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# 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

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# 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

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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 $PM_{2.5}$), 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, $SO_x$, $PM_{10}$, $PM_{2.5}$, and $NH_3$. 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 ($SO_2$) 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, $PM_{10}$, $PM_{2.5}$, $NH_3$, 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, $PM_{10}$, $PM_{2.5}$, and $NH_3$ 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 | $PM_{10}$ Rate (lbs/MMBtu) | CO Rate (lbs/MMBtu) | VOC Rate (lbs/MMBtu) | Stack Temp. (degrees F) | Stack Height (feet) | Stack Diameter (feet) | Stack Flow ($ft^3$/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; $PM_{10}$ 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 $PM_{10}$ 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) |
| LONC | 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, $SO_x$, $PM_{10}$, $PM_{2.5}$, and $NH_3$. 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 | | | Excludes $NO_x$ SIP Call Controls. |
| | PT07MS2H.DBF | PT07EP2H.TXT | PT07EM2H.TGZ | 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 | | | Excludes $NO_x$ SIP Call Controls. |
| | PT2MS2H2.DBF | PT2EP2H2.TXT | PT2EM2H2.TGZ | 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 | | | Excludes $NO_x$ SIP Call Controls. |
| | PT3MS2H2.DBF | PT3EP2H2.TXT | PT3EM2H2.TGZ | 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) |
| LONC | 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 exptrapolations 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, $PM_{10}$, $PM_{2.5}$, 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 nonatttainment 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<br>2465000000, 2465100000, 2465200000, 2465600000, 2456800000 | 25 | 100 |
| Architectural and Industrial Maintenance Coatings<br>2401001000, 2401001999, 2401100000, 2401008000 | 25 | 100 |
| Residential Wood Combustion<br>2104008000, 2104008001, 2104008010, 2104008030, 2104008050, 2104008051 | See Table IV-4 | |
| Onboard Vapor Recovery Systems; and Stage II for Gasoline Service Stations<br>2501060100, 2501060101, 2501060102 | See Table IV-5 | |
| **Title III MACT (National)** | | |
| Wood Furniture Surface Coating<br>2401020000 | 30 | 100 |
| Aerospace Surface Coating<br>2401075000 | 60 | 100 |
| Marine Vessel Surface Coating (Shipbuilding)<br>2401080000 | 24 | 100 |
| Halogenated Solvent Cleaners (Cold Cleaning)<br>2415300000, 2415305000, 2415310000, 2415320000, 2415325000, 2415330000, 2415335000, 2415340000, 2415345000, 2415355000, 2415360000, 2415365000 | 43 ** | 100 |
| Autobody Refinishing<br>2401005000 | 37 | 100 |
| Petroleum Refinery Fugitives<br>2306000000 | 60 *** | 100 |
| Synthetic Organic Chemical Manufacturing Industry (SOCMI) Fugitives (Hazardous Organic NESHAP)<br>2301040000 | 37 **** | 100 |
| Motor Vehicle Surface Coating<br>2401070000 | 36 | 100 |
| Metal Product Surface Coating<br>2401040000, 2401045000, 2401050000 | 36 | 100 |

## Table IV-3 (continued)

| Control Measure and Affected SCCs | VOC Percentage Reduction | VOC Rule Effectiveness |
|---|---|---|
| Wood Product Surface Coating<br>2401015000 | 36 | 100 |
| Open Top & Conveyorized Degreasing<br>2415100000, 2415105000, 2415110000, 2415120000, 2415125000, 2415130000, 2415135000, 2415140000, 2415145000, 2415199000, 2415200000 | 31 | 100 |
| Publicly Owned Treatment Works (POTWs)<br>2630000000 to 2630020000 | 80 | 100 |
| Metal Furniture & Appliances Surface Coating<br>2401025000, 2401060000 | 36 | 100 |
| Machinery, Railroad Surface Coating<br>2401055000, 2401085000, 2401090000 | 36 | 100 |
| Electronic Coating<br>2401065000 | 36 | 100 |
| **Title I RACT** | | |
| Petroleum Dry Cleaning<br>2420000370, 2420010370 | 44 | 80 |
| Paper Surface Coating<br>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 $PM_{10}$ and $PM_{2.5}$ emissions for the SCCs listed in Table IV-9 to simulate the transportable component of these emissions. In addition, $PM_{10}$ 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

| | | File Name | | | |
|---|---|---|---|---|---|
| Year | Scenario | Mass | EPS 2.5 | EMS-95 | Comments |
| 1996 | Base | AR96MS1H.DBF | | | |
| | | AR96MX1H.DBF | | | Includes 25% transportable PM factor and no wind erosion emissions for natural geogenic sources. |
| | | 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 | | | |
| | | AR07MX2H.DBF | | | Includes 25% transportable PM factor and no wind erosion emissions for natural geogenic sources. |
| | | 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 | | | |
| | | AR20MX2H.DBF | | | Includes 25% transportable PM factor and no wind erosion emissions for natural geogenic sources. |
| | | 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 | | | |
| | | AR30MX3H.DBF | | | Includes 25% transportable PM factor and no wind erosion emissions for natural geogenic sources. |
| | | 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 $PM_{10}$ 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, $SO_2$, $PM_{10}$, and $PM_{2.5}$ are reported by the model. The NONROAD model does not estimate $NH_3$ 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, $NO_x$, $SO_2$, CO, $PM_{10}$, 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 Runs[1]

| Season | Input[2] | 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 Runs[1]

| | Fuel Sulfur, ppm | |
|---|---|---|
| **Year** | **Base case[2]** | **Control case[3]** |
| 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. $SO_2$ 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 $SO_2$ 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. $PM_{10}$ was assumed to be equivalent to PM, and $PM_{2.5}$ was estimated by multiplying $PM_{10}$ 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 $NH_3$ 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. $NH_3$ 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 $NH_3$ 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.  $NH_3$ emissions for diesel engines were calculated by multiplying diesel fuel consumption by an emission factor of 165.86 milligrams/gallon.  $NH_3$ 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, $NH_3$ 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<br>2265xxxxxx<br>2267xxxxxx<br>2268xxxxxx<br>2270xxxxxx<br>2282xxxxxx<br>2285xxx015 | 2-stroke gasoline<br>4-stroke gasoline<br>CNG<br>LPG<br>Diesel<br>Recreational marine<br>Railway maintenance | Not applicable[1] |
| 2275050000, 2275060000<br>2275020000, 2275070000 | General Aviation and Air Taxis<br>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] $SO_2$ and $NH_3$ emissions were projected using growth factors; projection year estimates for all other pollutants provided by OTAQ.
[3] $SO_2$ and $NH_3$ 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 $SO_2$ 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.

Base year and controlled steady-state emission factors for various horsepower ranges of CI 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, 1998 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).

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] $PM_{10}$ is assumed to be equivalent to PM.

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

| Engine Tech Type | HC | CO | $NO_x$ | PM[1] | BSFC |
|---|---|---|---|---|---|
| ***Class III Engine Emissions for New Engines (g/kW-hr)*** | | | | | |
| 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 |
| ***Class IV Handheld New Engine Emissions (g/kW-hr)*** | | | | | |
| 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 |
| ***Class V Handheld New Engine Emissions (g/kW-hr)*** | | | | | |
| 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 |
| ***Class I Nonhandheld New Engine Emissions (g/kW-hr)*** | | | | | |
| 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 |
| ***Class II Nonhandheld New Engine Emissions (g/kW-hr)*** | | | | | |
| 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] $PM_{10}$ 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 $SO_2$; therefore, $SO_2$ 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 $NH_3$ 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 $NH_3$ emissions for the projection years. For aircraft, commercial marine, and locomotive categories, 1996 base year $NH_3$ 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 |
|---|---|---|
| Arizona (Southern RFG) | | |
| | Phoenix | |
| | | Maricopa Co |
| Connecticut (Northern RFG) | | |
| | Greater Connecticut | |
| | | Hartford Co |
| | | Litchfield Co |
| | | Middlesex Co |
| | | New Haven Co |
| | | New London Co |
| | | Tolland Co |
| | | Windham Co |
| | New York-Northern New Jersey-Long Island | |
| | | Fairfield Co |
| District of Columbia (Southern RFG) | | |
| | Washington DC | |
| | | Washington |
| Delaware (Northern RFG) | | |
| | Philadelphia-Wilmington-Trenton | |
| | | Kent Co |
| | | New Castle Co |
| | Sussex County | |
| | | Sussex Co |
| Illinois (Northern RFG) | | |
| | Chicago-Gary-Lake County | |
| | | Cook Co |
| | | Du Page Co |
| | | Grundy Co |
| | | Kane Co |
| | | Kendall Co |
| | | Lake Co |
| | | McHenry Co |
| | | Will Co |
| Indiana (Northern RFG) | | |
| | Chicago-Gary-Lake County | |
| | | Lake Co |
| | | Porter Co |
| Kentucky (Northern RFG) | | |
| | Cincinnati-Hamilton | |
| | | Boone Co |
| | | Campbell Co |
| | | Kenton Co |
| | Louisville | |
| | | Bullitt Co |
| | | Jefferson Co |
| Maine (Northern RFG) | | |
| | Knox & Lincoln Counties | |
| | | Knox Co |
| | | Lincoln Co |
| | Lewiston-Auburn | |
| | | Androscoggin Co |
| | | Kennebec Co |
| | Portland | |
| | | Cumberland Co |
| | | Sagadahoc Co |
| | | York Co |
| Maryland (Southern RFG) | | |
| | Baltimore | |
| | | Anne Arundel Co |
| | | Baltimore |
| | | Baltimore Co |
| | | Carroll Co |
| | | Harford Co |
| | | Howard Co |
| | Kent & Queen Annes Counties | |
| | | Kent Co |
| | | Queen Annes Co |
| | Philadelphia-Wilmington-Trenton | |
| | | Cecil Co |
| | Washington DC | |
| | | Calvert Co |
| | | Charles Co |
| | | Frederick Co |
| | | Montgomery Co |
| | | Prince Georges Co |
| Massachusetts (Northern RFG) | | |
| | Boston-Lawrence-Worcester-Eastern MA | |
| | | Barnstable Co |
| | | Bristol Co |
| | | Dukes Co |
| | | Essex Co |
| | | Middlesex Co |
| | | Nantucket Co |
| | | Norfolk Co |
| | | Plymouth Co |
| | | Suffolk Co |
| | | Worcester Co |
| | Springfield/Pittsfield-Western MA | |
| | | Berkshire Co |
| | | Franklin Co |

## Table VI-4 (continued)

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

## Table VI-4 (continued)

| State/ Nonattainment Area | County | State/ Nonattainment Area | County |
|---|---|---|---|
| | | | York Co |
| Virginia (Southern RFG) | | Wisconsin (Northern RFG) | |
| Richmond-Petersburg | | Milwaukee-Racine | |
| | Charles City Co | | Kenosha Co |
| | Chesterfield Co | | Milwaukee Co |
| | Colonial Heights | | Ozaukee Co |
| | Hanover Co | | Racine Co |
| | Henrico Co | | Washington Co |
| | Hopewell | | Waukesha Co |
| | Richmond | | |
| 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

| | | Market Shares (%) | | Oxygen Content (%) | | Oxygenated |
|---|---|---|---|---|---|---|
| State | County | MTBE | Alcohol Blends | MTBE | Alcohol Blends | Gasoline Season |
| 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 |
|---|---|---|---|---|---|---|
| | | MTBE | Alcohol Blends | MTBE | Alcohol Blends | Gasoline Season |
| 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 $SO_2$, $PM_{10}$, and $PM_{2.5}$ were calculated using EPA's PART5 model and $NH_3$ 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, $SO_2$, $PM_{10}$, 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 | Annual VMT (million miles) | | | VMT Fractions | | |
|---|---|---|---|---|---|---|
| **Type** | **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 $SO_2$ 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 | | | 1983 |
| Stringency Level (Percent) | | | 20 |
| Model Years Covered | | | 1986-2020 |
| Waiver Rate For Pre-1981 Model Years (%) | | | 3 |
| Waiver Rate For 1981 and Later Models (%) | | | 3 |
| Compliance Rate (%) | | | 96 |
| Program Type | | | TO |
| Inspection Frequency | | | Annual |
| Vehicle Types Inspected | | | |
| LDGV | | | YES |
| LDGT1 | | | YES |
| LDGT2 | | | YES |
| HDGV | | | NO |
| Test Type | | | TransientTest |
| I/M Cutpoints (g/mi HC/CO/$NO_x$) | | | 0.80/20.0/2.00 |
| 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 $SO_2$ Adjustment Factors

An additional set of factors was applied to PM and gasoline-fueled vehicle $SO_2$ 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 $PM_{10}$ 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 $SO_2$ 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 $PM_{10}$, exhaust $PM_{2.5}$, and $SO_2$. Exhaust and evaporative VOC emissions and $NO_x$ emissions were reduced from HDGVs. $SO_2$ 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
## $SO_2$ 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 (OFNSPyy.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 $PM_{25}$ 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 $NH_3$ 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, $SO_2$, $PM_{10}$, $PM_{2.5}$, and $NH_3$. For the 2007, 2020, and 2030 Control Case inventories, separate density maps are provided to show mobile and nonroad source emissions reductions for $NO_x$, $SO_2$, 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.

# CHAPTER VIII
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