2.5 air quality model preprocessors. Chapter VII provides 48-State emissions summaries and density maps for the emissions inventories.

CHAPTER II

ELECTRICITY GENERATING UNITS (EGUs)

A. 1996 BASE YEAR MASS EMISSIONS INVENTORY

The 1996 base year emissions inventory for EGUs is the 1996 National Emission Trends (NET) point source inventory version 3.12 (EPA, 2000a). This inventory includes both annual and typical summer season day (SSD) emissions for NO_x, VOC, CO, SO_x, PM₁₀, PM_{2.5}, and NH₃. SOA emissions were added to the inventory by applying fractional aerosol coefficients based on speciation of VOC emissions (Grosjean and Seinfeld, 1989). Inventory records with Source Classification Codes (SCCs) of 101xxxxx and 201xxxxx were extracted from the NET inventory to develop the 1996 EGU inventory.

B. 2007, 2020, AND 2030 FUTURE YEAR MASS EMISSIONS INVENTORIES

Projection year unit-level output files from the Integrated Planning Model (IPM) were provided to Pechan by EPA for the EGU sector for 2007 and 2020. The 2020 IPM output file was also used to represent EGU projections for 2030. These files include heat input, sulfur dioxide (SO₂) emissions, NO_x emissions, and unit characteristics such as prime mover (boiler, gas turbine), primary fuel, bottom type, and firing type. This section focuses on the steps used to create the future year mass emissions inventories for 2007, 2020, and 2030, by adding to the IPM files emissions for VOC, CO, PM₁₀, PM_{2.5}, NH₃, and SOA, as well as data elements needed for modeling (e.g., county codes, coordinates, and stack parameters). Note that the 2030 mass emissions file is identical to the 2020 file.

The data elements included in the original IPM parsed data sets are shown in Table II-1. The data sets include unit-level information for all existing or known planned units. For new units (additional capacity needed to meet generation demands), state-level estimates by plant type (prime mover) and fuel type are provided. Details about the additional or updated items for the final 2007, 2020, and 2030 emission files are discussed below.

1. ORISID AND BLRID

Unique utility plant (ORISID) and unit (BLRID) identifiers are provided in the original IPM parsed data set. These two variables were included in the emission inventories but were not reviewed for accuracy because of time and resource constraints associated with preparing the inventories for all sectors.

Table II-1
Data Elements Provided in EGU Projection Files IPM Parsed Data Sets

Data Elements	Description
Unit ID	IPM Unit ID
Plant Name	Plant name
Plant Type	Combined cycle, coal steam, oil/gas steam, turbine, other
State Name	State name
State Code	Federal Information Processing Standard (FIPS) State code
County Name	County name (sometimes missing)
County Code	FIPS county code (sometimes missing)
ORIS Code	ORIS plant code for those units assigned codes, IPM plant code otherwise
Blr	ORIS boiler or unit code where available, otherwise IPM unit code
Capacity	Boiler/unit capacity (MW)
July Day Heat	July day heat input (10^9 Btu/day)
Fuel Type	Primary fuel burned: coal, gas, natural gas, none, refuse, waste coal, wood waste
Bottom	Boiler bottom type: dry, wet, other, unknown, or blank
Firing	Firing type: cell, cyclone, tangential, vertical, well, wet, other, or unknown
Existing SO ₂ /NO _x Controls	Existing control for SO ₂ and/or NO _x - scrubbed, unscrubbed, or blank
Retrofit SO ₂ /NO _x Controls	Coal to combined cycle, gas reburn, oil/gas selective noncatalytic reduction (SNCR), oil/gas to combined cycle, retirement, coal selective catalytic reduction (SCR), coal scrubber, coal SNCR, or blank
Typical July Day NO _x	Typical July day NO _x emissions (tons/day)
Ash Content	Coal ash content (for fuel type - coal only)
Fuel Sum	5-month summer heat input (10^{12} Btu)
Fuel Tot	Annual heat input (10^{12} Btu)
NO _x Sum	5-month NO _x emissions (10^3 Ton)
NO _x Tot	Annual NO _x emissions (10^3 Ton)
SO ₂ Tot	Annual SO ₂ emissions (10^3 Ton)

2. County Identifiers

For those units with no county identifiers, counties available in cross-reference files developed for the NO_x State Implementation Plan (SIP) Call EGU file and other prior analyses were utilized to identify and assign the county code. Plants were matched to other inventories by State and plant name in some cases. Others were matched to Energy Information Administration (EIA)-860 planned unit files or to North American Electric Reliability Council reports to identify the county.

3. Latitude and Longitude

Latitude and longitude coordinates were assigned at the plant level and were taken from a data base file developed by Pechan. This file includes coordinates from other inventories, including the NET inventory and the Ozone Transport Assessment Group (OTAG) inventory, where units were matched to these inventories at the boiler or plant level. For units that have ORIS IDs that did match to this file, county centroids were assigned.

4. Universal Transverse Mercator (UTM) Coordinates

The UTM coordinates and zone corresponding to the latitude and longitude were determined by using a conversion program provided by EPA.

5. SCC

The SCC is needed to determine the appropriate emission rates to use for the additional pollutants and to incorporate default stack parameters for units that do not match to existing inventories. SCCs were assigned by first matching plant (ORISID) and unit (BLRID) identifiers to existing inventories and then by assigning SCCs based on the unit, fuel, firing, and bottom types. In cases where SCCs taken from other inventories indicate a fuel other than that specified in the IPM unit-level file, SCCs were updated based on the indicated fuel, unit, bottom, and firing types.

6. Stack Parameters

Stack parameters were added to the EGU file by matching to other inventories. For units where matches to other inventories could not be made, default parameters were assigned by SCC. These default parameters are shown in Table II-2. Stack flow rate, temperature, diameter, height, and velocity were quality assured using the ranges supplied by EPA (Stella, 2000); all stack flow values were then recalculated using the algorithm specified in a technical memorandum to EPA (Pechan-Avanti, 2000).

7. Emissions

Emissions of VOC, CO, PM₁₀, PM_{2.5}, and NH₃ were added to the inventory by applying average fuel-specific heat content and updated emission rates (based on updated AP-42

**Table II-2
HDDV Default Parameters for Utility Boilers**

SCC	Primary Fuel	PM₁₀ Rate (lbs/MMBtu)	CO Rate (lbs/MMBtu)	VOC Rate (lbs/MMBtu)	Stack Temp. (degrees F)	Stack Height (feet)	Stack Diameter (feet)	Stack Flow (ft³/sec)
10100101	Coal	0.0920*Ash ¹	0.0240	0.0028	175	570	24	16286
10100201	Coal	0.1000*Ash	0.0192	0.0015	175	570	24	16286
10100202	Coal	0.0885*Ash	0.0192	0.0023	175	570	24	16286
10100203	Coal	0.0100*Ash	0.0192	0.0042	175	570	24	16286
10100204	Coal	0.5077	0.1923	0.0019	175	570	24	16286
10100212	Coal	0.0885*Ash	0.0192	0.0023	175	570	24	16286
10100217	Coal	0.3000	0.6923	0.0019	175	570	24	16286
10100221	Coal	0.1000*Ash	0.0192	0.0015	175	570	24	16286
10100222	Coal	0.0885*Ash	0.0192	0.0023	175	570	24	16286
10100223	Coal	0.0100*Ash	0.0192	0.0042	175	570	24	16286
10100226	Coal	0.0885*Ash	0.0192	0.0023	175	570	24	16286
10100301	Coal	0.1298*Ash	0.0179	0.0050	175	570	24	16286
10100302	Coal	0.1643*Ash	0.0429	0.0050	175	570	24	16286
10100303	Coal	0.0621*Ash	0.0429	0.0050	175	570	24	16286
10100401	Oil	0.0393	0.0333	0.0051	300	290	12	3619
10100404	Oil	0.0393	0.0333	0.0051	300	290	12	3619
10100601	Gas	0.0018	0.0800	0.0052	300	280	12	2601
10100604	Gas	0.0018	0.0229	0.0052	300	280	12	2601
10101201	Waste	0.6648	0.0006	0.0769	175	570	24	16286
20100201	Gas	0.0419	0.1095	0.0010	300	280	12	2601
20100202	Gas	0.0095	0.3800	0.1105	300	280	12	2601

¹ Ash = coal ash content as a decimal; PM₁₀ rate is calculated by multiplying the number by the ash content of the coal.

uncontrolled emission factors) to the reported heat input for each unit. For PM₁₀ and PM_{2.5}, the reported ash content was also utilized along with control efficiency data obtained from other inventories. A default PM control efficiency of 90 percent was applied to all coal-fired units which did not match to other inventories. SOA emissions were added to the inventory. SOA emissions were calculated using fractional aerosol coefficients based on speciation of the VOC emissions (Grosjean and Seinfeld, 1989).

8. New Units

The IPM data sets provide projected heat input from new units by prime mover and fuel type. This projected heat input was divided into individual new units based on the model plant parameters shown in Table II-3. New units were then allocated to existing unit sites based on a hierarchy that avoids ozone nonattainment areas (Pechan-Avanti, 1997a). After siting the units, SCCs were assigned based on prime mover and fuel type. Default stack parameters and emissions were added using the same methods applied for existing units. Since the new units are defined as “new” after 1996, and 1998 data for new units were available, some new units could be matched to the 1998 data to obtain SCCs.

C. MASS EMISSIONS INVENTORY AND EMISSIONS PROCESSOR INPUT FILES

After adding the additional parameters to the IPM unit-level file, the final mass and modeling inventories were prepared. June and August daily heat input and emissions were added to the mass and EMS-95 files for ozone modeling (the IPM file contains July heat input and emissions). This was based on monthly percentage profiles by State, prime mover, and fuel provided by EPA (Stella, 1999). The 5-month (May through September) heat input was allocated to the month and then divided by the number of days in the month. Typical SSD emissions were allocated using the same procedure, assuming that the emission rate remained the same across these 5 months. Table II-4 documents the names of the EGU mass and modeling files. Because the 2020 IPM output file was used to represent EGU projections for 2030, the mass and modeling files for 2020 and 2030 are identical.

1. Mass Emission Inventory

The structure for the base year and projection year mass emission inventories is shown in Tables II-5 and II-6. The structures differ since the base year inventory was taken directly from the NET, while the projection year inventory was based on the IPM data set, which provides different information in some cases.

2. EPS 2.5 Emissions Processor Input Files

The EPS 2.5 emissions processor input files were derived directly from the mass emission files, utilizing the annual emissions. The structures for the base year and projection year files are shown in Tables II-7 and II-8.

3. EMS-95 Emissions Processor Input Files

The structure for the EGU EMS-95 emissions processor input files is identical to the non-EGU point source files as shown in Table III-10 in Chapter III. In order to eliminate potential duplicate identifiers, the letter “e” was added to all stack and segment IDs in the EGU EMS-95 input files.

A weekly profile code of 8 was utilized for all EGU sources, consistent with files prepared for the NO_x SIP Call analysis. This assumes operation 7 days a week, with slightly lower utilization on the weekends. A daily profile code of 33 was applied for all EGU sources.

**Table II-3
Model Plant Parameters for Projected New Utility Units by Type**

Plant Parameters	Combined		
	Cycle	Gas Turbine	Coal
Fuel Type	Natural Gas	Natural Gas	Coal
Unit Capacity (megawatts)	225	80	500
SCC	20100201	20100201	10100201
Stack Height [feet (ft)]	280	280	570
Stack Diameter (ft)	12	12	24
Stack Temperature (F)	300	300	175
Exhaust Gas Flow Rate (ft ³ /sec)	2,601	2,601	16,286
Stack Gas Velocity (ft/sec)	23	23	36

**Table II-4
EGU Mass and Emissions Processor Input Files**

Year	Mass	EPS 2.5	EMS95	Comments
1996	EG96MS3H.DBF	EG96EP2H.TXT	E696EM2H.TGZ	For EMS95, June day
			E796EM2H.TGZ	For EMS95, July day
			E896EM2H.TGZ	For EMS95, August day
2007	EG07MS2H.DBF	EG07EP2H.TXT	E607EM2H.TGZ	For EMS95, June day
			E707EM2H.TGZ	For EMS95, July day
			E807EM2H.TGZ	For EMS95, August day
2020	EG20MS2H.DBF	EG20EP2H.TXT	E620EM2H.TGZ	For EMS95, June day
			E720EM2H.TGZ	For EMS96, July day
			E820EM2H.TGZ	For EMS95, August day
2030	EG30MS2H.DBF	EG30EP2H.TXT	E630EM2H.TGZ	For EMS95, June day
			E730EM2H.TGZ	For EMS95, July day
			E830EM2H.TGZ	For EMS95, August day

**Table II-5
Structure for 1996 EGU Mass Emissions File**

Variable	Type	Length	Decimals	Description
YEAR	C	2	0	Year of Data
FIPSST	C	2	0	FIPS State Code
FIPSCNTY	C	3	0	FIPS County Code
PLANTID	C	15	0	State Plant ID
PLANTID5	C	5	0	State Plant ID (5 Digit)
POINTID	C	15	0	Point ID
POINTID5	C	5	0	Point ID (5 Digit)
STACKID	C	12	0	Stack ID
STACKID3	C	3	0	Stack ID (3 Digit)
ORISID	C	6	0	U.S. Department of Energy (DOE) Plant ID
BLRID	C	6	0	Boiler ID
SEGMENT	C	2	0	Segment ID
PLANT	C	40	0	Plant Name
SCC	C	10	0	SCC
STKHGT	N	4	0	Stack Height (ft)
STKDIAM	N	6	2	Stack Diameter (ft)
STKTEMP	N	4	0	Stack Temperature (degrees F)
STKFLOW	N	10	2	Stack Flow Rate (cubic feet per second)
STKVEL	N	9	2	Stack Velocity (ft/sec)
BOILCAP	N	8	2	Boiler Design Capacity
CAP_UNITS	C	1	0	Capacity Unit Code
WINTHRU	N	3	0	Winter Thruput (%)
SPRTHRU	N	3	0	Spring Thruput (%)
SUMTHRU	N	3	0	Summer Thruput (%)
FALTHRU	N	3	0	Fall Thruput (%)
HOURS	N	2	0	Hours per Day
START_HR	N	2	0	Hourly Start Time
DAYS	N	1	0	Days per Week
WEEKS	N	2	0	Weeks per Year
THRUPUT	N	11	1	Throughput Rate (SCC units/year)
MAXRATE	N	12	3	Maximum Ozone Season Rate (units/day)
HEATCON	N	8	2	Heat Content (MMBtu/SCC unit)
SULFCON	N	5	2	Sulfur Content (mass percent)
ASHCON	N	5	2	Ash Content (mass percent)
NETDC	N	9	3	Maximum Nameplate Capacity (MW)
SIC	N	4	0	Standard Industrial Classification (SIC) Code
LATC	N	9	4	Latitude (degrees)
LONC	N	9	4	Longitude (degrees)
VOC_EMF	N	11	4	VOC Emission Factor (SCC units)

Table II-5 (continued)

Variable	Type	Length	Decimals	Description
NOX_EMF	N	11	4	NO _x Emission Factor (SCC units)
CO_EMF	N	11	4	CO Emission Factor (SCC units)
SO2_EMF	N	11	4	SO ₂ Emission Factor (SCC units)
PM10_EMF	N	11	4	PM ₁₀ Emission Factor (SCC units)
PM25_EMF	N	11	4	PM _{2.5} Emission Factor (SCC units)
NH3_EMF	N	11	4	NH ₃ Emission Factor (SCC units)
VOC_CE	N	7	2	VOC Control Efficiency (%)
NOX_CE	N	7	2	NO _x Control Efficiency (%)
CO_CE	N	7	2	CO Control Efficiency (%)
SO2_CE	N	7	2	SO ₂ Control Efficiency (%)
PM10_CE	N	7	2	PM ₁₀ Control Efficiency (%)
PM25_CE	N	7	2	PM _{2.5} Control Efficiency (%)
NH3_CE	N	7	2	NH ₃ Control Efficiency (%)
VOC_CPRI	N	3	0	VOC Primary Control Equipment Code
NOX_CPRI	N	3	0	NO _x Primary Control Equipment Code
CO_CPRI	N	3	0	CO Primary Control Equipment Code
SO2_CPRI	N	3	0	SO ₂ Primary Control Equipment Code
PM10_CPRI	N	3	0	PM ₁₀ Primary Control Equipment Code
PM25_CPRI	N	3	0	PM _{2.5} Primary Control Equipment Code
NH3_CPRI	N	3	0	NH ₃ Primary Control Equipment Code
VOC_CSEC	N	3	0	VOC Secondary Control Equipment Code
NOX_CSEC	N	3	0	NO _x Secondary Control Equipment Code
CO_CSEC	N	3	0	CO Secondary Control Equipment Code
SO2_CSEC	N	3	0	SO ₂ Secondary Control Equipment Code
PM10_CSEC	N	3	0	PM ₁₀ Secondary Control Equipment Code
PM25_CSEC	N	3	0	PM _{2.5} Secondary Control Equipment Code
NH3_CSEC	N	3	0	NH ₃ Secondary Control Equipment Code
VOC_ANN	N	13	4	Annual VOC (tons)
NOX_ANN	N	13	4	Annual NO _x (tons)
CO_ANN	N	13	4	Annual CO (tons)
SO2_ANN	N	13	4	Annual SO ₂ (tons)
PM10_ANN	N	13	4	Annual PM ₁₀ (tons)
PM25_ANN	N	13	4	Annual PM _{2.5} (tons)
SOA_ANN	N	13	4	Annual SOA (tons)
NH3_ANN	N	13	4	Annual NH ₃ (tons)
VOC_OSD06	N	13	4	June Day VOC (tons)
NOX_OSD06	N	13	4	June Day NO _x (tons)
CO_OSD06	N	13	4	June Day CO (tons)
SO2_OSD06	N	13	4	June Day SO ₂ (tons)
PM10_OSD06	N	13	4	June Day PM ₁₀ (tons)

Table II-5 (continued)

Variable	Type	Length	Decimals	Description
PM25_OSD06	N	13	4	June Day PM _{2.5} (tons)
SOA_OSD06	N	13	4	June Day SOA (tons)
NH3_OSD06	N	13	4	June Day NH ₃ (tons)
VOC_OSD07	N	13	4	July Day VOC (tons)
NOX_OSD07	N	13	4	July Day NO _x (tons)
CO_OSD07	N	13	4	July Day CO (tons)
SO2_OSD07	N	13	4	July Day SO ₂ (tons)
PM10_OSD07	N	13	4	July Day PM ₁₀ (tons)
PM25_OSD07	N	13	4	July Day PM _{2.5} (tons)
SOA_OSD07	N	13	4	July Day SOA (tons)
NH3_OSD07	N	13	4	July Day NH ₃ (tons)
VOC_OSD08	N	13	4	August Day VOC (tons)
NOX_OSD08	N	13	4	August Day NO _x (tons)
CO_OSD08	N	13	4	August Day CO (tons)
SO2_OSD08	N	13	4	August Day SO ₂ (tons)
PM10_OSD08	N	13	4	August Day PM ₁₀ (tons)
PM25_OSD08	N	13	4	August Day PM _{2.5} (tons)
SOA_OSD08	N	13	4	August Day SOA (tons)
NH3_OSD08	N	13	4	August Day NH ₃ (tons)
VOC_RE	N	3	0	VOC Rule Effectiveness (%)
NOX_RE	N	3	0	NO _x Rule Effectiveness (%)
CO_RE	N	3	0	CO Rule Effectiveness (%)
SO2_RE	N	3	0	SO ₂ Rule Effectiveness (%)
PM10_RE	N	3	0	PM ₁₀ Rule Effectiveness (%)
PM25_RE	N	3	0	PM _{2.5} Rule Effectiveness (%)
NH3_RE	N	3	0	NH ₃ Rule Effectiveness (%)

**Table II-6
Structure for 2007, 2020, and 2030 EGU Mass Emissions Files**

Variable	Type	Length	Decimals	Description
FIPSST	C	2	0	FIPS State Code
FIPSCNTY	C	3	0	FIPS County Code
PLANTID	C	15	0	State Plant ID
POINTID	C	15	0	Point ID
STACKID	C	12	0	Stack ID
SEGMENT	C	2	0	Segment ID
ORISID	C	6	0	DOE 4-Digit ORIS Plant Code
BLRID	C	6	0	Boiler ID
PLANT	C	40	0	Plant Name
SCC	C	10	0	SCC
STKHGT	N	4	0	Stack Height (ft)
STKDIAM	N	6	2	Stack Diameter (ft)
STKTEMP	N	4	0	Stack Temperature (degrees F)
STKFLOW	N	10	2	Stack Flow Rate (cubic feet per second)
STKVEL	N	9	2	Stack Velocity (ft/sec)
BOILCAP	N	8	2	Boiler Design Capacity
LAT	N	9	4	Latitude (degrees)
LON	N	9	4	Longitude (degrees)
UTMEAST	N	9	2	UTM Horizontal (kilometers)
UTMNORTH	N	9	2	UTM Vertical (kilometers)
UTMZONE	N	2	0	UTM Zone
ANNHEAT	N	9	0	Annual Heat Input (MMBtu)
WINHEAT	N	9	0	7-Month Winter Heat Input (MMBtu)
SUMHEAT	N	9	0	5-Month Summer Heat Input (MMBtu)
JUNDHEAT	N	9	0	June Daily Heat Input (MMBtu)
JULDHEAT	N	9	0	July Daily Heat Input (MMBtu)
AUGDHEAT	N	9	0	August Daily Heat Input (MMBtu)
VOC_ANN	N	10	4	Annual VOC (tons)
VOC_WIN	N	10	4	7-Month Winter VOC (tons)
VOC_SUM	N	10	4	5-Month Summer VOC (tons)
VOC_OSD06	N	10	4	June Day VOC (tons)
VOC_OSD07	N	10	4	July Day VOC (tons)
VOC_OSD08	N	10	4	August Day VOC (tons)
NOX_ANN	N	10	4	Annual NO _x (tons)
NOX_WIN	N	10	4	7-Month Winter NO _x (tons)
NOX_SUM	N	10	4	5-Month Summer NO _x (tons)
NOX_OSD06	N	10	4	June Day NO _x (tons)
NOX_OSD07	N	10	4	July Day NO _x (tons)
NOX_OSD08	N	10	4	August Day NO _x (tons)
CO_ANN	N	10	4	Annual CO (tons)
CO_WIN	N	10	4	7-Month Winter CO (tons)

Table II-6 (continued)

Variable	Type	Length	Decimals	Description
CO_SUM	N	10	4	5-Month Summer CO (tons)
CO_OSD06	N	10	4	June Day CO (tons)
CO_OSD07	N	10	4	July Day CO (tons)
CO_OSD08	N	10	4	August Day CO (tons)
SO2_ANN	N	10	4	Annual SO ₂ (tons)
SO2_WIN	N	10	4	7-Month Winter SO ₂ (tons)
SO2_SUM	N	10	4	5-Month Summer SO ₂ (tons)
SO2_OSD06	N	10	4	June Day SO ₂ (tons)
SO2_OSD07	N	10	4	July Day SO ₂ (tons)
SO2_OSD08	N	10	4	August Day SO ₂ (tons)
PM10_ANN	N	10	4	Annual PM ₁₀ (tons)
PM10_WIN	N	10	4	7-Month Winter PM ₁₀ (tons)
PM10_SUM	N	10	4	5-Month Summer PM ₁₀ (tons)
PM10_OSD06	N	10	4	June Day PM ₁₀ (tons)
PM10_OSD07	N	10	4	July Day PM ₁₀ (tons)
PM10_OSD08	N	10	4	August Day PM ₁₀ (tons)
PM25_ANN	N	10	4	Annual PM _{2.5} (tons)
PM25_WIN	N	10	4	7-Month Winter PM _{2.5} (tons)
PM25_SUM	N	10	4	5-Month Summer PM _{2.5} (tons)
PM25_OSD06	N	10	4	June Day PM _{2.5} (tons)
PM25_OSD07	N	10	4	July Day PM _{2.5} (tons)
PM25_OSD08	N	10	4	August Day PM _{2.5} (tons)
NH3_ANN	N	10	4	Annual NH ₃ (tons)
NH3_WIN	N	10	4	7-Month Winter NH ₃ (tons)
NH3_SUM	N	10	4	5-Month Summer NH ₃ (tons)
NH3_OSD06	N	10	4	June Day NH ₃ (tons)
NH3_OSD07	N	10	4	July Day NH ₃ (tons)
NH3_OSD08	N	10	4	August Day NH ₃ (tons)
SOA_ANN	N	10	4	Annual SOA (tons)
SOA_WIN	N	10	4	7-Month Winter SOA (tons)
SOA_SUM	N	10	4	5-Month Summer SOA (tons)
SOA_OSD06	N	10	4	June Day SOA (tons)
SOA_OSD07	N	10	4	July Day SOA (tons)
SOA_OSD08	N	10	4	August Day SOA (tons)

**Table II-7
1996 EGU EPS 2.5 Emissions Processor Input File Structure**

Variable	Type	Length	Decimals	Description
FIPSST	C	2	0	FIPS State Code
FIPSCNTY	C	3	0	FIPS County Code
PLANTID	C	5	0	State Plant ID
POINTID	C	5	0	Point ID
SIC	N	4	0	SIC Code
STACKID	C	3	0	Stack ID
SEGMENT	C	2	0	Segment ID
SCC	C	8	0	SCC
STKHGT	N	4	0	Stack Height (ft)
STKDIAM	N	6	2	Stack Diameter (ft)
STKTEMP	N	4	0	Stack Temperature (degrees F)
STKFLOW	N	10	2	Stack Flow Rate (cubic feet per second)
WINTHRU	N	3	0	Winter Thruput (%)
SPRTHRU	N	3	0	Spring Thruput (%)
SUMTHRU	N	3	0	Summer Thruput (%)
FALTHRU	N	3	0	Fall Thruput (%)
HOURS	N	2	0	Hours per Day
DAYS	N	1	0	Days per Week
WEEKS	N	2	0	Weeks per Year
LATC	N	9	4	Latitude (degrees)
LONC	N	9	4	Longitude (degrees)
VOC	N	9	3	Annual VOC (tons)
NOX	N	9	3	Annual NO _x (tons)
CO	N	9	3	Annual CO (tons)
SO2	N	9	3	Annual SO ₂ (tons)
PM10	N	9	3	Annual PM ₁₀ (tons)
PM25	N	9	3	Annual PM _{2.5} (tons)
SOA	N	9	3	Annual SOA (tons)
NH3	N	9	3	Annual NH ₃ (tons)

**Table II-8
2007, 2020, and 2030 EGU EPS 2.5 Emissions Processor Input File Structure**

Variable	Type	Length	Decimals	Description
ORISID	C	6		ORIS Plant ID
BLRID	C	6		ORIS Boiler ID
SEGMENT	C	2		Segment ID
STACKID	C	6		Stack ID
STKHGT	N	4	0	Stack Height (ft)
STKDIAM	N	6	2	Stack Diameter (ft)
STKTEMP	N	4	0	Stack Temperature (degrees F)
STKFLOW	N	10	2	Stack Flow Rate (cubic feet per second)
IPMCAP	N	9	1	IPM Boiler Capacity (MW)
SCC	C	8		SCC
FIPSST	C	2		FIPS State Code
FIPSCNTY	C	3		FIPS County Code
LATC	N	9	4	Latitude (degrees)
LONGC	N	9	4	Longitude (degrees)
WINHEAT	N	9	3	Winter Heat Input (trillion Btu/7 months)
SUMHEAT	N	9	3	Summer Heat Input (trillion Btu/5 months)
WINVOC	N	9	3	Winter VOC (tons)
SUMVOC	N	9	3	Summer VOC (tons)
WINNOX	N	9	3	Winter NO _x (tons)
SUMNOX	N	9	3	Summer NO _x
WINCO	N	9	3	Winter CO
SUMCO	N	9	3	Summer CO
WINSO2	N	9	3	Winter SO ₂
SUMSO2	N	9	3	Summer SO ₂
WINPM10	N	9	3	Winter PM ₁₀
SUMPM10	N	9	3	Summer PM ₁₀
WINPM2.5	N	9	3	Winter PM _{2.5}
SUMPM2.5	N	9	3	Summer PM _{2.5}
WINNH3	N	9	3	Winter NH ₃
SUMNH3	N	9	3	Summer NH ₃
WINSOA	N	9	3	Winter SOA
SUMSOA	N	9	3	Summer SOA
PNAME	C	30		Plant Name

CHAPTER III NON-EGU POINT SOURCES

A. 1996 BASE YEAR MASS EMISSIONS INVENTORY

The 1996 base year inventory for non-EGUs is the 1996 NET point source inventory Version 3.12 (EPA, 2000a). This inventory includes both annual and typical summer season day (SSD) emissions for NO_x, VOC, CO, SO_x, PM₁₀, PM_{2.5}, and NH₃. SOA emissions were added to the inventory by applying fractional aerosol coefficients based on speciation of VOC emissions (Grosjean and Seinfeld, 1989). Inventory records with SCCs of 101xxxxx and 201xxxxx were excluded from the non-EGU inventory because they are included in the EGU inventory.

Latitude and longitude coordinates and stack parameters were corrected for several sources. For some sources, multiple SCCs were listed under a single point, stack, and segment. New non-duplicate segment IDs were created for the mass emissions file to ensure that each record had a unique identification code for inclusion in the emissions processor input files.

B. 2007, 2020, AND 2030 FUTURE YEAR MASS EMISSIONS INVENTORIES

Future year base case emissions for 2007, 2020, and 2030 were grown from the 1996 base year mass emission inventory utilizing Bureau of Economic Analysis (BEA) Gross State Product (GSP) growth factors at the State level by 2-digit Standard Industrial Classification (SIC) code. Control measures reflecting Clean Air Act (CAA) requirements were then incorporated. Two separate mass emissions inventories were created for each year to reflect emissions without and with the effects of the NO_x SIP Call control requirements.

1. Growth Assumptions

The 1995 BEA GSP projections (BEA, 1995) by 2-digit SIC code were applied to estimate changes in activity between 1996 and 2007, 2020, and 2030 for the non-EGU point source sector. For fuel combustion sectors, energy adjustment factors were also applied to the base year emission inventory. After applying the changes in activity, additional controls were added to reflect the alternative scenarios.

EPA guidance for projecting emissions (EPA, 1991) lists the following economic variables (in order of preference) for projecting emissions:

- product output;
- value added;
- earnings; and
- employment.

In the absence of product output projections, EPA guidance recommends value added projections. *Value added* is the difference between the value of industry outputs and inputs. BEA GSP projections represent a measure of value added, and are a fuller measure of growth than BEA's earnings projections because earnings represents only one component of GSP. GSP reflects the difference between revenues from selling a product and the amounts paid for inputs from other industries. By incorporating inputs to production, GSP reflects future changes in production processes, efficiency, and technological changes. A comparison of BEA's 1995 GSP projections and BEA's 1990 earnings projections indicates that GSP growth factors are slightly higher than the earnings data. This is most often true for capital-intensive industries (e.g., manufacturing) than for labor-intensive industries (e.g., services). Components of GSP include payments to capital. This is an important distinction to make because it implicitly reflects the effect of factor substitution in production. As discussed in EPA's projections guidance, factor substitution should be included in growth projections, making value added data preferable to earnings data for projecting emissions.

The 1995 BEA industry GSP projections by State are available at the 2-digit SIC code level. For each record in the non-EGU point source 1996 base year inventory, a link was established between the State FIPS code, the SIC code, and the applicable BEA GSP growth factor. National BEA GSP annual growth rates by industry are listed in Table III-1.

For fuel combustion sources, factors were applied to the 1996 base year emissions to account for improvements in energy efficiency between 1996 and 2007, 2020, and 2030. These factors, developed from the U.S. Department of Energy (DOE) publication *Annual Energy Outlook 1999*, account for increases in fuel and process efficiency in future years (DOE, 1998). Basically, less fuel will be needed to provide the same amount of energy (generally in the form of steam) to an industrial process and the amount of energy needed per unit output will also decrease as processes become more efficient. For example, DOE projects natural gas consumption in the commercial sector to rise from 3.392 quadrillion Btu in 1996 to 3.997 quadrillion Btu in 2020. Over this same time-frame, DOE projects commercial building square footage to increase from 59.5 billion square feet to 72.9 billion square feet. To reflect the projected change in natural gas consumed per square foot of commercial building space, natural gas energy intensity factors were calculated for 1996 and each projection year. For example, 0.2475 quadrillion Btu/square foot of natural gas is projected to be consumed in 2020 versus 0.2551 quadrillion Btu/square foot in 1996. For all commercial sector natural gas source categories, the BEA commercial sector growth factors are multiplied by 0.97, which represents the ratio of the 2020 energy intensity factor for commercial sector natural gas to the 1996 energy intensity factor for commercial natural gas. Similar ratios were calculated and applied for other fuels used in the commercial sector, and for all fuels used in the residential and industrial energy sectors. These adjustments were based on those used in the NET inventory projections (EPA, 2000a).

**Table III-1
BEA National GSP Growth Forecasts**

Industry (SIC Code)	Annual Growth (% per year) 1996 to 2007	Annual Growth (% per year) 1996 to 2020	Annual Growth (% per year) 1996 to 2030
All-Industry Total			
Farm (01)	1.8	1.5	1.2
Nonfarm (02)	1.8	1.5	1.2
Agricultural services (07, 08, 09)	3.8	3.2	2.7
Mining (10, 12, 13, 14)			
Metal mining (10)	3.2	2.7	2.3
Coal mining (12)	2.6	2.1	1.7
Oil and gas extraction (13)	0.1	0.2	0.3
Nonmetallic minerals (14)	1.3	1.2	1.1
Construction (15, 16, 17)	1.2	1.1	1.0
Manufacturing (20 - 39)			
Durable goods			
Lumber and wood products (24)	0.6	0.7	0.7
Furniture and fixtures (25)	1.6	1.4	1.3
Stone, clay, and glass products (32)	0.8	0.9	0.9
Primary metals (33)	0.4	0.5	0.5
Fabricated metals (34)	0.7	0.8	0.8
Industrial machinery (35)	3.3	2.6	2.1
Electronic equipment (36)	2.2	1.9	1.6
Motor vehicles and equipment (371)	1.1	1.0	1.0
Other transportation equipment (37, excluding 371)	2.3	2.0	1.8
Instruments and related products (38)	1.3	1.3	1.3
Miscellaneous manufacturing (39)	1.8	1.6	1.4
Nondurable Goods			
Food and kindred products (20)	1.2	1.1	1.1
Tobacco products (21)	-3.0	-2.5	-2.2
Textile mill products (22)	1.1	1.0	1.0
Apparel and other textile products (23)	1.6	1.4	1.2
Paper products (26)	2.0	1.8	1.6
Printing and publishing (27)	0.6	0.7	0.7
Chemicals and allied products (28)	1.4	1.3	1.3
Petroleum and coal products (29)	1.1	1.1	1.1
Rubber and plastics products (30)	2.9	2.5	2.2
Leather and leather products (31)	-0.1	-0.1	-0.1

Table III-1 (continued)

Industry (SIC Code)	Annual Growth (% per year) 1996 to 2007	Annual Growth (% per year) 1996 to 2020	Annual Growth (% per year) 1996 to 2030
Transportation and Public Utilities (40 - 49)			
Railroad transportation (40)	3.0	2.4	2.0
Local and interurban transit (41)	1.4	1.3	1.3
Trucking and warehousing (42)	2.1	1.8	1.6
Water transportation (44)	0.1	0.3	0.4
Transportation by air (45)	3.3	2.8	2.4
Pipelines (46)	1.0	0.9	0.8
Transportation services (47)	2.9	2.4	2.1
Communications (48)	2.8	2.4	2.1
Utilities (49)	1.9	1.7	1.5
Wholesale and Retail Trade (50 - 59)			
Wholesale trade (50, 51)	2.4	2.1	1.8
Retail trade (52 - 59)	2.1	1.8	1.6
Finance, Insurance, and Real Estate (60 - 67)			
Banks and investment (60, 61, 62, 67)	2.8	2.3	2.0
Insurance (63, 64)	1.8	1.7	1.6
Real estate (65)	2.0	1.8	1.6
Services (70 - 89)			
Hotels and other lodging (70)	2.1	1.9	1.7
Personal services (72)	1.0	0.9	0.9
Business services (73)	2.9	2.4	2.0
Auto repair and parking (75)	1.7	1.5	1.3
Amusement (79)	2.9	2.4	2.1
Health services (80)	2.3	2.0	1.8
Legal services (81)	1.5	1.3	1.2
Educational services (82)	1.8	1.6	1.5
Social services (83)	2.8	2.3	2.0
Private households (88)	0.9	0.8	0.8
Other services (84, 86, 89)	2.7	2.3	2.0
Government			
Federal, civilian	0.3	0.4	0.5
Federal, military	-0.1	0.2	0.4
State and local	1.4	1.3	1.2
Population	0.9	0.8	0.8

SOURCE: Developed from BEA, 1995.

2. Control Assumptions

Since the base year inventory for this effort is 1996, reasonably available control technology (RACT) requirements were assumed to have already been implemented. So, for stationary sources, CAA controls include Federal initiatives as shown in Table III-2 for point sources. Maximum achievable control technology (MACT) controls were also included as shown in Tables III-3 and III-4.

NO_x emissions for the 23 States (22 States plus the District of Columbia) covered by the NO_x SIP Call were also reduced to reflect the NO_x SIP Call requirements. The NO_x SIP Call controls were applied to the 2007 base case inventory. For the 2020 and 2030 base case inventories, sources affected by the NO_x SIP Call were capped at 2007 emission levels.

The NO_x SIP Call was modeled by first identifying the sources in the 1996 NET inventory which are large, and are within the source categories covered under the SIP Call. This procedure was performed by first matching the non-EGU point sources in the 1996 NET inventory file with the large sources in the NO_x SIP Call data base. This was computer matching that required that the numeric identifiers in each file be identical at the State, county, plant, and point level. After this exercise was performed, there were 633 sources in the 1996 NET inventory that were identified as large sources affected by the NO_x SIP Call. Because this included less than 30 percent of the 2,216 large sources in the NO_x SIP Call control region, additional steps were taken to identify the remaining large, affected sources in the 1996 NET non-EGU point source file. These steps were applied separately to the four major source categories that are affected by the SIP Call, as follows:

1. For boilers, all sources in the SIP Call-affected States with a boiler design capacity in the 1996 NET file greater than or equal to 250 million British thermal units (MMBtu) were deemed to be large sources.
2. For turbines, all sources in the SIP Call-affected States with a boiler design capacity in the 1996 NET file greater than or equal to 250 MMBtu were tagged as large sources.
3. For IC engines, all sources with 1996 NO_x emissions greater than 1 ton per day were tagged as large sources.
4. For cement manufacturing, all sources with 1996 NO_x emissions greater than 1 ton per day were tagged as large sources.

Once the large sources were determined, the following percentages were applied according to the source category affected:

Industrial Boilers	60%
Gas Turbines	60%
Internal Combustion Engines	90%
Cement Manufacturing	30%

Multiple estimates of NO_x emissions were supplied in the modeling files for non-EGU point sources to account for with and without SIP Call cases, and to reflect ozone versus non-ozone season emission differences for the NO_x controls expected to be operating only during the 5-

month ozone season. The typical SSD emission estimates incorporate the effects of NO_x SIP Call controls. Annual NO_x emission estimates are the sum of 5-month ozone season NO_x emissions, plus 7-month (October-April) NO_x emissions. Table III-5 shows the source types affected by the NO_x SIP Call and describes which controls were applied to each source type. For the source categories that are affected by the NO_x SIP Call, non-ozone season emissions were estimated using the same control percentages listed above if the dominant source type for that control device is expected to be one that provides year-round emission reductions. For seasonal controls, such as selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) applications to industrial boilers and cement kilns, NO_x controls were not applied during the 7-month non-ozone season when NO_x emissions were estimated. Table III-5 lists the primary NO_x control technology assumed for each category.

**Table III-2
Point Source CAA Baseline Control Assumptions**

Source Category	Pollutant	Control Efficiency (%)*
National Rules		
Marine vessel loading: petroleum liquids	VOC	80
Treatment, storage, and disposal facilities (TSDFs)	VOC	96
Municipal solid waste landfills	VOC	82

NOTE: *From uncontrolled levels.

**Table III-3
Point Source MACT Control Assumptions**

Source Category	VOC Control Efficiency (%)*
Benzene National Emission Standards for Hazardous Air Pollutants (NESHAP) (national)	
By-product coke mfg	85
By-product coke - flushing-liquor circulation tank	95
By-product coke - excess-NH ₃ liquor tank	98
By-product coke mfg. - tar storage	98
By-product coke mfg. - light oil sump	98
By-product coke mfg. - light oil dec/cond vents	98
By-product coke mfg. - tar bottom final cooler	81
By-product coke mfg. - naphthalene processing	100
By-product coke mfg. - equipment leaks	83
By-product coke manufacture - other	94
By-product coke manufacture - oven charging	94
Coke ovens - door and topside leaks	94
Coke oven by-product plants	94
2-Year MACT (national)	
Synthetic Organic Chemical Manufacturing Industry (SOCMI) Hazardous Organic NESHAP (HON)	
- SOCMI processes	79
- Volatile organic liquid storage	95
- SOCMI fugitives (equipment leak detection and repair)	60
- SOCMI wastewater	0
- Ethylene oxide manufacture	98
- Phenol manufacture	98
- Acrylonitrile manufacture	98
- Polypropylene manufacture	98
- Polyethylene manufacture	98
- Ethylene manufacture	98
Dry Cleaning	
- Perchloroethylene	95
- Other	70
4-Year MACT (national)	
TSDFs (offsite waste operations)	96
Shipbuilding and repair	24
Polymers and resins II	78
Polymers and resins IV	70
Styrene-butadiene rubber manufacture (polymers & resins group I)	70
Wood furniture surface coating	30
Aircraft surface coating (aerospace)	60
Petroleum Refineries: other sources	
- Fixed roof petroleum product tanks	98
- Fixed roof gasoline tanks	96
- External floating roof petroleum product tanks	90
- External floating roof gasoline tanks	95
- Petroleum refinery wastewater treatment	72
- Petroleum refinery fugitives	72
- Petroleum refineries - Blowdown w/o control	78
- Vacuum distillation	72

Table III-3 (continued)

Source Category	VOC Control Efficiency (%)*
Halogenated Solvent Cleaners	
– Open top degreasing - halogenated	63
– In-line (conveyorized) degreasing - halogenated	39
Printing	
– Flexographic	32
– Gravure	27
Gasoline Marketing	
– Storage	5
– Splash loading	99
– Balanced loading	87
– Submerged loading	99
– Transit	5
– Leaks	39
7/10-Year MACT (national)	
Paint and varnish manufacture	35
Rubber tire manufacture	70
Green tire spray	90
Automobile surface coating	79
Beverage can surface coating	57
Paper surface coating	78
Flatwood surface coating	90
Fabric printing	80
Metal surface coating	90
Plastic parts surface coating	45
Pulp and paper production	70
Agricultural chemical production	79
Pharmaceutical production	79
Polyesters	70
Fabric coating	70
Petroleum refineries - fluid catalytic cracking	70
Oil and natural gas production	90
Explosives	70
Plywood/particle board	70
Reinforced plastics	70
Publicly-Owned Treatment Works (POTWs)	70
Phthalate plasticizers	70
Polymers and resins III	78
Rayon production	70
Polyvinyl chloride	70
Spandex production	70
Nylon 6 production	70
Alkyd resins	70
Polyester resins	70
Chelating agents	70

NOTE: *From uncontrolled levels.

**Table III-4
Non-VOC Related MACT Assumptions**

Source Category	Pollutant	Percentage Reduction (%)*
Municipal Waste Combustors	PM	30
	SO ₂	50
Cement Manufacturing	PM	90
Secondary Aluminum	PM	90
Medical Waste Incineration	PM	88
	NO _x	20
	SO ₂	20
Hazardous Waste Incineration	PM	36

NOTE: *From uncontrolled levels.

**Table III-5
NO_x SIP Call Control Application**

Source Type Description	NO _x Control	Cost Pod Number	Cost Pod Name	Cost Pod Fuel Type
Year-round application				
Industrial Boilers (non-coal)	LNB and LNB plus flue gas recirculation	15	ICI Boilers	Residual Oil
		16	ICI Boilers	Distillate Oil
		17	ICI Boilers	Natural Gas
		41	ICI Boilers	Process Gas
		42	ICI Boilers	Coke
		43	ICI Boilers	LPG
Turbines	LNB plus water injection	23	Gas Turbines	Oil
		24	Gas Turbines	Natural Gas
		50	Gas Turbines	Jet Fuel
Cement Kilns (wet)	Mid-kiln firing	34	Cement Mfg. (wet)	NA
Reciprocating IC Engines	Low emission combustion	21	IC Engines	Oil
		22	IC Engines	Gas
		46	IC Engines	Gas, Diesel, LPG
Cement Kilns (dry)	Mid-kiln firing	33	Cement Mfg. (dry)	NA
5-month ozone season application				
Industrial Boilers (coal)	SCR or SNCR	11	ICI Boilers	Coal/Wall
		12	ICI Boilers	Coal/FBC
		13	ICI Boilers	Coal/Stoker
		14	ICI Boilers	Coal/Cyclone
Cement Kilns (coal)	SCR or SNCR	81	Cement Kiln	Coal

Notes: LNB = low-NO_x burners; ICI = industrial, commercial, and institutional; LPG = liquified petroleum gas; NA = not applicable; SCR = selective catalytic reduction; and SNCR = selective non-catalytic reduction.

C. MASS EMISSIONS INVENTORY AND EMISSIONS PROCESSOR INPUT FILES

Three new variables were added to the structures of the mass emissions inventories. Unique 5 character IDs for plant and point, and unique 3 character IDs for stack were added to facilitate the transition from mass to emissions processor input files. Table III-6 documents the names of the non-EGU mass and emissions processor input files.

1. Mass Emission Inventories

The structures for the mass emission inventories are detailed in Tables III-7 and III-8, as the base year and future year inventories differed. Data elements included in the base year inventory and excluded from the future year inventories include the pollutant emission factor (-EMF), primary control equipment code (-CPRI), and secondary control equipment code (-CSEC).

2. EPS 2.5 Emissions Processor Input Files

The EPS 2.5 emissions processor input file structure is detailed in Table III-9. Input files for EPS 2.5 limit the width of plant and point IDs to 5 characters, so the unique 5-character IDs were used in the EPS 2.5 input files. The unique 3-character IDs for stack were also used because of limitations on the data field width for stack ID.

3. EMS-95 Emissions Processor Input Files

The EMS-95 emissions processor input files include typical SSD VOC, NO_x, and CO emissions for ozone modeling. The EMS-95 input file structure is detailed in Table III-10. Universal Transverse Mercator (UTM) coordinates were added to the EMS-95 input files to account for input requirements of the model. The future year emissions files contain the effects of the NO_x SIP Call control requirements since only SSD emissions are provided in the EMS-95 input files.

A weekly profile code of 8 was utilized for all non-EGU sources, consistent with files prepared for the NO_x SIP Call analysis. This assumes operation 7 days a week, with slightly lower utilization on the weekends.

**Table III-6
Non-EGU Point Source Mass and Emissions Processor Input Files**

Year	Mass	EPS 2.5	EMS-95	Comments
1996	PT96MS2H.DBF	PT96EP1H.TXT	PT96EM1H.TGZ	
2007	PT7MS1H1.DBF PT07MS2H.DBF	PT07EP2H.TXT	PT07EM2H.TGZ	Excludes NO _x SIP Call Controls. Includes typical summer season day (SSD), 5-month, 7-month, and annual emissions. SSD and 5-month emissions include NO _x SIP Call controls. Annual emissions are sum of 5- and 7-month emissions.
2020	PT2MS1H1.DBF PT2MS2H2.DBF	PT2EP2H2.TXT	PT2EM2H2.TGZ	Excludes NO _x SIP Call Controls. Includes typical SSD, 5-month, 7-month, and annual emissions. SSD and 5-month emissions include NO _x SIP Call controls. Annual emissions are sum of 5- and 7-month emissions.
2030	PT3MS1H1.DBF PT3MS2H2.DBF	PT3EP2H2.TXT	PT3EM2H2.TGZ	Excludes NO _x SIP Call Controls. Includes typical SSD, 5-month, 7-month, and annual emissions. SSD and 5-month emissions include NO _x SIP Call controls. Annual emissions are sum of 5- and 7-month emissions.

**Table III-7
Structure for 1996 Base Year Non-EGU Mass Emissions File**

Variable	Type	Length	Decimals	Description
FIPSST	C	2	0	FIPS State Code
FIPSCNTY	C	3	0	FIPS County Code
PLANTID	C	15	0	State Plant ID
POINTID	C	15	0	Point ID
STACKID	C	12	0	Stack ID
SEGMENT	C	2	0	Segment ID
ORISID	C	6	0	DOE Plant ID
BLRID	C	6	0	Boiler ID
PLANT	C	40	0	Plant Name
SCC	C	10	0	SCC
UTMEAST	N	9	3	UTM easting (km)
UTMNORTH	N	9	3	UTM northing (km)
UTMZONE	N	9	3	UTM zone
STKHGT	N	4	0	Stack Height (ft)
STKDIAM	N	6	2	Stack Diameter (ft)
STKTEMP	N	4	0	Stack Temperature (degrees F)
STKFLOW	N	10	2	Stack Flow Rate (cubic feet per second)
STKVEL	N	9	2	Stack Velocity (ft/sec)
BOILCAP	N	8	2	Boiler Design Capacity (MMBtu/hour)
CAP_UNITS	C	1	0	Capacity Unit Code
WINTHRU	N	3	0	Winter Thruput (%)
SPRTHRU	N	3	0	Spring Thruput (%)
SUMTHRU	N	3	0	Summer Thruput (%)
FALTHRU	N	3	0	Fall Thruput (%)
HOURS	N	2	0	Hours per Day
START_HR	N	2	0	Hourly Start Time
DAYS	N	1	0	Days per Week
WEEKS	N	2	0	Weeks per Year
THRUPUT	N	11	1	Throughput Rate (SCC units/year)
MAXRATE	N	12	3	Maximum Ozone Season Rate (units/day)
HEATCON	N	8	2	Heat Content (MMBtu/SCC unit)
SULFCON	N	5	2	Sulfur Content (mass percent)
ASHCON	N	5	2	Ash Content (mass percent)
NETDC	N	9	3	Maximum Nameplate Capacity (MW)
SIC	N	4	0	SIC Code
LATC	N	9	4	Latitude (degrees)
LONC	N	9	4	Longitude (degrees)
VOC_EMF	N	11	4	VOC Emission Factor (SCC units)
NOX_EMF	N	11	4	NO _x Emission Factor (SCC units)
CO_EMF	N	11	4	CO Emission Factor (SCC units)
SO2_EMF	N	11	4	SO ₂ Emission Factor (SCC units)
PM10_EMF	N	11	4	PM ₁₀ Emission Factor (SCC units)
PM25_EMF	N	11	4	PM _{2.5} Emission Factor (SCC units)
NH3_EMF	N	11	4	NH ₃ Emission Factor (SCC units)
VOC_CE	N	7	2	VOC Control Efficiency (%)
NOX_CE	N	7	2	NO _x Control Efficiency (%)
CO_CE	N	7	2	CO Control Efficiency (%)
SO2_CE	N	7	2	SO ₂ Control Efficiency (%)

Table III-7 (continued)

Variable	Type	Length	Decimals	Description
PM10_CE	N	7	2	PM ₁₀ Control Efficiency (%)
PM25_CE	N	7	2	PM _{2.5} Control Efficiency (%)
NH3_CE	N	7	2	NH ₃ Control Efficiency (%)
VOC_CPRI	N	3	0	VOC Primary Control Equipment Code
NOX_CPRI	N	3	0	NO _x Primary Control Equipment Code
CO_CPRI	N	3	0	CO Primary Control Equipment Code
SO2_CPRI	N	3	0	SO ₂ Primary Control Equipment Code
PM10_CPRI	N	3	0	PM ₁₀ Primary Control Equipment Code
PM25_CPRI	N	3	0	PM _{2.5} Primary Control Equipment Code
NH3_CPRI	N	3	0	NH ₃ Primary Control Equipment Code
VOC_CSEC	N	3	0	VOC Secondary Control Equipment Code
NOX_CSEC	N	3	0	NO _x Secondary Control Equipment Code
CO_CSEC	N	3	0	CO Secondary Control Equipment Code
SO2_CSEC	N	3	0	SO ₂ Secondary Control Equipment Code
PM10_CSEC	N	3	0	PM ₁₀ Secondary Control Equipment Code
PM25_CSEC	N	3	0	PM _{2.5} Secondary Control Equipment Code
NH3_CSEC	N	3	0	NH ₃ Secondary Control Equipment Code
VOC_ANN	N	13	4	Annual VOC (tons)
NOX_ANN	N	13	4	Annual NO _x (tons)
CO_ANN	N	13	4	Annual CO (tons)
SO2_ANN	N	13	4	Annual SO ₂ (tons)
PM10_ANN	N	13	4	Annual PM ₁₀ (tons)
PM25_ANN	N	13	4	Annual PM _{2.5} (tons)
SOA_ANN	N	13	4	Annual SOA (tons)
NH3_ANN	N	13	4	Annual NH ₃ (tons)
VOC OSD	N	13	4	Summer Season Daily VOC (tons)
NOX OSD	N	13	4	Summer Season Daily NO _x (tons)
CO OSD	N	13	4	Summer Season Daily CO (tons)
SO2 OSD	N	13	4	Summer Season Daily SO ₂ (tons)
PM10 OSD	N	13	4	Summer Season Daily PM ₁₀ (tons)
PM25 OSD	N	13	4	Summer Season Daily PM _{2.5} (tons)
SOA OSD	N	13	4	Summer Season Daily SOA (tons)
NH3 OSD	N	13	4	Summer Season Daily NH ₃ (tons)
VOC_RE	N	3	0	VOC Rule Effectiveness (%)
NOX_RE	N	3	0	NO _x Rule Effectiveness (%)
CO_RE	N	3	0	CO Rule Effectiveness (%)
SO2_RE	N	3	0	SO ₂ Rule Effectiveness (%)
PM10_RE	N	3	0	PM ₁₀ Rule Effectiveness (%)
PM25_RE	N	3	0	PM _{2.5} Rule Effectiveness (%)
NH3_RE	N	3	0	NH ₃ Rule Effectiveness (%)
STACKID3	C	3	0	Stack ID (3 Digit)
PLANTID5	C	5	0	State Plant ID (5 Digit)
POINTID5	C	5	0	Point ID (5 Digit)

**Table III-8
Structure for 2007, 2020, and 2030 Future Year Non-EGU Mass Emissions Files**

Variable	Type	Length	Decimals	Description
FIPSST	C	2	0	FIPS State Code
FIPSCNTY	C	3	0	FIPS County Code
PLANTID	C	15	0	State Plant ID
POINTID	C	15	0	Point ID
STACKID	C	12	0	Stack ID
SEGMENT	C	2	0	Segment ID
PLANTID5	C	5	0	State Plant ID (5 Digit)
POINTID5	C	5	0	Point ID (5 Digit)
STACKID3	C	3	0	Stack ID (3 Digit)
ORISID	C	6	0	DOE Plant ID
BLRID	C	6	0	Boiler ID
PLANT	C	40	0	Plant Name
SCC	C	10	0	SCC
STKHGT	N	4	0	Stack Height (ft)
STKDIAM	N	6	2	Stack Diameter (ft)
STKTEMP	N	4	0	Stack Temperature (degrees F)
STKFLOW	N	10	2	Stack Flow Rate (cubic feet per second)
STKVEL	N	9	2	Stack Velocity (ft/sec)
BOILCAP	N	8	2	Boiler Design Capacity
CAP_UNITS	C	1	0	Capacity Unit Code
WINTHRU	N	3	0	Winter Thruput (%)
SPRTHRU	N	3	0	Spring Thruput (%)
SUMTHRU	N	3	0	Summer Thruput (%)
FALTHRU	N	3	0	Fall Thruput (%)
HOURS	N	2	0	Hours per Day
START_HR	N	2	0	Hourly Start Time
DAYS	N	1	0	Days per Week
WEEKS	N	2	0	Weeks per Year
THRUPUT	N	11	1	Throughput Rate (SCC units/year)
MAXRATE	N	12	3	Maximum Ozone Season Rate (units/day)
HEATCON	N	8	2	Heat Content (MMBtu/SCC unit)
SULFCON	N	5	2	Sulfur Content (mass percent)
ASHCON	N	5	2	Ash Content (mass percent)
NETDC	N	9	3	Maximum Nameplate Capacity (MW)
SIC	N	4	0	SIC Code
LATC	N	9	4	Latitude (degrees)
LONGC	N	9	4	Longitude (degrees)
UTMEAST	N	9	3	UTM easting (km)
UTMNORTH	N	9	3	UTM northing (km)
UTMZONE	N	9	3	UTM zone
VOC_EMF	N	11	4	VOC Emission Factor (SCC units)
NOX_EMF	N	11	4	NO _x Emission Factor (SCC units)
CO_EMF	N	11	4	CO Emission Factor (SCC units)

Table III-8 (continued)

Variable	Type	Length	Decimals	Description
SO2_EMF	N	11	4	SO ₂ Emission Factor (SCC units)
PM10_EMF	N	11	4	PM ₁₀ Emission Factor (SCC units)
PM25_EMF	N	11	4	PM _{2.5} Emission Factor (SCC units)
NH3_EMF	N	11	4	NH ₃ Emission Factor (SCC units)
VOC_CE	N	7	2	VOC Control Efficiency (%)
NOX_CE	N	7	2	NO _x Control Efficiency (%)
CO_CE	N	7	2	CO Control Efficiency (%)
SO2_CE	N	7	2	SO ₂ Control Efficiency (%)
PM10_CE	N	7	2	PM ₁₀ Control Efficiency (%)
PM25_CE	N	7	2	PM _{2.5} Control Efficiency (%)
NH3_CE	N	7	2	NH ₃ Control Efficiency (%)
VOC_CPRI	N	3	0	VOC Primary Control Equipment Code
NOX_CPRI	N	3	0	NO _x Primary Control Equipment Code
CO_CPRI	N	3	0	CO Primary Control Equipment Code
SO2_CPRI	N	3	0	SO ₂ Primary Control Equipment Code
PM10_CPRI	N	3	0	PM ₁₀ Primary Control Equipment Code
PM25_CPRI	N	3	0	PM _{2.5} Primary Control Equipment Code
NH3_CPRI	N	3	0	NH ₃ Primary Control Equipment Code
VOC_CSEC	N	3	0	VOC Secondary Control Equipment Code
NOX_CSEC	N	3	0	NO _x Secondary Control Equipment Code
CO_CSEC	N	3	0	CO Secondary Control Equipment Code
SO2_CSEC	N	3	0	SO ₂ Secondary Control Equipment Code
PM10_CSEC	N	3	0	PM ₁₀ Secondary Control Equipment Code
PM25_CSEC	N	3	0	PM _{2.5} Secondary Control Equipment Code
NH3_CSEC	N	3	0	NH ₃ Secondary Control Equipment Code
VOC_ANN	N	13	4	Annual VOC (tons)
NOX_ANN	N	13	4	Annual NO _x (tons)
CO_ANN	N	13	4	Annual CO (tons)
SO2_ANN	N	13	4	Annual SO ₂ (tons)
PM10_ANN	N	13	4	Annual PM ₁₀ (tons)
PM25_ANN	N	13	4	Annual PM _{2.5} (tons)
SOA_ANN	N	13	4	Annual SOA (tons)
NH3_ANN	N	13	4	Annual NH ₃ (tons)
VOC OSD	N	13	4	Summer Season Daily VOC (tons)
NOX OSD	N	13	4	Summer Season Daily NO _x (tons)
CO OSD	N	13	4	Summer Season Daily CO (tons)
SO2 OSD	N	13	4	Summer Season Daily SO ₂ (tons)
PM10 OSD	N	13	4	Summer Season Daily PM ₁₀ (tons)
PM25 OSD	N	13	4	Summer Season Daily PM _{2.5} (tons)
SOA OSD	N	13	4	Summer Season Daily SOA (tons)
NH3 OSD	N	13	4	Summer Season Daily NH ₃ (tons)
NOX_5MON	N	13	4	5-month Summer NO _x , May-September (tons)
NOX_7MON	N	13	4	7-month NO _x , October-April (tons)
VOC_RE	N	3	0	VOC Rule Effectiveness (%)

Table III-8 (continued)

Variable	Type	Length	Decimals	Description
NOX_RE	N	3	0	NO _x Rule Effectiveness (%)
CO_RE	N	3	0	CO Rule Effectiveness (%)
SO2_RE	N	3	0	SO ₂ Rule Effectiveness (%)
PM10_RE	N	3	0	PM ₁₀ Rule Effectiveness (%)
PM25_RE	N	3	0	PM _{2.5} Rule Effectiveness (%)
NH3_RE	N	3	0	NH ₃ Rule Effectiveness (%)
POD_VOC	C	3	0	VOC Cost Pod
ERAT	N	9	3	Energy Adjustment Factor
GFAC	N	9	3	BEA Growth Factor
SIPSIZE	C	1	0	Plant Size Based on NO _x SIP Call
POD_NOX	C	3	0	NO _x Cost Pod
POD	C	3	0	Cost Pod
SIC2	C	3	0	2-digit SIC Code
SIZE	C	1	0	Plant Size Based on Capacity or Emission (see text)

**Table III-9
Non-EGU EPS 2.5 Emissions Processor Input File Structure**

Variable	Type	Length	Decimals	Description
FIPSST	C	2	0	FIPS State Code
FIPSCNTY	C	3	0	FIPS County Code
PLANTID	C	5	0	State Plant ID (5 digit)
POINTID	C	5	0	Point ID (5 digit)
SIC	N	4	0	SIC Code
STACKID	C	3	0	Stack ID (3 digit)
SEGMENT	C	2	0	Segment ID
SCC	C	8	0	SCC
STKHGT	N	4	0	Stack Height (ft)
STKDIAM	N	6	2	Stack Diameter (ft)
STKTEMP	N	4	0	Stack Temperature (F)
STKFLOW	N	10	2	Stack Flow Rate (cubic ft per second)
WINTHRU	N	3	0	Winter Thruput (%)
SPRTHRU	N	3	0	Spring Thruput (%)
SUMTHRU	N	3	0	Summer Thruput (%)
FALTHRU	N	3	0	Fall Thruput (%)
HOURS	N	2	0	Hours per Day
DAYS	N	1	0	Days per Week
WEEKS	N	2	0	Weeks per Year
LATC	N	9	4	Latitude (degrees)
LONC	N	9	4	Longitude (degrees)
VOC	N	9	3	Annual VOC (tons)
NOX	N	9	3	Annual NO _x (tons)
CO	N	9	3	Annual CO (tons)
SO2	N	9	3	Annual SO ₂ (tons)
PM10	N	9	3	Annual PM ₁₀ (tons)
PM25	N	9	3	Annual PM _{2.5} (tons)
SOA	N	9	3	Annual SOA (tons)
NH3	N	9	3	Annual NH ₃ (tons)

**Table III-10
Non-EGU EMS-95 Emissions Processor Input File Structure**

Field	Type	Length	Description
Facility File:			
STID	N	2.	FIPS State Code
CYID	N	3.	FIPS County Code
FCID	C	15.	Facility ID
SIC	C	4.	Standard Industrial Classification
UTMX	N	9.1	UTM easting (m)
UTMY	N	9.1	UTM northing (m)
UTMZ	N	2.	UTM zone
NAME	C	40.	Facility Name
Stack File:			
STID	N	2.	FIPS State Code
CYID	N	3.	FIPS County Code
FCID	C	15.	Facility ID
STKID	C	12.	Stack ID
DIAM	N	8.4	Inside Stack Diameter (ft)
HEIT	N	7.2	Stack Height above Ground Surface (ft)
TEMP	N	7.2	Stack Exit Temperature (F)
VELOC	N	7.2	Stack Exit Velocity (ft/sec)
FLOW	N	10.2	Stack Exit Flow Rate (actual cubic ft/min)
UTMX	N	9.1	UTM easting (m)
UTMY	N	9.1	UTM northing (m)
ELEV	N	9.1	Elevation of Stack Base from Mean Sea Level (ft)
Device File:			
STID	N	2.	FIPS State Code
CYID	N	3.	FIPS County Code
FCID	C	15.	Facility ID
STKID	C	12.	Stack ID
DVID	C	12.	Device ID
SIC	C	4.	Standard Industrial Classification
DEC	N	5.3	Fractional December Throughput
JAN	N	5.3	Fractional January Throughput
FEB	N	5.3	Fractional February Throughput
MAR	N	5.3	Fractional March Throughput
APR	N	5.3	Fractional April Throughput
MAY	N	5.3	Fractional May Throughput
JUN	N	5.3	Fractional June Throughput
JUL	N	5.3	Fractional July Throughput
AUG	N	5.3	Fractional August Throughput
SEP	N	5.3	Fractional September Throughput
OCT	N	5.3	Fractional October Throughput
NOV	N	5.3	Fractional November Throughput
WIN	N	3.	Winter Throughput (Dec - Feb) (%)
SPR	N	3.	Spring Throughput (Mar - May) (%)

Table III-10 (continued)

Field	Type	Length	Description
SUM	N	3.	Summer Throughput (Jun - Aug) (%)
FAL	N	3.	Fall Throughput (Sep - Nov) (%)
HOURS	N	2.	Hours of Operation per Day (hours/day)
DAYS	N	2.	Days of Operation per Week (days/week)
WEEKS	N	2.	Weeks of Operation per Year (weeks/year)
DAYYEAR	N	3.	Days of Operation per Year (days/year)
HOURYEAR	N	4.	Hours of Operation per Year (hours/year)
Process File:			
STID	N	2.	FIPS State Code
CYID	N	3.	FIPS County Code
FCID	C	15.	Facility ID
STKID	C	12.	Stack ID
DVID	C	12.	Device ID
PRID	C	12.	Process ID
SCC	C	8.	Source Classification Code
PRRT	N	13.	Annual Process Rate (SCC units/year)
PRUN	C	15.	Optional Process Rate Units If Different from SCC
Emissions File:			
STID	N	2.	FIPS State Code
CYID	N	3.	FIPS County Code
FCID	C	15.	Facility ID
STKID	C	12.	Stack ID
DVID	C	12.	Device ID
PRID	C	12.	Process ID
POLID	C	5.	Pollutant ID
ACEF	N	13.	Actual Emission Factor (tons/SCC units)
ALEF	N	13.	Allowable Emission Factor (tons/SCC units)
ACEE	N	13.	Actual Emissions (tons)
ALEE	N	13.	Allowable Emissions (tons)
ESTT	C	2.	Temporal Basis (AA, AD, or DS)
PCEC	C	5.	Primary Control Equipment
SCEC	C	5.	Secondary Control Equipment
CEEF	N	7.4	Control Equipment Efficiency (%)

CHAPTER IV

STATIONARY AREA SOURCES

A. 1996 BASE YEAR EMISSIONS

The 1996 base year inventory for stationary area sources is the 1996 NET area source inventory Version 3.11 (EPA, 2000a). Version 3.11 is the most current version that reflects corrections to wildfire emission estimates for Kansas and removal of area source electric utility emissions to avoid double counting with point source EGU emissions. SOA emissions were added to the inventory by applying fractional aerosol coefficients based on speciation of VOC emissions (Grosjean and Seinfeld, 1989).

B. 2007, 2020, AND 2030 FUTURE YEAR EMISSIONS

Projection year emissions are a function of projected changes (growth or decline) in activity as well as changes in control levels. The following sections describe the growth and control assumptions utilized for this analysis.

1. Growth Assumptions

The BEA GSP growth, including population and combinations of industries (e.g., durable goods manufacturing, total manufacturing) were used to project emissions from 1996 to 2007, 2020, and 2030 for the area source sector. The surrogates used for each category were based on the same cross-reference list used in the Ozone/PM National Ambient Air Quality Standard (NAAQS) analysis (Pechan-Avanti, 1997b). Updated non-BEA growth factors were applied to estimate future year activity for prescribed burning (projections of acres of public land burned from EPA and Federal land managers), agricultural sources (acres planted projections), and unpaved road emissions based on work completed for EPA's Section 812 Prospective Analysis (Pechan-Avanti, 1998). Livestock emissions growth was also updated for this analysis, utilizing extrapolations of Census of Agriculture data.

Pechan matched area source categories with surrogate activity indicators (e.g., GSP by industry, population, or broader BEA categories) in order to utilize the BEA data. The variable chosen as a proxy for emissions growth is shown by source category in Table IV-1. For broad industrial categories such as Industrial Fuel Combustion and Miscellaneous Industrial Processes, BEA GSP growth for the manufacturing sector represents the activity level for projecting emissions. Population was used as a surrogate growth indicator for area source categories such as Dry Cleaning, Household Solvent Use, and Residential Fuel Combustion. Projected emissions for each State/area source SCC combination were calculated by multiplying base year emissions by the growth factor for the BEA growth indicator.

**Table IV-1
BEA Growth Categories Assigned by Major Source Category: Area Sources**

Source Category	BEA Growth Category*
Stationary Source Fuel Combustion:	
Industrial	Total Manufacturing
Commercial/Institutional	Government and Government Enterprises
Residential	Population
Industrial Processes:	
Process Emissions: Synthetic Fiber	Textile Mill Products (SIC 22)
Process Emissions: Pharmaceuticals	Chemicals and Allied Products (SIC 28)
SOCMI Fugitives	Chemicals and Allied Products (SIC 28)
Food & Kindred Products - Bakeries	Food and Kindred Products (SIC 20)
Petroleum Refining	Petroleum and Coal Products (SIC 29)
Oil & Gas Production	Oil and Gas Extraction (SIC 13)
Miscellaneous Industrial Processes	Total Manufacturing
Surface Coating:	
Architectural	Construction (SIC 15, 16, and 17)
Auto Refinishing	Auto Repair, Services, and Garages (SIC 75)
Traffic Markings	Construction (SIC 15, 16, and 17)
Flat Wood Coating	Lumber and Wood Products (SIC 24)
Wood and Metal Furniture	Furniture and Fixtures (SIC 25)
Paper Coating	Printing and Publishing (SIC 27)
Metal Can & Coating	Fabricated Metal Products (SIC 34)
Electrical Insulation	Machinery, except Electrical (SIC 35)
Appliances	Fabricated Metal Products (SIC 34)
Machinery	Electric and Electronic Equipment (SIC 36)
Motor Vehicles (New)	Motor Vehicles and Equipment (SIC 371)
Aircraft Coating	Transportation Equipment, excl. Motor Vehicles (SIC 37)
Marine Paints	Transportation Equipment, excl. Motor Vehicles (SIC 37)
Rail Equipment Coating	Transportation Equipment, excl. Motor Vehicles (SIC 37)
Miscellaneous Manufacturing	Misc. Manufacturing Industries (SIC 39)
Industrial Maintenance	Misc. Manufacturing Industries (SIC 39)
Aerosols, Specific Purpose	Misc. Manufacturing Industries (SIC 39)
Degreasing (Vapor and Cold Cleaning):	
Furniture	Manufacturing - Durable Goods
Metallurgical Process	Manufacturing - Durable Goods
Fabricated Metals	Manufacturing - Durable Goods
Industrial Machinery	Manufacturing - Durable Goods
Electrical Equipment	Manufacturing - Durable Goods
Transportation Equipment	Manufacturing - Durable Goods
Instrument Manufacturing	Manufacturing - Durable Goods
Miscellaneous Manufacturing	Manufacturing - Durable Goods
Automobile Dealers & Repair	Manufacturing - Durable Goods
Other Degreasing Sources	Manufacturing - Durable Goods

Table IV-1 (continued)

Source Category	BEA Growth Category*
Solvent Use:	
Dry Cleaning (all types)	Population
Graphic Arts	Printing and Publishing (SIC 27)
Rubber and Plastics	Rubber and Misc. Plastics Products (SIC 30)
Industrial Adhesives	Total Manufacturing
Cutback Asphalt	Local/Interurban Passenger Transit (SIC 41)
Pesticides - Farm	Population
Personal, Household and Automotive Products	Population
Commercial Adhesives	Population
Petroleum & Petroleum Product Storage & Transport:	
Bulk Stations/Terminals	Trucking and Warehousing (SIC 42)
Gasoline Service Stations (Stage I and II)	Gasoline Consumption**
Gasoline Service Stations (Underground Tank)	Gasoline Consumption**
Waste Disposal, Treatment, & Recovery:	
On-Site Incineration - Industrial	Total Manufacturing
On-Site Incineration - Commercial/Institutional	Government and Government Enterprises
On-Site Incineration - Residential	Population
Open Burning - Industrial	Total Manufacturing
Open Burning - Commercial/Institutional	Government and Government Enterprises
Open Burning - Residential	Population
Wastewater Treatment - Public Owned	Electric, Gas, and Sanitary Services (SIC 49)
TSDFs	Total Manufacturing
Miscellaneous Area Sources:	
Agriculture Production (field burning, tilling)	USDA - Agricultural Baseline Projections
Agricultural Livestock	Extrapolated from historical Census of Agriculture data
Prescribed burning	Reflects expected increases in Federal prescribed burning activity on public lands
Wildfires	Zero Growth
Unpaved Roads	Extrapolated from 1984 to 1996 trend in unpaved road mileage
Paved Roads	Vehicle miles traveled (VMT) from MOBILE4.1 Fuel Consumption Model (FCM)

NOTES: *BEA growth category refers to GSP projections for each industry, unless "Population" is indicated.
 **Gasoline consumption projections are from the MOBILE FCM.

The U.S. Department of Agriculture (USDA) has developed baseline projections of farm acres planted (USDA, 1998). These data, combined with historical data back to 1990, for eight major crop types shows an expected average annual growth of only 0.38 percent per year from 1990 to 2007. The BEA GSP projections for *farms* result in an annual average growth of 2.0 percent per year. Projections of acres planted represent better predictors of future activity than GSP for agricultural tilling, so they were used in this analysis. Levels of acres planted were assumed to remain constant between 2010 and 2030.

During an interagency (Department of the Interior/USDA) satellite conference held in April 1998, public forest land managers discussed an annual prescribed burning target of 5 million acres for 2010, although specific areas for burning were not identified. Using this target figure, public land activity levels were projected to arrive at 2010 public land activity estimates. For private forest lands, it is estimated that the level of prescribed burning activity remains constant at base year levels. Estimates for 2020 and 2030 were assumed to be the same as 2010. For 2007, data were extrapolated between 2000 and 2010.

Unpaved road emission projections reflect the historical downward trend in miles of unpaved roads. The States were divided into three geographic groups: East, Central, and West. East was defined as EPA Regions 1 through 4, Central as EPA Regions 5 through 8, and West as EPA Regions 9 and 10. Linear regression was used to estimate the continued decline in unpaved road miles to 2030. For the emission projections, 2007 and 2030 unpaved road emissions were estimated by applying the average annual change between 1984 and 1996 out to the projection year.

For fuel combustion sources, energy adjustment factors were also applied to the baseline inventory. These factors, developed from the DOE publication *Annual Energy Outlook 1999*, account for increases in fuel and process efficiency in future years (DOE, 1998). Basically, less fuel will be needed to provide the same amount of energy (generally in the form of steam) to an industrial process and the amount of energy needed per unit output will also decrease as processes become more efficient. For example, DOE projects natural gas consumption in the commercial sector to rise from 3.392 quadrillion Btu in 1996 to 3.997 quadrillion Btu in 2020. Over this same time-frame, DOE projects commercial square footage to increase from 59.5 billion square feet to 72.9 billion square feet. To reflect the projected change in natural gas consumed per square foot of commercial building space, natural gas energy intensity factors were calculated for 1996 and each projection year. For example, 0.2475 quadrillion Btu/square foot of natural gas is projected to be consumed in 2020 versus 0.2551 quadrillion Btu/square foot in 1996. For all commercial sector natural gas source categories, the BEA commercial sector growth factors are multiplied by 0.97, which represents the ratio of the 2020 energy intensity factor for commercial sector natural gas to the 1996 energy intensity factor for commercial natural gas. Similar ratios were calculated and applied for other fuels used in the commercial sector, and for all fuels used in the residential and industrial energy sectors. These adjustments are based on those used in the NET projections (EPA, 2000a).

For the animal husbandry SCCs displayed in Table IV-2, alternative methods were used to project emissions growth. For the majority of these SCCs (all except SCCs 2805001000, 2805020000, and 2805025000), emissions growth was based on projections of the number of

animals in each category that were developed based on national data from the 1987, 1992, and 1997 Census of Agriculture (USDA, 1997). For these SCCs, growth factors are based on the increase in the number of animals between the base year and 2007, 2020, and 2030 as estimated from linear extrapolations of the Census data. Because linear extrapolation of the Census' number of sheep and lambs yielded negative growth factors that were believed to be unrealistic, the number of these animals was projected using an exponential trend function that provided more realistic growth factors. The growth factor for total livestock production (SCC 2805000000) was computed as the median of the growth factors for the individual SCCs that comprise this total category.

For the following three animal husbandry source categories, growth factors were based on more comprehensive historical and projections data available from the USDA:

- Beef Cattle Feedlots (SCC 2805001000);
- Total Cattle/Calves (SCC 2805020000); and
- Hogs and Pigs (SCC 2805025000).

For this effort, animal population data specific to each of these source categories were compiled for 1970-1999. The USDA publishes estimates of the total number of cattle/calves; total number of hogs and pigs; and total cattle in feedlots for historical years (USDA, 2000a). The USDA also projects the inventory of total cattle, total beef cows, and total hogs for each year over the 1998-2009 period (USDA, 2000b). It is important to note that the categories included in the USDA projections series do not match the emission source categories as closely as the categories in the USDA historical data series. For example, USDA projections are available for total beef cows, not cattle in feedlots.

Because the USDA projections data represent somewhat different animal categories than the emission source categories and available historical data, the future animal counts were normalized on the same basis as the historic animal counts by computing the ratio of a source category's animal count in each future year to the animal count for 1999 as reported in the USDA's projections series. To estimate the future number of animals in each source category, these ratios are applied to the actual animal count for 1999, which is the latest year for which USDA historical data are available.

After projecting these animal counts through 2009, the historical and forecast series for each source category were graphed to determine the functional form that best represented the data. Because the major fluctuations in the historical data for each category contradicted the clear trend in the USDA projection series for each category, the post-2009 trend in each category was identified based on the normalized projected animal counts for 2000-2009. The 2020 and 2030 animal counts were estimated by extrapolating to each year based on the following functional forms identified from the 2000-2009 data:

- Beef Cattle Feedlots—linear (stable slow decline in number);
- Total Cattle/Calves—linear (stable slow increase in number); and
- Hogs and Pigs—logarithmic (declining rate of increase in number).

To compute the growth factors for each source category, the estimated animal counts in 2007, 2020, and 2030 were divided by the actual animal counts in 1996.

**Table IV-2
Animal Husbandry Categories and Growth Assumptions**

Source Classification Code (SCC)	SCC Description	Growth Function
2710020030	Natural Sources Biogenic Horses and Ponies	Linear extrapolation
2805000000	Misc. Area Sources Agric. Prod.-Livestock Total	Median of growth factors from individual SCCs below
2805001000	Misc. Area Sources Agric. Prod. - Livestock Beef Cattle Feedlots Total	Linear extrapolation
2805020000	Misc. Area Sources Agric. Prod. - Animal Husbandry Cattle and Calves Composite	Linear extrapolation
2805025000	Misc. Area Sources Agric. Prod. - Animal Husbandry Hogs and Pigs Composite	Logarithmic extrapolation
2805030000	Misc. Area Sources Agric. Prod. - Animal Husbandry Poultry -Chickens Composite	Linear extrapolation
2805040000	Misc. Area Sources Agric. Prod. - Animal Husbandry Sheep and Lambs Composite	Exponential extrapolation
2805045001	Misc. Area Sources Agric. Prod. - Animal Husbandry Goats Composite	Linear extrapolation

Reference: USDA, 1997.

2. Control Assumptions

VOC area source controls were applied for federal initiatives, such as VOC content limits for consumer solvents, Title III MACT assumptions, and Title I RACT assumptions that were not applied in the 1996 base year inventory. These controls are listed in Table IV-3.

Additional controls were applied for residential wood combustion and Stage II VOC for gasoline service stations. Table IV-4 shows the control efficiencies applied for residential wood combustion by pollutant (VOC, PM₁₀, PM_{2.5}, and CO) for each of the future year inventories. Residential wood combustion control efficiencies were derived from emission factors obtained from AP-42, a 4 percent per year growth rate for catalytic wood stoves starting in 1988, and an estimate of the control efficiencies applied in the 1996 base year inventory.

Table IV-5 shows the control efficiencies applied to account for VOC reductions associated with onboard vapor recovery systems and Stage II controls at gasoline service stations. Vehicle refueling VOC emissions were estimated using different methods for counties required to have Stage II VOC controls versus counties not required to have Stage II VOC controls. Serious and above ozone nonattainment areas are required to implement Stage II (at the nozzle) vapor recovery systems under Title I of the CAA. Table IV-6 shows the 227 counties required to have

Stage II controls. However, since onboard vapor recovery systems on gasoline-fueled vehicles are required in 1998 and later vehicles in all areas, independent of attainment status, higher control efficiencies are estimated for counties where Stage II refueling controls are required. Control efficiencies were calculated using weighted gram per gallon emission factors determined using a series of MOBILE5a runs. These runs also accounted for the expected effect of onboard vapor recovery systems on future year evaporative emissions from gasoline-powered vehicles.

**Table IV-3
Area Source VOC Control Measure Assumptions**

Control Measure and Affected SCCs	VOC Percentage Reduction	VOC Rule Effectiveness
Federal Control Measures (National)		
Consumer Solvents 2465000000, 2465100000, 2465200000, 2465600000, 2456800000	25	100
Architectural and Industrial Maintenance Coatings 2401001000, 2401001999, 2401100000, 2401008000	25	100
Residential Wood Combustion 2104008000, 2104008001, 2104008010, 2104008030, 2104008050, 2104008051	See Table IV-4	
Onboard Vapor Recovery Systems; and Stage II for Gasoline Service Stations 2501060100, 2501060101, 2501060102	See Table IV-5	
Title III MACT (National)		
Wood Furniture Surface Coating 2401020000	30	100
Aerospace Surface Coating 2401075000	60	100
Marine Vessel Surface Coating (Shipbuilding) 2401080000	24	100
Halogenated Solvent Cleaners (Cold Cleaning) 2415300000, 2415305000, 2415310000, 2415320000, 2415325000, 2415330000, 2415335000, 2415340000, 2415345000, 2415355000, 2415360000, 2415365000	43 **	100
Autobody Refinishing 2401005000	37	100
Petroleum Refinery Fugitives 2306000000	60 ***	100
Synthetic Organic Chemical Manufacturing Industry (SOCMI) Fugitives (Hazardous Organic NESHAP) 2301040000	37 ****	100
Motor Vehicle Surface Coating 2401070000	36	100
Metal Product Surface Coating 2401040000, 2401045000, 2401050000	36	100

Table IV-3 (continued)

Control Measure and Affected SCCs	VOC Percentage Reduction	VOC Rule Effectiveness
Wood Product Surface Coating 2401015000	36	100
Open Top & Conveyorized Degreasing 2415100000, 2415105000, 2415110000, 2415120000, 2415125000, 2415130000, 2415135000, 2415140000, 2415145000, 2415199000, 2415200000	31	100
Publicly Owned Treatment Works (POTWs) 2630000000 to 2630020000	80	100
Metal Furniture & Appliances Surface Coating 2401025000, 2401060000	36	100
Machinery, Railroad Surface Coating 2401055000, 2401085000, 2401090000	36	100
Electronic Coating 2401065000	36	100
Title I RACT		
Petroleum Dry Cleaning 2420000370, 2420010370	44	80
Paper Surface Coating 2401030000	78	80

NOTES:

* The efficiency of onboard vapor recovery systems varies depending on whether stage II vapor recovery systems are in place. It is determined based on MOBILE5b emission factors.

** Overall control efficiency of 63% with 35% already applied in base year.

*** Overall control efficiency of 78% with 43% already applied in base year.

**** Overall control efficiency of 60% with 37% already applied in base year.

**Table IV-4
Residential Wood Combustion Control Efficiency
Assumptions by Pollutant and Future Year Inventory**

Pollutant	2007 Percent Reduction	2020 Percent Reduction	2030 Percent Reduction
VOC	49	72	72
PM ₁₀ and PM _{2.5} ^a	33	51	51
CO	37	55	55

^a All residential wood combustion PM emissions are assumed to be less than or equal to PM_{2.5}.

**Table IV-5
Vehicle Refueling VOC Control Efficiency
Assumptions Included in the Future Year Inventories**

Does County Have Stage II Controls?	2007 Percent Reduction	2020 Percent Reduction	2030 Percent Reduction
No	52.0	82.4	85.8
Yes	81.7	87.6	88.3

**Table IV-6
Counties with Stage II Controls**

State	County	State FIPS Code	County FIPS Code
Arizona	Maricopa	04	013
California	Alameda	06	001
California	Contra Costa	06	013
California	El Dorado	06	017
California	Fresno	06	019
California	Kern	06	029
California	Kings	06	031
California	Los Angeles	06	037
California	Madera	06	039
California	Marin	06	041
California	Merced	06	047
California	Monterey	06	053
California	Napa	06	055
California	Orange	06	059
California	Placer	06	061
California	Riverside	06	065
California	Sacramento	06	067
California	San Benito	06	069
California	San Bernardino	06	071
California	San Diego	06	073
California	San Joaquin	06	077
California	San Mateo	06	081
California	Santa Barbara	06	083
California	Santa Clara	06	085
California	Santa Cruz	06	087
California	Solano	06	095
California	Sonoma	06	097
California	Stanislaus	06	099
California	Sutter	06	101
California	Tulare	06	107
California	Ventura	06	111
California	Yolo	06	113
Connecticut	Fairfield	09	001
Connecticut	Hartford	09	003
Connecticut	Litchfield	09	005
Connecticut	Middlesex	09	007
Connecticut	New Haven	09	009
Connecticut	New London	09	011
Connecticut	Tolland	09	013
Connecticut	Windham	09	015
Delaware	Kent	10	001
Delaware	New Castle	10	003
Delaware	Sussex	10	005
Dist. Columbia	Washington	11	001
Florida	Broward	12	011
Florida	Dade	12	025
Florida	Palm Beach	12	099
Georgia	Cherokee	13	057
Georgia	Clayton	13	063
Georgia	Cobb	13	067
Georgia	Coweta	13	077
Georgia	De Kalb	13	089
Georgia	Douglas	13	097
Georgia	Fayette	13	113
Georgia	Forsyth	13	117
Georgia	Fulton	13	121
Georgia	Gwinnett	13	135
Georgia	Henry	13	151
Georgia	Paulding	13	223

Table IV-6 (continued)

State	County	State FIPS Code	County FIPS Code
Georgia	Rockdale	13	247
Illinois	Cook	17	031
Illinois	Du Page	17	043
Illinois	Grundy	17	063
Illinois	Kane	17	089
Illinois	Kendall	17	093
Illinois	Lake	17	097
Illinois	McHenry	17	111
Illinois	Will	17	197
Indiana	Clark	18	019
Indiana	Floyd	18	043
Indiana	Lake	18	089
Indiana	Porter	18	127
Kentucky	Jefferson	21	111
Louisiana	Ascension Parish	22	005
Louisiana	East Baton Rouge Parish	22	033
Louisiana	Iberville Parish	22	047
Louisiana	Livingston Parish	22	063
Louisiana	Pointe Coupee Parish	22	077
Louisiana	West Baton Rouge Parish	22	121
Maryland	Anne Arundel	24	003
Maryland	Baltimore	24	005
Maryland	Calvert	24	009
Maryland	Carroll	24	013
Maryland	Cecil	24	015
Maryland	Charles	24	017
Maryland	Frederick	24	021
Maryland	Harford	24	025
Maryland	Howard	24	027
Maryland	Montgomery	24	031
Maryland	Prince Georges	24	033
Maryland	Baltim	24	510
Massachusetts	Barnstable	25	001
Massachusetts	Berkshire	25	003
Massachusetts	Bristol	25	005
Massachusetts	Dukes	25	007
Massachusetts	Essex	25	009
Massachusetts	Franklin	25	011
Massachusetts	Hampden	25	013
Massachusetts	Hampshire	25	015
Massachusetts	Middlesex	25	017
Massachusetts	Nantucket	25	019
Massachusetts	Norfolk	25	021
Massachusetts	Plymouth	25	023
Massachusetts	Suffolk	25	025
Massachusetts	Worcester	25	027
Michigan	Kent	26	081
Michigan	Livingston	26	093
Michigan	Macomb	26	099
Michigan	Monroe	26	115
Michigan	Oakland	26	125
Michigan	Ottawa	26	139
Michigan	St. Clair	26	147
Michigan	Washtenaw	26	161
Michigan	Wayne	26	163
Missouri	Franklin	29	071
Missouri	Jefferson	29	099
Missouri	St. Charles	29	183
Missouri	St. Louis	29	189
Missouri	St. Lo	29	510
Nevada	Clark	32	003

Table IV-6 (continued)

State	County	State FIPS Code	County FIPS Code
Nevada	Washoe	32	031
New Hampshire	Hillsborough	33	011
New Hampshire	Merrimack	33	013
New Hampshire	Rockingham	33	015
New Hampshire	Strafford	33	017
New Jersey	Atlantic	34	001
New Jersey	Bergen	34	003
New Jersey	Burlington	34	005
New Jersey	Camden	34	007
New Jersey	Cape May	34	009
New Jersey	Cumberland	34	011
New Jersey	Essex	34	013
New Jersey	Gloucester	34	015
New Jersey	Hudson	34	017
New Jersey	Hunterdon	34	019
New Jersey	Mercer	34	021
New Jersey	Middlesex	34	023
New Jersey	Monmouth	34	025
New Jersey	Morris	34	027
New Jersey	Ocean	34	029
New Jersey	Passaic	34	031
New Jersey	Salem	34	033
New Jersey	Somerset	34	035
New Jersey	Sussex	34	037
New Jersey	Union	34	039
New Jersey	Warren	34	041
New York	Bronx	36	005
New York	Kings	36	047
New York	Nassau	36	059
New York	New York	36	061
New York	Orange	36	071
New York	Queens	36	081
New York	Richmond	36	085
New York	Rockland	36	087
New York	Suffolk	36	103
New York	Westchester	36	119
Ohio	Ashtabula	39	007
Ohio	Clark	39	023
Ohio	Cuyahoga	39	035
Ohio	Geauga	39	055
Ohio	Greene	39	057
Ohio	Lake	39	085
Ohio	Lorain	39	093
Ohio	Lucas	39	095
Ohio	Medina	39	103
Ohio	Miami	39	109
Ohio	Montgomery	39	113
Ohio	Portage	39	133
Ohio	Summit	39	153
Ohio	Wood	39	173
Pennsylvania	Bucks	42	017
Pennsylvania	Chester	42	029
Pennsylvania	Delaware	42	045
Pennsylvania	Montgomery	42	091
Pennsylvania	Philadelphia	42	101
Rhode Island	Bristol	44	001
Rhode Island	Kent	44	003
Rhode Island	Newport	44	005
Rhode Island	Providence	44	007
Rhode Island	Washington	44	009
Tennessee	Davidson	47	037

Table IV-6 (continued)

State	County	State FIPS Code	County FIPS Code
Tennessee	Rutherford	47	149
Tennessee	Sumner	47	165
Tennessee	Williamson	47	187
Tennessee	Wilson	47	189
Texas	Brazoria	48	039
Texas	Chambers	48	071
Texas	Collin	48	085
Texas	Dallas	48	113
Texas	Denton	48	121
Texas	El Paso	48	141
Texas	Fort Bend	48	157
Texas	Galveston	48	167
Texas	Hardin	48	199
Texas	Harris	48	201
Texas	Jefferson	48	245
Texas	Liberty	48	291
Texas	Montgomery	48	339
Texas	Orange	48	361
Texas	Tarrant	48	439
Texas	Waller	48	473
Virginia	Arlington	51	013
Virginia	Charles City	51	036
Virginia	Chesterfield	51	041
Virginia	Fairfax	51	059
Virginia	Hanover	51	085
Virginia	Henrico	51	087
Virginia	Loudoun	51	107
Virginia	Prince William	51	153
Virginia	Stafford	51	179
Virginia	Alexandria	51	510
Virginia	Colonial Heights	51	570
Virginia	Fairfax	51	600
Virginia	Falls Church	51	610
Virginia	Hopewell	51	670
Virginia	Manassas	51	683
Virginia	Manassas Park	51	685
Virginia	Richmond	51	760
Wisconsin	Kenosha	55	059
Wisconsin	Kewaunee	55	061
Wisconsin	Manitowoc	55	071
Wisconsin	Milwaukee	55	079
Wisconsin	Ozaukee	55	089
Wisconsin	Racine	55	101
Wisconsin	Sheboygan	55	117
Wisconsin	Washington	55	131
Wisconsin	Waukesha	55	133

C. MASS EMISSIONS INVENTORY AND EMISSIONS PROCESSOR INPUT FILES

Table IV-7 shows the mass and emissions processor input files prepared for area sources. Note that nonroad emissions (discussed in Chapter V) are also included in these inventory files. The control scenario only affects nonroad sources, as discussed in Chapter V.

1. Mass Emission Inventories

The structure for the area source mass emission inventory files is shown in Table IV-8. The emissions processor input files were derived from the mass emission inventories. The only change to emissions is the application of the crustal PM factor. This factor accounts for the fact that only a portion of the crustal PM emissions are transportable. For the EPS 2.5 emissions processor input files, a factor of 25 percent was applied to PM₁₀ and PM_{2.5} emissions for the SCCs listed in Table IV-9 to simulate the transportable component of these emissions. In addition, PM₁₀ and PM_{2.5} emissions from wind erosion of natural geogenic sources (SCCs 2730100000 [total] and 2730100001 [dust devils]) were excluded from the modeling files.

2. EPS 2.5 Emissions Processor Input Files

The EPS 2.5 emissions processor input file structure is detailed in Table IV-10. Annual emissions estimates are provided in the EPS 2.5 emissions processor input files.

3. EMS-95 Emissions Processor Input Files

The EMS-95 emissions processor input files include typical SSD VOC, NO_x, and CO emissions for ozone modeling. The structure for the area source EMS-95 input files is given in Table IV-11. Two EMS-95 inventory files were prepared for the 1996 base year inventory, and the 2007, 2020, and 2030 base and control case inventories. One file provides area source and nonroad emissions at the 10-digit SCC level. The other file provides nonroad emissions at the 7-digit SCC level and area source emissions at the 10-digit SCC level.

**Table IV-7
Area/Nonroad Mass and Emissions Processor Input Files**

Year	Scenario	File Name			Comments
		Mass	EPS 2.5	EMS-95	
1996	Base	AR96MS1H.DBF			Includes 25% transportable PM factor and no wind erosion emissions for natural geogenic sources.
		AR96MX1H.DBF			
		NR96MS1H.DBF	AN96EP1H.TXT	AN96EM1H.TGZ	For EPS 2.5, includes area source MX and nonroad emissions.
		N96MS1H7.DBF		AN96EM17.TGZ	For EMS-95, use 7-digit SCC detail for nonroad sources.
2007	Base	AR07MS2H.DBF			Includes 25% transportable PM factor and no wind erosion emissions for natural geogenic sources.
		AR07MX2H.DBF			
		N7MS1HB.DBF	AN7EP2HB.TXT	AN7EM1HB.TGZ	For EPS 2.5, includes area source MX and nonroad emissions.
		N7MS1HB7.DBF		AN7EM1B7.TGZ	For EMS-95, use 7-digit SCC detail for nonroad sources.
	Control	N7MS1HC.DBF	AN7EP2HC.TXT	AN7EM1HC.TGZ	For EPS 2.5, includes area source MX and nonroad emissions.
		N7MS1HC7.DBF		AN7EM1C7.TGZ	For EMS-95, use 7-digit SCC detail for nonroad sources.
2020	Base	AR20MS2H.DBF			Includes 25% transportable PM factor and no wind erosion emissions for natural geogenic sources.
		AR20MX2H.DBF			
		N2MS1HB.DBF	AN2EP2HB.TXT	AN2EM1HB.TGZ	For EPS 2.5, includes area source MX and nonroad emissions.
		N2MS1HB7.DBF		AN2EM1B7.TGZ	For EMS-95, use 7-digit SCC detail for nonroad sources.
	Control	N2MS1HC.DBF	AN2EP2HC.TXT	AN2EM1HC.TGZ	For EPS 2.5, includes area source MX and nonroad emissions.
		N2MS1HC7.DBF		AN2EM1C7.TGZ	For EMS-95, use 7-digit SCC detail for nonroad sources.
2030	Base	AR30MS3H.DBF			Includes 25% transportable PM factor and no wind erosion emissions for natural geogenic sources.
		AR30MX3H.DBF			
		N3MS1HB.DBF	AN3EP3HB.TXT	AN3EM1HB.TGZ	For EPS 2.5, includes area source MX and nonroad emissions.
		N3MS1HB7.DBF		AN3EM1B7.TGZ	For EMS-95, use 7-digit SCC detail for nonroad sources.
	Control	N3MS1HC.DBF	AN3EP3HC.TXT	AN3EM1HC.TGZ	For EPS 2.5, includes area source MX and nonroad emissions.
		N3MS1HC7.DBF		AN3EM1C7.TGZ	For EMS-95, use 7-digit SCC detail for nonroad sources.

**Table IV-8
Area/Nonroad Mass Emissions Inventory File Structure**

Variable	Type	Length	Decimals	Description
FIPSST	C	2	0	FIPS State code
FIPSCNTY	C	3	0	FIPS county code
SCC	C	10	0	SCC
VOC_ANN	N	10	4	Annual VOC [tons per year (tpy)]
NOX_ANN	N	10	4	Annual NO _x (tpy)
CO_ANN	N	10	4	Annual CO (tpy)
SO2_ANN	N	10	4	Annual SO ₂ (tpy)
PM10_ANN	N	10	4	Annual PM ₁₀ (tpy)
PM25_ANN	N	10	4	Annual PM _{2.5} (tpy)
NH3_ANN	N	10	4	Annual NH ₃ (tpy)
SOA_ANN	N	10	4	Annual SOA (tpy)
VOC_OSD	N	10	4	OSD VOC (tpd)
NOX_OSD	N	10	4	OSD NO _x (tpd)
CO_OSD	N	10	4	OSD CO (tpd)
SO2_OSD	N	10	4	OSD SO ₂ (tpd)
PM10_OSD	N	10	4	OSD PM ₁₀ (tpd)
PM25_OSD	N	10	4	OSD PM _{2.5} (tpd)
NH3_OSD	N	10	6	OSD NH ₃ (tpd)
SOA_OSD	N	10	6	OSD SOA (tpd)
VOC_EMF	N	11	4	VOC Emission Factor
NOX_EMF	N	11	4	NO _x Emission Factor
CO_EMF	N	11	4	CO Emission Factor
SO2_EMF	N	11	4	SO ₂ Emission Factor
PM10_EMF	N	11	4	PM ₁₀ Emission Factor
PM25_EMF	N	11	4	PM _{2.5} Emission Factor
NH3_EMF	N	11	4	NH ₃ Emission Factor
VOC_CE	N	7	2	VOC Control Efficiency
NOX_CE	N	7	2	NO _x Control Efficiency
CO_CE	N	7	2	CO Control Efficiency
SO2_CE	N	7	2	SO ₂ Control Efficiency
PM10_CE	N	7	2	PM ₁₀ Control Efficiency
PM25_CE	N	7	2	PM _{2.5} Control Efficiency
NH3_CE	N	7	2	NH ₃ Control Efficiency
VOC_RE	N	3	0	VOC Rule Effectiveness

Table IV-8 (continued)

Variable	Type	Length	Decimals	Description
NOX_RE	N	3	0	NO _x Rule Effectiveness
CO_RE	N	3	0	CO Rule Effectiveness
SO2_RE	N	3	0	SO ₂ Rule Effectiveness
PM10_RE	N	3	0	PM ₁₀ Rule Effectiveness
PM25_RE	N	3	0	PM _{2.5} Rule Effectiveness
NH3_RE	N	3	0	NH ₃ Rule Effectiveness
VOC_RP	N	6	2	VOC Rule Penetration
NOX_RP	N	6	2	NO _x Rule Penetration
CO_RP	N	6	2	CO Rule Penetration
SO2_RP	N	6	2	SO ₂ Rule Penetration
PM10_RP	N	6	2	PM ₁₀ Rule Penetration
PM25_RP	N	6	2	PM _{2.5} Rule Penetration
NH3_RP	N	6	2	NH ₃ Rule Penetration

Table IV-9
Source Categories to which Crustal Factor was Applied to PM₁₀ and PM_{2.5}
Emissions in EPS 2.5 Emissions Processor Input Files

Sector/SCC	Source Category Description
Mobile Sources/Aircraft	
227508xxxx	Unpaved Airstrips
Mobile Sources/Paved Roads	
2294xxxxxx	Paved Roads
Mobile Sources/Unpaved Roads	
2296xxxxxx	Unpaved Roads
Industrial Processes/Construction (SIC codes 15 - 17)	
23110001xx	All Processes: Wind Erosion
23110101xx	General Building Construction: Wind Erosion
23110201xx	Heavy Construction: Wind Erosion
23110301xx	Road Construction: Wind Erosion
23110401xx	Special Trade Construction: Wind Erosion
Miscellaneous Area Sources/Agriculture Production - Crops	
28010xxxxx	Agriculture - Crops
28017xxxxx	Fertilizer Application
Miscellaneous Area Sources/Agriculture Production - Livestock	
2805xxxxxx	Agriculture Production - Livestock

Table IV-10
Area/Nonroad EPS 2.5 Emissions Processor Input File Structure

Variable	Type	Length	Decimals	Description
FIPSST	C	2	0	FIPS State Code
FIPSCNTY	C	3	0	FIPS county Code
SCC	C	10	0	AMS Source Category Code
VOC	N	12	4	Annual VOC Emissions (tpy)
NOX	N	12	4	Annual NO _x Emissions (tpy)
CO	N	12	4	Annual CO Emissions (tpy)
SO2	N	12	4	Annual SO ₂ Emissions (tpy)
PM10	N	12	4	Annual PM ₁₀ Emissions (tpy)
PM25	N	12	4	Annual PM _{2.5} Emissions (tpy)
SOA	N	12	4	Annual SOA Emissions (tpy)
NH3	N	12	4	Annual NH ₃ Emissions (tpy)

**Table IV-11
Area/Nonroad EMS-95 Emissions Processor Input File Structure**

Variable	Type	Length	Decimals	Description
Area File:				
STID	N	2	0	FIPS State Code
CYID	N	3	0	FIPS County Code
ASCT	C	15	0	Area Source Category
POLID	C	5	0	Pollutant ID
ACEF	N	13	0	Actual Emission Factor (tons/process unit)
ALEF	N	13	0	Allowable Emission Factor (tons/process unit)
ACEE	N	13	0	Actual Emissions (tons)
ALEE	N	13	0	Allowable Emissions (tons)
PCEC	C	5	0	Primary Control Equipment
SCEC	C	5	0	Secondary Control Equipment
CEEF	N	7	4	Control Equipment Efficiency (%)
ESTT	C	2	0	Temporal Basis (AA or AD)
Temporal File:				
STID	N	2	0	FIPS State Code
CYID	N	3	0	FIPS County Code
ASCT	C	15	0	Area Source Category
PRRT	N	13	0	Annual Process Rate (process units/year)
ACUN	C	15	0	Activity Units
DEC	N	5	3	Fractional December Throughput
JAN	N	5	3	Fractional January Throughput
FEB	N	5	3	Fractional February Throughput
MAR	N	5	3	Fractional March Throughput
APR	N	5	3	Fractional April Throughput
MAY	N	5	3	Fractional May Throughput
JUN	N	5	3	Fractional June Throughput
JUL	N	5	3	Fractional July Throughput
AUG	N	5	3	Fractional August Throughput
SEP	N	5	3	Fractional September Throughput
OCT	N	5	3	Fractional October Throughput
NOV	N	5	3	Fractional November Throughput
WIN	N	3	0	Winter Throughput (Dec - Feb) (%)
SPR	N	3	0	Spring Throughput (Mar - May) (%)
SUM	N	3	0	Summer Throughput (Jun - Aug) (%)
FAL	N	3	0	Fall Throughput (Sep - Nov) (%)
HOURS	N	2	0	Code Value for Hourly Operation
DAYS	N	2	0	Code Value for Daily Operation
WEEKS	N	2	0	Weeks of Operation per Year (weeks/year)
DAYYEAR	N	3	0	Days of Operation per Year (days/year)
HOURYEAR	N	4	0	Hours of Operation per Year (hours/year)

CHAPTER V NONROAD SOURCES

A. 1996 BASE YEAR MASS EMISSIONS INVENTORY

County-level emission estimates for 1996 for the majority of nonroad sources were developed using EPA's draft NONROAD model. Emission estimates for VOC, NO_x, CO, SO₂, PM₁₀, and PM_{2.5} are reported by the model. The NONROAD model does not estimate NH₃ and SOA emissions; therefore, these emissions were calculated outside the model. Aircraft, commercial marine, and locomotives are not presently included in the NONROAD model, and the procedures to develop emission estimates for these categories are discussed separately.

1. NONROAD Model Equipment Categories

The NONROAD model estimates pollutant emissions for the following general equipment categories: (1) agricultural; (2) airport service; (3) light commercial; (4) construction and mining; (5) industrial; (6) lawn and garden; (7) logging; (8) pleasure craft; (9) railway maintenance; and (10) recreational equipment. These applications are further classified according to fuel and engine type [diesel, gasoline 2-stroke, gasoline 4-stroke, compressed natural gas (CNG), and liquified petroleum gas (LPG)].

The base year nonroad mass emissions inventory for the HDD rulemaking was developed from two emission inventories including: 1) an existing 1996 county-level inventory, based on EPA's April 1999 draft NONROAD model; and 2) an updated national inventory, based on EPA's June 2000 draft version of the NONROAD model.

To develop the original 1996 county-level inventory, NONROAD model input files were prepared for each State to account for the average statewide temperatures and Reid vapor pressure (RVP) for four seasons, including summer, fall, winter, and spring. Input files were also generated to account for county-level differences in RVP, fuel characteristics due to reformulated gasoline (RFG) and oxygenated fuel programs, and Stage II controls. Emissions calculated for counties with fuel characteristic and control data that varied from statewide average values replaced emissions for these same counties generated by running the default input files. Typical SSD emissions were estimated by dividing total summer season emissions by 92 days.

This 1996 county-level emissions inventory was then updated to reflect revisions made to the NONROAD model since the April 1999 version. Using the June 2000 draft NONROAD model, national, seasonal emissions were generated at the SCC level for the following pollutants: VOC, NO_x, SO₂, CO, PM₁₀, and PM_{2.5}. The results for three seasonal runs (i.e., summer, winter, fall/spring combined) were summed to calculate annual emissions. Additional NONROAD model runs were performed to estimate typical summer weekday emissions as well. To account

for lower diesel fuel sulfur levels in California, separate runs were performed for this State for diesel-fueled equipment SCCs. Tables V-1a and V-1b present a summary of the input values used for the national NONROAD model runs.

**Table V-1a
Temperature and RVP Inputs for National NONROAD Model Runs¹**

Season	Input²	Value
Summer	RVP (psi)	8.1
	Min Temp (°F)	62
	Max Temp (°F)	82
	Average Temp (°F)	72
Fall/Spring	RVP (psi)	9.7
	Min Temp (°F)	43
	Max Temp (°F)	63
	Average Temp (°F)	53
Winter	RVP (psi)	13.1
	Min Temp (°F)	24
	Max Temp (°F)	44
	Average Temp (°F)	34
Typical Summer Weekday	RVP (psi)	8.1
	Min Temp (°F)	62
	Max Temp (°F)	82
	Average Temp (°F)	72

¹ The input values presented were the same for both base and control cases and for all years. The control case input values were the same for all three projection years (no control case was developed for 1996).

² Values for minimum, maximum, and average temperature are expressed in degrees Fahrenheit (°F).

**Table V-1b
Diesel Fuel Sulfur Input Values for National NONROAD Model Runs¹**

Year	Fuel Sulfur, ppm	
	Base case²	Control case³
1996	2527	Not applicable
2007	2654	2579
2020	2733	2667
2030	2770	2708

¹ Diesel fuel sulfur does not change seasonally. NONROAD runs were done using fuel sulfur inputs of 2859 ppm and 2808 ppm, for the base and control case, respectively. SO₂ output values, but not PM, were then adjusted to represent the values as listed for each year.

² For California base case runs, a diesel fuel sulfur content of 120 ppm was used for all seasons.

³ For California control case runs, a diesel fuel sulfur content of 103 ppm was used for all seasons.

SCC-specific ratios were calculated by dividing the updated national, annual emission estimates by the previous 1996 national values (i.e., based on the April 1999 version of NONROAD). County-level emissions were then calculated by multiplying each record in the existing 1996 inventory by the appropriate ratio for each SCC. In this manner, the county-level distribution of the existing 1996 inventory is normalized to the updated national, SCC-level totals for 1996. California diesel equipment emissions were also updated. Based on the results of the separate California NONROAD model runs, state-level, SCC emission ratios were calculated by dividing the updated California diesel emission estimates by the previous 1996 California values. These ratios were applied to existing county-level records for California, and the resulting emissions were incorporated into the 1996 mass emissions inventory.

Similar to annual emission ratios, SSD ratios were first developed by dividing updated SSD emissions by previous SSD emissions. However, when SSD ratios were applied to certain records, new SSD emission values were calculated that were larger than the corresponding annual emissions. This was occurring because SSD values had been calculated differently in the April 1999 data base (i.e., they had previously been calculated by dividing summer season emissions by 92, as opposed to performing separate runs for a typical summer day). To adjust this result, and to ensure that the total national SSD emissions were equivalent to what EPA's Office of Transportation and Air Quality (OTAQ) had originally provided, county-level SSD emissions were calculated by multiplying national SSD emissions by the ratio of county level annual emissions to national level annual emissions. This is shown in the formula below:

$$SSD_{county} = SSD_{national} \times (Annual_{county} \div Annual_{national})$$

Additional adjustments to the 1996 NONROAD emissions inventory included: 1) applied additional factors to SO₂ emissions to account for the true fuel sulfur level as a result of low sulfur diesel fuel spillover (i.e., as shown in Table V-1b); and 2) revised county-level emissions for air conditioning (AC)/refrigeration and railway maintenance in Suffolk County, MA to correct an error in the original equipment populations used to estimate emissions.

Finally, new SCCs have been added to the most recent version of NONROAD. Since the April 1999 county-level data base did not include these SCCs, surrogate SCCs were assigned to the new SCCs to use in allocating national emissions to the county-level. The additional SCCs and each corresponding surrogate SCC are shown in Table V-2.

2. Emission Estimates for Aircraft, Commercial Marine Vessels, and Locomotives

Base year aircraft and locomotive emissions were taken from the existing 1996 NET inventory (EPA, 2000a).

Hydrocarbon (HC), NO_x, CO, and total PM national emission estimates for commercial marine diesel engines were provided by OTAQ. VOC was calculated by multiplying HC emissions by a factor of 1.053. PM₁₀ was assumed to be equivalent to PM, and PM_{2.5} was estimated by multiplying PM₁₀ emissions by a factor of 0.92. The new national estimates

**Table V-2
Surrogate SCC Assignments for New SCCs in June 2000 NONROAD Model**

Additional SCCs	Description	Surrogate SCC	Description
2260002054	Gasoline, 2-Stroke Construction Equipment Crushing/Processing Equipment	2265002054	Gasoline, 4-Stroke Construction Equipment Crushing/Processing Equipment
2260005050	Gasoline, 2-Stroke Farm Equipment Hydro Power Units	2265005050	Gasoline, 4-Stroke Farm Equipment Hydro Power Units
2265001020	Gasoline, 4-Stroke Recreational Vehicles Snowmobiles	2260001020	Gasoline, 2-Stroke Recreational Vehicles Snowmobiles
2265007015	Gasoline, 4-Stroke Logging Equipment Skidders	2270007015	Diesel Logging Equipment Skidders
2267005055	LPG Farm Equipment Other Agricultural Equipment	2265005055	Gasoline, 4-Stroke Farm Equipment Other Agricultural Equipment
2268002081	CNG Construction Equipment Other Construction Equipment	2265002081	Gasoline, 4-Stroke Construction Equipment Other Construction Equipment
2268003020	CNG Industrial Equipment Forklifts	2265003020	Gasoline, 4-Stroke Industrial Equipment Forklifts
2268003040	CNG Industrial Equipment Other General Industrial Equipment	2265003040	Gasoline, 4-Stroke Industrial Equipment Other General Industrial Equipment
2268003070	CNG Industrial Equipment Terminal Tractors	2265003070	Gasoline, 4-Stroke Industrial Equipment Terminal Tractors
2268005050	CNG Farm Equipment Hydro Power Units	2265005050	Gasoline, 4-Stroke Farm Equipment Hydro Power Units
2268005055	CNG Farm Equipment Other Agricultural Equipment	2265005055	Gasoline, 4-Stroke Farm Equipment Other Agricultural Equipment
2268006015	CNG Light Commercial Air Compressors	2265006015	Gasoline, 4-Stroke Light Commercial Air Compressors

were distributed to counties using the geographic distribution in the existing 1996 NET data base.

3. Methodologies for NH₃ and SOA

Ammonia emissions were adjusted based on updated national, SCC-level fuel consumption estimates for diesel and gasoline engines, as reported by the June 2000 draft version of NONROAD. Fuel consumption estimates were not available for LPG- and CNG-fueled equipment. As with the criteria pollutant emission estimates, SCC-specific ratios were developed by dividing updated fuel consumption values by previous fuel consumption values. NH₃ emissions for California were also recalculated using updated diesel fuel consumption values generated for California-specific runs. Once a county-level data base of fuel consumption was developed, emission factors provided by OTAQ were then applied to these activity data to

estimate NH₃ emissions. The emission factors were derived primarily from light-duty on-road vehicle emission measurements, and extrapolated to nonroad engines on a fuel consumption basis. NH₃ emissions for diesel engines were calculated by multiplying diesel fuel consumption by an emission factor of 165.86 milligrams/gallon. NH₃ emissions from gasoline engines (without catalysts) were calculated by multiplying gasoline consumption by an emission factor of 153.47 milligrams/gallon.

For aircraft, commercial marine, and locomotive categories, national fuel consumption estimates for 1996 were obtained from various sources. Jet fuel and aviation gasoline consumption for general aviation and commercial aircraft were obtained from the “FAA Aviation Forecasts Fiscal Years, 1998-2009,” (FAA, 1998a). For the aircraft categories, NH₃ emission factors developed for diesel engines were applied to all fuel consumption estimates, since aviation gasoline consumption was determined to be relatively small compared to jet fuel, and the aircraft SCCs are not broken down by fuel type. Diesel consumption estimates for locomotives were obtained from “Locomotive Emission Standards - Regulatory Support Document (RSD),” (EPA, 1997). For commercial marine, data for distillate and residual fuel oil were reported in “Fuel Oil and Kerosene Sales,” (EIA, 1996).

Secondary organic aerosol emissions were calculated by applying the appropriate fractional aerosol coefficient to annual and SSD VOC emissions (Grosjean and Seinfeld, 1989). Default assignments were made to new nonroad SCCs that had not been previously assigned SOA fractions.

B. 2007, 2020, AND 2030 FUTURE YEAR MASS EMISSIONS INVENTORIES

The methods for developing base case and control scenario projection year inventories for nonroad sources are described in this section. Table V-3 provides a summary of the projection methods, as well as growth indicators, used for each nonroad equipment category.

1. Nonroad Model Equipment Categories

For NONROAD model categories, emission estimates for projection years were developed using a method comparable to that for the base year. First, three seasonal (i.e., summer, winter, and fall/spring combined) NONROAD model runs were performed at the national level. Seasonal runs accounted for differences in average seasonal temperature, as well as RVP. Second, year-specific ratios were calculated by dividing national SCC-level emission estimates for 2007, 2020, and 2030 by the 1996 national values. County-level estimates were then calculated for 2007, 2020, and 2030 by multiplying each ratio times the 1996 county-level emissions inventory. In this manner, the county-level distribution assumed for the 1996 inventory is normalized to the updated national, SCC-level totals for each projection year. As with the base year, separate NONROAD model runs were done for California diesel-fueled SCCs. Additional runs were also performed to estimate typical summer weekday emissions for each projection year.

**Table V-3
Growth Indicators/Projection Methods for Nonroad Sources**

Nonroad SCC	SCC Description	Growth Indicator
2260xxxxxx	2-stroke gasoline	Not applicable ¹
2265xxxxxx	4-stroke gasoline	
2267xxxxxx	CNG	
2268xxxxxx	LPG	
2270xxxxxx	Diesel	
2282xxxxxx	Recreational marine	
2285xxx015	Railway maintenance	
2275050000, 2275060000 2275020000, 2275070000	General Aviation and Air Taxis Commercial Aircraft and Auxiliary Power Units	Landing-Takeoff Operations (LTOs) for total aircraft operations
2275001xxx	Military Aircraft	992 - Federal, Military
2275085xxx	Unpaved Airstrips	SIC 45 - Air Transportation
2275900xxx	Aircraft Refueling	SIC 45 - Air Transportation
2280002xxx	Commercial Marine - Diesel Vessels	SIC 44 - Water Transportation ²
2280001xxx, 2280003xxx, 2280004xxx	Commercial Marine - Coal, Residual Oil, and Gas-fired Vessels	SIC 44 - Water Transportation
2283xxxxxx	Military Marine Vessels	992 - Federal, Military
2285xxxxxx	Locomotives	No growth ³

¹ Projection year emission estimates were derived from national NONROAD model runs allocated to counties based on the geographic distribution of a 1996 county-level inventory, developed from the April 1999 draft version of NONROAD.

² SO₂ and NH₃ emissions were projected using growth factors; projection year estimates for all other pollutants provided by OTAQ.

³ SO₂ and NH₃ emissions for projection years assumed to remain constant at 1996 uncontrolled levels; controlled projection year estimates for all other pollutants provided by OTAQ.

In addition to a base case scenario, control case emission inventories were developed for each projection year to account for the effects of proposed HDDV reductions in diesel sulfur content. Table V-1b presents the diesel fuel sulfur values assumed for the base case and control case scenario. Separate runs were performed for California to account for the lower diesel fuel sulfur content in this State (i.e., 120 ppm for the base case, and 103 ppm for the control scenario).

Similar adjustments were made to projection year NONROAD model inventories as were made for the 1996 base year nonroad inventory. These adjustments included: (1) calculating county SSD emissions by multiplying national SSD emissions by the ratio of county to national annual emissions, for each SCC; (2) applying additional factors to SO₂ emissions to account for the true fuel sulfur level as a result of low sulfur diesel fuel spillover (i.e., as shown in Table V-1b); and (3) revising emissions for AC/refrigeration and railway maintenance in Suffolk County, MA to correct an error in the original equipment populations.

a. Growth Assumptions

Nonroad category emissions have typically been projected using economic indicators that are believed to correlate to nonroad equipment activity. For example, nonroad agricultural equipment emissions have been grown in the past using BEA GSP projections for SIC code 01, which corresponds to the farm industry. However, instead of using economic indicators to project emissions or nonroad activity, the current version of the NONROAD model predicts future year nonroad equipment populations by extrapolating from a linear regression of historical equipment populations. Because total activity is never directly measured, the historical trend in population must be used as a surrogate. A time-series analysis using historic equipment populations is believed to better reflect market trends within each sector (e.g., a shift from gasoline-fueled equipment to diesel-fueled equipment). Accurately estimating the relative distribution of different engine types in the future is important since diesel and gasoline engines have distinct emission characteristics. This approach, however, is not planned to be used for all equipment types in the final version of the NONROAD model. Some exceptions include oil field equipment and aircraft ground support equipment, which will rely on BEA GSP data and Federal Aviation Administration (FAA) LTO data, respectively.

b. Control Assumptions

The NONROAD model accounts for the effect of Federal nonroad engine emission standards which are final, or proposed standards soon expected to be final. The emission levels associated with compression-ignition (CI) and spark-ignition (SI) engine standards are incorporated into emission factors, which are then applied to future year nonroad equipment populations. The control programs accounted for by the NONROAD model include: (1) Tier 1, Tier 2 and Tier 3 CI standards for diesel engines greater than 50 horsepower (hp); (2) Tier 1 and Tier 2 CI standards for diesel engines below 50 hp; (3) Phase I and Phase 2 of the SI standards for gasoline engines less than 25 hp; (4) recreational SI marine engine controls.

engines subject to the Tier 1, Tier 2, and Tier 3 standards are presented in Table V-4. Base year and controlled steady-state emission factors for SI engines below 25 hp (19 kilowatts) are presented in Table V-5. Additional details on the control levels reflected in NONROAD for future years for these categories, as well as SI recreational marine engines, are presented in technical reports that serve as supporting documentation for NONROAD model inputs (EPA, 1999 and EPA, 1999a). Compression-ignition engine emission factor values listed in Table V-4 reflect revisions made to the NONROAD model since the April 1999 draft version, which are documented in an EPA memorandum dated May 31, 2000 (EPA, 2000b).
Steady-state emission factors for various horsepower ranges of CI

The impact of RFG in the appropriate counties is reflected in the 1996 base year county-level inventory, in that the fuel RVP and percent oxygen were adjusted, as described in section V.A.1, for counties subject to RFG and oxygenated fuels requirements. No further adjustments were made to account for the use of RFG in future years.

**Table V-4
Steady-State Emission Factors for CI Engines in the NONROAD Model**

Engine Power (hp)	Model Year	Regulation	Emission Factors (g/hp-hr)			
			HC	CO	NO _x	PM ¹
>0 to 11	88-99	–	1.5	5.0	10.0	1.0
	00-04	Tier 1	0.3	4.1	5.6	0.52
	05-	Tier 2	0.3	4.1	4.3	0.44
>11 to 25	88-99	–	1.7	5.0	8.5	0.9
	00-04	Tier 1	0.2	1.3	4.0	0.36
	05-	Tier 2	0.2	1.3	4.3	0.36
>25 to 50	88-98	–	1.8	5.0	6.9	0.8
	99-03	Tier 1	0.13	1.8	4.8	0.38
	04-	Tier 2	0.13	1.8	4.3	0.32
>50 to 100	88-97	–	1.0	3.5	6.9	0.72
	98-03	Tier 1	0.56	2.0	5.3	0.37
	04-07	Tier 2	0.36	2.0	4.7	0.24
	08-	Tier 3	0.18	2.0	3.0	0.24
>100 to 175	88-96	–	0.7	2.7	8.4	0.4
	97-02	Tier 1	0.4	1.1	5.9	0.22
	03-06	Tier 2	0.36	1.1	4.1	0.18
	07-	Tier 3	0.18	1.1	2.5	0.18
>175 to 300	88-95	–	0.7	2.7	8.4	0.4
	96-02	Tier 1	0.35	0.8	5.8	0.19
	03-05	Tier 2	0.35	0.8	4.0	0.12
	06-	Tier 3	0.18	0.8	2.5	0.12
>300 to 600	88-95	–	0.7	2.7	8.4	0.4
	96-00	Tier 1	0.22	0.8	5.8	0.12
	01-05	Tier 2	0.22	0.8	4.1	0.12
	06-	Tier 3	0.18	0.8	2.5	0.12
>600 to 750	88-95	–	0.7	2.7	8.4	0.4
	96-01	Tier 1	0.2	1.2	5.8	0.14
	02-05	Tier 2	0.2	1.2	4.1	0.12
	06-	Tier 3	0.18	1.2	2.5	0.12
>750	88-99	–	0.7	2.7	8.4	0.4
	00-05	Tier 1	0.2	1.1	5.8	0.13
	06-	Tier 2	0.2	1.1	4.1	0.12

¹ PM₁₀ is assumed to be equivalent to PM.

**Table V-5
Emission Factors for SI Engines Below 25 hp**

Engine Tech Type	HC	CO	NO_x	PM¹	BSFC
<i>Class III Engine Emissions for New Engines (g/kW-hr)</i>					
Gas 2-stroke handheld Class III, baseline	350	964	1.30	10.33	830
Phase 1	295	644	1.05	10.33	720
Phase 1 with catalyst	295	644	1.05	10.33	720
Phase 2	44	380	1.22	10.33	500
Phase 2 with catalysts	36	190	2.00	10.33	500
<i>Class IV Handheld New Engine Emissions (g/kW-hr)</i>					
Gas 2-stroke handheld Class IV, baseline	350	964	1.26	10.33	830
Phase 1	241	546	0.688	10.33	720
Phase 1 with catalyst	241	546	0.688	10.33	720
Phase 1 4-stroke	30	715	2.40	0.08	515
Phase 2	44	380	1.22	10.33	500
Phase 2 with catalysts	36	190	2.00	10.33	500
Phase 2 4-stroke	35	580	1.51	0.08	515
<i>Class V Handheld New Engine Emissions (g/kW-hr)</i>					
Gas 2-stroke handheld Class V, baseline	214	696	1.30	10.33	560
Phase 1	161	471	2.436	10.33	529
Phase 1 with catalyst	161	471	2.436	10.33	529
Phase 2	64	380	1.22	10.33	370
Phase 2 with catalysts	54	190	2.00	10.33	370
<i>Class I Nonhandheld New Engine Emissions (g/kW-hr)</i>					
Gas 2-stroke nonhandheld Class I, baseline	279	651	0.39	10.33	529
Gas, side-valved, 4-stroke nonhandheld Class I, baseline	52	578	2.68	0.080	830
Gas, overhead-valved, 4-stroke nonhandheld Class I, baseline	18	548	2.41	0.080	603
2-stroke, Phase 1	161	603	5.36	10.33	529
Phase 1 side-valved, 4-stroke	11.27	474	4.83	0.080	560
Phase 1 overhead valved 4-stroke	11.27	471	4.34	0.080	475
Phase 1 side-valved, 4-stroke with catalyst	11.27	474	4.83	0.080	560
Phase 2 side-valved	10.63	474	3.17	0.080	560
Phase 2 overhead valved	8.22	471	2.46	0.080	475
<i>Class II Nonhandheld New Engine Emissions (g/kW-hr)</i>					
Gas 2-stroke nonhandheld Class II, baseline	279	651	0.39	10.33	529
Gas, side-valved, 4-stroke nonhandheld Class II, baseline	12.96	578	2.76	0.080	570
Gas, overhead-valved, 4-stroke nonhandheld Class II, baseline	6.97	548	4.69	0.080	570
Phase 1 side-valved, 4-stroke	7.37	519	6.03	0.080	528
Phase 1 overhead valved 4-stroke	6.97	473	4.69	0.080	450
Phase 2 side-valved	7.37	519	6.03	0.080	528
Phase 2 overhead valved	5.58	473	3.72	0.080	450

¹ PM₁₀ is assumed to be equivalent to PM.

2. Emission Estimates for Aircraft, Commercial Marine Vessels, and Locomotives

Aircraft emissions for 2007 were based on the existing NET projections, which used FAA LTO data as the growth surrogate for commercial and civil aircraft. Military aircraft were projected from 1996 using BEA GSP growth factors. Aircraft estimates for the years 2020 and 2030 were also based on existing NET emission estimates, which were developed from commercial and general aviation growth rates from the FAA. Forecasts were only available up to the year 2020 in “Long Range Aviation Forecasts Fiscal Years 2010, 2015, and 2020,” (FAA, 1998b). The annual average growth rate for the period 2015 to 2020 was assumed for estimating growth out to the year 2030. Military aviation activity was assumed to remain constant starting in 2010, so 2010 emissions from the NET were used for 2020 and 2030 estimates for this category. The EPA has promulgated NO_x and CO emission standards for commercial aircraft, but the impacts from these standards are not accounted for in this analysis.

Commercial marine emissions projections were developed similar to the 1996 base year estimates, with updated national commercial marine diesel emissions for 2007, 2020 and 2030 provided by OTAQ being distributed to the county based on the existing 1996 county-level distribution in the NET. These national estimates reflect the effect of Federal emission standards promulgated for new diesel-fueled commercial marine vessels. Commercial gasoline, commercial coal, and military marine emissions were grown from 1996 using BEA GSP growth factors.

Locomotive emission estimates for 2007, 2020 and 2030 were based on corrected emission estimates from the Regulatory Support Document for locomotive emission standards (EPA, 1997). The correction reflects the standards taking effect in 2007, not 2002. This report contained emission projections for all criteria pollutants except for SO₂; therefore, SO₂ estimates from the current NET inventory were used. For the rulemaking support analysis, EPA assumed that future year fuel consumption will remain constant at 1996 levels. It was thought that improvements in the fuel efficiency of locomotives will offset the increase in the amount of freight hauled; therefore, no growth was assumed. The national emission estimates also accounted for future, phased-in controls that will primarily reduce NO_x and PM emissions. These updated national estimates were distributed to the county-level using the existing county allocation in the 1996 NET inventory.

3. Methodologies for NH₃ and SOA

Updated values for national diesel and gasoline fuel consumption, as well as California diesel fuel consumption, were obtained from the June 2000 draft version of the NONROAD model for 2007, 2020, and 2030. Fuel consumption was distributed to counties using the 1996 county-level distribution. County-level fuel consumption estimates were then multiplied by the appropriate emission factor to estimate NH₃ emissions for the projection years. For aircraft, commercial marine, and locomotive categories, 1996 base year NH₃ emissions were projected to future years using the growth indicators listed in Table V-3.

SOA emissions were calculated for projection years using the same method used for the base year. Projected VOC emission estimates were multiplied by the appropriate fractional aerosol coefficient for each SCC.

C. MASS EMISSIONS INVENTORY AND EMISSIONS PROCESSOR INPUT FILES

Nonroad mass emissions were maintained in a separate data base from area source emissions, but the mass emissions file structure is the same for nonroad and area sources. Nonroad emissions are combined with area sources to produce the final emissions processor input files. Refer to Chapter IV for the mass and emissions processor input file names and structures.

CHAPTER VI ON-HIGHWAY VEHICLE SOURCES

A. 1996 BASE YEAR MASS EMISSIONS INVENTORY

This section summarizes the inputs and control programs that were modeled and adjustments that were made to the 1996 on-highway vehicle emissions inventory. The starting point for the 1996 on-highway vehicle emission inventory was the 1996 National Emission Trends highway vehicle emission factor database created in 1998 that was also used in support of EPA's Tier 2 rulemaking. The procedures document for the National Emissions Inventory provides more detail on the inputs contained in that analysis, but some of the key elements of that inventory are summarized here (EPA, 1998b). The 1996 vehicle miles traveled (VMT) used in this HDD analysis also uses the corresponding Trends VMT file as the starting point, with the updates discussed below.

The 1996 VMT data is based on historical 1996 Highway Performance Monitoring System (HPMS) data obtained from the Federal Highway Administration (FHWA, 1997). The HPMS database contains state-level summaries of average annual daily VMT by roadway type and by rural, small urban, and individual urban areas. The small urban and individual urban area VMT combined to make up the total urban VMT. Based on population data from the Bureau of Census (BOC, 1992), the HPMS data were distributed to counties at the roadway type level. A conversion was then made at the national roadway type level to convert the national VMT from the HPMS vehicle categories to the MOBILE5b vehicle type categories. EPA's OTAQ provided a new mapping of the HPMS VMT by vehicle category to the MOBILE5 vehicle categories. This was an update from the VMT mapping used in the 1996 Trends VMT data base. Table VI-1 shows this new HPMS to MOBILE5 VMT allocation by vehicle type. Using the data in the table, national 1996 HPMS VMT, by rural and urban categories, were converted to total fraction of VMT by MOBILE5 vehicle type for rural roads and urban roads. These fractions were then multiplied by the 1996 VMT distributed by county and roadway type to create the new 1996 VMT file by county, roadway type, and vehicle type. Table VI-2 summarizes the resulting VMT data by vehicle type and shows the fraction of VMT in each of the MOBILE5 vehicle categories.

Speeds modeled in this analysis, both in 1996 and the projection years, were constant by vehicle class and functional road class throughout the nation. In other words, the same speeds were modeled in all analysis years, and the speeds depended upon the vehicle type and road type. The origin of these speed data is an analysis performed on output from the HPMS impact analysis for 1990 (FHWA, 1990). Speeds from this analysis year were consistent with speeds from earlier analysis years. Table VI-3 shows the speeds modeled.

**Table VI-1
HPMS to MOBILE5 VMT Vehicle Category Assignments**

HPMS VMT Vehicle Category	MOBILE5 VMT Vehicle Category	1996 VMT Fraction
Motorcycle	MC	1.0000
Passenger Car	LDGV	0.9945
	LDDV	0.0055
Buses	HDGV	0.3077
	HDDV	0.6923
Other 2-axle, 4-tire vehicles	LDGT1	0.6621
	LDGT2	0.2284
	LDDT	0.0054
	HDGV	0.0759
	HDDV	0.0282
Single-unit 2-axle 6-tire or more trucks	HDGV	0.2925
	HDDV	0.7075
Combination trucks	HDGV	0.0000
	HDDV	1.0000

**Table VI-2
National 1996 VMT by Vehicle Type for HDD Analysis**

Vehicle Type	1996 VMT (million miles)	1996 VMT Fractions
LDGV	1,455,403	0.5880
LDGT1	538,255	0.2175
LDGT2	185,684	0.0750
HDGV	82,355	0.0333
LDDV	8,054	0.0033
LDDT	4,388	0.0018
HDDV	190,994	0.0772
MC	9,872	0.0040
Total	2,475,004	1.0000

**Table VI-3
Average Speeds by Road Type and Vehicle Type
(Miles per Hour)**

Rural Roadway Types						
	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 Roadway Types						
	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

Vehicle registration distributions by vehicle age used in the 1996 NET include distributions provided by States through OTAG and the NO_x SIP Call. Areas with no specified registration distribution were modeled with registration distributions by vehicle type developed based on national sales and registration data for 1996. The same registration distributions used in 1996 were also applied in both projection years. These registration distributions by age differ by the MOBILE5b vehicle categories.

Temperatures for 1996 were based on the average historical 1996 monthly maximum and minimum daily temperatures reported in a city selected to be representative of temperatures within a given State. Emission factors were calculated at the monthly level using these monthly temperatures. Monthly RVP data were also used in the MOBILE5b inputs. These inputs were based on January and July RVP data from American Automobile Manufacturers Association's (AAMA's) fuel surveys (AAMA, 1996), and then allocated by month and area. More details on the temperature inputs and the RVP allocation procedures can be found in the Trends procedures document (EPA, 1998b).

In addition to the inputs described above, control programs were modeled in 1996, as discussed below.

1. Inspection and Maintenance (I/M) Programs

Inspection and maintenance (I/M) programs were modeled in areas with such programs in place in 1996. The actual I/M inputs and the counties included in these programs were based on data collected in the OTAG process, as well as from state-level I/M program summary information provided by OTAQ (Somers, 1997a). The vehicle types affected by these programs vary by area but can include light-duty gasoline vehicles (LDGVs) and trucks (LDGT1s and LDGT2s) and heavy-duty gasoline vehicles (HDGVs).

2. RFG

Phase 1 of the Federal RFG program was modeled in the 1996 MOBILE5b inputs. The areas and counties that were modeled with RFG are shown in Table VI-4. Data on the RFG coverage was provided by OTAQ. The summertime RFG benefits were applied from May through September, while the winter RFG benefits were applied in the remaining months. California was modeled with the benefits of the Federal RFG program applied Statewide.

3. Oxygenated Gasoline

Oxygenated gasoline was modeled in the areas participating in this program in 1996. A listing of these areas was provided by OTAQ (Somers, 1997b), along with the months that the oxygenated gasoline program was in place in these areas and the market share of ether and alcohol blends. The average oxygen content of ether blend fuels was assumed to be 2.7 percent in all oxygenated gasoline areas and the average oxygen content of alcohol blend fuels was assumed to be 3.5 percent in all oxygenated gasoline areas. Table VI-5 lists the counties modeled with oxygenated gasoline and the corresponding fuel parameters.

4. Low Emission Vehicle (LEV) Programs

In the 1996 analysis year, LEV programs were modeled in California, Massachusetts, and New York. The California program was modeled with a 1994 start year, using the MOBILE5 default LEV schedule. The LEV programs in Massachusetts and New York were modeled with start years of 1995 and 1996, respectively, with 15 percent of 1995 model year new vehicle sales (in Massachusetts only) meeting the intermediate Transitional LEV (TLEV) emission standards, 20 percent of 1996 model year new vehicle sales meeting the TLEV emission standards, and the remaining new vehicle sales meeting the Federal Tier I emission standards. The LEV programs affect LDGVs and LDGT1s.

**Table VI-4
Counties Modeled with Federal Reformulated Gasoline (RFG)**

State/ Nonattainment Area	County	State/ Nonattainment Area	County
Arizona (Southern RFG)		Maine (Northern RFG)	
Phoenix		Knox & Lincoln Counties	
	Maricopa Co		Knox Co
Connecticut (Northern RFG)			Lincoln Co
Greater Connecticut		Lewiston-Auburn	
	Hartford Co		Androscoggin Co
	Litchfield Co		Kennebec Co
	Middlesex Co	Portland	
	New Haven Co		Cumberland Co
	New London Co		Sagadahoc Co
	Tolland Co		York Co
	Windham Co	Maryland (Southern RFG)	
New York-Northern New Jersey-Long Island		Baltimore	
Fairfield Co			Anne Arundel Co
District of Columbia (Southern RFG)			Baltimore
Washington DC			Baltimore Co
	Washington		Carroll Co
Delaware (Northern RFG)			Harford Co
Philadelphia-Wilmington-Trenton			Howard Co
	Kent Co	Kent & Queen Annes Counties	
	New Castle Co		Kent Co
Sussex County			Queen Annes Co
	Sussex Co	Philadelphia-Wilmington-Trenton	
Illinois (Northern RFG)			Cecil Co
Chicago-Gary-Lake County		Washington DC	
	Cook Co		Calvert Co
	Du Page Co		Charles Co
	Grundy Co		Frederick Co
	Kane Co		Montgomery Co
	Kendall Co		Prince Georges Co
	Lake Co	Massachusetts (Northern RFG)	
	McHenry Co	Boston-Lawrence-Worcester-Eastern MA	
	Will Co		Barnstable Co
Indiana (Northern RFG)			Bristol Co
Chicago-Gary-Lake County			Dukes Co
	Lake Co		Essex Co
	Porter Co		Middlesex Co
Kentucky (Northern RFG)			Nantucket Co
Cincinnati-Hamilton			Norfolk Co
	Boone Co		Plymouth Co
	Campbell Co		Suffolk Co
	Kenton Co		Worcester Co
Louisville		Springfield/Pittsfield-Western MA	
	Bullitt Co		Berkshire Co
	Jefferson Co		Franklin Co

Table VI-4 (continued)

State/	Nonattainment Area	County	State/	Nonattainment Area	County
		Oldham Co			Hampden Co
					Hampshire Co
New Hampshire (Northern RFG)	Manchester		New York (Northern RFG)	Poughkeepsie	
		Hillsborough Co			Dutchess Co
		Merrimack Co			Putnam Co
	Portsmouth-Dover-Rochester		Pennsylvania (Northern RFG)	Philadelphia-Wilmington-Trenton	
		Rockingham Co			Bucks Co
		Strafford Co			Chester Co
New Jersey (Northern RFG)	Allentown-Bethlehem-Easton				Delaware Co
		Warren Co			Montgomery Co
	Atlantic City				Philadelphia Co
		Atlantic Co	Rhode Island (Northern RFG)	Providence	
		Cape May Co			Bristol Co
	New York-Northern New Jersey-Long Island				Kent Co
		Bergen Co			Newport Co
		Essex Co			Providence Co
		Hudson Co			Washington Co
		Hunterdon Co	Texas (Southern RFG)	Dallas-Fort Worth	
		Middlesex Co			Collin Co
		Monmouth Co			Dallas Co
		Morris Co			Denton Co
		Ocean Co			Tarrant Co
		Passaic Co		Houston-Galveston-Brazoria	
		Somerset Co			Brazoria Co
		Sussex Co			Chambers Co
		Union Co			Fort Bend Co
	Philadelphia-Wilmington-Trenton				Galveston Co
		Burlington Co			Harris Co
		Camden Co			Liberty Co
		Cumberland Co			Montgomery Co
		Gloucester Co			Waller Co
		Mercer Co			
		Salem Co			
New York (Northern RFG)	New York-Northern New Jersey-Long Island		Virginia (Southern RFG)	Norfolk-Virginia Beach-Newport News	
		Bronx Co			Chesapeake
		Kings Co			Hampton
		Nassau Co			James City Co
		New York Co			Newport News
		Orange Co			Norfolk
		Queens Co			Poquoson
		Richmond Co			Portsmouth
		Rockland Co			Suffolk
		Suffolk Co			Virginia Beach
		Westchester Co			Williamsburg

Table VI-4 (continued)

State/ Nonattainment Area	County	State/ Nonattainment Area	County
Virginia (Southern RFG) Richmond-Petersburg	Charles City Co Chesterfield Co Colonial Heights Hanover Co Henrico Co Hopewell Richmond	Wisconsin (Northern RFG) Milwaukee-Racine	York Co Kenosha Co Milwaukee Co Ozaukee Co Racine Co Washington Co Waukesha Co
Washington DC	Alexandria Arlington Co Fairfax Fairfax Co Falls Church Loudoun Co Manassas Manassas Park Prince William Co Stafford Co		

NOTE: Federal reformulated gasoline was modeled statewide in California. Certain RFG fuel property requirements differ depending on whether an area receives Northern or Southern RFG.

**Table VI-5
Oxygenated Gasoline Modeling Parameters**

State	County	Market Shares (%)		Oxygen Content (%)		Oxygenated Gasoline Season
		MTBE	Alcohol Blends	MTBE	Alcohol Blends	
Alaska	Anchorage Ed	0	100	2.7	3.5	NOV-FEB (2007, 2020, & 2030)
Alaska	Anchorage Ed	0	100	2.7	3.5	NOV-DEC (1996 only)
Arizona	Maricopa Co	80	20	2.7	3.5	OCT-FEB
Colorado	Adams Co	75	25	2.7	3.5	NOV-FEB
Colorado	Arapahoe Co	75	25	2.7	3.5	NOV-FEB
Colorado	Boulder Co	75	25	2.7	3.5	NOV-FEB
Colorado	Douglas Co	75	25	2.7	3.5	NOV-FEB
Colorado	Jefferson Co	75	25	2.7	3.5	NOV-FEB
Colorado	Denver Co	75	25	2.7	3.5	NOV-FEB
Colorado	El Paso Co	75	25	2.7	3.5	NOV-FEB
Colorado	Larimer Co	75	25	2.7	3.5	NOV-FEB
Connecticut	Fairfield Co	90	10	2.7	3.5	NOV-FEB
Minnesota	Anoka Co	10	90	2.7	3.5	OCT-JAN
Minnesota	Carver Co	10	90	2.7	3.5	OCT-JAN
Minnesota	Dakota Co	10	90	2.7	3.5	OCT-JAN
Minnesota	Hennepin Co	10	90	2.7	3.5	OCT-JAN
Minnesota	Ramsey Co	10	90	2.7	3.5	OCT-JAN
Minnesota	Scott Co	10	90	2.7	3.5	OCT-JAN
Minnesota	Washington Co	10	90	2.7	3.5	OCT-JAN
Minnesota	Wright Co	10	90	2.7	3.5	OCT-JAN
Minnesota	Chisago Co	10	90	2.7	3.5	OCT-JAN
Minnesota	Isanti Co	10	90	2.7	3.5	OCT-JAN
Montana	Missoula Co	0	100	2.7	3.5	NOV-FEB
Nevada	Clark Co	0	100	2.7	3.5	OCT-MAR
Nevada	Washoe Co	95	5	2.7	3.5	OCT-JAN
New Jersey	Bergen Co	95	5	2.7	3.5	NOV-FEB
New Jersey	Essex Co	95	5	2.7	3.5	NOV-FEB
New Jersey	Hudson Co	95	5	2.7	3.5	NOV-FEB
New Jersey	Hunterdon Co	95	5	2.7	3.5	NOV-FEB
New Jersey	Mercer Co	95	5	2.7	3.5	JAN-FEB (1996 only)
New Jersey	Middlesex Co	95	5	2.7	3.5	NOV-FEB
New Jersey	Monmouth Co	95	5	2.7	3.5	NOV-FEB
New Jersey	Morris Co	95	5	2.7	3.5	NOV-FEB
New Jersey	Ocean Co	95	5	2.7	3.5	NOV-FEB
New Jersey	Passaic Co	95	5	2.7	3.5	NOV-FEB
New Jersey	Somerset Co	95	5	2.7	3.5	NOV-FEB
New Jersey	Sussex Co	95	5	2.7	3.5	NOV-FEB
New Jersey	Union Co	95	5	2.7	3.5	NOV-FEB
New Mexico	Bernalillo Co	15	85	2.7	3.5	JAN-FEB (1996 only)
New York	Bronx Co	95	5	2.7	3.5	NOV-FEB
New York	Kings Co	95	5	2.7	3.5	NOV-FEB

State	County	Market Shares (%)		Oxygen Content (%)		Oxygenated Gasoline Season
		MTBE	Alcohol Blends	MTBE	Alcohol Blends	
New York	Nassau Co	95	5	2.7	3.5	NOV-FEB
New York	New York Co	95	5	2.7	3.5	NOV-FEB
New York	Queens Co	95	5	2.7	3.5	NOV-FEB
New York	Richmond Co	95	5	2.7	3.5	NOV-FEB
New York	Rockland Co	95	5	2.7	3.5	NOV-FEB
New York	Suffolk Co	95	5	2.7	3.5	NOV-FEB
New York	Westchester Co	95	5	2.7	3.5	NOV-FEB
New York	Orange Co	95	5	2.7	3.5	NOV-FEB
New York	Putnam Co	95	5	2.7	3.5	NOV-FEB
Oregon	Clackamas Co	1	99	2.7	3.5	NOV-FEB
Oregon	Jackson Co	1	99	2.7	3.5	NOV-FEB
Oregon	Multnomah Co	1	99	2.7	3.5	NOV-FEB
Oregon	Washington Co	1	99	2.7	3.5	NOV-FEB
Oregon	Josephine Co	1	99	2.7	3.5	NOV-FEB
Oregon	Klamath Co	1	99	2.7	3.5	NOV-FEB
Oregon	Yamhill Co	1	99	2.7	3.5	NOV-FEB
Texas	El Paso Co	15	85	2.7	3.5	NOV-FEB
Utah	Utah Co	20	80	2.7	3.5	NOV-FEB
Washington	Clark Co	1	99	2.7	3.5	NOV-FEB
Washington	King Co	1	99	2.7	3.5	JAN-FEB (1996 only)
Washington	Snohomish Co	1	99	2.7	3.5	JAN-FEB (1996 only)
Washington	Spokane Co	1	99	2.7	3.5	SEP-FEB
Wisconsin	St. Croix Co	10	90	2.7	3.5	OCT-JAN

5. MOBILE5 to MOBILE6 Adjustment Factors

VOC, NO_x, and CO on-highway vehicle emission factors were calculated using the above inputs and EPA's MOBILE5b emission factor model. Emission factors for on-highway SO₂, PM₁₀, and PM_{2.5} were calculated using EPA's PART5 model and NH₃ emission factors for on-highway vehicles were calculated using national vehicle-specific emission factors (Harvey, 1983). Various adjustment factors were then applied to the MOBILE5b VOC and NO_x emission factors to simulate emission factors that would result from using MOBILE6, as well as accounting for issues not included in MOBILE5b. Each of these adjustments are discussed below. All of the adjustment factors discussed in these sections were provided by OTAQ.

a. VOC and NO_x Exhaust Adjustments

Adjustment factors to convert the MOBILE5b emission factors to MOBILE6 emission factors were applied to the VOC exhaust and NO_x MOBILE5b output emission factors for LDGVs, LDGT1s, LDGT2s, HDGVs, LDDVs, and LDDTs. These factors varied by vehicle type and by control combination. The control combination included one of three fuel types (conventional gasoline, western gasoline, and reformulated gasoline) and one of three I/M

categories (no I/M, I/M, and appropriate I/M). (An *appropriate I/M* program is defined as one that meets EPA's requirements to be modeled with the maximum LEV benefits.) Each county in the nation was assigned one of these control combinations. The corresponding adjustment factor was then applied to each monthly, vehicle type emission factor for each county in the nation. Table VI-6 lists the exhaust VOC MOBILE5b to MOBILE6 adjustment factors applied in 1996 and the projection years and Table VI-7 lists the NO_x MOBILE5b to MOBILE6 adjustment factors. Both tables are by vehicle type and control combination.

b. Air Conditioning Usage Factors

An additional adjustment was applied to the NO_x LDGV, LDGT1, and LDGT2 emission factors (already adjusted, as above to MOBILE6 emission rates) in 1996. This adjustment accounted for the additional NO_x emissions that would occur with air conditioning usage that is not included in the MOBILE5 emission factors. The air conditioning usage factors consist of two components: a factor simulating full air conditioning usage and a temperature dependent factor that adjusts the full usage factor for usage at the given temperature. These two factors were multiplied and then added to the MOBILE6-adjusted NO_x emission factors. The full usage factor is dependent upon vehicle type and the same control combinations listed with the MOBILE6 adjustments (with the exception that areas with both I/M and appropriate I/M are categorized together for this adjustment). Table VI-8 lists the full usage NO_x air conditioning usage factors. The air conditioning adjustment becomes 0 below temperatures of 68°F. Above temperatures of 109°F, the full usage factor is applied directly. The temperatures used to calculate this adjustment were the ambient temperatures calculated by MOBILE5b and included in the MOBILE5b output files. The temperature dependent equation is as follows:

$$\text{Temp Adj} = -3.631541 + 0.072465 * \text{AMBTEMP} - 0.000276 * (\text{AMBTEMP}^2)$$

This temperature adjustment was then multiplied by the corresponding full usage factor and the result was added to the MOBILE6-adjusted NO_x emission factors.

c. HDDV Adjustment Factors

The final set of adjustment factors applied to the 1996 on-highway vehicle emission inventories is the set of HDDV adjustment factors. These factors account for the emission factor updates from data collected by OTAQ for MOBILE6 for VOC, NO_x, CO, SO₂, PM₁₀, and PM_{2.5} as well as the NO_x emission changes due to the use of the HDDV defeat devices. The factors vary by roadway type, as shown in Table VI-9.

**Table VI-6
Exhaust VOC MOBILE5b to MOBILE6 Adjustment Factors**

Year	Control Combination	Adjustment Factor by Vehicle Type (unitless)					
		LDGV	LDGT1	LDGT2	LDDV	LDDT	HDGV
1996	APP IM CG	0.880	0.896	1.132	1.231	1.385	0.574
	APP IM RFG	0.969	0.973	1.203	1.231	1.385	0.574
	APP IM WEST	0.880	0.896	1.132	1.231	1.385	0.574
	IM CG	0.880	0.896	1.132	1.231	1.385	0.574
	IM RFG	0.969	0.973	1.203	1.231	1.385	0.574
	IM WEST	0.880	0.896	1.132	1.231	1.385	0.574
	NO IM CG	0.787	0.834	1.020	1.231	1.385	0.574
	NO IM RFG	0.870	0.905	1.084	1.231	1.385	0.574
	NO IM WEST	0.787	0.834	1.020	1.231	1.385	0.574
2007	APP IM CG	0.700	0.805	0.758	0.917	0.874	0.431
	APP IM RFG	0.849	0.969	0.973	0.907	0.853	0.431
	APP IM WEST	0.745	0.857	0.828	0.917	0.874	0.431
	IM CG	0.568	0.621	0.758	0.917	0.874	0.431
	IM RFG	0.682	0.742	0.973	0.907	0.853	0.431
	IM WEST	0.605	0.661	0.828	0.917	0.874	0.431
	NO IM CG	0.502	0.545	0.640	0.939	0.907	0.431
	NO IM RFG	0.608	0.652	0.826	0.905	0.881	0.431
	NO IM WEST	0.532	0.575	0.699	0.939	0.907	0.431
2020	APP IM CG	1.496	1.233	0.302	0.319	0.271	0.191
	APP IM RFG	1.751	1.443	0.347	0.288	0.229	0.191
	APP IM WEST	1.499	1.235	0.303	0.319	0.271	0.191
	IM CG	0.297	0.282	0.302	0.319	0.271	0.191
	IM RFG	0.344	0.327	0.347	0.288	0.229	0.191
	IM WEST	0.297	0.282	0.303	0.319	0.271	0.191
	NO IM CG	0.277	0.284	0.263	0.386	0.476	0.191
	NO IM RFG	0.337	0.346	0.309	0.440	0.409	0.191
	NO IM WEST	0.278	0.284	0.264	0.386	0.476	0.191
2030	APP IM CG	1.644	1.509	0.201	0.285	0.266	0.165
	APP IM RFG	1.925	1.766	0.241	0.253	0.222	0.165
	APP IM WEST	1.645	1.511	0.202	0.285	0.266	0.165
	IM CG	0.273	0.258	0.201	0.285	0.266	0.165
	IM RFG	0.321	0.303	0.241	0.253	0.222	0.165
	IM WEST	0.274	0.258	0.202	0.285	0.266	0.165
	NO IM CG	0.263	0.268	0.200	0.355	0.494	0.165
	NO IM RFG	0.324	0.330	0.249	0.422	0.424	0.165
	NO IM WEST	0.263	0.268	0.200	0.355	0.494	0.165

**Table VI-7
NO_x MOBILE5b to MOBILE6 Adjustment Factors**

Year	Control Combination	Adjustment Factor by Vehicle Type (unitless)					
		LDGV	LDGT1	LDGT2	LDDV	LDDT	HDGV
1996	APP IM CG	0.948	0.948	1.037	1.104	1.152	0.908
	APP IM RFG	0.965	0.961	1.045	1.104	1.152	0.908
	APP IM WEST	0.948	0.948	1.037	1.104	1.152	0.908
	IM CG	0.948	0.948	1.037	1.104	1.152	0.908
	IM RFG	0.965	0.961	1.045	1.104	1.152	0.908
	IM WEST	0.948	0.948	1.037	1.104	1.152	0.908
	NO IM CG	0.885	0.875	0.976	1.104	1.152	0.908
	NO IM RFG	0.901	0.886	0.984	1.104	1.152	0.908
	NO IM WEST	0.885	0.875	0.976	1.104	1.152	0.908
2007	APP IM CG	0.724	0.936	0.741	0.740	0.694	0.675
	APP IM RFG	0.761	0.977	0.772	0.739	0.688	0.675
	APP IM WEST	0.748	0.967	0.754	0.740	0.694	0.675
	IM CG	0.590	0.766	0.741	0.740	0.694	0.675
	IM RFG	0.620	0.801	0.772	0.739	0.688	0.675
	IM WEST	0.610	0.791	0.754	0.740	0.694	0.675
	NO IM CG	0.556	0.710	0.652	0.741	0.719	0.675
	NO IM RFG	0.584	0.743	0.679	0.740	0.714	0.675
	NO IM WEST	0.573	0.732	0.663	0.741	0.719	0.675
2020	APP IM CG	0.550	0.471	0.300	0.144	0.158	0.288
	APP IM RFG	0.583	0.497	0.314	0.143	0.155	0.288
	APP IM WEST	0.556	0.476	0.303	0.144	0.158	0.288
	IM CG	0.184	0.212	0.300	0.144	0.158	0.288
	IM RFG	0.195	0.224	0.314	0.143	0.155	0.288
	IM WEST	0.186	0.214	0.303	0.144	0.158	0.288
	NO IM CG	0.235	0.283	0.306	0.234	0.285	0.288
	NO IM RFG	0.250	0.300	0.321	0.226	0.280	0.288
	NO IM WEST	0.238	0.286	0.309	0.234	0.285	0.288
2030	APP IM CG	0.474	0.424	0.180	0.118	0.161	0.208
	APP IM RFG	0.505	0.450	0.189	0.116	0.159	0.208
	APP IM WEST	0.476	0.428	0.184	0.118	0.161	0.208
	IM CG	0.148	0.176	0.180	0.118	0.161	0.208
	IM RFG	0.157	0.187	0.189	0.116	0.159	0.208
	IM WEST	0.149	0.178	0.184	0.118	0.161	0.208
	NO IM CG	0.207	0.252	0.222	0.219	0.303	0.208
	NO IM RFG	0.220	0.267	0.233	0.210	0.298	0.208
	NO IM WEST	0.207	0.254	0.225	0.219	0.303	0.208

**Table VI-8
NO_x Full Usage Air Conditioning Adjustment Factors**

		Adjustment Factor by Vehicle Type (grams/mile)		
Year	Control Combination	LDGV	LDGT1	LDGT2
1996	IM CG	0.321	0.194	0.252
	IM RFG	0.321	0.194	0.252
	IM WEST	0.321	0.194	0.252
	NO IM CG	0.347	0.207	0.266
	NO IM RFG	0.347	0.207	0.266
	NO IM WEST	0.347	0.207	0.266
2007	IM CG	0.195	0.142	0.179
	IM RFG	0.190	0.138	0.176
	IM WEST	0.202	0.146	0.182
	NO IM CG	0.222	0.163	0.195
	NO IM RFG	0.217	0.159	0.192
	NO IM WEST	0.230	0.167	0.198
2020	IM CG	0.063	0.047	0.072
	IM RFG	0.062	0.046	0.071
	IM WEST	0.063	0.047	0.073
	NO IM CG	0.093	0.073	0.099
	NO IM RFG	0.092	0.072	0.097
	NO IM WEST	0.094	0.073	0.099
2030	IM CG	0.055	0.041	0.054
	IM RFG	0.054	0.040	0.053
	IM WEST	0.055	0.041	0.055
	NO IM CG	0.085	0.068	0.083
	NO IM RFG	0.084	0.067	0.082
	NO IM WEST	0.085	0.068	0.084

**Table VI-9
HDDV Base Case Adjustment Factors**

Year	Facility	Description	Adjustment Factor (unitless)				
			VOC	CO	NO _x	PM	SO ₂
1996	Interstate	Rural Interstate	0.6858	0.8030	2.2973	0.8666	0.7063
	Interstate	Rural Other Prin Arterial	0.6858	0.8030	2.2973	0.8666	0.7063
	Interstate	Urban Interstate	0.6858	0.8030	2.2973	0.8666	0.7063
	Interstate	Urban Other Freeways	0.6858	0.8030	2.2973	0.8666	0.7063
	Arterial	Rural Minor Arterial	0.5712	0.6106	1.2723	0.7110	0.6085
	Arterial	Rural Major Collector	0.5712	0.6106	1.2723	0.7110	0.6085
	Arterial	Rural Minor Collector	0.5712	0.6106	1.2723	0.7110	0.6085
	Arterial	Rural Local	0.5712	0.6106	1.2723	0.7110	0.6085
	Urban	Urban Other Prin Arterial	0.5916	0.6275	1.0240	0.7549	0.6268
	Urban	Urban Minor Arterial	0.5916	0.6275	1.0240	0.7549	0.6268
	Urban	Urban Collector	0.5916	0.6275	1.0240	0.7549	0.6268
	Urban	Urban Local	0.5916	0.6275	1.0240	0.7549	0.6268
2007	Interstate	Rural Interstate	0.3750	0.4076	1.6939	0.9564	0.6968
	Interstate	Rural Other Prin Arterial	0.3750	0.4076	1.6939	0.9564	0.6968
	Interstate	Urban Interstate	0.3750	0.4076	1.6939	0.9564	0.6968
	Interstate	Urban Other Freeways	0.3750	0.4076	1.6939	0.9564	0.6968
	Arterial	Rural Minor Arterial	0.3153	0.3191	1.1260	0.7918	0.6077
	Arterial	Rural Major Collector	0.3153	0.3191	1.1260	0.7918	0.6077
	Arterial	Rural Minor Collector	0.3153	0.3191	1.1260	0.7918	0.6077
	Arterial	Rural Local	0.3153	0.3191	1.1260	0.7918	0.6077
	Urban	Urban Other Prin Arterial	0.3090	0.3203	1.0908	0.7924	0.6264
	Urban	Urban Minor Arterial	0.3090	0.3203	1.0908	0.7924	0.6264
	Urban	Urban Collector	0.3090	0.3203	1.0908	0.7924	0.6264
	Urban	Urban Local	0.3090	0.3203	1.0908	0.7924	0.6264
2020	Interstate	Rural Interstate	0.3229	0.3721	1.7099	0.9220	0.6506
	Interstate	Rural Other Prin Arterial	0.3229	0.3721	1.7099	0.9220	0.6506
	Interstate	Urban Interstate	0.3229	0.3721	1.7099	0.9220	0.6506
	Interstate	Urban Other Freeways	0.3229	0.3721	1.7099	0.9220	0.6506
	Arterial	Rural Minor Arterial	0.2499	0.2852	1.3144	0.7506	0.5799
	Arterial	Rural Major Collector	0.2499	0.2852	1.3144	0.7506	0.5799
	Arterial	Rural Minor Collector	0.2499	0.2852	1.3144	0.7506	0.5799
	Arterial	Rural Local	0.2499	0.2852	1.3144	0.7506	0.5799
	Urban	Urban Other Prin Arterial	0.2351	0.2786	1.3130	0.7262	0.6005
	Urban	Urban Minor Arterial	0.2351	0.2786	1.3130	0.7262	0.6005
	Urban	Urban Collector	0.2351	0.2786	1.3130	0.7262	0.6005
	Urban	Urban Local	0.2351	0.2786	1.3130	0.7262	0.6005
2030	Interstate	Rural Interstate	0.3103	0.3658	1.7078	0.9131	0.5948
	Interstate	Rural Other Prin Arterial	0.3103	0.3658	1.7078	0.9131	0.5948
	Interstate	Urban Interstate	0.3103	0.3658	1.7078	0.9131	0.5948
	Interstate	Urban Other Freeways	0.3103	0.3658	1.7078	0.9131	0.5948
	Arterial	Rural Minor Arterial	0.2394	0.2809	1.3586	0.7411	0.5390
	Arterial	Rural Major Collector	0.2394	0.2809	1.3586	0.7411	0.5390
	Arterial	Rural Minor Collector	0.2394	0.2809	1.3586	0.7411	0.5390
	Arterial	Rural Local	0.2394	0.2809	1.3586	0.7411	0.5390
	Urban	Urban Other Prin Arterial	0.2251	0.2746	1.3713	0.7161	0.5606
	Urban	Urban Minor Arterial	0.2251	0.2746	1.3713	0.7161	0.5606
	Urban	Urban Collector	0.2251	0.2746	1.3713	0.7161	0.5606
	Urban	Urban Local	0.2251	0.2746	1.3713	0.7161	0.5606

B. 2007, 2020, AND 2030 FUTURE YEAR MASS EMISSIONS INVENTORIES

This section summarizes the growth assumptions made and control programs applied to calculate the 2007, 2020, and 2030 on-highway vehicle emission inventories. As discussed above, the registration distributions and speeds modeled in 1996 were also used in the projection years. The temperatures modeled in the projection years represented State-specific average monthly maximum and minimum daily temperatures averaged from 1970 through 1997 using data from the National Climatic Data Center. The same temperatures were modeled in 2007, 2020, and 2030.

1. Growth Assumptions

The VMT used in 2007, 2020, and 2030 were projected from 1996, using VMT projection data from EPA's Tier 2 rulemaking (EPA, 1999c). First, VMT from the Tier 2 analysis were totaled by county and vehicle type for 1996 and the projection years. Next, each VMT record from the 1996 data base (at the county, vehicle type, and roadway type level of detail) developed for this HDD rulemaking analysis and discussed earlier in this chapter was multiplied by the ratio of the corresponding Tier 2 projection year VMT to the 1996 Tier 2 VMT (both at the county and vehicle type level of detail). In this manner, the 1996 VMT shifts by vehicle class from the Tier 2 analysis to the HDD analysis were projected to the future using the area and vehicle type-specific growth factors from the Tier 2 analysis. The resulting projection year VMT and the corresponding VMT fractions by vehicle type are shown in Table VI-10.

**Table VI-10
National VMT Projections and VMT Fractions by Vehicle Type for HDD Analysis**

Vehicle Type	Annual VMT (million miles)			VMT Fractions		
	2007	2020	2030	2007	2020	2030
LDGV	1,245,991	1,283,189	1,311,807	0.397	0.329	0.292
LDGT1	1,207,617	1,670,987	2,027,426	0.385	0.428	0.452
LDGT2	268,323	371,876	451,534	0.086	0.095	0.101
HDGV	119,002	165,884	201,948	0.038	0.043	0.045
LDDV	0	0	0	0.000	0.000	0.000
LDDT	4,108	5,112	5,885	0.001	0.001	0.001
HDDV	275,722	384,106	467,480	0.088	0.098	0.104
MC	14,265	19,885	24,208	0.005	0.005	0.005
Total	3,135,027	3,901,040	4,490,287	1.000	1.000	1.000

2. Base Case Control Assumptions

This section summarizes the control programs that were modeled for highway vehicles in 2007, 2020, and 2030. The Control Case was modeled by applying reduction percentages to the heavy-duty gasoline vehicle (HDGV) and HDDV Base Case emissions and additional SO₂ reductions to light-duty diesel emissions.

a. I/M Programs

I/M program inputs were the same in all of the projection years. The default program parameters for counties expected to have I/M programs in place in the projection years are the EPA performance standard I/M program inputs. The specific inputs modeled for each of the I/M program performance standards are shown in Table VI-11. I/M program

**Table VI-11
I/M Performance Standard Program Inputs**

I/M Program Name	Basic I/M Performance Standard	Low Enhanced I/M Performance Standard	High Enhanced I/M Performance Standard
I/M Program Parameters			
Program Start Year	1983	1983	1983
Stringency Level (Percent)	20	20	20
Model Years Covered	1968-2020	1968-2020	1968-1985
Waiver Rate For Pre-1981 Model Years (%)	0	3	3
Waiver Rate For 1981 and Later Models (%)	0	3	3
Compliance Rate (%)	100	96	96
Program Type	TO	TO	TO
Inspection Frequency	Annual	Annual	Annual
Vehicle Types Inspected			
LDGV	YES	YES	YES
LDGT1	NO	YES	YES
LDGT2	NO	YES	YES
HDGV	NO	NO	NO
Test Type	IdleTest	IdleTest	2500/IdleTest
I/M Cutpoints	220/1.2/999	220/1.2/999	220/1.2/999
Effectiveness Rates (% hydrocarbon (HC)/CO/NO _x)	1.00/1.00/1.00	1.00/1.00/1.00	1.00/1.00/1.00
Program Start Year			
Program Start Year			1983
Stringency Level (Percent)			
Stringency Level (Percent)			20
Model Years Covered			
Model Years Covered			1986-2020
Waiver Rate For Pre-1981 Model Years (%)			
Waiver Rate For Pre-1981 Model Years (%)			3
Waiver Rate For 1981 and Later Models (%)			
Waiver Rate For 1981 and Later Models (%)			3
Compliance Rate (%)			
Compliance Rate (%)			96
Program Type			
Program Type			TO
Inspection Frequency			
Inspection Frequency			Annual
Vehicle Types Inspected			
LDGV			YES
LDGT1			YES
LDGT2			YES
HDGV			NO
Test Type			
Test Type			TransientTest
I/M Cutpoints (g/mi HC/CO/NO_x)			
I/M Cutpoints (g/mi HC/CO/NO _x)			0.80/20.0/2.00
Effectiveness Rates (% HC/CO/NO_x)			
Effectiveness Rates (% HC/CO/NO _x)			1.00/1.00/1.00
Anti-Tampering Program Parameters			
Program Start Year		1995	1995
Model Years Covered		1972-2020	1984-2020

Table VI-11 (continued)

I/M Program Name	Basic I/M Performance Standard	Low Enhanced I/M Performance Standard	High Enhanced I/M Performance Standard
I/M Program Parameters			
Vehicle Types Inspected			
LDGV		YES	YES
LDGT1		YES	YES
LDGT2		YES	YES
HDGV		NO	NO
Program Type		TO	TO
Effectiveness Rate		1.00	1.00
Inspection Frequency		Annual	Annual
Compliance Rate (%)		96	96
Inspections Performed			
Air Pump System		NO	NO
Catalyst		NO	YES
Fuel Inlet Restrictor		NO	YES
Tailpipe Lead Deposit Test		NO	NO
EGR System		YES	NO
Evaporative Emission Control System		NO	NO
PCV System		NO	NO
Gas Cap		NO	NO
Functional Pressure Test Program Parameters			
Program Start Year			1995
Model Years Covered			1983-2020
Effectiveness Rate			1.00
Vehicle Types Tested			
LDGV			YES
LDGT1			YES
LDGT2			YES
HDGV			NO
Program Type			TO
Inspection Frequency			Annual
Compliance Rate (%)			96
Purge Test Program Parameters			
Program Start Year			1995
Model Years Covered			1986-2020
Effectiveness Rate			1.00
Vehicle Types Tested			
LDGV			YES
LDGT1			YES
LDGT2			YES
HDGV			NO
Program Type			TO
Inspection Frequency			Annual
Compliance Rate (%)			96

NOTES: TO=Test Only
TRC=Test And Repair (Computerized)

coverage by county or area was based on data collected by EPA and Pechan for the OTAG and Section 812 emission projections. During this data collection process, each State was contacted to confirm which counties in that State would be implementing an I/M program in the future. Each State was also asked to indicate which of the EPA I/M program types the program would most closely resemble - high enhanced, low enhanced, basic, or Ozone Transport Region (OTR) low enhanced. Responses were collected from each State with a planned CAA I/M program. Any additional I/M-specific information collected during comment periods for EPA's NO_x SIP Call, and accepted by EPA, superseded the default and OTAG I/M data.

b. RFG

Phase II of this Federal RFG program was modeled in the projection years. Coverage of RFG in the projection years was the same as that in 1996, with the following exceptions: all Maine counties and Orange County, NY were removed from the 1996 list, shown in Table VI-4. The entire State of California was modeled with Federal Phase II RFG (ASTM Class B) in the projection years. Areas not participating in the RFG program were modeled during the ozone season months with Phase II RVP values of either 8.7 pounds per square inch (psi) or 7.8 psi. Areas that provided SIP Call comments documenting the presence of a low RVP program were modeled at that RVP during the ozone season.

c. Oxygenated Fuel

The oxygenated fuel program inputs and county coverages modeled are the same as those described for 1996, with the specific changes listed in Table VI-5 for several of the areas for 2007, 2020, and 2030.

d. National LEV (NLEV) Program

The NLEV program was included for all States in the projection year modeling. This program starts with the 2001 model year nationwide, and in 1999 in the Northeast Ozone Transport Commission (OTC) States. The implementation schedule of the NLEV program in the OTC States is shown below.

Model Year	Federal Tier I Standards	Transitional LEV Standards	LEV Standards
1999	30%	40%	30%
2000		40%	60%
2001 and later			100%

States in the OTC that have adopted a LEV program on their own were modeled with the characteristics of their programs. These States include Massachusetts, New York, Vermont, and Maine. California's LEV program began in 1994. This was modeled using the MOBILE5b default LEV implementation schedule, along with a start year of 1994 for this program.

The following table shows the emission standards of the Federal Tier I program, the transitional LEV (TLEV) standards, the LEV standards, and the Ultra-Low Emission Vehicle

(ULEV) standards. These standards apply to the LDGV and LDGT1a classes of vehicles. The LDGT1b category is also included in the NLEV program, but the emission standards for these vehicles are slightly less stringent than those listed below for the lighter vehicles.

Emission Standard	Nonmethane Organic Gas (NMOG)	CO	NO_x
Federal Tier 1	0.250 grams/mile nonmethane hydrocarbon (NMHC)	3.4 grams/mile	0.40 grams/mile
TLEV	0.125 grams/mile	3.4 grams/mile	0.40 grams/mile
LEV	0.075 grams/mile	3.4 grams/mile	0.20 grams/mile
ULEV	0.040 grams/mile	1.7 grams/mile	0.20 grams/mile

e. 2004 NO_x Standard for Heavy-Duty Diesel Engines

EPA determined that additional reductions in NO_x and NMHC emissions are needed at the national level from heavy-duty vehicles and promulgated a new NO_x plus NMHC standard of 2.5 grams per brake horsepower-hour (g/bhp-hr). This standard was modeled in the MOBILE5b input files following the guidance provided in “MOBILE5 Information Sheet #5, Inclusion of New 2004 NO_x Standard for Heavy-Duty Diesel Engines in MOBILE5a and MOBILE5b Modeling” issued on January 30, 1998. (<http://www.epa.gov/oms/models/mobile5/m5info5.pdf>) In effect, this modeling reduces the HDDV emission factors starting with the 2004 model year to be consistent with the new standard, and is applied nationally.

f. Tier 2/Low Sulfur Gasoline Controls and 2007, 2020, and 2030 Adjustment Factors

The 1996 section of this chapter discusses the VOC exhaust and NO_x MOBILE5b to MOBILE 6 adjustment factors, the air conditioning usage adjustment factors, and the HDDV NO_x defeat device adjustment factors. The actual factors applied, including those applied in 2007, 2020, and 2030 were shown in Tables VI-6 through VI-9. The adjustment factors applied in the projection years include the effect of the Tier 2 emission standards and low sulfur gasoline, in addition to MOBILE6 adjustments. Although the appropriate I/M category was included in the 1996 adjustment tables, the adjustments were the same as those for I/M. For the projection years, these two categories have different adjustment factors in most cases. In general, areas modeled with the EPA enhanced performance standard, or an equivalent I/M program, were grouped in the “APP IM” category. Several exceptions to this general rule occurred for areas that indicated through comments to the NO_x SIP Call that were accepted by EPA specifically indicating that the area should or should not be modeled with the maximum LEV benefits.

i. VOC Evaporative Adjustments

An additional set of MOBILE5b to MOBILE6 adjustment factors was applied to the VOC evaporative emission factors in 2007, 2020, and 2030 that were not applied in 1996. These adjustments result from the Tier 2 and low sulfur fuel controls. These factors were applied to the evaporative portion of the VOC emission factors for LDGVs, LDGT1s, and LDGT2s, and are shown in Table VI-12.

ii. On-board Diagnostics

To simulate the effects of on-board diagnostic (OBD) devices in the projection years, adjustments were made to the MOBILE5b input files for areas modeled with an I/M program. This was modeled by adding or modifying pressure and purge test input lines, such that 1996 and later model year LDGVs and LDGTs would receive the full benefits of a test-only pressure test and purge test.

iii. PM and SO₂ Adjustment Factors

An additional set of factors was applied to PM and gasoline-fueled vehicle SO₂ emission factors in the projection years. The PM factors are shown in Table VI-13 and were applied only to the exhaust portion of the PM₁₀ and PM_{2.5} emission factors for LDGVs, LDGTs, HDGVs, LDDVs, and LDDTs. The brake wear and tire wear portions of the PM factors were not adjusted. Table VI-14 lists the SO₂ factors applied. These factors apply to all gasoline vehicle types and account for the lower levels of sulfur in gasoline under EPA's final Tier 2/low sulfur fuel rulemaking.

3. Control Case Emission Reductions

Once the Base Case highway vehicle emission inventories were prepared, the highway vehicle Control Case emission inventories for 2007, 2020, and 2030 were calculated by multiplying the base emissions by the specified reduction percentages. Emission reduction percentages were supplied by OTAQ as national reduction percentages. Table VI-15 lists these reduction percentages for the vehicle types and pollutants whose emissions were reduced from the Base Case to the Control Case. For HDDVs, the controls were applied to VOC, NO_x, CO, exhaust PM₁₀, exhaust PM_{2.5}, and SO₂. Exhaust and evaporative VOC emissions and NO_x emissions were reduced from HDGVs. SO₂ emissions were reduced from LDDVs and LDDTs (as well as HDDVs) due to the lower diesel fuel sulfur content included in the HDD proposal.

C. MASS EMISSIONS INVENTORY AND EMISSIONS PROCESSOR INPUT FILES

1. EMS-95 Emissions Processor Input Files

The highway vehicle-related files submitted as inputs to EMS-95 consist of MOBILE5b input shells, three VMT-related files, and an adjustment factor file. The MOBILE5b input shells are a set of MOBILE5b input files that correspond to each of the MOBILE5b input files developed in calculating the mass emissions inventory, but with only one scenario, representing July controls and at a single speed and temperature combination. The EMS-95 models then use these MOBILE5b shells to generate emission factors at all of the temperature and speed combinations necessary for the hourly meteorological conditions being modeled. The three VMT files include a file with the total VMT by county and road type. The VMT data in these files represents an annual average day (i.e., annual VMT/365). The format of these files is shown in Table VI-16. These models then break the VMT down by vehicle type using the VMT mix by hour, county, road type, and vehicle type. The file structure of these VMT mix files are shown in Table VI-17. (It should be noted that for this analysis, there is no difference in the VMT mixes

**Table VI-12
Evaporative VOC MOBILE5b to MOBILE6 Adjustment Factors**

Year	Control Combination	Adjustment Factors by Vehicle Type (unitless)		
		LDGV	LDGT1	LDGT2
2007	IM CG	0.985	0.984	1.000
	IM RFG	0.984	0.983	1.000
	IM WEST	0.985	0.984	1.000
	NO IM CG	0.992	0.992	1.000
	NO IM RFG	0.988	0.991	1.000
	NO IM WEST	0.992	0.992	1.000
2020	IM CG	0.883	0.880	0.941
	IM RFG	0.846	0.855	0.915
	IM WEST	0.883	0.880	0.941
	NO IM CG	0.945	0.954	0.978
	NO IM RFG	0.919	0.935	0.967
	NO IM WEST	0.945	0.954	0.978
2030	IM CG	0.874	0.860	0.915
	IM RFG	0.842	0.830	0.884
	IM WEST	0.874	0.860	0.915
	NO IM CG	0.941	0.948	0.974
	NO IM RFG	0.913	0.926	0.959
	NO IM WEST	0.941	0.948	0.974

**Table VI-13
PM Adjustment Factors**

Year	Control Combination	Adjustment Factor by Vehicle Type (unitless)						
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	MC
2007	CG	0.416	0.342	0.370	0.767	0.826	0.800	1.000
	RFG	0.624	0.563	0.591	0.848	0.826	0.800	1.000
	WEST	0.416	0.342	0.370	0.767	0.826	0.800	1.000
2020	CG	0.416	0.337	0.349	0.767	0.421	0.408	1.000
	RFG	0.625	0.559	0.571	0.848	0.421	0.408	1.000
	WEST	0.416	0.337	0.349	0.767	0.421	0.408	1.000
2030	CG	0.417	0.333	0.333	0.767	0.109	0.107	1.000
	RFG	0.625	0.556	0.556	0.848	0.109	0.107	1.000
	WEST	0.417	0.333	0.333	0.767	0.109	0.107	1.000

**Table VI-14
SO₂ Adjustment Factors**

Year	Control Combination	Adjustment Factor by Vehicle Type (unitless)						
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	MC
2007	CG	0.088	0.088	0.088	0.088	1.000	1.000	0.088
	RFG	0.224	0.224	0.224	0.224	1.000	1.000	0.224
	WEST	0.088	0.088	0.088	0.088	1.000	1.000	0.088
2020	CG	0.088	0.088	0.088	0.088	1.000	1.000	0.088
	RFG	0.224	0.224	0.224	0.224	1.000	1.000	0.224
	WEST	0.088	0.088	0.088	0.088	1.000	1.000	0.088
2030	CG	0.088	0.088	0.088	0.088	1.000	1.000	0.088
	RFG	0.224	0.224	0.224	0.224	1.000	1.000	0.224
	WEST	0.088	0.088	0.088	0.088	1.000	1.000	0.088

**Table VI-15
HDD Control Case Emission Reduction Percentages**

Calendar Year	Vehicle Type	National Reduction						
		Exhaust VOC	Evaporative VOC	NO _x	CO	Exhaust PM ₁₀	Exhaust PM _{2.5}	SO ₂
2007	HDDV	4.82%	0.00%	1.08%	5.84%	11.96%	11.96%	97.64%
2020	HDDV	80.64%	0.00%	75.21%	82.40%	83.89%	83.89%	97.65%
2030	HDDV	89.43%	0.00%	89.50%	89.99%	92.43%	92.43%	97.65%
2007	HDGV	0.45%	0.60%	1.02%	0.00%	0.00%	0.00%	0.00%
2020	HDGV	17.17%	8.78%	33.43%	0.00%	0.00%	0.00%	0.00%
2030	HDGV	24.29%	9.78%	53.88%	0.00%	0.00%	0.00%	0.00%
2007	LDDV	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	97.88%
2020	LDDV	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	97.88%
2030	LDDV	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	97.88%
2007	LDDT	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	97.88%
2020	LDDT	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	97.88%
2030	LDDT	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	97.88%

**Table VI-16
Structure for VMT Files (OFNVMTyy.TXT)**

Variable	Type	Length	Decimals	Description
FIPSST	C	2	0	FIPS State Code
FIPSCNTY	C	3	0	FIPS County Code
ROADTYPE	C	2	0	Roadway Type as Defined by Codes Below: R1-Rural Interstates R2-Rural Other Principal Arterials R6-Rural Minor Arterials R7-Rural Major Collectors R8-Rural Minor Collectors R9-Rural Locals U1-Urban Interstates U2-Urban Other Freeways and Expressways U4-Urban Other Principal Arterials U6-Urban Minor Arterials U7-Urban Collectors U9-Urban Locals
VMT	N	15	3	Annual Average Daily VMT (miles)

**Table VI-17
Structure for VMT Vehicle Mix Files (NTVMIXyy.TXT)**

Variable	Type	Length	Decimals	Description
FIPSST	C	2	0	FIPS State Code
FIPSCNTY	C	3	0	FIPS County Code
ROADTYPE	C	2	0	Roadway Type as Defined by Codes Below: 01-Rural Interstates 02-Rural Other Principal Arterials 06-Rural Minor Arterials 07-Rural Major Collectors 08-Rural Minor Collectors 09-Rural Locals 11-Urban Interstates 12-Urban Other Freeways and Expressways 14-Urban Other Principal Arterials 16-Urban Minor Arterials 17-Urban Collectors 19-Urban Locals
LINKID	C	10	0	Not Used
HOUR	N	2	0	Hour of Day (1 through 24)
VEHMIX01	N	5	3	VMT Mix Fraction for Light-Duty Gas Vehicles
VEHMIX02	N	5	3	VMT Mix Fraction for Light-Duty Gas Trucks 1
VEHMIX03	N	5	3	VMT Mix Fraction for Light-Duty Gas Trucks 2
VEHMIX04	N	5	3	VMT Mix Fraction for Heavy-Duty Gas Vehicles
VEHMIX05	N	5	3	VMT Mix Fraction for Light-Duty Diesel Vehicles
VEHMIX06	N	5	3	VMT Mix Fraction for Light-Duty Diesel Trucks
VEHMIX07	N	5	3	VMT Mix Fraction for Heavy-Duty Diesel Vehicles
VEHMIX08	N	5	3	VMT Mix Fraction for Motorcycles

VMT mixes by hour of the day.) The third VMT-related file provided for each year includes a file with average speed information by county and road type. The format of these files is shown in Table VI-18. Each of these three VMT-related files varies only by year, and not by control case. The last file included for the EMS-95 modeling related to the on-highway vehicle modeling varies by year and control case and includes the adjustment factors to be applied by county and vehicle type. The format of these files is shown in Table VI-19. The HDDV adjustment factors, and the air conditioning temperature-dependent equation were applied separately in the modeling code and were not included in the adjustment factor files.

2. EPS 2.5 and Mass Emission Inventory - File Structures

The EPS 2.5 files for on-highway vehicle sources consist of monthly emissions data by county, vehicle type, and roadway type. The EPS 2.5 modeling files were assembled from detailed monthly emission files, developed as discussed in the sections above. Separate EPS 2.5 files were created for for each Base and Control Case. All of the on-highway EPS 2.5 emission files have the same format. This format is shown in Table VI-20. The format of the final mass emissions file, which contain annual and SSD emissions for each pollutant are shown in Table VI-21. The same set of years and cases applies to the mass emissions files. It should be noted that the SSD values for the on-highway vehicle emissions are calculated by dividing July emissions by 31.

An additional set of files was prepared for 1996, 2030 Base Case, and 2030 Control Case for use in air toxics modeling. These files were identical to the corresponding mass emissions files, except that the PM_{10} and $PM_{2.5}$ emission fields included only exhaust PM_{10} or $PM_{2.5}$ emissions. Emissions from brake wear and tire wear were excluded from these files. The format of these files is the format shown in Table VI-21. All exhaust PM_{10} and $PM_{2.5}$ adjustments discussed in this chapter were also applied in these files.

**Table VI-18
Structure for VMT Vehicle Mix Files (OFNSPpy.TXT)**

Variable	Type	Length	Decimals	Description
FIPSST	C	2	0	FIPS State Code
FIPSCNTY	C	3	0	FIPS County Code
ROADTYPE	C	2	0	Roadway Type as Defined by Codes Below: 01-Rural Interstates 02-Rural Other Principal Arterials 06-Rural Minor Arterials 07-Rural Major Collectors 08-Rural Minor Collectors 09-Rural Locals 11-Urban Interstates 12-Urban Other Freeways and Expressways 14-Urban Other Principal Arterials 16-Urban Minor Arterials 17-Urban Collectors 19-Urban Locals
AVESPEED	N	4	1	Average Vehicle Speed (miles per hour)

**Table VI-19
Structure for Adjustment Factor Files**

Variable	Type	Length	Decimals	Description
FIPSST	C	2	0	FIPS State Code
FIPSCNTY	C	3	0	FIPS County Code
V_TYPE	C	1	0	Vehicle Type : 1 = LDGV, 2 = LDGT1, 3 = LDGT2, 4 = HDGV, 5 = MC, 6 = LDDV, 7 = LDDT, 8 = HDDV
EXHVOCADJ	N	10	3	Multiplicative Exhaust VOC Adjustment Factor
EXHNOXADJ	N	10	3	Multiplicative NO _x Adjustment Factor
NOXACADJ	N	10	3	Additive NO _x Full Air Conditioning Usage Adjustment Factor (to be multiplied by temperature-dependent equation)
EVAPVOCADJ	N	10	3	Multiplicative Evaporative VOC Adjustment Factor

**Table VI-20
Structure for On-Highway Mobile Source EPS Data Files**

Variable	Type	Length	Decimals	Description
FIPSST	C	2	0	FIPS state code
FIPSCNTY	C	3	0	FIPS county code
SCC	C	10	0	AMS Source Category Code
V_TYPE	C	5	0	Vehicle Type
VOC	N	12	4	Annual VOC Emissions [tons per year (tpy)]
NOX	N	12	4	Annual NO _x Emissions (tpy)
CO	N	12	4	Annual CO Emissions (tpy)
SO2	N	12	4	Annual SO ₂ Emissions (tpy)
PM10	N	12	4	Annual PM ₁₀ Emissions (tpy)
PM25	N	12	4	Annual PM _{2.5} Emissions (tpy)
SOA	N	12	4	Annual SOA Emissions (tpy)
NH3	N	12	4	Annual NH ₃ Emissions (tpy)
VOC_JAN	N	12	4	Monthly VOC Emissions (tons per month)
VOC_FEB	N	12	4	Monthly VOC Emissions (tons per month)
VOC_MAR	N	12	4	Monthly VOC Emissions (tons per month)
VOC_APR	N	12	4	Monthly VOC Emissions (tons per month)
VOC_MAY	N	12	4	Monthly VOC Emissions (tons per month)
VOC_JUN	N	12	4	Monthly VOC Emissions (tons per month)
VOC_JUL	N	12	4	Monthly VOC Emissions (tons per month)
VOC_AUG	N	12	4	Monthly VOC Emissions (tons per month)
VOC_SEP	N	12	4	Monthly VOC Emissions (tons per month)
VOC_OCT	N	12	4	Monthly VOC Emissions (tons per month)
VOC_NOV	N	12	4	Monthly VOC Emissions (tons per month)
VOC_DEC	N	12	4	Monthly VOC Emissions (tons per month)
NOX_JAN	N	12	4	Monthly NO _x Emissions (tons per month)
NOX_FEB	N	12	4	Monthly NO _x Emissions (tons per month)
NOX_MAR	N	12	4	Monthly NO _x Emissions (tons per month)
NOX_APR	N	12	4	Monthly NO _x Emissions (tons per month)
NOX_MAY	N	12	4	Monthly NO _x Emissions (tons per month)
NOX_JUN	N	12	4	Monthly NO _x Emissions (tons per month)
NOX_JUL	N	12	4	Monthly NO _x Emissions (tons per month)
NOX_AUG	N	12	4	Monthly NO _x Emissions (tons per month)
NOX_SEP	N	12	4	Monthly NO _x Emissions (tons per month)
NOX_OCT	N	12	4	Monthly NO _x Emissions (tons per month)
NOX_NOV	N	12	4	Monthly NO _x Emissions (tons per month)
NOX_DEC	N	12	4	Monthly NO _x Emissions (tons per month)
CO_JAN	N	12	4	Monthly CO Emissions (tons per month)
CO_FEB	N	12	4	Monthly CO Emissions (tons per month)
CO_MAR	N	12	4	Monthly CO Emissions (tons per month)
CO_APR	N	12	4	Monthly CO Emissions (tons per month)
CO_MAY	N	12	4	Monthly CO Emissions (tons per month)

Table VI-20 (continued)

Variable	Type	Length	Decimals	Description
CO_JUN	N	12	4	Monthly CO Emissions (tons per month)
CO_JUL	N	12	4	Monthly CO Emissions (tons per month)
CO_AUG	N	12	4	Monthly CO Emissions (tons per month)
CO_SEP	N	12	4	Monthly CO Emissions (tons per month)
CO_OCT	N	12	4	Monthly CO Emissions (tons per month)
CO_NOV	N	12	4	Monthly CO Emissions (tons per month)
CO_DEC	N	12	4	Monthly CO Emissions (tons per month)
SO2_JAN	N	12	4	Monthly SO ₂ Emissions (tons per month)
SO2_FEB	N	12	4	Monthly SO ₂ Emissions (tons per month)
SO2_MAR	N	12	4	Monthly SO ₂ Emissions (tons per month)
SO2_APR	N	12	4	Monthly SO ₂ Emissions (tons per month)
SO2_MAY	N	12	4	Monthly SO ₂ Emissions (tons per month)
SO2_JUN	N	12	4	Monthly SO ₂ Emissions (tons per month)
SO2_JUL	N	12	4	Monthly SO ₂ Emissions (tons per month)
SO2_AUG	N	12	4	Monthly SO ₂ Emissions (tons per month)
SO2_SEP	N	12	4	Monthly SO ₂ Emissions (tons per month)
SO2_OCT	N	12	4	Monthly SO ₂ Emissions (tons per month)
SO2_NOV	N	12	4	Monthly SO ₂ Emissions (tons per month)
SO2_DEC	N	12	4	Monthly SO ₂ Emissions (tons per month)
PM10_JAN	N	12	4	Monthly PM ₁₀ Emissions (tons per month)
PM10_FEB	N	12	4	Monthly PM ₁₀ Emissions (tons per month)
PM10_MAR	N	12	4	Monthly PM ₁₀ Emissions (tons per month)
PM10_APR	N	12	4	Monthly PM ₁₀ Emissions (tons per month)
PM10_MAY	N	12	4	Monthly PM ₁₀ Emissions (tons per month)
PM10_JUN	N	12	4	Monthly PM ₁₀ Emissions (tons per month)
PM10_JUL	N	12	4	Monthly PM ₁₀ Emissions (tons per month)
PM10_AUG	N	12	4	Monthly PM ₁₀ Emissions (tons per month)
PM10_SEP	N	12	4	Monthly PM ₁₀ Emissions (tons per month)
PM10_OCT	N	12	4	Monthly PM ₁₀ Emissions (tons per month)
PM10_NOV	N	12	4	Monthly PM ₁₀ Emissions (tons per month)
PM10_DEC	N	12	4	Monthly PM ₁₀ Emissions (tons per month)
PM25_JAN	N	12	4	Monthly PM _{2.5} Emissions (tons per month)
PM25_FEB	N	12	4	Monthly PM _{2.5} Emissions (tons per month)
PM25_MAR	N	12	4	Monthly PM _{2.5} Emissions (tons per month)
PM25_APR	N	12	4	Monthly PM _{2.5} Emissions (tons per month)
PM25_MAY	N	12	4	Monthly PM _{2.5} Emissions (tons per month)
PM25_JUN	N	12	4	Monthly PM _{2.5} Emissions (tons per month)
PM25_JUL	N	12	4	Monthly PM _{2.5} Emissions (tons per month)
PM25_AUG	N	12	4	Monthly PM _{2.5} Emissions (tons per month)
PM25_SEP	N	12	4	Monthly PM _{2.5} Emissions (tons per month)
PM25_OCT	N	12	4	Monthly PM _{2.5} Emissions (tons per month)
PM25_NOV	N	12	4	Monthly PM _{2.5} Emissions (tons per month)

Table VI-20 (continued)

Variable	Type	Length	Decimals	Description
PM25_DEC	N	12	4	Monthly PM _{2.5} Emissions (tons per month)
SOA_JAN	N	12	4	Monthly SOA Emissions (tons per month)
SOA_FEB	N	12	4	Monthly SOA Emissions (tons per month)
SOA_MAR	N	12	4	Monthly SOA Emissions (tons per month)
SOA_APR	N	12	4	Monthly SOA Emissions (tons per month)
SOA_MAY	N	12	4	Monthly SOA Emissions (tons per month)
SOA_JUN	N	12	4	Monthly SOA Emissions (tons per month)
SOA_JUL	N	12	4	Monthly SOA Emissions (tons per month)
SOA_AUG	N	12	4	Monthly SOA Emissions (tons per month)
SOA_SEP	N	12	4	Monthly SOA Emissions (tons per month)
SOA_OCT	N	12	4	Monthly SOA Emissions (tons per month)
SOA_NOV	N	12	4	Monthly SOA Emissions (tons per month)
SOA_DEC	N	12	4	Monthly SOA Emissions (tons per month)
NH3_JAN	N	12	4	Monthly NH ₃ Emissions (tons per month)
NH3_FEB	N	12	4	Monthly NH ₃ Emissions (tons per month)
NH3_MAR	N	12	4	Monthly NH ₃ Emissions (tons per month)
NH3_APR	N	12	4	Monthly NH ₃ Emissions (tons per month)
NH3_MAY	N	12	4	Monthly NH ₃ Emissions (tons per month)
NH3_JUN	N	12	4	Monthly NH ₃ Emissions (tons per month)
NH3_JUL	N	12	4	Monthly NH ₃ Emissions (tons per month)
NH3_AUG	N	12	4	Monthly NH ₃ Emissions (tons per month)
NH3_SEP	N	12	4	Monthly NH ₃ Emissions (tons per month)
NH3_OCT	N	12	4	Monthly NH ₃ Emissions (tons per month)
NH3_NOV	N	12	4	Monthly NH ₃ Emissions (tons per month)
NH3_DEC	N	12	4	Monthly NH ₃ Emissions (tons per month)

**Table VI-21
Structure for On-Highway Mobile Source Mass Emissions Data Files**

Variable	Type	Length	Decimals	Description
FIPSST	C	2	0	FIPS State code
FIPSCNTY	C	3	0	FIPS county code
SCC	C	10	0	Source Category Classification Code
VOC_ANN	N	10	4	Annual VOC emissions from highway vehicles (tons per year)
NOX_ANN	N	10	4	Annual NO _x emissions from highway vehicles (tons per year)
CO_ANN	N	10	4	Annual CO emissions from highway vehicles (tons per year)
SO2_ANN	N	10	4	Annual SO ₂ emissions from highway vehicles (tons per year)
PM10_ANN	N	10	4	Annual PM ₁₀ emissions from highway vehicles (tons per year)
PM25_ANN	N	10	4	Annual PM _{2.5} emissions from highway vehicles (tons per year)
NH3_ANN	N	10	4	Annual NH ₃ emissions from highway vehicles (tons per year)
SOA_ANN	N	10	4	Annual SOA emissions from highway vehicles (tons per year)
VOC_OSD	N	10	4	Summer season day VOC emissions from highway vehicles [tons per day (tpd)]
NOX_OSD	N	10	4	Summer season day NO _x emissions from highway vehicles (tpd)
CO_OSD	N	10	4	Summer season day CO emissions from highway vehicles (tpd)
SO2_OSD	N	10	4	Summer season day SO ₂ emissions from highway vehicles (tpd)
PM10_OSD	N	10	4	Summer season day PM ₁₀ emissions from highway vehicles (tpd)
PM25_OSD	N	10	4	Summer season day PM _{2.5} emissions from highway vehicles (tpd)
NH3_OSD	N	10	4	Summer season day NH ₃ emissions from highway vehicles (tpd)
SOA_OSD	N	10	4	Summer season day SOA emissions from highway vehicles (tpd)
VMT_ANN	N	20	7	Annual VMT from highway vehicles using 8 vehicle types (million miles)

CHAPTER VII

EMISSION SUMMARIES AND COMPARISONS

Please note that, in this Chapter, "national" means "48-State" (contiguous United States). As noted in Chapter I, inventories were prepared for 50-States for mobile and nonroad sources, but the summaries have been prepared only for the contiguous 48 States.

Tables VII-1 through VII-10 present summaries of annual national emissions and emissions reductions by pollutant and source category as defined by the Tier 2-level emission summary for the 1996, 2007, 2020, and 2030 inventories. Table VII-1 summarizes national annual emissions for the 1996 Base Year inventory. Table VII-2 summarizes national annual emissions for the 2007 Base Case inventory, Table VII-3 summarizes national annual emissions for mobile and nonroad sources for the 2007 Control Case inventory, and Table VII-4 summarizes the mobile and nonroad emissions reductions associated with the 2007 Control Case relative to the 2007 Base Case. Table VII-5 summarizes national annual emissions for the 2020 Base Case inventory, Table VII-6 summarizes national annual emissions for mobile and nonroad sources for the 2020 Control Case inventory, and Table VII-7 summarizes the mobile and nonroad emissions reductions associated with the 2020 Control Case relative to the 2020 Base Case. Table VII-8 summarizes national annual emissions for the 2030 Base Case inventory, Table VII-9 summarizes national annual emissions for mobile and nonroad sources for the 2030 Control Case inventory, and Table VII-10 summarizes the mobile and nonroad emissions reductions associated with the 2030 Control Case relative to the 2030 Base Case.

Tables VII-11 through VII-20 present summaries of annual emissions and emissions reductions by State and pollutant for each of the major source categories (i.e., stationary area, nonroad, EGU, non-EGU point, and on-highway mobile sources). Table VII-11 summarizes annual emissions for the 1996 Base Year inventory. Table VII-12 summarizes national annual emissions for the 2007 Base Case inventory, Table VII-13 summarizes national annual emissions for mobile and nonroad sources for the 2007 Control Case inventory, and Table VII-14 summarizes the mobile and nonroad emissions reductions associated with the 2007 Control Case relative to the 2007 Base Case. Table VII-15 summarizes national annual emissions for the 2020 Base Case inventory, Table VII-16 summarizes national annual emissions for mobile and nonroad sources for the 2020 Control Case inventory, and Table VII-17 summarizes the mobile and nonroad emissions reductions associated with the 2020 Control Case relative to the 2030 Base Case. Table VII-18 summarizes national annual emissions for the 2030 Base Case inventory, Table VII-19 summarizes national annual emissions for mobile and nonroad sources for the 2030 Control Case inventory, and Table VII-20 summarizes the mobile and nonroad emissions reductions associated with the 2030 Control Case relative to the 2030 Base Case.

Table VII-21 summarizes the total annual emissions in each of the years and cases for all eight pollutants. Table VII-21 also shows the percent change in emissions between the Base and Control Case inventories for 2007, 2020, and 2030.

For the Tier 2-level summary tables presented in Tables VII-1 through VII-10 (excluding the tables showing emissions reductions), biogenic emissions for NH₃ are shown because these emissions are included in the area source inventories prepared under this project. Biogenic VOC emissions are not shown in these tables because they are prepared separately by EPA for input to the modeling analyses.

For the off-highway Tier 1 category shown in Tables VII-1 through VII-10 (excluding the tables showing emissions reductions), total off-highway emissions do not match the totals shown for nonroad emissions by State presented in Tables VII-11 through VII-20 (excluding the tables showing emissions reductions). This is because the emissions for four SCC's are included in the tables that summarize emissions by State, but do not fall under the off-highway Tier 1 category shown in Tables VII-1 through VII-10 (excluding the tables showing emissions reductions). The SCCs, their descriptions, and the Tier 1 and 2 categories to which they are assigned are as follows:

Tier 1 Category = Miscellaneous

Tier 2 Category = Fugitive Dust

SCC = 2275085000: Mobile Sources; Aircraft; Unpaved Airstrips

Tier 1 Category = Storage and Transportation

Tier 2 Category = Petroleum and Petroleum Product Storage

SCC = 2275900000: Mobile Sources; Aircraft; Refueling; All fuels; All processes

SCC = 2275900101: Mobile Sources; Aircraft; Refueling; All fuels; Displacement Loss/Uncontrolled

SCC = 2275900102: Mobile Sources; Aircraft; Refueling; All fuels; Displacement Loss/Controlled

The remainder of this chapter presents pollutant density maps for the 48-contiguous States and the District of Columbia. The density maps are in units of annual tons of pollutant emissions per square mile. For the 1996 Base Year and the 2007, 2020, and 2030 Base Case inventories, separate maps are presented by pollutant in the following order: VOC, NO_x, CO, SOA, SO₂, PM₁₀, PM_{2.5}, and NH₃. For the 2007, 2020, and 2030 Control Case inventories, separate density maps are provided to show mobile and nonroad source emissions reductions for NO_x, SO₂, and PM_{2.5}. Figures VII-1 through VII-8 present the maps for the 1996 Base Year inventory. For 2007, Figures VII-9 through VII-16 present the maps for the Base Case inventory, and Figures VII-17 through VII-19 present maps of the emissions reductions associated with the 2007 Control Case versus the 2007 Base Case inventory. For 2020, Figures VII-20 through VII-27 present the maps for the Base Case inventory, and Figures VII-28 through VII-30 present maps of the emissions reductions associated with the 2020 Control Case versus the 2020 Base Case inventory. For 2030, Figures VII-31 through VII-38 present the maps for the Base Case inventory, and Figures VII-39 through VII-41 present maps of the emissions reductions associated with the 2030 Control Case versus the 2030 Base Case inventory.

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