United States Environmental Protection Agency

PROCEDURES FOR DEVELOPING BASE YEAR AND FUTURE YEAR MASS EMISSION INVENTORIES FOR THE NONROAD DIESEL ENGINE 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
EPA	U.S. Environmental Protection Agency
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

ACRONYMS AND ABBREVIATIONS (continued)

MACT	maximum achievable control technology
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
SOCMI	Synthetic Organic Chemical Manufacturing Industry
SO_x	oxides of sulfur
SSD	summer season daily
TLEV	transitional LEV
tpd	tons per day
tpy	tons per year
TSDFs	treatment, storage, and disposal facilities

ACRONYMS AND ABBREVIATIONS (continued)

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 Nonroad Diesel mobile source emission standards, the United States (U.S.) Environmental Protection Agency (EPA) is developing national annual and temporal emission inventories and applying the Comprehensive Air Quality Model with Extensions (CAMx)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 modeled in this analysis.

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

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

These national inventories are prepared for the 48 contiguous States at the county-level for on-highway mobile, electric generating unit (EGU), non-EGU point, stationary area, and nonroad sources. The inventories do not include Alaska and Hawaii. The inventories contain annual and typical summer season day 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 $PM_{2.5}$), and ammonia (NH_3). The 2020 and 2030 Base Case inventories are prepared by applying growth and control assumptions to the 1996 Base Year inventory. The 2020 and 2030 Control Case inventories are developed from the 2020 and 2030 Base Case inventories, respectively, by applying nonroad diesel control assumptions to the nonroad emission source sectors. The growth and control assumptions used to prepare the 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; 2020 and 2030 Base Cases; and 2020 and 2030 Control Cases.

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. Inventory records with Source Classification Codes (SCCs) of 101xxxxx and 201xxxxx were extracted from the NET inventory to develop the 1996 EGU inventory.

B. 2020 AND 2030 FUTURE YEAR MASS EMISSIONS INVENTORIES

Projection year unit-level output files from the EPA Modeling Applications (v.2.1) of the Integrated Planning Model (IPM) were provided to Pechan by EPA for the EGU sector for 2020. These were the same files as modeled in the base case emission scenarios of the Clear Skies Initiative and includes a court remanded version of the Regional Transport NOx SIP Call reductions which excluded the additional control of emissions in Georgia and Missouri. The 2020 IPM output file was also used to represent EGU projections for 2030. This file includes 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 2020 and 2030, by adding to the IPM files emissions for VOC, CO, PM_{10}, $PM_{2.5}$, and NH_3, 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 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	Indicator of unit retrofit 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[1]	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)

[1] Not used in developing modeling files.

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 not match to this file, county centroids were assigned.

4. 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.

5. 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).

6. 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
Default Stack Parameters for Utility Boilers

SCC	Stack Temp. (degrees F)	Stack Height (feet)	Stack Diameter (feet)	Stack Flow (ft^3/sec)
10100101	175	570	24	16286
10100201	175	570	24	16286
10100202	175	570	24	16286
10100203	175	570	24	16286
10100204	175	570	24	16286
10100212	175	570	24	16286
10100217	175	570	24	16286
10100221	175	570	24	16286
10100222	175	570	24	16286
10100223	175	570	24	16286
10100226	175	570	24	16286
10100301	175	570	24	16286
10100302	175	570	24	16286
10100303	175	570	24	16286
10100401	300	290	12	3619
10100404	300	290	12	3619
10100601	300	280	12	2601
10100604	300	280	12	2601
10101201	175	570	24	16286
20100201	300	280	12	2601
20100202	300	280	12	2601

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. Condensible PM was not included in the estimate of PM_{10} or $PM_{2.5}$ emissions. A default PM control efficiency of 90 percent was applied to all coal-fired units which did not match to other inventories.

7. 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 more recent data for new units were available, some new units could be matched to the newer data to obtain SCCs.

C. MASS EMISSIONS INVENTORY FILES

After adding the additional parameters to the IPM unit-level file, the final mass emission inventories were prepared. 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 calculated using the same procedure, assuming that the emission rate remained the same across these 5 months. 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.

The structure for the base year and projection year mass emission inventories is shown in Tables II-4 and II-5. 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.

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
Structure for 1996 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
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
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
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_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	NH3 Control Efficiency (%)
VOC_CPRI	N	3	0	VOC Primary Control Equipment Code
NOX_CPRI	N	3	0	NO_x Primary Control Equipment Code

Table II-IV (continued)

Variable	Type	Length	Decimals	Description
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)
NH3_ANN	N	13	4	Annual NH_3 (tons)
VOC_OSD	N	13	4	Summer Day VOC (tons)
NOX_OSD	N	13	4	Summer Day NO_x (tons)
CO_OSD	N	13	4	Summer Day CO (tons)
SO2_OSD	N	13	4	Summer Day SO_2 (tons)
PM10_OSD	N	13	4	Summer Day PM_{10} (tons)
PM25_OSD	N	13	4	Summer Day $PM_{2.5}$ (tons)
NH3_OSD	N	13	4	Summer 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-5
Structure for 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
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)
LAT	N	9	4	Latitude (degrees)
LON	N	9	4	Longitude (degrees)
VOC_WIN	N	10	4	7-Month Winter VOC (tons)
VOC_SUM	N	10	4	5-Month Summer VOC (tons)
NOX_WIN	N	10	4	7-Month Winter NO_x (tons)
NOX_SUM	N	10	4	5-Month Summer NO_x (tons)
CO_WIN	N	10	4	7-Month Winter CO (tons)
CO_SUM	N	10	4	5-Month Summer CO (tons)
SO2_WIN	N	10	4	7-Month Winter SO_2 (tons)
SO2_SUM	N	10	4	5-Month Summer SO_2 (tons)
PM10_WIN	N	10	4	7-Month Winter PM_{10} (tons)
PM10_SUM	N	10	4	5-Month Summer PM_{10} (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)
NH3_WIN	N	10	4	7-Month Winter NH_3 (tons)
NH3_SUM	N	10	4	5-Month Summer NH_3 (tons)

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. 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. 2020 AND 2030 FUTURE YEAR MASS EMISSIONS INVENTORIES

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

Table III-1 (continued)

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

SOURCE: Developed from BEA, 1995.

2. Control Assumptions

Since the base year inventory for this effort is 1996, VOC and NOx reasonably available control technology (RACT) requirements were assumed to have already been implemented in 1-hr ozone nonattainment areas. 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 applied to identified source categories as shown in Tables III-3 and III-4.

NO_x emissions for the 20 States (22 original SIP Call States plus the District of Columbia, minus Wisconsin, Georgia, and Missouri) 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 a 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 (EPA, 1999a). 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%

Two estimates of NO_x emissions were calculated for non-EGU point sources 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. If NET96 control efficiencies were reported as lower than the applied control efficiency assumptions, an uncontrolled emission value was first calculated by removing this NET96 reported value and then a new emission estimate was calculated by applying the new control efficiency. If the NET96 control efficiency was higher than the applied control efficiency assumptions, no control efficiency changes were made to the source in the projection.

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. If NET96 control efficiencies were reported as lower than the applied control efficiency assumptions, an uncontrolled emission value was first calculated by removing this NET96 reported value and then a new emission estimate was calculated by applying the new control efficiency. If the NET96 control efficiency was higher than the applied control efficiency assumptions, no control efficiency changes were made to the source in the projection.

Table III-3 (continued)

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. If NET96 control efficiencies were reported as lower than the applied control efficiency assumptions, an uncontrolled emission value was first calculated by removing this NET96 reported value and then a new emission estimate was calculated by applying the new control efficiency. If the NET96 control efficiency was higher than the applied control efficiency assumptions, no control efficiency changes were made to the source in the projection.

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 FILES

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).

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
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 (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
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_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

Table III-7 (continued)

Variable	Type	Length	Decimals	Description
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)
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)
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 (%)

Table III-8
Structure for 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
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
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
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_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

Table III-8 (continued)

Variable	Type	Length	Decimals	Description
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)
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)
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 (%)
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 (%)

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 was at the time of this work 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. Additionally, residential, on-site incineration emissions were removed from all States in the inventory and commercial wood combustion emissions were removed from Maryland and Maine.

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

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

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

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

Table IV-1 (continued)

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

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

The U.S. Department of Agriculture (USDA) has developed baseline projections of farm acres planted (USDA, 1998). These data, combined with historical data back to 1990, for eight major crop types shows an expected average annual growth of only 0.38 percent per year from 1990 to 2007. The BEA GSP projections for *farms* result in an annual average growth of 2.0 percent per year. Projections of acres planted represent better predictors of future activity than GSP for agricultural tilling, so the 0.38 percent per year value was used in this analysis to calculate emission estimates for 2020 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. However, as specific areas for burning were not identified, emission estimates for 2020 and 2030 were assumed to remain the same as the base year 1996 in this analysis.

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, 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 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 2020 and 2030 were divided by the actual animal counts in 1996. Because all growth rates for agricultural livestock operations were applied nationally, the projection method assumes no shifts in regional patterns after 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. Onboard vapor recovery systems on gasoline-fueled vehicles are required in 1998 and later vehicles in all areas, independent of attainment status. However, slightly 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.

The Stage II control efficiencies used depended on both county and projection year. A cross-reference that contained the counties assumed to have Stage II controls at the pump in 1996 was developed and it was assumed that counties with base year Stage II controls did receive additional reductions in the future because of on-board vapor recovery systems being phased in over time.

Table IV-3
Area Source VOC Control Measure Assumptions

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

Table IV-3 (continued)

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

NOTES:

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

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

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

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

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

Pollutant	2020 Percent Reduction	2030 Percent Reduction
VOC	72	72
PM_{10} and $PM_{2.5}$[a]	51	51
CO	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 in 1996?	2020 Percent Reduction	2030 Percent Reduction
No	82.4	85.8
Yes	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
Georgia	Rockdale	13	247

Table IV-6 (continued)

State	County	State FIPS Code	County FIPS Code
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
Nevada	Washoe	32	031

Table IV-6 (continued)

State	County	State FIPS Code	County FIPS Code
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
Tennessee	Rutherford	47	149

Table IV-6 (continued)

State	County	State FIPS Code	County FIPS Code
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 FILES

The structure for the area source mass emission inventory files is shown in Table IV-7. A 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 emission files, a factor of 25 percent was applied to PM_{10} and $PM_{2.5}$ emissions for the SCCs listed in Table IV-8 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.

Table IV-7
Area 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)
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)
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
NOX_RE	N	3	0	NO_x Rule Effectiveness
CO_RE	N	3	0	CO Rule Effectiveness

Table IV-7 (continued)

Variable	Type	Length	Decimals	Description
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-8
Sources to which Crustal Factor was Applied to PM_{10} and $PM_{2.5}$ Emissions

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

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 March 2002 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 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 Nonroad Compression-Ignition (C-I) rulemaking was developed from two emission inventories including: (1) a 1996 county-level inventory, based on EPA's October 2001 draft NONROAD model; and (2) an updated national inventory, based on EPA's latest draft of the NONROAD model, dated March 2002. Using the county-level emission estimates referenced in (1), seasonal and daily county-to-national ratios were then developed for application to updated national estimates per season referenced in (2).

To develop an updated county-level inventory for 1996, 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. The statewide seasonal default RVP values used as input to the NONROAD model runs are presented in Table V-1. For areas subject to Phase I of the Federal RFG program, separate RVP values were modeled in the 1996 NONROAD inputs for May through September (values not shown). The areas and counties modeled with RFG are shown in Table VI-4 of Chapter VI "On-Highway Vehicle Sources." Oxygenated fuel was modeled in the areas participating in this program in 1996, as presented in Table VI-6. For all States except California, a diesel fuel sulfur level of 3300 parts per million (ppm) was used in the modeling runs. For California, a diesel fuel sulfur content of 120 ppm was used.

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.

Pechan calculated seasonal, county-to-national emissions ratios for each 10-digit SCC and pollutant based on county emissions divided by the sum total of county-level emissions for the nation. This was done for each of the four seasons and a typical summer weekday. This ensured that the fractions calculated for county-to-national emissions all added up to 1 at the national level. Fractions representing county-to-national fuel consumption were also developed in the same manner as the emission ratios, for use as activity to estimate NH_3 emissions. Fuel consumption was available for gasoline and diesel-fueled engines, as well as LPG and CNG engines.

The 1996 county-level emissions inventory was then updated to reflect revisions made to the NONROAD model since the October 2001 version. Using the March 2002 NONROAD model, national, seasonal emissions were generated at the SCC level for the following pollutants: VOC, NO_x, SO_2, CO, PM_{10}, and $PM_{2.5}$. Emission estimates were developed for 4 seasons, as well as for a typical summer weekday. To account for lower diesel fuel sulfur levels in California, separate runs were performed for this State for diesel-fueled equipment SCCs. Tables V-2a and V-2b present a summary of the input values used for the national NONROAD model runs. These national RVP input values were taken from the *Procedures Document for National Emission Inventory, Criteria Air Pollutants 1985-1999* (EPA, 1999c). The diesel fuel sulfur input values were provided to Pechan in personal communication with the Office of Air Quality and Transportation (OTAQ) staff.

National, SCC-level emissions for each of the four seasons (i.e., summer, winter, fall, and spring) were then multiplied by the season-specific county-to-national emissions ratios. The following formula represents how an updated 1996 (or alternate year) county-level annual emissions inventory was developed for a given SCC and pollutant.

$$E_{Ann,\,Cty,\,y} = \sum_{S} [(E_{S,\,Cty,1996} \div E_{S,\,N,1996}) * E_{S,\,N,\,y}]$$

Where:	E	=	Emissions, tons
	Ann	=	Annual
	S	=	Season (winter, spring, summer, fall)
	Cty	=	County
	N	=	National
	y	=	year of inventory (e.g., 1996, 2020, or 2030)

Table V-1.
Seasonal RVP Values Modeled for 1996 NONROAD Model Runs

State	FIPS[2] State Code	Seasonal RVP (psi)[1] Winter	Spring	Summer	Autumn
AL	01	12.4	9.3	7.5	8.8
AK	02	14.1	13.7	13	13.7
AZ	04	8.2	7.1	6.8	6.9
AR	05	13.7	9.5	6.8	10.1
CA (Los Angeles Region)	06	11.9	9.3	6.9	7.6
CA (San Francisco Region)	06	11.7	10.8	6.9	7.6
CO	08	12.5	10.1	7.8	9.4
CT	09	13.0	9.8	7.9	9.8
DE	10	13.5	10.0	7.9	9
DC	11	12.0	8.1	7.0	8.1
FL	12	11.8	7.4	7.4	7.4
GA	13	12.4	9.3	7.4	8.7
HI	15	10.0	10.0	9.8	10
ID	16	12.8	10.4	8.6	9.1
IL	17	14.1	10.2	7.8	9
IN	18	14.5	10.9	8.8	9.8
IA	19	14.9	11.2	9.0	11.2
KS	20	12.7	8.9	7.6	8.2
KY	21	13.4	9.5	8.4	9.5
LA	22	12.4	9.4	7.6	8.9
ME	23	13.2	10.3	9.0	10.3
MD	24	13.2	9.7	7.5	8.6
MA	25	12.9	9.7	7.8	9.7
MI	26	14.1	9.9	7.4	9.9
MN	27	14.9	11.4	9.0	10.4
MS	28	13.7	9.5	7.1	8.8
MO	29	12.6	10.0	7.2	9.4
MT	30	13.8	10.4	8.7	10.4
NE	31	13.9	10.6	8.6	9.2
NV	32	9.6	8.0	7.6	7.8
NH	33	12.9	9.7	7.8	9.7
NJ	34	13.7	10.5	8.8	10.5
NM	35	11.7	9.2	7.8	9.0

Table V-1 (Continued)

State	FIPS[2] State Code	Seasonal RVP (psi)[1] Winter	Spring	Summer	Autumn
NY	36	14.3	10.9	8.8	10.9
NC	37	12.4	10.3	7.4	9.7
ND	38	14.9	11.9	9.0	11.2
OH	39	14.6	11.0	8.7	9.8
OK	40	13.9	9.1	7.2	8.2
OR	41	12.3	9.8	7.7	8.7
PA	42	14.4	10.9	8.8	10.9
RI	44	12.9	9.7	7.8	9.7
SC	45	12.4	10.3	7.4	9.7
SD	46	14.4	11.2	9.0	9.9
TN	47	12.7	10.4	7.3	9.8
TX	48	12.2	9.7	7.8	8.7
UT	49	12.5	10.6	7.8	9.4
VT	50	14.9	11.4	9.0	11.4
VA	51	11.8	8.2	7.2	8.2
WA	53	14.0	10.6	8.5	9.5
WV	54	14.6	11.0	8.8	9.9
WI	55	14.6	11.1	9.0	10.1
WY	56	13.0	10.4	8.8	9.3

Notes: For areas receiving reformulated gasoline May through September, RVP values were modeled in place of the values shown here.
[1] pounds per square inch
[2] Federal Information Processing Standards

Pechan also generated state-level, seasonal emissions at the SCC level for California. County-to-state ratios were developed and applied in a manner similar to the county-to-national ratios to produce an updated diesel equipment inventory for California. These California results replace the diesel equipment emissions generated from prior application of county-to-national ratios.

In addition to the seasonal runs, typical summer weekday (SSD) NONROAD model runs were performed at the national level and for California. Updated county-level typical summer weekday emissions were developed by applying county-to-national daily emissions ratios (or county-to-state emission ratios for California) to the national daily results.

The emissions inputs developed for the air quality modeling and reported in this document are required early in the analytical process and therefore was based on a preliminary set of base and control scenario parameters. Since the preliminary scenario was developed, more information has been gathered regarding the technical feasibility of the standards. As a result minor changes have been made to the final baseline and control case fuel sulfur levels (EPA, 2003).

Table V-2a
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-2b
Diesel Fuel Sulfur Input Values for National NONROAD Model Runs[1]

	Fuel Sulfur, ppm	
Year	Base case[2]	Control case[3]
1996	2700	Not applicable

[1] Diesel fuel sulfur does not change seasonally.
[2] For 1996 California base case runs, a diesel fuel sulfur content of 120 ppm was used for all seasons.
[3] For 1996 California control case runs, a diesel fuel sulfur content of 120 ppm was used for all seasons.

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

Base year aircraft, locomotive and distillate commercial marine vessel (CMV) emissions were taken from the existing 1996 HDDV inventory (Pechan, 2000). Adjustments were made to PM_{10} and SO_2 emissions for locomotive source categories and SO_2 emissions for CMV source categories using 49-State and California SO_2 and PM_{10} emissions supplied by OTAQ (Wilcox, 2002). 49-State and California locomotive SO_2 emissions are based on new estimates of activity corresponding to 1996 locomotive fuel usage. The activity data were calculated by subtracting the 1996 railroad distillate consumption obtained from the Energy Information Administration (EIA) "*Fuel Oil and Kerosene Sales 2000*" report to the total rail maintenance source category fuel consumption obtained from the NONROAD model (EIA, 2000). The locomotive fuel usage was multiplied by the appropriate sulfur level and necessary conversion factors. Base and control case sulfur levels in parts per million for both 49-State and California are listed in Table V-3. CMV SO_2 emissions are based on activity data corresponding to 1996 commercial marine fuel usage. The activity data were calculated by subtracting the 1996 vessel bunkering distillate consumption obtained from the EIA "*Fuel Oil and Kerosene Sales* 2000" report to the total recreational marine diesel source category fuel consumption obtained from the NONROAD model. The CMV fuel usage was multiplied by the appropriate sulfur level.

The 1996 PM_{10} emissions for both locomotive and CMV were estimated using the same activity data as SO_2 emissions. The PM_{10} emission factor applied to fuel usage is listed in Table V-3. 49-State and California SSD SO_2 and PM_{10} emissions were estimated by dividing the annual emissions, supplied by OTAQ, by 365 days.

Table V-3
Sulfur Concentrations and PM_{10} Emission Factors for Locomotive and CMV Emission Calculations

Year	Area	Sulfur Concentration (ppm)	PM_{10} Emission Factor[1] (g/gal)
1996	49-State	2700	6.8
	California	120	

[1] PM_{10} Emission Factor is for locomotives only.

Locomotive and distillate CMV emissions from the 1996 HDDV inventory were first summed up to the 49-State and California level. A ratio adjustment factor was calculated by dividing the sums from the 1996 HDDV inventory by the appropriate SO_2 and PM_{10} emissions supplied by OTAQ. The adjustment factor was then applied back to the SO_2 and PM_{10} annual and SSD emissions in the county-level inventory to generate updated PM_{10} and SO_2 emissions. $PM_{2.5}$ emissions were estimated by multiplying the updated PM_{10} emissions by a factor of 0.92.

3. Methodologies for NH_3

Ammonia emissions were estimated based on updated national, SCC-level fuel consumption estimates, as reported by the March 2002 NONROAD model. As with the criteria pollutant emission estimates, SCC-specific ratios were developed by dividing county-level fuel consumption values by national fuel consumption values estimated with the October 2001 draft NONROAD model. 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. Base year locomotive and distillate CMV NH_3 emissions were taken from the existing 1996 HDDV inventory (Pechan, 2000).

For aircraft categories, 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.

B. 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-4 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, four seasonal NONROAD model runs were performed at the national level for both 2020 and 2030. Seasonal runs accounted for differences in average seasonal temperature, as well as RVP. Second, updated county-level estimates were then calculated for 2020 and 2030 by multiplying national, seasonal SCC-level emissions by the 1996 season-specific county-to-national emissions ratios. Seasonal county-level emissions are then summed up to estimate annual emissions. 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. County-to-state ratios were developed and applied in a manner similar to the county-to-national ratios to produce an updated diesel equipment inventory for California. Additional runs were also performed to estimate typical summer weekday emissions for each projection year.

In addition to a base case scenario, control case emission inventories were developed for each projection year to account for the effects of the proposed NONROAD C-I emission standards that are the subject of this rulemaking as well as proposed reductions in diesel sulfur content. Table V-5 presents the diesel fuel sulfur values assumed for the modeling base case and control case scenarios. 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 11 ppm for the control scenario).

Table V-4
Growth Indicators/Projection Methods for Nonroad Sources

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

[1] Projection year emission estimates were derived from national NONROAD model runs allocated to counties based on the geographic distribution of a 1996 county-level inventory, developed from the October2001 draft version of NONROAD.
[2] NH_3 emissions were projected using growth factors; projection year estimates for all other pollutants provided by OTAQ and allocated to counties using ratios from the 1996 inventory.
[3] 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.

As discussed earlier in this document, the emissions inputs for the air quality modeling are required early in the analytical process in order to be able to conduct the air quality modeling and present the results in this proposal. The air quality modeling was based on a preliminary control scenario. Since the preliminary control scenario was developed, more information was gathered regarding the technical feasibility of the standards. As a result, both the base and control case scenarios were modified. Detailed information on these modifications can be found in the associated Regulatory Impact Analysis Technical Support Document (EPA, 2003).

Table V-5
Diesel Fuel Sulfur Input Values for National NONROAD Model Runs[1]

Year	Fuel Sulfur, ppm	
	Base case[2]	Control case[3]
2020	2700	11
2030	2700	11

[1] Diesel fuel sulfur does not change seasonally.
[2] For 1996 California base case runs, a diesel fuel sulfur content of 120 ppm was used for all seasons. For 2020 and 2030 California base case runs, a diesel fuel sulfur content of 11 ppm was used for all seasons.
[3] For 1996 California control case runs, a diesel fuel sulfur content of 120 ppm was used for all seasons. For 2020 and 2030 California control case runs, a diesel fuel sulfur content of 11 ppm was used for all seasons.

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 were final at the time of model formulation, or proposed standards expected to be final soon after. 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 already in place accounted for in the base case inventories by the NONROAD model include: (1) Tier 1, Tier 2 and Tier 3 CI standards for diesel engines ranging from 50 horsepower (hp) to 750 hp; (2) Tier 1 and Tier 2 CI standards for diesel engines below 50 hp and greater than 750 hp; (3) Phase I and Phase 2 of the SI standards for gasoline engines less than 25 hp; and (4) recreational SI marine engine controls. The control case inventories also account for the effects of proposed CI standards covering all hp categories. The proposed CI standards as designated as Tier 4 standards.

Pre-controlled and controlled steady-state emission factors for various horsepower ranges of CI engines prior to control and subject to the current and proposed standards are presented in Table V-6. Pre-controlled and controlled steady-state emission factors for SI engines below 25 hp (19 kilowatts) are presented in Table V-7. Additional details for these categories, as well as SI engines greater than 25 hp and SI recreational marine engines, are presented in technical reports that serve as supporting documentation for NONROAD model inputs (EPA, 2002a and EPA, 2002b). Compression-ignition engine emission factor values listed in Table V-6 reflect revisions made to the NONROAD model since the June 2000 draft version.

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 the NONROAD inputs to account for the use of RFG in future years.

Table V-6
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	0.7628	4.1127	5.2298	0.4474
	05-09	Tier 2	0.5508	4.1127	4.3	0.50
	10-11	Transitional Tier 4[2]	0.1314	0.411	4.3	0.0092
	12-	Final Tier 4[2]	0.1314	0.411	0.276	0.0092
>11 to 25	88-99	–	1.7	5.0	8.5	0.9
	00-04	Tier 1	0.4380	2.1610	4.4399	0.2665
	05-09	Tier 2	0.4380	2.1610	4.4399	0.2665
	10-11	Transitional Tier 4[2]	0.1314	0.216	4.4399	0.0092
	12-	Final Tier 4[2]	0.1314	0.216	0.276	0.0092
>25 to 50	88-98	–	1.8	5.0	6.9	0.8
	99-03	Tier 1	0.2789	1.5323	4.7279	0.3389
	04-09	Tier 2	0.2789	1.5323	4.7279	0.3389
	10-11	Transitional Tier 4[2]	0.1314	0.153	4.7279	0.0092
	12-	Final Tier 4[2]	0.1314	0.153	0.276	0.0092
>50 to 100	88-97	–	0.99	3.49	6.9	0.722
	98-03	Tier 1	0.5213	2.3655	5.5988	0.4730
	04-07	Tier 2	0.3672	2.3655	4.7	0.24
	08-09	Tier 3	0.1836	2.3655	3.0	0.30
	10-11	Transitional Tier 4[2]	0.1314	0.237	3.0	0.0092
	12-	Final Tier 4[2]	0.1314	0.237	0.276	0.0092
>100 to 175	88-96	–	0.68	2.7	8.38	0.402
	97-02	Tier 1	0.3384	0.8667	5.6523	0.2799
	03-06	Tier 2	0.3384	0.8667	4.1	0.18
	07-09	Tier 3	0.1836	0.8667	2.5	0.22
	10-11	Transitional Tier 4[2]	0.1314	0.087	2.5	0.0092
	12-	Final Tier 4[2]	0.1314	0.087	0.276	0.0092
>175 to 300	88-95	–	0.68	2.7	8.38	0.402
	96-02	Tier 1	0.3085	0.7475	5.5772	0.2521
	03-05	Tier 2	0.3085	0.7475	4.0	0.1316
	06-08	Tier 3	0.1836	0.7475	2.5	0.15
	09-10	Transitional Tier 4[2]	0.1314	0.075	2.5	0.0092
	11-	Final Tier 4[2]	0.1314	0.075	0.276	0.0092

Table V-6 (continued)

Engine Power (hp)	Model Year	Regulation	Emission Factors (g/hp-hr)			
			HC	CO	NO_x	PM[1]
>300 to 600	88-95	–	0.68	2.7	8.38	0.402
	96-00	Tier 1	0.2025	1.3060	6.0153	0.2008
	01-05	Tier 2	0.1669	0.8425	4.3351	0.1316
	06-08	Tier 3	0.1669	0.8425	2.5	0.15
	09-10	Transitional Tier 4[2]	0.1314	0.084	2.5	0.0092
	11-	Final Tier 4[2]	0.1314	0.084	0.276	0.0092
>600 to 750	88-95	–	0.68	2.7	8.38	0.402
	96-01	Tier 1	0.1473	1.3272	5.8215	0.2201
	02-05	Tier 2	0.1669	1.3272	4.1	0.1316
	06-08	Tier 3	0.1669	1.3272	2.5	0.15
	09-10	Transitional Tier 4[2]	0.1314	0.133	2.5	0.0092
	11-	Final Tier 4[2]	0.1314	0.133	0.276	0.0092
>750	88-99	–	0.68	2.7	8.38	0.402
	00-05	Tier 1	0.2861	0.7642	6.1525	0.1934
	06-08	Tier 2	0.1669	0.7642	4.1	0.1316
	09-10	Transitional Tier 4[2]	0.1314	0.076	4.1	0.0092
	11-	Final Tier 4[2]	0.1314	0.076	0.276	0.0092

[1] PM_{10} is assumed to be equivalent to PM.
[2] The Tier 4 emission factors are considered to be transient.

Table V-7
Emission Factors for SI Engines Below 25 hp

Engine Tech Type	Emission Factors (g/hp-hr)			
	HC	CO	NO_x	PM[1]
Class III Handheld New Engine Emissions (<20cc)[2]				
Gas 2-stroke handheld Class III, baseline	261.00	718.87	0.97	7.7
Phase 1	219.99	480.31	0.78	7.7
Phase 1 with catalyst	219.99	480.31	0.78	7.7
Phase 2	33.07	283.37	0.91	7.7
Phase 2 with catalysts	26.87	141.69	1.49	7.7
Class IV Handheld New Engine Emissions (≥20cc and <50cc)				
Gas 2-stroke handheld Class IV, baseline	261.00	718.87	0.94	7.7
Phase 1	179.72	407.38	0.51	7.7
Phase 1 with catalyst	179.72	407.38	0.51	7.7
Phase 1 4-stroke	22.37	533.42	1.79	0.06
Phase 2	33.07	283.37	0.91	7.7
Phase 2 with catalysts	26.87	141.69	1.49	7.7
Phase 2 4-stroke	25.83	432.51	1.13	0.06
Class V Handheld New Engine Emissions (>50cc)				
Gas 2-stroke handheld Class V, baseline	159.58	519.02	0.97	7.7
Phase 1	120.06	351.02	1.82	7.7
Phase 1 with catalyst	120.06	351.02	1.82	7.7
Phase 2	47.98	283.37	0.91	7.7
Phase 2 with catalysts	40.15	141.69	1.49	7.7
Class I Nonhandheld New Engine Emissions (<225cc)				
Gas 2-stroke nonhandheld Class I, baseline	207.92	485.81	0.29	7.7
Gas, side-valved, 4-stroke nonhandheld Class I, baseline	38.99	430.84	2.00	0.06
Gas, overhead-valved, 4-stroke nonhandheld Class I, baseline	13.39	408.84	1.80	0.06
2-stroke, Phase 1	120.06	449.66	4.00	7.7
Phase 1 side-valved, 4-stroke	8.40	353.69	3.60	0.06
Phase 1 overhead valved 4-stroke	8.40	351.16	3.24	0.06
Phase 1 side-valved, 4-stroke with catalyst	8.40	353.69	3.60	0.06
Phase 2 side-valved	7.93	353.69	2.37	0.06
Phase 2 overhead valved	6.13	351.16	1.83	0.06
Class II Nonhandheld New Engine Emissions (≥225cc)				
Gas 2-stroke nonhandheld Class II, baseline	207.92	485.81	0.29	7.7
Gas, side-valved, 4-stroke nonhandheld Class II, baseline	9.66	430.84	2.06	0.06
Gas, overhead-valved, 4-stroke nonhandheld Class II, baseline	5.20	408.84	3.50	0.06
Phase 1 side-valved, 4-stroke	5.50	387.02	4.50	0.06
Phase 1 overhead valved 4-stroke	5.20	352.57	3.50	0.06
Phase 2 side-valved	5.50	387.02	4.50	0.06
Phase 2 overhead valved	4.16	352.57	2.77	0.06

[1] PM_{10} is assumed to be equivalent to PM.
[2] Assigned NONROAD hp ranges:
Class III<20cc: 0-1 hp; Class IV≥20cc and <50cc: 1-3 hp; Class V>50cc: 3-6 hp; Class I <225cc: 3-6hp; Class II ≥225cc: 6-25hp

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

Military aircraft were projected from 1996 using BEA GSP growth factors. Aircraft estimates for the years 2020 and 2030 were based on 1996 NET emission estimates and developed with 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 BEA GSP-based projections to 2010 were used for 2020 and 2030 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.

Locomotive and distillate CMV emissions were taken from the existing 2020 and 2030 control case HDDV inventory (Pechan, 2000). Adjustments were made to PM_{10} and SO_2 emissions for locomotive source categories and SO_2 emissions for CMV source categories using 49-State and California SO_2 and PM_{10} emissions supplied by OTAQ. 49-State and California locomotive SO_2 emissions are based on activity data corresponding to 2020 or 2030 locomotive fuel usage. The activity data were calculated by subtracting the 2000 railroad distillate consumption obtained from the EIA "*Fuel Oil and Kerosene Sales* 2000" report to the total rail maintenance source category fuel consumption obtained from the NONROAD model. The activity data were then multiplied by a growth factor representing rail energy use. The locomotive fuel usage was multiplied by the appropriate sulfur level, listed in Table V-8. CMV SO_2 emissions are based on activity data corresponding to 2020 and 2030 commercial marine fuel usage. The activity data were calculated by subtracting the 2000 vessel bunkering distillate consumption obtained from the EIA "*Fuel Oil and Kerosene Sales* 2000" report to the total recreational marine diesel source category fuel consumption obtained from the NONROAD model. The activity data were then multiplied by a growth factor. The CMV fuel usage was multiplied by the appropriate sulfur level, listed in Table V-8.

The 2020 and 2030 PM_{10} emissions for locomotives were estimated using the same activity data as SO_2 emissions. PM_{10} emission factors for 2020 and 2030 are listed in Table V-8. 49-State and California SSD SO_2 and PM_{10} emissions were estimated by dividing the annual emissions, supplied by OTAQ, by 365 days.

Locomotive and distillate CMV emissions from the 2020 and 2030 control case HDDV inventories were first summed up to the 49-State and California level. A ratio adjustment factor was calculated by dividing the sums from the 2020 and 2030 HDDV inventories by the appropriate SO_2 and PM_{10} emissions supplied by OTAQ. The adjustment factor was then applied back to the SO_2 and PM_{10} annual and SSD emissions in the county-level inventories to generate updated PM_{10} and SO_2 emissions. $PM_{2.5}$ emissions were estimated by multiplying the updated PM_{10} emissions by a factor of 0.92.

Distillate CMV PM_{10} emissions were adjusted for only the control cases. The PM_{10} emissions were first summed up to the 49-State and California level in both the 2020 and 2030 control case HDDV emission inventories. Total PM_{10} emissions from the HDDV inventories were reduced by the appropriate CMV sulfate PM "benefit" emissions supplied by OTAQ. The sulfate PM "benefit" emissions were generated by subtracting the control from the base case CMV sulfate PM emissions. The PM sulfate emissions are based on 2020 and 2030 commercial marine fuel usage multiplied by the appropriate sulfur level, listed in Table V-8. A ratio adjustment factor was calculated by dividing the PM_{10} sums from the 2020 and 2030 control case HDDV inventories by the CMV sulfate PM "benefit" emissions supplied by OTAQ. The adjustment factor was then applied to the PM_{10} county-level emissions in the inventories to estimate updated PM_{10} emissions. $PM_{2.5}$ emissions were estimated by multiplying the updated PM_{10} emissions by a factor of 0.92.

Table V-8
Sulfur Concentrations and PM_{10} Emission Factors for Locomotive and CMV Emission Calculations

Year	Area	Sulfur Concentration (ppm)	PM_{10} Emission Factor[1] (g/gal)
2020 base	49-State	2700	4.9
	California	120	
2020 control	49-State	11	
	California	11	
2030 base	49-State	2700	4.2
	California	120	
2030 control	49-State	11	
	California	11	

[1] PM_{10} Emission Factor is for locomotives only.

3. Methodologies for NH_3

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 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, 1996 base year NH_3 emissions were projected to future years using the growth indicators listed in Table V-5. Locomotive and commercial marine vessel (CMV) NH_3 emissions were taken from the existing 2020 and 2030 control case HDDV inventories (Pechan, 2000).

C. MASS EMISSIONS INVENTORY FILES

Mass emissions for NONROAD model sources were maintained in a separate data base from emissions for diesel commercial marine and locomotive categories. Table V-9 presents the nonroad mass emissions inventory file structure.

Table V-9
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)
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)

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 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 Nonroad 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). The counties that were modeled with I/M programs in the base year are shown in Table VI-4.

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-5. 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-6 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 Inspection and Maintenance (I/M) Programs

Table VI-4 (continued)

State	County
Arizona	Maricopa Co
Arizona	Pima Co
California	Alameda Co
California	Butte Co
California	Contra Costa Co
California	El Dorado Co
California	Madera Co
California	Merced Co
California	Orange Co
California	Placer Co
California	Riverside Co
California	San Bernardino Co
California	San Joaquin Co
California	Santa Clara Co
California	Solano Co
California	Stanislaus Co
California	Tulare Co
California	Ventura Co
California	Yolo Co
California	Marin Co
California	Monterey Co
California	San Luis Obispo Co
California	San Mateo Co
California	Santa Barbara Co
California	Santa Cruz Co
California	Sonoma Co
California	Fresno Co
California	Kern Co
California	Los Angeles Co
California	Napa Co
California	Sacramento Co
California	San Diego Co
California	San Francisco Co
Colorado	Adams Co
Colorado	Arapahoe Co
Colorado	Boulder Co
Colorado	Douglas Co
Colorado	Jefferson Co
Colorado	Denver Co
Colorado	Pitkin Co
Colorado	El Paso Co
Colorado	Larimer Co
Colorado	Weld Co
Connecticut	Fairfield Co
Connecticut	Hartford Co
Connecticut	Litchfield Co
State	**County**
Connecticut	Middlesex Co
Connecticut	New Haven Co
Connecticut	New London Co
Connecticut	Tolland Co
Connecticut	Windham Co
Delaware	Kent Co
Delaware	New Castle Co
Delaware	Sussex Co
DC	Washington
Florida	Broward Co
Florida	Dade Co
Florida	Duval Co
Florida	Hillsborough Co
Florida	Palm Beach Co
Florida	Pinellas Co
Georgia	Cobb Co
Georgia	De Kalb Co
Georgia	Fulton Co
Georgia	Gwinnett Co
Idaho	Ada Co
Illinois	Cook Co
Illinois	Du Page Co
Illinois	Lake Co
Illinois	Grundy Co
Illinois	Kane Co
Illinois	Kendall Co
Illinois	McHenry Co
Illinois	Will Co
Illinois	Madison Co
Illinois	St. Clair Co
Indiana	Clark Co
Indiana	Floyd Co
Indiana	Lake Co
Indiana	Porter Co
Kentucky	Boone Co
Kentucky	Campbell Co
Kentucky	Kenton Co
Kentucky	Jefferson Co
Louisiana	Ascension Par
Louisiana	Calcasieu Par
Louisiana	East Baton Rouge Par
Louisiana	Iberville Par
Louisiana	Livingston Par
Louisiana	Pointe Coupee Par
Louisiana	West Baton Rouge Par
Maryland	Anne Arundel Co
State	**County**
Maryland	Baltimore Co

Table VI-4 (continued)

State	County
Maryland	Carroll Co
Maryland	Harford Co
Maryland	Howard Co
Maryland	Baltimore
Maryland	Calvert Co
Maryland	Cecil Co
Maryland	Queen Annes Co
Maryland	Charles Co
Maryland	Frederick Co
Maryland	Montgomery Co
Maryland	Prince Georges Co
Maryland	Washington Co
Massachusetts	Barnstable Co
Massachusetts	Berkshire Co
Massachusetts	Bristol Co
Massachusetts	Dukes Co
Massachusetts	Essex Co
Massachusetts	Franklin Co
Massachusetts	Hampden Co
Massachusetts	Hampshire Co
Massachusetts	Middlesex Co
Massachusetts	Nantucket Co
Massachusetts	Norfolk Co
Massachusetts	Plymouth Co
Massachusetts	Suffolk Co
Massachusetts	Worcester Co
Minnesota	Anoka Co
Minnesota	Carver Co
Minnesota	Dakota Co
Minnesota	Hennepin Co
Minnesota	Ramsey Co
Minnesota	Scott Co
Minnesota	Washington Co
Minnesota	Wright Co
Missouri	Franklin Co
Missouri	Jefferson Co
Missouri	St. Charles Co
Missouri	St. Louis Co
Missouri	St. Louis
Nevada	Clark Co
Nevada	Washoe Co
New Jersey	Atlantic Co
New Jersey	Cape May Co
New Jersey	Warren Co
New Jersey	Bergen Co
New Jersey	Essex Co
New Jersey	Hudson Co
New Jersey	Hunterdon Co
New Jersey	Mercer Co
New Jersey	Middlesex Co
New Jersey	Monmouth Co
New Jersey	Morris Co
New Jersey	Ocean Co
New Jersey	Passaic Co
New Jersey	Somerset Co
New Jersey	Sussex Co
New Jersey	Union Co
New Jersey	Burlington Co
New Jersey	Camden Co
New Jersey	Cumberland Co
New Jersey	Gloucester Co
New Jersey	Salem Co
New Mexico	Bernalillo Co
New York	Bronx Co
New York	Kings Co
New York	Nassau Co
New York	New York Co
New York	Queens Co
New York	Richmond Co
New York	Rockland Co
New York	Suffolk Co
New York	Westchester Co
North Carolina	Davidson Co
North Carolina	Davie Co
North Carolina	Forsyth Co
North Carolina	Guilford Co
North Carolina	Durham Co
North Carolina	Granville Co
North Carolina	Gaston Co
North Carolina	Mecklenburg Co
North Carolina	Wake Co
Ohio	Clark Co
Ohio	Clermont Co
Ohio	Geauga Co
Ohio	Greene Co
Ohio	Medina Co
Ohio	Montgomery Co
Ohio	Portage Co
Ohio	Summit Co
Ohio	Warren Co
Ohio	Butler Co
Ohio	Hamilton Co
Ohio	Lake Co
Ohio	Lorain Co
Ohio	Cuyahoga Co

Table VI-4 (continued)

State	County
Oklahoma	Canadian Co
Oklahoma	Cleveland Co
Oklahoma	Kingfisher Co
Oklahoma	Lincoln Co
Oklahoma	Logan Co
Oklahoma	McClain Co
Oklahoma	Oklahoma Co
Oklahoma	Pottawatomie Co
Oklahoma	Creek Co
Oklahoma	Osage Co
Oklahoma	Rogers Co
Oklahoma	Tulsa Co
Oklahoma	Wagoner Co
Oregon	Clackamas Co
Oregon	Jackson Co
Oregon	Multnomah Co
Oregon	Washington Co
Pennsylvania	Allegheny Co
Pennsylvania	Beaver Co
Pennsylvania	Washington Co
Pennsylvania	Westmoreland Co
Pennsylvania	Lehigh Co
Pennsylvania	Northampton Co
Pennsylvania	Bucks Co
Pennsylvania	Chester Co
Pennsylvania	Delaware Co
Pennsylvania	Montgomery Co
Pennsylvania	Philadelphia Co
Rhode Island	Bristol Co
Rhode Island	Kent Co
Rhode Island	Newport Co
Rhode Island	Providence Co
Rhode Island	Washington Co
Tennessee	Rutherford Co
Tennessee	Sumner Co
Tennessee	Williamson Co
Tennessee	Wilson Co

State	County
Tennessee	Davidson Co
Tennessee	Shelby Co
Texas	Collin Co
Texas	Denton Co
Texas	Dallas Co
Texas	Tarrant Co
Texas	Ellis Co
Texas	Johnson Co
Texas	Kaufman Co
Texas	Parker Co
Texas	Rockwall Co
Texas	El Paso Co
Texas	Harris Co
Virginia	Arlington Co
Virginia	Fairfax Co
Virginia	Fairfax
Virginia	Prince William Co
Virginia	Alexandria
Virginia	Manassas
Virginia	Manassas Park
Virginia	Falls Church
Washington	King Co
Washington	Snohomish Co
Washington	Spokane Co
Wisconsin	Kenosha Co
Wisconsin	Milwaukee Co
Wisconsin	Ozaukee Co
Wisconsin	Racine Co
Wisconsin	Washington Co
Wisconsin	Waukesha Co
Wisconsin	Sheboygan Co
Utah	Davis Co
Utah	Salt Lake Co
Utah	Weber Co
Utah	Utah Co

Table VI-5
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
	Oldham 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
	Hampden Co

Table VI-5 (continued)

State	Nonattainment Area	County
		Hampshire 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
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
		York Co

Table VI-5 (continued)

State/ Nonattainment Area	County	State/ Nonattainment Area	County
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-6
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 (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

Table VI-6 (continued)

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-7 lists the exhaust VOC MOBILE5b to MOBILE6 adjustment factors applied in 1996 and the projection years and Table VI-8 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-9 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-10.

Table VI-7
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
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-8
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
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-9
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
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-10
HDDV 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
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. 2020 AND 2030 FUTURE YEAR MASS EMISSIONS INVENTORIES

This section summarizes the growth assumptions made and control programs applied to calculate the 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 2020 and 2030.

1. Growth Assumptions

The VMT used in 2020 and 2030 were projected from 1996, using VMT projection data from EPA's Tier 2 rulemaking (EPA, 1999d). 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 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 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-11.

Table VI-11
National VMT Projections Fractions by Vehicle Type for Nonroad Analysis

Vehicle	Annual VMT (10x6 Miles)		VMT Fractions	
Type	2020	2030	2020	2030
LDGV	1,283,189	1,311,807	0.329	0.292
LDGT1	1,670,987	2,027,426	0.428	0.452
LDGT2	371,876	451,534	0.095	0.101
HDGV	165,884	201,948	0.043	0.045
LDDV	0	0	0.000	0.000
LDDT	5,112	5,885	0.001	0.001
HDDV	384,106	467,480	0.098	0.104
MC	19,885	24,208	0.005	0.005
Total	**3,901,040**	**4,490,287**	**1.000**	**1.000**

2. Control Assumptions

This section summarizes the control programs that were modeled for highway vehicles in 2020 and 2030.

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-12.

I/M program 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. The counties that were modeled with I/M programs in the projection years are shown in Table VI-13.

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 depending on their ASTM Class and hence the applicable federal RVP requirements. 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-6 for several of the areas for 2020 and 2030.

Table VI-12
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
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

Table VI-12 (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			
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)

Table VI-13
Counties Modeled with Inspection and Maintenance (I/M) Programs

State	County
Arizona	Maricopa Co
Arizona	Pima Co
California	Alameda Co
California	Butte Co
California	Colusa Co
California	Contra Costa Co
California	El Dorado Co
California	Glenn Co
California	Kings Co
California	Madera Co
California	Merced Co
California	Nevada Co
California	Orange Co
California	Placer Co
California	Riverside Co
California	San Benito Co
California	San Bernardino Co
California	San Joaquin Co
California	Santa Clara Co
California	Shasta Co
California	Solano Co
California	Stanislaus Co
California	Sutter Co
California	Tehama Co
California	Tulare Co
California	Ventura Co
California	Yolo Co
California	Yuba Co
California	Marin Co
California	Monterey Co
California	San Luis Obispo Co
California	San Mateo Co
California	Santa Barbara Co
California	Santa Cruz Co
California	Sonoma Co
California	Fresno Co
California	Kern Co
California	Los Angeles Co
California	Napa Co
California	Sacramento Co
California	San Diego Co
California	San Francisco Co
Colorado	Adams Co
Colorado	Arapahoe Co
Colorado	Boulder Co
Colorado	Douglas Co
Colorado	Jefferson Co
Colorado	Denver Co
Colorado	Pitkin Co
Colorado	El Paso Co
Colorado	Larimer Co
Colorado	Weld Co
Connecticut	Fairfield Co
Connecticut	Hartford Co
Connecticut	Litchfield Co
Connecticut	Middlesex Co
Connecticut	New Haven Co
Connecticut	New London Co
Connecticut	Tolland Co
Connecticut	Windham Co
Delaware	Kent Co
Delaware	New Castle Co
Delaware	Sussex Co
DC	Washington
Florida	Broward Co
Florida	Dade Co
Florida	Duval Co
Florida	Hillsborough Co
Florida	Palm Beach Co
Florida	Pinellas Co
Georgia	Cherokee Co
Georgia	Clayton Co
Georgia	Coweta Co
Georgia	Douglas Co
Georgia	Fayette Co
Georgia	Forsyth Co
Georgia	Henry Co
Georgia	Paulding Co
Georgia	Rockdale Co
Georgia	Cobb Co
Georgia	De Kalb Co
Georgia	Fulton Co
Georgia	Gwinnett Co
Idaho	Ada Co
Illinois	Cook Co
Illinois	Du Page Co
Illinois	Lake Co
Illinois	Grundy Co
Illinois	Kane Co
Illinois	Kendall Co
Illinois	McHenry Co
Illinois	Will Co

Table VI-13 (continued)

State	County
Illinois	Madison Co
Illinois	St. Clair Co
Illinois	Monroe Co
Indiana	Clark Co
Indiana	Floyd Co
Indiana	Lake Co
Indiana	Porter Co
Kentucky	Boyd Co
Kentucky	Greenup Co
Kentucky	Boone Co
Kentucky	Campbell Co
Kentucky	Kenton Co
Kentucky	Jefferson Co
Louisiana	Ascension Par
Louisiana	East Baton Rouge Par
Louisiana	Iberville Par
Louisiana	Livingston Par
Louisiana	Pointe Coupee Par
Louisiana	West Baton Rouge Par
Maine	Cumberland Co
Maryland	Anne Arundel Co
Maryland	Baltimore Co
Maryland	Carroll Co
Maryland	Harford Co
Maryland	Howard Co
Maryland	Baltimore
Maryland	Calvert Co
Maryland	Cecil Co
Maryland	Queen Annes Co
Maryland	Charles Co
Maryland	Frederick Co
Maryland	Montgomery Co
Maryland	Prince Georges Co
Maryland	Washington Co
Massachusetts	Barnstable Co
Massachusetts	Berkshire Co
Massachusetts	Bristol Co
Massachusetts	Dukes Co
Massachusetts	Essex Co
Massachusetts	Franklin Co
Massachusetts	Hampden Co
Massachusetts	Hampshire Co
Massachusetts	Middlesex Co
Massachusetts	Nantucket Co
Massachusetts	Norfolk Co
Massachusetts	Plymouth Co
Massachusetts	Suffolk Co
Massachusetts	Worcester Co

State	County
Minnesota	Anoka Co
Minnesota	Carver Co
Minnesota	Dakota Co
Minnesota	Hennepin Co
Minnesota	Ramsey Co
Minnesota	Scott Co
Minnesota	Washington Co
Missouri	Franklin Co
Missouri	Jefferson Co
Missouri	St. Charles Co
Missouri	St. Louis Co
Missouri	St. Louis
Nevada	Clark Co
Nevada	Washoe Co
New Hampshire	Hillsborough Co
New Hampshire	Rockingham Co
New Hampshire	Merrimack Co
New Hampshire	Strafford Co
New Jersey	Atlantic Co
New Jersey	Cape May Co
New Jersey	Warren Co
New Jersey	Burlington Co
New Jersey	Camden Co
New Jersey	Cumberland Co
New Jersey	Gloucester Co
New Jersey	Salem Co
New Jersey	Bergen Co
New Jersey	Essex Co
New Jersey	Hudson Co
New Jersey	Hunterdon Co
New Jersey	Middlesex Co
New Jersey	Monmouth Co
New Jersey	Morris Co
New Jersey	Ocean Co
New Jersey	Passaic Co
New Jersey	Somerset Co
New Jersey	Sussex Co
New Jersey	Union Co
New Jersey	Mercer Co
New Mexico	Bernalillo Co
New York	Albany Co
New York	Allegany Co
New York	Broome Co
New York	Cattaraugus Co
New York	Cayuga Co
New York	Chautauqua Co

Table VI-13 (continued)

State	County
New York	Chemung Co
New York	Chenango Co
New York	Clinton Co
New York	Columbia Co
New York	Cortland Co
New York	Delaware Co
New York	Erie Co
New York	Essex Co
New York	Franklin Co
New York	Fulton Co
New York	Genesee Co
New York	Greene Co
New York	Hamilton Co
New York	Herkimer Co
New York	Jefferson Co
New York	Lewis Co
New York	Livingston Co
New York	Madison Co
New York	Monroe Co
New York	Montgomery Co
New York	Niagara Co
New York	Oneida Co
New York	Onondaga Co
New York	Ontario Co
New York	Orleans Co
New York	Oswego Co
New York	Otsego Co
New York	Rensselaer Co
New York	St. Lawrence Co
New York	Saratoga Co
New York	Schenectady Co
New York	Schoharie Co
New York	Schuyler Co
New York	Seneca Co
New York	Steuben Co
New York	Sullivan Co
New York	Tioga Co
New York	Tompkins Co
New York	Ulster Co
New York	Warren Co
New York	Washington Co
New York	Wayne Co
New York	Wyoming Co
New York	Yates Co
New York	Bronx Co
New York	Kings Co
New York	Nassau Co
New York	New York Co
New York	Queens Co
New York	Richmond Co
New York	Rockland Co
New York	Suffolk Co
New York	Westchester Co
New York	Dutchess Co
New York	Orange Co
New York	Putnam Co
North Carolina	Cabarrus Co
North Carolina	Union Co
North Carolina	Orange Co
North Carolina	Forsyth Co
North Carolina	Guilford Co
North Carolina	Durham Co
North Carolina	Gaston Co
North Carolina	Mecklenburg Co
North Carolina	Wake Co
Ohio	Clark Co
Ohio	Clermont Co
Ohio	Geauga Co
Ohio	Medina Co
Ohio	Montgomery Co
Ohio	Portage Co
Ohio	Summit Co
Ohio	Warren Co
Ohio	Butler Co
Ohio	Hamilton Co
Ohio	Lake Co
Ohio	Lorain Co
Ohio	Cuyahoga Co
Oregon	Clackamas Co
Oregon	Jackson Co
Oregon	Multnomah Co
Oregon	Washington Co
Oregon	Josephine Co
Pennsylvania	Berks Co
Pennsylvania	Blair Co
Pennsylvania	Cambria Co
Pennsylvania	Centre Co
Pennsylvania	Cumberland Co
Pennsylvania	Dauphin Co
Pennsylvania	Lackawanna Co
Pennsylvania	Lancaster Co
Pennsylvania	Lebanon Co
Pennsylvania	Luzerne Co
Pennsylvania	Lycoming Co

Table VI-13 (continued)

Pennsylvania	York Co
Pennsylvania	Allegheny Co
Pennsylvania	Beaver Co
Pennsylvania	Washington Co
State	**County**
Pennsylvania	Westmoreland Co
Pennsylvania	Bucks Co
Pennsylvania	Chester Co
Pennsylvania	Delaware Co
Pennsylvania	Montgomery Co
Pennsylvania	Philadelphia Co
Pennsylvania	Erie Co
Pennsylvania	Mercer Co
Pennsylvania	Lehigh Co
Pennsylvania	Northampton Co
Rhode Island	Bristol Co
Rhode Island	Kent Co
Rhode Island	Newport Co
Rhode Island	Providence Co
Rhode Island	Washington Co
Tennessee	Rutherford Co
Tennessee	Sumner Co
Tennessee	Williamson Co
Tennessee	Wilson Co
Tennessee	Davidson Co
Tennessee	Shelby Co
Texas	Dallas Co
Texas	Tarrant Co
Texas	El Paso Co
Texas	Harris Co
Utah	Davis Co
Utah	Salt Lake Co
Utah	Utah Co
Utah	Weber Co
Vermont	Addison Co
Vermont	Bennington Co
Vermont	Caledonia Co
Vermont	Chittenden Co
Vermont	Essex Co
State	**County**
Vermont	Franklin Co
Vermont	Grand Isle Co
Vermont	Lamoille Co
Vermont	Orange Co
Vermont	Orleans Co
Vermont	Rutland Co
Vermont	Washington Co
Vermont	Windham Co
Vermont	Windsor Co
Virginia	Arlington Co
Virginia	Fairfax Co
Virginia	Loudoun Co
Virginia	Prince William Co
Virginia	Stafford Co
Virginia	Alexandria
Virginia	Manassas
Virginia	Manassas Park
Virginia	Fairfax
Virginia	Falls Church
Washington	Pierce Co
Washington	Clark Co
Washington	King Co
Washington	Snohomish Co
Washington	Spokane Co
Wisconsin	Kenosha Co
Wisconsin	Milwaukee Co
Wisconsin	Ozaukee Co
Wisconsin	Racine Co
Wisconsin	Washington Co
Wisconsin	Waukesha Co
Wisconsin	Sheboygan Co

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

The EPA promulgated a new NO_x plus NMHC standard for Heavy Duty Vehicles 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 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 2020 and 2030 were shown in Tables VI-7 through VI-10. 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 non-I/M 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 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-14.

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-15 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-16 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.

g. Heavy Duty Diesel Emission Reductions

Emission reduction percentages simulating the Heavy Duty Diesel regulation were supplied by OTAQ as national reduction percentages. Table VI-17 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 FILES

The format of the final mass emissions file, which contain annual and SSD emissions for each pollutant are shown in Table VI-18. It should be noted that the SSD values for the on-highway vehicle emissions are calculated by dividing July emissions by 31.

Table VI-14
Evaporative VOC MOBILE5b to MOBILE6 Adjustment Factors

Year	Control Combination	Adjustment Factors by Vehicle Type (unitless)		
		LDGV	LDGT1	LDGT2
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-15
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-16
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-17
HDD 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-18
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 (tons per year)
NOX_ANN	N	10	4	Annual NO_x emissions (tpy)
CO_ANN	N	10	4	Annual CO emissions (tpy)
SO2_ANN	N	10	4	Annual SO_2 emissions (tpy)
PM10_ANN	N	10	4	Annual PM_{10} emissions (tpy)
PM25_ANN	N	10	4	Annual $PM_{2.5}$ emissions (tpy)
NH3_ANN	N	10	4	Annual NH_3 emissions (tpy)
VOC_OSD	N	10	4	Summer season day VOC emissions [tons per day (tpd)]
NOX_OSD	N	10	4	Summer season day NO_x emissions (tpd)
CO_OSD	N	10	4	Summer season day CO emissions (tpd)
SO2_OSD	N	10	4	Summer season day SO_2 emissions (tpd)
PM10_OSD	N	10	4	Summer season day PM_{10} emissions (tpd)
PM25_OSD	N	10	4	Summer season day PM_{25} emissions (tpd)
NH3_OSD	N	10	4	Summer season day NH_3 emissions (tpd)

CHAPTER VII
EMISSION FILE DESCRIPTION

Year	Source Sector	Filename	Description
1996	EGU	egu96nr.dbf	Electric generating utility (EGU) annual and summer season daily (SSD) emissions.
	Non-EGU Point	pt96nr.dbf	Non-EGU point source annual and SSD emissions.
	Stationary Area	ar96nr.dbf	Stationary area source annual and SSD emissions.
	Highway Mobile	mv96nr.dbf	Highway mobile source annual and SSD emissions.
	Nonroad Mobile	nr96b3.dbf	Nonroad mobile source annual and SSD emissions.
2020	EGU	egu20nr.dbf	Electric generating utility (EGU) winter and summer season emissions.
	Non-EGU Point	pt20nr.dbf	Non-EGU point source annual and SSD emissions.
	Stationary Area	ar20nr.dbf	Stationary area source annual and SSD emissions.
	Highway Mobile	mv20nr.dbf	Highway mobile source annual and SSD emissions.
	Nonroad Mobile	nr20b3.dbf	Nonroad mobile source base case annual and SSD emissions.
		nr20c3.dbf[1]	Nonroad mobile source preliminary control annual and SSD emissions.
2030	EGU	egu30nr.dbf	Electric generating utility (EGU) winter and summer season emissions.
	Non-EGU Point	pt30nr.dbf	Non-EGU point source annual and SSD emissions.
	Stationary Area	ar30nr.dbf	Stationary area source annual and SSD emissions.
	Highway Mobile	mv30nr.dbf	Highway mobile source annual and SSD emissions.
	Nonroad Mobile	nr30b3.dbf	Nonroad mobile source base case annual and SSD emissions.
		nr30c3.dbf[1]	Nonroad mobile source preliminary case annual and SSD emissions.

[1] Final control case scenario emission summaries are available in the Nonroad RIA (EPA, 2003).

CHAPTER VIII
REFERENCES

AAMA, 1996: American Automobile Manufacturers Association, "Fuel Volatility Survey 1996," Washington, DC, 1996.

BEA, 1995: Bureau of Economic Analysis, "Regional State Projections of Economic Activity and Population to 2045," U.S. Department of Commerce, Washington, DC, July 1995.

BOC, 1992: Bureau of the Census, "1990 Census of Population, Volume 1 Characteristics of Population, Chapter B Number of Inhabitants," U.S. Department of Commerce, Washington, DC, July 1992.

DOE, 1998: U.S. Department of Energy, Office of Integrated Analysis and Forecasting, Energy Information Administration, "Annual Energy Outlook 1999, with Projections through 2020," DOE/EIA-0383(99). December 1998.

EIA, 1996: U.S. Department of Energy, Energy Information Administration, "Fuel Oil and Kerosene Sales," Washington, DC, DOE/EIA-0380. 1996.

EIA, 2000: U.S. Department of Energy, Energy Information Administration, "Fuel Oil and Kerosene Sales," Washington, DC, DOE/EIA-0535. 2000.

EPA, 1991: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, "Procedures for Preparing Emissions Projections," Research Triangle Park, NC, EPA-450/4-91-019. July 1991.

EPA, 1997: U.S. Environmental Protection Agency, Office of Mobile Sources, "Locomotive Emission Standards - Regulatory Support Document (RSD)," Ann Arbor, MI. April 1997.

EPA, 1998a: U.S. Environmental Protection Agency, Office of Mobile Sources, Assessment and Modeling Division, "Exhaust Emission Factors for Nonroad Engine Modeling - Compression Ignition," Report No. NR-009A, Ann Arbor MI. June 1998.

EPA, 1998b: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, "National Air Pollutant Emission Trends Procedures Document, 1900-1996," EPA-454/R-98-008, Research Triangle Park, NC, May 1998.

EPA, 1999a: U.S. Environmental Protection Agency, Office of Air Quality, Planning and Standards, "Development of Emission Budget Inventories for Regional Transport NOx SIP Call - Technical Amendment Version," Research Triangle Park, NC, December 1999.

EPA, 1999b: U.S. Environmental Protection Agency, Office of Mobile Sources, Assessment and Modeling Division, "Exhaust Emission Factors for Nonroad Engine Modeling - Spark Ignition," Report No. NR-010b, EPA420-R-99-009, Ann Arbor MI. March 1999.

EPA, 1999c: U.S. Environmental Protection Agency, Office of Air Quality, Planning and Standards, "Procedures Document for National Emissions Inventory, Volume I: Criteria Air Pollutants 1900-1999," Research Triangle Park, NC. September 2000.

EPA, 1999d: U.S. Environmental Protection Agency, Office of Air Quality, Planning and Standards, "Procedures for Developing Base Year and Future Year Mass and Modeling Inventories for the Tier 2 Final Rulemaking," EPA420-R-99-034, Research Triangle Park, NC. September 1999.

EPA, 2000a: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, "National Air Pollutant Emission Trends, 1900-1998," EPA-454/R-00-002, Research Triangle Park, NC. March 2000.

EPA, 2000b: U.S. Environmental Protection Agency, "Changes to the NONROAD model for the April 2000 Version Used in Support of the 2007 Heavy-Duty Diesel Engine Rule," EPA Memorandum from the Nonroad Engine Emissions Modeling Team to Docket A-99-06. May 31, 2000.

EPA, 2002a: U.S. Environmental Protection Agency, Office of Transportation and Air Quality, "Exhaust Emission Factors for Nonroad Engine Modeling–Spark Ignition," Report No. NR-010c, revised July 10, 2002.

EPA, 2003: U.S. Environmental Protection Agency, Office of Transportation and Air Quality, "Draft Regulatory Impact Analysis: Control of Emissions from Nonroad Diesel Engines," Report No. EPA-420/D-03-008, Ann Arbor, MI, April 2003.

FAA, 1998a: Federal Aviation Administration, Office of Aviation Policy and Plans, "FAA Aviation Forecasts Fiscal Years, 1998-2009." March 1998.

FAA, 1998b: Federal Aviation Administration, Office of Aviation Policy and Plans, "Long Range Aviation Forecasts Fiscal Years 2010, 2015, and 2020," FAA-APO-98-9. June 1998.

FHWA, 1990: U.S. Department of Transportation, Federal Highway Administration, "Highway Performance Monitoring System Field Manual," Washington, DC. December 1990.

FHWA, 1997: U.S. Department of Transportation, Federal Highway Administration, *1996 Highway Statistics*, Office of Highway Information Management, Washington, DC, 1997 (http://fhwa.dot.gov/ohim/1996/index.html).

Harvey, 1983: Craig A. Harvey, Robert J. Garbe, Thomas M. Baines, Joseph H. Somers, Karl H. Hellman, and Penny M. Carey, U.S. Environmental Protection Agency, "A Study of the

Potential Impact of Some Unregulated Motor Vehicle Emissions," SAE Technical Paper Series 830987, presented at the Passenger Car Meeting, Dearborn, Michigan. June 6-9, 1983.

Pechan-Avanti, 1997a: The Pechan-Avanti Group, "Ozone Transport Assessment Group (OTAG) Emissions Inventory Development Report, Volume III: Projections and Controls," draft prepared for U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. June 1997.

Pechan-Avanti, 1997b: The Pechan-Avanti Group, "2010 Clean Air Act Amendment Baseline Emission Projections for the Integrated Ozone, Particulate Matter, and Regional Haze Cost Analysis," prepared for U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. July 17, 1997.

Pechan-Avanti, 1998: The Pechan-Avanti Group, "Emission Projections for the Clean Air Act Section 812 Prospective Analysis," prepared for Industrial Economics, Inc., Cambridge, MA. June 1998.

Pechan-Avanti, 2000: The Pechan-Avanti Group, "Development of National Emission Trends (NET) Data for FY2000, Technical Memorandum, Task 2, Development of Quality Assurance (QA) Plan," prepared for U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Factors and Inventory Group, Research Triangle Park, NC. March 2000. EPA Contract Number 68-D7-0067; Work Assignment Number 3-12.

Pechan, 2000: E.H. Pechan and Associates, " Procedures for Developing Base Year and Future Year Mass and Modeling Inventories for the Heavy-Duty Diesel (HDD) Rulemaking," prepared for U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. September 2000. EPA Contract Number 68-D7-0067; Work Assignment Number 3-15.

Stella, 2000: Greg Stella, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Factors and Inventory Group, e-mail transmission to Frank Divita, The Pechan-Avanti Group, providing ranges for stack flow rate, temperature, diameter, height, and velocity to identify values outside of ranges for correcting stack parameter values in point source inventory. May 9, 2000.

Somers, 1997a: Joseph Somers, Office of Mobile Sources, U.S. Environmental Protection Agency, "Major Modeling Elements for Operating I/M Programs,," table provided to E.H. Pechan & Associates, Inc., July 10, 1997.

Somers, 1997b: Joseph Somers, Office of Mobile Sources, U.S. Environmental Protection Agency, "State Winter Oxygenated Fuel Programs," table provided to E.H. Pechan & Associates, Inc. February 25, 1997.

USDA, 1997: U.S. Department of Agriculture, "1997 Census of Agriculture Geographic Area Series, Volume 1, 1A, 1B, 1C; CD ROM Set." Issued June 1999. AC97-CD-VOL1-1A, 1B, and 1C.

USDA, 1998: U.S. Department of Agriculture, World Agricultural Outlook Board, Office of the Chief Economist, "USDA - Agricultural Baseline Projections to 2007," Staff Report No. WOAB-98-1. 1998.

USDA, 2000a: U.S. Department of Agriculture, National Agricultural Statistics Service, "Published Estimates Data Base," located at www.nass.usda.gov:81/idepb.

USDA, 2000b: U.S. Department of Agriculture, World Agricultural Outlook Board, "USDA Agricultural Baseline Projections to 2009," Staff Report No. WAOB-2000-1. February 2000.

Wilcox, 2002: Rich Wilcox, U.S. Environmental Protection Agency, Office of Transportation and Air Quality, e-mail transmission to Kirstin Thesing and Melissa Dagan, E.H. Pechan and Associates, Inc., providing locomotive and distillate commercial marine vessel emissions. May 31, 2002.

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