

# **Appendix, Documentation of VISTAS Inventories and Georgia 2002 CERR Inventory**

- a. Documentation of the Base G 2002 Base Year, 2009 and 2018, Emission Inventories for VISTAS**
- b. Development of the Draft 2002 Vistas Emission Inventory for Regional Haze Modeling**

Part 1 -- Review of 1999 NEI Version 2 Final and Recommendations for Developing the 2002 VISTAS Inventory for Regional Haze Modeling (Area and Point Sources)

Part 2 -- Development of the Draft 2002 VISTAS Emission Inventory for Regional Haze Modeling (Point Source Methodology)

Part 3 -- Development of the Draft 2002 VISTAS Emission Inventory for Regional Haze Modeling (Area Source Methodology)

Part 4 -- Development of the VISTAS Draft 2002 Mobile Source Emission Inventory (February 2004 Version)

Part 5 -- Documentation of the Revised 2002 Base Year, Revised 2018, and Initial 2009 Emission Inventories for VISTAS

- c. Changes made to VISTASv2 2002 Inventory to make it a Georgia CERR 2002 Inventory**

**Documentation of the Base G 2002 Base Year, 2009 and 2018,  
Emission Inventories for VISTAS**

**Prepared for:**

**Visibility Improvement State and Tribal Association of the Southeast  
(VISTAS)**

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## Acronyms and Abbreviations

AEO	Annual Energy Outlook
AF&PA	American Forest and Paper Association
APCD	Air Pollution Control District
ATP	Anti-Tampering Program
BLRID	Boiler Identification (Boiler ID)
CAA	Clean Air Act
CAIR	Clean Air Interstate Rule
CEM	Continuous Emissions Monitoring
CAMD	Clean Air Markets Division
CERR	Consolidated Emissions Reporting Rule
CMU	Carnegie Mellon University
CMV	commercial marine vessels
CE	Control Efficiency
CO	carbon monoxide
DENR	North Carolina Department of Environment and Natural Resources
DHEC	South Carolina Department of Health and Environmental Control
EDMS	Emissions Data Management Systems
ESD	Emissions Standards Division
EPA	Environmental Protection Agency
EGU	Electric Generating Unit
ICF	ICF International, Inc.
FIP	Federal Implementation Plan
FLM	Federal Land Manager
FTP	File transfer protocol
FR	Federal Register
FS	Forest Service
HDD	Heavy Duty Diesel
HDD RULE	Heavy Duty Diesel Rule
ICF	ICF International, Inc.
ID	Identification
I/M	Inspection and Maintenance
IPM <sup>®</sup>	Integrated Planning Model <sup>®</sup>
IAQTR	Interstate Air Quality Transport Rule
LTO	Landing and take off
MACT	Maximum achievable control technology

### Acronyms and Abbreviations (continued)

MACTEC	MACTEC Engineering and Consulting, Inc.
MOBILE 6	MOBILE emissions estimation model version 6
MRPO	Midwest Regional Planning Organization
NH <sub>3</sub>	Ammonia
NEI	National Emission Inventory
NIF	National Emission Inventory Format
NLEV	National Low Emission Vehicle regulation
NMIM	National Mobile Inventory Model
NONROAD	no acronym (model name)
NO <sub>x</sub>	Oxides of nitrogen
NWR	National Wildlife Refuge
OTB	On the books
OTW	On the way
ORIS	Office of Regulatory Information Systems
OTAQ	Office of Transportation and Air Quality
OTC	Ozone Transport Commission
PFC	Portable fuel containers
PM	Particulate matter
PM <sub>10</sub> -FIL	Particulate matter less than or equal to 10 microns in diameter that can be captured on a filter
PM <sub>10</sub> -PRI	Particulate matter less than or equal to 10 microns in diameter that includes both the filterable and condensable components of particulate matter
PM <sub>2.5</sub> -FIL	Particulate matter less than or equal to 2.5 microns in diameter that can be captured on a filter
PM <sub>2.5</sub> -PRI	Particulate matter less than or equal to 2.5 microns in diameter that includes both the filterable and condensable components of particulate matter
PM-CON	Particulate matter created by the condensation of hot materials to form particulates, usually less than 2.5 microns in diameter
ppmW	parts per million by weight
PRI	Primary
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
REMI	Regional Economic Models, Inc.
RFG	Reformulated gasoline
RVP	Reid Vapor Pressure
SCC	Source Classification Code

**Acronyms and Abbreviations (continued)**

SCR	Selective Catalytic Reduction
SIP	State Implementation Plan
SIWG	Special Interest Workgroup
S/L/T	State/Local/Tribal
SMOKE	Sparse Matrix Operator Kernel Emissions Modeling System
S/L	State and Local
SO <sub>2</sub>	Oxides of Sulfur
T4	Tier 4
VISTAS	Visibility Improvement State and Tribal Association of the Southeast
VMT	Vehicle Miles Traveled
VOC	Volatile organic compounds
WRAP	Western Regional Air Partnership

## **Documentation of the Base G 2002 Base Year, 2009 and 2018, Emission Inventories for VISTAS**

### **Introduction**

#### **History of VISTAS Base and Projection Year Emission Inventory Development**

This section is provided to supply the history behind the development of the base and projection year inventories provided to VISTAS. Through the various iterations, the inventories that have been developed have typically had version numbers provided by the contractors who developed the inventories and to a certain extent these were also based on their purpose. Different components of the 2002 base year inventories have been supplied by E.H. Pechan and Associates, Inc. (Pechan), MACTEC Engineering and Consulting, Inc. (MACTEC), and by Alpine Geophysics, Inc.

The initial 2002 base year inventory was jointly developed by Pechan and MACTEC. Pechan developed the on-road and non-road mobile source components of the inventory while MACTEC developed the point and area source component of the inventory. This version of the inventory included updates to on-road mobile that incorporated information from the 1999 NEI Version 2 final along with updated information on VMT, fuel programs, and other inputs to the MOBILE6 model to produce a draft version of the 2002 inventory. For non-road sources, a similar approach was used. Updated State information on temperatures and fuel characteristics were obtained from VISTAS States and used with the NONROAD 2002 model to calculate 2002 emissions for NONROAD model sources. These estimates were coupled with data for commercial marine vessels, locomotives and airplanes projected to 2002 using appropriate growth surrogates. A draft version of these inventories was prepared in late 2003, with a final version in early 2004. An overview of the development of the on-road component can be found at: [http://www.vistas-sesarm.org/documents/Pechan\\_drafton-roadinventory\\_082803.ppt](http://www.vistas-sesarm.org/documents/Pechan_drafton-roadinventory_082803.ppt) while an overview of the non-road component can be found at: [http://www.vistas-sesarm.org/documents/Pechan\\_Non-roadInventory\\_082803.ppt](http://www.vistas-sesarm.org/documents/Pechan_Non-roadInventory_082803.ppt).

Similarly, draft versions of the 2002 point and area source base year inventories were prepared by MACTEC in the same timeframe (late 2003 for the draft, final in early 2004). The point source component was based on data submitted by the VISTAS States or on the 1999 NEI. The data submitted by the States ranged from 1999 to 2001 and was all projected to 2002 using appropriate growth surrogates from Economic Growth

Analysis System (EGAS) version 4. Toxic Release Inventory (TRI) data were used to augment the inventory for NH<sub>3</sub>. Continuous Emissions Monitor (CEM) data from the U.S. EPA's Clean Air Markets Division was used to supply emissions for electric generating utilities (EGUs). Particulate matter emissions were augmented (when missing) by using emission factor ratios. Details on all these calculations are discussed in Section 1.1.1.3 of this document.

The area source component of the 2002 draft base year emissions was prepared similarly to the point sources, using State submittals and the 1999 NEI Version 2 final as the basis for projecting emissions to 2002 using EGAS growth factors. For ammonia area sources the Carnegie Mellon University (CMU) ammonia model was used to calculate emissions. Finally, data on acreage burned on a fire by fire basis was solicited from State forestry agencies in order to calculate fire emissions on a fire by fire basis. Virtually all VISTAS State forestry agencies provided data for these calculations at least for wild and prescribed fires. An overview of the point and area source development methods can be found at:

[http://www.vistas-sesarm.org/documents/MACTEC\\_draftpointareainventory\\_82803.ppt](http://www.vistas-sesarm.org/documents/MACTEC_draftpointareainventory_82803.ppt).

Three interim versions of the 2002 base year inventory were developed. The first was delivered in August of 2003, the second in April of 2004 and the final one in October of 2004. The August 2003 and April 2004 inventories were prepared by MACTEC and Pechan. A draft version of the revised 2002 base year inventory was released in June of 2004, with a final version released in October 2004. That 2002 base year inventory was solely prepared by MACTEC. The October 2004 inventory incorporated 2002 Consolidated Emissions Reporting Rule (CERR) data into the inventory along with some updated data from the VISTAS States. This inventory is typically referred to as version 3.1 of the VISTAS inventory

Closely following the version 3.1 2002 base year inventory, a "preliminary" 2018 projection inventory was developed. This "preliminary" 2018 inventory was developed in late 2004 (Oct/Nov) and was designed solely for use in modeling sensitivity runs to provide a quick and dirty assessment of what "on the books" and "on the way" controls could be expected to provide in terms of improvements to visibility and regional haze impairment. A brief overview of the history of the three versions of the 2002 base year and the 2018 preliminary inventory use can be found at: <http://www.vistas-sesarm.org/documents/STAD1204/2002and2018Emissions14Dec2004.ppt>.

Following preparation of the final 3.1 version of the 2002 base year inventory, States were asked to review and provide comments on that inventory to MACTEC for update

and revision. At the same time MACTEC prepared a revised draft version of the 2018 projection inventory (January 2005) and a draft version of a 2009 projection inventory (April 2005). All of these were known as version 3.1 and were provided to the VISTAS States for review and comment. Comments were received and updates to the inventories based on these comments were prepared. The revised inventories were provided to the VISTAS States. At that time to be consistent with the modeling nomenclature being used by AG in performing their modeling runs, the inventory became the Base F VISTAS inventory. The Base F inventory was delivered for review and comment in August of 2005. In addition, MACTEC delivered a report entitled *Documentation of the Revised 2002 Base Year, Revised 2018, and Initial 2009 Emission Inventories for VISTAS* on August 2, 2005 that described the methods used to develop the Base F inventories. For the Electric Generating Utilities (EGU) different versions of the Integrated Planning Model were used between Base D and Base F, resulting in different projections of future EGU emissions.

Over the period from August 2005 until June/July 2006 MACTEC received comments and updates to some categories from VISTAS States, particularly EGU. In addition, a new NONROAD model (NONROAD05) was released. Thus additional updates to the inventory were prepared based on the comments received along with revised NONROAD emission estimates from NONROAD05. The resultant inventory became the Base G inventory.

This document details the development of the Base G inventories for 2002, 2009 and 2018. The information that follows describes the development of the VISTAS inventory by sector from version 3.1 forward. Unless specific updates were made to an inventory sector, the methods used for version 3.1 were retained. Similarly unless specific changes were made to methods used for Base F, Base G methods were the same as Base F/version 3.1 (if unchanged in Base F).

Table I-1 through Table I-3 indicate roughly which version of the inventory is in use for each sector of the inventory as of Base G.

**Table I-1: Inventory Version in Use by Year and Source Sector Through Base G - 2002**

Source	AL	FL	GA	KY	MS	NC	SC	TN	VA	WV
<b>EGU</b>	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G
<b>Non-EGU Point</b>	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G
<b>Area<sup>1</sup></b>	Base F for ammonia sources (CMU Model) and for some area sources, Base G for selected sources updated by the State with State supplied data	Base F except for some emissions zeroed out (and records removed) for some southern FL counties for Base G.	Base F	Base F	Base F	Base F for ammonia sources (CMU Model) and for some area sources, Base G for selected sources updated by the State with State supplied data. Some corrections applied by MACTEC to correct PM values	Base F	Base F	Base F for ammonia Sources (CMU Model) and for some area sources, Base G for selected sources updated by the State with State supplied data.	Base F
<b>On-road</b>	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G
<b>Non-road</b>	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources, except aircraft and locomotives updated for Base G.	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources except for aircraft in Cincinnati/N. KY Int. Airport, which are Base G.	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources	Base G for all sources included in the NONROAD model. NC moved from Southern to Mid-Atlantic State in seasonal adjustment file.  Base F for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources, except for aircraft emissions which are Base G.	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources
<b>Fires</b>	Base F Typical	Base F Typical	Base F Typical	Base F Typical	Base F Typical	Base F Typical	Base F Typical	Base F Typical	Base F Typical	Base F Typical

**Notes:**

Base G global Area Source changes that apply to ALL States: A) removal of Stage II refueling from area source file to non-road and on-road; B) modification of PM2.5 ratio for several fugitive dust sources per WRAP methodology; C) addition of portable fuel container (PFC) emissions to all States based on OTAQ report.

**Table I-2: Inventory Version in Use by Year and Source Sector Through Base G - 2009**

Source	AL	FL	GA	KY	MS	NC	SC	TN	VA	WV
<b>EGU<sup>1</sup></b>	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G
<b>Non-EGU Point<sup>2</sup></b>	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G
<b>Area</b>	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.  Some specific source categories updated using State supplied file to override projected values.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.
<b>On-road</b>	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G
<b>Non-road</b>	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources.	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources except for aircraft in Cincinnati/N. KY Int. Airport, which are Base G using State supplied growth factors.	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources
<b>Fires</b>	Base F typical except for Rx fires	Base F typical	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires

Notes:

1. All EGU emissions updated with new IPM runs in Base G
2. Revised growth factors from DOE AEO2006 fuel use projections



**Table I-3: Inventory Version in Use by Year and Source Sector Through Base G - 2018**

Source	AL	FL	GA	KY	MS	NC	SC	TN	VA	WV
<b>EGU<sup>1</sup></b>	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G
<b>Non-EGU Point<sup>2</sup></b>	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G
<b>Area</b>	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.  Some specific source categories updated using State supplied file to override projected values.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.
<b>On-road</b>	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G
<b>Non-road</b>	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources.	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources except for aircraft in Cincinnati/N. KY Int. Airport, which are Base G using State supplied growth factors.	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources
<b>Fires</b>	Base F typical except for Rx fires	Base F typical	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires

**Notes:**

1. All EGU emissions updated with new IPM runs in Base G
2. Revised growth factors from DOE AEO2006 fuel use projections

## **1.0 2002 Base Year Inventory Development**

### **1.1 Point Sources**

This section details the development of the 2002 base year inventory for point sources. There were two major components to the development of the point source sector of the inventory. The first component was the incorporation of data submitted by the Visibility Improvement State and Tribal Association of the Southeast (VISTAS) States and local (S/L) agencies to the United States Environmental Protection Agency (EPA) as part of the Consolidated Emissions Reporting Rule (CERR) requirements. Work on incorporating the CERR data into the revised base year involved: 1) obtaining the data from EPA or the S/L agency, 2) evaluating the emissions and pollutants reported in the CERR submittals, 3) augmenting CERR data with annual emission estimates for PM<sub>10</sub>-PRI and PM<sub>2.5</sub>-PRI; 4) evaluating the emissions from electric generating units, 5) completing quality assurance reviews for each component of the point source inventory, and 6) updating the database with corrections or new information from S/L agencies based on their review of the 2002 inventory. The processes used to perform those operations are described in the first portion of this section.

The second component was the development of a “typical” year inventory for electric generating units (EGUs). VISTAS determined that a typical year electric generating units (EGU) inventory was necessary to smooth out any anomalies in emissions from the EGU sector due to meteorology, economic, and outage factors in 2002. The typical year EGU inventory is intended to represent the five year (2000-2004) period that will be used to determine the regional haze reasonable progress goals. The second part of this section discusses the development of the typical year EGU inventory.

#### ***1.1.1 Development of 2002 Point Source Inventory***

MACTEC developed a draft 2002 emission inventory in June 2004 (*Development of the Draft 2002 VISTAS Emission Inventory for Regional Haze Modeling – Point Sources*, MACTEC, June 18, 2004). The starting point for the draft 2002 emission inventory was EPA’s 1999 National Emission Inventory (NEI), Version 2 Final (NEI99V2). For several states, we replaced the NEI99V2 data with more recent inventories for either calendar year 1999, 2000, or 2001 as submitted by the S/L agencies. We also performed several other updates, including updating emission estimates for selected large source of ammonia, incorporating 2002 Continuous Emissions Monitoring-(CEM)-based SO<sub>2</sub> and NO<sub>x</sub> emissions for electric utilities, adding PM<sub>10</sub> and PM<sub>2.5</sub> emissions when they were missing from an S/L submittal, and performing a variety of additional Quality assurance/Quality control (QA/QC) checks.

The next version of the 2002 inventory (referred to as Base F) was released in August 2005 (*Documentation of the Revised 2002 Base Year, Revised 2018, and Initial 2009 Emission Inventories for VISTAS*, MACTEC, August 2, 2005). The primary task in preparing the Base F 2002 base year inventory was the replacement of NEI99V2 data with data submitted by the VISTAS S/L agencies as part of the CERR submittal and included in EPA's 2002 NEI.

The current version of the 2002 inventory (referred to as Base G) was released in August 2006 and is documented in this report. The primary task in preparing the Base G 2002 base year inventory was the incorporation of corrections and new information as submitted by the S/L agencies based on their review of the Base F inventory. The following subsections document the data sources for the Base G inventory, the checks made on the CERR submittals, the process for augmenting the inventory with PM<sub>10</sub> and PM<sub>2.5</sub> emissions, the evaluation of EGU emissions, other QA/QC checks, and other Base G updates. The final subsection summarizes the Base G 2002 inventory by state, pollutant, and sector (EGU and non-EGU).

#### **1.1.1.1 Data Sources**

Several data sources were used to compile the Base F point source inventory: 1) the inventories that the S/L submitted to EPA from May through July 2004 as required by the CERR; 2) supplemental data supplied by the S/L agencies that may have been revised or finalized after the CERR submittal to EPA, and 3) the draft VISTAS 2002 inventory in cases where S/L CERR data were not available. For the Base G inventory, we replaced data from Hamilton County, Tennessee, using data from Hamilton County's CERR submittal as contained in EPA's 2002 NEI inventory (in Base F, the inventory for Hamilton County was based on the draft VISTAS 2002 inventory, which in turn was based on the 1999 NEI).

Table 1.1-1 summarizes the data used as the starting point for the Base F 2002 inventory. Once all of the files were obtained, MACTEC ran the files through the EPA National Emission Inventory Format (NIF) Basic Format and Content checking tool to ensure that the files were submitted in standard NIF format and that there were no referential integrity issues with those files. In a couple of cases small errors were found. For example, in one case non-standard pollutant designations were used for particulate matter (PM) and ammonia emissions. MACTEC contacted each VISTAS State point source contact person to resolve the issues with the files and corrections were made. Once all corrections to the native files were made, MACTEC continued with the incorporation of the data into the VISTAS point source files. S/L agencies completed a detailed review of the Base F inventory. Additional updates and corrections to the Base F inventory were requested by S/L agencies and incorporated into the Base G inventory. The Base G changes are documented in more detail in Section 1.1.1.6.

**Table 1.1-1. State Data Submittals Used for the Base F 2002 Point Source Inventory.**

State / Local Program	Point Source Emissions Data Source
AL	C
FL	B
GA	B
KY	C
MS	B
NC	C
SC	C
TN	C
VA	B
WV	B
Davidson County, TN	B
Hamilton County, TN	D
Memphis/Shelby County, TN	B
Knox County, TN	B
Jefferson County, AL	B
Jefferson County, KY	B
Buncombe County, NC	B
Forsyth County, NC	B
Mecklenburg County, NC	B

**Key**

A = Draft VISTAS 2002

B = CERR Submittal from EPA's file transfer protocol (FTP) site

C = Other (CERR or other submittal sent directly from S/L agency to MACTEC)

D = CERR Submittal from EPA's NEI 2002 Final Inventory

**1.1.1.2 Initial Data Evaluation**

For the Base F inventory, we conducted an initial review of the 2002 point source CERR data in accordance with the QA procedures specified in the Quality Assurance Project Plan (QAPP) for this project. The following evaluations were completed to identify potential data quality issues associated with the CERR data:

- Compared the number of sites in the CERR submittal to the number of sites in the VISTAS draft 2002 inventory; for all States, the number of sites in the CERR submittal was less than in the VISTAS draft 2002 inventory, since the CERR data was limited to major sources, while the VISTAS draft 2002 inventory contained data for both major and minor sources; verified with S/L contacts that minor sources not included in the CERR point source inventory were included in the CERR area source inventory.
- Checked for correct pollutant codes and corrected to make them NIF-compliant; for example, some S/L agencies reported ammonia emissions using the CAS Number or as “ammonia”, rather than the NIF-compliant “NH<sub>3</sub>” code.

- Checked for types of particulate matter codes reported (i.e., PM-FIL, PM-CON, PM-PRI, PM<sub>10</sub>-PRI, PM<sub>10</sub>-FIL, PM<sub>2.5</sub>-PRI, PM<sub>2.5</sub>-FIL); corrected codes with obvious errors (i.e., changed PMPRI to PM-PRI). (The PM augmentation process for filling in missing PM pollutants is discussed later in Section 1.1.1.3)
- Converted all emission values that weren't in tons to tons to allow for preparation of emission summaries using consistent units.
- Checked start and end dates in the PE and EM tables to confirm consistency with the 2002 base year.
- Compared annual and daily emissions when daily emissions were reported; in some cases, the daily value was non-zero (but very small) but the annual value was zero. This was generally the result of rounding in an S/L agency's submittal.
- Compared ammonia emissions as reported in the CERR submittals and the 2002 Toxics Release Inventory; worked with S/L agencies to resolve any outstanding discrepancies.
- Compared SO<sub>2</sub> and NO<sub>x</sub> emissions for EGUs to EPA's Clean Air Markets Division CEM database to identify any outstanding discrepancies. (A full discussion of the EGU emissions analysis is discussed later in Section 1.1.1.4)
- Prepared State-level emission summaries by pollutant for both the EGU and non-EGU sectors to allow S/L agencies to compare emissions as reported in the 1999 NEI Version 2, the VISTAS draft 2002 inventory, and the CERR submittals.
- Prepared facility-level emission summaries by pollutant to allow S/L agencies to review facility level emissions for reasonableness and accuracy.

We communicated the results of these analyses through email/telephone exchanges with the S/L point source contacts as well as through Excel summary spreadsheets. S/L agencies submitted corrections and updates as necessary to resolve any QA/QC issues from these checks.

### 1.1.1.3 PM Augmentation

Particulate matter emissions can be reported in many different forms, as follows:

<b>PM Category</b>	<b>Description</b>
PM-PRI	Primary PM (includes filterable and condensable)
PM-CON	Primary PM, condensable portion only (all less than 1 micron)
PM-FIL	Primary PM, filterable portion only

PM <sub>10</sub> -PRI	Primary PM <sub>10</sub> (includes filterable and condensable)
PM <sub>10</sub> -FIL	Primary PM <sub>10</sub> filterable portion only
PM <sub>2.5</sub> -PRI	Primary PM <sub>2.5</sub> (includes filterable and condensable)
PM <sub>2.5</sub> -FIL	Primary PM <sub>2.5</sub> filterable portion only

S/L agencies did not report PM emissions in a consistent manner. The State/local inventories submitted for VISTAS included emissions data for either PM-FIL, PM-PRI, PM<sub>10</sub>-FIL, PM<sub>10</sub>-PRI, PM<sub>2.5</sub> -FIL, PM<sub>2.5</sub> -PRI, and/or PM-CON. From any one of these pollutants, EPA has developed augmentation procedures to estimate PM<sub>10</sub>-PRI, PM<sub>10</sub>-FIL, PM<sub>2.5</sub> -PRI, PM<sub>2.5</sub> -FIL, and PM-CON. If not included in a State/local inventory, PM<sub>10</sub>-PRI and PM<sub>2.5</sub> -PRI were calculated by adding PM<sub>10</sub>-FIL and PM-CON or PM<sub>2.5</sub> -FIL and PM-CON, respectively.

The procedures for augmenting point source PM emissions are documented in detail in Appendix C of *Documentation for the Final 1999 National Emissions Inventory {Version 3} for Criteria Air Pollutants and Ammonia – Point Sources*, January 31, 2004). Briefly, the PM data augmentation procedure includes the following five steps:

- Step 1: Prepare S/L/T PM and PM<sub>10</sub> Emissions for Input to the PM Calculator
- Step 2: Develop and Apply Source-Specific Conversion Factors
- Step 3: Prepare Factors from PM Calculator
- Step 4: Develop and Apply Algorithms to Estimate Emissions from S/L/T Inventory Data
- Step 5: Review Results and Update the NEI with Emission Estimates and Control Information.

Please refer to the EPA documentation for a complete description of the PM augmentation procedures.

Table 1.1-2 compares the original PM emission estimates from the S/L CERR submittals and the revised 2002 VISTAS emissions estimates calculated using the above methodology. This table is intended to show that we took whatever States provided in the way of PM and filled in gaps to add in PM-CON where emissions were missing in order to calculate PM<sub>10</sub>-PRI and PM<sub>2.5</sub> -PRI for all processes to get a complete set of particulate data. We did not compare any other pollutants besides PM, since for other pollutants CERR emissions equal VISTAS emissions. As noted in Table 1.1-2, we made significant revisions to the PM emissions for Kentucky in the Base F inventory and for South Carolina in the Base G inventory.

**Table 1.1-2. Comparison of Particulate Matter Emissions from the S/L Data Submittals and the Base G 2002 VISTAS Point Source Inventory**

State	Database	PM-PRI	PM-FIL	PM-CON	PM <sub>10</sub> -PRI	PM <sub>10</sub> -FIL	PM <sub>2.5</sub> -PRI	PM <sub>2.5</sub> -FIL
AL	CERR	28,803	9,174	0	16,522	6,548	8,895	4,765
	VISTAS	43,368	33,336	10,129	32,791	22,661	23,290	13,328
FL	CERR	0	33,732	0	0	32,254	0	0
	VISTAS	61,728	37,325	24,403	57,243	32,840	46,147	21,744
GA	CERR	42,846	0	0	27,489	0	15,750	0
	VISTAS	44,835	37,088	7,799	33,202	25,403	22,777	15,085
KY	CERR	0	3,809	0	19,748	1,360	0	0
	VISTAS	27,719	22,349	5,329	21,326	15,963	14,173	8,749
MS	CERR	23,925	0	0	20,968	0	10,937	0
	VISTAS	23,928	17,632	6,296	21,089	14,793	11,044	5,739
NC	CERR	48,110	0	0	36,222	0	24,159	0
	VISTAS	48,114	41,407	6,708	36,992	30,284	27,512	21,113
SC	CERR	0	43,837	0	0	32,656	0	21,852
	VISTAS	43,844	38,633	5,210	34,799	29,588	26,418	21,207
TN	CERR	1,660	25,500	21,482	43,413	22,164	34,167	12,140
	VISTAS	56,797	32,085	24,715	50,937	26,269	41,442	16,774
VA	CERR	0	0	0	17,065	0	12,000	0
	VISTAS	40,856	36,414	4,442	17,065	12,623	12,771	8,607
WV	CERR	0	29,277	0	0	14,778	0	8445
	VISTAS	36,188	29,392	6,795	22,053	15,258	15,523	8,733

**Note 1:** CERR refers to data as submitted by S/L agencies; VISTAS refers to data calculated by MACTEC using the PM augmentation methodologies described in this document.

**Note 2:** KY DEP's initial CERR submittal reported particulate matter emissions using only PM-PRI pollutant code. MACTEC used this pollutant code during the initial PM augmentation routine. In February 2005, KY DEP indicated that data reported using the PM-PRI code should actually have been reported using the PM<sub>10</sub>-PRI code. MACTEC performed a subsequent PM augmentation in April 2005 using the PM<sub>10</sub>-PRI code. These changes were reflected in the Base F emission inventory.

**Note 3:** South Carolina Department of Health and Environmental Control (SC DHEC) initial CERR submittal reported particulate matter emissions using the PM-FIL, PM<sub>10</sub>-FIL, and PM<sub>2.5</sub> -FIL pollutant codes. MACTEC used these pollutant codes during the initial PM augmentation routine. In August 2005, SC DHEC indicated that data reported using the PM-FIL, PM<sub>10</sub>-FIL, and PM<sub>2.5</sub> -FIL pollutant codes should actually have been reported using the PM-PRI, PM<sub>10</sub>-PRI, and PM<sub>2.5</sub> -PRI codes. MACTEC performed a subsequent PM augmentation in April 2006 using the revised pollutant codes. These changes were reflected in the Base G emission inventory.

**Note 4:** The emission values in the VISTAS emission rows above differ slightly from the final values in the Base G inventory. This is due to several corrections and updates to the 2002 inventory submitted by S/L agencies after the PM augmentation was performed as discussed in Section 1.1.1.6.



After the PM augmentation process was performed, we executed a series of checks to identify potential inconsistencies in the PM inventory. These checks included:

- PM-PRI less than PM<sub>10</sub>-PRI, PM<sub>2.5</sub> -PRI, PM<sub>10</sub>-FIL, PM<sub>2.5</sub> -FIL, or PM-CON;
- PM-FIL less than PM<sub>10</sub>-FIL, PM<sub>2.5</sub> -FIL;
- PM<sub>10</sub>-PRI less than PM<sub>2.5</sub> -PRI, PM<sub>10</sub>-FIL, PM<sub>2.5</sub> -FIL or PM-CON;
- PM<sub>10</sub>-FIL less than PM<sub>2.5</sub> -FIL;
- PM<sub>2.5</sub>-PRI less than PM<sub>2.5</sub> -FIL or PM-CON;
- The sum of PM<sub>10</sub>-FIL and PM-CON not equal to PM<sub>10</sub>-PRI; and
- The sum of PM<sub>2.5</sub> -FIL and PM-CON not equal to PM<sub>2.5</sub> -PRI.

S/L agencies were asked to review this information and provide corrections where the inconsistencies were significant. In general, corrections (or general directions) were provided in the case of the potential inconsistency issues. In other cases, the agency provided specific process level pollutant corrections.

Note that for the Base G inventory, only the PM<sub>10</sub>-PRI and PM<sub>2.5</sub> -PRI emission estimates were retained since they are the only two PM species that are included in the air quality modeling. Other PM species were removed from the Base G inventory to facilitate emissions modeling.

#### **1.1.1.4 EGU Analysis**

We made a comparison of the annual SO<sub>2</sub> and NO<sub>x</sub> emissions for EGUs as reported in the S/L agencies CERR submittals and the data from EPA's Clean Air Markets Division (CAMD) CEM database to identify any outstanding discrepancies. Facilities report hourly CEM data to EPA for units that are subject to CEM reporting requirements of the NO<sub>x</sub> State Implementation Plan (SIP) Call rule and Title IV of the Clean Air Act (CAA). EPA sums the hourly CEM emissions to the annual level, and we compared these annual CEM emissions to those in the S/L inventories. The 2002 CEM inventory containing NO<sub>x</sub> and SO<sub>2</sub> emissions and heat input data were downloaded from the EPA CAMD web site ([www.epa.gov/airmarkets](http://www.epa.gov/airmarkets)). The data were provided by quarter and emission unit.

The first step in the EGU analysis involved preparing a crosswalk file to match facilities and units in the CAMD inventory to facilities and units in the S/L inventories. In the CAMD inventory, the Office of Regulatory Information Systems (ORIS) identification (ID) code identifies unique facilities and the unit ID identifies unique boilers and internal combustion engines (i.e., turbines and reciprocating engines). In the S/L inventories, the State and county FIPS and State facility ID together identify unique facilities and the emission unit ID identifies unique boilers or internal combustion engines. In most cases, there is a one-to-one correspondence between the CAMD identifiers and the S/L identifiers. However, in some of the S/L inventories, the emissions for multiple emission units are summed and reported under one



emission unit ID. We created an Excel spreadsheet that contained an initial crosswalk with the ORIS ID and unit ID in the CEM inventory matched to the State and county Federal Implementation Plan (FIPS), State facility ID, and emission unit ID in the S/L inventory. The initial crosswalk contained both the annual emissions summed from the CAMD database as well as the S/L emission estimate. It should be noted that the initial matching of the IDs in both inventories was based on previous crosswalks that had been developed for the preliminary VISTAS 2002 inventory and in-house information compiled by MACTEC and Alpine Geophysics. The matching at the facility level was nearly complete. In some cases, however, S/L agency or stakeholder assistance was needed to match some of the CEM units to emission units in the S/L inventories.

The second step in the EGU analysis was to prepare an Excel spreadsheet that compared the annual emissions from the hourly CAMD inventory to the annual emissions reported in the S/L inventory. The facility-level comparison of CEM to emission inventory NO<sub>x</sub> and SO<sub>2</sub> emissions found that for most facilities, the annual emissions from the S/L inventory equaled the CAMD CEM emissions. Minor differences could be explained because the facility in the S/L inventory contained additional small or emergency units that were not included in the CAMD database.

The final step in the EGU analysis was to compare the SO<sub>2</sub> and NO<sub>x</sub> emissions for select Southern Company units in the VISTAS region. Southern Company is a super-regional company that owns EGUs in four VISTAS States – Alabama, Florida, Georgia, and Mississippi – and participates in VISTAS as an industry stakeholder. Southern Company independently provided emission estimates for 2002 as part of the development of the preliminary VISTAS 2002 inventory. In most cases, these estimates were reviewed by the States and incorporated into the States CERR submittal. The exception to this was a decision made by Georgia’s Department of Environmental Protection (GDEP) to utilize CEM-based emissions for the actual 2002 emissions inventory for sources within the State when Southern Company also provided data. There were no major inconsistencies between the Southern Company data, the CAMD data, and the S/L CERR data.

The minor inconsistencies found included small differences in emission estimates (<2 percent difference), exclusion/inclusion of small gas-fired units in the different databases, and grouping of emission units in S/L CERR submittals where CAMD listed each unit individually. We compared SO<sub>2</sub> and NO<sub>x</sub> emissions on a unit by unit basis and did not find any major inconsistencies.

#### **1.1.1.5 QA Review of Base F Inventory**

QA checks were run on the Base F point source inventory data set to ensure that all corrections provided by the S/L agencies and stakeholders were correctly incorporated into the S/L

inventories and that there were no remaining QA issues. After exporting the inventory to ASCII text files in NIF 3.0, the EPA QA program was run on the ASCII files and the QA output was reviewed to verify that all QA issues that could be addressed were resolved

Throughout the inventory development process, QA steps were performed to ensure that no double counting of emissions occurred, and to ensure that a full and complete inventory was developed for VISTAS. QA was an important component to the inventory development process and MACTEC performed the following QA steps on the point source component of the VISTAS revised 2002 base year inventory:

1. Facility level emission summaries were prepared and evaluated to ensure that emissions were consistent and that there were no missing sources.
2. State-level EGU and non-EGU comparisons (by pollutant) were developed between the Base F 2002 base year inventory, the draft VISTAS 2002 inventory, and the 1999 NEI Version 2 inventory.
3. Data product summaries and raw NIF 3.0 data files were provided to the VISTAS Emission Inventory Technical Advisor and to the Point Source, EGU, and non-EGU Special Interest Work Group representatives for review and comment. Changes based on these comments were reviewed and approved by the S/L point source contact prior to implementing the changes in the files.
4. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from Base F1 to Base F2.

#### **1.1.1.6 Additional Base G Updates and Corrections**

S/L agencies completed a detailed review of the Base F inventory. Table 1.1-3 summarizes the updates and corrections to the Base F inventory that were requested by S/L agencies and incorporated into the Base G inventory.

There was a discrepancy between the base year 2002 and 2009/2018 emissions for PM<sub>10</sub>-PRI, PM<sub>2.5</sub>-PRI, and NH<sub>3</sub>. The 2002 emissions were provided directly by the S/L agencies and were estimated using a variety of techniques (i.e., EPA emission factors, S/L emission factors, site-specific emission factors, and source test data). The 2009/2018 emissions, on the other hand, were estimated by Pechan (see Section 2.1.1.3) using an emission factor file based solely on AP-42 emission factors. An adjustment was made for 2002 EGU PM and NH<sub>3</sub> emissions to reconcile these differences. The post-processed Integrated Planning Model<sup>®</sup> (IPM<sup>®</sup>) 2009/2018 output uses a set of PM and NH<sub>3</sub> emission factors that are “the most recent EPA approved uncontrolled emission factors” – these are most likely not the same emission factors used by States and emission inventory preparation contractors for estimating these emissions in 2002 for EGUs in the VISTAS domain. VISTAS performed a set of modifications to replace 2002 base

year PM and NH<sub>3</sub> emission estimates with estimates derived from the most recent EPA-approved emission factors. For further details of the methodology used to make this adjustment, see *EGU Emission Factors and Emission Factor Assignment*, memorandum from Greg Stella to VISTAS State Point Source Contacts and VISTAS EGU Special Interest Workgroup, June 13, 2005.

**Table 1.1-3. Summary of Updates and Corrections to the Base F 2002 Inventory Incorporated into the 2002 Base G Inventory.**

Affected State(s)	Nature of Update/Correction
TN, WV	The latitude and longitude values for TN (except the four local programs) and WV were truncated to two decimal places in the Base F inventory. MACTEC re-exported the NIF ER tables in a manner that so that the latitude and longitude were not truncated in the Base G inventory.
AL	Corrected the latitude and longitude for two facilities: Ergon Terminalling (Site ID: 01-073-010730167) and Southern Power Franklin (Site ID: 01-081-0036). Corrections to stack parameters at 10 facilities for stacks with parameters that do not appear to fall into the ranges typically termed "acceptable" for AQ modeling.
FL	Corrected emission values for the Miami Dade RRF facility (Site ID: 12-086-0250348).
GA	Hercules Incorporated (12-051-05100005) had an erroneous process id (#3) within emission unit id SB9 and was deleted. This removes about 6,000 tons of SO <sub>2</sub> from the 2002 inventory. Provided a revised file of location coordinates at the stack level that was used to replace the location coordinated in the ER file.
NC	Made several changes to Base F inventory to correct the following errors: 1. Corrected emissions at Hooker Furniture (Site ID: 37-081-08100910), release point G-29, 9211.38 tons volatile organic compounds (VOC's) should be 212.2 tons, 529.58 tons PM <sub>10</sub> should be 17.02 tons, 529.58 tons PM <sub>2.5</sub> should be 15.79 tons in 2002 inventory. 2. Identified many stack parameters in the ER file that were unrealistic. Several have zero for height, diameter, gas velocity, and flow rate. NC used the procedures outlined in Section 8 of the document ""National Emission Inventory QA and Augmentation Report" to correct unrealistic stack parameters. 3. Identified truncated latitude and longitude values in Base F inventory. NC updated all Title V facility latitude and longitude that was submitted to EPA for those facilities in 2004. Smaller facilities with only two decimal places were not corrected. 4. Corrected emissions for International Paper (3709700045) Emission Unit ID, G-12, should be 1.8844 tons VOCs instead of 2819.19 tons in 2002
SC	Corrected PM species emission values. SC DHEC's initial CERR submittal reported particulate matter emissions using the PM-FIL, PM <sub>10</sub> -FIL, and PM <sub>25</sub> -FIL pollutant codes. In August 2005, SC DHEC indicated that data reported using the PM-FIL, PM <sub>10</sub> -FIL, and PM <sub>25</sub> -FIL pollutant codes should actually have been reported using the PM-PRI, PM <sub>10</sub> -PRI, and PM <sub>25</sub> _PRI codes. MACTEC performed a subsequent PM augmentation in April 2006 using the revised pollutant codes. These changes were reflected in the Base G emission inventory.
TN	Identified six facilities that closed in 2000/2001 but had non-zero emissions in the 2002 Base F inventory. MACTEC changed emissions to zero for all pollutants in the Base G 2002 inventory. Supplied updated emission inventory for the Bowater facility (47-107-0012) based on the facility's updated 2002 emission inventory update. Replaced data from Hamilton County, Tennessee, using data from Hamilton County's CERR submittal as contained in EPA's 2002 NEI (in Base F, the inventory for Hamilton County was based on the draft VISTAS 2002 inventory, which in turn was based on the 1999 NEI). Updated emissions for PCS Nitrogen Fertilizer LP (Site ID: 47-157-00146)
WV	Updated emissions for Steel of West Virginia (Site ID: 54-011-0009) Made changes to several Site ID names due to changes in ownership Made corrections to latitude/longitude and stack parameters at a few facilities for stacks with parameters that do not appear to fall into the ranges typically termed "acceptable" for AQ modeling.

### 1.1.1.7 Summary of Base G 2002 Inventory

Tables 1.1-4 through 1.1-10 summarize the Base G 2002 base year inventory. All values are in tons. For the purposes of Tables 1.1-4 through 1.1-10, EGU emissions include the emissions from all processes with a Source Classification Code (SCC) of either 1-01-xxx-xx (External Combustion Boilers – Electric Generation) or 2-01-xxx-xx (Internal Combustion Engines – Electric Generation). Emissions for all other SCCs are included in the non-EGU column. Note that aggregating emissions into EGU and non-EGU sectors based on the above SCCs causes a minor inconsistency with the EGU emissions reported in EPA’s CAMD database. The EGU emissions summarized in these tables may include emissions from some smaller electric generating units in the VISTAS inventory that are not in CAMD’s 2002 CEM database or the IPM forecasted emissions. The minor inconsistencies result in a less than 2 percent difference between the summary tables below and the data from CAMD’s CEM database.

**Table 1.1-4. Base G 2002 VISTAS Point Source Inventory for SO<sub>2</sub> (tons/year).**

State	All Point Sources	EGUs	Non-EGUs
AL	544,309	447,828	96,481
FL	518,721	453,631	65,090
GA	568,731	514,952	53,778
KY	518,086	484,057	34,029
MS	103,388	67,429	35,960
NC	522,113	477,990	44,123
SC	259,916	206,399	53,518
TN	413,755	334,151	79,604
VA	305,106	241,204	63,903
WV	570,153	516,084	54,070
<b>Total</b>	<b>4,324,278</b>	<b>3,743,725</b>	<b>580,556</b>

Note: EGU emissions include SCCs 1-01-xxx-xx and 2-01-xxx-xx; non-EGU has all other SCCs.

**Table 1.1-5. Base G 2002 VISTAS Point Source Inventory for NO<sub>x</sub> (tons/year).**

State	All Point Sources	EGUs	Non-EGUs
AL	244,348	161,038	83,310
FL	302,834	257,677	45,156
GA	196,767	147,517	49,251
KY	237,209	198,817	38,392
MS	104,661	43,135	61,526
NC	196,782	151,854	44,928
SC	130,394	88,241	42,153
TN	221,652	157,307	64,344
VA	147,300	86,886	60,415
WV	277,589	230,977	46,612
<b>Total</b>	<b>2,059,536</b>	<b>1,523,449</b>	<b>536,087</b>

Note: EGU emissions include SCCs 1-01-xxx-xx and 2-01-xxx-xx; non-EGU has all other SCCs.

**Table 1.1-6. Base G 2002 VISTAS Point Source Inventory for VOC (tons/year).**

State	All Point Sources	EGUs	Non-EGUs
AL	49,332	2,295	47,037
FL	40,995	2,524	38,471
GA	34,952	1,244	33,709
KY	46,321	1,487	44,834
MS	43,852	648	43,204
NC	62,170	988	61,182
SC	38,927	470	38,458
TN	85,254	926	84,328
VA	43,906	754	43,152
WV	15,775	1,180	14,595
<b>Total</b>	<b>461,484</b>	<b>12,516</b>	<b>448,970</b>

Note: EGU emissions include SCCs 1-01-xxx-xx and 2-01-xxx-xx; non-EGU has all other SCCs.

**Table 1.1-7. Base G 2002 VISTAS Point Source Inventory for CO (tons/year).**

State	All Point Sources	EGUs	Non-EGUs
AL	185,550	11,279	174,271
FL	139,045	57,113	81,933
GA	140,561	9,712	130,850
KY	122,555	12,619	109,936
MS	59,871	5,303	54,568
NC	64,461	13,885	50,576
SC	63,305	6,990	56,315
TN	122,348	7,084	115,264
VA	70,688	6,892	63,796
WV	100,220	10,341	89,879
<b>Total</b>	<b>1,068,604</b>	<b>141,218</b>	<b>927,388</b>

Note: EGU emissions include SCCs 1-01-xxx-xx and 2-01-xxx-xx; non-EGU has all other SCCs.

**Table 1.1-8. Base G 2002 VISTAS Point Source Inventory for PM<sub>10</sub>-PRI (tons/year).**

State	All Point Sources	EGUs	Non-EGUs
AL	32,886	7,646	25,240
FL	57,243	21,387	35,857
GA	32,834	11,224	21,610
KY	21,326	4,701	16,626
MS	21,106	1,633	19,472
NC	36,592	22,754	13,838
SC	35,542	21,400	14,142
TN	49,814	14,640	35,174
VA	17,211	3,960	13,252
WV	22,076	4,573	17,503
<b>Total</b>	<b>326,630</b>	<b>113,918</b>	<b>212,714</b>

Note: EGU emissions include SCCs 1-01-xxx-xx and 2-01-xxx-xx; non-EGU has all other SCCs.

**Table 1.1-9. Base G 2002 VISTAS Point Source Inventory for PM<sub>2.5</sub> -PRI (tons/year).**

State	All Point Sources	EGUs	Non-EGUs
AL	23,291	4,113	19,178
FL	46,148	15,643	30,504
GA	22,401	4,939	17,462
KY	14,173	2,802	11,372
MS	11,044	1,138	9,906
NC	26,998	16,498	10,500
SC	27,399	17,154	10,245
TN	39,973	12,166	27,807
VA	12,771	2,606	10,165
WV	15,523	2,210	13,313
<b>Total</b>	<b>239,721</b>	<b>79,269</b>	<b>160,452</b>

Note: EGU emissions include SCCs 1-01-xxx-xx and 2-01-xxx-xx; non-EGU has all other SCCs.

**Table 1.1-10. Base G 2002 VISTAS Point Source Inventory for NH<sub>3</sub> (tons/year).**

State	All Point Sources	EGUs	Non-EGUs
AL	2,200	317	1,883
FL	1,657	234	1,423
GA	3,697	83	3,613
KY	1,000	326	674
MS	1,359	190	1,169
NC	1,234	54	1,180
SC	1,553	142	1,411
TN	1,817	204	1,613
VA	3,230	127	3,104
WV	453	121	332
<b>Total</b>	<b>18,200</b>	<b>1,798</b>	<b>16,402</b>

Note: EGU emissions include SCCs 1-01-xxx-xx and 2-01-xxx-xx; non-EGU has all other SCCs.

### 1.1.2 *Development of Typical Year EGU inventory*

VISTAS developed a typical year 2002 emission inventory for EGUs to avoid anomalies in emissions due to variability in meteorology, economic, and outage factors in 2002. The typical year inventory represents the five year (2000-2004) starting period that would be used to determine the regional haze reasonable progress goals.



Data from EPA's CAMD were used to develop normalization factors for producing a 2002 typical year inventory for EGUs. We used the ratio of the 2000-2004 average heat input and the 2002 actual heat input to normalize the 2002 actual emissions. MACTEC obtained data from EPA's CAMD for utilities regulated by the Acid Rain program. Annual data for the period 2000 to 2004 were obtained from the CAMD web site ([www.epa.gov/airmarkets](http://www.epa.gov/airmarkets)). The parameters available were the SO<sub>2</sub> and NO<sub>x</sub> emission rates, heat input, and operating hours.

We used the actual 2002 heat input and the average heat input for the 5-year period from 2000-2004 as the normalization factor, as follows:

$$\text{Normalization Factor: } \frac{\text{2000-2004 average heat input}}{\text{2002 actual heat input}}$$

If the unit did not operate for all five years, then the 2000-2004 average heat input was calculated for the one or two years in which the unit did operate. For example, if the unit operated only during 2002, then the normalization factor would be 1.0. The annual actual emissions were multiplied by the normalization factor to determine the typical emissions for 2002, as follows:

$$\text{Typical Emissions} = \text{2002 actual emissions} \times \text{Normalization Factor}$$

After applying the normalization factor, some adjustments were needed for special circumstances. For example, a unit may not have operated in 2002 and thus have zero emissions. If the unit had been permanently retired prior to 2002, then we used zero emissions for the typical year. If the unit had not been permanently retired and would normally operate in a typical year, then we used the 2001 (or 2000) heat input and emission rate to calculate the typical year emissions.

The Southern Company provided typical year data for their sources. Hourly emissions data for criteria pollutants were provided. MACTEC aggregated the hourly emissions into annual values. Further documentation of how Southern Company created the typical year inventory for their units can be found in *Developing Southern Company Emissions and Flue Gas Characteristics for VISTAS Regional Haze Modeling (April 2005, presented at 14<sup>th</sup> International Emission Inventory Conference* <http://www.epa.gov/ttn/chief/conference/ei14/session9/kandasamy.pdf>). Since Southern Company only supplied filterable particulate emissions, we ran the PM<sub>10</sub>/PM<sub>2.5</sub> augmentation routine to calculate annual emission estimates for PM<sub>10</sub>-PRI and PM<sub>2.5</sub>-PRI.

The Southern Company typical year data were used for Southern Company sources in Alabama, Florida, and Mississippi. Georgia EPD elected to use the typical year normalization factor derived from the CAMD data instead of the Southern Company typical year data (as was used in the Base F inventory).

The final step was to replace the 2002 actual emissions with the 2002 typical year data described above. MACTEC provided the raw data and results of the typical year calculations in a spreadsheet for S/L agency review and comment. Any comments made were incorporated into the Base G inventory.

Table 1.1-11 summarizes emissions by State and pollutant for the actual 2002 EGU inventory and the typical year EGU inventory. For the entire VISTAS region, actual 2002 SO<sub>2</sub> emissions were about 0.5 percent higher than the typical year emissions. The differences on a state-by-state basis ranged from actual emissions being 6.6 percent lower in Florida to 10.9 percent higher in Mississippi. For the entire VISTAS region, actual 2002 NO<sub>x</sub> emissions were about 0.1 percent lower than the typical year emissions. The differences on a state-by-state basis ranged from actual emissions being 9.6 percent lower in Florida to 6.3 percent higher in Mississippi.

**Table 1.1-11. Comparison of SO<sub>2</sub> and NO<sub>x</sub> Emissions (tons/year) for EGUs from Base G Actual 2002 Inventory and Typical 2002 Inventory.**

State	SO <sub>2</sub> Emissions (tons/year)			NO <sub>x</sub> Emissions (tons/year)		
	Actual 2002	Typical 2002	Percentage Difference	Actual 2002	Typical 2002	Percentage Difference
AL	447,828	423,736	5.4	161,038	154,704	3.9
FL	453,631	483,590	-6.6	257,677	282,507	-9.6
GA	514,952	517,633	-0.5	147,517	148,126	-0.4
KY	484,057	495,153	-2.3	198,817	201,928	-1.6
MS	67,429	60,086	10.9	43,135	40,433	6.3
NC	477,990	478,489	-0.1	151,854	148,812	2.0
SC	206,399	210,272	-1.9	88,241	88,528	-0.3
TN	334,151	320,146	4.2	157,307	152,137	3.3
VA	241,204	233,691	3.1	86,886	85,081	2.1
WV	516,084	500,381	3.0	230,977	222,437	3.7
<b>Total</b>	<b>3,743,725</b>	<b>3,723,177</b>	<b>0.5</b>	<b>1,523,449</b>	<b>1,524,693</b>	<b>-0.1</b>

## 1.2 Area Sources

This section details the development of the Base G 2002 base year inventory for area sources. There are three major components of the area source sector of the inventory. The first component is the “typical” year fire inventory. Version 3.1 of the VISTAS base year fire inventory provided actual 2002 emissions estimates. Since fire emissions are not easily grown or projected, in order

to effectively represent fires in both the base and future year inventories, VISTAS determined that a typical year fire inventory was necessary. Development of the “typical” year fire inventory covered wildfire, prescribed burning, agricultural fires and land clearing fires. The first part of this section of the report discusses the development of the typical year fire inventory. The methodology provided in that section is identical to the documentation provided for Base F since the “typical” year inventory was developed as part of the Base F development effort. The major change in Base G for the fire component of the inventory was the development of projection year inventories that represent alternatives to the “typical” year inventory. These alternative projections incorporated projected changes in the acreage burned for prescribed fires on Federal lands. These projections are an augmentation of the “typical” year inventory.

The second component of the area source inventory was the incorporation of data submitted by the VISTAS States to the United States Environmental Protection Agency (EPA) as part of the CERR. Work on incorporating the CERR data into the revised base year involved: 1) obtaining the data from EPA, 2) evaluating the emissions and pollutants reported in order to avoid double counting and 3) backfilling from the existing VISTAS 2002 base year inventory for missing sources/pollutants. The processes used to perform those operations are described in the second portion of this section. That work was performed as part of the Base F inventory effort. In general no changes to that method were made as part of the Base G inventory updates. The methods used for the Base F inventory development effort using the CERR submittals have been maintained in this document. Where necessary, additional documentation has been added to 1) reflect changes that resulted from VISTAS States review of the Base F inventory and the incorporation of those changes into Base G, 2) changes made to how certain sources were estimated or 3) addition of new sources not found in Base F.

The final component of the area source inventory was related to the development of NH<sub>3</sub> emission estimates for livestock and fertilizers and paved road PM emissions. For the NH<sub>3</sub> emission estimates for livestock and fertilizers we used version 3.6 of the Carnegie Mellon University (CMU) NH<sub>3</sub> model. For the paved road PM emissions, we used the most recent estimates developed by EPA as part of the National Emission Inventory (NEI) development effort. EPA had developed an improved methodology for estimating paved road emissions so those values were substituted directly into the inventory after receiving consensus from all of the VISTAS States to perform the replacement. Details on these methods are provided in the third portion of this section of the document. That section is virtually identical to that from the Base F inventory document as there were only a couple of changes to the ammonia portion of the inventory and some updates to all fugitive dust categories including paved roads on a global basis between Base F and Base G.

Finally, quality assurance steps for each component of the area source inventory are discussed.

### 1.2.1 Development of a “typical” year fire inventory

Typical year fire emissions were developed starting from the actual fire acreage data and emission calculated for each VISTAS State. The table below shows the data submitted by each State in the VISTAS region indicating what data was received from each State for the purposes of calculating actual fire emissions.

Fire Type	AL	FL	GA	KY	MS	NC	SC	TN	VA	WV
Land Clearing	✓	✓	✓				✓			
Ag Burning	✓	✓	✓				✓			
Wildfires	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Prescribed	✓	✓	✓	✓	✓	✓	✓	✓		✓

In order to effectively characterize fire emissions in the VISTAS region, a typical (as opposed to strictly 2002 year based inventory) was required. Development of a typical year fire inventory provided the capability of using a comparable data set for both the base year and future years. Thus fire emissions would remain the same for air quality and visibility modeling in both the base and any future years. MACTEC originally proposed five different methods for developing the typical fire year to the VISTAS Fire Special Interest Work Group (SIWG) and requested their feedback and preference for developing the final typical year inventory. The method that was selected by SIWG members was to use a method similar to that used to develop an early version of a 2018 projection inventory. For that early 2018 inventory, State level ratios of acres over a longer term record (three or more years) developed for each fire type relative to 2002. The 2002 acreage was then scaled up or down based on these ratios to develop a typical year inventory. For Base F and G, the decision of the VISTAS Fire SIWG was to base the ratio on county level data for States that supplied long term fire-by-fire acreage data rather than State-level ratios. Where States did not supply long term fire-by-fire acreage data, MACTEC reverted to using State-level ratios. With one broad exception (wildfires) this method was implemented for all fires. MACTEC solicited long term fire-by-fire acreage data by fire type from each VISTAS State. A minimum of three or more years of data were used to develop the ratios. Those data were then used to develop a ratio for each county based on the number of acres burned in each county for each fire type relative to 2002.

Thus if we had long term county prescribed fire data from a State, we developed a county acreage ratio of:

$$\text{Ratio} = \frac{\text{Long term average county level Rx acres}}{\text{2002 actual county level Rx acreage}}$$

This ratio was then multiplied times the actual 2002 acreage to get a typical value (basically the long term average county level acres). Wherever possible this calculation was performed on a fire by fire basis. The acreage calculated using the ratio was then used with the fuel loading and emission factor values that we already had (and had been reviewed by the SIWG) to calculate emissions using the same method used for the 2002 actual values (which were previously documented). The following lists indicate which counties used the State ratios by fire type.

<b>Land Clearing</b>		<b>Agricultural Fires</b>		<b>Prescribed Burning</b>	
<b>FIPS</b>	<b>COUNTY</b>	<b>FIPS</b>	<b>COUNTY</b>	<b>FIPS</b>	<b>COUNTY</b>
12086	Miami-Dade County	13063	Clayton County	13059	Clarke County
12037	Franklin County	13083	Dade County	13083	Dade County
12043	Glades County	13089	Dekalb County	13089	Dekalb County
12045	Gulf County	13097	Douglas County	13097	Douglas County
12049	Hardee County	13121	Fulton County	13121	Fulton County
12057	Hillsborough County	13135	Gwinnett County	13123	Gilmer County
12073	Leon County	13137	Habersham County	13135	Gwinnett County
12077	Liberty County	13215	Muscogee County	13139	Hall County
12081	Manatee County	13227	Pickens County	13215	Muscogee County
12095	Orange County	13241	Rabun County	13241	Rabun County
12097	Osceola County	13247	Rockdale County	13247	Rockdale County
12103	Pinellas County	13311	White County		
12115	Sarasota County				
13015	Bartow County				
13021	Bibb County				
13045	Carroll County				
13047	Catoosa County				
13057	Cherokee County				
13059	Clarke County				
13063	Clayton County				
13073	Columbia County				
13077	Coweta County				
13083	Dade County				
13089	Dekalb County				
13097	Douglas County				
13117	Forsyth County				
13121	Fulton County				
13129	Gordon County				
13135	Gwinnett County				
13137	Habersham County				
13143	Haralson County				
13147	Hart County				
13151	Henry County				
13169	Jones County				
13215	Muscogee County				
13237	Putnam County				
13241	Rabun County				
13291	Union County				
13311	White County				

There were three exceptions to this method.

#### Exception 1: Use of State Ratios for Wildfires

The first exception was that wildfires estimates were developed using State ratios rather than county ratios. This change was made after initial quality assurance of the draft estimates revealed that some counties were showing unrealistic values created by very short term data records or missing data that created unrealistic ratios. In addition, exceptionally large and small fires were removed from the database since they were felt to be atypical. For example the Blackjack Complex fire in Georgia was removed from the dataset because the number of acres burned was “atypical” in that fire. We also removed all fires less than 0.1 acres from the dataset.

#### Exception 2: Correction for Blackened Acres on Forest Service Lands

Following discussions with the United States Forest Service (Forest Service) (memo from Cindy Huber and Bill Jackson, dated August 13, 2004), it was determined that the acres submitted by the Forest Service for wildfires and prescribed fires represented perimeter acres rather than “blackened” acres. Thus for wildfires and prescribed fires on Forest Service lands, a further correction was implemented to correct the perimeter acre values to blackened acres. The correction was made based on the size of the fire. For prescribed fires over 100 acres in size the acreage was adjusted to be 80 percent of the initial reported value. For prescribed fires of 100 acres or less the acreage values were maintained as reported. For wildfires, all reported acreage values were adjusted to be 66 percent of their initially reported values. These changes were made to all values reported for Forest Service managed lands.

#### Exception 3: Missing/Non-reported data

When we did not receive data from a VISTAS State for a particular fire type, a composite average for the entire VISTAS region was used to determine the typical value for that type fire. For example, if no agricultural burning long term acreage data was reported for a particular State, MACTEC determined an overall VISTAS regional average ratio that was used to multiply times the 2002 values to produce the “typical” values. This technique was applied to all fire types when data was missing.

In addition, for wildfires and prescribed burning, ratios were developed for “northern” and “southern” tier States within the VISTAS region and those ratios were applied to each State with missing data depending upon whether they were considered a “northern” or “southern” tier State. Development of “southern” and “northern” tier data was an attempt to account for a change from a predominantly pine/evergreen ecosystem (southern) to a pine/deciduous ecosystem (northern). States classified as “southern” included: AL, FL, GA, MS, and SC. States classified as “northern” included: KY, NC, TN, VA, and WV.

Finally for land clearing and agricultural fires, there are no NH<sub>3</sub> and SO<sub>2</sub> emissions. This is due to the lack of emission factors for these pollutants for these fire types.

Table 1.2-1 shows fire emissions from the original base year emission inventory (VISTAS 3.1), the actual 2002 emissions and the typical year emissions for the entire VISTAS region. The actual 2002 and typical fire emissions represent the Base F and Base G 2002 emissions. The typical emissions also represent the 2009 and 2018 emissions for all fire types with the exception of prescribed burning. Revisions made to the typical year prescribed fire emissions for 2009 and 2018 are detailed in the projection section. Also, State level Base G emissions from fires for all years can be found in the tables in Appendix A. Values for fires in those tables are “typical” year values.

Figures 1.2-1 through 1.2-4 show the State by State changes in emissions between the original 2002 base year fire inventories, the actual 2002 and the typical year inventories for carbon monoxide (CO) by fire type. Due to the relative magnitude of CO emissions compared to other criteria and PM pollutants from fires; this pollutant is normally chosen to represent the distribution of fires in the example plots.

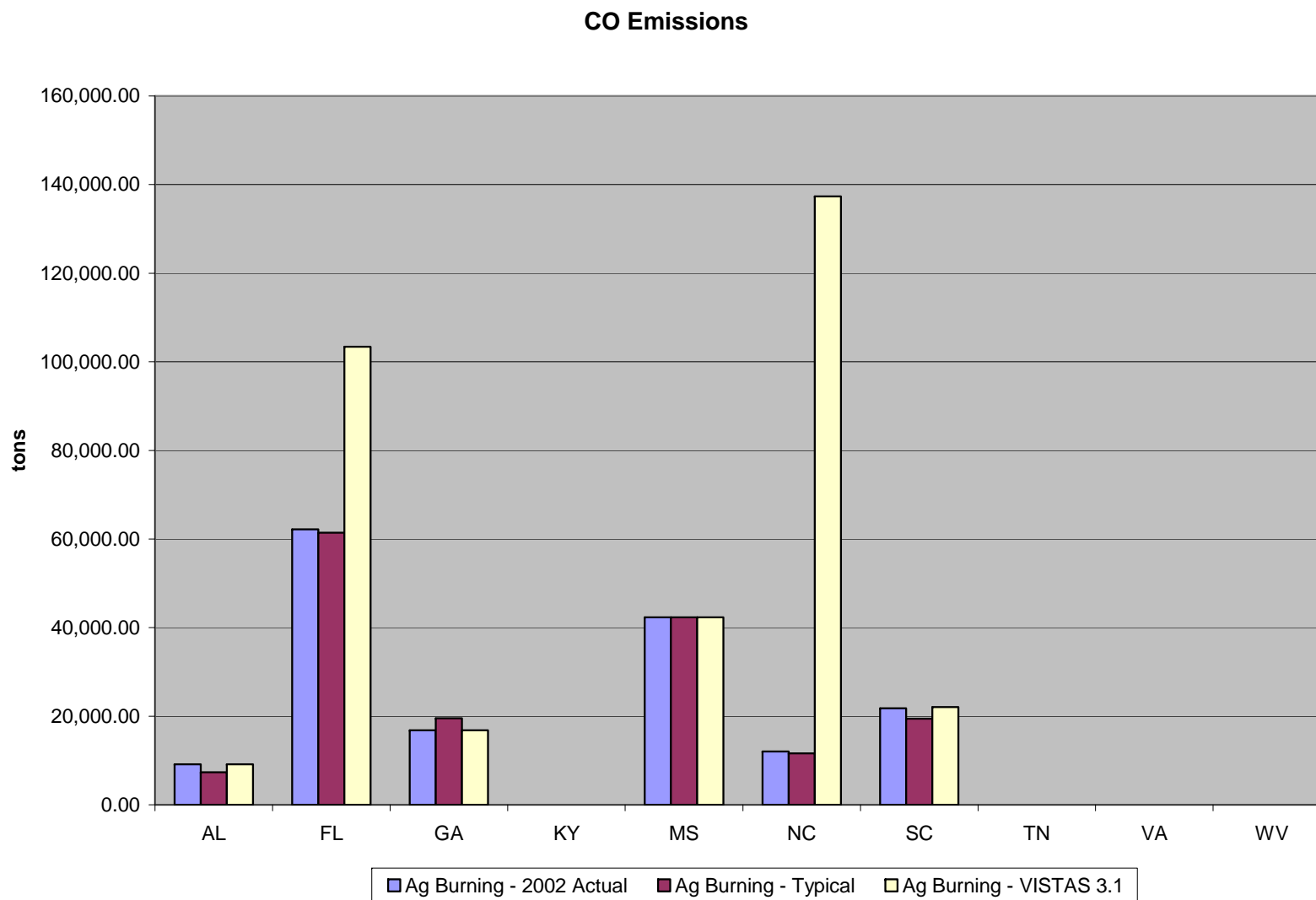
**Table 1.2-1. Emissions from Fires in the VISTAS Region – Comparison between Original Base Year 2002 (VISTAS 3.1), 2002 Actual and Typical Year Base G Emissions.**

		CO	NH <sub>3</sub>	NO <sub>x</sub>	PM <sub>10</sub> -FIL	PM <sub>10</sub> -PRI	PM <sub>2.5</sub> -FIL	PM <sub>2.5</sub> -PRI	SO <sub>2</sub>	VOC
<b>Total LC</b>	Actual (Base G)	492,409	0	14,568	62,146	62,146	62,146	62,146	0	33,799
	Typical (Base G)	675,838	0	19,995	80,598	80,598	80,598	80,598	0	46,389
	VISTAS 3.1	484,240	0	14,327	61,325	61,325	61,325	61,325	0	33,238
<b>Total Ag</b>	Actual (Base G)	164,273	0	903	30,958	30,958	30,385	30,385	0	21,946
	Typical (Base G)	161,667	0	903	30,465	30,465	29,892	29,892	0	21,595
	VISTAS 3.1	331,073	0	903	41,480	41,480	40,192	40,192	0	41,875
<b>Total WF</b>	Actual (Base G)	298,835	1,333	6,628	28,923	28,923	24,926	24,926	1,611	16,804
	Typical (Base G)	547,174	2,451	11,955	53,070	53,070	45,635	45,635	3,072	28,491
	VISTAS 3.1	275,766	1,230	6,133	26,680	26,680	23,002	23,002	1,476	15,718
<b>Total RX</b>	Actual (Base G)	1,678,216	7,616	36,561	168,938	168,938	145,175	145,175	9,839	78,988
	Typical (Base G)	1,635,776	7,425	35,650	164,811	164,811	141,636	141,636	9,590	76,990
	VISTAS 3.1	1,724,940	7,822	37,556	173,590	173,590	149,181	149,181	10,101	81,188

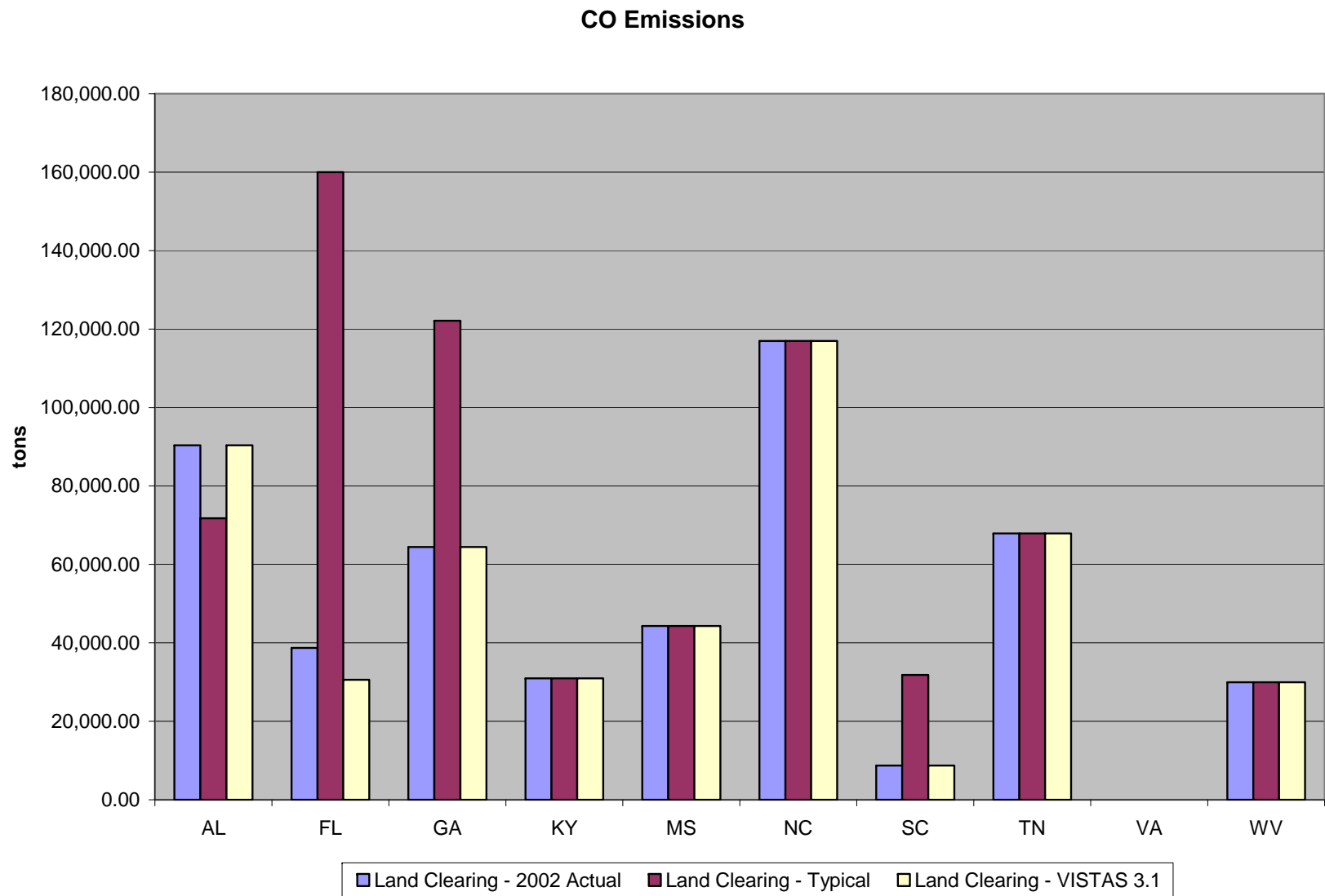
Key: LC = Land Clearing; Ag = Agricultural burning; WF = wildfires; RX = prescribed burning. Actual and Typical represent Base F and Base G (e.g., no change in methodology for Base F and Base G) for 2002.



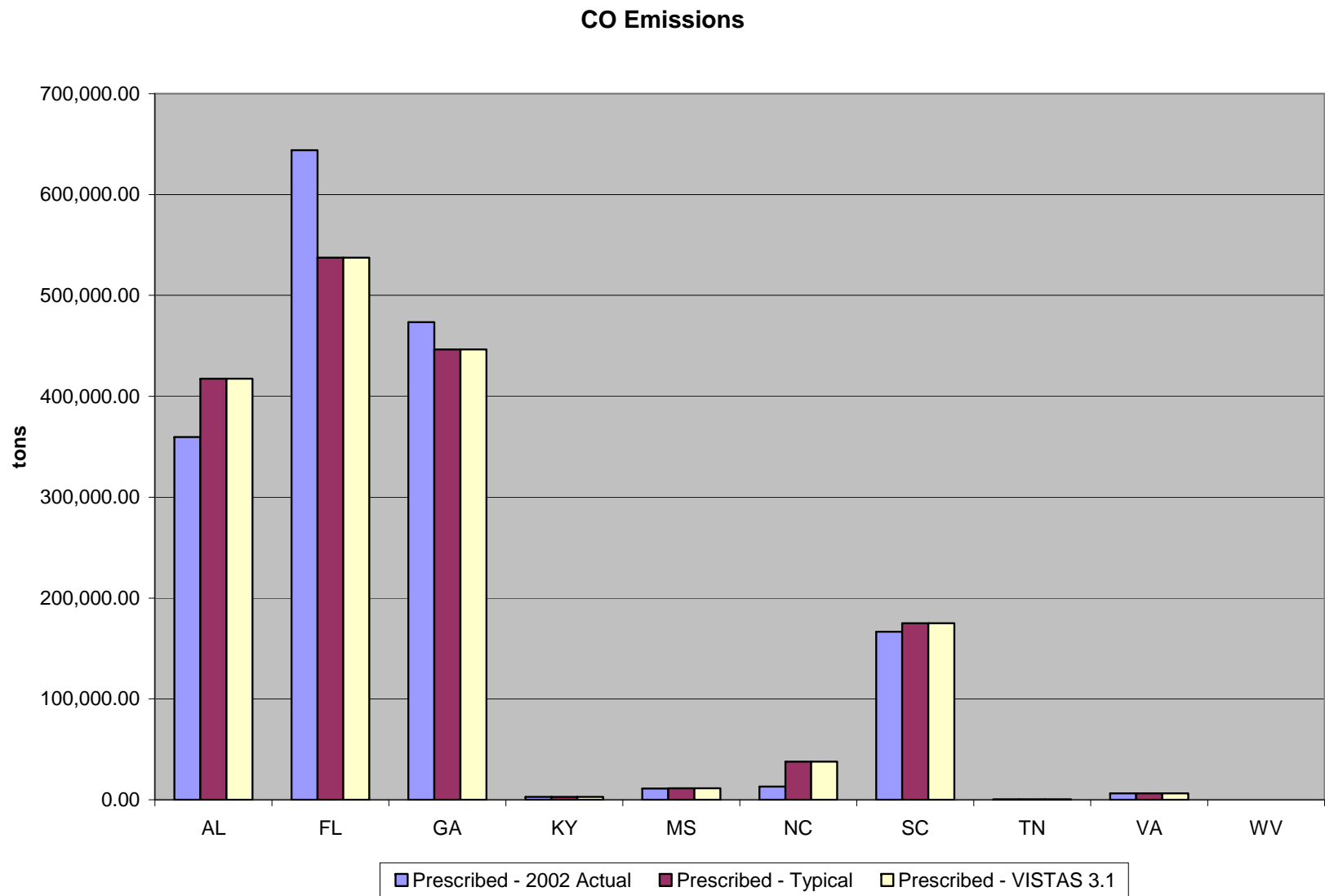
**Figure 1.2-1. CO Emissions from Agricultural Burning for the Original Base Year, 2002 Actual Base G, and 2002 Typical Base G Inventories.**



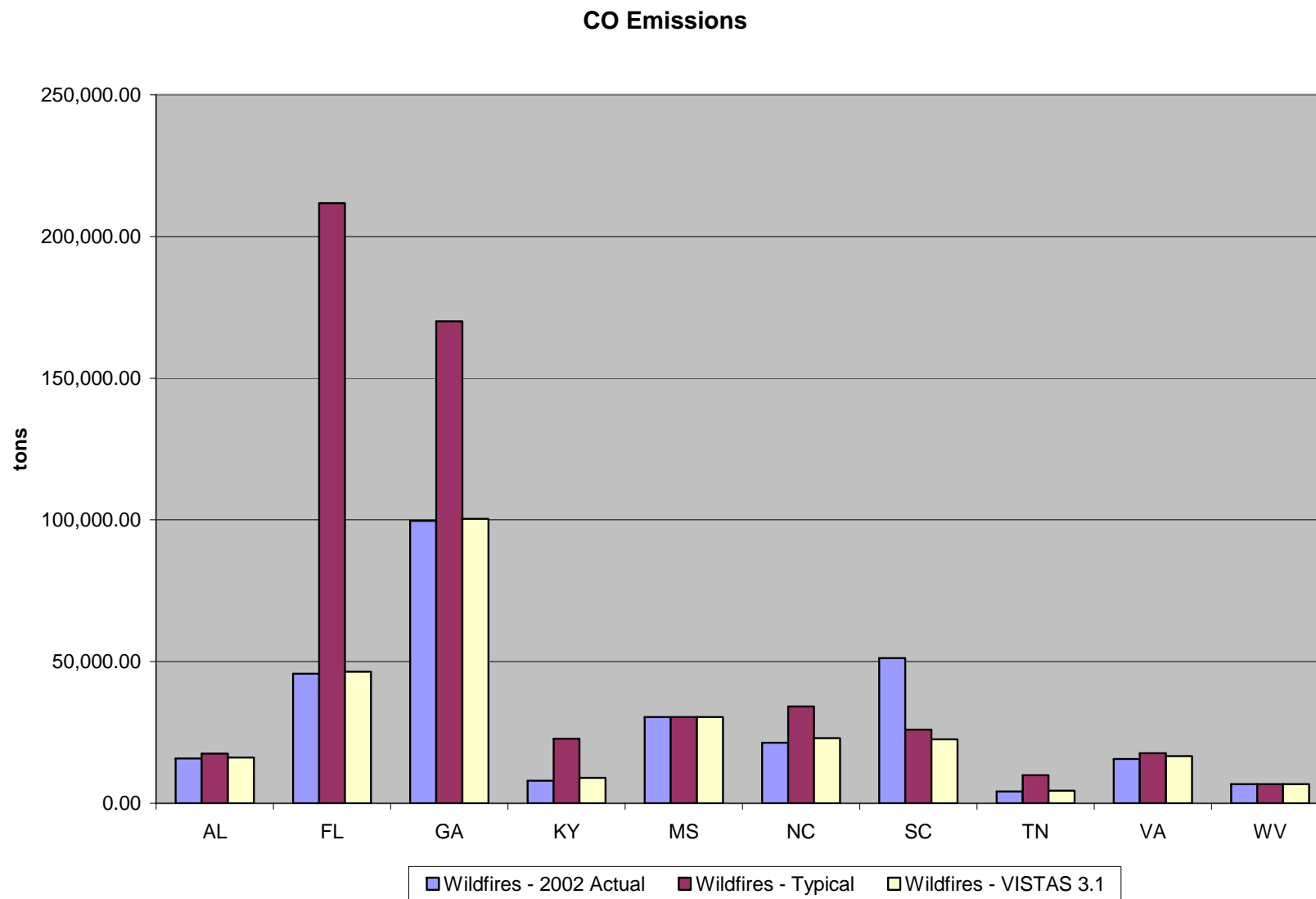
**Figure 1.2-2. CO Emissions from Land Clearing Burning for the Original Base Year, 2002 Actual Base G and 2002 Typical Base G Inventories.**



**Figure 1.2-3. CO Emissions from Prescribed Burning for the Original Base Year, 2002 Actual Base G and 2002 Typical Base G Inventories.**



**Figure 1.2-4. CO Emissions from Wildfire Burning for the Original Base Year, 2002 Actual Base G and 2002 Typical Base G Inventories.**



### **1.2.2      *Development of non-fire inventory***

The second task in preparing the area source component of the Base F and Base G 2002 base year inventory was the incorporation of data submitted by the VISTAS States to the EPA as part of the CERR. With few exceptions, Base F and Base G inventories for this component of the inventory are identical. Modifications to the Base F methodology (described below) only resulted from modifications from the VISTAS States during review of the Base F inventory. The changes made to the inventory based on these reviews are described in the last portion of this section of the report. The information presented below describes the method used to incorporate CERR data as part of Base F.

Work on incorporating the CERR data into the 2002 Base F inventory involved: 1) obtaining the data from EPA, 2) evaluating the emissions and pollutants reported in order to avoid double counting and 3) backfilling from the earlier version of the VISTAS 2002 base year inventory for missing sources/pollutants. The processes used to perform those operations are described below. This work did not include any of the fire emission estimates described above. In addition it did not include emission estimates for ammonia from agricultural and fertilizer sources. Finally it did not include PM emissions from paved roads. Each of those categories was estimated separately.

Data on the CERR submittals was obtained from EPA's Draft NEI download file transfer protocol (FTP) site where the data are stored after they've been processed for review. The data submitted in National Emission Inventory Format (NIF) was downloaded from that site. Once all of the files were obtained, MACTEC ran the files through the EPA NIF Format and Content checking tool to ensure that the files were submitted in standard NIF format and that there were no issues with those files. In a couple of cases small errors were found. For example, in one case a county FIPs code that was no longer in use was found. MACTEC contacted each VISTAS State area source contact person to resolve the issues with the files and corrections were made. Once all corrections to the native files were completed, MACTEC continued with the incorporation of the data into the VISTAS area source files.

Our general assumption was that unless we determined otherwise, the CERR submittals represented full and complete inventories. Where a State submitted a complete inventory, our plan was to simply delete the previous 2002 base year data and replace it with the CERR submittal. Prior to this replacement however, we stripped out the following emissions:

1. All wildfire, prescribed burning, land clearing and agricultural burning emissions submitted to EPA by the States as part of the CERR process were removed since they were to be replaced with emissions estimated using methods described earlier.
2. All fertilizer and agricultural ammonia emission records submitted to EPA by the States as part of the CERR process were removed. These were replaced with the estimates developed using the CMU Ammonia model.

3. All emissions from paved roads submitted to EPA by the States as part of the CERR process were removed. These emissions were replaced with updated emissions developed by U.S. EPA as part of their 2002 NEI development effort.

This approach was used for most State and Local emission submittals to prepare the Base F inventory. There were a few cases where alternative data were used to prepare the Base F inventory. In general, these alternatives involved submittal of alternative files to the CERR data by S/L agencies. Table 1.2-2 below summarizes the data used to prepare the Base F inventory. In general the data were derived from one of the following sources:

1. CERR submittal obtained from EPA FTP site as directed by VISTAS States;
2. State submitted file (either revised from CERR submittal or separate format);
3. VISTAS original 2002 base year (VISTAS version 3.1 base year file); or
4. EPA's preliminary 2002 NEI.

**Table 1.2-2. Summary of State Data Submittals for the 2002 VISTAS Area Source Base F Inventory**

State / Local Program	Area Source Emissions Data Source
AL	B
FL	B
GA	C
KY	A
MS	B
NC	C
SC	B
TN	B
VA	B
WV	A/C
Davidson County, TN	B
Hamilton County, TN	C
Memphis/Shelby County, TN	A
Knox County, TN	B
Jefferson County, AL	* so B from State
Jefferson County, KY	B
Buncombe County, NC	* so C from State
Forsyth County, NC	* so C from State
Mecklenburg County, NC	* so C from State

A = VISTAS 2002 (version 3.1)

B = CERR Submittal from EPA's ftp site

C = Other (CERR or other submittal sent directly from State to MACTEC)

\* = No response

In order to track the sources of data in the final Base F and Base G NIF files, a field was added to the NIF format files developed for VISTAS to track each data source. A field named Data\_Source was added to the EM table. A series of codes were added to this field to mark the source of each emissions value in the Base F and Base G inventories. Values in this field are detailed in Table 1.2-3.

**Table 1.2-3: Data Source Codes and Data Sources for VISTAS 2002 Base F Area Source Emissions Inventory.**

Data Source Codes	Data Source
Base F Codes	
CMU Model E-02-X or E-99-F or L-02-X or S-02-X	CMU Ammonia model v 3.6 EPA CERR submittal (from FTP site)
EPA Paved	EPA Paved Road emissions estimates
EPAPRE02NEI	EPA Preliminary 2002 NEI
STATEFILE	State submitted file
VISTBASYSR31	VISTAS 2002 Base Year version 3.1
VISTRATIO	Developed from VISTAS Ratios (used only for missing pollutants)
Additional Base G Codes	
ALBASEGFILE	Base G update file provided by AL
NCBASEGFILE	Base G update file provided by NC
OTAQRPT	Portable Fuel Container Emissions from OTAQ Report
STELLA	Revised data provided by VISTAS EI Advisor Greg Stella
VABASEGFILE	Base G update file provided by VA
VASStateFile	Revisions/additions to Base G update file provided by VA

Most States submitted complete inventories for Base F. Virginia's inventory required a two stage update. Virginia's CERR submittal only contained ozone precursor pollutants (including CO). For Virginia, MACTEC's original plan was to maintain the previous 2002 VISTAS base year emissions for non-ozone pollutants and then do a simple replacement for ozone pollutants. However during the QA phase of the work, MACTEC discovered that there were categories that had ozone precursor or CO emissions in the submittal that weren't in the original 2002 VISTAS base year inventory that should have PM or SO<sub>2</sub> emissions. For those records, MACTEC used an

emissions ratio to build records for emissions of these pollutants. Data for Virginia PM and SO<sub>2</sub> emissions were generated by developing SCC level ratios to NO<sub>x</sub> from the VISTAS 2002 base year inventory (version 3.1) or from emission factors and then calculating the emissions based on that ratio.

### **1.2.3 2002 Base G inventory updates**

After the Base F inventory was submitted and used for modeling, VISTAS States were provided an opportunity for further review and comment on the Base F inventory. As a result of this review and comment period, several VISTAS States provided revisions to the Base F inventory.

In addition to and as an outgrowth of some of the comments provided by the States during the review process, some of the changes made to the inventory were made globally across the entire VISTAS region. This section discusses the specific State changes followed by the global changes made to the area source component of the inventory for all VISTAS States.

#### **1.2.3.1 Changes resulting from State review and comment**

##### **Alabama**

Alabama suggested several changes and had questions concerning a few categories in the Base F inventory. The changes/questions were:

1. For Source Classification Code (SCC) 2102005000 (Industrial Boilers: Residual Oil) and SCC 2103007000 (Institutional/Commercial Heating: Liquefied Petroleum Gas) the Alabama noted that the Base F VISTAS inventory had values for NO<sub>x</sub>, VOC and CO for the State, but no values for SO<sub>2</sub>, PM<sub>10</sub> or PM<sub>2.5</sub>.

MACTEC evaluated this information and found that there were actually emissions for two counties in AL for that SCC that had either SO<sub>2</sub> and/or PM emissions. The data used to develop the 2002 Base F inventory for AL came from the preliminary 2002 CERR submittals (see above) which should have included SO<sub>2</sub> and PM but did not except for two counties. According to MACTEC's protocol for use of these files, the files received from EPA were to be used "as is" unless the States provided comments during the Base F comment period to correct the CERR submittal. No comments were received from AL on the CERR submittal used for Base F. For 2002 Base G, AL provided an updated database file for these SCCs for all counties in the State that provided revised values for emissions and included SO<sub>2</sub> and PM. The revised file was used to update the Base F data for Base G.

2. AL noted that the Base F inventory included SCC 2401002000 (Solvent Utilization, Surface Coating, Architectural Coatings - Solvent-based, Total: All Solvent Types) and 2401003000 (Solvent Utilization, Surface Coating,



Architectural Coatings - Water-based, Total: All Solvent Types) as well as SCC 2401001000 (Solvent Utilization, Surface Coating, Architectural Coatings, Total: All Solvent Types). This resulted in double counting of the emissions for this category. AL suggested removal of the breakdown SCCs and use of the total SCC.

MACTEC deleted records for the breakdown SCCs and retained the total all solvents SCC emissions.

3. AL found the SCCs listed below missing from the Base F VISTAS inventory.

SCC	VOC Emissions	SCC Description
2401025000	1139.91	Surface Coatings: Metal Furniture, all coating types
2401030000	425.27	Surface Coatings: Paper, all coating types
2401065000	344.08	Surface Coatings: Electronic and Other Electrical, all coating types
2430000000	504.29	Solvent Utilization, Rubber/Plastics, All Processes, Total: All Solvent Types
2440020000	3043.78	Solvent Utilization, Miscellaneous Industrial, Adhesive (Industrial) Application, Total: All Solvent Types
Total for AL	5457.32	

MACTEC found that the emissions for these SCCs were included in the Base F inventory, but with slightly different total emissions. AL provided an updated county-level emissions file for use in updating the Base G inventory. That file was used to update the NIF records for AL for those SCCs.

4. AL noted that emissions in the Base F inventory were found for SCC 2465000000 and SCCs 2465100000, 2465200000, 2465400000, 2465600000, and 2465800000. These last five SCCs represent a subset of the emissions in the 2465000000 SCC resulting in potential double counting of emissions.

MACTEC deleted all emissions associated with the Total SCC 2465000000 and retained the subset SCCs for the Base G inventory.

### **Florida**

Florida provided comments indicating that they felt that emissions from the following sources and counties were too high, especially for CO and PM and were likely zero:

- motor vehicle fire - Palm Beach County
- woodstoves - Miami Dade, Hillsborough, Orange, Polk, Ft Myers, Pasco and Sarasota Counties
- fireplaces - Miami Dade and Hillsborough Counties

Emissions from these sources in the counties specified were set to zero by MACTEC for the Base G inventory.

### **North Carolina**

North Carolina provided corrected emission files for 2002 Base F. A text file with emission values was provided and used to update the Base F emissions to Base G. The updated emissions were applied directly to the Base F NIF file. The file provided was similar to the “EM” NIF table. An update query was used to update the data supplied in the text file to the Access database NIF file. All changes were implemented.

### **South Carolina**

South Carolina had two issues concerning the Base F inventory. These issues related to 1) additional SCCs that were in BASE F 2009 and 2018, but not in 2002 Base F and 2) SCCs that were in the U.S. EPA 2002 NEI inventory, but not in the VISTAS 2002, 2009, or 2018 Base F inventory.

MACTEC investigated the additional SCCs found in 2009 and 2018 Base F and found that the SCCs actually were not missing in the 2002 Base F inventory but only had emissions for PM. Thus the emissions were maintained as they were provided in Base F.

With respect to the SCCs that were found in the U.S. EPA 2002 NEI, MACTEC investigated and found that they were not included in the Base F inventory because they were not included in the 2002 CERR submittal used to produce the Base F updates. The SCCs were apparently added by EPA later in the NEI development process. In addition, MACTEC also evaluated whether or not the SCCs were found in other VISTAS States Base F inventories. MACTEC found that some States included them and some did not, there was no consistency between the States. MACTEC also found that typically emissions for these SCCs were low in emissions, generally with emissions of only a few tons to tens of tons per year. The decision was made with South Carolina concurrence not to add these SCCs to the Base G inventory. These SCCs were: 210205000, 2102011000, 2103007000, 2103011000, 2104007000, 2104011000, 2302002100, 2302002200, 2302003100, 2302003200, 2610000500, 2810001000, and 281001500.

### **Virginia**

Virginia provided an updated 2002 base year emissions file. The data in that file were used to update the Base F inventory emission values to those for Base G. In addition, Virginia provided

information on several source categories that required controls for future year projections since the sources were located in counties/cities in northern Virginia and were subject to future year Ozone Transport Commission (OTC) regulations. MACTEC added in the base year control levels to the Base G inventory file for these categories so that they could be estimated correctly in future years. The controls added were for mobile equipment repair/refinishing sources, architectural and industrial maintenance coating sources, consumer products sources, and solvent metal cleaning sources. Minor errors were found in some entries for the initial file provided and VA provided a revised file with corrections and minor additions.

#### **1.2.4 Ammonia and paved road emissions**

The final component of the Base F inventory development was estimation of NH<sub>3</sub> emission estimates for livestock and fertilizers and paved road PM emissions. For the NH<sub>3</sub> emission estimates for livestock and fertilizers we used version 3.6 of the CMU NH<sub>3</sub> model (<http://www.cmu.edu/ammonia/>). Results from this model were used for all VISTAS States. The CMU model version 3.6 was used in large part because it had been just recently been updated to include the latest (2002) Census of Agriculture animal population statistics. Prior to inclusion of the CMU model estimates, MACTEC removed any ammonia records for agricultural livestock or fertilizer emissions from the VISTAS 2002 initial base year inventory. MACTEC also generated emissions from human perspiration and from wildlife using the CMU model and added those emissions for each State.

For the Base G ammonia inventory, MACTEC removed all wildlife and human perspiration emissions. VISTAS decided to remove these emissions from the inventory. Human perspiration was dropped due to a discrepancy in the units used for the emission factor that was not resolved prior to preparing the estimates and wildlife was dropped because VISTAS felt the activity data was too uncertain. Thus all emissions from these two categories were deleted in the Base G 2002 inventory.

For the paved road PM Base F emissions, we used the most recent estimates developed by EPA as part of the NEI development effort (Roy Huntley, U.S. EPA, email communication, 8/30/2004). EPA had developed an improved methodology for estimating paved road emissions for 2002 and had used that method to calculate emissions for that source category. MACTEC obtained those emissions from EPA and those values were substituted directly into the inventory after receiving consensus from all of the VISTAS States to perform the replacement. These files were obtained in March of 2005 in NIF format from the EPA FTP site.

For the Base G emissions, modifications were made to the emissions estimates based on changes suggested by work of the Western Regional Air Partnership and U.S. EPA. Details of these changes are provided below in the section on global changes made as part of the Base G inventory updates.

### **1.2.5 Global Changes Made for Base G**

There were three global changes made between the Base F and the Base G inventory (beyond the removal of wildlife and human perspiration NH<sub>3</sub> emissions). These changes were:

1. Removal of Stage II emissions from the area source inventory and inclusion in the mobile sector of the inventory,
2. Adjustment of fugitive dust PM<sub>2.5</sub> emissions, and
3. Addition of emissions from portable fuel containers.

As part of the Base F review process, several VISTAS States had expressed surprise that the Stage II refueling emission estimates were in the area source component of the inventory. This decision had been made with SIWG agreement early on in the inventory development process because 1) some States had included it in their CERR submittals and 2) because the non-road and on-road mobile estimates had differing activity factor units and could not be easily combined. However for Base G, the VISTAS States all agreed, especially in light of the different ways in which the emissions were reported in the CERR, to remove the Stage II refueling emissions from the area source inventory and include them in the non-road and on-road sectors. Thus all records related to Stage II refueling were removed from the area source component of the Base G inventory.

PM<sub>2.5</sub> emissions from several fugitive dust sources were also updated for Base G. The Western Regional Air Partnership (WRAP) and U.S. EPA had been investigating overestimation of the PM<sub>2.5</sub> / PM<sub>10</sub> ratio in several fugitive dust categories and U.S. EPA was in the process of making revisions to AP-42 for several categories during preparation of the Base G inventory. Based on data received from U.S. EPA, VISTAS decided to revise the PM<sub>2.5</sub> emissions from construction, paved roads and unpaved road sources. PM<sub>2.5</sub> emissions in Base F were multiplied by 0.67, 0.6, and 0.67 for construction, paved roads and unpaved roads respectively to produce the values found in Base G. No changes were made to PM<sub>10</sub>, only to PM<sub>2.5</sub>.

Finally, as part of Virginia's comments on the Base F inventory, emissions from portable fuel containers were mentioned as being absent from the inventory. MACTEC was tasked with developing a methodology that could be used to add these emissions to the Base G area source inventory. In investigating options for a method of estimating emissions, MACTEC found that the U.S. EPA had prepared a national inventory of emissions by State for portable fuel containers. Data on emissions from this source prepared by U.S. EPA were presented in, "Estimating Emissions Associated with Portable Fuel Containers (PFCs), Draft Report, Office of Transportation and Air Quality, United States Environmental Protection Agency, Report # EPA420-D-06-003, February 2006".

State-level emission estimates for 2005 derived from Appendix Table B-2 of the PFCs report were used as the starting point for developing 2002 county-level emissions estimates. State emissions were derived from that table by using all of the emission estimates in that table with the exception of values for vapor displacement and spillage from refueling operations. Those components of the State emissions were left out of the State-level emissions to avoid double counting refueling emissions in the non-road sector. For the purposes of 2002 emission estimates for Base G, the 2005 values were assumed equal to 2002 values.

The 2005 State-level estimates minus the refueling component from Appendix Table B-2 of the report were summed for each State and then allocated to the county-level. The county-level allocation was based on the fuel usage information obtained from the NONROAD 2005 model runs conducted as part of the Base G inventory development effort (see the 2002 base year Base G non-road section below). MACTEC used the spillage file from the NONROAD model (normally located in the DATA\EMSFAC directory in a standard installation of NONROAD) to determine the SCCs that used containers for refueling. The spillage file contains information by SCC and horsepower indicating whether or not the refueling occurs using a container or a pump. All SCC and horsepower classes using containers were extracted from the file and cross-referenced with the fuel usage by county for those SCC/horsepower combinations from the appropriate year model runs (2002, 2009 or 2018). Then the fuel usages by county from the NONROAD 2005 runs prepared for VISTAS were summed for those SCCs by county. The county level fuel use was then divided by the State total fuel use for the same SCCs to determine the fraction of total State fuel usage and that fraction was used to allocate the State-level emissions to the county.

### **1.2.6**      *Quality Assurance steps*

Throughout the inventory development process, quality assurance steps were performed to ensure that no double counting of emissions occurred, and to ensure that a full and complete inventory was developed for VISTAS. Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on the area source component of the 2002 Base F inventory:

1. All CERR and NIF format State supplied data submittals were run through EPA's Format and Content checking software.
2. SCC level emission summaries were prepared and evaluated to ensure that emissions were consistent and that there were no missing sources.
3. Tier comparisons (by pollutant) were developed between the revised 2002 base year inventory and the previous (version 3.1) base year inventory.

4. Fields were either added or used within each NIF data table to track the sources of data for each emission record.
5. Data product summaries were provided to both the VISTAS Emission Inventory Technical Advisor and to Area Source and Fires SIWG representatives for review and comment. Changes based on these comments were implemented in the files.
6. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from 1.0 to 2.0. A minor change would cause a version number to go from 1.0 to 1.1. Minor changes resulting from largely editorial changes would result in a change from 1.00 to 1.01.

In addition, for the fires inventory, data related to fuel loading and fuel consumption was reviewed and approved by the VISTAS Fire SIWG to ensure that values used for each type of fire and each individual fire were appropriate. Members of the VISTAS Fire SIWG included representatives from most State Divisions of Forestry (or equivalent) as well as U.S. Forest Service and National Park Service personnel.

For Base G, similar QA steps to those outlined above for Base F were undertaken. In addition, all final NIF files were checked using the EPA Format and Content checking software and summary information by State and pollutant were prepared comparing the Base F and Base G inventories.

### **1.3 Mobile Sources**

This section describes the revisions made to the initial 2002 VISTAS Base Year emission inventory on-road mobile source input files. For this work actual emission estimates were not made, rather data files consistent with Mobile Emissions Estimation Model Version 6 (MOBILE6) were developed and provided to the VISTAS modeling contractor. These input data files were then run during the VISTAS modeling to generate on-road mobile source emissions using episodic and meteorological specific conditions configured in the sparse matrix operator Kernel Emissions modeling system (SMOKE) emissions processor.

During initial discussions with the VISTAS Mobile Source SIWG, some States indicated a desire to use CERR mobile source emissions data in place of the VISTAS 2002 inventories generated by E.H. Pechan and Associates, Inc. (the initial VISTAS 2002 Base Year inventory files).

However, the CERR emissions data by itself were not sufficient for an inventory process that includes both base and future year inventories. MACTEC needed to be able to replicate the CERR data rather than simply obtain CERR emissions estimates. The reason for this is that only input files were being prepared to provide revised 2002 estimates during the VISTAS modeling process, rather than the actual emission estimates and that the 2002 input data files would be

used as a starting point for the projected emission estimates. This meant that the appropriate vehicle miles traveled (VMT), MOBILE6, and/or NONROAD model input data needed to be provided. If these data were provided with the CERR emissions estimates we used it as the starting point for revision of the 2002 Base Year inventory. However MACTEC did not have access to the on-road mobile CERR submissions from EPA, so re-submittal of these data directly to MACTEC was requested in order to begin compiling the appropriate input file data.

In those cases where States did not provide CERR on-road mobile source input data files, our default approach was to maintain the data input files and VMT estimates for the initial 2002 Base Year inventory prepared by Pechan.

### ***1.3.1 Development of on-road mobile source input files and VMT estimates***

Development of the 2002 on-road input files and VMT was a multi-step process depending upon what the State mobile source contacts instructed us to use as their data. Information provided below provides incremental revisions made to on-road mobile source inventories or inputs in series from one inventory version to the next. In general the process involved one of three steps from the original 2002 on-road mobile source data.

#### **Base F Revisions**

1. The first step was to evaluate the initial 2002 base year files and make any non-substantive changes (i.e., changes only to confirm that the files posted for 2002 by Pechan were executable and that all the necessary external files needed to run MOBILE6 were present). This approach was taken for AL, FL, GA, MS, SC, and WV. For these States the determination was made that the previous files would be okay to use as originally prepared. For SC, the VMT file was updated, but that did not affect the MOBILE6 input files.
2. For other States, modification to the input files was required. The information below indicates what changes were made for other States in the VISTAS region.

KY – For Kentucky, the Inspection and Maintenance (I/M) records in the input files for Jefferson County were updated in order to better reflect the actual I/M program in the Louisville metropolitan area.

NC - Substantial revisions were implemented to these input files based on input from the State. The modifications necessary to reflect the desires of the State led to complete replacement of the previous input files. Among the changes made were:

- The regrouping of counties (including the movement of some counties from one county group to another and the creation of new input files for previously grouped



- counties). There were originally 32 input files; after the changes there were 49. The pointer file was corrected to reflect these changes.
- Travel speeds were updated in over 3000 scenarios.
  - All I/M records were updated.
  - All registration distributions were updated.
  - I/M VMT fractions were updated (which only affected the pointer file).
  - VMT estimates were updated (which has no direct effect on the MOBILE6 input files but does ultimately affect emissions).
3. VA and TN – For these States, new input files were provided due to substantive changes that the State wanted to make relative to the 2002 initial base year input files. In addition, revised VMT data were developed for each State.

### **Base G Revisions**

For the production of the VISTAS 2002 Base G inventory, VISTAS states reviewed the Base F inputs, and provided corrections, updates and supplemental data.

For all states modeled, the Base G updates include:

Adding Stage II refueling emissions calculations to the SMOKE processing.

Revised the HDD compliance for all states. (REBUILD EFFECTS = .1)

In addition to the global changes, individual VISTAS states made the following updates:

KY – updated VMT and M6 input values for selected counties.

NC – revised VMT and registration distributions.

TN - revised VMT and vehicle registration distributions for selected counties.

VA – revised winter RFG calculations in Mobile 6 inputs.

WV – revised VMT input data.

AL, FL, and GA did not provide updates for Base G and therefore the Base F inputs were used for these States.

#### **1.3.1.1 Emissions from on-road mobile sources**

The MOBILE6 module of the Sparse Matrix Operator Kernel Emissions (SMOKE) model was used to develop the on-road mobile source emissions estimates for CO, NO<sub>x</sub>, NH<sub>3</sub>, SO<sub>2</sub>, PM, and



VOC emissions. The MOBILE6 parameters, vehicle fleet descriptions, and VMT estimates are combined with gridded, episode-specific temperature data to calculate the gridded, temporalized emission estimates. The MOBILE6 emissions factors are based on episode-specific temperatures predicted by the meteorological model. Further, the MOBILE6 emissions factors model accounts for the following:

- Hourly and daily minimum/maximum temperatures;
- Facility speeds;
- Locale-specific inspection/maintenance (I/M) control programs, if any;
- Adjustments for running losses;
- Splitting of evaporative and exhaust emissions into separate source categories;
- VMT, fleet turnover, and changes in fuel composition and Reid vapor pressure (RVP).

The primary input to MOBILE6 is the MOBILE shell file. The MOBILE shell contains the various options (e.g. type of inspection and maintenance program in effect, type of oxygenated fuel program in effect, alternative vehicle mix profiles, RVP of in-use fuel, operating mode) that direct the calculation of the MOBILE6 emissions factors. The shells used in these runs were based on VISTAS Base F modeling inputs as noted in the previous section.

For this analysis, the on-road mobile source emissions were produced using selected weeks (seven days) of each month and using these days as representative of the entire month. This selection criterion allows for the representation of day-of-the-week variability in the on-road motor vehicles, and models a representation of the meteorological variability in each month. The modeled weeks were selected from mid-month, avoiding inclusion of major holidays.

The parameters for the SMOKE runs are as follows:

Episodes:

2002 Initial Base Year, and  
2009 and 2018 Future years, using 2009/2018 inventories and modeled using the same meteorology and episode days as 2002.

Episode represented by the following weeks per month:

January 15-21  
February 12-18  
March 12-18  
April 16-22

May 14-20

June 11-17

July 16-22

August 13-19

September 17-23

October 15-21

November 12-18

December 17-23

Days modeled as holidays for annual run:

New Year's Day - January 1

Good Friday – March 29

Memorial Day – May 27

July 4th

Labor Day – September 2

Thanksgiving Day – November 28, 29

Christmas Eve – December 24

Christmas Day – December 25

Output time zone:

Greenwich Mean Time (zone 0)

Projection:

Lambert Conformal with Alpha=33, Beta=45, Gamma=-97, and center at (-97, 40).

Domain:

36 Kilometer Grid: Origin at (-2736, -2088) kilometers with 148 rows by 112 columns and 36-km square grid cells.

12 Kilometer Grid: Origin at (108, -1620) kilometers with 168 rows by 177 columns and 12-km square grid cells.

CMAQ model species:

The CMAQ configuration was CB-IV with PM. The model species produced were: CO, NO, NO<sub>2</sub>, ALD<sub>2</sub>, ETH, FORM, ISOP, NR, OLE, PAR, TERPB, TOL, XYL, NH<sub>3</sub>, SO<sub>2</sub>, SULF, PEC, PMFINE, PNO<sub>3</sub>, POA, PSO<sub>4</sub>, and PMC.

Meteorology data:

Daily (25-hour). SMOKE requires the following five types of MCIP outputs: (1) Grid cross 2-d, (2) Grid cross 3-d, (3) Met cross 2-d, (4) Met cross 3-d, and (5), Met dot 3-d.

The reconstructed emissions based on the representative week run were calculated by mapping each day of week (Mon, Tue, Wed, etc.) from the modeled month to the same day of week generated in the representative week run. In the case of holidays, these days were mapped to representative week Sundays. An example of this mapping for the January episode is presented in Table 1.3-1 below. Note that although the emissions were generated for individual calendar years (2002, 2009 and 2018) the meteorology is based on 2002.

**Table 1.3-1. Representative day mapping for January episode  
(Highlighted representative week).**

Modeled Date	Representative Day	Modeled Date	Representative Day	Modeled Date	Representative Day
1/1/2002*	1/20/2002	1/11/2002	1/18/2002	1/22/2002	1/15/2002
1/2/2002	1/16/2002	1/12/2002	1/19/2002	1/23/2002	1/16/2002
1/3/2002	1/17/2002	1/13/2002	1/20/2002	1/24/2002	1/17/2002
1/4/2002	1/18/2002	1/14/2002	1/21/2002	1/25/2002	1/18/2002
1/5/2002	1/19/2002	1/15/2002	1/15/2002	1/26/2002	1/19/2002
1/6/2002	1/20/2002	1/16/2002	1/16/2002	1/27/2002	1/20/2002
1/7/2002	1/21/2002	1/17/2002	1/17/2002	1/28/2002	1/21/2002
1/8/2002	1/15/2002	1/18/2002	1/18/2002	1/29/2002	1/15/2002
1/9/2002	1/16/2002	1/19/2002	1/19/2002	1/30/2002	1/16/2002
1/10/2002	1/17/2002	1/20/2002	1/20/2002	1/31/2002	1/17/2002
		1/21/2002	1/21/2002		

\* Modeled holiday

### 1.3.2 Development of non-road emission estimates

Emissions from non-road sources were estimated in two steps. First, emissions for non-road sources that are included in the NONROAD model were developed. Second, emissions from sources not included in the NONROAD model were estimated. The sections below detail the procedures used for each group of sources.

#### 1.3.2.1 Emissions from NONROAD model sources

An initial 2002 base year emissions inventory for non-road engines and equipment covered by the EPA NONROAD model was prepared for VISTAS in early 2004. The methods and assumptions used to develop the inventory are presented in a February 9, 2004 report “*Development of the VISTAS Draft 2002 Mobile Source Emission Inventory (February 2004 Version)*” as prepared by E.H. Pechan & Associates, Inc. Except as otherwise stated below, all aspects of the preparation methodology documented in that report continue to apply to the revised NONROAD modeling discussed in this section.

Revisions to the initial 2002 NONROAD emissions inventory were implemented to ensure that the latest State and local data were considered, as well as to more accurately reflect gasoline sulfur contents for 2002 and correct other State-specific discrepancies. Those revisions comprise the Base F VISTAS non-road inventory. This section details the specific revisions made to the NONROAD model input files for the Base F and Base G VISTAS base year inventories, and provides insight into some key differences between the versions of the NONROAD model employed for the Base F and Base G inventories and the previous version employed for the initial 2002 base year inventory prepared by Pechan.

Revisions to the initial 2002 emissions inventory prepared by Pechan were actually implemented in two stages. An initial set of revisions was implemented in the fall of 2004. Those revisions resulted in the Base F inventory. These were followed by a second set of revisions in the spring of 2006. Those estimates produced the Base G base year inventory. To accurately document the combined effects of both sets of revisions, each set is discussed separately below. Unless otherwise indicated, all revisions implemented in Base F were carried directly into the Base G revision process without change. Thus, the inventories that resulted from the Base F revisions served as the starting point for the Base G revisions.

For Base F, three VISTAS States provided detailed data revisions for consideration in developing revised model inputs. These States were:

1. North Carolina
2. Tennessee (including a separate submission for Davidson County), and
3. Virginia.

The remaining seven VISTAS States indicated that the initial 2002 VISTAS input files prepared by Pechan continued to reflect the most recent data available. These States were:

1. Alabama,
2. Florida,
3. Georgia,
4. Kentucky,
5. Mississippi,
6. South Carolina, and
7. West Virginia.

However, it should be recognized that the NONROAD input files for *all* ten VISTAS States were updated to reflect gasoline sulfur content revisions for the Base F 2002 base year inventory (as discussed below). The original files prepared by Pechan are available on their FTP site in the /pub/VISTAS/MOB\_0104/ directory.

Before presenting the specific implemented revisions, it is important to note that the Base F 2002 base year inventory utilized a newer release of the NONROAD model than was used for the initial 2002 base year inventory (prepared by Pechan). The Base F 2002 base year inventory, as developed in spring 2004, was based on the Draft NONROAD2004 model, which was released by the EPA in May of 2004. This model is no longer available on EPA's website. The initial 2002 base year inventory (prepared by Pechan) was based on the Draft NONROAD2002a version of the model (which is also no longer available on EPA's website). Key differences between the models are as follows:

- Draft NONROAD2004 included the effects of the Tier 4 non-road engine and equipment standards (this did not impact the Base F 2002 inventory estimates, but did affect Base F future year forecasts).
- Draft NONROAD2004 included the *exhaust* emission impacts of the large spark-ignition engine standards; the evaporative impacts of these standards are *not* incorporated (this does not impact 2002 inventory estimates, but does affect future year forecasts).
- Draft NONROAD2004 included revised equipment population estimates.
- The PM<sub>2.5</sub> fraction for *diesel* equipment in Draft NONROAD2004 had been updated from 0.92 to 0.97.
- Draft NONROAD2004 included revisions to recreational marine activity, useful life, and emission rates.

To the extent that these revisions affect 2002 emissions estimates, they will be reflected as differentials between the initial and Base F 2002 VISTAS base year inventories. It is perhaps important to identify that, at the time of the Base F inventory revisions; the EPA recognized the Draft NONROAD2004 model as an appropriate mechanism for SIP development. Although the model was designated as a draft update, it reflected the latest and most accurate NONROAD planning data at that time, as evidenced by the EPA's use of that version for the Tier 4 Final Rulemaking.

Prior to the Base G inventory revisions implemented in 2006, the EPA released another updated version of the NONROAD model, designated as Final NONROAD2005 (which can be downloaded from: <http://www.epa.gov/OMSWWW/nonrdmdl.htm#model>). This version ostensibly represents the final version of the model, although certain components of it have been updated since its first release in December 2005. For the Base G inventory developed in the first half of 2006, all updates of the Final NONROAD2005 model through March 2006 are included. Key differences between Final NONROAD2005 and Draft NONROAD2004 are as follows:

- Final NONROAD2005 reflects the latest basic emission rate and deterioration data.

- Final NONROAD2005 includes emission estimates for a range of evaporative emissions categories not included in Draft NONROAD2004 (tank and hose permeation, hot soak, and running loss emissions).
- Final NONROAD2005 includes a revised diurnal emissions algorithm.
- Final NONROAD2005 includes a revised equipment scrappage algorithm.
- Final NONROAD2005 includes revised state and county equipment allocation data.
- Final NONROAD2005 allows separate sulfur content inputs for marine and land-based diesel fuel.
- Final NONROAD2005 includes revised conversion factors for hydrocarbon emissions.
- Final NONROAD2005 includes the evaporative emission impacts of the large spark-ignition engine standards (this does not impact 2002 inventory estimates, but does affect future year forecasts).

Unfortunately, due to the extensive revisions associated with Final NONROAD2005, input files created for use with Draft NONROAD2004 (e.g., Base F input files) and earlier versions of the model cannot be used directly with Final NONROAD2005 (used for Base G). This created a rather significant impact in that the VISTAS NONROAD modeling process involves the consideration of over 200 unique sets of input data. To avoid creating new input files for each of these datasets, a conversion process was undertaken wherein each of the Draft NONROAD2004 (Base F) input data files were converted into the proper format required for proper execution in Final NONROAD2005 (Base G).<sup>1</sup> This process consisted of the following steps:

- Revise the Draft NONROAD2004 (Base F) input files to include the following two line EPA-developed comment at the end of the input file header (this is a nonsubstantive change implemented solely for consistency with input files produced directly using Final NONROAD2005):

```
9/2005 epa: Add growth & tech years to OPTIONS packet  
and Counties & Retrofit files to RUNFILES packet.
```

---

<sup>1</sup> The necessary conversions were developed by comparing substantively identical input files created using the graphical user interfaces for both Draft NONROAD2004 and Final NONROAD2005. The differences between the input files indicated the specific revisions necessary to convert existing VISTAS input files into Final NONROAD2005 format.

- Revise the Draft NONROAD2004 (Base F) input files to include the following two command lines after the “Weekday or weekend” command in the PERIOD packet:

```
Year of growth calc:  
Year of tech sel   :
```

- Revise the Draft NONROAD2004 (Base F) input files to include the following command line after the “Diesel sulfur percent” command in the OPTIONS packet:

```
Marine Dsl sulfur %: 0.2638
```

Note that the value 0.2638 (2638 parts per million by weight [ppmW]) is applicable only for 2002 modeling and was accordingly revised (as described below) for both the 2009 and 2018 Base G forecast inventories. The 2638 ppmW sulfur value for 2002 marine diesel fuel was taken from the 48-State (excludes Alaska and Hawaii) tabulation presented in the April 27, 2004 EPA document “*Diesel Fuel Sulfur Inputs for the Draft NONROAD2004 Model used in the 2004 Non-road Diesel Engine Final Rule.*” It should also be noted that this value differs by about 5 percent from the 2500 ppmW value previously used for the initial 2002 VISTAS modeling (performed by Pechan). Prior to Final NONROAD2005 (used for Base G), the NONROAD model allowed only a single diesel fuel sulfur input that was applied to both land-based and marine equipment. As documented in the February 9, 2004 report “*Development of the VISTAS Draft 2002 Mobile Source Emission Inventory (February 2004 Version)*” as prepared by E.H. Pechan & Associates, Inc., a value of 2500 ppmW sulfur was used for all 2002 VISTAS NONROAD modeling. Given the ability of Final NONROAD2005 to distinguish a separate sulfur content for marine equipment and the existing EPA guidance document suggesting an appropriate marine sulfur value of 2638 ppmW for 2002, the existing modeling value of 2500 ppmW was modified (for marine equipment only).

- Replace the Draft NONROAD2004 (Base F) input files RUNFILES packet command line:

```
TECHNOLOGY           : c:\non-road\data\tech\tech.dat
```

with the command lines:

```
EXH TECHNOLOGY       : c:\non-road\data\tech\tech-exh.dat  
EVP TECHNOLOGY       : c:\non-road\data\tech\tech-evp.dat
```

- Revise the Draft NONROAD2004 (Base F) input files to include the following two command lines after the “EPS2 AMS” command in the RUNFILES packet:

```
US COUNTIES FIPS      : c:\non-road\data\allocate\fips.dat
RETROFIT              :
```

- Revise the Draft NONROAD2004 (Base F) input files to include the following command line after the “Rec marine outbrd” command in the ALLOC FILES packet:

```
Locomotive NOx       : c:\non-road\data\allocate\XX_rail.alo
```

Where “XX” varies across input files. For any given file, “XX” is the two digit abbreviation of the state associated with the scenario being modeled (e.g., for Alabama modeling, XX=AL).

- Replace the Draft NONROAD2004 (Base F) input files EMFAC FILES packet command line:

```
Diurnal              : c:\non-road\data\emsfac\diurnal.emf
```

with the eight command lines:

```
Diurnal              : c:\non-road\data\emsfac\evdiu.emf
TANK PERM            : c:\non-road\data\emsfac\evtank.emf
NON-RM HOSE PERM    : c:\non-road\data\emsfac\evhose.emf
RM FILL NECK PERM   : c:\non-road\data\emsfac\evneck.emf
RM SUPPLY/RETURN    : c:\non-road\data\emsfac\evsupret.emf
RM VENT PERM        : c:\non-road\data\emsfac\evvent.emf
HOT SOAKS           : c:\non-road\data\emsfac\evhotsk.emf
RUNINGLOSS          : c:\non-road\data\emsfac\evrunls.emfEVP
```

- Revise the Draft NONROAD2004 (Base F) input files to include the following command line after the “PM exhaust” command in the DETERIORATE FILES packet:

```
Diurnal              : c:\non-road\data\detfac\evdiu.det
```

Once revised in this format, the VISTAS non-road input files developed for use with Draft NONROAD2004 (Base F) were executable under the Final NONROAD2005 model (Base G).

The only additional revisions implemented to develop a Final NONROAD2005-based inventory (Base G) involved elimination of non-default equipment allocation files for North Carolina and West Virginia. Due to concerns about improper equipment allocation across counties under the Draft NONROAD2004 model (used for Base F), as well as for earlier versions of the NONROAD model, North Carolina had produced alternative allocation data files indicating the number of employees in air transportation by county, the number of wholesale establishments by county, and the number of employees in landscaping services by county. For the same reason, West Virginia had produced alternative equipment allocation files indicating the number of



employees in air transportation by county, the tonnage of underground coal production by county, the number of golf courses and country clubs by county, the number of wholesale establishments by county, the number of employees in logging operations by county, the number of employees in landscaping services by county, the number of employees in manufacturing operations by county, the number of employees in oil and gas drilling and extraction operations by county, and the number of recreational vehicle parks and campgrounds by county. These alternative equipment allocation files were used for all VISTAS inventory modeling conducted prior to the release of Final NONROAD2005 (i.e., through Base F). However, both North Carolina and West Virginia determined that the default allocation file revisions associated with the release of Final NONROAD2005 were appropriate to address the concerns that led to the development of the alternative allocation files. As a result, all alternative allocation file commands were removed from VISTAS NONROAD2005 (Base G) input files for North Carolina and West Virginia, so that the entire region under the Base G inventory is now modeled using the default allocation files provided with NONROAD2005.

In addition to the alternative equipment allocation files, North Carolina had previously developed an alternative seasonal adjustment file that was used for the Base F inventory in place of the default file provided with Draft NONROAD2004 (and earlier model versions). The alternative data file implemented a single change, namely reclassifying North Carolina as a southeastern state rather than a mid-Atlantic state (as identified in the default data file). Since Final NONROAD2005 continues to identify North Carolina as a mid-Atlantic state, North Carolina requested that the southeastern reclassification be continued for all NONROAD2005 modeling (Base G). To ensure that any other revisions associated with the seasonal adjustment file released with NONROAD2005 were not overlooked, the previously developed alternative seasonal adjustment file for North Carolina was scrapped and a new alternative file was created from the default seasonal adjustment file provided with Final NONROAD2005 for Base G inventory development. The alternative file, which was used for all North Carolina modeling, reclassifies North Carolina from a mid-Atlantic to a southeastern state. This represents the only non-default data file used for VISTAS NONROAD2005-based (Base G) modeling.

The remainder of this section documents all changes to the originally established VISTAS input file values as documented in the February 9, 2004 report “*Development of the VISTAS Draft 2002 Mobile Source Emission Inventory (February 2004 Version)*” as prepared by E.H. Pechan & Associates, Inc. Unless specifically stated below, all values from that report continue to be used without change in the latest VISTAS modeling.

### **Base F Revisions:**

For the initial 2002 base year inventory (developed by Pechan), all NONROAD modeling runs for VISTAS were performed utilizing a gasoline sulfur content of 339 ppmW and a diesel sulfur

content of 2,500 ppmW. Although the EPA-recommended non-road diesel fuel sulfur content for 2002 is 2,283 ppmW, the 2,500 ppmW sulfur content used for the initial 2002 base year VISTAS inventory was designed to remove the effect of lower non-road diesel fuel sulfur limits applicable only in California. (The EPA recommended inputs can be found in “*Diesel Fuel Sulfur Inputs for the Draft NONROAD2004 Model used in the 2004 Non-road Diesel Engine Final Rule*,” EPA, April 27, 2004.) This correction is appropriate and was retained for the Base F 2002 inventory. Thus, the Base F inventory continued to assume a diesel fuel sulfur content of 2,500 ppmW across the VISTAS region.

However, 339 ppmW is not the EPA recommended 2002 gasoline sulfur content for either eastern conventional gasoline areas or Federal Reformulated Gasoline (RFG) areas. The recommended sulfur content for eastern conventional gasoline is 279 ppmW year-round, while the recommended sulfur content for RFG areas is 129 ppmW during the summer season and 279 ppmW during the winter season. (Conventional gasoline and RFG sulfur contents for 2002 can be found in “*User’s Guide to MOBILE6.1 and MOBILE6.2, Mobile Source Emission Factor Model*,” EPA420-R-03-010, U.S. EPA, August 2003 [pages 149-155] (available at link at <http://www.epa.gov/otaq/m6.htm>) and in the source code for MOBILE6.2 at Block Data BD05.) Given the differences in the EPA-recommended values and the value used to generate the initial 2002 base year inventory, the input files for Base F for *all* VISTAS areas were updated to reflect revised gasoline sulfur content assumptions.

Since the VISTAS NONROAD modeling is performed on a seasonal basis, and since gasoline sulfur content in RFG areas varies with the RFG season, seasonally-specific gasoline sulfur content values were estimated for use in RFG area modeling. In addition, 25 counties in Georgia are subject to a summertime gasoline sulfur limit of 150 ppmW, so that seasonal sulfur content estimates were also estimated for these counties. The initial 2002 base year NONROAD inventory (prepared by Pechan) for these Georgia counties was based on a year-round 339 ppmW gasoline sulfur content, but that oversight was corrected in the Base F 2002 base year inventory. Based on the seasonal definitions employed in the NONROAD model, monthly sulfur contents were averaged to estimate seasonal gasoline sulfur contents as follows:

Month/Season	RFG Areas	Conventional Gasoline Areas	Georgia Gasoline Control Areas
March	279 ppmW	279 ppmW	279 ppmW
April	279 ppmW	279 ppmW	279 ppmW
May	129 ppmW	279 ppmW	150 ppmW
Spring	229 ppmW	279 ppmW	236 ppmW
June	129 ppmW	279 ppmW	150 ppmW
July	129 ppmW	279 ppmW	150 ppmW

August	129 ppmW	279 ppmW	150 ppmW
Summer	129 ppmW	279 ppmW	150 ppmW
September	129 ppmW	279 ppmW	150 ppmW
October	279 ppmW	279 ppmW	279 ppmW
November	279 ppmW	279 ppmW	279 ppmW
Fall	229 ppmW	279 ppmW	236 ppmW
December	279 ppmW	279 ppmW	279 ppmW
January	279 ppmW	279 ppmW	279 ppmW
February	279 ppmW	279 ppmW	279 ppmW
Winter	279 ppmW	279 ppmW	279 ppmW

Note that the seasonal data are based on simple arithmetic averages and do not consider any monthly variation in activity (and fuel sales), and that the transition between summer and winter seasons is also not considered. Additionally, the summer fuel control season is treated as though it applies from May through September, while the summer RFG season actually ends on September 15 and the Georgia fuel control season does not officially begin until June 1. This treatment is consistent with the treatment of both fuel control programs in the VISTAS on-road vehicle modeling. Each of these influences will result in some error in the estimated sulfur content estimates, but it is expected that this error is small relative to the overall correction from a year-round sulfur content estimate of 339 ppmW.

All NONROAD modeling revisions made as part of the Base F inventory preparation process are presented in Table 1.3-2. Due to more involved updates in several areas, the number of NONROAD input files as well as sequence numbers used to represent these files was also updated in a few instances (as compared to the files used to create the initial 2002 VISTAS non-road inventory, as documented in the February 9, 2004 report “*Development of the VISTAS Draft 2002 Mobile Source Emission Inventory (February 2004 Version)*” as prepared by E.H. Pechan & Associates, Inc. These structural revisions are presented in Table 1.3-3, and are provided solely for the benefit of NONROAD modelers as the indicated revisions have no impact on generated emission estimates.

**Table 1.3-2. Summary of Base F NONROAD Modeling Revisions**

State	Revisions Implemented
AL	(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).
FL	(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).
GA	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all seasons for conventional gasoline counties.</p> <p>(2) Gasoline sulfur content changed from 339 ppmW to 150 ppmW in the summer for all gasoline control counties.</p> <p>(3) Gasoline sulfur content changed from 339 ppmW to 236 ppmW in the spring and fall for all gasoline control counties.</p> <p>(4) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in the winter for all gasoline control counties.</p> <p><i>Gasoline control counties: Barrow, Bartow, Butts, Carroll, Cherokee (a), Clayton (a), Cobb (a), Coweta (a), Dawson, De Kalb (a), Douglas (a), Fayette (a), Forsyth (a), Fulton (a), Gwinnett (a), Hall, Haralson, Henry (a), Jackson, Newton, Paulding (a), Pickens, Rockdale (a), Spalding, and Walton</i></p>
KY	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all seasons for conventional gasoline counties.</p> <p>(2) Gasoline sulfur content changed from 339 ppmW to 129 ppmW in the summer for all gasoline control counties.</p> <p>(3) Gasoline sulfur content changed from 339 ppmW to 229 ppmW in the spring and fall for all gasoline control counties.</p> <p>(4) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in the winter for all gasoline control counties.</p> <p><i>Gasoline control counties: Boone, Bullitt (b), Campbell, Jefferson, Kenton, and Oldham (b)</i></p>
MS	(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).
NC	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).</p> <p>(2) Utilize revised (i.e., local) allocation files for three equipment categories.</p> <p>(3) Utilize revised (i.e., local) seasonal activity data.</p>
SC	(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).
TN	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).</p> <p>(2) Gasoline Reid Vapor Pressure (RVP) values changed in accordance with local recommendations.</p> <p>(3) Temperature data changed in accordance with local recommendations.</p> <p>(4) Counties regrouped in accordance with local recommendations.</p>

- continued -

**Table 1.3-2. Summary of Base F NONROAD Modeling Revisions (continued)**

State	Revisions Implemented
VA	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all seasons for conventional gasoline counties.</p> <p>(2) Gasoline sulfur content changed from 339 ppmW to 129 ppmW in the summer for all gasoline control counties.</p> <p>(3) Gasoline sulfur content changed from 339 ppmW to 229 ppmW in the spring and fall for all gasoline control counties.</p> <p>(4) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in the winter for all gasoline control counties.</p> <p>(5) Gasoline RVP values changed in accordance with local recommendations.</p> <p>(6) Counties regrouped in accordance with local recommendations.</p> <p>(7) The control effectiveness for counties subject to Stage II controls revised to 77 percent in accordance with local recommendations.</p> <p><i>Gasoline control counties: Arlington Co., Fairfax Co., Loudoun Co., Prince William Co., Stafford Co., Alexandria City, Fairfax City, Falls Church City, Manassas City, Manassas Park City, Chesterfield Co., Hanover Co., Henrico Co., Colonial Heights City, Hopewell City, Richmond City, James City, York Co., Chesapeake City, Hampton City, Newport News City, Norfolk City, Poquoson City, Portsmouth City, Suffolk City, Virginia Beach City, and Williamsburg City (c)</i></p>
WV	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).</p> <p>(2) Continue to utilize local allocation files for nine equipment categories.</p>

**Notes:**

- (a) County is subject to local control currently, but is scheduled to join the RFG program in January 2005.
- (b) Control area is a portion of the county, but modeling is performed as though the control applies countywide.
- (c) The EPA also lists Charles City County as an RFG area, but local planners indicate that Charles City County is a conventional gasoline area and it is modeled as such.

**Table 1.3-3. Base F NONROAD Input File Sequence and Structural Revisions**

State	Initial 2002 Base Year Inventory Input File Sequence Numbers	Revised 2002 Inventory Input File Sequence Numbers	Reason(s) for Change	Number of Revised 2002 Inventory NONROAD Input Files
AL	01-08	01-08	No Structural Changes	32 (at 8 per season)
FL	09-10	09-10	No Structural Changes	8 (at 2 per season)
GA	11-13	11-13	No Structural Changes	12 (at 3 per season)
KY	14-22	14-22	No Structural Changes	36 (at 9 per season)
MS	48	48	No Structural Changes	4 (at 1 per season)
NC	23-25	23-25	No Structural Changes	12 (at 3 per season)
SC	26-32	26-32	No Structural Changes	28 (at 7 per season)
TN	33-34	33-34, 49-52	Counties Regrouped	24 (at 6 per season)
VA	35-43	35-38, 40-43	Counties Regrouped	32 (at 8 per season)
WV	44-47	44-47	No Structural Changes	16 (at 4 per season)
<b>All</b>	<b>01-48</b>	<b>01-38, 40-52</b>		<b>204 (at 51 per season)</b>

- Note:** (1) All files include internal revisions to reflect the data changes summarized in Table 1.3-3 above. This table is intended to present structural revisions that are of interest in assembling the NONROAD model input files into a complete VISTAS region inventory. The indicated revisions do not (in and of themselves) result in emission estimate changes.
- (2) The NONROAD model imposes an eight digit input file name limit, so all input files for the revised 2002 base year inventory follow a modified naming convention to allow each to be distinguished from the input files for the initial 2002 base year inventory. For the initial 2002 base year inventory, the naming convention was:

**ss02aaqq,** where: ss = the two character State abbreviation,  
aa = a two character season indicator as follows: AU = autumn,  
WI = winter, SP = spring, and SU = summer, and  
qq = the two digit sequence number indicated above.

For the revised 2002 inventory, the naming convention was modified to:

**ss02aFqq,** where: ss = the two character State abbreviation,  
a = a one character season indicator as follows: A = autumn,  
W = winter, S = spring, and X = summer, and  
qq = the two digit sequence number indicated above.

**Base G Revisions:**

As described above, the primary modeling revision implemented for the Base G 2002 inventory was the use of the Final NONROAD2005 model (in place of the Base F use of Draft NONROAD2004). However, there were other minor revisions implemented for 13 Georgia counties and somewhat more significant revisions implemented for Tennessee. In Georgia, Stage II refueling control was assumed for 13 counties that previously were modeled as having no refueling control under Base F. In addition, to accommodate this Stage II change as well as forecast year changes in gasoline vapor pressure, corresponding changes in the structure and sequence of Georgia NONROAD input files were made. With the exception of the minor Stage II impacts, these structural and sequence changes have no impact on 2002 emission estimates, but allow for consistency between 2002 and forecast year input file structure and sequence. In Tennessee, more significant changes were implemented to gasoline vapor pressure assumptions, as well as similar minor changes in Stage II refueling control assumptions.

In accordance with instructions from Georgia regulators, Stage II refueling control was assumed in the following 13 Georgia counties at a control efficiency value of 81 percent for the Base G inventory:

Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding, and Rockdale.

No Stage II control was assumed in these counties in prior inventories.

Tennessee regulators provided revised monthly values for gasoline vapor pressure. Based on the seasonal definitions employed in the NONROAD model, monthly vapor pressures were averaged to estimate seasonal vapor pressures as follows:

Month/Season	Nashville Area	Memphis Area	Remainder of Tennessee
March	13.5 psi	13.5 psi	13.5 psi
April	13.5 psi	13.5 psi	13.5 psi
May	9.0 psi	9.0 psi	9.0 psi
Spring	12.0 psi	12.0 psi	12.0 psi
June	7.8 psi	7.8 psi	9.0 psi
July	7.8 psi	7.8 psi	9.0 psi
August	7.8 psi	7.8 psi	9.0 psi
Summer	7.8 psi	7.8 psi	9.0 psi
September 1-15	7.8 psi	7.8 psi	9.0 psi
September 16-30	11.5 psi	11.5 psi	11.5 psi
October	13.5 psi	13.5 psi	13.5 psi
November	13.5 psi	13.5 psi	13.5 psi
Fall	12.2 psi	12.2 psi	12.4 psi
December	15.0 psi	15.0 psi	15.0 psi
January	15.0 psi	15.0 psi	15.0 psi
February	13.5 psi	13.5 psi	13.5 psi
Winter	14.5 psi	14.5 psi	14.5 psi

Note: The Nashville area consists of Davidson, Rutherford, Sumner, Williamson and Wilson counties, the Memphis area consists of Shelby County.

As with the Base F revisions, the seasonal data are based on simple arithmetic averages and do not consider any monthly variation in activity (and fuel sales), nor is the transition between summer and winter seasons considered. Additionally, a monthly average of the September 1-15 and September 16-30 data is calculated prior to averaging the September-November data to estimate a fall average vapor pressure, so that the month of September is weighted identically to the months of October and November.

Tennessee regulators also indicated that Stage II vapor recovery was not in effect in Shelby County, so the Base F NONROAD input files for the county (which assumed Stage II was in place) were revised accordingly.

All Base G NONROAD modeling revisions are presented in Table 1.3-4. As indicated above, the differentiation of inputs across previously grouped counties also required revision to the overall number and sequence of VISTAS NONROAD input files (as compared to the files used to create



both the initial VISTAS non-road inventory, as documented in the February 9, 2004 report “*Development of the VISTAS Draft 2002 Mobile Source Emission Inventory (February 2004 Version)*” as prepared by E.H. Pechan & Associates, Inc., and the Base F revised inventory as documented above. These structural revisions are presented in Table 1.3-5, and are provided solely for the benefit of NONROAD modelers as the indicated revisions have no impact on generated emission estimates.

**Table 1.3-4. Summary of Base G NONROAD Modeling Revisions**

State	Revisions Implemented
AL	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons.
FL	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons.
GA	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons. (2) Stage II refueling vapor recovery implemented in 13 counties at an efficiency of 81 percent. (3) Counties regrouped to accommodate base and forecast year data differentiations. <i>Stage II control counties: Cherokee, Clayton, Cobb, Coweta, De Kalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding, and Rockdale</i>
KY	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons.
MS	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons.
NC	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons. (2) Revert to default equipment allocation files for all equipment categories. (3) Utilize revised (i.e., local) seasonal activity data.
SC	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons.
TN	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons. (2) Gasoline RVP values changed in accordance with local recommendations. (3) Stage II vapor recovery eliminated from Shelby County modeling.
VA	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons.
WV	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons. (2) Revert to default equipment allocation files for all equipment categories.

**Table 1.3-5. Spring 2006 NONROAD Input File Sequence and Structural Revisions**

State	2002 Inventory Input File Sequence Numbers (Fall 2004)	2002 Inventory Input File Sequence Numbers (Spring 2006)	Reason(s) for Change	Number of Final 2002 Inventory NONROAD Input Files
AL	01-08	01-08	No Structural Changes	32 (at 8 per season)
FL	09-10	09-10	No Structural Changes	8 (at 2 per season)
GA	11-13	11-13, 53-54	Counties Regrouped	20 (at 5 per season)
KY	14-22	14-22	No Structural Changes	36 (at 9 per season)
MS	48	48	No Structural Changes	4 (at 1 per season)
NC	23-25	23-25	No Structural Changes	12 (at 3 per season)
SC	26-32	26-32	No Structural Changes	28 (at 7 per season)
TN	33-34, 49-52	33-34, 49-52	No Structural Changes	24 (at 6 per season)
VA	35-38, 40-43	35-38, 40-43	No Structural Changes	32 (at 8 per season)
WV	44-47	44-47	No Structural Changes	16 (at 4 per season)
<b>All</b>	<b>01-38, 40-52</b>	<b>01-38, 40-54</b>		<b>212 (at 53 per season)</b>

- Note:** (1) All files include internal revisions to reflect the data changes summarized in Table 1.3-5 above. This table is intended to present structural revisions that are of interest in assembling the NONROAD model input files into a complete VISTAS region inventory. The indicated revisions do not (in and of themselves) result in emission estimate changes.
- (2) The NONROAD model imposes an eight digit input file name limit, so all input files for the revised 2002 base year inventory follow a modified naming convention to allow each to be distinguished from the input files for the initial 2002 and fall 2004-revised 2002 base year inventory. For the initial 2002 base year inventory, the naming convention was:

**ss02aaqq,** where: ss = the two character State abbreviation,  
aa = a two character season indicator as follows: AU = autumn,  
WI = winter, SP = spring, and SU = summer, and  
qq = the two digit sequence number indicated above.

For the fall 2004-revised 2002 inventory, the naming convention was modified to:

**ss02aFqq,** where: ss = the two character State abbreviation,  
a = a one character season indicator as follows: A = autumn,  
W = winter, S = spring, and X = summer, and  
qq = the two digit sequence number indicated above.

For the spring 2006-revised 2002 inventory, the naming convention was modified to:

**ss02aCqq,** where: ss = the two character State abbreviation,  
a = a one character season indicator as follows: A = autumn,  
W = winter, S = spring, and X = summer, and  
qq = the two digit sequence number indicated above.

### **1.3.2.2 Emissions from Commercial Marine Vessels, Locomotives, and Airplanes**

An initial 2002 base year emissions inventory for aircraft, locomotives, and commercial marine vessels (CMV) was prepared for VISTAS in early 2004. The methods and data used to develop the inventory are presented in a February 9, 2004 report “*Development of the VISTAS Draft 2002 Mobile Source Emission Inventory (February 2004 Version)*” as prepared by E.H. Pechan & Associates, Inc. A summary of the initial 2002 base year emissions inventory is presented in Table 1.3-6. Except as otherwise stated below, all aspects of the preparation methodology continue to apply to the Base F and Base G emission inventories.

Revisions to the initial 2002 emissions inventory (prepared by Pechan) were implemented to ensure that the latest State and local data were incorporated as well as to correct an overestimation of PM emissions from aircraft. Revisions were actually implemented in two stages. An initial set of revisions was implemented in the fall of 2004. Those revisions constitute the Base F inventory. These were followed by a second set of revisions in 2006, which constitute the Base G inventory. To accurately document the combined effects of both sets of revisions, each set is discussed separately below. Unless otherwise indicated, all revisions implemented for Base F were carried directly into the Base G revision process without change. Thus, the inventories that resulted from the Base F revisions served as the starting point for the Base G revisions.

#### **Base F Revisions:**

Revisions to the initial 2002 base year emissions inventory were implemented to ensure that the latest State and local data were incorporated as well as to correct an overestimation of PM emissions from aircraft. Seven of the ten VISTAS States provided revised inventory data in the form of emissions reported to the EPA under the CERR. States providing CERR data were Alabama, Georgia, Mississippi, North Carolina, Tennessee (excluding Davidson, Hamilton, Knox, and Shelby Counties), Virginia, and West Virginia.

In many cases, the CERR data were only marginally different than the initial 2002 base year inventory data, but there were several instances where significant updates were evident. The remaining three VISTAS States (Florida, Kentucky, and South Carolina), plus Davidson, Hamilton, Knox, and Shelby counties in Tennessee, indicated that the initial 2002 VISTAS inventory continued to reflect the most recent data available. Florida did provide updated aircraft emissions data for one county (Miami-Dade) and these data were incorporated into the Base F 2002 inventory as described below.

Since several States recommended retaining the initial 2002 base year inventory data for Base F, the initial step toward revising the 2002 inventory consisted of modifying the estimated aircraft PM emissions of the initial inventory. The overestimation of aircraft PM became evident shortly

after the release of the initial 2002 base year inventory, when it was determined that VISTAS region airports would constitute the top seven, and 11 of the top 15, PM sources in the nation. Moreover, PM emissions for one airport (Miami International) were a full order of magnitude larger than *all* other modeled elemental carbon PM emission sources. In addition, unexpected relationships across airports were also observed, with emissions for Atlanta's Hartsfield International being substantially less than those of Miami International, even though Atlanta handles over twice as many aircraft operations annually. Given the pervasiveness of this problem, and since the CERR data submitted by States was based on the initial 2002 VISTAS inventory data, aircraft PM emissions for the entire VISTAS region were recalculated.

**Table 1.3-6. Initial 2002 Base Year Aircraft, Locomotive, and Non-Recreational Marine Emissions as Reported in February 2004 Pechan Report (annual tons)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	3,787	175	688	475	17	196
	FL	28,518	11,955	46,352	31,983	1,050	3,703
	GA	3,175	992	3,919	2,704	94	353
	KY	2,666	657	2,597	1,792	63	263
	MS	1,593	140	553	381	13	96
	NC	6,088	1,548	6,115	4,219	148	613
	SC	6,505	515	452	312	88	863
	TN	6,854	2,665	7,986	5,510	225	920
	VA	17,676	5,607	14,476	9,988	234	3,229
	WV	1,178	78	310	214	8	66
	Total	78,040	24,332	83,448	57,578	1,940	10,302
Commercial Marine (2280)	AL	1,195	9,217	917	843	3,337	736
	FL	5,888	44,817	1,936	1,781	6,683	1,409
	GA	1,038	7,874	334	307	1,173	246
	KY	6,607	50,267	2,246	2,066	9,608	1,569
	MS	5,687	43,233	1,903	1,750	7,719	1,351
	NC	599	4,547	193	178	690	142
	SC	1,067	8,100	343	316	1,205	253
	TN	4,129	31,397	1,390	1,278	5,753	980
	VA	1,198	3,426	929	855	3,258	596
	WV	2,094	15,882	668	614	720	497
	Total	29,503	218,760	10,858	9,989	40,146	7,779
Military Marine (2283)	VA	136	387	28	26	30	59
	Total	136	387	28	26	30	59
Locomotives (2285)	AL	3,490	26,339	592	533	1,446	1,354
	FL	1,006	9,969	247	222	605	404
	GA	2,654	26,733	664	598	1,622	1,059
	KY	2,166	21,811	542	488	1,321	867
	MS	2,302	23,267	578	520	1,429	899
	NC	1,638	16,502	410	369	1,001	654
	SC	1,160	11,690	291	261	710	462
	TN	4,530	44,793	1,110	999	2,689	1,805
	VA	1,928	19,334	1,407	1,266	3,443	798
	WV	1,105	11,150	277	249	681	436
	Total	21,980	211,588	6,118	5,505	14,947	8,738
Grand Total		129,659	455,067	100,452	73,099	57,062	26,877

Aircraft do emit PM while operating. However, official EPA inventory procedures for aircraft generally do not include PM emission factors and, therefore, aircraft PM is generally erroneously reported as zero. In an effort to overcome this deficiency, the developers of the initial VISTAS 2002 base year aircraft inventory (Pechan) estimated PM emission rates for aircraft using estimated NO<sub>x</sub> emissions and an unreported PM-to-NO<sub>x</sub> ratio (i.e., PM = NO<sub>x</sub> times a PM-to-NO<sub>x</sub> ratio). According to the initial 2002 base year inventory documentation, this approach was applied only to commercial aircraft NO<sub>x</sub>, but a review of that inventory indicates that the technique was also applied to military, general aviation, and air taxi aircraft in many, but not all, instances. Although there is nothing inherently incorrect with this approach, the accuracy and inconsistent application of the assumed PM-to-NO<sub>x</sub> ratio results in grossly overestimated aircraft PM.

Through examination of the initial 2002 base year aircraft inventory (prepared by E.H. Pechan and Associates, Inc.), it is apparent that the commercial aircraft PM-to-NO<sub>x</sub> ratio used to generate PM emission estimates was approximately equal to 3.95 (i.e., PM = NO<sub>x</sub> times 3.95). While the majority of observed commercial aircraft PM-to-NO<sub>x</sub> ratios in that inventory are equal to 3.95, a few range as low as 3.00. If all aircraft estimates are included (i.e., commercial plus military, general aviation, and air taxi), observed PM-to-NO<sub>x</sub> ratios range from 0 to 123.0, and average 3.43 as illustrated in Table 1.3-7

**Table 1.3-7 PM-to-NO<sub>x</sub> Ratios by Aircraft Type In Initial 2002 Base Year Inventory.**

Aircraft Type	Average PM-to-NO <sub>x</sub>	Range of PM-to-NO <sub>x</sub>	Average PM <sub>2.5</sub> / PM <sub>10</sub>	Range of PM <sub>2.5</sub> / PM <sub>10</sub>
Undefined <sup>(1)</sup>	0.046	0-0.062	0.690	0.690-0.690
Military	0.073	0-92.3	0.688	0.333-1.000
Commercial	3.953	3.00-3.953	0.690	0.667-0.696
General Aviation	2.059	0-9.00	0.689	0.500-1.000
Air Taxi	2.734	0-123.0	0.690	0.500-1.000
Aggregate	3.427	0-123.0	0.690	0.333-1.000

**Note:** (1) Two counties report aircraft emissions as SCC 2275000000 "all aircraft."

As indicated, the aggregate PM-to-NO<sub>x</sub> ratio is similar in magnitude to the ratio for commercial aircraft. This results from the dominant nature of commercial aircraft NO<sub>x</sub> emissions relative to NO<sub>x</sub> from other aircraft types. It is surmised that ratios that deviate from 3.95 are based on PM emission estimates generated by local planners, which were retained without change in the PM estimation process (although a considerable number of unexplained "zero PM" records also exist

in the initial 2002 base year inventory dataset). Regardless, based on previous statistical analyses performed in support of aircraft emissions inventory development outside the VISTAS region, a PM-to-NO<sub>x</sub> ratio of 3.95 is too large by over an order of magnitude.

In analyses performed for the Tucson, Arizona planning area, PM-to-NO<sub>x</sub> ratios for aircraft over a standard aircraft landing and takeoff (LTO) cycle are shown in Table 1.3-8. Data for this table is taken from “Emissions Inventories for the Tucson Air Planning Area, Volume I., Study Description and Results,” prepared for the Pima Association of Governments, Tucson, AZ, November 2001. Pages 4-40 through 4-42 of that report, which document the statistical derivation of these ratios, are included in this report as Appendix E.

**Table 1.3-8. Tucson, AZ PM-to-NO<sub>x</sub> Ratios by Aircraft Type.**

Aircraft Type	PM-to-NO <sub>x</sub>
Commercial Aircraft	0.26
Military Aircraft	0.88
Air Taxi Aircraft	0.50
General Aviation Aircraft	1.90

**Note:**

The PM and NO<sub>x</sub> emission estimates presented in the Tucson study are for local aircraft operating mode times. For this work, emission estimates for Tucson were recalculated for a standard LTO cycle, so that the ratios presented are applicable to the standard LTO cycle and not a Tucson-specific cycle. Thus, the ratios presented herein vary somewhat from those associated with the emission estimates presented in the Tucson study report.

In reviewing these data, it should be considered that they apply to a standard (i.e., EPA-defined) commercial aircraft LTO cycle.<sup>2</sup> Aircraft PM-to-NO<sub>x</sub> ratios vary with operating mode, so that aircraft at airports with mode times that differ from the standard cycle will exhibit varying ratios. However, conducting an airport-specific analysis for all airports in the VISTAS region was beyond the scope of this work. While local PM-to-NO<sub>x</sub> ratios could vary somewhat from the indicated standard cycle ratios, any error due to this variation will be significantly less than the order of magnitude error associated with the 3.95 commercial aircraft ratio used for the initial 2002 base year inventory.

It should be recognized that while the Tucson area is far removed from the VISTAS region, the data analyzed to generate the PM-to-NO<sub>x</sub> ratios is standard aircraft emission factor data routinely

<sup>2</sup> As defined in AP-42, *Compilation of Air Pollutant Emission Factors, Volume II, Mobile Sources, a standard commercial aircraft LTO cycle consists of 4 minutes of approach time, 26 minutes of taxi (7 minutes in plus 19 minutes out), 0.7 minutes of takeoff, and 2.2 minutes of climbout time (approach and climbout times being based on a 3000 foot mixing height).*

employed for inventory purposes throughout the United States (as encoded in models such as the Federal Aviation Administration's Emissions Data Management Systems [EDMS]). With the exception of aircraft operating conditions, there are no inherent geographic implications associated with the use of data from the Tucson study. As indicated above, issues associated with local operating conditions have been eliminated by recalculating the Tucson study ratios for a standard LTO cycle.

To implement the revised PM-to-NO<sub>x</sub> ratios in the Base F inventory, *all* aircraft PM records were removed from the initial 2002 base year inventory (prepared by Pechan). This includes records for which local planners may have estimated PM emissions. This approach was taken for two reasons. First, there is no way to distinguish which records may have been generated by local planners. Second, the data available to local planners may be no better than that used to generate the presented PM-to-NO<sub>x</sub> ratio data, so the consistent application of these data to the entire VISTAS region was determined to be the most appropriate approach to generating consistent inventories throughout the region. In undertaking this removal, it became apparent that there was an imbalance in the aircraft NO<sub>x</sub> and PM records in the initial 2002 base year inventory. Whereas there were 1,531 NO<sub>x</sub> records in the NIF emission data sets for this source category, there were only 1,212 PM records. The imbalance was distributed between three States, South Carolina, Tennessee, and Virginia as follows:

**Table 1.3-9 Non-Corresponding Aircraft Emissions Records**

<i>Aircraft NO<sub>x</sub> records with no corresponding PM record:</i>			
<b>Aircraft Type</b>	<b>South Carolina</b>	<b>Virginia</b>	<b>Total</b>
Military Aircraft	8	100	108
General Aviation Aircraft	14	94	108
Air Taxi Aircraft	5	99	104
Aggregate	27	293	320
<i>Aircraft PM records with no corresponding NO<sub>x</sub> record:</i>			
<b>Aircraft Type</b>	<b>Tennessee</b>	<b>Total</b>	
Air Taxi Aircraft	1	1	
Aggregate	1	1	

The unmatched PM record was for Hamilton County (Chattanooga), Tennessee and when removed, was not replaced since there was no corresponding NO<sub>x</sub> record with which to estimate revised PM emissions. It is unclear how this orphaned record originated, but clearly there can be no air taxi PM emissions without other combustion-related emissions. Thus, the removal of the



PM<sub>10</sub> and PM<sub>2.5</sub> records for Hamilton County permanently reduced the overall size of the 2002 initial base year inventory database used as a starting point for Base F by two records.

Of the 320 unmatched NO<sub>x</sub> records, 269 were records for which the reported emission rate was zero. Therefore, even though associated PM records were missing, the overall inventory was not affected. However, the 51 missing records for which NO<sub>x</sub> emissions were non-zero, did impact PM estimates for the overall inventory.

Replacement PM<sub>10</sub> records were calculated for all aircraft NO<sub>x</sub> records using the PM-to-NO<sub>x</sub> ratios presented above. Aircraft type-specific ratios were utilized in all cases, except for two counties where aircraft emissions were reported under the generic aircraft SCC 2275000000. For these counties (Palm Beach County, Florida and Davidson County, Tennessee), the commercial aircraft PM-to-NO<sub>x</sub> ratio was applied since both contain commercial airports (Palm Beach International and Nashville International).

Replacement aircraft PM<sub>2.5</sub> records were also developed. The initial 2002 base year inventory assumed that aircraft PM<sub>2.5</sub> was 69 percent of aircraft PM<sub>10</sub>. The origin of this fraction is not clear, but it is very low for combustion related PM. The majority of internal combustion engine related PM is typically 1 micron or smaller (PM<sub>1.0</sub>), so that typical internal combustion engine PM<sub>2.5</sub> fractions approach 100 percent. For example, the EPA NONROAD model assumes 92 percent for gasoline engine particulate and 97 percent for diesel engine particulate. Based on recent correspondence from the EPA, it appears that the agency is preparing to recommend a PM<sub>2.5</sub> fraction of 98 percent for aircraft. (August 12, 2004 e-mail correspondence from U.S. EPA to Gregory Stella of Alpine Geophysics.) This is substantially more consistent with expectations based on emissions test data for other internal combustion engine sources and was used as the basis for the recalculated aircraft PM<sub>2.5</sub> emission estimates in the Base F inventory.

Although a substantial portion of the initial 2002 base year inventory was ultimately replaced with data prepared by State and local planners under CERR requirements in developing the Base F inventory, it was necessary to first revise the initial 2002 base year aircraft inventory as described so that records extracted from the inventory for areas not supplying CERR data for the Base F update would be accurate. Therefore, in *no case* is the aggregated State data reported for the Base F inventory identical to that of the initial 2002 base year inventory. Even areas relying on the initial 2002 base year inventory will reflect updates in Base F due to changes in emissions of PM<sub>10</sub> and PM<sub>2.5</sub> from aircraft.

Table 1.3-10 presents the updated initial 2002 base year inventory estimates. These estimates do not reflect any changes related to modifications made to incorporate the CERR data, but instead indicate the impacts associated solely with the recalculation of aircraft PM emissions alone to apply the more appropriate PM to NO<sub>x</sub> ratios. Table 1.3-11 presents a summary of the net

impacts of these changes, where an over 90 percent reduction in aircraft PM is observed for all VISTAS areas except South Carolina and Virginia. The reasons for the lesser changes in these two States is that the overall aircraft NO<sub>x</sub> inventories for both include a large share of military aircraft NO<sub>x</sub> to which no (or very low) particulate estimates were assigned in the initial 2002 base year inventory. Since these operations are assigned non-zero PM emissions under the revised approach, the increase in military aircraft PM offsets a portion of the reduction in commercial aircraft PM. In Virginia, zero (or near zero) PM military operations were responsible for about 35 percent of total aircraft NO<sub>x</sub>, while the corresponding fraction in South Carolina was almost 70 percent. As indicated, aggregate aircraft, locomotive, and commercial marine vessel PM is 70-75 percent lower in the updated 2002 base year inventory.

**Table 1.3-10. Initial 2002 Base Year Aircraft, Locomotive, and Non-Recreational Marine Emissions with Modified Aircraft PM Emission Rates (annual tons)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	3,787	175	64	62	17	196
	FL	28,518	11,955	3,193	3,129	1,050	3,703
	GA	3,175	992	269	264	94	353
	KY	2,666	657	179	175	63	263
	MS	1,593	140	44	43	13	96
	NC	6,088	1,548	419	411	148	613
	SC	6,505	515	409	401	88	863
	TN	6,854	2,665	707	692	225	920
	VA	17,676	5,607	2,722	2,667	234	3,229
	WV	1,178	78	25	24	8	66
	<b>Total</b>	<b>78,040</b>	<b>24,332</b>	<b>8,030</b>	<b>7,870</b>	<b>1,940</b>	<b>10,302</b>
Commercial Marine (2280)	AL	1,195	9,217	917	843	3,337	736
	FL	5,888	44,817	1,936	1,781	6,683	1,409
	GA	1,038	7,874	334	307	1,173	246
	KY	6,607	50,267	2,246	2,066	9,608	1,569
	MS	5,687	43,233	1,903	1,750	7,719	1,351
	NC	599	4,547	193	178	690	142
	SC	1,067	8,100	343	316	1,205	253
	TN	4,129	31,397	1,390	1,278	5,753	980
	VA	1,198	3,426	929	855	3,258	596
	WV	2,094	15,882	668	614	720	497
	<b>Total</b>	<b>29,503</b>	<b>218,760</b>	<b>10,858</b>	<b>9,989</b>	<b>40,146</b>	<b>7,779</b>
Military Marine (2283)	VA	136	387	28	26	30	59
	<b>Total</b>	<b>136</b>	<b>387</b>	<b>28</b>	<b>26</b>	<b>30</b>	<b>59</b>
Locomotives (2285)	AL	3,490	26,339	592	533	1,446	1,354
	FL	1,006	9,969	247	222	605	404
	GA	2,654	26,733	664	598	1,622	1,059
	KY	2,166	21,811	542	488	1,321	867
	MS	2,302	23,267	578	520	1,429	899
	NC	1,638	16,502	410	369	1,001	654
	SC	1,160	11,690	291	261	710	462
	TN	4,530	44,793	1,110	999	2,689	1,805
	VA	1,928	19,334	1,407	1,266	3,443	798
	WV	1,105	11,150	277	249	681	436
	<b>Total</b>	<b>21,980</b>	<b>211,588</b>	<b>6,118</b>	<b>5,505</b>	<b>14,947</b>	<b>8,738</b>
<b>Grand Total</b>		<b>129,659</b>	<b>455,067</b>	<b>25,034</b>	<b>23,390</b>	<b>57,062</b>	<b>26,877</b>

**Table 1.3-11. Change in Initial 2002 Base Year Emissions due to Aircraft PM Emission Rate Modifications.**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	0%	0%	-91%	-87%	0%	0%
	FL	0%	0%	-93%	-90%	0%	0%
	GA	0%	0%	-93%	-90%	0%	0%
	KY	0%	0%	-93%	-90%	0%	0%
	MS	0%	0%	-92%	-89%	0%	0%
	NC	0%	0%	-93%	-90%	0%	0%
	SC	0%	0%	-9%	+29%	0%	0%
	TN	0%	0%	-91%	-87%	0%	0%
	VA	0%	0%	-81%	-73%	0%	0%
	WV	0%	0%	-92%	-89%	0%	0%
	Total	0%	0%	-90%	-86%	0%	0%
Commercial Marine (2280)	AL	0%	0%	0%	0%	0%	0%
	FL	0%	0%	0%	0%	0%	0%
	GA	0%	0%	0%	0%	0%	0%
	KY	0%	0%	0%	0%	0%	0%
	MS	0%	0%	0%	0%	0%	0%
	NC	0%	0%	0%	0%	0%	0%
	SC	0%	0%	0%	0%	0%	0%
	TN	0%	0%	0%	0%	0%	0%
	VA	0%	0%	0%	0%	0%	0%
	WV	0%	0%	0%	0%	0%	0%
Total	0%	0%	0%	0%	0%	0%	
Military Marine (2283)	VA	0%	0%	0%	0%	0%	0%
	Total	0%	0%	0%	0%	0%	0%
Locomotives (2285)	AL	0%	0%	0%	0%	0%	0%
	FL	0%	0%	0%	0%	0%	0%
	GA	0%	0%	0%	0%	0%	0%
	KY	0%	0%	0%	0%	0%	0%
	MS	0%	0%	0%	0%	0%	0%
	NC	0%	0%	0%	0%	0%	0%
	SC	0%	0%	0%	0%	0%	0%
	TN	0%	0%	0%	0%	0%	0%
	VA	0%	0%	0%	0%	0%	0%
	WV	0%	0%	0%	0%	0%	0%
Total	0%	0%	0%	0%	0%	0%	
Grand Total		0%	0%	-75%	-68%	0%	0%

As indicated above, for the Base F 2002 base year inventory, data for all or portions of seven VISTAS States were replaced with corresponding data from recent (as of the fall of 2004) CERR submissions for 2002. Before replacing these data, however, an analysis of the CERR data was performed to ensure consistency with VISTAS inventory methods. It should perhaps also be noted that three of the CERR datasets provided for the Base F 2002 base year inventory (specifically those for Tennessee, Virginia, and West Virginia) included both annual and daily emissions data. Only the annual data were used. Daily values were removed.

Several important observations resulted from this analysis. First, it was clear that all of the CERR data continued to rely on the inaccurate aircraft PM estimation approach employed for the initial 2002 base year inventory. Therefore, an identical aircraft PM replacement procedure as described above for updating the initial 2002 base year inventory was undertaken for CERR supplied data. As a result, the CERR data for *all* VISTAS States has been modified for inclusion in the Base F 2002 VISTAS base year inventory due to PM replacement procedures.

As was the case with the initial VISTAS 2002 base year inventory, there were a substantial number of aircraft NO<sub>x</sub> records without corresponding PM records, so that the number of recalculated PM records added to the CERR dataset is greater than the number of PM records removed. The aggregated CERR inventory data, reflecting data for all or parts of seven States, consisted of 13,656 records, of which 1,211 were aircraft NO<sub>x</sub> records. However, the number of corresponding aircraft PM records was 662 (662 PM<sub>10</sub> records and 662 PM<sub>2.5</sub> records). This imbalance was distributed as follows:

**Table 1.3-12 CERR Aircraft NO<sub>x</sub> Records with No Corresponding PM Record.**

Aircraft Type	Georgia	Tennessee	Virginia	Total
Military Aircraft			136	136
Commercial Aircraft		4	136	140
General Aviation Aircraft	1		136	137
Air Taxi Aircraft			136	136
Aggregate	1	4	544	549

From this tabulation, it is clear that virtually the entire imbalance is associated with the Virginia CERR submission, with minor imbalances in Georgia and Tennessee. Of the 549 unmatched NO<sub>x</sub> records, 461 were records for which the reported emission rate was zero. Therefore, even though the associated PM records were missing, the overall inventory was not affected. However, the 88 missing records for which NO<sub>x</sub> emissions were non-zero do impact PM emission estimates for the overall inventory.

Replacement aircraft PM records (both PM<sub>10</sub> and PM<sub>2.5</sub>) were generated for the CERR dataset using procedures identical to those described above for the updated initial 2002 base year inventory.

Further analysis revealed that the CERR data for Virginia included only VOC, CO, and NO<sub>x</sub> emissions for all aircraft, locomotives, and non-recreational marine vessels. Since SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> records are included in the 2002 VISTAS inventory, an estimation method was developed for these emission species and applied to the Virginia CERR data. For PM, the

developed methodology was only employed for locomotive and marine vessel data since aircraft PM was estimated using the PM-to-NO<sub>x</sub> ratio methodology described above.

Consideration was given to simply adding the Virginia SO<sub>2</sub> and non-aircraft PM records from the initial 2002 VISTAS inventory dataset, but it is very unlikely that either the source distribution or associated emission rates are identical across the CERR and initial VISTAS inventories. This was confirmed through a comparative analysis of dataset CO records. Therefore, an estimation methodology was developed using Virginia source-specific SO<sub>2</sub>/CO, PM<sub>10</sub>/CO, and PM<sub>2.5</sub>/PM<sub>10</sub> ratios from the initial 2002 base year VISTAS inventory. The calculated ratios were then applied to the source-specific CERR CO emission estimates to derive associated source-specific SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> emissions for the Base F inventory.

Initially, the development of the emissions ratios from the initial 2002 base year inventory was performed at the State (i.e., Virginia), county, and SCC level of detail. However, it readily became clear that there were substantial inconsistencies in ratios for identical SCCs across counties. For example, in one county, the SO<sub>2</sub>/CO ratio might be 0.2, while in the next county it would be 2.0. Since the sources in question are virtually identical (e.g., diesel locomotives) and since the fueling infrastructure for these large non-road equipment sources is regional as opposed to local in nature, such variations in emission rates are not realistic. Therefore, a more aggregated approach was employed in which SCC-specific emission ratios were developed for the State as a whole. Through this approach county-to-county variation in emission ratios is eliminated, but the underlying variation in CO emissions does continue to influence the resulting aggregate emission estimates. The applied emission ratios are as follows:

**Table 1.3-13 Calculated Emission Ratios for VA.**

Source	SCC	SO <sub>2</sub> /CO	PM <sub>10</sub> /CO	PM <sub>2.5</sub> /CO	PM <sub>2.5</sub> /PM <sub>10</sub>
Military Aircraft	2275001000	0.0215			
Commercial Aircraft	2275020000	0.3292			
General Aviation Aircraft	2275050000	0.0002			
Air Taxi Aircraft	2275060000	0.0015			
Aircraft Refueling	2275900000	0.0000	0.0000	0.0000	
Diesel Commercial Marine	2280002000	0.3697	0.3434	0.3157	0.92
Residual Commercial Marine	2280003000	0.3697	0.3434	0.3157	0.92
Diesel Military Marine	2283002000	0.2422	0.2248	0.2068	0.92
Line Haul Locomotives	2285002005	3.2757	1.2999	1.1696	0.90
Yard Locomotives	2285002010	2.2908	1.2461	1.1205	0.90

*Emissions estimated using  
PM-to-NO<sub>x</sub> ratios as  
described previously.*

It is important to recognize that the inconsistency of emissions ratios across Virginia counties for sources of virtually identical design, which utilize a regional rather than local fueling infrastructure, has potential implications for other VISTAS States. There is no immediately obvious reason to believe that such inconsistencies would be isolated to Virginia.

One final revision to the CERR dataset was undertaken as part of the Base F effort, and that was the removal of two records for unpaved airstrip particulate (SCC 2275085000) in Alabama. Otherwise identical records for these emissions were reported both in terms of filterable and primary particulate. The filterable particulate records were removed as all other particulate emissions in the VISTAS inventories are in terms of primary particulate. It is also perhaps worth noting that a series of aircraft refueling records (SCC 2275900000) for Virginia were left in place, even through typically such emissions would be reported under SCC 2501080XXX in the area source inventory. If additional VISTAS aircraft refueling emissions are reported under SCC 2501080XXX, then it may be desirable to recode these records.

Finally, data for areas of the VISTAS region not represented in the CERR dataset were added to the CERR data by extracting the appropriate records from the initial 2002 base year inventory (with revisions for aircraft PM to NO<sub>x</sub> ratios). Specifically, records applicable to the States of Florida, Kentucky, South Carolina, and the Tennessee counties of Davidson, Hamilton, Knox, and Shelby were extracted from the revised initial 2002 inventory and added to the CERR dataset to establish the 2002 Base F inventory.

Following this aggregation, one last dataset revision was implemented to complete the development of the 2002 Base F inventory. As indicated in the introduction of this section, the initial 2002 base year emission estimates for Miami International Airport were determined to be excessive. Although the reason for this inaccuracy was not apparent, revised estimates for aircraft emissions in Miami-Dade County were obtained from Florida planners and used to overwrite the erroneous estimates. (Aircraft emission estimates were provided in an August 10, 2004 e-mail transmittal from Bruce Coward of Miami-Dade County to Martin Costello of the Florida Department of Environmental Protection.)

Table 1.3-14 presents a summary of the resulting Base F VISTAS 2002 base year inventory estimates for aircraft, locomotives, and non-recreational marine vessels. Table 1.3-15 provides a comparison of the Base F 2002 base year inventory estimates to those of the initial 2002 base year inventory. As indicated, total emissions for VOC, CO, NO<sub>x</sub>, and SO<sub>2</sub> are generally within 10 percent, but final PM emissions are reduced by 70-80 percent due to the approximate 90 percent reductions in aircraft PM estimates. In addition, the significant changes in Georgia aircraft emissions are due to the CERR correction of Atlanta Hartsfield International Airport emissions, which were significantly underestimated in the initial 2002 base year inventory. The

reduction in Florida aircraft emissions due to the correction of Miami International estimates is also apparent.

Lastly, Table 1.3-16 provides a direct comparison of emission estimates from the initial and Base F 2002 base year inventories for all 16 VISTAS region airports with estimated annual aircraft NO<sub>x</sub> emissions of 200 tons or greater (as identified at the conclusion of the Base F revisions).<sup>3</sup> The table entries are sorted in order of decreasing NO<sub>x</sub> and once again, the dramatic reduction in PM emissions is evident. However, in addition, the appropriate reversal of the relationship between Atlanta's Hartsfield and Miami International Airport is also depicted. As a rough method of quality assurance, Table 1.3-15 also includes a *gross* estimate of expected airport NO<sub>x</sub> emissions using detailed NO<sub>x</sub> estimates developed for Tucson International Airport in conjunction with the ratio of local to Tucson LTOs. (The Tucson NO<sub>x</sub> estimates are revised to reflect a standard LTO cycle rather than the Tucson-specific LTO cycle. This should provide for a more realistic comparison to VISTAS estimates.) This is not meant to serve as anything other than a crude indicator of the propriety of the developed VISTAS estimates, and it is clear that the range of estimated-to-expected NO<sub>x</sub> emissions has been substantially narrowed in the Base F 2002 base year inventory. Whereas estimated-to-expected ratios varied from about 0.2 to over 3.5 in the initial 2002 base year inventory, the range of variation is tightened on both ends, from about 0.5 to 1.75 for the Base F 2002 base year inventory. In effect, all estimates are now within a factor of two of the expected estimates, which is quite reasonable given likely variation in local and standard LTO cycles and variations in aircraft fleet mix across airports.

It is perhaps important to note that some shifting in county emissions assignments is evident between the initial and Base F 2002 base year aircraft inventories. For example, for the initial 2002 base year inventory, Atlanta Hartsfield estimates were assigned to Fulton County (FIP 13121), while they are assigned to Clayton County (FIP 13063) for the Base F 2002 base year inventory. Similarly, Dulles International Airport emissions were assigned solely to Fairfax County, Virginia (FIP 51059) in the initial 2002 base year inventory, but are split between Fairfax and Loudoun County (FIP 51107) for Base F. Such shifts reflect local planner decision-making and are not an artifact of the revisions described above.

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<sup>3</sup> Subsequent revisions performed for Base G result in the addition of the Cincinnati/Northern Kentucky International Airport to the group of airports with aircraft operations generating at least 200 tons of NO<sub>x</sub>. These revisions are discussed below, including the addition of an appropriately modified version of the aircraft emissions table.



**Table 1.3-14. Base F 2002 Base Year Aircraft, Locomotive, and Non-Recreational Marine Emissions (tons/year)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	3,787	175	226	87	17	196
	FL	25,431	8,891	2,424	2,375	800	3,658
	GA	6,622	5,372	1,475	1,446	451	443
	KY	2,666	657	179	175	63	263
	MS	1,593	140	44	43	13	96
	NC	6,088	1,548	419	411	148	613
	SC	6,505	515	409	401	88	863
	TN	7,251	2,766	734	719	235	943
	VA	9,763	2,756	1,137	1,115	786	2,529
	WV	1,178	78	25	24	8	66
	<b>Total</b>	<b>70,884</b>	<b>22,899</b>	<b>7,072</b>	<b>6,797</b>	<b>2,607</b>	<b>9,670</b>
Commercial Marine (2280)	AL	1,196	9,218	917	844	3,337	737
	FL	5,888	44,817	1,936	1,781	6,683	1,409
	GA	1,038	7,875	334	307	1,173	246
	KY	6,607	50,267	2,246	2,066	9,608	1,569
	MS	5,688	43,233	1,903	1,751	7,719	1,351
	NC	599	4,547	193	178	690	142
	SC	1,067	8,100	343	316	1,205	253
	TN	3,624	27,555	1,217	1,120	4,974	860
	VA	972	2,775	334	307	359	483
	WV	1,528	11,586	487	448	525	362
	<b>Total</b>	<b>28,207</b>	<b>209,972</b>	<b>9,911</b>	<b>9,118</b>	<b>36,275</b>	<b>7,413</b>
Military Marine (2283)	VA	110	313	25	23	27	48
	<b>Total</b>	<b>110</b>	<b>313</b>	<b>25</b>	<b>23</b>	<b>27</b>	<b>48</b>
Locomotives (2285)	AL	3,490	26,339	592	533	1,446	1,354
	FL	1,006	9,969	247	222	605	404
	GA	2,725	27,453	682	614	1,667	1,086
	KY	2,166	21,811	542	488	1,321	867
	MS	2,302	23,267	578	520	1,429	899
	NC	1,638	16,502	410	369	1,001	654
	SC	1,160	11,690	291	261	710	462
	TN	2,626	25,627	633	570	1,439	1,041
	VA	1,186	11,882	1,529	1,375	3,641	492
	WV	1,311	13,224	329	296	808	517
	<b>Total</b>	<b>19,611</b>	<b>187,764</b>	<b>5,833</b>	<b>5,248</b>	<b>14,066</b>	<b>7,777</b>
<b>Grand Total</b>		<b>118,812</b>	<b>420,948</b>	<b>22,841</b>	<b>21,186</b>	<b>52,976</b>	<b>24,908</b>

**Table 1.3-15. Change in 2002 Emissions, Base F Inventory Relative to Initial Inventory**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	0%	0%	-67%	-82%	0%	0%
	FL	-11%	-26%	-95%	-93%	-24%	-1%
	GA	+109%	+442%	-62%	-47%	+379%	+26%
	KY	0%	0%	-93%	-90%	0%	0%
	MS	0%	0%	-92%	-89%	0%	0%
	NC	0%	0%	-93%	-90%	0%	0%
	SC	0%	0%	-9%	+29%	0%	0%
	TN	+6%	+4%	-91%	-87%	+4%	+2%
	VA	-45%	-51%	-92%	-89%	+236%	-22%
	WV	0%	0%	-92%	-89%	0%	0%
	<b>Total</b>	<b>-9%</b>	<b>-6%</b>	<b>-92%</b>	<b>-88%</b>	<b>+34%</b>	<b>-6%</b>
Commercial Marine (2280)	AL	+0%	+0%	+0%	+0%	+0%	+0%
	FL	0%	0%	0%	0%	0%	0%
	GA	+0%	+0%	+0%	+0%	+0%	+0%
	KY	0%	0%	0%	0%	0%	0%
	MS	+0%	+0%	+0%	+0%	+0%	+0%
	NC	+0%	+0%	+0%	+0%	+0%	+0%
	SC	0%	0%	0%	0%	0%	0%
	TN	-12%	-12%	-12%	-12%	-14%	-12%
	VA	-19%	-19%	-64%	-64%	-89%	-19%
	WV	-27%	-27%	-27%	-27%	-27%	-27%
	<b>Total</b>	<b>-4%</b>	<b>-4%</b>	<b>-9%</b>	<b>-9%</b>	<b>-10%</b>	<b>-5%</b>
Military Marine (2283)	VA	-19%	-19%	-12%	-12%	-12%	-19%
	<b>Total</b>	<b>-19%</b>	<b>-19%</b>	<b>-12%</b>	<b>-12%</b>	<b>-12%</b>	<b>-19%</b>
Locomotives (2285)	AL	0%	0%	0%	0%	0%	0%
	FL	0%	0%	0%	0%	0%	0%
	GA	+3%	+3%	+3%	+3%	+3%	+3%
	KY	0%	0%	0%	0%	0%	0%
	MS	0%	0%	0%	0%	0%	0%
	NC	0%	0%	0%	0%	0%	0%
	SC	0%	0%	0%	0%	0%	0%
	TN	-42%	-43%	-43%	-43%	-46%	-42%
	VA	-38%	-39%	+9%	+9%	+6%	-38%
	WV	+19%	+19%	+19%	+19%	+19%	+19%
	<b>Total</b>	<b>-11%</b>	<b>-11%</b>	<b>-5%</b>	<b>-5%</b>	<b>-6%</b>	<b>-11%</b>
<b>Grand Total</b>		<b>-8%</b>	<b>-7%</b>	<b>-77%</b>	<b>-71%</b>	<b>-7%</b>	<b>-7%</b>

**Table 1.3-16. Base F Comparison of Aircraft Emissions  
(Airports with Aircraft NO<sub>x</sub> > 200 tons per year)**

Airport	FIP	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC	Approx. LTOs	Predicted NO <sub>x</sub>	VISTAS to Predicted
<i>Initial 2002 Base Year Inventory</i>										
Miami	12086	9,757	5,997	23,706	16,357	525	1,641	150,000	1,680	3.57
Orlando	12095	3,456	2,170	8,578	5,919	204	642	150,000	1,680	1.29
Memphis	47157	3,462	1,934	7,645	5,275	185	603	125,000	1,400	1.38
Reagan	51013	3,892	1,806	7,138	4,925	164	302	100,000	1,120	1.61
Hampton	51650	2,690	1,705	0	0	0	611	Military		
Dulles	51059	2,032	1,330	5,246	3,620	0	272	75,000	840	1.58
Orlando-Sanford	12117	3,615	1,225	4,837	3,337	100	351			
Atlanta	13121	1,457	913	3,608	2,490	86	274	420,000	4,704	0.19
Fort Lauderdale	12011	1,930	809	3,196	2,206	75	257	75,000	840	0.96
Charlotte	37119	1,643	788	3,113	2,148	75	255	150,000	1,680	0.47
Tampa	12057	1,399	785	3,101	2,140	74	240	75,000	840	0.93
Nashville	47037	1,819	653	40	28	33	239	60,000	672	0.97
Raleigh	37183	1,584	592	2,338	1,613	56	204	75,000	840	0.70
Louisville	21111	1,073	468	1,851	1,277	45	155	60,000	672	0.70
Jacksonville	12031	871	325	1,284	886	31	112	30,000	336	0.97
Palm Beach	12099	1,156	226	0	0	1	132	30,000	336	0.67
Aggregate		41,836	21,724	75,682	52,220	1,655	6,290			0.19-3.57
<i>Base F 2002 Base Year Inventory</i>										
Atlanta	13063	4,121	5,288	1,435	1,406	443	337	420,000	4,704	1.12
Miami	12086	6,670	2,933	805	789	274	1,596	150,000	1,680	1.75
Orlando	12095	3,456	2,170	568	556	204	642	150,000	1,680	1.29
Memphis	47157	3,462	1,934	506	495	185	603	125,000	1,400	1.38
Orlando-Sanford	12117	3,615	1,225	338	332	100	351			
Fort Lauderdale	12011	1,930	809	217	212	75	257	75,000	840	0.96
Charlotte	37119	1,643	788	206	202	75	255	150,000	1,680	0.47
Tampa	12057	1,399	785	206	202	74	240	75,000	840	0.93
Nashville	47037	1,819	653	170	166	33	239	60,000	672	0.97
Reagan	51013	1,269	635	171	168	193	97	100,000	1,120	0.57
Dulles 1	51107	1,807	595	164	161	252	153	37,500	420	1.42
Raleigh	37183	1,584	592	156	153	56	204	75,000	840	0.70
Dulles 2	51059	1,095	591	156	153	252	115	37,500	420	1.41
Hampton	51650	858	535	471	461	18	305	Military		
Louisville	21111	1,073	468	123	121	45	155	60,000	672	0.70
Jacksonville	12031	871	325	87	85	31	112	30,000	336	0.97
Palm Beach	12099	1,156	226	59	58	1	132	30,000	336	0.67
Aggregate		37,829	20,550	5,838	5,721	2,312	5,793			0.47-1.75
Net Change		-10%	-5%	-92%	-89%	+40%	-8%			

Note: For the Base F inventory, Dulles International Airport emissions are split between two Virginia counties. Predicted NO<sub>x</sub> is based on the ratio of airport LTOs to test airport (Tucson International Airport) LTOs and NO<sub>x</sub>. This is not a rigorous comparison, but rather an approximate indicator of expected magnitude.

**Base G Revisions:**

Further revisions to the 2002 base year emissions inventory were implemented in response to additional state data submittals in the spring of 2006. The inventories developed through the Base F revision process (as described above) served as the starting point for the 2006 revisions. Thus, unless otherwise indicated below, all documented Base F revisions continue to apply to the Base G-revised 2002 base year inventory.

As part of the Base G review and update process, Virginia regulators provided 443 updated emission records for aircraft. These records reflected revisions to aircraft VOC, CO, and NO<sub>x</sub>, and in a few cases SO<sub>2</sub>, emissions records that were already in the Base F VISTAS 2002 inventory (as opposed to the addition of previously unreported data). The specific revisions broke down as follows:

**Table 1.3-17 Base G VA Aircraft Records Updates**

Aircraft Type	VOC	CO	NO <sub>x</sub>	SO <sub>2</sub>	Total
Military Aircraft	9	9	9	1	28
Commercial Aircraft	12	12	12	17	53
General Aviation Aircraft	65	66	66	0	197
Air Taxi Aircraft	56	56	53	0	165
Aggregate	142	143	140	18	443

Emissions values for each of the 443 records in the Base F 2002 VISTAS inventory were updated for Base G to reflect the revised data. However, as described above for the Base F revisions, all aircraft SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> emissions in Virginia are estimated on the basis of CO (in the case of SO<sub>2</sub>) and NO<sub>x</sub> emissions (in the cases of PM<sub>10</sub> and PM<sub>2.5</sub>). Therefore, since Virginia regulators did not provide updated SO<sub>2</sub> emissions for all updated CO emissions records, or updated PM<sub>10</sub> or PM<sub>2.5</sub> emissions for all updated NO<sub>x</sub> emissions records, it was necessary to re-estimate aircraft SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> emissions in all cases where updated CO or NO<sub>x</sub> emissions were provided for Base G (and explicit SO<sub>2</sub> and/or PM<sub>10</sub> and PM<sub>2.5</sub> emissions were not).

The procedure used to estimate the SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> emissions revisions was identical to that described above for the Base F inventory revisions, except that revised SO<sub>2</sub>-to-CO emissions ratios were calculated for commercial aircraft, where 12 pairs of revised CO and SO<sub>2</sub> emissions estimates were available. Although a single pair of revised CO and SO<sub>2</sub> emissions records was available for military aircraft, this was deemed an insufficient sample with which to replace the military aircraft SO<sub>2</sub>-to-CO emissions ratios previously calculated in Base F. However, it is worth noting that the SO<sub>2</sub>-to-CO emissions ratio for the revised military aircraft emissions pair

was within 16 percent of the previously calculated ratio, so any error associated with retention of the Base F ratio will be minor. Table 1.3-18 presents the emissions ratios.

**Table 1.3-18 Calculated Base G Emission Ratios for VA.**

Source	SCC	SO <sub>2</sub> /CO (fall 2004)	SO <sub>2</sub> /CO (spring 2006)	SO <sub>2</sub> /CO (used in 2006)	PM <sub>10</sub> /NO <sub>x</sub>	PM <sub>2.5</sub> /PM <sub>10</sub>
Military Aircraft	2275001000	0.0215	0.0180	0.0215	0.88	0.98
Commercial Aircraft	2275020000	0.3292	0.0696	0.0696	0.26	0.98
General Aviation Aircraft	2275050000	0.00016	n/a	0.00016	1.9	0.98
Air Taxi Aircraft	2275060000	0.0015	n/a	0.0015	0.5	0.98

Application of the SO<sub>2</sub>-to-CO emissions ratios to the 130 revised aircraft CO records, for which no corresponding SO<sub>2</sub> emission revisions were provided, resulted in an additional 130 aircraft SO<sub>2</sub> emission records updates for Virginia. Similarly, application of the PM<sub>10</sub>-to-NO<sub>x</sub> emissions ratios to the 140 revised aircraft NO<sub>x</sub> records for which no corresponding PM<sub>10</sub> emission revisions were provided, resulted in an additional 140 aircraft PM<sub>10</sub> emission records updates for Virginia. Application of the PM<sub>2.5</sub>-to-PM<sub>10</sub> emissions ratios to the 140 revised aircraft PM<sub>10</sub> records resulted in an additional 140 aircraft PM<sub>2.5</sub> emission records updates for Virginia. Thus, in total, 853 (443+130+140+140) Virginia aircraft emissions records were updated for Base G.

Also as part of the Base G review and update process, Alabama regulators provided 178 updated PM emission records for aircraft (89 records for PM<sub>10</sub> and 89 records for PM<sub>2.5</sub>), 42 additional emissions records for locomotives (14 records for VOC, 14 records for CO, and 14 records for NO<sub>x</sub>), and 179 additional emission records for aircraft (30 records for VOC, 30 records for CO, 30 records for NO<sub>x</sub>, 29 records for SO<sub>2</sub>, 30 records for PM<sub>10</sub>, and 30 records for PM<sub>2.5</sub>). After review, it was determined that the 178 updated PM emission records for aircraft actually reflected the original (overestimated) aircraft PM data that was replaced universally throughout the VISTAS region for Base F. Implementing these latest revisions would, in effect, “undo” the Base F aircraft PM revisions. Following discussions with Alabama regulators, it was determined that the 178 aircraft PM records would not be updated for the Base G revisions.

The 42 additional emissions records for locomotives were determined to correspond exactly to existing SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> emissions records already in the Base F VISTAS 2002 inventory. It is not clear why these existing records contained no corresponding data for VOC, CO, and NO<sub>x</sub>, but those data are now reflected through the additional 42 records that have now been added to the Base G 2002 VISTAS inventory for Alabama.

After examining the 179 additional aircraft emissions records in conjunction with Alabama regulators, it was determined that 17 of the records (commercial aircraft records in Dale,

Limestone, and Talladega counties) were erroneous and should be excluded from the update. The remaining 162 records reflected additional general aviation, air taxi, and military aircraft activity in 20 counties and were specifically comprised of 27 records each for VOC, CO, NO<sub>x</sub>, SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub>. There were no further issues with the VOC, CO, NO<sub>x</sub>, and SO<sub>2</sub> records and these were added to the Base G 2002 VISTAS inventory without change. It was, however, apparent that the PM<sub>10</sub> and PM<sub>2.5</sub> records reflected an overestimation of aircraft PM similar to that which was previously corrected throughout the VISTAS region for Base F (as documented above). To overcome this overestimation, the additional aircraft PM<sub>10</sub> and PM<sub>2.5</sub> records provided by Alabama regulators were replaced with revised emission estimates developed on the basis of the PM<sub>10</sub>-to-NO<sub>x</sub> and PM<sub>2.5</sub>-to-PM<sub>10</sub> ratios documented under the Base F revisions above. So although 27 aircraft PM<sub>10</sub> records and 27 aircraft PM<sub>2.5</sub> records were added to the 2002 Alabama inventory, they reflected different emissions values than those provided directly by Alabama regulators.

In total, 204 additional emissions records (42 for locomotives and 162 for aircraft) were added to the Base G 2002 Alabama inventory.

Finally, as part of the Base G review and update process, Kentucky regulators provided 12 updated aircraft emission records for Boone County, to correct previously underestimated aircraft emissions associated with the Cincinnati/Northern Kentucky International Airport. VOC, CO, and NO<sub>x</sub> emissions data were provided for military, commercial, general aviation, and air taxi aircraft. No associated updates for SO<sub>2</sub>, PM<sub>10</sub>, or PM<sub>2.5</sub> emissions were provided. Corresponding PM<sub>10</sub> emission estimates were developed by applying the PM<sub>10</sub>-to-NO<sub>x</sub> ratios presented in Table 1.3-17 above to the updated NO<sub>x</sub> emission estimates. PM<sub>2.5</sub> emission estimates were developed by applying the PM<sub>2.5</sub>-to-PM<sub>10</sub> ratios from that same table to the estimated PM<sub>10</sub> emissions. SO<sub>2</sub> emission estimates were developed by applying the SO<sub>2</sub>-to-PM<sub>10</sub> ratios developed from the older data (i.e., the data being replaced) for Boone County aircraft to the updated PM<sub>10</sub> emissions. Thus, a total of 24 inventory records for Kentucky were updated (VOC, CO, NO<sub>x</sub>, SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> for four aircraft types).

Upon implementation of the universe of updates, 877 existing emission records were revised (853 in Virginia and 24 in Kentucky) and 204 additional emission records (all in Alabama) were added to the 2002 VISTAS inventory. The total number of aircraft, locomotive, and commercial marine inventory records thus changed from 22,838 records in Base F to 23,042 records in Base G.

Table 1.3-19 presents a summary of the resulting Base G VISTAS 2002 base year inventory estimates for aircraft, locomotives, and non-recreational marine vessels. Table 1.3-20 provides a comparison of the Base G 2002 base year inventory estimates to those of the Base F 2002 base

year inventory. As indicated, total emissions for VOC, CO, NO<sub>x</sub>, and SO<sub>2</sub> are generally within about 5 percent, with changes restricted to the states of Alabama, Kentucky, and Virginia.

Lastly, Table 1.3-21 provides an updated comparison of emission estimates from the Base F and Base G 2002 base year inventories for all 17 VISTAS region airports with estimated annual aircraft NO<sub>x</sub> emissions of 200 tons or greater. As compared to Table 1.3-16, the table reflects the Base G addition of the Cincinnati/Northern Kentucky International Airport. Aircraft emission estimates for the other 16 airports are unchanged from their Base F values.

**Table 1.3-19. Base G-Revised 2002 Base Year Aircraft, Locomotive, and Non-Recreational Marine Emissions (tons/year)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	5,595	185	238	99	18	276
	FL	25,431	8,891	2,424	2,375	800	3,658
	GA	6,620	5,372	1,475	1,446	451	443
	KY	5,577	925	251	246	88	397
	MS	1,593	140	44	43	13	96
	NC	6,088	1,548	419	411	148	613
	SC	6,505	515	409	401	88	863
	TN	7,251	2,766	734	719	235	943
	VA	11,873	3,885	2,010	1,970	272	2,825
	WV	1,178	78	25	24	8	66
	<b>Total</b>	<b>77,712</b>	<b>24,305</b>	<b>8,029</b>	<b>7,734</b>	<b>2,121</b>	<b>10,179</b>
Commercial Marine (2280)	AL	1,196	9,218	917	844	3,337	737
	FL	5,888	44,817	1,936	1,781	6,683	1,409
	GA	1,038	7,875	334	307	1,173	246
	KY	6,607	50,267	2,246	2,066	9,608	1,569
	MS	5,688	43,233	1,903	1,751	7,719	1,351
	NC	599	4,547	193	178	690	142
	SC	1,067	8,100	343	316	1,205	253
	TN	3,624	27,555	1,217	1,120	4,974	860
	VA	972	2,775	334	307	359	483
	WV	1,528	11,586	487	448	525	362
	<b>Total</b>	<b>28,207</b>	<b>209,972</b>	<b>9,911</b>	<b>9,118</b>	<b>36,275</b>	<b>7,413</b>
Military Marine (2283)	VA	110	313	25	23	27	48
	<b>Total</b>	<b>110</b>	<b>313</b>	<b>25</b>	<b>23</b>	<b>27</b>	<b>48</b>
Locomotives (2285)	AL	3,518	26,623	592	533	1,446	1,365
	FL	1,006	9,969	247	222	605	404
	GA	2,654	26,733	664	598	1,622	1,059
	KY	2,166	21,811	542	488	1,321	867
	MS	2,302	23,267	578	520	1,429	899
	NC	1,638	16,502	410	369	1,001	654
	SC	1,160	11,690	291	261	710	462
	TN	2,626	25,627	633	570	1,439	1,041
	VA	1,186	11,882	1,529	1,375	3,641	492
	WV	1,311	13,224	329	296	808	517
	<b>Total</b>	<b>19,568</b>	<b>187,328</b>	<b>5,815</b>	<b>5,232</b>	<b>14,022</b>	<b>7,761</b>
<b>Grand Total</b>		<b>125,597</b>	<b>421,918</b>	<b>23,780</b>	<b>22,107</b>	<b>52,444</b>	<b>25,401</b>



**Table 1.3-20. Change in 2002 Emissions, Base G Inventory  
Relative to Base F Inventory**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	+48%	+6%	+5%	+14%	+7%	+41%
	FL	0%	0%	0%	0%	0%	0%
	GA	0%	0%	0%	0%	0%	0%
	KY	+109%	+41%	+40%	+40%	+41%	+51%
	MS	0%	0%	0%	0%	0%	0%
	NC	0%	0%	0%	0%	0%	0%
	SC	0%	0%	0%	0%	0%	0%
	TN	0%	0%	0%	0%	0%	0%
	VA	+22%	+41%	+77%	+77%	-65%	+12%
	WV	0%	0%	0%	0%	0%	0%
	<b>Total</b>		<b>+10%</b>	<b>+6%</b>	<b>+14%</b>	<b>+14%</b>	<b>-19%</b>
Commercial Marine (2280)	AL	0%	0%	0%	0%	0%	0%
	FL	0%	0%	0%	0%	0%	0%
	GA	0%	0%	0%	0%	0%	0%
	KY	0%	0%	0%	0%	0%	0%
	MS	0%	0%	0%	0%	0%	0%
	NC	0%	0%	0%	0%	0%	0%
	SC	0%	0%	0%	0%	0%	0%
	TN	0%	0%	0%	0%	0%	0%
	VA	0%	0%	0%	0%	0%	0%
	WV	0%	0%	0%	0%	0%	0%
	<b>Total</b>		<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>
Military Marine (2283)	VA	0%	0%	0%	0%	0%	0%
	<b>Total</b>		<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>
Locomotives (2285)	AL	+1%	+1%	0%	0%	0%	+1%
	FL	0%	0%	0%	0%	0%	0%
	GA	0%	0%	0%	0%	0%	0%
	KY	0%	0%	0%	0%	0%	0%
	MS	0%	0%	0%	0%	0%	0%
	NC	0%	0%	0%	0%	0%	0%
	SC	0%	0%	0%	0%	0%	0%
	TN	0%	0%	0%	0%	0%	0%
	VA	0%	0%	0%	0%	0%	0%
	WV	0%	0%	0%	0%	0%	0%
<b>Total</b>		<b>+0%</b>	<b>+0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>+0%</b>
<b>Grand Total</b>		<b>+6%</b>	<b>+0%</b>	<b>+4%</b>	<b>+4%</b>	<b>-1%</b>	<b>+2%</b>

**Table 1.3-21. Base G Comparison of Aircraft Emissions  
(Airports with Aircraft NO<sub>x</sub> > 200 tons per year)**

Airport	FIP	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC	Approx. LTOs	Predicted NO <sub>x</sub>	VISTAS to Predicted
<i>Base F 2002 Base Year Inventory</i>										
Atlanta	13063	4,121	5,288	1,435	1,406	443	337	420,000	4,704	1.12
Miami	12086	6,670	2,933	805	789	274	1,596	150,000	1,680	1.75
Orlando	12095	3,456	2,170	568	556	204	642	150,000	1,680	1.29
Memphis	47157	3,462	1,934	506	495	185	603	125,000	1,400	1.38
Orlando-Sanford	12117	3,615	1,225	338	332	100	351			
Fort Lauderdale	12011	1,930	809	217	212	75	257	75,000	840	0.96
Charlotte	37119	1,643	788	206	202	75	255	150,000	1,680	0.47
Tampa	12057	1,399	785	206	202	74	240	75,000	840	0.93
Nashville	47037	1,819	653	170	166	33	239	60,000	672	0.97
Reagan	51013	1,269	635	171	168	193	97	100,000	1,120	0.57
Dulles 1	51107	1,807	595	164	161	252	153	37,500	420	1.42
Raleigh	37183	1,584	592	156	153	56	204	75,000	840	0.70
Dulles 2	51059	1,095	591	156	153	252	115	37,500	420	1.41
Hampton	51650	858	535	471	461	18	305	Military		
Louisville	21111	1,073	468	123	121	45	155	60,000	672	0.70
Jacksonville	12031	871	325	87	85	31	112	30,000	336	0.97
Palm Beach	12099	1,156	226	59	58	1	132	30,000	336	0.67
Cincinnati	21015	467	144	38	37	14	54	50,000	560	0.26
Aggregate		38,296	20,694	5,876	5,758	2,326	5,847			0.26-1.75
<i>Base G 2002 Base Year Inventory</i>										
Atlanta	13063	4,121	5,288	1,435	1,406	443	337	420,000	4,704	1.12
Miami	12086	6,670	2,933	805	789	274	1,596	150,000	1,680	1.75
Orlando	12095	3,456	2,170	568	556	204	642	150,000	1,680	1.29
Memphis	47157	3,462	1,934	506	495	185	603	125,000	1,400	1.38
Orlando-Sanford	12117	3,615	1,225	338	332	100	351			
Fort Lauderdale	12011	1,930	809	217	212	75	257	75,000	840	0.96
Charlotte	37119	1,643	788	206	202	75	255	150,000	1,680	0.47
Tampa	12057	1,399	785	206	202	74	240	75,000	840	0.93
Nashville	47037	1,819	653	170	166	33	239	60,000	672	0.97
Reagan	51013	1,269	635	171	168	193	97	100,000	1,120	0.57
Dulles 1	51107	1,807	595	164	161	252	153	37,500	420	1.42
Raleigh	37183	1,584	592	156	153	56	204	75,000	840	0.70
Dulles 2	51059	1,095	591	156	153	252	115	37,500	420	1.41
Hampton	51650	858	535	471	461	18	305	Military		
Louisville	21111	1,073	468	123	121	45	155	60,000	672	0.70
Cincinnati	21015	3,378	411	110	107	39	187	50,000	560	0.73
Jacksonville	12031	871	325	87	85	31	112	30,000	336	0.97
Palm Beach	12099	1,156	226	59	58	1	132	30,000	336	0.67
Aggregate		41,207	20,961	5,947	5,828	2,352	5,981			0.47-1.75
Net Change		+8%	+1%	+1%	+1%	+1%	+2%			

Note: For the revised inventory, Dulles International Airport emissions are split between two Virginia counties. Predicted NO<sub>x</sub> is based on the ratio of airport LTOs to test airport (Tucson International Airport) LTOs and NO<sub>x</sub>. This is not a rigorous comparison, but rather an approximate indicator of expected magnitude.

### 1.3.2.3 Emissions from NONROAD Model Sources in Illinois, Indiana, and Ohio

As part of the Base G update process, VISTAS requested that emissions estimates for 2002 be produced for the states of Illinois, Indiana, and Ohio. These estimates were to be produced at the same spatial (i.e., county level by SCC) and temporal resolution as estimates for the VISTAS region.

The requested estimates were produced by extracting a complete set of county-level input data applicable to each of the three states from the latest version of the EPA's NMIM (National Mobile Inventory Model) model. This included appropriate consideration of all non-default NMIM input files generated by the Midwest Regional Planning Organization (MRPO), as described below. These input data were then assembled into appropriate input files for the Final NONROAD2005 model and emission estimates were produced using the same procedure employed for the VISTAS region as part of the Base G updates.

A complete set of monthly input data was developed for each county in Illinois, Indiana, and Ohio by extracting data from the following NMIM database files (using the NMIM MySQL query browser):

county, countrynrfile, countyyear, countyyearmonth, countyyearmonthhour,  
gasoline, diesel, and natural gas

The database files:

countrynrfile, countyyear, countyyearmonth, and gasoline

were non-default database files provided to VISTAS by the MRPO, and are intended to reflect the latest planning data being used by MRPO modelers.

From these files, monthly data for gasoline vapor pressure, gasoline oxygen content, gasoline sulfur content, diesel sulfur content for land-based equipment, diesel sulfur content for marine-based equipment, natural gas sulfur content, minimum daily temperature, maximum daily temperature, and average daily temperature were developed. In addition, the altitude and Stage II refueling control status of each county, as well as the identity of the associated equipment population, activity, growth, allocation, and seasonal distribution files, was determined. These data were then assembled into Final NONROAD2005 input files on a seasonal basis, with monthly data being arithmetically averaged to produce seasonal equivalents as follows:

Winter = Average of December, January, and February  
Spring = Average of March, April, and May  
Summer = Average of June, July, and August,  
Fall = Average of September, October, and November

Unlike the VISTAS Base G approach, this approach results in the use of the following non-default data files during the Final NONROAD2005 modeling process:

**Table 1.3-22 Non-Default Files Used for MRPO Modeling**

Data File	Illinois	Indiana	Ohio
Activity File	1700002.act	1800002.act	3900002.act
Growth File	17000.grw	18000.grw	39000.grw
Population File	17000.pop	18000.pop	39000.pop
Season File	17000.sea	18000.sea	39000.sea
Inboard Marine Allocation File	17000wib.alo	18000wib.alo	39000wib.alo
Outboard Marine Allocation File	17000wob.alo	18000wob.alo	39000wob.alo
Specific Fuel Consumption	MRPO-specific file provided by MRPO modelers (arbitrarily named "mrpoBSFC.emf" for this work)		

One compromise was made relative to the level of resolution that is available through the basic approach described above, that being the treatment of ambient temperature data. Because NMIM offers a unique temperature profile for every U.S. county -- developed by aggregating temperature data from included and surrounding weather stations on the basis of their distances from the county population centroid -- it is not possible to explicitly group counties with otherwise identical input streams. Ungrouped however, there would be 1,128 distinct input streams to be processed (102 Illinois counties plus 92 Indiana counties plus 88 Ohio counties at four seasons each), or over five times the number of files processed for the entire VISTAS region.

To surmount this problem and allow counties with similar temperature profiles to be grouped an approach was employed wherein counties were considered groupable if *all* temperature inputs<sup>4</sup> are within  $\pm 2$  °F of the corresponding group average. This criterion is quite stringent in that it results in less tolerant grouping than that employed for VISTAS modeling, which uses temperature data from the nearest meteorological station as opposed to "unique" meteorological

<sup>4</sup> Non-road temperature inputs used for county grouping are: winter minimum, spring minimum, summer minimum, fall minimum, winter maximum, spring maximum, summer maximum, fall maximum, winter average, spring average, summer average, and fall average.

data for each county. Under this approach, the actual deviation for grouped counties is *much* less than  $\pm 2$  °F for the overwhelming majority of the 12 grouped temperature inputs.

In addition to the required temperature consistency, all other input data for counties to be grouped had to be identical for all four seasons. Using this criterion, Illinois emissions were modeled using 12 county groups, Indiana emissions were modeled using 9 county groups, and Ohio emissions were modeled using 10 county groups. Thus, 31 iterations of NONROAD2002 were required per season, as compared to the 53 iterations per season required for the VISTAS region.

It should be noted that a potential quality assurance issue was noted in assembling the NONROAD2005 input data for a number of Indiana counties. Specifically, the gasoline vapor pressure for most Indiana counties reflects a value of 9.0 psi in *all* spring, summer, fall, and winter months. This is likely to indicate a problem with the accuracy of the NMIM databases for these counties, but these data were used as defined for this work.

### **1.3.3      *Quality Assurance steps***

Throughout the inventory development process, quality assurance steps were performed to ensure that no double counting of emissions occurred, and to ensure that a full and complete inventory was developed for VISTAS. Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on the area source component of the 2002 base year revised:

1. All CERR and NIF format State supplied data submittals were run through EPA's Format and Content checking software.
2. SCC level emission summaries were prepared and evaluated to ensure that emissions were consistent and that there were no missing sources.
3. Tier comparisons (by pollutant) were developed between the revised 2002 base year inventory and the initial base year inventory.
4. Data product summaries were provided to both the VISTAS Emission Inventory Technical Advisor and to Mobile Source SIWG representatives for review and comment. Changes based on these comments were implemented in the files.
5. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from 1.0 to 2.0. A minor change would cause a version number to go from 1.0 to 1.1. Minor changes resulting from largely editorial changes would result in a change from 1.00 to 1.01.

## **2.0 Projection Inventory Development**

### **2.1 Point Sources**

We used different approaches for different sectors of the point source inventory:

- For the EGUs, VISTAS relied primarily on the Integrated Planning Model<sup>®</sup> (IPM<sup>®</sup>) to project future generation as well as to calculate the impact of future emission control programs. The IPM results were adjusted based on S/L agency knowledge of planned emission controls at specific EGUs.
- For non-EGUs, we used recently updated growth and control data consistent with the data used in EPA's CAIR analyses, and supplemented these data with available S/L agency input and updated fuel use forecast data for the U.S. Department of Energy.

For both sectors, we generated 2009 and 2018 inventories for a combined on-the-books (OTB) and on-the-way (OTW) control scenario. The OTB/OTW control scenario accounts for post-2002 emission reductions from promulgated and proposed federal, State, local, and site-specific control programs as of July 1, 2004. Section 2.1.1 discusses the EGU projection inventory development, while Section 2.1.2 discusses the non-EGU projection inventory development.

#### **2.1.1 EGU Emission Projections**

The following subsections discuss the following specific aspects of the development of the EGU projections. First, we present a chronology of the EGU development process and discuss key decisions in selecting the final methods for performing the emissions projections. Next, we describe the development of the final set of IPM runs that are included in the VISTAS Base G inventory. Next, we describe the process of transforming the IPM parsed files into NIF format. Fourth, we discuss the process for ensuring that units accounted for in IPM were not double-counted in the non-EGU inventory. Fifth, we describe the QA/QC checks that were made to ensure that the IPM results were properly incorporated into the VISTAS inventory. Sixth, we document the changes to the IPM results that S/L agencies specified they wanted included in the VISTAS inventory based on new information that was not accounted for in the IPM runs. Finally, we present summarize the Base G projected EGU emissions by year, state, and pollutant.

##### **2.1.1.1 Chronology of the Development of EGU Projections**

At the beginning of the EGU inventory development process, VISTAS considered three options for developing the VISTAS 2009 and 2018 projection inventories for EGUs:

- Option 1 – Use the results of IPM modeling conducted in support of the proposed Clean Air Interstate Rule (CAIR) base and control case analyses as the starting point and refine the projections with readily available inputs from stakeholders; these IPM runs were

conducted for 2010 and 2015, which VISTAS would use to represent projected emissions in 2009 and 2018 respectively.

- Option 2 – Use the VISTAS 2002 typical year as the starting point, apply growth factors from the Energy Information Administration, and refine future emission rates with stakeholder input regarding utilization rates, capacity, retirements, and new unit information.
- Option 3 – Use the results of a new round of IPM modeling sponsored by VISTAS and the Midwest Regional Planning Organization (MRPO). These runs incorporated VISTAS specific unit and regulation modified parameters, and generate results for 2009 and 2018 explicitly.

An additional consideration for each of the three options was the inclusion of emission projections developed by the Southern Company specifically for their units. Southern Company is a super-regional company which owns EGUs in Alabama, Florida, Georgia, and Mississippi and participates in VISTAS as an industry stakeholder. Southern Company used their energy budget forecast to project net generation and heat input for every existing and future Southern Company EGU for the years 2009 and 2018. Further documentation of how Southern Company generated the 2009/2018 inventory for their units can be found in *Developing Southern Company Emissions and Flue Gas Characteristics for VISTAS Regional Haze Modeling (April 2005, presented at 14<sup>th</sup> International Emission Inventory Conference)*.

Each of these three options and the Southern Company projections were discussed in a series of conference calls with the VISTAS EGU Special Interest Work Group (SIWG) during the fall of 2004. During a conference call on December 6, 2004, the VISTAS EGU SIWG approved the use of the latest VISTAS/MRPO sponsored IPM runs (Option 3) to represent the 2009 and 2018 EGU forecasts of emissions for the OTB and OTW cases. During the call, Alabama and Georgia specified that they did not wish to use Southern Company provided emissions forecasts of 2009 and 2018 to represent the sources in their States. Mississippi decided to utilize the Southern Company projections to represent activity at Southern Company facilities in Mississippi. After the call, Florida decided against using Southern Company provided emissions forecasts of 2009 and 2018 to represent the sources in their State. Thus, Southern Company data was used only for Southern Company units in Mississippi for both the Base F and Base G projections.

The Option 3 IPM modeling resulted from a joint agreement by VISTAS and MRPO to work together to develop future year utility emissions based on IPM modeling. The decision to use IPM modeling was based in part on a study of utility forecast methods by E.H. Pechan and Associates, Inc. (Pechan) for MRPO, which recommended IPM as a viable methodology (see *Electricity Generating Unit {EGU} Growth Modeling Method Task 2 Evaluation*, February 11,



2004). Although IPM results were available from EPA's modeling to support their rulemaking for the Clean Air Interstate Rule (CAIR), VISTAS stakeholders felt that certain model inputs needed to be improved. Thus, VISTAS and MRPO decided to hire contractors to conduct new IPM modeling and to post-process the IPM results. Southern Company projections in 2009 were roughly comparable with IPM. For 2018, Southern Company projections were generally less than IPM because of assumptions made by Southern Company on which units would be economical to control and incorrect data in the NEEDS database which feeds IPM.

In August 2004, VISTAS contracted with ICF International, Inc., to run IPM to provide utility forecasts for 2009 and 2018 under two future scenarios – Base Case and CAIR Case. The Base Case represents the current operation of the power system under currently known laws and regulations (as known at the time the run was made), including those that come into force in the study horizon. The CAIR Case is the Base Case with the proposed CAIR rule superimposed. The run results were parsed at the unit level for the 2009 and 2018 run years. Also in August 2004, MRPO contracted with E.H. Pechan to post-process the IPM outputs generated by ICF to provide model-ready emission files. The IPM output files were delivered by ICF to VISTAS in November (*Future Year Electricity Generating Sector Emission Inventory Development Using the Integrated Planning Model (IPM<sup>®</sup>) in Support of Fine Particulate Mass and Visibility Modeling in the VISTAS and Midwest RPO Regions*, January 2005), and the post-processed data files were delivered by Pechan to the MRPO in December 2004 (*LADCO IPM Model Parsed File Post-Processing Methodology and File Preparation*, February 8, 2005).

On March 10, 2005, EPA issued the final Clean Air Interstate Rule. VISTAS and MRPO, in conjunction with other RPOs, conducted another round of IPM modeling which reflected changes to control assumptions based on the final CAIR as well as additional changes to model inputs based on S/L agency and stakeholder comments. Several conference calls were conducted in the spring of 2005 to discuss and provide comments on IPM assumptions related to six main topics: power system operation, generating resources, emission control technologies, set-up parameters and rule, financial assumptions, and fuel assumptions. Based on these discussions, VISTAS sponsored a new set of IPM runs to reflect the final CAIR requirements as well as certain changes to IPM assumptions that were agreed to by the VISTAS states. This set of IPM runs is documented in *Future Year Electricity Generating Sector Emission Inventory Development Using the Integrated Planning Model (IPM<sup>®</sup>) in Support of Fine Particulate Mass and Visibility Modeling in the VISTAS and Midwest RPO Regions*, April 2005 (these runs are referred to as the VISTAS Phase I analysis).

Further refinements to the IPM inputs and assumptions were made by the RPOs, and ICF performed the following four runs using IPM during the summer of 2005 (these runs are referred to as the VISTAS/CENRAP Phase II analysis):



Base Case with EPA 2.1.9 coal, gas and oil price assumptions.

- Base Case with EPA 2.1.9 coal and gas supply curves adjusted for AEO 2005 reference case price and volume relationships.
- Strategy Case with EPA 2.1.9 coal, gas and oil price assumptions.
- Strategy Case with EPA 2.1.9 coal and gas supply curves adjusted for AEO 2005 reference case price and volume relationships.

The above runs were parsed for 2009 and 2018 run years. The above four runs were based on VISTAS Phase I and the EPA 2.1.9 assumptions. The changes that were implemented in the above four runs are summarized below:

- Unadjusted AEO 2005 electricity demand projections were incorporated in the above four runs.
- The gas supply curves were adjusted for AEO 2005 reference case price and volume relationships. The EPA 2.1.9 gas supply curves were scaled such that IPM will solve for AEO 2005 gas prices when the power sector gas demand in IPM is consistent with AEO 2005 power sector gas demand projections.
- The coal supply curves used in EPA 2.1.9 were scaled in such a manner that the average mine mouth coal prices that the IPM is solving in aggregated coal supply regions are comparable to AEO 2005. Due to the fact that the coal grades and supply regions between AEO 2005 and the EPA 2.1.9 are not directly comparable, this was an approximate approach and had to be performed in an iterative fashion. The coal transportation matrix was not updated with EIA assumptions due to significant differences between the EPA 2.1.9 and EIA AEO 2005 coal supply and coal demand region configurations.
- The cost and performance of new units were updated to AEO 2005 reference case levels in all of the above four runs.
- The run years 2008, 2009, 2012, 2015, 2018, 2020 and 2026 were modeled.
- The AEO 2005 life extension costs for fossil and nuclear units were incorporated in the above runs.
- The extensive NEEDS comments provided by VISTAS, MRPO, CENRAP and MANE-VU were incorporated into the VISTAS Phase I NEEDS.

- MANE-VU's comments in regards to the state regulations in the northeast were incorporated.
- Renewable Portfolio Standards (RPS) in the northeast was modeled based on the Regional Greenhouse Gas Initiative analysis. A single RPS cap was modeled for MA, RI, NY, NJ, MD and CT. These states could buy credits from NY, PJM and New England model regions.
- The investments required under the Illinois power, Mirant and First Energy NSR settlements were incorporated in the above runs.

For the VISTAS/CENRAP Phase II set of IPM runs, ICF generated two different parsed files. One file includes all fuel burning units (fossil, biomass, landfill gas) as well as non-fuel burning units (hydro, wind, etc.). The second file contains just the fossil-fuel burning units (e.g., emissions from biomass and landfill gas are omitted). The RPOs decided to use the fossil-only file for modeling to be consistent with EPA, since EPA used the fossil only results for CAIR analyses. For the 10 VISTAS states, non-fossil fuels accounted for only 0.13 percent of the NO<sub>x</sub> emissions and 0.04 percent of the SO<sub>2</sub> emissions in the 2009 IPM runs.

S/L agencies reviewed the results of the VISTAS/CENRAP Phase II set of IPM runs, which were incorporated into the VISTAS Base F inventory. S/L agencies primarily reviewed and commented on the IPM results with respect to IPM decisions on NO<sub>x</sub> post-combustion controls and SO<sub>2</sub> scrubbers. S/L agencies provided the latest information on when and where new SO<sub>2</sub> and NO<sub>x</sub> controls are planned to come online. S/L agencies also reviewed the IPM results to verify that existing controls and emission rates were properly reflected in the IPM runs. As directed by the S/L agencies, adjustments to the IPM results were made to specific units with any new information they had as part of the permitting process or other contact with the industry that indicates which units will install controls as a result of CAIR and when these new controls will come on-line. Mississippi decided to continue to use the Southern Company projections instead of the IPM projections to represent emissions at Southern Company facilities in Mississippi. The state-specified changes to the VISTAS/CENRAP Phase II set of IPM runs were used to create the Base G projection inventory (and are documented later in Section 2.1.1.6).

#### **2.1.1.2 VISTAS IPM runs for EGU sources**

The following general summary of the VISTAS IPM<sup>®</sup> modeling is based on ICF's documentation *Future Year Electricity Generating Sector Emission Inventory Development Using the IPM<sup>®</sup> in Support of Fine Particulate Mass and Visibility Modeling in the VISTAS and Midwest RPO Regions*, April 2005. The ICF documentation is to be used as an extension to EPA's proposed CAIR modeling runs documented in *Documentation Supplement for EPA Modeling Applications (V.2.1.6) Using the IPM*, EPA 430/R-03-007, July 2003.

IPM provides “forecasts of least-cost capacity expansion, electricity dispatch, and emission control strategies for meeting energy demand and environmental, transmission, dispatch, and reliability constraints.” The underlying database in this modeling is U.S. EPA’s National Electric Energy Data System (NEEDS) released with the CAIR Notice of Data Availability (NODA). The NEEDS database contains the existing and planned/committed unit data in EPA modeling applications of IPM. NEEDS includes basic geographic, operating, air emissions, and other data on these generating units. VISTAS States and stakeholders provided changes for:

- NO<sub>x</sub> post-combustion control on existing units
- SO<sub>2</sub> scrubbers on existing units
- SO<sub>2</sub> emission limitations
- PM controls on existing units
- Summer net dependable capacity
- Heat rate for existing units
- SO<sub>2</sub> and NO<sub>x</sub> control plans based on State rules or enforcement settlements

The years 2009 and 2018 were explicitly modeled.

### **2.1.1.3 Post-Processing of IPM Parsed Files**

The following summary of the VISTAS/Midwest Regional Planning Organization (MRPO) IPM modeling is based on Pechan’s documentation *LADCO IPM Model Parsed File Post-Processing Methodology and File Preparation*, February 8, 2005. The essence of the IPM model post-processing methodology is to take an initial IPM model output file and transform it into air quality model input files. ICF via VISTAS/MRPO provides an initial spreadsheet file containing unit-level records of both

- (1) “existing” units and
- (2) committed or new generic aggregates.

All records have unit and fuel type data; existing, retrofit (for SO<sub>2</sub> and NO<sub>x</sub>), and separate NO<sub>x</sub> control information; annual SO<sub>2</sub> and NO<sub>x</sub> emissions and heat input; summer season (May-September) NO<sub>x</sub> and heat input; July day NO<sub>x</sub> and heat input; coal heat input by coal type; nameplate capacity megawatt (MW), and State FIPS code. Existing units also have county FIPS code, a unique plant identifier (ORISPL) and unit ID (also called boiler ID) (BLRID); generic units do not have these data. The processing includes estimating various types of emissions and adding in control efficiencies, stack parameters, latitude-longitude coordinates, and State identifiers (plant ID, point ID, stack ID, process ID). Additionally, the generic units are sited in a county and given appropriate IDs. This processing is described in more detail below.

The data are prepared by transforming the generic aggregates into units similar to the existing units in terms of the available data. The generic aggregates are split into smaller generic units based on their unit types and capacity, are provided a dummy ORIS unique plant and boiler ID, and are given a county FIPS code based on an algorithm that sites each generic by assigning a sister plant that is in a county based on its attainment/nonattainment status. Within a State, plants (in county then ORIS plant code order) in attainment counties are used first as sister sites to generic units, followed by plants in PM nonattainment counties, followed by plants in 8-hour ozone nonattainment counties. Note that no LADCO or VISTAS States provided blackout counties that would not be considered when siting generics, so this process is identical to the one used for EPA IPM post-processing.

SCCs were assigned for all units; unit/fuel/firing/bottom type data were used for existing units' assignments, while only unit and fuel type were used for generic units' assignments. Latitude-longitude coordinates were assigned, first using the EPA-provided data files, secondly using the September 17, 2004 Pechan in-house latitude-longitude file, and lastly using county centroids. These data were only used when the data were not provided in the 2002 NIF files. Stack parameters were attached, first using the EPA-provided data files, secondly using a March 9, 2004 Pechan in-house stack parameter file based on previous EIA-767 data, and lastly using an EPA June 2003 SCC-based default stack parameter file. These data were only used when the data were not provided in the 2002 NIF files.

Additional data were required for estimating VOC, CO, filterable primary PM<sub>10</sub> and PM<sub>2.5</sub>, PM condensable, and NH<sub>3</sub> emissions for all units. Thus, ash and sulfur contents were assigned by first using 2002 EIA-767 values for existing units or SCC-based defaults; filterable PM<sub>10</sub> and PM<sub>2.5</sub> efficiencies were obtained from the 2002 EGU NEI that were based on 2002 EIA-767 control data and the PM Calculator program (a default of 99.2 percent is used for coal units if necessary); fuel use was back calculated from the given heat input and a default SCC-based heat content; and emission factors were obtained from an EPA-approved October 7, 2004 Pechan emission factor file based on AP-42 emission factors. Note that this updated file is not the one used for estimating emissions for previous EPA post-processed IPM files. Emissions for 28 temporal-pollutant combinations were estimated since there are seven pollutants (VOC, CO, primary PM<sub>10</sub> and PM<sub>2.5</sub>, NH<sub>3</sub>, SO<sub>2</sub> and NO<sub>x</sub>) and four temporal periods (annual, summer season, winter season, July day).

The next step was to match the IPM unit IDs with the identifiers in VISTAS 2002 inventory. A crosswalk file was used to obtain FIPS State and county, plant ID (within State and county), and point ID. If the FIPS State and county, plant ID and point ID are in the 2002 VISTAS NIF tables, then the process ID and stack ID are obtained from the NIF; otherwise, defaults, described above, were used.

Pechan provided the post-processed files in NIF 3.0 format. Two sets of tables were developed : “NIF files” for IPM units that have a crosswalk match and are in the 2002 VISTAS inventory, and “NoNIF files” for IPM units that are not in the 2002 VISTAS inventory (which includes existing units with or without a crosswalk match as well as generic units).

For Base F and Base G projections, VISTAS reviewed the PM and NH<sub>3</sub> emissions from EGUs as provided by Pechan and identified significantly higher emissions in 2009/2018 than in 2002. VISTAS determined that Pechan used a set of PM and NH<sub>3</sub> emission factors that are “the most recent EPA approved uncontrolled emission factors” for estimating 2009/2018 emissions. These factors are most likely not the same emission factors used by States for estimating these emissions in 2002 for EGUs in the VISTAS domain. Thus, the emission increase from 2002 to 2009/2018 was simply an artifact of the change in emission factor, not anything to do with changes in activity or control technology application. Also, VISTAS identified an inconsistent use of SCCs for determining emission factors between the base and future years.

VISTAS resolution of the PM and NH<sub>3</sub> problem is fully documented in *EGU Emission Factors and Emission Factor Assignment*, memorandum from Greg Stella to VISTAS State Point Source Contacts and VISTAS EGU Special Interest Workgroup, June 13, 2005. The first step was the adjustment of the 2002 base year emissions inventory. Using the latest “EPA-approved” uncontrolled emission factors by SCC, Alpine Geophysics utilized CERR or VISTAS reported annual heat input, fuel throughput, heat, ash and sulfur content to estimate annual uncontrolled emissions for units identified as output by IPM. This step was conducted for non-CEM pollutants (CO, VOC, PM, and NH<sub>3</sub>) only. For PM emissions, the condensable component of emissions was calculated and added to the resulting PM primary estimations. The resulting emissions were then adjusted by any control efficiency factors reported in the CERR or VISTAS data collection effort. The second adjustment was to the future year inventories. Alpine Geophysics updated the SCCs in the future year inventory to assign the same base year SCC. Using the same methods as described for the 2002 revisions, those non-IPM generated pollutants were estimated using IPM predicted fuel characteristics and base year 2002 SCC assignments.

#### **2.1.1.4 Eliminating Double Counting of EGU Units**

The following procedures were used to avoid double counting of EGU emissions in the 2009/2018 point source inventory. The 2002 VISTAS point source emission inventory contains both EGUs and non-EGUs. Since this file contains both EGUs and non-EGU point sources, and EGU emissions are projected using the IPM, it was necessary to split the 2002 point source file into two components. The first component contains those emission units accounted for in the IPM forecasts. The second component contains all other point sources not accounted for in IPM.

As described in the previous section, Pechan developed 2009/2018 NIF files for EGUs from the IPM parsed files. All IPM matched units were initially removed from the 2009/2018 point source

inventory to create the non-EGU inventory (which was projected to 2009/2018 using the non-EGU growth and control factors described in Section 2.1.2). This was done on a unit-by-unit basis based on a cross-reference table that matches IPM emission unit identifiers (ORISPL plant code and BLRID emission unit code) to VISTAS NIF emission unit identifiers (FIPSST state code, FIPSCNTY county code, State Plant ID, State Point ID). When there was a match between the IPM ORISPL/BLRID and the VISTAS emission unit ID, the unit was assigned to the EGU inventory; all other emission units were assigned to the non-EGU inventory.

If an emission unit was contained in the NIF files created by Pechan from the IPM output, the corresponding unit was removed from the initial 2009/2018 point source inventory. The NIF 2009/2018 EGU files from the IPM parsed files were then merged with the non-EGU 2009/2018 files to create the 2009/2018 Base F point source files.

Next, we prepared several ad-hoc QA/QC queries to verify that there was no double-counting of emissions in the EGU and non-EGU inventories:

- We reviewed the IPM parsed files { VISTASII\_PC\_1f\_AllUnits\_2009 (To Client).xls and VISTASII\_PC\_1f\_AllUnits\_2018 (To Client).xls } to identify EGUs accounted for in IPM. We compared this list of emission units to the non-EGU inventory derived from the VISTAS cross-reference table to verify that units accounted for in IPM were not double-counted in the non-EGU inventory. As a result of this comparison, we made a few adjustments in the cross-reference table to add emission units for four plants to ensure these units accounted for in IPM were moved to the EGU inventory.
- We reviewed the non-EGU inventory to identify remaining emission units with an Standard Industrial Classification (SIC) code of “4911 Electrical Services” or Source Classification Code of “1-01-xxx-xx External Combustion Boiler, Electric Generation”. We compared the list of sources meeting these selection criteria to the IPM parsed file to ensure that these units were not double-counted.

S/L agencies also reviewed the 2009/2018 point source inventory to verify whether there was any double counting of EGU emissions. In two instances, S/L agencies provided corrections where an emission unit was double counted.

#### **2.1.1.5 Quality Assurance steps**

Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on the EGU component of the VISTAS revised 2009/2018 EGU inventory:



1. Provided parsed files (i.e., Excel spreadsheets that provide unit-level results derived from the model plant projections obtained by the IPM) to the VISTAS EGU SIWG for review and comment.
2. Provided facility level emission summaries for 2009/2018 for both the base case and CAIR case to the VISTAS EGU SIWG to ensure that emissions were consistent and that there were no missing sources.
3. Compared, at the State-level, emissions from the IPM parsed files and the post-processed NIF files to verify that the post-processed NIF files were consistent with the IPM parsed file results.

VISTAS requested S/L review of these files – the changes specified by states as a result of this review are documented in the following subsection.

#### **2.1.1.6 S/L Adjustments to IPM Modeling Results for Base G Projections**

After S/L agency review of the final set of IPM runs (as incorporated into the Base F inventory), S/L agencies specified a number of changes to the IPM results to better reflect current information on when and where future controls would occur. These changes to the IPM results primarily involved S/L agency addition or subtraction future emission controls based on the best available data from state rules, enforcement agreements, compliance plans, permits, and discussions/commitments from individual companies.

For example, Dominion Virginia Power released their company-wide plan to reduce emission to meet the requirements of CAIR and other programs. This plan varies substantially from the IPM results both in terms current and future controls and timing of these controls. As a result, VA DEQ developed their best estimates of future controls on EGUs in Virginia. Also, Duke Energy and Progress Energy have updated their plans for complying with North Carolina's Clean Smokestack Act. These plans vary substantially from the IPM results both in terms current and future controls and timing of these controls. As a result, NC DENR replaced the IPM emission projections for 2009 with projections from the Duke Energy and Progress Energy compliance plan. NC DENR elected to use the IPM results for 2018.

Some S/L agencies specified changes to the controls assigned by IPM to reflect their best estimates of emission controls. The changes specified by the S/L agencies are summarized in Table 2.1-1. These changes involved either 1) adding selective catalytic reduction (SCR) or scrubber controls to units where IPM did not predict SCR or scrubber controls, or 2) removing IPM-assigned SCR or scrubber controls at units where the S/L agency indicated their were no firm plans for controls at those units. We used a scrubber control efficiency of 90 percent when adding or removing SO<sub>2</sub> scrubber controls. We used a control efficiency of 90 percent when adding or removing NO<sub>x</sub> SCR controls at coal-fired plants, 80 percent when adding or removing

NO<sub>x</sub> SCR controls at gas-fired plants, and 35 percent when adding or removing NO<sub>x</sub> SNCR controls.

In addition to the changes to the IPM-assigned controls, the S/L agencies also specified other types of changes to the IPM results. These other specific changes to the IPM results are summarized in Table 2.1-2.

S/L agencies provided information and/or comment on changes in stack parameters from the 2002 inventory for 2009/2018 inventory. Changes to stack parameters were also made in cases where new controls are scheduled to be installed. In cases where an emission unit projected to have a SO<sub>2</sub> scrubber in either 2009 or 2018, some states were able to provide revised stack parameters for some units based on design features for the new control system. Other units projected to install scrubbers by 2009 or 2018 are not far enough along in the design process to have specific design details. For those units, the VISTAS EGU SIWG made the following assumptions: 1) the scrubber is a wet scrubber; 2) keep the current stack height the same; 3) keep the current flow rate the same, and 4) change the stack exit temperature to 169 degrees F (this is the virtual temperature derived from a wet temperature of 130 degrees F). VISTAS determined that exit temperature (wet) of 130 degrees F +/- 5 degrees F is representative of different size units and wet scrubber technology.

#### **2.1.1.7 Summary of Base F and Base G 2009/2018 EGU Point Source Inventories**

Tables 2.1-3 through 2.1-9 compare the Base G 2002 base year inventory to the Base F4 and Base G 2009/2018 projection inventories. The Base F4 projections rely primarily on the results of the IPM, while the Base G projections include the adjustments to the IPM results specified by the S/L agencies in the previous section.



**Table 2.1-1 Adjustments to IPM Control Determinations Specified by S/L Agencies for the Base G 2009/2018 EGU Inventories.**

State	Plant Name and ID	Unit	NO <sub>x</sub> Emission Controls				SO <sub>2</sub> Emission Controls				
			2009		2018		2009		2018		
			IPM	State	IPM	State	IPM	State	IPM	State	
AL	James H. Miller ORISID=6002	1 & 2	SCR during ozone season	SCR probable year round due to CAIR	SCR during ozone season	SCR probable year round due to CAIR	None	None	None	Scrubber	
		3 & 4	SCR during ozone season	SCR year round from Consent Decree	SCR during ozone season	SCR year round from Consent Decree	None	None	None	Scrubber	
	Barry ORISID=3	1, 2, 3	None	SNCR	SCR	SNCR	None	None	None	None	
		4	None	SNCR	SCR	SNCR	None	None	Scrubber	Scrubber	
		5	None	None	SCR	SCR	None	None	Scrubber	Scrubber	
	E C Gaston ORISID=26	1 - 4	SCR	None	SCR	None	None	None	Scrubber	Scrubber	
		5	SCR	SCR	SCR	SCR	Scrubber	None	Scrubber	Scrubber	
	Gorgas ORISID=8	6 & 7	None	None	None	None	None	None	None	None	
		8 & 9	None	None	None	None	None	Scrubber	None	Scrubber	
		10	SCR	SCR	SCR	SCR	None	Scrubber	Scrubber	Scrubber	
	Charles R. Lowman ORISID=56	1	None	None	None	None	None	Scrubber	None	Scrubber	
		2 & 3	SCR	SCR	SCR	SCR	Scrubber	Scrubber	Scrubber	Scrubber	
	GA	Bowen ORISID=703	1BLR	SCR	SCR	SCR	SCR	IPM had retrofit scrubbers but little emission reductions	None	Scrubber	Scrubber
			2BLR	SCR	SCR	SCR	SCR		None	Scrubber	Scrubber
3BLR			SCR	SCR	SCR	SCR	Scrubber		Scrubber	Scrubber	
4BLR			SCR	SCR	SCR	SCR	Scrubber		Scrubber	Scrubber	

**Table 2.1-1 (continued)**

State	Plant Name and ID	Unit	NO <sub>x</sub> Emission Controls				SO <sub>2</sub> Emission Controls				
			2009		2018		2009		2018		
			IPM	State	IPM	State	IPM	State	IPM	State	
GA	Wansley ORISID=6052	1	SCR	SCR	SCR	SCR	IPM had retrofit scrubbers but little emission reductions	Scrubber	Scrubber	Scrubber	
		2	SCR	SCR	SCR	SCR		None	Scrubber	Scrubber	
	Kraft ORISID=733	1, 2	None	None	None	None	None	None	None	None	
		3	None	None	SCR	None	None	None	None	None	
	McIntosh ORISID=6124	1	None	None	SCR	None	None	None	None	None	
	Yates ORISID=728	1	None	None	None	None	Scrubber	Scrubber	Scrubber	Scrubber	
		2, 3	None	None	None	None	None	None	None	None	
		4 – 7	None	None	SCR	SCR	None	None	Scrubber	None	
	Hammond ORISID=708	1	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber	
		2	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber	
		3	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber	
		4	SCR	SCR	SCR	SCR	Scrubber	Scrubber	Scrubber	Scrubber	
	KY	Ghent ORISID=1356	1	None	SCR	SCR	SCR	Scrubber	Scrubber	Scrubber	Scrubber
			2	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber
3, 4			None	SCR	SCR	SCR	None	Scrubber	Scrubber	Scrubber	
Coleman ORISID=1381		C1	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber	
		C2	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber	
		C3	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber	
HMP&L Station 2		H1	SCR	SCR	SCR	SCR	Scrubber	Scrubber	Scrubber	Scrubber	
		H2	None	SCR	SCR	SCR	Scrubber	Scrubber	Scrubber	Scrubber	

Table 2.1-1 (continued)

State	Plant Name and ID	Unit	NO <sub>x</sub> Emission Controls				SO <sub>2</sub> Emission Controls			
			2009		2018		2009		2018	
			IPM	State	IPM	State	IPM	State	IPM	State
KY	E W Brown ORISID=1355	1	None	None	None	None	None	Scrubber	None	Scrubber
		2	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber
		3	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber
SC	Jeffries ORISID=3319	3	SCR	None	SCR	None	None	None	None	None
		4	None	None	None	None	None	None	None	None
	Wateree ORISID=3297	WAT1	SCR	SCR	SCR	SCR	None	Scrubber	None	Scrubber
		WAT2	SCR	SCR	SCR	SCR	None	Scrubber	Scrubber	Scrubber
	Canadys ORISID=3280	CAN1	None	None	None	None	None	None	None	None
		CAN2	None	None	None	None	None	None	None	None
		CAN3	None	None	None	None	None	Scrubber	None	Scrubber
	Rainey ORISID=7834	CT1A	None	SCR	None	SCR	None	None	None	None
CT1B		None	SCR	None	SCR	None	None	None	None	
TN	Kingston ORISID=3407	1 – 8	SCR	SCR	SCR	SCR	None	None	Scrubber	Scrubber
		9	None	SCR	SCR	SCR	None	None	Scrubber	Scrubber
	Johnsonville ORISID=3406	1 – 10	SCR	None	SCR	SCR	None	None	None	None
WV	Willow Island ORISID=3946	2	SCR	None	SCR	SCR	Scrubber	None	Scrubber	Scrubber
	Kammer ORISID=3947	1 -3	SCR	None	SCR	SCR	Scrubber	None	Scrubber	Scrubber

**Table 2.1-2. Other Adjustments to IPM Results Specified by S/L Agencies for the Base G 2009/2018 EGU Inventories.**

State	Plant Name and ID	Unit	Nature of Update/Correction
FL	Central Power and Lime ORISID= 10333	GEN1	Central Power and Lime (ORIS10333) is a duplicate entry. This is point 18 in Florida Crushed Stone (12-053-0530021). Removed IPM emissions for Central Power and Lime.
	Cedar Bay Generating ORISID=10672	GEN1	FLDEP disagrees with IPM projections - no knowledge of expansion of this facility and the cogeneration facility should not grow faster than the underlying industry. Cedar Bay is connected to Stone Container (12-031-0310067). Replaced IPM emissions with 2002 emissions for Cedar Bay (12-031-0310337) times the growth factors for Stone Container.
	Indiantown Cogeneration ORISID=50976	GEN1	FLDEP disagrees with IPM projections - no knowledge of expansion of this facility and the cogeneration facility should not grow faster than the underlying industry. Indiantown is connected to Louis Dreyfus Citrus (12-085-0850002). Replaced IPM emissions with 2002 emissions for Indiantown (12-085-0850102) times the growth factors for Louis Drefus Citrus.
GA	Bowen ORISID=703	1BLR 2BLR 3BLR 4BLR	IPM indicated retrofit scrubbers on all 4 units in 2009, but the IPM emissions showed little reductions from 2002 levels. Changed emissions to reflect scrubbers on 3BLR and 4BLR by 2009.
	Wansley ORISID=6052	1, 2	IPM indicated retrofit scrubbers on both units in 2009, but the IPM emissions showed little reductions from 2002 levels. Changed emissions to reflect one scrubber on Unit 1 by 2009.
	Riverside ORISID=734	4	All of plant Riverside was retired from service June 1, 2005; emissions set to zero in 2009 and 2018.
	McIntosh ORISID=727	CT10A CT10B CT11A CT11B	The McIntosh Combined Cycle facility became commercial June 1, 2005. Added 346 tons of NO <sub>x</sub> and 121 tons of SO <sub>2</sub> per unit to the 2009 and 2018 inventories.
	Longleaf Energy Station	1, 2	Longleaf Energy Station is being proposed by LS Power Development, Inc. GA specified that the emissions from this proposed plant be included in the 2018 projections. Boilers 1 and 2 added 1,882 tons of NO <sub>x</sub> and 3,227 tons of SO <sub>2</sub> per unit to the 2018 inventory.
	Duke Murray (55382)	1	Corrected coordinates to 34.7189 and -84.9353
MS	R D Morrow ORISID=6061	1, 2	Revised the 2018 emissions to reflect controls not indicated by IPM. The SO <sub>2</sub> emissions are much lower than IPM, but their expected NO <sub>x</sub> emissions are actually higher than IPM. The controls will be coming online 2009 or 2010, so the 2009 inventory did not change.
	Jack Watson (2049) Victor J Daniel (6073) Chevron Oil (2047)	All	MS DEQ specified that the emission projections provided by the Southern Company for their units in Mississippi were to be used instead of the IPM results.

**Table 2.1-2 (continued)**

State	Plant Name and ID	Unit	Nature of Update/Correction
NC	G G Allen (2718) Belews Creek (8042)1 Buck (2720) Cliffside (2721) Dan River (2723) Marshall (2727) Riverbend (2732)	All	Replaced all IPM 2009 results with emission projections from Duke Power's NC Clean Air Compliance Plan for 2006. Used IPM results for 2018
	Asheville (2706) Cape Fear (2708) Lee (2709) Mayo (6250) Roxboro (2712) Sutton (2713) Weatherspoon (2716)	All	Replaced all IPM 2009 results with emission projections from Progress Energy's NC Clean Smokestacks Act Calendar Year 2005 Progress Report. Used IPM results for 2018
	Dwayne Collier Battle Cogeneration Facility ORISID=10384	GEN1 GEN2	Dwayne Collier Battle is a duplicate entry. This is Cogentrix of Rocky Mount (37-065-3706500146, stacks G-26 and G-27). Duplicate entries were removed both the 2009 and 2018 inventories.
	Kannapolis Energy Partners ORISID=10626	GEN2 GEN3	Kannapolis Energy emissions are being used as credits for another facility. IPM emissions from this facility (37-025-ORIS10626) were removed from the EGU inventory for 2009 and 2018. Emissions from Kannapolis Energy (37-025-3702500113) were carried forward in the 2009/2018 inventory.
SC	Cross ORISID=130	1, 2	Unit 1: upgrade scrubber from 82 percent to 95 percent removal efficiency by June 30, 2006. Recalculate emissions based on upgrade in control efficiency. Unit 2: upgrade scrubber from 70 percent to 87 percent removal efficiency by June 30, 2006. Recalculate emissions based on upgrade in control efficiency.
	Winyah ORISID=6249	1 – 4	Unit 1: Install scrubber that meets 95 percent removal efficiency by Dec. 31, 2008; Upgrade ESP from 0.38 to 0.03 lb/mmBTU by Dec. 31, 2008 Unit 2: Replace scrubber with one that meets 95 percent removal efficiency from 45 percent by Dec. 31, 2008; Upgrade ESP from 0.10 to 0.03 lb/mmBTU by Dec. 31, 2008 Unit 3: Upgrade scrubber from 70 percent to 90 percent removal efficiency by Dec. 31, 2012; Upgrade ESP from 0.10 to 0.03 lb/mmBTU by Dec. 31, 2012 Unit 4: Upgrade scrubber from 70 percent to 90 percent removal efficiency by Dec. 31, 2007; Upgrade ESP from 0.10 to 0.03 lb/mmBTU by Dec. 31, 2007 Recalculated SO <sub>2</sub> and PM emissions based on upgrade in control efficiencies.

**Table 2.1-2 (continued)**

State	Plant Name and ID	Unit	Nature of Update/Correction
SC	Dolphus Grainger ORISID=3317	1, 2	Unit 1: Upgrade ESP from 0.60 to 0.03 lb/mmBTU by Dec. 31, 2012. Reduced PM <sub>10</sub> and PM <sub>25</sub> emissions in 2018 by 95 percent based on change in allowable emission rate Unit 2: Install low NO <sub>x</sub> burners that meet 0.46 lb/mmBTU from 0.9 by May 1, 2004. Recalculated NO <sub>x</sub> emissions using 0.46/lbs/mmBtu and IPM heat input Unit 2: Upgrade ESP from 0.60 to 0.03 lb/mmBTU by Dec. 31, 2012. Reduced PM <sub>10</sub> and PM <sub>25</sub> emissions in 2018 by 95 percent based on change in allowable emission rate
SC	Jeffries ORISID=3319	3, 4	Unit 3: Upgrade ESP from 0.54 to 0.03 lb/mmBTU by Dec. 31, 2012. Reduced PM <sub>10</sub> and PM <sub>25</sub> emissions in 2018 by 94.44 percent based on change in allowable emission rate Unit 4: Upgrade ESP from 0.54 to 0.03 lb/mmBTU by Dec. 31, 2012. Reduced PM <sub>10</sub> and PM <sub>25</sub> emissions in 2018 by 94.44 percent based on change in allowable emission rate
	W S Lee ORISID=3264	1, 2	IPM does not indicate that these units are installing SOFA NO <sub>x</sub> control technology by April 30, 2006 to meet 0.27 lb/mmBTU, down from 0.45 lb/mmBtu. Calculated NO <sub>x</sub> emissions using IPM heat input and 0.27 lbs/mmBtu
	Generic Unit ORISID=900545	All	All predictions for generic units appear reasonable with the exception of Plant ID ORIS900545 Point ID GSC45 which was modeled in Georgetown County. It will be very difficult to add new generation this close to the Cape Romain Class I area. Santee Cooper has no plans for future generation in Georgetown County, but does have plans for new future generation in Florence County. This unit was moved to coordinates specified in Florence County.
VA	AEP Clinch River ORISID=3775	1, 2, 3	Used IPM results for 2009; replaced all 2018 IPM results with VADEQ's growth and control estimates (no SCR or scrubbers).
	AEP Glen Lyn ORISID=3776	51, 52, 6	Used 2009/2018 IPM results for units 51 and 52; used 2009 IPM for unit 6; replaced 2018 IPM for unit 6 with VADEQ's growth and control estimates (nor SCR or scrubber).
	Dominion Clover ORISID=7213	1, 2	Used 2009/2018 IPM results.
	Dominion Bremono ORISID=3796	3, 4	Used 2009/2018 IPM results.
	Dominion Chesterfield ORISID=3797	3, 4, 5, 6	Replaced all 2009/2018 IPM results using VADEQ's growth and control estimates.
	Dominion Yorktown ORISID=3809	1, 2, 3	Units 1, 2: Used 2009/2018 IPM results for NO <sub>x</sub> and used VADEQ's growth and control estimates for SO <sub>2</sub> . Unit 3: IPM predicts zero heat input for this 880 MW #6 oil fired unit. Dominion plans to continue to operate Unit 3. Replaced all 2009/2018 IPM results using VADEQ's growth and control estimates.

**Table 2.1-2 (continued)**

State	Plant Name and ID	Unit	Nature of Update/Correction
VA	Dominion Chesapeake ORISID=3803	1 – 4	Unit 1: Used 2009/2018 IPM for NO <sub>x</sub> ; used 2009 IPM for SO <sub>2</sub> ; used VADEQ's growth and control estimates for SO <sub>2</sub> (added scrubber that IPM did not have) Unit 2: Used 2009/2018 IPM for NO <sub>x</sub> ; used 2009 IPM for SO <sub>2</sub> ; used VADEQ's growth and control estimates for SO <sub>2</sub> (added scrubber that IPM did not have) Unit 3: Used VA DEQ's growth and control estimates for 2009 NO <sub>x</sub> (added SCR that IPM did not have); used IPM result for 2018 NO <sub>x</sub> ; Used 2009/2018 IPM for SO <sub>2</sub> . Unit 4: Used VA DEQ's growth and control estimates for 2009 NO <sub>x</sub> (added SCR that IPM did not have); used IPM result for 2018 NO <sub>x</sub> ; Used 2009/2018 IPM for SO <sub>2</sub> .
	Dominion Possum Point ORISID=3804	3 & 4 5 6	Unit 3&4: IPM had 137 tons of NO <sub>x</sub> for these units in 2009 and 111 tons in 2018. VA DEQ specified that the permitted emission rates should be used, which equates to 3,066 tons in 2009 and 2018. Unit 5: IPM had zero heat input. Replaced all 2009/2018 IPM results using VADEQ's growth and control estimates. Unit 6: Replaced all 2009/2018 IPM results using VADEQ's growth and control estimates.
	Potomac River ORISID=3788	1 - 5	Units 1&2: IPM retired these units. Mirant has no plans at this time to retire any units. Replaced all 2009/2018 IPM results using VADEQ's growth and control estimates. Units 3, 4, 5: Replaced all 2009/2018 IPM results using VADEQ's growth and control estimates.
WV	Albright ORISID=3942	1, 2	IPM predicted early retirement for these units. AEP indicated there are no plans for early retirement. For 2009, used 2002 actual emissions as these units are not likely to retire by 2009. For 2018, used IPM prediction of retirement.
	Rivesville ORISID=3945	7, 8	IPM predicted early retirement for these units. AEP indicated there are no plans for early retirement. For 2009, used 2002 actual emissions as these units are not likely to retire by 2009. For 2018, used IPM prediction of retirement.
	Willow Island ORISID=3946	1, 2	Unit 1: IPM predicted early retirement for these units. AEP indicated there are no plans for early retirement. For 2009, used 2002 emissions as these units are not likely to retire by 2009. For 2018, used IPM prediction of retirement. Unit 2: IPM predicted SCR and scrubber for 2009. These controls will not be in place by 2009.
	North Branch Power Station ORISID=7537	1A, 1B	SO <sub>2</sub> Permit Rate was corrected from 2.7 to 0.678 lb/MMBtu. Used SO <sub>2</sub> Permit Rate of 0.678 lb/MMBtu and IPM predicted total fuel used to calculate SO <sub>2</sub> emissions in 2009 and 2018
	Mt. Storm ORISID=3954	1, 2, 3	SO <sub>2</sub> Permit Rate was corrected from 2.7 to 0.15 lb/MMBtu. Used SO <sub>2</sub> Permit Rate of 0.15 lb/MMBtu and IPM predicted total fuel used to calculate SO <sub>2</sub> emissions in 2009 and 2018

**Table 2.1-3 EGU Point Source SO<sub>2</sub> Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS BaseG	Base F4 IPM Based	Base G IPM Based with S/L Adjustments	Base F4 IPM Based	Base G IPM Based with S/L Adjustments
AL	447,828	340,194	378,052	190,099	305,262
FL	453,631	195,790	186,055	141,551	132,177
GA	514,952	534,469	417,449	180,178	230,856
KY	484,057	371,944	290,193	229,603	226,062
MS	67,429	85,629	76,579	27,230	15,146
NC	477,990	205,018	242,286	110,382	108,492
SC	206,399	171,206	124,608	121,694	93,274
TN	334,151	255,400	255,410	112,662	112,672
VA	241,204	169,714	225,653	90,935	140,233
WV	516,084	226,127	277,489	124,466	115,324
<b>Total</b>	<b>3,743,725</b>	<b>2,555,491</b>	<b>2,473,774</b>	<b>1,328,800</b>	<b>1,479,498</b>

Note: Emission summaries above are based on SCCs 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-4 EGU Point Source NO<sub>x</sub> Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS BaseG	Base F4 IPM Based	Base G IPM Based with S/L Adjustments	Base F4 IPM Based	Base G IPM Based with S/L Adjustments
AL	161,038	70,852	82,305	42,769	64,358
FL	257,677	89,610	86,165	77,080	73,125
GA	147,517	97,146	98,497	58,095	75,717
KY	198,817	107,890	92,021	64,378	64,378
MS	43,135	11,475	36,011	8,945	10,271
NC	151,854	66,431	66,522	60,914	62,353
SC	88,241	43,817	46,915	48,346	51,456
TN	157,307	41,767	66,405	31,725	31,715
VA	86,886	63,220	66,219	49,420	75,594
WV	230,977	63,510	86,328	51,241	51,241
<b>Total</b>	<b>1,523,449</b>	<b>655,718</b>	<b>727,388</b>	<b>492,913</b>	<b>560,208</b>

Note: Emission summaries above are based on SCCs 1-01-xxx-xx and 2-01-xxx-xx.



**Table 2.1-5 EGU Point Source VOC Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS BaseG	Base F4 IPM Based	Base G IPM Based with S/L Adjustments	Base F4 IPM Based	Base G IPM Based with S/L Adjustments
AL	2,295	2,441	2,473	2,952	2,952
FL	2,524	1,867	1,910	2,324	2,376
GA	1,244	1,571	2,314	1,903	2,841
KY	1,487	1,369	1,369	1,426	1,426
MS	648	406	404	1,124	1,114
NC	988	974	954	1,272	1,345
SC	470	660	660	906	906
TN	926	932	932	977	976
VA	754	685	778	903	996
WV	1,180	1,342	1,361	1,387	1,387
<b>Total</b>	<b>12,516</b>	<b>12,247</b>	<b>13,155</b>	<b>15,174</b>	<b>16,319</b>

Note: Emission summaries above are based on SCCs 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-6 EGU Point Source CO Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS BaseG	Base F4 IPM Based	Base G IPM Based with S/L Adjustments	Base F4 IPM Based	Base G IPM Based with S/L Adjustments
AL	11,279	14,948	14,986	24,342	24,342
FL	57,113	45,391	35,928	63,673	53,772
GA	9,712	20,066	23,721	32,744	44,476
KY	12,619	15,812	15,812	17,144	17,144
MS	5,303	5,078	5,051	15,364	15,282
NC	13,885	15,141	14,942	19,612	20,223
SC	6,990	11,135	11,135	14,786	14,786
TN	7,084	7,221	7,213	7,733	7,723
VA	6,892	11,869	12,509	14,755	15,420
WV	10,341	11,328	11,493	11,961	11,961
<b>Total</b>	<b>141,218</b>	<b>157,989</b>	<b>152,790</b>	<b>222,114</b>	<b>225,129</b>

Note: Emission summaries above are based on SCCs 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-7 EGU Point Source PM<sub>10</sub>-PRI Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS BaseG	Base F4 IPM Based	Base G IPM Based with S/L Adjustments	Base F4 IPM Based	Base G IPM Based with S/L Adjustments
AL	7,646	6,959	6,969	7,822	7,822
FL	21,387	9,384	9,007	10,310	9,953
GA	11,224	17,088	17,891	18,329	20,909
KY	4,701	6,463	6,463	6,694	6,694
MS	1,633	5,487	4,957	7,624	7,187
NC	22,754	22,888	22,152	33,742	37,376
SC	21,400	28,650	19,395	37,864	28,826
TN	14,640	15,608	15,608	15,941	15,941
VA	3,960	4,479	5,508	12,744	13,775
WV	4,573	5,471	5,657	6,349	6,349
<b>Total</b>	<b>113,918</b>	<b>122,477</b>	<b>113,607</b>	<b>157,419</b>	<b>154,832</b>

Note: Emission summaries above are based on SCCs 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-8 EGU Point Source PM<sub>2.5</sub> -PRI Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS BaseG	Base F4 IPM Based	Base G IPM Based with S/L Adjustments	Base F4 IPM Based	Base G IPM Based with S/L Adjustments
AL	4,113	3,916	3,921	4,768	4,768
FL	15,643	6,250	5,910	7,171	6,843
GA	4,939	10,104	10,907	11,403	13,983
KY	2,802	4,279	4,279	4,434	4,434
MS	1,138	5,310	4,777	7,469	7,033
NC	16,498	16,514	15,949	26,966	29,792
SC	17,154	23,366	16,042	32,180	25,032
TN	12,166	13,092	13,092	13,387	13,387
VA	2,606	3,194	4,067	11,101	11,976
WV	2,210	2,850	2,940	3,648	3,648
<b>Total</b>	<b>79,269</b>	<b>88,875</b>	<b>81,884</b>	<b>122,527</b>	<b>120,896</b>

Note: Emission summaries above are based on SCCs 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-9 EGU Point Source NH<sub>3</sub> Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS BaseG	Base F4 IPM Based	Base G IPM Based with S/L Adjustments	Base F4 IPM Based	Base G IPM Based with S/L Adjustments
AL	317	359	359	1,072	1,072
FL	234	1,659	1,631	3,004	2,976
GA	83	686	686	1,677	1,677
KY	326	400	400	476	476
MS	190	333	333	827	827
NC	54	423	445	691	663
SC	142	343	343	617	617
TN	204	227	227	241	241
VA	127	632	694	558	622
WV	121	330	330	180	180
<b>Total</b>	<b>1,798</b>	<b>5,392</b>	<b>5,448</b>	<b>9,343</b>	<b>9,351</b>

Note: Emission summaries above are based on SCCs 1-01-xxx-xx and 2-01-xxx-xx.

### **2.1.2 Non-EGU Emission Projections**

The general approach for assembling future year data was to use growth and control data consistent with the data used in EPA's Clean Air Interstate Rule analyses, supplement these data with available stakeholder input, and provide the results for stakeholder review to ensure credibility. We used the revised 2002 VISTAS base year inventory, based on the 2002 CERR submittals as the starting point for the non-EGU projection inventories. As described in Section 2.1.1.4, we split the point source inventory into EGU and non-EGU components. MACTEC performed the following activities to apply growth and control factors to the 2002 inventory to generate the 2009 and 2018 projection inventories:

- Obtained, reviewed, and applied the most current growth factors developed by EPA, based on forecasts from an updated Regional Economic Models, Inc. (REMI) model (version 5.5) and the latest *Annual Energy Outlook* published by the Department of Energy (DOE);
- Obtained, reviewed, and applied any State-specific or sector-specific growth factors submitted by stakeholders;
- Obtained and incorporated information regarding sources that have shut down after 2002 and set the emissions to zero in the projection inventories;
- Obtained, reviewed, and applied control assumptions for programs “on-the-books” and “on-the-way”;
- Provided data files in NIF3.0 format and emission summaries in EXCEL format for review and comment; and
- Updated the database with corrections or new information from S/L agencies based on their review of the Base F 2009/2018 inventories.

The following sections discuss each of these steps.

#### **2.1.2.1 Growth assumptions for non-EGU sources**

This section describes the growth factor data used in developing the Base F inventory for 2009 and 2018, as well as the changes to the growth factor data made for the Base G inventory.

The growth factor data used in developing the Base F inventory were consistent with EPA's analyses for the CAIR rulemaking. These growth factors are fully documented in the reports entitled *Development of Growth Factors for Future Year Modeling Inventories* (dated April 30, 2004) and *CAIR Emission Inventory Overview* (dated July 23, 2004). Three sources of data were used in developing the growth factors for the Base F inventory:

- State-specific growth rates from the Regional Economic Model, Inc. (REMI) Policy Insight<sup>®</sup> model, version 5.5 (being used in the development of the EGAS Version 5.0). The REMI socioeconomic data (output by industry sector, population, farm sector value

added, and gasoline and oil expenditures) are available by 4-digit SIC code at the State level.

- Energy consumption data from the DOE's Energy Information Administration's (EIA) *Annual Energy Outlook 2004, with Projections through 2025* for use in generating growth factors for non-EGU fuel combustion sources. These data include regional or national fuel-use forecast data that were mapped to specific SCCs for the non-EGU fuel use sectors (e.g., commercial coal, industrial natural gas). Growth factors for the residential natural gas combustion category, for example, are based on residential natural gas consumption forecasts that are reported at the Census division level. These Census divisions represent a group of States (e.g., the South Atlantic division includes eight southeastern States and the District of Columbia). Although one would expect different growth rates in each of these States due to unique demographic and socioeconomic trends, EIA's projects all States within each division using the same growth rate.
- Specific changes for sectors (e.g., plastics, synthetic rubber, carbon black, cement manufacturing, primary metals, fabricated metals, motor vehicles and equipment) where the REMI-based rates were unrealistic or highly uncertain. Growth projections for these sectors were based on industry group forecasts, Bureau of Labor Statistics (BLS) projections and Bureau of Economic Analysis (BEA) historical growth from 1987-2002.

In addition to the growth data described above, we received two sets of growth projections from VISTAS stakeholders.

The American Forest and Paper Association (AF&PA) supplied growth projections for the pulp and paper sector, which were applied to SIC 26xx Paper and Allied Products. The AF&PA projection factors are for the U.S. industry and apply to all States equally. The numbers come from the 15-year forecast for world pulp and recovered paper prepared by Resource Information Systems Inc. (RISI).

SIC Code	Sector	AF&PA Growth Factor	
		2002 to 2009	2002 to 2018
2611	Pulp Mills	1.067	1.169
2621	Paper Mills	1.067	1.169
2631	Paperboard Mills	1.067	1.169

For both the Base F and Base G inventories, we used the above AF&PA growth factors by SIC instead of the factors obtained from EPA's CAIR analysis.

For the Base F inventory, the NCDENR supplied recent projections for three key sectors in North Carolina where declining production was anticipated – SIC 22xx Textile Mill Products, 23xx Apparel and Other Fabrics, and 25xx Furniture and Fixtures. For the Base G inventory, NCDENR decided to use a growth factor of 1.0 for these SIC codes for both 2009 and 2018. Although NCDENR has data that shows a steady decline in these industries in NC, NCDENR wanted to maintain the emission levels at 2002 levels so the future emission reduction credits were available in the event that they are needed for nonattainment areas. The specific growth factors for these industrial sectors in North Carolina were:

NCDENR Growth Factors for Specific Industrial Sectors					
SIC Code	Industrial Sector	2009		2018	
		Base F	Base G	Base F	Base G
22xx	Textile Mill Products	0.6239	1.00	0.2792	1.00
23xx	Apparel and Other Fabrics	0.5867	1.00	0.2247	1.00
25xx	Furniture and Fixtures	0.8970	1.00	0.7647	1.00

For the Base G inventory, we made one additional change to the growth factors. The Base F inventory relied on DOE's AEO2004 forecasts for projecting emissions for fuel-burning SCCs (applies mainly to ICI boilers 1-02-xxx-xx and 1-03-xxx-xx, as well as in-process fuel use). We replaced the AEO2004 data with the more recent AEO2006 forecasts (released in February 2006) to reflect changes in the energy market and to improve the emissions growth factors produced. We obtained the corresponding AEO2006 projection tables from DOE's web site located at <http://www.eia.doe.gov/oiaf/aeo/supplement/supref.html>. We developed tables comparing the growth factors based on AEO2004 and AEO2006. These comparison tables were reviewed by the S/L agencies. Based on this review, VISTAS decided to use the AEO2006 growth factors for fuel burning SCCs.

We used the EPA's EGAS model and updated the corresponding AEO2006 projection tables to create growth factors by SCC. We applied the updated growth factors to 2002 actual emissions and replaced the 2009 and 2018 emissions in NIF EM tables for the affected SCCs.

### 2.1.2.2 Source Shutdowns

A few states indicated that significant source shutdowns have occurred since 2002 and that emissions from these sources should not be included in the future year inventories. These sources are identified in Table 2.1-10.

**Table 2.1-10. Summary of Source Shutdowns Incorporated in Base G Inventory.**

State	Description of Source Shutdowns
AL	None specified.
FL	The following facilities are shutdown and projected emissions were set to zero in 2009/2018. 0570075 CORONET INDUSTRIES, INC. 1050050 U S AGRI-CHEMICALS CORP. 1050051 U.S. AGRI-CHEMICALS CORPORATION These facilities emitted 2,417 tons of SO <sub>2</sub> and 113 tons of NO <sub>x</sub> in 2002.
GA	Georgia indicated that the former Blue Circle (now LaFarge) facility in downtown Atlanta will likely shut down before 2009. The facility has two cement kilns, one of which is already shut down. The second kiln will continue to operate until the new facility in Alabama has enough milling capacity, after which the entire Atlanta facility will be completely closed down. This facility emitted 1,617 tons of SO <sub>2</sub> and 587 tons of NO <sub>x</sub> in 2002.
KY	None specified.
MS	AF&PA indicated that the International Paper Natchez Mill (28-001-2800100010) has shut down. This facility emitted 1,398 tons of SO <sub>2</sub> and 1,773 tons of NO <sub>x</sub> in 2002. The Magnolia Resources - Pachuta Harmony Gas Plant (28-023-00031) is out of business and no longer holds an air permit. This facility emitted 2,257 tons of SO <sub>2</sub> and 134 tons of NO <sub>x</sub> in 2002.
NC	In Base F, two paper mills were identified as being shut down in the 2018 inventory. NCDENR indicated that these mills are not expected to close. The two facilities are Ecusta Business Development (37-175-3717500056) and International Paper (37-083-00007). Their emissions were added back into the Base G 2018 inventory. BASF Corporation (37-021-724) in Buncombe County is currently operating but has plans to shut down in 2007. This facility emitted 461 tons of SO <sub>2</sub> and 266 tons of NO <sub>x</sub> in 2002.
SC	South Carolina provided a list of facilities that were identified as closing down on or after Jan. 1, 2003. The emissions for these facilities were set to zero in the 2009 and 2018 projection inventories. Emissions from these plants in 2002 were: 6,195 tons of SO <sub>2</sub> , 2,994 tons of NO <sub>x</sub> , and 2,836 tons of VOC. Most of the emissions were from one facility – Celanese Acetate (45-091-2440-0010) in York County.
TN	Davidson County (Nashville) indicated that significant source shutdowns have occurred since data were submitted for the 2002 CERR. Source number 47-037-00002 (Dupont) shut down a portion of their facility, which was permanently taken out of service. Source 47-037-00050 (Nashville Thermal Transfer Corp.) shut down their municipal waste combustors and replaced them with natural gas fired boilers with propane stand by. Weyerhaeuser (AKA Willamette) Power Boiler 7 (47-163-0022, EU ID = 017) is being shut down. This emission unit emitted 4,297 tons of SO <sub>2</sub> and 1,443 tons of NO <sub>x</sub> in 2002. Liberty Fibers (47-063-0197) in Hamblen County has recently shut down. This facility emitted 5,377 tons of SO <sub>2</sub> ; 2,057 tons of NO <sub>x</sub> ; and 9,059 tons of VOC in 2002.
VA	Rock-Tenn (51-680-00097) received a permit dated 9/13/2003 which required the shutdown of units 1 and 2 by 2/27/2004. This permit was part of a netting exercise that allowed the installation of a new NG/DO boiler. These two units emitted 507 tons of SO <sub>2</sub> and 276 tons of NO <sub>x</sub> in 2002.
WV	None specified.

### 2.1.2.3 Control Programs applied to non-EGU sources

We used the same control programs for both the 2009 and 2018 non-EGU point inventory. Two control scenarios were developed: on-the-books (OTB) controls and on-the-way (OTW) controls. The OTB control scenario accounts for post-2002 emission reductions from promulgated federal, State, local, and site-specific control programs. The OTW control scenario accounts for proposed (but not final) control programs that are reasonably anticipated to result in post-2002 emission reductions. The methodologies used to account for the emission reductions associated with these emission control programs are discussed in the following sections.

**Table 2.1-11. Non-EGU Point Source Control Programs Included in 2009/2018 Projection Inventories.**

**On-the-Books (Cut-off of July 1, 2004 for Base 1 adoption)**

- Atlanta / Northern Kentucky / Birmingham 1-hr SIPs
- Industrial Boiler/Process Heater/RICE MACT
- NO<sub>x</sub> RACT in 1-hr NAA SIPs
- NO<sub>x</sub> SIP Call (Phase I- except where States have adopted II already e.g. NC)
- Petroleum Refinery Initiative (October 1, 2003 notice; MS & WV)
- RFP 3 percent Plans where in place for one hour plans
- VOC 2-, 4-, 7-, and 10-year maximum achievable control technology (MACTO Standards)
- Combustion Turbine MACT

**On-the-Way**

- NO<sub>x</sub> SIP Call (Phase II – remaining States & IC engines)

#### 2.1.2.3.1 OTB - NO<sub>x</sub> SIP Call (Phase I)

Phase I of the NO<sub>x</sub> SIP call applies to certain large non-EGUs, including large industrial boilers and turbines, and cement kilns. States in the VISTAS region affected by the NO<sub>x</sub> SIP call have developed rules for the control of NO<sub>x</sub> emissions that have been approved by EPA. We reviewed the available State rules and guidance documents to determine the affected sources and ozone season allowances. We also obtained and reviewed information in the EPA's CAMD NO<sub>x</sub> Allowance Tracking System – Allowances Held Report. Since these controls are to be in effect by the year 2007, we capped the emissions for NO<sub>x</sub> SIP call affected sources at 2007 levels and



carried forward the capped levels for the 2009/2018 future year inventories. Since the NO<sub>x</sub> SIP call allowances are given in terms of tons per ozone season (5 month period from May to September), we calculated annual emissions by multiplying the 5-month allowances by a factor of 12 divided by 5.

#### **2.1.2.3.2 OTB - Industrial Boiler/Process Heater MACT**

EPA anticipates reductions in PM and SO<sub>2</sub> as a result of the Industrial Boiler/Process Heater MACT standard. The methods used to account for these reductions are the same as those used for the CAIR analysis. Reductions were included for existing units firing solid fuel (coal, wood, waste, biomass) which had a design capacity greater than 10 mmBtu/hr. EPA prepared a list of SCCs for solid fuel industrial and commercial/ institutional boilers and process heaters. We identified boilers greater than 10 mmBtu/hr using either the boiler capacity from the VISTAS 2002 inventory, or if the boiler capacity was missing, a default capacity based on a methodology developed by EPA for assigning default capacities based on SCC. The applied MACT control efficiencies were 4 percent for SO<sub>2</sub> and 40 percent for PM<sub>10</sub> and PM<sub>2.5</sub> to account for the co-benefit from installation of acid gas scrubbers and other control equipment to reduce HAPs.

#### **2.1.2.3.3 OTB - 2, 4, 7, and 10-year MACT Standards**

Maximum achievable control technology (MACT) requirements were also applied, as documented in the report entitled *Control Packet Development and Data Sources*, dated July 14, 2004. The point source MACTs and associated emission reductions were designed from Federal Register (FR) notices and discussions with EPA's Emission Standards Division (ESD) staff. We did not apply reductions for MACT standards with an initial compliance date of 2001 or earlier, assuming that the effects of these controls are already accounted for in the 2002 inventories supplied by the States. Emission reductions were applied only for MACT standards with an initial compliance date of 2002 or greater.

#### **2.1.2.3.4 OTB Combustion Turbine MACT**

The projection inventories do not include the NO<sub>x</sub> co-benefit effects of the MACT regulations for Gas Turbines or stationary Reciprocating Internal Combustion Engines, which EPA estimates to be small compared to the overall inventory.

#### **2.1.2.3.5 OTB - Petroleum Refinery Initiative (MS and WV)**

Three refineries in the VISTAS region are affected by two October 2003 Clean Air Act settlements under the EPA Petroleum Refinery Initiative. The refineries are: (1) the Chevron refinery in Pascagoula, MS; (2) the Ergon refinery in Vicksburg, MS; and (3) the Ergon refinery in Newell, WV.

The first consent decree pertained to Chevron refineries in Richmond and El Segundo, CA; Pascagoula, MS; Salt Lake City, UT; and Kapolei, HI. Actions required under the Consent Decree will reduce annual emissions of NO<sub>x</sub> by 3,300 tons and SO<sub>2</sub> by 6,300 tons. The consent decree requires a program to reduce NO<sub>x</sub> emissions from refinery heaters and boilers through the installation of NO<sub>x</sub> controls that meet at least an SNCR level of control. The refineries are to eliminate fuel oil burning in any combustion unit. The consent decree also requires reductions of NO<sub>x</sub> and SO<sub>2</sub> from the fluid catalytic cracking unit and control of acid gas flaring incidents. The consent decree does not provide sufficient information to calculate emission reductions for the FCCU or flaring at the Pascagoula refinery. Therefore, we calculated a general percent reduction for NO<sub>x</sub> and SO<sub>2</sub> by dividing the expected emission reductions at the five Chevron refineries by the total emissions from these five refineries (as reported in the 1999 NEI). This resulted in applying percent reductions of 45 percent for SO<sub>2</sub> and 28 percent for NO<sub>x</sub> to FCCU and flaring emissions at the Chevron Pascagoula refinery.

The second consent decree pertained to the Ergon-West Virginia refinery in Newell, WV; and the Ergon Refining facility in Vicksburg, MS. The consent decree requires the two facilities to implement a 6-year program to reduce NO<sub>x</sub> emission from all heaters and boilers greater than 40 mmBtu/hr, and to eliminate fuel oil burning in any combustion unit (except during periods of natural gas curtailment). Specifically, ultra low NO<sub>x</sub> burners are required on Boilers A and B at Newell, a low NO<sub>x</sub>-equivalent level of control for heater H-101 at Newell and heaters H-1 and H-3 at Vicksburg, and an ultra low NO<sub>x</sub> burner level of control for heater H-451 at Vicksburg.

#### **2.1.2.3.6 OTW - NO<sub>x</sub> SIP Call (Phase II)**

The final Phase II NO<sub>x</sub> SIP call rule was finalized on April 21, 2004. States had until April 21, 2005, to submit SIPs meeting the Phase II NO<sub>x</sub> budget requirements. The Phase II rule applies to large IC engines, which are primarily used in pipeline transmission service at compressor stations. We identified affected units using the same methodology as was used by EPA in the proposed Phase II rule (i.e., a large IC engine is one that emitted, on average, more than 1 ton per day during 2002). The final rule reflects a control level of 82 percent for natural gas-fired IC engines and 90 percent for diesel or dual fuel categories. As shown later in Table 2.1-12, several S/L agencies provided more specific information on the anticipated controls at the compressor stations. This information was used in the Base G inventory instead of the default approach used by EPA in the proposed Phase II rule.

#### **2.1.2.3.7 Clean Air Interstate Rule**

CAIR does not require or assume additional emission reductions from non-EGU boilers and turbines.

#### **2.1.2.4 Quality Assurance steps**

Final QA checks were run on the revised projection inventory data set to ensure that all corrections provided by the S/L agencies and stakeholders were correctly incorporated into the S/L inventories and that there were no remaining QA issues that could be addressed during the duration of the project. After exporting the inventory to ASCII text files in NIF 3.0, the EPA QA program was run on the ASCII files and the QA output was reviewed to verify that all QA issues that could be addressed were resolved

Throughout the inventory development process, quality assurance steps were performed to ensure that no double counting of emissions occurred, and to ensure that a full and complete inventory was developed for VISTAS. Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on the point source component of the VISTAS revised 2002 base year inventory:

1. Facility level emission summaries were prepared and evaluated to ensure that emissions were consistent and reasonable. The summaries included base year 2002 emissions, 2009/2018 projected emissions accounting only for growth, 2009/2018 projected emissions accounting for both growth and emission reductions from OTB and OTW controls.
2. State-level non-EGU comparisons (by pollutant) were developed for the base year 2002 emissions, 2009/2018 projected emissions accounting only for growth, 2009/2018 projected emissions accounting for both growth and emission reductions from OTB and OTW controls.
3. Data product summaries and raw NIF 3.0 data files were provided to the VISTAS Emission Inventory Technical Advisor and to the Point Source, EGU, and non-EGU Special Interest Work Group representatives for review and comment. Changes based on these comments were reviewed and approved by the S/L point source contact prior to implementing the changes in the files.
4. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from Base F1 to Base F2.

#### **2.1.2.5 Additional Base G Updates and Corrections**

Table 2.1-12 summarizes the updates and corrections to the Base F inventory that were requested by S/L agencies and incorporated into the Base G 2009/2018 inventories.

#### **2.1.2.6 Summary of Revised 2009/2018 non-EGU Point Source Inventories**

Tables 2.1-13 through 2.1-19 summarize the revised 2009/2018 non-EGU point source inventories. The “growth only” column does not include the shutdowns (section 2.1.2.2) or control factors (section 2.1.2.3), only the growth factors described in section 2.1.2.1.

**Table 2.1-12. Summary of Updates and Corrections to the Base F 2009/2018 Inventories Incorporated into the Base G 2009/2018 Inventories.**

State	Nature of Update/Correction
AL	Corrected the latitude and longitude for two facilities: Ergon Terminalling (Site ID: 01-073-010730167) and Southern Power Franklin (Site ID: 01-081-0036).
AL	Corrections to stack parameters at 10 facilities for stacks with parameters that do not appear to fall into the ranges typically termed "acceptable" for AQ modeling.
FL	Corrected 2009/2018 emission values for the Miami Dade RRF facility (Site ID: 12-086-0250348) based on revised 2002 emissions and application of growth control factors for 2009/2018.
GA	Hercules Incorporated (12-051-05100005) had an erroneous process id (#3) within emission unit id SB9 and was deleted. This removes about 6,000 tons of SO <sub>2</sub> from the 2009/2018 inventories.
	Provided a revised file of location coordinates at the stack level that was used to replace the location coordinated in the ER file.
	There are several sources that have updated their emissions from their BART eligible units. most of these changes were for fairly small (<50 tpy) sources.
NC	Made several changes to Base F inventory to correct the following errors: 1. Corrected emissions at Hooker Furniture (Site ID: 37-081-3708100910), release point G-29, to use the corrected values in 2002 and carry those same numbers through to 2009 and 2018 since NCDENR assumes zero growth for furniture industry. 2. Identified many stack parameters in the ER file that were unrealistic. Several have zero for height, diameter, gas velocity, and flow rate. NC used the procedures outlined in Section 8 of the document ""National Emission Inventory QA and Augmentation Report" to correct unrealistic stack parameters. 3. Identified truncated latitude and longitude values in Base F inventory. NC updated all Title V facility latitude and longitude that was submitted to EPA for those facilities in 2004. Smaller facilities with only two decimal places were not corrected. 4. Corrected 2018 VOC emissions for International Paper (3709700045) Emission Unit ID, G-12, to reflect changes to the 2002 inventory.
	There are three Transcontinental Natural Gas Pipeline facilities in NC that are subject to the NO <sub>x</sub> SIP call. NCDENR took 2004 emissions and grew them to 2009 & 2018 and capped those units that are subject to the NO <sub>x</sub> SIP Call Rule. These facility IDs are 37-057-3705700300, 37-097-3709700225, and 37-157-3715700131.
	NCDENR applied NO <sub>x</sub> RACT to a two facilities located in the Charlotte nonattainment area. NCDENR provided 2009 & 2018 emissions for Philip Morris USA (37-025-3702500048) and Norandal USA (37-159-3715900057).
SC	Corrected PM species emission values. SC DHEC's initial CERR submittal reported particulate matter emissions using the PM-FIL, PM <sub>10</sub> -FIL, and PM <sub>2.5</sub> -FIL pollutant codes. In August 2005, SC DHEC indicated that data reported using the PM-FIL, PM <sub>10</sub> -FIL, and PM <sub>2.5</sub> -FIL pollutant codes should actually have been reported using the PM-PRI, PM <sub>10</sub> -PRI, and PM <sub>2.5</sub> _PRI codes. MACTEC performed a subsequent PM augmentation in April 2006 using the revised pollutant codes. These changes were reflected in the Base G 2009/2018 emission inventory.
	Specified that the Bowater Inc. facility (45-091-2440-0005) in York County conducted an expansion in 2003/2004 and plans a future expansion. SC provided updated emissions for 2009 and 2018 for this facility.

**Table 2.1-12. Continued.**

State	Nature of Update/Correction
TN	Updated 2009/2018 emissions for Eastman Chemical (47-163-0003) based on final (Feb. 2005) BART rule.
	Updated 2009/2018 emission inventory for the Bowater facility (47-107-0012) based on the facility's updated 2002 emission inventory update.
	Replaced 2009/2018 data from Hamilton County, Tennessee, using data from Hamilton County's CERR submittal as contained in EPA's 2002 NEI (in Base F, the inventory for Hamilton County was based on the draft VISTAS 2002 inventory, which in turn was based on the 1999 NEI); applied growth and control factors to revised 2002 inventory to generate emission projections for 2009/2018.
	Updated 2009/2018 emissions for PCS Nitrogen Fertilizer LP (Site ID: 47-157-00146) based on the facility's updated 2002 emission inventory update.
	The 2002 NEI correctly reports the actual emissions for CEMEX (47-093-0008) after the NO <sub>x</sub> SIP call. There is no reason to suspect that that rate would change in 2008, 2009, or 2018. Emissions for 2009/2018 were set equal to 2002 emissions.
	In the Base F 2009/2018 inventories, NO <sub>x</sub> controls were applied for two units at Columbia Gulf Transmission (47-111-0004). There are no plans for controls at these units, EO3 and EO4. The assumed control efficiency of 82 percent was backed out in the 2009/2018 inventories.
VA	VADEQ provided 2009/2018 NO <sub>x</sub> emission estimates for NO <sub>x</sub> Phase II gas transmission sources at three Transco facilities (51-011-00011, 51-137-00027, 51-143-00120) which were used to replace the default NO <sub>x</sub> Phase II control assumptions for these facilities.
	VADEQ provided updated 2009/2018 NO <sub>x</sub> and SO <sub>2</sub> emissions based on new controls required by a November 2005 permit modification and netting exercise. The entire power plant facility is limited to 213 tons of NO <sub>x</sub> and 107 tons of SO <sub>2</sub> per year. The permit also allowed the installation of 3 new boilers, also under the 213 tons of NO <sub>x</sub> /year cap.
WV	Updated 2009/2018 emissions for Steel of West Virginia (Site ID: 54-011-0009) based on the facility's updated 2002 emission inventory update.
	Made changes to several Site ID names due to changes in ownership
	Base F emissions were much too high for Weirton Steel (54-021-0029). WV believes that the source is very unlikely to emit the NO <sub>x</sub> SIP Call budgeted amounts in 2009 or 2018. WV provided revised emission estimates based on EGAS for 2009/2018.
	Made corrections to latitude/longitude and stack parameters at a few facilities for stacks with parameters that do not appear to fall into the ranges typically termed "acceptable" for AQ modeling.

**Table 2.1-13 Non-EGU Point Source SO<sub>2</sub> Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	Base G	Base F4	Base G	Base F4	Base G
AL	96,481	100,744	101,246	112,703	113,224
FL	65,090	68,549	65,511	79,015	75,047
GA	53,778	61,535	53,987	68,409	59,349
KY	34,029	35,470	36,418	38,806	40,682
MS	35,960	27,488	25,564	40,195	39,221
NC	44,123	48,751	42,536	50,415	46,314
SC	53,518	55,975	48,324	56,968	53,577
TN	79,604	89,149	70,678	96,606	77,247
VA	63,903	63,075	62,560	69,776	68,909
WV	54,070	54,698	55,973	60,137	62,193
<b>Total</b>	<b>580,556</b>	<b>605,434</b>	<b>562,797</b>	<b>673,030</b>	<b>635,763</b>

Note: Emission summaries above include all SCCs except 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-14 Non-EGU Point Source NO<sub>x</sub> Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	BaseG	Base F4	Base G	Base F4	BaseG
AL	83,310	69,676	69,409	79,101	78,318
FL	45,156	44,859	46,020	50,635	51,902
GA	49,251	51,556	50,353	57,323	55,824
KY	38,392	36,526	37,758	40,363	41,034
MS	61,526	55,877	56,397	62,132	61,533
NC	44,928	44,877	34,767	47,200	37,801
SC	42,153	42,501	40,019	44,480	44,021
TN	64,344	63,431	57,883	70,313	63,453
VA	60,415	51,335	51,046	56,876	55,945
WV	46,612	40,433	38,031	44,902	43,359
<b>Total</b>	<b>536,087</b>	<b>501,071</b>	<b>481,683</b>	<b>553,325</b>	<b>533,190</b>

Note: Emission summaries above include all SCCs except 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-15 Non-EGU Point Source VOC Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	Base G	Base F4	Base G	Base F4	Base G
AL	47,037	46,660	46,644	54,268	54,291
FL	38,471	36,675	36,880	42,787	42,811
GA	33,709	34,082	34,116	40,267	40,282
KY	44,834	47,648	47,785	55,564	55,861
MS	43,204	37,921	37,747	45,769	45,338
NC	61,182	70,464	61,925	76,027	70,875
SC	38,458	38,273	35,665	44,545	43,656
TN	84,328	89,380	74,089	111,608	93,266
VA	43,152	43,620	43,726	53,065	53,186
WV	14,595	14,012	13,810	16,632	16,565
<b>Total</b>	<b>448,970</b>	<b>458,735</b>	<b>432,387</b>	<b>540,532</b>	<b>516,131</b>

Note: Emission summaries above include all SCCs except 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-16 Non-EGU Point Source CO Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	Base G	Base F4	Base G	Base F4	Base G
AL	174,271	176,899	180,369	194,280	201,794
FL	81,933	83,937	87,037	96,642	96,819
GA	130,850	147,362	147,427	168,570	167,904
KY	109,936	121,727	122,024	139,121	139,437
MS	54,568	58,023	57,748	67,764	66,858
NC	50,576	53,955	53,744	61,127	62,197
SC	56,315	62,144	60,473	71,318	68,988
TN	115,264	123,844	119,665	146,407	140,942
VA	63,796	67,046	68,346	74,364	76,998
WV	89,879	100,248	100,045	119,318	119,332
<b>Total</b>	<b>927,388</b>	<b>995,185</b>	<b>996,878</b>	<b>1,138,911</b>	<b>1,141,269</b>

Note: Emission summaries above include all SCCs except 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-17 Non-EGU Point Source PM<sub>10</sub>-PRI Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	Base G	Base F4	Base G	Base F4	Base G
AL	25,240	25,450	25,421	29,973	29,924
FL	35,857	39,363	39,872	46,573	46,456
GA	21,610	23,509	23,103	27,781	27,273
KY	16,626	17,164	17,174	20,142	20,153
MS	19,472	19,200	19,245	22,952	22,859
NC	13,838	14,738	13,910	15,816	15,737
SC	14,142	17,631	13,370	20,197	15,139
TN	35,174	37,040	34,833	45,168	42,280
VA	13,252	13,043	13,048	15,150	15,112
WV	17,503	17,723	17,090	21,699	21,735
<b>Total</b>	<b>212,714</b>	<b>224,861</b>	<b>217,066</b>	<b>265,451</b>	<b>256,668</b>

Note: Emission summaries above include all SCCs except 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-18 Non-EGU Point Source PM<sub>25</sub>-PRI Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	Base G	Base F4	Base G	Base F4	Base G
AL	19,178	19,256	19,230	22,628	22,598
FL	30,504	33,387	33,946	39,436	39,430
GA	17,462	19,361	18,982	22,882	22,416
KY	11,372	11,680	11,686	13,734	13,739
MS	9,906	9,144	9,199	10,768	10,739
NC	10,500	11,192	10,458	11,927	11,825
SC	10,245	13,101	9,390	14,947	11,086
TN	27,807	29,302	27,577	35,750	33,532
VA	10,165	9,980	9,988	11,604	11,594
WV	13,313	13,364	12,769	16,474	16,516
<b>Total</b>	<b>160,452</b>	<b>169,767</b>	<b>163,225</b>	<b>200,150</b>	<b>193,475</b>

Note: Emission summaries above include all SCCs except 1-01-xxx-xx and 2-01-xxx-xx.



**Table 2.1-19 Non-EGU Point Source NH<sub>3</sub> Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	Base G	Base F4	Base G	Base F4	Base G
AL	1,883	2,132	2,132	2,464	2,464
FL	1,423	1,544	1,544	1,829	1,829
GA	3,613	3,963	3,963	4,799	4,797
KY	674	733	760	839	901
MS	1,169	667	668	761	764
NC	1,180	1,288	1,285	1,422	1,466
SC	1,411	1,578	1,578	1,779	1,779
TN	1,613	1,861	1,841	2,240	2,214
VA	3,104	3,050	3,049	3,613	3,604
WV	332	341	341	416	413
<b>Total</b>	<b>16,402</b>	<b>17,157</b>	<b>17,161</b>	<b>20,162</b>	<b>20,231</b>

Note: Emission summaries above include all SCCs except 1-01-xxx-xx and 2-01-xxx-xx.

## 2.2 Area Sources

This section describes the methodology used to develop the 2009 and 2018 projection Base F and Base G projection inventories. This section describes two approaches to these projections. Separate methods for projecting emissions were used for non-agricultural (stationary area) and agricultural area sources (predominantly NH<sub>3</sub> emissions). The two methods used for these sectors are described in the sections that follow.

### 2.2.1 Stationary area sources

The general approach used to calculate Base F projected emissions for stationary area sources was as follows:

1. Use the VISTAS Base F 2002 base year inventory as the starting point for projections.
2. MACTEC then worked with the VISTAS States (via the Stationary Area Source SIWG) to obtain any State specific growth factors and/or future controls from the States to use in developing the projections.
3. MACTEC then back calculated uncontrolled emissions from the Base F 2002 base year inventory based on existing controls reported in the 2002 Base F base year inventory.
4. Controls (including control efficiency, rule effectiveness and rule penetration) provided by the States or originally developed for use in estimating projected emissions for U.S. EPA's Heavy Duty Diesel (HDD) rulemaking emission projections and used in the Clean

Air Interstate Rule (CAIR) projections were then used to calculate controlled emissions. State submitted controls had precedence over the U.S. EPA developed controls.

5. Growth factors supplied from the States or the U.S. EPA's CAIR emission projections were then applied to project the controlled emissions to the appropriate year. In some cases EGAS Version 5 growth factors were used if no growth factor was available from either the States or the CAIR growth factor files. The use of EGAS Version 5 growth factors was on a case-by-case basis wherever State-supplied or CAIR factors were not available for SCCs found in the 2002 Base F inventory. Use of the EGAS factors was necessitated due to the CERR submittals used in constructing the Base F 2002 inventory. Use of the CERR data resulted in SCCs that were not found in the CAIR inventory and if no State-supplied growth factor was provided required the use of an EGAS growth factor.
6. MACTEC then provided the final draft Base F projection inventory for review and comment by the VISTAS States.

For Base F stationary area sources, no State-supplied growth or control factors were provided. Thus for all of the sources in this sector of the inventory, growth and controls for Base F were applied based on controls initially identified for the CAIR and growth factors identified for the CAIR projections.

For the Base G projections, the Base G 2002 base year inventory (see section 1.2.3) was used as a starting point. States provided some updated future controls but growth factors used were identical to those used for Base F. The revised controls for Base G were largely for new sources added as part of the 2002 Base F comments. The calculation of Base G projections was identical to the six steps outlined above with the exception of revisions made to prescribed fire for 2009 and 2018 and for the State of North Carolina. North Carolina provided 2009 and 2018 updated emission files used to update the emissions for each year for several source categories. However not all sources in the inventory were included in these NC updates. As a consequence, the final Base G 2009 and 2018 inventory for NC included emissions updated using the NC supplied files and emissions developed using growth and control factors as outlined above.

In a few cases, additional growth factors had to be added for source categories that had not initially been included in the Base F inventory. These growth factors were obtained from EGAS 5.0. Finally updates to growth factors from EGAS 5.0 were made for fuel fired emission sources. The updated growth factors reflected the most recent data from the Department of Energy's Annual Energy Outlook (AEO). These data were used to reflect changes in energy efficiency resulting from new or updated fuel firing technologies.

### 2.2.1.1 Stationary area source controls

The controls obtained by MACTEC for the HDD rulemaking were controls for the years 2007, 2020, and 2030. Since MACTEC was preparing 2009 and 2018 projections, control values for intermediate years were prepared using a straight line interpolation of control level between 2007 and 2020. The equation used to calculate the control level was as follows:

$$CE = (((2020\ CE - 2007\ CE)/13)*YRS) + 2007\ CE$$

*Where:*

CE = Control Efficiency for either 2009 or 2018

2020 CE = HDD Control Efficiency value for 2020

2007 CE = HDD Control Efficiency value for 2007

13 = Number of years between 2020 and 2007

YRS = Number of years beyond 2007 to VISTAS Projection year

For 2009 the value of YRS would be two (2) and for 2018 the value would be eleven (11). Control efficiency values were determined for VOC, CO and PM. Rule penetration values for each year in the HDD controls tables obtained by MACTEC were always 100 percent so those values were maintained for the VISTAS projections.

Prior to performing the linear interpolation of the controls, MACTEC evaluated controls from the CAIR projections (NOTE: Initially the controls came from the IAQTR projections, however the controls used in CAIR were virtually identical to those in IAQTR). Those controls appeared to be identical to those used for the HDD rulemaking. In addition, MACTEC received some additional information on some controls for area source solvents (email from Jim Wilson, E.H. Pechan and Associates, Inc. to Gregory Stella, VISTAS Emission Inventory Technical Advisor, 3/5/04) that were used to check against the controls in the HDD rulemaking files. Where those controls proved to be more stringent than the HDD values, MACTEC updated the control file with those values (which were then used in the interpolation to develop 2009 and 2018 values). Finally, for VOC the HDD controls were initially provided at the State-county-SCC level. However, upon direction from the VISTAS Emission Inventory Technical advisor, the VOC controls were consolidated at the SCC level and applied across all counties within the VISTAS region (email from Gregory Stella, Alpine Geophysics, 3/3/2004) to ensure that no controls were missed due to changes in county FIPS codes and/or SCC designations between the time the HDD controls were developed and 2002.

The equation below indicates how VOC emissions were projected for stationary area sources.

$$VOC_{2018} = VOC_{2002} \times \left( 1 - \left( \frac{VOC\_CE_{2018}}{100} \right) \left( \frac{VOC\_RE_{2018}}{100} \right) \left( \frac{VOC\_RP_{2018}}{100} \right) \right)$$

Where:

$VOC_{2018}$  = VOC emissions for 2018

$VOC_{2002}$  = Uncontrolled VOC emissions for 2002

$VOC\_CE_{2018}$  = Control Efficiency for VOC (in this example for 2018)

$VOC\_RE_{2018}$  = Rule Effectiveness for VOC (in this example for 2018)

$VOC\_RP_{2018}$  = Rule Penetration for VOC (in this example for 2018)

A similar equation could be constructed for either PM or CO. It should be noted that the control efficiencies calculated based on the HDD rulemaking were only applied if they were greater than any existing 2002 base year controls. No controls were found for SO<sub>2</sub> or NO<sub>x</sub> area sources.

In the pre-Base F 2018 emission estimates, an energy efficiency factor was applied to energy related stationary area sources. The energy efficiency factor was applied along with the growth factor to account for both growth and changes in energy efficiency. That factor was not applied to the Base F projections since information supplied by U.S. EPA related to the CAIR growth factors indicated that growth values for those categories were derived from U.S. Department of Energy (DOE) and were felt to account for changes in growth and projected energy efficiency. For the Base G inventory, these energy efficiency factors were re-instituted and used in conjunction with EGAS 5.0 growth factors in a manner identical to that used for the pre-Base F inventories. The energy efficiency factors were derived from U.S. DOE's Annual Energy Outlook report.

One significant difference between the Base F and Base G control factors was for counties and independent cities in northern Virginia. Several counties and independent cities in northern Virginia are subject to Ozone Transport Commission rules. For these counties and independent cities, controls for portable fuel containers, mobile equipment repair/refinishing, consumer products, solvent metal cleaning, and the architectural and industrial maintenance rules were added. The counties/independent cities (FIPS code) included in the changes for Base G were: Alexandria City (51510), Arlington (51013), Fairfax City (51600), Fairfax (51059), Falls Church City (51610), Fredericksburg City (51630), Loudoun (51107), Manassas City (51683), Manassas Park City (51685), Prince William County (51153), Spotsylvania (51177), and Stafford (51179). Not all OTC rules applied to all counties/cities.

### **2.2.1.2 Stationary area source growth**

As indicated above, growth factors for the Base F and Base G 2009 and 2018 inventories were obtained from the U.S. EPA and are linear interpolations of the growth factors used for the Clean Air Interstate Rule (CAIR) projections. The growth factors for the CAIR obtained by MACTEC were developed using a base year of 2001 and provided growth factors for 2010 and 2015. MACTEC used the TREND function in Microsoft Excel™ to calculate 2002, 2009 and 2018 values from the 2001, 2010 and 2015 values. The TREND function provides a linear interpolation of intermediate values from a known series of data points (in this case the 2001, 2010 and 2015 values) based on the equation for a straight line. These values were calculated at the State and SCC level with the exception of paved road emissions (SCC = 2294000000). The growth factors for paved roads were available in the CAIR data set at the State, county and SCC level so they were applied at that level.

Prior to utilizing the growth factors from the CAIR projections, MACTEC confirmed that all SCCs found in the VISTAS 2002 base year inventory were in the CAIR file (for Base F the starting point was the version 3.1 2002 base year inventory, for Base G the starting point was the Base F 2002 base year inventory). Some SCCs were not found in the CAIR file. For those SCCs, the growth factors used were derived in one of five ways. First where possible, they were taken from a beta version of EGAS 5.0. In other cases, the growth factor was set to one (i.e., no growth). In other cases, a similar SCC that had a CAIR growth factor was used. In a few cases a growth factor based on an average CAIR growth at the 6 digit SCC level was calculated. Finally a number of records used population as the growth surrogate. For the Base G inventory, CAIR growth factors for fuel fired area sources were replaced with EGAS 5.0 growth factors (used in conjunction with AEO fuel efficiency factors). A comment field in the growth factor file was used to mark those records that were not taken directly from the CAIR projection growth factors.

### **2.2.1.3 Differences between 2009/2018**

Methodologically, there was no difference in the way that 2009 and 2018 emissions were calculated for stationary area sources. The individual control and growth factors were different (due to the linear interpolation used to calculate the values) but the calculation methods were identical. This applies to both Base F and Base G.

The only exception to this is for the State of North Carolina for Base G. North Carolina provided an emissions update file used to override calculated projections for a number of area source categories. The values in these files (provided for both 2009 and 2018) were used to overwrite the calculated projected emissions in the final NIF file.

## **2.2.2 Agricultural area sources**

The general approach used to calculate projected emissions for agricultural area sources (predominantly NH<sub>3</sub> emission sources) was as follows:

1. MACTEC used the version 3.1 2002 base year inventory data (which was based on the CMU ammonia model version 3.6).
2. MACTEC worked with the VISTAS States (via the Agricultural Sources SIWG) to obtain any State specific growth and/or future controls from the States for agricultural sources.
3. Since the base year emissions were uncontrolled, and no future controls for these sources were identified, MACTEC projected the agricultural emissions using State-specific growth if available, otherwise the U.S. EPA's Interstate Air Quality Transport Rule (IAQTR)/Ammonia inventory was used to develop the growth factors used to project the revised 2002 base year inventory to 2009 or 2018. Since the IAQTR inventory was only used to construct growth factors rather than using the emissions directly, no updated growth factors were prepared from the CAIR inventory values.
4. MACTEC then provided the final draft inventory for review and comment by the VISTAS States.

No change in the agricultural area source emission projections were made between Base F and Base G other than the removal of wild animal and human perspiration as a result of their removal from the 2002 base year file for Base G.

### **2.2.2.1 Control assumptions for agricultural area sources**

No controls were identified either by the individual VISTAS States or in the information provided in the EPA's IAQTR or CAIR Ammonia inventory documents. Thus all projected emissions for agricultural area sources represent simple growth with no controls.

### **2.2.2.2 Growth assumptions for agricultural area sources**

Growth for several agricultural area source livestock categories was developed using the actual emission estimates developed by the EPA as part of the NEI. That work included projections for the years 2002, 2010, 2015, 2020, and 2030. The actual emissions themselves were not used other than to develop growth factors since the 2002 NEI upon which the growth projections were based was prepared prior to the release of the 2002 Census of Agriculture data which was included in the CMU model (version 3.6) used to develop the Base F 2002 VISTAS base year inventory. Thus VISTAS Agricultural Sources SIWG decided to use the NEI ammonia inventory

projected emissions to develop the 2009 and revised 2018 growth factors used to project emission for VISTAS. Details on the NEI inventory and projections can be found at:

[http://www.epa.gov/ttn/chief/ap42/ch09/related/nh3inventorydraft\\_jan2004.pdf](http://www.epa.gov/ttn/chief/ap42/ch09/related/nh3inventorydraft_jan2004.pdf). The actual data files for the projected emissions can be found at:

[http://www.epa.gov/ttn/chief/ap42/ch09/related/nh3output01\\_23\\_04.zip](http://www.epa.gov/ttn/chief/ap42/ch09/related/nh3output01_23_04.zip).

In order to use the NEI projected emissions as growth factors, several steps were required. These steps were as follows:

1. NEI projected emissions were only available for the years 2002, 2010, 2015, 2020, and 2030, thus the first task was to calculate intermediate year emissions for 2009 and 2018. These values were calculated based on linear interpolation of the existing data.
2. Once the intermediate emissions were calculated, MACTEC developed emission ratios to provide growth factors for 2009 and 2018. Ratios of emissions were established relative to the 2002 NEI emissions.
3. Once the growth factors were established, MACTEC then evaluated whether or not all agricultural SCCs within the revised 2002 base year inventory had corresponding growth factors. MACTEC established that not all SCCs within the base year inventory had growth factors. These SCCs fell into one of two categories:
  - a. SCCs that had multiple entries in the NEI but only a single SCC in the 2002 VISTAS base year inventory. The NEI was established using a process model and for some categories of animals, emissions were calculated for several aspects of the process. The CMU model version 3.6 which was the basis for the VISTAS 2002 Base F inventory did not use a process model. As a consequence a mapping of SCCs in the NEI projections and corresponding SCCs in the CMU inventory was made and for those SCCs an average growth factor was calculated from the NEI projections for use with the corresponding SCC in the CMU based 2002 Base F inventory.
  - b. There were also State, county, SCC trios in the 2002 VISTAS Base F inventory which had no corresponding emissions in the NEI files. For these instances, MACTEC first developed State level average growth factors from the NEI projections for use in growing these records. Even after developing State level average growth factors there were still some State/SCC pairs that did not have matching growth. For these records, MACTEC developed VISTAS regional average growth factors at the SCC level from the NEI data.



4. Once all of the growth factors were developed, they were used to project the emissions to 2009 and 2018. Growth factors were first applied at the State, county and SCC level. Then remaining records were grown with the State/SCC specific growth factors. Finally, any remaining ungrown records were projected at the SCC level using the VISTAS regional growth factor.

For the livestock categories, the NEI emission projections only had data for beef and dairy cattle, poultry and swine. Thus for other livestock categories and for fertilizers alternative growth factors were required.

The growth factors for other livestock categories and fertilizers were obtained from growth factors used for the IAQTR projections made by the U.S. EPA. The methodology for these categories was identical to that used for dairy, beef, poultry and swine with the exception that State/SCC and VISTAS/SCC growth factors were not required for these categories since the IAQTR data contained State, county and SCC level growth factors. The IAQTR data provided growth factors for 1996, 2007, 2010, 2015 and 2020. Linear interpolation was used to develop the growth factors for the intermediate years 2009 and 2018 required for the VISTAS projections.

There were a few exceptions to the methods used for projecting agricultural sources for the VISTAS projections. These exceptions were:

1. All swine emissions for North Carolina were maintained at 2002 levels for each projection year to capture a moratorium on swine production in that State.
2. Ammonia growth factors for a few categories (mainly feedlots) were assigned to be the same as growth factors for PM emissions from the NEI projections. This assignment was made because the CMU model showed emissions from these categories but the NEI projections did not show ammonia emissions but did show PM emissions.
3. No growth factors were found for horse and pony emissions. These emissions were held constant at 2002 levels.

There was no change in this method between Base F and Base G. Thus Base F and Base G agricultural emissions are the same in each inventory. Future efforts on the agricultural emissions category should look at any changes made to the CMU model to reflect the model farm approach used by EPA in their inventory plus any updated growth factors that may be more recent than the EPA inventory used to develop growth estimates for Base F/G.



### 2.2.2.2.1 Differences between 2009/2018

Methodologically, there was no difference in the way that 2009 and 2018 emissions were calculated for agricultural area sources. The growth factors were different (due to the linear interpolation used to calculate the values) but the calculation methods were identical. In addition there was no difference between Base F and Base G for this category. Thus Base F and Base G agricultural emissions are the same in each inventory.

Tables 2.2-1 show the differences between Base F and Base G emissions for all area sources (including agricultural sources but excluding fires) for the 2002 base year and 2009 and 2018 by State and pollutant.

**Table 2.2-1 2002 Base Year Emissions and Percentage Difference for Base F and Base G (based on actual emissions).**

Actual Area 2002 - Base G							
State	CO	NH3	NOX	PM10-PRI	PM25-PRI	SO2	VOC
AL	83,958	58,318	23,444	393,588	56,654	52,253	182,674
FL	71,079	37,446	28,872	443,346	58,878	40,491	404,302
GA	108,083	80,913	36,142	695,414	103,794	57,559	299,679
KY	66,752	51,135	39,507	233,559	45,453	41,805	95,375
MS	37,905	58,721	4,200	343,377	50,401	771	131,808
NC	345,315	161,860	36,550	280,379	64,052	5,412	237,926
SC	113,714	28,166	19,332	260,858	40,291	12,900	161,000
TN	89,828	34,393	17,844	212,554	42,566	29,917	153,307
VA	155,873	43,905	51,418	237,577	43,989	105,890	174,116
WV	39,546	9,963	12,687	115,346	21,049	11,667	60,443
Base F							
AL	83,958	59,486	23,444	393,093	73,352	47,074	196,538
FL	105,849	44,902	29,477	446,821	81,341	40,537	439,019
GA	107,889	84,230	36,105	695,320	133,542	57,555	309,411
KY	66,752	51,097	39,507	233,559	52,765	41,805	100,174
MS	37,905	59,262	4,200	343,377	63,135	771	135,106
NC	373,585	164,467	48,730	303,492	69,663	7,096	346,060
SC	113,714	29,447	19,332	260,858	51,413	12,900	187,466
TN	89,235	35,571	17,829	211,903	49,131	29,897	161,069
VA	155,873	46,221	51,418	237,577	52,271	9,510	129,792
WV	39,546	10,779	12,687	115,346	25,850	11,667	61,490
Percentage Difference (negative values means Base G increased from Base F)							
AL	0.00%	1.96%	0.00%	-0.13%	22.76%	-11.00%	7.05%
FL	32.85%	16.61%	2.05%	0.78%	27.62%	0.12%	7.91%
GA	-0.18%	3.94%	-0.10%	-0.01%	22.28%	-0.01%	3.15%
KY	0.00%	-0.07%	0.00%	0.00%	13.86%	0.00%	4.79%
MS	0.00%	0.91%	0.00%	0.00%	20.17%	0.00%	2.44%
NC	7.57%	1.59%	24.99%	7.62%	8.05%	23.74%	31.25%
SC	0.00%	4.35%	0.00%	0.00%	21.63%	0.00%	14.12%
TN	-0.67%	3.31%	-0.09%	-0.31%	13.36%	-0.07%	4.82%
VA	0.00%	5.01%	0.00%	0.00%	15.84%	-1013.45%	-34.15%
WV	0.00%	7.57%	0.00%	0.00%	18.57%	0.00%	1.70%

**Table 2.2-2 2009 Projection Year Emissions and Percentage Difference for Base F and Base G (based on actual emissions).**

Actual Area 2009 - Base G							
State	CO	NH3	NOX	PM10-PRI	PM25-PRI	SO2	VOC
AL	66,654	64,268	23,930	413,020	58,699	48,228	143,454
FL	57,011	38,616	28,187	503,230	64,589	36,699	420,172
GA	94,130	89,212	37,729	776,411	112,001	57,696	272,315
KY	57,887	53,005	42,088	242,177	46,243	43,087	94,042
MS	27,184	63,708	4,249	356,324	51,661	753	124,977
NC	301,163	170,314	39,954	292,443	69,457	5,751	187,769
SC	90,390	30,555	19,360	278,299	41,613	13,051	146,107
TN	74,189	35,253	18,499	226,098	44,124	30,577	154,377
VA	128,132	46,639	52,618	252,488	44,514	105,984	147,034
WV	31,640	10,625	13,439	115,089	20,664	12,284	55,288
Base F							
AL	68,882	65,441	26,482	411,614	76,248	17,818	157,405
FL	101,356	46,950	31,821	507,515	90,487	52,390	462,198
GA	103,579	92,838	38,876	776,935	146,691	57,377	294,204
KY	64,806	53,023	42,122	242,345	54,397	40,779	94,253
MS	37,161	64,289	4,789	356,516	65,321	637	125,382
NC	332,443	173,187	53,550	317,847	75,570	7,607	252,553
SC	95,826	31,966	20,852	278,852	54,230	12,945	176,104
TN	82,196	36,578	19,148	225,650	51,753	29,787	160,265
VA	133,738	49,173	53,344	252,924	54,587	10,619	120,022
WV	37,704	11,461	13,816	115,410	25,835	12,156	57,082
Percentage Difference (negative values means Base G increased from Base F)							
AL	3.24%	1.79%	9.64%	-0.34%	23.02%	-170.67%	8.86%
FL	43.75%	17.75%	11.42%	0.84%	28.62%	29.95%	9.09%
GA	9.12%	3.91%	2.95%	0.07%	23.65%	-0.56%	7.44%
KY	10.68%	0.03%	0.08%	0.07%	14.99%	-5.66%	0.22%
MS	26.85%	0.90%	11.27%	0.05%	20.91%	-18.10%	0.32%
NC	9.41%	1.66%	25.39%	7.99%	8.09%	24.41%	25.65%
SC	5.67%	4.41%	7.16%	0.20%	23.27%	-0.82%	17.03%
TN	9.74%	3.62%	3.39%	-0.20%	14.74%	-2.65%	3.67%
VA	4.19%	5.15%	1.36%	0.17%	18.45%	-898.09%	-22.51%
WV	16.08%	7.29%	2.73%	0.28%	20.02%	-1.06%	3.14%

**Table 2.2-3 2018 Projection Year Emissions and Percentage Difference for Base F and Base G (based on actual emissions).**

Actual Area 2018 - Base G							
State	CO	NH3	NOX	PM10-PRI	PM25-PRI	SO2	VOC
AL	59,626	71,915	25,028	445,256	62,323	50,264	153,577
FL	53,903	40,432	30,708	578,516	72,454	38,317	489,975
GA	93,827	99,885	41,332	880,199	123,704	59,729	319,328
KY	54,865	55,211	44,346	256,052	47,645	44,186	103,490
MS	22,099	69,910	4,483	375,495	53,222	746	140,134
NC	290,809	180,866	43,865	315,294	71,262	6,085	189,591
SC	83,167	33,496	20,592	304,251	44,319	13,457	161,228
TN	68,809	36,291	19,597	246,252	46,692	31,962	182,222
VA	121,690	50,175	56,158	275,351	46,697	109,380	150,919
WV	28,773	11,504	14,828	121,549	21,490	12,849	60,747
Base F							
AL	63,773	73,346	28,754	445,168	82,449	49,975	168,507
FL	100,952	49,889	35,047	582,832	101,872	59,413	533,141
GA	105,059	103,911	42,260	880,800	163,925	61,155	342,661
KY	65,297	55,356	45,597	256,544	57,110	42,326	102,117
MS	36,425	70,565	5,230	375,931	68,338	831	139,419
NC	327,871	184,167	60,073	345,275	85,018	8,273	234,207
SC	89,343	35,082	22,467	304,940	58,441	13,517	196,946
TN	81,242	37,812	20,928	245,893	55,712	31,047	188,977
VA	129,037	53,023	56,668	275,790	58,141	11,479	128,160
WV	36,809	12,390	15,079	121,964	27,088	13,450	62,164
Percentage Difference (negative values means Base G increased from Base F)							
AL	6.50%	1.95%	12.96%	-0.02%	24.41%	-0.58%	8.86%
FL	46.61%	18.96%	12.38%	0.74%	28.88%	35.51%	8.10%
GA	10.69%	3.87%	2.20%	0.07%	24.54%	2.33%	6.81%
KY	15.98%	0.26%	2.74%	0.19%	16.57%	-4.40%	-1.34%
MS	39.33%	0.93%	14.28%	0.12%	22.12%	10.19%	-0.51%
NC	11.30%	1.79%	26.98%	8.68%	16.18%	26.45%	19.05%
SC	6.91%	4.52%	8.34%	0.23%	24.16%	0.44%	18.14%
TN	15.30%	4.02%	6.36%	-0.15%	16.19%	-2.95%	3.57%
VA	5.69%	5.37%	0.90%	0.16%	19.68%	-852.83%	-17.76%
WV	21.83%	7.15%	1.66%	0.34%	20.66%	4.46%	2.28%

### 2.2.3 Changes to Prescribed Fire for 2009/2018 Base G

Just prior to release of version 3.1 of the VISTAS inventory, several Federal agencies indicated that they had plans for increased prescribed fire burning in future years and that the “typical” fire inventory would likely not adequately capture those increases (memo from Bill Jackson and Cindy Huber, August 13, 2004). However data were not readily available to incorporate those changes up through the Base F inventory. As a consequence MACTEC worked with Federal Land Managers to acquire the data necessary to provide 2009 and 2018 specific projections for the prescribed fire component of the Base G fire inventory. The 2009 and 2018 projections developed using the method described below are being used by VISTAS as the 2009 and 2018

base case inventories for all States except FL. For FL the supplied data from the FLMs is not being used as FL felt that their data adequately reflected current and future prescribed burning practices. The “typical” fire projection is the 2002 base prescribed fire projection.

One of the biggest issues in preparing the projection was how best to incorporate the data. Two agencies submitted data: Fish and Wildlife Service (FWS) and Forest Service (FS). FWS submitted annual acreage data by National Wildlife Refuge (NWR) and county with estimates of acres burned per day for each NWR. FS provided fire-by-fire acreage estimates based on mapping projected burning acreage to current 2002 modeling days. However, FWS did not submit data for VISTAS original base year preparation process, thus there was no known FWS data in the 2002 actual or typical inventories. Thus MACTEC had to develop a method that could use the county level data submitted by FWS.

In addition, despite the fact that the FS submitted fire-by-fire data for the 2002 actual inventory and had mapped the projections to current burn days in the 2002 actual inventory, MACTEC could not do a simple replacement of those records with the 2009/2018 projections. This situation was created because several VISTAS States run a prescribed fire permitting program. To avoid double counting, only State data was used in those States for the 2002 actual inventory. Thus there were no Federal data in those States since the Federal data could have potentially duplicated State-supplied prescribed fire data. In VISTAS States without permit programs, the FS supplied data for 2002 was used and those records were marked in database. Thus for those States, the FS supplied 2009/2018 data could be directly substituted for the 2002 data.

The method used by MACTEC to include the FS data applied a county level data approach for FS data where a State had a prescribed fire permitting program and a fire-by-fire replacement for FS data in States without permit programs. MACTEC used a county level approach for all of the FWS data. The approach used for each data set is discussed below.

For the FWS data MACTEC summed the annual acres burned supplied by the FWS across all NWRs in a county. We then subtracted out 2002 acreage for that county from the FWS projected acreage annual total to avoid double counting. The remaining acreage was then multiplied by 0.8 to account for blackened acres instead of the total perimeter acres that were reported. The revised total additional FWS acreage was then added to the total county “typical” acreage to determine future acreage burned for either 2009 or 2018. MACTEC then allocated the increased acreage to current modeling days. The average daily acres burned data provided by FWS per NWR/county was used to allocate the acreage to the correct number of days required to burn all of the acres. Guidance supplied by FWS indicated that up to three times the average daily acres burned could potentially be allocated to any one day. Thus if the estimated acreage per day were 100 acres then up to 300 acres could actually be allocated to a particular day. This approach (use of up to three times the average daily acres burned) was used if there were an insufficient number of 2002

modeling days available to account for all of the acreage increase. MACTEC used an incremental approach to using the increase above the base average daily acres. First we used twice the average daily acreage if that was sufficient to completely allocate the increased acreage over the total number of days available. If that wasn't sufficient then we used three times the average daily acres burned to allocate the acreage. We applied the highest increases to days in the database that already had the highest acreage burned since we felt those days were most likely to represent days with representative conditions for conducting prescribed burns.

The approach used by MACTEC for the FS was slightly different. For States that had permit programs, we used similar approach to the FWS county level approach. First we summed the FS data at county level, we then added that value to the typical acreage and then we allocated the acres to current modeling days. The mapping to current modeling days was performed by Bill Jackson of the USFS and provided to MACTEC. For States that do not have a prescribed fire permit program, MACTEC simply replaced the current fire-by-fire records in the database with fire-by-fire records from the FS and recalculated emissions based on fuel model and fuel loading. We also applied the same 0.8 correction for blackened acres applied to all FS supplied acreage as the supplied values represented perimeter acres.

An additional problem with developing year-specific prescribed fire projections was how to adequately capture the temporal profile for those fires. In the 2002 actual fire inventory, fires occur on same days as state/FLM records. In the 2002 "typical" year inventory, fire acreage increased or decreased from acreage on the same fire days as were in the 2002 actual inventory, since the acres were simply increased for each day based on a multiplier used to convert from actual to typical.

When prescribed fires acreage was added to a future year, MACTEC added acreage to individual fire days proportional to the annual increase (if acreage on a day is 10 percent of annual, add 10 percent of projected increase to that same day).

The table below shows how the FWS data for Okefenokee NWR were allocated for 2009 for Clinch County (Okefenokee NWR is located in four different counties). You can see that the total additional acres for the Clinch County portion of Okefenokee NWR was 1,956 acres. Two hundred eighty (280) acres were the estimated average daily acres burned for that NWR/county combination. Thus to allocate the entire 1,956 acres would require almost 7 burn days (1,956 divided by 280). However only 5 burn days were found for Clinch County in the 2002 actual fire database. Thus we allocated twice the average acreage to the burn day with the most acres burned in the 2002 actual fire database (since our method allowed us to increase the average daily acres burned up to three times the recommended level). Thus the first burn day received 560 acres and all others received 280 except the final day which received 276 to make the total equal to the required 1,956 acres. The table also indicates that the increased acres burned

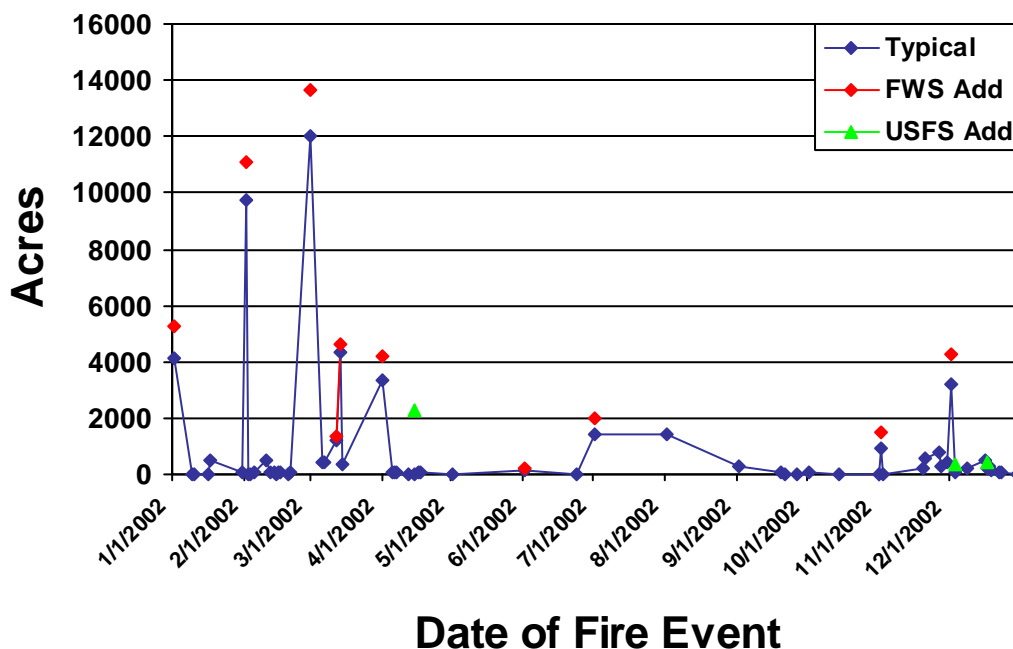
provided increases of from 10-48 percent in the acres burned on the individual burn days and an average of approximately 14 percent for the year as a whole.

CLINCH COUNTY	3/1/2002	4/1/2002	2/1/2002	1/1/2002	11/1/2002	12/1/2002	Total Annual
Acres (typical)	3,757	2,612	1,996	1,801	616	472	11,764
Add on FWS Projection	560	280	280	280	280	276	1,956
Total	4,316	2,891	2,276	2,080	895	747	13,720
Percent Increase	14.9%	10.7%	14.0%	15.6%	45.5%	58.5%	14.3%

The figure below shows the increases for prescribed burning in the four counties that comprise the Okefenokee NWR area (which also includes FS land). In this figure you can see the additional acreage added for the burn days from FWS and the individual day increases caused by projected increases in prescribed burning based on FS data. It should be noted that while the emissions represent 2009, all fire event dates listed are for 2002 to match up with the base year meteorology used in modeling exercises.

Table 2.2-4 shows the percentage difference between the 2009 and 2018 projections developed for Base F and Base G. Base G includes the revised prescribed burning estimates described above. Values are calculated using Base F as the basis for change, thus negative values imply an increase in emissions for Base G.

Figure 2.2-1 Prescribed Fire Projection for Okeefenokee NWR for 2009



**Table 2.2-4 Percentage Difference Between Base F and Base G Fire Emissions by State**

State	CO	NH3	NOX	PM10-PRI	PM25-PRI	SO2	VOC	CO	NH3	NOX	PM10-PRI	PM25-PRI	SO2	VOC	
<b>2009 Fires Base G</b>								<b>2018 Fires Base G</b>							
AL	534,873	2,050	11,901	52,851	46,543	2,681	27,502	535,658	2,054	11,918	52,927	46,608	2,686	27,539	
FL	923,310	3,157	19,791	98,470	88,756	4,129	51,527	923,310	3,157	19,791	98,470	88,756	4,129	51,527	
GA	637,177	2,229	14,243	63,973	57,116	2,914	34,710	637,177	2,229	14,243	63,973	57,116	2,914	34,710	
KY	31,810	143	682	3,093	2,653	187	1,497	33,296	150	714	3,237	2,777	196	1,567	
MS	48,160	217	1,033	4,683	4,016	283	2,266	50,037	225	1,073	4,865	4,173	294	2,355	
NC	96,258	433	2,065	9,359	8,027	566	4,530	111,266	501	2,387	10,819	9,279	655	5,236	
SC	282,307	1,039	5,899	29,153	25,955	1,359	16,045	282,307	1,039	5,899	29,153	25,955	1,359	16,045	
TN	17,372	78	373	1,689	1,449	102	817	18,860	85	405	1,834	1,573	111	888	
VA	21,130	95	453	2,054	1,762	124	994	26,923	121	578	2,618	2,245	158	1,267	
WV	3,949	18	85	384	329	23	186	5,013	23	108	487	418	29	236	
<b>2009 Fires Base F</b>								<b>2018 Fires Base F</b>							
AL	514,120	1,957	11,456	50,833	44,812	2,559	26,526	514,120	1,957	11,456	50,833	44,812	2,559	26,526	
FL	923,310	3,157	19,791	98,470	88,756	4,129	51,527	923,310	3,157	19,791	98,470	88,756	4,129	51,527	
GA	620,342	2,153	13,882	62,336	55,712	2,815	33,918	620,342	2,153	13,882	62,336	55,712	2,815	33,918	
KY	56,686	110	1,460	6,667	6,310	136	3,338	56,686	110	1,460	6,667	6,310	136	3,338	
MS	128,471	177	3,328	14,693	13,680	100	13,625	128,471	177	3,328	14,693	13,680	100	13,625	
NC	200,564	324	5,005	20,488	19,491	423	12,499	200,564	324	5,005	20,488	19,491	423	12,499	
SC	253,005	908	5,270	26,304	23,511	1,187	14,666	253,005	908	5,270	26,304	23,511	1,187	14,666	
TN	78,370	46	2,232	8,875	8,730	59	5,153	78,370	46	2,232	8,875	8,730	59	5,153	
VA	19,159	159	978	18,160	17,361	99	912	19,159	159	978	18,160	17,361	99	912	
WV	32,656	12	944	3,276	3,239	16	2,184	32,656	12	944	3,276	3,239	16	2,184	
<b>Percentage Difference (negative number means an increase in Base G emissions)</b>															
AL	-4.04%	-4.77%	-3.89%	-3.97%	-3.86%	-4.77%	-3.68%	-4.19%	-4.95%	-4.03%	-4.12%	-4.01%	-4.95%	-3.82%	
FL	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
GA	-2.71%	-3.52%	-2.60%	-2.63%	-2.52%	-3.52%	-2.34%	-2.71%	-3.52%	-2.60%	-2.63%	-2.52%	-3.52%	-2.34%	
KY	43.88%	-29.52%	53.25%	53.61%	57.96%	-37.90%	55.15%	41.26%	-35.57%	51.07%	51.44%	56.00%	-44.34%	53.06%	
MS	62.51%	-22.07%	68.95%	68.13%	70.64%	-183.85%	83.37%	61.05%	-26.83%	67.74%	66.89%	69.50%	-194.91%	82.72%	
NC	52.01%	-33.75%	58.74%	54.32%	58.82%	-33.75%	63.76%	44.52%	-54.60%	52.31%	47.19%	52.40%	-54.60%	58.11%	
SC	-11.58%	-14.52%	-11.93%	-10.83%	-10.39%	-14.52%	-9.40%	-11.58%	-14.52%	-11.93%	-10.83%	-10.39%	-14.52%	-9.40%	
TN	77.83%	-69.40%	83.30%	80.97%	83.41%	-74.42%	84.14%	75.93%	-83.92%	81.87%	79.34%	81.98%	-89.36%	82.78%	
VA	-10.29%	40.36%	53.67%	88.69%	89.85%	-25.40%	-9.03%	-40.53%	24.00%	40.97%	85.59%	87.07%	-59.79%	-38.93%	
WV	87.91%	-48.65%	91.03%	88.28%	89.83%	-49.46%	91.49%	84.65%	-88.70%	88.61%	85.12%	87.09%	-89.73%	89.20%	



#### **2.2.4**      *Quality Assurance steps*

Throughout the inventory development process, quality assurance steps were performed to ensure that no double counting of emissions occurred, to ensure that a full and complete inventory was developed for VISTAS, and to make sure that projection calculations were working correctly. Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on the stationary and agricultural area source components of the 2009 and revised 2018 projection inventories:

1. All final files were run through EPA's Format and Content checking software.
2. SCC level emission summaries were prepared and evaluated to ensure that emissions were consistent and that there were no missing sources.
3. Tier comparisons (by pollutant) were developed between the 2002 base year inventory and the 2009 and 2018 projection inventories. In addition, total VISTAS pollutant summaries were prepared to compare total emissions by pollutant between versions of the inventory (e.g., between Base F and Base G).
4. Data product summaries were provided to both the VISTAS Emission Inventory Technical Advisor and to the SIWG representatives for review and comment. Changes based on these comments were implemented in the files.
5. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from 1.0 to 2.0. A minor change would cause a version number to go from 1.0 to 1.1. Minor changes resulting from largely editorial changes would result in a change from 1.00 to 1.01.

### **2.3**      **Mobile Sources**

Our general approach for assembling data was to use as much existing data from the pre-Base F preliminary projections as possible for these inventories, supplement these data with easily available stakeholder input, and provide the results for stakeholder review to ensure credibility. To develop the "base case" projections, MACTEC originally assembled data to develop two 2009 and 2018 base case inventories: 1) an inventory that included all "on-the-books" control programs and 2) an "on-the-way" inventory that included controls that were likely to be "on-the-way". For the Base F and Base G emission forecasts to the mobile source sector, "on-the-books" and "on-the-way" are defined with the same strategies and therefore only a single projection scenario was developed for each forecast year.

To ensure consistency across evaluation years, the 2009 and 2018 base case inventories were developed, to the maximum extent practical, using methodologies identical to those employed in



developing the 2002 on-road portion of the revised 2002 VISTAS base year inventory. All modifications to the 2002 inventory methods were developed in consultation with the Mobile Source Special Interest Workgroup (MSSIWG). Generally, modifications were only made to properly account for actual changes expected in the intervening period (i.e., between 2002 and 2009 and between 2002 and 2018), but the underlying inventory development methodology was identical, except to the extent requested by VISTAS or the MSSIWG.

MACTEC developed a preliminary 2018 inventory in early 2004. That inventory was designed to 1) be used for modeling sensitivity evaluations and 2) help establish the methods that would be used for the final 2018 inventory and the initial 2009 inventory. Since that work took place prior to the revision of the 2002 base year inventory data files, MACTEC provided a review of the data and methods used to develop on-road mobile source input files for the initial 2002 base year inventory prior to developing the preliminary 2018 inventory. Through this review, MACTEC determined the following:

- On-road VMT. Most States provided local data for 2002 (or a neighboring year that was converted to 2002 using appropriate VMT growth surrogates such as population). Since these data were not applicable to 2018 due to intervening growth, input for 2018 was solicited from the MSSIWG. At the same time we researched county-specific growth rate data utilized for recent national rulemakings as a backstop approach to State supplied VMT projections.
- Modeling Temperatures. Actual 2002 temperatures were used for the initial 2002 base year inventory.
- Vehicle Registration Mix (age fractions by type of vehicle). A mix of State, local, and MOBILE6 default data were used for the 2002 initial base year inventory. Forecast data were solicited from the States, with a fallback position that we hold the fractions constant at their 2002 values.
- Vehicle Speed by Roadway Type. For the 2002 initial base year inventory, speeds varying by vehicle and road type were used.
- VMT Mixes (fraction of VMT by vehicle type). A mix of State, local, and quasi MOBILE6 default (i.e., MOBILE6 defaults normalized to better reflect local conditions) data were used for the 2002 initial base year inventory. Forecast data were solicited from the States.
- Diesel Sales Fractions. As with the VMT mix data, the diesel sales fraction data employed for the 2002 initial base year inventory represents a mix of State, local, and quasi MOBILE6 default data. The issues related to updating these data to 2018 are

also similar, but are complicated by the fact that MOBILE6 treats diesel sales fraction on a model year, rather than age specific basis. Therefore, diesel sales fractions generally cannot be held constant across time. Once again, we solicited any local projections, with a fallback position that we would keep the data for 2002 and earlier model years constant for the forecast inventory, supplemented with MOBILE6 default data for 2003 and newer model years.

- **State/Local Fuel Standards.** For the 2002 initial base year inventory, these data were based on appropriate local requirements and updated data for 2018 was only required if changes were expected between 2002 and 2018. There are some national changes in required fuel quality for both on-road and non-road fuels that are expected to occur between 2002 and 2018 and these would be reflected in the 2018 inventory in the absence of more stringent local fuel controls. Expected changes in local fuel control programs were solicited.
- **Vehicle Standards.** The 2002 initial base year inventory assumed NLEV applicability. This was altered to reflect Tier 2 for 2018, unless a State indicated a specific plan to adopt the California LEV II program. If so, we made the required changes to implement those plans for the preliminary 2018 inventory.
- **Other Local Controls.** This includes vehicle emissions inspection (i.e., I/M) programs, Stage II vapor recovery programs, anti tampering programs, etc. By nature, the assumptions used for the 2002 initial base year inventory vary across the VISTAS region, but our presumption is that these data accurately reflected each State's situation as it existed in 2002. If a State had no plans to change program requirements between 2002 and 2018, we proposed to maintain the 2002 program descriptions without change. However, if a State planned changes, we requested information on those plans. In the final implementation of the Base F and earlier inventories, Stage II controls were exercised in the area source component of the inventory, since the units used to develop Stage II refueling estimates are different between MOBILE6 and the NONROAD models. However, in the Base G inventories, Stage II refueling was moved to the on-road and non-road sectors.

Once the preliminary 2018 (pre-Base F) base case projection inventory data were compiled, MACTEC applied the data and methods selected and proceeded to develop the preliminary (pre-base F) base case 2018 projection inventories. The resulting inventories were provided to the MSSIWG in a user-friendly format for review. After stakeholder review and comment, the final preliminary 2018 base case inventories and input files were provided to VISTAS in formats identified by the VISTAS Technical Advisor (in this case, MOBILE input files and VMT, NONROAD input files and annual inventory files for NONROAD in NIF 3.0 format). Annual

inventory files for MOBILE were not developed as part of this work, only input files and VMT forecasts. MOBILE emissions were calculated by VISTAS air quality modeling contractor using the provided files.

### **2.3.1 Development of on-road mobile source input files**

As indicated above, MACTEC prepared a preliminary version of the 2018 base case mobile inventory input data files. These files were then updated to provide a final set of 2018 base case inventory input data files as well as a set of input files for 2009. The information below describes the updates performed on the preliminary 2018 files and the development of the 2009 input data files for Base F emission estimation.

Our default approach to preparing the revised 2018 and initial 2009 projection inventories for on-road mobile sources was to estimate the emissions by using either:

1. the revised 2002 data provided by each State coupled with the projection methods employed for the preliminary 2018 inventory, or
2. the same data and methods used to generate the preliminary 2018 inventory.

We also investigated whether or not there was more recent VMT forecasting data available (e.g., from the CAIR and if appropriate revised the default VMT growth rates accordingly. This did not affect any State that provided local VMT forecasting data, but would alter the VMT estimates used for other areas.

Since no preliminary 2009 inventory was developed there did not exist an option (2) above for 2009. As a consequence, MACTEC crafted the 2009 initial inventory for on-road mobile sources using methods identical to those employed for the 2018 preliminary inventories coupled with any changes/revisions provided by the States during the review of the revised 2002 base year and the 2018 preliminary inventories. Therefore, as was the case for 2018, we obtained from the States any input data revisions, methodological revisions, and local control program specifications (to the extent that they differed from 2002/2018).

#### **2.3.1.1 Preparation of revised 2018 input data files**

Preparation of the revised 2018 inventories required the following updates:

1. The evaluation year was updated to 2018 in all files.
2. The diesel fuel sulfur content was revised from 500 ppm to 11 ppm, consistent with EPA data for 2018 in all files.
3. Since the input data is model year, rather than age, specific for diesel sales fractions (with data for the newest 25 model years required), we updated all files that included

diesel sales fractions. In the revised 2002 base year files, the data included applied to model years 1978-2002. For 2018, the data included would reflect model years 1994-2018. To forecast the 2002 data, MACTEC took the data for 1994-2002 from the 2002 files and added data for 2003-2018. To estimate the data for these years, we employed the assumption employed by "default" in MOBILE6 -- namely that diesel sales fractions for 1996 and later are constant. Therefore, we set the diesel sales fractions for 2003-2018 at the same value as 2002.

4. VMT mix fractions must be updated to reflect expected changes in sales patterns between 2002 and 2018. If explicit VMT mix fractions are not provided, these changes are handled internally by MOBILE6 or externally through absolute VMT distributions. However, files that include explicit VMT mix fractions override the default MOBILE6 update and may or may not be consistent with external VMT distributions. MACTEC updated the VMT mix in such files as follows:

First, we calculated the VMT fractions for LDV, LDT1, LDT2, HDV, and MC from the external VMT files for 2018. This calculation was performed in accordance with section 5.3.2 of the MOBILE6 Users Guide which indicates:

$$\text{LDV} = \text{LDGV} + \text{LDDV}$$

$$\text{LDT1} = \text{LDGT1} + \text{LDDT}$$

$$\text{LDT2} = \text{LDGT2}$$

$$\text{HDV} = \text{HDGV} + \text{HDDV}$$

$$\text{MC} = \text{MC}$$

The resulting five VMT fractions were then split into the 16 fractions required by MOBILE6 using the distributions for 2018 provided in Appendix D of the MOBILE6 Users Guide. This approach ensures that explicit input file VMT fractions are consistent with the absolute VMT distributions prepared by MACTEC. These changes were made to all files that included VMT mixes.

5. All other input data were retained at 2002 values, except as otherwise instructed by the States. This includes all control program descriptions (I/M, Anti-Tampering Program [ATP], Stage II, etc.), all other fuel qualities (RVP, oxy content, etc.), all other vehicle descriptive data (registrations age distributions, etc.), and all scenario descriptive data. The State-specific updates performed are described below.

### **Kentucky:**

MACTEC revised the 2018 input files for the Louisville, Kentucky area (Louisville Air Pollution Control District [APCD]) based on comments received relative to several components of

MOBILE input data. Based on these comments, the input files for Jefferson County, Kentucky were updated accordingly as follows:

- a) I/M and tampering program definitions were removed since the program was discontinued at the end of 2003.
- b) The "Speed VMT", "Facility VMT" and "Registration Age Distribution" file pointers were updated to reflect revised 2002 files provided by the Louisville APCD.
- c) The "VMT Mix" data, which was previously based on the default approach of "growing" 2002 data, was replaced by 2018-specific data provided by the Louisville APCD.

### **North Carolina:**

North Carolina provided a wide range of revised input data, including complete MOBILE6 input files for July modeling. MACTEC did not use the provided input files directly as they did not match the 2002 NC input files for critical elements such as temperature distributions and gasoline RVP (while they were close, they were slightly different). To maintain continuity between 2002 and 2018 modeling, MACTEC instead elected to revise the 2002 input files to reflect all control program and vehicle-related changes implied by the new 2018 files, while retaining the basic temperature and gasoline RVP assumptions at their 2002 values. Under this approach, the following changes were made:

- a) NC provided a county cross reference file specific to 2018 that differed from that used for 2002. We removed files that were referenced in the 2002 input data and replaced those files with those referenced in the 2018 data. In addition, since NC only provided 2018 input files for July, we estimated the basic data for these new files for the other months by cross referencing the target files for 2002 by county against the target files for 2018 by county.
- b) We then revised the 2002 version of each input file to reflect the 2018 "header" data included in the NC-provided 2018 files. These data are exclusively limited to I/M and ATP program descriptions, so that the 2002 I/M and ATP data were replaced with 2018 I/M and ATP data.
- c) We retained the registration age fractions at their 2002 "values" (external file pointers) as per NC instructions.
- d) We retained all scenario-specific data (i.e., temperatures, RVP, etc.) at 2002 values, which (as indicated above), were slightly different in most cases from data included in the 2018 files provided by NC. We believe these differences were due to small deviations between the data assembled to support VISTAS 2002 and the process used to generate the 2018 files provided by NC, and that revising the VISTAS 2002 data to

reflect these variations was not appropriate given the resulting inconsistencies that would be reflected between VISTAS 2002 and VISTAS 2018.

- e) NC also provided non-I/M versions of the 2018 input files that would generally be used to model the non-I/M portion of VMT. While these files were retained they were not used for the 2018 input data preparation.

Finally, NC also provided a speed profile file and a speed profile cross reference file for 2018. We did not use these in our updates as they have no bearing on the MOBILE6 input files, but they were maintained in case they needed to be included in SMOKE control files for a future year control strategy scenario.

### **Virginia:**

In accordance with instructions from VA, the input files that referenced an external I/M descriptive program file (VAIM02.IM) were revised to reference an alternative external file (VAIM05.IM). This change was to make the I/M program more relevant to the year 2018.

One additional important difference was made with respect to the revised 2018 and initial 2009 on-road mobile source input data files for all States. MACTEC developed updated SMOKE ready input files rather than MOBILE6 files so that the input data could be used directly by the VISTAS modeling contractor to estimate on-road mobile source emissions during modeling runs.

#### **2.3.1.2 Preparation of initial 2009 input data files**

The methodology used to develop the 2009 on-road input files was based on forecasting the previously developed revised 2002 base year input files and is identical to that previously described for the revised 2018 methodology except as follows:

1. The evaluation year was updated to 2009.
2. Diesel fuel sulfur content was revised from 500 ppm to 29 ppm. The 29 ppm value was derived from an EPA report entitled "Summary and Analysis of the Highway Diesel Fuel 2003 Pre-compliance Reports" (EPA420-R-03-013, October 2003), which includes the Agency's estimates for the year-to-year fuel volumes associated with the transition from 500 ppm to 15 ppm diesel fuel. According to Table 2 of the report, there will be 2,922,284 barrels per day of 15 ppm diesel distributed in 2009 along with 110,488 barrels per day of 500 ppm diesel. Treating the 15 ppm diesel as 11 ppm on average (consistent with EPA assumptions and assumptions employed for the 2018 input files) and sales weighting the two sulfur content fuels results in an average 2009 diesel fuel sulfur content estimate of 29 ppm.

3. Diesel sales fractions were updated identically to 2018 except that the diesel sales fractions for 2003-2009 were set at the same value as those for 2002 (rather than 2003-2018).
4. VMT mix fractions were updated to 2009 using an identical method to that described for 2018.
5. All other input data were retained at 2002 values, except as otherwise instructed by individual States (see below). This includes all control program descriptions (I/M, ATP, Stage II, etc.), all other fuel qualities (RVP, oxy content, etc.), all other vehicle descriptive data (registration age distributions, etc.), and all scenario descriptive data.

In addition to the updates described above that were applied to all VISTAS-region inputs, the following additional State-specific updates were performed:

**KY** – Identical changes to those made for 2018 (but specific to 2009) were made for the 2009 input files.

**NC** – Identical changes to those made for 2018 (but specific to 2009) were made for the 2009 input files.

**VA** – Identical changes to those made for 2018 were made for 2009.

### **2.3.2 VMT Data**

The basic methodology used to generate the 2009 and 2018 VMT for use in estimating on-road mobile source emissions was as follows:

1. All estimates start from the final VMT estimates used for the 2002 revised base year inventory.
2. Initial 2009 and 2018 VMT estimates were based on linear growth rates for each State, county, and vehicle type as derived from the VMT data assembled by the U.S. EPA for their most recent HDD (heavy duty diesel) rulemaking. The methodology used to derive the growth factors is identical to that employed for the preliminary 2018 VMT estimates (which is described in the next section).
3. For States that provided no independent forecast data, the estimates derived in step 2 are also the final estimates. These States are: Alabama, Florida, Georgia, Kentucky, Mississippi, and West Virginia. For States that provided forecast data, the provided data were used to either replace or augment the forecast data based on the HDD rule. These States, and the specific approaches employed, are detailed following the growth method description.

The steps involved in performing the growth estimates for VMT were as follows:



1. Linear growth estimates were used (although MACTEC investigated the potential use of nonlinear factors and presented that information to the MSSIWG, the decision was made to use linear growth factors instead of nonlinear).
2. Estimates were developed at the vehicle class (i.e., LDGV, LDGT1, LDGT2, etc.) level of detail since the base year 2002 estimates were presented at that level of resolution. In effect, the county and vehicle class specific growth factors were applied to the 2002 VMT estimates for each vehicle and road class.
3. Overall county-specific VMT estimates for each year (developed by summing the vehicle and road class specific forecasts) were then compared to overall county-specific growth. Since overall county growth is a more appropriate controlling factor as it includes the combined impacts of all vehicle classes, the initial year-specific vehicle and road class VMT forecasts were normalized so that they matched the overall county VMT growth. Mathematically, this process is as follows:

$$(\text{Est}_{rv\_f}) = (\text{Est}_{rv\_i}) * (\text{C}_{20XX} / \text{Sum}(\text{Est}_{rv\_i}))$$

where:

Est<sub>rv\_f</sub> = the final road/vehicle class-specific estimates,

Est<sub>rv\_i</sub> = the initial road/vehicle class-specific estimates, and

C<sub>20XX</sub> = the county-specific growth target for year 20XX.

Table 2.3-1 presents a basic summary of the forecasts for the preliminary 2018 inventory for illustrative purposes:

**Table 2.3-1 2002 versus 2018 VMT (million miles per year)**

State	2002	2018	Growth Factor
Alabama	55,723	72,966	1.309
Florida	178,681	258,191	1.445
Georgia	106,785	148,269	1.388
Kentucky	51,020	66,300	1.299
Mississippi	36,278	46,996	1.295
North Carolina	80,166	110,365	1.377
South Carolina	47,074	63,880	1.357
Tennessee	68,316	91,647	1.342
Virginia	76,566	102,971	1.345
West Virginia	19,544	24,891	1.274



The following States provided some types of forecast data for VMT. The information presented below indicates how those data were processed by MACTEC for use in the VISTAS projection inventories.

**Kentucky:**

Revised 2009 and 2018 VMT mix data were provided by the Louisville APCD. Therefore, the distribution of Jefferson County VMT by vehicle type within the KY VMT file was revised to reflect the provided mix. This did not affect the total forecasted VMT for either Jefferson County or the State, but does alter the fraction of that VMT accumulated by each of the eight vehicle types reflected in the VMT file. The following procedure was employed to make the VMT estimates consistent with the provided 2009/2018 VMT mix:

- a) The 16 MOBILE6 VMT mix fractions were aggregated into the following five vehicle types: LDV, LDT1, LDT2, HDV, and MC.
- b) The 8 VMT mileage classes were aggregated into the same five vehicle types (across all roadway types) and converted to fractions by normalizing against the total Jefferson County VMT.
- c) The ratio of the "desired" VMT fraction (i.e., that provided in the Louisville APCD VMT mix) to the "forecasted" VMT fraction (i.e., that calculated on the basis of the forecasted VMT data) was calculated for each of the five vehicle classes.
- d) All forecasted VMT data for Jefferson County were multiplied by the applicable ratio from step c as follows:

$$\begin{aligned} \text{new LDGV} &= \text{old LDGV} * \text{LDV ratio} \\ \text{new LDGT1} &= \text{old LDGT1} * \text{LDT1 ratio} \\ \text{new LDGT2} &= \text{old LDGT2} * \text{LDT2 ratio} \\ \text{new HDGV} &= \text{old HDGV} * \text{HDV ratio} \\ \text{new LDDV} &= \text{old LDDV} * \text{LDV ratio} \\ \text{new LDDT} &= \text{old LDDT} * \text{LDT1 ratio} \\ \text{new HDDV} &= \text{old HDDV} * \text{HDV ratio} \\ \text{new MC} &= \text{old MC} * \text{MC ratio} \end{aligned}$$

The total forecasted VMT for Jefferson County was then checked to ensure that it was unchanged.

**North Carolina:**

North Carolina provided both VMT and VMT mix data by county and roadway type for 2018. Therefore, these data replaced the data developed for North Carolina using HDD rule growth

rates in their entirety. Similar data were submitted for 2009. Table 2.3-2 presents the resulting VMT estimates which differ from the "default" HDD rule estimates as follows:

**Table 2.3-2 VMT and HDD Rule Estimates for North Carolina (million miles per year)**

North Carolina		
2002	106,795	
	State Data	HDD Data
2009	123,396	124,626
2018	129,552	146,989

As indicated, there are substantial reductions in the State-provided forecast data relative to that derived from the HDD rule. The growth rates for both 2009 and 2018 are only about half that implied by the HDD data (1.15 versus 1.17 for 2009 and 1.21 versus 1.38 for 2018). The resulting growth rates are the lowest in the VISTAS region.

NC did not provide VMT mix data for 2009. Therefore, the VMT mix fractions estimated using the "default" HDD rule growth rates were applied to the State-provided VMT estimates to generate vehicle-specific VMT. Essentially, the default HDD methodology produces VMT estimates at the county-road type-vehicle type level of detail, and these data can be converted into VMT fractions at that same level of detail. Note that these are not HDD VMT fractions, but VMT fractions developed from 2002 NC data using HDD vehicle-specific growth rates. In effect, they are 2002 NC VMT fractions "grown" to 2009.

The default VMT mix fraction was applied to the State-provided VMT data at the county and road type level of detail to generate VMT data at the county-road type-vehicle type level of detail. The one exception was for county 063, road 110, for which no VMT data were included in the HDD rule. For this single county/road combination, State-aggregate VMT mix fractions (using the HDD growth methodology) were applied to the county/road VMT data. The difference between road 110 VMT fractions across all NC counties is minimal, so there is no effective difference in utilizing this more aggregate approach vis-à-vis the more resolved county/road approach.

### **South Carolina:**

South Carolina provided county and roadway type-specific VMT data for several future years. Data for 2018 was included and was used directly. Data for 2009 was not included, but was linearly interpolated from data provided for 2007 and 2010. The data were disaggregated into vehicle type-specific VMT using the VMT mixes developed for South Carolina using the HDD rule VMT growth rates. Table 2.3-3 presents the resulting VMT estimates which differ from the "default" HDD rule estimates as follows:

**Table 2.3-3 VMT and HDD Rule Estimates for South Carolina (million miles per year)**

South Carolina		
2002	47,074	
	State Data	HDD Data
2009	55,147	54,543
2018	65,133	63,880

**Tennessee:**

In general, Tennessee estimates are based on the HDD rule growth rate as described in step two. However, Knox County provided independent VMT estimates for 2018 and these were used in place of the HDD rule-derived estimates. The Knox County estimates were total county VMT data only, so these were disaggregated into roadway and vehicle-type VMT using the distributions developed for Knox County in step two using the HDD rule VMT growth rates. No data for Knox County were provided for 2009, so the estimates derived using the HDD rule growth factors were adjusted by the ratio of "Knox County provided 2018 VMT" to "Knox County HDD Rule-derived 2018 VMT." Table 2.3-4 presents the resulting VMT estimates which differ from the "default" HDD rule estimates as follows:

**Table 2.3-4 VMT and HDD Rule Estimates for Tennessee (million miles per year)**

Tennessee		
2002	68,316	
	State Data	HDD Data
2009	78,615	78,813
2018	91,417	91,647

**Virginia:**

Virginia provided county and roadway type-specific annual VMT growth rates and these data were applied to Virginia -provided VMT data for 2002 to estimate VMT in both 2009 and 2018. Virginia provided VMT mix data for 2002, but not 2009 or 2018. Therefore, the estimated VMT data for both 2009 and 2018 were disaggregated into vehicle type-specific VMT using the VMT mixes developed for VA using the HDD rule VMT growth rates. Table 2.3-5 presents the resulting VMT estimates which differ from the "default" HDD rule estimates as follows:

**Table 2.3-5 VMT and HDD Rule Estimates for Virginia (million miles per year)**

Virginia		
2002	77,472	
	State Data	HDD Data
2009	88,419	89,196
2018	104,944	104,164

### 2.3.3 Base G Revisions

For the development of the VISTAS 2009 and 2018 Base G inventories and input files, VISTAS states reviewed the Base F inputs, and provided corrections, updates and supplemental data as noted below.

For all states modeled, the Base G updates include:

- Adding Stage II refueling emissions calculations to the SMOKE processing.
- Revised the HDD compliance. (REBUILD EFFECTS = .1)
- Revised Diesel sulfur values in 2009 to 43 ppm and 2018 to 11 ppm

In addition to the global changes, individual VISTAS states made the following updates:

KY – updated VMT and M6 input values for selected counties

NC – revised VMT estimates, speeds and vehicle distributions and updated registration distributions for Mobile 6.

TN - revised VMT and vehicle registration distributions for selected counties.

WV – revised VMT input data

AL, FL, and GA and VA did not provide updates for 2009/2018 Base G, and the Base F inputs were used for these States.

### 2.3.4 Development of non-road emission estimates

The sections that follow describe the projection process used to develop 2009 and 2018 non-road projection estimates, as revised through the spring of 2006, for sources found in the NONROAD model and those sources estimated outside of the model (locomotives, airplanes and commercial marine vessels).

### 2.3.4.1 NONROAD model sources

NONROAD model input files were prepared in both the fall of 2004 (Base F) and the spring of 2006 (Base G) based on the corresponding 2002 base year inventory input files available at the time the forecasts were developed, with appropriate updates for the projection years. Generally, this means that the Base F 2002 base year input files (as updated through the fall of 2004) were used as the basis for Base F projection year input file development and Base G 2002 base year input files as updated through the spring of 2006 were used as the basis for Base G projection year input file development. Thus, all base year revisions are inherently incorporated into the associated projection year revisions. Other specific updates for the projection years for NONROAD model sources consist of:

1. Revise the emission inventory year in the model (as well as various output file naming commands) to be reflective of the projection year.
2. Revise the fuel sulfur content for gasoline and diesel powered equipment.
3. Implement a limited number of local control program charges (national control program changes are handled internally within the NONROAD model, so explicit input file changes are not required).

All equipment population growth and fleet turnover impacts are also handled internally within the NONROAD model, so that explicit changes input file changes are not required.

#### Base F Input File Changes:

To correctly account for diesel fuel sulfur content differences between the base and projection years, two sets of input and output files were prepared for each forecast year, one set for land-based equipment and one set for marine equipment. This two-step projection process was required for Base F, because diesel fuel sulfur contents varied between land-based and marine-based non-road equipment and the Draft NONROAD2004 used for Base F allowed only a single diesel fuel sulfur input. Thus, the model was executed separately for land-based and marine-based equipment for Base F, and the associated outputs subsequently combined. The specific diesel fuel sulfur contents modeled were as follows:

<b>Diesel S (ppm)</b>	<b>2002</b>	<b>2009</b>	<b>2018</b>
Land-Based	2500	348	11
Marine-Based	2500	408	56

As indicated, the Draft NONROAD2004 model was run with both sets of input files and the output file results were then combined to produce a single NONROAD output set.

To correctly account for the national reduction in gasoline sulfur content (a national control not explicitly handled by the NONROAD model), all NONROAD input files for both 2009 and 2018 were revised to reflect a gasoline fuel sulfur content of 30 ppmW.

**Base G Input File Changes:**

With the release of Final NONROAD2005 that was used for the Base G projection year inventory development, the NONROAD model is capable of handling separate diesel fuel sulfur inputs for land-based and marine-based non-road equipment in a single model execution. Therefore, the two step modeling process described above for Base F updates was no longer required. Instead, the differential diesel fuel sulfur values are assembled into a single NONROAD input file as follows:

<b>Diesel S (ppm)</b>	<b>2002</b>	<b>2009</b>	<b>2018</b>
Land-Based	2500	348	11
Marine-Based	2638	408	56

Additionally, revised gasoline vapor pressure data were provided by Georgia regulators for 20 counties<sup>5</sup> where reduced volatility requirements were established in 2003. Since this requirement began after the 2002 base year, the vapor pressure values in the base year input files for these counties are not correct for either the 2009 or 2018 forecast years. Therefore, to correctly forecast emissions in these counties, the forecast year gasoline vapor pressure inputs were revised to:

<b>Gasoline RVP (psi)</b>	<b>2002</b>	<b>2009</b>	<b>2018</b>
Spring	9.87	9.2	9.2
Summer	9.0	7.0	7.0
Fall	9.87	9.2	9.2
Winter	12.5	12.5	12.5

The summer vapor pressure was simply set equal to the 2003 control value, while the spring and fall vapor pressures were adjusted to reflect a single month of the reduced volatility limit. The winter volatility was assumed to be unaffected by the summertime control requirement.

**2.3.4.1.1 Differences between 2009/2018**

Other than diesel fuel sulfur content and the year of the projections, there are no differences in the methodology used to estimate emissions from NONROAD model sources. As indicated above, however the Base F 2009/2018 projections were developed using Draft NONROAD2004, while the Base G 2009/2018 projections were made using Final NONROAD2005.

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<sup>5</sup> The specific counties are: Banks, Chattooga, Clarke, Floyd, Gordon, Heard, Jasper, Jones, Lamar, Lumpkin, Madison, Meriwether, Monroe, Morgan, Oconee, Pike, Polk, Putnam, Troup, and Upson.

#### **2.3.4.2 Non-NONROAD model sources**

Using the 2002 base year emissions inventory for aircraft, locomotives, and commercial marine vessels (CMV) prepared as described earlier in this document, corresponding emission projections for 2009 and 2018 were developed in both the fall of 2004 (Base F) and the spring of 2006 (Base G). This section describes the procedures employed in developing those inventories. The information presented is intended to build off of that presented in the section describing the 2002 Base F base year inventory. It should be recognized that for both the Base F and Base G inventories, the base year inventory used to develop the emission forecasts was the latest available at the time of forecast development. Generally, this means that the 2002 base year inventory as updated through the fall of 2004 was used as the basis for the Base F projection year inventory development, and the Base F 2002 base year inventory was used as the basis for Base G projection year inventory development. Thus, all base year revisions (as described earlier in this document) are inherently incorporated into the associated projection year revisions.

#### **Base F Revisions:**

Table 2.3-6 shows the 2002 base year emissions for each State in the VISTAS region for aircraft, locomotives and CMV (as they existed prior to Base F development).

**Table 2.3-6. Pre-Base F 2002 Aircraft, Locomotive, and Non-Recreational Marine Emissions**  
(annual tons, as of the fall of 2004)

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	3,787	175	226	87	17	196
	FL	25,431	8,891	2,424	2,375	800	3,658
	GA	6,620	5,372	1,475	1,446	451	443
	KY	2,666	657	179	175	63	263
	MS	1,593	140	44	43	13	96
	NC	6,088	1,548	419	411	148	613
	SC	6,505	515	409	401	88	863
	TN	7,251	2,766	734	719	235	943
	VA	9,763	2,756	1,137	1,115	786	2,529
	WV	1,178	78	25	24	8	66
	<b>Total</b>	<b>70,882</b>	<b>22,899</b>	<b>7,072</b>	<b>6,797</b>	<b>2,607</b>	<b>9,670</b>
Commercial Marine (2280)	AL	1,196	9,218	917	844	3,337	737
	FL	5,888	44,817	1,936	1,781	6,683	1,409
	GA	1,038	7,875	334	307	1,173	246
	KY	6,607	50,267	2,246	2,066	9,608	1,569
	MS	5,688	43,233	1,903	1,751	7,719	1,351
	NC	599	4,547	193	178	690	142
	SC	1,067	8,100	343	316	1,205	253
	TN	3,624	27,555	1,217	1,120	4,974	860
	VA	972	2,775	334	307	359	483
	WV	1,528	11,586	487	448	525	362
	<b>Total</b>	<b>28,207</b>	<b>209,972</b>	<b>9,911</b>	<b>9,118</b>	<b>36,275</b>	<b>7,413</b>
Military Marine (2283)	VA	110	313	25	23	27	48
	<b>Total</b>	<b>110</b>	<b>313</b>	<b>25</b>	<b>23</b>	<b>27</b>	<b>48</b>
Locomotives (2285)	AL	3,490	26,339	592	533	1,446	1,354
	FL	1,006	9,969	247	222	605	404
	GA	2,654	26,733	664	598	1,622	1,059
	KY	2,166	21,811	542	488	1,321	867
	MS	2,302	23,267	578	520	1,429	899
	NC	1,638	16,502	410	369	1,001	654
	SC	1,160	11,690	291	261	710	462
	TN	2,626	25,627	633	570	1,439	1,041
	VA	1,186	11,882	1,529	1,375	3,641	492
	WV	1,311	13,224	329	296	808	517
	<b>Total</b>	<b>19,540</b>	<b>187,044</b>	<b>5,815</b>	<b>5,232</b>	<b>14,022</b>	<b>7,750</b>
<b>Grand Total</b>		<b>118,739</b>	<b>420,228</b>	<b>22,823</b>	<b>21,170</b>	<b>52,931</b>	<b>24,881</b>



Although some of the data utilized was updated, the methodology used to develop the Base F 2009 and 2018 emissions forecasts for aircraft, locomotives, and CMV is identical to that used earlier to develop preliminary 2018 Base 1 (“On the Books”) and 2018 Base 2 (“On the Way”) inventories. Briefly, the methodology relies on growth and control factors developed from inventories used in support of recent EPA rulemakings, and consists of the following steps:

- (a) Begin with the 2002 base year emission estimates for aircraft, locomotive, and CMV as described above (at the State-county-SCC-pollutant level of detail).
- (b) Detailed inventory data (both before and after controls) for these same emission sources for 1996, 2010, 2015, and 2020 were obtained from the EPA's Clean Air Interstate Rule (CAIR) Technical Support Document (which can be found at <http://www.epa.gov/cair/pdfs/finaltech01.pdf>). Using these data, combined growth and control factors for the period 2002-2009 and 2002-2018 were estimated using straight line interpolation between 1996 and 2010 (for 2009) and 2015 and 2020 (for 2018). This is done at the State-county-SCC-pollutant level of detail.
- (c) The EPA growth and control data are matched against the 2002 VISTAS base year data using State-county-SCC-pollutant as the match key. Ideally, there would be a one-to-one match and the process would end at this point. Unfortunately, actual match results were not always ideal, so additional matching criteria were required. For subsequent reference, this initial (highest resolution) matching criterion is denoted as the “CAIR-Primary” criterion.
- (d) A second matching criterion is applied that utilizes a similar, but higher-level SCC (lower resolution) matching approach. For example, SCC 2275020000 (commercial aircraft) in the 2002 base year inventory data would be matched with SCC 2275000000 (all aircraft) in the CAIR data. This criterion is applied to records in the 2002 base year emissions file that are not matched using the “CAIR-Primary” criterion, and is also performed at the State-county-SCC-pollutant level of detail. For subsequent reference, this is denoted as the “CAIR-Secondary” criterion. At the end of this process, a number of unmatched records remained, so a third level matching criterion was required.
- (e) In the third matching step, the most frequently used SCC in the EPA CAIR files for each of the aircraft, locomotive, and commercial marine sectors was averaged at the State level to produce a “default” State and pollutant-specific growth and control factor for the sector. The resulting factor is used as a “default” growth factor for all unmatched county-SCC-pollutant level data in each State. In effect, State-specific growth data are applied to county level data for which an explicit match between the VISTAS 2002 base year data and EPA CAIR data could not be developed. The default growth and control

SCCs are 2275020000 (commercial aircraft) for the aircraft sector, 2280002000 (commercial marine diesel total) for the CMV sector, and 2285002000 (railroad equipment diesel total) for the locomotive sector. Matches made using this criterion are denoted as “CAIR-Tertiary” matches.

- (f) According to EPA documentation, the CAIR baseline emissions include the impacts of the (then proposed) Tier 4 (T4) non-road diesel rulemaking, which implements a low sulfur fuel requirement that affects both future CMV and locomotive emissions. However, the impacts of this rule were originally intended to be excluded from the initial VISTAS 2018 forecast, which was to include only “on-the-books” controls. (The T4 rule was finalized subsequent to the development of the preliminary 2018 inventory in March of 2004.) Given its final status, T4 impacts were moved into the “on the books” inventory for non-road equipment. In addition, since there are no other proposed rules affecting the non-road sector between 2002 and 2018, there is no difference between the 2018 “on the books” and 2018 “on the way” inventories for the sector; so that only a single forecast inventory (for each evaluation year) was developed. Nevertheless, since the algorithms developed to produce the VISTAS forecasts were developed when there was a distinction between the “on the books” and “on the way” inventories, the distinct algorithms used to produce the two inventories have been maintained even though the conceptual distinctions have been lost. This approach was taken for two reasons. First, it allowed the previously developed algorithms to be utilized without change. Second, it allowed for separate treatment of the T4 emissions impact which was important as those impacts changed between the proposed and final T4 rules. Thus, previous EPA inventories that include the proposed T4 impacts would not be accurate. Therefore, the procedural discussion continues to reflect the distinctions between non-T4 and T4 emissions, as these distinctions continue to be intrinsically important to the forecasting process. Therefore, a second set of EPA CAIR files that excluded the Tier 4 diesel impacts was obtained and the same matching exercise described above in steps (b) through (e) was performed using these “No T4” files. It is important to note that the matching exercise described in steps (b) through (e) cannot simply be replaced because the “No T4” files obtained from the EPA include only those SCCs specifically affected by the T4 rule (i.e., diesel CMV and locomotives). So in effect, the matching exercise was augmented (rather than replaced) with an additional three criteria analogous to those described in steps (c) through (e), and these are denoted as the “No T4-Primary,” “No T4-Secondary,” and “No T4-Tertiary” criteria. Because they exclude the impacts of the proposed T4 rule, matches using the “No T4” criteria supersede matches made using the basic CAIR criteria (as described in steps (c) through (e) above).

- (g) The CAIR matching criteria were overridden for any record for which States provided local growth data. Only North Carolina provided these forecasts, as that State has provided specific growth factors for airport emissions in four counties. Because the provided data were based on forecasted changes in landings and takeoffs at major North Carolina airports, the factors were applied only to commercial (SCC 2275020000) and air taxi (SCC 2275060000) emissions. Emissions forecasts for military and general aviation aircraft operations, as well as all aircraft operations in counties other than the four identified in the North Carolina growth factor submission, continued to utilize the growth factors developed according to steps (b) through (f) above. Table 2.3-7 presents the locally generated growth factors applied in North Carolina.

**Table 2.3-7 Locally Generated Growth Factors for North Carolina**

FIP	2009 Factor	2018 Factor
37067	0.71	0.84
37081	0.97	0.89
37119	1.15	1.01
37183	0.88	0.81

**Note:**

Growth factor = Year Emissions/2002 Emissions.

Under CAIR approach, 2009 = 1.16 to 1.17 for all 4 counties.

Under CAIR approach, 2018 = 1.36 to 1.37 for all 4 counties.

- (h) Using this approach, each State-county-SCC-pollutant was assigned a combined growth and control factor using the EPA CAIR forecast or locally provided data. The 22,838 data records for aircraft, locomotives, and CMV in the 2002 revised base year emissions file were assigned growth factors in accordance with the following breakdown:

48 records matched State-provided growth factors,  
 4,179 records matched using the CAIR-Primary criterion,  
 240 records matched using the CAIR-Secondary criterion,  
 7,463 records matched using the CAIR-Tertiary criterion,  
 720 records matched using the No T4-Primary criterion,  
 3,858 records matched using the No T4-Secondary criterion, and  
 6,330 records matched using the No T4-Tertiary criterion.

- (i) Finally, the impacts of the T4 rule as adopted were applied to the grown “non T4” emission estimates. The actual T4 emission standards do not affect aircraft, locomotive, or CMV directly, but associated diesel fuel sulfur requirements do affect locomotives and CMV. Lower fuel sulfur content affects both SO<sub>2</sub> and PM emissions. Expected fuel sulfur

contents were obtained for each evaluation year from the EPA technical support document for the final T4 rule (*Final Regulatory Analysis: Control of Emissions from Non-road Diesel Engines*, EPA420-R-04-007, May 2004). According to that document, the average diesel fuel sulfur content for locomotives and CMV is expected to be 408 ppmW in 2009 and 56 ppmW in 2018. These compare to expected non-T4 fuel sulfur levels of 2599 ppmW in 2009 and 2336 ppmW in 2018. Table 2.3-8 uses calculated emissions estimates for base and T4 control scenarios to estimate emission reduction impacts.

**Table 2.3-8 Estimated Emission Reduction Impacts based on T-4 Rule**

				2009	2018
CMV SO <sub>2</sub>	=	Non-T4 SO <sub>2</sub>	×	0.1569	0.0241
Locomotive SO <sub>2</sub>	=	Non-T4 SO <sub>2</sub>	×	0.1569	0.0241
CMV PM	=	Non-T4 PM	×	0.8962	0.8762
Locomotive PM	=	Non-T4 PM	×	0.8117	0.7734

However, since the diesel fuel sulfur content assumed for the 2002 VISTAS base year inventory, upon which both the 2009 and 2018 inventories were based, is 2500 ppmW, a small adjustment to the emission reduction multipliers calculated from the T4 rule is appropriate since they are measured relative to modestly different sulfur contents (2599 ppmW for 2009 and 2336 ppmW for 2018). Correcting for these modest differences produces the emission reduction impact estimates relative to forecasts based on the VISTAS 2002 inventory shown in Table 2.3-9.

**Table 2.3-9 Estimated Emission Reduction Impacts Relative to VISTAS 2002 Base Year Values**

				2009	2018
CMV SO <sub>2</sub>	=	Non-T4 SO <sub>2</sub>	×	0.1632	0.0225
Locomotive SO <sub>2</sub>	=	Non-T4 SO <sub>2</sub>	×	0.1632	0.0225
CMV PM	=	Non-T4 PM	×	0.9004	0.8685
Locomotive PM	=	Non-T4 PM	×	0.8187	0.7610

These factors were applied directly to the non-T4 emission forecasts to produce the final VISTAS 2009 and 2018 emissions inventories for aircraft, locomotive, and CMV.

The only exception is for Palm Beach County, Florida, where CMV emissions are reported as “all fuels” rather than separately by residual and diesel fuel components. To estimate T4 impacts in Palm Beach County, the ratio of diesel CMV emissions to total

CMV emissions in the remainder of Florida was calculated and the T4 impact estimates for Palm Beach County were adjusted to reflect that ratio. Table 2.3-10 shows the calculated diesel CMV ratios.

**Table 2.3-10 Diesel CMV Adjustment Ratios for Palm Beach County, FL**

GROWTH BASIS	SO <sub>2</sub>	PM
2009 (1996, 2020 Growth Basis)	0.2410	0.7861
2009 (1996, 2010, 2015, and 2020 Growth Basis)	0.1279	0.7875
2018 (1996, 2020 Growth Basis)	0.2432	0.7925
2018 (1996, 2010, 2015, and 2020 Growth Basis)	0.2624	0.7918

*The differences between the growth bases are discussed in detail below.*

Combining these ratios with the T4 impact estimates for diesel engines, as presented above, yields the following impact adjustment factors for Palm Beach County:

**Table 2.3-11 Overall Adjustment Factors for Palm Beach County, FL**

GROWTH BASIS		
2009 SO <sub>2</sub> (19, 20 Growth Basis)	0.7894	[0.1632×0.2410+(1-0.2410)]
2009 SO <sub>2</sub> (96, 10, 15, and 20 Growth Basis)	0.8930	[0.1632×0.1279+(1-0.1279)]
2018 SO <sub>2</sub> (96, 20 Growth Basis)	0.7623	[0.0225×0.2432+(1-0.2432)]
2018 SO <sub>2</sub> (96, 10, 15, and 20 Growth Basis)	0.7436	[0.0225×0.2624+(1-0.2624)]
2009 PM (19, 20 Growth Basis)	0.9217	[0.9004×0.7861+(1-0.7861)]
2009 PM (96, 10, 15, and 20 Growth Basis)	0.9216	[0.9004×0.7875+(1-0.7875)]
2018 PM (96, 20 Growth Basis)	0.8958	[0.8685×0.7925+(1-0.7925)]
2018 PM (96, 10, 15, and 20 Growth Basis)	0.8959	[0.8685×0.7918+(1-0.7918)]

*The differences between the growth bases are discussed in detail below.*

Utilizing this approach, emission inventory forecasts for both 2009 and 2018 were developed. As indicated in step (b) above, basic growth factors were developed using EPA CAIR inventory data for 1996, 2010, 2015, and 2020. From these data, equivalent EPA CAIR inventories for 2002 and 2009 were developed through linear interpolation of the 1996 and 2010 inventories, while an equivalent CAIR inventory for 2018 was developed through linear interpolation of the 2015 and 2020 inventories. Growth factors for 2009 and 2018 were then estimated as the ratios of the CAIR 2009 and 2018 inventories to the CAIR 2002 inventory.

During the development of the preliminary 2018 VISTAS inventory in March 2004, this process yielded reasonable results and exhibited no particular systematic concerns. However, when the 2009 Base F inventory was developed, significant concerns related to SO<sub>2</sub> and PM were encountered. Essentially, what was revealed by the Base F 2009 forecast was a series of apparent inconsistencies in the CAIR 2010 and 2015 emission inventories (as compared to the 1996 and 2020 CAIR inventories) that were masked during the construction of the “longer-term” 2018 inventory.

The apparent inconsistencies are best illustrated by looking at the actual data extracted from the CAIR inventory files. Note that although a limited example is being presented, the same general issue applies throughout the CAIR files. For FIP 01001 (Autauga County, Alabama) and SCC 2285002000 (Diesel Rail), the CAIR inventories indicate SO<sub>2</sub> emission estimates as shown in Table 2.3-12.

**Table 2.3-12 SO<sub>2</sub> Emissions for Diesel Rail in Autauga County, AL from the CAIR Projections**

YEAR	TONS
1996:	15.3445
2010:	2.7271
2015:	2.8178
2020:	16.6232

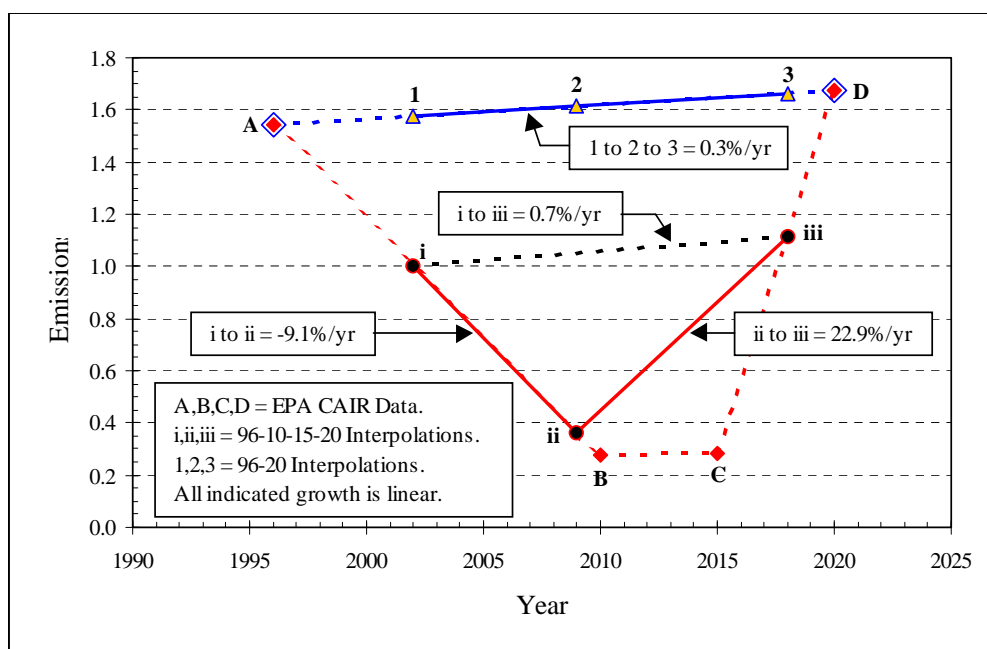
Clearly, there is a major drop in emissions between 1996 and 2010, followed by a major increase in emissions between 2015 and 2020. Several observations regarding these changes are important. First, the CAIR data were reported to exclude the T4 rule, so that the drop in emissions should be related to something other than simply a change in diesel fuel sulfur content. Second, if the T4 rule impacts were “accidentally” included in the estimates, there should be a resultant 90 percent drop in diesel sulfur between 2010 and 2015; so such inclusion is unlikely. Third, the rate of growth between 2015 and 2020 (43 percent *per year* compound or 97 percent *per year* linear) is well beyond any reasonable expectations for rail service; and fuel sulfur content during this period is constant both with and without T4. In short, there appeared to be no rational explanation for the data, yet the same basic relations are observed for thousands of CAIR inventory records.

For the most part, the issue seems to be centered on SO<sub>2</sub> and PM records, which are those records primarily affected by the T4 rule. But, as noted above, there does not seem to be any pattern of consistency that would indicate that either inclusion or exclusion of T4 rule impacts is the underlying cause. Moreover, where they occur, the observed growth extremes generally affect both SO<sub>2</sub> and PM equally, while one would expect PM effects to be buffered if the T4 rule

was the underlying cause, since changes in diesel fuel sulfur content will only affect a fraction of PM (i.e., sulfate), while directly reducing SO<sub>2</sub>.

The data presented in Figure 2.3-1 illustrates what this meant to the VISTAS forecasting process. Figure 2.3-1 depicts the same data presented above for Autauga County, Alabama, but normalized so that the interpolated 2002 CAIR emissions estimate equals unity. The “raw” CAIR data is depicted by the markers labeled A, B, C, and D. Interpolated data for 2002 and 2009, based on 1996 and 2010 CAIR data, is depicted by the markers labeled “i” and “ii.” Interpolated data for 2018, based on 2015 and 2020 CAIR data is depicted by the marker labeled “iii.” The relationship between marker “iii” and marker “i” is exactly the relationship used to construct the preliminary (e.g., pre-Base F) 2018 VISTAS inventory (i.e., a linear growth rate equal to 0.7 percent per year). Thus, it is easy to see that although there is a major “dip and rise” between 2002 and 2018, it is essentially masked unless data for intervening years are examined. Since no intervening year was examined for the preliminary 2018 inventory, the “dip and rise” was not discovered. However, upon the development of the 2009 inventory forecast, the issue became obvious, as the marker labeled “ii” readily illustrates. In effect, the 2009 inventory reflected very low negative “growth rates” for some SCCs and pollutants relative to the 2002 inventory, while the 2018 inventory reflected very high and positive growth rates for those same SCCs and pollutants. In effect, the path between 2002 and 2018 that previously looked like the dotted line connecting markers “i” and “iii,” now looks like the solid line connecting markers “i,” “ii,” and “iii.” For reference purposes, this path is hereafter referred to as the 1996, 2010, 2015, and 2020 growth basis, since all interpolated data is based on CAIR data for those four years.

**Figure 2.3-1. Impacts of the Apparent CAIR Inventory Discrepancy**





In light of the apparent discrepancies inherent in the 1996, 2010, 2015, and 2020 growth basis data and the inconsistencies its use would impart into the 2009 and 2018 VISTAS inventories, a secondary forecasting method was developed. This second method relies on the apparent consistency between the 1996 and 2020 non-T4 CAIR inventories, interpolating equivalent 2002, 2009, and 2018 inventories solely from these two inventories. In effect, the CAIR inventories for 2010 and 2015 are ignored. In Figure 2.3-1, this secondary approach is depicted by the data points that lie along the lines connecting markers A and D. Markers A and D represent the 1996 and 2020 CAIR inventories, and the markers labeled 1, 2, and 3 represent the interpolated 2002, 2009, and 2018 CAIR equivalent inventories. The growth rate between 2009 and 2002 is then equal to the ratio of the 2009 and 2002 CAIR inventories, while that between 2018 and 2002 is equal to the ratio of the 2018 and 2002 CAIR inventories. For the example data, the resulting linear growth estimate is 0.3 percent per year. For reference purposes, this path is hereafter referred to as the 1996-2020 growth basis, since all interpolated data are based on CAIR data for only those two years.

It is perhaps worth noting that the only elements of Figure 2.3-1 that have any bearing on the VISTAS inventories are the growth rates. The absolute CAIR data are of importance only in determining those rates, as all VISTAS inventories were developed on the basis of the VISTAS 2002 base year inventory, not any of the CAIR inventories. So referring to Figure 2.3-1, the two growth options are summarized in Table 2.3-13.

**Table 2.3-13 Growth Options based on CAIR Data**

<b>GROWTH BASIS</b>	<b>PERCENT PER YEAR</b>
1996, 2010, 2015, 2020 Growth Basis:	-9.1% per year (linear) between 2002 and 2009
1996-2020 Growth Basis:	+0.3% per year (linear) between 2002 and 2009
1996, 2010, 2015, 2020 Growth Basis:	+22.9% per year (linear) between 2009 and 2018
1996-2020 Growth Basis:	+0.3% per year (linear) between 2009 and 2018
1996, 2010, 2015, 2020 Growth Basis:	+0.7% per year (linear) between 2002 and 2018
1996-2020 Growth Basis:	+0.3% per year (linear) between 2002 and 2018

Of course, these specific rates are applicable only to the example case (i.e., diesel rail SO<sub>2</sub> in Autauga County, Alabama), but there are thousands of additional CAIR records that are virtually identical from a growth viewpoint.

While forecast inventories for aircraft, locomotives, and CMV were developed for 2009 and 2018 using both growth methods, it was ultimately decided to utilize the 1996-2020 growth basis for Base F since it provided more reasonable growth rates for 2009. Tables 2.3-14 and 2.3-15 present a summary of each Base F inventory, while Tables 2.3-16 and 2.3-17 present the associated change in emissions for each Base F forecast inventory relative to the Base F 2002



base year VISTAS inventory. The larger reduction in CMV SO<sub>2</sub> emissions in 2009 and 2018 (relative to 2002) for Virginia and West Virginia is notable relative to the other VISTAS States, but this has been checked and is attributable to a high diesel contribution to total CMV SO<sub>2</sub> in the 2002 inventories for these two States.

Figures 2.3-2 through 2.3-13 graphically depict the relationships between the various Base F inventories and preliminary 2002 and 2018 projections prepared prior to Base F. There are two figures for each pollutant, the first of which presents a comparison of total VISTAS regional emission estimates for aircraft, locomotives, and CMV, and the second of which presents total VISTAS region emission estimates for locomotives only. This two figure approach is intended to provide a more robust illustration of the differences between the various inventories, as some of the differences are less distinct when viewed through overall aggregate emissions totals. All of the figures include the following emissions estimates:

- The 2002 Base F base year VISTAS emissions inventory (labeled as “2002”),
- The 2002 pre-Base F base year VISTAS emissions inventory (labeled as “2002 Prelim”),
- The Base F 2009 VISTAS emissions inventory developed using growth rates derived from 1996 and 2020 EPA CAIR data (labeled as “2009”),
- The Base F 2018 VISTAS emissions inventory developed using growth rates derived from 1996 and 2020 EPA CAIR data (labeled as “2018”), and
- The pre-Base F 2018 VISTAS emissions inventory estimates as developed using growth rates derived from 1996, 2010, 2015, and 2020 EPA CAIR data (labeled as “2018 Prelim”).

All 12 figures generally illustrate a reduction in emissions estimates between the 2002 pre-Base F emission estimates published in February 2004 (the initial 2002 VISTAS inventory) and the 2002 Base F emission estimates. This reduction generally results from emission updates reflected in the State 2002 CERR submittals used to develop the Base F 2002 base year inventory, although the major differences in aggregate PM emission estimates are driven to a greater extent by modifications in the methodology used to estimate aircraft PM in the Base F 2002 base year inventory (as documented under the base year inventory section of this report).

**Table 2.3-14. Base F 2009 Aircraft, Locomotive, and Non-Recreational Marine Emissions  
(annual tons) -- Based on Growth Using 1996 and 2020 EPA Inventories**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	4,178	202	278	102	19	217
	FL	29,258	10,316	2,812	2,756	928	4,235
	GA	7,635	6,233	1,712	1,678	523	512
	KY	3,075	762	207	203	73	304
	MS	1,765	162	51	50	16	108
	NC	6,551	1,601	436	427	153	644
	SC	7,372	559	446	437	98	975
	TN	8,020	3,096	824	807	268	1,050
	VA	10,994	3,094	1,239	1,214	907	2,892
	WV	1,312	91	28	28	9	74
	<b>Total</b>		<b>80,159</b>	<b>26,116</b>	<b>8,033</b>	<b>7,704</b>	<b>2,993</b>
Commercial Marine (2280)	AL	1,280	8,888	872	802	2,753	768
	FL	6,236	43,198	1,838	1,691	5,864	1,467
	GA	1,097	7,599	317	291	974	256
	KY	7,087	48,039	2,158	1,985	8,350	1,649
	MS	6,074	41,437	1,821	1,676	6,587	1,415
	NC	634	4,386	184	169	584	148
	SC	1,133	7,796	326	300	1,012	264
	TN	3,887	26,333	1,168	1,074	4,512	904
	VA	1,042	2,662	312	286	61	506
	WV	1,638	11,073	455	419	89	381
	<b>Total</b>		<b>30,109</b>	<b>201,412</b>	<b>9,450</b>	<b>8,693</b>	<b>30,786</b>
Military Marine (2283)	VA	118	299	23	21	5	50
	<b>Total</b>		<b>118</b>	<b>299</b>	<b>23</b>	<b>21</b>	<b>50</b>
Locomotives (2285)	AL	3,648	23,529	452	406	242	1,279
	FL	1,052	8,905	189	170	101	382
	GA	2,769	24,398	507	456	271	1,003
	KY	2,264	19,597	415	374	221	819
	MS	2,406	20,785	441	397	239	849
	NC	1,712	14,741	313	282	167	618
	SC	1,213	10,443	222	200	119	437
	TN	2,745	23,924	483	435	240	984
	VA	1,236	11,134	1,167	1,050	608	467
	WV	1,369	12,177	251	226	135	489
	<b>Total</b>		<b>20,412</b>	<b>169,635</b>	<b>4,440</b>	<b>3,995</b>	<b>2,343</b>
<b>Grand Total</b>		<b>130,798</b>	<b>397,462</b>	<b>21,946</b>	<b>20,413</b>	<b>36,126</b>	<b>26,148</b>

**Table 2.3-15. Base F 2018 Aircraft, Locomotive, and Non-Recreational Marine Emissions  
(annual tons) -- Based on Growth Using 1996 and 2020 EPA Inventories**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	4,681	236	345	122	23	245
	FL	34,178	12,147	3,312	3,246	1,093	4,976
	GA	8,939	7,340	2,016	1,976	616	601
	KY	3,602	898	244	239	86	357
	MS	1,986	190	60	58	18	122
	NC	6,728	1,454	400	392	139	615
	SC	8,487	616	493	484	112	1,119
	TN	9,009	3,519	939	921	309	1,187
	VA	12,578	3,528	1,370	1,342	1,063	3,358
	WV	1,484	106	33	33	10	85
	<b>Total</b>	<b>91,670</b>	<b>30,035</b>	<b>9,213</b>	<b>8,814</b>	<b>3,468</b>	<b>12,666</b>
Commercial Marine (2280)	AL	1,388	8,464	880	809	2,715	809
	FL	6,684	41,117	1,853	1,705	6,248	1,543
	GA	1,174	7,246	319	293	976	269
	KY	7,703	45,174	2,199	2,023	8,383	1,752
	MS	6,571	39,129	1,850	1,702	6,556	1,498
	NC	679	4,179	185	170	596	155
	SC	1,217	7,406	329	303	1,027	278
	TN	4,225	24,763	1,190	1,095	4,808	960
	VA	1,133	2,517	314	289	9	537
	WV	1,781	10,412	459	422	13	404
	<b>Total</b>	<b>32,554</b>	<b>190,407</b>	<b>9,578</b>	<b>8,811</b>	<b>31,330</b>	<b>8,205</b>
Military Marine (2283)	VA	128	282	23	21	1	53
	<b>Total</b>	<b>128</b>	<b>282</b>	<b>23</b>	<b>21</b>	<b>1</b>	<b>53</b>
Locomotives (2285)	AL	3,850	19,917	381	343	34	1,183
	FL	1,110	7,538	159	143	14	353
	GA	2,917	21,395	427	385	38	932
	KY	2,389	16,751	352	317	31	757
	MS	2,540	17,594	372	335	34	785
	NC	1,807	12,478	264	237	24	571
	SC	1,280	8,840	187	168	17	404
	TN	2,897	21,735	407	367	34	910
	VA	1,300	10,173	983	885	86	436
	WV	1,444	10,831	212	190	19	453
	<b>Total</b>	<b>21,534</b>	<b>147,252</b>	<b>3,744</b>	<b>3,368</b>	<b>333</b>	<b>6,785</b>
<b>Grand Total</b>		<b>145,885</b>	<b>367,975</b>	<b>22,557</b>	<b>21,015</b>	<b>35,132</b>	<b>27,709</b>

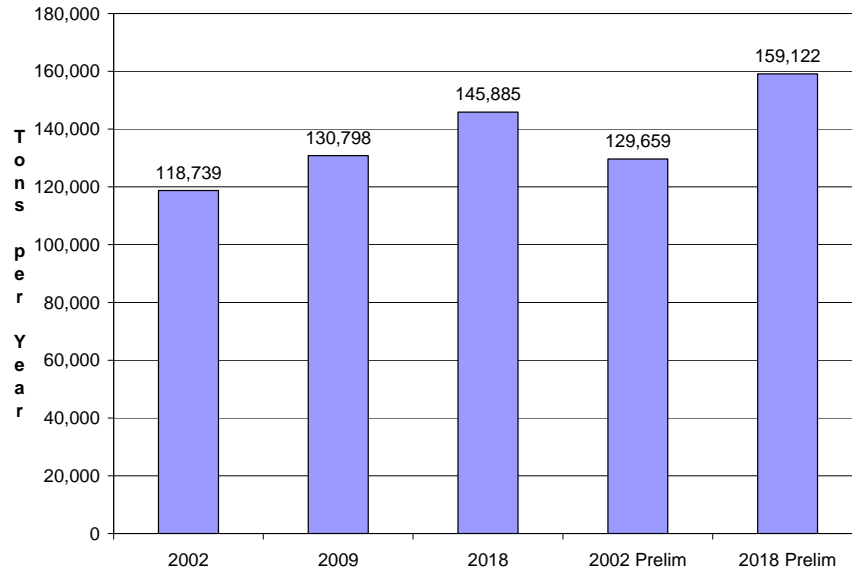
**Table 2.3-16. Change in Emissions between 2009 and 2002 Base F Inventories (Based on Growth Using 1996 and 2020 EPA Inventories)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	+10%	+15%	+23%	+18%	+16%	+11%
	FL	+15%	+16%	+16%	+16%	+16%	+16%
	GA	+15%	+16%	+16%	+16%	+16%	+16%
	KY	+15%	+16%	+16%	+16%	+16%	+16%
	MS	+11%	+16%	+15%	+15%	+16%	+12%
	NC	+8%	+3%	+4%	+4%	+3%	+5%
	SC	+13%	+9%	+9%	+9%	+12%	+13%
	TN	+11%	+12%	+12%	+12%	+14%	+11%
	VA	+13%	+12%	+9%	+9%	+15%	+14%
	WV	+11%	+16%	+15%	+15%	+16%	+12%
	<b>Total</b>		<b>+13%</b>	<b>+14%</b>	<b>+14%</b>	<b>+13%</b>	<b>+15%</b>
Commercial Marine (2280)	AL	+7%	-4%	-5%	-5%	-18%	+4%
	FL	+6%	-4%	-5%	-5%	-12%	+4%
	GA	+6%	-3%	-5%	-5%	-17%	+4%
	KY	+7%	-4%	-4%	-4%	-13%	+5%
	MS	+7%	-4%	-4%	-4%	-15%	+5%
	NC	+6%	-4%	-5%	-5%	-15%	+4%
	SC	+6%	-4%	-5%	-5%	-16%	+4%
	TN	+7%	-4%	-4%	-4%	-9%	+5%
	VA	+7%	-4%	-7%	-7%	-83%	+5%
	WV	+7%	-4%	-7%	-7%	-83%	+5%
	<b>Total</b>		<b>+7%</b>	<b>-4%</b>	<b>-5%</b>	<b>-5%</b>	<b>-15%</b>
Military Marine (2283)	VA	+7%	-4%	-7%	-7%	-83%	+5%
	<b>Total</b>		<b>+7%</b>	<b>-4%</b>	<b>-7%</b>	<b>-7%</b>	<b>-83%</b>
Locomotives (2285)	AL	+5%	-11%	-24%	-24%	-83%	-6%
	FL	+5%	-11%	-24%	-24%	-83%	-6%
	GA	+4%	-9%	-24%	-24%	-83%	-5%
	KY	+5%	-10%	-23%	-23%	-83%	-6%
	MS	+5%	-11%	-24%	-24%	-83%	-6%
	NC	+5%	-11%	-24%	-24%	-83%	-6%
	SC	+5%	-11%	-24%	-24%	-83%	-6%
	TN	+5%	-7%	-24%	-24%	-83%	-6%
	VA	+4%	-6%	-24%	-24%	-83%	-5%
	WV	+4%	-8%	-24%	-24%	-83%	-5%
	<b>Total</b>		<b>+4%</b>	<b>-9%</b>	<b>-24%</b>	<b>-24%</b>	<b>-83%</b>
<b>Grand Total</b>		<b>+10%</b>	<b>-5%</b>	<b>-4%</b>	<b>-4%</b>	<b>-32%</b>	<b>+5%</b>

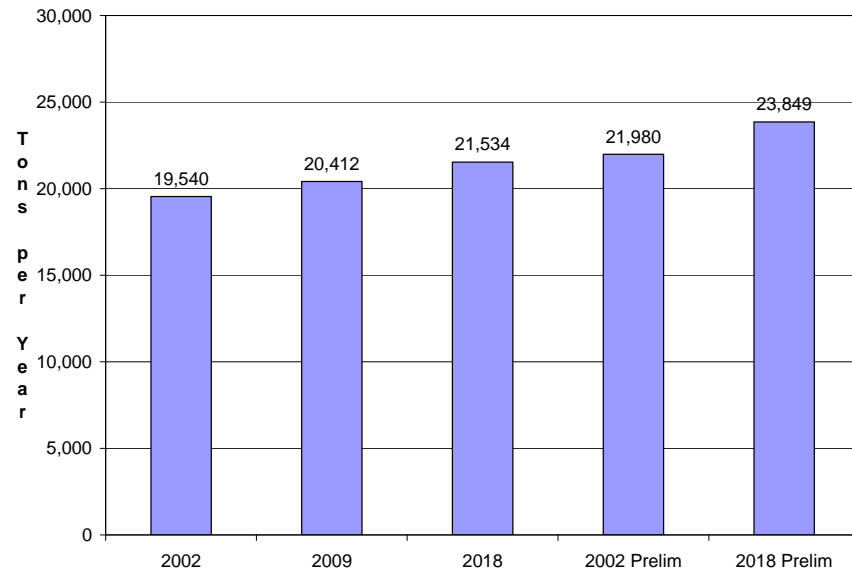
**Table 2.3-17. Change in Emissions between 2018 and 2002 Base F Inventories (Based on Growth Using 1996 and 2020 EPA Inventories)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC	
Aircraft (2275)	AL	+24%	+35%	+53%	+41%	+36%	+25%	
	FL	+34%	+37%	+37%	+37%	+37%	+36%	
	GA	+35%	+37%	+37%	+37%	+37%	+36%	
	KY	+35%	+37%	+37%	+37%	+37%	+36%	
	MS	+25%	+36%	+35%	+35%	+36%	+27%	
	NC	+10%	-6%	-5%	-5%	-6%	0%	
	SC	+30%	+20%	+21%	+21%	+27%	+30%	
	TN	+24%	+27%	+28%	+28%	+31%	+26%	
	VA	+29%	+28%	+20%	+20%	+35%	+33%	
	WV	+26%	+36%	+35%	+35%	+36%	+28%	
	<b>Total</b>		<b>+29%</b>	<b>+31%</b>	<b>+30%</b>	<b>+30%</b>	<b>+33%</b>	<b>+31%</b>
Commercial Marine (2280)	AL	+16%	-8%	-4%	-4%	-19%	+10%	
	FL	+14%	-8%	-4%	-4%	-7%	+9%	
	GA	+13%	-8%	-5%	-5%	-17%	+9%	
	KY	+17%	-10%	-2%	-2%	-13%	+12%	
	MS	+16%	-9%	-3%	-3%	-15%	+11%	
	NC	+13%	-8%	-4%	-4%	-14%	+9%	
	SC	+14%	-9%	-4%	-4%	-15%	+10%	
	TN	+17%	-10%	-2%	-2%	-3%	+12%	
	VA	+17%	-9%	-6%	-6%	-98%	+11%	
	WV	+17%	-10%	-6%	-6%	-98%	+12%	
	<b>Total</b>		<b>+15%</b>	<b>-9%</b>	<b>-3%</b>	<b>-3%</b>	<b>-14%</b>	<b>+11%</b>
Military Marine (2283)	VA	+17%	-10%	-6%	-6%	-98%	+12%	
	<b>Total</b>		<b>+17%</b>	<b>-10%</b>	<b>-6%</b>	<b>-6%</b>	<b>-98%</b>	<b>+12%</b>
Locomotives (2285)	AL	+10%	-24%	-36%	-36%	-98%	-13%	
	FL	+10%	-24%	-36%	-36%	-98%	-13%	
	GA	+10%	-20%	-36%	-36%	-98%	-12%	
	KY	+10%	-23%	-35%	-35%	-98%	-13%	
	MS	+10%	-24%	-36%	-36%	-98%	-13%	
	NC	+10%	-24%	-36%	-36%	-98%	-13%	
	SC	+10%	-24%	-36%	-36%	-98%	-13%	
	TN	+10%	-15%	-36%	-36%	-98%	-13%	
	VA	+10%	-14%	-36%	-36%	-98%	-11%	
	WV	+10%	-18%	-36%	-36%	-98%	-12%	
	<b>Total</b>		<b>+10%</b>	<b>-21%</b>	<b>-36%</b>	<b>-36%</b>	<b>-98%</b>	<b>-12%</b>
<b>Grand Total</b>			<b>+23%</b>	<b>-12%</b>	<b>-1%</b>	<b>-1%</b>	<b>-34%</b>	<b>+11%</b>

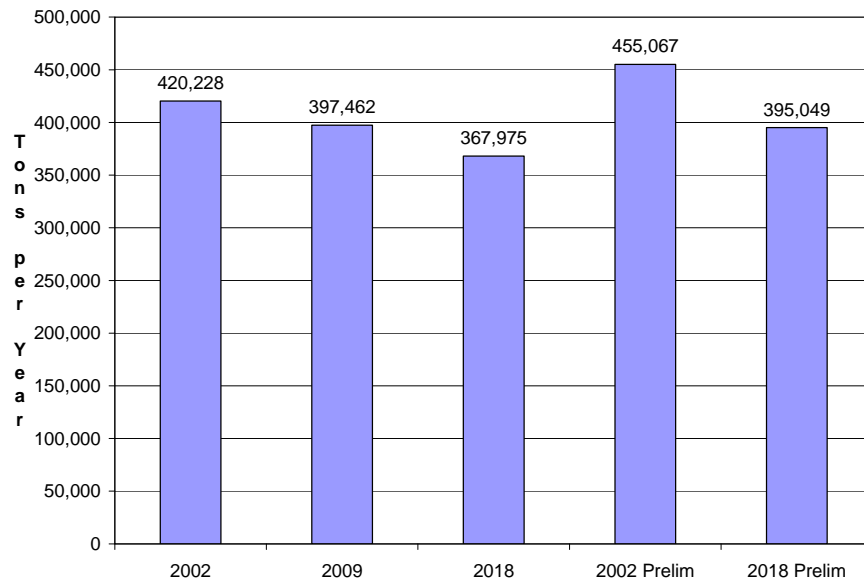
**Figure 2.3-2. Total Aircraft, Locomotive, and CMV CO Emissions (Base F)**



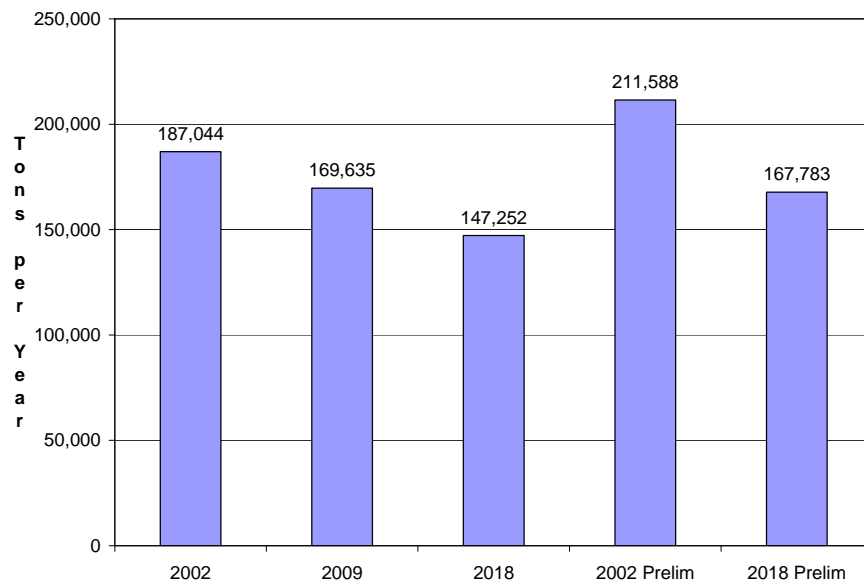
**Figure 2.3-3. Locomotive CO Emissions (Base F)**



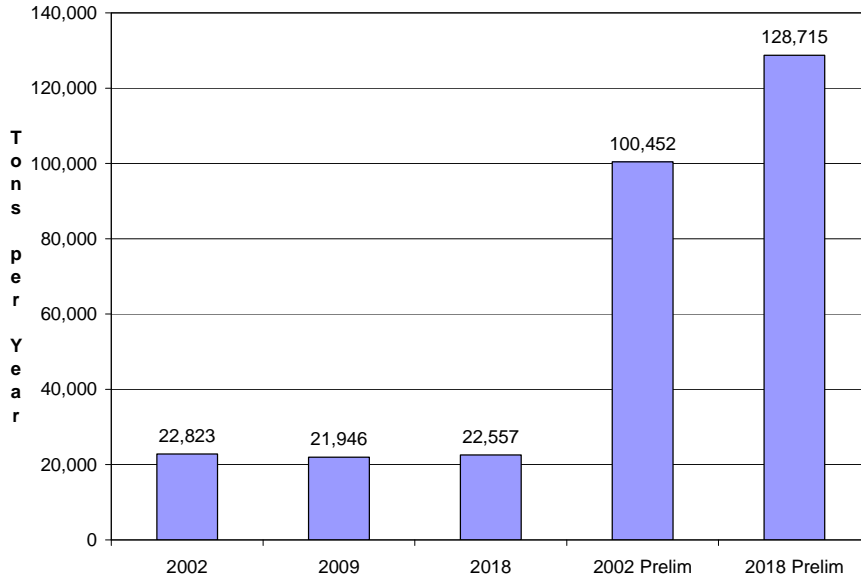
**Figure 2.3-4. Total Aircraft, Locomotive, and CMV NO<sub>x</sub> Emissions (Base F)**



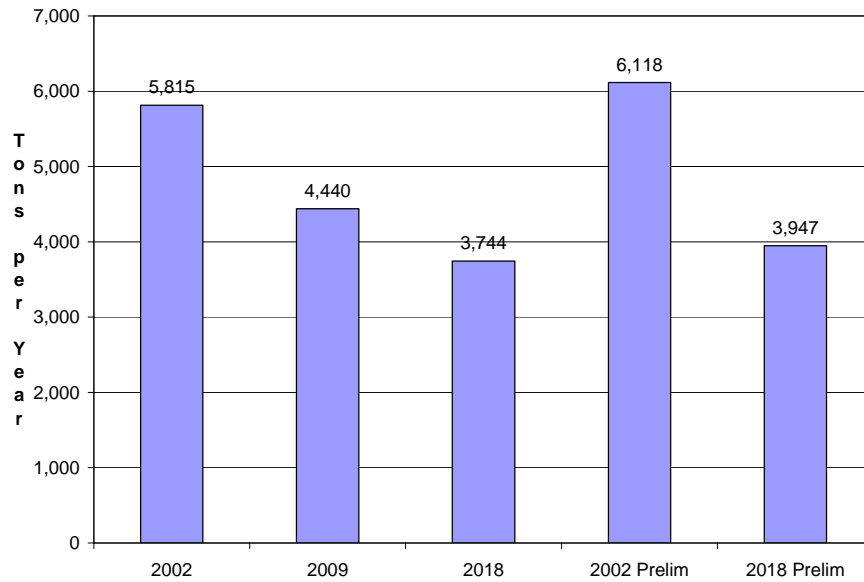
**Figure 2.3-5. Locomotive NO<sub>x</sub> Emissions (Base F)**



**Figure 2.3-6. Total Aircraft, Locomotive, and CMV PM<sub>10</sub> Emissions (Base F)**

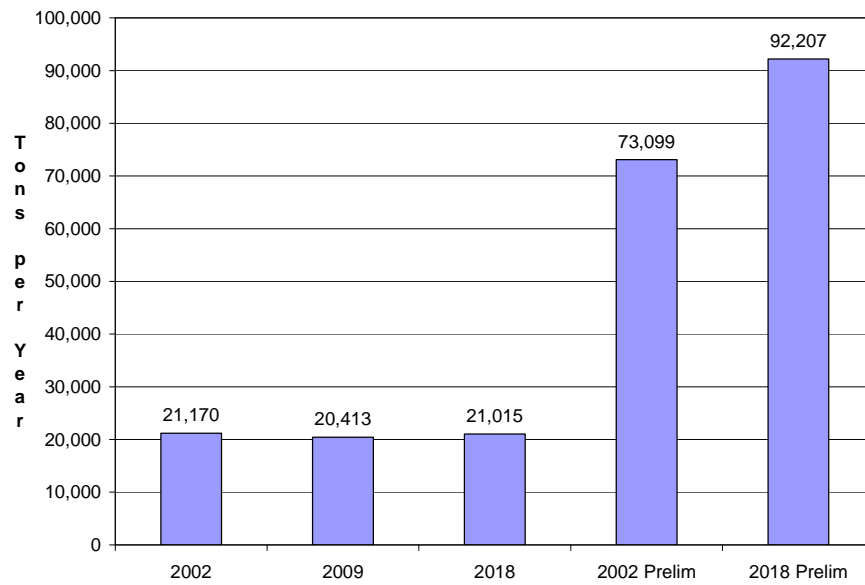


**Figure 2.3-7. Locomotive PM<sub>10</sub> Emissions (Base F)**

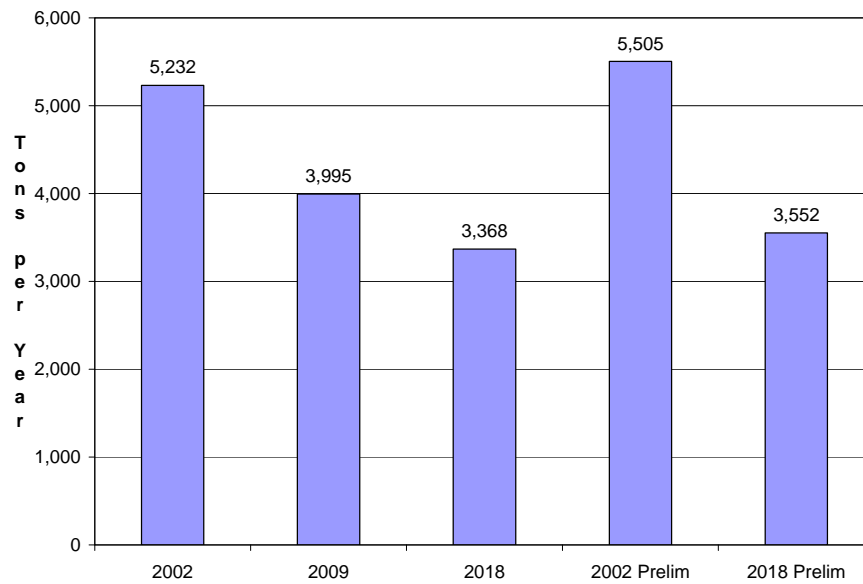




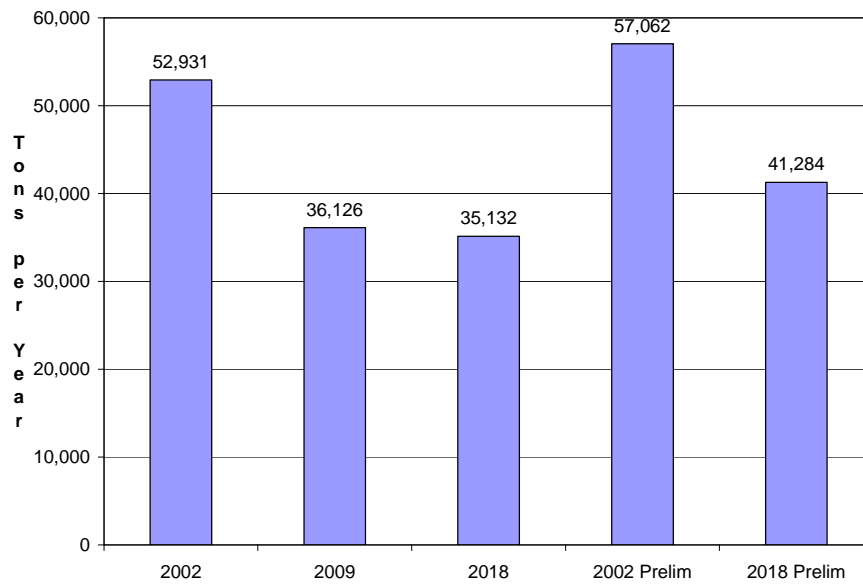
**Figure 2.3-8. Total Aircraft, Locomotive, and CMV PM<sub>2.5</sub> Emissions (Base F)**



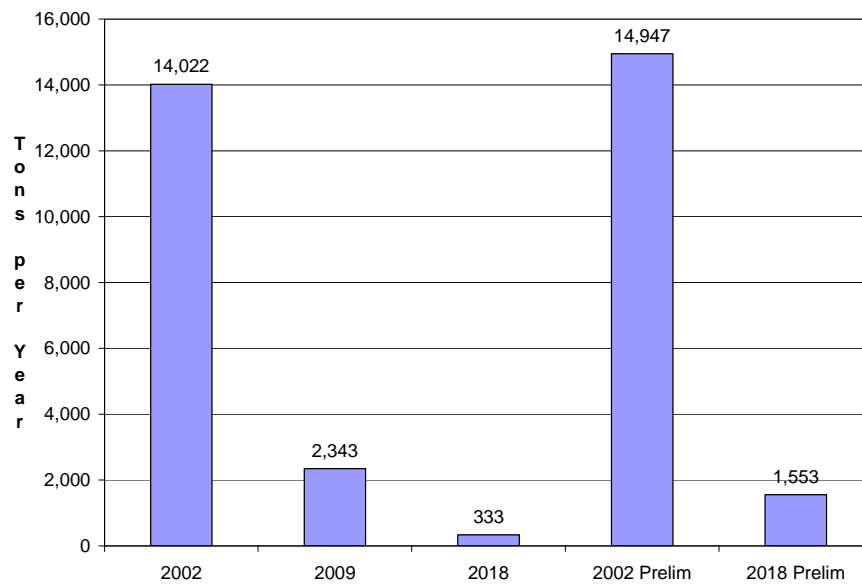
**Figure 2.3-9. Locomotive PM<sub>2.5</sub> Emissions (Base F)**



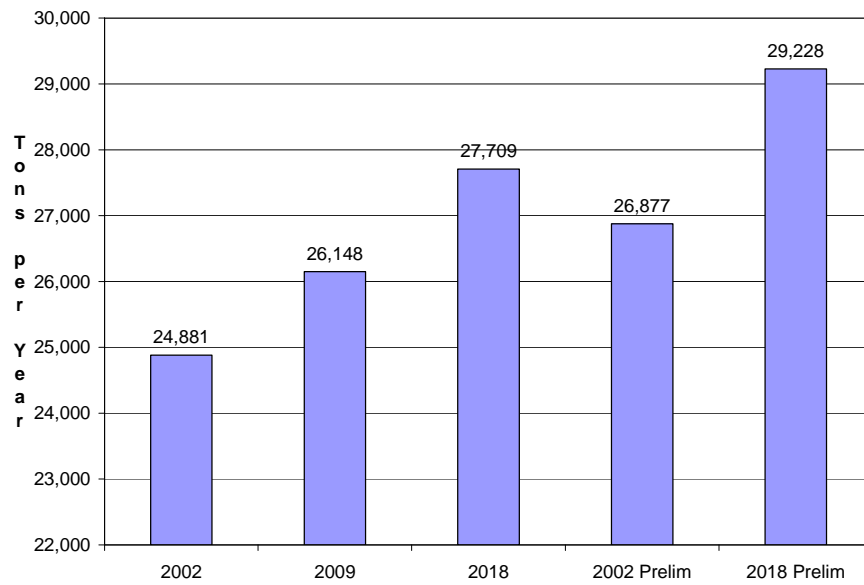
**Figure 2.3-10. Total Aircraft, Locomotive, and CMV SO<sub>2</sub> Emissions (Base F)**



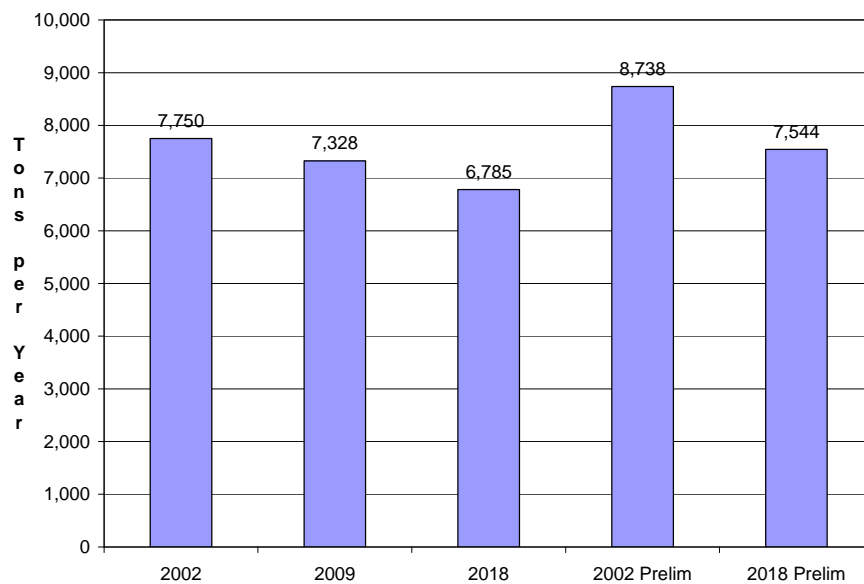
**Figure 2.3-11. Locomotive SO<sub>2</sub> Emissions (Base F)**



**Figure 2.3-12. Total Aircraft, Locomotive, and CMV VOC Emissions (Base F)**



**Figure 2.3-13. Locomotive VOC Emissions (Base F)**



### **Base G Revisions:**

Table 2.3-18 shows the Base G 2002 base year emissions for each State in the VISTAS region for aircraft, locomotives and CMV. Although some of these data are updated relative to those used as the basis of the Base F emissions forecasts, the methodology used to develop 2009 and 2018 emissions forecasts for aircraft, locomotives, and CMV for Base G is identical to that used for Base F (as documented above). The only exceptions are as follows:

- (a) As indicated in the discussion of the Base F forecasts, the CAIR (growth rate) matching criteria were overridden for any record for which States provided local growth data. For Base F, only North Carolina provided such data. However, for Base G, Kentucky regulators provided growth data for aircraft emissions associated with Cincinnati/Northern Kentucky International Airport (located in Boone County, Kentucky). These data were applied to all pollutants and all aircraft types (i.e., military aircraft (SCC 2275001000), commercial aircraft (SCC 2275020000), general aviation aircraft (SCC 2275050000), and air taxi aircraft (SCC 2275060000)). Emissions forecasts for all aircraft operations in counties other than Boone continued to utilize the growth factors developed according to the CAIR matching criteria. Table 2.3-19 presents the locally generated growth factors applied in Kentucky. It should be recognized that although the locally provided growth factors presented in the table are significantly greater than those that would apply under the CAIR matching criteria, this is to be expected as local regulators noted a very significant decline in activity at the Cincinnati/Northern Kentucky International Airport in 2002 (relative to activity in preceding years). Moreover, this downward spike seems to have been alleviated since 2002, so that the provided growth factors represent not only “routine” growth expected between 2002 and the two forecast years, but growth required to offset the temporary decline observed in 2002.

**Table 2.3-18. Base G 2002 Aircraft, Locomotive, and Non-Recreational Marine Emissions  
(annual tons)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	5,595	185	238	99	18	276
	FL	25,431	8,891	2,424	2,375	800	3,658
	GA	6,620	5,372	1,475	1,446	451	443
	KY	5,577	925	251	246	88	397
	MS	1,593	140	44	43	13	96
	NC	6,088	1,548	419	411	148	613
	SC	6,505	515	409	401	88	863
	TN	7,251	2,766	734	719	235	943
	VA	11,873	3,885	2,010	1,970	272	2,825
	WV	1,178	78	25	24	8	66
	<b>Total</b>		<b>77,712</b>	<b>24,305</b>	<b>8,029</b>	<b>7,734</b>	<b>2,121</b>
Commercial Marine (2280)	AL	1,196	9,218	917	844	3,337	737
	FL	5,888	44,817	1,936	1,781	6,683	1,409
	GA	1,038	7,875	334	307	1,173	246
	KY	6,607	50,267	2,246	2,066	9,608	1,569
	MS	5,688	43,233	1,903	1,751	7,719	1,351
	NC	599	4,547	193	178	690	142
	SC	1,067	8,100	343	316	1,205	253
	TN	3,624	27,555	1,217	1,120	4,974	860
	VA	972	2,775	334	307	359	483
	WV	1,528	11,586	487	448	525	362
	<b>Total</b>		<b>28,207</b>	<b>209,972</b>	<b>9,911</b>	<b>9,118</b>	<b>36,275</b>
Military Marine (2283)	VA	110	313	25	23	27	48
	<b>Total</b>		<b>110</b>	<b>313</b>	<b>25</b>	<b>23</b>	<b>48</b>
Locomotives (2285)	AL	3,518	26,623	592	533	1,446	1,365
	FL	1,006	9,969	247	222	605	404
	GA	2,654	26,733	664	598	1,622	1,059
	KY	2,166	21,811	542	488	1,321	867
	MS	2,302	23,267	578	520	1,429	899
	NC	1,638	16,502	410	369	1,001	654
	SC	1,160	11,690	291	261	710	462
	TN	2,626	25,627	633	570	1,439	1,041
	VA	1,186	11,882	1,529	1,375	3,641	492
	WV	1,311	13,224	329	296	808	517
	<b>Total</b>		<b>19,568</b>	<b>187,328</b>	<b>5,815</b>	<b>5,232</b>	<b>14,022</b>
<b>Grand Total</b>		<b>125,597</b>	<b>421,918</b>	<b>23,780</b>	<b>22,107</b>	<b>52,444</b>	<b>25,401</b>

**Table 2.3-19 Locally Generated Growth Factors for Kentucky**

FIP	2009 Factor	2018 Factor
21015	1.31	1.81

**Note:**

Growth factor = Year Emissions/2002 Emissions.

Under CAIR approach, 2009 = 0.99 to 1.17.

Under CAIR approach, 2018 = 0.97 to 1.40.

(b) Because of the additional emissions records added in Alabama, as discussed in the Base G 2002 base year inventory section of this report, the total number of emissions records in the Base G 2009 and 2018 forecasts increased to 23,042 (as compared to 22,838 for Base F). The 23,042 data records for aircraft, locomotives, and CMV were assigned growth factors in accordance with the following breakdown:

72 records matched State-provided growth factors,  
 4,287 records matched using the CAIR-Primary criterion,  
 240 records matched using the CAIR-Secondary criterion,  
 7,511 records matched using the CAIR-Tertiary criterion,  
 720 records matched using the No T4-Primary criterion,  
 3,858 records matched using the No T4-Secondary criterion, and  
 6,354 records matched using the No T4-Tertiary criterion.

Tables 2.3-20 and 2.3-21 present a summary of the resulting Base G 2009 and 2018 inventories, while Tables 2.3-22 and 2.3-23 present the associated change in emissions for each forecast inventory relative to the Base G 2002 base year VISTAS. As was the case with Base F, the larger reduction in CMV SO<sub>2</sub> emissions in 2009 and 2018 (relative to 2002) for Virginia and West Virginia is notable relative to the other VISTAS States, but is attributable to a high diesel contribution to total CMV SO<sub>2</sub> in the 2002 inventories for these two States.

Figures 2.3-14 through 2.3-25 graphically depict the relationships between the various inventories, as revised through Base G. There are two figures for each pollutant, the first of which presents a comparison of total VISTAS regional emission estimates for aircraft, locomotives, and CMV, and the second of which presents total VISTAS region emission estimates for locomotives only. This two figure approach is intended to provide a more robust illustration of the differences between the various inventories, as some of the differences are less distinct when viewed through overall aggregate emissions totals. All of the figures include the following emissions estimates:

- The Base G 2002 base year VISTAS emissions inventory (labeled as “2002”),
- The pre-Base F 2002 base year VISTAS emissions inventory (labeled as “2002 Prelim”),
- The Base G 2009 VISTAS emissions inventory developed using growth rates derived from 1996 and 2020 EPA CAIR data (labeled as “2009”),
- The Base G 2018 VISTAS emissions inventory developed using growth rates derived from 1996 and 2020 EPA CAIR data (labeled as “2018”), and
- The pre-Base F 2018 VISTAS emissions inventory estimates developed using growth rates derived from 1996, 2010, 2015, and 2020 EPA CAIR data (labeled as “2018 Prelim”).

All 12 figures generally illustrate a reduction in emissions estimates between the pre-Base F 2002 emission estimates published in February 2004 and the Base G 2002 base year emission estimates. This reduction generally results from emission updates reflected in the Base F State CERR submittals, although the major differences in aggregate PM emission estimates are driven to a greater extent by modifications in the methodology used to estimate aircraft PM in the Base F revisions to the 2002 Base F base year inventory (as documented under the base year inventory section of this report).

**Table 2.3-20. Base G 2009 Aircraft, Locomotive, and Non-Recreational Marine Emissions (annual tons) -- Based on Growth Using 1996 and 2020 EPA Inventories**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	6,265	213	292	116	21	309
	FL	29,258	10,316	2,812	2,756	928	4,235
	GA	7,635	6,233	1,712	1,678	523	512
	KY	6,959	1,135	307	301	108	487
	MS	1,765	162	51	50	16	108
	NC	6,991	1,795	486	477	171	709
	SC	7,372	559	446	437	98	975
	TN	8,020	3,096	824	807	268	1,050
	VA	13,141	4,244	2,124	2,082	306	3,153
	WV	1,312	91	28	28	9	74
	<b>Total</b>		<b>88,716</b>	<b>27,844</b>	<b>9,083</b>	<b>8,732</b>	<b>2,447</b>
Commercial Marine (2280)	AL	1,280	8,888	872	802	2,753	768
	FL	6,236	43,198	1,838	1,691	5,864	1,467
	GA	1,097	7,599	317	291	974	256
	KY	7,087	48,039	2,158	1,985	8,350	1,649
	MS	6,074	41,437	1,821	1,676	6,587	1,415
	NC	634	4,386	184	169	584	148
	SC	1,133	7,796	326	300	1,012	264
	TN	3,887	26,333	1,168	1,074	4,512	904
	VA	1,042	2,662	312	286	61	506
	WV	1,638	11,073	455	419	89	381
	<b>Total</b>		<b>30,108</b>	<b>201,412</b>	<b>9,450</b>	<b>8,693</b>	<b>30,786</b>
Military Marine (2283)	VA	118	299	23	21	5	50
	<b>Total</b>		<b>118</b>	<b>299</b>	<b>23</b>	<b>21</b>	<b>50</b>
Locomotives (2285)	AL	3,677	23,783	452	406	242	1,289
	FL	1,052	8,905	189	170	101	382
	GA	2,769	24,398	507	456	271	1,003
	KY	2,264	19,597	415	374	221	819
	MS	2,406	20,785	441	397	239	849
	NC	1,690	14,662	311	279	165	613
	SC	1,213	10,443	222	200	119	437
	TN	2,745	23,924	483	435	240	984
	VA	1,236	11,134	1,167	1,050	608	467
	WV	1,369	12,177	251	226	135	489
	<b>Total</b>		<b>20,420</b>	<b>169,808</b>	<b>4,437</b>	<b>3,993</b>	<b>2,341</b>
<b>Grand Total</b>		<b>139,362</b>	<b>399,364</b>	<b>22,994</b>	<b>21,440</b>	<b>35,578</b>	<b>26,754</b>



**Table 2.3-21. Base G 2018 Aircraft, Locomotive, and Non-Recreational Marine Emissions (annual tons) -- Based on Growth Using 1996 and 2020 EPA Inventories**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	7,126	249	361	139	24	352
	FL	34,178	12,147	3,312	3,246	1,093	4,976
	GA	8,939	7,340	2,016	1,976	616	601
	KY	9,078	1,446	391	383	138	623
	MS	1,986	190	60	58	18	122
	NC	8,150	2,114	572	561	202	831
	SC	8,487	616	493	484	112	1,119
	TN	9,009	3,519	939	921	309	1,187
	VA	14,770	4,706	2,271	2,226	349	3,574
	WV	1,484	106	33	33	10	85
	<b>Total</b>	<b>103,206</b>	<b>32,435</b>	<b>10,450</b>	<b>10,027</b>	<b>2,871</b>	<b>13,472</b>
Commercial Marine (2280)	AL	1,388	8,464	880	809	2,715	809
	FL	6,684	41,117	1,853	1,705	6,248	1,543
	GA	1,174	7,246	319	293	976	269
	KY	7,703	45,174	2,199	2,023	8,383	1,752
	MS	6,571	39,129	1,850	1,702	6,556	1,498
	NC	678	4,179	185	170	596	155
	SC	1,217	7,406	329	303	1,027	278
	TN	4,225	24,763	1,190	1,095	4,808	960
	VA	1,133	2,517	314	289	9	537
	WV	1,781	10,412	459	422	13	404
	<b>Total</b>	<b>32,554</b>	<b>190,407</b>	<b>9,578</b>	<b>8,811</b>	<b>31,330</b>	<b>8,205</b>
Military Marine (2283)	VA	128	282	23	21	1	53
	<b>Total</b>	<b>128</b>	<b>282</b>	<b>23</b>	<b>21</b>	<b>1</b>	<b>53</b>
Locomotives (2285)	AL	3,881	20,131	381	343	34	1,192
	FL	1,110	7,538	159	143	14	353
	GA	2,917	21,395	427	385	38	932
	KY	2,389	16,751	352	317	31	757
	MS	2,540	17,594	372	335	34	785
	NC	1,782	12,539	263	237	23	570
	SC	1,280	8,840	187	168	17	404
	TN	2,897	21,735	407	367	34	910
	VA	1,300	10,173	983	885	86	436
	WV	1,444	10,831	212	190	19	453
	<b>Total</b>	<b>21,539</b>	<b>147,527</b>	<b>3,743</b>	<b>3,368</b>	<b>332</b>	<b>6,792</b>
<b>Grand Total</b>		<b>157,427</b>	<b>370,651</b>	<b>23,794</b>	<b>22,227</b>	<b>34,534</b>	<b>28,522</b>

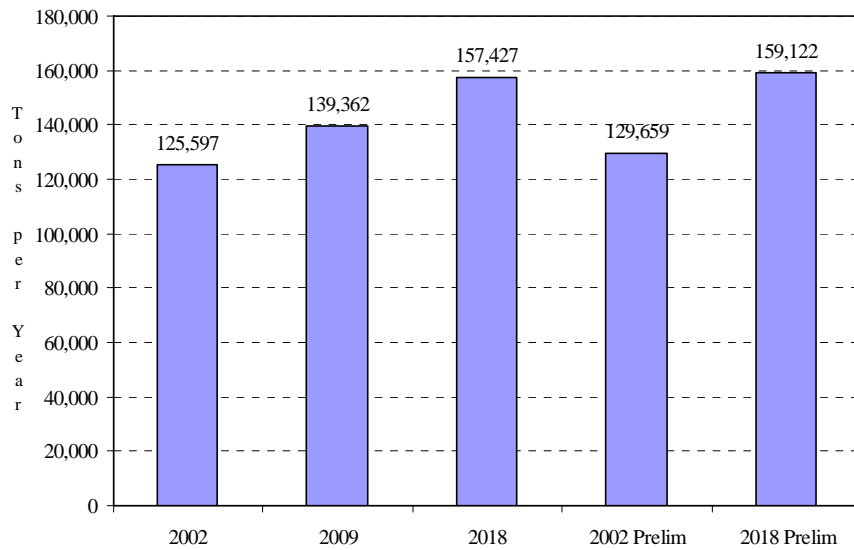
**Table 2.3-22. Change in Emissions between 2009 Base G and 2002 Base F Inventories  
(Based on Growth Using 1996 and 2020 EPA Inventories)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC	
Aircraft (2275)	AL	+12%	+15%	+23%	+18%	+16%	+12%	
	FL	+15%	+16%	+16%	+16%	+16%	+16%	
	GA	+15%	+16%	+16%	+16%	+16%	+16%	
	KY	+25%	+23%	+23%	+23%	+23%	+23%	
	MS	+11%	+16%	+15%	+15%	+16%	+12%	
	NC	+15%	+16%	+16%	+16%	+16%	+16%	
	SC	+13%	+9%	+9%	+9%	+12%	+13%	
	TN	+11%	+12%	+12%	+12%	+14%	+11%	
	VA	+11%	+9%	+6%	+6%	+12%	+12%	
	WV	+11%	+16%	+15%	+15%	+16%	+12%	
	<b>Total</b>		<b>+14%</b>	<b>+15%</b>	<b>+13%</b>	<b>+13%</b>	<b>+15%</b>	<b>+14%</b>
Commercial Marine (2280)	AL	+7%	-4%	-5%	-5%	-18%	+4%	
	FL	+6%	-4%	-5%	-5%	-12%	+4%	
	GA	+6%	-3%	-5%	-5%	-17%	+4%	
	KY	+7%	-4%	-4%	-4%	-13%	+5%	
	MS	+7%	-4%	-4%	-4%	-15%	+5%	
	NC	+6%	-4%	-5%	-5%	-15%	+4%	
	SC	+6%	-4%	-5%	-5%	-16%	+4%	
	TN	+7%	-4%	-4%	-4%	-9%	+5%	
	VA	+7%	-4%	-7%	-7%	-83%	+5%	
	WV	+7%	-4%	-7%	-7%	-83%	+5%	
	<b>Total</b>		<b>+7%</b>	<b>-4%</b>	<b>-5%</b>	<b>-5%</b>	<b>-15%</b>	<b>+5%</b>
Military Marine (2283)	VA	+7%	-4%	-7%	-7%	-83%	+5%	
	<b>Total</b>		<b>+7%</b>	<b>-4%</b>	<b>-7%</b>	<b>-7%</b>	<b>-83%</b>	<b>+5%</b>
Locomotives (2285)	AL	+5%	-11%	-24%	-24%	-83%	-6%	
	FL	+5%	-11%	-24%	-24%	-83%	-6%	
	GA	+4%	-9%	-24%	-24%	-83%	-5%	
	KY	+5%	-10%	-23%	-23%	-83%	-6%	
	MS	+5%	-11%	-24%	-24%	-83%	-6%	
	NC	+3%	-11%	-24%	-24%	-83%	-6%	
	SC	+5%	-11%	-24%	-24%	-83%	-6%	
	TN	+5%	-7%	-24%	-24%	-83%	-6%	
	VA	+4%	-6%	-24%	-24%	-83%	-5%	
	WV	+4%	-8%	-24%	-24%	-83%	-5%	
	<b>Total</b>		<b>+4%</b>	<b>-9%</b>	<b>-24%</b>	<b>-24%</b>	<b>-83%</b>	<b>-6%</b>
<b>Grand Total</b>			<b>+11%</b>	<b>-5%</b>	<b>-3%</b>	<b>-3%</b>	<b>-32%</b>	<b>+5%</b>

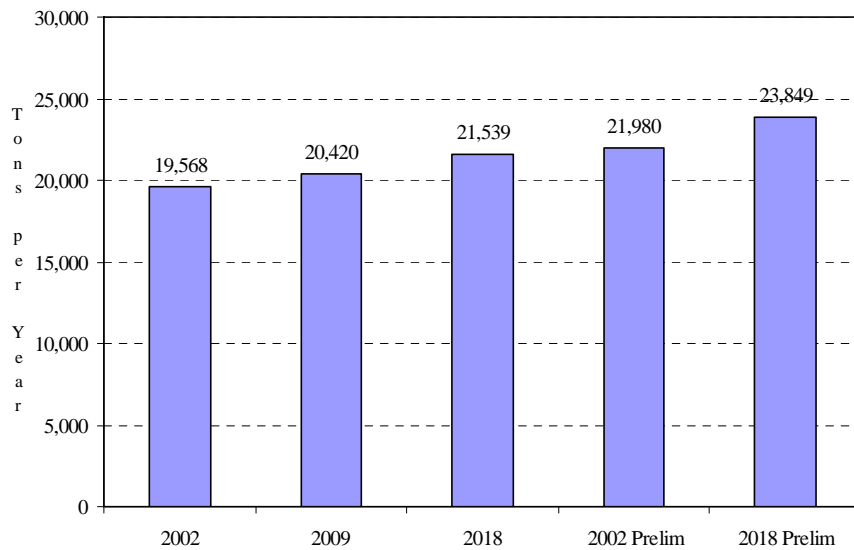
**Table 2.3-23. Change in Emissions between 2018 Base G and 2002 Base F Inventories  
(Based on Growth Using 1996 and 2020 EPA Inventories)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC	
Aircraft (2275)	AL	+27%	+35%	+52%	+41%	+36%	+28%	
	FL	+34%	+37%	+37%	+37%	+37%	+36%	
	GA	+35%	+37%	+37%	+37%	+37%	+36%	
	KY	+63%	+56%	+56%	+56%	+56%	+57%	
	MS	+25%	+36%	+35%	+35%	+36%	+27%	
	NC	+34%	+37%	+36%	+36%	+37%	+36%	
	SC	+30%	+20%	+21%	+21%	+27%	+30%	
	TN	+24%	+27%	+28%	+28%	+31%	+26%	
	VA	+24%	+21%	+13%	+13%	+28%	+27%	
	WV	+26%	+36%	+35%	+35%	+36%	+28%	
	<b>Total</b>		<b>+33%</b>	<b>+33%</b>	<b>+30%</b>	<b>+30%</b>	<b>+35%</b>	<b>+32%</b>
Commercial Marine (2280)	AL	+16%	-8%	-4%	-4%	-19%	+10%	
	FL	+14%	-8%	-4%	-4%	-7%	+9%	
	GA	+13%	-8%	-5%	-5%	-17%	+9%	
	KY	+17%	-10%	-2%	-2%	-13%	+12%	
	MS	+16%	-9%	-3%	-3%	-15%	+11%	
	NC	+13%	-8%	-4%	-4%	-14%	+9%	
	SC	+14%	-9%	-4%	-4%	-15%	+10%	
	TN	+17%	-10%	-2%	-2%	-3%	+12%	
	VA	+17%	-9%	-6%	-6%	-98%	+11%	
	WV	+17%	-10%	-6%	-6%	-98%	+12%	
	<b>Total</b>		<b>+15%</b>	<b>-9%</b>	<b>-3%</b>	<b>-3%</b>	<b>-14%</b>	<b>+11%</b>
Military Marine (2283)	VA	+17%	-10%	-6%	-6%	-98%	+12%	
	<b>Total</b>		<b>+17%</b>	<b>-10%</b>	<b>-6%</b>	<b>-6%</b>	<b>-98%</b>	<b>+12%</b>
Locomotives (2285)	AL	+10%	-24%	-36%	-36%	-98%	-13%	
	FL	+10%	-24%	-36%	-36%	-98%	-13%	
	GA	+10%	-20%	-36%	-36%	-98%	-12%	
	KY	+10%	-23%	-35%	-35%	-98%	-13%	
	MS	+10%	-24%	-36%	-36%	-98%	-13%	
	NC	+9%	-24%	-36%	-36%	-98%	-13%	
	SC	+10%	-24%	-36%	-36%	-98%	-13%	
	TN	+10%	-15%	-36%	-36%	-98%	-13%	
	VA	+10%	-14%	-36%	-36%	-98%	-11%	
	WV	+10%	-18%	-36%	-36%	-98%	-12%	
	<b>Total</b>		<b>+10%</b>	<b>-21%</b>	<b>-36%</b>	<b>-36%</b>	<b>-98%</b>	<b>-12%</b>
<b>Grand Total</b>			<b>+25%</b>	<b>-12%</b>	<b>+0%</b>	<b>+1%</b>	<b>-34%</b>	<b>+12%</b>

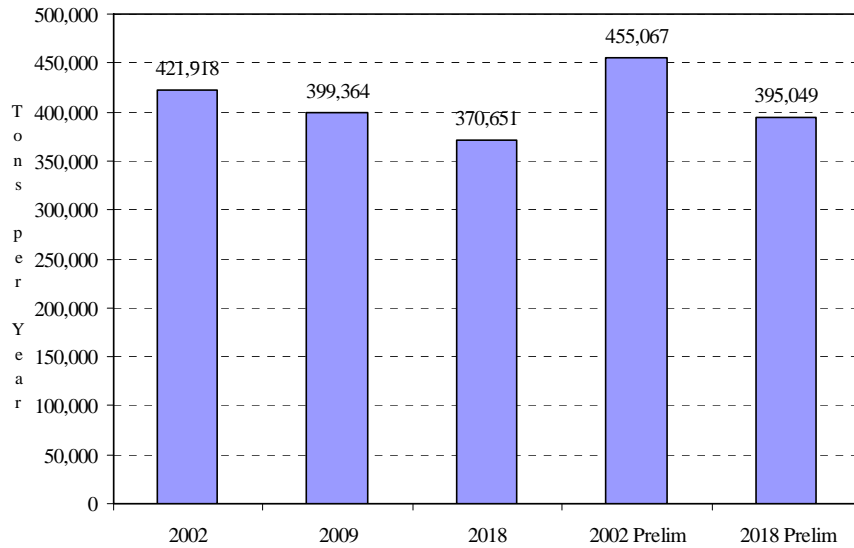
**Figure 2.3-14. Total Aircraft, Locomotive, and CMV CO Emissions (Base G)**



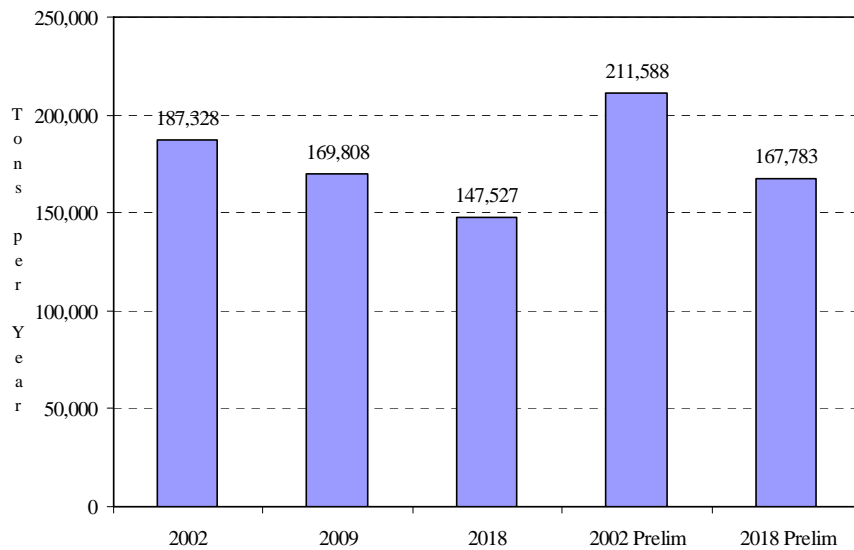
**Figure 2.3-15. Locomotive CO Emissions (Base G)**



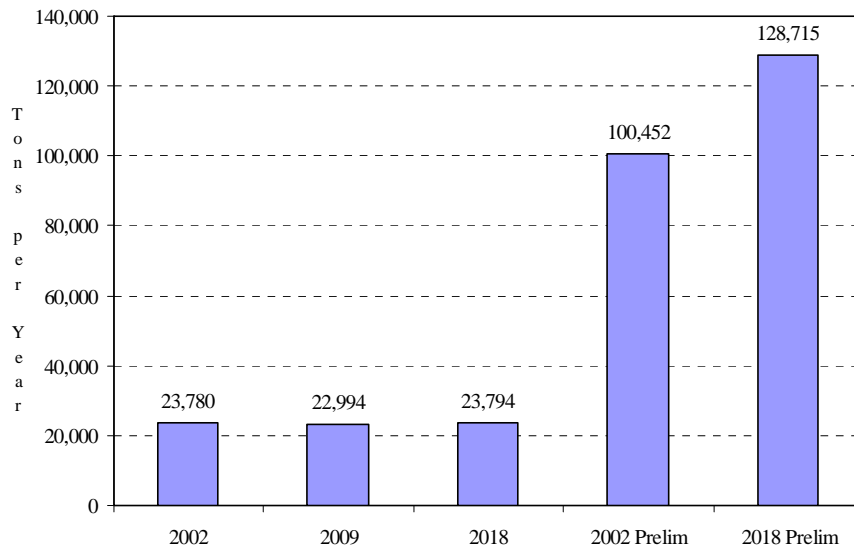
**Figure 2.3-16. Total Aircraft, Locomotive, and CMV NO<sub>x</sub> Emissions (Base G)**



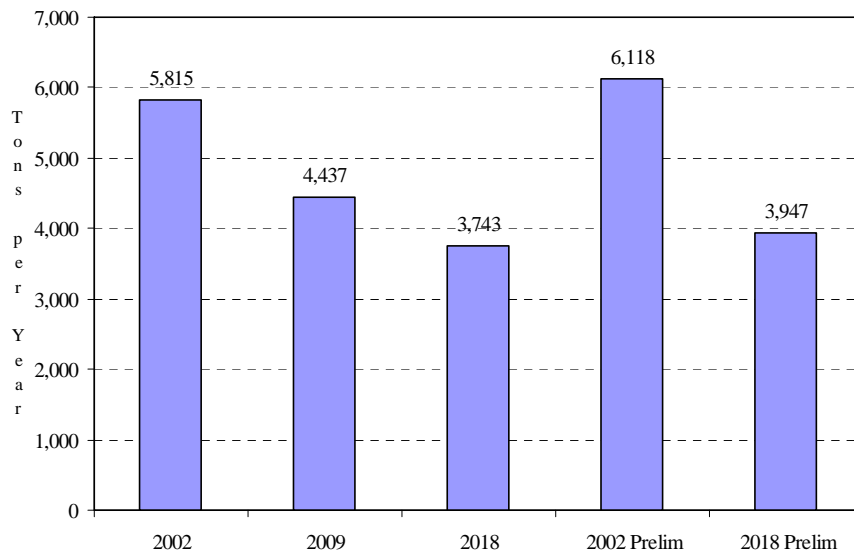
**Figure 2.3-17. Locomotive NO<sub>x</sub> Emissions (Base G)**



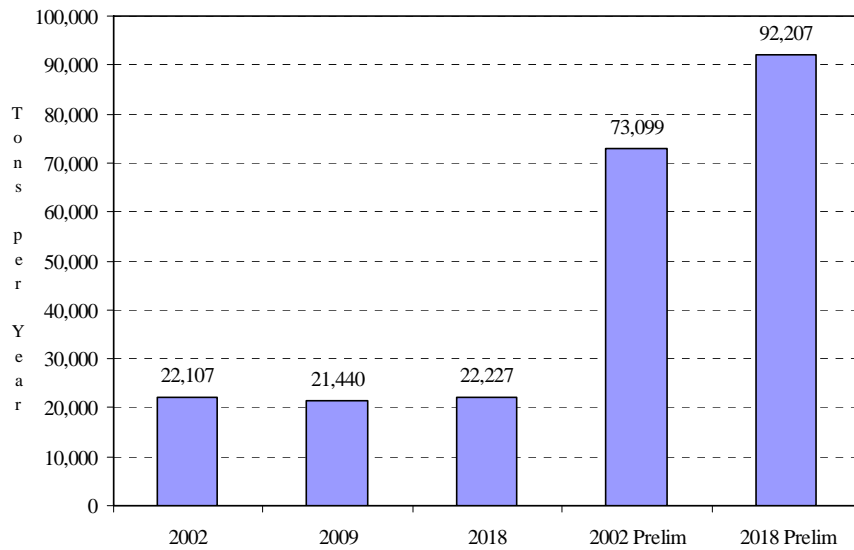
**Figure 2.3-18. Total Aircraft, Locomotive, and CMV PM<sub>10</sub> Emissions (Base G)**



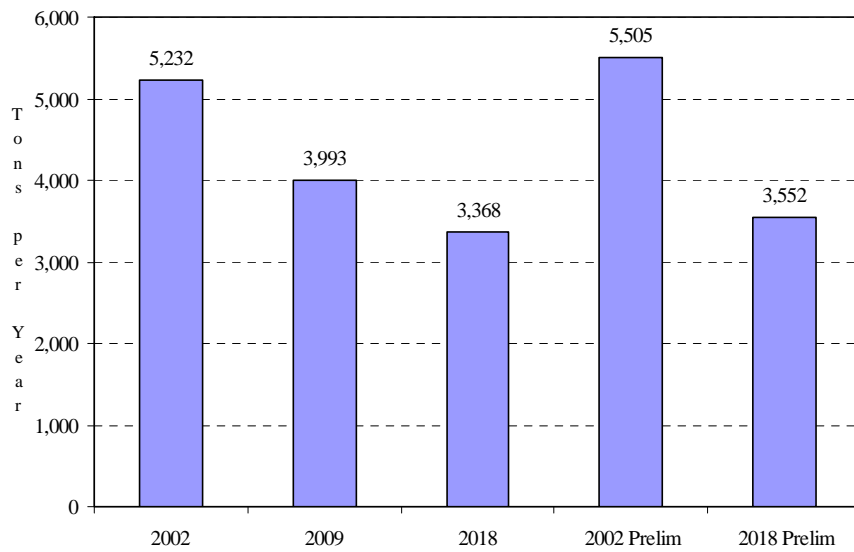
**Figure 2.3-19. Locomotive PM<sub>10</sub> Emissions (Base G)**



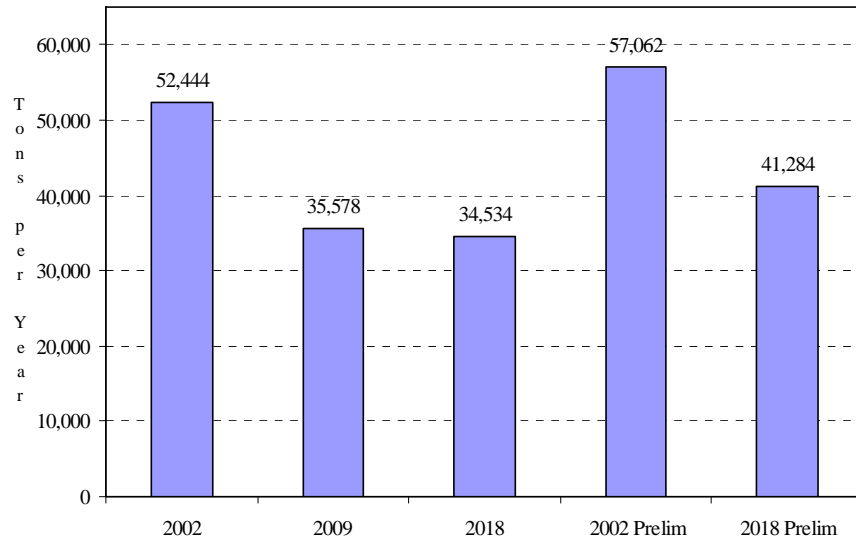
**Figure 2.3-20. Total Aircraft, Locomotive, and CMV PM<sub>2.5</sub> Emissions (Base G)**



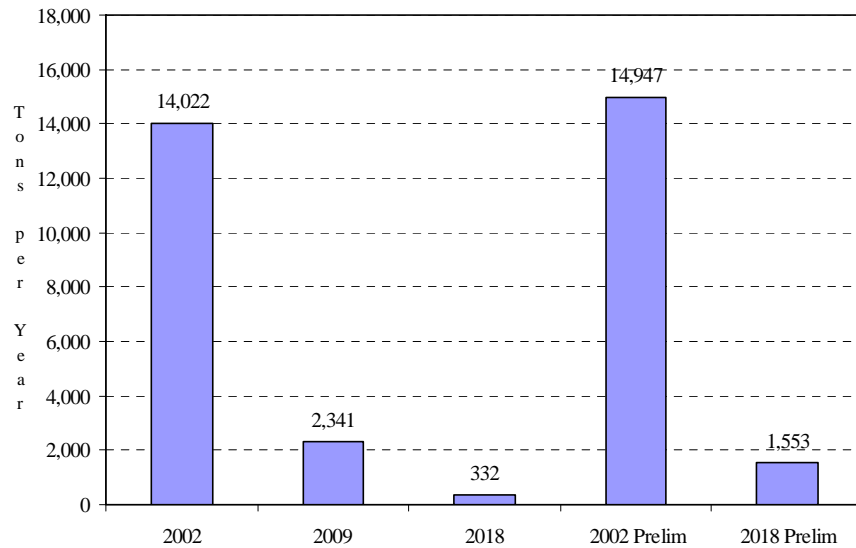
**Figure 2.3-21. Locomotive PM<sub>2.5</sub> Emissions (Base G)**



**Figure 2.3-22. Total Aircraft, Locomotive, and CMV SO<sub>2</sub> Emissions (Base G)**

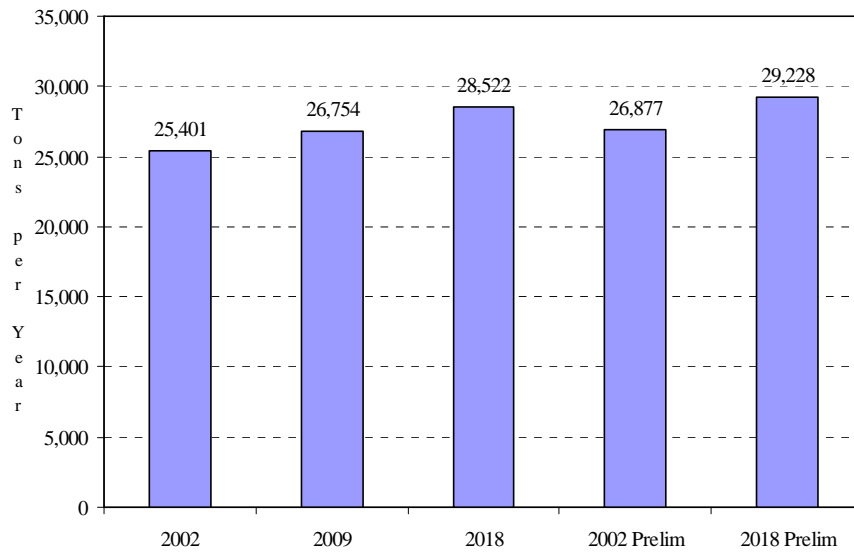


**Figure 2.3-23. Locomotive SO<sub>2</sub> Emissions (Base G)**

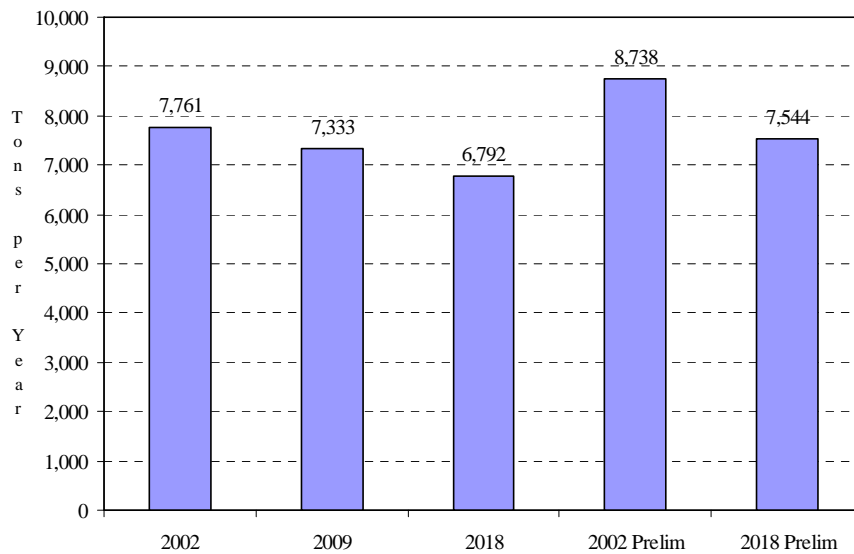




**Figure 2.3-24. Total Aircraft, Locomotive, and CMV VOC Emissions (Base G)**



**Figure 2.3-25. Locomotive VOC Emissions (Base G)**



### **2.3.4.3 Emissions from NONROAD Model Sources in Illinois, Indiana, and Ohio**

Base G projection inventories for 2009 and 2018 for NONROAD model sources in the states of Illinois, Indiana, and Ohio were produced using a methodology identical to that employed to develop a Base G 2002 base year inventory for the same states (as documented earlier in this report). This method consists of the extraction of a complete set of county-level input data applicable to each of the three states (in each of the two projection years) from the latest version of the EPA's NMIM model. This includes appropriate consideration of all non-default NMIM input files generated by the Midwest Regional Planning Organization as documented earlier in the discussion of the Base G 2002 base year inventory. These input data were then assembled into appropriate input files for the Final NONROAD2005 model and emission estimates were produced using the same procedure employed for the VISTAS region.

Changes noted between the base year (2002) and forecast year (2009 and 2018) input data extracted from NMIM include differences in gasoline vapor pressure, gasoline sulfur content, and diesel sulfur content in most counties. All temperature data (minimum, maximum, and average daily temperatures) was constant across years.

As described in the discussion of the Base G 2002 base year inventory, counties in the three states were grouped for modeling purposes using a temperature aggregation scheme that allowed for county-specific temperature variations of no more than 2 °F from group average temperatures (for all temperature inputs). The same grouping scheme was applied to projection year modeling, so that Illinois emissions were modeled using 12 county groups, Indiana emissions were modeled using 9 county groups, and Ohio emissions were modeled using 10 county groups. Thus, 31 iterations of NONROAD2002 were required per season per projection year, as compared to the 53 iterations per season per projection year required for the VISTAS region.

As was also described in the discussion of the Base G 2002 base year inventory, several non-default equipment population, growth, activity, seasonal distribution, and county allocation files are assigned by NMIM model inputs for these counties. As was the case for the base year inventory development, these same non-default assignments were retained for both projection inventories.

### **2.3.4.4 Differences between 2009/2018**

Methodologically, there was no difference in the way that 2009 and 2018 emissions were calculated for non-road mobile sources. The actual value of the growth factors were different for each type of mobile source considered, but the calculation methods were identical.

### 2.3.5 *Quality Assurance steps*

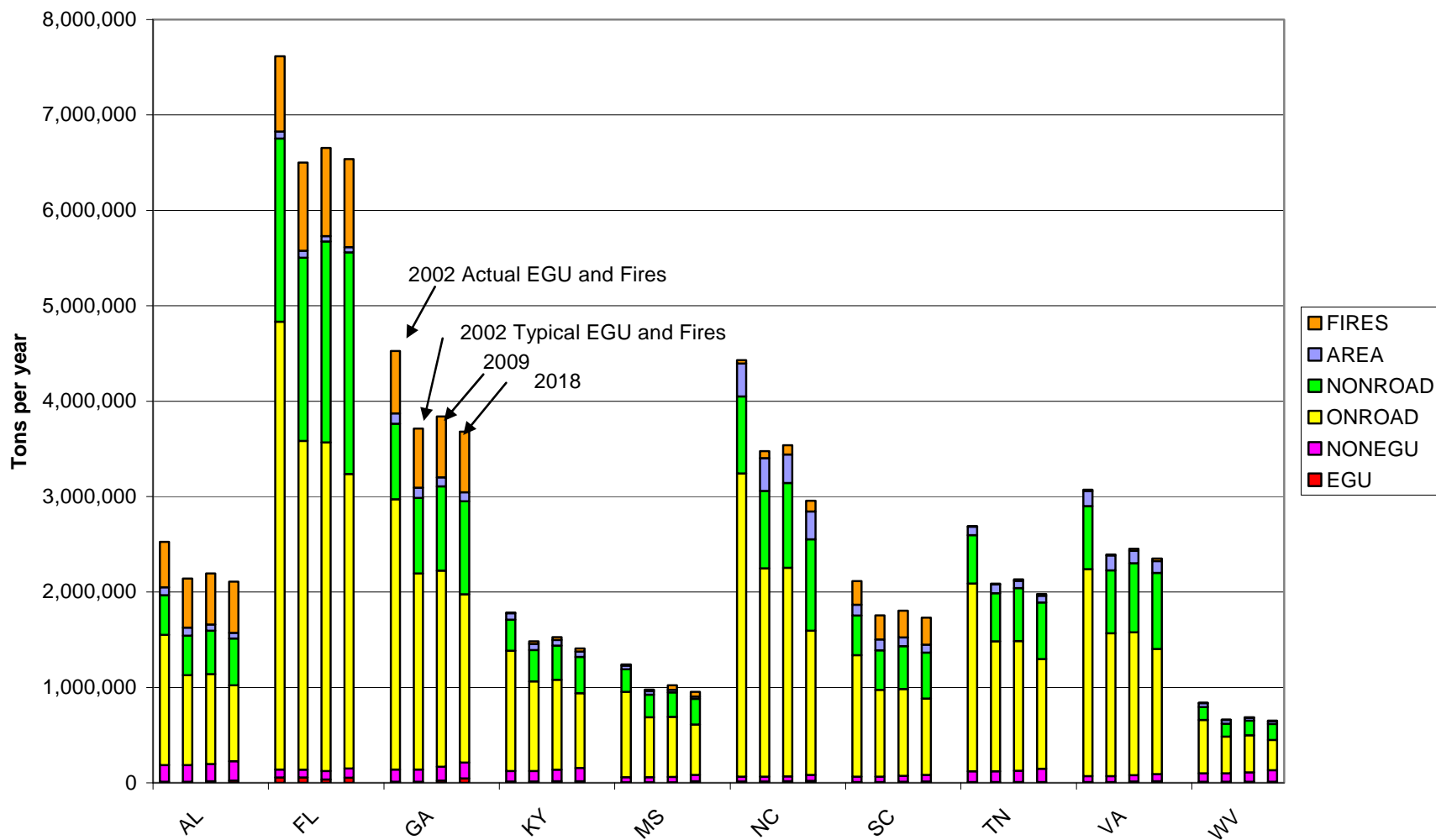
Throughout the inventory development process, quality assurance steps were performed to ensure that no double counting of emissions occurred, to ensure that a full and complete inventory was developed for VISTAS, and to make sure that projection calculations were working correctly. Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on mobile source components of the 2009 and revised 2018 projection inventories:

1. All final files (NONROAD only) were run through EPA's Format and Content checking software. Input data files for MOBILE and VMT growth estimates were reviewed by the corresponding SIWG and by the VISTAS Emission Inventory Technical Advisor.
2. SCC level emission summaries were prepared and evaluated to ensure that emissions were consistent and that there were no missing sources (NONROAD only).
3. Tier comparisons (by pollutant) were developed between the 2002 base year inventory and the 2009 and 2018 projection inventories (NONROAD only). Total VISTAS level summaries by pollutant were developed for these sources to compare Base F and Base G emission levels.
4. Data product summaries were provided to both the VISTAS Emission Inventory Technical Advisor and to the SIWG representatives for review and comment. Changes based on these comments were implemented in the files.
5. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from 1.0 to 2.0. A minor change would cause a version number to go from 1.0 to 1.1. Minor changes resulting from largely editorial changes would result in a change from 1.00 to 1.01.

**APPENDIX A:**

**STATE EMISSION TOTALS BY POLLUTANT AND SECTOR**

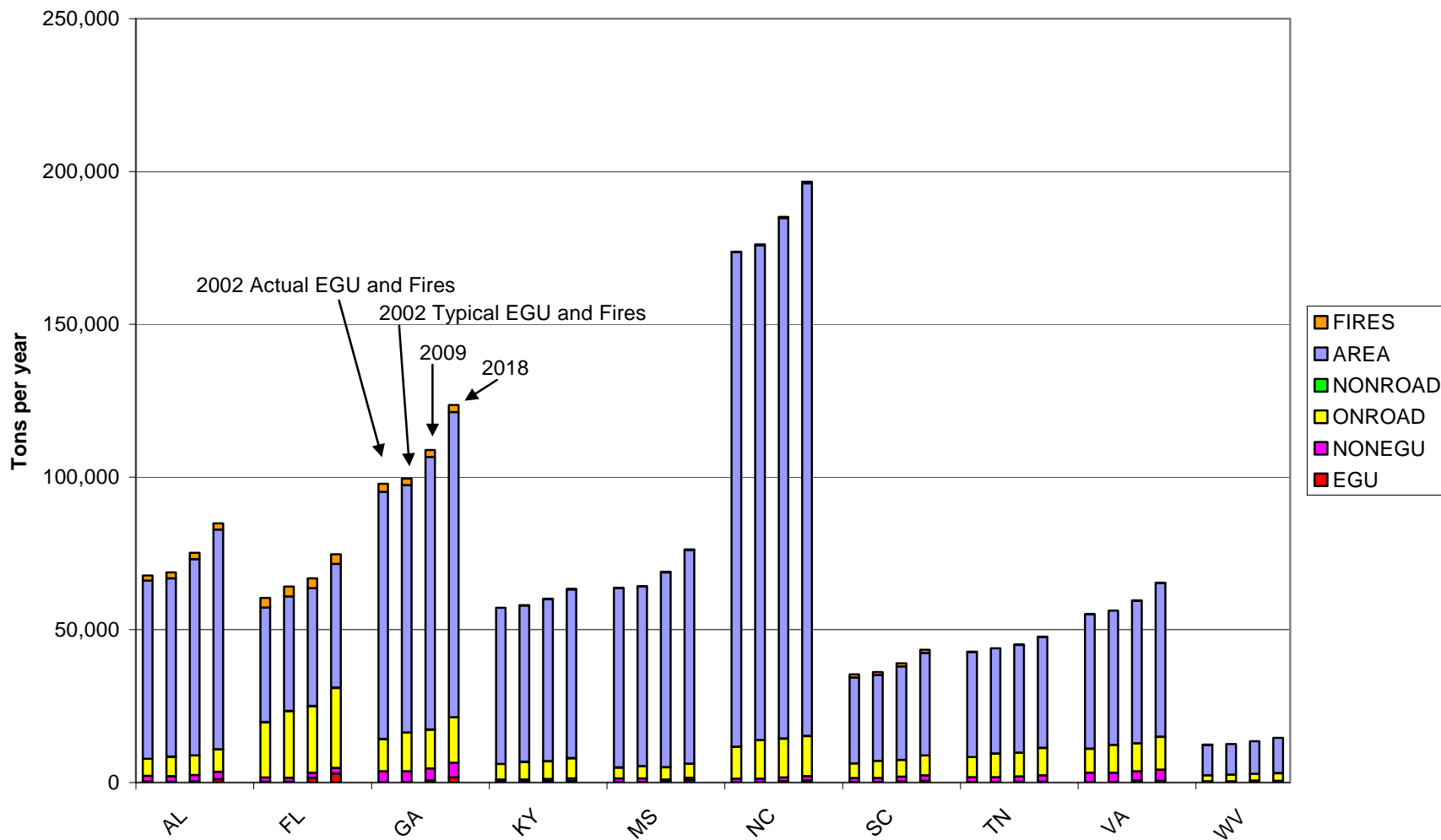
### Annual CO Emissions by Source Sector



## Annual CO Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR
	11,279	174,271	1,366,056	414,385	83,958	474,959	2002 Actual
	11,460	174,260	942,793	414,385	83,958	514,120	2002 Typical
<b>AL</b>	14,986	180,369	942,793	454,686	66,654	534,873	2009
	24,342	201,794	797,966	488,924	59,626	535,658	2018
	57,113	81,933	4,693,893	1,920,729	71,079	790,620	2002 Actual
	55,899	81,928	3,446,095	1,920,729	71,079	923,310	2002 Typical
<b>FL</b>	35,928	87,037	3,446,095	2,104,920	57,011	923,310	2009
	53,772	96,819	3,086,330	2,323,327	53,903	923,310	2018
	9,712	130,656	2,833,468	791,158	108,083	654,411	2002 Actual
	9,650	130,656	2,053,694	791,158	108,083	620,342	2002 Typical
<b>GA</b>	23,721	147,215	2,053,694	882,970	94,130	637,177	2009
	44,476	167,644	1,765,020	973,872	93,827	637,177	2018
	12,619	109,936	1,260,682	325,993	66,752	8,703	2002 Actual
	12,607	109,937	942,350	325,993	66,752	24,900	2002 Typical
<b>KY</b>	15,812	122,024	942,350	357,800	57,887	31,810	2009
	17,144	139,437	782,423	381,215	54,865	33,296	2018
	5,303	54,568	894,639	236,752	37,905	13,209	2002 Actual
	5,219	54,567	628,151	236,752	37,905	14,353	2002 Typical
<b>MS</b>	5,051	57,748	628,151	257,453	27,184	48,160	2009
	15,282	66,858	528,898	270,726	22,099	50,037	2018
	13,885	50,531	3,176,811	808,231	345,315	34,515	2002 Actual
	14,074	50,531	2,184,901	808,231	345,315	71,970	2002 Typical
<b>NC</b>	14,942	53,696	2,184,901	887,605	301,163	96,258	2009
	20,223	62,145	1,510,848	960,709	290,809	111,266	2018
	6,990	56,315	1,275,161	413,964	113,714	248,341	2002 Actual
	6,969	56,315	912,280	413,964	113,714	253,005	2002 Typical
<b>SC</b>	11,135	60,473	912,280	448,625	90,390	282,307	2009
	14,786	68,988	800,619	481,332	83,167	282,307	2018
	7,084	114,681	1,967,658	505,163	89,828	4,302	2002 Actual
	6,787	114,681	1,361,408	505,163	89,828	10,124	2002 Typical
<b>TN</b>	7,214	119,039	1,361,408	554,121	74,189	17,372	2009
	7,723	140,138	1,150,516	593,100	68,809	18,860	2018
	6,892	63,796	2,170,508	660,105	155,873	15,625	2002 Actual
	6,797	63,784	1,495,771	660,105	155,873	12,611	2002 Typical
<b>VA</b>	12,509	68,346	1,495,771	726,815	128,132	21,130	2009
	15,420	76,998	1,310,698	797,683	121,690	26,923	2018
	10,341	89,879	560,717	133,113	39,546	6,738	2002 Actual
	10,117	89,878	385,994	133,113	39,546	2,652	2002 Typical
<b>WV</b>	11,493	100,045	385,994	152,862	31,640	3,949	2009
	11,961	119,332	319,030	167,424	28,773	5,013	2018

### Annual NH<sub>3</sub> Emissions by Source Sector

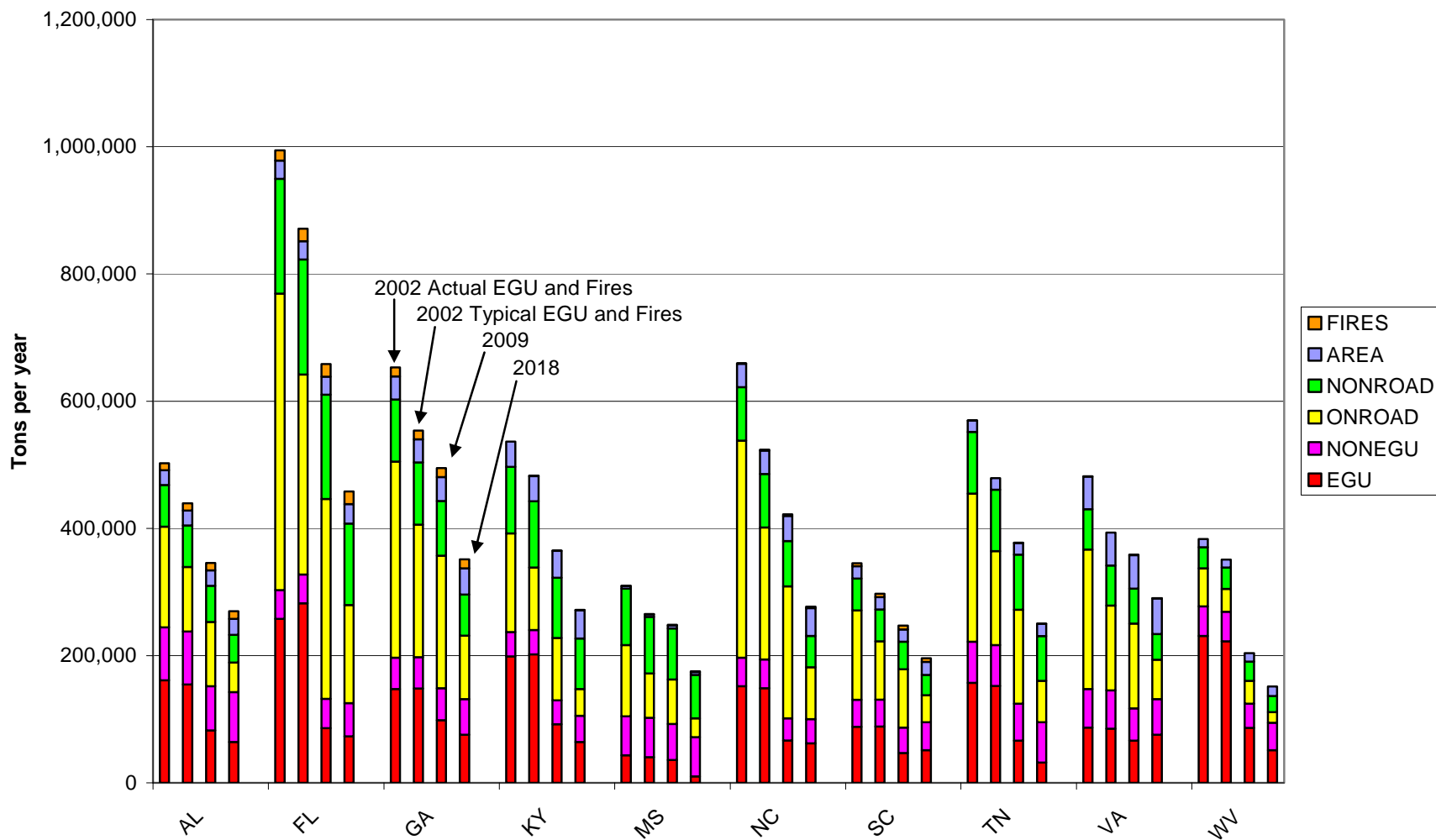


Annual NH<sub>3</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR
	317	1,883	5,576	33	58,318	1,689	2002 Actual
	239	1,883	6,350	33	58,318	1,957	2002 Typical
<b>AL</b>	359	2,132	6,350	36	64,268	2,050	2009
	1,072	2,464	7,296	42	71,915	2,054	2018
	234	1,423	18,078	134	37,446	3,102	2002 Actual
	222	1,423	21,737	134	37,446	3,157	2002 Typical
<b>FL</b>	1,631	1,544	21,737	148	38,616	3,157	2009
	2,976	1,829	26,154	171	40,432	3,157	2018
	83	3,613	10,524	60	80,913	2,578	2002 Actual
	86	3,613	12,660	60	80,913	2,153	2002 Typical
<b>GA</b>	686	3,963	12,660	68	89,212	2,229	2009
	1,677	4,797	14,871	79	99,885	2,229	2018
	326	674	5,044	31	51,135	39	2002 Actual
	321	674	5,795	31	51,135	112	2002 Typical
<b>KY</b>	400	760	5,795	34	53,005	143	2009
	476	901	6,584	40	55,211	150	2018
	190	1,169	3,577	23	58,721	59	2002 Actual
	198	1,169	4,026	23	58,721	65	2002 Typical
<b>MS</b>	334	668	4,026	25	63,708	217	2009
	827	764	4,565	29	69,910	225	2018
	54	1,179	10,455	65	161,860	155	2002 Actual
	55	1,179	12,637	65	161,860	324	2002 Typical
<b>NC</b>	445	1,285	12,637	72	170,314	433	2009
	663	1,465	13,077	83	180,866	501	2018
	142	1,411	4,684	33	28,166	980	2002 Actual
	141	1,411	5,510	33	28,166	908	2002 Typical
<b>SC</b>	343	1,578	5,510	36	30,555	1,039	2009
	617	1,779	6,472	41	33,496	1,039	2018
	204	1,542	6,616	43	34,393	19	2002 Actual
	197	1,542	7,738	43	34,393	46	2002 Typical
<b>TN</b>	227	1,764	7,738	48	35,253	78	2009
	241	2,115	8,962	55	36,291	85	2018
	127	3,104	7,837	48	43,905	70	2002 Actual
	130	3,104	9,066	48	43,905	57	2002 Typical
<b>VA</b>	694	3,049	9,066	53	46,639	95	2009
	622	3,604	10,757	61	50,175	121	2018
	121	332	1,933	9	9,963	30	2002 Actual
	121	332	2,183	9	9,963	12	2002 Typical
<b>WV</b>	330	341	2,183	11	10,625	18	2009
	180	413	2,484	13	11,504	23	2018



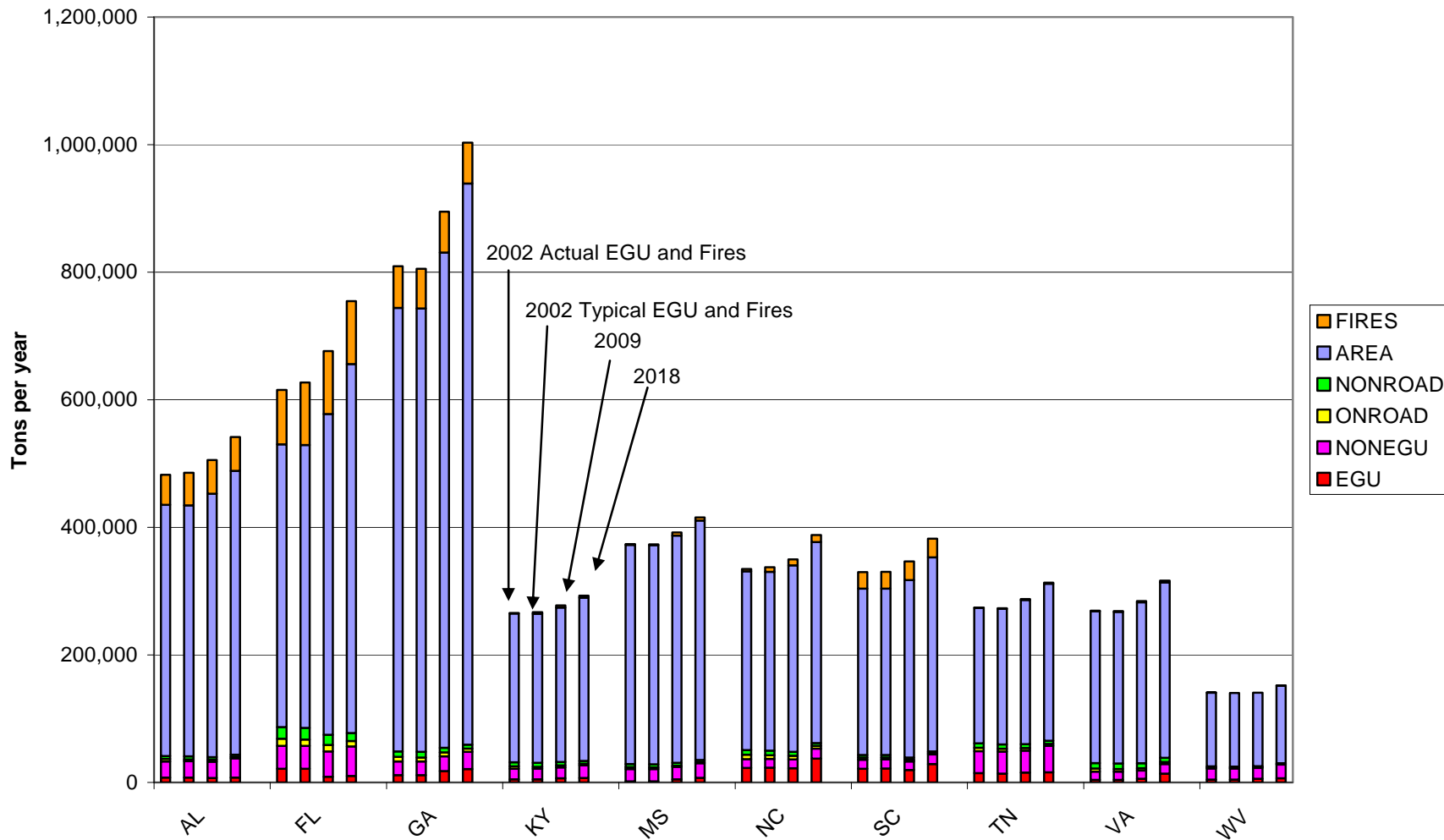
### Annual NOx Emissions by Source Sector



Annual NO<sub>x</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR
	161,038	83,310	158,423	65,366	23,444	10,728	2002 Actual
	154,704	83,302	101,323	65,366	23,444	11,456	2002 Typical
<b>AL</b>	82,305	69,409	101,323	56,862	23,930	11,901	2009
	64,358	78,318	46,222	43,799	25,028	11,918	2018
	257,677	45,156	466,098	180,627	28,872	15,942	2002 Actual
	282,507	45,150	314,307	180,627	28,872	19,791	2002 Typical
<b>FL</b>	86,165	46,020	314,307	163,794	28,187	19,791	2009
	73,125	51,902	154,611	127,885	30,708	19,791	2018
	147,517	49,214	308,013	97,961	36,142	14,203	2002 Actual
	148,126	49,214	208,393	97,961	36,142	13,882	2002 Typical
<b>GA</b>	98,497	50,312	208,393	85,733	37,729	14,243	2009
	75,717	55,775	99,821	64,579	41,332	14,243	2018
	198,817	38,392	154,899	104,571	39,507	187	2002 Actual
	201,928	38,434	97,912	104,571	39,507	534	2002 Typical
<b>KY</b>	92,021	37,758	97,912	94,752	42,088	682	2009
	64,378	41,034	42,104	79,392	44,346	714	2018
	43,135	61,526	111,791	88,787	4,200	283	2002 Actual
	40,433	61,553	69,949	88,787	4,200	308	2002 Typical
<b>MS</b>	36,011	56,398	69,949	80,567	4,249	1,033	2009
	10,271	61,533	29,717	68,252	4,483	1,073	2018
	151,850	44,881	341,198	84,284	36,550	740	2002 Actual
	148,809	44,881	207,648	84,284	36,550	1,544	2002 Typical
<b>NC</b>	66,517	34,719	207,648	70,997	39,954	2,065	2009
	62,346	37,750	81,706	49,046	43,865	2,387	2018
	88,241	42,153	140,428	50,249	19,332	4,932	2002 Actual
	88,528	42,153	91,696	50,249	19,332	5,270	2002 Typical
<b>SC</b>	46,915	40,019	91,696	43,235	19,360	5,899	2009
	51,456	44,021	42,354	31,758	20,592	5,899	2018
	157,307	64,331	233,324	96,827	17,844	92	2002 Actual
	152,137	64,331	147,757	96,827	17,844	217	2002 Typical
<b>TN</b>	66,405	57,869	147,757	86,641	18,499	373	2009
	31,715	63,435	65,242	70,226	19,597	405	2018
	86,886	60,415	219,602	63,219	51,418	335	2002 Actual
	85,081	60,390	133,170	63,219	51,418	271	2002 Typical
<b>VA</b>	66,219	51,046	133,170	54,993	52,618	453	2009
	75,594	55,945	61,881	40,393	56,158	578	2018
	230,977	46,612	59,612	33,239	12,687	145	2002 Actual
	222,437	46,618	36,049	33,239	12,687	57	2002 Typical
<b>WV</b>	86,328	38,031	36,049	30,133	13,439	85	2009
	51,241	43,359	16,274	25,710	14,828	108	2018

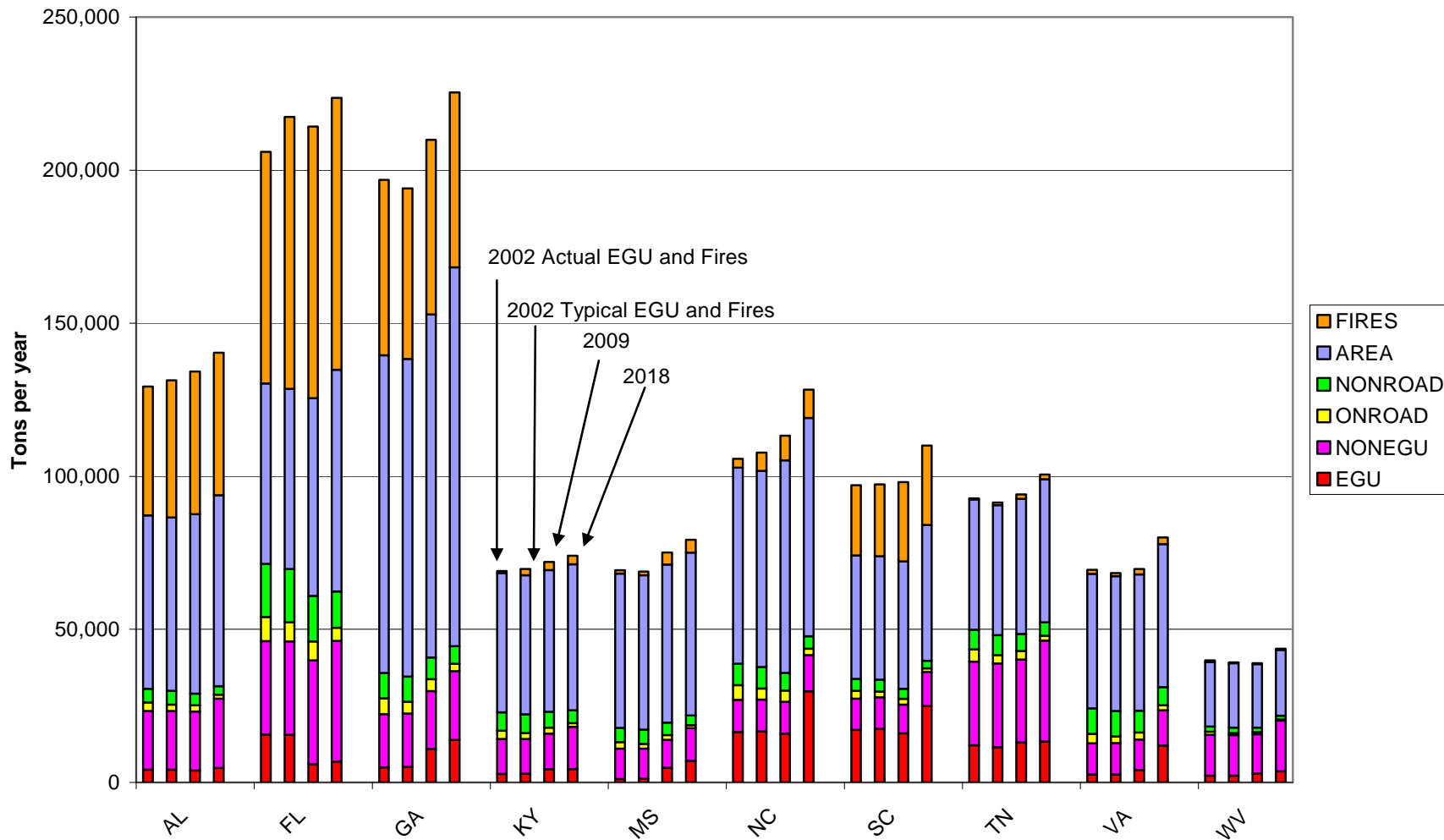
### Annual PM<sub>10</sub> Emissions by Source Sector



Annual PM<sub>10</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR
	7,646	25,240	3,898	4,787	393,588	47,237	2002 Actual
	7,845	25,239	3,188	4,787	393,588	50,833	2002 Typical
<b>AL</b>	6,969	25,421	3,188	4,027	413,020	52,851	2009
	7,822	29,924	2,488	3,041	445,256	52,927	2018
	21,387	35,857	11,253	18,281	443,346	85,263	2002 Actual
	21,391	35,856	9,953	18,281	443,346	98,470	2002 Typical
<b>FL</b>	9,007	39,872	9,953	15,613	503,230	98,470	2009
	9,953	46,456	8,489	12,497	578,516	98,470	2018
	11,224	21,516	7,236	8,618	695,414	65,227	2002 Actual
	11,467	21,516	6,103	8,618	695,414	62,336	2002 Typical
<b>GA</b>	17,891	22,997	6,103	7,521	776,411	63,973	2009
	20,909	27,143	4,995	6,015	880,199	63,973	2018
	4,701	16,626	3,720	6,425	233,559	846	2002 Actual
	4,795	16,626	3,002	6,425	233,559	2,421	2002 Typical
<b>KY</b>	6,463	17,174	3,002	5,544	242,177	3,093	2009
	6,694	20,153	2,283	4,556	256,052	3,237	2018
	1,633	19,472	2,856	5,010	343,377	1,284	2002 Actual
	1,706	19,469	2,290	5,010	343,377	1,396	2002 Typical
<b>MS</b>	4,957	19,245	2,290	4,270	356,324	4,683	2009
	7,187	22,859	1,688	3,452	375,495	4,865	2018
	22,754	13,785	6,905	7,348	280,379	3,356	2002 Actual
	22,994	13,785	5,861	7,348	280,379	6,998	2002 Typical
<b>NC</b>	22,152	13,855	5,861	6,055	292,443	9,359	2009
	37,376	15,678	4,299	4,298	315,294	10,819	2018
	21,400	14,142	3,446	4,152	260,858	25,968	2002 Actual
	21,827	14,142	2,878	4,152	260,858	26,304	2002 Typical
<b>SC</b>	19,395	13,370	2,878	3,471	278,299	29,153	2009
	28,826	15,139	2,258	2,617	304,251	29,153	2018
	14,640	34,534	5,338	6,819	212,554	418	2002 Actual
	13,866	34,534	4,238	6,819	212,554	984	2002 Typical
<b>TN</b>	15,608	34,145	4,238	5,877	226,098	1,689	2009
	15,941	41,397	3,199	4,672	246,252	1,834	2018
	3,960	13,252	4,537	8,728	237,577	1,519	2002 Actual
	3,892	13,252	3,760	8,728	237,577	1,226	2002 Typical
<b>VA</b>	5,508	13,048	3,760	7,510	252,488	2,054	2009
	13,775	15,112	3,343	6,208	275,351	2,618	2018
	4,573	17,503	1,395	1,850	115,346	655	2002 Actual
	4,472	17,503	1,096	1,850	115,346	258	2002 Typical
<b>WV</b>	5,657	17,090	1,096	1,640	115,089	384	2009
	6,349	21,735	844	1,292	121,549	487	2018

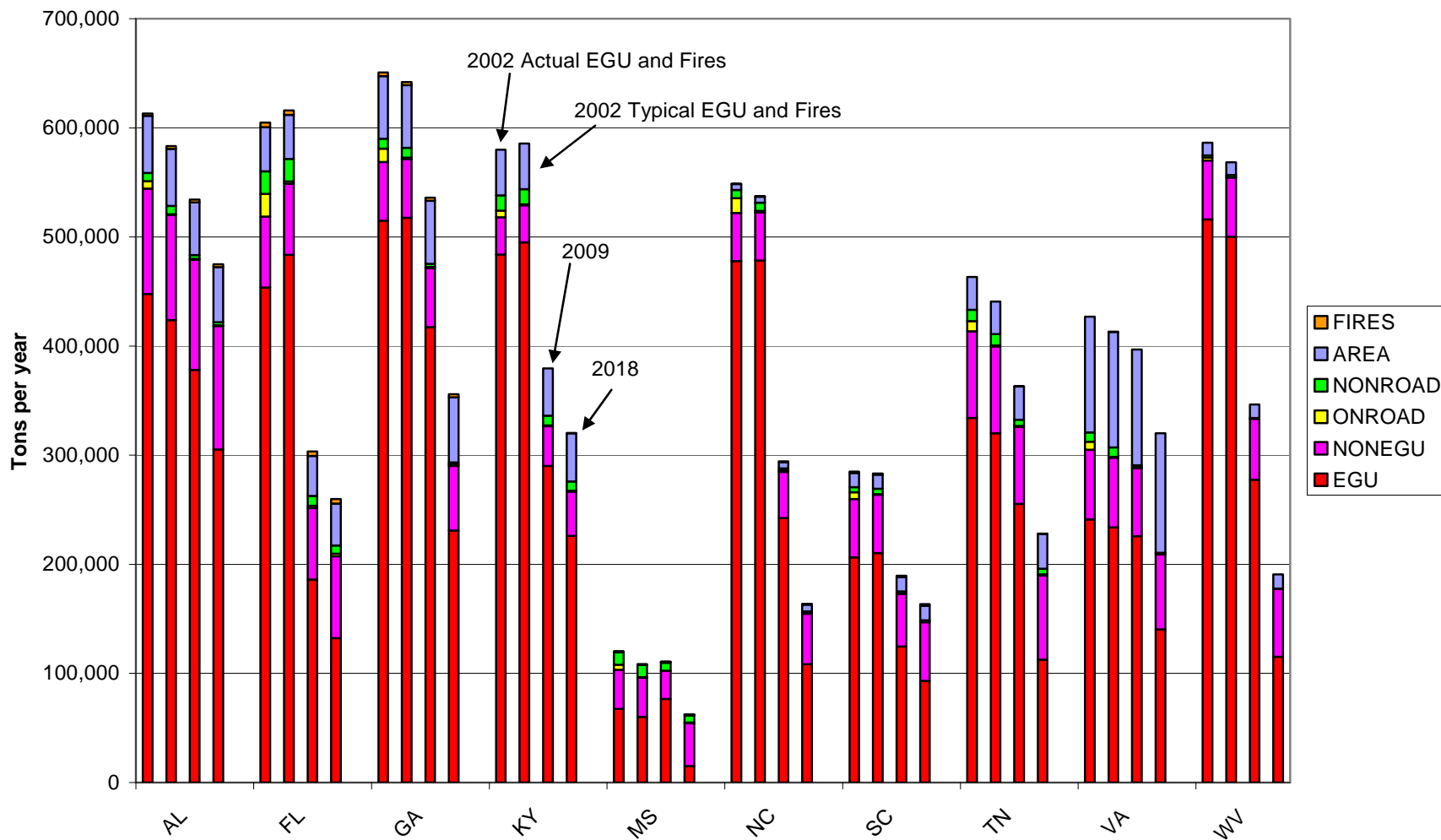
### Annual PM<sub>2.5</sub> Emissions by Source Sector



Annual PM<sub>2.5</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR
	4,113	19,178	2,794	4,502	56,654	42,041	2002 Actual
	4,176	19,177	2,049	4,502	56,654	44,812	2002 Typical
<b>AL</b>	3,921	19,230	2,049	3,776	58,699	46,543	2009
	4,768	22,598	1,262	2,835	62,323	46,608	2018
	15,643	30,504	7,852	17,415	58,878	75,717	2002 Actual
	15,575	30,504	6,216	17,415	58,878	88,756	2002 Typical
<b>FL</b>	5,910	33,946	6,216	14,866	64,589	88,756	2009
	6,843	39,430	4,242	11,868	72,454	88,756	2018
	4,939	17,394	5,158	8,226	103,794	57,293	2002 Actual
	5,070	17,394	3,869	8,226	103,794	55,712	2002 Typical
<b>GA</b>	10,907	18,906	3,869	7,175	112,001	57,116	2009
	13,983	22,323	2,517	5,730	123,704	57,116	2018
	2,802	11,372	2,693	6,046	45,453	726	2002 Actual
	2,847	11,372	1,941	6,046	45,453	2,076	2002 Typical
<b>KY</b>	4,279	11,686	1,941	5,203	46,243	2,653	2009
	4,434	13,739	1,160	4,256	47,645	2,777	2018
	1,138	9,906	2,109	4,690	50,401	1,102	2002 Actual
	1,147	9,902	1,522	4,690	50,401	1,197	2002 Typical
<b>MS</b>	4,777	9,199	1,522	3,985	51,661	4,016	2009
	7,033	10,739	876	3,203	53,222	4,173	2018
	16,498	10,455	4,816	7,005	64,052	2,878	2002 Actual
	16,623	10,455	3,643	7,005	64,052	6,002	2002 Typical
<b>NC</b>	15,949	10,411	3,643	5,760	69,457	8,027	2009
	29,791	11,775	2,158	4,069	71,262	9,279	2018
	17,154	10,245	2,496	3,945	40,291	22,953	2002 Actual
	17,521	10,245	1,870	3,945	40,291	23,511	2002 Typical
<b>SC</b>	16,042	9,390	1,870	3,294	41,613	25,955	2009
	25,032	11,086	1,154	2,474	44,319	25,955	2018
	12,166	27,345	3,919	6,458	42,566	359	2002 Actual
	11,491	27,345	2,782	6,458	42,566	844	2002 Typical
<b>TN</b>	13,092	27,079	2,782	5,557	44,124	1,449	2009
	13,387	32,893	1,643	4,403	46,692	1,573	2018
	2,606	10,165	3,090	8,288	43,989	1,303	2002 Actual
	2,650	10,165	2,254	8,288	43,989	1,052	2002 Typical
<b>VA</b>	4,067	9,988	2,254	7,136	44,514	1,762	2009
	11,976	11,594	1,641	5,891	46,697	2,245	2018
	2,210	13,313	1,003	1,728	21,049	562	2002 Actual
	2,163	13,313	703	1,728	21,049	221	2002 Typical
<b>WV</b>	2,940	12,769	703	1,528	20,664	329	2009
	3,648	16,516	428	1,198	21,490	418	2018

### Annual SO<sub>2</sub> Emissions by Source Sector

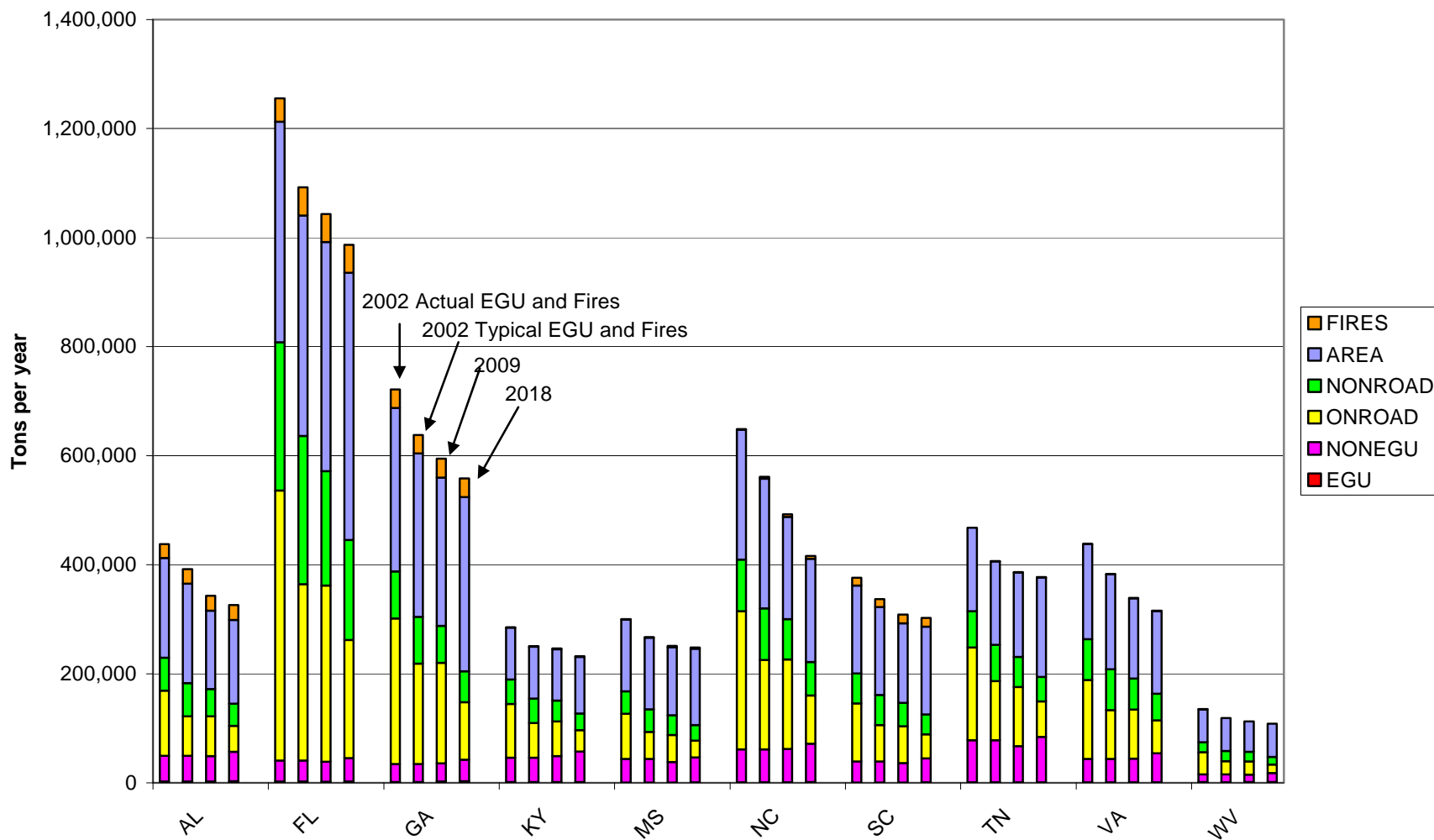


Annual SO<sub>2</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR
	447,828	96,481	6,885	7,584	52,253	2,208	2002 Actual
	423,736	96,481	635	7,584	52,253	2,559	2002 Typical
<b>AL</b>	378,052	101,246	635	3,471	48,228	2,681	2009
	305,262	113,224	720	2,818	50,264	2,686	2018
	453,631	65,090	20,872	20,614	40,491	4,057	2002 Actual
	483,590	65,090	2,120	20,614	40,491	4,129	2002 Typical
<b>FL</b>	186,055	65,511	2,120	8,967	36,699	4,129	2009
	132,177	75,047	2,533	7,536	38,317	4,129	2018
	514,952	53,774	12,155	9,005	57,559	3,372	2002 Actual
	517,633	53,774	1,254	9,005	57,559	2,815	2002 Typical
<b>GA</b>	417,449	53,983	1,254	2,725	57,696	2,914	2009
	230,856	59,343	1,458	1,709	59,729	2,914	2018
	484,057	34,029	5,974	14,043	41,805	51	2002 Actual
	495,153	34,029	585	14,043	41,805	146	2002 Typical
<b>KY</b>	290,193	36,418	585	9,180	43,087	187	2009
	226,062	40,682	651	8,592	44,186	196	2018
	67,429	35,960	4,604	11,315	771	78	2002 Actual
	60,086	35,954	397	11,315	771	84	2002 Typical
<b>MS</b>	76,579	25,564	397	7,191	753	283	2009
	15,146	39,221	441	6,638	746	294	2018
	477,990	44,103	13,343	7,693	5,412	203	2002 Actual
	478,488	44,103	1,311	7,693	5,412	423	2002 Typical
<b>NC</b>	242,286	42,516	1,311	1,892	5,751	566	2009
	108,492	46,292	1,323	905	6,085	655	2018
	206,399	53,518	5,958	4,866	12,900	1,281	2002 Actual
	210,272	53,518	556	4,866	12,900	1,187	2002 Typical
<b>SC</b>	124,608	48,325	556	1,701	13,051	1,359	2009
	93,274	53,577	643	1,198	13,457	1,359	2018
	334,151	79,584	9,184	10,441	29,917	25	2002 Actual
	320,146	79,584	831	10,441	29,917	60	2002 Typical
<b>TN</b>	255,410	70,657	831	5,651	30,577	102	2009
	112,672	77,219	944	5,207	31,962	111	2018
	241,204	63,903	7,218	8,663	105,890	92	2002 Actual
	233,691	63,900	900	8,663	105,890	74	2002 Typical
<b>VA</b>	225,653	62,560	900	1,707	105,984	124	2009
	140,233	68,909	1,059	507	109,380	158	2018
	516,084	54,070	2,489	2,112	11,667	40	2002 Actual
	500,381	54,077	227	2,112	11,667	16	2002 Typical
<b>WV</b>	277,489	55,973	227	359	12,284	23	2009
	115,324	62,193	255	56	12,849	29	2018



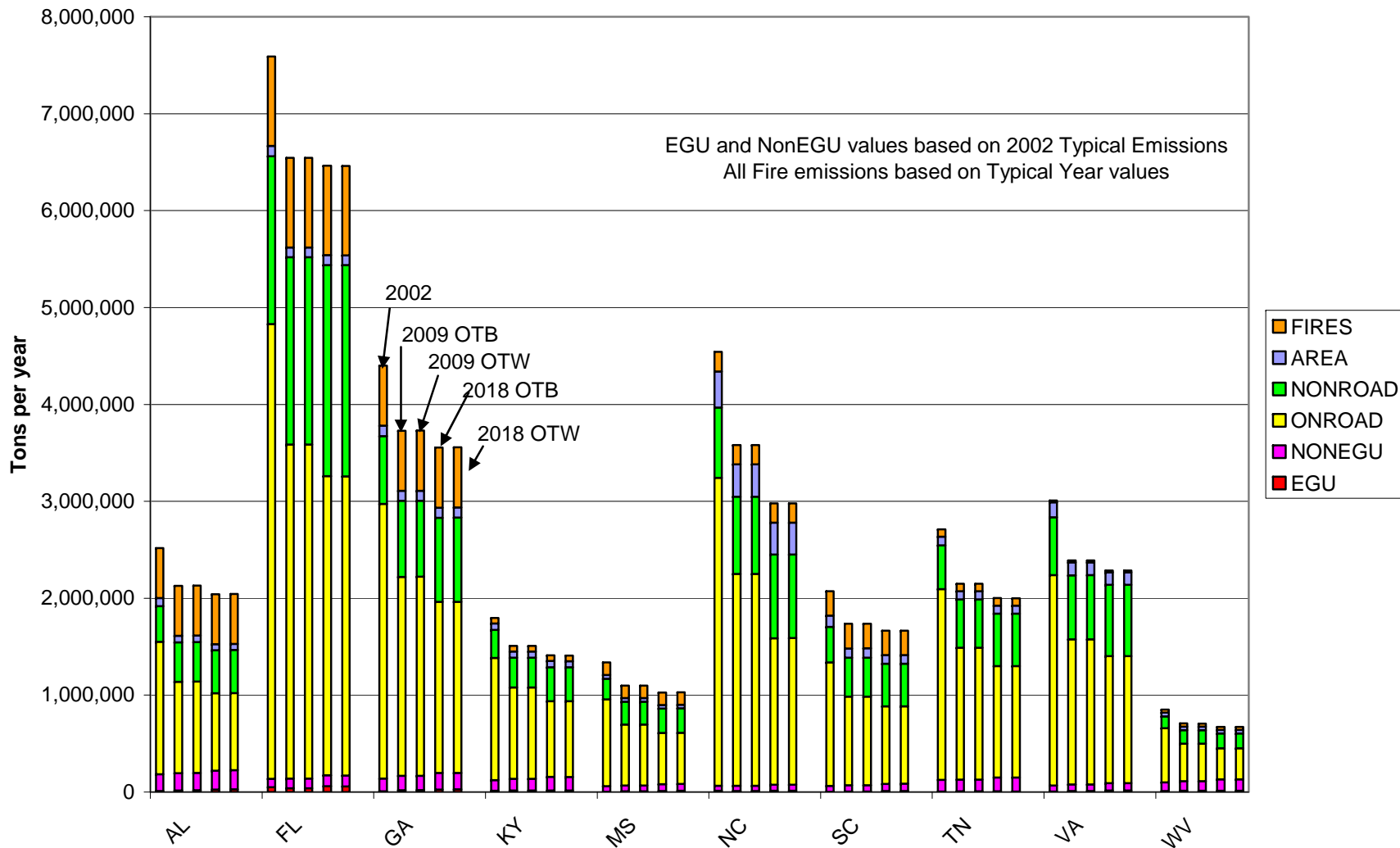
### Annual VOC Emissions by Source Sector



## Annual VOC Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR
	2,295	47,037	119,790	60,487	182,674	25,278	2002 Actual
	2,288	47,035	72,848	60,487	182,674	26,526	2002 Typical
AL	2,473	46,644	72,848	50,249	143,454	27,502	2009
	2,952	54,291	47,296	40,407	153,577	27,539	2018
	2,524	38,471	495,225	272,072	404,302	42,724	2002 Actual
	2,531	38,471	323,290	272,072	404,302	51,527	2002 Typical
FL	1,910	36,880	323,290	209,543	420,172	51,527	2009
	2,376	42,811	216,620	183,452	489,975	51,527	2018
	1,244	33,157	267,378	85,965	299,679	33,979	2002 Actual
	1,256	33,157	184,239	85,965	299,679	33,918	2002 Typical
GA	2,314	33,444	184,239	67,686	272,315	34,710	2009
	2,841	39,485	105,507	56,761	319,328	34,710	2018
	1,487	44,834	98,311	44,805	95,375	410	2002 Actual
	1,481	44,834	63,258	44,805	95,375	1,172	2002 Typical
KY	1,369	47,786	63,258	38,558	94,042	1,497	2009
	1,426	55,861	39,084	30,920	103,490	1,567	2018
	648	43,204	82,810	41,081	131,808	622	2002 Actual
	629	43,203	49,670	41,081	131,808	675	2002 Typical
MS	404	37,747	49,670	36,197	124,977	2,266	2009
	1,114	45,338	30,734	28,842	140,134	2,355	2018
	988	60,496	253,374	94,480	237,926	1,624	2002 Actual
	986	60,496	163,803	94,480	237,926	3,387	2002 Typical
NC	954	61,207	163,803	74,056	187,769	4,530	2009
	1,345	70,100	88,620	61,327	189,591	5,236	2018
	470	38,458	106,792	55,016	161,000	14,202	2002 Actual
	470	38,458	67,281	55,016	161,000	14,666	2002 Typical
SC	660	35,665	67,281	43,061	146,107	16,045	2009
	906	43,656	44,700	36,131	161,228	16,045	2018
	926	77,304	169,914	66,450	153,307	202	2002 Actual
	890	77,304	108,200	66,450	153,307	476	2002 Typical
TN	932	66,538	108,200	55,358	154,377	817	2009
	976	83,573	64,665	45,084	182,222	888	2018
	754	43,152	144,684	74,866	174,116	735	2002 Actual
	747	43,152	89,678	74,866	174,116	593	2002 Typical
VA	778	43,726	89,678	57,009	147,034	994	2009
	997	53,186	60,454	49,052	150,919	1,267	2018
	1,180	14,595	40,066	18,566	60,443	317	2002 Actual
	1,140	14,595	23,907	18,566	60,443	125	2002 Typical
WV	1,361	13,810	23,907	18,069	55,288	186	2009
	1,387	16,565	15,463	14,086	60,747	236	2018

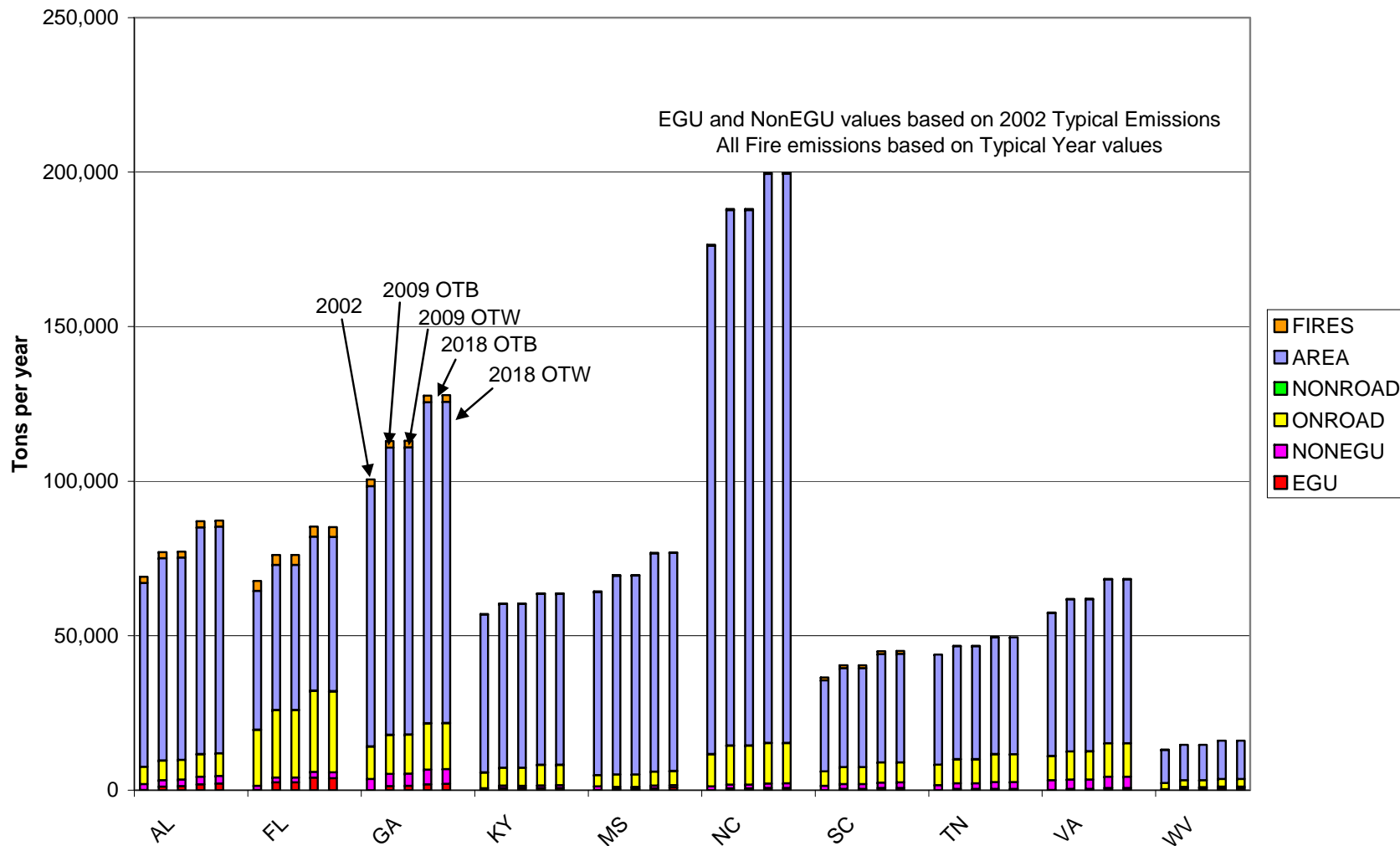
### Annual CO Emissions by Source Sector



## Annual CO Emissions by Source Sector

Name	AREA	EGU	FIRES	NONEGU	NONROAD	ONROAD	YEAR	Basis
	83,958	10,812	514,120	174,306	367,038	1,366,056	2002	OTB - Typical 2002
	68,882	16,494	514,120	177,145	408,424	942,793	2009	OTB - Typical 2002
AL	68,882	19,205	514,120	177,145	408,424	942,793	2009	OTW - Typical 2002
	63,773	26,600	514,120	194,801	443,100	797,966	2018	OTB - Typical 2002
	63,773	29,893	514,120	194,801	443,100	797,966	2018	OTW - Typical 2002
	105,849	51,165	923,310	84,920	1,731,519	4,693,893	2002	OTB - Typical 2002
	101,356	40,642	923,310	98,325	1,934,550	3,446,095	2009	OTB - Typical 2002
FL	101,356	40,641	923,310	98,325	1,934,550	3,446,095	2009	OTW - Typical 2002
	100,952	59,793	923,310	113,923	2,179,296	3,086,330	2018	OTB - Typical 2002
	100,952	57,759	923,310	113,923	2,179,296	3,086,330	2018	OTW - Typical 2002
	107,889	8,098	620,342	131,417	700,427	2,833,468	2002	OTB - Typical 2002
	103,579	19,170	620,342	147,835	783,990	2,053,694	2009	OTB - Typical 2002
GA	103,579	20,024	620,342	147,835	783,990	2,053,694	2009	OTW - Typical 2002
	105,059	27,152	620,342	169,156	868,018	1,765,020	2018	OTB - Typical 2002
	105,059	28,895	620,342	169,156	868,018	1,765,020	2018	OTW - Typical 2002
	66,752	12,888	56,686	110,141	289,967	1,260,682	2002	OTB - Typical 2002
	64,806	15,273	56,686	121,981	306,884	942,350	2009	OTB - Typical 2002
KY	64,806	15,119	56,686	121,981	306,884	942,350	2009	OTW - Typical 2002
	65,297	16,974	56,686	139,395	349,285	782,423	2018	OTB - Typical 2002
	65,297	14,954	56,686	139,395	349,285	782,423	2018	OTW - Typical 2002
	37,905	3,831	128,471	57,711	213,779	894,639	2002	OTB - Typical 2002
	37,161	6,714	128,471	60,709	237,297	628,151	2009	OTB - Typical 2002
MS	37,161	6,954	128,471	60,709	237,297	628,151	2009	OTW - Typical 2002
	36,425	10,553	128,471	70,454	252,658	528,898	2018	OTB - Typical 2002
	36,425	12,928	128,471	70,454	252,658	528,898	2018	OTW - Typical 2002
	373,585	12,027	200,564	52,542	725,734	3,176,811	2002	OTB - Typical 2002
	332,443	11,091	200,564	54,791	797,360	2,184,901	2009	OTB - Typical 2002
NC	332,443	11,170	200,564	54,791	797,360	2,184,901	2009	OTW - Typical 2002
	327,871	13,482	200,564	63,699	863,536	1,510,848	2018	OTB - Typical 2002
	327,871	13,777	200,564	63,699	863,536	1,510,848	2018	OTW - Typical 2002
	113,714	3,675	253,005	59,605	367,575	1,275,161	2002	OTB - Typical 2002
	95,826	6,316	253,005	65,612	402,871	912,280	2009	OTB - Typical 2002
SC	95,826	6,526	253,005	65,612	402,871	912,280	2009	OTW - Typical 2002
	89,343	10,175	253,005	75,209	438,027	800,619	2018	OTB - Typical 2002
	89,343	10,671	253,005	75,209	438,027	800,619	2018	OTW - Typical 2002
	89,235	6,339	78,370	119,405	451,480	1,967,658	2002	OTB - Typical 2002
	82,196	6,750	78,370	121,420	500,186	1,361,408	2009	OTB - Typical 2002
TN	82,196	6,651	78,370	121,420	500,186	1,361,408	2009	OTW - Typical 2002
	81,242	7,074	78,370	143,845	540,143	1,150,516	2018	OTB - Typical 2002
	81,242	6,509	78,370	143,845	540,143	1,150,516	2018	OTW - Typical 2002
	155,873	5,958	19,159	62,534	595,311	2,170,508	2002	OTB - Typical 2002
	133,738	9,811	19,159	69,822	661,295	1,495,771	2009	OTB - Typical 2002
VA	133,738	10,245	19,159	69,822	661,295	1,495,771	2009	OTW - Typical 2002
	129,037	14,788	19,159	77,590	734,294	1,310,698	2018	OTB - Typical 2002
	129,037	14,839	19,159	77,590	734,294	1,310,698	2018	OTW - Typical 2002
	39,546	9,927	32,656	89,928	119,089	560,717	2002	OTB - Typical 2002
	37,704	12,622	32,656	100,292	138,999	385,994	2009	OTB - Typical 2002
WV	37,704	12,328	32,656	100,292	138,999	385,994	2009	OTW - Typical 2002
	36,809	13,064	32,656	119,367	152,932	319,030	2018	OTB - Typical 2002
	36,809	12,992	32,656	119,367	152,932	319,030	2018	OTW - Typical 2002

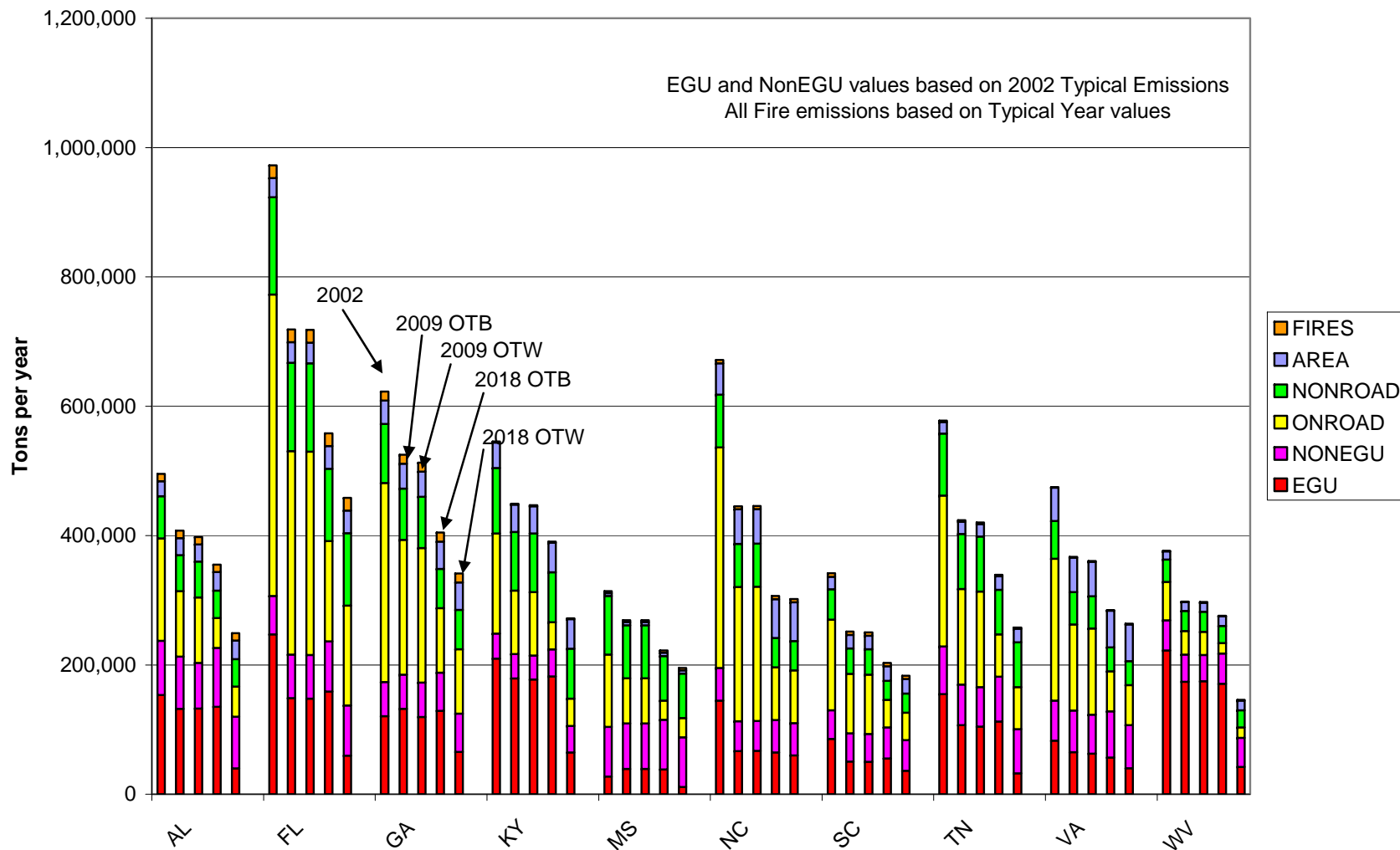
### Annual NH<sub>3</sub> Emissions by Source Sector



Annual NH<sub>3</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	89	1,883	5,576	32	59,486	1,957	2002	OTB - Typical 2002
	1,128	2,112	6,350	35	65,441	1,957	2009	OTB - Typical 2002
AL	1,344	2,112	6,350	35	65,441	1,957	2009	OTW - Typical 2002
	1,909	2,456	7,296	40	73,346	1,957	2018	OTB - Typical 2002
	2,173	2,456	7,296	40	73,346	1,957	2018	OTW - Typical 2002
	53	1,383	18,078	108	44,902	3,157	2002	OTB - Typical 2002
	2,524	1,605	21,737	119	46,950	3,157	2009	OTB - Typical 2002
FL	2,524	1,605	21,737	119	46,950	3,157	2009	OTW - Typical 2002
	4,022	1,905	26,154	138	49,889	3,157	2018	OTB - Typical 2002
	3,865	1,905	26,154	138	49,889	3,157	2018	OTW - Typical 2002
	5	3,613	10,524	54	84,230	2,153	2002	OTB - Typical 2002
	1,305	3,963	12,660	60	92,838	2,153	2009	OTB - Typical 2002
GA	1,376	3,963	12,660	60	92,838	2,153	2009	OTW - Typical 2002
	1,912	4,799	14,871	71	103,911	2,153	2018	OTB - Typical 2002
	2,057	4,799	14,871	71	103,911	2,153	2018	OTW - Typical 2002
	0	674	5,044	28	51,097	110	2002	OTB - Typical 2002
	717	733	5,795	30	53,023	110	2009	OTB - Typical 2002
KY	710	733	5,795	30	53,023	110	2009	OTW - Typical 2002
	763	839	6,584	36	55,356	110	2018	OTB - Typical 2002
	771	839	6,584	36	55,356	110	2018	OTW - Typical 2002
	97	1,169	3,577	23	59,262	177	2002	OTB - Typical 2002
	388	667	4,026	26	64,289	177	2009	OTB - Typical 2002
MS	407	667	4,026	26	64,289	177	2009	OTW - Typical 2002
	686	761	4,565	30	70,565	177	2018	OTB - Typical 2002
	872	761	4,565	30	70,565	177	2018	OTW - Typical 2002
	35	1,171	10,455	61	164,467	324	2002	OTB - Typical 2002
	577	1,255	12,637	68	173,187	324	2009	OTB - Typical 2002
NC	574	1,255	12,637	68	173,187	324	2009	OTW - Typical 2002
	740	1,412	13,077	79	184,167	324	2018	OTB - Typical 2002
	781	1,412	13,077	79	184,167	324	2018	OTW - Typical 2002
	0	1,411	4,684	29	29,447	908	2002	OTB - Typical 2002
	409	1,578	5,510	32	31,966	908	2009	OTB - Typical 2002
SC	422	1,578	5,510	32	31,966	908	2009	OTW - Typical 2002
	702	1,779	6,472	37	35,082	908	2018	OTB - Typical 2002
	742	1,779	6,472	37	35,082	908	2018	OTW - Typical 2002
	0	1,620	6,616	41	35,571	46	2002	OTB - Typical 2002
	406	1,861	7,738	45	36,578	46	2009	OTB - Typical 2002
TN	400	1,861	7,738	45	36,578	46	2009	OTW - Typical 2002
	427	2,240	8,962	53	37,812	46	2018	OTB - Typical 2002
	394	2,240	8,962	53	37,812	46	2018	OTW - Typical 2002
	122	3,097	7,837	44	46,221	159	2002	OTB - Typical 2002
	396	3,057	9,066	48	49,173	159	2009	OTB - Typical 2002
VA	439	3,057	9,066	48	49,173	159	2009	OTW - Typical 2002
	759	3,620	10,757	57	53,023	159	2018	OTB - Typical 2002
	783	3,620	10,757	57	53,023	159	2018	OTW - Typical 2002
	12	331	1,933	10	10,779	12	2002	OTB - Typical 2002
	691	342	2,183	11	11,461	12	2009	OTB - Typical 2002
WV	673	342	2,183	11	11,461	12	2009	OTW - Typical 2002
	722	416	2,484	13	12,390	12	2018	OTB - Typical 2002
	719	416	2,484	13	12,390	12	2018	OTW - Typical 2002

### Annual NOx Emissions by Source Sector

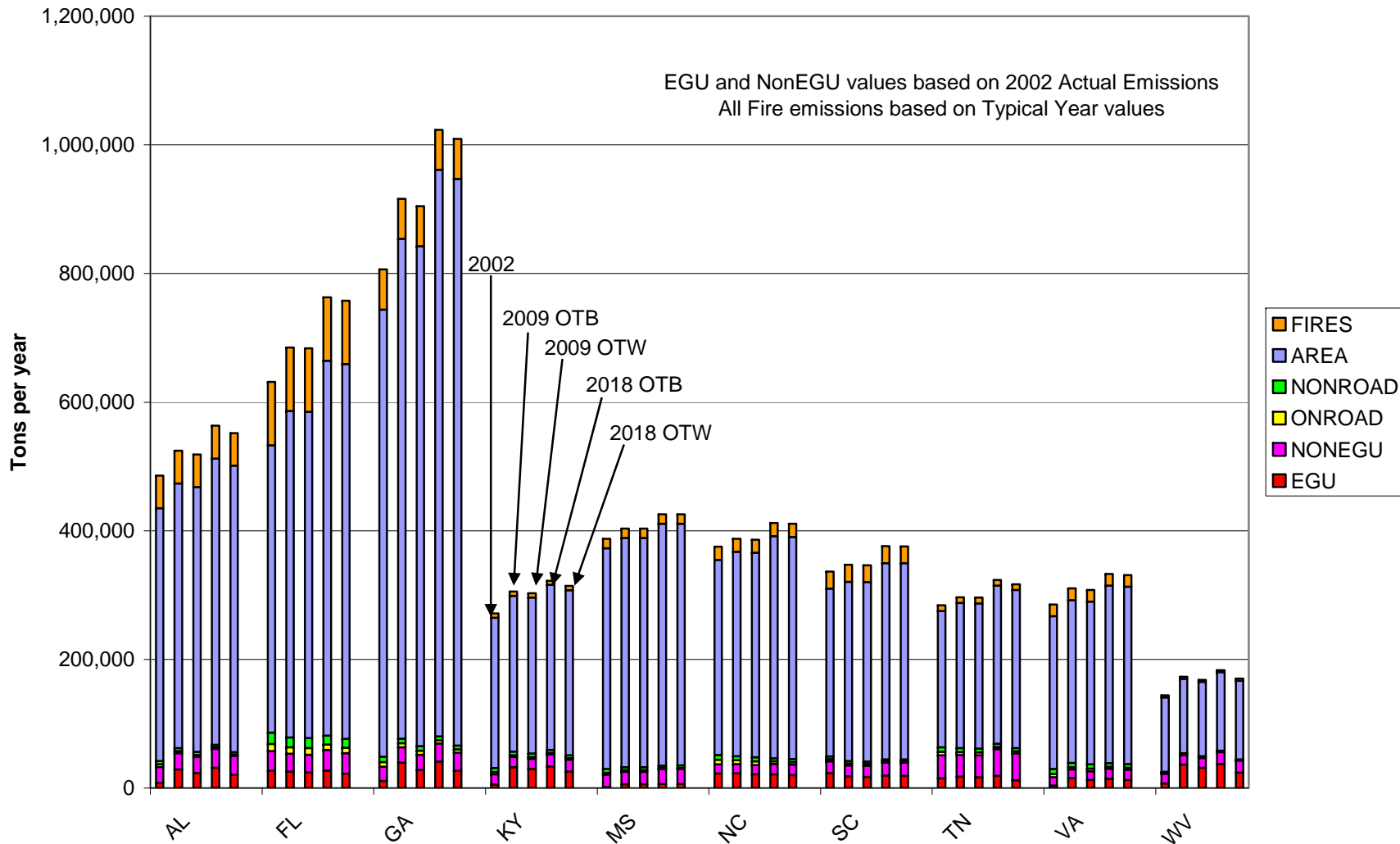


Annual NO<sub>x</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	153,349	83,868	158,423	64,891	23,444	11,456	2002	OTB - Typical 2002
	131,988	80,738	101,323	55,494	26,482	11,456	2009	OTB - Typical 2002
AL	132,323	70,644	101,323	55,494	26,482	11,456	2009	OTW - Typical 2002
	135,010	91,052	46,222	42,573	28,754	11,456	2018	OTB - Typical 2002
	39,942	80,031	46,222	42,573	28,754	11,456	2018	OTW - Typical 2002
	247,099	59,517	466,098	150,519	29,477	19,791	2002	OTB - Typical 2002
	148,522	67,533	314,307	136,851	31,821	19,791	2009	OTB - Typical 2002
FL	147,801	67,533	314,307	136,851	31,821	19,791	2009	OTW - Typical 2002
	159,004	77,551	154,611	111,959	35,047	19,791	2018	OTB - Typical 2002
	59,446	77,551	154,611	111,959	35,047	19,791	2018	OTW - Typical 2002
	120,785	52,425	308,013	91,386	36,105	13,882	2002	OTB - Typical 2002
	131,901	53,008	208,393	79,049	38,876	13,882	2009	OTB - Typical 2002
GA	119,425	53,008	208,393	79,049	38,876	13,882	2009	OTW - Typical 2002
	128,938	59,005	99,821	60,650	42,260	13,882	2018	OTB - Typical 2002
	65,559	59,005	99,821	60,650	42,260	13,882	2018	OTW - Typical 2002
	209,802	38,460	154,899	101,261	39,507	1,460	2002	OTB - Typical 2002
	178,930	37,960	97,912	90,803	42,122	1,460	2009	OTB - Typical 2002
KY	177,272	37,201	97,912	90,803	42,122	1,460	2009	OTW - Typical 2002
	182,192	41,776	42,104	77,295	45,597	1,460	2018	OTB - Typical 2002
	64,674	40,948	42,104	77,295	45,597	1,460	2018	OTW - Typical 2002
	27,254	76,906	111,791	90,686	4,200	3,328	2002	OTB - Typical 2002
	38,911	70,463	69,949	81,780	4,789	3,328	2009	OTB - Typical 2002
MS	38,978	70,463	69,949	81,780	4,789	3,328	2009	OTW - Typical 2002
	38,355	76,738	29,717	68,781	5,230	3,328	2018	OTB - Typical 2002
	11,206	76,738	29,717	68,781	5,230	3,328	2018	OTW - Typical 2002
	144,730	50,393	341,198	81,448	48,730	5,005	2002	OTB - Typical 2002
	66,598	46,242	207,648	66,382	53,550	5,005	2009	OTB - Typical 2002
NC	67,051	46,242	207,648	66,382	53,550	5,005	2009	OTW - Typical 2002
	64,537	50,044	81,706	45,146	60,073	5,005	2018	OTB - Typical 2002
	59,917	50,044	81,706	45,146	60,073	5,005	2018	OTW - Typical 2002
	85,555	44,123	140,428	46,789	19,332	5,270	2002	OTB - Typical 2002
	50,433	43,799	91,696	39,544	20,852	5,270	2009	OTB - Typical 2002
SC	50,128	42,944	91,696	39,544	20,852	5,270	2009	OTW - Typical 2002
	55,103	48,314	42,354	29,512	22,467	5,270	2018	OTB - Typical 2002
	36,264	47,403	42,354	29,512	22,467	5,270	2018	OTW - Typical 2002
	155,028	73,384	233,324	95,968	17,829	2,232	2002	OTB - Typical 2002
	106,979	62,435	147,757	85,084	19,148	2,232	2009	OTB - Typical 2002
TN	104,528	61,176	147,757	85,084	19,148	2,232	2009	OTW - Typical 2002
	112,411	69,374	65,242	69,093	20,928	2,232	2018	OTB - Typical 2002
	32,411	67,999	65,242	69,093	20,928	2,232	2018	OTW - Typical 2002
	82,911	61,528	219,602	58,524	51,418	978	2002	OTB - Typical 2002
	64,950	64,298	133,170	50,120	53,344	978	2009	OTB - Typical 2002
VA	62,810	60,027	133,170	50,120	53,344	978	2009	OTW - Typical 2002
	56,716	71,480	61,881	36,970	56,668	978	2018	OTB - Typical 2002
	40,045	66,931	61,881	36,970	56,668	978	2018	OTW - Typical 2002
	222,090	46,715	59,612	34,442	12,687	944	2002	OTB - Typical 2002
	173,977	42,140	36,049	31,148	13,816	944	2009	OTB - Typical 2002
WV	174,572	40,469	36,049	31,148	13,816	944	2009	OTW - Typical 2002
	170,522	46,846	16,274	26,279	15,079	944	2018	OTB - Typical 2002
	42,227	44,944	16,274	26,279	15,079	944	2018	OTW - Typical 2002



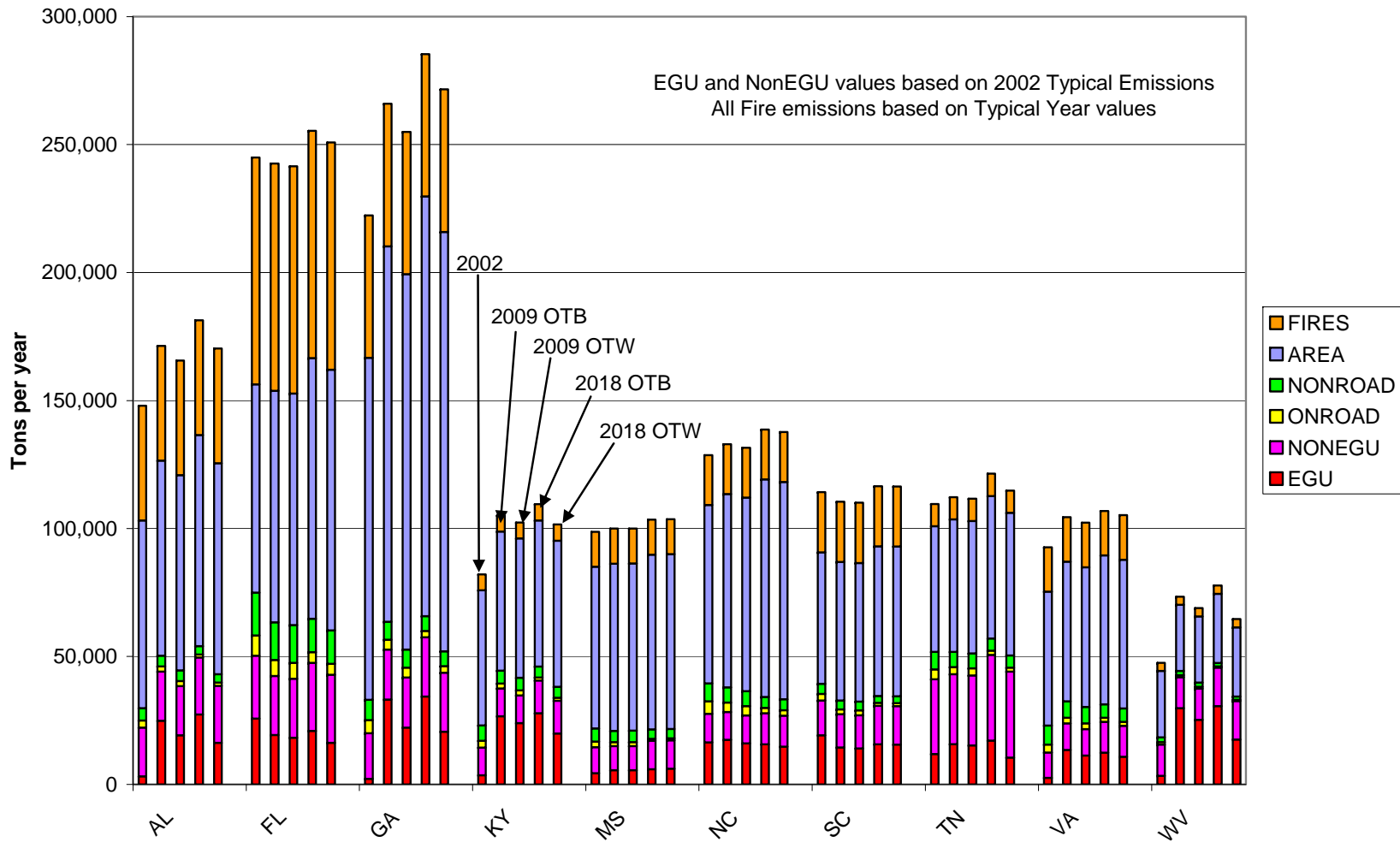
### Annual PM<sub>10</sub> Emissions by Source Sector



Annual PM<sub>10</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	5,737	24,957	3,898	5,331	393,093	50,833	2002	OTB - Typical 2002
	29,053	25,161	3,188	4,597	411,614	50,833	2009	OTB - Typical 2002
AL	23,250	25,161	3,188	4,597	411,614	50,833	2009	OTW - Typical 2002
	31,815	29,278	2,488	3,690	445,168	50,833	2018	OTB - Typical 2002
	20,450	29,278	2,488	3,690	445,168	50,833	2018	OTW - Typical 2002
	33,182	28,882	11,253	17,692	446,821	98,470	2002	OTB - Typical 2002
	25,779	27,531	9,953	15,630	507,515	98,470	2009	OTB - Typical 2002
FL	24,493	27,531	9,953	15,630	507,515	98,470	2009	OTW - Typical 2002
	27,320	31,890	8,489	13,827	582,832	98,470	2018	OTB - Typical 2002
	22,204	31,890	8,489	13,827	582,832	98,470	2018	OTW - Typical 2002
	5,447	22,058	7,236	8,295	695,320	62,336	2002	OTB - Typical 2002
	39,580	23,861	6,103	7,368	776,935	62,336	2009	OTB - Typical 2002
GA	28,118	23,861	6,103	7,368	776,935	62,336	2009	OTW - Typical 2002
	41,221	28,177	4,995	6,068	880,800	62,336	2018	OTB - Typical 2002
	26,905	28,177	4,995	6,068	880,800	62,336	2018	OTW - Typical 2002
	6,000	15,613	3,720	6,389	233,559	6,667	2002	OTB - Typical 2002
	32,406	15,858	3,002	5,312	242,345	6,667	2009	OTB - Typical 2002
KY	29,606	15,858	3,002	5,312	242,345	6,667	2009	OTW - Typical 2002
	33,784	18,587	2,283	4,602	256,544	6,667	2018	OTB - Typical 2002
	25,733	18,587	2,283	4,602	256,544	6,667	2018	OTW - Typical 2002
	4,783	19,680	2,856	5,551	343,377	14,693	2002	OTB - Typical 2002
	5,864	19,439	2,290	4,754	356,516	14,693	2009	OTB - Typical 2002
MS	5,883	19,439	2,290	4,754	356,516	14,693	2009	OTW - Typical 2002
	6,268	23,145	1,688	3,873	375,931	14,693	2018	OTB - Typical 2002
	6,459	23,145	1,688	3,873	375,931	14,693	2018	OTW - Typical 2002
	22,689	14,507	6,905	7,449	303,492	20,488	2002	OTB - Typical 2002
	23,028	14,301	5,861	6,210	317,847	20,488	2009	OTB - Typical 2002
NC	21,459	14,301	5,861	6,210	317,847	20,488	2009	OTW - Typical 2002
	21,417	16,002	4,299	4,474	345,275	20,488	2018	OTB - Typical 2002
	20,258	16,002	4,299	4,474	345,275	20,488	2018	OTW - Typical 2002
	23,492	18,149	3,446	4,211	260,858	26,304	2002	OTB - Typical 2002
	18,023	17,368	2,878	3,593	278,852	26,304	2009	OTB - Typical 2002
SC	17,493	17,368	2,878	3,593	278,852	26,304	2009	OTW - Typical 2002
	19,290	20,272	2,258	2,889	304,940	26,304	2018	OTB - Typical 2002
	19,182	20,272	2,258	2,889	304,940	26,304	2018	OTW - Typical 2002
	14,537	35,982	5,338	7,145	211,903	8,875	2002	OTB - Typical 2002
	17,735	33,838	4,238	6,218	225,650	8,875	2009	OTB - Typical 2002
TN	17,159	33,838	4,238	6,218	225,650	8,875	2009	OTW - Typical 2002
	19,103	41,466	3,199	5,019	245,893	8,875	2018	OTB - Typical 2002
	12,432	41,466	3,199	5,019	245,893	8,875	2018	OTW - Typical 2002
	3,790	12,799	4,537	7,928	237,577	18,160	2002	OTB - Typical 2002
	15,343	13,470	3,760	6,763	252,924	18,160	2009	OTB - Typical 2002
VA	12,804	13,470	3,760	6,763	252,924	18,160	2009	OTW - Typical 2002
	14,390	15,661	3,343	5,564	275,790	18,160	2018	OTB - Typical 2002
	12,653	15,661	3,343	5,564	275,790	18,160	2018	OTW - Typical 2002
	7,145	14,866	1,395	2,072	115,346	3,276	2002	OTB - Typical 2002
	36,442	14,926	1,096	1,819	115,410	3,276	2009	OTB - Typical 2002
WV	31,780	14,926	1,096	1,819	115,410	3,276	2009	OTW - Typical 2002
	37,425	18,433	844	1,381	121,964	3,276	2018	OTB - Typical 2002
	24,253	18,433	844	1,381	121,964	3,276	2018	OTW - Typical 2002

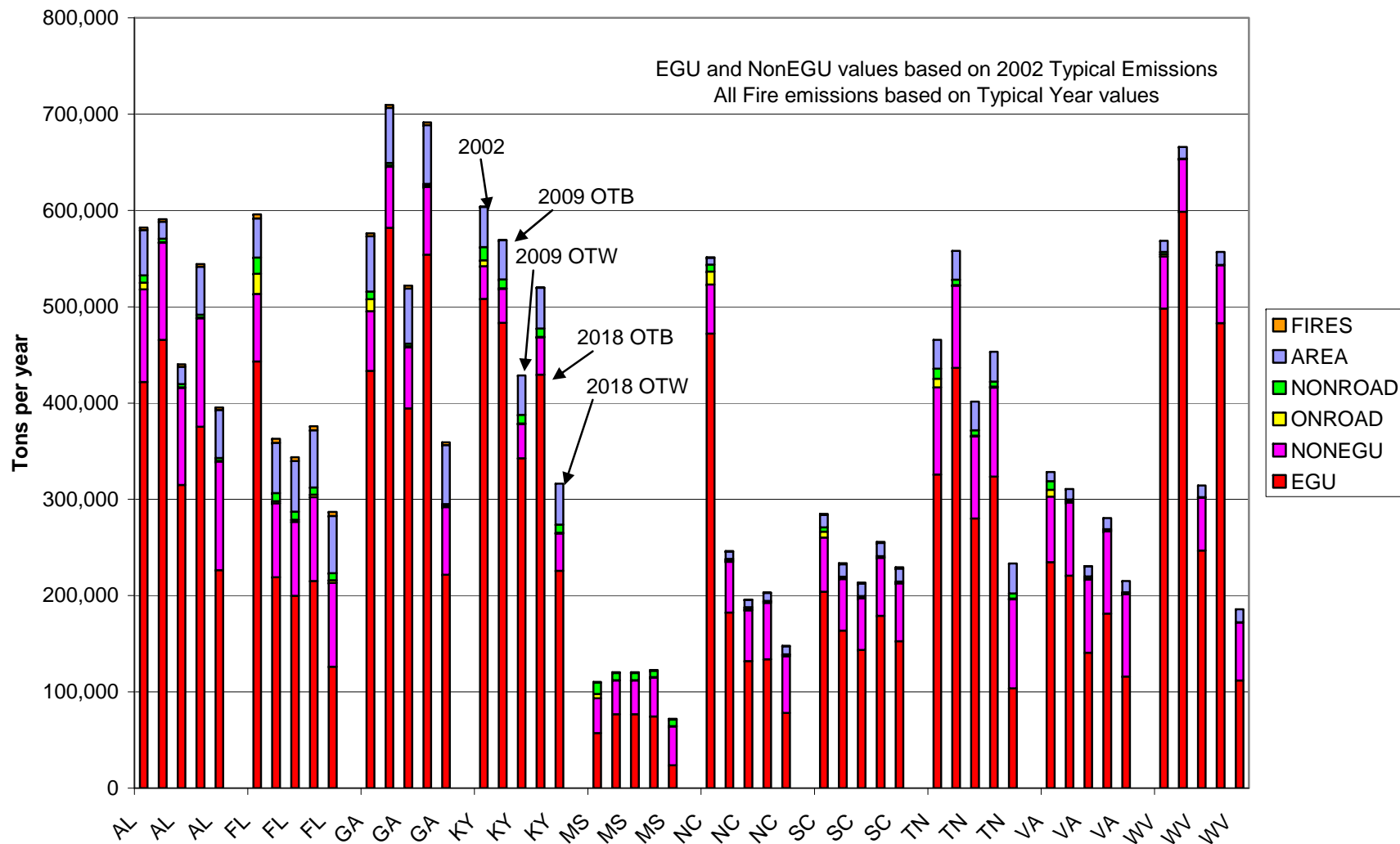
### Annual PM<sub>2.5</sub> Emissions by Source Sector



Annual PM<sub>2.5</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	3,131	19,016	2,794	4,877	73,352	44,812	2002	OTB - Typical 2002
	24,875	19,184	2,049	4,144	76,248	44,812	2009	OTB - Typical 2002
AL	19,190	19,184	2,049	4,144	76,248	44,812	2009	OTW - Typical 2002
	27,280	22,268	1,262	3,231	82,449	44,812	2018	OTB - Typical 2002
	16,279	22,268	1,262	3,231	82,449	44,812	2018	OTW - Typical 2002
	25,761	24,569	7,852	16,739	81,341	88,756	2002	OTB - Typical 2002
	19,307	23,063	6,216	14,786	90,487	88,756	2009	OTB - Typical 2002
FL	18,186	23,063	6,216	14,786	90,487	88,756	2009	OTW - Typical 2002
	20,848	26,622	4,242	13,044	101,872	88,756	2018	OTB - Typical 2002
	16,278	26,622	4,242	13,044	101,872	88,756	2018	OTW - Typical 2002
	2,137	17,893	5,158	7,899	133,542	55,712	2002	OTB - Typical 2002
	33,111	19,562	3,869	7,014	146,691	55,712	2009	OTB - Typical 2002
GA	22,163	19,562	3,869	7,014	146,691	55,712	2009	OTW - Typical 2002
	34,361	23,110	2,517	5,769	163,925	55,712	2018	OTB - Typical 2002
	20,549	23,110	2,517	5,769	163,925	55,712	2018	OTW - Typical 2002
	3,605	10,729	2,693	5,998	52,765	6,310	2002	OTB - Typical 2002
	26,640	10,837	1,941	4,978	54,397	6,310	2009	OTB - Typical 2002
KY	23,915	10,837	1,941	4,978	54,397	6,310	2009	OTW - Typical 2002
	27,857	12,738	1,160	4,289	57,110	6,310	2018	OTB - Typical 2002
	19,915	12,738	1,160	4,289	57,110	6,310	2018	OTW - Typical 2002
	4,384	10,187	2,109	5,200	63,135	13,680	2002	OTB - Typical 2002
	5,511	9,459	1,522	4,440	65,321	13,680	2009	OTB - Typical 2002
MS	5,530	9,459	1,522	4,440	65,321	13,680	2009	OTW - Typical 2002
	5,919	11,068	876	3,597	68,338	13,680	2018	OTB - Typical 2002
	6,110	11,068	876	3,597	68,338	13,680	2018	OTW - Typical 2002
	16,428	11,204	4,816	7,079	69,663	19,491	2002	OTB - Typical 2002
	17,449	10,888	3,643	5,889	75,570	19,491	2009	OTB - Typical 2002
NC	16,034	10,888	3,643	5,889	75,570	19,491	2009	OTW - Typical 2002
	15,636	12,136	2,158	4,215	85,018	19,491	2018	OTB - Typical 2002
	14,702	12,136	2,158	4,215	85,018	19,491	2018	OTW - Typical 2002
	19,238	13,565	2,496	3,985	51,413	23,511	2002	OTB - Typical 2002
	14,471	12,977	1,870	3,396	54,230	23,511	2009	OTB - Typical 2002
SC	14,079	12,977	1,870	3,396	54,230	23,511	2009	OTW - Typical 2002
	15,601	15,092	1,154	2,718	58,441	23,511	2018	OTB - Typical 2002
	15,509	15,092	1,154	2,718	58,441	23,511	2018	OTW - Typical 2002
	11,918	29,130	3,919	6,756	49,131	8,730	2002	OTB - Typical 2002
	15,770	27,313	2,782	5,873	51,753	8,730	2009	OTB - Typical 2002
TN	15,228	27,313	2,782	5,873	51,753	8,730	2009	OTW - Typical 2002
	17,103	33,502	1,643	4,724	55,712	8,730	2018	OTB - Typical 2002
	10,514	33,502	1,643	4,724	55,712	8,730	2018	OTW - Typical 2002
	2,559	9,868	3,090	7,486	52,271	17,361	2002	OTB - Typical 2002
	13,451	10,368	2,254	6,388	54,587	17,361	2009	OTB - Typical 2002
VA	11,237	10,368	2,254	6,388	54,587	17,361	2009	OTW - Typical 2002
	12,366	12,062	1,641	5,241	58,141	17,361	2018	OTB - Typical 2002
	10,755	12,062	1,641	5,241	58,141	17,361	2018	OTW - Typical 2002
	3,356	12,154	1,003	1,941	25,850	3,239	2002	OTB - Typical 2002
	29,773	12,138	703	1,699	25,835	3,239	2009	OTB - Typical 2002
WV	25,251	12,138	703	1,699	25,835	3,239	2009	OTW - Typical 2002
	30,628	15,045	428	1,284	27,088	3,239	2018	OTB - Typical 2002
	17,548	15,045	428	1,284	27,088	3,239	2018	OTW - Typical 2002

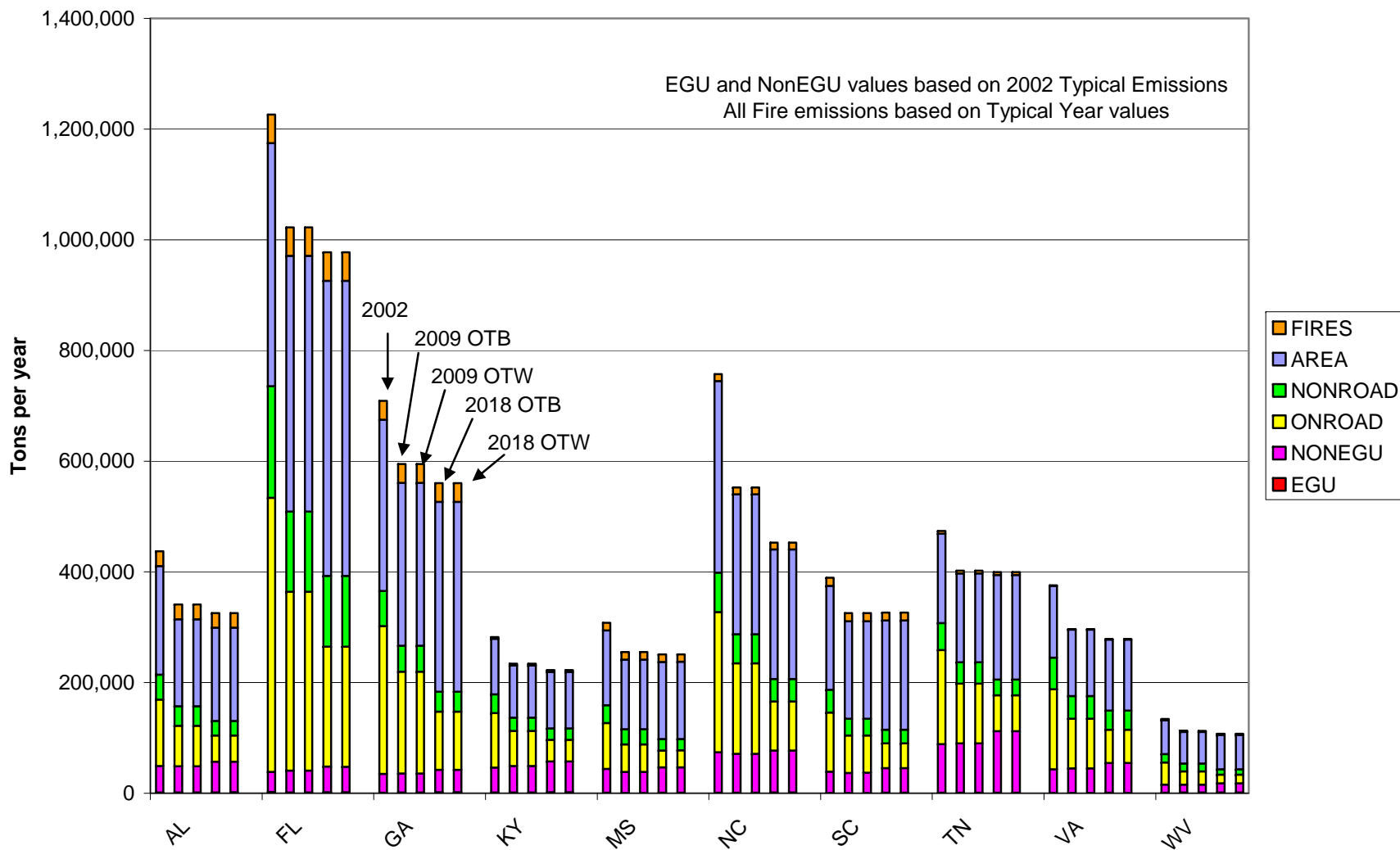
### Annual SO<sub>2</sub> Emissions by Source Sector



Annual SO<sub>2</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
AL	421,734	96,447	6,885	7,539	47,074	2,559	2002	OTB - Typical 2002
AL	465,576	100,845	635	3,463	17,818	2,559	2009	OTB - Typical 2002
AL	314,841	100,845	635	3,463	17,818	2,559	2009	OTW - Typical 2002
AL	375,305	112,771	720	2,815	49,975	2,559	2018	OTB - Typical 2002
AL	226,506	112,771	720	2,815	49,975	2,559	2018	OTW - Typical 2002
FL	443,152	70,165	20,872	17,023	40,537	4,129	2002	OTB - Typical 2002
FL	219,072	76,851	2,120	8,380	52,390	4,129	2009	OTB - Typical 2002
FL	199,834	76,851	2,120	8,380	52,390	4,129	2009	OTW - Typical 2002
FL	215,177	87,065	2,533	7,511	59,413	4,129	2018	OTB - Typical 2002
FL	126,280	87,065	2,533	7,511	59,413	4,129	2018	OTW - Typical 2002
GA	433,513	62,032	12,155	8,145	57,555	2,815	2002	OTB - Typical 2002
GA	582,078	63,348	1,254	2,588	57,377	2,815	2009	OTB - Typical 2002
GA	394,425	63,348	1,254	2,588	57,377	2,815	2009	OTW - Typical 2002
GA	554,013	70,386	1,458	1,702	61,155	2,815	2018	OTB - Typical 2002
GA	221,615	70,386	1,458	1,702	61,155	2,815	2018	OTW - Typical 2002
KY	508,139	34,026	5,974	13,739	41,805	136	2002	OTB - Typical 2002
KY	483,235	35,479	585	9,092	40,779	136	2009	OTB - Typical 2002
KY	342,670	35,479	585	9,092	40,779	136	2009	OTW - Typical 2002
KY	429,418	38,816	651	8,536	42,326	136	2018	OTB - Typical 2002
KY	225,772	38,816	651	8,536	42,326	136	2018	OTW - Typical 2002
MS	57,263	36,071	4,604	11,551	771	100	2002	OTB - Typical 2002
MS	76,855	35,028	397	7,232	637	100	2009	OTB - Typical 2002
MS	76,855	35,028	397	7,232	637	100	2009	OTW - Typical 2002
MS	74,505	40,318	441	6,638	831	100	2018	OTB - Typical 2002
MS	23,768	40,318	441	6,638	831	100	2018	OTW - Typical 2002
NC	472,192	51,049	13,343	7,207	7,096	423	2002	OTB - Typical 2002
NC	182,356	52,693	1,311	1,798	7,607	423	2009	OTB - Typical 2002
NC	132,054	52,693	1,311	1,798	7,607	423	2009	OTW - Typical 2002
NC	133,691	58,671	1,323	838	8,273	423	2018	OTB - Typical 2002
NC	78,205	58,671	1,323	838	8,273	423	2018	OTW - Typical 2002
SC	203,978	56,329	5,958	4,449	12,900	1,187	2002	OTB - Typical 2002
SC	163,560	53,746	556	1,633	12,945	1,187	2009	OTB - Typical 2002
SC	143,492	53,746	556	1,633	12,945	1,187	2009	OTW - Typical 2002
SC	178,938	60,300	643	1,195	13,517	1,187	2018	OTB - Typical 2002
SC	152,457	60,300	643	1,195	13,517	1,187	2018	OTW - Typical 2002
TN	325,779	90,374	9,184	10,413	29,897	59	2002	OTB - Typical 2002
TN	436,453	85,275	831	5,649	29,787	59	2009	OTB - Typical 2002
TN	279,931	85,275	831	5,649	29,787	59	2009	OTW - Typical 2002
TN	323,654	92,396	944	5,205	31,047	59	2018	OTB - Typical 2002
TN	103,602	92,396	944	5,205	31,047	59	2018	OTW - Typical 2002
VA	234,714	68,038	7,218	8,796	9,510	99	2002	OTB - Typical 2002
VA	220,686	76,081	900	2,248	10,619	99	2009	OTB - Typical 2002
VA	140,665	76,081	900	2,248	10,619	99	2009	OTW - Typical 2002
VA	181,338	85,351	1,059	1,217	11,479	99	2018	OTB - Typical 2002
VA	115,987	85,351	1,059	1,217	11,479	99	2018	OTW - Typical 2002
WV	497,991	54,045	2,489	2,305	11,667	16	2002	OTB - Typical 2002
WV	598,555	54,701	227	392	12,156	16	2009	OTB - Typical 2002
WV	246,851	54,701	227	392	12,156	16	2009	OTW - Typical 2002
WV	482,959	60,141	255	56	13,450	16	2018	OTB - Typical 2002
WV	111,937	60,141	255	56	13,450	16	2018	OTW - Typical 2002

### Annual VOC Emissions by Source Sector



## Annual VOC Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	1,501	47,893	119,790	44,978	196,538	26,526	2002	OTB - Typical 2002
	1,261	47,600	72,848	35,498	157,405	26,526	2009	OTB - Typical 2002
<b>AL</b>	1,312	47,600	72,848	35,498	157,405	26,526	2009	OTW - Typical 2002
	1,574	55,373	47,296	26,338	168,507	26,526	2018	OTB - Typical 2002
	1,612	55,373	47,296	26,338	168,507	26,526	2018	OTW - Typical 2002
	2,362	36,301	495,225	201,960	439,019	51,527	2002	OTB - Typical 2002
	1,562	39,255	323,290	144,749	462,198	51,527	2009	OTB - Typical 2002
<b>FL</b>	1,559	39,255	323,290	144,749	462,198	51,527	2009	OTW - Typical 2002
	2,052	46,049	216,620	128,131	533,141	51,527	2018	OTB - Typical 2002
	1,988	46,049	216,620	128,131	533,141	51,527	2018	OTW - Typical 2002
	984	33,753	267,378	63,337	309,411	33,918	2002	OTB - Typical 2002
	1,497	34,153	184,239	46,722	294,204	33,918	2009	OTB - Typical 2002
<b>GA</b>	1,499	34,153	184,239	46,722	294,204	33,918	2009	OTW - Typical 2002
	1,794	40,354	105,507	36,014	342,661	33,918	2018	OTB - Typical 2002
	1,790	40,354	105,507	36,014	342,661	33,918	2018	OTW - Typical 2002
	1,518	44,854	98,311	34,156	100,174	3,338	2002	OTB - Typical 2002
	1,594	47,733	63,258	23,980	94,253	3,338	2009	OTB - Typical 2002
<b>KY</b>	1,580	47,733	63,258	23,980	94,253	3,338	2009	OTW - Typical 2002
	1,635	55,729	39,084	20,795	102,117	3,338	2018	OTB - Typical 2002
	1,616	55,729	39,084	20,795	102,117	3,338	2018	OTW - Typical 2002
	696	43,401	82,810	32,401	135,106	13,625	2002	OTB - Typical 2002
	584	38,119	49,670	27,650	125,382	13,625	2009	OTB - Typical 2002
<b>MS</b>	590	38,119	49,670	27,650	125,382	13,625	2009	OTW - Typical 2002
	766	45,966	30,734	20,576	139,419	13,625	2018	OTB - Typical 2002
	827	45,966	30,734	20,576	139,419	13,625	2018	OTW - Typical 2002
	1,043	72,856	253,374	71,378	346,060	12,499	2002	OTB - Typical 2002
	1,100	70,146	163,803	52,430	252,553	12,499	2009	OTB - Typical 2002
<b>NC</b>	1,093	70,146	163,803	52,430	252,553	12,499	2009	OTW - Typical 2002
	1,183	75,985	88,620	40,576	234,207	12,499	2018	OTB - Typical 2002
	1,172	75,985	88,620	40,576	234,207	12,499	2018	OTW - Typical 2002
	438	38,493	106,792	41,374	187,466	14,666	2002	OTB - Typical 2002
	601	36,410	67,281	30,531	176,104	14,666	2009	OTB - Typical 2002
<b>SC</b>	626	36,410	67,281	30,531	176,104	14,666	2009	OTW - Typical 2002
	745	44,586	44,700	24,989	196,946	14,666	2018	OTB - Typical 2002
	754	44,586	44,700	24,989	196,946	14,666	2018	OTW - Typical 2002
	819	87,975	169,914	49,056	161,069	5,153	2002	OTB - Typical 2002
	866	89,128	108,200	38,686	160,265	5,153	2009	OTB - Typical 2002
<b>TN</b>	854	89,128	108,200	38,686	160,265	5,153	2009	OTW - Typical 2002
	899	111,372	64,665	28,667	188,977	5,153	2018	OTB - Typical 2002
	826	111,372	64,665	28,667	188,977	5,153	2018	OTW - Typical 2002
	672	42,589	144,684	57,050	129,792	912	2002	OTB - Typical 2002
	546	44,359	89,678	40,897	120,022	912	2009	OTB - Typical 2002
<b>VA</b>	503	44,359	89,678	40,897	120,022	912	2009	OTW - Typical 2002
	694	53,968	60,454	34,412	128,160	912	2018	OTB - Typical 2002
	674	53,968	60,454	34,412	128,160	912	2018	OTW - Typical 2002
	1,128	14,599	40,066	14,805	61,490	2,184	2002	OTB - Typical 2002
	1,442	14,015	23,907	14,249	57,082	2,184	2009	OTB - Typical 2002
<b>WV</b>	1,397	14,015	23,907	14,249	57,082	2,184	2009	OTW - Typical 2002
	1,471	16,636	15,463	9,500	62,164	2,184	2018	OTB - Typical 2002
	1,456	16,636	15,463	9,500	62,164	2,184	2018	OTW - Typical 2002



**APPENDIX B:**

**STATE VMT TOTALS**

## State VMT Totals

## Million Miles Per Year

2002	LDGV	LDGT1	LDGT2	HDDV	LDDV	LDDT	HDDV	MC	TOTAL
AL	31,982	12,728	4,347	1,630	63	69	4,709	196	55,723
FL	105,340	40,835	13,945	5,079	206	220	12,465	591	178,681
GA	61,660	24,394	8,331	3,103	121	132	8,673	371	106,785
KY	28,751	12,189	3,366	1,606	55	55	4,827	171	51,020
MS	23,933	6,724	439	1,025	330	125	3,610	92	36,278
NC	51,189	30,339	10,787	4,119	230	230	9,440	461	106,795
SC	26,672	10,750	3,671	1,395	52	58	4,306	171	47,074
TN	30,809	20,272	6,922	2,943	52	111	6,810	397	68,316
VA	36,336	24,784	8,667	2,148	61	139	4,969	369	77,472
WV	9,010	5,931	2,028	732	25	37	1,664	117	19,544
2009	LDGV	LDGT1	LDGT2	HDDV	LDDV	LDDT	HDDV	MC	TOTAL
AL	30,638	18,598	5,511	2,069	65	72	5,976	249	63,178
FL	107,641	62,449	18,697	6,820	215	230	16,743	794	213,590
GA	61,569	36,641	10,933	4,077	126	137	11,374	487	125,343
KY	28,006	16,984	4,428	1,983	58	57	5,983	231	57,729
MS	23,641	10,131	573	1,341	356	135	4,719	120	41,017
NC	48,495	43,484	15,122	4,576	40	224	10,928	527	123,396
SC	26,451	16,119	4,796	1,824	55	61	5,617	223	55,147
TN	28,775	28,650	8,521	3,627	52	111	8,391	490	78,615
VA	33,663	34,814	10,597	2,624	61	137	6,073	451	88,419
WV	8,128	8,205	2,427	878	25	37	1,995	140	21,835
2018	LDGV	LDGT1	LDGT2	HDDV	LDDV	LDDT	HDDV	MC	TOTAL
AL	31,706	23,562	6,990	2,634	67	84	7,607	317	72,966
FL	116,576	83,385	24,996	9,156	221	301	22,491	1,066	258,191
GA	65,214	47,687	14,245	5,332	129	171	14,853	637	148,269
KY	29,353	21,058	5,558	2,463	60	66	7,454	288	66,300
MS	24,787	12,984	736	1,727	372	159	6,076	155	46,996
NC	42,247	51,568	18,260	4,985	279	279	11,396	553	129,566
SC	27,930	20,880	6,220	2,375	57	75	7,306	290	65,133
TN	29,253	35,702	10,629	4,538	52	130	10,500	613	91,417
VA	35,030	44,438	13,543	3,358	62	164	7,770	578	104,944
WV	8,130	10,025	2,969	1,078	25	41	2,451	172	24,891

**APPENDIX C:**

**STATE TIER 1 EMISSION TOTALS**

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
AL	2002	01	FUEL COMB. ELEC. UTIL.	11,460	239	154,704	7,845	4,176	423,736	2,288
AL	2002	02	FUEL COMB. INDUSTRIAL	67,121	234	51,527	6,729	3,791	40,918	2,237
AL	2002	03	FUEL COMB. OTHER	70,498	169	19,237	6,411	5,528	39,606	56,120
AL	2002	04	CHEMICAL & ALLIED PRODUCT	5,721	35	2,032	1,220	888	12,770	7,273
AL	2002	05	METALS PROCESSING	38,247	376	6,011	9,107	7,803	14,039	3,299
AL	2002	06	PETROLEUM & RELATED	13,606	0	878	194	155	22,991	4,024
AL	2002	07	OTHER INDUSTRIAL PROCESSES	47,676	1,468	25,252	22,689	9,516	17,904	25,304
AL	2002	08	SOLVENT UTILIZATION	216	0	226	149	126	3	108,437
AL	2002	09	STORAGE & TRANSPORT	174	0	230	1,086	636	13	16,522
AL	2002	10	WASTE DISPOSAL & RECYCLING	86,302	10	3,465	13,960	13,073	489	11,334
AL	2002	11	HIGHWAY VEHICLES	1,366,056	5,576	158,423	3,898	2,794	6,885	119,790
AL	2002	12	OFF-HIGHWAY	414,385	33	65,366	4,787	4,502	7,584	60,487
AL	2002	14	MISCELLANEOUS	442,778	59,864	9,343	408,115	79,127	2,559	21,686
	<b>2002 Total</b>			<b>2,564,239</b>	<b>68,005</b>	<b>496,695</b>	<b>486,190</b>	<b>132,115</b>	<b>589,499</b>	<b>438,800</b>
AL	2009	01	FUEL COMB. ELEC. UTIL.	14,986	359	82,305	6,969	3,921	378,052	2,473
AL	2009	02	FUEL COMB. INDUSTRIAL	68,146	274	36,301	6,140	3,438	40,651	2,191
AL	2009	03	FUEL COMB. OTHER	52,256	158	19,514	5,904	5,104	36,048	31,403
AL	2009	04	CHEMICAL & ALLIED PRODUCT	6,118	38	2,273	1,257	912	13,660	6,613
AL	2009	05	METALS PROCESSING	38,969	500	6,021	9,062	7,756	16,629	3,305
AL	2009	06	PETROLEUM & RELATED	13,241	0	858	221	177	22,495	3,336
AL	2009	07	OTHER INDUSTRIAL PROCESSES	52,004	1,571	26,340	24,196	10,197	19,383	26,519
AL	2009	08	SOLVENT UTILIZATION	247	0	257	165	139	4	92,631
AL	2009	09	STORAGE & TRANSPORT	192	0	253	1,146	584	14	17,738
AL	2009	10	WASTE DISPOSAL & RECYCLING	87,225	11	3,634	14,504	13,485	590	11,207
AL	2009	11	HIGHWAY VEHICLES	942,793	6,350	101,323	3,188	2,049	635	72,848
AL	2009	12	OFF-HIGHWAY	454,686	36	56,862	4,027	3,776	3,471	50,249
AL	2009	14	MISCELLANEOUS	463,498	65,899	9,788	428,698	82,679	2,681	22,657
	<b>2009 Total</b>			<b>2,194,361</b>	<b>75,195</b>	<b>345,729</b>	<b>505,475</b>	<b>134,217</b>	<b>534,314</b>	<b>343,169</b>
AL	2018	01	FUEL COMB. ELEC. UTIL.	24,342	1,072	64,358	7,822	4,768	305,262	2,952
AL	2018	02	FUEL COMB. INDUSTRIAL	69,198	275	38,781	6,462	3,613	43,170	2,295
AL	2018	03	FUEL COMB. OTHER	43,744	164	20,185	5,641	4,818	37,162	21,215
AL	2018	04	CHEMICAL & ALLIED PRODUCT	7,384	46	2,804	1,523	1,106	16,509	8,040
AL	2018	05	METALS PROCESSING	49,770	674	7,519	11,036	9,423	21,824	4,234
AL	2018	06	PETROLEUM & RELATED	13,002	0	848	258	207	22,242	3,421
AL	2018	07	OTHER INDUSTRIAL PROCESSES	60,452	1,732	30,831	27,727	11,812	21,843	30,267
AL	2018	08	SOLVENT UTILIZATION	301	0	317	200	169	4	112,412
AL	2018	09	STORAGE & TRANSPORT	234	0	307	1,366	699	17	18,900
AL	2018	10	WASTE DISPOSAL & RECYCLING	88,758	13	3,867	15,343	14,143	718	11,938
AL	2018	11	HIGHWAY VEHICLES	797,966	7,296	46,222	2,488	1,262	720	47,296
AL	2018	12	OFF-HIGHWAY	488,924	42	43,799	3,041	2,835	2,818	40,407
AL	2018	14	MISCELLANEOUS	464,235	73,529	9,803	458,551	85,538	2,686	22,686
	<b>2018 Total</b>			<b>2,108,311</b>	<b>84,843</b>	<b>269,643</b>	<b>541,458</b>	<b>140,394</b>	<b>474,974</b>	<b>326,063</b>

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
FL	2002	01	FUEL COMB. ELEC. UTIL.	55,899	222	282,507	21,391	15,575	483,590	2,531
FL	2002	02	FUEL COMB. INDUSTRIAL	64,794	131	45,153	20,442	18,547	42,524	4,219
FL	2002	03	FUEL COMB. OTHER	49,230	99	11,593	8,464	8,074	20,031	16,123
FL	2002	04	CHEMICAL & ALLIED PRODUCT	745	1,101	2,221	1,868	1,488	34,462	3,542
FL	2002	05	METALS PROCESSING	1,404	1	194	449	334	882	82
FL	2002	06	PETROLEUM & RELATED	1,070	0	560	259	129	470	724
FL	2002	07	OTHER INDUSTRIAL PROCESSES	18,586	19	12,325	23,419	11,844	6,515	27,024
FL	2002	08	SOLVENT UTILIZATION	0	0	1	128	110	0	304,582
FL	2002	09	STORAGE & TRANSPORT	161	0	561	1,645	720	38	79,281
FL	2002	10	WASTE DISPOSAL & RECYCLING	175,989	351	6,123	22,142	21,604	659	17,449
FL	2002	11	HIGHWAY VEHICLES	4,693,893	18,078	466,098	11,253	7,852	20,872	495,225
FL	2002	12	OFF-HIGHWAY	1,920,729	134	180,627	18,281	17,415	20,614	272,072
FL	2002	14	MISCELLANEOUS	764,337	40,324	15,083	498,855	115,287	4,129	41,274
	2002 Total			7,746,839	60,460	1,023,045	628,597	218,979	634,786	1,264,128
FL	2009	01	FUEL COMB. ELEC. UTIL.	35,928	1,631	86,165	9,007	5,910	186,055	1,910
FL	2009	02	FUEL COMB. INDUSTRIAL	69,972	146	44,480	16,265	14,827	38,225	4,473
FL	2009	03	FUEL COMB. OTHER	33,014	100	10,800	7,555	7,174	19,882	10,907
FL	2009	04	CHEMICAL & ALLIED PRODUCT	901	1,231	2,461	1,908	1,526	34,961	3,821
FL	2009	05	METALS PROCESSING	1,545	1	176	361	251	993	82
FL	2009	06	PETROLEUM & RELATED	1,190	0	612	304	156	519	748
FL	2009	07	OTHER INDUSTRIAL PROCESSES	18,593	26	13,521	33,084	19,357	6,881	26,413
FL	2009	08	SOLVENT UTILIZATION	0	0	1	132	113	0	319,723
FL	2009	09	STORAGE & TRANSPORT	187	0	621	1,661	727	50	83,880
FL	2009	10	WASTE DISPOSAL & RECYCLING	177,953	342	6,251	22,971	22,364	698	17,241
FL	2009	11	HIGHWAY VEHICLES	3,446,095	21,737	314,307	9,953	6,216	2,120	323,290
FL	2009	12	OFF-HIGHWAY	2,104,920	148	163,794	15,613	14,866	8,967	209,543
FL	2009	14	MISCELLANEOUS	764,004	41,471	15,075	557,331	120,796	4,129	41,290
	2009 Total			6,654,301	66,833	658,265	676,145	214,282	303,479	1,043,321
FL	2018	01	FUEL COMB. ELEC. UTIL.	53,772	2,976	73,125	9,953	6,843	132,177	2,376
FL	2018	02	FUEL COMB. INDUSTRIAL	76,847	156	47,835	17,808	16,255	40,443	4,892
FL	2018	03	FUEL COMB. OTHER	27,094	110	12,344	7,254	6,852	20,975	8,878
FL	2018	04	CHEMICAL & ALLIED PRODUCT	1,200	1,448	3,119	2,367	1,907	41,395	4,739
FL	2018	05	METALS PROCESSING	1,973	2	225	466	323	1,325	106
FL	2018	06	PETROLEUM & RELATED	1,513	0	778	387	198	659	918
FL	2018	07	OTHER INDUSTRIAL PROCESSES	20,748	35	15,855	39,871	23,301	7,741	29,716
FL	2018	08	SOLVENT UTILIZATION	0	0	1	158	135	0	387,657
FL	2018	09	STORAGE & TRANSPORT	226	0	690	2,008	879	58	87,732
FL	2018	10	WASTE DISPOSAL & RECYCLING	180,730	418	6,486	24,140	23,427	769	18,335
FL	2018	11	HIGHWAY VEHICLES	3,086,330	26,154	154,611	8,489	4,242	2,533	216,620
FL	2018	12	OFF-HIGHWAY	2,323,327	171	127,885	12,497	11,868	7,536	183,452
FL	2018	14	MISCELLANEOUS	763,701	43,251	15,068	628,984	127,364	4,129	41,338
	2018 Total			6,537,461	74,720	458,023	754,381	223,592	259,739	986,760

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
GA	2002	01	FUEL COMB. ELEC. UTIL.	9,650	86	148,126	11,467	5,070	517,633	1,256
GA	2002	02	FUEL COMB. INDUSTRIAL	59,492	27	53,039	12,037	7,886	88,791	3,956
GA	2002	03	FUEL COMB. OTHER	63,314	17	14,465	10,142	10,057	10,740	27,226
GA	2002	04	CHEMICAL & ALLIED PRODUCT	5,387	920	2,277	391	305	2,721	2,668
GA	2002	05	METALS PROCESSING	330	0	60	147	94	0	70
GA	2002	06	PETROLEUM & RELATED	41	0	3	69	44	68	175
GA	2002	07	OTHER INDUSTRIAL PROCESSES	27,960	2,666	12,215	39,630	13,073	8,701	26,999
GA	2002	08	SOLVENT UTILIZATION	4	0	22	13	13	0	234,744
GA	2002	09	STORAGE & TRANSPORT	39	0	6	583	360	0	26,334
GA	2002	10	WASTE DISPOSAL & RECYCLING	203,892	16	6,872	29,227	28,311	312	18,964
GA	2002	11	HIGHWAY VEHICLES	2,833,468	10,524	308,013	7,236	5,158	12,155	267,378
GA	2002	12	OFF-HIGHWAY	791,158	60	97,961	8,618	8,226	9,005	85,965
GA	2002	14	MISCELLANEOUS	498,622	83,032	10,279	687,028	116,756	2,815	25,618
	2002 Total			4,493,357	97,349	653,338	806,587	195,354	652,942	721,352
GA	2009	01	FUEL COMB. ELEC. UTIL.	23,721	686	98,497	17,891	10,907	417,449	2,314
GA	2009	02	FUEL COMB. INDUSTRIAL	63,067	28	53,726	11,206	7,390	89,850	4,163
GA	2009	03	FUEL COMB. OTHER	45,184	17	15,347	8,496	8,400	10,981	15,683
GA	2009	04	CHEMICAL & ALLIED PRODUCT	6,044	1,032	2,531	436	341	2,743	2,814
GA	2009	05	METALS PROCESSING	363	0	61	159	100	0	47
GA	2009	06	PETROLEUM & RELATED	50	0	4	83	54	82	154
GA	2009	07	OTHER INDUSTRIAL PROCESSES	29,976	2,902	12,528	45,339	14,758	7,662	28,441
GA	2009	08	SOLVENT UTILIZATION	4	0	25	14	14	0	216,248
GA	2009	09	STORAGE & TRANSPORT	45	0	7	649	401	0	27,821
GA	2009	10	WASTE DISPOSAL & RECYCLING	218,460	18	7,419	31,955	30,900	360	18,711
GA	2009	11	HIGHWAY VEHICLES	2,053,694	12,660	208,393	6,103	3,869	1,254	184,239
GA	2009	12	OFF-HIGHWAY	882,970	68	85,733	7,521	7,175	2,725	67,686
GA	2009	14	MISCELLANEOUS	515,329	91,406	10,637	765,043	125,665	2,914	26,388
	2009 Total			3,838,907	108,817	494,908	894,896	209,973	536,020	594,708
GA	2018	01	FUEL COMB. ELEC. UTIL.	44,476	1,677	75,717	20,909	13,983	230,856	2,841
GA	2018	02	FUEL COMB. INDUSTRIAL	67,067	30	57,232	11,755	7,769	94,403	4,424
GA	2018	03	FUEL COMB. OTHER	39,440	17	17,801	7,722	7,622	11,958	11,482
GA	2018	04	CHEMICAL & ALLIED PRODUCT	7,076	1,208	2,982	517	405	3,436	3,524
GA	2018	05	METALS PROCESSING	421	0	76	185	118	0	55
GA	2018	06	PETROLEUM & RELATED	63	0	5	105	68	104	191
GA	2018	07	OTHER INDUSTRIAL PROCESSES	33,611	3,559	14,460	55,130	17,899	8,748	33,333
GA	2018	08	SOLVENT UTILIZATION	5	0	30	22	22	0	264,326
GA	2018	09	STORAGE & TRANSPORT	54	0	9	764	470	0	29,409
GA	2018	10	WASTE DISPOSAL & RECYCLING	235,690	22	8,120	35,280	34,038	423	20,411
GA	2018	11	HIGHWAY VEHICLES	1,765,020	14,871	99,821	4,995	2,517	1,458	105,507
GA	2018	12	OFF-HIGHWAY	973,872	79	64,579	6,015	5,730	1,709	56,761
GA	2018	14	MISCELLANEOUS	515,220	102,075	10,635	859,835	134,730	2,914	26,368
	2018 Total			3,682,015	123,537	351,467	1,003,235	225,372	356,010	558,631

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
KY	2002	01	FUEL COMB. ELEC. UTIL.	12,607	321	201,928	4,795	2,847	495,153	1,481
KY	2002	02	FUEL COMB. INDUSTRIAL	14,110	182	60,716	2,155	1,463	41,825	1,566
KY	2002	03	FUEL COMB. OTHER	40,806	55	4,997	7,679	7,352	9,647	12,711
KY	2002	04	CHEMICAL & ALLIED PRODUCT	176	214	296	774	581	2,345	3,462
KY	2002	05	METALS PROCESSING	89,197	6	1,082	3,396	2,720	12,328	1,508
KY	2002	06	PETROLEUM & RELATED	4,304	335	2,519	308	205	5,747	2,895
KY	2002	07	OTHER INDUSTRIAL PROCESSES	6,493	78	6,518	31,429	10,394	3,333	25,388
KY	2002	08	SOLVENT UTILIZATION	0	10	9	317	241	1	61,834
KY	2002	09	STORAGE & TRANSPORT	33	8	15	1,920	1,177	3	18,853
KY	2002	10	WASTE DISPOSAL & RECYCLING	20,622	8	1,768	7,229	6,476	606	7,927
KY	2002	11	HIGHWAY VEHICLES	1,260,682	5,044	154,899	3,720	2,693	5,974	98,311
KY	2002	12	OFF-HIGHWAY	325,993	31	104,571	6,425	6,046	14,043	44,805
KY	2002	14	MISCELLANEOUS	25,849	51,026	556	197,402	28,291	146	5,238
	2002 Total			1,800,871	57,318	539,873	267,547	70,486	591,151	285,977
KY	2009	01	FUEL COMB. ELEC. UTIL.	15,812	400	92,021	6,463	4,279	290,193	1,369
KY	2009	02	FUEL COMB. INDUSTRIAL	14,986	195	61,683	2,105	1,456	42,433	1,476
KY	2009	03	FUEL COMB. OTHER	30,045	54	5,178	7,035	6,725	10,123	9,148
KY	2009	04	CHEMICAL & ALLIED PRODUCT	179	249	300	851	633	2,384	3,635
KY	2009	05	METALS PROCESSING	99,428	7	1,156	3,246	2,550	13,735	1,772
KY	2009	06	PETROLEUM & RELATED	4,818	377	2,828	344	230	6,460	3,052
KY	2009	07	OTHER INDUSTRIAL PROCESSES	7,212	84	6,674	32,194	10,912	3,634	27,548
KY	2009	08	SOLVENT UTILIZATION	0	10	11	371	283	1	62,595
KY	2009	09	STORAGE & TRANSPORT	38	9	18	2,064	1,268	3	20,038
KY	2009	10	WASTE DISPOSAL & RECYCLING	22,388	9	1,979	7,770	6,925	733	7,725
KY	2009	11	HIGHWAY VEHICLES	942,350	5,795	97,912	3,002	1,941	585	63,258
KY	2009	12	OFF-HIGHWAY	357,800	34	94,752	5,544	5,203	9,180	38,558
KY	2009	14	MISCELLANEOUS	32,627	52,915	702	206,463	29,601	187	6,335
	2009 Total			1,527,684	60,137	365,214	277,453	72,006	379,651	246,509
KY	2018	01	FUEL COMB. ELEC. UTIL.	17,144	476	64,378	6,694	4,434	226,062	1,426
KY	2018	02	FUEL COMB. INDUSTRIAL	15,692	205	64,533	2,203	1,528	43,772	1,555
KY	2018	03	FUEL COMB. OTHER	24,764	53	5,550	6,469	6,169	9,947	7,479
KY	2018	04	CHEMICAL & ALLIED PRODUCT	219	317	367	1,054	781	2,884	4,384
KY	2018	05	METALS PROCESSING	114,470	9	1,508	3,898	3,065	15,800	2,343
KY	2018	06	PETROLEUM & RELATED	5,495	434	3,244	392	262	7,426	3,394
KY	2018	07	OTHER INDUSTRIAL PROCESSES	8,303	93	7,872	35,349	12,377	4,141	31,394
KY	2018	08	SOLVENT UTILIZATION	0	12	14	464	352	1	73,525
KY	2018	09	STORAGE & TRANSPORT	44	10	21	2,408	1,481	4	21,196
KY	2018	10	WASTE DISPOSAL & RECYCLING	24,677	11	2,256	8,481	7,518	894	8,392
KY	2018	11	HIGHWAY VEHICLES	782,423	6,584	42,104	2,283	1,160	651	39,084
KY	2018	12	OFF-HIGHWAY	381,215	40	79,392	4,556	4,256	8,592	30,920
KY	2018	14	MISCELLANEOUS	33,931	55,118	729	218,725	30,626	196	7,254
	2018 Total			1,408,378	63,361	271,967	292,975	74,010	320,369	232,347

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
MS	2002	01	FUEL COMB. ELEC. UTIL.	5,219	198	40,433	1,706	1,147	60,086	629
MS	2002	02	FUEL COMB. INDUSTRIAL	22,710	28	48,726	5,007	3,634	9,740	8,023
MS	2002	03	FUEL COMB. OTHER	36,752	34	4,502	5,445	5,414	789	22,923
MS	2002	04	CHEMICAL & ALLIED PRODUCT	15,410	361	1,725	849	440	1,663	2,375
MS	2002	05	METALS PROCESSING	1,031	0	115	122	58	36	371
MS	2002	06	PETROLEUM & RELATED	975	20	1,187	790	335	15,560	20,788
MS	2002	07	OTHER INDUSTRIAL PROCESSES	13,884	747	9,219	27,617	8,051	8,866	15,525
MS	2002	08	SOLVENT UTILIZATION	45	7	105	219	178	1	80,760
MS	2002	09	STORAGE & TRANSPORT	74	0	80	124	38	40	23,327
MS	2002	10	WASTE DISPOSAL & RECYCLING	1,414	9	89	447	324	31	886
MS	2002	11	HIGHWAY VEHICLES	894,639	3,577	111,791	2,856	2,109	4,604	82,810
MS	2002	12	OFF-HIGHWAY	236,752	23	88,787	5,010	4,690	11,315	41,081
MS	2002	14	MISCELLANEOUS	14,529	58,746	312	323,622	43,028	84	708
	2002	Total		1,243,435	63,753	307,072	373,815	69,446	112,814	300,206
MS	2009	01	FUEL COMB. ELEC. UTIL.	5,051	334	36,011	4,957	4,777	76,579	404
MS	2009	02	FUEL COMB. INDUSTRIAL	24,607	30	44,095	3,728	2,787	7,388	8,007
MS	2009	03	FUEL COMB. OTHER	26,023	33	4,514	5,278	5,245	751	17,445
MS	2009	04	CHEMICAL & ALLIED PRODUCT	16,141	405	1,955	941	488	1,880	2,614
MS	2009	05	METALS PROCESSING	1,098	0	128	129	62	37	402
MS	2009	06	PETROLEUM & RELATED	1,101	23	1,262	894	379	7,926	13,317
MS	2009	07	OTHER INDUSTRIAL PROCESSES	14,181	197	8,376	31,381	8,629	8,254	16,282
MS	2009	08	SOLVENT UTILIZATION	50	8	118	239	194	1	80,393
MS	2009	09	STORAGE & TRANSPORT	92	0	100	172	59	49	23,494
MS	2009	10	WASTE DISPOSAL & RECYCLING	1,486	10	95	473	339	32	743
MS	2009	11	HIGHWAY VEHICLES	628,151	4,026	69,949	2,290	1,522	397	49,670
MS	2009	12	OFF-HIGHWAY	257,453	25	80,567	4,270	3,985	7,191	36,197
MS	2009	14	MISCELLANEOUS	48,314	63,886	1,037	337,018	46,695	283	2,295
	2009	Total		1,023,747	68,978	248,207	391,770	75,160	110,767	251,261
MS	2018	01	FUEL COMB. ELEC. UTIL.	15,282	827	10,271	7,187	7,033	15,146	1,114
MS	2018	02	FUEL COMB. INDUSTRIAL	27,056	33	46,929	4,093	3,058	8,169	8,559
MS	2018	03	FUEL COMB. OTHER	20,900	32	4,767	4,964	4,928	726	14,670
MS	2018	04	CHEMICAL & ALLIED PRODUCT	20,175	475	2,337	1,132	588	2,242	3,290
MS	2018	05	METALS PROCESSING	1,357	0	167	160	79	48	461
MS	2018	06	PETROLEUM & RELATED	1,267	26	1,438	1,010	430	19,028	14,407
MS	2018	07	OTHER INDUSTRIAL PROCESSES	16,267	216	9,996	38,494	10,494	9,657	20,301
MS	2018	08	SOLVENT UTILIZATION	60	9	141	301	244	1	98,354
MS	2018	09	STORAGE & TRANSPORT	115	0	124	210	73	62	24,537
MS	2018	10	WASTE DISPOSAL & RECYCLING	1,638	12	114	533	372	34	870
MS	2018	11	HIGHWAY VEHICLES	528,898	4,565	29,717	1,688	876	441	30,734
MS	2018	12	OFF-HIGHWAY	270,726	29	68,252	3,452	3,203	6,638	28,842
MS	2018	14	MISCELLANEOUS	50,160	70,096	1,076	352,321	47,869	294	2,377
	2018	Total		953,900	76,320	175,329	415,546	79,246	62,486	248,517



## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
NC	2002	01	FUEL COMB. ELEC. UTIL.	14,074	55	148,809	22,994	16,623	478,488	986
NC	2002	02	FUEL COMB. INDUSTRIAL	23,578	301	48,590	5,596	4,334	33,395	2,540
NC	2002	03	FUEL COMB. OTHER	217,008	2,318	16,460	31,777	26,746	3,971	87,985
NC	2002	04	CHEMICAL & ALLIED PRODUCT	13,952	535	859	866	538	5,736	4,313
NC	2002	05	METALS PROCESSING	5,876	60	201	564	467	1,010	2,512
NC	2002	06	PETROLEUM & RELATED	461	0	174	104	52	283	140
NC	2002	07	OTHER INDUSTRIAL PROCESSES	8,552	480	7,380	25,328	8,924	3,426	18,025
NC	2002	08	SOLVENT UTILIZATION	130	307	229	524	484	26	151,383
NC	2002	09	STORAGE & TRANSPORT	66	46	53	639	354	1	16,120
NC	2002	10	WASTE DISPOSAL & RECYCLING	125,528	247	7,482	2,239	2,218	1,666	15,568
NC	2002	11	HIGHWAY VEHICLES	3,176,811	10,455	341,198	6,905	4,816	13,343	253,374
NC	2002	12	OFF-HIGHWAY	808,231	65	84,284	7,348	7,005	7,693	94,480
NC	2002	14	MISCELLANEOUS	72,673	159,069	1,561	233,551	36,414	423	3,528
	2002	Total		4,466,940	173,937	657,279	338,434	108,975	549,463	650,954
NC	2009	01	FUEL COMB. ELEC. UTIL.	14,942	445	66,517	22,152	15,949	242,286	954
NC	2009	02	FUEL COMB. INDUSTRIAL	24,871	312	38,160	5,159	3,871	30,788	2,509
NC	2009	03	FUEL COMB. OTHER	158,837	2,723	18,441	25,334	19,467	4,060	49,819
NC	2009	04	CHEMICAL & ALLIED PRODUCT	14,732	599	933	981	607	6,286	4,925
NC	2009	05	METALS PROCESSING	6,358	67	207	627	528	1,130	2,790
NC	2009	06	PETROLEUM & RELATED	556	0	212	127	64	349	162
NC	2009	07	OTHER INDUSTRIAL PROCESSES	9,211	507	8,061	28,524	9,788	3,712	18,144
NC	2009	08	SOLVENT UTILIZATION	142	335	246	549	506	28	136,114
NC	2009	09	STORAGE & TRANSPORT	75	51	55	696	380	1	17,367
NC	2009	10	WASTE DISPOSAL & RECYCLING	139,518	307	8,354	2,774	2,750	1,913	17,331
NC	2009	11	HIGHWAY VEHICLES	2,184,901	12,637	207,648	5,861	3,643	1,311	163,803
NC	2009	12	OFF-HIGHWAY	887,605	72	70,997	6,055	5,760	1,892	74,056
NC	2009	14	MISCELLANEOUS	96,825	167,131	2,080	250,912	49,956	566	4,648
	2009	Total		3,538,573	185,185	421,913	349,750	113,268	294,321	492,624
NC	2018	01	FUEL COMB. ELEC. UTIL.	20,223	663	62,346	37,376	29,791	108,492	1,345
NC	2018	02	FUEL COMB. INDUSTRIAL	26,872	341	40,897	5,594	4,222	32,507	2,702
NC	2018	03	FUEL COMB. OTHER	131,365	2,857	20,027	21,847	16,231	4,050	34,104
NC	2018	04	CHEMICAL & ALLIED PRODUCT	18,463	702	1,105	1,175	726	7,414	6,113
NC	2018	05	METALS PROCESSING	7,576	76	255	771	657	1,335	3,516
NC	2018	06	PETROLEUM & RELATED	712	0	272	162	82	448	207
NC	2018	07	OTHER INDUSTRIAL PROCESSES	10,675	559	9,259	34,339	11,601	4,357	20,978
NC	2018	08	SOLVENT UTILIZATION	169	375	277	588	540	31	152,979
NC	2018	09	STORAGE & TRANSPORT	91	59	67	808	430	2	19,511
NC	2018	10	WASTE DISPOSAL & RECYCLING	156,599	387	9,456	3,502	3,474	2,234	19,789
NC	2018	11	HIGHWAY VEHICLES	1,510,848	13,077	81,706	4,299	2,158	1,323	88,620
NC	2018	12	OFF-HIGHWAY	960,709	83	49,046	4,298	4,069	905	61,327
NC	2018	14	MISCELLANEOUS	111,705	177,474	2,399	273,030	54,376	655	5,333
	2018	Total		2,956,008	196,655	277,112	387,788	128,356	163,752	416,523

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
SC	2002	01	FUEL COMB. ELEC. UTIL.	6,969	141	88,528	21,827	17,521	210,272	470
SC	2002	02	FUEL COMB. INDUSTRIAL	31,771	97	38,081	5,308	3,641	44,958	1,338
SC	2002	03	FUEL COMB. OTHER	75,800	65	4,367	6,261	6,166	4,318	49,171
SC	2002	04	CHEMICAL & ALLIED PRODUCT	2,526	173	25	501	318	59	8,784
SC	2002	05	METALS PROCESSING	13,833	0	450	639	408	4,160	660
SC	2002	06	PETROLEUM & RELATED	248	0	283	120	71	170	114
SC	2002	07	OTHER INDUSTRIAL PROCESSES	9,502	1,237	15,145	15,224	6,981	12,128	16,342
SC	2002	08	SOLVENT UTILIZATION	0	1	1	78	60	0	88,878
SC	2002	09	STORAGE & TRANSPORT	10	0	4	1,025	626	0	21,009
SC	2002	10	WASTE DISPOSAL & RECYCLING	67,908	10	4,063	9,172	8,641	625	15,291
SC	2002	11	HIGHWAY VEHICLES	1,275,161	4,684	140,428	3,446	2,496	5,958	106,792
SC	2002	12	OFF-HIGHWAY	413,964	33	50,249	4,152	3,945	4,866	55,016
SC	2002	14	MISCELLANEOUS	221,436	28,903	4,335	262,974	47,136	1,187	12,535
	2002 Total			2,119,129	35,343	345,960	330,728	98,009	288,701	376,401
SC	2009	01	FUEL COMB. ELEC. UTIL.	11,135	343	46,915	19,395	16,042	124,608	660
SC	2009	02	FUEL COMB. INDUSTRIAL	33,201	105	35,660	3,307	2,370	37,792	1,414
SC	2009	03	FUEL COMB. OTHER	49,914	63	4,551	5,264	5,183	4,359	25,073
SC	2009	04	CHEMICAL & ALLIED PRODUCT	2,798	173	26	543	345	60	7,409
SC	2009	05	METALS PROCESSING	15,632	0	449	631	378	4,856	663
SC	2009	06	PETROLEUM & RELATED	302	0	340	145	86	200	131
SC	2009	07	OTHER INDUSTRIAL PROCESSES	10,241	1,403	15,069	18,267	8,045	13,443	15,697
SC	2009	08	SOLVENT UTILIZATION	1	1	1	90	69	0	95,538
SC	2009	09	STORAGE & TRANSPORT	13	0	5	569	352	0	21,989
SC	2009	10	WASTE DISPOSAL & RECYCLING	70,379	11	4,215	9,526	8,977	666	15,998
SC	2009	11	HIGHWAY VEHICLES	912,280	5,510	91,696	2,878	1,870	556	67,281
SC	2009	12	OFF-HIGHWAY	448,625	36	43,235	3,471	3,294	1,701	43,061
SC	2009	14	MISCELLANEOUS	250,690	31,416	4,962	282,480	51,151	1,359	13,906
	2009 Total			1,805,210	39,061	247,124	346,565	98,163	189,601	308,820
SC	2018	01	FUEL COMB. ELEC. UTIL.	14,786	617	51,456	28,826	25,032	93,274	906
SC	2018	02	FUEL COMB. INDUSTRIAL	36,105	113	37,333	4,037	2,855	39,714	1,525
SC	2018	03	FUEL COMB. OTHER	39,627	65	5,135	4,791	4,711	4,469	16,391
SC	2018	04	CHEMICAL & ALLIED PRODUCT	3,296	212	32	664	423	74	9,107
SC	2018	05	METALS PROCESSING	18,853	0	587	773	476	5,920	868
SC	2018	06	PETROLEUM & RELATED	389	0	438	186	110	258	166
SC	2018	07	OTHER INDUSTRIAL PROCESSES	12,136	1,566	17,507	20,215	9,044	15,863	18,636
SC	2018	08	SOLVENT UTILIZATION	1	1	1	116	89	0	120,433
SC	2018	09	STORAGE & TRANSPORT	16	0	6	1,380	842	0	22,742
SC	2018	10	WASTE DISPOSAL & RECYCLING	73,403	13	4,512	10,038	9,443	735	17,167
SC	2018	11	HIGHWAY VEHICLES	800,619	6,472	42,354	2,258	1,154	643	44,700
SC	2018	12	OFF-HIGHWAY	481,332	41	31,758	2,617	2,474	1,198	36,131
SC	2018	14	MISCELLANEOUS	250,637	34,345	4,961	306,342	53,367	1,359	13,896
	2018 Total			1,731,198	43,446	196,081	382,244	110,019	163,509	302,665

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
TN	2002	01	FUEL COMB. ELEC. UTIL.	6,787	197	152,137	13,866	11,491	320,146	890
TN	2002	02	FUEL COMB. INDUSTRIAL	15,257	6	44,510	8,015	6,649	74,146	2,021
TN	2002	03	FUEL COMB. OTHER	77,857	25	15,568	7,967	7,549	16,253	18,346
TN	2002	04	CHEMICAL & ALLIED PRODUCT	36,920	1,518	1,772	3,246	2,201	6,516	24,047
TN	2002	05	METALS PROCESSING	41,371	14	1,182	7,620	7,030	5,818	6,898
TN	2002	06	PETROLEUM & RELATED	543	0	331	314	243	383	1,850
TN	2002	07	OTHER INDUSTRIAL PROCESSES	9,420	44	11,794	30,484	12,867	5,845	27,336
TN	2002	08	SOLVENT UTILIZATION	275	1	5,066	2,103	1,818	58	110,872
TN	2002	09	STORAGE & TRANSPORT	22	24	105	1,249	736	134	21,962
TN	2002	10	WASTE DISPOSAL & RECYCLING	22,143	31	1,839	7,068	6,469	349	15,505
TN	2002	11	HIGHWAY VEHICLES	1,967,658	6,616	233,324	5,338	3,919	9,184	169,914
TN	2002	12	OFF-HIGHWAY	505,163	43	96,827	6,819	6,458	10,441	66,450
TN	2002	14	MISCELLANEOUS	10,824	34,318	225	180,006	25,193	60	2,252
	2002	Total		2,694,242	42,836	564,680	274,095	92,622	449,332	468,342
TN	2009	01	FUEL COMB. ELEC. UTIL.	7,214	227	66,405	15,608	13,092	255,410	932
TN	2009	02	FUEL COMB. INDUSTRIAL	15,943	7	37,369	7,195	6,004	63,511	1,915
TN	2009	03	FUEL COMB. OTHER	61,443	27	14,793	7,134	6,786	16,955	12,781
TN	2009	04	CHEMICAL & ALLIED PRODUCT	35,440	1,719	1,958	3,519	2,400	7,056	15,594
TN	2009	05	METALS PROCESSING	45,183	15	1,245	7,337	6,823	6,537	7,676
TN	2009	06	PETROLEUM & RELATED	615	0	373	356	276	435	1,433
TN	2009	07	OTHER INDUSTRIAL PROCESSES	9,911	62	12,635	32,661	13,737	6,240	28,598
TN	2009	08	SOLVENT UTILIZATION	309	1	5,984	2,431	2,095	65	112,312
TN	2009	09	STORAGE & TRANSPORT	26	31	12	1,218	733	42	23,687
TN	2009	10	WASTE DISPOSAL & RECYCLING	23,810	35	1,993	7,618	6,968	393	14,922
TN	2009	11	HIGHWAY VEHICLES	1,361,408	7,738	147,757	4,238	2,782	831	108,200
TN	2009	12	OFF-HIGHWAY	554,121	48	86,641	5,877	5,557	5,651	55,358
TN	2009	14	MISCELLANEOUS	17,921	35,200	379	192,464	26,830	102	2,814
	2009	Total		2,133,342	45,108	377,545	287,655	94,083	363,228	386,222
TN	2018	01	FUEL COMB. ELEC. UTIL.	7,723	241	31,715	15,941	13,387	112,672	976
TN	2018	02	FUEL COMB. INDUSTRIAL	17,038	7	38,908	7,693	6,447	65,823	2,054
TN	2018	03	FUEL COMB. OTHER	54,486	30	15,503	6,757	6,412	18,091	10,269
TN	2018	04	CHEMICAL & ALLIED PRODUCT	45,455	2,053	2,424	4,443	3,044	9,088	20,071
TN	2018	05	METALS PROCESSING	52,834	17	1,589	9,579	8,953	7,790	9,956
TN	2018	06	PETROLEUM & RELATED	715	0	430	416	324	508	1,636
TN	2018	07	OTHER INDUSTRIAL PROCESSES	10,946	88	14,157	38,250	16,286	7,286	35,587
TN	2018	08	SOLVENT UTILIZATION	380	1	7,675	3,155	2,718	79	140,793
TN	2018	09	STORAGE & TRANSPORT	33	41	14	1,572	939	49	25,493
TN	2018	10	WASTE DISPOSAL & RECYCLING	26,712	42	2,326	8,562	7,828	468	17,530
TN	2018	11	HIGHWAY VEHICLES	1,150,516	8,962	65,242	3,199	1,643	944	64,665
TN	2018	12	OFF-HIGHWAY	593,100	55	70,226	4,672	4,403	5,207	45,084
TN	2018	14	MISCELLANEOUS	19,210	36,213	408	209,058	28,209	111	3,293
	2018	Total		1,979,148	47,749	250,619	313,294	100,592	228,116	377,408

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
VA	2002	01	FUEL COMB. ELEC. UTIL.	6,797	130	85,081	3,892	2,650	233,691	747
VA	2002	02	FUEL COMB. INDUSTRIAL	64,386	100	75,807	18,480	8,453	137,448	5,332
VA	2002	03	FUEL COMB. OTHER	98,788	13	15,648	11,572	11,236	5,508	54,496
VA	2002	04	CHEMICAL & ALLIED PRODUCT	321	2,158	8,062	449	393	2,126	1,530
VA	2002	05	METALS PROCESSING	3,580	0	937	1,575	1,349	5,251	513
VA	2002	06	PETROLEUM & RELATED	23,384	0	182	255	153	170	501
VA	2002	07	OTHER INDUSTRIAL PROCESSES	12,002	726	9,279	33,409	9,795	17,702	13,086
VA	2002	08	SOLVENT UTILIZATION	0	4	0	225	210	2	111,511
VA	2002	09	STORAGE & TRANSPORT	16	7	11	745	505	0	26,121
VA	2002	10	WASTE DISPOSAL & RECYCLING	16,566	109	1,866	3,152	1,277	1,581	4,065
VA	2002	11	HIGHWAY VEHICLES	2,170,508	7,837	219,602	4,537	3,090	7,218	144,684
VA	2002	12	OFF-HIGHWAY	660,105	48	63,219	8,728	8,288	8,663	74,866
VA	2002	14	MISCELLANEOUS	13,225	43,948	285	182,193	21,835	74	706
	2002	Total		3,069,678	55,080	479,980	269,212	69,233	419,436	438,158
VA	2009	01	FUEL COMB. ELEC. UTIL.	12,509	694	66,219	5,508	4,067	225,653	778
VA	2009	02	FUEL COMB. INDUSTRIAL	67,422	105	67,263	18,346	8,345	135,612	5,483
VA	2009	03	FUEL COMB. OTHER	66,037	14	15,966	10,062	9,742	5,258	28,063
VA	2009	04	CHEMICAL & ALLIED PRODUCT	286	2,082	7,790	477	413	1,996	1,419
VA	2009	05	METALS PROCESSING	3,397	0	827	1,563	1,332	4,813	390
VA	2009	06	PETROLEUM & RELATED	26,288	0	197	275	169	187	557
VA	2009	07	OTHER INDUSTRIAL PROCESSES	12,471	733	9,425	33,961	9,984	18,871	13,394
VA	2009	08	SOLVENT UTILIZATION	0	5	0	248	231	3	110,127
VA	2009	09	STORAGE & TRANSPORT	17	7	12	797	544	0	26,456
VA	2009	10	WASTE DISPOSAL & RECYCLING	20,109	119	2,174	3,823	1,515	1,805	4,789
VA	2009	11	HIGHWAY VEHICLES	1,495,771	9,066	133,170	3,760	2,254	900	89,678
VA	2009	12	OFF-HIGHWAY	726,815	53	54,993	7,510	7,136	1,707	57,009
VA	2009	14	MISCELLANEOUS	21,582	46,719	464	198,040	23,990	124	1,077
	2009	Total		2,452,703	59,596	358,500	284,369	69,721	396,929	339,219
VA	2018	01	FUEL COMB. ELEC. UTIL.	15,420	622	75,594	13,775	11,976	140,233	997
VA	2018	02	FUEL COMB. INDUSTRIAL	72,218	114	70,343	19,248	8,892	140,995	5,861
VA	2018	03	FUEL COMB. OTHER	53,171	14	17,852	9,427	9,086	5,369	18,603
VA	2018	04	CHEMICAL & ALLIED PRODUCT	338	2,462	9,211	579	502	2,291	1,708
VA	2018	05	METALS PROCESSING	4,034	0	1,017	1,861	1,592	5,948	469
VA	2018	06	PETROLEUM & RELATED	30,284	0	228	315	194	217	642
VA	2018	07	OTHER INDUSTRIAL PROCESSES	14,029	877	10,836	37,553	11,276	21,294	15,636
VA	2018	08	SOLVENT UTILIZATION	0	6	0	314	293	3	127,953
VA	2018	09	STORAGE & TRANSPORT	21	8	15	949	648	0	27,357
VA	2018	10	WASTE DISPOSAL & RECYCLING	24,293	141	2,595	4,694	1,828	2,171	5,821
VA	2018	11	HIGHWAY VEHICLES	1,310,698	10,757	61,881	3,343	1,641	1,059	60,454
VA	2018	12	OFF-HIGHWAY	797,683	61	40,393	6,208	5,891	507	49,052
VA	2018	14	MISCELLANEOUS	27,223	50,279	584	218,141	26,225	158	1,322
	2018	Total		2,349,413	65,342	290,549	316,406	80,044	320,246	315,875

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
WV	2002	01	FUEL COMB. ELEC. UTIL.	10,117	121	222,437	4,472	2,163	500,381	1,140
WV	2002	02	FUEL COMB. INDUSTRIAL	8,685	97	33,831	1,583	1,332	37,118	1,097
WV	2002	03	FUEL COMB. OTHER	29,480	13	15,220	3,814	3,683	3,990	9,275
WV	2002	04	CHEMICAL & ALLIED PRODUCT MFG	50,835	80	1,627	950	831	9,052	5,755
WV	2002	05	METALS PROCESSING	28,837	143	1,570	8,749	7,515	5,619	1,393
WV	2002	06	PETROLEUM & RELATED INDUSTRIES	1	0	1,086	475	475	7,550	2,163
WV	2002	07	OTHER INDUSTRIAL PROCESSES	2,003	56	5,347	18,751	5,567	2,316	1,803
WV	2002	08	SOLVENT UTILIZATION	15	0	18	49	44	0	35,989
WV	2002	09	STORAGE & TRANSPORT	15	0	3	1,952	947	0	12,432
WV	2002	10	WASTE DISPOSAL & RECYCLING	9,395	8	599	4,153	3,731	100	5,098
WV	2002	11	HIGHWAY VEHICLES	560,717	1,933	59,612	1,395	1,003	2,489	40,066
WV	2002	12	OFF-HIGHWAY	133,113	9	33,239	1,850	1,728	2,112	18,566
WV	2002	14	MISCELLANEOUS	2,811	9,909	61	92,633	10,458	16	157
	2002 Total			836,024	12,371	374,650	140,825	39,478	570,742	134,936
WV	2009	01	FUEL COMB. ELEC. UTIL.	11,493	330	86,328	5,657	2,940	277,489	1,361
WV	2009	02	FUEL COMB. INDUSTRIAL	9,296	104	27,094	1,415	1,220	36,912	998
WV	2009	03	FUEL COMB. OTHER	21,558	13	14,229	3,351	3,216	4,047	6,824
WV	2009	04	CHEMICAL & ALLIED PRODUCT MFG	58,271	82	1,804	987	864	10,166	5,426
WV	2009	05	METALS PROCESSING	30,939	142	1,517	7,985	6,724	5,971	1,380
WV	2009	06	PETROLEUM & RELATED INDUSTRIES	1	0	1,221	535	535	8,495	2,172
WV	2009	07	OTHER INDUSTRIAL PROCESSES	2,288	59	4,995	19,228	5,899	2,570	2,064
WV	2009	08	SOLVENT UTILIZATION	17	0	20	52	47	0	32,305
WV	2009	09	STORAGE & TRANSPORT	17	0	3	2,062	1,003	0	12,997
WV	2009	10	WASTE DISPOSAL & RECYCLING	9,131	8	583	4,050	3,632	97	4,898
WV	2009	11	HIGHWAY VEHICLES	385,994	2,183	36,049	1,096	703	227	23,907
WV	2009	12	OFF-HIGHWAY	152,862	11	30,133	1,640	1,528	359	18,069
WV	2009	14	MISCELLANEOUS	4,116	10,574	89	92,900	10,624	23	219
	2009 Total			685,983	13,508	204,064	140,956	38,933	346,356	112,621
WV	2018	01	FUEL COMB. ELEC. UTIL.	11,961	180	51,241	6,349	3,648	115,324	1,387
WV	2018	02	FUEL COMB. INDUSTRIAL	9,917	111	28,710	1,493	1,290	38,531	1,072
WV	2018	03	FUEL COMB. OTHER	18,891	16	17,254	3,160	3,024	4,065	6,270
WV	2018	04	CHEMICAL & ALLIED PRODUCT MFG	70,252	99	2,183	1,188	1,041	12,280	6,560
WV	2018	05	METALS PROCESSING	36,850	183	2,061	10,944	9,372	7,182	1,790
WV	2018	06	PETROLEUM & RELATED INDUSTRIES	1	0	1,407	616	616	9,786	2,338
WV	2018	07	OTHER INDUSTRIAL PROCESSES	2,756	68	5,949	21,347	6,794	3,101	2,561
WV	2018	08	SOLVENT UTILIZATION	20	0	24	61	55	0	38,023
WV	2018	09	STORAGE & TRANSPORT	19	0	4	2,522	1,225	0	13,394
WV	2018	10	WASTE DISPOSAL & RECYCLING	9,237	10	592	4,134	3,692	98	5,272
WV	2018	11	HIGHWAY VEHICLES	319,030	2,484	16,274	844	428	255	15,463
WV	2018	12	OFF-HIGHWAY	167,424	13	25,710	1,292	1,198	56	14,086
WV	2018	14	MISCELLANEOUS	5,175	11,453	112	98,307	11,316	29	268
	2018 Total			651,532	14,617	151,521	152,256	43,699	190,706	108,484

		CO	NH3	NOX	PM10	PM2.5	SO2	VOC
VISTAS	2002 Total	31,034,756	666,451	5,442,572	3,916,030	1,094,698	4,858,865	5,079,254
VISTAS	2009 Total	25,854,812	722,418	3,721,469	4,155,033	1,119,806	3,454,666	4,118,474
VISTAS	2018 Total	24,357,364	790,588	2,692,309	4,559,582	1,205,324	2,539,907	3,873,273

**APPENDIX D:**

**VISTAS TIER 1 EMISSION TOTALS**

## VISTAS Tier 1 Emission Totals

Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
2002	01	FUEL COMB. ELEC. UTIL.	139,579	1,710	1,524,690	114,256	79,263	3,723,175	12,417
2002	02	FUEL COMB. INDUSTRIAL	371,905	1,204	499,981	85,353	59,731	550,864	32,330
2002	03	FUEL COMB. OTHER	759,534	2,810	122,058	99,532	91,805	114,852	354,375
2002	04	CHEMICAL & ALLIED PRODUCT MFG	131,993	7,093	20,896	11,114	7,982	77,450	63,748
2002	05	METALS PROCESSING	223,705	601	11,801	32,367	27,778	49,143	17,306
2002	06	PETROLEUM & RELATED INDUSTRIES	44,633	355	7,204	2,887	1,863	53,392	33,374
2002	07	OTHER INDUSTRIAL PROCESSES	156,077	7,520	114,474	267,980	97,013	86,736	196,831
2002	08	SOLVENT UTILIZATION	687	331	5,677	3,805	3,284	90	1,288,990
2002	09	STORAGE & TRANSPORT	610	85	1,069	10,968	6,100	230	261,959
2002	10	WASTE DISPOSAL & RECYCLING	729,760	801	34,165	98,788	92,125	6,418	112,088
2002	11	HIGHWAY VEHICLES	20,199,593	74,325	2,193,387	50,584	35,929	88,684	1,778,345
2002	12	OFF-HIGHWAY	6,209,596	477	865,130	72,019	68,302	96,336	813,788
2002	14	MISCELLANEOUS	2,067,084	569,139	42,039	3,066,378	523,524	11,494	113,703
<b>2002 Total</b>			31,034,756	666,451	5,442,572	3,916,030	1,094,698	4,858,865	5,079,254
2009	01	FUEL COMB. ELEC. UTIL.	152,790	5,449	727,384	113,607	81,884	2,473,773	13,155
2009	02	FUEL COMB. INDUSTRIAL	391,510	1,305	445,832	74,864	51,709	523,163	32,629
2009	03	FUEL COMB. OTHER	544,310	3,201	123,331	85,412	77,042	112,463	207,146
2009	04	CHEMICAL & ALLIED PRODUCT MFG	140,910	7,611	22,031	11,898	8,528	81,191	54,270
2009	05	METALS PROCESSING	242,911	732	11,788	31,098	26,505	54,700	18,507
2009	06	PETROLEUM & RELATED INDUSTRIES	48,161	399	7,908	3,283	2,124	47,147	25,061
2009	07	OTHER INDUSTRIAL PROCESSES	166,088	7,545	117,625	298,836	111,304	90,649	203,100
2009	08	SOLVENT UTILIZATION	771	360	6,662	4,290	3,690	100	1,257,986
2009	09	STORAGE & TRANSPORT	702	98	1,087	11,035	6,051	160	275,466
2009	10	WASTE DISPOSAL & RECYCLING	770,459	869	36,697	105,463	97,855	7,287	113,566
2009	11	HIGHWAY VEHICLES	14,353,436	87,703	1,408,206	42,370	26,848	8,817	1,146,174
2009	12	OFF-HIGHWAY	6,827,857	530	767,707	61,528	58,279	42,845	649,786
2009	14	MISCELLANEOUS	2,214,906	606,617	45,212	3,311,350	567,986	12,370	121,629
<b>2009 Total</b>			25,854,812	722,418	3,721,469	4,155,033	1,119,806	3,454,666	4,118,474
2018	01	FUEL COMB. ELEC. UTIL.	225,129	9,351	560,200	154,832	120,895	1,479,499	16,318
2018	02	FUEL COMB. INDUSTRIAL	418,010	1,384	471,501	80,386	55,928	547,527	34,938
2018	03	FUEL COMB. OTHER	453,482	3,358	136,418	78,031	69,853	116,812	149,363
2018	04	CHEMICAL & ALLIED PRODUCT MFG	173,857	9,023	26,564	14,641	10,522	97,612	67,534
2018	05	METALS PROCESSING	288,138	961	15,006	39,673	34,058	67,170	23,798
2018	06	PETROLEUM & RELATED INDUSTRIES	53,442	460	9,088	3,846	2,491	60,676	27,321
2018	07	OTHER INDUSTRIAL PROCESSES	189,922	8,793	136,722	348,275	130,883	104,030	238,409
2018	08	SOLVENT UTILIZATION	936	404	8,480	5,378	4,618	119	1,516,454
2018	09	STORAGE & TRANSPORT	855	119	1,258	13,988	7,686	192	290,271
2018	10	WASTE DISPOSAL & RECYCLING	821,737	1,068	40,324	114,708	105,763	8,545	125,525
2018	11	HIGHWAY VEHICLES	12,052,347	101,223	639,931	33,884	17,080	10,027	713,143
2018	12	OFF-HIGHWAY	7,438,312	612	601,040	48,648	45,927	35,166	546,062
2018	14	MISCELLANEOUS	2,241,196	653,831	45,776	3,623,293	599,620	12,532	124,137
<b>2018 Total</b>			24,357,364	790,588	2,692,309	4,559,582	1,205,324	2,539,907	3,873,273

**APPENDIX E:**

**AIRCRAFT PM EXCERPT FROM 2001 TUCSON REPORT**



**Final Report**

**EMISSIONS INVENTORIES FOR  
THE TUCSON AIR PLANNING AREA**

**VOLUME I. STUDY DESCRIPTION AND RESULTS**

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## **ABBREVIATIONS AND ACRONYMS**

ADEQ	Arizona Department of Environmental Quality
ADWM	Arizona Department of Weights and Measures
ALD2	High Molecular Weight Aldehydes (RCHO, R≠H)
AML	Arc Macro Language
AQM	Air Quality Model
APU	Aircraft Power Unit
ARB	California Air Resources Board
ASC	Area Source Category Code
AT	Air Taxi
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CSF	Chemical Speciation Factor
DM	Davis-Monthan Air Force Base
DOT	Department of Transportation
EDMS	Emissions Dispersion Modeling System
EEA	Energy & Environmental Analysis, Inc.
EIPP	Emission Inventory Preparation Plan
EPA	The U.S. Environmental Protection Agency
ETH	Ethene (CH <sub>2</sub> =CH <sub>2</sub> )
FAA	Federal Aviation Administration
FAEED	FAA Aircraft Engine Emission Database
FIPS	Federal Information Processing System
FIRE	EPA's Factor Information REtrieval Data System
FORM	Formaldehyde (CH <sub>2</sub> =O)
GA	General Aviation
GIS	Geographical Information System
GSE	Ground Support Equipment
ICAO	International Civil Aviation Organization

## **ABBREVIATIONS AND ACRONYMS**

ISOP	Isoprene
LPG	Liquid Petroleum Gas
LTO	Landing and TakeOff
NAD27	North American Datum - 1927
NCDC	National Climatic Data Center
NEI	US EPA National Emission Inventory
NEVES	Nonroad Engine and Vehicle Emission Study
NG	Natural Gas
NO	Nitric Oxide
NO <sub>2</sub>	Nitrogen Dioxide
NO <sub>x</sub>	Oxides of Nitrogen
OLE	Olefinic Carbon Bond (C=C)
ORNL	Oak Ridge National Laboratory
PAG	Pima Association of Governments
PAR	Paraffinic Carbon Bond (C—C)
PDEQ	Pima County Department of Environmental Quality
PM	Particulate Matter
PM <sub>2.5</sub>	Particulate Matter less than 2.5 microns
PM <sub>10</sub>	Particulate Matter less than 10 microns
RASP	Regional Aviation System Plan
RVP	Reid Vapor Pressure
SAF	Spatial Allocation Factor
SCC	Source Category Code
SCF	Standard Cubic Foot
SIC	Standard Industrial Classification
SIP	State Implementation Plan
SO <sub>2</sub>	Sulfur Dioxide
SO <sub>x</sub>	Oxides of Sulfur
TAF	Temporal Allocation Factor

## **ABBREVIATIONS AND ACRONYMS**

TAPA	Tucson Air Planning Area
TAZ	Transportation Analysis Zone
THC	Total Hydrocarbon
TIA	Tucson International Airport
TIM	Time-In-Mode
TOL	Tolulene (C <sub>6</sub> H <sub>5</sub> —CH <sub>3</sub> )
TTN	EPA Technology Transfer Network
UAM	Urban Airshed Model
UP	Union Pacific Railroad
VOC	Volatile Organic Compounds as defined by the 1990 Clean Air Act Amendments
XYL	Xylene (C <sub>6</sub> H <sub>6</sub> —(CH <sub>3</sub> ) <sub>2</sub> )



*(Prior material unrelated to VISTAS modeling is intentionally omitted)*

While emission rates for HC, CO, and NO<sub>x</sub> are routinely measured from (new) commercial air carrier engines under the emissions certification component of International Civil Aviation Organization (ICAO) regulations, measurement of PM emissions is not required. As a result, almost all aircraft engine PM emission rate data have been collected under special studies. Currently, such data exists for only about 20 aircraft engines, with a considerable portion of these data collected by the U.S. Air Force for military aircraft engines. While emission factors for these engines are included in the AP-42 database upon which the FAEED and EDMS emission inventory models were developed, they have not been included in either model due to their limited applicability. To date, it has been standard EPA practice not to estimate PM emissions for aircraft engines. However, since the emissions models maintain a placekeeper for PM emission rates and include PM emission estimates for GSE, it can appear to the uninformed user that aircraft PM emission rates are zero. As a result, aircraft are often incorrectly considered to be insignificant PM sources even though those engines tested for PM have demonstrated significant emission rates. This policy of exclusion by omission is not appropriate in developing an accurate modeling inventory, even in the absence of a large emissions database. While a precise emissions estimate cannot be made with available data, it is clear that a zero emission rate is far from accurate.

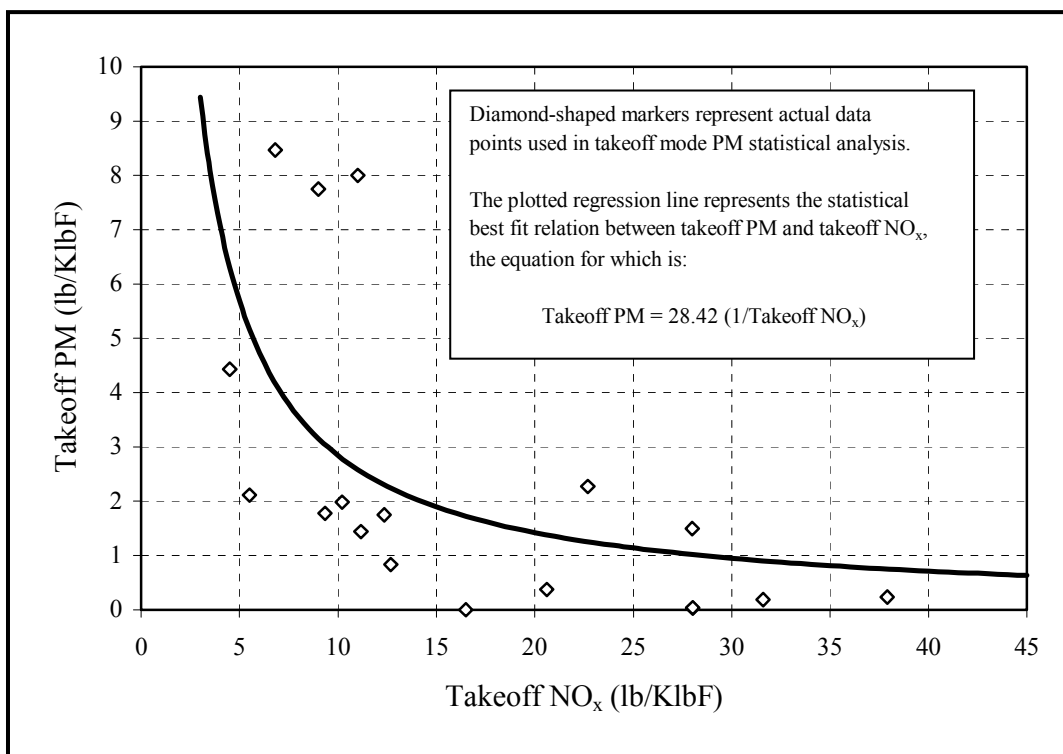
As an alternative for this study, measured emissions data for aircraft engines that have been tested for PM were statistically analyzed to determine whether or not a relationship to other measured emissions parameters could be established. Intuitively, it was hoped that an inverse relationship with NO<sub>x</sub> might be demonstrated, as such a relationship is theoretically attractive. While the level of sophistication of the statistical analysis is constrained by the quantity of data available, simple direct and indirect linear relationships can be examined. Because data are not available for each test engine in each of the four LTO cycle modes and because relationships might be expected to vary by operating mode (due to significant changes in engine and combustion efficiency), all statistical analysis was performed for each operating mode individually.

Statistically significant relationships were found for the direct linear analysis for three of the four LTO cycle modes. Significant in this context means that coefficient t-statistics for one or more of the other measured pollutants (HC, CO, or NO<sub>x</sub>) indicated a direct relationship with measured PM (at a confidence level exceeding 95 percent). In all cases, correlation coefficients were poor (as expected), suggesting a high level of variability and poor predictability of PM emissions for any given engine. Nevertheless, statistics were unbiased and should provide an accurate mechanism to initially assess PM emissions on an aggregate basis (i.e., over a range of aircraft engine models such as those associated with an analysis for an entire set of airport operations). Only at idle was no significant relation found, which is not surprising given relative engine inefficiency in this mode.

The indirect linear analysis revealed a consistent and significant inverse relationship between PM and NO<sub>x</sub> based on calculated t-statistics. Correlation coefficients continue to be poor, but t-statistics are generally improved over those of the direct linear analysis (all developed inverse relations, including idle, were significant at the 99 percent confidence level). In selecting the most appropriate relationship for estimation of PM emission rates for non-tested aircraft engines, the statistical analysis that produced the best combination of a significant t-statistic, a relatively low root mean square error, and an intuitive engineering basis was identified. This was the inverse NO<sub>x</sub> relationship for the takeoff (i.e., full throttle) mode of operation. Figure 4-1 illustrates the selected statistical relationship.

With this relationship established, PM emission rate data for the other aircraft operating modes (i.e., the approach, taxi, and climbout modes) was statistically analyzed against observed PM emission rate data for the takeoff mode. Statistically significant relations were developed for all three modes. Table 4-23 presents the coefficients developed for these PM-to-PM regressions as well as the statistics for the PM-to-NO<sub>x</sub> regression developed for the takeoff mode. These four relations were used to develop a set of fleetwide PM emission factors based on measured takeoff NO<sub>x</sub> emission rates. These emission factors were then input into the EEA aircraft emissions model and used to generate PM emission estimates for TIA aircraft operations.

**FIGURE 4-1. Relationship Used to Estimate Aircraft PM Emission Rates**



**TABLE 4-23. Statistics for Aircraft and APU PM Relations**

Statistical Parameter	Takeoff PM	Climbout PM	Approach PM	Taxi PM
Predictive Parameter	1/Takeoff NO <sub>x</sub>	Takeoff PM	Takeoff PM	Takeoff PM
Coefficient	28.42	1.42	1.53	3.10
Coefficient t-statistic	5.1	11.8	14.9	5.7
Correlation Coefficient	0.30	0.84	0.91	0.56
F-statistic	7.4	86.1	135.7	21.9
Number of Observations	18	17	15	18

*(Subsequent material unrelated to VISTAS modeling is intentionally omitted)*

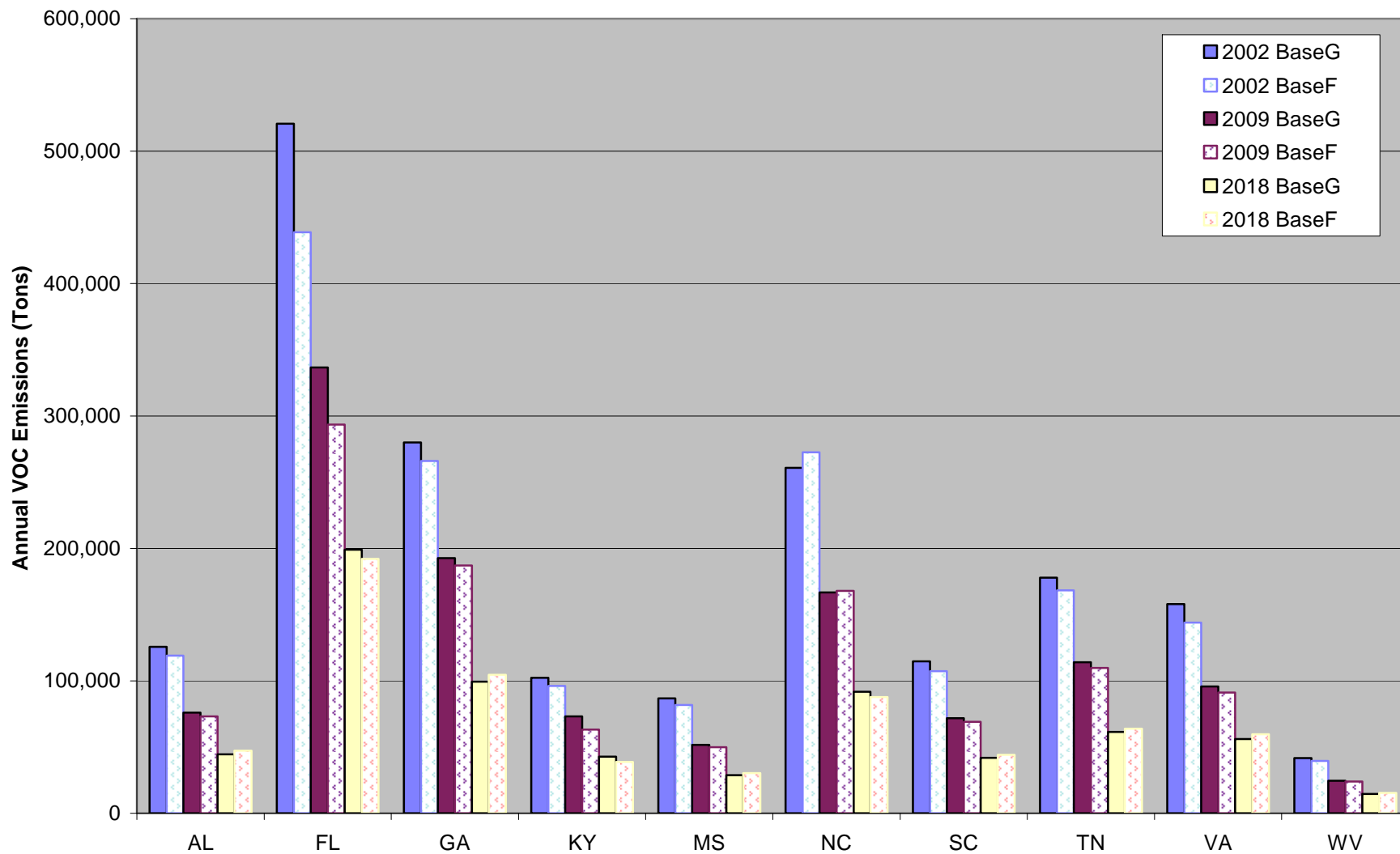
**APPENDIX F:**

**COMPARISON OF BASE F AND BASE G ON-ROAD MOBILE EMISSIONS**

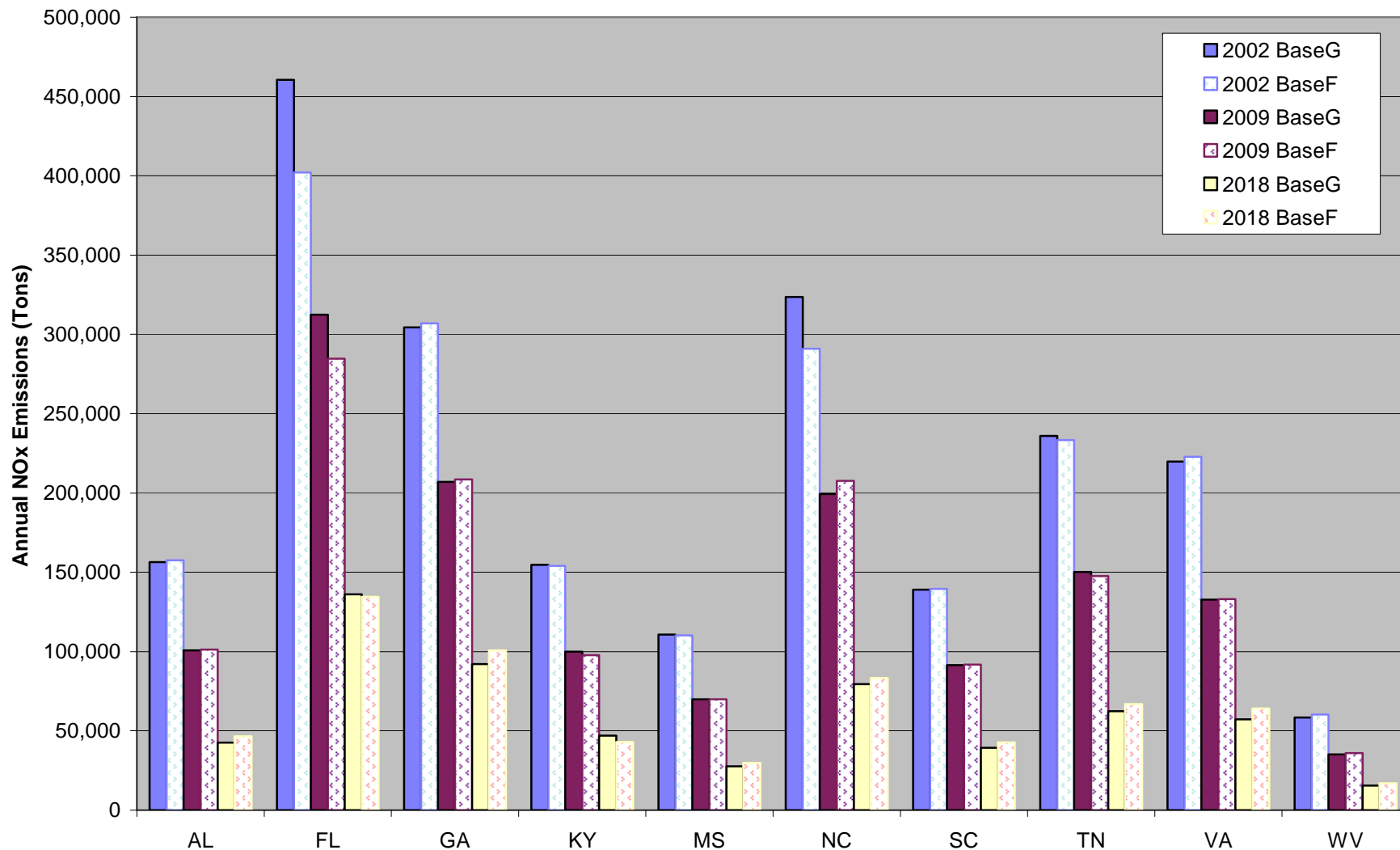
Documentation of the Base G 2002 Base Year, 2009 and 2018, Emission Inventories for VISTAS

Base G Onroad Mobile Emissions (Annual Tons)																					
FIPSST	VOC			NOx			CO			SO2			PM-10			PM-2.5			NH3		
	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018
AL	125,768	76,065	44,503	156,460	100,693	42,622	1,303,508	902,469	594,725	6,827	802	654	3,861	3,136	2,193	2,768	2,010	1,085	5,530	6,298	6,630
FL	520,757	336,707	199,050	460,503	312,321	136,040	4,493,820	3,308,863	2,263,190	20,687	2,584	2,302	11,148	9,801	7,516	7,779	6,104	3,671	17,922	21,549	23,778
GA	279,975	192,773	99,464	304,309	207,024	92,113	2,699,650	1,956,263	1,303,529	12,043	1,568	1,325	7,165	6,005	4,406	5,110	3,797	2,166	10,436	12,554	13,511
KY	102,362	73,142	42,810	154,634	100,025	46,993	1,214,191	950,912	711,211	6,238	751	694	3,682	2,944	2,348	2,667	1,899	1,158	5,003	5,737	7,095
MS	86,811	51,600	28,699	110,672	69,952	27,620	853,774	602,257	394,247	4,566	532	401	2,828	2,250	1,479	2,089	1,491	746	3,549	3,995	4,147
NC	260,895	166,844	91,720	323,606	199,281	79,433	2,839,283	1,966,195	1,207,391	12,286	1,487	1,346	6,505	5,510	3,994	4,571	3,453	1,931	9,601	11,702	12,776
SC	114,861	71,781	41,866	138,940	91,471	39,348	1,226,555	878,825	588,536	5,909	713	584	3,414	2,831	1,986	2,473	1,834	988	4,646	5,466	5,878
TN	177,943	114,032	61,339	235,869	150,179	62,446	1,893,704	1,320,562	863,682	9,127	1,065	862	5,312	4,160	2,813	3,904	2,720	1,405	6,556	7,702	8,196
VA	157,989	95,694	55,992	219,835	132,699	57,192	2,136,288	1,435,359	954,463	8,196	1,067	949	4,499	3,706	2,922	3,067	2,216	1,404	7,770	8,990	9,653
WV	41,703	24,570	14,652	58,340	35,234	15,530	526,841	360,865	243,683	2,438	276	231	1,366	1,057	747	984	676	369	1,889	2,126	2,268
<b>VISTAS</b>	<b>1,869,063</b>	<b>1,203,208</b>	<b>680,096</b>	<b>2,163,168</b>	<b>1,398,879</b>	<b>599,336</b>	<b>19,187,613</b>	<b>13,682,570</b>	<b>9,124,656</b>	<b>88,316</b>	<b>10,844</b>	<b>9,348</b>	<b>49,780</b>	<b>41,400</b>	<b>30,403</b>	<b>35,411</b>	<b>26,200</b>	<b>14,922</b>	<b>72,902</b>	<b>86,118</b>	<b>93,932</b>
Base F Onroad Mobile (Annual Tons)																					
FIPSST	VOC			NOx			CO			SO2			PM-10			PM-2.5			NH3		
	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018
AL	118,978	73,137	47,151	157,626	101,299	46,598	1,300,754	934,442	675,902	6,898	637	720	3,905	3,195	2,488	2,799	2,053	1,262	5,586	6,362	7,296
FL	438,761	293,423	192,096	402,099	284,737	134,465	4,022,000	3,090,443	2,306,759	18,802	1,911	2,289	10,185	9,027	7,691	7,126	5,653	3,848	16,183	19,553	23,595
GA	265,972	187,102	104,678	306,998	208,568	100,707	2,712,473	2,044,169	1,474,029	12,182	1,256	1,458	7,252	6,116	4,995	5,169	3,877	2,517	10,545	12,685	14,870
KY	96,202	63,210	38,814	154,093	97,731	43,014	1,195,656	932,296	669,891	5,988	587	651	3,728	3,008	2,283	2,699	1,946	1,160	5,055	5,807	6,584
MS	81,701	49,986	30,337	110,242	69,949	29,829	849,049	624,575	445,150	4,614	398	441	2,863	2,296	1,688	2,114	1,525	876	3,585	4,035	4,565
NC	272,594	167,894	87,718	290,873	207,670	83,399	2,677,118	2,192,253	1,238,802	12,482	1,314	1,323	6,733	5,874	4,299	4,754	3,651	2,158	9,711	12,663	13,077
SC	107,236	69,026	44,121	139,403	91,832	42,641	1,220,825	921,308	663,597	5,972	558	643	3,454	2,884	2,258	2,502	1,874	1,154	4,694	5,522	6,472
TN	168,389	109,716	63,916	233,324	147,591	66,879	1,881,893	1,359,880	961,929	9,202	833	944	5,349	4,247	3,199	3,927	2,788	1,643	6,629	7,753	8,962
VA	143,969	91,230	59,737	222,830	133,039	64,079	1,996,287	1,483,125	1,091,546	7,234	902	1,059	4,546	3,768	3,343	3,097	2,258	1,641	7,852	9,084	10,757
WV	39,581	23,914	15,375	60,335	36,000	16,940	533,258	379,272	273,900	2,495	228	255	1,399	1,099	844	1,005	705	428	1,938	2,188	2,484
<b>VISTAS</b>	<b>1,733,382</b>	<b>1,128,638</b>	<b>683,942</b>	<b>2,077,822</b>	<b>1,378,416</b>	<b>628,551</b>	<b>18,389,312</b>	<b>13,961,764</b>	<b>9,801,505</b>	<b>85,868</b>	<b>8,622</b>	<b>9,783</b>	<b>49,414</b>	<b>41,513</b>	<b>33,086</b>	<b>35,191</b>	<b>26,330</b>	<b>16,687</b>	<b>71,778</b>	<b>85,652</b>	<b>98,664</b>
Emissions Change (Base G - Base F, Annual Tons) -- Positive Value Indicates Increase from Base F																					
FIPSST	VOC			NOx			CO			SO2			PM-10			PM-2.5			NH3		
	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018
AL	6,789	2,928	-2,647	-1,166	-606	-3,977	2,754	-31,973	-81,178	-71	165	-66	-45	-58	-295	-31	-43	-178	-56	-63	-666
FL	81,997	43,284	6,955	58,404	27,584	1,575	471,820	218,420	-43,569	1,885	672	14	963	774	-175	653	451	-177	1,738	1,996	183
GA	14,003	5,671	-5,214	-2,689	-1,544	-8,594	-12,823	-87,906	-170,500	-139	312	-133	-86	-111	-589	-59	-80	-352	-109	-131	-1,359
KY	6,160	9,933	3,996	541	2,294	3,979	18,534	18,615	41,319	250	164	43	-46	-65	65	-32	-47	-2	-52	-70	512
MS	5,110	1,613	-1,638	430	3	-2,209	4,724	-22,319	-50,903	-48	134	-41	-35	-46	-209	-25	-34	-130	-35	-40	-419
NC	-11,699	-1,049	4,001	32,734	-8,389	-3,966	162,165	-226,057	-31,411	-196	174	23	-228	-364	-304	-183	-198	-226	-111	-961	-302
SC	7,625	2,755	-2,255	-462	-362	-3,293	5,731	-42,483	-75,061	-63	156	-59	-40	-53	-272	-29	-40	-166	-48	-56	-594
TN	9,554	4,316	-2,577	2,545	2,589	-4,433	11,811	-39,318	-98,246	-75	232	-82	-37	-87	-385	-22	-68	-238	-73	-52	-766
VA	14,020	4,464	-3,744	-2,995	-340	-6,887	140,001	-47,766	-137,084	962	165	-110	-47	-62	-420	-30	-42	-237	-83	-94	-1,104
WV	2,122	656	-723	-1,995	-766	-1,410	-6,416	-18,407	-30,217	-57	49	-24	-32	-42	-97	-22	-29	-59	-49	-62	-217
<b>VISTAS</b>	<b>135,680</b>	<b>74,570</b>	<b>-3,846</b>	<b>85,346</b>	<b>20,462</b>	<b>-29,215</b>	<b>798,301</b>	<b>-279,194</b>	<b>-676,850</b>	<b>2,448</b>	<b>2,222</b>	<b>-435</b>	<b>367</b>	<b>-114</b>	<b>-2,683</b>	<b>219</b>	<b>-130</b>	<b>-1,764</b>	<b>1,123</b>	<b>466</b>	<b>-4,732</b>
Emissions Change (Base G - Base F/Base F, Annual %) -- Positive Value Indicates Increase from Base F																					
FIPSST	VOC			NOx			CO			SO2			PM-10			PM-2.5			NH3		
	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018
AL	6%	4%	-6%	-1%	-1%	-9%	0%	-3%	-12%	-1%	26%	-9%	-1%	-2%	-12%	-1%	-2%	-14%	-1%	-1%	-9%
FL	19%	15%	4%	15%	10%	1%	12%	7%	-2%	10%	35%	1%	9%	9%	-2%	9%	8%	-5%	11%	10%	1%
GA	5%	3%	-5%	-1%	-1%	-9%	0%	-4%	-12%	-1%	25%	-9%	-1%	-2%	-12%	-1%	-2%	-14%	-1%	-1%	-9%
KY	6%	16%	10%	0%	2%	9%	2%	2%	6%	4%	28%	7%	-1%	-2%	3%	-1%	-2%	0%	-1%	-1%	8%
MS	6%	3%	-5%	0%	0%	-7%	1%	-4%	-11%	-1%	34%	-9%	-1%	-2%	-12%	-1%	-2%	-15%	-1%	-1%	-9%
NC	-4%	-1%	5%	11%	-4%	-5%	6%	-10%	-3%	-2%	13%	2%	-3%	-6%	-7%	-4%	-5%	-10%	-1%	-8%	-2%
SC	7%	4%	-5%	0%	0%	-8%	0%	-5%	-11%	-1%	28%	-9%	-1%	-2%	-12%	-1%	-2%	-14%	-1%	-1%	-9%
TN	6%	4%	-4%	1%	2%	-7%	1%	-3%	-10%	-1%	28%	-9%	-1%	-2%	-12%	-1%	-2%	-14%	-1%	-1%	-9%
VA	10%	5%	-6%	-1%	0%	-11%	7%	-3%	-13%	13%	18%	-10%	-1%	-2%	-13%	-1%	-2%	-14%	-1%	-1%	-10%
WV	5%	3%	-5%	-3%	-2%	-11%	-1%	-5%	-11%	-2%	21%	-9%	-2%	-4%	-12%	-2%	-4%	-14%	-3%	-3%	-9%
<b>VISTAS</b>	<b>8%</b>	<b>7%</b>	<b>-1%</b>	<b>4%</b>	<b>1%</b>	<b>-5%</b>	<b>4%</b>	<b>-2%</b>	<b>-7%</b>	<b>3%</b>	<b>26%</b>	<b>-4%</b>	<b>1%</b>	<b>0%</b>	<b>-8%</b>	<b>1%</b>	<b>0%</b>	<b>-11%</b>	<b>2%</b>	<b>1%</b>	<b>-5%</b>

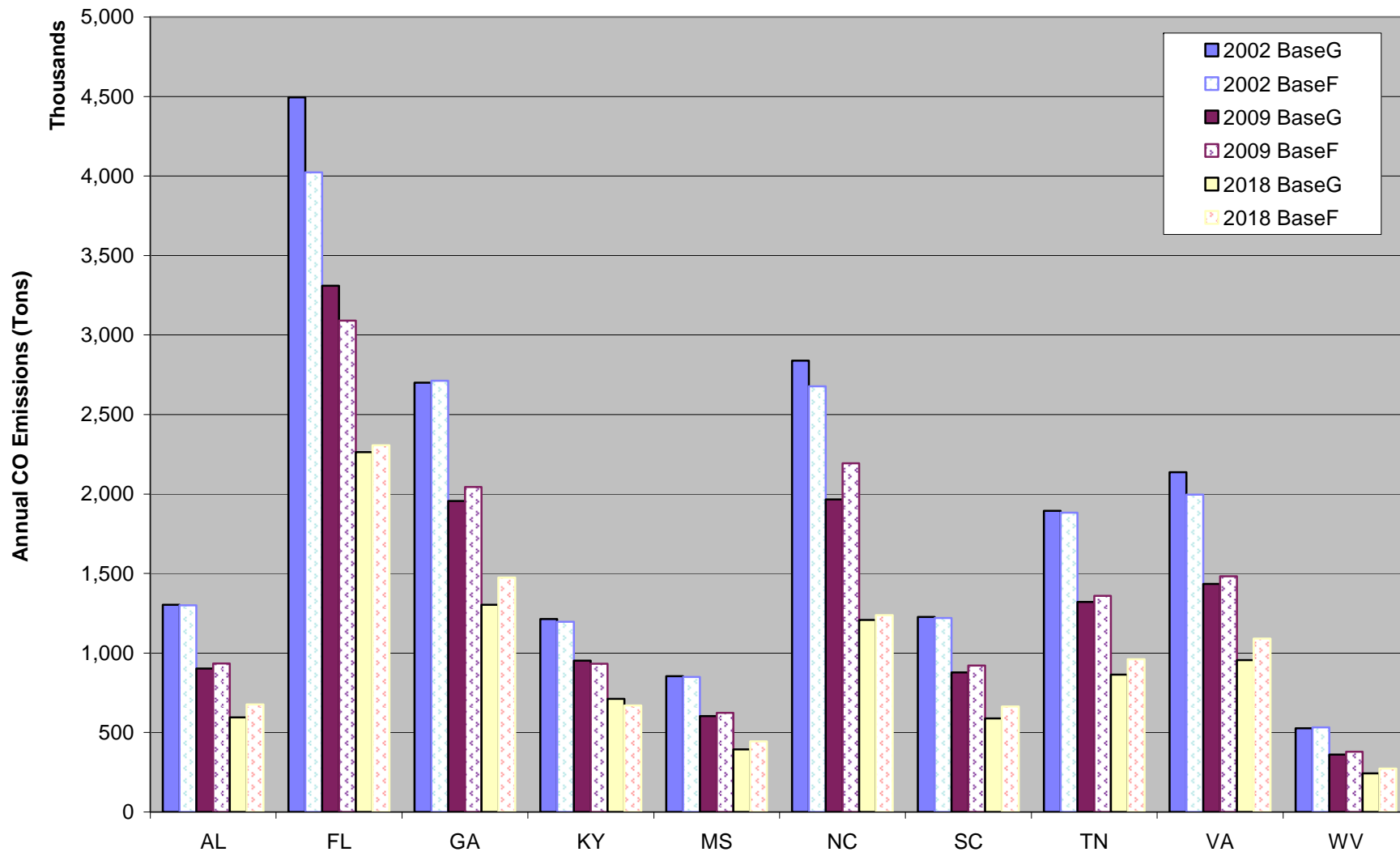
### Annual Onroad Emissions Comparison



### Annual Onroad Emissions Comparison

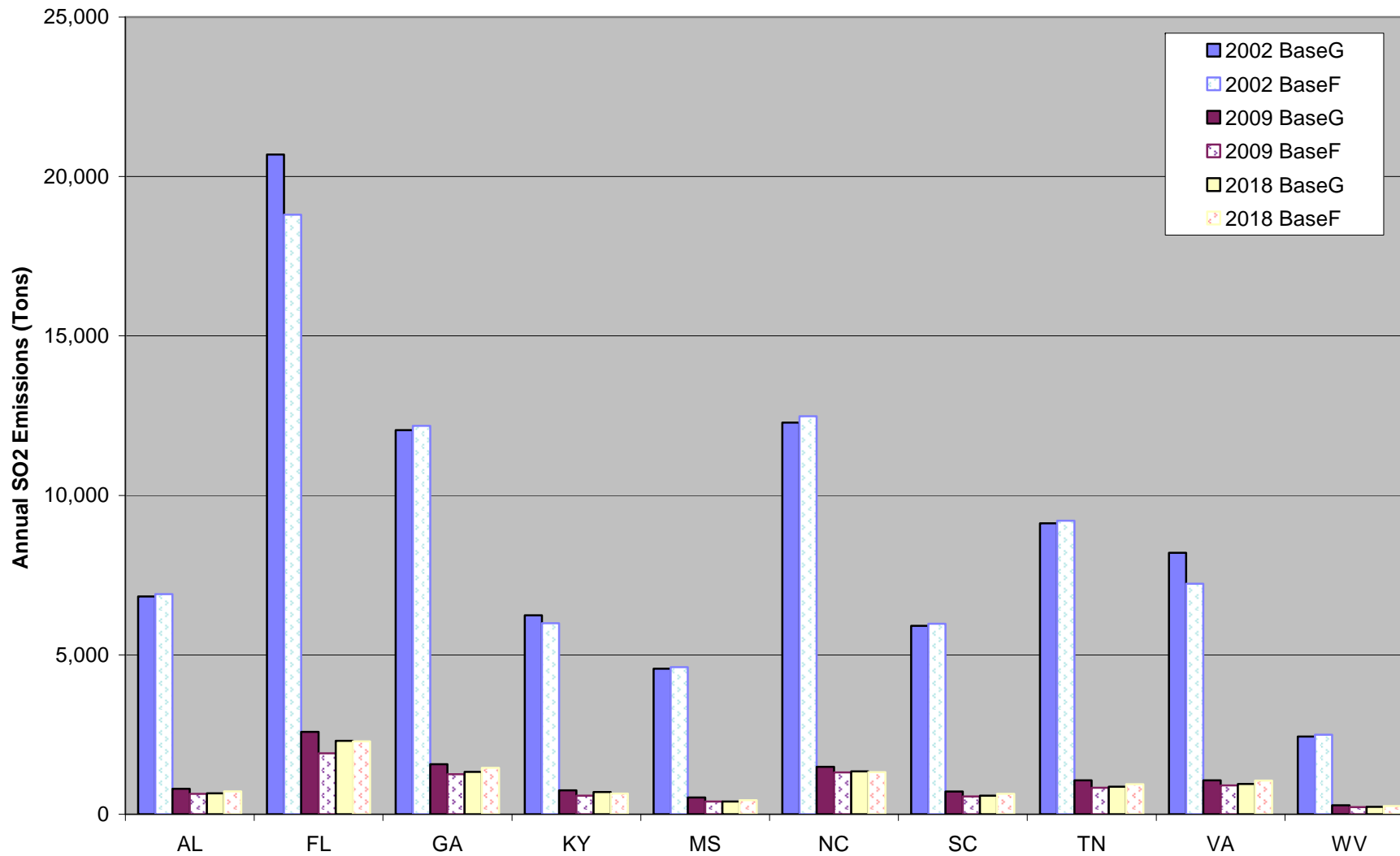


### Annual Onroad Emissions Comparison

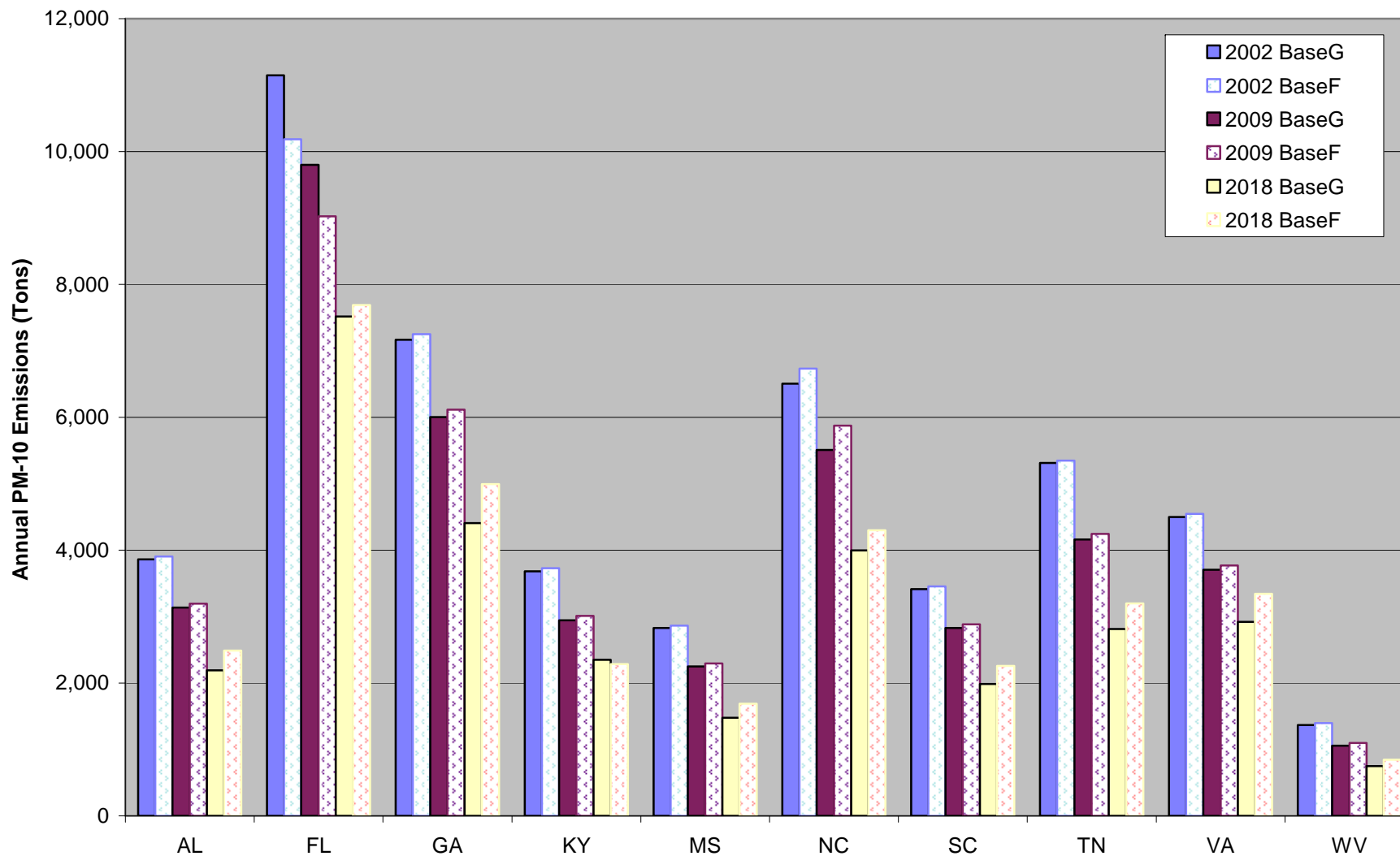




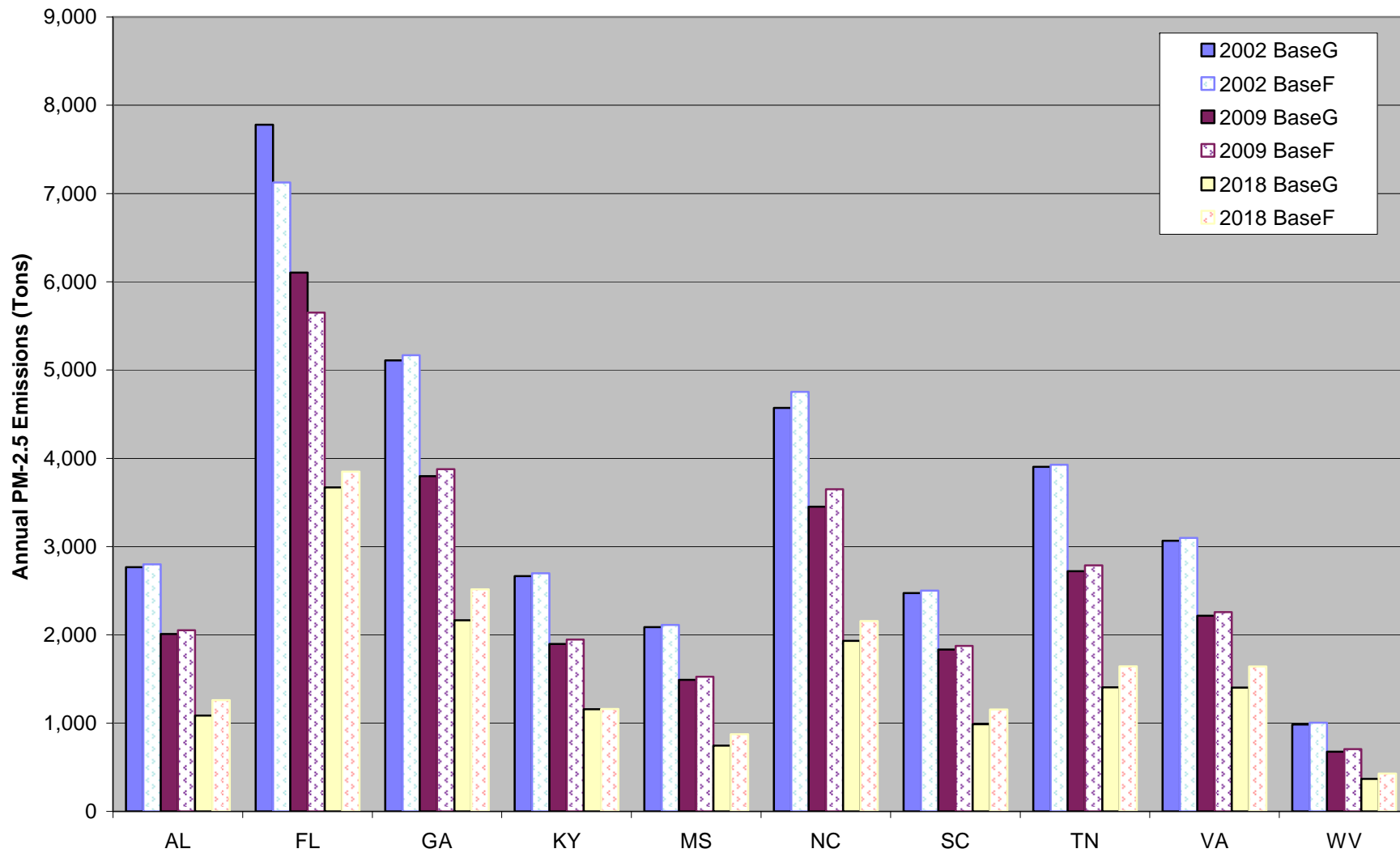
### Annual Onroad Emissions Comparison



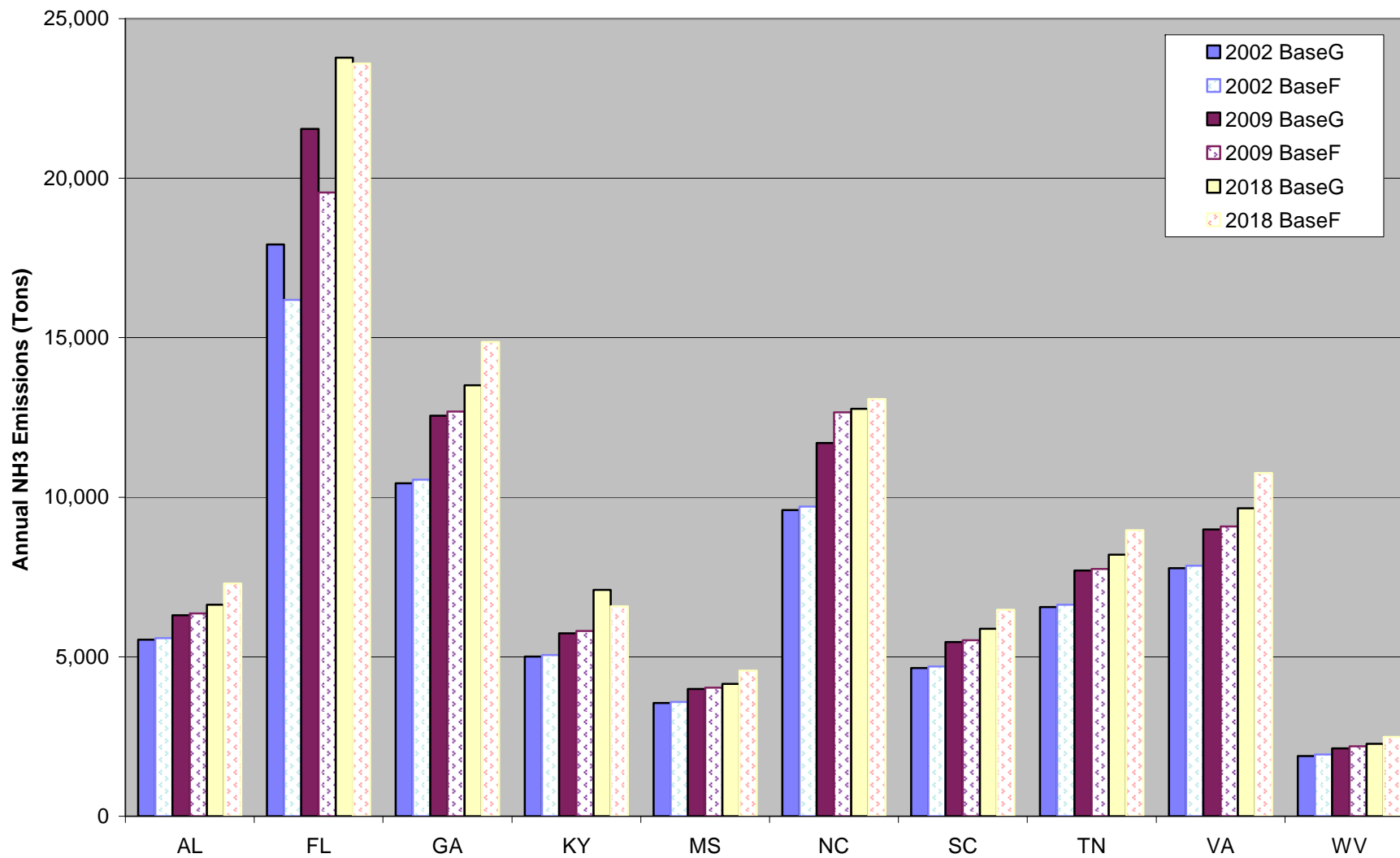
### Annual Onroad Emissions Comparison



### Annual Onroad Emissions Comparison



### Annual Onroad Emissions Comparison



**Development of the Draft 2002 Vistas Emission  
Inventory for Regional Haze Modeling**

**PART 1**

**Review of 1999 NEI Version 2 Final  
and  
Recommendations for Developing the 2002 VISTAS  
Inventory for Regional Haze Modeling  
(Area and Point Sources)**

**DRAFT REPORT**

**REVIEW OF 1999 NEI VERSION 2 FINAL  
AND  
RECOMMENDATIONS FOR DEVELOPING  
THE 2002 VISTAS INVENTORY FOR REGIONAL HAZE MODELING  
AREA AND POINT SOURCES**

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- Appendix A – State-by-State Area Source Summaries by Pollutant
- Appendix B – State-by-State Point Source Summaries by Pollutant



## **SECTION 1**

### **EXECUTIVE SUMMARY**

#### **INTRODUCTION**

This report presents the results of a review of existing or developing efforts to support the development of a 2002 emission inventory for the VISTAS region to support regional haze planning. This review focused on area and point sources (the review for non-road equipment and highway vehicles is presented in a separate report prepared by E.H. Pechan). This report has three objectives:

1. Summarize the 1999 National Emission Inventory (NEI), Version 2 Final, to provide an indication of the relative importance of each type of source in the 10-state VISTAS region (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia).
2. Identify on-going emission inventory improve efforts that are being conducted by other Regional Planning Organizations, the U.S. EPA, and other Federal agencies.
3. Provide recommendations for short-term improvements that can be accomplished by September 2003 to produce a preliminary 2002 inventory and for longer-term efforts to further improve the inventory in calendar year 2004.

This Executive Summary summarizes the recommendations for area and point source improvements. Section 2 looks at the relative magnitude of emissions from all sources in the VISTAS area, including point, area, highway vehicles, and nonroad equipment. Section 3 examines area sources and Section 4 examines point sources. Appendices A and B contain state-by-state emission summary tables for area and point sources, respectively.

#### **RECOMMENDATIONS FOR AREA SOURCE IMPROVEMENTS**

Listed below are our short-term recommendations for developing the area source component of the preliminary 2002 VISTAS regional emission inventory. This is followed by our longer-term recommendations for making future improvements to the inventory. Our recommendations are based on our review of the 1999 NEI Version 2 Final and the various on-going emission inventory improvement activities discussed in Section 3 of this report. The short-term recommendations can be accomplished over the next six months, resulting in a preliminary 2002 inventory that can be fed into an emission model to produce the episode-specific inputs needed for preliminary atmospheric modeling. The longer-term activities can likely be accomplished over the next 2-3 years.

## **Recommendations for Short-term Activities to Produce VISTAS Preliminary 2002 Area Source Inventory**

1. Obtain updated activity data related to fugitive dust sources, primarily paved and unpaved roads, livestock activities and agricultural activity (tilling). Updating the agricultural activity will also assist in the development of ammonia emissions. In addition, these source categories are not as amenable to using growth factors as some other less important categories so the improvement from obtaining activity data would have a greater impact. Finally, the emission factors for these categories in the NEI tends to change less dramatically from year to year so changes in activity data will provide the greatest impact on estimating emissions in 2002.
2. Obtain updated activity data for fire sources. In particular, activity (and fuel data if available) will provide for updated estimates for wildfires, prescribed burns, residential combustion, and land clearing operations. Each of these sources is important for fine particulate. None of these sources is easily projected using growth factors.
3. Obtain updated activity data for animal operations. Use that data with the CMU ammonia model to provide updated estimates of ammonia from animal operations. Determine (in conjunction with VISTAS) if any of the State supplied data for ammonia emissions should be used to replace ammonia emissions calculated with the CMU model.
4. Conduct QA/QC of State/local agency area source submittals. Review area source submittals to determine how much information submitted matches with the current NEI and to determine if there are significant missing sources. Evaluate the pollutants that are missing that will need to be estimated using alternative means. Evaluate whether or not the State/local submittals provide any new information related to temporal profiles. Work with the point source inventory to assess potential double counting of sources.
5. Provide State/local agencies with the comparison of emissions reported in the 1999 NEI Version 2 Final and the State/local supplied data. Identify gaps and logical inconsistencies. Ask States/local agencies to provide feedback on large scale inconsistencies and on missing sources. Update database with State/local supplied revisions.
6. Review speciation information to determine if there are gaps in the data required to develop a speciated emission inventory. In addition, review older version of NEI to determine speciation factors used to prepare elemental and organic carbon estimates (never published).
7. Convert preliminary 2002 VISTAS inventory from NIF format to format required by the selected emission modeling system.

These short-term activities are generally consistent with the activities identified in our Final Work Plan (November 25, 2001), and can be completed within the contract budget and time schedules identified in the Work Plan for area sources. For those sources not

specifically updated with revised activity data or estimates from State/local agencies, growth factors will be produced to provide 2002 emission estimates.

### **Recommendations for Longer-term Activities to Produce VISTAS Final 2002 Area Source Inventory**

1. Establish on-going long term mechanism to collect activity, fuel and other data related to fires. This work may be carried out in conjunction with other agencies.
2. Establish on-going long term mechanism to collect activity data related to unpaved roads. This work may be carried out in conjunction with other agencies.
3. Update ammonia emissions when new emission factors become available from EPA or other agencies for important source categories.
4. Update PM<sub>2.5</sub> emissions as new emission factors are prepared by EPA.

These longer-term activities are beyond the scope of the activities identified in our Final Work Plan (November 25, 2001). We would be glad to prepare a cost estimate and time schedule for completing these activities to produce the Final 2002 area source inventory.

### **RECOMMENDATIONS FOR POINT SOURCE IMPROVEMENTS**

Listed below are our short-term recommendations for developing the preliminary 2002 VISTAS regional emission inventory. This is followed by our longer-term recommendations for making future improvements to the inventory. Our recommendations are based on our review of the 1999 NEI Version 2 Final and the various on-going emission inventory improvement activities discussed in Section 4 of this report. The short-term recommendations can be accomplished over the next six months, resulting in a preliminary 2002 inventory that can be fed into an emission model to produce the episode-specific inputs needed for preliminary atmospheric modeling. The longer-term activities can likely be accomplished over the next 2-3 years.

### **Recommendations for Short-term Activities to Produce VISTAS Preliminary 2002 Point Source Inventory**

1. Obtain post-1999 point source inventories from State/local agencies to better represent episodes in the 2000-2002 time frame. Replace 1999 NEI data with more recent State data for PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>x</sub>, VOC, and CO. Augment State data with PM<sub>2.5</sub> and ammonia from 1999 NEI. "Grow" the 1999/2000/2001 to 2002.
2. Conduct QA/QC of State/local agency point source submittals. Review point source physical parameters, temporal profiles, and locations needed for modeling. Focus on large sources and provide States/local agencies with parameters to review and possibly correct. Incorporate State/local agency corrections and updates. Supplement with default stack characteristics and county-level locations.
3. Compare facility-level emissions in 1999 NEI to State/local submittals to identify potentially missing or new sources and to flag facilities with large emission

changes. Ask States to verify whether facilities any large emitters have closed, whether new sources began operation in 2002, and whether any large emission changes are reasonable.

4. Provide State/local agencies with the comparison of ammonia emissions reported in the 1999 NEI Version 2 Final and the 1999/2000 Toxics Release Inventory. Identify gaps and logical inconsistencies. Ask States/local agencies to target largest emitters to obtain information on emissions, stack characteristics, seasonal variations, etc. Update database with State/local updates.
5. Obtain and incorporate “preliminary” annual 2002 CEM data for utilities from EPA’s Clean Air Markets Division.
6. Help States/local agencies conduct surveys of selected point sources to obtain any missing information identified in the above tasks. Coordinate with State/local agency in developing information request, and if deemed appropriate by the State/local agency, contact the facility to attempt to obtain the requested information. Augment database with the collected survey data.
7. Apply existing speciation factors to create estimates of elemental carbon, organic carbon, and other species required for modeling.
8. Convert preliminary 2002 VISTAS inventory from NIF format to format required by the selected emission modeling system.

These short-term activities are generally consistent with the activities identified in our Final Work Plan (November 25, 2001), and can be completed within the contract budget and time schedules identified in the Work Plan for point sources.

### **Recommendations for Longer-term Activities to Produce VISTAS Final 2002 Point Source Inventory**

1. Obtain and incorporate “final” CEM data (Fall 2003).
2. Apply improved SPECIATE factors (Fall 2003).
3. Update ammonia emissions when new emission factors are available from EPA (2004) for important source categories.
4. Update PM<sub>2.5</sub> emissions when new emission factors are prepared by EPA (2004).
5. Obtain “official” 2002 point source inventories required by the Consolidated Emissions Reporting Rule (June 2004).

These longer-term activities are beyond the scope of the activities identified in our Final Work Plan (November 25, 2001). We would be glad to prepare a cost estimate and time schedule for completing these activities to produce the Final 2002 point source inventory.

## SECTION 2

### SUMMARY OF 1999 NEI (VERSION 2 FINAL)

The first component of our review looks at the relative magnitude of emissions from all source in the VISTAS area, including point, area, highway vehicles, and nonroad equipment. Tables 2-1 through 2-7 provide information on the emissions by source category, including the percentage of total emissions and cumulative percentage of total emissions for seven pollutants: particulate matter less than 10 microns in diameter (PM10), particulate matter less than 2.5 microns in diameter (PM2.5), sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), ammonia (NH<sub>3</sub>), carbon monoxide (CO), and volatile organic compounds (VOCs). Data for these tables was derived from Version 2 Final of the 1999 National Emission Inventory (NEI). These tables provide an indication of the relative importance of each type of source in the 10-state VISTAS region (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia).

#### **PM10/PM2.5**

Tables 2-1 and 2-2 clearly show that the most important source categories for PM10 and PM2.5 are the fugitive dust categories. Paved and unpaved roads, agricultural crop/livestock activities, and construction activities comprise over 75 percent of the total inventory for PM10 and slightly over 40 percent of the inventory for PM2.5. For PM2.5, various area source burning categories become more important with wildfires, prescribed, and open burning being important categories, representing between 4-8 percent of the inventory each. Other types of fuel combustion (utility, industrial, residential wood, off-highway vehicles, highway vehicles) also become relatively more important for PM2.5, representing between 2-5 percent of the inventory each. Non-combustion point source industrial processes are relatively minor contributors to the overall PM10/PM2.5 emissions, contributing about 4% of the total PM10 and 8% of the total PM2.5 emissions.

#### **SULFUR DIOXIDE**

Table 2-3 shows that utility coal combustion is far and away the most important source category in the VISTAS states for SO<sub>2</sub>. Utility coal combustion accounts for 70% of regionwide SO<sub>2</sub> emissions. Other types of utility and industrial fuel combustion account for another 17% of the total SO<sub>2</sub>. The industrial component is a “blended” category (with both point and area source components - the actual contributions to these categories from each component will be shown in later tables).

#### **OXIDES OF NITROGEN**

For NO<sub>x</sub>, Table 2-4 shows no single source category stands out. Rather, four types of sources are predominant – utility coal combustion, diesel highway vehicles, gasoline highway vehicles, and nonroad equipment. These four categories account for over 75%

over the total NO<sub>x</sub> emissions in the VISTAS region. Other types of fuel combustion (utility, industrial, and residential) 14% of the total NO<sub>x</sub> emissions.

## **AMMONIA**

Table 2-5 provides an overview of emissions for NH<sub>3</sub> in the VISTAS region. That table clearly shows that the majority of NH<sub>3</sub> emissions are from area sources with livestock activities, crops (fertilizer application) and wastewater treatment processes representing over 85 percent of the total emissions in the VISTAS area. Agricultural chemical manufacturing is the primary ammonia point source category according to the NEI.

## **CARBON MONOXIDE**

Table 2-6 summarizes CO emissions in the VISTAS region. As would be expected, gasoline combustion in highway vehicles and off-road equipment account for most of the CO emissions (over 75%). However, area sources also play an important role in CO emissions in the region, especially the different types of fire categories and residential wood combustion. Point sources have a relatively small contribution in relation to the other source categories

## **VOLATILE ORGANIC COMPOUNDS**

Table 2-7 summarizes VOC emissions in the VISTAS region. All source categories play a major role in VOC emissions in the region. Highway vehicles and nonroad equipment are clearly important. Solvent utilization and volatile liquid storage/transport have both point and area source components, and account for 32% of the total VOC. For the “pure” area sources, the major category contributors to VOC emissions are the burning categories (wildfires, prescribed burning, residential wood combustion, etc.). These burning categories account for over 14 % of the emissions in the VISTAS area. “Pure” point sources contribute about 7% of the total VOC emissions.

**TABLE 2-1****PM10 EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Source Type</b>	<b>Emissions (tons/year)</b>	<b>Percent of Total</b>	<b>Cumulative Percent of Total</b>
Fugitive Dust - Unpaved Roads	Area	1,338,464	31.9	31.9
Fugitive Dust - Paved Roads	Area	811,377	19.3	51.3
Agriculture Crops/Livestock	Area	549,040	13.1	64.3
Fugitive Dust - Construction	Area	337,997	8.1	72.4
Fugitive Dust - Other	Area	166,110	4.0	76.4
Fires - Slash/Prescribed Burning	Area	126,360	3.0	79.4
Fuel Combustion - Electric Generation	Point	96,929	2.3	81.7
Open Burning - Land Clearing Debris	Area	93,790	2.2	83.9
Fuel Combustion - Industrial	Point/Area	89,118	2.1	86.0
Fires - Forest Wildfires	Area	81,737	1.9	88.0
Fuel Combustion - Residential Wood	Area	69,600	1.7	89.7
Off-highway Vehicles	Nonroad	64,588	1.5	91.2
Open Burning - Residential	Area	58,515	1.4	92.6
Wood, Pulp & Paper	Point	51,475	1.2	93.8
Highway Vehicles - Diesel	Highway	39,454	0.9	94.8
Metals Processing	Point	38,398	0.9	95.7
Fires - Agricultural	Area	30,709	0.7	96.4
Mineral Products	Point	29,318	0.7	97.1
Other Industrial Processes	Point/Area	23,613	0.6	97.7
Highway Vehicles - Gasoline	Highway	23,370	0.6	98.2
Storage and Transport	Point	21,450	0.5	98.7
Fuel Combustion - Other	Point/Area	20,724	0.5	99.2
Chemical and Allied Product Mfg.	Point	11,818	0.3	99.5
Other	Area	10,175	0.2	99.8
Petroleum and Related Industries	Point	4,926	0.1	99.9
Other Open Burning	Area	3,797	0.1	100.0
Solvent Utilization	Point/Area	1,663	0.0	100.0
Total for VISTAS States		4,194,515	100.0	

**TABLE 2-2**

**PM2.5 EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Source Type</b>	<b>Emissions (tons/year)</b>	<b>Percent of Total</b>	<b>Cumulative Percent of Total</b>
Fugitive Dust - Paved Roads	Area	203,162	14.1	14.1
Fugitive Dust - Unpaved Roads	Area	202,508	14.1	28.2
Fires - Forest Wildfires	Area	114,283	7.9	36.2
Agriculture Crops/Livestock	Area	103,946	7.2	43.4
Open Burning - Land Clearing Debris	Area	93,790	6.5	49.9
Fires - Slash/Prescribed Burning	Area	73,851	5.1	55.0
Fuel Combustion - Residential Wood	Area	69,600	4.8	59.9
Fugitive Dust - Construction	Area	67,599	4.7	64.6
Fuel Combustion - Industrial	Point/Area	66,865	4.6	69.2
Fuel Combustion - Electric Generation	Point	64,616	4.5	73.7
Off-highway Vehicles	Nonroad	59,153	4.1	77.8
Open Burning - Residential	Area	53,588	3.7	81.6
Wood, Pulp & Paper	Point	42,791	3.0	84.5
Highway Vehicles - Diesel	Highway	34,967	2.4	87.0
Fugitive Dust - Other	Area	33,152	2.3	89.3
Metals Processing	Point	32,354	2.2	91.5
Fires - Agricultural	Area	27,917	1.9	93.5
Fuel Combustion - Other	Point/Area	17,728	1.2	94.7
Mineral Products	Point	16,803	1.2	95.9
Highway Vehicles - Gasoline	Highway	13,503	0.9	96.8
Storage and Transport	Point	12,374	0.9	97.7
Other Industrial Processes	Point/Area	10,660	0.7	98.4
Chemical and Allied Product Mfg.	Point	9,843	0.7	99.1
Other	Area	6,657	0.5	99.6
Other Open Burning	Area	3,764	0.3	99.8
Petroleum and Related Industries	Point	2,582	0.2	100.0
Total for VISTAS States		1,438,056	100.0	

**TABLE 2-3**



**SO2 EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Source Type</b>	<b>Emissions (tons/year)</b>	<b>Percent of Total</b>	<b>Cumulative Percent of Total</b>
Fuel Combustion - Electric Generation - Coal	Point	4,134,176	70.5	70.5
Fuel Combustion - Industrial – Coal	Point/Area	420,855	7.2	77.7
Fuel Combustion - Electric Generation - Oil	Point	315,809	5.4	83.0
Fuel Combustion - Industrial – Oil	Point/Area	125,019	2.1	85.2
Fuel Combustion - Electric Generation - Gas	Point	118,469	2.0	87.2
Off-highway Vehicles	Nonroad	84,431	1.4	88.6
Petroleum and Related Industries	Point	80,696	1.4	90.0
Wood, Pulp & Paper	Point	71,109	1.2	91.2
Fuel Combustion - Comm/Inst – Oil	Point/Area	67,927	1.2	92.4
Chemical and Allied Product Mfg.	Point	67,317	1.1	93.5
Highway Vehicles – Gasoline	Highway	52,915	0.9	94.4
Fuel Combustion - Electric Generation - Other	Point	49,699	0.8	95.3
Metals Processing	Point	48,502	0.8	96.1
Fuel Combustion - Industrial – Gas	Point/Area	47,873	0.8	96.9
Mineral Products	Point	44,506	0.8	97.7
Fuel Combustion - Industrial – Other	Point/Area	34,529	0.6	98.3
Highway Vehicles – Diesel	Highway	28,241	0.5	98.7
Fuel Combustion - Comm/Inst – Coal	Point/Area	19,880	0.3	99.1
Other Industrial Processes	Point/Area	19,815	0.3	99.4
Fuel Combustion - Residential - All Fuels	Area	17,885	0.3	99.7
Fuel Combustion - Comm/Inst – Gas	Point/Area	7,287	0.1	99.9
Waste Disposal and Recycling	Point/Area	5,656	0.1	99.9
Storage and Transport	Point	1,747	0.0	100.0
Other	Area	1,349	0.0	100.0
Total for VISTAS States		5,865,692	100.0	

**TABLE 2-4****NO<sub>x</sub> EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Source Type</b>	<b>Emissions (tons/year)</b>	<b>Percent of Total</b>	<b>Cumulative Percent of Total</b>
Fuel Combustion - Electric Generation - Coal	Point	1,653,624	26.9	26.9
Highway Vehicles - Diesel	Highway	1,097,875	17.8	44.7
Highway Vehicles - Gasoline	Highway	1,049,145	17.1	61.8
Off-highway Vehicles	Nonroad	928,350	15.1	76.9
Fuel Combustion - Industrial - Coal	Point/Area	230,668	3.7	80.6
Fuel Combustion - Industrial - Int Comb	Point/Area	191,686	3.1	83.7
Fuel Combustion - Industrial - Gas	Point/Area	174,549	2.8	86.6
Fuel Combustion - Electric Generation - Oil	Point	98,112	1.6	88.2
Fuel Combustion - Residential - All Fuels	Area	97,713	1.6	89.8
Fuel Combustion - Electric Generation - Gas	Point	86,831	1.4	91.2
Mineral Products	Point	80,070	1.3	92.5
Fires	Area	64,896	1.1	93.5
Fuel Combustion - Electric Generation - Other	Point	61,401	1.0	94.5
Fuel Combustion - Industrial - Other	Point/Area	54,360	0.9	95.4
Fuel Combustion - Comm/Inst - Gas	Point/Area	49,699	0.8	96.2
Wood, Pulp & Paper	Point	49,550	0.8	97.0
Waste Disposal and Recycling	Point/Area	46,245	0.8	97.8
Fuel Combustion - Industrial - Oil	Point/Area	42,670	0.7	98.5
Chemical and Allied Product Mfg.	Point	24,917	0.4	98.9
Other	Area	15,562	0.3	99.1
Metals Processing	Point	13,945	0.2	99.4
Fuel Combustion - Comm/Inst - Oil	Point/Area	12,231	0.2	99.6
Petroleum and Related Industries	Point	11,229	0.2	99.7
Fuel Combustion - Comm/Inst - Coal	Point/Area	7,205	0.1	99.9
Other Industrial Processes	Point/Area	6,991	0.1	100.0
Solvent Utilization	Point/Area	2,207	0.0	100.0
Total for VISTAS States		6,151,731	100.0	

**TABLE 2-5**

**NH3 EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Source Type</b>	<b>Emissions (tons/year)</b>	<b>Percent of Total</b>	<b>Cumulative Percent of Total</b>
Agriculture Livestock	Area	656,346	73.4	73.4
Agriculture Crops	Area	94,911	10.6	84.0
Highway Vehicles - Gasoline	Highway	64,214	7.2	91.1
Agricultural Chemical Mfg.	Point	38,504	4.3	95.4
Wastewater Treatment	Area	15,695	1.8	97.2
Off-highway Vehicles	Nonroad	6,628	0.7	97.9
Fuel Combustion - Electric Generation - Int Comb	Point	5,507	0.6	98.5
Fuel Combustion - Industrial	Point/Area	5,144	0.6	99.1
Other Industrial Processes	Point/Area	1,934	0.2	99.3
Highway Vehicles - Diesel	Highway	1,627	0.2	99.5
Fuel Combustion - Electric Generation - Ext Comb	Point	1,492	0.2	99.7
Fuel Combustion - Other	Point/Area	1,057	0.1	99.8
Metals Processing	Point	750	0.1	99.9
Other	Area	574	0.1	100.0
Petroleum and Related Industries	Point	425	0.0	100.0
Total for VISTAS States		894,808	100.0	

**TABLE 2-6****CO EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Source Type</b>	<b>Emissions (tons/year)</b>	<b>Percent of Total</b>	<b>Cumulative Percent of Total</b>
Highway Vehicles - Gasoline	Highway	16,615,022	59.2	59.2
Off-highway Vehicles	Nonroad	5,444,825	19.4	78.6
Fires - Slash/Prescribed Burning	Area	1,491,954	5.3	83.9
Open Burning - Land Clearing Debris	Area	932,387	3.3	87.2
Fires - Forest Wildfires	Area	880,244	3.1	90.4
Fuel Combustion - Residential Wood	Area	738,833	2.6	93.0
Highway Vehicles - Diesel	Highway	318,149	1.1	94.1
Fuel Combustion - Industrial	Point/Area	301,076	1.1	95.2
Wood, Pulp & Paper	Point	238,196	0.8	96.0
Fires - Agricultural	Area	217,585	0.8	96.8
Metals Processing	Point	180,465	0.6	97.5
Open Burning - Residential	Area	152,608	0.5	98.0
Fuel Combustion - Electric Generation	Point	137,867	0.5	98.5
Chemical and Allied Product Mfg.	Point	136,405	0.5	99.0
Fuel Combustion - Other	Point/Area	65,496	0.2	99.2
Mineral Products	Point	53,708	0.2	99.4
Solvent Utilization	Point/Area	50,646	0.2	99.6
Petroleum and Related Industries	Point	44,260	0.2	99.7
Other	Area	31,250	0.1	99.9
Other Industrial Processes	Point/Area	21,035	0.1	99.9
Other Open Burning	Area	17,096	0.1	100.0
Storage and Transport	Point	1,058	0.0	100.0
Total for VISTAS States		28,070,165	100.0	

**TABLE 2-7****VOC EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Source Type</b>	<b>Emissions (tons/year)</b>	<b>Percent of Total</b>	<b>Cumulative Percent of Total</b>
Highway Vehicles - Gasoline	Highway	1,378,207	28.3	28.3
Solvent Utilization	Point/Area	1,240,964	25.5	53.8
Off-highway Vehicles	Nonroad	617,622	12.7	66.5
Storage and Transport	Point/Area	333,597	6.9	73.3
Fuel Combustion - Residential Wood	Area	272,507	5.6	78.9
Fires - Forest Wildfires	Area	169,353	3.5	82.4
Chemical and Allied Product Mfg.	Point	150,949	3.1	85.5
Fires - Slash/Prescribed Burning	Area	131,352	2.7	88.2
Wood, Pulp & Paper	Point	77,619	1.6	89.8
Other Industrial Processes	Point/Area	75,417	1.5	91.3
Highway Vehicles - Diesel	Highway	65,408	1.3	92.7
Open Burning - Land Clearing Debris	Area	63,998	1.3	94.0
Open Burning - Residential	Area	53,864	1.1	95.1
Agriculture, Food, Kindred Products	Point	51,802	1.1	96.2
Other Open Burning	Area	40,386	0.8	97.0
Fuel Combustion - Industrial	Point/Area	38,301	0.8	97.8
Petroleum and Related Industries	Point	31,526	0.6	98.4
Fires - Agricultural	Area	24,246	0.5	98.9
Metals Processing	Point	15,353	0.3	99.2
Fuel Combustion - Electric Generation	Point	13,492	0.3	99.5
Fuel Combustion - Other	Point/Area	12,683	0.3	99.8
Other	Area	11,325	0.2	100.0
Total for VISTAS States		4,869,971	100.0	

## SECTION 3

### AREA SOURCES

This section discussing area sources is divided into three subsections. First, we provide a summary of the NEI for area sources and describe the important source categories for each pollutant. Second, we summarize the on-going efforts to improve the area source emission estimates that are being conducted by other Regional Planning Organizations, the U.S. EPA, and other Federal agencies. Finally, based on what we learned from the NEI review and the on-going emission improvement activities, we recommend specific short-term and long-term activities that can be undertaken to improve the area source emission inventory in the VISTAS region.

#### EMISSION SUMMARY

The tables that follow (Tables 3-1 to 3-14) provide information on emissions and the ranking of each Tier 3 category within each State in the VISTAS region. The tables that show emissions provide information solely from area sources in the VISTAS region and for each individual VISTAS State. The data presented in these tables is shown by Tier 3 category. The Tier 3 resolution of these tables is slightly more detailed than that presented in Tables 2-1 through 2-7. For instance in Tables 2-1 and 2-2, information was presented for PM10 and PM2.5 concerning Agricultural Crops/Livestock. In actuality the Agricultural Crops/Livestock category in Tables 2-1 and 2-2 represents Agricultural Crops and Agricultural Livestock which are two separate Tier 3 categories and are presented as such in the tables that follow.

Emission tables for each individual VISTAS State are presented in Appendix A. These tables show the emissions for each pollutant by Tier 3 source category along with the cumulative percentage of total area source emissions for that State. Each table in the appendix is presented in the same pollutant order as those presented above.

#### PM10

Table 3-1 shows the PM10 emissions for all area sources across the VISTAS region at the Tier 3 level. This table clearly shows that over 95 percent of the PM10 is found in 10 categories with the majority of those emissions in fugitive dust categories. The remaining categories are all combustion related and are primarily open burning/combustion processes (slash/prescribed, land clearing, wildfires, and residential open burning). Commercial/institutional and industrial sources play minor roles in the overall emission levels of PM10 in the VISTAS region.

Table 3-2 shows the ranking of each Tier 3 category within each State in the VISTAS region. This table clearly shows that paved or unpaved roads are the most important emission categories with the exception of AL (prescribed burning is most important). For all other States in the VISTAS region, either paved or unpaved road emissions are the

most important PM10 emission source. Frequently these two source categories are among the top four categories with the exception of NC and TN where unpaved roads rank 10<sup>th</sup> and 6<sup>th</sup> respectively.

## **PM2.5**

Table 3-3 shows the PM2.5 emissions for all area sources across the VISTAS region. This table clearly shows that over 95 percent of the PM2.5 emissions come from 13 categories. These categories are either fugitive dust or burning activities. The rise in importance of burning activities relative to the information shown in Table 3-1 for PM10 is simply an indication of the change in particle size. Burning activities produce particles that are predominantly in the PM2.5 or smaller range while mechanical activities produce primarily larger particles. Thus the relative importance of fugitive categories (while still important overall) is lessened while burning activities are greater than for PM10.

Table 3-4 provides information on the State-by-State ranking of emission categories for PM2.5. The table shows similar results to the one for PM10. Again, paved or unpaved roads are the most important source for all States except AL. Both categories are among the top 4 in all cases except for NC and TN where unpaved roads again rank 10<sup>th</sup> and 6<sup>th</sup> respectively.

## **Sulfur Dioxide**

Table 3-5 shows the emissions for SO2 from area sources in the VISTAS region. This table clearly shows that the majority of emissions come from area source fuel combustion. Over 95 percent of all SO2 emissions from area sources come from coal or oil fuel combustion, primarily from the commercial/institutional or residential sectors.

Table 3-6 shows the ranking of sources by State for the VISTAS region for SO2. Table 3-6 indicates that for 4 of the 10 VISTAS States, small scale coal combustion (Coal – other) is the highest emitting source, while for 3 of the 10, commercial/institutional coal combustion is the highest emissions source. Distillate or residual oil combustion from either residential or other sources are the highest emitters for the remaining States.

## **Oxides of Nitrogen**

Table 3-7 shows the emissions for NOx from area sources in the VISTAS region. This table clearly indicates that, like SO2, the majority of emissions come from area source fuel combustion. However, unlike SO2, natural gas combustion accounts for over 50 percent of these emissions with coal and oil primarily contributing the remainder. Most of the emissions are centered in either the commercial/institutional or residential sectors.

Table 3-8 details the Tier 3 category rankings for NOx from the VISTAS States. The top ranked source categories are fairly evenly split between miscellaneous natural gas combustion (GA, KY), other coal combustion (SC, VA), miscellaneous other combustion (AL, FL, MS), and residential natural gas (NC, TN, WV).

## **Ammonia**

NH<sub>3</sub> emissions for the VISTAS region are shown in Table 3-9. NH<sub>3</sub> emissions are predominantly derived from two primary source categories, agricultural livestock operations and fertilizer application on crops. Over 97 percent of all NH<sub>3</sub> emissions come from these source categories.

The State-by-State ranking of sources in Table 3-10 indicates two things. First, that for all States in the VISTAS region, NH<sub>3</sub> emission ranks are identical to that shown for the VISTAS region as a whole, with livestock operations ranked first in all States followed by fertilizer application on crops. Second, the reason that this information so closely matches for each State is due to the magnitude of these sources compared to other NH<sub>3</sub> sources as well as the fact that few State have their own NH<sub>3</sub> inventories, thus the methods used to estimate emissions for the 1999 NEI are the same for all States in the VISTAS region.

## **Carbon Monoxide**

As would be expected, over 95 percent of emissions of CO are from burning sources, primarily open burning sources and residential wood combustion. Table 3-11 shows that for the VISTAS region, over 30 percent of all area source CO emissions come from prescribed burning. Burning for land clearing purposes and forest wildfires account for approximately 40 percent of the emissions.

The data presented in Table 3-12 illustrates that open burning sources consistently rank highly in all of the VISTAS States. For example, prescribed burning is ranked either 1, 2 or 3 in all VISTAS States except WV and open burning for land clearing purposes is consistently in the top three.

## **Volatile Organic Compounds**

VOC emissions from area sources in the VISTAS region are shown in Table 3-13. This table shows that VOC emissions arise from a number of categories, however, the majority of emissions are from solvent use, burning, surface coating operations, and fuels handling. Over 70 percent of the area source VOC emissions in the VISTAS region arise from these types of source categories.

Table 3-14 shows the rankings of the various categories that contribute to the VOC emissions in the VISTAS region. Consumer solvent usage rates as number 1 or 2 except for FL, SC and WV. Some combustion sources show wide variability (forest wildfires range from second to 47<sup>th</sup>), while others are fairly closely spaced (residential wood combustion in fireplaces ranges from first to 14<sup>th</sup>).



**TABLE 3-1****PM10 AREA SOURCE EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Emissions (tons/year)</b>	<b>Cumulative Percent of Total</b>
Fugitive Dust-unpaved roads	1,334,224	36.0%
Fugitive Dust-paved roads	810,575	57.8%
Agriculture & Forestry-agricultural crops	431,805	69.5%
Fugitive Dust-construction	337,997	78.6%
Fugitive Dust-other	165,017	83.0%
Other Combustion-slash/prescribed burning	126,360	86.4%
Agriculture & Forestry-agricultural livestock	117,235	89.6%
Open Burning-land clearing debris	93,790	92.1%
Other Combustion-forest wildfires	81,737	94.3%
Open Burning-residential	58,515	95.9%
Residential Wood-woodstoves	37,574	96.9%
Other Combustion-agricultural fires	30,709	97.7%
Residential Wood-fireplaces	26,526	98.4%
Coal-other	10,562	98.7%
Residential Other-other	9,269	99.0%
Incineration-other	5,560	99.1%
Residential Wood-other	5,501	99.3%
Gas-natural	5,190	99.4%
Commercial/Institutional Oil-other	3,843	99.5%
Open Burning-other	3,666	99.6%
Miscellaneous Industrial Processes-other	3,621	99.7%
Agriculture, Food, & Kindred Products-other	3,147	99.8%
Commercial/Institutional Gas-other	2,970	99.9%
Oil-distillate	1,199	99.9%
Oil-residual	1,038	99.9%
Other Combustion-structural fires	719	100.0%
Commercial/Institutional Coal-other	554	100.0%
Other-wood/bark waste	289	100.0%
Other-other	274	100.0%
Misc. Fuel Comb. (Except Residential)-other	221	100.0%
Other Combustion-other	133	100.0%
Total for VISTAS States	3,709,819	

**TABLE 3-2**

**STATE-BY-STATE RANKING OF PM10 AREA SOURCE EMISSIONS AT THE  
TIER 3 CATEGORY LEVEL FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Tier</b>	<b>AL</b>	<b>FL</b>	<b>GA</b>	<b>KY</b>	<b>MS</b>	<b>NC</b>	<b>SC</b>	<b>TN</b>	<b>VA</b>	<b>WV</b>
Agriculture & Forestry - agricultural crops	6	11	4	2	2	2	5	2	10	10
Agriculture & Forestry - agricultural livestock	10	12	13	12	11	13	12	11	12	9
Agriculture, Food, & Kindred Products - other	27	25	24		18	27	23	25	27	
Coal - other	21			20		16	21	19	13	24
Commercial/Institutional Coal - other	28	24	25	23		21	22	24	26	22
Commercial/Institutional Gas - other	20	16	16	18	15	20	17	12	20	13
Commercial/Institutional Oil - other	13	14	20	21	19	18	16	18	18	18
Fugitive Dust - construction	7	6	5	5	5	6	8	3	4	4
Fugitive Dust - other	9	13	11	8	8	11	11	9	8	7
Fugitive Dust - paved roads	4	1	2	1	3	1	2	1	1	3
Fugitive Dust - unpaved roads	2	2	1	4	1	10	1	6	3	1
Gas - natural	14	18	19	14		22	18	23	11	17
Gas - process	25							26		
Incineration - other	16	23	18	15		19		16	16	
Misc. Fuel Comb. (Except Residential) - other						26			21	20
Miscellaneous Industrial Processes - other	19	21	17	17	16	17	15	14		12
Oil - distillate	24	22	23	19		24	20	21	23	15
Oil - residual	29	17	22					22	25	
Open Burning - land clearing debris	5	5	3	9	7	3	3	4	2	6
Open Burning - other	18	19	15	16	14	15	14	15	17	14
Open Burning - residential	8	9	8	6	20	4	6	5	6	5
Other - other	26								19	
Other - wood/bark waste						23		27	22	19
Other Combustion - agricultural fires	15	8	7		6	7				
Other Combustion - forest wildfires	3	3	9	3	9	14	9	17	15	8
Other Combustion - other	22									21
Other Combustion - slash/prescribed burning	1	4	6	7	4	5	4	7	5	16
Other Combustion - structural fires	23	20	21	22	17	25	19	20	24	23
Residential Other - other	17	15	14	13	13	12	13	13	14	11
Residential Wood - fireplaces	12	10	12	11	12	9	10	10	9	
Residential Wood - other										2
Residential Wood - woodstoves	11	7	10	10	10	8	7	8	7	

**TABLE 3-3****PM2.5 AREA SOURCE EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Emissions (tons/year)</b>	<b>Cumulative Percent of Total</b>
Fugitive Dust-paved roads	202,645	18.9%
Fugitive Dust-unpaved roads	200,134	37.5%
Other Combustion-slash/prescribed burning	114,283	48.2%
Open Burning-land clearing debris	93,790	56.9%
Agriculture & Forestry-agricultural crops	86,361	64.9%
Other Combustion-forest wildfires	73,851	71.8%
Fugitive Dust-construction	67,599	78.1%
Open Burning-residential	53,588	83.1%
Residential Wood-woodstoves	37,574	86.6%
Fugitive Dust-other	33,006	89.7%
Other Combustion-agricultural fires	27,917	92.3%
Residential Wood-fireplaces	26,526	94.8%
Agriculture & Forestry-agricultural livestock	17,585	96.4%
Residential Other-other	8,439	97.2%
Residential Wood-other	5,501	97.7%
Gas-natural	4,567	98.1%
Open Burning-other	3,666	98.5%
Commercial/Institutional Gas-other	2,924	98.7%
Incineration-other	2,756	99.0%
Commercial/Institutional Oil-other	2,627	99.2%
Miscellaneous Industrial Processes-other	2,509	99.5%
Coal-other	2,277	99.7%
Oil-distillate	872	99.8%
Other Combustion-structural fires	654	99.8%
Oil-residual	480	99.9%
Commercial/Institutional Coal-other	310	99.9%
Other-wood/bark waste	289	99.9%
Other-other	274	100.0%
Misc. Fuel Comb. (Except Residential)-other	221	100.0%
Other Combustion-other	121	100.0%
Agriculture, Food, & Kindred Products-other	83	100.0%
Gas-process	37	100.0%
Total for VISTAS States	1,073,466	

**TABLE 3-4**

**STATE-BY-STATE RANKING OF PM2.5 AREA SOURCE EMISSIONS AT THE  
TIER 3 CATEGORY LEVEL FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Tier</b>	<b>AL</b>	<b>FL</b>	<b>GA</b>	<b>KY</b>	<b>MS</b>	<b>NC</b>	<b>SC</b>	<b>TN</b>	<b>VA</b>	<b>WV</b>
Agriculture & Forestry - agricultural crops	6	11	4	2	2	2	5	2	10	10
Agriculture & Forestry - agricultural livestock	10	12	13	12	11	13	12	11	12	9
Agriculture, Food, & Kindred Products - other	27	25	24		18	27	23	25	27	
Coal - other	21			20		16	21	19	13	24
Commercial/Institutional Coal - other	28	24	25	23		21	22	24	26	22
Commercial/Institutional Gas - other	20	16	16	18	15	20	17	12	20	13
Commercial/Institutional Oil - other	13	14	20	21	19	18	16	18	18	18
Fugitive Dust - construction	7	6	5	5	5	6	8	3	4	4
Fugitive Dust - other	9	13	11	8	8	11	11	9	8	7
Fugitive Dust - paved roads	4	1	2	1	3	1	2	1	1	3
Fugitive Dust - unpaved roads	2	2	1	4	1	10	1	6	3	1
Gas - natural	14	18	19	14		22	18	23	11	17
Gas - process	25							26		
Incineration - other	16	23	18	15		19		16	16	
Misc. Fuel Comb. (Except Residential) - other						26			21	20
Miscellaneous Industrial Processes - other	19	21	17	17	16	17	15	14		12
Oil - distillate	24	22	23	19		24	20	21	23	15
Oil - residual	29	17	22					22	25	
Open Burning - land clearing debris	5	5	3	9	7	3	3	4	2	6
Open Burning - other	18	19	15	16	14	15	14	15	17	14
Open Burning - residential	8	9	8	6	20	4	6	5	6	5
Other - other	26								19	
Other - wood/bark waste						23		27	22	19
Other Combustion - agricultural fires	15	8	7		6	7				
Other Combustion - forest wildfires	3	3	9	3	9	14	9	17	15	8
Other Combustion - other	22									21
Other Combustion - slash/prescribed burning	1	4	6	7	4	5	4	7	5	16
Other Combustion - structural fires	23	20	21	22	17	25	19	20	24	23
Residential Other - other	17	15	14	13	13	12	13	13	14	11
Residential Wood - fireplaces	12	10	12	11	12	9	10	10	9	
Residential Wood - other										2
Residential Wood - woodstoves	11	7	10	10	10	8	7	8	7	

**TABLE 3-5****SO2 AREA SOURCE EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Emissions (tons/year)</b>	<b>Cumulative Percent of Total</b>
Coal-other	85,293	34.9%
Commercial/Institutional Oil-other	65,928	61.8%
Oil-distillate	21,707	70.7%
Oil-residual	20,914	79.2%
Other-other	10,454	83.5%
Commercial/Institutional Coal-other	9,419	87.4%
Residential Other-distillate oil	7,913	90.6%
Residential Other-bituminous/subbituminous coal	6,167	93.1%
Commercial/Institutional Gas-other	6,002	95.6%
Gas-other	4,250	97.3%
Open Burning-other	1,540	97.9%
Other Combustion-other	1,271	98.4%
Incineration-other	1,003	98.9%
Residential Wood-other	980	99.3%
Incineration-industrial	902	99.6%
Residential Other-other	606	99.9%
Miscellaneous Industrial Processes-other	231	100.0%
Misc. Fuel Comb. (Except Residential)-other	72	100.0%
Total for VISTAS States	244,654	

**TABLE 3-6**

**STATE-BY-STATE RANKING OF SO<sub>2</sub> AREA SOURCE EMISSIONS AT THE  
TIER 3 CATEGORY LEVEL FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Tier</b>	<b>AL</b>	<b>FL</b>	<b>GA</b>	<b>KY</b>	<b>MS</b>	<b>NC</b>	<b>SC</b>	<b>TN</b>	<b>VA</b>	<b>WV</b>
Coal - other	2			1		1	1	1	2	5
Commercial/Institutional Coal - other	4	8	13	4		4	4	5	13	3
Commercial/Institutional Gas - other	15	9	4	10	7	15	12	2	16	12
Commercial/Institutional Oil - other	1	1	1	5	2	6	2	3	3	4
Gas - other	12	11	2	7		16	13	4	10	14
Incineration - industrial	5	14	14	9		13		10	5	
Incineration - other	7	12	11	12		9		14	4	
Misc. Fuel Comb. (Except Residential) - other			15	17				16	17	15
Miscellaneous Industrial Processes - other	13	13	16		4	12	11	15		10
Oil - distillate	3	3	9	2		7	3	7	8	1
Oil - residual	16	2	6	16				6	1	
Open Burning - other	6	6	5	11	8	8	7	11	6	8
Other - other			12	14		2		12	12	2
Other Combustion - other	9	5	3	13	3	11	9	18	11	11
Residential Other - bituminous/subbituminous coal	8			3		5	6	9	14	7
Residential Other - distillate oil	11	4	7	6	1	3	5	8	9	6
Residential Other - other	14	10	10	8	6	14	10	17	15	13
Residential Wood - other	10	7	8	15	5	10	8	13	7	9

**TABLE 3-7****NO<sub>x</sub> AREA SOURCE EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Emissions (tons/year)</b>		<b>Cumulative Percent of Total</b>
Gas-natural	89,248	89,248	22.3%
Residential Other-natural gas	79,916	169,164	42.2%
Other Combustion-other	64,896	234,060	58.4%
Coal-other	45,172	279,232	69.6%
Open Burning-other	38,358	317,590	79.2%
Commercial/Institutional Gas-other	26,032	343,622	85.7%
Commercial/Institutional Oil-other	10,718	354,339	88.4%
Oil-distillate	9,369	363,708	90.7%
Oil-residual	7,870	371,578	92.7%
Residential Wood-other	6,956	378,534	94.4%
Residential Other-distillate oil	5,795	384,330	95.8%
Residential Other-other	5,046	389,375	97.1%
Incineration-other	4,467	393,842	98.2%
Commercial/Institutional Coal-other	2,588	396,430	98.9%
Other-other	2,282	398,712	99.4%
Misc. Fuel Comb. (Except Residential)-other	804	399,516	99.6%
Other-wood/bark waste	783	400,300	99.8%
Miscellaneous Industrial Processes-other	559	400,859	100.0%
Gas-process	168	401,027	100.0%
Landfills-other	14	401,041	100.0%
Total for VISTAS States	401,041		

**TABLE 3-8**

**STATE-BY-STATE RANKING OF NO<sub>x</sub> AREA SOURCE EMISSIONS AT THE  
TIER 3 CATEGORY LEVEL FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Tier</b>	<b>AL</b>	<b>FL</b>	<b>GA</b>	<b>KY</b>	<b>MS</b>	<b>NC</b>	<b>SC</b>	<b>TN</b>	<b>VA</b>	<b>WV</b>
Coal - other	16		5	2			1	3	1	12
Commercial/Institutional Coal - other	17	15	15	8			14	11	15	9
Commercial/Institutional Gas - other	5	6	6	5	4	5	7	2	7	3
Commercial/Institutional Oil - other	12	4	9	11	8		9	8	16	11
Gas - natural	15	2	1	1		4	4	5	2	2
Gas - process	14							18		
Incineration - other	10	14	12	10		7		13	5	
Landfills - other		16								
Misc. Fuel Comb. (Except Residential) - other	11	11	14	16				17	17	16
Miscellaneous Industrial Processes - other	13	17	17		7		13	15		15
Oil - distillate	4	9	11	4			10	10	8	6
Oil - residual	7	7	7	15			3	12	14	
Open Burning - other	3	5	2	6	3	3	2	4	3	4
Other - other	9	12	13	14				16	11	13
Other - wood/bark waste								19	13	14
Other Combustion - other	1	1	4	3	1	2	5	7	9	8
Residential Other - distillate oil	18	8	16	12	5		11	14	6	7
Residential Other - natural gas	2	3	3	7	2	1	6	1	4	1
Residential Other - other	6	13	10	13			12	6	10	5
Residential Wood - other	8	10	8	9	6	6	8	9	12	10



**TABLE 3-9****NH3 AREA SOURCE EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Emissions (tons/year)</b>		<b>Cumulative Percent of Total</b>
Agriculture & Forestry-agricultural livestock	656,346	656,346	85.3%
Agriculture & Forestry-agricultural crops	94,911	751,257	97.7%
POTW-wastewater treatment	15,695	766,952	99.7%
Gas-other	867	767,819	99.8%
Residential Other-other	595	768,415	99.9%
Commercial/Institutional Oil-other	299	768,713	100.0%
Oil-other	179	768,892	100.0%
Commercial/Institutional Gas-other	110	769,002	100.0%
Miscellaneous Industrial Processes-other	17	769,019	100.0%
Coal-other	1	769,020	100.0%
Commercial/Institutional Coal-other	0	769,020	100.0%
Total for VISTAS States	769,020		

**TABLE 3-10**

**STATE-BY-STATE RANKING OF NH3 AREA SOURCE EMISSIONS AT THE  
TIER 3 CATEGORY LEVEL FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Tier</b>	<b>AL</b>	<b>FL</b>	<b>GA</b>	<b>KY</b>	<b>MS</b>	<b>NC</b>	<b>SC</b>	<b>TN</b>	<b>VA</b>	<b>WV</b>
Agriculture & Forestry - agricultural crops	2	2	2	2	2	2	2	2	2	2
Agriculture & Forestry - agricultural livestock	1	1	1	1	1	1	1	1	1	1
Coal - other	9			9		9	10	8	9	
Commercial/Institutional Coal - other				10						
Commercial/Institutional Gas - other	8	8	6	7	5	8	8	5	7	7
Commercial/Institutional Oil - other	5	5	7	8	6	6	6	6	6	8
Gas - other	4	4	4	4		4	4		5	6
Miscellaneous Industrial Processes - other		7					9			
Oil - other	7	9		5		7	7	7	8	4
POTW - wastewater treatment	3	3	3	3	3	3	3	3	3	3
Residential Other - other	6	6	5	6	4	5	5	4	4	5

**TABLE 3-11****CO AREA SOURCE EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Emissions (tons/year)</b>	<b>Cumulative Percent of Total</b>
Other Combustion-slash/prescribed burning	1,491,954	32.7%
Open Burning-land clearing debris	932,387	53.1%
Other Combustion-forest wildfires	880,244	72.4%
Residential Wood-fireplaces	433,484	81.9%
Residential Wood-woodstoves	265,189	87.7%
Other Combustion-agricultural fires	217,585	92.5%
Open Burning-residential	152,608	95.9%
Residential Wood-other	40,160	96.7%
Residential Other-other	35,022	97.5%
Coal-other	22,348	98.0%
Gas-other	19,250	98.4%
Open Burning-other	16,796	98.8%
Other-other	14,992	99.1%
Other Combustion-other	8,673	99.3%
Commercial/Institutional Gas-other	8,284	99.5%
Incineration-commercial/institutional	5,715	99.6%
Incineration-industrial	4,219	99.7%
Other Combustion-structural fires	3,993	99.8%
Oil-other	3,050	99.9%
Incineration-other	2,532	99.9%
Commercial/Institutional Oil-other	1,638	100.0%
Commercial/Institutional Coal-other	1,282	100.0%
Miscellaneous Industrial Processes-other	359	100.0%
Misc. Fuel Comb. (Except Residential)-other	311	100.0%
Landfills-other	46	100.0%
<b>Total for VISTAS States</b>	<b>4,562,123</b>	

**TABLE 3-12**

**STATE-BY-STATE RANKING OF CO AREA SOURCE EMISSIONS AT THE  
TIER 3 CATEGORY LEVEL FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Tier</b>	<b>AL</b>	<b>FL</b>	<b>GA</b>	<b>KY</b>	<b>MS</b>	<b>NC</b>	<b>SC</b>	<b>TN</b>	<b>VA</b>	<b>WV</b>
Coal - other	20		17	8			13	7	5	16
Commercial/Institutional Coal - other	21	22	16	14			16	18	15	17
Commercial/Institutional Gas - other	9	14	11	15	9	13	10	10	18	10
Commercial/Institutional Oil - other	17	13	18	17	12		14	17	20	13
Gas - other	18	10	7	7		10	7	12	11	9
Incineration - commercial/institutional	11	21	13	12		11		15	10	
Incineration - industrial	10	19	12	11				13	14	
Incineration - other		16						11	13	
Landfills - other		17								
Misc. Fuel Comb. (Except Residential) - other	19	18	20	19				21	19	15
Miscellaneous Industrial Processes - other	14	23	21		11		15	19		18
Oil - other	12	15	15	13			11	16	16	11
Open Burning - land clearing debris	3	2	1	2	2	2	2	1	1	2
Open Burning - other	8	11	9	10	7	9	9	9	12	8
Open Burning - residential	5	7	6	6	13	6	4	5	7	4
Other - other	16	20	19	18				20	6	6
Other Combustion - agricultural fires	7	5	10		3	3				
Other Combustion - forest wildfires	2	1	3	1	4	7	5	8	8	3
Other Combustion - other	15	8								14
Other Combustion - slash/prescribed burning	1	3	2	3	1	1	3	2	2	7
Other Combustion - structural fires	13	12	14	16	10	12	12	14	17	12
Residential Other - other	6	9	8	9	8	8	8	6	9	5
Residential Wood - fireplaces	4	6	5	5	6	5	1	4	4	
Residential Wood - other										1
Residential Wood - woodstoves		4	4	4	5	4	6	3	3	

**TABLE 3-13**

**VOC AREA SOURCE EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Emissions (tons/year)</b>	<b>Cumulative Percent of Total</b>
Nonindustrial-consumer solvents	201,918	9.1%
Residential Wood-fireplaces	176,828	17.1%
Other Combustion-slash/prescribed burning	169,353	24.8%
Other Combustion-forest wildfires	131,352	30.8%
Surface Coating-architectural	122,744	36.3%
Service Stations: Stage II-other	118,908	41.7%
Service Stations: Stage I-other	104,221	46.4%
Degreasing-other	89,620	50.5%
Nonindustrial-pesticide application	64,370	53.4%
Open Burning-land clearing debris	63,998	56.3%
Surface Coating-other	60,166	59.0%
Residential Wood-woodstoves	59,272	61.7%
Open Burning-residential	53,864	64.1%
Nonindustrial-adhesives	51,165	66.4%
Polymer & Resin Mfg-synthetic fiber	48,889	68.6%
Surface Coating-wood furniture	47,578	70.8%
Bulk Terminals & Plants-area source: gasoline	46,495	72.9%
Nonindustrial-cutback asphalt	46,364	75.0%
Graphic Arts-other	41,026	76.9%
Residential Wood-other	36,408	78.5%
Surface Coating-industrial adhesives	33,779	80.0%
Surface Coating-metal furniture	29,823	81.4%
Dry Cleaning-petroleum solvent	28,043	82.7%
Surface Coating-auto refinishing	25,671	83.8%
Other Combustion-agricultural fires	24,246	84.9%
Surface Coating-maintenance coatings	23,603	86.0%
Surface Coating-metal cans	23,094	87.0%
Surface Coating-traffic markings	21,911	88.0%
Petroleum Refineries & Related Industries-other	18,897	88.9%
Surface Coating-autos & light trucks	18,725	89.7%
Dry Cleaning-perchloroethylene	16,222	90.5%
Surface Coating-electronic & other electrical	15,870	91.2%
Organic Chemical Mfg-socmi fugitives	13,697	91.8%
Service Stations: Breathing & Emptying-other	13,249	92.4%
Agriculture, Food, & Kindred Products-bakeries	13,018	93.0%
Surface Coating-metal coil	10,474	93.5%
Petroleum & Petroleum Product Transport-other	10,026	93.9%
Surface Coating-large ships	10,013	94.4%
Petroleum & Petroleum Product Storage-other	9,942	94.8%
Surface Coating-large appliances	8,575	95.2%
Agriculture & Forestry-other	7,521	95.5%
Other-other	7,464	95.9%

<b>Source Category</b>	<b>Emissions (tons/year)</b>	<b>Cumulative Percent of Total</b>
Other Industrial-rubber & plastics mfg	7,222	96.2%
Surface Coating-machinery	6,698	96.5%
POTW-other	6,573	96.8%
Residential Other-other	6,530	97.1%
Solvent Utilization NEC-other	5,951	97.4%
Nonindustrial-other asphalt	5,496	97.6%
Surface Coating-paper	5,407	97.9%
Dry Cleaning-other	4,861	98.1%
TSDf-other	4,485	98.3%
Landfills-other	4,208	98.5%
Surface Coating-flatwood products	4,051	98.7%
Incineration-other	3,421	98.8%
Open Burning-other	3,133	99.0%
Oil & Gas Production-other	2,994	99.1%
Bulk Terminals & Plants-other	2,532	99.2%
Other Combustion-other	2,220	99.3%
Coal-other	2,218	99.4%
Miscellaneous Industrial Processes-other	1,656	99.5%
Gas-other	1,605	99.6%
Pharmaceutical Mfg-other	1,422	99.6%
Commercial/Institutional Gas-other	1,081	99.7%
Surface Coating-aircraft	939	99.7%
Graphic Arts-lithographic	925	99.8%
Agriculture, Food, & Kindred Products-other	881	99.8%
Other Combustion-structural fires	732	99.8%
Other-other	648	99.9%
Catastrophic/Accidental Releases-other	519	99.9%
Surface Coating-misc. metal parts	452	99.9%
Surface Coating-railroad	430	99.9%
Oil-other	371	99.9%
Commercial/Institutional Oil-other	233	99.9%
Industrial Waste Water-other	204	100.0%
Graphic Arts-flexographic	202	100.0%
Graphic Arts-letterpress	157	100.0%
Graphic Arts-gravure	152	100.0%
Rubber & Miscellaneous Plastic Products-other	133	100.0%
Commercial/Institutional Coal-other	125	100.0%
Nonindustrial-other	100	100.0%
Misc. Fuel Comb. (Except Residential)-other	80	100.0%
Inorganic Chemical Mfg-other	11	100.0%
Organic Chemical Storage-other	4	100.0%
Total for VISTAS States	2,209,462	

**TABLE 3-14**

**STATE-BY-STATE RANKING OF VOC AREA SOURCE EMISSIONS AT THE  
TIER 3 CATEGORY LEVEL FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Tier</b>	<b>AL</b>	<b>FL</b>	<b>GA</b>	<b>KY</b>	<b>MS</b>	<b>NC</b>	<b>SC</b>	<b>TN</b>	<b>VA</b>	<b>WV</b>
Agriculture & Forestry - other				13				21		
Agriculture, Food, & Kindred Products - bakeries	38	34	23	26	40	28	34	29	38	32
Agriculture, Food, & Kindred Products - other		43	46					69	50	
Bulk Terminals & Plants - area source: gasoline	9	15	16	9	3		12	20	21	9
Bulk Terminals & Plants - other		66		41				37	39	
Catastrophic/Accidental Releases - other		44						59	54	
Coal - other	67		64	54			50	53	29	
Commercial/Institutional Coal - other	68	67	63	58			55	65	49	61
Commercial/Institutional Gas - other	56	51	53	56	48	44	48	52	48	53
Commercial/Institutional Oil - other	66	50	67	62	52		54	60	53	60
Degreasing - other	4	7	9	7	16	10	3	7	18	5
Dry Cleaning - other	34		24						33	
Dry Cleaning - perchloroethylene	25	25	32	33	28	26	23	27		31
Dry Cleaning - petroleum solvent	18	18	26	25	24	18	17	17		24
Gas - other	64	48	50	38		42	44	57	46	52
Graphic Arts - flexographic			51							
Graphic Arts - gravure			56							
Graphic Arts - letterpress			55							
Graphic Arts - lithographic			36							
Graphic Arts - other	17	9	27	19	22	22	10	18	15	17
Incineration - other	48	62	47	55		40		46	28	
Industrial Waste Water - other				47						
Inorganic Chemical Mfg - other								64		
Landfills - other	49	45	69	49				40	24	59
Misc. Fuel Comb. (Except Residential) - other	63	60	70	64				67	52	58
Miscellaneous Industrial Processes - other	51	55	58	48	43		52	44		36
Nonindustrial - adhesives	29	5	14	10	15	14	28	9		27
Nonindustrial - consumer solvents	5	1	1	1	2	2	7	1	1	4
Nonindustrial - cutback asphalt	14	14	17	16	12	17	15	19	6	
Nonindustrial - other	52								55	
Nonindustrial - other asphalt	46		60						14	
Nonindustrial - pesticide application	8	24	11	14	4	16	25	16	2	12
Oil - other	60	61	65	51			51	61	51	49
Oil & Gas Production - other	42	56	71	34	34		53	56		21
Open Burning - land clearing debris	11	11	3	17	17	12	11	14	9	10
Open Burning - other	47	46	42	42	41	38	38	51	44	37
Open Burning - residential	15	23	13	11	53	15	4	13	16	8
Organic Chemical Mfg - socmi fugitives	20	42	30	21	42		20	23		14
Organic Chemical Storage - other								68		
Other - other	126	112	134	102		47		77	84	86
Other Combustion - agricultural fires	40	21	43		9	8				
Other Combustion - forest wildfires	3	2	5	2	10	33	14	47	32	6
Other Combustion - other	59	30								57

<b>Tier</b>	<b>AL</b>	<b>FL</b>	<b>GA</b>	<b>KY</b>	<b>MS</b>	<b>NC</b>	<b>SC</b>	<b>TN</b>	<b>VA</b>	<b>WV</b>
Other Combustion - slash/prescribed burning	1	17	2	23	18	1	22	31	26	51
Other Combustion - structural fires	57	49	59	57	47	45	49	55	47	55
Other Industrial - rubber & plastics mfg	44	37	39	36	37	29	27	38		40
Petroleum & Petroleum Product Storage - other	58	53	15	44		49		43	19	50
Petroleum & Petroleum Product Transport - other	55	19	61	53		43		54	20	56
Petroleum Refineries & Related Industries - other	41		62	15	1			36		41
Pharmaceutical Mfg - other	54	57	48		39		41	49		54
Polymer & Resin Mfg - synthetic fiber	21	10	19		49		2	6		
POTW - other	53	39	29	37	44		43	42	30	35
Residential Other - other	35	38	41	45	46	32	42	39	40	28
Residential Wood - fireplaces	2	8	6	3	14	5	1	5	4	
Residential Wood - other										1
Residential Wood - woodstoves		13	8	8	19	9	9	10	8	
Rubber & Miscellaneous Plastic Products - other		54								
Service Stations: Breathing & Emptying - other	31	28	31	31	29	30	29	35	27	29
Service Stations: Stage I - other	22	6	12	6	7	3	6	3	7	2
Service Stations: Stage II - other	7	4	7	4	6	20	5	2	3	7
Solvent Utilization NEC - other	13									13
Surface Coating - aircraft	43	58	54	61	51	48	46	62		46
Surface Coating - architectural	6	3	4	5	8	4	8	4	5	3
Surface Coating - auto refinishing	10	20	18	28	32	27	31	32	22	26
Surface Coating - autos & light trucks	23	33	34	29	21	23	26	25	25	19
Surface Coating - electronic & other electrical	28	31	33	27	31	24	21	30	35	47
Surface Coating - flatwood products	27	52	49	59	45	41	36	58	34	33
Surface Coating - industrial adhesives	19	22	20	18	20	13	13	15		22
Surface Coating - large appliances	30	63	37	22	35	36	45	26	42	38
Surface Coating - large ships	50	36	44	50	27	39	40	50	12	39
Surface Coating - machinery	39	40	45	46	36	34	30	45	37	25
Surface Coating - maintenance coatings	24	27	22	24	25	19	24	24	23	23
Surface Coating - metal cans	32	29	21	32	23	21	39	33	11	16
Surface Coating - metal coil	33	32	35	35	30	31	32	34	36	34
Surface Coating - metal furniture	36	35	38	40	13	11	19	22	10	43
Surface Coating - misc. metal parts										30
Surface Coating - other	12	12	10	12	11	6	18	8	17	15
Surface Coating - paper	45	41	40	52	33	35	33	41		45
Surface Coating - railroad	62	64	57	60	50	46	47	63		48
Surface Coating - traffic markings	26	16	28	20	26	25	35	28	31	20
Surface Coating - wood furniture	16	26	25	30	5	7	16	12	13	11
TSDF - other	37	59	52	43	38	37	37	48	45	18



## **ON-GOING EFFORTS TO IMPROVE AREA SOURCE INVENTORY**

### **Implications of the NEI Review on Development of Emission Estimates for the VISTAS Region**

The data presented above indicates that for a number of source categories, “typical” growth factors may not be sufficient to project the emissions from those sources. With source categories like fugitive dust, wildfires and prescribed burning and agricultural sources representing major components of the emissions of several regional haze pollutants, different types of growth or projection indicators will be needed to develop the 2002 inventory.

### **On-Going Work By Other RPOs That May Impact VISTAS Emission Inventory Development**

#### **MARAMA**

MARAMA has started work on a survey designed to update and enhance the current methods for estimating residential wood combustion and open burning activity data. This work was initiated in 2001. A survey design document (dated July 2001) has been developed and is available on the MARAMA website at the following web address:

[http://www.marama.org/visibility/combustion\\_project.pdf](http://www.marama.org/visibility/combustion_project.pdf)

For open burning activity (primarily yard waste) MARAMA’s contractor developed a survey instrument and surveyed local fire wardens and chiefs to collect as much information as possible related to activity data as recommended by the EIIP method (e.g., how many households in a jurisdiction are burning their household or yard waste, how much, and how often, and how does it vary throughout the year, etc.). They also obtained information on rule effectiveness in those areas where open burning was prohibited. A test survey and work plan are available on the MARAMA website at the following web address:

[http://www.marama.org/visibility/techmemo\\_Jan31.pdf](http://www.marama.org/visibility/techmemo_Jan31.pdf)

However the final results of the survey have not been posted to the MARAMA website as of the date of this report (the final update of the report was completed in December 2002). Nor has the work related to residential wood combustion been posted. If information on the survey results is available, it may be useful in assisting with developing emissions estimates for these sources for VISTAS, however it will need to be reviewed for applicability to the VISTAS emission inventory effort.

Since ammonia is of particular interest to VISTAS, MARAMA completed a contract with Carnegie Mellon University (CMU) in March 2002 that resulted in an updated version of the CMU ammonia inventory model. That model will be used to develop the emission estimates for this work. The model can be found at the following link:

<http://www.envinst.cmu.edu/nh3/nh3inven.zip>

The user's manual can be found at the following link:

<http://www.envinst.cmu.edu/nh3/cmuh3userguide.pdf>

#### CenSARA/CenRAP

Current status of work in the CenRAP RPO is unclear at this point. They are currently working on an emission inventory but the status is unclear as is the applicability of the inventory work to the area source component of the VISTAS inventory.

#### MANE-VU

MANE-VU is affiliated with many of the States in the MARAMA region (as well as NESCAUM and the OTC). A revised Test Survey and Work Plan for Open Burning Emission Inventory development was prepared for MANE-VU and submitted in January 2002. This work is associated with the work discussed in the MARAMA section. The information on the MANE-VU website does not provide additional information on the current status of the work.

#### WRAP

WRAP has been active in working on several emission inventory issues. In particular their fire emissions committee has been looking at updated information on estimating emissions from prescribed, agricultural, and wildfire emissions. Some of the information developed by WRAP may be applicable and available for use by VISTAS. However, because of the differences in types of fuels and fuel loadings, these data may have limited applicability to VISTAS States.

In addition, WRAP currently has a project underway that is designed to estimate primary particulate emissions from vacant lands in the western U.S. The approach being developed for that work is to use wind tunnel studies to characterize the emission factors along with the soil characteristics of the vacant lands in order to develop a classification scheme that will be used to provide a corresponding emission factor for each vacant land area. Emission estimates will then be developed using these factors and corresponding meteorological information. Estimates of emissions from this category are currently missing from the NEI. It is unlikely that this information will be available in the timeframe required for VISTAS. In addition, since the study will only be looking at wind tunnel studies in the western U.S. and for western soils the applicability to the VISTAS area may be limited. One component of the work that may have some applicability to VISTAS would be information on cropping schedules.

WRAP has also performed an evaluation of fugitive dust sources. The results of the expert panel convened to evaluate fugitive dust sources was published on the WRAP website. The link for that report is:

<http://www.wrapair.org/forums/RDev/projects/dust/FugativeDustFinal.doc>

As a consequence of the WRAP expert panel findings, EPA has been actively working on developing fugitive dust “attenuation “ factors for use by modelers. These factors are designed to take into account the reduction of emissions via impaction and deposition between the emission release point and the actual measurement at ambient monitoring locations. These factors are best applied during emissions modeling, rather than being applied to the inventory itself, but it is possible to apply them to the inventory. Application to the inventory would require additional data on land use and plant species information.

### **EPA Improvements to the NEI**

EPA considers the 1999 NEI version 2 final inventory to be suitable for general use at this time. However, this inventory is not the last 1999 criteria emissions inventory EPA plans to issue. EPA is still working a draft of version 3 of this inventory, which will incorporate data received too late for this version 2, after which EPA will seek comments and corrections and issue a final version 3. Some of the states for which 1999 data were not available when version 2 final was compiled have now provided EPA with their data, and EPA is working to incorporate this data into the next versions. Among the VISTAS states, this includes for area sources Georgia, Mississippi, Tennessee (Davidson county), and Virginia. These data will be incorporated into 1999 version 3 for criteria pollutants.

Also, the 1999 NEI version 2 final inventory includes some estimates by EPA which EPA has since decided to reconsider. Specifically, the estimates for construction related soil dust emissions and for open burning of debris from land clearing for road and building construction will be reconsidered, especially for urban areas. Possibly, the next version of the criteria emissions inventory will incorporate recent or forthcoming emission estimates by the Western Regional Air Partnership for wildfires, prescribed burning, agricultural burning, and unpaved road dust. There may be other revisions at EPA’s initiative.

### **Potential Remaining Weaknesses with Current Emission Inventories**

While reviewing the 1999 NEI and current work being performed by RPOs we looked at the recommendations made for MARAMA as part of the “Assessment of Emissions Inventory Needs for Regional Haze Plans” document to help determine where progress had been made and where needs still exist for inventory improvement. In the executive summary of that report, a number of recommendations for improvement were made. Those recommendations were:

1. Develop an accepted source monitoring method or methods to accurately measure the filterable and condensable fractions of fine particulate matter from additional types of combustion sources;

2. Improve the scientific understanding of the mechanisms that alter or decrease the mass of primary fine particulate matter from fugitive dust sources;
3. Obtain better information about the chemical mechanisms and reactions that control gas-to-particle conversion processes;
4. Develop better emissions factors for ammonia sources;
5. Improve scientific understanding of the nature of ammonia sinks and the interactions between sources and sinks under varying ambient concentrations;
6. Develop improved speciation factors for sources of organic and fine particulate pollutants.

With respect to these areas for improvement, the current 1999 NEI Version 2 evaluated here has addressed item #1 since it now includes limited information concerning both filterable and condensable fractions of fine PM. The PM numbers presented here represent combined estimates of filterable and condensable. Work by WRAP and EPA had started to address item #2, but (as indicated above) should normally be applied during modeling rather than directly to the inventory. Little new work has been performed on items #3, 4, 5 or 6. Most of the work to address weaknesses in the current inventories, especially as it relates to the area source component has focused on improvements to the activity data associated with the emission sources.

Significant changes in the way emissions are estimated for some burning sources have been made in the NEI. In particular emissions from burning of debris for land clearing purposes and residential yard waste burning have resulted in increased emissions from these categories relative to earlier versions of the inventory. Other changes have been made in how some of the fugitive dust categories have been estimated however these categories still represent a substantial fraction of the overall emissions.

## **RECOMMENDATIONS FOR IMPROVING THE AREA SOURCE INVENTORY**

Listed below are our short-term recommendations for developing the area source component of the preliminary 2002 VISTAS regional emission inventory. This is followed by our longer-term recommendations for making future improvements to the inventory. Our recommendations are based on our review of the 1999 NEI Version 2 Final and the various on-going emission inventory improvement activities discussed in Section 4 of this report. The short-term recommendations can be accomplished over the next six months, resulting in a preliminary 2002 inventory that can be fed into an emission model to produce the episode-specific inputs needed for preliminary atmospheric modeling. The longer-term activities can likely be accomplished over the next 2-3 years.

### **Recommendations for Short-term Activities to Produce VISTAS Preliminary 2002 Area Source Inventory**

1. Obtain updated activity data related to fugitive dust sources, primarily paved and unpaved roads, livestock activities and agricultural activity (tilling). Updating the

agricultural activity will also assist in the development of ammonia emissions. In addition, these source categories are not as amenable to using growth factors as some other less important categories so the improvement from obtaining activity data would have a greater impact. Finally, the emission factors for these categories in the NEI tends to change less dramatically from year to year so changes in activity data will provide the greatest impact on estimating emissions in 2002.

2. Obtain updated activity data for fire sources. In particular, activity (and fuel data if available) will provide for updated estimates for wildfires, prescribed burns, residential combustion, and land clearing operations. Each of these sources is important for fine particulate. None of these sources is easily projected using growth factors.
3. Obtain updated activity data for animal operations. Use that data with the CMU ammonia model to provide updated estimates of ammonia from animal operations. Determine (in conjunction with VISTAS) if any of the State supplied data for ammonia emissions should be used to replace ammonia emissions calculated with the CMU model.
4. Conduct QA/QC of State/local agency area source submittals. Review area source submittals to determine how much information submitted matches with the current NEI and to determine if there are significant missing sources. Evaluate the pollutants that are missing that will need to be estimated using alternative means. Evaluate whether or not the State/local submittals provide any new information related to temporal profiles. Work with the point source inventory to assess potential double counting of sources.
5. Provide State/local agencies with the comparison of emissions reported in the 1999 NEI Version 2 Final and the State/local supplied data. Identify gaps and logical inconsistencies. Ask States/local agencies to provide feedback on large scale inconsistencies and on missing sources. Update database with State/local supplied revisions.
6. Review speciation information to determine if there are gaps in the data required to develop a speciated emission inventory. In addition, review older version of NEI to determine speciation factors used to prepare elemental and organic carbon estimates (never published).
7. Convert preliminary 2002 VISTAS inventory from NIF format to format required by the selected emission modeling system.

For those sources not specifically updated with revised activity data or estimates from State/local agencies, growth factors will be produced to provide 2002 emission estimates.

### **Recommendations for Longer-term Activities to Produce VISTAS Final 2002 Area Source Inventory**

1. Establish on-going long term mechanism to collect activity, fuel and other data related to fires. This work may be carried out in conjunction with other agencies.

2. Establish on-going long term mechanism to collect activity data related to unpaved roads. This work may be carried out in conjunction with other agencies.
3. Update ammonia emissions when new emission factors become available from EPA or other agencies for important source categories.
4. Update PM2.5 emissions as new emission factors are prepared by EPA.

## **SECTION 4**

### **POINT SOURCES**

This section discussing point sources is divided into three subsections. First, we provide a summary of the NEI for point sources and describe the important source categories for each pollutant. Second, we summarize the on-going efforts to improve the point source emission estimates that are being conducted by other Regional Planning Organizations, the U.S. EPA, and other Federal agencies. Finally, based on what we learned from the NEI review and the on-going emission improvement activities, we recommend specific short-term and long-term activities that can be undertaken to improve the point source emission inventory in the VISTAS region.

#### **EMISSION SUMMARY**

Table 4-1 summarizes point source emissions for each state in the VISTAS region. The table has three summaries – total emissions, utility emissions, and non-utility emissions. The table shows that emissions of SO<sub>2</sub> and NO<sub>x</sub> are predominantly generated by utilities, while the non-utility sector generates most of the PM<sub>10</sub>, PM<sub>2.5</sub>, CO, VOC and ammonia.

Tables 4-2 to 4-8 provide information on emissions and the ranking of each Tier 3 category within each State in the VISTAS region. The tables show emissions solely from point sources, grouped by EPA Tier 3 category. The Tier 3 resolution of these tables is more detailed than that presented earlier in Tables 2-1 through 2-7. Emission tables for each individual VISTAS State are presented in Appendix B. Each table in the appendix is presented in the same pollutant order as those presented here.

#### **PM<sub>10</sub>**

Table 4-1 shows the PM<sub>10</sub> emissions for all point sources across the VISTAS region. This table shows that there are a variety of important fuel combustion and industrial process point source categories. While utility coal combustion is the largest single category, other utility fuel combustion (oil, natural gas, internal combustion) and industrial fuel combustion (coal, oil, wood, natural gas, bagasse) are also significant. In total, utility fuel combustion accounts for 27% of the total point source PM<sub>10</sub> emissions, while industrial fuel combustion accounts for 20% of the total. Several industrial process categories are also significant – pulp & paper, mineral products, ferrous metals, non-ferrous metals, and chemical manufacturing/storage.

#### **PM<sub>2.5</sub>**

Table 4.2 shows the PM<sub>2.5</sub> emissions for all point sources across the VISTAS region. The important PM<sub>2.5</sub> source categories are the same as the important PM<sub>10</sub> source categories. Utility fuel combustion accounts for 25% of the total point source PM<sub>2.5</sub> emissions, while industrial fuel combustion accounts for 22% of the total. Several

industrial process categories are also significant – pulp & paper, mineral products, ferrous metals, non-ferrous metals, and chemical manufacturing/storage.

### **Sulfur Dioxide**

Table 4-3 shows the emissions for SO<sub>2</sub> from area sources in the VISTAS region. This table clearly shows that the majority of emissions (about 75%) come from coal combustion at electric utilities. Other combustion at utilities accounts for another 9% of the total. Industrial fuel combustion accounts for about 9% of the total SO<sub>2</sub>.

### **Oxides of Nitrogen**

Table 4-4 shows the emissions for NO<sub>x</sub> from area sources in the VISTAS region. Coal combustion at electric utilities again is the dominant source category, accounting for 62% of the total NO<sub>x</sub> emissions. Other combustion at utilities accounts for another 9% of the total. Industrial fuel combustion, including internal combustion units, accounts for about 20% of the total NO<sub>x</sub>.

### **Ammonia**

NH<sub>3</sub> emissions for the VISTAS region are shown in Table 4-5. NH<sub>3</sub> emissions are predominantly derived from the manufacture of agricultural chemicals. Over 72% of all point source NH<sub>3</sub> emissions come from this source category. Smaller but significant amounts of ammonia are emitted from utility and industrial internal combustion units, presumably resulting from “ammonia slip” from use of selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR) to reduce emissions of NO<sub>x</sub> from stationary sources. As will be discussed later, there is a large degree of uncertainty associated with point source ammonia emissions.

### **Carbon Monoxide**

CO emissions from point sources in the VISTAS region are summarized in Table 4-6. This table shows that there are a variety of important fuel combustion and industrial process point source categories. The wood products/pulp & paper industry is the largest source category, accounting for 21% of the total CO emissions. Industrial fuel combustion (wood and bagasse) and chemical manufacturing are the next largest source categories, each accounting for roughly 12% of the total CO. Utility coal combustion and several industrial process categories are also significant – chemical manufacturing, non-ferrous metals, ferrous metals, and mineral products.

### **Volatile Organic Compounds**

VOC emissions from point sources in the VISTAS region are shown in Table 4-7. This table shows that VOC emissions arise from a number of categories. Surface coating is the largest VOC-emitting category, accounting for about 25% of the total VOC. But there are also a wide variety of other industrial processes that are important.



**TABLE 4-1**

**SUMMARY OF POINT SOURCE EMISSIONS BY STATE  
FROM 1999 NEI VERSION 2 FINAL**

<b>All Point Sources (tons/year)</b>							
<b>State</b>	<b>SO2</b>	<b>NOx</b>	<b>VOC</b>	<b>CO</b>	<b>PM2.5</b>	<b>PM10</b>	<b>NH3</b>
AL	653,198	288,834	70,359	168,456	27,149	37,128	4,015
FL	815,639	391,589	49,003	172,444	54,238	70,583	1,677
GA	596,291	244,631	36,069	178,723	41,645	55,495	15,794
KY	701,844	359,896	66,892	105,054	17,553	28,816	579
MS	213,125	184,415	60,732	70,401	29,793	41,156	27,867
NC	525,264	267,689	87,675	79,461	22,519	34,866	950
SC	285,933	138,236	35,386	58,907	11,941	17,897	1,053
TN	604,652	286,098	120,993	108,030	27,241	35,718	113
VA	304,139	174,564	49,716	76,011	12,657	18,364	777
WV	<u>755,387</u>	<u>339,371</u>	<u>22,433</u>	<u>112,572</u>	<u>12,128</u>	<u>17,169</u>	<u>486</u>
<b>Total</b>	<b>5,455,472</b>	<b>2,675,323</b>	<b>599,258</b>	<b>1,130,059</b>	<b>256,864</b>	<b>357,192</b>	<b>53,311</b>
<b>Utility Point Source Emissions (tons/year)</b>							
<b>State</b>	<b>SO2</b>	<b>NOx</b>	<b>VOC</b>	<b>CO</b>	<b>PM2.5</b>	<b>PM10</b>	<b>NH3</b>
AL	542,657	186,387	2,235	11,515	1,743	3,764	16
FL	741,336	336,362	2,519	48,648	22,847	31,883	1,176
GA	513,541	175,996	1,009	8,404	4,929	9,493	35
KY	662,812	307,077	1,401	11,973	3,571	6,184	16
MS	142,500	81,394	2,134	17,300	6,974	7,438	5,618
NC	380,687	139,160	808	8,753	9,454	15,762	14
SC	228,515	93,227	418	6,656	4,770	8,729	9
TN	473,921	189,137	1,068	7,219	7,732	9,219	10
VA	234,568	103,783	735	7,244	2,157	3,558	86
WV	<u>697,614</u>	<u>287,444</u>	<u>1,162</u>	<u>10,154</u>	<u>435</u>	<u>895</u>	<u>16</u>
<b>Total</b>	<b>4,618,151</b>	<b>1,899,967</b>	<b>13,489</b>	<b>137,866</b>	<b>64,612</b>	<b>96,925</b>	<b>6,996</b>
<b>Non-Utility Point Source Emissions (tons/year)</b>							
<b>State</b>	<b>SO2</b>	<b>NOx</b>	<b>VOC</b>	<b>CO</b>	<b>PM2.5</b>	<b>PM10</b>	<b>NH3</b>
AL	110,541	102,447	68,124	156,941	25,406	33,364	3,999
FL	74,303	55,227	46,484	123,796	31,391	38,700	501
GA	82,750	68,635	35,060	170,319	36,716	46,002	15,759
KY	39,032	52,819	65,491	93,081	13,982	22,632	563
MS	70,625	103,021	58,598	53,101	22,819	33,718	22,249
NC	144,577	128,529	86,867	70,708	13,065	19,104	936
SC	57,418	45,009	34,968	52,251	7,171	9,168	1,044
TN	130,731	96,961	119,925	100,811	19,509	26,499	103
VA	69,571	70,781	48,981	68,767	10,500	14,806	691
WV	<u>57,773</u>	<u>51,927</u>	<u>21,271</u>	<u>102,418</u>	<u>11,693</u>	<u>16,274</u>	<u>470</u>
<b>Total</b>	<b>837,321</b>	<b>775,356</b>	<b>585,769</b>	<b>992,193</b>	<b>192,252</b>	<b>260,267</b>	<b>46,315</b>

**TABLE 4-2**

**PM10 POINT SOURCE EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Emissions (tons/year)</b>	<b>Cumulative Percent of Total</b>
Utility – coal	59,701	16.7
Wood, Pulp & Paper	51,469	31.1
Industrial - other fuel (wood, bagasse)	36,738	41.4
Mineral Products	29,307	49.6
Utility – oil	20,160	55.3
Ferrous Metals Processing	17,879	60.3
Non-Ferrous Metals	16,884	65.0
Industrial - natural gas	13,120	68.7
Other Chemical Storage	11,952	72.0
Industrial – coal	10,312	74.9
Utility - int. comb.	9,541	77.6
Chemical Manufacturing	9,485	80.2
Petroleum Storage/Transport	9,478	82.9
Industrial - oil	8,713	85.3
Miscellaneous	8,104	87.6
Agriculture/Food Products	7,334	89.6
Utility - natural gas	6,716	91.5
Petroleum Refineries	4,889	92.9
Metals Processing	3,627	93.9
Misc. Industrial Process	3,173	94.8
Machinery Products	3,025	95.6
Misc fuel combustion	2,459	96.3
Agricultural Chemical Mfg	2,293	97.0
Rubber	2,219	97.6
Industrial - int. comb.	1,632	98.0
Surface Coating	1,365	98.4
Incineration	1,337	98.8
Textiles/Leather/Apparel	985	99.1
Utility - other fuel	807	99.3
Comm/Inst - nat gas	659	99.5
Comm/Inst - coal	491	99.6
Landfills	318	99.7
Comm/Inst - oil	256	99.8
Other Solvent Use	157	99.8
Open Burning	131	99.9
Graphic Arts	124	99.9
Transportation Equipment	92	99.9
Waste Disposal - Other	91	100.0
All Other Point Sources	179	100.0
<b>PM10 Total</b>	<b>357,192</b>	

**TABLE 4-3**

**PM2.5 POINT SOURCE EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Emissions (tons/year)</b>	<b>Cumulative Percent of Total</b>
Wood, Pulp & Paper	42,779	16.7
Utility - coal	32,578	29.3
Industrial - other fuel	32,356	41.9
Mineral Products	16,784	48.5
Ferrous Metals Processing	15,806	54.6
Utility - oil	15,433	60.6
Non-Ferrous Metals	13,254	65.8
Industrial - natural gas	12,718	70.7
Utility - int. comb.	9,519	74.4
Chemical Manufacturing	8,079	77.6
Petroleum Storage/Transport	6,827	80.3
Industrial - oil	6,581	82.8
Utility - natural gas	6,501	85.3
Other Chemical Storage	5,528	87.5
Industrial - coal	4,794	89.4
Miscellaneous	4,792	91.2
Agriculture/Food Products	3,568	92.6
Metals Processing	3,284	93.9
Petroleum Refineries	2,546	94.9
Misc fuel combustion	2,089	95.7
Machinery Products	1,834	96.4
Agricultural Chemical Mfg	1,731	97.1
Industrial - int. comb.	1,602	97.7
Rubber	1,600	98.3
Incineration	1,064	98.7
Textiles/Leather/Apparel	709	99.0
Comm/Inst - nat gas	649	99.3
Utility - other fuel	581	99.5
Comm/Inst - coal	297	99.6
Misc. Industrial Process	266	99.7
Landfills	206	99.8
Comm/Inst - oil	168	99.9
Open Burning	98	99.9
Transportation Equipment	68	99.9
Waste Disposal - Other	48	100.0
Oil & Gas Production	32	100.0
Pharmaceutical Mfg	25	100.0
Industrial Waste Water	25	100.0
All Other Point Sources	45	100.0
<b>PM2.5 Total</b>	<b>256,863</b>	

**TABLE 4-4**

**SO2 POINT SOURCE EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Emissions</b>	<b>Cumulative</b>
------------------------	------------------	-------------------

	(tons/year)	Percent of Total
Utility – coal	4,134,176	75.8
Industrial - coal	335,562	81.9
Utility - oil	315,809	87.7
Utility - natural gas	118,469	89.9
Industrial - oil	82,398	91.4
Wood, Pulp & Paper	71,109	92.7
Chemical Manufacturing	66,644	93.9
Oil & Gas Production	55,710	94.9
Mineral Products	44,506	95.8
Industrial - natural gas	43,622	96.6
Utility - int. comb.	36,213	97.2
Non-Ferrous Metals	27,460	97.7
Petroleum Refineries	24,986	98.2
Industrial - other fuel	23,026	98.6
Misc. Industrial Process	17,881	98.9
Ferrous Metals Processing	16,503	99.2
Utility - other fuel	13,485	99.5
Comm/Inst - coal	10,461	99.7
Metals Processing	4,539	99.8
Misc fuel combustion	2,146	99.8
Incineration	2,003	99.8
Comm/Inst - oil	1,998	99.9
Petroleum Storage/Transport	1,575	99.9
Agriculture/Food Products	1,297	99.9
Comm/Inst - nat gas	1,284	100.0
Industrial - int. comb.	1,048	100.0
Agricultural Chemical Mfg	355	100.0
Pharmaceutical Mfg	318	100.0
Textiles/Leather/Apparel	267	100.0
Landfills	181	100.0
Other Chemical Storage	165	100.0
Machinery Products	134	100.0
Surface Coating	83	100.0
Industrial Waste Water	21	100.0
Graphic Arts	14	100.0
Other Solvent Use	7	100.0
Service Stations	5	100.0
All Other Point Sources	12	100.0
<b>SO2 Total</b>	<b>5,455,473</b>	

**TABLE 4-5****NO<sub>x</sub> POINT SOURCE EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Emissions (tons/year)</b>	<b>Cumulative Percent of Total</b>
Utility – coal	1,653,624	61.8
Industrial - int. comb.	191,686	69.0
Industrial – coal	185,496	75.9
Utility – oil	98,112	79.6
Utility - natural gas	86,831	82.8
Industrial - natural gas	85,132	86.0
Mineral Products	80,070	89.0
Industrial - other fuel	51,293	90.9
Wood, Pulp & Paper	49,550	92.8
Utility - int. comb.	42,521	94.4
Industrial - oil	25,431	95.3
Comm/Inst - nat gas	23,667	96.2
Utility - other fuel	18,881	96.9
Chemical Manufacturing	17,736	97.6
Misc fuel combustion	14,429	98.1
Ferrous Metals Processing	11,649	98.5
Petroleum Refineries	9,623	98.9
Agricultural Chemical Mfg	7,124	99.2
Misc. Industrial Process	4,680	99.3
Comm/Inst - coal	4,618	99.5
Incineration	2,814	99.6
Non-Ferrous Metals	2,149	99.7
Surface Coating	2,017	99.8
Oil & Gas Production	1,606	99.8
Comm/Inst - oil	1,513	99.9
Agriculture/Food Products	952	99.9
Landfills	455	99.9
Textiles/Leather/Apparel	324	99.9
Machinery Products	322	100.0
Graphic Arts	175	100.0
Metals Processing	147	100.0
Bulk Terminal/Plants	136	100.0
Rubber	129	100.0
Petroleum Storage/Transport	74	100.0
Other Chemical Storage	69	100.0
Waste Disposal - Other	63	100.0
Pharmaceutical Mfg	57	100.0
All Other Point Sources	170	100.0
<b>NO<sub>x</sub> Total</b>	<b>2,675,321</b>	

**TABLE 4-6****AMMONIA POINT SOURCE EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Emissions (tons/year)</b>	<b>Cumulative Percent of Total</b>
Agricultural Chemical Mfg	38,504	72.2
Utility - int. comb.	5,507	82.6
Industrial - natural gas	2,618	87.5
Industrial - int. comb.	1,163	89.6
Agriculture/Food Products	1,046	91.6
Utility - oil	815	93.1
Ferrous Metals Processing	743	94.5
Wood, Pulp & Paper	539	95.5
Utility - natural gas	449	96.4
Petroleum Refineries	423	97.2
Chemical Manufacturing	346	97.8
Industrial - oil	218	98.2
Utility - coal	209	98.6
Misc. Industrial Process	198	99.0
Mineral Products	65	99.1
Surface Coating	62	99.2
Industrial - other fuel	57	99.3
Textiles/Leather/Apparel	55	99.4
Industrial Waste Water	49	99.5
Graphic Arts	39	99.6
Comm/Inst - nat gas	37	99.7
Industrial - coal	37	99.8
Bulk Terminal/Plants	29	99.8
Pharmaceutical Mfg	25	99.9
Utility - other fuel	16	99.9
Rubber	11	99.9
Other Solvent Use	10	99.9
Comm/Inst - oil	9	99.9
Misc fuel combustion	6	99.9
Other Chemical Storage	4	100.0
Non-Ferrous Metals	4	100.0
Incineration	4	100.0
TSDF	4	100.0
Machinery Products	3	100.0
Petroleum Storage/Transport	3	100.0
Metals Processing	3	100.0
Oil & Gas Production	1	100.0
Comm/Inst - coal	1	100.0
<b>NH3 Total</b>	<b>53,310</b>	

**TABLE 4-7**

**CO POINT SOURCE EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Emissions (tons/year)</b>	<b>Cumulative Percent of Total</b>
Wood, Pulp & Paper	238,196	21.1
Industrial - other fuel	140,330	33.5
Chemical Manufacturing	134,451	45.4
Non-Ferrous Metals	98,350	54.1
Utility - coal	69,508	60.2
Ferrous Metals Processing	59,491	65.5
Mineral Products	53,708	70.3
Surface Coating	50,568	74.7
Industrial - int. comb.	34,763	77.8
Petroleum Refineries	34,498	80.9
Industrial - natural gas	33,712	83.9
Utility - oil	30,659	86.6
Industrial - coal	24,556	88.7
Metals Processing	22,624	90.7
Utility - int. comb.	18,199	92.4
Misc. Industrial Process	15,040	93.7
Utility - other fuel	11,155	94.7
Misc fuel combustion	10,263	95.6
Oil & Gas Production	9,761	96.4
Utility - natural gas	8,344	97.2
Industrial - oil	8,072	97.9
Comm/Inst - nat gas	5,926	98.4
Agriculture/Food Products	4,717	98.8
Incineration	3,525	99.1
Landfills	2,452	99.4
Comm/Inst - coal	2,321	99.6
Agricultural Chemical Mfg	1,879	99.7
Other Chemical Storage	830	99.8
Comm/Inst - oil	447	99.8
Machinery Products	328	99.9
Transportation Equipment	328	99.9
Open Burning	299	99.9
Textiles/Leather/Apparel	150	99.9
Bulk Terminal/Plants	131	100.0
Rubber	106	100.0
All Other Point Sources	373	100.0
<b>CO Total</b>	<b>1,130,060</b>	

**TABLE 4-8**

**VOC POINT SOURCE EMISSION SUMMARY FOR VISTAS STATES  
FROM 1999 NEI VERSION 2 FINAL**

<b>Source Category</b>	<b>Emissions (tons/year)</b>	<b>Cumulative Percent of Total</b>
Surface Coating	151,401	25.3
Chemical Manufacturing	84,296	39.3
Wood, Pulp & Paper	77,618	52.3
Agriculture/Food Products	37,902	58.6
Graphic Arts	33,974	64.3
Misc. Industrial Process	26,087	68.6
Rubber	18,186	71.7
Other Solvent Use	17,925	74.7
Industrial - other fuel	15,735	77.3
Petroleum Storage/Transport	13,527	79.5
Textiles/Leather/Apparel	12,724	81.7
Industrial - int. comb.	8,826	83.1
Utility - coal	8,604	84.6
Petroleum Refineries	7,664	85.9
Landfills	7,626	87.1
Bulk Terminal/Plants	7,619	88.4
Mineral Products	7,554	89.7
Non-Ferrous Metals	7,284	90.9
Machinery Products	7,270	92.1
Ferrous Metals Processing	7,269	93.3
Industrial - natural gas	6,540	94.4
Other Chemical Storage	6,447	95.5
Degreasing	3,598	96.1
Comm/Inst - nat gas	2,766	96.5
Utility - int. comb.	2,642	97.0
Oil & Gas Production	1,971	97.3
Agricultural Chemical Mfg	1,846	97.6
Misc fuel combustion	1,500	97.9
Transportation Equipment	1,446	98.1
Industrial - coal	1,318	98.3
Waste Disposal - Other	1,261	98.5
Utility - oil	1,207	98.7
Industrial - oil	1,036	98.9
POTW	801	99.0
Metals Processing	799	99.2
Pharmaceutical Mfg	785	99.3
Service Stations	625	99.4
Incineration	620	99.5
All Other Point Sources	2,959	99.6
VOC Total	599,259	

## **ON-GOING EFFORTS TO IMPROVE POINT SOURCE INVENTORY**

### **EPA Improvements to the NEI**

EPA considers the 1999 NEI Version 2 Final inventory to be suitable for general use at this time. However, this inventory is not the last 1999 criteria emissions inventory EPA



plans to issue. EPA is still working a draft of Version 3 of this inventory, which will incorporate data received too late for this Version 2, after which EPA will seek comments and corrections and issue a final Version 3. Some of the states for which 1999 data were not available when Version 2 Final was compiled have now provided EPA with their data, and EPA is working to incorporate this data into the next versions. Among the VISTAS states, this includes Georgia and Tennessee for point sources. Also, the 1999 NEI Version 2 Final inventory includes some estimates by EPA which EPA has since decided to reconsider. However, none of these revaluations by EPA appear to affect point sources. Since we have received more recent point source submittals from both Georgia and Tennessee, it appears that EPA's work on Version 3 of the 1999 inventory will not impact the development of VISTAS point source inventory.

EPA is also beginning work on the development of the 2002 inventory. Our current understanding of the schedule is as follows.

- December 2003 – EPA plans to release preliminary 2002 NEI based on emissions projected to 2002 (from 99NEI V3), 2002 CEM Utility Data (SO<sub>2</sub> and NO<sub>x</sub>), and 2002 Onroad/Nonroad emissions from OTAQ.
- June 2004 - state submissions under Consolidated Emission Reporting Rule, States are required to submit a comprehensive (point, area, mobile) three year inventory for the year 2002.
- Fall 2004 – EPA incorporates CERR data and releases draft final 2002 NEI .

The final 2002 NEI is not likely to be completed until June 2005.

### **Availability of Point Source Data from the States**

As mentioned above, States are not required to submit 2002 point source inventory data to EPA until June 2004. Most States will receive 2002 submittals from industry in the Spring of 2003, and will need some time to process and quality assure the submittals. Some States may be able to provide 2002 point source available prior to the June 2004 reporting deadline. However, it is unlikely that quality assured 2002 point source data would be available from the States until late in calendar year 2003, at the earliest.

In lieu of 2002 data, States were asked to submit their most recent inventory for inclusion in developing the VISTAS inventory to support preliminary modeling of regional haze episodes occurring in the 2000-2002 time frame. The submittals received are identified in Table 4-9.

**TABLE 4-9****STATE AND LOCAL AGENCY POINT SOURCE SUBMITTALS  
FOR THE PRELIMINARY 2002 VISTAS EMISSION INVENTORY**

<b>State</b>	<b>Agency</b>	<b>Comments</b>	<b>Year</b>
AL	AL DEM	Sent 1999 NEI data, both the original submittal and selected revisions.	1999
AL	City of Huntsville	Sent data in an XLS; not in NIF format. May be able to use data to update larger sources manually.	2000
AL	Jefferson County	Indicated that we should use 1999 NEI for smaller sources and provided 2000 data for large (>250 tpy) sources.	2000
FL	FL DEP	Sent 2001 point source for entire State	2001
GA	GA DNR	Sent 1999 data for Atlanta area (VOC, NOx, CO only) and 1999 data for three GA areas (Augusta, Columbus, Macon). Indicated that the 1999 NEI should be used for other counties.	1999
KY	KY DEP	Sent 2001 inventory	2001
KY	Jefferson County	Sent 1999 data in NIF format	1999
MS	MS DEQ	Sent point source file for 2001 in NIF format	2001
NC	NC DENR	Provided 2000 data for major sources only, use 1999 for other sources with permits.	2000
NC	Forsyth County	Use 1999 NEI	1999
NC	Mecklenburg County	Cannot create NEI format; need to contact after looking at 1999 NEI	
NC	Western NC Regional	Sent an XLS; not in NIF format, may be able to use to update larger sources.	
SC	SC DHEC	Sent 1999 data in NIF format	1999
TN	TN DEC	Carol Norman UT Knoxville sent file in NIF format	1999
TN	Chattanooga-Hamilton County	Nothing	
TN	Knox County	Sent data in NIF ACCESS format	1999
TN	Memphis-Shelby County	Sent 1999 point source data in NIF format	1999
TN	Nashville Metro	Sent 1999 point source data in NIF	1999

<b>State</b>	<b>Agency</b>	<b>Comments</b>	<b>Year</b>
		format	
VA	VA DEQ	Sent 2001 inventory in NIF .txt format; all facilities >10 tpy; no PM2.5 or ammonia	2001
WV	WV DEP	Sent 1999 inventory for all sources; sent 2000 inventory for major Title V point sources	2000

## CEM Data Availability

The following describes EPA's plan for making CEM data available (obtained from [EPA's Clean Air Markets - Description of Preliminary Summary Emissions Reports](#))

- Each quarter electric utilities are required to submit a data file to the EPA. This file contains detailed hourly information on SO<sub>2</sub>, NO<sub>X</sub>, and CO<sub>2</sub> emissions, unit heat input (the caloric value of the fuel burned), operating parameters, plant configuration, and continuous emission monitor (CEM) quality assurance. This file also contains summary emissions and heat input data.
- These data files are subjected to automated quality screening when they are submitted to the EPA. If a serious reporting problem is detected, the file is rejected and the utility is required to correct the problem and resubmit the file. "Serious" problems are ones that do not allow EPA to read or interpret the meaning of the data.
- During the screening process, many calculations and summations included in the reports are checked for accuracy. If there is an inconsistency between a utility calculation and an EPA calculation, generally EPA "accepts" the higher of the different values. These accepted values are the numbers included in the Summary Emissions Reports.
- The Clean Air Markets Division makes every attempt to have these Summary Emissions Reports posted on the Clean Air Markets Division's web page 21 days after the reporting deadline for utilities. At the end of each calendar quarter, the utilities are given 30 days to compile and submit their data files. Adding another 20-21 days for EPA to process the data and assemble the summary reports means that preliminary 2002 data would be posted on February 21, 2003 at the earliest. The data may be posted slightly later if unforeseen complications arise.
- Once the EPA can perform rigorous quality assessment of the reported data, the final reports are released as "scorecards" and "compliance reports." For 2002 data, these final reports will be released in the October/November time frame.

Thus, preliminary data to update the VISTAS inventory with 2002 CEM data may be available as early as the end of February. The final data will not be released until the fall of 2003.

Raw hourly data is also available from the Clean Air Markets Division. However, we do not envision obtaining the hourly data since we will be compiling annual emissions. Hourly data from the CEM database are typically extracted during the emissions modeling process once specific episodes have been selected. The RPOs have been working on developing data exchange protocols for hourly CEM data to provide all necessary modeling information for ozone, PM-2.5, Regional Haze and acid rain

modeling by combining the NEI and ETS/CEM data sets (see: [http://www.ladco.org/emis/protocol/manevu\\_cems.pdf](http://www.ladco.org/emis/protocol/manevu_cems.pdf)).

## **Ammonia Emissions**

Although the 1999 NEI contains ammonia emissions for point sources, it is generally thought that these emission estimates are inadequate. Most of the ammonia point source emission estimates were originally developed for the 1985 NAPAP inventory, and have been continually “grown” to the current year.

Comparing the 1999 NEI ammonia emissions with the 1999 ammonia emissions reported in the EPA’s Toxic Release Inventory (TRI) demonstrates the considerable uncertainty associated with point source ammonia emissions. Table 4-10 summarizes the ammonia emissions for large point sources (i.e., facilities with ammonia emissions greater than 100 tons/year as reported in either the 1999 NEI Version 2, the 1999 TRI, or the 2000 TRI). There seems to be little or no correspondence between the emission estimates in the 1999 NEI and the 1999/2000 TRI. There are four very large sources in 1999 NEI with ammonia emissions greater than 3,000 tons/year, yet the TRI reported ammonia emissions for these facilities are much lower. Likewise, there are many facilities reporting more than 100 tons/year of ammonia emissions to TRI that have little or no ammonia emissions in the 1999 NEI.

EPA recognizes the need to provide better ammonia emissions estimates. Resources from the Emission Inventory Improvement Program (EIIP) will be used to conduct this project. Roy Huntley of EPA provided the following description of the project:

- “The project requires updating information in Chapter 4 (*Ammonia Emissions in Industry*) and Chapter 5 (*Ammonia Emissions from Combustion*) of the Battye Report (*Development and Selection of Ammonia Emission Factors* dated August 1994 by EC/R). This will involve consulting the literature, working with state and local agencies across the country to update NH<sub>3</sub> emissions for stationary source categories identified in these chapters, and extracting information from EPA’s Toxics Release Inventory System (TRIS). The TRI is expected to be a valuable resource since many sources and updated emissions information are expected to have been added since publication of the Battye report. Particular attention should be paid to information presented in Table 4-6 [*List of Discrete Major Sources (>90.72 Mg or >100 tons) of Ammonia with No Applicable Emission Factors*]. One goal of this project is to update Table 4-6 by identifying newly available emission factors for these sources and source types. When updating Chapter 5, one area of focus should be on Section 5.4 regarding “ammonia slip” from use of selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR) to reduce emissions of NO<sub>x</sub> from stationary sources.”

Mr. Huntley is leading this project, which is scheduled to begin in January 2003. Improved emission factors are not likely to be available until the fall of 2003, at the earliest.

**TABLE 4-10**

**COMPARISON OF AMMONIA EMISSIONS (tons/year)  
FOR LARGE POINT SOURCES**

STATE	COUNTY	FACILITY NAME	SIC	1999 NEI	1999 TRI	2000 TRI
AL	COLBERT	EL DORADO CHEMICAL COMPANY CHEROKEE	2873	3,506	0	0
AL	COLBERT	TVA ENVIRONMENTAL RESEARCH CENTER	8733	103	0	0
AL	COLBERT	WISE ALLOYS L.L.C. - ALABAMA R	3341	0	361	306
AL	ETOWAH	GULF STATES STEEL	3312	129	3	0
AL	MOBILE	KIMBERLY-CLARK TISSUE	2621	116	25	0
AL	MONROE	ALABAMA RIVER PULP CO. INC.	2611	0	150	165
AL	RUSSELL	MEAD COATED BOARD INC.	2631	5	102	99
AL	RUSSELL	OWENS-CORNING HT INC.	3296	0	93	120
FL	BROWARD	FLORIDA POWER & LIGHT (PPE)	4911	119	0	0
FL	HAMILTON	PCS PHOSPHATE - WHITE SPRINGS	2819	0	152	122
FL	HILLSBOROUGH	CF INDS. INC., PLANT CITY PHOS	2874	98	101	122
FL	HILLSBOROUGH	NITRAM, INC.	2873	52	177	161
FL	MANATEE	FLORIDA POWER & LIGHT (PMT)	4911	133	0	0
FL	PASCO	FLORIDA POWER COMPANY	4911	107	0	0
FL	POLK	CF IND. INC. BARTOW PHOSPHATE	2874	9	295	190
FL	POLK	FARMLAND HYDRO L.P.	2819	15	370	350
FL	POLK	IMC-AGRICO CO. NEW WALES PLANT	2874	14	505	400
FL	POLK	U.S. AGRI-CHEMICALS CORP.	2874	113	98	93
FL	SANTA ROSA	AIR PRODS. & CHEMICALS INC.	2869	85	240	220
FL	TAYLOR	BUCKEYE FLORIDA L.P.	2611	0	106	100
GA	BARROW	JOHNS MANVILLE INTL.	3296	0	80	107
GA	BIBB	RIVERWOOD INTL. CORP.	2611	4	105	90
GA	CHATHAM	PCS NITROGEN FERTILIZER L.P.	2873	3,044	5	0
GA	CHATHAM	UNION CAMP CORP.	2611	0	82	1,068
GA	CLARKE	CERTAINTED CORP.	3296	0	239	148
GA	DECATUR	ENGELHARD CORP. ATTAPULGUS OPS	2873	1	1,506	1,448
GA	DECATUR	IMC AGRIBUSINESS INC.	2873	655	0	0
GA	FLOYD	INLAND PAPERBOARD & PACKAGING	2611	16	247	256
GA	FULTON	OWENS-CORNING	3296	0	152	131
GA	GLYNN	GEORGIA-PACIFIC CORP. BRUNSWIC	2611	0	103	106
GA	RICHMOND	INTERNATIONAL PAPER	2631	17	180	175
GA	RICHMOND	PCS NITROGEN FERTILIZER L.P.	2873	11,840	751	767
GA	WAYNE	RAYONIER, SPECIALTY PULP PRODS	2611	3	125	135
KY	BOYD	MARATHON ASHLAND PET LCC	2911	345	0	0
KY	JEFFERSON	S_D-CHEMIE INC. SOUTH PLANT	2819	0	234	123
KY	JEFFERSON	SUD-CHEMIE INC. WEST PLANT	2819	0	161	86

Note: Includes all facilities in the VISTAS region with ammonia emissions of 100 tons per year or greater, as reported in either the 1999 NEI Version 2, the 1999 TRI, or the 2000 TRI.

**TABLE 4-10 (continued)**

STATE	COUNTY	FACILITY NAME	SIC	1999 NEI	1999 TRI	2000 TRI
MS	ADAMS	ETHYL CORP.	2869	0	158	85
MS	JACKSON	CHEVRON USA	2911	567	24	0
MS	JACKSON	MISSISSIPPI PHOSPHATES CORP.	2874	0	20	166
MS	MONROE	KERR-MCGEE CHEMICAL L.L.C. ELE	2816	0	81	146
MS	PERRY	LEAF RIVER FOREST PRODS.	2611	0	204	194
MS	WARREN	ERGON REFINING INC.	2911	0	651	327
MS	YAZOO	MISSCHEM NITROGEN L.L.C.	2873	27,041	384	545
NC	BEAUFORT	PCS PHOSPHATE CO. INC. AURORA	2819	0	765	665
NC	COLUMBUS	INTERNATIONAL PAPER	2611	149	191	121
NC	FORSYTH	R.J.R. TOBACCO CO., WHITAKER P	2111	0	2	116
NC	HAYWOOD	BLUE RIDGE PAPER PRODS. INC.	2621	59	250	250
NC	MARTIN	WEYERHAEUSER CO., PLYMOUTH NC	2611	108	170	195
SC	CALHOUN	DEVRO-TEEPAK, INC.	2013	860	855	765
TN	HUMPHREYS	INLAND PAPERBOARD & PACKAGING	2611	0	205	90
TN	SHELBY	ENENCO INC.	2843	0	108	111
TN	SHELBY	PCS NITROGEN FERTILIZER L.P.	2873	0	2,133	1,510
TN	SHELBY	WITCO CORP.	2099	0	107	185
VA	ALLEGHANY	WESTVACO OF VIRGINIA. INC.	2631	0	135	145
VA	BUCHANAN	JEWEL COKE COMPANY LLP	3312	379	0	0
VA	CHESTERFIELD	CARTER-WALLACE INC.	3069	0	235	262
VA	HOPEWELL CITY	HONEYWELL INTL. INC. HOPEWELL	2819	16	2,248	2,077
VA	ISLE OF WIGHT	INTERNATIONAL PAPER FRANKLIN	2611	3	85	115
VA	RICHMOND CITY	PHILIP MORRIS USA - BL/LPF/TQA	2141	0	600	460
VA	YORK	BP AMOCO YORKTOWN REFY.	2911	243	109	65
WV	BOONE	HOBET MINING INC.	1221	0	95	232
WV	BROOKE	WHEELING-PITTSBURGH STEEL	3312	340	31	0
WV	KANAWHA	CATENARY COAL CO.	1221	0	143	269

Note: Includes all facilities in the VISTAS region with ammonia emissions of 100 tons per year or greater, as reported in either the 1999 NEI Version 2, the 1999 TRI, or the 2000 TRI.

## **PM2.5 Emission Factors**

For the most part, PM2.5 emissions in the 1999 NEI Version 2 were calculated by EPA using its data augmentation procedure (see Appendix A of [Pt\\_doc99v2\\_Oct02.pdf on ftp.epa.gov](#) for details). EPA states that the most significant uncertainty associated with the PM augmentation procedures is the lack of particle-size specific emission factors for uncontrolled sources and controlled sources for various types of control equipment combinations. The particle-size-specific emission factors for uncontrolled and controlled stationary external and internal fuel combustion sources in AP-42 are good. However, good data for other SCCs is lacking. Thus, S/L/T agencies should conduct research to prioritize source categories of fine PM emissions and focus on improving the data needed to estimate fine PM emissions for the highest priority categories.

EPA is initiating work to improve PM2.5 emission factors. According to Roy Huntley, a scoping study has been completed that recommends which AP-42 source categories could be revised based on the availability of new PM<sub>2.5</sub> and condensable PM emission test data. The second purpose is to recommend which source categories would be good candidates for future emission testing programs.

(see: <http://www.epa.gov/ttn/chief/ap42/AP42Scopingstudymemo.pdf>)

There are four categories where EPA believes sufficient data exists to update AP-42. These are coal-fired boilers, natural gas-fired boilers, fiberglass manufacturing, and process heaters. Since this activity is just being initiated, it is unlikely that draft AP-42 emission factors would be available before the fall of 2003.

In addition, EPA recommended 11 source categories for future testing. Utility diesel internal combustion engines, process gas-fired boiler and refinery-gas-fired boilers were the top three sources recommended for future testing. Other point source categories include copper smelting, grey iron foundries, carbon black production, ammonia nitrate production, ammonia production, and nitric acid production. Also included were two area source categories – residential charbroiling and commercial charbroiling. Results from these testing efforts would be available in 2004, at the very earliest.

## **Speciation Profiles**

State point sources inventories typically contain emission estimates for criteria (PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>x</sub>, VOC, and CO) and hazardous air pollutants. EPA's 1999 NEI also includes estimates for ammonia and PM<sub>2.5</sub>. In order to be properly modeled for chemical transformations and deposition, both organic gases and particulate matter emissions estimates, and to a lesser extent SO<sub>x</sub> and NO<sub>x</sub> estimates, must be split, or speciated, into more defined compounds. The number and types of compounds depends upon the atmospheric model (CMAQ, CAMx, REMSAD) that is being used.

MACTEC is expecting to begin work on project for Ron Ryan at OAQPS to extract new speciation data from published literature and incorporate the data into the SPECIATE database. The Work Assignment has been delayed due to funding uncertainty, and work



will not begin until February 2003. The results of this work will not be available until the fall of 2003.

## **RECOMMENDATIONS FOR IMPROVING THE POINT SOURCE INVENTORY**

Listed below our short-term recommendations for developing the preliminary 2002 VISTAS regional emission inventory and longer-term recommendations for making future improvements to the inventory. Our recommendations are based on our review of the 1999 NEI Version 2 Final and the various on-going emission inventory improvement activities discussed above. The short-term recommendations can be accomplished over the next six months, resulting in a preliminary 2002 inventory that can be fed into an emission model to produce the episode-specific inputs needed by the atmospheric models. The longer-term activities can likely be accomplished over the next 2-3 years.

### **Recommendations for Short-term Activities to Produce VISTAS Preliminary 2002 Point Source Inventory**

1. Obtain post-1999 point source inventories from State/local agencies to better represent episodes in the 2000-2002 time frame. Replace 1999 NEI data with more recent State data for PM10, SO<sub>2</sub>, NO<sub>x</sub>, VOC, and CO. Augment State data with PM<sub>2.5</sub> and ammonia from 1999 NEI. “Grow” the 1999/2000/2001 to 2002.
2. Conduct QA/QC of State/local agency point source submittals. Review point source physical parameters, temporal profiles, and locations needed for modeling. Focus on large sources and provide States/local agencies with parameters to review and possibly correct. Incorporate State/local agency corrections and updates. Supplement with default stack characteristics and county-level locations.
3. Compare facility-level emissions in 1999 NEI to State/local submittals to identify potentially missing or new sources and to flag facilities with large emission changes. Ask States to verify whether facilities any large emitters have closed, whether new sources began operation in 2002, and whether any large emission changes are reasonable.
4. Provide State/local agencies with the comparison of ammonia emissions reported in the 1999 NEI Version 2 Final and the 1999/2000 Toxics Release Inventory. Identify gaps and logical inconsistencies. Ask States/local agencies to target largest emitters to obtain information on emissions, stack characteristics, seasonal variations, etc. Update database with State/local updates.
5. Obtain and incorporate “preliminary” annual 2002 CEM data for utilities from EPA’s Clean Air Markets Division.
6. Help States/local agencies conduct surveys of selected point sources to obtain any missing information identified in the above tasks. Coordinate with State/local agency in developing information request, and if deemed appropriate by the State/local agency, contact the facility to attempt to obtain the requested information. Augment database with the collected survey data.

7. Apply existing speciation factors to create estimates of elemental carbon, organic carbon, and other species required for modeling.
8. Convert preliminary 2002 VISTAS inventory from NIF format to format required by the selected emission modeling system.

These short-term activities are generally consistent with the activities identified in our Final Work Plan (November 25, 2001), and can be completed within the contract budget and time schedules identified in the Work Plan for point sources.

### **Recommendations for Longer-term Activities to Produce VISTAS Final 2002 Point Source Inventory**

1. Obtain and incorporate “final” CEM data (Fall 2003).
2. Apply improved SPECIATE factors (Fall 2003).
3. Update ammonia emissions when new emission factors are available from EPA (2004) for important source categories.
4. Update PM<sub>2.5</sub> emissions when new emission factors are prepared by EPA (2004).
5. Obtain “official” 2002 point source inventories required by the Consolidated Emissions Reporting Rule (June 2004).
6. Obtain and incorporate “final” CEM data (Fall 2003).

**Documentation of the Base G 2002 Base Year, 2009 and 2018,  
Emission Inventories for VISTAS**

**Prepared for:**

**Visibility Improvement State and Tribal Association of the Southeast  
(VISTAS)**

**Prepared by:**

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## Acronyms and Abbreviations

AEO	Annual Energy Outlook
AF&PA	American Forest and Paper Association
APCD	Air Pollution Control District
ATP	Anti-Tampering Program
BLRID	Boiler Identification (Boiler ID)
CAA	Clean Air Act
CAIR	Clean Air Interstate Rule
CEM	Continuous Emissions Monitoring
CAMD	Clean Air Markets Division
CERR	Consolidated Emissions Reporting Rule
CMU	Carnegie Mellon University
CMV	commercial marine vessels
CE	Control Efficiency
CO	carbon monoxide
DENR	North Carolina Department of Environment and Natural Resources
DHEC	South Carolina Department of Health and Environmental Control
EDMS	Emissions Data Management Systems
ESD	Emissions Standards Division
EPA	Environmental Protection Agency
EGU	Electric Generating Unit
ICF	ICF International, Inc.
FIP	Federal Implementation Plan
FLM	Federal Land Manager
FTP	File transfer protocol
FR	Federal Register
FS	Forest Service
HDD	Heavy Duty Diesel
HDD RULE	Heavy Duty Diesel Rule
ICF	ICF International, Inc.
ID	Identification
I/M	Inspection and Maintenance
IPM <sup>®</sup>	Integrated Planning Model <sup>®</sup>
IAQTR	Interstate Air Quality Transport Rule
LTO	Landing and take off
MACT	Maximum achievable control technology

### Acronyms and Abbreviations (continued)

MACTEC	MACTEC Engineering and Consulting, Inc.
MOBILE 6	MOBILE emissions estimation model version 6
MRPO	Midwest Regional Planning Organization
NH <sub>3</sub>	Ammonia
NEI	National Emission Inventory
NIF	National Emission Inventory Format
NLEV	National Low Emission Vehicle regulation
NMIM	National Mobile Inventory Model
NONROAD	no acronym (model name)
NO <sub>x</sub>	Oxides of nitrogen
NWR	National Wildlife Refuge
OTB	On the books
OTW	On the way
ORIS	Office of Regulatory Information Systems
OTAQ	Office of Transportation and Air Quality
OTC	Ozone Transport Commission
PFC	Portable fuel containers
PM	Particulate matter
PM <sub>10</sub> -FIL	Particulate matter less than or equal to 10 microns in diameter that can be captured on a filter
PM <sub>10</sub> -PRI	Particulate matter less than or equal to 10 microns in diameter that includes both the filterable and condensable components of particulate matter
PM <sub>2.5</sub> -FIL	Particulate matter less than or equal to 2.5 microns in diameter that can be captured on a filter
PM <sub>2.5</sub> -PRI	Particulate matter less than or equal to 2.5 microns in diameter that includes both the filterable and condensable components of particulate matter
PM-CON	Particulate matter created by the condensation of hot materials to form particulates, usually less than 2.5 microns in diameter
ppmW	parts per million by weight
PRI	Primary
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
REMI	Regional Economic Models, Inc.
RFG	Reformulated gasoline
RVP	Reid Vapor Pressure
SCC	Source Classification Code

**Acronyms and Abbreviations (continued)**

SCR	Selective Catalytic Reduction
SIP	State Implementation Plan
SIWG	Special Interest Workgroup
S/L/T	State/Local/Tribal
SMOKE	Sparse Matrix Operator Kernel Emissions Modeling System
S/L	State and Local
SO <sub>2</sub>	Oxides of Sulfur
T4	Tier 4
VISTAS	Visibility Improvement State and Tribal Association of the Southeast
VMT	Vehicle Miles Traveled
VOC	Volatile organic compounds
WRAP	Western Regional Air Partnership

## **Documentation of the Base G 2002 Base Year, 2009 and 2018, Emission Inventories for VISTAS**

### **Introduction**

#### **History of VISTAS Base and Projection Year Emission Inventory Development**

This section is provided to supply the history behind the development of the base and projection year inventories provided to VISTAS. Through the various iterations, the inventories that have been developed have typically had version numbers provided by the contractors who developed the inventories and to a certain extent these were also based on their purpose. Different components of the 2002 base year inventories have been supplied by E.H. Pechan and Associates, Inc. (Pechan), MACTEC Engineering and Consulting, Inc. (MACTEC), and by Alpine Geophysics, Inc.

The initial 2002 base year inventory was jointly developed by Pechan and MACTEC. Pechan developed the on-road and non-road mobile source components of the inventory while MACTEC developed the point and area source component of the inventory. This version of the inventory included updates to on-road mobile that incorporated information from the 1999 NEI Version 2 final along with updated information on VMT, fuel programs, and other inputs to the MOBILE6 model to produce a draft version of the 2002 inventory. For non-road sources, a similar approach was used. Updated State information on temperatures and fuel characteristics were obtained from VISTAS States and used with the NONROAD 2002 model to calculate 2002 emissions for NONROAD model sources. These estimates were coupled with data for commercial marine vessels, locomotives and airplanes projected to 2002 using appropriate growth surrogates. A draft version of these inventories was prepared in late 2003, with a final version in early 2004. An overview of the development of the on-road component can be found at: [http://www.vistas-sesarm.org/documents/Pechan\\_drafton-roadinventory\\_082803.ppt](http://www.vistas-sesarm.org/documents/Pechan_drafton-roadinventory_082803.ppt) while an overview of the non-road component can be found at: [http://www.vistas-sesarm.org/documents/Pechan\\_Non-roadInventory\\_082803.ppt](http://www.vistas-sesarm.org/documents/Pechan_Non-roadInventory_082803.ppt).

Similarly, draft versions of the 2002 point and area source base year inventories were prepared by MACTEC in the same timeframe (late 2003 for the draft, final in early 2004). The point source component was based on data submitted by the VISTAS States or on the 1999 NEI. The data submitted by the States ranged from 1999 to 2001 and was all projected to 2002 using appropriate growth surrogates from Economic Growth

Analysis System (EGAS) version 4. Toxic Release Inventory (TRI) data were used to augment the inventory for NH<sub>3</sub>. Continuous Emissions Monitor (CEM) data from the U.S. EPA's Clean Air Markets Division was used to supply emissions for electric generating utilities (EGUs). Particulate matter emissions were augmented (when missing) by using emission factor ratios. Details on all these calculations are discussed in Section 1.1.1.3 of this document.

The area source component of the 2002 draft base year emissions was prepared similarly to the point sources, using State submittals and the 1999 NEI Version 2 final as the basis for projecting emissions to 2002 using EGAS growth factors. For ammonia area sources the Carnegie Mellon University (CMU) ammonia model was used to calculate emissions. Finally, data on acreage burned on a fire by fire basis was solicited from State forestry agencies in order to calculate fire emissions on a fire by fire basis. Virtually all VISTAS State forestry agencies provided data for these calculations at least for wild and prescribed fires. An overview of the point and area source development methods can be found at:

[http://www.vistas-sesarm.org/documents/MACTEC\\_draftpointareainventory\\_82803.ppt](http://www.vistas-sesarm.org/documents/MACTEC_draftpointareainventory_82803.ppt).

Three interim versions of the 2002 base year inventory were developed. The first was delivered in August of 2003, the second in April of 2004 and the final one in October of 2004. The August 2003 and April 2004 inventories were prepared by MACTEC and Pechan. A draft version of the revised 2002 base year inventory was released in June of 2004, with a final version released in October 2004. That 2002 base year inventory was solely prepared by MACTEC. The October 2004 inventory incorporated 2002 Consolidated Emissions Reporting Rule (CERR) data into the inventory along with some updated data from the VISTAS States. This inventory is typically referred to as version 3.1 of the VISTAS inventory

Closely following the version 3.1 2002 base year inventory, a “preliminary” 2018 projection inventory was developed. This “preliminary” 2018 inventory was developed in late 2004 (Oct/Nov) and was designed solely for use in modeling sensitivity runs to provide a quick and dirty assessment of what “on the books” and “on the way” controls could be expected to provide in terms of improvements to visibility and regional haze impairment. A brief overview of the history of the three versions of the 2002 base year and the 2018 preliminary inventory use can be found at: <http://www.vistas-sesarm.org/documents/STAD1204/2002and2018Emissions14Dec2004.ppt>.

Following preparation of the final 3.1 version of the 2002 base year inventory, States were asked to review and provide comments on that inventory to MACTEC for update

and revision. At the same time MACTEC prepared a revised draft version of the 2018 projection inventory (January 2005) and a draft version of a 2009 projection inventory (April 2005). All of these were known as version 3.1 and were provided to the VISTAS States for review and comment. Comments were received and updates to the inventories based on these comments were prepared. The revised inventories were provided to the VISTAS States. At that time to be consistent with the modeling nomenclature being used by AG in performing their modeling runs, the inventory became the Base F VISTAS inventory. The Base F inventory was delivered for review and comment in August of 2005. In addition, MACTEC delivered a report entitled *Documentation of the Revised 2002 Base Year, Revised 2018, and Initial 2009 Emission Inventories for VISTAS* on August 2, 2005 that described the methods used to develop the Base F inventories. For the Electric Generating Utilities (EGU) different versions of the Integrated Planning Model were used between Base D and Base F, resulting in different projections of future EGU emissions.

Over the period from August 2005 until June/July 2006 MACTEC received comments and updates to some categories from VISTAS States, particularly EGU. In addition, a new NONROAD model (NONROAD05) was released. Thus additional updates to the inventory were prepared based on the comments received along with revised NONROAD emission estimates from NONROAD05. The resultant inventory became the Base G inventory.

This document details the development of the Base G inventories for 2002, 2009 and 2018. The information that follows describes the development of the VISTAS inventory by sector from version 3.1 forward. Unless specific updates were made to an inventory sector, the methods used for version 3.1 were retained. Similarly unless specific changes were made to methods used for Base F, Base G methods were the same as Base F/version 3.1 (if unchanged in Base F).

Table I-1 through Table I-3 indicate roughly which version of the inventory is in use for each sector of the inventory as of Base G.

**Table I-1: Inventory Version in Use by Year and Source Sector Through Base G - 2002**

Source	AL	FL	GA	KY	MS	NC	SC	TN	VA	WV
<b>EGU</b>	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G
<b>Non-EGU Point</b>	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G	Base F with some source specific revisions in Base G
<b>Area<sup>1</sup></b>	Base F for ammonia sources (CMU Model) and for some area sources, Base G for selected sources updated by the State with State supplied data	Base F except for some emissions zeroed out (and records removed) for some southern FL counties for Base G.	Base F	Base F	Base F	Base F for ammonia sources (CMU Model) and for some area sources, Base G for selected sources updated by the State with State supplied data. Some corrections applied by MACTEC to correct PM values	Base F	Base F	Base F for ammonia Sources (CMU Model) and for some area sources, Base G for selected sources updated by the State with State supplied data.	Base F
<b>On-road</b>	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G
<b>Non-road</b>	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources, except aircraft and locomotives updated for Base G.	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources except for aircraft in Cincinnati/N. KY Int. Airport, which are Base G.	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources	Base G for all sources included in the NONROAD model. NC moved from Southern to Mid-Atlantic State in seasonal adjustment file.  Base F for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources, except for aircraft emissions which are Base G.	Base G for all sources included in the NONROAD model.  Base F for non-NONROAD model sources
<b>Fires</b>	Base F Typical	Base F Typical	Base F Typical	Base F Typical	Base F Typical	Base F Typical	Base F Typical	Base F Typical	Base F Typical	Base F Typical

**Notes:**

Base G global Area Source changes that apply to ALL States: A) removal of Stage II refueling from area source file to non-road and on-road; B) modification of PM2.5 ratio for several fugitive dust sources per WRAP methodology; C) addition of portable fuel container (PFC) emissions to all States based on OTAQ report.



**Table I-2: Inventory Version in Use by Year and Source Sector Through Base G - 2009**

Source	AL	FL	GA	KY	MS	NC	SC	TN	VA	WV
<b>EGU<sup>1</sup></b>	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G
<b>Non-EGU Point<sup>2</sup></b>	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G
<b>Area</b>	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.  Some specific source categories updated using State supplied file to override projected values.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.
<b>On-road</b>	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G
<b>Non-road</b>	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources.	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources except for aircraft in Cincinnati/N. KY Int. Airport, which are Base G using State supplied growth factors.	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources
<b>Fires</b>	Base F typical except for Rx fires	Base F typical	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires

Notes:

1. All EGU emissions updated with new IPM runs in Base G
2. Revised growth factors from DOE AEO2006 fuel use projections

**Table I-3: Inventory Version in Use by Year and Source Sector Through Base G - 2018**

Source	AL	FL	GA	KY	MS	NC	SC	TN	VA	WV
<b>EGU<sup>1</sup></b>	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G
<b>Non-EGU Point<sup>2</sup></b>	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G	Base F methodology but with revised growth factors for fuel fired sources in Base G
<b>Area</b>	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.  Some specific source categories updated using State supplied file to override projected values.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.	Base F with updated AEO growth factors for fuel fired sources. Agricultural ammonia sources from CMU model.
<b>On-road</b>	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G	Base G
<b>Non-road</b>	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources.	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources except for aircraft in Cincinnati/N. KY Int. Airport, which are Base G using State supplied growth factors.	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources	Base G for all sources included in the NONROAD model.  Base F projection methodology used for non-NONROAD model sources
<b>Fires</b>	Base F typical except for Rx fires	Base F typical	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires	Base F typical except for Rx fires

**Notes:**

1. All EGU emissions updated with new IPM runs in Base G
2. Revised growth factors from DOE AEO2006 fuel use projections

## **1.0 2002 Base Year Inventory Development**

### **1.1 Point Sources**

This section details the development of the 2002 base year inventory for point sources. There were two major components to the development of the point source sector of the inventory. The first component was the incorporation of data submitted by the Visibility Improvement State and Tribal Association of the Southeast (VISTAS) States and local (S/L) agencies to the United States Environmental Protection Agency (EPA) as part of the Consolidated Emissions Reporting Rule (CERR) requirements. Work on incorporating the CERR data into the revised base year involved: 1) obtaining the data from EPA or the S/L agency, 2) evaluating the emissions and pollutants reported in the CERR submittals, 3) augmenting CERR data with annual emission estimates for PM<sub>10</sub>-PRI and PM<sub>2.5</sub>-PRI; 4) evaluating the emissions from electric generating units, 5) completing quality assurance reviews for each component of the point source inventory, and 6) updating the database with corrections or new information from S/L agencies based on their review of the 2002 inventory. The processes used to perform those operations are described in the first portion of this section.

The second component was the development of a “typical” year inventory for electric generating units (EGUs). VISTAS determined that a typical year electric generating units (EGU) inventory was necessary to smooth out any anomalies in emissions from the EGU sector due to meteorology, economic, and outage factors in 2002. The typical year EGU inventory is intended to represent the five year (2000-2004) period that will be used to determine the regional haze reasonable progress goals. The second part of this section discusses the development of the typical year EGU inventory.

#### ***1.1.1 Development of 2002 Point Source Inventory***

MACTEC developed a draft 2002 emission inventory in June 2004 (*Development of the Draft 2002 VISTAS Emission Inventory for Regional Haze Modeling – Point Sources*, MACTEC, June 18, 2004). The starting point for the draft 2002 emission inventory was EPA’s 1999 National Emission Inventory (NEI), Version 2 Final (NEI99V2). For several states, we replaced the NEI99V2 data with more recent inventories for either calendar year 1999, 2000, or 2001 as submitted by the S/L agencies. We also performed several other updates, including updating emission estimates for selected large source of ammonia, incorporating 2002 Continuous Emissions Monitoring-(CEM)-based SO<sub>2</sub> and NO<sub>x</sub> emissions for electric utilities, adding PM<sub>10</sub> and PM<sub>2.5</sub> emissions when they were missing from an S/L submittal, and performing a variety of additional Quality assurance/Quality control (QA/QC) checks.

The next version of the 2002 inventory (referred to as Base F) was released in August 2005 (*Documentation of the Revised 2002 Base Year, Revised 2018, and Initial 2009 Emission Inventories for VISTAS*, MACTEC, August 2, 2005). The primary task in preparing the Base F 2002 base year inventory was the replacement of NEI99V2 data with data submitted by the VISTAS S/L agencies as part of the CERR submittal and included in EPA's 2002 NEI.

The current version of the 2002 inventory (referred to as Base G) was released in August 2006 and is documented in this report. The primary task in preparing the Base G 2002 base year inventory was the incorporation of corrections and new information as submitted by the S/L agencies based on their review of the Base F inventory. The following subsections document the data sources for the Base G inventory, the checks made on the CERR submittals, the process for augmenting the inventory with PM<sub>10</sub> and PM<sub>2.5</sub> emissions, the evaluation of EGU emissions, other QA/QC checks, and other Base G updates. The final subsection summarizes the Base G 2002 inventory by state, pollutant, and sector (EGU and non-EGU).

#### **1.1.1.1 Data Sources**

Several data sources were used to compile the Base F point source inventory: 1) the inventories that the S/L submitted to EPA from May through July 2004 as required by the CERR; 2) supplemental data supplied by the S/L agencies that may have been revised or finalized after the CERR submittal to EPA, and 3) the draft VISTAS 2002 inventory in cases where S/L CERR data were not available. For the Base G inventory, we replaced data from Hamilton County, Tennessee, using data from Hamilton County's CERR submittal as contained in EPA's 2002 NEI inventory (in Base F, the inventory for Hamilton County was based on the draft VISTAS 2002 inventory, which in turn was based on the 1999 NEI).

Table 1.1-1 summarizes the data used as the starting point for the Base F 2002 inventory. Once all of the files were obtained, MACTEC ran the files through the EPA National Emission Inventory Format (NIF) Basic Format and Content checking tool to ensure that the files were submitted in standard NIF format and that there were no referential integrity issues with those files. In a couple of cases small errors were found. For example, in one case non-standard pollutant designations were used for particulate matter (PM) and ammonia emissions. MACTEC contacted each VISTAS State point source contact person to resolve the issues with the files and corrections were made. Once all corrections to the native files were made, MACTEC continued with the incorporation of the data into the VISTAS point source files. S/L agencies completed a detailed review of the Base F inventory. Additional updates and corrections to the Base F inventory were requested by S/L agencies and incorporated into the Base G inventory. The Base G changes are documented in more detail in Section 1.1.1.6.

**Table 1.1-1. State Data Submittals Used for the Base F 2002 Point Source Inventory.**

State / Local Program	Point Source Emissions Data Source
AL	C
FL	B
GA	B
KY	C
MS	B
NC	C
SC	C
TN	C
VA	B
WV	B
Davidson County, TN	B
Hamilton County, TN	D
Memphis/Shelby County, TN	B
Knox County, TN	B
Jefferson County, AL	B
Jefferson County, KY	B
Buncombe County, NC	B
Forsyth County, NC	B
Mecklenburg County, NC	B

**Key**

A = Draft VISTAS 2002

B = CERR Submittal from EPA's file transfer protocol (FTP) site

C = Other (CERR or other submittal sent directly from S/L agency to MACTEC)

D = CERR Submittal from EPA's NEI 2002 Final Inventory

**1.1.1.2 Initial Data Evaluation**

For the Base F inventory, we conducted an initial review of the 2002 point source CERR data in accordance with the QA procedures specified in the Quality Assurance Project Plan (QAPP) for this project. The following evaluations were completed to identify potential data quality issues associated with the CERR data:

- Compared the number of sites in the CERR submittal to the number of sites in the VISTAS draft 2002 inventory; for all States, the number of sites in the CERR submittal was less than in the VISTAS draft 2002 inventory, since the CERR data was limited to major sources, while the VISTAS draft 2002 inventory contained data for both major and minor sources; verified with S/L contacts that minor sources not included in the CERR point source inventory were included in the CERR area source inventory.
- Checked for correct pollutant codes and corrected to make them NIF-compliant; for example, some S/L agencies reported ammonia emissions using the CAS Number or as “ammonia”, rather than the NIF-compliant “NH<sub>3</sub>” code.

- Checked for types of particulate matter codes reported (i.e., PM-FIL, PM-CON, PM-PRI, PM<sub>10</sub>-PRI, PM<sub>10</sub>-FIL, PM<sub>2.5</sub>-PRI, PM<sub>2.5</sub>-FIL); corrected codes with obvious errors (i.e., changed PMPRI to PM-PRI). (The PM augmentation process for filling in missing PM pollutants is discussed later in Section 1.1.1.3)
- Converted all emission values that weren't in tons to tons to allow for preparation of emission summaries using consistent units.
- Checked start and end dates in the PE and EM tables to confirm consistency with the 2002 base year.
- Compared annual and daily emissions when daily emissions were reported; in some cases, the daily value was non-zero (but very small) but the annual value was zero. This was generally the result of rounding in an S/L agency's submittal.
- Compared ammonia emissions as reported in the CERR submittals and the 2002 Toxics Release Inventory; worked with S/L agencies to resolve any outstanding discrepancies.
- Compared SO<sub>2</sub> and NO<sub>x</sub> emissions for EGUs to EPA's Clean Air Markets Division CEM database to identify any outstanding discrepancies. (A full discussion of the EGU emissions analysis is discussed later in Section 1.1.1.4)
- Prepared State-level emission summaries by pollutant for both the EGU and non-EGU sectors to allow S/L agencies to compare emissions as reported in the 1999 NEI Version 2, the VISTAS draft 2002 inventory, and the CERR submittals.
- Prepared facility-level emission summaries by pollutant to allow S/L agencies to review facility level emissions for reasonableness and accuracy.

We communicated the results of these analyses through email/telephone exchanges with the S/L point source contacts as well as through Excel summary spreadsheets. S/L agencies submitted corrections and updates as necessary to resolve any QA/QC issues from these checks.

### 1.1.1.3 PM Augmentation

Particulate matter emissions can be reported in many different forms, as follows:

<b>PM Category</b>	<b>Description</b>
PM-PRI	Primary PM (includes filterable and condensable)
PM-CON	Primary PM, condensable portion only (all less than 1 micron)
PM-FIL	Primary PM, filterable portion only

PM <sub>10</sub> -PRI	Primary PM <sub>10</sub> (includes filterable and condensable)
PM <sub>10</sub> -FIL	Primary PM <sub>10</sub> filterable portion only
PM <sub>2.5</sub> -PRI	Primary PM <sub>2.5</sub> (includes filterable and condensable)
PM <sub>2.5</sub> -FIL	Primary PM <sub>2.5</sub> filterable portion only

S/L agencies did not report PM emissions in a consistent manner. The State/local inventories submitted for VISTAS included emissions data for either PM-FIL, PM-PRI, PM<sub>10</sub>-FIL, PM<sub>10</sub>-PRI, PM<sub>2.5</sub> -FIL, PM<sub>2.5</sub> -PRI, and/or PM-CON. From any one of these pollutants, EPA has developed augmentation procedures to estimate PM<sub>10</sub>-PRI, PM<sub>10</sub>-FIL, PM<sub>2.5</sub> -PRI, PM<sub>2.5</sub> -FIL, and PM-CON. If not included in a State/local inventory, PM<sub>10</sub>-PRI and PM<sub>2.5</sub> -PRI were calculated by adding PM<sub>10</sub>-FIL and PM-CON or PM<sub>2.5</sub> -FIL and PM-CON, respectively.

The procedures for augmenting point source PM emissions are documented in detail in Appendix C of *Documentation for the Final 1999 National Emissions Inventory {Version 3} for Criteria Air Pollutants and Ammonia – Point Sources*, January 31, 2004). Briefly, the PM data augmentation procedure includes the following five steps:

- Step 1: Prepare S/L/T PM and PM<sub>10</sub> Emissions for Input to the PM Calculator
- Step 2: Develop and Apply Source-Specific Conversion Factors
- Step 3: Prepare Factors from PM Calculator
- Step 4: Develop and Apply Algorithms to Estimate Emissions from S/L/T Inventory Data
- Step 5: Review Results and Update the NEI with Emission Estimates and Control Information.

Please refer to the EPA documentation for a complete description of the PM augmentation procedures.

Table 1.1-2 compares the original PM emission estimates from the S/L CERR submittals and the revised 2002 VISTAS emissions estimates calculated using the above methodology. This table is intended to show that we took whatever States provided in the way of PM and filled in gaps to add in PM-CON where emissions were missing in order to calculate PM<sub>10</sub>-PRI and PM<sub>2.5</sub> -PRI for all processes to get a complete set of particulate data. We did not compare any other pollutants besides PM, since for other pollutants CERR emissions equal VISTAS emissions. As noted in Table 1.1-2, we made significant revisions to the PM emissions for Kentucky in the Base F inventory and for South Carolina in the Base G inventory.

**Table 1.1-2. Comparison of Particulate Matter Emissions from the S/L Data Submittals and the Base G 2002 VISTAS Point Source Inventory**

State	Database	PM-PRI	PM-FIL	PM-CON	PM <sub>10</sub> -PRI	PM <sub>10</sub> -FIL	PM <sub>2.5</sub> -PRI	PM <sub>2.5</sub> -FIL
AL	CERR	28,803	9,174	0	16,522	6,548	8,895	4,765
	VISTAS	43,368	33,336	10,129	32,791	22,661	23,290	13,328
FL	CERR	0	33,732	0	0	32,254	0	0
	VISTAS	61,728	37,325	24,403	57,243	32,840	46,147	21,744
GA	CERR	42,846	0	0	27,489	0	15,750	0
	VISTAS	44,835	37,088	7,799	33,202	25,403	22,777	15,085
KY	CERR	0	3,809	0	19,748	1,360	0	0
	VISTAS	27,719	22,349	5,329	21,326	15,963	14,173	8,749
MS	CERR	23,925	0	0	20,968	0	10,937	0
	VISTAS	23,928	17,632	6,296	21,089	14,793	11,044	5,739
NC	CERR	48,110	0	0	36,222	0	24,159	0
	VISTAS	48,114	41,407	6,708	36,992	30,284	27,512	21,113
SC	CERR	0	43,837	0	0	32,656	0	21,852
	VISTAS	43,844	38,633	5,210	34,799	29,588	26,418	21,207
TN	CERR	1,660	25,500	21,482	43,413	22,164	34,167	12,140
	VISTAS	56,797	32,085	24,715	50,937	26,269	41,442	16,774
VA	CERR	0	0	0	17,065	0	12,000	0
	VISTAS	40,856	36,414	4,442	17,065	12,623	12,771	8,607
WV	CERR	0	29,277	0	0	14,778	0	8445
	VISTAS	36,188	29,392	6,795	22,053	15,258	15,523	8,733

**Note 1:** CERR refers to data as submitted by S/L agencies; VISTAS refers to data calculated by MACTEC using the PM augmentation methodologies described in this document.

**Note 2:** KY DEP's initial CERR submittal reported particulate matter emissions using only PM-PRI pollutant code. MACTEC used this pollutant code during the initial PM augmentation routine. In February 2005, KY DEP indicated that data reported using the PM-PRI code should actually have been reported using the PM<sub>10</sub>-PRI code. MACTEC performed a subsequent PM augmentation in April 2005 using the PM<sub>10</sub>-PRI code. These changes were reflected in the Base F emission inventory.

**Note 3:** South Carolina Department of Health and Environmental Control (SC DHEC) initial CERR submittal reported particulate matter emissions using the PM-FIL, PM<sub>10</sub>-FIL, and PM<sub>2.5</sub> -FIL pollutant codes. MACTEC used these pollutant codes during the initial PM augmentation routine. In August 2005, SC DHEC indicated that data reported using the PM-FIL, PM<sub>10</sub>-FIL, and PM<sub>2.5</sub> -FIL pollutant codes should actually have been reported using the PM-PRI, PM<sub>10</sub>-PRI, and PM<sub>2.5</sub> -PRI codes. MACTEC performed a subsequent PM augmentation in April 2006 using the revised pollutant codes. These changes were reflected in the Base G emission inventory.

**Note 4:** The emission values in the VISTAS emission rows above differ slightly from the final values in the Base G inventory. This is due to several corrections and updates to the 2002 inventory submitted by S/L agencies after the PM augmentation was performed as discussed in Section 1.1.1.6.



After the PM augmentation process was performed, we executed a series of checks to identify potential inconsistencies in the PM inventory. These checks included:

- PM-PRI less than PM<sub>10</sub>-PRI, PM<sub>2.5</sub> -PRI, PM<sub>10</sub>-FIL, PM<sub>2.5</sub> -FIL, or PM-CON;
- PM-FIL less than PM<sub>10</sub>-FIL, PM<sub>2.5</sub> -FIL;
- PM<sub>10</sub>-PRI less than PM<sub>2.5</sub> -PRI, PM<sub>10</sub>-FIL, PM<sub>2.5</sub> -FIL or PM-CON;
- PM<sub>10</sub>-FIL less than PM<sub>2.5</sub> -FIL;
- PM<sub>2.5</sub>-PRI less than PM<sub>2.5</sub> -FIL or PM-CON;
- The sum of PM<sub>10</sub>-FIL and PM-CON not equal to PM<sub>10</sub>-PRI; and
- The sum of PM<sub>2.5</sub> -FIL and PM-CON not equal to PM<sub>2.5</sub> -PRI.

S/L agencies were asked to review this information and provide corrections where the inconsistencies were significant. In general, corrections (or general directions) were provided in the case of the potential inconsistency issues. In other cases, the agency provided specific process level pollutant corrections.

Note that for the Base G inventory, only the PM<sub>10</sub>-PRI and PM<sub>2.5</sub> -PRI emission estimates were retained since they are the only two PM species that are included in the air quality modeling. Other PM species were removed from the Base G inventory to facilitate emissions modeling.

#### **1.1.1.4 EGU Analysis**

We made a comparison of the annual SO<sub>2</sub> and NO<sub>x</sub> emissions for EGUs as reported in the S/L agencies CERR submittals and the data from EPA's Clean Air Markets Division (CAMD) CEM database to identify any outstanding discrepancies. Facilities report hourly CEM data to EPA for units that are subject to CEM reporting requirements of the NO<sub>x</sub> State Implementation Plan (SIP) Call rule and Title IV of the Clean Air Act (CAA). EPA sums the hourly CEM emissions to the annual level, and we compared these annual CEM emissions to those in the S/L inventories. The 2002 CEM inventory containing NO<sub>x</sub> and SO<sub>2</sub> emissions and heat input data were downloaded from the EPA CAMD web site ([www.epa.gov/airmarkets](http://www.epa.gov/airmarkets)). The data were provided by quarter and emission unit.

The first step in the EGU analysis involved preparing a crosswalk file to match facilities and units in the CAMD inventory to facilities and units in the S/L inventories. In the CAMD inventory, the Office of Regulatory Information Systems (ORIS) identification (ID) code identifies unique facilities and the unit ID identifies unique boilers and internal combustion engines (i.e., turbines and reciprocating engines). In the S/L inventories, the State and county FIPS and State facility ID together identify unique facilities and the emission unit ID identifies unique boilers or internal combustion engines. In most cases, there is a one-to-one correspondence between the CAMD identifiers and the S/L identifiers. However, in some of the S/L inventories, the emissions for multiple emission units are summed and reported under one

emission unit ID. We created an Excel spreadsheet that contained an initial crosswalk with the ORIS ID and unit ID in the CEM inventory matched to the State and county Federal Implementation Plan (FIPS), State facility ID, and emission unit ID in the S/L inventory. The initial crosswalk contained both the annual emissions summed from the CAMD database as well as the S/L emission estimate. It should be noted that the initial matching of the IDs in both inventories was based on previous crosswalks that had been developed for the preliminary VISTAS 2002 inventory and in-house information compiled by MACTEC and Alpine Geophysics. The matching at the facility level was nearly complete. In some cases, however, S/L agency or stakeholder assistance was needed to match some of the CEM units to emission units in the S/L inventories.

The second step in the EGU analysis was to prepare an Excel spreadsheet that compared the annual emissions from the hourly CAMD inventory to the annual emissions reported in the S/L inventory. The facility-level comparison of CEM to emission inventory NO<sub>x</sub> and SO<sub>2</sub> emissions found that for most facilities, the annual emissions from the S/L inventory equaled the CAMD CEM emissions. Minor differences could be explained because the facility in the S/L inventory contained additional small or emergency units that were not included in the CAMD database.

The final step in the EGU analysis was to compare the SO<sub>2</sub> and NO<sub>x</sub> emissions for select Southern Company units in the VISTAS region. Southern Company is a super-regional company that owns EGUs in four VISTAS States – Alabama, Florida, Georgia, and Mississippi – and participates in VISTAS as an industry stakeholder. Southern Company independently provided emission estimates for 2002 as part of the development of the preliminary VISTAS 2002 inventory. In most cases, these estimates were reviewed by the States and incorporated into the States CERR submittal. The exception to this was a decision made by Georgia’s Department of Environmental Protection (GDEP) to utilize CEM-based emissions for the actual 2002 emissions inventory for sources within the State when Southern Company also provided data. There were no major inconsistencies between the Southern Company data, the CAMD data, and the S/L CERR data.

The minor inconsistencies found included small differences in emission estimates (<2 percent difference), exclusion/inclusion of small gas-fired units in the different databases, and grouping of emission units in S/L CERR submittals where CAMD listed each unit individually. We compared SO<sub>2</sub> and NO<sub>x</sub> emissions on a unit by unit basis and did not find any major inconsistencies.

#### **1.1.1.5 QA Review of Base F Inventory**

QA checks were run on the Base F point source inventory data set to ensure that all corrections provided by the S/L agencies and stakeholders were correctly incorporated into the S/L

inventories and that there were no remaining QA issues. After exporting the inventory to ASCII text files in NIF 3.0, the EPA QA program was run on the ASCII files and the QA output was reviewed to verify that all QA issues that could be addressed were resolved

Throughout the inventory development process, QA steps were performed to ensure that no double counting of emissions occurred, and to ensure that a full and complete inventory was developed for VISTAS. QA was an important component to the inventory development process and MACTEC performed the following QA steps on the point source component of the VISTAS revised 2002 base year inventory:

1. Facility level emission summaries were prepared and evaluated to ensure that emissions were consistent and that there were no missing sources.
2. State-level EGU and non-EGU comparisons (by pollutant) were developed between the Base F 2002 base year inventory, the draft VISTAS 2002 inventory, and the 1999 NEI Version 2 inventory.
3. Data product summaries and raw NIF 3.0 data files were provided to the VISTAS Emission Inventory Technical Advisor and to the Point Source, EGU, and non-EGU Special Interest Work Group representatives for review and comment. Changes based on these comments were reviewed and approved by the S/L point source contact prior to implementing the changes in the files.
4. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from Base F1 to Base F2.

#### **1.1.1.6 Additional Base G Updates and Corrections**

S/L agencies completed a detailed review of the Base F inventory. Table 1.1-3 summarizes the updates and corrections to the Base F inventory that were requested by S/L agencies and incorporated into the Base G inventory.

There was a discrepancy between the base year 2002 and 2009/2018 emissions for PM<sub>10</sub>-PRI, PM<sub>2.5</sub>-PRI, and NH<sub>3</sub>. The 2002 emissions were provided directly by the S/L agencies and were estimated using a variety of techniques (i.e., EPA emission factors, S/L emission factors, site-specific emission factors, and source test data). The 2009/2018 emissions, on the other hand, were estimated by Pechan (see Section 2.1.1.3) using an emission factor file based solely on AP-42 emission factors. An adjustment was made for 2002 EGU PM and NH<sub>3</sub> emissions to reconcile these differences. The post-processed Integrated Planning Model<sup>®</sup> (IPM<sup>®</sup>) 2009/2018 output uses a set of PM and NH<sub>3</sub> emission factors that are “the most recent EPA approved uncontrolled emission factors” – these are most likely not the same emission factors used by States and emission inventory preparation contractors for estimating these emissions in 2002 for EGUs in the VISTAS domain. VISTAS performed a set of modifications to replace 2002 base

year PM and NH<sub>3</sub> emission estimates with estimates derived from the most recent EPA-approved emission factors. For further details of the methodology used to make this adjustment, see *EGU Emission Factors and Emission Factor Assignment*, memorandum from Greg Stella to VISTAS State Point Source Contacts and VISTAS EGU Special Interest Workgroup, June 13, 2005.

**Table 1.1-3. Summary of Updates and Corrections to the Base F 2002 Inventory  
Incorporated into the 2002 Base G Inventory.**

Affected State(s)	Nature of Update/Correction
TN, WV	The latitude and longitude values for TN (except the four local programs) and WV were truncated to two decimal places in the Base F inventory. MACTEC re-exported the NIF ER tables in a manner that so that the latitude and longitude were not truncated in the Base G inventory.
AL	Corrected the latitude and longitude for two facilities: Ergon Terminalling (Site ID: 01-073-010730167) and Southern Power Franklin (Site ID: 01-081-0036). Corrections to stack parameters at 10 facilities for stacks with parameters that do not appear to fall into the ranges typically termed "acceptable" for AQ modeling.
FL	Corrected emission values for the Miami Dade RRF facility (Site ID: 12-086-0250348).
GA	Hercules Incorporated (12-051-05100005) had an erroneous process id (#3) within emission unit id SB9 and was deleted. This removes about 6,000 tons of SO <sub>2</sub> from the 2002 inventory. Provided a revised file of location coordinates at the stack level that was used to replace the location coordinated in the ER file.
NC	Made several changes to Base F inventory to correct the following errors: 1. Corrected emissions at Hooker Furniture (Site ID: 37-081-08100910), release point G-29, 9211.38 tons volatile organic compounds (VOC's) should be 212.2 tons, 529.58 tons PM <sub>10</sub> should be 17.02 tons, 529.58 tons PM <sub>2.5</sub> should be 15.79 tons in 2002 inventory. 2. Identified many stack parameters in the ER file that were unrealistic. Several have zero for height, diameter, gas velocity, and flow rate. NC used the procedures outlined in Section 8 of the document ""National Emission Inventory QA and Augmentation Report" to correct unrealistic stack parameters. 3. Identified truncated latitude and longitude values in Base F inventory. NC updated all Title V facility latitude and longitude that was submitted to EPA for those facilities in 2004. Smaller facilities with only two decimal places were not corrected. 4. Corrected emissions for International Paper (3709700045) Emission Unit ID, G-12, should be 1.8844 tons VOCs instead of 2819.19 tons in 2002
SC	Corrected PM species emission values. SC DHEC's initial CERR submittal reported particulate matter emissions using the PM-FIL, PM <sub>10</sub> -FIL, and PM <sub>25</sub> -FIL pollutant codes. In August 2005, SC DHEC indicated that data reported using the PM-FIL, PM <sub>10</sub> -FIL, and PM <sub>25</sub> -FIL pollutant codes should actually have been reported using the PM-PRI, PM <sub>10</sub> -PRI, and PM <sub>25</sub> _PRI codes. MACTEC performed a subsequent PM augmentation in April 2006 using the revised pollutant codes. These changes were reflected in the Base G emission inventory.
TN	Identified six facilities that closed in 2000/2001 but had non-zero emissions in the 2002 Base F inventory. MACTEC changed emissions to zero for all pollutants in the Base G 2002 inventory. Supplied updated emission inventory for the Bowater facility (47-107-0012) based on the facility's updated 2002 emission inventory update. Replaced data from Hamilton County, Tennessee, using data from Hamilton County's CERR submittal as contained in EPA's 2002 NEI (in Base F, the inventory for Hamilton County was based on the draft VISTAS 2002 inventory, which in turn was based on the 1999 NEI). Updated emissions for PCS Nitrogen Fertilizer LP (Site ID: 47-157-00146)
WV	Updated emissions for Steel of West Virginia (Site ID: 54-011-0009) Made changes to several Site ID names due to changes in ownership Made corrections to latitude/longitude and stack parameters at a few facilities for stacks with parameters that do not appear to fall into the ranges typically termed "acceptable" for AQ modeling.

### 1.1.1.7 Summary of Base G 2002 Inventory

Tables 1.1-4 through 1.1-10 summarize the Base G 2002 base year inventory. All values are in tons. For the purposes of Tables 1.1-4 through 1.1-10, EGU emissions include the emissions from all processes with a Source Classification Code (SCC) of either 1-01-xxx-xx (External Combustion Boilers – Electric Generation) or 2-01-xxx-xx (Internal Combustion Engines – Electric Generation). Emissions for all other SCCs are included in the non-EGU column. Note that aggregating emissions into EGU and non-EGU sectors based on the above SCCs causes a minor inconsistency with the EGU emissions reported in EPA’s CAMD database. The EGU emissions summarized in these tables may include emissions from some smaller electric generating units in the VISTAS inventory that are not in CAMD’s 2002 CEM database or the IPM forecasted emissions. The minor inconsistencies result in a less than 2 percent difference between the summary tables below and the data from CAMD’s CEM database.

**Table 1.1-4. Base G 2002 VISTAS Point Source Inventory for SO<sub>2</sub> (tons/year).**

State	All Point Sources	EGUs	Non-EGUs
AL	544,309	447,828	96,481
FL	518,721	453,631	65,090
GA	568,731	514,952	53,778
KY	518,086	484,057	34,029
MS	103,388	67,429	35,960
NC	522,113	477,990	44,123
SC	259,916	206,399	53,518
TN	413,755	334,151	79,604
VA	305,106	241,204	63,903
WV	570,153	516,084	54,070
<b>Total</b>	<b>4,324,278</b>	<b>3,743,725</b>	<b>580,556</b>

Note: EGU emissions include SCCs 1-01-xxx-xx and 2-01-xxx-xx; non-EGU has all other SCCs.

**Table 1.1-5. Base G 2002 VISTAS Point Source Inventory for NO<sub>x</sub> (tons/year).**

State	All Point Sources	EGUs	Non-EGUs
AL	244,348	161,038	83,310
FL	302,834	257,677	45,156
GA	196,767	147,517	49,251
KY	237,209	198,817	38,392
MS	104,661	43,135	61,526
NC	196,782	151,854	44,928
SC	130,394	88,241	42,153
TN	221,652	157,307	64,344
VA	147,300	86,886	60,415
WV	277,589	230,977	46,612
<b>Total</b>	<b>2,059,536</b>	<b>1,523,449</b>	<b>536,087</b>

Note: EGU emissions include SCCs 1-01-xxx-xx and 2-01-xxx-xx; non-EGU has all other SCCs.

**Table 1.1-6. Base G 2002 VISTAS Point Source Inventory for VOC (tons/year).**

State	All Point Sources	EGUs	Non-EGUs
AL	49,332	2,295	47,037
FL	40,995	2,524	38,471
GA	34,952	1,244	33,709
KY	46,321	1,487	44,834
MS	43,852	648	43,204
NC	62,170	988	61,182
SC	38,927	470	38,458
TN	85,254	926	84,328
VA	43,906	754	43,152
WV	15,775	1,180	14,595
<b>Total</b>	<b>461,484</b>	<b>12,516</b>	<b>448,970</b>

Note: EGU emissions include SCCs 1-01-xxx-xx and 2-01-xxx-xx; non-EGU has all other SCCs.

**Table 1.1-7. Base G 2002 VISTAS Point Source Inventory for CO (tons/year).**

State	All Point Sources	EGUs	Non-EGUs
AL	185,550	11,279	174,271
FL	139,045	57,113	81,933
GA	140,561	9,712	130,850
KY	122,555	12,619	109,936
MS	59,871	5,303	54,568
NC	64,461	13,885	50,576
SC	63,305	6,990	56,315
TN	122,348	7,084	115,264
VA	70,688	6,892	63,796
WV	100,220	10,341	89,879
<b>Total</b>	<b>1,068,604</b>	<b>141,218</b>	<b>927,388</b>

Note: EGU emissions include SCCs 1-01-xxx-xx and 2-01-xxx-xx; non-EGU has all other SCCs.

**Table 1.1-8. Base G 2002 VISTAS Point Source Inventory for PM<sub>10</sub>-PRI (tons/year).**

State	All Point Sources	EGUs	Non-EGUs
AL	32,886	7,646	25,240
FL	57,243	21,387	35,857
GA	32,834	11,224	21,610
KY	21,326	4,701	16,626
MS	21,106	1,633	19,472
NC	36,592	22,754	13,838
SC	35,542	21,400	14,142
TN	49,814	14,640	35,174
VA	17,211	3,960	13,252
WV	22,076	4,573	17,503
<b>Total</b>	<b>326,630</b>	<b>113,918</b>	<b>212,714</b>

Note: EGU emissions include SCCs 1-01-xxx-xx and 2-01-xxx-xx; non-EGU has all other SCCs.



**Table 1.1-9. Base G 2002 VISTAS Point Source Inventory for PM<sub>2.5</sub> -PRI (tons/year).**

State	All Point Sources	EGUs	Non-EGUs
AL	23,291	4,113	19,178
FL	46,148	15,643	30,504
GA	22,401	4,939	17,462
KY	14,173	2,802	11,372
MS	11,044	1,138	9,906
NC	26,998	16,498	10,500
SC	27,399	17,154	10,245
TN	39,973	12,166	27,807
VA	12,771	2,606	10,165
WV	15,523	2,210	13,313
<b>Total</b>	<b>239,721</b>	<b>79,269</b>	<b>160,452</b>

Note: EGU emissions include SCCs 1-01-xxx-xx and 2-01-xxx-xx; non-EGU has all other SCCs.

**Table 1.1-10. Base G 2002 VISTAS Point Source Inventory for NH<sub>3</sub> (tons/year).**

State	All Point Sources	EGUs	Non-EGUs
AL	2,200	317	1,883
FL	1,657	234	1,423
GA	3,697	83	3,613
KY	1,000	326	674
MS	1,359	190	1,169
NC	1,234	54	1,180
SC	1,553	142	1,411
TN	1,817	204	1,613
VA	3,230	127	3,104
WV	453	121	332
<b>Total</b>	<b>18,200</b>	<b>1,798</b>	<b>16,402</b>

Note: EGU emissions include SCCs 1-01-xxx-xx and 2-01-xxx-xx; non-EGU has all other SCCs.

### 1.1.2 *Development of Typical Year EGU inventory*

VISTAS developed a typical year 2002 emission inventory for EGUs to avoid anomalies in emissions due to variability in meteorology, economic, and outage factors in 2002. The typical year inventory represents the five year (2000-2004) starting period that would be used to determine the regional haze reasonable progress goals.

Data from EPA's CAMD were used to develop normalization factors for producing a 2002 typical year inventory for EGUs. We used the ratio of the 2000-2004 average heat input and the 2002 actual heat input to normalize the 2002 actual emissions. MACTEC obtained data from EPA's CAMD for utilities regulated by the Acid Rain program. Annual data for the period 2000 to 2004 were obtained from the CAMD web site ([www.epa.gov/airmarkets](http://www.epa.gov/airmarkets)). The parameters available were the SO<sub>2</sub> and NO<sub>x</sub> emission rates, heat input, and operating hours.

We used the actual 2002 heat input and the average heat input for the 5-year period from 2000-2004 as the normalization factor, as follows:

$$\text{Normalization Factor: } \frac{\text{2000-2004 average heat input}}{\text{2002 actual heat input}}$$

If the unit did not operate for all five years, then the 2000-2004 average heat input was calculated for the one or two years in which the unit did operate. For example, if the unit operated only during 2002, then the normalization factor would be 1.0. The annual actual emissions were multiplied by the normalization factor to determine the typical emissions for 2002, as follows:

$$\text{Typical Emissions} = \text{2002 actual emissions} \times \text{Normalization Factor}$$

After applying the normalization factor, some adjustments were needed for special circumstances. For example, a unit may not have operated in 2002 and thus have zero emissions. If the unit had been permanently retired prior to 2002, then we used zero emissions for the typical year. If the unit had not been permanently retired and would normally operate in a typical year, then we used the 2001 (or 2000) heat input and emission rate to calculate the typical year emissions.

The Southern Company provided typical year data for their sources. Hourly emissions data for criteria pollutants were provided. MACTEC aggregated the hourly emissions into annual values. Further documentation of how Southern Company created the typical year inventory for their units can be found in *Developing Southern Company Emissions and Flue Gas Characteristics for VISTAS Regional Haze Modeling (April 2005, presented at 14<sup>th</sup> International Emission Inventory Conference* <http://www.epa.gov/ttn/chief/conference/ei14/session9/kandasamy.pdf>). Since Southern Company only supplied filterable particulate emissions, we ran the PM<sub>10</sub>/PM<sub>2.5</sub> augmentation routine to calculate annual emission estimates for PM<sub>10</sub>-PRI and PM<sub>2.5</sub>-PRI.

The Southern Company typical year data were used for Southern Company sources in Alabama, Florida, and Mississippi. Georgia EPD elected to use the typical year normalization factor derived from the CAMD data instead of the Southern Company typical year data (as was used in the Base F inventory).

The final step was to replace the 2002 actual emissions with the 2002 typical year data described above. MACTEC provided the raw data and results of the typical year calculations in a spreadsheet for S/L agency review and comment. Any comments made were incorporated into the Base G inventory.

Table 1.1-11 summarizes emissions by State and pollutant for the actual 2002 EGU inventory and the typical year EGU inventory. For the entire VISTAS region, actual 2002 SO<sub>2</sub> emissions were about 0.5 percent higher than the typical year emissions. The differences on a state-be-state basis ranged from actual emissions being 6.6 percent lower in Florida to 10.9 percent higher in Mississippi. For the entire VISTAS region, actual 2002 NO<sub>x</sub> emissions were about 0.1 percent lower than the typical year emissions. The differences on a state-be-state basis ranged from actual emissions being 9.6 percent lower in Florida to 6.3 percent higher in Mississippi.

**Table 1.1-11. Comparison of SO<sub>2</sub> and NO<sub>x</sub> Emissions (tons/year) for EGUs from Base G Actual 2002 Inventory and Typical 2002 Inventory.**

State	SO <sub>2</sub> Emissions (tons/year)			NO <sub>x</sub> Emissions (tons/year)		
	Actual 2002	Typical 2002	Percentage Difference	Actual 2002	Typical 2002	Percentage Difference
AL	447,828	423,736	5.4	161,038	154,704	3.9
FL	453,631	483,590	-6.6	257,677	282,507	-9.6
GA	514,952	517,633	-0.5	147,517	148,126	-0.4
KY	484,057	495,153	-2.3	198,817	201,928	-1.6
MS	67,429	60,086	10.9	43,135	40,433	6.3
NC	477,990	478,489	-0.1	151,854	148,812	2.0
SC	206,399	210,272	-1.9	88,241	88,528	-0.3
TN	334,151	320,146	4.2	157,307	152,137	3.3
VA	241,204	233,691	3.1	86,886	85,081	2.1
WV	516,084	500,381	3.0	230,977	222,437	3.7
<b>Total</b>	<b>3,743,725</b>	<b>3,723,177</b>	<b>0.5</b>	<b>1,523,449</b>	<b>1,524,693</b>	<b>-0.1</b>

## 1.2 Area Sources

This section details the development of the Base G 2002 base year inventory for area sources. There are three major components of the area source sector of the inventory. The first component is the “typical” year fire inventory. Version 3.1 of the VISTAS base year fire inventory provided actual 2002 emissions estimates. Since fire emissions are not easily grown or projected, in order

to effectively represent fires in both the base and future year inventories, VISTAS determined that a typical year fire inventory was necessary. Development of the “typical” year fire inventory covered wildfire, prescribed burning, agricultural fires and land clearing fires. The first part of this section of the report discusses the development of the typical year fire inventory. The methodology provided in that section is identical to the documentation provided for Base F since the “typical” year inventory was developed as part of the Base F development effort. The major change in Base G for the fire component of the inventory was the development of projection year inventories that represent alternatives to the “typical” year inventory. These alternative projections incorporated projected changes in the acreage burned for prescribed fires on Federal lands. These projections are an augmentation of the “typical” year inventory.

The second component of the area source inventory was the incorporation of data submitted by the VISTAS States to the United States Environmental Protection Agency (EPA) as part of the CERR. Work on incorporating the CERR data into the revised base year involved: 1) obtaining the data from EPA, 2) evaluating the emissions and pollutants reported in order to avoid double counting and 3) backfilling from the existing VISTAS 2002 base year inventory for missing sources/pollutants. The processes used to perform those operations are described in the second portion of this section. That work was performed as part of the Base F inventory effort. In general no changes to that method were made as part of the Base G inventory updates. The methods used for the Base F inventory development effort using the CERR submittals have been maintained in this document. Where necessary, additional documentation has been added to 1) reflect changes that resulted from VISTAS States review of the Base F inventory and the incorporation of those changes into Base G, 2) changes made to how certain sources were estimated or 3) addition of new sources not found in Base F.

The final component of the area source inventory was related to the development of NH<sub>3</sub> emission estimates for livestock and fertilizers and paved road PM emissions. For the NH<sub>3</sub> emission estimates for livestock and fertilizers we used version 3.6 of the Carnegie Mellon University (CMU) NH<sub>3</sub> model. For the paved road PM emissions, we used the most recent estimates developed by EPA as part of the National Emission Inventory (NEI) development effort. EPA had developed an improved methodology for estimating paved road emissions so those values were substituted directly into the inventory after receiving consensus from all of the VISTAS States to perform the replacement. Details on these methods are provided in the third portion of this section of the document. That section is virtually identical to that from the Base F inventory document as there were only a couple of changes to the ammonia portion of the inventory and some updates to all fugitive dust categories including paved roads on a global basis between Base F and Base G.

Finally, quality assurance steps for each component of the area source inventory are discussed.

### 1.2.1 Development of a “typical” year fire inventory

Typical year fire emissions were developed starting from the actual fire acreage data and emission calculated for each VISTAS State. The table below shows the data submitted by each State in the VISTAS region indicating what data was received from each State for the purposes of calculating actual fire emissions.

Fire Type	AL	FL	GA	KY	MS	NC	SC	TN	VA	WV
Land Clearing	✓	✓	✓				✓			
Ag Burning	✓	✓	✓				✓			
Wildfires	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Prescribed	✓	✓	✓	✓	✓	✓	✓	✓		✓

In order to effectively characterize fire emissions in the VISTAS region, a typical (as opposed to strictly 2002 year based inventory) was required. Development of a typical year fire inventory provided the capability of using a comparable data set for both the base year and future years. Thus fire emissions would remain the same for air quality and visibility modeling in both the base and any future years. MACTEC originally proposed five different methods for developing the typical fire year to the VISTAS Fire Special Interest Work Group (SIWG) and requested their feedback and preference for developing the final typical year inventory. The method that was selected by SIWG members was to use a method similar to that used to develop an early version of a 2018 projection inventory. For that early 2018 inventory, State level ratios of acres over a longer term record (three or more years) developed for each fire type relative to 2002. The 2002 acreage was then scaled up or down based on these ratios to develop a typical year inventory. For Base F and G, the decision of the VISTAS Fire SIWG was to base the ratio on county level data for States that supplied long term fire-by-fire acreage data rather than State-level ratios. Where States did not supply long term fire-by-fire acreage data, MACTEC reverted to using State-level ratios. With one broad exception (wildfires) this method was implemented for all fires. MACTEC solicited long term fire-by-fire acreage data by fire type from each VISTAS State. A minimum of three or more years of data were used to develop the ratios. Those data were then used to develop a ratio for each county based on the number of acres burned in each county for each fire type relative to 2002.

Thus if we had long term county prescribed fire data from a State, we developed a county acreage ratio of:

$$\text{Ratio} = \frac{\text{Long term average county level Rx acres}}{\text{2002 actual county level Rx acreage}}$$

This ratio was then multiplied times the actual 2002 acreage to get a typical value (basically the long term average county level acres). Wherever possible this calculation was performed on a fire by fire basis. The acreage calculated using the ratio was then used with the fuel loading and emission factor values that we already had (and had been reviewed by the SIWG) to calculate emissions using the same method used for the 2002 actual values (which were previously documented). The following lists indicate which counties used the State ratios by fire type.

Land Clearing		Agricultural Fires		Prescribed Burning	
FIPS	COUNTY	FIPS	COUNTY	FIPS	COUNTY
12086	Miami-Dade County	13063	Clayton County	13059	Clarke County
12037	Franklin County	13083	Dade County	13083	Dade County
12043	Glades County	13089	Dekalb County	13089	Dekalb County
12045	Gulf County	13097	Douglas County	13097	Douglas County
12049	Hardee County	13121	Fulton County	13121	Fulton County
12057	Hillsborough County	13135	Gwinnett County	13123	Gilmer County
12073	Leon County	13137	Habersham County	13135	Gwinnett County
12077	Liberty County	13215	Muscogee County	13139	Hall County
12081	Manatee County	13227	Pickens County	13215	Muscogee County
12095	Orange County	13241	Rabun County	13241	Rabun County
12097	Osceola County	13247	Rockdale County	13247	Rockdale County
12103	Pinellas County	13311	White County		
12115	Sarasota County				
13015	Bartow County				
13021	Bibb County				
13045	Carroll County				
13047	Catoosa County				
13057	Cherokee County				
13059	Clarke County				
13063	Clayton County				
13073	Columbia County				
13077	Coweta County				
13083	Dade County				
13089	Dekalb County				
13097	Douglas County				
13117	Forsyth County				
13121	Fulton County				
13129	Gordon County				
13135	Gwinnett County				
13137	Habersham County				
13143	Haralson County				
13147	Hart County				
13151	Henry County				
13169	Jones County				
13215	Muscogee County				
13237	Putnam County				
13241	Rabun County				
13291	Union County				
13311	White County				

There were three exceptions to this method.

#### Exception 1: Use of State Ratios for Wildfires

The first exception was that wildfires estimates were developed using State ratios rather than county ratios. This change was made after initial quality assurance of the draft estimates revealed that some counties were showing unrealistic values created by very short term data records or missing data that created unrealistic ratios. In addition, exceptionally large and small fires were removed from the database since they were felt to be atypical. For example the Blackjack Complex fire in Georgia was removed from the dataset because the number of acres burned was “atypical” in that fire. We also removed all fires less than 0.1 acres from the dataset.

#### Exception 2: Correction for Blackened Acres on Forest Service Lands

Following discussions with the United States Forest Service (Forest Service) (memo from Cindy Huber and Bill Jackson, dated August 13, 2004), it was determined that the acres submitted by the Forest Service for wildfires and prescribed fires represented perimeter acres rather than “blackened” acres. Thus for wildfires and prescribed fires on Forest Service lands, a further correction was implemented to correct the perimeter acre values to blackened acres. The correction was made based on the size of the fire. For prescribed fires over 100 acres in size the acreage was adjusted to be 80 percent of the initial reported value. For prescribed fires of 100 acres or less the acreage values were maintained as reported. For wildfires, all reported acreage values were adjusted to be 66 percent of their initially reported values. These changes were made to all values reported for Forest Service managed lands.

#### Exception 3: Missing/Non-reported data

When we did not receive data from a VISTAS State for a particular fire type, a composite average for the entire VISTAS region was used to determine the typical value for that type fire. For example, if no agricultural burning long term acreage data was reported for a particular State, MACTEC determined an overall VISTAS regional average ratio that was used to multiply times the 2002 values to produce the “typical” values. This technique was applied to all fire types when data was missing.

In addition, for wildfires and prescribed burning, ratios were developed for “northern” and “southern” tier States within the VISTAS region and those ratios were applied to each State with missing data depending upon whether they were considered a “northern” or “southern” tier State. Development of “southern” and “northern” tier data was an attempt to account for a change from a predominantly pine/evergreen ecosystem (southern) to a pine/deciduous ecosystem (northern). States classified as “southern” included: AL, FL, GA, MS, and SC. States classified as “northern” included: KY, NC, TN, VA, and WV.

Finally for land clearing and agricultural fires, there are no NH<sub>3</sub> and SO<sub>2</sub> emissions. This is due to the lack of emission factors for these pollutants for these fire types.

Table 1.2-1 shows fire emissions from the original base year emission inventory (VISTAS 3.1), the actual 2002 emissions and the typical year emissions for the entire VISTAS region. The actual 2002 and typical fire emissions represent the Base F and Base G 2002 emissions. The typical emissions also represent the 2009 and 2018 emissions for all fire types with the exception of prescribed burning. Revisions made to the typical year prescribed fire emissions for 2009 and 2018 are detailed in the projection section. Also, State level Base G emissions from fires for all years can be found in the tables in Appendix A. Values for fires in those tables are “typical” year values.

Figures 1.2-1 through 1.2-4 show the State by State changes in emissions between the original 2002 base year fire inventories, the actual 2002 and the typical year inventories for carbon monoxide (CO) by fire type. Due to the relative magnitude of CO emissions compared to other criteria and PM pollutants from fires; this pollutant is normally chosen to represent the distribution of fires in the example plots.

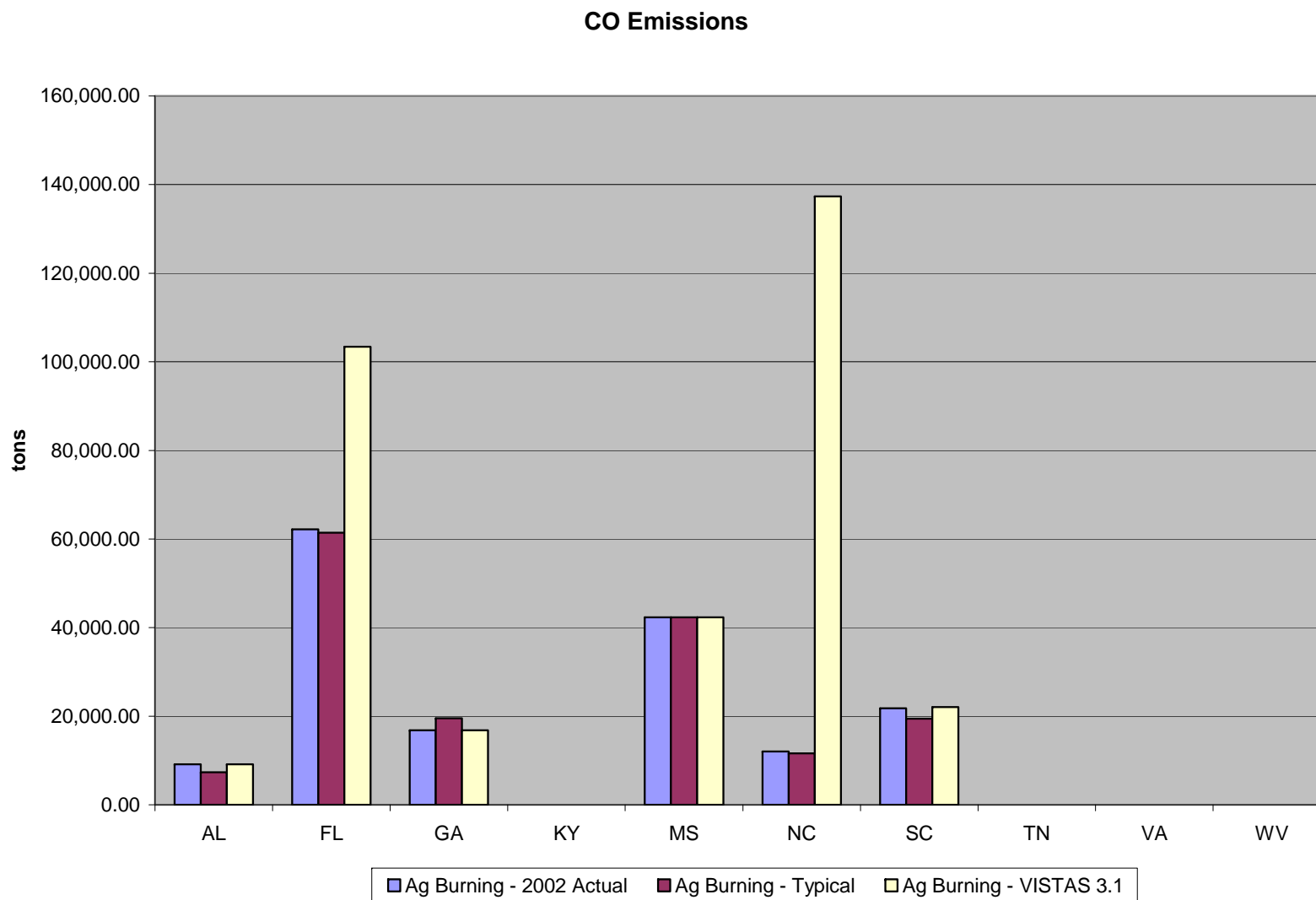


**Table 1.2-1. Emissions from Fires in the VISTAS Region – Comparison between Original Base Year 2002 (VISTAS 3.1), 2002 Actual and Typical Year Base G Emissions.**

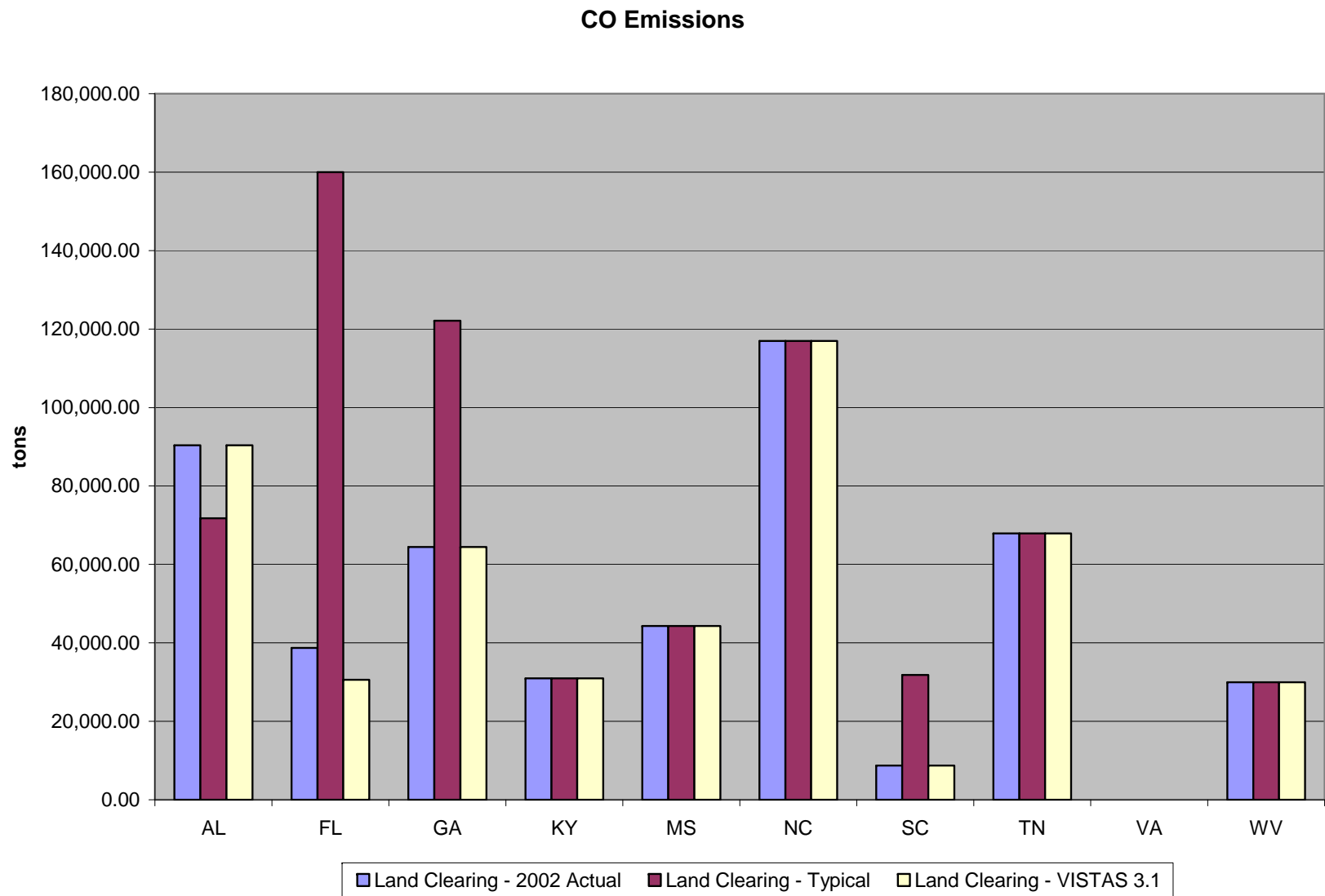
		CO	NH <sub>3</sub>	NO <sub>x</sub>	PM <sub>10</sub> -FIL	PM <sub>10</sub> -PRI	PM <sub>2.5</sub> -FIL	PM <sub>2.5</sub> -PRI	SO <sub>2</sub>	VOC
<b>Total LC</b>	Actual (Base G)	492,409	0	14,568	62,146	62,146	62,146	62,146	0	33,799
	Typical (Base G)	675,838	0	19,995	80,598	80,598	80,598	80,598	0	46,389
	VISTAS 3.1	484,240	0	14,327	61,325	61,325	61,325	61,325	0	33,238
<b>Total Ag</b>	Actual (Base G)	164,273	0	903	30,958	30,958	30,385	30,385	0	21,946
	Typical (Base G)	161,667	0	903	30,465	30,465	29,892	29,892	0	21,595
	VISTAS 3.1	331,073	0	903	41,480	41,480	40,192	40,192	0	41,875
<b>Total WF</b>	Actual (Base G)	298,835	1,333	6,628	28,923	28,923	24,926	24,926	1,611	16,804
	Typical (Base G)	547,174	2,451	11,955	53,070	53,070	45,635	45,635	3,072	28,491
	VISTAS 3.1	275,766	1,230	6,133	26,680	26,680	23,002	23,002	1,476	15,718
<b>Total RX</b>	Actual (Base G)	1,678,216	7,616	36,561	168,938	168,938	145,175	145,175	9,839	78,988
	Typical (Base G)	1,635,776	7,425	35,650	164,811	164,811	141,636	141,636	9,590	76,990
	VISTAS 3.1	1,724,940	7,822	37,556	173,590	173,590	149,181	149,181	10,101	81,188

Key: LC = Land Clearing; Ag = Agricultural burning; WF = wildfires; RX = prescribed burning. Actual and Typical represent Base F and Base G (e.g., no change in methodology for Base F and Base G) for 2002.

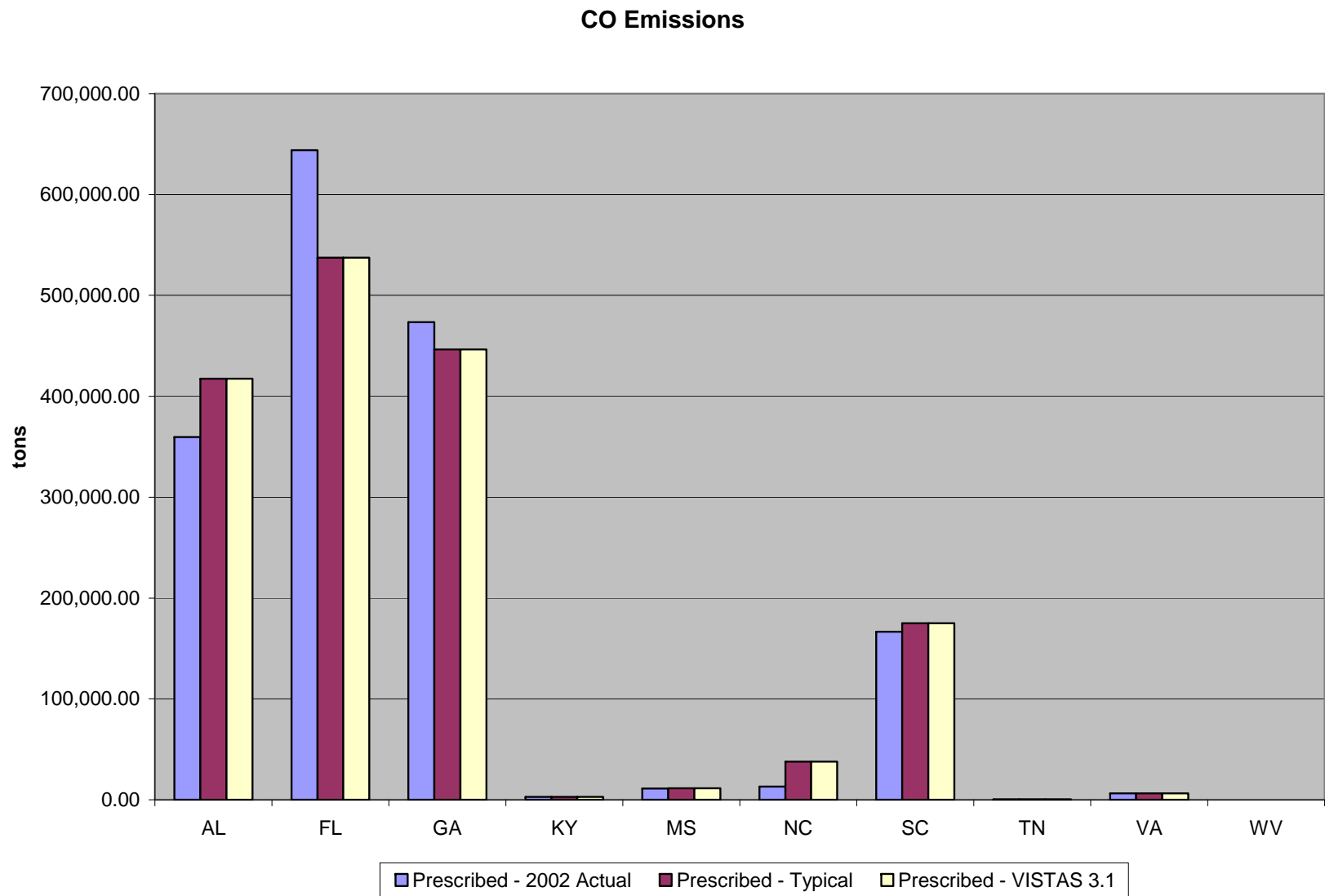
**Figure 1.2-1. CO Emissions from Agricultural Burning for the Original Base Year, 2002 Actual Base G, and 2002 Typical Base G Inventories.**



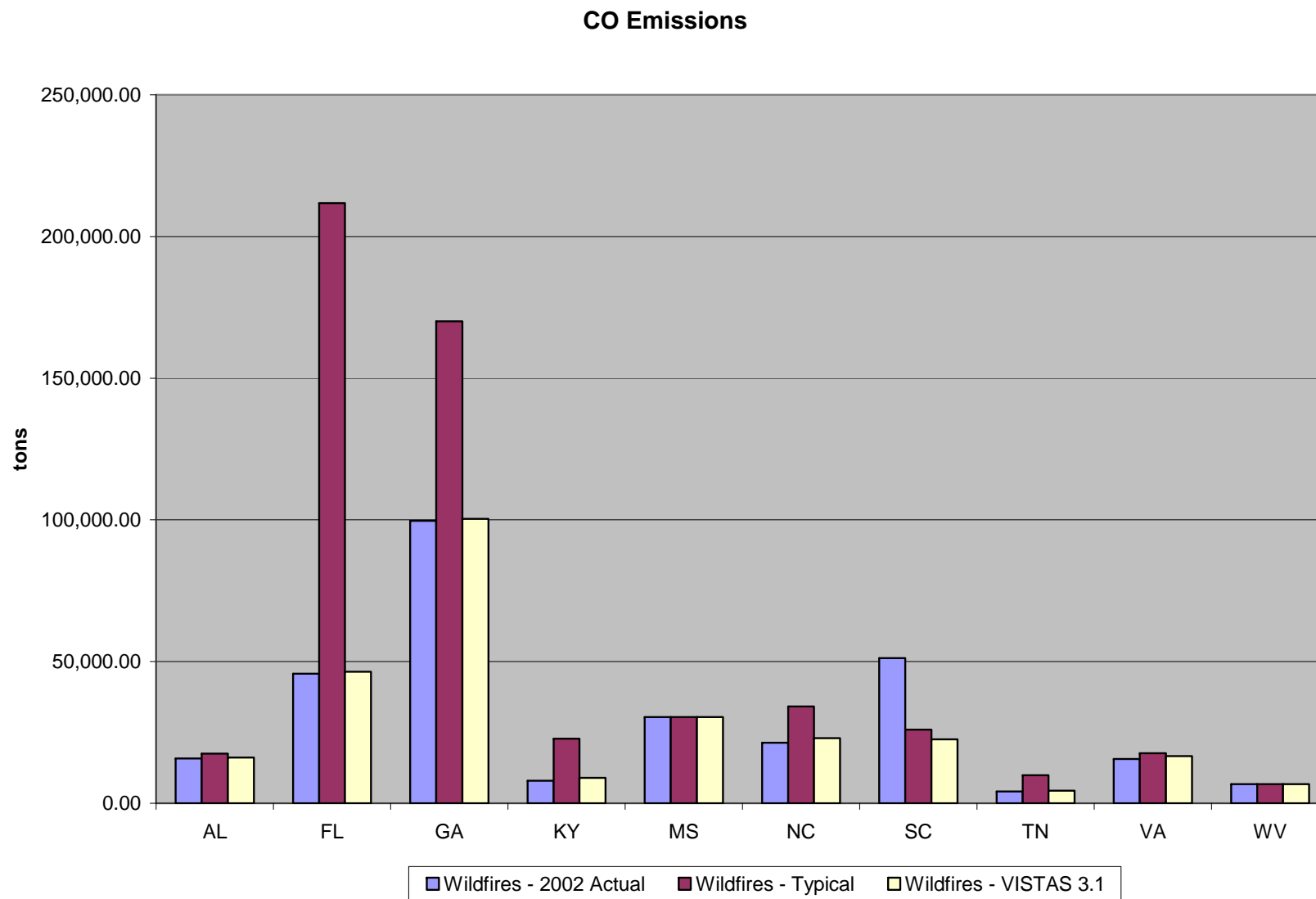
**Figure 1.2-2. CO Emissions from Land Clearing Burning for the Original Base Year, 2002 Actual Base G and 2002 Typical Base G Inventories.**



**Figure 1.2-3. CO Emissions from Prescribed Burning for the Original Base Year, 2002 Actual Base G and 2002 Typical Base G Inventories.**



**Figure 1.2-4. CO Emissions from Wildfire Burning for the Original Base Year, 2002 Actual Base G and 2002 Typical Base G Inventories.**



### **1.2.2      *Development of non-fire inventory***

The second task in preparing the area source component of the Base F and Base G 2002 base year inventory was the incorporation of data submitted by the VISTAS States to the EPA as part of the CERR. With few exceptions, Base F and Base G inventories for this component of the inventory are identical. Modifications to the Base F methodology (described below) only resulted from modifications from the VISTAS States during review of the Base F inventory. The changes made to the inventory based on these reviews are described in the last portion of this section of the report. The information presented below describes the method used to incorporate CERR data as part of Base F.

Work on incorporating the CERR data into the 2002 Base F inventory involved: 1) obtaining the data from EPA, 2) evaluating the emissions and pollutants reported in order to avoid double counting and 3) backfilling from the earlier version of the VISTAS 2002 base year inventory for missing sources/pollutants. The processes used to perform those operations are described below. This work did not include any of the fire emission estimates described above. In addition it did not include emission estimates for ammonia from agricultural and fertilizer sources. Finally it did not include PM emissions from paved roads. Each of those categories was estimated separately.

Data on the CERR submittals was obtained from EPA's Draft NEI download file transfer protocol (FTP) site where the data are stored after they've been processed for review. The data submitted in National Emission Inventory Format (NIF) was downloaded from that site. Once all of the files were obtained, MACTEC ran the files through the EPA NIF Format and Content checking tool to ensure that the files were submitted in standard NIF format and that there were no issues with those files. In a couple of cases small errors were found. For example, in one case a county FIPs code that was no longer in use was found. MACTEC contacted each VISTAS State area source contact person to resolve the issues with the files and corrections were made. Once all corrections to the native files were completed, MACTEC continued with the incorporation of the data into the VISTAS area source files.

Our general assumption was that unless we determined otherwise, the CERR submittals represented full and complete inventories. Where a State submitted a complete inventory, our plan was to simply delete the previous 2002 base year data and replace it with the CERR submittal. Prior to this replacement however, we stripped out the following emissions:

1. All wildfire, prescribed burning, land clearing and agricultural burning emissions submitted to EPA by the States as part of the CERR process were removed since they were to be replaced with emissions estimated using methods described earlier.
2. All fertilizer and agricultural ammonia emission records submitted to EPA by the States as part of the CERR process were removed. These were replaced with the estimates developed using the CMU Ammonia model.

3. All emissions from paved roads submitted to EPA by the States as part of the CERR process were removed. These emissions were replaced with updated emissions developed by U.S. EPA as part of their 2002 NEI development effort.

This approach was used for most State and Local emission submittals to prepare the Base F inventory. There were a few cases where alternative data were used to prepare the Base F inventory. In general, these alternatives involved submittal of alternative files to the CERR data by S/L agencies. Table 1.2-2 below summarizes the data used to prepare the Base F inventory. In general the data were derived from one of the following sources:

1. CERR submittal obtained from EPA FTP site as directed by VISTAS States;
2. State submitted file (either revised from CERR submittal or separate format);
3. VISTAS original 2002 base year (VISTAS version 3.1 base year file); or
4. EPA's preliminary 2002 NEI.

**Table 1.2-2. Summary of State Data Submittals for the 2002 VISTAS Area Source Base F Inventory**

State / Local Program	Area Source Emissions Data Source
AL	B
FL	B
GA	C
KY	A
MS	B
NC	C
SC	B
TN	B
VA	B
WV	A/C
Davidson County, TN	B
Hamilton County, TN	C
Memphis/Shelby County, TN	A
Knox County, TN	B
Jefferson County, AL	* so B from State
Jefferson County, KY	B
Buncombe County, NC	* so C from State
Forsyth County, NC	* so C from State
Mecklenburg County, NC	* so C from State

A = VISTAS 2002 (version 3.1)

B = CERR Submittal from EPA's ftp site

C = Other (CERR or other submittal sent directly from State to MACTEC)

\* = No response

In order to track the sources of data in the final Base F and Base G NIF files, a field was added to the NIF format files developed for VISTAS to track each data source. A field named Data\_Source was added to the EM table. A series of codes were added to this field to mark the source of each emissions value in the Base F and Base G inventories. Values in this field are detailed in Table 1.2-3.

**Table 1.2-3: Data Source Codes and Data Sources for VISTAS 2002 Base F Area Source Emissions Inventory.**

Data Source Codes	Data Source
Base F Codes	
CMU Model E-02-X or E-99-F or L-02-X or S-02-X	CMU Ammonia model v 3.6 EPA CERR submittal (from FTP site)
EPA Paved	EPA Paved Road emissions estimates
EPAPRE02NEI	EPA Preliminary 2002 NEI
STATEFILE	State submitted file
VISTBAS31	VISTAS 2002 Base Year version 3.1
VISTRATIO	Developed from VISTAS Ratios (used only for missing pollutants)
Additional Base G Codes	
ALBASEGFILE	Base G update file provided by AL
NCBASEGFILE	Base G update file provided by NC
OTAQRPT	Portable Fuel Container Emissions from OTAQ Report
STELLA	Revised data provided by VISTAS EI Advisor Greg Stella
VABASEGFILE	Base G update file provided by VA
VASStateFile	Revisions/additions to Base G update file provided by VA

Most States submitted complete inventories for Base F. Virginia's inventory required a two stage update. Virginia's CERR submittal only contained ozone precursor pollutants (including CO). For Virginia, MACTEC's original plan was to maintain the previous 2002 VISTAS base year emissions for non-ozone pollutants and then do a simple replacement for ozone pollutants. However during the QA phase of the work, MACTEC discovered that there were categories that had ozone precursor or CO emissions in the submittal that weren't in the original 2002 VISTAS base year inventory that should have PM or SO<sub>2</sub> emissions. For those records, MACTEC used an



emissions ratio to build records for emissions of these pollutants. Data for Virginia PM and SO<sub>2</sub> emissions were generated by developing SCC level ratios to NO<sub>x</sub> from the VISTAS 2002 base year inventory (version 3.1) or from emission factors and then calculating the emissions based on that ratio.

### **1.2.3 2002 Base G inventory updates**

After the Base F inventory was submitted and used for modeling, VISTAS States were provided an opportunity for further review and comment on the Base F inventory. As a result of this review and comment period, several VISTAS States provided revisions to the Base F inventory.

In addition to and as an outgrowth of some of the comments provided by the States during the review process, some of the changes made to the inventory were made globally across the entire VISTAS region. This section discusses the specific State changes followed by the global changes made to the area source component of the inventory for all VISTAS States.

#### **1.2.3.1 Changes resulting from State review and comment**

##### **Alabama**

Alabama suggested several changes and had questions concerning a few categories in the Base F inventory. The changes/questions were:

1. For Source Classification Code (SCC) 2102005000 (Industrial Boilers: Residual Oil) and SCC 2103007000 (Institutional/Commercial Heating: Liquefied Petroleum Gas) the Alabama noted that the Base F VISTAS inventory had values for NO<sub>x</sub>, VOC and CO for the State, but no values for SO<sub>2</sub>, PM<sub>10</sub> or PM<sub>2.5</sub>.

MACTEC evaluated this information and found that there were actually emissions for two counties in AL for that SCC that had either SO<sub>2</sub> and/or PM emissions. The data used to develop the 2002 Base F inventory for AL came from the preliminary 2002 CERR submittals (see above) which should have included SO<sub>2</sub> and PM but did not except for two counties. According to MACTEC's protocol for use of these files, the files received from EPA were to be used "as is" unless the States provided comments during the Base F comment period to correct the CERR submittal. No comments were received from AL on the CERR submittal used for Base F. For 2002 Base G, AL provided an updated database file for these SCCs for all counties in the State that provided revised values for emissions and included SO<sub>2</sub> and PM. The revised file was used to update the Base F data for Base G.

2. AL noted that the Base F inventory included SCC 2401002000 (Solvent Utilization, Surface Coating, Architectural Coatings - Solvent-based, Total: All Solvent Types) and 2401003000 (Solvent Utilization, Surface Coating,

Architectural Coatings - Water-based, Total: All Solvent Types) as well as SCC 2401001000 (Solvent Utilization, Surface Coating, Architectural Coatings, Total: All Solvent Types). This resulted in double counting of the emissions for this category. AL suggested removal of the breakdown SCCs and use of the total SCC.

MACTEC deleted records for the breakdown SCCs and retained the total all solvents SCC emissions.

3. AL found the SCCs listed below missing from the Base F VISTAS inventory.

SCC	VOC Emissions	SCC Description
2401025000	1139.91	Surface Coatings: Metal Furniture, all coating types
2401030000	425.27	Surface Coatings: Paper, all coating types
2401065000	344.08	Surface Coatings: Electronic and Other Electrical, all coating types
2430000000	504.29	Solvent Utilization, Rubber/Plastics, All Processes, Total: All Solvent Types
2440020000	3043.78	Solvent Utilization, Miscellaneous Industrial, Adhesive (Industrial) Application, Total: All Solvent Types
Total for AL	5457.32	

MACTEC found that the emissions for these SCCs were included in the Base F inventory, but with slightly different total emissions. AL provided an updated county-level emissions file for use in updating the Base G inventory. That file was used to update the NIF records for AL for those SCCs.

4. AL noted that emissions in the Base F inventory were found for SCC 2465000000 and SCCs 2465100000, 2465200000, 2465400000, 2465600000, and 2465800000. These last five SCCs represent a subset of the emissions in the 2465000000 SCC resulting in potential double counting of emissions.

MACTEC deleted all emissions associated with the Total SCC 2465000000 and retained the subset SCCs for the Base G inventory.

### **Florida**

Florida provided comments indicating that they felt that emissions from the following sources and counties were too high, especially for CO and PM and were likely zero:

- motor vehicle fire - Palm Beach County
- woodstoves - Miami Dade, Hillsborough, Orange, Polk, Ft Myers, Pasco and Sarasota Counties
- fireplaces - Miami Dade and Hillsborough Counties

Emissions from these sources in the counties specified were set to zero by MACTEC for the Base G inventory.

### **North Carolina**

North Carolina provided corrected emission files for 2002 Base F. A text file with emission values was provided and used to update the Base F emissions to Base G. The updated emissions were applied directly to the Base F NIF file. The file provided was similar to the “EM” NIF table. An update query was used to update the data supplied in the text file to the Access database NIF file. All changes were implemented.

### **South Carolina**

South Carolina had two issues concerning the Base F inventory. These issues related to 1) additional SCCs that were in BASE F 2009 and 2018, but not in 2002 Base F and 2) SCCs that were in the U.S. EPA 2002 NEI inventory, but not in the VISTAS 2002, 2009, or 2018 Base F inventory.

MACTEC investigated the additional SCCs found in 2009 and 2018 Base F and found that the SCCs actually were not missing in the 2002 Base F inventory but only had emissions for PM. Thus the emissions were maintained as they were provided in Base F.

With respect to the SCCs that were found in the U.S. EPA 2002 NEI, MACTEC investigated and found that they were not included in the Base F inventory because they were not included in the 2002 CERR submittal used to produce the Base F updates. The SCCs were apparently added by EPA later in the NEI development process. In addition, MACTEC also evaluated whether or not the SCCs were found in other VISTAS States Base F inventories. MACTEC found that some States included them and some did not, there was no consistency between the States. MACTEC also found that typically emissions for these SCCs were low in emissions, generally with emissions of only a few tons to tens of tons per year. The decision was made with South Carolina concurrence not to add these SCCs to the Base G inventory. These SCCs were: 210205000, 2102011000, 2103007000, 2103011000, 2104007000, 2104011000, 2302002100, 2302002200, 2302003100, 2302003200, 2610000500, 2810001000, and 281001500.

### **Virginia**

Virginia provided an updated 2002 base year emissions file. The data in that file were used to update the Base F inventory emission values to those for Base G. In addition, Virginia provided

information on several source categories that required controls for future year projections since the sources were located in counties/cities in northern Virginia and were subject to future year Ozone Transport Commission (OTC) regulations. MACTEC added in the base year control levels to the Base G inventory file for these categories so that they could be estimated correctly in future years. The controls added were for mobile equipment repair/refinishing sources, architectural and industrial maintenance coating sources, consumer products sources, and solvent metal cleaning sources. Minor errors were found in some entries for the initial file provided and VA provided a revised file with corrections and minor additions.

#### **1.2.4 Ammonia and paved road emissions**

The final component of the Base F inventory development was estimation of NH<sub>3</sub> emission estimates for livestock and fertilizers and paved road PM emissions. For the NH<sub>3</sub> emission estimates for livestock and fertilizers we used version 3.6 of the CMU NH<sub>3</sub> model (<http://www.cmu.edu/ammonia/>). Results from this model were used for all VISTAS States. The CMU model version 3.6 was used in large part because it had been just recently been updated to include the latest (2002) Census of Agriculture animal population statistics. Prior to inclusion of the CMU model estimates, MACTEC removed any ammonia records for agricultural livestock or fertilizer emissions from the VISTAS 2002 initial base year inventory. MACTEC also generated emissions from human perspiration and from wildlife using the CMU model and added those emissions for each State.

For the Base G ammonia inventory, MACTEC removed all wildlife and human perspiration emissions. VISTAS decided to remove these emissions from the inventory. Human perspiration was dropped due to a discrepancy in the units used for the emission factor that was not resolved prior to preparing the estimates and wildlife was dropped because VISTAS felt the activity data was too uncertain. Thus all emissions from these two categories were deleted in the Base G 2002 inventory.

For the paved road PM Base F emissions, we used the most recent estimates developed by EPA as part of the NEI development effort (Roy Huntley, U.S. EPA, email communication, 8/30/2004). EPA had developed an improved methodology for estimating paved road emissions for 2002 and had used that method to calculate emissions for that source category. MACTEC obtained those emissions from EPA and those values were substituted directly into the inventory after receiving consensus from all of the VISTAS States to perform the replacement. These files were obtained in March of 2005 in NIF format from the EPA FTP site.

For the Base G emissions, modifications were made to the emissions estimates based on changes suggested by work of the Western Regional Air Partnership and U.S. EPA. Details of these changes are provided below in the section on global changes made as part of the Base G inventory updates.

### **1.2.5 Global Changes Made for Base G**

There were three global changes made between the Base F and the Base G inventory (beyond the removal of wildlife and human perspiration NH<sub>3</sub> emissions). These changes were:

1. Removal of Stage II emissions from the area source inventory and inclusion in the mobile sector of the inventory,
2. Adjustment of fugitive dust PM<sub>2.5</sub> emissions, and
3. Addition of emissions from portable fuel containers.

As part of the Base F review process, several VISTAS States had expressed surprise that the Stage II refueling emission estimates were in the area source component of the inventory. This decision had been made with SIWG agreement early on in the inventory development process because 1) some States had included it in their CERR submittals and 2) because the non-road and on-road mobile estimates had differing activity factor units and could not be easily combined. However for Base G, the VISTAS States all agreed, especially in light of the different ways in which the emissions were reported in the CERR, to remove the Stage II refueling emissions from the area source inventory and include them in the non-road and on-road sectors. Thus all records related to Stage II refueling were removed from the area source component of the Base G inventory.

PM<sub>2.5</sub> emissions from several fugitive dust sources were also updated for Base G. The Western Regional Air Partnership (WRAP) and U.S. EPA had been investigating overestimation of the PM<sub>2.5</sub> / PM<sub>10</sub> ratio in several fugitive dust categories and U.S. EPA was in the process of making revisions to AP-42 for several categories during preparation of the Base G inventory. Based on data received from U.S. EPA, VISTAS decided to revise the PM<sub>2.5</sub> emissions from construction, paved roads and unpaved road sources. PM<sub>2.5</sub> emissions in Base F were multiplied by 0.67, 0.6, and 0.67 for construction, paved roads and unpaved roads respectively to produce the values found in Base G. No changes were made to PM<sub>10</sub>, only to PM<sub>2.5</sub>.

Finally, as part of Virginia's comments on the Base F inventory, emissions from portable fuel containers were mentioned as being absent from the inventory. MACTEC was tasked with developing a methodology that could be used to add these emissions to the Base G area source inventory. In investigating options for a method of estimating emissions, MACTEC found that the U.S. EPA had prepared a national inventory of emissions by State for portable fuel containers. Data on emissions from this source prepared by U.S. EPA were presented in, "Estimating Emissions Associated with Portable Fuel Containers (PFCs), Draft Report, Office of Transportation and Air Quality, United States Environmental Protection Agency, Report # EPA420-D-06-003, February 2006".

State-level emission estimates for 2005 derived from Appendix Table B-2 of the PFCs report were used as the starting point for developing 2002 county-level emissions estimates. State emissions were derived from that table by using all of the emission estimates in that table with the exception of values for vapor displacement and spillage from refueling operations. Those components of the State emissions were left out of the State-level emissions to avoid double counting refueling emissions in the non-road sector. For the purposes of 2002 emission estimates for Base G, the 2005 values were assumed equal to 2002 values.

The 2005 State-level estimates minus the refueling component from Appendix Table B-2 of the report were summed for each State and then allocated to the county-level. The county-level allocation was based on the fuel usage information obtained from the NONROAD 2005 model runs conducted as part of the Base G inventory development effort (see the 2002 base year Base G non-road section below). MACTEC used the spillage file from the NONROAD model (normally located in the DATA\EMSFAC directory in a standard installation of NONROAD) to determine the SCCs that used containers for refueling. The spillage file contains information by SCC and horsepower indicating whether or not the refueling occurs using a container or a pump. All SCC and horsepower classes using containers were extracted from the file and cross-referenced with the fuel usage by county for those SCC/horsepower combinations from the appropriate year model runs (2002, 2009 or 2018). Then the fuel usages by county from the NONROAD 2005 runs prepared for VISTAS were summed for those SCCs by county. The county level fuel use was then divided by the State total fuel use for the same SCCs to determine the fraction of total State fuel usage and that fraction was used to allocate the State-level emissions to the county.

### **1.2.6**      *Quality Assurance steps*

Throughout the inventory development process, quality assurance steps were performed to ensure that no double counting of emissions occurred, and to ensure that a full and complete inventory was developed for VISTAS. Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on the area source component of the 2002 Base F inventory:

1. All CERR and NIF format State supplied data submittals were run through EPA's Format and Content checking software.
2. SCC level emission summaries were prepared and evaluated to ensure that emissions were consistent and that there were no missing sources.
3. Tier comparisons (by pollutant) were developed between the revised 2002 base year inventory and the previous (version 3.1) base year inventory.

4. Fields were either added or used within each NIF data table to track the sources of data for each emission record.
5. Data product summaries were provided to both the VISTAS Emission Inventory Technical Advisor and to Area Source and Fires SIWG representatives for review and comment. Changes based on these comments were implemented in the files.
6. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from 1.0 to 2.0. A minor change would cause a version number to go from 1.0 to 1.1. Minor changes resulting from largely editorial changes would result in a change from 1.00 to 1.01.

In addition, for the fires inventory, data related to fuel loading and fuel consumption was reviewed and approved by the VISTAS Fire SIWG to ensure that values used for each type of fire and each individual fire were appropriate. Members of the VISTAS Fire SIWG included representatives from most State Divisions of Forestry (or equivalent) as well as U.S. Forest Service and National Park Service personnel.

For Base G, similar QA steps to those outlined above for Base F were undertaken. In addition, all final NIF files were checked using the EPA Format and Content checking software and summary information by State and pollutant were prepared comparing the Base F and Base G inventories.

### **1.3 Mobile Sources**

This section describes the revisions made to the initial 2002 VISTAS Base Year emission inventory on-road mobile source input files. For this work actual emission estimates were not made, rather data files consistent with Mobile Emissions Estimation Model Version 6 (MOBILE6) were developed and provided to the VISTAS modeling contractor. These input data files were then run during the VISTAS modeling to generate on-road mobile source emissions using episodic and meteorological specific conditions configured in the sparse matrix operator Kernel Emissions modeling system (SMOKE) emissions processor.

During initial discussions with the VISTAS Mobile Source SIWG, some States indicated a desire to use CERR mobile source emissions data in place of the VISTAS 2002 inventories generated by E.H. Pechan and Associates, Inc. (the initial VISTAS 2002 Base Year inventory files).

However, the CERR emissions data by itself were not sufficient for an inventory process that includes both base and future year inventories. MACTEC needed to be able to replicate the CERR data rather than simply obtain CERR emissions estimates. The reason for this is that only input files were being prepared to provide revised 2002 estimates during the VISTAS modeling process, rather than the actual emission estimates and that the 2002 input data files would be



used as a starting point for the projected emission estimates. This meant that the appropriate vehicle miles traveled (VMT), MOBILE6, and/or NONROAD model input data needed to be provided. If these data were provided with the CERR emissions estimates we used it as the starting point for revision of the 2002 Base Year inventory. However MACTEC did not have access to the on-road mobile CERR submissions from EPA, so re-submittal of these data directly to MACTEC was requested in order to begin compiling the appropriate input file data.

In those cases where States did not provide CERR on-road mobile source input data files, our default approach was to maintain the data input files and VMT estimates for the initial 2002 Base Year inventory prepared by Pechan.

### ***1.3.1 Development of on-road mobile source input files and VMT estimates***

Development of the 2002 on-road input files and VMT was a multi-step process depending upon what the State mobile source contacts instructed us to use as their data. Information provided below provides incremental revisions made to on-road mobile source inventories or inputs in series from one inventory version to the next. In general the process involved one of three steps from the original 2002 on-road mobile source data.

#### **Base F Revisions**

1. The first step was to evaluate the initial 2002 base year files and make any non-substantive changes (i.e., changes only to confirm that the files posted for 2002 by Pechan were executable and that all the necessary external files needed to run MOBILE6 were present). This approach was taken for AL, FL, GA, MS, SC, and WV. For these States the determination was made that the previous files would be okay to use as originally prepared. For SC, the VMT file was updated, but that did not affect the MOBILE6 input files.
2. For other States, modification to the input files was required. The information below indicates what changes were made for other States in the VISTAS region.

KY – For Kentucky, the Inspection and Maintenance (I/M) records in the input files for Jefferson County were updated in order to better reflect the actual I/M program in the Louisville metropolitan area.

NC - Substantial revisions were implemented to these input files based on input from the State. The modifications necessary to reflect the desires of the State led to complete replacement of the previous input files. Among the changes made were:

- The regrouping of counties (including the movement of some counties from one county group to another and the creation of new input files for previously grouped



- counties). There were originally 32 input files; after the changes there were 49. The pointer file was corrected to reflect these changes.
- Travel speeds were updated in over 3000 scenarios.
  - All I/M records were updated.
  - All registration distributions were updated.
  - I/M VMT fractions were updated (which only affected the pointer file).
  - VMT estimates were updated (which has no direct effect on the MOBILE6 input files but does ultimately affect emissions).
3. VA and TN – For these States, new input files were provided due to substantive changes that the State wanted to make relative to the 2002 initial base year input files. In addition, revised VMT data were developed for each State.

### **Base G Revisions**

For the production of the VISTAS 2002 Base G inventory, VISTAS states reviewed the Base F inputs, and provided corrections, updates and supplemental data.

For all states modeled, the Base G updates include:

Adding Stage II refueling emissions calculations to the SMOKE processing.

Revised the HDD compliance for all states. (REBUILD EFFECTS = .1)

In addition to the global changes, individual VISTAS states made the following updates:

KY – updated VMT and M6 input values for selected counties.

NC – revised VMT and registration distributions.

TN - revised VMT and vehicle registration distributions for selected counties.

VA – revised winter RFG calculations in Mobile 6 inputs.

WV – revised VMT input data.

AL, FL, and GA did not provide updates for Base G and therefore the Base F inputs were used for these States.

#### **1.3.1.1 Emissions from on-road mobile sources**

The MOBILE6 module of the Sparse Matrix Operator Kernel Emissions (SMOKE) model was used to develop the on-road mobile source emissions estimates for CO, NO<sub>x</sub>, NH<sub>3</sub>, SO<sub>2</sub>, PM, and

VOC emissions. The MOBILE6 parameters, vehicle fleet descriptions, and VMT estimates are combined with gridded, episode-specific temperature data to calculate the gridded, temporalized emission estimates. The MOBILE6 emissions factors are based on episode-specific temperatures predicted by the meteorological model. Further, the MOBILE6 emissions factors model accounts for the following:

- Hourly and daily minimum/maximum temperatures;
- Facility speeds;
- Locale-specific inspection/maintenance (I/M) control programs, if any;
- Adjustments for running losses;
- Splitting of evaporative and exhaust emissions into separate source categories;
- VMT, fleet turnover, and changes in fuel composition and Reid vapor pressure (RVP).

The primary input to MOBILE6 is the MOBILE shell file. The MOBILE shell contains the various options (e.g. type of inspection and maintenance program in effect, type of oxygenated fuel program in effect, alternative vehicle mix profiles, RVP of in-use fuel, operating mode) that direct the calculation of the MOBILE6 emissions factors. The shells used in these runs were based on VISTAS Base F modeling inputs as noted in the previous section.

For this analysis, the on-road mobile source emissions were produced using selected weeks (seven days) of each month and using these days as representative of the entire month. This selection criterion allows for the representation of day-of-the-week variability in the on-road motor vehicles, and models a representation of the meteorological variability in each month. The modeled weeks were selected from mid-month, avoiding inclusion of major holidays.

The parameters for the SMOKE runs are as follows:

Episodes:

2002 Initial Base Year, and  
2009 and 2018 Future years, using 2009/2018 inventories and modeled using the same meteorology and episode days as 2002.

Episode represented by the following weeks per month:

January 15-21  
February 12-18  
March 12-18  
April 16-22

May 14-20

June 11-17

July 16-22

August 13-19

September 17-23

October 15-21

November 12-18

December 17-23

Days modeled as holidays for annual run:

New Year's Day - January 1

Good Friday – March 29

Memorial Day – May 27

July 4th

Labor Day – September 2

Thanksgiving Day – November 28, 29

Christmas Eve – December 24

Christmas Day – December 25

Output time zone:

Greenwich Mean Time (zone 0)

Projection:

Lambert Conformal with Alpha=33, Beta=45, Gamma=-97, and center at (-97, 40).

Domain:

36 Kilometer Grid: Origin at (-2736, -2088) kilometers with 148 rows by 112 columns and 36-km square grid cells.

12 Kilometer Grid: Origin at (108, -1620) kilometers with 168 rows by 177 columns and 12-km square grid cells.

CMAQ model species:

The CMAQ configuration was CB-IV with PM. The model species produced were: CO, NO, NO<sub>2</sub>, ALD<sub>2</sub>, ETH, FORM, ISOP, NR, OLE, PAR, TERPB, TOL, XYL, NH<sub>3</sub>, SO<sub>2</sub>, SULF, PEC, PMFINE, PNO<sub>3</sub>, POA, PSO<sub>4</sub>, and PMC.

Meteorology data:

Daily (25-hour). SMOKE requires the following five types of MCIP outputs: (1) Grid cross 2-d, (2) Grid cross 3-d, (3) Met cross 2-d, (4) Met cross 3-d, and (5), Met dot 3-d.

The reconstructed emissions based on the representative week run were calculated by mapping each day of week (Mon, Tue, Wed, etc.) from the modeled month to the same day of week generated in the representative week run. In the case of holidays, these days were mapped to representative week Sundays. An example of this mapping for the January episode is presented in Table 1.3-1 below. Note that although the emissions were generated for individual calendar years (2002, 2009 and 2018) the meteorology is based on 2002.

**Table 1.3-1. Representative day mapping for January episode  
(Highlighted representative week).**

Modeled Date	Representative Day	Modeled Date	Representative Day	Modeled Date	Representative Day
1/1/2002*	1/20/2002	1/11/2002	1/18/2002	1/22/2002	1/15/2002
1/2/2002	1/16/2002	1/12/2002	1/19/2002	1/23/2002	1/16/2002
1/3/2002	1/17/2002	1/13/2002	1/20/2002	1/24/2002	1/17/2002
1/4/2002	1/18/2002	1/14/2002	1/21/2002	1/25/2002	1/18/2002
1/5/2002	1/19/2002	1/15/2002	1/15/2002	1/26/2002	1/19/2002
1/6/2002	1/20/2002	1/16/2002	1/16/2002	1/27/2002	1/20/2002
1/7/2002	1/21/2002	1/17/2002	1/17/2002	1/28/2002	1/21/2002
1/8/2002	1/15/2002	1/18/2002	1/18/2002	1/29/2002	1/15/2002
1/9/2002	1/16/2002	1/19/2002	1/19/2002	1/30/2002	1/16/2002
1/10/2002	1/17/2002	1/20/2002	1/20/2002	1/31/2002	1/17/2002
		1/21/2002	1/21/2002		

\* Modeled holiday

### 1.3.2 Development of non-road emission estimates

Emissions from non-road sources were estimated in two steps. First, emissions for non-road sources that are included in the NONROAD model were developed. Second, emissions from sources not included in the NONROAD model were estimated. The sections below detail the procedures used for each group of sources.

#### 1.3.2.1 Emissions from NONROAD model sources

An initial 2002 base year emissions inventory for non-road engines and equipment covered by the EPA NONROAD model was prepared for VISTAS in early 2004. The methods and assumptions used to develop the inventory are presented in a February 9, 2004 report “*Development of the VISTAS Draft 2002 Mobile Source Emission Inventory (February 2004 Version)*” as prepared by E.H. Pechan & Associates, Inc. Except as otherwise stated below, all aspects of the preparation methodology documented in that report continue to apply to the revised NONROAD modeling discussed in this section.

Revisions to the initial 2002 NONROAD emissions inventory were implemented to ensure that the latest State and local data were considered, as well as to more accurately reflect gasoline sulfur contents for 2002 and correct other State-specific discrepancies. Those revisions comprise the Base F VISTAS non-road inventory. This section details the specific revisions made to the NONROAD model input files for the Base F and Base G VISTAS base year inventories, and provides insight into some key differences between the versions of the NONROAD model employed for the Base F and Base G inventories and the previous version employed for the initial 2002 base year inventory prepared by Pechan.

Revisions to the initial 2002 emissions inventory prepared by Pechan were actually implemented in two stages. An initial set of revisions was implemented in the fall of 2004. Those revisions resulted in the Base F inventory. These were followed by a second set of revisions in the spring of 2006. Those estimates produced the Base G base year inventory. To accurately document the combined effects of both sets of revisions, each set is discussed separately below. Unless otherwise indicated, all revisions implemented in Base F were carried directly into the Base G revision process without change. Thus, the inventories that resulted from the Base F revisions served as the starting point for the Base G revisions.

For Base F, three VISTAS States provided detailed data revisions for consideration in developing revised model inputs. These States were:

1. North Carolina
2. Tennessee (including a separate submission for Davidson County), and
3. Virginia.

The remaining seven VISTAS States indicated that the initial 2002 VISTAS input files prepared by Pechan continued to reflect the most recent data available. These States were:

1. Alabama,
2. Florida,
3. Georgia,
4. Kentucky,
5. Mississippi,
6. South Carolina, and
7. West Virginia.

However, it should be recognized that the NONROAD input files for *all* ten VISTAS States were updated to reflect gasoline sulfur content revisions for the Base F 2002 base year inventory (as discussed below). The original files prepared by Pechan are available on their FTP site in the /pub/VISTAS/MOB\_0104/ directory.

Before presenting the specific implemented revisions, it is important to note that the Base F 2002 base year inventory utilized a newer release of the NONROAD model than was used for the initial 2002 base year inventory (prepared by Pechan). The Base F 2002 base year inventory, as developed in spring 2004, was based on the Draft NONROAD2004 model, which was released by the EPA in May of 2004. This model is no longer available on EPA's website. The initial 2002 base year inventory (prepared by Pechan) was based on the Draft NONROAD2002a version of the model (which is also no longer available on EPA's website). Key differences between the models are as follows:

- Draft NONROAD2004 included the effects of the Tier 4 non-road engine and equipment standards (this did not impact the Base F 2002 inventory estimates, but did affect Base F future year forecasts).
- Draft NONROAD2004 included the *exhaust* emission impacts of the large spark-ignition engine standards; the evaporative impacts of these standards are *not* incorporated (this does not impact 2002 inventory estimates, but does affect future year forecasts).
- Draft NONROAD2004 included revised equipment population estimates.
- The PM<sub>2.5</sub> fraction for *diesel* equipment in Draft NONROAD2004 had been updated from 0.92 to 0.97.
- Draft NONROAD2004 included revisions to recreational marine activity, useful life, and emission rates.

To the extent that these revisions affect 2002 emissions estimates, they will be reflected as differentials between the initial and Base F 2002 VISTAS base year inventories. It is perhaps important to identify that, at the time of the Base F inventory revisions; the EPA recognized the Draft NONROAD2004 model as an appropriate mechanism for SIP development. Although the model was designated as a draft update, it reflected the latest and most accurate NONROAD planning data at that time, as evidenced by the EPA's use of that version for the Tier 4 Final Rulemaking.

Prior to the Base G inventory revisions implemented in 2006, the EPA released another updated version of the NONROAD model, designated as Final NONROAD2005 (which can be downloaded from: <http://www.epa.gov/OMSWWW/nonrdmdl.htm#model>). This version ostensibly represents the final version of the model, although certain components of it have been updated since its first release in December 2005. For the Base G inventory developed in the first half of 2006, all updates of the Final NONROAD2005 model through March 2006 are included. Key differences between Final NONROAD2005 and Draft NONROAD2004 are as follows:

- Final NONROAD2005 reflects the latest basic emission rate and deterioration data.

- Final NONROAD2005 includes emission estimates for a range of evaporative emissions categories not included in Draft NONROAD2004 (tank and hose permeation, hot soak, and running loss emissions).
- Final NONROAD2005 includes a revised diurnal emissions algorithm.
- Final NONROAD2005 includes a revised equipment scrappage algorithm.
- Final NONROAD2005 includes revised state and county equipment allocation data.
- Final NONROAD2005 allows separate sulfur content inputs for marine and land-based diesel fuel.
- Final NONROAD2005 includes revised conversion factors for hydrocarbon emissions.
- Final NONROAD2005 includes the evaporative emission impacts of the large spark-ignition engine standards (this does not impact 2002 inventory estimates, but does affect future year forecasts).

Unfortunately, due to the extensive revisions associated with Final NONROAD2005, input files created for use with Draft NONROAD2004 (e.g., Base F input files) and earlier versions of the model cannot be used directly with Final NONROAD2005 (used for Base G). This created a rather significant impact in that the VISTAS NONROAD modeling process involves the consideration of over 200 unique sets of input data. To avoid creating new input files for each of these datasets, a conversion process was undertaken wherein each of the Draft NONROAD2004 (Base F) input data files were converted into the proper format required for proper execution in Final NONROAD2005 (Base G).<sup>1</sup> This process consisted of the following steps:

- Revise the Draft NONROAD2004 (Base F) input files to include the following two line EPA-developed comment at the end of the input file header (this is a nonsubstantive change implemented solely for consistency with input files produced directly using Final NONROAD2005):

```
9/2005 epa: Add growth & tech years to OPTIONS packet  
and Counties & Retrofit files to RUNFILES packet.
```

---

<sup>1</sup> The necessary conversions were developed by comparing substantively identical input files created using the graphical user interfaces for both Draft NONROAD2004 and Final NONROAD2005. The differences between the input files indicated the specific revisions necessary to convert existing VISTAS input files into Final NONROAD2005 format.

- Revise the Draft NONROAD2004 (Base F) input files to include the following two command lines after the “Weekday or weekend” command in the PERIOD packet:

```
Year of growth calc:  
Year of tech sel   :
```

- Revise the Draft NONROAD2004 (Base F) input files to include the following command line after the “Diesel sulfur percent” command in the OPTIONS packet:

```
Marine Dsl sulfur %: 0.2638
```

Note that the value 0.2638 (2638 parts per million by weight [ppmW]) is applicable only for 2002 modeling and was accordingly revised (as described below) for both the 2009 and 2018 Base G forecast inventories. The 2638 ppmW sulfur value for 2002 marine diesel fuel was taken from the 48-State (excludes Alaska and Hawaii) tabulation presented in the April 27, 2004 EPA document “*Diesel Fuel Sulfur Inputs for the Draft NONROAD2004 Model used in the 2004 Non-road Diesel Engine Final Rule.*” It should also be noted that this value differs by about 5 percent from the 2500 ppmW value previously used for the initial 2002 VISTAS modeling (performed by Pechan). Prior to Final NONROAD2005 (used for Base G), the NONROAD model allowed only a single diesel fuel sulfur input that was applied to both land-based and marine equipment. As documented in the February 9, 2004 report “*Development of the VISTAS Draft 2002 Mobile Source Emission Inventory (February 2004 Version)*” as prepared by E.H. Pechan & Associates, Inc., a value of 2500 ppmW sulfur was used for all 2002 VISTAS NONROAD modeling. Given the ability of Final NONROAD2005 to distinguish a separate sulfur content for marine equipment and the existing EPA guidance document suggesting an appropriate marine sulfur value of 2638 ppmW for 2002, the existing modeling value of 2500 ppmW was modified (for marine equipment only).

- Replace the Draft NONROAD2004 (Base F) input files RUNFILES packet command line:

```
TECHNOLOGY           : c:\non-road\data\tech\tech.dat
```

with the command lines:

```
EXH TECHNOLOGY       : c:\non-road\data\tech\tech-exh.dat  
EVP TECHNOLOGY       : c:\non-road\data\tech\tech-evp.dat
```

- Revise the Draft NONROAD2004 (Base F) input files to include the following two command lines after the “EPS2 AMS” command in the RUNFILES packet:



```
US COUNTIES FIPS : c:\non-road\data\allocate\fips.dat
RETROFIT          :
```

- Revise the Draft NONROAD2004 (Base F) input files to include the following command line after the “Rec marine outbrd” command in the ALLOC FILES packet:

```
Locomotive NOx   : c:\non-road\data\allocate\XX_rail.alo
```

Where “XX” varies across input files. For any given file, “XX” is the two digit abbreviation of the state associated with the scenario being modeled (e.g., for Alabama modeling, XX=AL).

- Replace the Draft NONROAD2004 (Base F) input files EMFAC FILES packet command line:

```
Diurnal          : c:\non-road\data\emsfac\diurnal.emf
```

with the eight command lines:

```
Diurnal          : c:\non-road\data\emsfac\evdiu.emf
TANK PERM        : c:\non-road\data\emsfac\evtank.emf
NON-RM HOSE PERM : c:\non-road\data\emsfac\evhose.emf
RM FILL NECK PERM : c:\non-road\data\emsfac\evneck.emf
RM SUPPLY/RETURN : c:\non-road\data\emsfac\evsupret.emf
RM VENT PERM     : c:\non-road\data\emsfac\evvent.emf
HOT SOAKS       : c:\non-road\data\emsfac\evhotsk.emf
RUNINGLOSS      : c:\non-road\data\emsfac\evrunls.emfEVP
```

- Revise the Draft NONROAD2004 (Base F) input files to include the following command line after the “PM exhaust” command in the DETERIORATE FILES packet:

```
Diurnal          : c:\non-road\data\detfac\evdiu.det
```

Once revised in this format, the VISTAS non-road input files developed for use with Draft NONROAD2004 (Base F) were executable under the Final NONROAD2005 model (Base G).

The only additional revisions implemented to develop a Final NONROAD2005-based inventory (Base G) involved elimination of non-default equipment allocation files for North Carolina and West Virginia. Due to concerns about improper equipment allocation across counties under the Draft NONROAD2004 model (used for Base F), as well as for earlier versions of the NONROAD model, North Carolina had produced alternative allocation data files indicating the number of employees in air transportation by county, the number of wholesale establishments by county, and the number of employees in landscaping services by county. For the same reason, West Virginia had produced alternative equipment allocation files indicating the number of

employees in air transportation by county, the tonnage of underground coal production by county, the number of golf courses and country clubs by county, the number of wholesale establishments by county, the number of employees in logging operations by county, the number of employees in landscaping services by county, the number of employees in manufacturing operations by county, the number of employees in oil and gas drilling and extraction operations by county, and the number of recreational vehicle parks and campgrounds by county. These alternative equipment allocation files were used for all VISTAS inventory modeling conducted prior to the release of Final NONROAD2005 (i.e., through Base F). However, both North Carolina and West Virginia determined that the default allocation file revisions associated with the release of Final NONROAD2005 were appropriate to address the concerns that led to the development of the alternative allocation files. As a result, all alternative allocation file commands were removed from VISTAS NONROAD2005 (Base G) input files for North Carolina and West Virginia, so that the entire region under the Base G inventory is now modeled using the default allocation files provided with NONROAD2005.

In addition to the alternative equipment allocation files, North Carolina had previously developed an alternative seasonal adjustment file that was used for the Base F inventory in place of the default file provided with Draft NONROAD2004 (and earlier model versions). The alternative data file implemented a single change, namely reclassifying North Carolina as a southeastern state rather than a mid-Atlantic state (as identified in the default data file). Since Final NONROAD2005 continues to identify North Carolina as a mid-Atlantic state, North Carolina requested that the southeastern reclassification be continued for all NONROAD2005 modeling (Base G). To ensure that any other revisions associated with the seasonal adjustment file released with NONROAD2005 were not overlooked, the previously developed alternative seasonal adjustment file for North Carolina was scrapped and a new alternative file was created from the default seasonal adjustment file provided with Final NONROAD2005 for Base G inventory development. The alternative file, which was used for all North Carolina modeling, reclassifies North Carolina from a mid-Atlantic to a southeastern state. This represents the only non-default data file used for VISTAS NONROAD2005-based (Base G) modeling.

The remainder of this section documents all changes to the originally established VISTAS input file values as documented in the February 9, 2004 report “*Development of the VISTAS Draft 2002 Mobile Source Emission Inventory (February 2004 Version)*” as prepared by E.H. Pechan & Associates, Inc. Unless specifically stated below, all values from that report continue to be used without change in the latest VISTAS modeling.

### **Base F Revisions:**

For the initial 2002 base year inventory (developed by Pechan), all NONROAD modeling runs for VISTAS were performed utilizing a gasoline sulfur content of 339 ppmW and a diesel sulfur

content of 2,500 ppmW. Although the EPA-recommended non-road diesel fuel sulfur content for 2002 is 2,283 ppmW, the 2,500 ppmW sulfur content used for the initial 2002 base year VISTAS inventory was designed to remove the effect of lower non-road diesel fuel sulfur limits applicable only in California. (The EPA recommended inputs can be found in “*Diesel Fuel Sulfur Inputs for the Draft NONROAD2004 Model used in the 2004 Non-road Diesel Engine Final Rule*,” EPA, April 27, 2004.) This correction is appropriate and was retained for the Base F 2002 inventory. Thus, the Base F inventory continued to assume a diesel fuel sulfur content of 2,500 ppmW across the VISTAS region.

However, 339 ppmW is not the EPA recommended 2002 gasoline sulfur content for either eastern conventional gasoline areas or Federal Reformulated Gasoline (RFG) areas. The recommended sulfur content for eastern conventional gasoline is 279 ppmW year-round, while the recommended sulfur content for RFG areas is 129 ppmW during the summer season and 279 ppmW during the winter season. (Conventional gasoline and RFG sulfur contents for 2002 can be found in “*User’s Guide to MOBILE6.1 and MOBILE6.2, Mobile Source Emission Factor Model*,” EPA420-R-03-010, U.S. EPA, August 2003 [pages 149-155] (available at link at <http://www.epa.gov/otaq/m6.htm>) and in the source code for MOBILE6.2 at Block Data BD05.) Given the differences in the EPA-recommended values and the value used to generate the initial 2002 base year inventory, the input files for Base F for *all* VISTAS areas were updated to reflect revised gasoline sulfur content assumptions.

Since the VISTAS NONROAD modeling is performed on a seasonal basis, and since gasoline sulfur content in RFG areas varies with the RFG season, seasonally-specific gasoline sulfur content values were estimated for use in RFG area modeling. In addition, 25 counties in Georgia are subject to a summertime gasoline sulfur limit of 150 ppmW, so that seasonal sulfur content estimates were also estimated for these counties. The initial 2002 base year NONROAD inventory (prepared by Pechan) for these Georgia counties was based on a year-round 339 ppmW gasoline sulfur content, but that oversight was corrected in the Base F 2002 base year inventory. Based on the seasonal definitions employed in the NONROAD model, monthly sulfur contents were averaged to estimate seasonal gasoline sulfur contents as follows:

Month/Season	RFG Areas	Conventional Gasoline Areas	Georgia Gasoline Control Areas
March	279 ppmW	279 ppmW	279 ppmW
April	279 ppmW	279 ppmW	279 ppmW
May	129 ppmW	279 ppmW	150 ppmW
Spring	229 ppmW	279 ppmW	236 ppmW
June	129 ppmW	279 ppmW	150 ppmW
July	129 ppmW	279 ppmW	150 ppmW

August	129 ppmW	279 ppmW	150 ppmW
Summer	129 ppmW	279 ppmW	150 ppmW
September	129 ppmW	279 ppmW	150 ppmW
October	279 ppmW	279 ppmW	279 ppmW
November	279 ppmW	279 ppmW	279 ppmW
Fall	229 ppmW	279 ppmW	236 ppmW
December	279 ppmW	279 ppmW	279 ppmW
January	279 ppmW	279 ppmW	279 ppmW
February	279 ppmW	279 ppmW	279 ppmW
Winter	279 ppmW	279 ppmW	279 ppmW

Note that the seasonal data are based on simple arithmetic averages and do not consider any monthly variation in activity (and fuel sales), and that the transition between summer and winter seasons is also not considered. Additionally, the summer fuel control season is treated as though it applies from May through September, while the summer RFG season actually ends on September 15 and the Georgia fuel control season does not officially begin until June 1. This treatment is consistent with the treatment of both fuel control programs in the VISTAS on-road vehicle modeling. Each of these influences will result in some error in the estimated sulfur content estimates, but it is expected that this error is small relative to the overall correction from a year-round sulfur content estimate of 339 ppmW.

All NONROAD modeling revisions made as part of the Base F inventory preparation process are presented in Table 1.3-2. Due to more involved updates in several areas, the number of NONROAD input files as well as sequence numbers used to represent these files was also updated in a few instances (as compared to the files used to create the initial 2002 VISTAS non-road inventory, as documented in the February 9, 2004 report “*Development of the VISTAS Draft 2002 Mobile Source Emission Inventory (February 2004 Version)*” as prepared by E.H. Pechan & Associates, Inc. These structural revisions are presented in Table 1.3-3, and are provided solely for the benefit of NONROAD modelers as the indicated revisions have no impact on generated emission estimates.

**Table 1.3-2. Summary of Base F NONROAD Modeling Revisions**

State	Revisions Implemented
AL	(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).
FL	(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).
GA	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all seasons for conventional gasoline counties.</p> <p>(2) Gasoline sulfur content changed from 339 ppmW to 150 ppmW in the summer for all gasoline control counties.</p> <p>(3) Gasoline sulfur content changed from 339 ppmW to 236 ppmW in the spring and fall for all gasoline control counties.</p> <p>(4) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in the winter for all gasoline control counties.</p> <p><i>Gasoline control counties: Barrow, Bartow, Butts, Carroll, Cherokee (a), Clayton (a), Cobb (a), Coweta (a), Dawson, De Kalb (a), Douglas (a), Fayette (a), Forsyth (a), Fulton (a), Gwinnett (a), Hall, Haralson, Henry (a), Jackson, Newton, Paulding (a), Pickens, Rockdale (a), Spalding, and Walton</i></p>
KY	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all seasons for conventional gasoline counties.</p> <p>(2) Gasoline sulfur content changed from 339 ppmW to 129 ppmW in the summer for all gasoline control counties.</p> <p>(3) Gasoline sulfur content changed from 339 ppmW to 229 ppmW in the spring and fall for all gasoline control counties.</p> <p>(4) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in the winter for all gasoline control counties.</p> <p><i>Gasoline control counties: Boone, Bullitt (b), Campbell, Jefferson, Kenton, and Oldham (b)</i></p>
MS	(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).
NC	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).</p> <p>(2) Utilize revised (i.e., local) allocation files for three equipment categories.</p> <p>(3) Utilize revised (i.e., local) seasonal activity data.</p>
SC	(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).
TN	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).</p> <p>(2) Gasoline Reid Vapor Pressure (RVP) values changed in accordance with local recommendations.</p> <p>(3) Temperature data changed in accordance with local recommendations.</p> <p>(4) Counties regrouped in accordance with local recommendations.</p>

- continued -

**Table 1.3-2. Summary of Base F NONROAD Modeling Revisions (continued)**

State	Revisions Implemented
VA	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all seasons for conventional gasoline counties.</p> <p>(2) Gasoline sulfur content changed from 339 ppmW to 129 ppmW in the summer for all gasoline control counties.</p> <p>(3) Gasoline sulfur content changed from 339 ppmW to 229 ppmW in the spring and fall for all gasoline control counties.</p> <p>(4) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in the winter for all gasoline control counties.</p> <p>(5) Gasoline RVP values changed in accordance with local recommendations.</p> <p>(6) Counties regrouped in accordance with local recommendations.</p> <p>(7) The control effectiveness for counties subject to Stage II controls revised to 77 percent in accordance with local recommendations.</p> <p><i>Gasoline control counties: Arlington Co., Fairfax Co., Loudoun Co., Prince William Co., Stafford Co., Alexandria City, Fairfax City, Falls Church City, Manassas City, Manassas Park City, Chesterfield Co., Hanover Co., Henrico Co., Colonial Heights City, Hopewell City, Richmond City, James City, York Co., Chesapeake City, Hampton City, Newport News City, Norfolk City, Poquoson City, Portsmouth City, Suffolk City, Virginia Beach City, and Williamsburg City (c)</i></p>
WV	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).</p> <p>(2) Continue to utilize local allocation files for nine equipment categories.</p>

**Notes:**

- (a) County is subject to local control currently, but is scheduled to join the RFG program in January 2005.
- (b) Control area is a portion of the county, but modeling is performed as though the control applies countywide.
- (c) The EPA also lists Charles City County as an RFG area, but local planners indicate that Charles City County is a conventional gasoline area and it is modeled as such.

**Table 1.3-3. Base F NONROAD Input File Sequence and Structural Revisions**

State	Initial 2002 Base Year Inventory Input File Sequence Numbers	Revised 2002 Inventory Input File Sequence Numbers	Reason(s) for Change	Number of Revised 2002 Inventory NONROAD Input Files
AL	01-08	01-08	No Structural Changes	32 (at 8 per season)
FL	09-10	09-10	No Structural Changes	8 (at 2 per season)
GA	11-13	11-13	No Structural Changes	12 (at 3 per season)
KY	14-22	14-22	No Structural Changes	36 (at 9 per season)
MS	48	48	No Structural Changes	4 (at 1 per season)
NC	23-25	23-25	No Structural Changes	12 (at 3 per season)
SC	26-32	26-32	No Structural Changes	28 (at 7 per season)
TN	33-34	33-34, 49-52	Counties Regrouped	24 (at 6 per season)
VA	35-43	35-38, 40-43	Counties Regrouped	32 (at 8 per season)
WV	44-47	44-47	No Structural Changes	16 (at 4 per season)
<b>All</b>	<b>01-48</b>	<b>01-38, 40-52</b>		<b>204 (at 51 per season)</b>

- Note:** (1) All files include internal revisions to reflect the data changes summarized in Table 1.3-3 above. This table is intended to present structural revisions that are of interest in assembling the NONROAD model input files into a complete VISTAS region inventory. The indicated revisions do not (in and of themselves) result in emission estimate changes.
- (2) The NONROAD model imposes an eight digit input file name limit, so all input files for the revised 2002 base year inventory follow a modified naming convention to allow each to be distinguished from the input files for the initial 2002 base year inventory. For the initial 2002 base year inventory, the naming convention was:

**ss02aaqq,** where: ss = the two character State abbreviation,  
aa = a two character season indicator as follows: AU = autumn,  
WI = winter, SP = spring, and SU = summer, and  
qq = the two digit sequence number indicated above.

For the revised 2002 inventory, the naming convention was modified to:

**ss02aFqq,** where: ss = the two character State abbreviation,  
a = a one character season indicator as follows: A = autumn,  
W = winter, S = spring, and X = summer, and  
qq = the two digit sequence number indicated above.

**Base G Revisions:**

As described above, the primary modeling revision implemented for the Base G 2002 inventory was the use of the Final NONROAD2005 model (in place of the Base F use of Draft NONROAD2004). However, there were other minor revisions implemented for 13 Georgia counties and somewhat more significant revisions implemented for Tennessee. In Georgia, Stage II refueling control was assumed for 13 counties that previously were modeled as having no refueling control under Base F. In addition, to accommodate this Stage II change as well as forecast year changes in gasoline vapor pressure, corresponding changes in the structure and sequence of Georgia NONROAD input files were made. With the exception of the minor Stage II impacts, these structural and sequence changes have no impact on 2002 emission estimates, but allow for consistency between 2002 and forecast year input file structure and sequence. In Tennessee, more significant changes were implemented to gasoline vapor pressure assumptions, as well as similar minor changes in Stage II refueling control assumptions.

In accordance with instructions from Georgia regulators, Stage II refueling control was assumed in the following 13 Georgia counties at a control efficiency value of 81 percent for the Base G inventory:

Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding, and Rockdale.

No Stage II control was assumed in these counties in prior inventories.

Tennessee regulators provided revised monthly values for gasoline vapor pressure. Based on the seasonal definitions employed in the NONROAD model, monthly vapor pressures were averaged to estimate seasonal vapor pressures as follows:



Month/Season	Nashville Area	Memphis Area	Remainder of Tennessee
March	13.5 psi	13.5 psi	13.5 psi
April	13.5 psi	13.5 psi	13.5 psi
May	9.0 psi	9.0 psi	9.0 psi
Spring	12.0 psi	12.0 psi	12.0 psi
June	7.8 psi	7.8 psi	9.0 psi
July	7.8 psi	7.8 psi	9.0 psi
August	7.8 psi	7.8 psi	9.0 psi
Summer	7.8 psi	7.8 psi	9.0 psi
September 1-15	7.8 psi	7.8 psi	9.0 psi
September 16-30	11.5 psi	11.5 psi	11.5 psi
October	13.5 psi	13.5 psi	13.5 psi
November	13.5 psi	13.5 psi	13.5 psi
Fall	12.2 psi	12.2 psi	12.4 psi
December	15.0 psi	15.0 psi	15.0 psi
January	15.0 psi	15.0 psi	15.0 psi
February	13.5 psi	13.5 psi	13.5 psi
Winter	14.5 psi	14.5 psi	14.5 psi

Note: The Nashville area consists of Davidson, Rutherford, Sumner, Williamson and Wilson counties, the Memphis area consists of Shelby County.

As with the Base F revisions, the seasonal data are based on simple arithmetic averages and do not consider any monthly variation in activity (and fuel sales), nor is the transition between summer and winter seasons considered. Additionally, a monthly average of the September 1-15 and September 16-30 data is calculated prior to averaging the September-November data to estimate a fall average vapor pressure, so that the month of September is weighted identically to the months of October and November.

Tennessee regulators also indicated that Stage II vapor recovery was not in effect in Shelby County, so the Base F NONROAD input files for the county (which assumed Stage II was in place) were revised accordingly.

All Base G NONROAD modeling revisions are presented in Table 1.3-4. As indicated above, the differentiation of inputs across previously grouped counties also required revision to the overall number and sequence of VISTAS NONROAD input files (as compared to the files used to create

both the initial VISTAS non-road inventory, as documented in the February 9, 2004 report “*Development of the VISTAS Draft 2002 Mobile Source Emission Inventory (February 2004 Version)*” as prepared by E.H. Pechan & Associates, Inc., and the Base F revised inventory as documented above. These structural revisions are presented in Table 1.3-5, and are provided solely for the benefit of NONROAD modelers as the indicated revisions have no impact on generated emission estimates.

**Table 1.3-4. Summary of Base G NONROAD Modeling Revisions**

State	Revisions Implemented
AL	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons.
FL	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons.
GA	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons. (2) Stage II refueling vapor recovery implemented in 13 counties at an efficiency of 81 percent. (3) Counties regrouped to accommodate base and forecast year data differentiations. <i>Stage II control counties: Cherokee, Clayton, Cobb, Coweta, De Kalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding, and Rockdale</i>
KY	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons.
MS	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons.
NC	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons. (2) Revert to default equipment allocation files for all equipment categories. (3) Utilize revised (i.e., local) seasonal activity data.
SC	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons.
TN	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons. (2) Gasoline RVP values changed in accordance with local recommendations. (3) Stage II vapor recovery eliminated from Shelby County modeling.
VA	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons.
WV	(1) Marine diesel sulfur content changed from 2500 ppmW to 2638 ppmW in all counties and seasons. (2) Revert to default equipment allocation files for all equipment categories.

**Table 1.3-5. Spring 2006 NONROAD Input File Sequence and Structural Revisions**

State	2002 Inventory Input File Sequence Numbers (Fall 2004)	2002 Inventory Input File Sequence Numbers (Spring 2006)	Reason(s) for Change	Number of Final 2002 Inventory NONROAD Input Files
AL	01-08	01-08	No Structural Changes	32 (at 8 per season)
FL	09-10	09-10	No Structural Changes	8 (at 2 per season)
GA	11-13	11-13, 53-54	Counties Regrouped	20 (at 5 per season)
KY	14-22	14-22	No Structural Changes	36 (at 9 per season)
MS	48	48	No Structural Changes	4 (at 1 per season)
NC	23-25	23-25	No Structural Changes	12 (at 3 per season)
SC	26-32	26-32	No Structural Changes	28 (at 7 per season)
TN	33-34, 49-52	33-34, 49-52	No Structural Changes	24 (at 6 per season)
VA	35-38, 40-43	35-38, 40-43	No Structural Changes	32 (at 8 per season)
WV	44-47	44-47	No Structural Changes	16 (at 4 per season)
<b>All</b>	<b>01-38, 40-52</b>	<b>01-38, 40-54</b>		<b>212 (at 53 per season)</b>

- Note:** (1) All files include internal revisions to reflect the data changes summarized in Table 1.3-5 above. This table is intended to present structural revisions that are of interest in assembling the NONROAD model input files into a complete VISTAS region inventory. The indicated revisions do not (in and of themselves) result in emission estimate changes.
- (2) The NONROAD model imposes an eight digit input file name limit, so all input files for the revised 2002 base year inventory follow a modified naming convention to allow each to be distinguished from the input files for the initial 2002 and fall 2004-revised 2002 base year inventory. For the initial 2002 base year inventory, the naming convention was:

**ss02aaqq,** where: ss = the two character State abbreviation,  
aa = a two character season indicator as follows: AU = autumn,  
WI = winter, SP = spring, and SU = summer, and  
qq = the two digit sequence number indicated above.

For the fall 2004-revised 2002 inventory, the naming convention was modified to:

**ss02aFqq,** where: ss = the two character State abbreviation,  
a = a one character season indicator as follows: A = autumn,  
W = winter, S = spring, and X = summer, and  
qq = the two digit sequence number indicated above.

For the spring 2006-revised 2002 inventory, the naming convention was modified to:

**ss02aCqq,** where: ss = the two character State abbreviation,  
a = a one character season indicator as follows: A = autumn,  
W = winter, S = spring, and X = summer, and  
qq = the two digit sequence number indicated above.

### **1.3.2.2 Emissions from Commercial Marine Vessels, Locomotives, and Airplanes**

An initial 2002 base year emissions inventory for aircraft, locomotives, and commercial marine vessels (CMV) was prepared for VISTAS in early 2004. The methods and data used to develop the inventory are presented in a February 9, 2004 report “*Development of the VISTAS Draft 2002 Mobile Source Emission Inventory (February 2004 Version)*” as prepared by E.H. Pechan & Associates, Inc. A summary of the initial 2002 base year emissions inventory is presented in Table 1.3-6. Except as otherwise stated below, all aspects of the preparation methodology continue to apply to the Base F and Base G emission inventories.

Revisions to the initial 2002 emissions inventory (prepared by Pechan) were implemented to ensure that the latest State and local data were incorporated as well as to correct an overestimation of PM emissions from aircraft. Revisions were actually implemented in two stages. An initial set of revisions was implemented in the fall of 2004. Those revisions constitute the Base F inventory. These were followed by a second set of revisions in 2006, which constitute the Base G inventory. To accurately document the combined effects of both sets of revisions, each set is discussed separately below. Unless otherwise indicated, all revisions implemented for Base F were carried directly into the Base G revision process without change. Thus, the inventories that resulted from the Base F revisions served as the starting point for the Base G revisions.

#### **Base F Revisions:**

Revisions to the initial 2002 base year emissions inventory were implemented to ensure that the latest State and local data were incorporated as well as to correct an overestimation of PM emissions from aircraft. Seven of the ten VISTAS States provided revised inventory data in the form of emissions reported to the EPA under the CERR. States providing CERR data were Alabama, Georgia, Mississippi, North Carolina, Tennessee (excluding Davidson, Hamilton, Knox, and Shelby Counties), Virginia, and West Virginia.

In many cases, the CERR data were only marginally different than the initial 2002 base year inventory data, but there were several instances where significant updates were evident. The remaining three VISTAS States (Florida, Kentucky, and South Carolina), plus Davidson, Hamilton, Knox, and Shelby counties in Tennessee, indicated that the initial 2002 VISTAS inventory continued to reflect the most recent data available. Florida did provide updated aircraft emissions data for one county (Miami-Dade) and these data were incorporated into the Base F 2002 inventory as described below.

Since several States recommended retaining the initial 2002 base year inventory data for Base F, the initial step toward revising the 2002 inventory consisted of modifying the estimated aircraft PM emissions of the initial inventory. The overestimation of aircraft PM became evident shortly

after the release of the initial 2002 base year inventory, when it was determined that VISTAS region airports would constitute the top seven, and 11 of the top 15, PM sources in the nation. Moreover, PM emissions for one airport (Miami International) were a full order of magnitude larger than *all* other modeled elemental carbon PM emission sources. In addition, unexpected relationships across airports were also observed, with emissions for Atlanta's Hartsfield International being substantially less than those of Miami International, even though Atlanta handles over twice as many aircraft operations annually. Given the pervasiveness of this problem, and since the CERR data submitted by States was based on the initial 2002 VISTAS inventory data, aircraft PM emissions for the entire VISTAS region were recalculated.

**Table 1.3-6. Initial 2002 Base Year Aircraft, Locomotive, and Non-Recreational Marine Emissions as Reported in February 2004 Pechan Report (annual tons)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	3,787	175	688	475	17	196
	FL	28,518	11,955	46,352	31,983	1,050	3,703
	GA	3,175	992	3,919	2,704	94	353
	KY	2,666	657	2,597	1,792	63	263
	MS	1,593	140	553	381	13	96
	NC	6,088	1,548	6,115	4,219	148	613
	SC	6,505	515	452	312	88	863
	TN	6,854	2,665	7,986	5,510	225	920
	VA	17,676	5,607	14,476	9,988	234	3,229
	WV	1,178	78	310	214	8	66
	<b>Total</b>		<b>78,040</b>	<b>24,332</b>	<b>83,448</b>	<b>57,578</b>	<b>1,940</b>
Commercial Marine (2280)	AL	1,195	9,217	917	843	3,337	736
	FL	5,888	44,817	1,936	1,781	6,683	1,409
	GA	1,038	7,874	334	307	1,173	246
	KY	6,607	50,267	2,246	2,066	9,608	1,569
	MS	5,687	43,233	1,903	1,750	7,719	1,351
	NC	599	4,547	193	178	690	142
	SC	1,067	8,100	343	316	1,205	253
	TN	4,129	31,397	1,390	1,278	5,753	980
	VA	1,198	3,426	929	855	3,258	596
	WV	2,094	15,882	668	614	720	497
	<b>Total</b>		<b>29,503</b>	<b>218,760</b>	<b>10,858</b>	<b>9,989</b>	<b>40,146</b>
Military Marine (2283)	VA	136	387	28	26	30	59
	<b>Total</b>	<b>136</b>	<b>387</b>	<b>28</b>	<b>26</b>	<b>30</b>	<b>59</b>
Locomotives (2285)	AL	3,490	26,339	592	533	1,446	1,354
	FL	1,006	9,969	247	222	605	404
	GA	2,654	26,733	664	598	1,622	1,059
	KY	2,166	21,811	542	488	1,321	867
	MS	2,302	23,267	578	520	1,429	899
	NC	1,638	16,502	410	369	1,001	654
	SC	1,160	11,690	291	261	710	462
	TN	4,530	44,793	1,110	999	2,689	1,805
	VA	1,928	19,334	1,407	1,266	3,443	798
	WV	1,105	11,150	277	249	681	436
	<b>Total</b>		<b>21,980</b>	<b>211,588</b>	<b>6,118</b>	<b>5,505</b>	<b>14,947</b>
<b>Grand Total</b>		<b>129,659</b>	<b>455,067</b>	<b>100,452</b>	<b>73,099</b>	<b>57,062</b>	<b>26,877</b>

Aircraft do emit PM while operating. However, official EPA inventory procedures for aircraft generally do not include PM emission factors and, therefore, aircraft PM is generally erroneously reported as zero. In an effort to overcome this deficiency, the developers of the initial VISTAS 2002 base year aircraft inventory (Pechan) estimated PM emission rates for aircraft using estimated NO<sub>x</sub> emissions and an unreported PM-to-NO<sub>x</sub> ratio (i.e., PM = NO<sub>x</sub> times a PM-to-NO<sub>x</sub> ratio). According to the initial 2002 base year inventory documentation, this approach was applied only to commercial aircraft NO<sub>x</sub>, but a review of that inventory indicates that the technique was also applied to military, general aviation, and air taxi aircraft in many, but not all, instances. Although there is nothing inherently incorrect with this approach, the accuracy and inconsistent application of the assumed PM-to-NO<sub>x</sub> ratio results in grossly overestimated aircraft PM.

Through examination of the initial 2002 base year aircraft inventory (prepared by E.H. Pechan and Associates, Inc.), it is apparent that the commercial aircraft PM-to-NO<sub>x</sub> ratio used to generate PM emission estimates was approximately equal to 3.95 (i.e., PM = NO<sub>x</sub> times 3.95). While the majority of observed commercial aircraft PM-to-NO<sub>x</sub> ratios in that inventory are equal to 3.95, a few range as low as 3.00. If all aircraft estimates are included (i.e., commercial plus military, general aviation, and air taxi), observed PM-to-NO<sub>x</sub> ratios range from 0 to 123.0, and average 3.43 as illustrated in Table 1.3-7

**Table 1.3-7 PM-to-NO<sub>x</sub> Ratios by Aircraft Type In Initial 2002 Base Year Inventory.**

Aircraft Type	Average PM-to-NO <sub>x</sub>	Range of PM-to-NO <sub>x</sub>	Average PM <sub>2.5</sub> / PM <sub>10</sub>	Range of PM <sub>2.5</sub> / PM <sub>10</sub>
Undefined <sup>(1)</sup>	0.046	0-0.062	0.690	0.690-0.690
Military	0.073	0-92.3	0.688	0.333-1.000
Commercial	3.953	3.00-3.953	0.690	0.667-0.696
General Aviation	2.059	0-9.00	0.689	0.500-1.000
Air Taxi	2.734	0-123.0	0.690	0.500-1.000
Aggregate	3.427	0-123.0	0.690	0.333-1.000

**Note:** (1) Two counties report aircraft emissions as SCC 2275000000 "all aircraft."

As indicated, the aggregate PM-to-NO<sub>x</sub> ratio is similar in magnitude to the ratio for commercial aircraft. This results from the dominant nature of commercial aircraft NO<sub>x</sub> emissions relative to NO<sub>x</sub> from other aircraft types. It is surmised that ratios that deviate from 3.95 are based on PM emission estimates generated by local planners, which were retained without change in the PM estimation process (although a considerable number of unexplained "zero PM" records also exist

in the initial 2002 base year inventory dataset). Regardless, based on previous statistical analyses performed in support of aircraft emissions inventory development outside the VISTAS region, a PM-to-NO<sub>x</sub> ratio of 3.95 is too large by over an order of magnitude.

In analyses performed for the Tucson, Arizona planning area, PM-to-NO<sub>x</sub> ratios for aircraft over a standard aircraft landing and takeoff (LTO) cycle are shown in Table 1.3-8. Data for this table is taken from “Emissions Inventories for the Tucson Air Planning Area, Volume I., Study Description and Results,” prepared for the Pima Association of Governments, Tucson, AZ, November 2001. Pages 4-40 through 4-42 of that report, which document the statistical derivation of these ratios, are included in this report as Appendix E.

**Table 1.3-8. Tucson, AZ PM-to-NO<sub>x</sub> Ratios by Aircraft Type.**

Aircraft Type	PM-to-NO <sub>x</sub>
Commercial Aircraft	0.26
Military Aircraft	0.88
Air Taxi Aircraft	0.50
General Aviation Aircraft	1.90

**Note:**

The PM and NO<sub>x</sub> emission estimates presented in the Tucson study are for local aircraft operating mode times. For this work, emission estimates for Tucson were recalculated for a standard LTO cycle, so that the ratios presented are applicable to the standard LTO cycle and not a Tucson-specific cycle. Thus, the ratios presented herein vary somewhat from those associated with the emission estimates presented in the Tucson study report.

In reviewing these data, it should be considered that they apply to a standard (i.e., EPA-defined) commercial aircraft LTO cycle.<sup>2</sup> Aircraft PM-to-NO<sub>x</sub> ratios vary with operating mode, so that aircraft at airports with mode times that differ from the standard cycle will exhibit varying ratios. However, conducting an airport-specific analysis for all airports in the VISTAS region was beyond the scope of this work. While local PM-to-NO<sub>x</sub> ratios could vary somewhat from the indicated standard cycle ratios, any error due to this variation will be significantly less than the order of magnitude error associated with the 3.95 commercial aircraft ratio used for the initial 2002 base year inventory.

It should be recognized that while the Tucson area is far removed from the VISTAS region, the data analyzed to generate the PM-to-NO<sub>x</sub> ratios is standard aircraft emission factor data routinely

<sup>2</sup> As defined in AP-42, *Compilation of Air Pollutant Emission Factors, Volume II, Mobile Sources*, a standard commercial aircraft LTO cycle consists of 4 minutes of approach time, 26 minutes of taxi (7 minutes in plus 19 minutes out), 0.7 minutes of takeoff, and 2.2 minutes of climbout time (approach and climbout times being based on a 3000 foot mixing height).



employed for inventory purposes throughout the United States (as encoded in models such as the Federal Aviation Administration's Emissions Data Management Systems [EDMS]). With the exception of aircraft operating conditions, there are no inherent geographic implications associated with the use of data from the Tucson study. As indicated above, issues associated with local operating conditions have been eliminated by recalculating the Tucson study ratios for a standard LTO cycle.

To implement the revised PM-to-NO<sub>x</sub> ratios in the Base F inventory, *all* aircraft PM records were removed from the initial 2002 base year inventory (prepared by Pechan). This includes records for which local planners may have estimated PM emissions. This approach was taken for two reasons. First, there is no way to distinguish which records may have been generated by local planners. Second, the data available to local planners may be no better than that used to generate the presented PM-to-NO<sub>x</sub> ratio data, so the consistent application of these data to the entire VISTAS region was determined to be the most appropriate approach to generating consistent inventories throughout the region. In undertaking this removal, it became apparent that there was an imbalance in the aircraft NO<sub>x</sub> and PM records in the initial 2002 base year inventory. Whereas there were 1,531 NO<sub>x</sub> records in the NIF emission data sets for this source category, there were only 1,212 PM records. The imbalance was distributed between three States, South Carolina, Tennessee, and Virginia as follows:

**Table 1.3-9 Non-Corresponding Aircraft Emissions Records**

<i>Aircraft NO<sub>x</sub> records with no corresponding PM record:</i>			
<b>Aircraft Type</b>	<b>South Carolina</b>	<b>Virginia</b>	<b>Total</b>
Military Aircraft	8	100	108
General Aviation Aircraft	14	94	108
Air Taxi Aircraft	5	99	104
Aggregate	27	293	320
<i>Aircraft PM records with no corresponding NO<sub>x</sub> record:</i>			
<b>Aircraft Type</b>	<b>Tennessee</b>	<b>Total</b>	
Air Taxi Aircraft	1	1	
Aggregate	1	1	

The unmatched PM record was for Hamilton County (Chattanooga), Tennessee and when removed, was not replaced since there was no corresponding NO<sub>x</sub> record with which to estimate revised PM emissions. It is unclear how this orphaned record originated, but clearly there can be no air taxi PM emissions without other combustion-related emissions. Thus, the removal of the

PM<sub>10</sub> and PM<sub>2.5</sub> records for Hamilton County permanently reduced the overall size of the 2002 initial base year inventory database used as a starting point for Base F by two records.

Of the 320 unmatched NO<sub>x</sub> records, 269 were records for which the reported emission rate was zero. Therefore, even though associated PM records were missing, the overall inventory was not affected. However, the 51 missing records for which NO<sub>x</sub> emissions were non-zero, did impact PM estimates for the overall inventory.

Replacement PM<sub>10</sub> records were calculated for all aircraft NO<sub>x</sub> records using the PM-to-NO<sub>x</sub> ratios presented above. Aircraft type-specific ratios were utilized in all cases, except for two counties where aircraft emissions were reported under the generic aircraft SCC 2275000000. For these counties (Palm Beach County, Florida and Davidson County, Tennessee), the commercial aircraft PM-to-NO<sub>x</sub> ratio was applied since both contain commercial airports (Palm Beach International and Nashville International).

Replacement aircraft PM<sub>2.5</sub> records were also developed. The initial 2002 base year inventory assumed that aircraft PM<sub>2.5</sub> was 69 percent of aircraft PM<sub>10</sub>. The origin of this fraction is not clear, but it is very low for combustion related PM. The majority of internal combustion engine related PM is typically 1 micron or smaller (PM<sub>1.0</sub>), so that typical internal combustion engine PM<sub>2.5</sub> fractions approach 100 percent. For example, the EPA NONROAD model assumes 92 percent for gasoline engine particulate and 97 percent for diesel engine particulate. Based on recent correspondence from the EPA, it appears that the agency is preparing to recommend a PM<sub>2.5</sub> fraction of 98 percent for aircraft. (August 12, 2004 e-mail correspondence from U.S. EPA to Gregory Stella of Alpine Geophysics.) This is substantially more consistent with expectations based on emissions test data for other internal combustion engine sources and was used as the basis for the recalculated aircraft PM<sub>2.5</sub> emission estimates in the Base F inventory.

Although a substantial portion of the initial 2002 base year inventory was ultimately replaced with data prepared by State and local planners under CERR requirements in developing the Base F inventory, it was necessary to first revise the initial 2002 base year aircraft inventory as described so that records extracted from the inventory for areas not supplying CERR data for the Base F update would be accurate. Therefore, in *no case* is the aggregated State data reported for the Base F inventory identical to that of the initial 2002 base year inventory. Even areas relying on the initial 2002 base year inventory will reflect updates in Base F due to changes in emissions of PM<sub>10</sub> and PM<sub>2.5</sub> from aircraft.

Table 1.3-10 presents the updated initial 2002 base year inventory estimates. These estimates do not reflect any changes related to modifications made to incorporate the CERR data, but instead indicate the impacts associated solely with the recalculation of aircraft PM emissions alone to apply the more appropriate PM to NO<sub>x</sub> ratios. Table 1.3-11 presents a summary of the net

impacts of these changes, where an over 90 percent reduction in aircraft PM is observed for all VISTAS areas except South Carolina and Virginia. The reasons for the lesser changes in these two States is that the overall aircraft NO<sub>x</sub> inventories for both include a large share of military aircraft NO<sub>x</sub> to which no (or very low) particulate estimates were assigned in the initial 2002 base year inventory. Since these operations are assigned non-zero PM emissions under the revised approach, the increase in military aircraft PM offsets a portion of the reduction in commercial aircraft PM. In Virginia, zero (or near zero) PM military operations were responsible for about 35 percent of total aircraft NO<sub>x</sub>, while the corresponding fraction in South Carolina was almost 70 percent. As indicated, aggregate aircraft, locomotive, and commercial marine vessel PM is 70-75 percent lower in the updated 2002 base year inventory.

**Table 1.3-10. Initial 2002 Base Year Aircraft, Locomotive, and Non-Recreational Marine Emissions with Modified Aircraft PM Emission Rates (annual tons)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	3,787	175	64	62	17	196
	FL	28,518	11,955	3,193	3,129	1,050	3,703
	GA	3,175	992	269	264	94	353
	KY	2,666	657	179	175	63	263
	MS	1,593	140	44	43	13	96
	NC	6,088	1,548	419	411	148	613
	SC	6,505	515	409	401	88	863
	TN	6,854	2,665	707	692	225	920
	VA	17,676	5,607	2,722	2,667	234	3,229
	WV	1,178	78	25	24	8	66
	<b>Total</b>	<b>78,040</b>	<b>24,332</b>	<b>8,030</b>	<b>7,870</b>	<b>1,940</b>	<b>10,302</b>
Commercial Marine (2280)	AL	1,195	9,217	917	843	3,337	736
	FL	5,888	44,817	1,936	1,781	6,683	1,409
	GA	1,038	7,874	334	307	1,173	246
	KY	6,607	50,267	2,246	2,066	9,608	1,569
	MS	5,687	43,233	1,903	1,750	7,719	1,351
	NC	599	4,547	193	178	690	142
	SC	1,067	8,100	343	316	1,205	253
	TN	4,129	31,397	1,390	1,278	5,753	980
	VA	1,198	3,426	929	855	3,258	596
	WV	2,094	15,882	668	614	720	497
	<b>Total</b>	<b>29,503</b>	<b>218,760</b>	<b>10,858</b>	<b>9,989</b>	<b>40,146</b>	<b>7,779</b>
Military Marine (2283)	VA	136	387	28	26	30	59
	<b>Total</b>	<b>136</b>	<b>387</b>	<b>28</b>	<b>26</b>	<b>30</b>	<b>59</b>
Locomotives (2285)	AL	3,490	26,339	592	533	1,446	1,354
	FL	1,006	9,969	247	222	605	404
	GA	2,654	26,733	664	598	1,622	1,059
	KY	2,166	21,811	542	488	1,321	867
	MS	2,302	23,267	578	520	1,429	899
	NC	1,638	16,502	410	369	1,001	654
	SC	1,160	11,690	291	261	710	462
	TN	4,530	44,793	1,110	999	2,689	1,805
	VA	1,928	19,334	1,407	1,266	3,443	798
	WV	1,105	11,150	277	249	681	436
	<b>Total</b>	<b>21,980</b>	<b>211,588</b>	<b>6,118</b>	<b>5,505</b>	<b>14,947</b>	<b>8,738</b>
<b>Grand Total</b>		<b>129,659</b>	<b>455,067</b>	<b>25,034</b>	<b>23,390</b>	<b>57,062</b>	<b>26,877</b>

**Table 1.3-11. Change in Initial 2002 Base Year Emissions due to Aircraft PM Emission Rate Modifications.**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	0%	0%	-91%	-87%	0%	0%
	FL	0%	0%	-93%	-90%	0%	0%
	GA	0%	0%	-93%	-90%	0%	0%
	KY	0%	0%	-93%	-90%	0%	0%
	MS	0%	0%	-92%	-89%	0%	0%
	NC	0%	0%	-93%	-90%	0%	0%
	SC	0%	0%	-9%	+29%	0%	0%
	TN	0%	0%	-91%	-87%	0%	0%
	VA	0%	0%	-81%	-73%	0%	0%
	WV	0%	0%	-92%	-89%	0%	0%
	<b>Total</b>	<b>0%</b>	<b>0%</b>	<b>-90%</b>	<b>-86%</b>	<b>0%</b>	<b>0%</b>
Commercial Marine (2280)	AL	0%	0%	0%	0%	0%	0%
	FL	0%	0%	0%	0%	0%	0%
	GA	0%	0%	0%	0%	0%	0%
	KY	0%	0%	0%	0%	0%	0%
	MS	0%	0%	0%	0%	0%	0%
	NC	0%	0%	0%	0%	0%	0%
	SC	0%	0%	0%	0%	0%	0%
	TN	0%	0%	0%	0%	0%	0%
	VA	0%	0%	0%	0%	0%	0%
	WV	0%	0%	0%	0%	0%	0%
<b>Total</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	
Military Marine (2283)	VA	0%	0%	0%	0%	0%	0%
	<b>Total</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>
Locomotives (2285)	AL	0%	0%	0%	0%	0%	0%
	FL	0%	0%	0%	0%	0%	0%
	GA	0%	0%	0%	0%	0%	0%
	KY	0%	0%	0%	0%	0%	0%
	MS	0%	0%	0%	0%	0%	0%
	NC	0%	0%	0%	0%	0%	0%
	SC	0%	0%	0%	0%	0%	0%
	TN	0%	0%	0%	0%	0%	0%
	VA	0%	0%	0%	0%	0%	0%
	WV	0%	0%	0%	0%	0%	0%
<b>Total</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	
<b>Grand Total</b>		<b>0%</b>	<b>0%</b>	<b>-75%</b>	<b>-68%</b>	<b>0%</b>	<b>0%</b>

As indicated above, for the Base F 2002 base year inventory, data for all or portions of seven VISTAS States were replaced with corresponding data from recent (as of the fall of 2004) CERR submissions for 2002. Before replacing these data, however, an analysis of the CERR data was performed to ensure consistency with VISTAS inventory methods. It should perhaps also be noted that three of the CERR datasets provided for the Base F 2002 base year inventory (specifically those for Tennessee, Virginia, and West Virginia) included both annual and daily emissions data. Only the annual data were used. Daily values were removed.

Several important observations resulted from this analysis. First, it was clear that all of the CERR data continued to rely on the inaccurate aircraft PM estimation approach employed for the initial 2002 base year inventory. Therefore, an identical aircraft PM replacement procedure as described above for updating the initial 2002 base year inventory was undertaken for CERR supplied data. As a result, the CERR data for *all* VISTAS States has been modified for inclusion in the Base F 2002 VISTAS base year inventory due to PM replacement procedures.

As was the case with the initial VISTAS 2002 base year inventory, there were a substantial number of aircraft NO<sub>x</sub> records without corresponding PM records, so that the number of recalculated PM records added to the CERR dataset is greater than the number of PM records removed. The aggregated CERR inventory data, reflecting data for all or parts of seven States, consisted of 13,656 records, of which 1,211 were aircraft NO<sub>x</sub> records. However, the number of corresponding aircraft PM records was 662 (662 PM<sub>10</sub> records and 662 PM<sub>2.5</sub> records). This imbalance was distributed as follows:

**Table 1.3-12 CERR Aircraft NO<sub>x</sub> Records with No Corresponding PM Record.**

Aircraft Type	Georgia	Tennessee	Virginia	Total
Military Aircraft			136	136
Commercial Aircraft		4	136	140
General Aviation Aircraft	1		136	137
Air Taxi Aircraft			136	136
Aggregate	1	4	544	549

From this tabulation, it is clear that virtually the entire imbalance is associated with the Virginia CERR submission, with minor imbalances in Georgia and Tennessee. Of the 549 unmatched NO<sub>x</sub> records, 461 were records for which the reported emission rate was zero. Therefore, even though the associated PM records were missing, the overall inventory was not affected. However, the 88 missing records for which NO<sub>x</sub> emissions were non-zero do impact PM emission estimates for the overall inventory.

Replacement aircraft PM records (both PM<sub>10</sub> and PM<sub>2.5</sub>) were generated for the CERR dataset using procedures identical to those described above for the updated initial 2002 base year inventory.

Further analysis revealed that the CERR data for Virginia included only VOC, CO, and NO<sub>x</sub> emissions for all aircraft, locomotives, and non-recreational marine vessels. Since SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> records are included in the 2002 VISTAS inventory, an estimation method was developed for these emission species and applied to the Virginia CERR data. For PM, the

developed methodology was only employed for locomotive and marine vessel data since aircraft PM was estimated using the PM-to-NO<sub>x</sub> ratio methodology described above.

Consideration was given to simply adding the Virginia SO<sub>2</sub> and non-aircraft PM records from the initial 2002 VISTAS inventory dataset, but it is very unlikely that either the source distribution or associated emission rates are identical across the CERR and initial VISTAS inventories. This was confirmed through a comparative analysis of dataset CO records. Therefore, an estimation methodology was developed using Virginia source-specific SO<sub>2</sub>/CO, PM<sub>10</sub>/CO, and PM<sub>2.5</sub>/PM<sub>10</sub> ratios from the initial 2002 base year VISTAS inventory. The calculated ratios were then applied to the source-specific CERR CO emission estimates to derive associated source-specific SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> emissions for the Base F inventory.

Initially, the development of the emissions ratios from the initial 2002 base year inventory was performed at the State (i.e., Virginia), county, and SCC level of detail. However, it readily became clear that there were substantial inconsistencies in ratios for identical SCCs across counties. For example, in one county, the SO<sub>2</sub>/CO ratio might be 0.2, while in the next county it would be 2.0. Since the sources in question are virtually identical (e.g., diesel locomotives) and since the fueling infrastructure for these large non-road equipment sources is regional as opposed to local in nature, such variations in emission rates are not realistic. Therefore, a more aggregated approach was employed in which SCC-specific emission ratios were developed for the State as a whole. Through this approach county-to-county variation in emission ratios is eliminated, but the underlying variation in CO emissions does continue to influence the resulting aggregate emission estimates. The applied emission ratios are as follows:

**Table 1.3-13 Calculated Emission Ratios for VA.**

Source	SCC	SO <sub>2</sub> /CO	PM <sub>10</sub> /CO	PM <sub>2.5</sub> /CO	PM <sub>2.5</sub> /PM <sub>10</sub>
Military Aircraft	2275001000	0.0215			
Commercial Aircraft	2275020000	0.3292			
General Aviation Aircraft	2275050000	0.0002			
Air Taxi Aircraft	2275060000	0.0015			
Aircraft Refueling	2275900000	0.0000	0.0000	0.0000	
Diesel Commercial Marine	2280002000	0.3697	0.3434	0.3157	0.92
Residual Commercial Marine	2280003000	0.3697	0.3434	0.3157	0.92
Diesel Military Marine	2283002000	0.2422	0.2248	0.2068	0.92
Line Haul Locomotives	2285002005	3.2757	1.2999	1.1696	0.90
Yard Locomotives	2285002010	2.2908	1.2461	1.1205	0.90

*Emissions estimated using  
PM-to-NO<sub>x</sub> ratios as  
described previously.*

It is important to recognize that the inconsistency of emissions ratios across Virginia counties for sources of virtually identical design, which utilize a regional rather than local fueling infrastructure, has potential implications for other VISTAS States. There is no immediately obvious reason to believe that such inconsistencies would be isolated to Virginia.

One final revision to the CERR dataset was undertaken as part of the Base F effort, and that was the removal of two records for unpaved airstrip particulate (SCC 2275085000) in Alabama. Otherwise identical records for these emissions were reported both in terms of filterable and primary particulate. The filterable particulate records were removed as all other particulate emissions in the VISTAS inventories are in terms of primary particulate. It is also perhaps worth noting that a series of aircraft refueling records (SCC 2275900000) for Virginia were left in place, even through typically such emissions would be reported under SCC 2501080XXX in the area source inventory. If additional VISTAS aircraft refueling emissions are reported under SCC 2501080XXX, then it may be desirable to recode these records.

Finally, data for areas of the VISTAS region not represented in the CERR dataset were added to the CERR data by extracting the appropriate records from the initial 2002 base year inventory (with revisions for aircraft PM to NO<sub>x</sub> ratios). Specifically, records applicable to the States of Florida, Kentucky, South Carolina, and the Tennessee counties of Davidson, Hamilton, Knox, and Shelby were extracted from the revised initial 2002 inventory and added to the CERR dataset to establish the 2002 Base F inventory.

Following this aggregation, one last dataset revision was implemented to complete the development of the 2002 Base F inventory. As indicated in the introduction of this section, the initial 2002 base year emission estimates for Miami International Airport were determined to be excessive. Although the reason for this inaccuracy was not apparent, revised estimates for aircraft emissions in Miami-Dade County were obtained from Florida planners and used to overwrite the erroneous estimates. (Aircraft emission estimates were provided in an August 10, 2004 e-mail transmittal from Bruce Coward of Miami-Dade County to Martin Costello of the Florida Department of Environmental Protection.)

Table 1.3-14 presents a summary of the resulting Base F VISTAS 2002 base year inventory estimates for aircraft, locomotives, and non-recreational marine vessels. Table 1.3-15 provides a comparison of the Base F 2002 base year inventory estimates to those of the initial 2002 base year inventory. As indicated, total emissions for VOC, CO, NO<sub>x</sub>, and SO<sub>2</sub> are generally within 10 percent, but final PM emissions are reduced by 70-80 percent due to the approximate 90 percent reductions in aircraft PM estimates. In addition, the significant changes in Georgia aircraft emissions are due to the CERR correction of Atlanta Hartsfield International Airport emissions, which were significantly underestimated in the initial 2002 base year inventory. The



reduction in Florida aircraft emissions due to the correction of Miami International estimates is also apparent.

Lastly, Table 1.3-16 provides a direct comparison of emission estimates from the initial and Base F 2002 base year inventories for all 16 VISTAS region airports with estimated annual aircraft NO<sub>x</sub> emissions of 200 tons or greater (as identified at the conclusion of the Base F revisions).<sup>3</sup> The table entries are sorted in order of decreasing NO<sub>x</sub> and once again, the dramatic reduction in PM emissions is evident. However, in addition, the appropriate reversal of the relationship between Atlanta's Hartsfield and Miami International Airport is also depicted. As a rough method of quality assurance, Table 1.3-15 also includes a *gross* estimate of expected airport NO<sub>x</sub> emissions using detailed NO<sub>x</sub> estimates developed for Tucson International Airport in conjunction with the ratio of local to Tucson LTOs. (The Tucson NO<sub>x</sub> estimates are revised to reflect a standard LTO cycle rather than the Tucson-specific LTO cycle. This should provide for a more realistic comparison to VISTAS estimates.) This is not meant to serve as anything other than a crude indicator of the propriety of the developed VISTAS estimates, and it is clear that the range of estimated-to-expected NO<sub>x</sub> emissions has been substantially narrowed in the Base F 2002 base year inventory. Whereas estimated-to-expected ratios varied from about 0.2 to over 3.5 in the initial 2002 base year inventory, the range of variation is tightened on both ends, from about 0.5 to 1.75 for the Base F 2002 base year inventory. In effect, all estimates are now within a factor of two of the expected estimates, which is quite reasonable given likely variation in local and standard LTO cycles and variations in aircraft fleet mix across airports.

It is perhaps important to note that some shifting in county emissions assignments is evident between the initial and Base F 2002 base year aircraft inventories. For example, for the initial 2002 base year inventory, Atlanta Hartsfield estimates were assigned to Fulton County (FIP 13121), while they are assigned to Clayton County (FIP 13063) for the Base F 2002 base year inventory. Similarly, Dulles International Airport emissions were assigned solely to Fairfax County, Virginia (FIP 51059) in the initial 2002 base year inventory, but are split between Fairfax and Loudoun County (FIP 51107) for Base F. Such shifts reflect local planner decision-making and are not an artifact of the revisions described above.

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<sup>3</sup> Subsequent revisions performed for Base G result in the addition of the Cincinnati/Northern Kentucky International Airport to the group of airports with aircraft operations generating at least 200 tons of NO<sub>x</sub>. These revisions are discussed below, including the addition of an appropriately modified version of the aircraft emissions table.

**Table 1.3-14. Base F 2002 Base Year Aircraft, Locomotive, and Non-Recreational Marine Emissions (tons/year)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	3,787	175	226	87	17	196
	FL	25,431	8,891	2,424	2,375	800	3,658
	GA	6,622	5,372	1,475	1,446	451	443
	KY	2,666	657	179	175	63	263
	MS	1,593	140	44	43	13	96
	NC	6,088	1,548	419	411	148	613
	SC	6,505	515	409	401	88	863
	TN	7,251	2,766	734	719	235	943
	VA	9,763	2,756	1,137	1,115	786	2,529
	WV	1,178	78	25	24	8	66
	<b>Total</b>	<b>70,884</b>	<b>22,899</b>	<b>7,072</b>	<b>6,797</b>	<b>2,607</b>	<b>9,670</b>
Commercial Marine (2280)	AL	1,196	9,218	917	844	3,337	737
	FL	5,888	44,817	1,936	1,781	6,683	1,409
	GA	1,038	7,875	334	307	1,173	246
	KY	6,607	50,267	2,246	2,066	9,608	1,569
	MS	5,688	43,233	1,903	1,751	7,719	1,351
	NC	599	4,547	193	178	690	142
	SC	1,067	8,100	343	316	1,205	253
	TN	3,624	27,555	1,217	1,120	4,974	860
	VA	972	2,775	334	307	359	483
	WV	1,528	11,586	487	448	525	362
	<b>Total</b>	<b>28,207</b>	<b>209,972</b>	<b>9,911</b>	<b>9,118</b>	<b>36,275</b>	<b>7,413</b>
Military Marine (2283)	VA	110	313	25	23	27	48
	<b>Total</b>	<b>110</b>	<b>313</b>	<b>25</b>	<b>23</b>	<b>27</b>	<b>48</b>
Locomotives (2285)	AL	3,490	26,339	592	533	1,446	1,354
	FL	1,006	9,969	247	222	605	404
	GA	2,725	27,453	682	614	1,667	1,086
	KY	2,166	21,811	542	488	1,321	867
	MS	2,302	23,267	578	520	1,429	899
	NC	1,638	16,502	410	369	1,001	654
	SC	1,160	11,690	291	261	710	462
	TN	2,626	25,627	633	570	1,439	1,041
	VA	1,186	11,882	1,529	1,375	3,641	492
	WV	1,311	13,224	329	296	808	517
	<b>Total</b>	<b>19,611</b>	<b>187,764</b>	<b>5,833</b>	<b>5,248</b>	<b>14,066</b>	<b>7,777</b>
<b>Grand Total</b>		<b>118,812</b>	<b>420,948</b>	<b>22,841</b>	<b>21,186</b>	<b>52,976</b>	<b>24,908</b>

**Table 1.3-15. Change in 2002 Emissions, Base F Inventory Relative to Initial Inventory**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	0%	0%	-67%	-82%	0%	0%
	FL	-11%	-26%	-95%	-93%	-24%	-1%
	GA	+109%	+442%	-62%	-47%	+379%	+26%
	KY	0%	0%	-93%	-90%	0%	0%
	MS	0%	0%	-92%	-89%	0%	0%
	NC	0%	0%	-93%	-90%	0%	0%
	SC	0%	0%	-9%	+29%	0%	0%
	TN	+6%	+4%	-91%	-87%	+4%	+2%
	VA	-45%	-51%	-92%	-89%	+236%	-22%
	WV	0%	0%	-92%	-89%	0%	0%
	<b>Total</b>	<b>-9%</b>	<b>-6%</b>	<b>-92%</b>	<b>-88%</b>	<b>+34%</b>	<b>-6%</b>
Commercial Marine (2280)	AL	+0%	+0%	+0%	+0%	+0%	+0%
	FL	0%	0%	0%	0%	0%	0%
	GA	+0%	+0%	+0%	+0%	+0%	+0%
	KY	0%	0%	0%	0%	0%	0%
	MS	+0%	+0%	+0%	+0%	+0%	+0%
	NC	+0%	+0%	+0%	+0%	+0%	+0%
	SC	0%	0%	0%	0%	0%	0%
	TN	-12%	-12%	-12%	-12%	-14%	-12%
	VA	-19%	-19%	-64%	-64%	-89%	-19%
WV	-27%	-27%	-27%	-27%	-27%	-27%	
	<b>Total</b>	<b>-4%</b>	<b>-4%</b>	<b>-9%</b>	<b>-9%</b>	<b>-10%</b>	<b>-5%</b>
Military Marine (2283)	VA	-19%	-19%	-12%	-12%	-12%	-19%
	<b>Total</b>	<b>-19%</b>	<b>-19%</b>	<b>-12%</b>	<b>-12%</b>	<b>-12%</b>	<b>-19%</b>
Locomotives (2285)	AL	0%	0%	0%	0%	0%	0%
	FL	0%	0%	0%	0%	0%	0%
	GA	+3%	+3%	+3%	+3%	+3%	+3%
	KY	0%	0%	0%	0%	0%	0%
	MS	0%	0%	0%	0%	0%	0%
	NC	0%	0%	0%	0%	0%	0%
	SC	0%	0%	0%	0%	0%	0%
	TN	-42%	-43%	-43%	-43%	-46%	-42%
	VA	-38%	-39%	+9%	+9%	+6%	-38%
	WV	+19%	+19%	+19%	+19%	+19%	+19%
	<b>Total</b>	<b>-11%</b>	<b>-11%</b>	<b>-5%</b>	<b>-5%</b>	<b>-6%</b>	<b>-11%</b>
<b>Grand Total</b>		<b>-8%</b>	<b>-7%</b>	<b>-77%</b>	<b>-71%</b>	<b>-7%</b>	<b>-7%</b>

**Table 1.3-16. Base F Comparison of Aircraft Emissions  
(Airports with Aircraft NO<sub>x</sub> > 200 tons per year)**

Airport	FIP	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC	Approx. LTOs	Predicted NO <sub>x</sub>	VISTAS to Predicted
<i>Initial 2002 Base Year Inventory</i>										
Miami	12086	9,757	5,997	23,706	16,357	525	1,641	150,000	1,680	3.57
Orlando	12095	3,456	2,170	8,578	5,919	204	642	150,000	1,680	1.29
Memphis	47157	3,462	1,934	7,645	5,275	185	603	125,000	1,400	1.38
Reagan	51013	3,892	1,806	7,138	4,925	164	302	100,000	1,120	1.61
Hampton	51650	2,690	1,705	0	0	0	611	Military		
Dulles	51059	2,032	1,330	5,246	3,620	0	272	75,000	840	1.58
Orlando-Sanford	12117	3,615	1,225	4,837	3,337	100	351			
Atlanta	13121	1,457	913	3,608	2,490	86	274	420,000	4,704	0.19
Fort Lauderdale	12011	1,930	809	3,196	2,206	75	257	75,000	840	0.96
Charlotte	37119	1,643	788	3,113	2,148	75	255	150,000	1,680	0.47
Tampa	12057	1,399	785	3,101	2,140	74	240	75,000	840	0.93
Nashville	47037	1,819	653	40	28	33	239	60,000	672	0.97
Raleigh	37183	1,584	592	2,338	1,613	56	204	75,000	840	0.70
Louisville	21111	1,073	468	1,851	1,277	45	155	60,000	672	0.70
Jacksonville	12031	871	325	1,284	886	31	112	30,000	336	0.97
Palm Beach	12099	1,156	226	0	0	1	132	30,000	336	0.67
Aggregate		41,836	21,724	75,682	52,220	1,655	6,290			0.19-3.57
<i>Base F 2002 Base Year Inventory</i>										
Atlanta	13063	4,121	5,288	1,435	1,406	443	337	420,000	4,704	1.12
Miami	12086	6,670	2,933	805	789	274	1,596	150,000	1,680	1.75
Orlando	12095	3,456	2,170	568	556	204	642	150,000	1,680	1.29
Memphis	47157	3,462	1,934	506	495	185	603	125,000	1,400	1.38
Orlando-Sanford	12117	3,615	1,225	338	332	100	351			
Fort Lauderdale	12011	1,930	809	217	212	75	257	75,000	840	0.96
Charlotte	37119	1,643	788	206	202	75	255	150,000	1,680	0.47
Tampa	12057	1,399	785	206	202	74	240	75,000	840	0.93
Nashville	47037	1,819	653	170	166	33	239	60,000	672	0.97
Reagan	51013	1,269	635	171	168	193	97	100,000	1,120	0.57
Dulles 1	51107	1,807	595	164	161	252	153	37,500	420	1.42
Raleigh	37183	1,584	592	156	153	56	204	75,000	840	0.70
Dulles 2	51059	1,095	591	156	153	252	115	37,500	420	1.41
Hampton	51650	858	535	471	461	18	305	Military		
Louisville	21111	1,073	468	123	121	45	155	60,000	672	0.70
Jacksonville	12031	871	325	87	85	31	112	30,000	336	0.97
Palm Beach	12099	1,156	226	59	58	1	132	30,000	336	0.67
Aggregate		37,829	20,550	5,838	5,721	2,312	5,793			0.47-1.75
Net Change		-10%	-5%	-92%	-89%	+40%	-8%			

Note: For the Base F inventory, Dulles International Airport emissions are split between two Virginia counties. Predicted NO<sub>x</sub> is based on the ratio of airport LTOs to test airport (Tucson International Airport) LTOs and NO<sub>x</sub>. This is not a rigorous comparison, but rather an approximate indicator of expected magnitude.

**Base G Revisions:**

Further revisions to the 2002 base year emissions inventory were implemented in response to additional state data submittals in the spring of 2006. The inventories developed through the Base F revision process (as described above) served as the starting point for the 2006 revisions. Thus, unless otherwise indicated below, all documented Base F revisions continue to apply to the Base G-revised 2002 base year inventory.

As part of the Base G review and update process, Virginia regulators provided 443 updated emission records for aircraft. These records reflected revisions to aircraft VOC, CO, and NO<sub>x</sub>, and in a few cases SO<sub>2</sub>, emissions records that were already in the Base F VISTAS 2002 inventory (as opposed to the addition of previously unreported data). The specific revisions broke down as follows:

**Table 1.3-17 Base G VA Aircraft Records Updates**

Aircraft Type	VOC	CO	NO <sub>x</sub>	SO <sub>2</sub>	Total
Military Aircraft	9	9	9	1	28
Commercial Aircraft	12	12	12	17	53
General Aviation Aircraft	65	66	66	0	197
Air Taxi Aircraft	56	56	53	0	165
Aggregate	142	143	140	18	443

Emissions values for each of the 443 records in the Base F 2002 VISTAS inventory were updated for Base G to reflect the revised data. However, as described above for the Base F revisions, all aircraft SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> emissions in Virginia are estimated on the basis of CO (in the case of SO<sub>2</sub>) and NO<sub>x</sub> emissions (in the cases of PM<sub>10</sub> and PM<sub>2.5</sub>). Therefore, since Virginia regulators did not provide updated SO<sub>2</sub> emissions for all updated CO emissions records, or updated PM<sub>10</sub> or PM<sub>2.5</sub> emissions for all updated NO<sub>x</sub> emissions records, it was necessary to re-estimate aircraft SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> emissions in all cases where updated CO or NO<sub>x</sub> emissions were provided for Base G (and explicit SO<sub>2</sub> and/or PM<sub>10</sub> and PM<sub>2.5</sub> emissions were not).

The procedure used to estimate the SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> emissions revisions was identical to that described above for the Base F inventory revisions, except that revised SO<sub>2</sub>-to-CO emissions ratios were calculated for commercial aircraft, where 12 pairs of revised CO and SO<sub>2</sub> emissions estimates were available. Although a single pair of revised CO and SO<sub>2</sub> emissions records was available for military aircraft, this was deemed an insufficient sample with which to replace the military aircraft SO<sub>2</sub>-to-CO emissions ratios previously calculated in Base F. However, it is worth noting that the SO<sub>2</sub>-to-CO emissions ratio for the revised military aircraft emissions pair

was within 16 percent of the previously calculated ratio, so any error associated with retention of the Base F ratio will be minor. Table 1.3-18 presents the emissions ratios.

**Table 1.3-18 Calculated Base G Emission Ratios for VA.**

Source	SCC	SO <sub>2</sub> /CO (fall 2004)	SO <sub>2</sub> /CO (spring 2006)	SO <sub>2</sub> /CO (used in 2006)	PM <sub>10</sub> /NO <sub>x</sub>	PM <sub>2.5</sub> /PM <sub>10</sub>
Military Aircraft	2275001000	0.0215	0.0180	0.0215	0.88	0.98
Commercial Aircraft	2275020000	0.3292	0.0696	0.0696	0.26	0.98
General Aviation Aircraft	2275050000	0.00016	n/a	0.00016	1.9	0.98
Air Taxi Aircraft	2275060000	0.0015	n/a	0.0015	0.5	0.98

Application of the SO<sub>2</sub>-to-CO emissions ratios to the 130 revised aircraft CO records, for which no corresponding SO<sub>2</sub> emission revisions were provided, resulted in an additional 130 aircraft SO<sub>2</sub> emission records updates for Virginia. Similarly, application of the PM<sub>10</sub>-to-NO<sub>x</sub> emissions ratios to the 140 revised aircraft NO<sub>x</sub> records for which no corresponding PM<sub>10</sub> emission revisions were provided, resulted in an additional 140 aircraft PM<sub>10</sub> emission records updates for Virginia. Application of the PM<sub>2.5</sub>-to-PM<sub>10</sub> emissions ratios to the 140 revised aircraft PM<sub>10</sub> records resulted in an additional 140 aircraft PM<sub>2.5</sub> emission records updates for Virginia. Thus, in total, 853 (443+130+140+140) Virginia aircraft emissions records were updated for Base G.

Also as part of the Base G review and update process, Alabama regulators provided 178 updated PM emission records for aircraft (89 records for PM<sub>10</sub> and 89 records for PM<sub>2.5</sub>), 42 additional emissions records for locomotives (14 records for VOC, 14 records for CO, and 14 records for NO<sub>x</sub>), and 179 additional emission records for aircraft (30 records for VOC, 30 records for CO, 30 records for NO<sub>x</sub>, 29 records for SO<sub>2</sub>, 30 records for PM<sub>10</sub>, and 30 records for PM<sub>2.5</sub>). After review, it was determined that the 178 updated PM emission records for aircraft actually reflected the original (overestimated) aircraft PM data that was replaced universally throughout the VISTAS region for Base F. Implementing these latest revisions would, in effect, “undo” the Base F aircraft PM revisions. Following discussions with Alabama regulators, it was determined that the 178 aircraft PM records would not be updated for the Base G revisions.

The 42 additional emissions records for locomotives were determined to correspond exactly to existing SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> emissions records already in the Base F VISTAS 2002 inventory. It is not clear why these existing records contained no corresponding data for VOC, CO, and NO<sub>x</sub>, but those data are now reflected through the additional 42 records that have now been added to the Base G 2002 VISTAS inventory for Alabama.

After examining the 179 additional aircraft emissions records in conjunction with Alabama regulators, it was determined that 17 of the records (commercial aircraft records in Dale,

Limestone, and Talladega counties) were erroneous and should be excluded from the update. The remaining 162 records reflected additional general aviation, air taxi, and military aircraft activity in 20 counties and were specifically comprised of 27 records each for VOC, CO, NO<sub>x</sub>, SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub>. There were no further issues with the VOC, CO, NO<sub>x</sub>, and SO<sub>2</sub> records and these were added to the Base G 2002 VISTAS inventory without change. It was, however, apparent that the PM<sub>10</sub> and PM<sub>2.5</sub> records reflected an overestimation of aircraft PM similar to that which was previously corrected throughout the VISTAS region for Base F (as documented above). To overcome this overestimation, the additional aircraft PM<sub>10</sub> and PM<sub>2.5</sub> records provided by Alabama regulators were replaced with revised emission estimates developed on the basis of the PM<sub>10</sub>-to-NO<sub>x</sub> and PM<sub>2.5</sub>-to-PM<sub>10</sub> ratios documented under the Base F revisions above. So although 27 aircraft PM<sub>10</sub> records and 27 aircraft PM<sub>2.5</sub> records were added to the 2002 Alabama inventory, they reflected different emissions values than those provided directly by Alabama regulators.

In total, 204 additional emissions records (42 for locomotives and 162 for aircraft) were added to the Base G 2002 Alabama inventory.

Finally, as part of the Base G review and update process, Kentucky regulators provided 12 updated aircraft emission records for Boone County, to correct previously underestimated aircraft emissions associated with the Cincinnati/Northern Kentucky International Airport. VOC, CO, and NO<sub>x</sub> emissions data were provided for military, commercial, general aviation, and air taxi aircraft. No associated updates for SO<sub>2</sub>, PM<sub>10</sub>, or PM<sub>2.5</sub> emissions were provided. Corresponding PM<sub>10</sub> emission estimates were developed by applying the PM<sub>10</sub>-to-NO<sub>x</sub> ratios presented in Table 1.3-17 above to the updated NO<sub>x</sub> emission estimates. PM<sub>2.5</sub> emission estimates were developed by applying the PM<sub>2.5</sub>-to-PM<sub>10</sub> ratios from that same table to the estimated PM<sub>10</sub> emissions. SO<sub>2</sub> emission estimates were developed by applying the SO<sub>2</sub>-to-PM<sub>10</sub> ratios developed from the older data (i.e., the data being replaced) for Boone County aircraft to the updated PM<sub>10</sub> emissions. Thus, a total of 24 inventory records for Kentucky were updated (VOC, CO, NO<sub>x</sub>, SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> for four aircraft types).

Upon implementation of the universe of updates, 877 existing emission records were revised (853 in Virginia and 24 in Kentucky) and 204 additional emission records (all in Alabama) were added to the 2002 VISTAS inventory. The total number of aircraft, locomotive, and commercial marine inventory records thus changed from 22,838 records in Base F to 23,042 records in Base G.

Table 1.3-19 presents a summary of the resulting Base G VISTAS 2002 base year inventory estimates for aircraft, locomotives, and non-recreational marine vessels. Table 1.3-20 provides a comparison of the Base G 2002 base year inventory estimates to those of the Base F 2002 base

year inventory. As indicated, total emissions for VOC, CO, NO<sub>x</sub>, and SO<sub>2</sub> are generally within about 5 percent, with changes restricted to the states of Alabama, Kentucky, and Virginia.

Lastly, Table 1.3-21 provides an updated comparison of emission estimates from the Base F and Base G 2002 base year inventories for all 17 VISTAS region airports with estimated annual aircraft NO<sub>x</sub> emissions of 200 tons or greater. As compared to Table 1.3-16, the table reflects the Base G addition of the Cincinnati/Northern Kentucky International Airport. Aircraft emission estimates for the other 16 airports are unchanged from their Base F values.



**Table 1.3-19. Base G-Revised 2002 Base Year Aircraft, Locomotive, and Non-Recreational Marine Emissions (tons/year)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	5,595	185	238	99	18	276
	FL	25,431	8,891	2,424	2,375	800	3,658
	GA	6,620	5,372	1,475	1,446	451	443
	KY	5,577	925	251	246	88	397
	MS	1,593	140	44	43	13	96
	NC	6,088	1,548	419	411	148	613
	SC	6,505	515	409	401	88	863
	TN	7,251	2,766	734	719	235	943
	VA	11,873	3,885	2,010	1,970	272	2,825
	WV	1,178	78	25	24	8	66
	<b>Total</b>	<b>77,712</b>	<b>24,305</b>	<b>8,029</b>	<b>7,734</b>	<b>2,121</b>	<b>10,179</b>
Commercial Marine (2280)	AL	1,196	9,218	917	844	3,337	737
	FL	5,888	44,817	1,936	1,781	6,683	1,409
	GA	1,038	7,875	334	307	1,173	246
	KY	6,607	50,267	2,246	2,066	9,608	1,569
	MS	5,688	43,233	1,903	1,751	7,719	1,351
	NC	599	4,547	193	178	690	142
	SC	1,067	8,100	343	316	1,205	253
	TN	3,624	27,555	1,217	1,120	4,974	860
	VA	972	2,775	334	307	359	483
	WV	1,528	11,586	487	448	525	362
	<b>Total</b>	<b>28,207</b>	<b>209,972</b>	<b>9,911</b>	<b>9,118</b>	<b>36,275</b>	<b>7,413</b>
Military Marine (2283)	VA	110	313	25	23	27	48
	<b>Total</b>	<b>110</b>	<b>313</b>	<b>25</b>	<b>23</b>	<b>27</b>	<b>48</b>
Locomotives (2285)	AL	3,518	26,623	592	533	1,446	1,365
	FL	1,006	9,969	247	222	605	404
	GA	2,654	26,733	664	598	1,622	1,059
	KY	2,166	21,811	542	488	1,321	867
	MS	2,302	23,267	578	520	1,429	899
	NC	1,638	16,502	410	369	1,001	654
	SC	1,160	11,690	291	261	710	462
	TN	2,626	25,627	633	570	1,439	1,041
	VA	1,186	11,882	1,529	1,375	3,641	492
	WV	1,311	13,224	329	296	808	517
	<b>Total</b>	<b>19,568</b>	<b>187,328</b>	<b>5,815</b>	<b>5,232</b>	<b>14,022</b>	<b>7,761</b>
<b>Grand Total</b>		<b>125,597</b>	<b>421,918</b>	<b>23,780</b>	<b>22,107</b>	<b>52,444</b>	<b>25,401</b>

**Table 1.3-20. Change in 2002 Emissions, Base G Inventory  
Relative to Base F Inventory**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	+48%	+6%	+5%	+14%	+7%	+41%
	FL	0%	0%	0%	0%	0%	0%
	GA	0%	0%	0%	0%	0%	0%
	KY	+109%	+41%	+40%	+40%	+41%	+51%
	MS	0%	0%	0%	0%	0%	0%
	NC	0%	0%	0%	0%	0%	0%
	SC	0%	0%	0%	0%	0%	0%
	TN	0%	0%	0%	0%	0%	0%
	VA	+22%	+41%	+77%	+77%	-65%	+12%
	WV	0%	0%	0%	0%	0%	0%
	<b>Total</b>	<b>+10%</b>	<b>+6%</b>	<b>+14%</b>	<b>+14%</b>	<b>-19%</b>	<b>+5%</b>
Commercial Marine (2280)	AL	0%	0%	0%	0%	0%	0%
	FL	0%	0%	0%	0%	0%	0%
	GA	0%	0%	0%	0%	0%	0%
	KY	0%	0%	0%	0%	0%	0%
	MS	0%	0%	0%	0%	0%	0%
	NC	0%	0%	0%	0%	0%	0%
	SC	0%	0%	0%	0%	0%	0%
	TN	0%	0%	0%	0%	0%	0%
	VA	0%	0%	0%	0%	0%	0%
	WV	0%	0%	0%	0%	0%	0%
	<b>Total</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>
Military Marine (2283)	VA	0%	0%	0%	0%	0%	0%
	<b>Total</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>
Locomotives (2285)	AL	+1%	+1%	0%	0%	0%	+1%
	FL	0%	0%	0%	0%	0%	0%
	GA	0%	0%	0%	0%	0%	0%
	KY	0%	0%	0%	0%	0%	0%
	MS	0%	0%	0%	0%	0%	0%
	NC	0%	0%	0%	0%	0%	0%
	SC	0%	0%	0%	0%	0%	0%
	TN	0%	0%	0%	0%	0%	0%
	VA	0%	0%	0%	0%	0%	0%
	WV	0%	0%	0%	0%	0%	0%
<b>Total</b>	<b>+0%</b>	<b>+0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>+0%</b>	
<b>Grand Total</b>		<b>+6%</b>	<b>+0%</b>	<b>+4%</b>	<b>+4%</b>	<b>-1%</b>	<b>+2%</b>

**Table 1.3-21. Base G Comparison of Aircraft Emissions  
(Airports with Aircraft NO<sub>x</sub> > 200 tons per year)**

Airport	FIP	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC	Approx. LTOs	Predicted NO <sub>x</sub>	VISTAS to Predicted
<i>Base F 2002 Base Year Inventory</i>										
Atlanta	13063	4,121	5,288	1,435	1,406	443	337	420,000	4,704	1.12
Miami	12086	6,670	2,933	805	789	274	1,596	150,000	1,680	1.75
Orlando	12095	3,456	2,170	568	556	204	642	150,000	1,680	1.29
Memphis	47157	3,462	1,934	506	495	185	603	125,000	1,400	1.38
Orlando-Sanford	12117	3,615	1,225	338	332	100	351			
Fort Lauderdale	12011	1,930	809	217	212	75	257	75,000	840	0.96
Charlotte	37119	1,643	788	206	202	75	255	150,000	1,680	0.47
Tampa	12057	1,399	785	206	202	74	240	75,000	840	0.93
Nashville	47037	1,819	653	170	166	33	239	60,000	672	0.97
Reagan	51013	1,269	635	171	168	193	97	100,000	1,120	0.57
Dulles 1	51107	1,807	595	164	161	252	153	37,500	420	1.42
Raleigh	37183	1,584	592	156	153	56	204	75,000	840	0.70
Dulles 2	51059	1,095	591	156	153	252	115	37,500	420	1.41
Hampton	51650	858	535	471	461	18	305	Military		
Louisville	21111	1,073	468	123	121	45	155	60,000	672	0.70
Jacksonville	12031	871	325	87	85	31	112	30,000	336	0.97
Palm Beach	12099	1,156	226	59	58	1	132	30,000	336	0.67
Cincinnati	21015	467	144	38	37	14	54	50,000	560	0.26
Aggregate		38,296	20,694	5,876	5,758	2,326	5,847			0.26-1.75
<i>Base G 2002 Base Year Inventory</i>										
Atlanta	13063	4,121	5,288	1,435	1,406	443	337	420,000	4,704	1.12
Miami	12086	6,670	2,933	805	789	274	1,596	150,000	1,680	1.75
Orlando	12095	3,456	2,170	568	556	204	642	150,000	1,680	1.29
Memphis	47157	3,462	1,934	506	495	185	603	125,000	1,400	1.38
Orlando-Sanford	12117	3,615	1,225	338	332	100	351			
Fort Lauderdale	12011	1,930	809	217	212	75	257	75,000	840	0.96
Charlotte	37119	1,643	788	206	202	75	255	150,000	1,680	0.47
Tampa	12057	1,399	785	206	202	74	240	75,000	840	0.93
Nashville	47037	1,819	653	170	166	33	239	60,000	672	0.97
Reagan	51013	1,269	635	171	168	193	97	100,000	1,120	0.57
Dulles 1	51107	1,807	595	164	161	252	153	37,500	420	1.42
Raleigh	37183	1,584	592	156	153	56	204	75,000	840	0.70
Dulles 2	51059	1,095	591	156	153	252	115	37,500	420	1.41
Hampton	51650	858	535	471	461	18	305	Military		
Louisville	21111	1,073	468	123	121	45	155	60,000	672	0.70
Cincinnati	21015	3,378	411	110	107	39	187	50,000	560	0.73
Jacksonville	12031	871	325	87	85	31	112	30,000	336	0.97
Palm Beach	12099	1,156	226	59	58	1	132	30,000	336	0.67
Aggregate		41,207	20,961	5,947	5,828	2,352	5,981			0.47-1.75
Net Change		+8%	+1%	+1%	+1%	+1%	+2%			

Note: For the revised inventory, Dulles International Airport emissions are split between two Virginia counties. Predicted NO<sub>x</sub> is based on the ratio of airport LTOs to test airport (Tucson International Airport) LTOs and NO<sub>x</sub>. This is not a rigorous comparison, but rather an approximate indicator of expected magnitude.

### 1.3.2.3 Emissions from NONROAD Model Sources in Illinois, Indiana, and Ohio

As part of the Base G update process, VISTAS requested that emissions estimates for 2002 be produced for the states of Illinois, Indiana, and Ohio. These estimates were to be produced at the same spatial (i.e., county level by SCC) and temporal resolution as estimates for the VISTAS region.

The requested estimates were produced by extracting a complete set of county-level input data applicable to each of the three states from the latest version of the EPA's NMIM (National Mobile Inventory Model) model. This included appropriate consideration of all non-default NMIM input files generated by the Midwest Regional Planning Organization (MRPO), as described below. These input data were then assembled into appropriate input files for the Final NONROAD2005 model and emission estimates were produced using the same procedure employed for the VISTAS region as part of the Base G updates.

A complete set of monthly input data was developed for each county in Illinois, Indiana, and Ohio by extracting data from the following NMIM database files (using the NMIM MySQL query browser):

county, countrynrfile, countyyear, countyyearmonth, countyyearmonthhour,  
gasoline, diesel, and natural gas

The database files:

countrynrfile, countyyear, countyyearmonth, and gasoline

were non-default database files provided to VISTAS by the MRPO, and are intended to reflect the latest planning data being used by MRPO modelers.

From these files, monthly data for gasoline vapor pressure, gasoline oxygen content, gasoline sulfur content, diesel sulfur content for land-based equipment, diesel sulfur content for marine-based equipment, natural gas sulfur content, minimum daily temperature, maximum daily temperature, and average daily temperature were developed. In addition, the altitude and Stage II refueling control status of each county, as well as the identity of the associated equipment population, activity, growth, allocation, and seasonal distribution files, was determined. These data were then assembled into Final NONROAD2005 input files on a seasonal basis, with monthly data being arithmetically averaged to produce seasonal equivalents as follows:

Winter = Average of December, January, and February  
Spring = Average of March, April, and May  
Summer = Average of June, July, and August,  
Fall = Average of September, October, and November

Unlike the VISTAS Base G approach, this approach results in the use of the following non-default data files during the Final NONROAD2005 modeling process:

**Table 1.3-22 Non-Default Files Used for MRPO Modeling**

Data File	Illinois	Indiana	Ohio
Activity File	1700002.act	1800002.act	3900002.act
Growth File	17000.grw	18000.grw	39000.grw
Population File	17000.pop	18000.pop	39000.pop
Season File	17000.sea	18000.sea	39000.sea
Inboard Marine Allocation File	17000wib.alo	18000wib.alo	39000wib.alo
Outboard Marine Allocation File	17000wob.alo	18000wob.alo	39000wob.alo
Specific Fuel Consumption	MRPO-specific file provided by MRPO modelers (arbitrarily named "mrpoBSFC.emf" for this work)		

One compromise was made relative to the level of resolution that is available through the basic approach described above, that being the treatment of ambient temperature data. Because NMIM offers a unique temperature profile for every U.S. county -- developed by aggregating temperature data from included and surrounding weather stations on the basis of their distances from the county population centroid -- it is not possible to explicitly group counties with otherwise identical input streams. Ungrouped however, there would be 1,128 distinct input streams to be processed (102 Illinois counties plus 92 Indiana counties plus 88 Ohio counties at four seasons each), or over five times the number of files processed for the entire VISTAS region.

To surmount this problem and allow counties with similar temperature profiles to be grouped an approach was employed wherein counties were considered groupable if *all* temperature inputs<sup>4</sup> are within  $\pm 2$  °F of the corresponding group average. This criterion is quite stringent in that it results in less tolerant grouping than that employed for VISTAS modeling, which uses temperature data from the nearest meteorological station as opposed to "unique" meteorological

<sup>4</sup> Non-road temperature inputs used for county grouping are: winter minimum, spring minimum, summer minimum, fall minimum, winter maximum, spring maximum, summer maximum, fall maximum, winter average, spring average, summer average, and fall average.

data for each county. Under this approach, the actual deviation for grouped counties is *much* less than  $\pm 2$  °F for the overwhelming majority of the 12 grouped temperature inputs.

In addition to the required temperature consistency, all other input data for counties to be grouped had to be identical for all four seasons. Using this criterion, Illinois emissions were modeled using 12 county groups, Indiana emissions were modeled using 9 county groups, and Ohio emissions were modeled using 10 county groups. Thus, 31 iterations of NONROAD2002 were required per season, as compared to the 53 iterations per season required for the VISTAS region.

It should be noted that a potential quality assurance issue was noted in assembling the NONROAD2005 input data for a number of Indiana counties. Specifically, the gasoline vapor pressure for most Indiana counties reflects a value of 9.0 psi in *all* spring, summer, fall, and winter months. This is likely to indicate a problem with the accuracy of the NMIM databases for these counties, but these data were used as defined for this work.

### **1.3.3      *Quality Assurance steps***

Throughout the inventory development process, quality assurance steps were performed to ensure that no double counting of emissions occurred, and to ensure that a full and complete inventory was developed for VISTAS. Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on the area source component of the 2002 base year revised:

1. All CERR and NIF format State supplied data submittals were run through EPA's Format and Content checking software.
2. SCC level emission summaries were prepared and evaluated to ensure that emissions were consistent and that there were no missing sources.
3. Tier comparisons (by pollutant) were developed between the revised 2002 base year inventory and the initial base year inventory.
4. Data product summaries were provided to both the VISTAS Emission Inventory Technical Advisor and to Mobile Source SIWG representatives for review and comment. Changes based on these comments were implemented in the files.
5. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from 1.0 to 2.0. A minor change would cause a version number to go from 1.0 to 1.1. Minor changes resulting from largely editorial changes would result in a change from 1.00 to 1.01.

## **2.0 Projection Inventory Development**

### **2.1 Point Sources**

We used different approaches for different sectors of the point source inventory:

- For the EGUs, VISTAS relied primarily on the Integrated Planning Model<sup>®</sup> (IPM<sup>®</sup>) to project future generation as well as to calculate the impact of future emission control programs. The IPM results were adjusted based on S/L agency knowledge of planned emission controls at specific EGUs.
- For non-EGUs, we used recently updated growth and control data consistent with the data used in EPA's CAIR analyses, and supplemented these data with available S/L agency input and updated fuel use forecast data for the U.S. Department of Energy.

For both sectors, we generated 2009 and 2018 inventories for a combined on-the-books (OTB) and on-the-way (OTW) control scenario. The OTB/OTW control scenario accounts for post-2002 emission reductions from promulgated and proposed federal, State, local, and site-specific control programs as of July 1, 2004. Section 2.1.1 discusses the EGU projection inventory development, while Section 2.1.2 discusses the non-EGU projection inventory development.

#### **2.1.1 EGU Emission Projections**

The following subsections discuss the following specific aspects of the development of the EGU projections. First, we present a chronology of the EGU development process and discuss key decisions in selecting the final methods for performing the emissions projections. Next, we describe the development of the final set of IPM runs that are included in the VISTAS Base G inventory. Next, we describe the process of transforming the IPM parsed files into NIF format. Fourth, we discuss the process for ensuring that units accounted for in IPM were not double-counted in the non-EGU inventory. Fifth, we describe the QA/QC checks that were made to ensure that the IPM results were properly incorporated into the VISTAS inventory. Sixth, we document the changes to the IPM results that S/L agencies specified they wanted included in the VISTAS inventory based on new information that was not accounted for in the IPM runs. Finally, we present summarize the Base G projected EGU emissions by year, state, and pollutant.

##### **2.1.1.1 Chronology of the Development of EGU Projections**

At the beginning of the EGU inventory development process, VISTAS considered three options for developing the VISTAS 2009 and 2018 projection inventories for EGUs:

- Option 1 – Use the results of IPM modeling conducted in support of the proposed Clean Air Interstate Rule (CAIR) base and control case analyses as the starting point and refine the projections with readily available inputs from stakeholders; these IPM runs were



conducted for 2010 and 2015, which VISTAS would use to represent projected emissions in 2009 and 2018 respectively.

- Option 2 – Use the VISTAS 2002 typical year as the starting point, apply growth factors from the Energy Information Administration, and refine future emission rates with stakeholder input regarding utilization rates, capacity, retirements, and new unit information.
- Option 3 – Use the results of a new round of IPM modeling sponsored by VISTAS and the Midwest Regional Planning Organization (MRPO). These runs incorporated VISTAS specific unit and regulation modified parameters, and generate results for 2009 and 2018 explicitly.

An additional consideration for each of the three options was the inclusion of emission projections developed by the Southern Company specifically for their units. Southern Company is a super-regional company which owns EGUs in Alabama, Florida, Georgia, and Mississippi and participates in VISTAS as an industry stakeholder. Southern Company used their energy budget forecast to project net generation and heat input for every existing and future Southern Company EGU for the years 2009 and 2018. Further documentation of how Southern Company generated the 2009/2018 inventory for their units can be found in *Developing Southern Company Emissions and Flue Gas Characteristics for VISTAS Regional Haze Modeling (April 2005, presented at 14<sup>th</sup> International Emission Inventory Conference)*.

Each of these three options and the Southern Company projections were discussed in a series of conference calls with the VISTAS EGU Special Interest Work Group (SIWG) during the fall of 2004. During a conference call on December 6, 2004, the VISTAS EGU SIWG approved the use of the latest VISTAS/MRPO sponsored IPM runs (Option 3) to represent the 2009 and 2018 EGU forecasts of emissions for the OTB and OTW cases. During the call, Alabama and Georgia specified that they did not wish to use Southern Company provided emissions forecasts of 2009 and 2018 to represent the sources in their States. Mississippi decided to utilize the Southern Company projections to represent activity at Southern Company facilities in Mississippi. After the call, Florida decided against using Southern Company provided emissions forecasts of 2009 and 2018 to represent the sources in their State. Thus, Southern Company data was used only for Southern Company units in Mississippi for both the Base F and Base G projections.

The Option 3 IPM modeling resulted from a joint agreement by VISTAS and MRPO to work together to develop future year utility emissions based on IPM modeling. The decision to use IPM modeling was based in part on a study of utility forecast methods by E.H. Pechan and Associates, Inc. (Pechan) for MRPO, which recommended IPM as a viable methodology (see *Electricity Generating Unit {EGU} Growth Modeling Method Task 2 Evaluation*, February 11,



2004). Although IPM results were available from EPA's modeling to support their rulemaking for the Clean Air Interstate Rule (CAIR), VISTAS stakeholders felt that certain model inputs needed to be improved. Thus, VISTAS and MRPO decided to hire contractors to conduct new IPM modeling and to post-process the IPM results. Southern Company projections in 2009 were roughly comparable with IPM. For 2018, Southern Company projections were generally less than IPM because of assumptions made by Southern Company on which units would be economical to control and incorrect data in the NEEDS database which feeds IPM.

In August 2004, VISTAS contracted with ICF International, Inc., to run IPM to provide utility forecasts for 2009 and 2018 under two future scenarios – Base Case and CAIR Case. The Base Case represents the current operation of the power system under currently known laws and regulations (as known at the time the run was made), including those that come into force in the study horizon. The CAIR Case is the Base Case with the proposed CAIR rule superimposed. The run results were parsed at the unit level for the 2009 and 2018 run years. Also in August 2004, MRPO contracted with E.H. Pechan to post-process the IPM outputs generated by ICF to provide model-ready emission files. The IPM output files were delivered by ICF to VISTAS in November (*Future Year Electricity Generating Sector Emission Inventory Development Using the Integrated Planning Model (IPM<sup>®</sup>) in Support of Fine Particulate Mass and Visibility Modeling in the VISTAS and Midwest RPO Regions*, January 2005), and the post-processed data files were delivered by Pechan to the MRPO in December 2004 (*LADCO IPM Model Parsed File Post-Processing Methodology and File Preparation*, February 8, 2005).

On March 10, 2005, EPA issued the final Clean Air Interstate Rule. VISTAS and MRPO, in conjunction with other RPOs, conducted another round of IPM modeling which reflected changes to control assumptions based on the final CAIR as well as additional changes to model inputs based on S/L agency and stakeholder comments. Several conference calls were conducted in the spring of 2005 to discuss and provide comments on IPM assumptions related to six main topics: power system operation, generating resources, emission control technologies, set-up parameters and rule, financial assumptions, and fuel assumptions. Based on these discussions, VISTAS sponsored a new set of IPM runs to reflect the final CAIR requirements as well as certain changes to IPM assumptions that were agreed to by the VISTAS states. This set of IPM runs is documented in *Future Year Electricity Generating Sector Emission Inventory Development Using the Integrated Planning Model (IPM<sup>®</sup>) in Support of Fine Particulate Mass and Visibility Modeling in the VISTAS and Midwest RPO Regions*, April 2005 (these runs are referred to as the VISTAS Phase I analysis).

Further refinements to the IPM inputs and assumptions were made by the RPOs, and ICF performed the following four runs using IPM during the summer of 2005 (these runs are referred to as the VISTAS/CENRAP Phase II analysis):

Base Case with EPA 2.1.9 coal, gas and oil price assumptions.

- Base Case with EPA 2.1.9 coal and gas supply curves adjusted for AEO 2005 reference case price and volume relationships.
- Strategy Case with EPA 2.1.9 coal, gas and oil price assumptions.
- Strategy Case with EPA 2.1.9 coal and gas supply curves adjusted for AEO 2005 reference case price and volume relationships.

The above runs were parsed for 2009 and 2018 run years. The above four runs were based on VISTAS Phase I and the EPA 2.1.9 assumptions. The changes that were implemented in the above four runs are summarized below:

- Unadjusted AEO 2005 electricity demand projections were incorporated in the above four runs.
- The gas supply curves were adjusted for AEO 2005 reference case price and volume relationships. The EPA 2.1.9 gas supply curves were scaled such that IPM will solve for AEO 2005 gas prices when the power sector gas demand in IPM is consistent with AEO 2005 power sector gas demand projections.
- The coal supply curves used in EPA 2.1.9 were scaled in such a manner that the average mine mouth coal prices that the IPM is solving in aggregated coal supply regions are comparable to AEO 2005. Due to the fact that the coal grades and supply regions between AEO 2005 and the EPA 2.1.9 are not directly comparable, this was an approximate approach and had to be performed in an iterative fashion. The coal transportation matrix was not updated with EIA assumptions due to significant differences between the EPA 2.1.9 and EIA AEO 2005 coal supply and coal demand region configurations.
- The cost and performance of new units were updated to AEO 2005 reference case levels in all of the above four runs.
- The run years 2008, 2009, 2012, 2015, 2018, 2020 and 2026 were modeled.
- The AEO 2005 life extension costs for fossil and nuclear units were incorporated in the above runs.
- The extensive NEEDS comments provided by VISTAS, MRPO, CENRAP and MANE-VU were incorporated into the VISTAS Phase I NEEDS.

- MANE-VU's comments in regards to the state regulations in the northeast were incorporated.
- Renewable Portfolio Standards (RPS) in the northeast was modeled based on the Regional Greenhouse Gas Initiative analysis. A single RPS cap was modeled for MA, RI, NY, NJ, MD and CT. These states could buy credits from NY, PJM and New England model regions.
- The investments required under the Illinois power, Mirant and First Energy NSR settlements were incorporated in the above runs.

For the VISTAS/CENRAP Phase II set of IPM runs, ICF generated two different parsed files. One file includes all fuel burning units (fossil, biomass, landfill gas) as well as non-fuel burning units (hydro, wind, etc.). The second file contains just the fossil-fuel burning units (e.g., emissions from biomass and landfill gas are omitted). The RPOs decided to use the fossil-only file for modeling to be consistent with EPA, since EPA used the fossil only results for CAIR analyses. For the 10 VISTAS states, non-fossil fuels accounted for only 0.13 percent of the NO<sub>x</sub> emissions and 0.04 percent of the SO<sub>2</sub> emissions in the 2009 IPM runs.

S/L agencies reviewed the results of the VISTAS/CENRAP Phase II set of IPM runs, which were incorporated into the VISTAS Base F inventory. S/L agencies primarily reviewed and commented on the IPM results with respect to IPM decisions on NO<sub>x</sub> post-combustion controls and SO<sub>2</sub> scrubbers. S/L agencies provided the latest information on when and where new SO<sub>2</sub> and NO<sub>x</sub> controls are planned to come online. S/L agencies also reviewed the IPM results to verify that existing controls and emission rates were properly reflected in the IPM runs. As directed by the S/L agencies, adjustments to the IPM results were made to specific units with any new information they had as part of the permitting process or other contact with the industry that indicates which units will install controls as a result of CAIR and when these new controls will come on-line. Mississippi decided to continue to use the Southern Company projections instead of the IPM projections to represent emissions at Southern Company facilities in Mississippi. The state-specified changes to the VISTAS/CENRAP Phase II set of IPM runs were used to create the Base G projection inventory (and are documented later in Section 2.1.1.6).

#### **2.1.1.2 VISTAS IPM runs for EGU sources**

The following general summary of the VISTAS IPM<sup>®</sup> modeling is based on ICF's documentation *Future Year Electricity Generating Sector Emission Inventory Development Using the IPM<sup>®</sup> in Support of Fine Particulate Mass and Visibility Modeling in the VISTAS and Midwest RPO Regions*, April 2005. The ICF documentation is to be used as an extension to EPA's proposed CAIR modeling runs documented in *Documentation Supplement for EPA Modeling Applications (V.2.1.6) Using the IPM*, EPA 430/R-03-007, July 2003.

IPM provides “forecasts of least-cost capacity expansion, electricity dispatch, and emission control strategies for meeting energy demand and environmental, transmission, dispatch, and reliability constraints.” The underlying database in this modeling is U.S. EPA’s National Electric Energy Data System (NEEDS) released with the CAIR Notice of Data Availability (NODA). The NEEDS database contains the existing and planned/committed unit data in EPA modeling applications of IPM. NEEDS includes basic geographic, operating, air emissions, and other data on these generating units. VISTAS States and stakeholders provided changes for:

- NO<sub>x</sub> post-combustion control on existing units
- SO<sub>2</sub> scrubbers on existing units
- SO<sub>2</sub> emission limitations
- PM controls on existing units
- Summer net dependable capacity
- Heat rate for existing units
- SO<sub>2</sub> and NO<sub>x</sub> control plans based on State rules or enforcement settlements

The years 2009 and 2018 were explicitly modeled.

### **2.1.1.3 Post-Processing of IPM Parsed Files**

The following summary of the VISTAS/Midwest Regional Planning Organization (MRPO) IPM modeling is based on Pechan’s documentation *LADCO IPM Model Parsed File Post-Processing Methodology and File Preparation*, February 8, 2005. The essence of the IPM model post-processing methodology is to take an initial IPM model output file and transform it into air quality model input files. ICF via VISTAS/MRPO provides an initial spreadsheet file containing unit-level records of both

- (1) “existing” units and
- (2) committed or new generic aggregates.

All records have unit and fuel type data; existing, retrofit (for SO<sub>2</sub> and NO<sub>x</sub>), and separate NO<sub>x</sub> control information; annual SO<sub>2</sub> and NO<sub>x</sub> emissions and heat input; summer season (May-September) NO<sub>x</sub> and heat input; July day NO<sub>x</sub> and heat input; coal heat input by coal type; nameplate capacity megawatt (MW), and State FIPS code. Existing units also have county FIPS code, a unique plant identifier (ORISPL) and unit ID (also called boiler ID) (BLRID); generic units do not have these data. The processing includes estimating various types of emissions and adding in control efficiencies, stack parameters, latitude-longitude coordinates, and State identifiers (plant ID, point ID, stack ID, process ID). Additionally, the generic units are sited in a county and given appropriate IDs. This processing is described in more detail below.

The data are prepared by transforming the generic aggregates into units similar to the existing units in terms of the available data. The generic aggregates are split into smaller generic units based on their unit types and capacity, are provided a dummy ORIS unique plant and boiler ID, and are given a county FIPS code based on an algorithm that sites each generic by assigning a sister plant that is in a county based on its attainment/nonattainment status. Within a State, plants (in county then ORIS plant code order) in attainment counties are used first as sister sites to generic units, followed by plants in PM nonattainment counties, followed by plants in 8-hour ozone nonattainment counties. Note that no LADCO or VISTAS States provided blackout counties that would not be considered when siting generics, so this process is identical to the one used for EPA IPM post-processing.

SCCs were assigned for all units; unit/fuel/firing/bottom type data were used for existing units' assignments, while only unit and fuel type were used for generic units' assignments. Latitude-longitude coordinates were assigned, first using the EPA-provided data files, secondly using the September 17, 2004 Pechan in-house latitude-longitude file, and lastly using county centroids. These data were only used when the data were not provided in the 2002 NIF files. Stack parameters were attached, first using the EPA-provided data files, secondly using a March 9, 2004 Pechan in-house stack parameter file based on previous EIA-767 data, and lastly using an EPA June 2003 SCC-based default stack parameter file. These data were only used when the data were not provided in the 2002 NIF files.

Additional data were required for estimating VOC, CO, filterable primary PM<sub>10</sub> and PM<sub>2.5</sub>, PM condensable, and NH<sub>3</sub> emissions for all units. Thus, ash and sulfur contents were assigned by first using 2002 EIA-767 values for existing units or SCC-based defaults; filterable PM<sub>10</sub> and PM<sub>2.5</sub> efficiencies were obtained from the 2002 EGU NEI that were based on 2002 EIA-767 control data and the PM Calculator program (a default of 99.2 percent is used for coal units if necessary); fuel use was back calculated from the given heat input and a default SCC-based heat content; and emission factors were obtained from an EPA-approved October 7, 2004 Pechan emission factor file based on AP-42 emission factors. Note that this updated file is not the one used for estimating emissions for previous EPA post-processed IPM files. Emissions for 28 temporal-pollutant combinations were estimated since there are seven pollutants (VOC, CO, primary PM<sub>10</sub> and PM<sub>2.5</sub>, NH<sub>3</sub>, SO<sub>2</sub> and NO<sub>x</sub>) and four temporal periods (annual, summer season, winter season, July day).

The next step was to match the IPM unit IDs with the identifiers in VISTAS 2002 inventory. A crosswalk file was used to obtain FIPS State and county, plant ID (within State and county), and point ID. If the FIPS State and county, plant ID and point ID are in the 2002 VISTAS NIF tables, then the process ID and stack ID are obtained from the NIF; otherwise, defaults, described above, were used.

Pechan provided the post-processed files in NIF 3.0 format. Two sets of tables were developed : “NIF files” for IPM units that have a crosswalk match and are in the 2002 VISTAS inventory, and “NoNIF files” for IPM units that are not in the 2002 VISTAS inventory (which includes existing units with or without a crosswalk match as well as generic units).

For Base F and Base G projections, VISTAS reviewed the PM and NH<sub>3</sub> emissions from EGUs as provided by Pechan and identified significantly higher emissions in 2009/2018 than in 2002. VISTAS determined that Pechan used a set of PM and NH<sub>3</sub> emission factors that are “the most recent EPA approved uncontrolled emission factors” for estimating 2009/2018 emissions. These factors are most likely not the same emission factors used by States for estimating these emissions in 2002 for EGUs in the VISTAS domain. Thus, the emission increase from 2002 to 2009/2018 was simply an artifact of the change in emission factor, not anything to do with changes in activity or control technology application. Also, VISTAS identified an inconsistent use of SCCs for determining emission factors between the base and future years.

VISTAS resolution of the PM and NH<sub>3</sub> problem is fully documented in *EGU Emission Factors and Emission Factor Assignment*, memorandum from Greg Stella to VISTAS State Point Source Contacts and VISTAS EGU Special Interest Workgroup, June 13, 2005. The first step was the adjustment of the 2002 base year emissions inventory. Using the latest “EPA-approved” uncontrolled emission factors by SCC, Alpine Geophysics utilized CERR or VISTAS reported annual heat input, fuel throughput, heat, ash and sulfur content to estimate annual uncontrolled emissions for units identified as output by IPM. This step was conducted for non-CEM pollutants (CO, VOC, PM, and NH<sub>3</sub>) only. For PM emissions, the condensable component of emissions was calculated and added to the resulting PM primary estimations. The resulting emissions were then adjusted by any control efficiency factors reported in the CERR or VISTAS data collection effort. The second adjustment was to the future year inventories. Alpine Geophysics updated the SCCs in the future year inventory to assign the same base year SCC. Using the same methods as described for the 2002 revisions, those non-IPM generated pollutants were estimated using IPM predicted fuel characteristics and base year 2002 SCC assignments.

#### **2.1.1.4 Eliminating Double Counting of EGU Units**

The following procedures were used to avoid double counting of EGU emissions in the 2009/2018 point source inventory. The 2002 VISTAS point source emission inventory contains both EGUs and non-EGUs. Since this file contains both EGUs and non-EGU point sources, and EGU emissions are projected using the IPM, it was necessary to split the 2002 point source file into two components. The first component contains those emission units accounted for in the IPM forecasts. The second component contains all other point sources not accounted for in IPM.

As described in the previous section, Pechan developed 2009/2018 NIF files for EGUs from the IPM parsed files. All IPM matched units were initially removed from the 2009/2018 point source



inventory to create the non-EGU inventory (which was projected to 2009/2018 using the non-EGU growth and control factors described in Section 2.1.2). This was done on a unit-by-unit basis based on a cross-reference table that matches IPM emission unit identifiers (ORISPL plant code and BLRID emission unit code) to VISTAS NIF emission unit identifiers (FIPSST state code, FIPSCNTY county code, State Plant ID, State Point ID). When there was a match between the IPM ORISPL/BLRID and the VISTAS emission unit ID, the unit was assigned to the EGU inventory; all other emission units were assigned to the non-EGU inventory.

If an emission unit was contained in the NIF files created by Pechan from the IPM output, the corresponding unit was removed from the initial 2009/2018 point source inventory. The NIF 2009/2018 EGU files from the IPM parsed files were then merged with the non-EGU 2009/2018 files to create the 2009/2018 Base F point source files.

Next, we prepared several ad-hoc QA/QC queries to verify that there was no double-counting of emissions in the EGU and non-EGU inventories:

- We reviewed the IPM parsed files { VISTASII\_PC\_1f\_AllUnits\_2009 (To Client).xls and VISTASII\_PC\_1f\_AllUnits\_2018 (To Client).xls } to identify EGUs accounted for in IPM. We compared this list of emission units to the non-EGU inventory derived from the VISTAS cross-reference table to verify that units accounted for in IPM were not double-counted in the non-EGU inventory. As a result of this comparison, we made a few adjustments in the cross-reference table to add emission units for four plants to ensure these units accounted for in IPM were moved to the EGU inventory.
- We reviewed the non-EGU inventory to identify remaining emission units with an Standard Industrial Classification (SIC) code of “4911 Electrical Services” or Source Classification Code of “1-01-xxx-xx External Combustion Boiler, Electric Generation”. We compared the list of sources meeting these selection criteria to the IPM parsed file to ensure that these units were not double-counted.

S/L agencies also reviewed the 2009/2018 point source inventory to verify whether there was any double counting of EGU emissions. In two instances, S/L agencies provided corrections where an emission unit was double counted.

#### **2.1.1.5 Quality Assurance steps**

Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on the EGU component of the VISTAS revised 2009/2018 EGU inventory:

1. Provided parsed files (i.e., Excel spreadsheets that provide unit-level results derived from the model plant projections obtained by the IPM) to the VISTAS EGU SIWG for review and comment.
2. Provided facility level emission summaries for 2009/2018 for both the base case and CAIR case to the VISTAS EGU SIWG to ensure that emissions were consistent and that there were no missing sources.
3. Compared, at the State-level, emissions from the IPM parsed files and the post-processed NIF files to verify that the post-processed NIF files were consistent with the IPM parsed file results.

VISTAS requested S/L review of these files – the changes specified by states as a result of this review are documented in the following subsection.

#### **2.1.1.6 S/L Adjustments to IPM Modeling Results for Base G Projections**

After S/L agency review of the final set of IPM runs (as incorporated into the Base F inventory), S/L agencies specified a number of changes to the IPM results to better reflect current information on when and where future controls would occur. These changes to the IPM results primarily involved S/L agency addition or subtraction future emission controls based on the best available data from state rules, enforcement agreements, compliance plans, permits, and discussions/commitments from individual companies.

For example, Dominion Virginia Power released their company-wide plan to reduce emission to meet the requirements of CAIR and other programs. This plan varies substantially from the IPM results both in terms current and future controls and timing of these controls. As a result, VA DEQ developed their best estimates of future controls on EGUs in Virginia. Also, Duke Energy and Progress Energy have updated their plans for complying with North Carolina's Clean Smokestack Act. These plans vary substantially from the IPM results both in terms current and future controls and timing of these controls. As a result, NC DENR replaced the IPM emission projections for 2009 with projections from the Duke Energy and Progress Energy compliance plan. NC DENR elected to use the IPM results for 2018.

Some S/L agencies specified changes to the controls assigned by IPM to reflect their best estimates of emission controls. The changes specified by the S/L agencies are summarized in Table 2.1-1. These changes involved either 1) adding selective catalytic reduction (SCR) or scrubber controls to units where IPM did not predict SCR or scrubber controls, or 2) removing IPM-assigned SCR or scrubber controls at units where the S/L agency indicated their were no firm plans for controls at those units. We used a scrubber control efficiency of 90 percent when adding or removing SO<sub>2</sub> scrubber controls. We used a control efficiency of 90 percent when adding or removing NO<sub>x</sub> SCR controls at coal-fired plants, 80 percent when adding or removing



NO<sub>x</sub> SCR controls at gas-fired plants, and 35 percent when adding or removing NO<sub>x</sub> SNCR controls.

In addition to the changes to the IPM-assigned controls, the S/L agencies also specified other types of changes to the IPM results. These other specific changes to the IPM results are summarized in Table 2.1-2.

S/L agencies provided information and/or comment on changes in stack parameters from the 2002 inventory for 2009/2018 inventory. Changes to stack parameters were also made in cases where new controls are scheduled to be installed. In cases where an emission unit projected to have a SO<sub>2</sub> scrubber in either 2009 or 2018, some states were able to provide revised stack parameters for some units based on design features for the new control system. Other units projected to install scrubbers by 2009 or 2018 are not far enough along in the design process to have specific design details. For those units, the VISTAS EGU SIWG made the following assumptions: 1) the scrubber is a wet scrubber; 2) keep the current stack height the same; 3) keep the current flow rate the same, and 4) change the stack exit temperature to 169 degrees F (this is the virtual temperature derived from a wet temperature of 130 degrees F). VISTAS determined that exit temperature (wet) of 130 degrees F +/- 5 degrees F is representative of different size units and wet scrubber technology.

#### **2.1.1.7 Summary of Base F and Base G 2009/2018 EGU Point Source Inventories**

Tables 2.1-3 through 2.1-9 compare the Base G 2002 base year inventory to the Base F4 and Base G 2009/2018 projection inventories. The Base F4 projections rely primarily on the results of the IPM, while the Base G projections include the adjustments to the IPM results specified by the S/L agencies in the previous section.

**Table 2.1-1 Adjustments to IPM Control Determinations Specified by S/L Agencies for the Base G 2009/2018 EGU Inventories.**

State	Plant Name and ID	Unit	NO <sub>x</sub> Emission Controls				SO <sub>2</sub> Emission Controls				
			2009		2018		2009		2018		
			IPM	State	IPM	State	IPM	State	IPM	State	
AL	James H. Miller ORISID=6002	1 & 2	SCR during ozone season	SCR probable year round due to CAIR	SCR during ozone season	SCR probable year round due to CAIR	None	None	None	Scrubber	
		3 & 4	SCR during ozone season	SCR year round from Consent Decree	SCR during ozone season	SCR year round from Consent Decree	None	None	None	Scrubber	
	Barry ORISID=3	1, 2, 3	None	SNCR	SCR	SNCR	None	None	None	None	
		4	None	SNCR	SCR	SNCR	None	None	Scrubber	Scrubber	
		5	None	None	SCR	SCR	None	None	Scrubber	Scrubber	
	E C Gaston ORISID=26	1 - 4	SCR	None	SCR	None	None	None	Scrubber	Scrubber	
		5	SCR	SCR	SCR	SCR	Scrubber	None	Scrubber	Scrubber	
	Gorgas ORISID=8	6 & 7	None	None	None	None	None	None	None	None	
		8 & 9	None	None	None	None	None	Scrubber	None	Scrubber	
		10	SCR	SCR	SCR	SCR	None	Scrubber	Scrubber	Scrubber	
	Charles R. Lowman ORISID=56	1	None	None	None	None	None	Scrubber	None	Scrubber	
		2 & 3	SCR	SCR	SCR	SCR	Scrubber	Scrubber	Scrubber	Scrubber	
	GA	Bowen ORISID=703	1BLR	SCR	SCR	SCR	SCR	IPM had retrofit scrubbers but little emission reductions	None	Scrubber	Scrubber
			2BLR	SCR	SCR	SCR	SCR		None	Scrubber	Scrubber
3BLR			SCR	SCR	SCR	SCR	Scrubber		Scrubber	Scrubber	
4BLR			SCR	SCR	SCR	SCR	Scrubber		Scrubber	Scrubber	

**Table 2.1-1 (continued)**

State	Plant Name and ID	Unit	NO <sub>x</sub> Emission Controls				SO <sub>2</sub> Emission Controls				
			2009		2018		2009		2018		
			IPM	State	IPM	State	IPM	State	IPM	State	
GA	Wansley ORISID=6052	1	SCR	SCR	SCR	SCR	IPM had retrofit scrubbers but little emission reductions	Scrubber	Scrubber	Scrubber	
		2	SCR	SCR	SCR	SCR		None	Scrubber	Scrubber	
	Kraft ORISID=733	1, 2	None	None	None	None	None	None	None	None	
		3	None	None	SCR	None	None	None	None	None	
	McIntosh ORISID=6124	1	None	None	SCR	None	None	None	None	None	
	Yates ORISID=728	1	None	None	None	None	Scrubber	Scrubber	Scrubber	Scrubber	
		2, 3	None	None	None	None	None	None	None	None	
		4 – 7	None	None	SCR	SCR	None	None	Scrubber	None	
	Hammond ORISID=708	1	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber	
		2	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber	
		3	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber	
		4	SCR	SCR	SCR	SCR	Scrubber	Scrubber	Scrubber	Scrubber	
	KY	Ghent ORISID=1356	1	None	SCR	SCR	SCR	Scrubber	Scrubber	Scrubber	Scrubber
			2	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber
3, 4			None	SCR	SCR	SCR	None	Scrubber	Scrubber	Scrubber	
Coleman ORISID=1381		C1	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber	
		C2	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber	
		C3	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber	
HMP&L Station 2		H1	SCR	SCR	SCR	SCR	Scrubber	Scrubber	Scrubber	Scrubber	
		H2	None	SCR	SCR	SCR	Scrubber	Scrubber	Scrubber	Scrubber	

Table 2.1-1 (continued)

State	Plant Name and ID	Unit	NO <sub>x</sub> Emission Controls				SO <sub>2</sub> Emission Controls			
			2009		2018		2009		2018	
			IPM	State	IPM	State	IPM	State	IPM	State
KY	E W Brown ORISID=1355	1	None	None	None	None	None	Scrubber	None	Scrubber
		2	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber
		3	None	None	SCR	SCR	None	Scrubber	Scrubber	Scrubber
SC	Jeffries ORISID=3319	3	SCR	None	SCR	None	None	None	None	None
		4	None	None	None	None	None	None	None	None
	Wateree ORISID=3297	WAT1	SCR	SCR	SCR	SCR	None	Scrubber	None	Scrubber
		WAT2	SCR	SCR	SCR	SCR	None	Scrubber	Scrubber	Scrubber
	Canadys ORISID=3280	CAN1	None	None	None	None	None	None	None	None
		CAN2	None	None	None	None	None	None	None	None
		CAN3	None	None	None	None	None	Scrubber	None	Scrubber
	Rainey ORISID=7834	CT1A	None	SCR	None	SCR	None	None	None	None
CT1B		None	SCR	None	SCR	None	None	None	None	
TN	Kingston ORISID=3407	1 – 8	SCR	SCR	SCR	SCR	None	None	Scrubber	Scrubber
		9	None	SCR	SCR	SCR	None	None	Scrubber	Scrubber
	Johnsonville ORISID=3406	1 – 10	SCR	None	SCR	SCR	None	None	None	None
WV	Willow Island ORISID=3946	2	SCR	None	SCR	SCR	Scrubber	None	Scrubber	Scrubber
	Kammer ORISID=3947	1 -3	SCR	None	SCR	SCR	Scrubber	None	Scrubber	Scrubber

**Table 2.1-2. Other Adjustments to IPM Results Specified by S/L Agencies for the Base G 2009/2018 EGU Inventories.**

State	Plant Name and ID	Unit	Nature of Update/Correction
FL	Central Power and Lime ORISID= 10333	GEN1	Central Power and Lime (ORIS10333) is a duplicate entry. This is point 18 in Florida Crushed Stone (12-053-0530021). Removed IPM emissions for Central Power and Lime.
	Cedar Bay Generating ORISID=10672	GEN1	FLDEP disagrees with IPM projections - no knowledge of expansion of this facility and the cogeneration facility should not grow faster than the underlying industry. Cedar Bay is connected to Stone Container (12-031-0310067). Replaced IPM emissions with 2002 emissions for Cedar Bay (12-031-0310337) times the growth factors for Stone Container.
	Indiantown Cogeneration ORISID=50976	GEN1	FLDEP disagrees with IPM projections - no knowledge of expansion of this facility and the cogeneration facility should not grow faster than the underlying industry. Indiantown is connected to Louis Dreyfus Citrus (12-085-0850002). Replaced IPM emissions with 2002 emissions for Indiantown (12-085-0850102) times the growth factors for Louis Drefus Citrus.
GA	Bowen ORISID=703	1BLR 2BLR 3BLR 4BLR	IPM indicated retrofit scrubbers on all 4 units in 2009, but the IPM emissions showed little reductions from 2002 levels. Changed emissions to reflect scrubbers on 3BLR and 4BLR by 2009.
	Wansley ORISID=6052	1, 2	IPM indicated retrofit scrubbers on both units in 2009, but the IPM emissions showed little reductions from 2002 levels. Changed emissions to reflect one scrubber on Unit 1 by 2009.
	Riverside ORISID=734	4	All of plant Riverside was retired from service June 1, 2005; emissions set to zero in 2009 and 2018.
	McIntosh ORISID=727	CT10A CT10B CT11A CT11B	The McIntosh Combined Cycle facility became commercial June 1, 2005. Added 346 tons of NO <sub>x</sub> and 121 tons of SO <sub>2</sub> per unit to the 2009 and 2018 inventories.
	Longleaf Energy Station	1, 2	Longleaf Energy Station is being proposed by LS Power Development, Inc. GA specified that the emissions from this proposed plant be included in the 2018 projections. Boilers 1 and 2 added 1,882 tons of NO <sub>x</sub> and 3,227 tons of SO <sub>2</sub> per unit to the 2018 inventory.
	Duke Murray (55382)	1	Corrected coordinates to 34.7189 and -84.9353
MS	R D Morrow ORISID=6061	1, 2	Revised the 2018 emissions to reflect controls not indicated by IPM. The SO <sub>2</sub> emissions are much lower than IPM, but their expected NO <sub>x</sub> emissions are actually higher than IPM. The controls will be coming online 2009 or 2010, so the 2009 inventory did not change.
	Jack Watson (2049) Victor J Daniel (6073) Chevron Oil (2047)	All	MS DEQ specified that the emission projections provided by the Southern Company for their units in Mississippi were to be used instead of the IPM results.

**Table 2.1-2 (continued)**

State	Plant Name and ID	Unit	Nature of Update/Correction
NC	G G Allen (2718) Belews Creek (8042)1 Buck (2720) Cliffside (2721) Dan River (2723) Marshall (2727) Riverbend (2732)	All	Replaced all IPM 2009 results with emission projections from Duke Power's NC Clean Air Compliance Plan for 2006. Used IPM results for 2018
	Asheville (2706) Cape Fear (2708) Lee (2709) Mayo (6250) Roxboro (2712) Sutton (2713) Weatherspoon (2716)	All	Replaced all IPM 2009 results with emission projections from Progress Energy's NC Clean Smokestacks Act Calendar Year 2005 Progress Report. Used IPM results for 2018
	Dwayne Collier Battle Cogeneration Facility ORISID=10384	GEN1 GEN2	Dwayne Collier Battle is a duplicate entry. This is Cogentrix of Rocky Mount (37-065-3706500146, stacks G-26 and G-27). Duplicate entries were removed both the 2009 and 2018 inventories.
	Kannapolis Energy Partners ORISID=10626	GEN2 GEN3	Kannapolis Energy emissions are being used as credits for another facility. IPM emissions from this facility (37-025-ORIS10626) were removed from the EGU inventory for 2009 and 2018. Emissions from Kannapolis Energy (37-025-3702500113) were carried forward in the 2009/2018 inventory.
SC	Cross ORISID=130	1, 2	Unit 1: upgrade scrubber from 82 percent to 95 percent removal efficiency by June 30, 2006. Recalculate emissions based on upgrade in control efficiency. Unit 2: upgrade scrubber from 70 percent to 87 percent removal efficiency by June 30, 2006. Recalculate emissions based on upgrade in control efficiency.
	Winyah ORISID=6249	1 – 4	Unit 1: Install scrubber that meets 95 percent removal efficiency by Dec. 31, 2008; Upgrade ESP from 0.38 to 0.03 lb/mmBTU by Dec. 31, 2008 Unit 2: Replace scrubber with one that meets 95 percent removal efficiency from 45 percent by Dec. 31, 2008; Upgrade ESP from 0.10 to 0.03 lb/mmBTU by Dec. 31, 2008 Unit 3: Upgrade scrubber from 70 percent to 90 percent removal efficiency by Dec. 31, 2012; Upgrade ESP from 0.10 to 0.03 lb/mmBTU by Dec. 31, 2012 Unit 4: Upgrade scrubber from 70 percent to 90 percent removal efficiency by Dec. 31, 2007; Upgrade ESP from 0.10 to 0.03 lb/mmBTU by Dec. 31, 2007 Recalculated SO <sub>2</sub> and PM emissions based on upgrade in control efficiencies.

**Table 2.1-2 (continued)**

State	Plant Name and ID	Unit	Nature of Update/Correction
SC	Dolphus Grainger ORISID=3317	1, 2	Unit 1: Upgrade ESP from 0.60 to 0.03 lb/mmBTU by Dec. 31, 2012. Reduced PM <sub>10</sub> and PM <sub>25</sub> emissions in 2018 by 95 percent based on change in allowable emission rate Unit 2: Install low NO <sub>x</sub> burners that meet 0.46 lb/mmBTU from 0.9 by May 1, 2004. Recalculated NO <sub>x</sub> emissions using 0.46/lbs/mmBtu and IPM heat input Unit 2: Upgrade ESP from 0.60 to 0.03 lb/mmBTU by Dec. 31, 2012. Reduced PM <sub>10</sub> and PM <sub>25</sub> emissions in 2018 by 95 percent based on change in allowable emission rate
SC	Jeffries ORISID=3319	3, 4	Unit 3: Upgrade ESP from 0.54 to 0.03 lb/mmBTU by Dec. 31, 2012. Reduced PM <sub>10</sub> and PM <sub>25</sub> emissions in 2018 by 94.44 percent based on change in allowable emission rate Unit 4: Upgrade ESP from 0.54 to 0.03 lb/mmBTU by Dec. 31, 2012. Reduced PM <sub>10</sub> and PM <sub>25</sub> emissions in 2018 by 94.44 percent based on change in allowable emission rate
	W S Lee ORISID=3264	1, 2	IPM does not indicate that these units are installing SOFA NO <sub>x</sub> control technology by April 30, 2006 to meet 0.27 lb/mmBTU, down from 0.45 lb/mmBtu. Calculated NO <sub>x</sub> emissions using IPM heat input and 0.27 lbs/mmBtu
	Generic Unit ORISID=900545	All	All predictions for generic units appear reasonable with the exception of Plant ID ORIS900545 Point ID GSC45 which was modeled in Georgetown County. It will be very difficult to add new generation this close to the Cape Romain Class I area. Santee Cooper has no plans for future generation in Georgetown County, but does have plans for new future generation in Florence County. This unit was moved to coordinates specified in Florence County.
VA	AEP Clinch River ORISID=3775	1, 2, 3	Used IPM results for 2009; replaced all 2018 IPM results with VADEQ's growth and control estimates (no SCR or scrubbers).
	AEP Glen Lyn ORISID=3776	51, 52, 6	Used 2009/2018 IPM results for units 51 and 52; used 2009 IPM for unit 6; replaced 2018 IPM for unit 6 with VADEQ's growth and control estimates (nor SCR or scrubber).
	Dominion Clover ORISID=7213	1, 2	Used 2009/2018 IPM results.
	Dominion Bremono ORISID=3796	3, 4	Used 2009/2018 IPM results.
	Dominion Chesterfield ORISID=3797	3, 4, 5, 6	Replaced all 2009/2018 IPM results using VADEQ's growth and control estimates.
	Dominion Yorktown ORISID=3809	1, 2, 3	Units 1, 2: Used 2009/2018 IPM results for NO <sub>x</sub> and used VADEQ's growth and control estimates for SO <sub>2</sub> . Unit 3: IPM predicts zero heat input for this 880 MW #6 oil fired unit. Dominion plans to continue to operate Unit 3. Replaced all 2009/2018 IPM results using VADEQ's growth and control estimates.

**Table 2.1-2 (continued)**

State	Plant Name and ID	Unit	Nature of Update/Correction
VA	Dominion Chesapeake ORISID=3803	1 – 4	Unit 1: Used 2009/2018 IPM for NO <sub>x</sub> ; used 2009 IPM for SO <sub>2</sub> ; used VADEQ's growth and control estimates for SO <sub>2</sub> (added scrubber that IPM did not have) Unit 2: Used 2009/2018 IPM for NO <sub>x</sub> ; used 2009 IPM for SO <sub>2</sub> ; used VADEQ's growth and control estimates for SO <sub>2</sub> (added scrubber that IPM did not have) Unit 3: Used VA DEQ's growth and control estimates for 2009 NO <sub>x</sub> (added SCR that IPM did not have); used IPM result for 2018 NO <sub>x</sub> ; Used 2009/2018 IPM for SO <sub>2</sub> . Unit 4: Used VA DEQ's growth and control estimates for 2009 NO <sub>x</sub> (added SCR that IPM did not have); used IPM result for 2018 NO <sub>x</sub> ; Used 2009/2018 IPM for SO <sub>2</sub> .
	Dominion Possum Point ORISID=3804	3 & 4 5 6	Unit 3&4: IPM had 137 tons of NO <sub>x</sub> for these units in 2009 and 111 tons in 2018. VA DEQ specified that the permitted emission rates should be used, which equates to 3,066 tons in 2009 and 2018. Unit 5: IPM had zero heat input. Replaced all 2009/2018 IPM results using VADEQ's growth and control estimates. Unit 6: Replaced all 2009/2018 IPM results using VADEQ's growth and control estimates.
	Potomac River ORISID=3788	1 - 5	Units 1&2: IPM retired these units. Mirant has no plans at this time to retire any units. Replaced all 2009/2018 IPM results using VADEQ's growth and control estimates. Units 3, 4, 5: Replaced all 2009/2018 IPM results using VADEQ's growth and control estimates.
WV	Albright ORISID=3942	1, 2	IPM predicted early retirement for these units. AEP indicated there are no plans for early retirement. For 2009, used 2002 actual emissions as these units are not likely to retire by 2009. For 2018, used IPM prediction of retirement.
	Rivesville ORISID=3945	7, 8	IPM predicted early retirement for these units. AEP indicated there are no plans for early retirement. For 2009, used 2002 actual emissions as these units are not likely to retire by 2009. For 2018, used IPM prediction of retirement.
	Willow Island ORISID=3946	1, 2	Unit 1: IPM predicted early retirement for these units. AEP indicated there are no plans for early retirement. For 2009, used 2002 emissions as these units are not likely to retire by 2009. For 2018, used IPM prediction of retirement. Unit 2: IPM predicted SCR and scrubber for 2009. These controls will not be in place by 2009.
	North Branch Power Station ORISID=7537	1A, 1B	SO <sub>2</sub> Permit Rate was corrected from 2.7 to 0.678 lb/MMBtu. Used SO <sub>2</sub> Permit Rate of 0.678 lb/MMBtu and IPM predicted total fuel used to calculate SO <sub>2</sub> emissions in 2009 and 2018
	Mt. Storm ORISID=3954	1, 2, 3	SO <sub>2</sub> Permit Rate was corrected from 2.7 to 0.15 lb/MMBtu. Used SO <sub>2</sub> Permit Rate of 0.15 lb/MMBtu and IPM predicted total fuel used to calculate SO <sub>2</sub> emissions in 2009 and 2018



**Table 2.1-3 EGU Point Source SO<sub>2</sub> Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS BaseG	Base F4 IPM Based	Base G IPM Based with S/L Adjustments	Base F4 IPM Based	Base G IPM Based with S/L Adjustments
AL	447,828	340,194	378,052	190,099	305,262
FL	453,631	195,790	186,055	141,551	132,177
GA	514,952	534,469	417,449	180,178	230,856
KY	484,057	371,944	290,193	229,603	226,062
MS	67,429	85,629	76,579	27,230	15,146
NC	477,990	205,018	242,286	110,382	108,492
SC	206,399	171,206	124,608	121,694	93,274
TN	334,151	255,400	255,410	112,662	112,672
VA	241,204	169,714	225,653	90,935	140,233
WV	516,084	226,127	277,489	124,466	115,324
<b>Total</b>	<b>3,743,725</b>	<b>2,555,491</b>	<b>2,473,774</b>	<b>1,328,800</b>	<b>1,479,498</b>

Note: Emission summaries above are based on SCCs 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-4 EGU Point Source NO<sub>x</sub> Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS BaseG	Base F4 IPM Based	Base G IPM Based with S/L Adjustments	Base F4 IPM Based	Base G IPM Based with S/L Adjustments
AL	161,038	70,852	82,305	42,769	64,358
FL	257,677	89,610	86,165	77,080	73,125
GA	147,517	97,146	98,497	58,095	75,717
KY	198,817	107,890	92,021	64,378	64,378
MS	43,135	11,475	36,011	8,945	10,271
NC	151,854	66,431	66,522	60,914	62,353
SC	88,241	43,817	46,915	48,346	51,456
TN	157,307	41,767	66,405	31,725	31,715
VA	86,886	63,220	66,219	49,420	75,594
WV	230,977	63,510	86,328	51,241	51,241
<b>Total</b>	<b>1,523,449</b>	<b>655,718</b>	<b>727,388</b>	<b>492,913</b>	<b>560,208</b>

Note: Emission summaries above are based on SCCs 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-5 EGU Point Source VOC Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS BaseG	Base F4 IPM Based	Base G IPM Based with S/L Adjustments	Base F4 IPM Based	Base G IPM Based with S/L Adjustments
AL	2,295	2,441	2,473	2,952	2,952
FL	2,524	1,867	1,910	2,324	2,376
GA	1,244	1,571	2,314	1,903	2,841
KY	1,487	1,369	1,369	1,426	1,426
MS	648	406	404	1,124	1,114
NC	988	974	954	1,272	1,345
SC	470	660	660	906	906
TN	926	932	932	977	976
VA	754	685	778	903	996
WV	1,180	1,342	1,361	1,387	1,387
<b>Total</b>	<b>12,516</b>	<b>12,247</b>	<b>13,155</b>	<b>15,174</b>	<b>16,319</b>

Note: Emission summaries above are based on SCCs 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-6 EGU Point Source CO Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS BaseG	Base F4 IPM Based	Base G IPM Based with S/L Adjustments	Base F4 IPM Based	Base G IPM Based with S/L Adjustments
AL	11,279	14,948	14,986	24,342	24,342
FL	57,113	45,391	35,928	63,673	53,772
GA	9,712	20,066	23,721	32,744	44,476
KY	12,619	15,812	15,812	17,144	17,144
MS	5,303	5,078	5,051	15,364	15,282
NC	13,885	15,141	14,942	19,612	20,223
SC	6,990	11,135	11,135	14,786	14,786
TN	7,084	7,221	7,213	7,733	7,723
VA	6,892	11,869	12,509	14,755	15,420
WV	10,341	11,328	11,493	11,961	11,961
<b>Total</b>	<b>141,218</b>	<b>157,989</b>	<b>152,790</b>	<b>222,114</b>	<b>225,129</b>

Note: Emission summaries above are based on SCCs 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-7 EGU Point Source PM<sub>10</sub>-PRI Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS BaseG	Base F4 IPM Based	Base G IPM Based with S/L Adjustments	Base F4 IPM Based	Base G IPM Based with S/L Adjustments
AL	7,646	6,959	6,969	7,822	7,822
FL	21,387	9,384	9,007	10,310	9,953
GA	11,224	17,088	17,891	18,329	20,909
KY	4,701	6,463	6,463	6,694	6,694
MS	1,633	5,487	4,957	7,624	7,187
NC	22,754	22,888	22,152	33,742	37,376
SC	21,400	28,650	19,395	37,864	28,826
TN	14,640	15,608	15,608	15,941	15,941
VA	3,960	4,479	5,508	12,744	13,775
WV	4,573	5,471	5,657	6,349	6,349
<b>Total</b>	<b>113,918</b>	<b>122,477</b>	<b>113,607</b>	<b>157,419</b>	<b>154,832</b>

Note: Emission summaries above are based on SCCs 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-8 EGU Point Source PM<sub>2.5</sub> -PRI Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS BaseG	Base F4 IPM Based	Base G IPM Based with S/L Adjustments	Base F4 IPM Based	Base G IPM Based with S/L Adjustments
AL	4,113	3,916	3,921	4,768	4,768
FL	15,643	6,250	5,910	7,171	6,843
GA	4,939	10,104	10,907	11,403	13,983
KY	2,802	4,279	4,279	4,434	4,434
MS	1,138	5,310	4,777	7,469	7,033
NC	16,498	16,514	15,949	26,966	29,792
SC	17,154	23,366	16,042	32,180	25,032
TN	12,166	13,092	13,092	13,387	13,387
VA	2,606	3,194	4,067	11,101	11,976
WV	2,210	2,850	2,940	3,648	3,648
<b>Total</b>	<b>79,269</b>	<b>88,875</b>	<b>81,884</b>	<b>122,527</b>	<b>120,896</b>

Note: Emission summaries above are based on SCCs 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-9 EGU Point Source NH<sub>3</sub> Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS BaseG	Base F4 IPM Based	Base G IPM Based with S/L Adjustments	Base F4 IPM Based	Base G IPM Based with S/L Adjustments
AL	317	359	359	1,072	1,072
FL	234	1,659	1,631	3,004	2,976
GA	83	686	686	1,677	1,677
KY	326	400	400	476	476
MS	190	333	333	827	827
NC	54	423	445	691	663
SC	142	343	343	617	617
TN	204	227	227	241	241
VA	127	632	694	558	622
WV	121	330	330	180	180
<b>Total</b>	<b>1,798</b>	<b>5,392</b>	<b>5,448</b>	<b>9,343</b>	<b>9,351</b>

Note: Emission summaries above are based on SCCs 1-01-xxx-xx and 2-01-xxx-xx.

### **2.1.2 Non-EGU Emission Projections**

The general approach for assembling future year data was to use growth and control data consistent with the data used in EPA's Clean Air Interstate Rule analyses, supplement these data with available stakeholder input, and provide the results for stakeholder review to ensure credibility. We used the revised 2002 VISTAS base year inventory, based on the 2002 CERR submittals as the starting point for the non-EGU projection inventories. As described in Section 2.1.1.4, we split the point source inventory into EGU and non-EGU components. MACTEC performed the following activities to apply growth and control factors to the 2002 inventory to generate the 2009 and 2018 projection inventories:

- Obtained, reviewed, and applied the most current growth factors developed by EPA, based on forecasts from an updated Regional Economic Models, Inc. (REMI) model (version 5.5) and the latest *Annual Energy Outlook* published by the Department of Energy (DOE);
- Obtained, reviewed, and applied any State-specific or sector-specific growth factors submitted by stakeholders;
- Obtained and incorporated information regarding sources that have shut down after 2002 and set the emissions to zero in the projection inventories;
- Obtained, reviewed, and applied control assumptions for programs “on-the-books” and “on-the-way”;
- Provided data files in NIF3.0 format and emission summaries in EXCEL format for review and comment; and
- Updated the database with corrections or new information from S/L agencies based on their review of the Base F 2009/2018 inventories.

The following sections discuss each of these steps.

#### **2.1.2.1 Growth assumptions for non-EGU sources**

This section describes the growth factor data used in developing the Base F inventory for 2009 and 2018, as well as the changes to the growth factor data made for the Base G inventory.

The growth factor data used in developing the Base F inventory were consistent with EPA's analyses for the CAIR rulemaking. These growth factors are fully documented in the reports entitled *Development of Growth Factors for Future Year Modeling Inventories* (dated April 30, 2004) and *CAIR Emission Inventory Overview* (dated July 23, 2004). Three sources of data were used in developing the growth factors for the Base F inventory:

- State-specific growth rates from the Regional Economic Model, Inc. (REMI) Policy Insight<sup>®</sup> model, version 5.5 (being used in the development of the EGAS Version 5.0). The REMI socioeconomic data (output by industry sector, population, farm sector value

added, and gasoline and oil expenditures) are available by 4-digit SIC code at the State level.

- Energy consumption data from the DOE's Energy Information Administration's (EIA) *Annual Energy Outlook 2004, with Projections through 2025* for use in generating growth factors for non-EGU fuel combustion sources. These data include regional or national fuel-use forecast data that were mapped to specific SCCs for the non-EGU fuel use sectors (e.g., commercial coal, industrial natural gas). Growth factors for the residential natural gas combustion category, for example, are based on residential natural gas consumption forecasts that are reported at the Census division level. These Census divisions represent a group of States (e.g., the South Atlantic division includes eight southeastern States and the District of Columbia). Although one would expect different growth rates in each of these States due to unique demographic and socioeconomic trends, EIA's projects all States within each division using the same growth rate.
- Specific changes for sectors (e.g., plastics, synthetic rubber, carbon black, cement manufacturing, primary metals, fabricated metals, motor vehicles and equipment) where the REMI-based rates were unrealistic or highly uncertain. Growth projections for these sectors were based on industry group forecasts, Bureau of Labor Statistics (BLS) projections and Bureau of Economic Analysis (BEA) historical growth from 1987-2002.

In addition to the growth data described above, we received two sets of growth projections from VISTAS stakeholders.

The American Forest and Paper Association (AF&PA) supplied growth projections for the pulp and paper sector, which were applied to SIC 26xx Paper and Allied Products. The AF&PA projection factors are for the U.S. industry and apply to all States equally. The numbers come from the 15-year forecast for world pulp and recovered paper prepared by Resource Information Systems Inc. (RISI).

SIC Code	Sector	AF&PA Growth Factor	
		2002 to 2009	2002 to 2018
2611	Pulp Mills	1.067	1.169
2621	Paper Mills	1.067	1.169
2631	Paperboard Mills	1.067	1.169

For both the Base F and Base G inventories, we used the above AF&PA growth factors by SIC instead of the factors obtained from EPA's CAIR analysis.

For the Base F inventory, the NCDENR supplied recent projections for three key sectors in North Carolina where declining production was anticipated – SIC 22xx Textile Mill Products, 23xx Apparel and Other Fabrics, and 25xx Furniture and Fixtures. For the Base G inventory, NCDENR decided to use a growth factor of 1.0 for these SIC codes for both 2009 and 2018. Although NCDENR has data that shows a steady decline in these industries in NC, NCDENR wanted to maintain the emission levels at 2002 levels so the future emission reduction credits were available in the event that they are needed for nonattainment areas. The specific growth factors for these industrial sectors in North Carolina were:

NCDENR Growth Factors for Specific Industrial Sectors					
SIC Code	Industrial Sector	2009		2018	
		Base F	Base G	Base F	Base G
22xx	Textile Mill Products	0.6239	1.00	0.2792	1.00
23xx	Apparel and Other Fabrics	0.5867	1.00	0.2247	1.00
25xx	Furniture and Fixtures	0.8970	1.00	0.7647	1.00

For the Base G inventory, we made one additional change to the growth factors. The Base F inventory relied on DOE's AEO2004 forecasts for projecting emissions for fuel-burning SCCs (applies mainly to ICI boilers 1-02-xxx-xx and 1-03-xxx-xx, as well as in-process fuel use). We replaced the AEO2004 data with the more recent AEO2006 forecasts (released in February 2006) to reflect changes in the energy market and to improve the emissions growth factors produced. We obtained the corresponding AEO2006 projection tables from DOE's web site located at <http://www.eia.doe.gov/oiaf/aeo/supplement/supref.html>. We developed tables comparing the growth factors based on AEO2004 and AEO2006. These comparison tables were reviewed by the S/L agencies. Based on this review, VISTAS decided to use the AEO2006 growth factors for fuel burning SCCs.

We used the EPA's EGAS model and updated the corresponding AEO2006 projection tables to create growth factors by SCC. We applied the updated growth factors to 2002 actual emissions and replaced the 2009 and 2018 emissions in NIF EM tables for the affected SCCs.

### 2.1.2.2 Source Shutdowns

A few states indicated that significant source shutdowns have occurred since 2002 and that emissions from these sources should not be included in the future year inventories. These sources are identified in Table 2.1-10.

**Table 2.1-10. Summary of Source Shutdowns Incorporated in Base G Inventory.**

State	Description of Source Shutdowns
AL	None specified.
FL	The following facilities are shutdown and projected emissions were set to zero in 2009/2018. 0570075 CORONET INDUSTRIES, INC. 1050050 U S AGRI-CHEMICALS CORP. 1050051 U.S. AGRI-CHEMICALS CORPORATION These facilities emitted 2,417 tons of SO <sub>2</sub> and 113 tons of NO <sub>x</sub> in 2002.
GA	Georgia indicated that the former Blue Circle (now LaFarge) facility in downtown Atlanta will likely shut down before 2009. The facility has two cement kilns, one of which is already shut down. The second kiln will continue to operate until the new facility in Alabama has enough milling capacity, after which the entire Atlanta facility will be completely closed down. This facility emitted 1,617 tons of SO <sub>2</sub> and 587 tons of NO <sub>x</sub> in 2002.
KY	None specified.
MS	AF&PA indicated that the International Paper Natchez Mill (28-001-2800100010) has shut down. This facility emitted 1,398 tons of SO <sub>2</sub> and 1,773 tons of NO <sub>x</sub> in 2002.
	The Magnolia Resources - Pachuta Harmony Gas Plant (28-023-00031) is out of business and no longer holds an air permit. This facility emitted 2,257 tons of SO <sub>2</sub> and 134 tons of NO <sub>x</sub> in 2002.
NC	In Base F, two paper mills were identified as being shut down in the 2018 inventory. NCDENR indicated that these mills are not expected to close. The two facilities are Ecusta Business Development (37-175-3717500056) and International Paper (37-083-00007). Their emissions were added back into the Base G 2018 inventory.
	BASF Corporation (37-021-724) in Buncombe County is currently operating but has plans to shut down in 2007. This facility emitted 461 tons of SO <sub>2</sub> and 266 tons of NO <sub>x</sub> in 2002.
SC	South Carolina provided a list of facilities that were identified as closing down on or after Jan. 1, 2003. The emissions for these facilities were set to zero in the 2009 and 2018 projection inventories. Emissions from these plants in 2002 were: 6,195 tons of SO <sub>2</sub> , 2,994 tons of NO <sub>x</sub> , and 2,836 tons of VOC. Most of the emissions were from one facility – Celanese Acetate (45-091-2440-0010) in York County.
TN	Davidson County (Nashville) indicated that significant source shutdowns have occurred since data were submitted for the 2002 CERR. Source number 47-037-00002 (Dupont) shut down a portion of their facility, which was permanently taken out of service. Source 47-037-00050 (Nashville Thermal Transfer Corp.) shut down their municipal waste combustors and replaced them with natural gas fired boilers with propane stand by.
	Weyerhaeuser (AKA Willamette) Power Boiler 7 (47-163-0022, EU ID = 017) is being shut down. This emission unit emitted 4,297 tons of SO <sub>2</sub> and 1,443 tons of NO <sub>x</sub> in 2002.
	Liberty Fibers (47-063-0197) in Hamblen County has recently shut down. This facility emitted 5,377 tons of SO <sub>2</sub> ; 2,057 tons of NO <sub>x</sub> ; and 9,059 tons of VOC in 2002.
VA	Rock-Tenn (51-680-00097) received a permit dated 9/13/2003 which required the shutdown of units 1 and 2 by 2/27/2004. This permit was part of a netting exercise that allowed the installation of a new NG/DO boiler. These two units emitted 507 tons of SO <sub>2</sub> and 276 tons of NO <sub>x</sub> in 2002.
WV	None specified.



### 2.1.2.3 Control Programs applied to non-EGU sources

We used the same control programs for both the 2009 and 2018 non-EGU point inventory. Two control scenarios were developed: on-the-books (OTB) controls and on-the-way (OTW) controls. The OTB control scenario accounts for post-2002 emission reductions from promulgated federal, State, local, and site-specific control programs. The OTW control scenario accounts for proposed (but not final) control programs that are reasonably anticipated to result in post-2002 emission reductions. The methodologies used to account for the emission reductions associated with these emission control programs are discussed in the following sections.

**Table 2.1-11. Non-EGU Point Source Control Programs Included in 2009/2018 Projection Inventories.**

**On-the-Books (Cut-off of July 1, 2004 for Base 1 adoption)**

- Atlanta / Northern Kentucky / Birmingham 1-hr SIPs
- Industrial Boiler/Process Heater/RICE MACT
- NO<sub>x</sub> RACT in 1-hr NAA SIPs
- NO<sub>x</sub> SIP Call (Phase I- except where States have adopted II already e.g. NC)
- Petroleum Refinery Initiative (October 1, 2003 notice; MS & WV)
- RFP 3 percent Plans where in place for one hour plans
- VOC 2-, 4-, 7-, and 10-year maximum achievable control technology (MACTO Standards)
- Combustion Turbine MACT

**On-the-Way**

- NO<sub>x</sub> SIP Call (Phase II – remaining States & IC engines)

#### 2.1.2.3.1 OTB - NO<sub>x</sub> SIP Call (Phase I)

Phase I of the NO<sub>x</sub> SIP call applies to certain large non-EGUs, including large industrial boilers and turbines, and cement kilns. States in the VISTAS region affected by the NO<sub>x</sub> SIP call have developed rules for the control of NO<sub>x</sub> emissions that have been approved by EPA. We reviewed the available State rules and guidance documents to determine the affected sources and ozone season allowances. We also obtained and reviewed information in the EPA's CAMD NO<sub>x</sub> Allowance Tracking System – Allowances Held Report. Since these controls are to be in effect by the year 2007, we capped the emissions for NO<sub>x</sub> SIP call affected sources at 2007 levels and

carried forward the capped levels for the 2009/2018 future year inventories. Since the NO<sub>x</sub> SIP call allowances are given in terms of tons per ozone season (5 month period from May to September), we calculated annual emissions by multiplying the 5-month allowances by a factor of 12 divided by 5.

#### **2.1.2.3.2 OTB - Industrial Boiler/Process Heater MACT**

EPA anticipates reductions in PM and SO<sub>2</sub> as a result of the Industrial Boiler/Process Heater MACT standard. The methods used to account for these reductions are the same as those used for the CAIR analysis. Reductions were included for existing units firing solid fuel (coal, wood, waste, biomass) which had a design capacity greater than 10 mmBtu/hr. EPA prepared a list of SCCs for solid fuel industrial and commercial/ institutional boilers and process heaters. We identified boilers greater than 10 mmBtu/hr using either the boiler capacity from the VISTAS 2002 inventory, or if the boiler capacity was missing, a default capacity based on a methodology developed by EPA for assigning default capacities based on SCC. The applied MACT control efficiencies were 4 percent for SO<sub>2</sub> and 40 percent for PM<sub>10</sub> and PM<sub>2.5</sub> to account for the co-benefit from installation of acid gas scrubbers and other control equipment to reduce HAPs.

#### **2.1.2.3.3 OTB - 2, 4, 7, and 10-year MACT Standards**

Maximum achievable control technology (MACT) requirements were also applied, as documented in the report entitled *Control Packet Development and Data Sources*, dated July 14, 2004. The point source MACTs and associated emission reductions were designed from Federal Register (FR) notices and discussions with EPA's Emission Standards Division (ESD) staff. We did not apply reductions for MACT standards with an initial compliance date of 2001 or earlier, assuming that the effects of these controls are already accounted for in the 2002 inventories supplied by the States. Emission reductions were applied only for MACT standards with an initial compliance date of 2002 or greater.

#### **2.1.2.3.4 OTB Combustion Turbine MACT**

The projection inventories do not include the NO<sub>x</sub> co-benefit effects of the MACT regulations for Gas Turbines or stationary Reciprocating Internal Combustion Engines, which EPA estimates to be small compared to the overall inventory.

#### **2.1.2.3.5 OTB - Petroleum Refinery Initiative (MS and WV)**

Three refineries in the VISTAS region are affected by two October 2003 Clean Air Act settlements under the EPA Petroleum Refinery Initiative. The refineries are: (1) the Chevron refinery in Pascagoula, MS; (2) the Ergon refinery in Vicksburg, MS; and (3) the Ergon refinery in Newell, WV.

The first consent decree pertained to Chevron refineries in Richmond and El Segundo, CA; Pascagoula, MS; Salt Lake City, UT; and Kapolei, HI. Actions required under the Consent Decree will reduce annual emissions of NO<sub>x</sub> by 3,300 tons and SO<sub>2</sub> by 6,300 tons. The consent decree requires a program to reduce NO<sub>x</sub> emissions from refinery heaters and boilers through the installation of NO<sub>x</sub> controls that meet at least an SNCR level of control. The refineries are to eliminate fuel oil burning in any combustion unit. The consent decree also requires reductions of NO<sub>x</sub> and SO<sub>2</sub> from the fluid catalytic cracking unit and control of acid gas flaring incidents. The consent decree does not provide sufficient information to calculate emission reductions for the FCCU or flaring at the Pascagoula refinery. Therefore, we calculated a general percent reduction for NO<sub>x</sub> and SO<sub>2</sub> by dividing the expected emission reductions at the five Chevron refineries by the total emissions from these five refineries (as reported in the 1999 NEI). This resulted in applying percent reductions of 45 percent for SO<sub>2</sub> and 28 percent for NO<sub>x</sub> to FCCU and flaring emissions at the Chevron Pascagoula refinery.

The second consent decree pertained to the Ergon-West Virginia refinery in Newell, WV; and the Ergon Refining facility in Vicksburg, MS. The consent decree requires the two facilities to implement a 6-year program to reduce NO<sub>x</sub> emission from all heaters and boilers greater than 40 mmBtu/hr, and to eliminate fuel oil burning in any combustion unit (except during periods of natural gas curtailment). Specifically, ultra low NO<sub>x</sub> burners are required on Boilers A and B at Newell, a low NO<sub>x</sub>-equivalent level of control for heater H-101 at Newell and heaters H-1 and H-3 at Vicksburg, and an ultra low NO<sub>x</sub> burner level of control for heater H-451 at Vicksburg.

#### **2.1.2.3.6 OTW - NO<sub>x</sub> SIP Call (Phase II)**

The final Phase II NO<sub>x</sub> SIP call rule was finalized on April 21, 2004. States had until April 21, 2005, to submit SIPs meeting the Phase II NO<sub>x</sub> budget requirements. The Phase II rule applies to large IC engines, which are primarily used in pipeline transmission service at compressor stations. We identified affected units using the same methodology as was used by EPA in the proposed Phase II rule (i.e., a large IC engine is one that emitted, on average, more than 1 ton per day during 2002). The final rule reflects a control level of 82 percent for natural gas-fired IC engines and 90 percent for diesel or dual fuel categories. As shown later in Table 2.1-12, several S/L agencies provided more specific information on the anticipated controls at the compressor stations. This information was used in the Base G inventory instead of the default approach used by EPA in the proposed Phase II rule.

#### **2.1.2.3.7 Clean Air Interstate Rule**

CAIR does not require or assume additional emission reductions from non-EGU boilers and turbines.

#### **2.1.2.4 Quality Assurance steps**

Final QA checks were run on the revised projection inventory data set to ensure that all corrections provided by the S/L agencies and stakeholders were correctly incorporated into the S/L inventories and that there were no remaining QA issues that could be addressed during the duration of the project. After exporting the inventory to ASCII text files in NIF 3.0, the EPA QA program was run on the ASCII files and the QA output was reviewed to verify that all QA issues that could be addressed were resolved

Throughout the inventory development process, quality assurance steps were performed to ensure that no double counting of emissions occurred, and to ensure that a full and complete inventory was developed for VISTAS. Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on the point source component of the VISTAS revised 2002 base year inventory:

1. Facility level emission summaries were prepared and evaluated to ensure that emissions were consistent and reasonable. The summaries included base year 2002 emissions, 2009/2018 projected emissions accounting only for growth, 2009/2018 projected emissions accounting for both growth and emission reductions from OTB and OTW controls.
2. State-level non-EGU comparisons (by pollutant) were developed for the base year 2002 emissions, 2009/2018 projected emissions accounting only for growth, 2009/2018 projected emissions accounting for both growth and emission reductions from OTB and OTW controls.
3. Data product summaries and raw NIF 3.0 data files were provided to the VISTAS Emission Inventory Technical Advisor and to the Point Source, EGU, and non-EGU Special Interest Work Group representatives for review and comment. Changes based on these comments were reviewed and approved by the S/L point source contact prior to implementing the changes in the files.
4. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from Base F1 to Base F2.

#### **2.1.2.5 Additional Base G Updates and Corrections**

Table 2.1-12 summarizes the updates and corrections to the Base F inventory that were requested by S/L agencies and incorporated into the Base G 2009/2018 inventories.

#### **2.1.2.6 Summary of Revised 2009/2018 non-EGU Point Source Inventories**

Tables 2.1-13 through 2.1-19 summarize the revised 2009/2018 non-EGU point source inventories. The “growth only” column does not include the shutdowns (section 2.1.2.2) or control factors (section 2.1.2.3), only the growth factors described in section 2.1.2.1.

**Table 2.1-12. Summary of Updates and Corrections to the Base F 2009/2018 Inventories Incorporated into the Base G 2009/2018 Inventories.**

State	Nature of Update/Correction
AL	Corrected the latitude and longitude for two facilities: Ergon Terminalling (Site ID: 01-073-010730167) and Southern Power Franklin (Site ID: 01-081-0036).
AL	Corrections to stack parameters at 10 facilities for stacks with parameters that do not appear to fall into the ranges typically termed "acceptable" for AQ modeling.
FL	Corrected 2009/2018 emission values for the Miami Dade RRF facility (Site ID: 12-086-0250348) based on revised 2002 emissions and application of growth control factors for 2009/2018.
GA	Hercules Incorporated (12-051-05100005) had an erroneous process id (#3) within emission unit id SB9 and was deleted. This removes about 6,000 tons of SO <sub>2</sub> from the 2009/2018 inventories.
	Provided a revised file of location coordinates at the stack level that was used to replace the location coordinated in the ER file.
	There are several sources that have updated their emissions from their BART eligible units. most of these changes were for fairly small (<50 tpy) sources.
NC	Made several changes to Base F inventory to correct the following errors: 1. Corrected emissions at Hooker Furniture (Site ID: 37-081-3708100910), release point G-29, to use the corrected values in 2002 and carry those same numbers through to 2009 and 2018 since NCDENR assumes zero growth for furniture industry. 2. Identified many stack parameters in the ER file that were unrealistic. Several have zero for height, diameter, gas velocity, and flow rate. NC used the procedures outlined in Section 8 of the document ""National Emission Inventory QA and Augmentation Report" to correct unrealistic stack parameters. 3. Identified truncated latitude and longitude values in Base F inventory. NC updated all Title V facility latitude and longitude that was submitted to EPA for those facilities in 2004. Smaller facilities with only two decimal places were not corrected. 4. Corrected 2018 VOC emissions for International Paper (3709700045) Emission Unit ID, G-12, to reflect changes to the 2002 inventory.
	There are three Transcontinental Natural Gas Pipeline facilities in NC that are subject to the NO <sub>x</sub> SIP call. NCDENR took 2004 emissions and grew them to 2009 & 2018 and capped those units that are subject to the NO <sub>x</sub> SIP Call Rule. These facility IDs are 37-057-3705700300, 37-097-3709700225, and 37-157-3715700131.
	NCDENR applied NO <sub>x</sub> RACT to a two facilities located in the Charlotte nonattainment area. NCDENR provided 2009 & 2018 emissions for Philip Morris USA (37-025-3702500048) and Norandal USA (37-159-3715900057).
SC	Corrected PM species emission values. SC DHEC's initial CERR submittal reported particulate matter emissions using the PM-FIL, PM <sub>10</sub> -FIL, and PM <sub>2.5</sub> -FIL pollutant codes. In August 2005, SC DHEC indicated that data reported using the PM-FIL, PM <sub>10</sub> -FIL, and PM <sub>2.5</sub> -FIL pollutant codes should actually have been reported using the PM-PRI, PM <sub>10</sub> -PRI, and PM <sub>2.5</sub> _PRI codes. MACTEC performed a subsequent PM augmentation in April 2006 using the revised pollutant codes. These changes were reflected in the Base G 2009/2018 emission inventory.
	Specified that the Bowater Inc. facility (45-091-2440-0005) in York County conducted an expansion in 2003/2004 and plans a future expansion. SC provided updated emissions for 2009 and 2018 for this facility.

**Table 2.1-12. Continued.**

State	Nature of Update/Correction
TN	Updated 2009/2018 emissions for Eastman Chemical (47-163-0003) based on final (Feb. 2005) BART rule.
	Updated 2009/2018 emission inventory for the Bowater facility (47-107-0012) based on the facility's updated 2002 emission inventory update.
	Replaced 2009/2018 data from Hamilton County, Tennessee, using data from Hamilton County's CERR submittal as contained in EPA's 2002 NEI (in Base F, the inventory for Hamilton County was based on the draft VISTAS 2002 inventory, which in turn was based on the 1999 NEI); applied growth and control factors to revised 2002 inventory to generate emission projections for 2009/2018.
	Updated 2009/2018 emissions for PCS Nitrogen Fertilizer LP (Site ID: 47-157-00146) based on the facility's updated 2002 emission inventory update.
	The 2002 NEI correctly reports the actual emissions for CEMEX (47-093-0008) after the NO <sub>x</sub> SIP call. There is no reason to suspect that that rate would change in 2008, 2009, or 2018. Emissions for 2009/2018 were set equal to 2002 emissions.
	In the Base F 2009/2018 inventories, NO <sub>x</sub> controls were applied for two units at Columbia Gulf Transmission (47-111-0004). There are no plans for controls at these units, EO3 and EO4. The assumed control efficiency of 82 percent was backed out in the 2009/2018 inventories.
VA	VADEQ provided 2009/2018 NO <sub>x</sub> emission estimates for NO <sub>x</sub> Phase II gas transmission sources at three Transco facilities (51-011-00011, 51-137-00027, 51-143-00120) which were used to replace the default NO <sub>x</sub> Phase II control assumptions for these facilities.
	VADEQ provided updated 2009/2018 NO <sub>x</sub> and SO <sub>2</sub> emissions based on new controls required by a November 2005 permit modification and netting exercise. The entire power plant facility is limited to 213 tons of NO <sub>x</sub> and 107 tons of SO <sub>2</sub> per year. The permit also allowed the installation of 3 new boilers, also under the 213 tons of NO <sub>x</sub> /year cap.
WV	Updated 2009/2018 emissions for Steel of West Virginia (Site ID: 54-011-0009) based on the facility's updated 2002 emission inventory update.
	Made changes to several Site ID names due to changes in ownership
	Base F emissions were much too high for Weirton Steel (54-021-0029). WV believes that the source is very unlikely to emit the NO <sub>x</sub> SIP Call budgeted amounts in 2009 or 2018. WV provided revised emission estimates based on EGAS for 2009/2018.
	Made corrections to latitude/longitude and stack parameters at a few facilities for stacks with parameters that do not appear to fall into the ranges typically termed "acceptable" for AQ modeling.

**Table 2.1-13 Non-EGU Point Source SO<sub>2</sub> Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	Base G	Base F4	Base G	Base F4	Base G
AL	96,481	100,744	101,246	112,703	113,224
FL	65,090	68,549	65,511	79,015	75,047
GA	53,778	61,535	53,987	68,409	59,349
KY	34,029	35,470	36,418	38,806	40,682
MS	35,960	27,488	25,564	40,195	39,221
NC	44,123	48,751	42,536	50,415	46,314
SC	53,518	55,975	48,324	56,968	53,577
TN	79,604	89,149	70,678	96,606	77,247
VA	63,903	63,075	62,560	69,776	68,909
WV	54,070	54,698	55,973	60,137	62,193
<b>Total</b>	<b>580,556</b>	<b>605,434</b>	<b>562,797</b>	<b>673,030</b>	<b>635,763</b>

Note: Emission summaries above include all SCCs except 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-14 Non-EGU Point Source NO<sub>x</sub> Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	BaseG	Base F4	Base G	Base F4	BaseG
AL	83,310	69,676	69,409	79,101	78,318
FL	45,156	44,859	46,020	50,635	51,902
GA	49,251	51,556	50,353	57,323	55,824
KY	38,392	36,526	37,758	40,363	41,034
MS	61,526	55,877	56,397	62,132	61,533
NC	44,928	44,877	34,767	47,200	37,801
SC	42,153	42,501	40,019	44,480	44,021
TN	64,344	63,431	57,883	70,313	63,453
VA	60,415	51,335	51,046	56,876	55,945
WV	46,612	40,433	38,031	44,902	43,359
<b>Total</b>	<b>536,087</b>	<b>501,071</b>	<b>481,683</b>	<b>553,325</b>	<b>533,190</b>

Note: Emission summaries above include all SCCs except 1-01-xxx-xx and 2-01-xxx-xx.



**Table 2.1-15 Non-EGU Point Source VOC Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	Base G	Base F4	Base G	Base F4	Base G
AL	47,037	46,660	46,644	54,268	54,291
FL	38,471	36,675	36,880	42,787	42,811
GA	33,709	34,082	34,116	40,267	40,282
KY	44,834	47,648	47,785	55,564	55,861
MS	43,204	37,921	37,747	45,769	45,338
NC	61,182	70,464	61,925	76,027	70,875
SC	38,458	38,273	35,665	44,545	43,656
TN	84,328	89,380	74,089	111,608	93,266
VA	43,152	43,620	43,726	53,065	53,186
WV	14,595	14,012	13,810	16,632	16,565
<b>Total</b>	<b>448,970</b>	<b>458,735</b>	<b>432,387</b>	<b>540,532</b>	<b>516,131</b>

Note: Emission summaries above include all SCCs except 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-16 Non-EGU Point Source CO Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	Base G	Base F4	Base G	Base F4	Base G
AL	174,271	176,899	180,369	194,280	201,794
FL	81,933	83,937	87,037	96,642	96,819
GA	130,850	147,362	147,427	168,570	167,904
KY	109,936	121,727	122,024	139,121	139,437
MS	54,568	58,023	57,748	67,764	66,858
NC	50,576	53,955	53,744	61,127	62,197
SC	56,315	62,144	60,473	71,318	68,988
TN	115,264	123,844	119,665	146,407	140,942
VA	63,796	67,046	68,346	74,364	76,998
WV	89,879	100,248	100,045	119,318	119,332
<b>Total</b>	<b>927,388</b>	<b>995,185</b>	<b>996,878</b>	<b>1,138,911</b>	<b>1,141,269</b>

Note: Emission summaries above include all SCCs except 1-01-xxx-xx and 2-01-xxx-xx.



**Table 2.1-17 Non-EGU Point Source PM<sub>10</sub>-PRI Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	Base G	Base F4	Base G	Base F4	Base G
AL	25,240	25,450	25,421	29,973	29,924
FL	35,857	39,363	39,872	46,573	46,456
GA	21,610	23,509	23,103	27,781	27,273
KY	16,626	17,164	17,174	20,142	20,153
MS	19,472	19,200	19,245	22,952	22,859
NC	13,838	14,738	13,910	15,816	15,737
SC	14,142	17,631	13,370	20,197	15,139
TN	35,174	37,040	34,833	45,168	42,280
VA	13,252	13,043	13,048	15,150	15,112
WV	17,503	17,723	17,090	21,699	21,735
<b>Total</b>	<b>212,714</b>	<b>224,861</b>	<b>217,066</b>	<b>265,451</b>	<b>256,668</b>

Note: Emission summaries above include all SCCs except 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-18 Non-EGU Point Source PM<sub>25</sub>-PRI Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	Base G	Base F4	Base G	Base F4	Base G
AL	19,178	19,256	19,230	22,628	22,598
FL	30,504	33,387	33,946	39,436	39,430
GA	17,462	19,361	18,982	22,882	22,416
KY	11,372	11,680	11,686	13,734	13,739
MS	9,906	9,144	9,199	10,768	10,739
NC	10,500	11,192	10,458	11,927	11,825
SC	10,245	13,101	9,390	14,947	11,086
TN	27,807	29,302	27,577	35,750	33,532
VA	10,165	9,980	9,988	11,604	11,594
WV	13,313	13,364	12,769	16,474	16,516
<b>Total</b>	<b>160,452</b>	<b>169,767</b>	<b>163,225</b>	<b>200,150</b>	<b>193,475</b>

Note: Emission summaries above include all SCCs except 1-01-xxx-xx and 2-01-xxx-xx.

**Table 2.1-19 Non-EGU Point Source NH<sub>3</sub> Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	Base G	Base F4	Base G	Base F4	Base G
AL	1,883	2,132	2,132	2,464	2,464
FL	1,423	1,544	1,544	1,829	1,829
GA	3,613	3,963	3,963	4,799	4,797
KY	674	733	760	839	901
MS	1,169	667	668	761	764
NC	1,180	1,288	1,285	1,422	1,466
SC	1,411	1,578	1,578	1,779	1,779
TN	1,613	1,861	1,841	2,240	2,214
VA	3,104	3,050	3,049	3,613	3,604
WV	332	341	341	416	413
<b>Total</b>	<b>16,402</b>	<b>17,157</b>	<b>17,161</b>	<b>20,162</b>	<b>20,231</b>

Note: Emission summaries above include all SCCs except 1-01-xxx-xx and 2-01-xxx-xx.

## 2.2 Area Sources

This section describes the methodology used to develop the 2009 and 2018 projection Base F and Base G projection inventories. This section describes two approaches to these projections. Separate methods for projecting emissions were used for non-agricultural (stationary area) and agricultural area sources (predominantly NH<sub>3</sub> emissions). The two methods used for these sectors are described in the sections that follow.

### 2.2.1 Stationary area sources

The general approach used to calculate Base F projected emissions for stationary area sources was as follows:

1. Use the VISTAS Base F 2002 base year inventory as the starting point for projections.
2. MACTEC then worked with the VISTAS States (via the Stationary Area Source SIWG) to obtain any State specific growth factors and/or future controls from the States to use in developing the projections.
3. MACTEC then back calculated uncontrolled emissions from the Base F 2002 base year inventory based on existing controls reported in the 2002 Base F base year inventory.
4. Controls (including control efficiency, rule effectiveness and rule penetration) provided by the States or originally developed for use in estimating projected emissions for U.S. EPA's Heavy Duty Diesel (HDD) rulemaking emission projections and used in the Clean

Air Interstate Rule (CAIR) projections were then used to calculate controlled emissions. State submitted controls had precedence over the U.S. EPA developed controls.

5. Growth factors supplied from the States or the U.S. EPA's CAIR emission projections were then applied to project the controlled emissions to the appropriate year. In some cases EGAS Version 5 growth factors were used if no growth factor was available from either the States or the CAIR growth factor files. The use of EGAS Version 5 growth factors was on a case-by-case basis wherever State-supplied or CAIR factors were not available for SCCs found in the 2002 Base F inventory. Use of the EGAS factors was necessitated due to the CERR submittals used in constructing the Base F 2002 inventory. Use of the CERR data resulted in SCCs that were not found in the CAIR inventory and if no State-supplied growth factor was provided required the use of an EGAS growth factor.
6. MACTEC then provided the final draft Base F projection inventory for review and comment by the VISTAS States.

For Base F stationary area sources, no State-supplied growth or control factors were provided. Thus for all of the sources in this sector of the inventory, growth and controls for Base F were applied based on controls initially identified for the CAIR and growth factors identified for the CAIR projections.

For the Base G projections, the Base G 2002 base year inventory (see section 1.2.3) was used as a starting point. States provided some updated future controls but growth factors used were identical to those used for Base F. The revised controls for Base G were largely for new sources added as part of the 2002 Base F comments. The calculation of Base G projections was identical to the six steps outlined above with the exception of revisions made to prescribed fire for 2009 and 2018 and for the State of North Carolina. North Carolina provided 2009 and 2018 updated emission files used to update the emissions for each year for several source categories. However not all sources in the inventory were included in these NC updates. As a consequence, the final Base G 2009 and 2018 inventory for NC included emissions updated using the NC supplied files and emissions developed using growth and control factors as outlined above.

In a few cases, additional growth factors had to be added for source categories that had not initially been included in the Base F inventory. These growth factors were obtained from EGAS 5.0. Finally updates to growth factors from EGAS 5.0 were made for fuel fired emission sources. The updated growth factors reflected the most recent data from the Department of Energy's Annual Energy Outlook (AEO). These data were used to reflect changes in energy efficiency resulting from new or updated fuel firing technologies.

### 2.2.1.1 Stationary area source controls

The controls obtained by MACTEC for the HDD rulemaking were controls for the years 2007, 2020, and 2030. Since MACTEC was preparing 2009 and 2018 projections, control values for intermediate years were prepared using a straight line interpolation of control level between 2007 and 2020. The equation used to calculate the control level was as follows:

$$CE = (((2020\ CE - 2007\ CE)/13)*YRS) + 2007\ CE$$

*Where:*

CE = Control Efficiency for either 2009 or 2018

2020 CE = HDD Control Efficiency value for 2020

2007 CE = HDD Control Efficiency value for 2007

13 = Number of years between 2020 and 2007

YRS = Number of years beyond 2007 to VISTAS Projection year

For 2009 the value of YRS would be two (2) and for 2018 the value would be eleven (11). Control efficiency values were determined for VOC, CO and PM. Rule penetration values for each year in the HDD controls tables obtained by MACTEC were always 100 percent so those values were maintained for the VISTAS projections.

Prior to performing the linear interpolation of the controls, MACTEC evaluated controls from the CAIR projections (NOTE: Initially the controls came from the IAQTR projections, however the controls used in CAIR were virtually identical to those in IAQTR). Those controls appeared to be identical to those used for the HDD rulemaking. In addition, MACTEC received some additional information on some controls for area source solvents (email from Jim Wilson, E.H. Pechan and Associates, Inc. to Gregory Stella, VISTAS Emission Inventory Technical Advisor, 3/5/04) that were used to check against the controls in the HDD rulemaking files. Where those controls proved to be more stringent than the HDD values, MACTEC updated the control file with those values (which were then used in the interpolation to develop 2009 and 2018 values). Finally, for VOC the HDD controls were initially provided at the State-county-SCC level. However, upon direction from the VISTAS Emission Inventory Technical advisor, the VOC controls were consolidated at the SCC level and applied across all counties within the VISTAS region (email from Gregory Stella, Alpine Geophysics, 3/3/2004) to ensure that no controls were missed due to changes in county FIPS codes and/or SCC designations between the time the HDD controls were developed and 2002.

The equation below indicates how VOC emissions were projected for stationary area sources.

$$VOC_{2018} = VOC_{2002} \times \left( 1 - \left( \frac{VOC\_CE_{2018}}{100} \right) \left( \frac{VOC\_RE_{2018}}{100} \right) \left( \frac{VOC\_RP_{2018}}{100} \right) \right)$$

Where:

$VOC_{2018}$  = VOC emissions for 2018

$VOC_{2002}$  = Uncontrolled VOC emissions for 2002

$VOC\_CE_{2018}$  = Control Efficiency for VOC (in this example for 2018)

$VOC\_RE_{2018}$  = Rule Effectiveness for VOC (in this example for 2018)

$VOC\_RP_{2018}$  = Rule Penetration for VOC (in this example for 2018)

A similar equation could be constructed for either PM or CO. It should be noted that the control efficiencies calculated based on the HDD rulemaking were only applied if they were greater than any existing 2002 base year controls. No controls were found for SO<sub>2</sub> or NO<sub>x</sub> area sources.

In the pre-Base F 2018 emission estimates, an energy efficiency factor was applied to energy related stationary area sources. The energy efficiency factor was applied along with the growth factor to account for both growth and changes in energy efficiency. That factor was not applied to the Base F projections since information supplied by U.S. EPA related to the CAIR growth factors indicated that growth values for those categories were derived from U.S. Department of Energy (DOE) and were felt to account for changes in growth and projected energy efficiency. For the Base G inventory, these energy efficiency factors were re-instituted and used in conjunction with EGAS 5.0 growth factors in a manner identical to that used for the pre-Base F inventories. The energy efficiency factors were derived from U.S. DOE's Annual Energy Outlook report.

One significant difference between the Base F and Base G control factors was for counties and independent cities in northern Virginia. Several counties and independent cities in northern Virginia are subject to Ozone Transport Commission rules. For these counties and independent cities, controls for portable fuel containers, mobile equipment repair/refinishing, consumer products, solvent metal cleaning, and the architectural and industrial maintenance rules were added. The counties/independent cities (FIPS code) included in the changes for Base G were: Alexandria City (51510), Arlington (51013), Fairfax City (51600), Fairfax (51059), Falls Church City (51610), Fredericksburg City (51630), Loudoun (51107), Manassas City (51683), Manassas Park City (51685), Prince William County (51153), Spotsylvania (51177), and Stafford (51179). Not all OTC rules applied to all counties/cities.

### **2.2.1.2 Stationary area source growth**

As indicated above, growth factors for the Base F and Base G 2009 and 2018 inventories were obtained from the U.S. EPA and are linear interpolations of the growth factors used for the Clean Air Interstate Rule (CAIR) projections. The growth factors for the CAIR obtained by MACTEC were developed using a base year of 2001 and provided growth factors for 2010 and 2015. MACTEC used the TREND function in Microsoft Excel™ to calculate 2002, 2009 and 2018 values from the 2001, 2010 and 2015 values. The TREND function provides a linear interpolation of intermediate values from a known series of data points (in this case the 2001, 2010 and 2015 values) based on the equation for a straight line. These values were calculated at the State and SCC level with the exception of paved road emissions (SCC = 2294000000). The growth factors for paved roads were available in the CAIR data set at the State, county and SCC level so they were applied at that level.

Prior to utilizing the growth factors from the CAIR projections, MACTEC confirmed that all SCCs found in the VISTAS 2002 base year inventory were in the CAIR file (for Base F the starting point was the version 3.1 2002 base year inventory, for Base G the starting point was the Base F 2002 base year inventory). Some SCCs were not found in the CAIR file. For those SCCs, the growth factors used were derived in one of five ways. First where possible, they were taken from a beta version of EGAS 5.0. In other cases, the growth factor was set to one (i.e., no growth). In other cases, a similar SCC that had a CAIR growth factor was used. In a few cases a growth factor based on an average CAIR growth at the 6 digit SCC level was calculated. Finally a number of records used population as the growth surrogate. For the Base G inventory, CAIR growth factors for fuel fired area sources were replaced with EGAS 5.0 growth factors (used in conjunction with AEO fuel efficiency factors). A comment field in the growth factor file was used to mark those records that were not taken directly from the CAIR projection growth factors.

### **2.2.1.3 Differences between 2009/2018**

Methodologically, there was no difference in the way that 2009 and 2018 emissions were calculated for stationary area sources. The individual control and growth factors were different (due to the linear interpolation used to calculate the values) but the calculation methods were identical. This applies to both Base F and Base G.

The only exception to this is for the State of North Carolina for Base G. North Carolina provided an emissions update file used to override calculated projections for a number of area source categories. The values in these files (provided for both 2009 and 2018) were used to overwrite the calculated projected emissions in the final NIF file.

## **2.2.2 Agricultural area sources**

The general approach used to calculate projected emissions for agricultural area sources (predominantly NH<sub>3</sub> emission sources) was as follows:

1. MACTEC used the version 3.1 2002 base year inventory data (which was based on the CMU ammonia model version 3.6).
2. MACTEC worked with the VISTAS States (via the Agricultural Sources SIWG) to obtain any State specific growth and/or future controls from the States for agricultural sources.
3. Since the base year emissions were uncontrolled, and no future controls for these sources were identified, MACTEC projected the agricultural emissions using State-specific growth if available, otherwise the U.S. EPA's Interstate Air Quality Transport Rule (IAQTR)/Ammonia inventory was used to develop the growth factors used to project the revised 2002 base year inventory to 2009 or 2018. Since the IAQTR inventory was only used to construct growth factors rather than using the emissions directly, no updated growth factors were prepared from the CAIR inventory values.
4. MACTEC then provided the final draft inventory for review and comment by the VISTAS States.

No change in the agricultural area source emission projections were made between Base F and Base G other than the removal of wild animal and human perspiration as a result of their removal from the 2002 base year file for Base G.

### **2.2.2.1 Control assumptions for agricultural area sources**

No controls were identified either by the individual VISTAS States or in the information provided in the EPA's IAQTR or CAIR Ammonia inventory documents. Thus all projected emissions for agricultural area sources represent simple growth with no controls.

### **2.2.2.2 Growth assumptions for agricultural area sources**

Growth for several agricultural area source livestock categories was developed using the actual emission estimates developed by the EPA as part of the NEI. That work included projections for the years 2002, 2010, 2015, 2020, and 2030. The actual emissions themselves were not used other than to develop growth factors since the 2002 NEI upon which the growth projections were based was prepared prior to the release of the 2002 Census of Agriculture data which was included in the CMU model (version 3.6) used to develop the Base F 2002 VISTAS base year inventory. Thus VISTAS Agricultural Sources SIWG decided to use the NEI ammonia inventory



projected emissions to develop the 2009 and revised 2018 growth factors used to project emission for VISTAS. Details on the NEI inventory and projections can be found at:

[http://www.epa.gov/ttn/chief/ap42/ch09/related/nh3inventorydraft\\_jan2004.pdf](http://www.epa.gov/ttn/chief/ap42/ch09/related/nh3inventorydraft_jan2004.pdf). The actual data files for the projected emissions can be found at:

[http://www.epa.gov/ttn/chief/ap42/ch09/related/nh3output01\\_23\\_04.zip](http://www.epa.gov/ttn/chief/ap42/ch09/related/nh3output01_23_04.zip).

In order to use the NEI projected emissions as growth factors, several steps were required. These steps were as follows:

1. NEI projected emissions were only available for the years 2002, 2010, 2015, 2020, and 2030, thus the first task was to calculate intermediate year emissions for 2009 and 2018. These values were calculated based on linear interpolation of the existing data.
2. Once the intermediate emissions were calculated, MACTEC developed emission ratios to provide growth factors for 2009 and 2018. Ratios of emissions were established relative to the 2002 NEI emissions.
3. Once the growth factors were established, MACTEC then evaluated whether or not all agricultural SCCs within the revised 2002 base year inventory had corresponding growth factors. MACTEC established that not all SCCs within the base year inventory had growth factors. These SCCs fell into one of two categories:
  - a. SCCs that had multiple entries in the NEI but only a single SCC in the 2002 VISTAS base year inventory. The NEI was established using a process model and for some categories of animals, emissions were calculated for several aspects of the process. The CMU model version 3.6 which was the basis for the VISTAS 2002 Base F inventory did not use a process model. As a consequence a mapping of SCCs in the NEI projections and corresponding SCCs in the CMU inventory was made and for those SCCs an average growth factor was calculated from the NEI projections for use with the corresponding SCC in the CMU based 2002 Base F inventory.
  - b. There were also State, county, SCC trios in the 2002 VISTAS Base F inventory which had no corresponding emissions in the NEI files. For these instances, MACTEC first developed State level average growth factors from the NEI projections for use in growing these records. Even after developing State level average growth factors there were still some State/SCC pairs that did not have matching growth. For these records, MACTEC developed VISTAS regional average growth factors at the SCC level from the NEI data.



4. Once all of the growth factors were developed, they were used to project the emissions to 2009 and 2018. Growth factors were first applied at the State, county and SCC level. Then remaining records were grown with the State/SCC specific growth factors. Finally, any remaining ungrown records were projected at the SCC level using the VISTAS regional growth factor.

For the livestock categories, the NEI emission projections only had data for beef and dairy cattle, poultry and swine. Thus for other livestock categories and for fertilizers alternative growth factors were required.

The growth factors for other livestock categories and fertilizers were obtained from growth factors used for the IAQTR projections made by the U.S. EPA. The methodology for these categories was identical to that used for dairy, beef, poultry and swine with the exception that State/SCC and VISTAS/SCC growth factors were not required for these categories since the IAQTR data contained State, county and SCC level growth factors. The IAQTR data provided growth factors for 1996, 2007, 2010, 2015 and 2020. Linear interpolation was used to develop the growth factors for the intermediate years 2009 and 2018 required for the VISTAS projections.

There were a few exceptions to the methods used for projecting agricultural sources for the VISTAS projections. These exceptions were:

1. All swine emissions for North Carolina were maintained at 2002 levels for each projection year to capture a moratorium on swine production in that State.
2. Ammonia growth factors for a few categories (mainly feedlots) were assigned to be the same as growth factors for PM emissions from the NEI projections. This assignment was made because the CMU model showed emissions from these categories but the NEI projections did not show ammonia emissions but did show PM emissions.
3. No growth factors were found for horse and pony emissions. These emissions were held constant at 2002 levels.

There was no change in this method between Base F and Base G. Thus Base F and Base G agricultural emissions are the same in each inventory. Future efforts on the agricultural emissions category should look at any changes made to the CMU model to reflect the model farm approach used by EPA in their inventory plus any updated growth factors that may be more recent than the EPA inventory used to develop growth estimates for Base F/G.

### 2.2.2.2.1 Differences between 2009/2018

Methodologically, there was no difference in the way that 2009 and 2018 emissions were calculated for agricultural area sources. The growth factors were different (due to the linear interpolation used to calculate the values) but the calculation methods were identical. In addition there was no difference between Base F and Base G for this category. Thus Base F and Base G agricultural emissions are the same in each inventory.

Tables 2.2-1 show the differences between Base F and Base G emissions for all area sources (including agricultural sources but excluding fires) for the 2002 base year and 2009 and 2018 by State and pollutant.

**Table 2.2-1 2002 Base Year Emissions and Percentage Difference for Base F and Base G (based on actual emissions).**

Actual Area 2002 - Base G							
State	CO	NH3	NOX	PM10-PRI	PM25-PRI	SO2	VOC
AL	83,958	58,318	23,444	393,588	56,654	52,253	182,674
FL	71,079	37,446	28,872	443,346	58,878	40,491	404,302
GA	108,083	80,913	36,142	695,414	103,794	57,559	299,679
KY	66,752	51,135	39,507	233,559	45,453	41,805	95,375
MS	37,905	58,721	4,200	343,377	50,401	771	131,808
NC	345,315	161,860	36,550	280,379	64,052	5,412	237,926
SC	113,714	28,166	19,332	260,858	40,291	12,900	161,000
TN	89,828	34,393	17,844	212,554	42,566	29,917	153,307
VA	155,873	43,905	51,418	237,577	43,989	105,890	174,116
WV	39,546	9,963	12,687	115,346	21,049	11,667	60,443
Base F							
AL	83,958	59,486	23,444	393,093	73,352	47,074	196,538
FL	105,849	44,902	29,477	446,821	81,341	40,537	439,019
GA	107,889	84,230	36,105	695,320	133,542	57,555	309,411
KY	66,752	51,097	39,507	233,559	52,765	41,805	100,174
MS	37,905	59,262	4,200	343,377	63,135	771	135,106
NC	373,585	164,467	48,730	303,492	69,663	7,096	346,060
SC	113,714	29,447	19,332	260,858	51,413	12,900	187,466
TN	89,235	35,571	17,829	211,903	49,131	29,897	161,069
VA	155,873	46,221	51,418	237,577	52,271	9,510	129,792
WV	39,546	10,779	12,687	115,346	25,850	11,667	61,490
Percentage Difference (negative values means Base G increased from Base F)							
AL	0.00%	1.96%	0.00%	-0.13%	22.76%	-11.00%	7.05%
FL	32.85%	16.61%	2.05%	0.78%	27.62%	0.12%	7.91%
GA	-0.18%	3.94%	-0.10%	-0.01%	22.28%	-0.01%	3.15%
KY	0.00%	-0.07%	0.00%	0.00%	13.86%	0.00%	4.79%
MS	0.00%	0.91%	0.00%	0.00%	20.17%	0.00%	2.44%
NC	7.57%	1.59%	24.99%	7.62%	8.05%	23.74%	31.25%
SC	0.00%	4.35%	0.00%	0.00%	21.63%	0.00%	14.12%
TN	-0.67%	3.31%	-0.09%	-0.31%	13.36%	-0.07%	4.82%
VA	0.00%	5.01%	0.00%	0.00%	15.84%	-1013.45%	-34.15%
WV	0.00%	7.57%	0.00%	0.00%	18.57%	0.00%	1.70%

**Table 2.2-2 2009 Projection Year Emissions and Percentage Difference for Base F and Base G (based on actual emissions).**

Actual Area 2009 - Base G							
State	CO	NH3	NOX	PM10-PRI	PM25-PRI	SO2	VOC
AL	66,654	64,268	23,930	413,020	58,699	48,228	143,454
FL	57,011	38,616	28,187	503,230	64,589	36,699	420,172
GA	94,130	89,212	37,729	776,411	112,001	57,696	272,315
KY	57,887	53,005	42,088	242,177	46,243	43,087	94,042
MS	27,184	63,708	4,249	356,324	51,661	753	124,977
NC	301,163	170,314	39,954	292,443	69,457	5,751	187,769
SC	90,390	30,555	19,360	278,299	41,613	13,051	146,107
TN	74,189	35,253	18,499	226,098	44,124	30,577	154,377
VA	128,132	46,639	52,618	252,488	44,514	105,984	147,034
WV	31,640	10,625	13,439	115,089	20,664	12,284	55,288
Base F							
AL	68,882	65,441	26,482	411,614	76,248	17,818	157,405
FL	101,356	46,950	31,821	507,515	90,487	52,390	462,198
GA	103,579	92,838	38,876	776,935	146,691	57,377	294,204
KY	64,806	53,023	42,122	242,345	54,397	40,779	94,253
MS	37,161	64,289	4,789	356,516	65,321	637	125,382
NC	332,443	173,187	53,550	317,847	75,570	7,607	252,553
SC	95,826	31,966	20,852	278,852	54,230	12,945	176,104
TN	82,196	36,578	19,148	225,650	51,753	29,787	160,265
VA	133,738	49,173	53,344	252,924	54,587	10,619	120,022
WV	37,704	11,461	13,816	115,410	25,835	12,156	57,082
Percentage Difference (negative values means Base G increased from Base F)							
AL	3.24%	1.79%	9.64%	-0.34%	23.02%	-170.67%	8.86%
FL	43.75%	17.75%	11.42%	0.84%	28.62%	29.95%	9.09%
GA	9.12%	3.91%	2.95%	0.07%	23.65%	-0.56%	7.44%
KY	10.68%	0.03%	0.08%	0.07%	14.99%	-5.66%	0.22%
MS	26.85%	0.90%	11.27%	0.05%	20.91%	-18.10%	0.32%
NC	9.41%	1.66%	25.39%	7.99%	8.09%	24.41%	25.65%
SC	5.67%	4.41%	7.16%	0.20%	23.27%	-0.82%	17.03%
TN	9.74%	3.62%	3.39%	-0.20%	14.74%	-2.65%	3.67%
VA	4.19%	5.15%	1.36%	0.17%	18.45%	-898.09%	-22.51%
WV	16.08%	7.29%	2.73%	0.28%	20.02%	-1.06%	3.14%

**Table 2.2-3 2018 Projection Year Emissions and Percentage Difference for Base F and Base G (based on actual emissions).**

Actual Area 2018 - Base G							
State	CO	NH3	NOX	PM10-PRI	PM25-PRI	SO2	VOC
AL	59,626	71,915	25,028	445,256	62,323	50,264	153,577
FL	53,903	40,432	30,708	578,516	72,454	38,317	489,975
GA	93,827	99,885	41,332	880,199	123,704	59,729	319,328
KY	54,865	55,211	44,346	256,052	47,645	44,186	103,490
MS	22,099	69,910	4,483	375,495	53,222	746	140,134
NC	290,809	180,866	43,865	315,294	71,262	6,085	189,591
SC	83,167	33,496	20,592	304,251	44,319	13,457	161,228
TN	68,809	36,291	19,597	246,252	46,692	31,962	182,222
VA	121,690	50,175	56,158	275,351	46,697	109,380	150,919
WV	28,773	11,504	14,828	121,549	21,490	12,849	60,747
Base F							
AL	63,773	73,346	28,754	445,168	82,449	49,975	168,507
FL	100,952	49,889	35,047	582,832	101,872	59,413	533,141
GA	105,059	103,911	42,260	880,800	163,925	61,155	342,661
KY	65,297	55,356	45,597	256,544	57,110	42,326	102,117
MS	36,425	70,565	5,230	375,931	68,338	831	139,419
NC	327,871	184,167	60,073	345,275	85,018	8,273	234,207
SC	89,343	35,082	22,467	304,940	58,441	13,517	196,946
TN	81,242	37,812	20,928	245,893	55,712	31,047	188,977
VA	129,037	53,023	56,668	275,790	58,141	11,479	128,160
WV	36,809	12,390	15,079	121,964	27,088	13,450	62,164
Percentage Difference (negative values means Base G increased from Base F)							
AL	6.50%	1.95%	12.96%	-0.02%	24.41%	-0.58%	8.86%
FL	46.61%	18.96%	12.38%	0.74%	28.88%	35.51%	8.10%
GA	10.69%	3.87%	2.20%	0.07%	24.54%	2.33%	6.81%
KY	15.98%	0.26%	2.74%	0.19%	16.57%	-4.40%	-1.34%
MS	39.33%	0.93%	14.28%	0.12%	22.12%	10.19%	-0.51%
NC	11.30%	1.79%	26.98%	8.68%	16.18%	26.45%	19.05%
SC	6.91%	4.52%	8.34%	0.23%	24.16%	0.44%	18.14%
TN	15.30%	4.02%	6.36%	-0.15%	16.19%	-2.95%	3.57%
VA	5.69%	5.37%	0.90%	0.16%	19.68%	-852.83%	-17.76%
WV	21.83%	7.15%	1.66%	0.34%	20.66%	4.46%	2.28%

### 2.2.3 Changes to Prescribed Fire for 2009/2018 Base G

Just prior to release of version 3.1 of the VISTAS inventory, several Federal agencies indicated that they had plans for increased prescribed fire burning in future years and that the “typical” fire inventory would likely not adequately capture those increases (memo from Bill Jackson and Cindy Huber, August 13, 2004). However data were not readily available to incorporate those changes up through the Base F inventory. As a consequence MACTEC worked with Federal Land Managers to acquire the data necessary to provide 2009 and 2018 specific projections for the prescribed fire component of the Base G fire inventory. The 2009 and 2018 projections developed using the method described below are being used by VISTAS as the 2009 and 2018

base case inventories for all States except FL. For FL the supplied data from the FLMs is not being used as FL felt that their data adequately reflected current and future prescribed burning practices. The “typical” fire projection is the 2002 base prescribed fire projection.

One of the biggest issues in preparing the projection was how best to incorporate the data. Two agencies submitted data: Fish and Wildlife Service (FWS) and Forest Service (FS). FWS submitted annual acreage data by National Wildlife Refuge (NWR) and county with estimates of acres burned per day for each NWR. FS provided fire-by-fire acreage estimates based on mapping projected burning acreage to current 2002 modeling days. However, FWS did not submit data for VISTAS original base year preparation process, thus there was no known FWS data in the 2002 actual or typical inventories. Thus MACTEC had to develop a method that could use the county level data submitted by FWS.

In addition, despite the fact that the FS submitted fire-by-fire data for the 2002 actual inventory and had mapped the projections to current burn days in the 2002 actual inventory, MACTEC could not do a simple replacement of those records with the 2009/2018 projections. This situation was created because several VISTAS States run a prescribed fire permitting program. To avoid double counting, only State data was used in those States for the 2002 actual inventory. Thus there were no Federal data in those States since the Federal data could have potentially duplicated State-supplied prescribed fire data. In VISTAS States without permit programs, the FS supplied data for 2002 was used and those records were marked in database. Thus for those States, the FS supplied 2009/2018 data could be directly substituted for the 2002 data.

The method used by MACTEC to include the FS data applied a county level data approach for FS data where a State had a prescribed fire permitting program and a fire-by-fire replacement for FS data in States without permit programs. MACTEC used a county level approach for all of the FWS data. The approach used for each data set is discussed below.

For the FWS data MACTEC summed the annual acres burned supplied by the FWS across all NWRs in a county. We then subtracted out 2002 acreage for that county from the FWS projected acreage annual total to avoid double counting. The remaining acreage was then multiplied by 0.8 to account for blackened acres instead of the total perimeter acres that were reported. The revised total additional FWS acreage was then added to the total county “typical” acreage to determine future acreage burned for either 2009 or 2018. MACTEC then allocated the increased acreage to current modeling days. The average daily acres burned data provided by FWS per NWR/county was used to allocate the acreage to the correct number of days required to burn all of the acres. Guidance supplied by FWS indicated that up to three times the average daily acres burned could potentially be allocated to any one day. Thus if the estimated acreage per day were 100 acres then up to 300 acres could actually be allocated to a particular day. This approach (use of up to three times the average daily acres burned) was used if there were an insufficient number of 2002

modeling days available to account for all of the acreage increase. MACTEC used an incremental approach to using the increase above the base average daily acres. First we used twice the average daily acreage if that was sufficient to completely allocate the increased acreage over the total number of days available. If that wasn't sufficient then we used three times the average daily acres burned to allocate the acreage. We applied the highest increases to days in the database that already had the highest acreage burned since we felt those days were most likely to represent days with representative conditions for conducting prescribed burns.

The approach used by MACTEC for the FS was slightly different. For States that had permit programs, we used similar approach to the FWS county level approach. First we summed the FS data at county level, we then added that value to the typical acreage and then we allocated the acres to current modeling days. The mapping to current modeling days was performed by Bill Jackson of the USFS and provided to MACTEC. For States that do not have a prescribed fire permit program, MACTEC simply replaced the current fire-by-fire records in the database with fire-by-fire records from the FS and recalculated emissions based on fuel model and fuel loading. We also applied the same 0.8 correction for blackened acres applied to all FS supplied acreage as the supplied values represented perimeter acres.

An additional problem with developing year-specific prescribed fire projections was how to adequately capture the temporal profile for those fires. In the 2002 actual fire inventory, fires occur on same days as state/FLM records. In the 2002 "typical" year inventory, fire acreage increased or decreased from acreage on the same fire days as were in the 2002 actual inventory, since the acres were simply increased for each day based on a multiplier used to convert from actual to typical.

When prescribed fires acreage was added to a future year, MACTEC added acreage to individual fire days proportional to the annual increase (if acreage on a day is 10 percent of annual, add 10 percent of projected increase to that same day).

The table below shows how the FWS data for Okefenokee NWR were allocated for 2009 for Clinch County (Okefenokee NWR is located in four different counties). You can see that the total additional acres for the Clinch County portion of Okefenokee NWR was 1,956 acres. Two hundred eighty (280) acres were the estimated average daily acres burned for that NWR/county combination. Thus to allocate the entire 1,956 acres would require almost 7 burn days (1,956 divided by 280). However only 5 burn days were found for Clinch County in the 2002 actual fire database. Thus we allocated twice the average acreage to the burn day with the most acres burned in the 2002 actual fire database (since our method allowed us to increase the average daily acres burned up to three times the recommended level). Thus the first burn day received 560 acres and all others received 280 except the final day which received 276 to make the total equal to the required 1,956 acres. The table also indicates that the increased acres burned

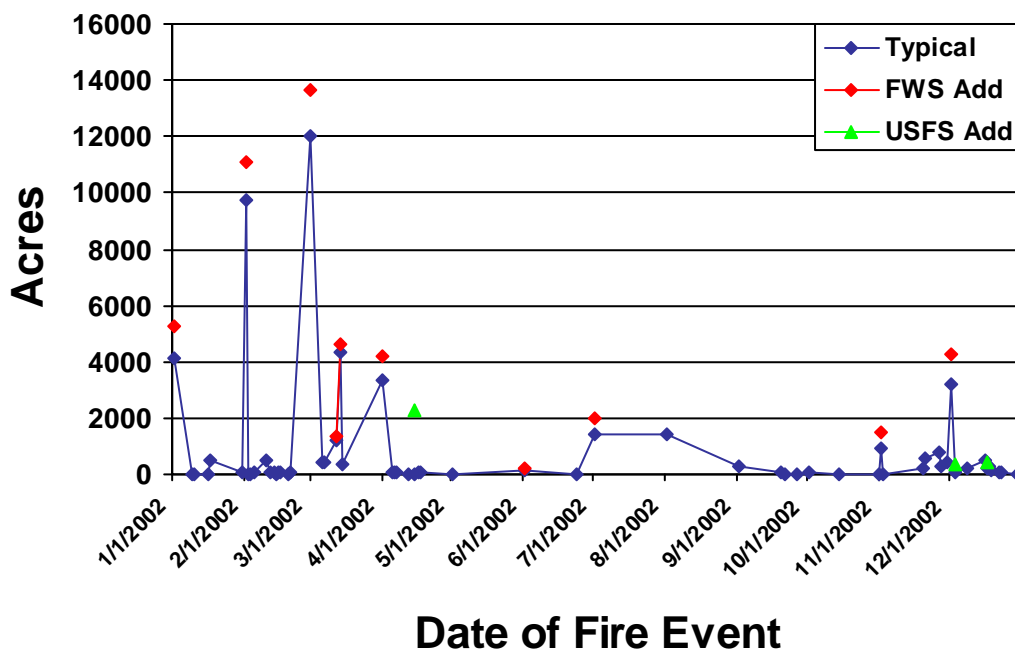
provided increases of from 10-48 percent in the acres burned on the individual burn days and an average of approximately 14 percent for the year as a whole.

CLINCH COUNTY	3/1/2002	4/1/2002	2/1/2002	1/1/2002	11/1/2002	12/1/2002	Total Annual
Acres (typical)	3,757	2,612	1,996	1,801	616	472	11,764
Add on FWS Projection	560	280	280	280	280	276	1,956
Total	4,316	2,891	2,276	2,080	895	747	13,720
Percent Increase	14.9%	10.7%	14.0%	15.6%	45.5%	58.5%	14.3%

The figure below shows the increases for prescribed burning in the four counties that comprise the Okefenokee NWR area (which also includes FS land). In this figure you can see the additional acreage added for the burn days from FWS and the individual day increases caused by projected increases in prescribed burning based on FS data. It should be noted that while the emissions represent 2009, all fire event dates listed are for 2002 to match up with the base year meteorology used in modeling exercises.

Table 2.2-4 shows the percentage difference between the 2009 and 2018 projections developed for Base F and Base G. Base G includes the revised prescribed burning estimates described above. Values are calculated using Base F as the basis for change, thus negative values imply an increase in emissions for Base G.

Figure 2.2-1 Prescribed Fire Projection for Okeefenokee NWR for 2009





**Table 2.2-4 Percentage Difference Between Base F and Base G Fire Emissions by State**

State	CO	NH3	NOX	PM10-PRI	PM25-PRI	SO2	VOC	CO	NH3	NOX	PM10-PRI	PM25-PRI	SO2	VOC	
<b>2009 Fires Base G</b>								<b>2018 Fires Base G</b>							
AL	534,873	2,050	11,901	52,851	46,543	2,681	27,502	535,658	2,054	11,918	52,927	46,608	2,686	27,539	
FL	923,310	3,157	19,791	98,470	88,756	4,129	51,527	923,310	3,157	19,791	98,470	88,756	4,129	51,527	
GA	637,177	2,229	14,243	63,973	57,116	2,914	34,710	637,177	2,229	14,243	63,973	57,116	2,914	34,710	
KY	31,810	143	682	3,093	2,653	187	1,497	33,296	150	714	3,237	2,777	196	1,567	
MS	48,160	217	1,033	4,683	4,016	283	2,266	50,037	225	1,073	4,865	4,173	294	2,355	
NC	96,258	433	2,065	9,359	8,027	566	4,530	111,266	501	2,387	10,819	9,279	655	5,236	
SC	282,307	1,039	5,899	29,153	25,955	1,359	16,045	282,307	1,039	5,899	29,153	25,955	1,359	16,045	
TN	17,372	78	373	1,689	1,449	102	817	18,860	85	405	1,834	1,573	111	888	
VA	21,130	95	453	2,054	1,762	124	994	26,923	121	578	2,618	2,245	158	1,267	
WV	3,949	18	85	384	329	23	186	5,013	23	108	487	418	29	236	
<b>2009 Fires Base F</b>								<b>2018 Fires Base F</b>							
AL	514,120	1,957	11,456	50,833	44,812	2,559	26,526	514,120	1,957	11,456	50,833	44,812	2,559	26,526	
FL	923,310	3,157	19,791	98,470	88,756	4,129	51,527	923,310	3,157	19,791	98,470	88,756	4,129	51,527	
GA	620,342	2,153	13,882	62,336	55,712	2,815	33,918	620,342	2,153	13,882	62,336	55,712	2,815	33,918	
KY	56,686	110	1,460	6,667	6,310	136	3,338	56,686	110	1,460	6,667	6,310	136	3,338	
MS	128,471	177	3,328	14,693	13,680	100	13,625	128,471	177	3,328	14,693	13,680	100	13,625	
NC	200,564	324	5,005	20,488	19,491	423	12,499	200,564	324	5,005	20,488	19,491	423	12,499	
SC	253,005	908	5,270	26,304	23,511	1,187	14,666	253,005	908	5,270	26,304	23,511	1,187	14,666	
TN	78,370	46	2,232	8,875	8,730	59	5,153	78,370	46	2,232	8,875	8,730	59	5,153	
VA	19,159	159	978	18,160	17,361	99	912	19,159	159	978	18,160	17,361	99	912	
WV	32,656	12	944	3,276	3,239	16	2,184	32,656	12	944	3,276	3,239	16	2,184	
<b>Percentage Difference (negative number means an increase in Base G emissions)</b>															
AL	-4.04%	-4.77%	-3.89%	-3.97%	-3.86%	-4.77%	-3.68%	-4.19%	-4.95%	-4.03%	-4.12%	-4.01%	-4.95%	-3.82%	
FL	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
GA	-2.71%	-3.52%	-2.60%	-2.63%	-2.52%	-3.52%	-2.34%	-2.71%	-3.52%	-2.60%	-2.63%	-2.52%	-3.52%	-2.34%	
KY	43.88%	-29.52%	53.25%	53.61%	57.96%	-37.90%	55.15%	41.26%	-35.57%	51.07%	51.44%	56.00%	-44.34%	53.06%	
MS	62.51%	-22.07%	68.95%	68.13%	70.64%	-183.85%	83.37%	61.05%	-26.83%	67.74%	66.89%	69.50%	-194.91%	82.72%	
NC	52.01%	-33.75%	58.74%	54.32%	58.82%	-33.75%	63.76%	44.52%	-54.60%	52.31%	47.19%	52.40%	-54.60%	58.11%	
SC	-11.58%	-14.52%	-11.93%	-10.83%	-10.39%	-14.52%	-9.40%	-11.58%	-14.52%	-11.93%	-10.83%	-10.39%	-14.52%	-9.40%	
TN	77.83%	-69.40%	83.30%	80.97%	83.41%	-74.42%	84.14%	75.93%	-83.92%	81.87%	79.34%	81.98%	-89.36%	82.78%	
VA	-10.29%	40.36%	53.67%	88.69%	89.85%	-25.40%	-9.03%	-40.53%	24.00%	40.97%	85.59%	87.07%	-59.79%	-38.93%	
WV	87.91%	-48.65%	91.03%	88.28%	89.83%	-49.46%	91.49%	84.65%	-88.70%	88.61%	85.12%	87.09%	-89.73%	89.20%	



#### **2.2.4**      *Quality Assurance steps*

Throughout the inventory development process, quality assurance steps were performed to ensure that no double counting of emissions occurred, to ensure that a full and complete inventory was developed for VISTAS, and to make sure that projection calculations were working correctly. Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on the stationary and agricultural area source components of the 2009 and revised 2018 projection inventories:

1. All final files were run through EPA's Format and Content checking software.
2. SCC level emission summaries were prepared and evaluated to ensure that emissions were consistent and that there were no missing sources.
3. Tier comparisons (by pollutant) were developed between the 2002 base year inventory and the 2009 and 2018 projection inventories. In addition, total VISTAS pollutant summaries were prepared to compare total emissions by pollutant between versions of the inventory (e.g., between Base F and Base G).
4. Data product summaries were provided to both the VISTAS Emission Inventory Technical Advisor and to the SIWG representatives for review and comment. Changes based on these comments were implemented in the files.
5. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from 1.0 to 2.0. A minor change would cause a version number to go from 1.0 to 1.1. Minor changes resulting from largely editorial changes would result in a change from 1.00 to 1.01.

### **2.3**      **Mobile Sources**

Our general approach for assembling data was to use as much existing data from the pre-Base F preliminary projections as possible for these inventories, supplement these data with easily available stakeholder input, and provide the results for stakeholder review to ensure credibility. To develop the "base case" projections, MACTEC originally assembled data to develop two 2009 and 2018 base case inventories: 1) an inventory that included all "on-the-books" control programs and 2) an "on-the-way" inventory that included controls that were likely to be "on-the-way". For the Base F and Base G emission forecasts to the mobile source sector, "on-the-books" and "on-the-way" are defined with the same strategies and therefore only a single projection scenario was developed for each forecast year.

To ensure consistency across evaluation years, the 2009 and 2018 base case inventories were developed, to the maximum extent practical, using methodologies identical to those employed in

developing the 2002 on-road portion of the revised 2002 VISTAS base year inventory. All modifications to the 2002 inventory methods were developed in consultation with the Mobile Source Special Interest Workgroup (MSSIWG). Generally, modifications were only made to properly account for actual changes expected in the intervening period (i.e., between 2002 and 2009 and between 2002 and 2018), but the underlying inventory development methodology was identical, except to the extent requested by VISTAS or the MSSIWG.

MACTEC developed a preliminary 2018 inventory in early 2004. That inventory was designed to 1) be used for modeling sensitivity evaluations and 2) help establish the methods that would be used for the final 2018 inventory and the initial 2009 inventory. Since that work took place prior to the revision of the 2002 base year inventory data files, MACTEC provided a review of the data and methods used to develop on-road mobile source input files for the initial 2002 base year inventory prior to developing the preliminary 2018 inventory. Through this review, MACTEC determined the following:

- On-road VMT. Most States provided local data for 2002 (or a neighboring year that was converted to 2002 using appropriate VMT growth surrogates such as population). Since these data were not applicable to 2018 due to intervening growth, input for 2018 was solicited from the MSSIWG. At the same time we researched county-specific growth rate data utilized for recent national rulemakings as a backstop approach to State supplied VMT projections.
- Modeling Temperatures. Actual 2002 temperatures were used for the initial 2002 base year inventory.
- Vehicle Registration Mix (age fractions by type of vehicle). A mix of State, local, and MOBILE6 default data were used for the 2002 initial base year inventory. Forecast data were solicited from the States, with a fallback position that we hold the fractions constant at their 2002 values.
- Vehicle Speed by Roadway Type. For the 2002 initial base year inventory, speeds varying by vehicle and road type were used.
- VMT Mixes (fraction of VMT by vehicle type). A mix of State, local, and quasi MOBILE6 default (i.e., MOBILE6 defaults normalized to better reflect local conditions) data were used for the 2002 initial base year inventory. Forecast data were solicited from the States.
- Diesel Sales Fractions. As with the VMT mix data, the diesel sales fraction data employed for the 2002 initial base year inventory represents a mix of State, local, and quasi MOBILE6 default data. The issues related to updating these data to 2018 are

also similar, but are complicated by the fact that MOBILE6 treats diesel sales fraction on a model year, rather than age specific basis. Therefore, diesel sales fractions generally cannot be held constant across time. Once again, we solicited any local projections, with a fallback position that we would keep the data for 2002 and earlier model years constant for the forecast inventory, supplemented with MOBILE6 default data for 2003 and newer model years.

- **State/Local Fuel Standards.** For the 2002 initial base year inventory, these data were based on appropriate local requirements and updated data for 2018 was only required if changes were expected between 2002 and 2018. There are some national changes in required fuel quality for both on-road and non-road fuels that are expected to occur between 2002 and 2018 and these would be reflected in the 2018 inventory in the absence of more stringent local fuel controls. Expected changes in local fuel control programs were solicited.
- **Vehicle Standards.** The 2002 initial base year inventory assumed NLEV applicability. This was altered to reflect Tier 2 for 2018, unless a State indicated a specific plan to adopt the California LEV II program. If so, we made the required changes to implement those plans for the preliminary 2018 inventory.
- **Other Local Controls.** This includes vehicle emissions inspection (i.e., I/M) programs, Stage II vapor recovery programs, anti tampering programs, etc. By nature, the assumptions used for the 2002 initial base year inventory vary across the VISTAS region, but our presumption is that these data accurately reflected each State's situation as it existed in 2002. If a State had no plans to change program requirements between 2002 and 2018, we proposed to maintain the 2002 program descriptions without change. However, if a State planned changes, we requested information on those plans. In the final implementation of the Base F and earlier inventories, Stage II controls were exercised in the area source component of the inventory, since the units used to develop Stage II refueling estimates are different between MOBILE6 and the NONROAD models. However, in the Base G inventories, Stage II refueling was moved to the on-road and non-road sectors.

Once the preliminary 2018 (pre-Base F) base case projection inventory data were compiled, MACTEC applied the data and methods selected and proceeded to develop the preliminary (pre-base F) base case 2018 projection inventories. The resulting inventories were provided to the MSSIWG in a user-friendly format for review. After stakeholder review and comment, the final preliminary 2018 base case inventories and input files were provided to VISTAS in formats identified by the VISTAS Technical Advisor (in this case, MOBILE input files and VMT, NONROAD input files and annual inventory files for NONROAD in NIF 3.0 format). Annual

inventory files for MOBILE were not developed as part of this work, only input files and VMT forecasts. MOBILE emissions were calculated by VISTAS air quality modeling contractor using the provided files.

### **2.3.1      *Development of on-road mobile source input files***

As indicated above, MACTEC prepared a preliminary version of the 2018 base case mobile inventory input data files. These files were then updated to provide a final set of 2018 base case inventory input data files as well as a set of input files for 2009. The information below describes the updates performed on the preliminary 2018 files and the development of the 2009 input data files for Base F emission estimation.

Our default approach to preparing the revised 2018 and initial 2009 projection inventories for on-road mobile sources was to estimate the emissions by using either:

1. the revised 2002 data provided by each State coupled with the projection methods employed for the preliminary 2018 inventory, or
2. the same data and methods used to generate the preliminary 2018 inventory.

We also investigated whether or not there was more recent VMT forecasting data available (e.g., from the CAIR and if appropriate revised the default VMT growth rates accordingly. This did not affect any State that provided local VMT forecasting data, but would alter the VMT estimates used for other areas.

Since no preliminary 2009 inventory was developed there did not exist an option (2) above for 2009. As a consequence, MACTEC crafted the 2009 initial inventory for on-road mobile sources using methods identical to those employed for the 2018 preliminary inventories coupled with any changes/revisions provided by the States during the review of the revised 2002 base year and the 2018 preliminary inventories. Therefore, as was the case for 2018, we obtained from the States any input data revisions, methodological revisions, and local control program specifications (to the extent that they differed from 2002/2018).

#### **2.3.1.1      *Preparation of revised 2018 input data files***

Preparation of the revised 2018 inventories required the following updates:

1. The evaluation year was updated to 2018 in all files.
2. The diesel fuel sulfur content was revised from 500 ppm to 11 ppm, consistent with EPA data for 2018 in all files.
3. Since the input data is model year, rather than age, specific for diesel sales fractions (with data for the newest 25 model years required), we updated all files that included

diesel sales fractions. In the revised 2002 base year files, the data included applied to model years 1978-2002. For 2018, the data included would reflect model years 1994-2018. To forecast the 2002 data, MACTEC took the data for 1994-2002 from the 2002 files and added data for 2003-2018. To estimate the data for these years, we employed the assumption employed by "default" in MOBILE6 -- namely that diesel sales fractions for 1996 and later are constant. Therefore, we set the diesel sales fractions for 2003-2018 at the same value as 2002.

4. VMT mix fractions must be updated to reflect expected changes in sales patterns between 2002 and 2018. If explicit VMT mix fractions are not provided, these changes are handled internally by MOBILE6 or externally through absolute VMT distributions. However, files that include explicit VMT mix fractions override the default MOBILE6 update and may or may not be consistent with external VMT distributions. MACTEC updated the VMT mix in such files as follows:

First, we calculated the VMT fractions for LDV, LDT1, LDT2, HDV, and MC from the external VMT files for 2018. This calculation was performed in accordance with section 5.3.2 of the MOBILE6 Users Guide which indicates:

$$\text{LDV} = \text{LDGV} + \text{LDDV}$$

$$\text{LDT1} = \text{LDGT1} + \text{LDDT}$$

$$\text{LDT2} = \text{LDGT2}$$

$$\text{HDV} = \text{HDGV} + \text{HDDV}$$

$$\text{MC} = \text{MC}$$

The resulting five VMT fractions were then split into the 16 fractions required by MOBILE6 using the distributions for 2018 provided in Appendix D of the MOBILE6 Users Guide. This approach ensures that explicit input file VMT fractions are consistent with the absolute VMT distributions prepared by MACTEC. These changes were made to all files that included VMT mixes.

5. All other input data were retained at 2002 values, except as otherwise instructed by the States. This includes all control program descriptions (I/M, Anti-Tampering Program [ATP], Stage II, etc.), all other fuel qualities (RVP, oxy content, etc.), all other vehicle descriptive data (registrations age distributions, etc.), and all scenario descriptive data. The State-specific updates performed are described below.

### **Kentucky:**

MACTEC revised the 2018 input files for the Louisville, Kentucky area (Louisville Air Pollution Control District [APCD]) based on comments received relative to several components of

MOBILE input data. Based on these comments, the input files for Jefferson County, Kentucky were updated accordingly as follows:

- a) I/M and tampering program definitions were removed since the program was discontinued at the end of 2003.
- b) The "Speed VMT", "Facility VMT" and "Registration Age Distribution" file pointers were updated to reflect revised 2002 files provided by the Louisville APCD.
- c) The "VMT Mix" data, which was previously based on the default approach of "growing" 2002 data, was replaced by 2018-specific data provided by the Louisville APCD.

### **North Carolina:**

North Carolina provided a wide range of revised input data, including complete MOBILE6 input files for July modeling. MACTEC did not use the provided input files directly as they did not match the 2002 NC input files for critical elements such as temperature distributions and gasoline RVP (while they were close, they were slightly different). To maintain continuity between 2002 and 2018 modeling, MACTEC instead elected to revise the 2002 input files to reflect all control program and vehicle-related changes implied by the new 2018 files, while retaining the basic temperature and gasoline RVP assumptions at their 2002 values. Under this approach, the following changes were made:

- a) NC provided a county cross reference file specific to 2018 that differed from that used for 2002. We removed files that were referenced in the 2002 input data and replaced those files with those referenced in the 2018 data. In addition, since NC only provided 2018 input files for July, we estimated the basic data for these new files for the other months by cross referencing the target files for 2002 by county against the target files for 2018 by county.
- b) We then revised the 2002 version of each input file to reflect the 2018 "header" data included in the NC-provided 2018 files. These data are exclusively limited to I/M and ATP program descriptions, so that the 2002 I/M and ATP data were replaced with 2018 I/M and ATP data.
- c) We retained the registration age fractions at their 2002 "values" (external file pointers) as per NC instructions.
- d) We retained all scenario-specific data (i.e., temperatures, RVP, etc.) at 2002 values, which (as indicated above), were slightly different in most cases from data included in the 2018 files provided by NC. We believe these differences were due to small deviations between the data assembled to support VISTAS 2002 and the process used to generate the 2018 files provided by NC, and that revising the VISTAS 2002 data to

reflect these variations was not appropriate given the resulting inconsistencies that would be reflected between VISTAS 2002 and VISTAS 2018.

- e) NC also provided non-I/M versions of the 2018 input files that would generally be used to model the non-I/M portion of VMT. While these files were retained they were not used for the 2018 input data preparation.

Finally, NC also provided a speed profile file and a speed profile cross reference file for 2018. We did not use these in our updates as they have no bearing on the MOBILE6 input files, but they were maintained in case they needed to be included in SMOKE control files for a future year control strategy scenario.

### **Virginia:**

In accordance with instructions from VA, the input files that referenced an external I/M descriptive program file (VAIM02.IM) were revised to reference an alternative external file (VAIM05.IM). This change was to make the I/M program more relevant to the year 2018.

One additional important difference was made with respect to the revised 2018 and initial 2009 on-road mobile source input data files for all States. MACTEC developed updated SMOKE ready input files rather than MOBILE6 files so that the input data could be used directly by the VISTAS modeling contractor to estimate on-road mobile source emissions during modeling runs.

#### **2.3.1.2 Preparation of initial 2009 input data files**

The methodology used to develop the 2009 on-road input files was based on forecasting the previously developed revised 2002 base year input files and is identical to that previously described for the revised 2018 methodology except as follows:

1. The evaluation year was updated to 2009.
2. Diesel fuel sulfur content was revised from 500 ppm to 29 ppm. The 29 ppm value was derived from an EPA report entitled "Summary and Analysis of the Highway Diesel Fuel 2003 Pre-compliance Reports" (EPA420-R-03-013, October 2003), which includes the Agency's estimates for the year-to-year fuel volumes associated with the transition from 500 ppm to 15 ppm diesel fuel. According to Table 2 of the report, there will be 2,922,284 barrels per day of 15 ppm diesel distributed in 2009 along with 110,488 barrels per day of 500 ppm diesel. Treating the 15 ppm diesel as 11 ppm on average (consistent with EPA assumptions and assumptions employed for the 2018 input files) and sales weighting the two sulfur content fuels results in an average 2009 diesel fuel sulfur content estimate of 29 ppm.



3. Diesel sales fractions were updated identically to 2018 except that the diesel sales fractions for 2003-2009 were set at the same value as those for 2002 (rather than 2003-2018).
4. VMT mix fractions were updated to 2009 using an identical method to that described for 2018.
5. All other input data were retained at 2002 values, except as otherwise instructed by individual States (see below). This includes all control program descriptions (I/M, ATP, Stage II, etc.), all other fuel qualities (RVP, oxy content, etc.), all other vehicle descriptive data (registration age distributions, etc.), and all scenario descriptive data.

In addition to the updates described above that were applied to all VISTAS-region inputs, the following additional State-specific updates were performed:

**KY** – Identical changes to those made for 2018 (but specific to 2009) were made for the 2009 input files.

**NC** – Identical changes to those made for 2018 (but specific to 2009) were made for the 2009 input files.

**VA** – Identical changes to those made for 2018 were made for 2009.

### **2.3.2**      *VMT Data*

The basic methodology used to generate the 2009 and 2018 VMT for use in estimating on-road mobile source emissions was as follows:

1. All estimates start from the final VMT estimates used for the 2002 revised base year inventory.
2. Initial 2009 and 2018 VMT estimates were based on linear growth rates for each State, county, and vehicle type as derived from the VMT data assembled by the U.S. EPA for their most recent HDD (heavy duty diesel) rulemaking. The methodology used to derive the growth factors is identical to that employed for the preliminary 2018 VMT estimates (which is described in the next section).
3. For States that provided no independent forecast data, the estimates derived in step 2 are also the final estimates. These States are: Alabama, Florida, Georgia, Kentucky, Mississippi, and West Virginia. For States that provided forecast data, the provided data were used to either replace or augment the forecast data based on the HDD rule. These States, and the specific approaches employed, are detailed following the growth method description.

The steps involved in performing the growth estimates for VMT were as follows:



1. Linear growth estimates were used (although MACTEC investigated the potential use of nonlinear factors and presented that information to the MSSIWG, the decision was made to use linear growth factors instead of nonlinear).
2. Estimates were developed at the vehicle class (i.e., LDGV, LDGT1, LDGT2, etc.) level of detail since the base year 2002 estimates were presented at that level of resolution. In effect, the county and vehicle class specific growth factors were applied to the 2002 VMT estimates for each vehicle and road class.
3. Overall county-specific VMT estimates for each year (developed by summing the vehicle and road class specific forecasts) were then compared to overall county-specific growth. Since overall county growth is a more appropriate controlling factor as it includes the combined impacts of all vehicle classes, the initial year-specific vehicle and road class VMT forecasts were normalized so that they matched the overall county VMT growth. Mathematically, this process is as follows:

$$(\text{Est}_{rv\_f}) = (\text{Est}_{rv\_i}) * (\text{C}_{20XX} / \text{Sum}(\text{Est}_{rv\_i}))$$

where:

Est<sub>rv\_f</sub> = the final road/vehicle class-specific estimates,

Est<sub>rv\_i</sub> = the initial road/vehicle class-specific estimates, and

C<sub>20XX</sub> = the county-specific growth target for year 20XX.

Table 2.3-1 presents a basic summary of the forecasts for the preliminary 2018 inventory for illustrative purposes:

**Table 2.3-1 2002 versus 2018 VMT (million miles per year)**

State	2002	2018	Growth Factor
Alabama	55,723	72,966	1.309
Florida	178,681	258,191	1.445
Georgia	106,785	148,269	1.388
Kentucky	51,020	66,300	1.299
Mississippi	36,278	46,996	1.295
North Carolina	80,166	110,365	1.377
South Carolina	47,074	63,880	1.357
Tennessee	68,316	91,647	1.342
Virginia	76,566	102,971	1.345
West Virginia	19,544	24,891	1.274

The following States provided some types of forecast data for VMT. The information presented below indicates how those data were processed by MACTEC for use in the VISTAS projection inventories.

**Kentucky:**

Revised 2009 and 2018 VMT mix data were provided by the Louisville APCD. Therefore, the distribution of Jefferson County VMT by vehicle type within the KY VMT file was revised to reflect the provided mix. This did not affect the total forecasted VMT for either Jefferson County or the State, but does alter the fraction of that VMT accumulated by each of the eight vehicle types reflected in the VMT file. The following procedure was employed to make the VMT estimates consistent with the provided 2009/2018 VMT mix:

- a) The 16 MOBILE6 VMT mix fractions were aggregated into the following five vehicle types: LDV, LDT1, LDT2, HDV, and MC.
- b) The 8 VMT mileage classes were aggregated into the same five vehicle types (across all roadway types) and converted to fractions by normalizing against the total Jefferson County VMT.
- c) The ratio of the "desired" VMT fraction (i.e., that provided in the Louisville APCD VMT mix) to the "forecasted" VMT fraction (i.e., that calculated on the basis of the forecasted VMT data) was calculated for each of the five vehicle classes.
- d) All forecasted VMT data for Jefferson County were multiplied by the applicable ratio from step c as follows:

$$\begin{aligned} \text{new LDGV} &= \text{old LDGV} * \text{LDV ratio} \\ \text{new LDGT1} &= \text{old LDGT1} * \text{LDT1 ratio} \\ \text{new LDGT2} &= \text{old LDGT2} * \text{LDT2 ratio} \\ \text{new HDGV} &= \text{old HDGV} * \text{HDV ratio} \\ \text{new LDDV} &= \text{old LDDV} * \text{LDV ratio} \\ \text{new LDDT} &= \text{old LDDT} * \text{LDT1 ratio} \\ \text{new HDDV} &= \text{old HDDV} * \text{HDV ratio} \\ \text{new MC} &= \text{old MC} * \text{MC ratio} \end{aligned}$$

The total forecasted VMT for Jefferson County was then checked to ensure that it was unchanged.

**North Carolina:**

North Carolina provided both VMT and VMT mix data by county and roadway type for 2018. Therefore, these data replaced the data developed for North Carolina using HDD rule growth

rates in their entirety. Similar data were submitted for 2009. Table 2.3-2 presents the resulting VMT estimates which differ from the "default" HDD rule estimates as follows:

**Table 2.3-2 VMT and HDD Rule Estimates for North Carolina (million miles per year)**

North Carolina		
2002	106,795	
	State Data	HDD Data
2009	123,396	124,626
2018	129,552	146,989

As indicated, there are substantial reductions in the State-provided forecast data relative to that derived from the HDD rule. The growth rates for both 2009 and 2018 are only about half that implied by the HDD data (1.15 versus 1.17 for 2009 and 1.21 versus 1.38 for 2018). The resulting growth rates are the lowest in the VISTAS region.

NC did not provide VMT mix data for 2009. Therefore, the VMT mix fractions estimated using the "default" HDD rule growth rates were applied to the State-provided VMT estimates to generate vehicle-specific VMT. Essentially, the default HDD methodology produces VMT estimates at the county-road type-vehicle type level of detail, and these data can be converted into VMT fractions at that same level of detail. Note that these are not HDD VMT fractions, but VMT fractions developed from 2002 NC data using HDD vehicle-specific growth rates. In effect, they are 2002 NC VMT fractions "grown" to 2009.

The default VMT mix fraction was applied to the State-provided VMT data at the county and road type level of detail to generate VMT data at the county-road type-vehicle type level of detail. The one exception was for county 063, road 110, for which no VMT data were included in the HDD rule. For this single county/road combination, State-aggregate VMT mix fractions (using the HDD growth methodology) were applied to the county/road VMT data. The difference between road 110 VMT fractions across all NC counties is minimal, so there is no effective difference in utilizing this more aggregate approach vis-à-vis the more resolved county/road approach.

### **South Carolina:**

South Carolina provided county and roadway type-specific VMT data for several future years. Data for 2018 was included and was used directly. Data for 2009 was not included, but was linearly interpolated from data provided for 2007 and 2010. The data were disaggregated into vehicle type-specific VMT using the VMT mixes developed for South Carolina using the HDD rule VMT growth rates. Table 2.3-3 presents the resulting VMT estimates which differ from the "default" HDD rule estimates as follows:

**Table 2.3-3 VMT and HDD Rule Estimates for South Carolina (million miles per year)**

South Carolina		
2002	47,074	
	State Data	HDD Data
2009	55,147	54,543
2018	65,133	63,880

**Tennessee:**

In general, Tennessee estimates are based on the HDD rule growth rate as described in step two. However, Knox County provided independent VMT estimates for 2018 and these were used in place of the HDD rule-derived estimates. The Knox County estimates were total county VMT data only, so these were disaggregated into roadway and vehicle-type VMT using the distributions developed for Knox County in step two using the HDD rule VMT growth rates. No data for Knox County were provided for 2009, so the estimates derived using the HDD rule growth factors were adjusted by the ratio of "Knox County provided 2018 VMT" to "Knox County HDD Rule-derived 2018 VMT." Table 2.3-4 presents the resulting VMT estimates which differ from the "default" HDD rule estimates as follows:

**Table 2.3-4 VMT and HDD Rule Estimates for Tennessee (million miles per year)**

Tennessee		
2002	68,316	
	State Data	HDD Data
2009	78,615	78,813
2018	91,417	91,647

**Virginia:**

Virginia provided county and roadway type-specific annual VMT growth rates and these data were applied to Virginia -provided VMT data for 2002 to estimate VMT in both 2009 and 2018. Virginia provided VMT mix data for 2002, but not 2009 or 2018. Therefore, the estimated VMT data for both 2009 and 2018 were disaggregated into vehicle type-specific VMT using the VMT mixes developed for VA using the HDD rule VMT growth rates. Table 2.3-5 presents the resulting VMT estimates which differ from the "default" HDD rule estimates as follows:

**Table 2.3-5 VMT and HDD Rule Estimates for Virginia (million miles per year)**

Virginia		
2002	77,472	
	State Data	HDD Data
2009	88,419	89,196
2018	104,944	104,164

### 2.3.3 Base G Revisions

For the development of the VISTAS 2009 and 2018 Base G inventories and input files, VISTAS states reviewed the Base F inputs, and provided corrections, updates and supplemental data as noted below.

For all states modeled, the Base G updates include:

- Adding Stage II refueling emissions calculations to the SMOKE processing.
- Revised the HDD compliance. (REBUILD EFFECTS = .1)
- Revised Diesel sulfur values in 2009 to 43 ppm and 2018 to 11 ppm

In addition to the global changes, individual VISTAS states made the following updates:

KY – updated VMT and M6 input values for selected counties

NC – revised VMT estimates, speeds and vehicle distributions and updated registration distributions for Mobile 6.

TN - revised VMT and vehicle registration distributions for selected counties.

WV – revised VMT input data

AL, FL, and GA and VA did not provide updates for 2009/2018 Base G, and the Base F inputs were used for these States.

### 2.3.4 Development of non-road emission estimates

The sections that follow describe the projection process used to develop 2009 and 2018 non-road projection estimates, as revised through the spring of 2006, for sources found in the NONROAD model and those sources estimated outside of the model (locomotives, airplanes and commercial marine vessels).

### 2.3.4.1 NONROAD model sources

NONROAD model input files were prepared in both the fall of 2004 (Base F) and the spring of 2006 (Base G) based on the corresponding 2002 base year inventory input files available at the time the forecasts were developed, with appropriate updates for the projection years. Generally, this means that the Base F 2002 base year input files (as updated through the fall of 2004) were used as the basis for Base F projection year input file development and Base G 2002 base year input files as updated through the spring of 2006 were used as the basis for Base G projection year input file development. Thus, all base year revisions are inherently incorporated into the associated projection year revisions. Other specific updates for the projection years for NONROAD model sources consist of:

1. Revise the emission inventory year in the model (as well as various output file naming commands) to be reflective of the projection year.
2. Revise the fuel sulfur content for gasoline and diesel powered equipment.
3. Implement a limited number of local control program charges (national control program changes are handled internally within the NONROAD model, so explicit input file changes are not required).

All equipment population growth and fleet turnover impacts are also handled internally within the NONROAD model, so that explicit changes input file changes are not required.

#### Base F Input File Changes:

To correctly account for diesel fuel sulfur content differences between the base and projection years, two sets of input and output files were prepared for each forecast year, one set for land-based equipment and one set for marine equipment. This two-step projection process was required for Base F, because diesel fuel sulfur contents varied between land-based and marine-based non-road equipment and the Draft NONROAD2004 used for Base F allowed only a single diesel fuel sulfur input. Thus, the model was executed separately for land-based and marine-based equipment for Base F, and the associated outputs subsequently combined. The specific diesel fuel sulfur contents modeled were as follows:

<b>Diesel S (ppm)</b>	<b>2002</b>	<b>2009</b>	<b>2018</b>
Land-Based	2500	348	11
Marine-Based	2500	408	56

As indicated, the Draft NONROAD2004 model was run with both sets of input files and the output file results were then combined to produce a single NONROAD output set.

To correctly account for the national reduction in gasoline sulfur content (a national control not explicitly handled by the NONROAD model), all NONROAD input files for both 2009 and 2018 were revised to reflect a gasoline fuel sulfur content of 30 ppmW.

**Base G Input File Changes:**

With the release of Final NONROAD2005 that was used for the Base G projection year inventory development, the NONROAD model is capable of handling separate diesel fuel sulfur inputs for land-based and marine-based non-road equipment in a single model execution. Therefore, the two step modeling process described above for Base F updates was no longer required. Instead, the differential diesel fuel sulfur values are assembled into a single NONROAD input file as follows:

<b>Diesel S (ppm)</b>	<b>2002</b>	<b>2009</b>	<b>2018</b>
Land-Based	2500	348	11
Marine-Based	2638	408	56

Additionally, revised gasoline vapor pressure data were provided by Georgia regulators for 20 counties<sup>5</sup> where reduced volatility requirements were established in 2003. Since this requirement began after the 2002 base year, the vapor pressure values in the base year input files for these counties are not correct for either the 2009 or 2018 forecast years. Therefore, to correctly forecast emissions in these counties, the forecast year gasoline vapor pressure inputs were revised to:

<b>Gasoline RVP (psi)</b>	<b>2002</b>	<b>2009</b>	<b>2018</b>
Spring	9.87	9.2	9.2
Summer	9.0	7.0	7.0
Fall	9.87	9.2	9.2
Winter	12.5	12.5	12.5

The summer vapor pressure was simply set equal to the 2003 control value, while the spring and fall vapor pressures were adjusted to reflect a single month of the reduced volatility limit. The winter volatility was assumed to be unaffected by the summertime control requirement.

**2.3.4.1.1 Differences between 2009/2018**

Other than diesel fuel sulfur content and the year of the projections, there are no differences in the methodology used to estimate emissions from NONROAD model sources. As indicated above, however the Base F 2009/2018 projections were developed using Draft NONROAD2004, while the Base G 2009/2018 projections were made using Final NONROAD2005.

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<sup>5</sup> The specific counties are: Banks, Chattooga, Clarke, Floyd, Gordon, Heard, Jasper, Jones, Lamar, Lumpkin, Madison, Meriwether, Monroe, Morgan, Oconee, Pike, Polk, Putnam, Troup, and Upson.

#### **2.3.4.2 Non-NONROAD model sources**

Using the 2002 base year emissions inventory for aircraft, locomotives, and commercial marine vessels (CMV) prepared as described earlier in this document, corresponding emission projections for 2009 and 2018 were developed in both the fall of 2004 (Base F) and the spring of 2006 (Base G). This section describes the procedures employed in developing those inventories. The information presented is intended to build off of that presented in the section describing the 2002 Base F base year inventory. It should be recognized that for both the Base F and Base G inventories, the base year inventory used to develop the emission forecasts was the latest available at the time of forecast development. Generally, this means that the 2002 base year inventory as updated through the fall of 2004 was used as the basis for the Base F projection year inventory development, and the Base F 2002 base year inventory was used as the basis for Base G projection year inventory development. Thus, all base year revisions (as described earlier in this document) are inherently incorporated into the associated projection year revisions.

#### **Base F Revisions:**

Table 2.3-6 shows the 2002 base year emissions for each State in the VISTAS region for aircraft, locomotives and CMV (as they existed prior to Base F development).



**Table 2.3-6. Pre-Base F 2002 Aircraft, Locomotive, and Non-Recreational Marine Emissions**  
(annual tons, as of the fall of 2004)

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	3,787	175	226	87	17	196
	FL	25,431	8,891	2,424	2,375	800	3,658
	GA	6,620	5,372	1,475	1,446	451	443
	KY	2,666	657	179	175	63	263
	MS	1,593	140	44	43	13	96
	NC	6,088	1,548	419	411	148	613
	SC	6,505	515	409	401	88	863
	TN	7,251	2,766	734	719	235	943
	VA	9,763	2,756	1,137	1,115	786	2,529
	WV	1,178	78	25	24	8	66
	<b>Total</b>	<b>70,882</b>	<b>22,899</b>	<b>7,072</b>	<b>6,797</b>	<b>2,607</b>	<b>9,670</b>
Commercial Marine (2280)	AL	1,196	9,218	917	844	3,337	737
	FL	5,888	44,817	1,936	1,781	6,683	1,409
	GA	1,038	7,875	334	307	1,173	246
	KY	6,607	50,267	2,246	2,066	9,608	1,569
	MS	5,688	43,233	1,903	1,751	7,719	1,351
	NC	599	4,547	193	178	690	142
	SC	1,067	8,100	343	316	1,205	253
	TN	3,624	27,555	1,217	1,120	4,974	860
	VA	972	2,775	334	307	359	483
	WV	1,528	11,586	487	448	525	362
	<b>Total</b>	<b>28,207</b>	<b>209,972</b>	<b>9,911</b>	<b>9,118</b>	<b>36,275</b>	<b>7,413</b>
Military Marine (2283)	VA	110	313	25	23	27	48
	<b>Total</b>	<b>110</b>	<b>313</b>	<b>25</b>	<b>23</b>	<b>27</b>	<b>48</b>
Locomotives (2285)	AL	3,490	26,339	592	533	1,446	1,354
	FL	1,006	9,969	247	222	605	404
	GA	2,654	26,733	664	598	1,622	1,059
	KY	2,166	21,811	542	488	1,321	867
	MS	2,302	23,267	578	520	1,429	899
	NC	1,638	16,502	410	369	1,001	654
	SC	1,160	11,690	291	261	710	462
	TN	2,626	25,627	633	570	1,439	1,041
	VA	1,186	11,882	1,529	1,375	3,641	492
	WV	1,311	13,224	329	296	808	517
	<b>Total</b>	<b>19,540</b>	<b>187,044</b>	<b>5,815</b>	<b>5,232</b>	<b>14,022</b>	<b>7,750</b>
<b>Grand Total</b>		<b>118,739</b>	<b>420,228</b>	<b>22,823</b>	<b>21,170</b>	<b>52,931</b>	<b>24,881</b>

Although some of the data utilized was updated, the methodology used to develop the Base F 2009 and 2018 emissions forecasts for aircraft, locomotives, and CMV is identical to that used earlier to develop preliminary 2018 Base 1 (“On the Books”) and 2018 Base 2 (“On the Way”) inventories. Briefly, the methodology relies on growth and control factors developed from inventories used in support of recent EPA rulemakings, and consists of the following steps:

- (a) Begin with the 2002 base year emission estimates for aircraft, locomotive, and CMV as described above (at the State-county-SCC-pollutant level of detail).
- (b) Detailed inventory data (both before and after controls) for these same emission sources for 1996, 2010, 2015, and 2020 were obtained from the EPA's Clean Air Interstate Rule (CAIR) Technical Support Document (which can be found at <http://www.epa.gov/cair/pdfs/finaltech01.pdf>). Using these data, combined growth and control factors for the period 2002-2009 and 2002-2018 were estimated using straight line interpolation between 1996 and 2010 (for 2009) and 2015 and 2020 (for 2018). This is done at the State-county-SCC-pollutant level of detail.
- (c) The EPA growth and control data are matched against the 2002 VISTAS base year data using State-county-SCC-pollutant as the match key. Ideally, there would be a one-to-one match and the process would end at this point. Unfortunately, actual match results were not always ideal, so additional matching criteria were required. For subsequent reference, this initial (highest resolution) matching criterion is denoted as the “CAIR-Primary” criterion.
- (d) A second matching criterion is applied that utilizes a similar, but higher-level SCC (lower resolution) matching approach. For example, SCC 2275020000 (commercial aircraft) in the 2002 base year inventory data would be matched with SCC 2275000000 (all aircraft) in the CAIR data. This criterion is applied to records in the 2002 base year emissions file that are not matched using the “CAIR-Primary” criterion, and is also performed at the State-county-SCC-pollutant level of detail. For subsequent reference, this is denoted as the “CAIR-Secondary” criterion. At the end of this process, a number of unmatched records remained, so a third level matching criterion was required.
- (e) In the third matching step, the most frequently used SCC in the EPA CAIR files for each of the aircraft, locomotive, and commercial marine sectors was averaged at the State level to produce a “default” State and pollutant-specific growth and control factor for the sector. The resulting factor is used as a “default” growth factor for all unmatched county-SCC-pollutant level data in each State. In effect, State-specific growth data are applied to county level data for which an explicit match between the VISTAS 2002 base year data and EPA CAIR data could not be developed. The default growth and control

SCCs are 2275020000 (commercial aircraft) for the aircraft sector, 2280002000 (commercial marine diesel total) for the CMV sector, and 2285002000 (railroad equipment diesel total) for the locomotive sector. Matches made using this criterion are denoted as “CAIR-Tertiary” matches.

- (f) According to EPA documentation, the CAIR baseline emissions include the impacts of the (then proposed) Tier 4 (T4) non-road diesel rulemaking, which implements a low sulfur fuel requirement that affects both future CMV and locomotive emissions. However, the impacts of this rule were originally intended to be excluded from the initial VISTAS 2018 forecast, which was to include only “on-the-books” controls. (The T4 rule was finalized subsequent to the development of the preliminary 2018 inventory in March of 2004.) Given its final status, T4 impacts were moved into the “on the books” inventory for non-road equipment. In addition, since there are no other proposed rules affecting the non-road sector between 2002 and 2018, there is no difference between the 2018 “on the books” and 2018 “on the way” inventories for the sector; so that only a single forecast inventory (for each evaluation year) was developed. Nevertheless, since the algorithms developed to produce the VISTAS forecasts were developed when there was a distinction between the “on the books” and “on the way” inventories, the distinct algorithms used to produce the two inventories have been maintained even though the conceptual distinctions have been lost. This approach was taken for two reasons. First, it allowed the previously developed algorithms to be utilized without change. Second, it allowed for separate treatment of the T4 emissions impact which was important as those impacts changed between the proposed and final T4 rules. Thus, previous EPA inventories that include the proposed T4 impacts would not be accurate. Therefore, the procedural discussion continues to reflect the distinctions between non-T4 and T4 emissions, as these distinctions continue to be intrinsically important to the forecasting process. Therefore, a second set of EPA CAIR files that excluded the Tier 4 diesel impacts was obtained and the same matching exercise described above in steps (b) through (e) was performed using these “No T4” files. It is important to note that the matching exercise described in steps (b) through (e) cannot simply be replaced because the “No T4” files obtained from the EPA include only those SCCs specifically affected by the T4 rule (i.e., diesel CMV and locomotives). So in effect, the matching exercise was augmented (rather than replaced) with an additional three criteria analogous to those described in steps (c) through (e), and these are denoted as the “No T4-Primary,” “No T4-Secondary,” and “No T4-Tertiary” criteria. Because they exclude the impacts of the proposed T4 rule, matches using the “No T4” criteria supersede matches made using the basic CAIR criteria (as described in steps (c) through (e) above).

- (g) The CAIR matching criteria were overridden for any record for which States provided local growth data. Only North Carolina provided these forecasts, as that State has provided specific growth factors for airport emissions in four counties. Because the provided data were based on forecasted changes in landings and takeoffs at major North Carolina airports, the factors were applied only to commercial (SCC 2275020000) and air taxi (SCC 2275060000) emissions. Emissions forecasts for military and general aviation aircraft operations, as well as all aircraft operations in counties other than the four identified in the North Carolina growth factor submission, continued to utilize the growth factors developed according to steps (b) through (f) above. Table 2.3-7 presents the locally generated growth factors applied in North Carolina.

**Table 2.3-7 Locally Generated Growth Factors for North Carolina**

FIP	2009 Factor	2018 Factor
37067	0.71	0.84
37081	0.97	0.89
37119	1.15	1.01
37183	0.88	0.81

**Note:**

Growth factor = Year Emissions/2002 Emissions.

Under CAIR approach, 2009 = 1.16 to 1.17 for all 4 counties.

Under CAIR approach, 2018 = 1.36 to 1.37 for all 4 counties.

- (h) Using this approach, each State-county-SCC-pollutant was assigned a combined growth and control factor using the EPA CAIR forecast or locally provided data. The 22,838 data records for aircraft, locomotives, and CMV in the 2002 revised base year emissions file were assigned growth factors in accordance with the following breakdown:

48 records matched State-provided growth factors,  
 4,179 records matched using the CAIR-Primary criterion,  
 240 records matched using the CAIR-Secondary criterion,  
 7,463 records matched using the CAIR-Tertiary criterion,  
 720 records matched using the No T4-Primary criterion,  
 3,858 records matched using the No T4-Secondary criterion, and  
 6,330 records matched using the No T4-Tertiary criterion.

- (i) Finally, the impacts of the T4 rule as adopted were applied to the grown “non T4” emission estimates. The actual T4 emission standards do not affect aircraft, locomotive, or CMV directly, but associated diesel fuel sulfur requirements do affect locomotives and CMV. Lower fuel sulfur content affects both SO<sub>2</sub> and PM emissions. Expected fuel sulfur

contents were obtained for each evaluation year from the EPA technical support document for the final T4 rule (*Final Regulatory Analysis: Control of Emissions from Non-road Diesel Engines*, EPA420-R-04-007, May 2004). According to that document, the average diesel fuel sulfur content for locomotives and CMV is expected to be 408 ppmW in 2009 and 56 ppmW in 2018. These compare to expected non-T4 fuel sulfur levels of 2599 ppmW in 2009 and 2336 ppmW in 2018. Table 2.3-8 uses calculated emissions estimates for base and T4 control scenarios to estimate emission reduction impacts.

**Table 2.3-8 Estimated Emission Reduction Impacts based on T-4 Rule**

				2009	2018
CMV SO <sub>2</sub>	=	Non-T4 SO <sub>2</sub>	×	0.1569	0.0241
Locomotive SO <sub>2</sub>	=	Non-T4 SO <sub>2</sub>	×	0.1569	0.0241
CMV PM	=	Non-T4 PM	×	0.8962	0.8762
Locomotive PM	=	Non-T4 PM	×	0.8117	0.7734

However, since the diesel fuel sulfur content assumed for the 2002 VISTAS base year inventory, upon which both the 2009 and 2018 inventories were based, is 2500 ppmW, a small adjustment to the emission reduction multipliers calculated from the T4 rule is appropriate since they are measured relative to modestly different sulfur contents (2599 ppmW for 2009 and 2336 ppmW for 2018). Correcting for these modest differences produces the emission reduction impact estimates relative to forecasts based on the VISTAS 2002 inventory shown in Table 2.3-9.

**Table 2.3-9 Estimated Emission Reduction Impacts Relative to VISTAS 2002 Base Year Values**

				2009	2018
CMV SO <sub>2</sub>	=	Non-T4 SO <sub>2</sub>	×	0.1632	0.0225
Locomotive SO <sub>2</sub>	=	Non-T4 SO <sub>2</sub>	×	0.1632	0.0225
CMV PM	=	Non-T4 PM	×	0.9004	0.8685
Locomotive PM	=	Non-T4 PM	×	0.8187	0.7610

These factors were applied directly to the non-T4 emission forecasts to produce the final VISTAS 2009 and 2018 emissions inventories for aircraft, locomotive, and CMV.

The only exception is for Palm Beach County, Florida, where CMV emissions are reported as “all fuels” rather than separately by residual and diesel fuel components. To estimate T4 impacts in Palm Beach County, the ratio of diesel CMV emissions to total

CMV emissions in the remainder of Florida was calculated and the T4 impact estimates for Palm Beach County were adjusted to reflect that ratio. Table 2.3-10 shows the calculated diesel CMV ratios.

**Table 2.3-10 Diesel CMV Adjustment Ratios for Palm Beach County, FL**

GROWTH BASIS	SO <sub>2</sub>	PM
2009 (1996, 2020 Growth Basis)	0.2410	0.7861
2009 (1996, 2010, 2015, and 2020 Growth Basis)	0.1279	0.7875
2018 (1996, 2020 Growth Basis)	0.2432	0.7925
2018 (1996, 2010, 2015, and 2020 Growth Basis)	0.2624	0.7918

*The differences between the growth bases are discussed in detail below.*

Combining these ratios with the T4 impact estimates for diesel engines, as presented above, yields the following impact adjustment factors for Palm Beach County:

**Table 2.3-11 Overall Adjustment Factors for Palm Beach County, FL**

GROWTH BASIS		
2009 SO <sub>2</sub> (19, 20 Growth Basis)	0.7894	[0.1632×0.2410+(1-0.2410)]
2009 SO <sub>2</sub> (96, 10, 15, and 20 Growth Basis)	0.8930	[0.1632×0.1279+(1-0.1279)]
2018 SO <sub>2</sub> (96, 20 Growth Basis)	0.7623	[0.0225×0.2432+(1-0.2432)]
2018 SO <sub>2</sub> (96, 10, 15, and 20 Growth Basis)	0.7436	[0.0225×0.2624+(1-0.2624)]
2009 PM (19, 20 Growth Basis)	0.9217	[0.9004×0.7861+(1-0.7861)]
2009 PM (96, 10, 15, and 20 Growth Basis)	0.9216	[0.9004×0.7875+(1-0.7875)]
2018 PM (96, 20 Growth Basis)	0.8958	[0.8685×0.7925+(1-0.7925)]
2018 PM (96, 10, 15, and 20 Growth Basis)	0.8959	[0.8685×0.7918+(1-0.7918)]

*The differences between the growth bases are discussed in detail below.*

Utilizing this approach, emission inventory forecasts for both 2009 and 2018 were developed. As indicated in step (b) above, basic growth factors were developed using EPA CAIR inventory data for 1996, 2010, 2015, and 2020. From these data, equivalent EPA CAIR inventories for 2002 and 2009 were developed through linear interpolation of the 1996 and 2010 inventories, while an equivalent CAIR inventory for 2018 was developed through linear interpolation of the 2015 and 2020 inventories. Growth factors for 2009 and 2018 were then estimated as the ratios of the CAIR 2009 and 2018 inventories to the CAIR 2002 inventory.

During the development of the preliminary 2018 VISTAS inventory in March 2004, this process yielded reasonable results and exhibited no particular systematic concerns. However, when the 2009 Base F inventory was developed, significant concerns related to SO<sub>2</sub> and PM were encountered. Essentially, what was revealed by the Base F 2009 forecast was a series of apparent inconsistencies in the CAIR 2010 and 2015 emission inventories (as compared to the 1996 and 2020 CAIR inventories) that were masked during the construction of the “longer-term” 2018 inventory.

The apparent inconsistencies are best illustrated by looking at the actual data extracted from the CAIR inventory files. Note that although a limited example is being presented, the same general issue applies throughout the CAIR files. For FIP 01001 (Autauga County, Alabama) and SCC 2285002000 (Diesel Rail), the CAIR inventories indicate SO<sub>2</sub> emission estimates as shown in Table 2.3-12.

**Table 2.3-12 SO<sub>2</sub> Emissions for Diesel Rail in Autauga County, AL from the CAIR Projections**

YEAR	TONS
1996:	15.3445
2010:	2.7271
2015:	2.8178
2020:	16.6232

Clearly, there is a major drop in emissions between 1996 and 2010, followed by a major increase in emissions between 2015 and 2020. Several observations regarding these changes are important. First, the CAIR data were reported to exclude the T4 rule, so that the drop in emissions should be related to something other than simply a change in diesel fuel sulfur content. Second, if the T4 rule impacts were “accidentally” included in the estimates, there should be a resultant 90 percent drop in diesel sulfur between 2010 and 2015; so such inclusion is unlikely. Third, the rate of growth between 2015 and 2020 (43 percent *per year* compound or 97 percent *per year* linear) is well beyond any reasonable expectations for rail service; and fuel sulfur content during this period is constant both with and without T4. In short, there appeared to be no rational explanation for the data, yet the same basic relations are observed for thousands of CAIR inventory records.

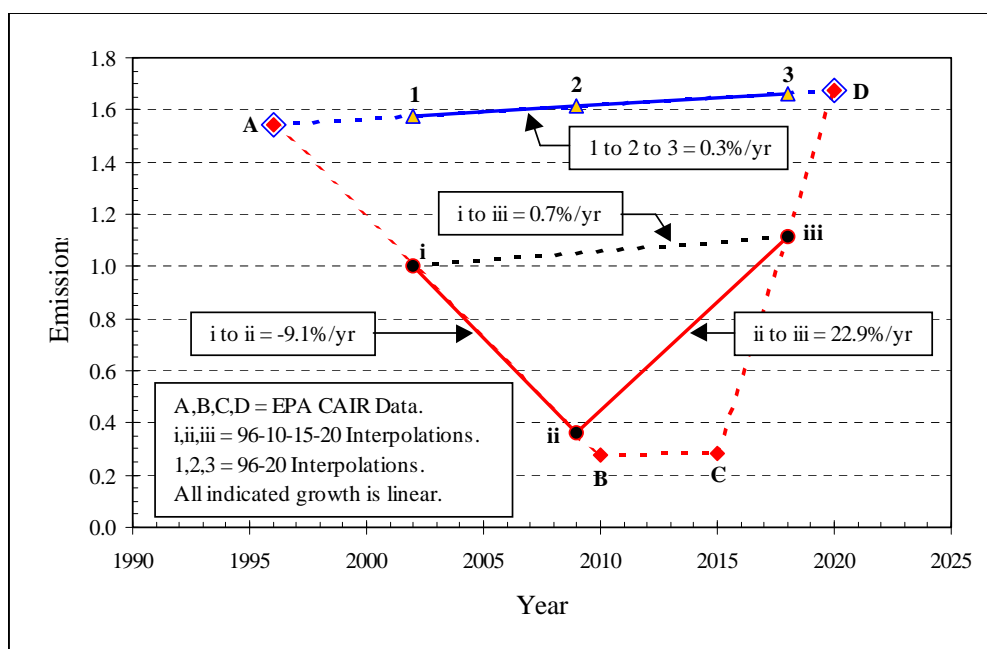
For the most part, the issue seems to be centered on SO<sub>2</sub> and PM records, which are those records primarily affected by the T4 rule. But, as noted above, there does not seem to be any pattern of consistency that would indicate that either inclusion or exclusion of T4 rule impacts is the underlying cause. Moreover, where they occur, the observed growth extremes generally affect both SO<sub>2</sub> and PM equally, while one would expect PM effects to be buffered if the T4 rule



was the underlying cause, since changes in diesel fuel sulfur content will only affect a fraction of PM (i.e., sulfate), while directly reducing SO<sub>2</sub>.

The data presented in Figure 2.3-1 illustrates what this meant to the VISTAS forecasting process. Figure 2.3-1 depicts the same data presented above for Autauga County, Alabama, but normalized so that the interpolated 2002 CAIR emissions estimate equals unity. The “raw” CAIR data is depicted by the markers labeled A, B, C, and D. Interpolated data for 2002 and 2009, based on 1996 and 2010 CAIR data, is depicted by the markers labeled “i” and “ii.” Interpolated data for 2018, based on 2015 and 2020 CAIR data is depicted by the marker labeled “iii.” The relationship between marker “iii” and marker “i” is exactly the relationship used to construct the preliminary (e.g., pre-Base F) 2018 VISTAS inventory (i.e., a linear growth rate equal to 0.7 percent per year). Thus, it is easy to see that although there is a major “dip and rise” between 2002 and 2018, it is essentially masked unless data for intervening years are examined. Since no intervening year was examined for the preliminary 2018 inventory, the “dip and rise” was not discovered. However, upon the development of the 2009 inventory forecast, the issue became obvious, as the marker labeled “ii” readily illustrates. In effect, the 2009 inventory reflected very low negative “growth rates” for some SCCs and pollutants relative to the 2002 inventory, while the 2018 inventory reflected very high and positive growth rates for those same SCCs and pollutants. In effect, the path between 2002 and 2018 that previously looked like the dotted line connecting markers “i” and “iii,” now looks like the solid line connecting markers “i,” “ii,” and “iii.” For reference purposes, this path is hereafter referred to as the 1996, 2010, 2015, and 2020 growth basis, since all interpolated data is based on CAIR data for those four years.

**Figure 2.3-1. Impacts of the Apparent CAIR Inventory Discrepancy**





In light of the apparent discrepancies inherent in the 1996, 2010, 2015, and 2020 growth basis data and the inconsistencies its use would impart into the 2009 and 2018 VISTAS inventories, a secondary forecasting method was developed. This second method relies on the apparent consistency between the 1996 and 2020 non-T4 CAIR inventories, interpolating equivalent 2002, 2009, and 2018 inventories solely from these two inventories. In effect, the CAIR inventories for 2010 and 2015 are ignored. In Figure 2.3-1, this secondary approach is depicted by the data points that lie along the lines connecting markers A and D. Markers A and D represent the 1996 and 2020 CAIR inventories, and the markers labeled 1, 2, and 3 represent the interpolated 2002, 2009, and 2018 CAIR equivalent inventories. The growth rate between 2009 and 2002 is then equal to the ratio of the 2009 and 2002 CAIR inventories, while that between 2018 and 2002 is equal to the ratio of the 2018 and 2002 CAIR inventories. For the example data, the resulting linear growth estimate is 0.3 percent per year. For reference purposes, this path is hereafter referred to as the 1996-2020 growth basis, since all interpolated data are based on CAIR data for only those two years.

It is perhaps worth noting that the only elements of Figure 2.3-1 that have any bearing on the VISTAS inventories are the growth rates. The absolute CAIR data are of importance only in determining those rates, as all VISTAS inventories were developed on the basis of the VISTAS 2002 base year inventory, not any of the CAIR inventories. So referring to Figure 2.3-1, the two growth options are summarized in Table 2.3-13.

**Table 2.3-13 Growth Options based on CAIR Data**

<b>GROWTH BASIS</b>	<b>PERCENT PER YEAR</b>
1996, 2010, 2015, 2020 Growth Basis:	-9.1% per year (linear) between 2002 and 2009
1996-2020 Growth Basis:	+0.3% per year (linear) between 2002 and 2009
1996, 2010, 2015, 2020 Growth Basis:	+22.9% per year (linear) between 2009 and 2018
1996-2020 Growth Basis:	+0.3% per year (linear) between 2009 and 2018
1996, 2010, 2015, 2020 Growth Basis:	+0.7% per year (linear) between 2002 and 2018
1996-2020 Growth Basis:	+0.3% per year (linear) between 2002 and 2018

Of course, these specific rates are applicable only to the example case (i.e., diesel rail SO<sub>2</sub> in Autauga County, Alabama), but there are thousands of additional CAIR records that are virtually identical from a growth viewpoint.

While forecast inventories for aircraft, locomotives, and CMV were developed for 2009 and 2018 using both growth methods, it was ultimately decided to utilize the 1996-2020 growth basis for Base F since it provided more reasonable growth rates for 2009. Tables 2.3-14 and 2.3-15 present a summary of each Base F inventory, while Tables 2.3-16 and 2.3-17 present the associated change in emissions for each Base F forecast inventory relative to the Base F 2002

base year VISTAS inventory. The larger reduction in CMV SO<sub>2</sub> emissions in 2009 and 2018 (relative to 2002) for Virginia and West Virginia is notable relative to the other VISTAS States, but this has been checked and is attributable to a high diesel contribution to total CMV SO<sub>2</sub> in the 2002 inventories for these two States.

Figures 2.3-2 through 2.3-13 graphically depict the relationships between the various Base F inventories and preliminary 2002 and 2018 projections prepared prior to Base F. There are two figures for each pollutant, the first of which presents a comparison of total VISTAS regional emission estimates for aircraft, locomotives, and CMV, and the second of which presents total VISTAS region emission estimates for locomotives only. This two figure approach is intended to provide a more robust illustration of the differences between the various inventories, as some of the differences are less distinct when viewed through overall aggregate emissions totals. All of the figures include the following emissions estimates:

- The 2002 Base F base year VISTAS emissions inventory (labeled as “2002”),
- The 2002 pre-Base F base year VISTAS emissions inventory (labeled as “2002 Prelim”),
- The Base F 2009 VISTAS emissions inventory developed using growth rates derived from 1996 and 2020 EPA CAIR data (labeled as “2009”),
- The Base F 2018 VISTAS emissions inventory developed using growth rates derived from 1996 and 2020 EPA CAIR data (labeled as “2018”), and
- The pre-Base F 2018 VISTAS emissions inventory estimates as developed using growth rates derived from 1996, 2010, 2015, and 2020 EPA CAIR data (labeled as “2018 Prelim”).

All 12 figures generally illustrate a reduction in emissions estimates between the 2002 pre-Base F emission estimates published in February 2004 (the initial 2002 VISTAS inventory) and the 2002 Base F emission estimates. This reduction generally results from emission updates reflected in the State 2002 CERR submittals used to develop the Base F 2002 base year inventory, although the major differences in aggregate PM emission estimates are driven to a greater extent by modifications in the methodology used to estimate aircraft PM in the Base F 2002 base year inventory (as documented under the base year inventory section of this report).

**Table 2.3-14. Base F 2009 Aircraft, Locomotive, and Non-Recreational Marine Emissions  
(annual tons) -- Based on Growth Using 1996 and 2020 EPA Inventories**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	4,178	202	278	102	19	217
	FL	29,258	10,316	2,812	2,756	928	4,235
	GA	7,635	6,233	1,712	1,678	523	512
	KY	3,075	762	207	203	73	304
	MS	1,765	162	51	50	16	108
	NC	6,551	1,601	436	427	153	644
	SC	7,372	559	446	437	98	975
	TN	8,020	3,096	824	807	268	1,050
	VA	10,994	3,094	1,239	1,214	907	2,892
	WV	1,312	91	28	28	9	74
	<b>Total</b>		<b>80,159</b>	<b>26,116</b>	<b>8,033</b>	<b>7,704</b>	<b>2,993</b>
Commercial Marine (2280)	AL	1,280	8,888	872	802	2,753	768
	FL	6,236	43,198	1,838	1,691	5,864	1,467
	GA	1,097	7,599	317	291	974	256
	KY	7,087	48,039	2,158	1,985	8,350	1,649
	MS	6,074	41,437	1,821	1,676	6,587	1,415
	NC	634	4,386	184	169	584	148
	SC	1,133	7,796	326	300	1,012	264
	TN	3,887	26,333	1,168	1,074	4,512	904
	VA	1,042	2,662	312	286	61	506
	WV	1,638	11,073	455	419	89	381
	<b>Total</b>		<b>30,109</b>	<b>201,412</b>	<b>9,450</b>	<b>8,693</b>	<b>30,786</b>
Military Marine (2283)	VA	118	299	23	21	5	50
	<b>Total</b>		<b>118</b>	<b>299</b>	<b>23</b>	<b>21</b>	<b>50</b>
Locomotives (2285)	AL	3,648	23,529	452	406	242	1,279
	FL	1,052	8,905	189	170	101	382
	GA	2,769	24,398	507	456	271	1,003
	KY	2,264	19,597	415	374	221	819
	MS	2,406	20,785	441	397	239	849
	NC	1,712	14,741	313	282	167	618
	SC	1,213	10,443	222	200	119	437
	TN	2,745	23,924	483	435	240	984
	VA	1,236	11,134	1,167	1,050	608	467
	WV	1,369	12,177	251	226	135	489
	<b>Total</b>		<b>20,412</b>	<b>169,635</b>	<b>4,440</b>	<b>3,995</b>	<b>2,343</b>
<b>Grand Total</b>		<b>130,798</b>	<b>397,462</b>	<b>21,946</b>	<b>20,413</b>	<b>36,126</b>	<b>26,148</b>

**Table 2.3-15. Base F 2018 Aircraft, Locomotive, and Non-Recreational Marine Emissions  
(annual tons) -- Based on Growth Using 1996 and 2020 EPA Inventories**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	4,681	236	345	122	23	245
	FL	34,178	12,147	3,312	3,246	1,093	4,976
	GA	8,939	7,340	2,016	1,976	616	601
	KY	3,602	898	244	239	86	357
	MS	1,986	190	60	58	18	122
	NC	6,728	1,454	400	392	139	615
	SC	8,487	616	493	484	112	1,119
	TN	9,009	3,519	939	921	309	1,187
	VA	12,578	3,528	1,370	1,342	1,063	3,358
	WV	1,484	106	33	33	10	85
	<b>Total</b>	<b>91,670</b>	<b>30,035</b>	<b>9,213</b>	<b>8,814</b>	<b>3,468</b>	<b>12,666</b>
Commercial Marine (2280)	AL	1,388	8,464	880	809	2,715	809
	FL	6,684	41,117	1,853	1,705	6,248	1,543
	GA	1,174	7,246	319	293	976	269
	KY	7,703	45,174	2,199	2,023	8,383	1,752
	MS	6,571	39,129	1,850	1,702	6,556	1,498
	NC	679	4,179	185	170	596	155
	SC	1,217	7,406	329	303	1,027	278
	TN	4,225	24,763	1,190	1,095	4,808	960
	VA	1,133	2,517	314	289	9	537
	WV	1,781	10,412	459	422	13	404
	<b>Total</b>	<b>32,554</b>	<b>190,407</b>	<b>9,578</b>	<b>8,811</b>	<b>31,330</b>	<b>8,205</b>
Military Marine (2283)	VA	128	282	23	21	1	53
	<b>Total</b>	<b>128</b>	<b>282</b>	<b>23</b>	<b>21</b>	<b>1</b>	<b>53</b>
Locomotives (2285)	AL	3,850	19,917	381	343	34	1,183
	FL	1,110	7,538	159	143	14	353
	GA	2,917	21,395	427	385	38	932
	KY	2,389	16,751	352	317	31	757
	MS	2,540	17,594	372	335	34	785
	NC	1,807	12,478	264	237	24	571
	SC	1,280	8,840	187	168	17	404
	TN	2,897	21,735	407	367	34	910
	VA	1,300	10,173	983	885	86	436
	WV	1,444	10,831	212	190	19	453
	<b>Total</b>	<b>21,534</b>	<b>147,252</b>	<b>3,744</b>	<b>3,368</b>	<b>333</b>	<b>6,785</b>
<b>Grand Total</b>		<b>145,885</b>	<b>367,975</b>	<b>22,557</b>	<b>21,015</b>	<b>35,132</b>	<b>27,709</b>

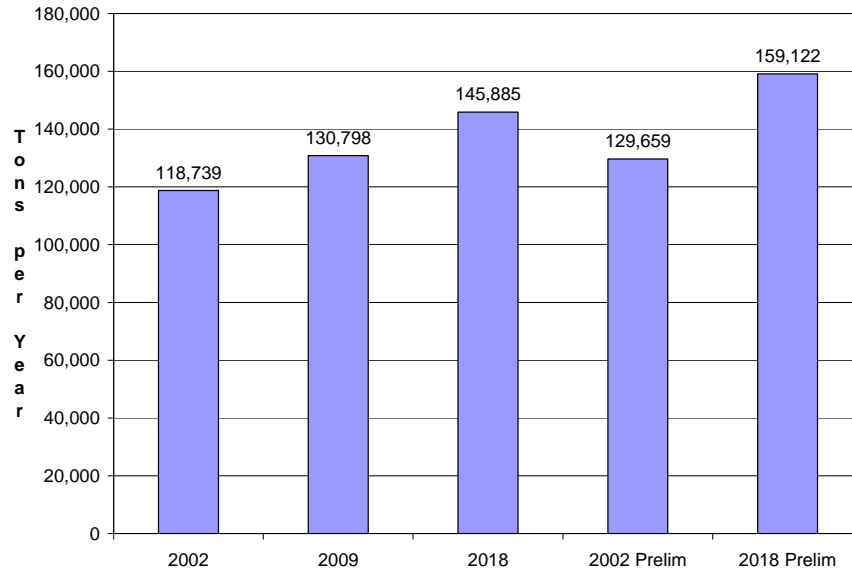
**Table 2.3-16. Change in Emissions between 2009 and 2002 Base F Inventories (Based on Growth Using 1996 and 2020 EPA Inventories)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	+10%	+15%	+23%	+18%	+16%	+11%
	FL	+15%	+16%	+16%	+16%	+16%	+16%
	GA	+15%	+16%	+16%	+16%	+16%	+16%
	KY	+15%	+16%	+16%	+16%	+16%	+16%
	MS	+11%	+16%	+15%	+15%	+16%	+12%
	NC	+8%	+3%	+4%	+4%	+3%	+5%
	SC	+13%	+9%	+9%	+9%	+12%	+13%
	TN	+11%	+12%	+12%	+12%	+14%	+11%
	VA	+13%	+12%	+9%	+9%	+15%	+14%
	WV	+11%	+16%	+15%	+15%	+16%	+12%
	<b>Total</b>		<b>+13%</b>	<b>+14%</b>	<b>+14%</b>	<b>+13%</b>	<b>+15%</b>
Commercial Marine (2280)	AL	+7%	-4%	-5%	-5%	-18%	+4%
	FL	+6%	-4%	-5%	-5%	-12%	+4%
	GA	+6%	-3%	-5%	-5%	-17%	+4%
	KY	+7%	-4%	-4%	-4%	-13%	+5%
	MS	+7%	-4%	-4%	-4%	-15%	+5%
	NC	+6%	-4%	-5%	-5%	-15%	+4%
	SC	+6%	-4%	-5%	-5%	-16%	+4%
	TN	+7%	-4%	-4%	-4%	-9%	+5%
	VA	+7%	-4%	-7%	-7%	-83%	+5%
	WV	+7%	-4%	-7%	-7%	-83%	+5%
	<b>Total</b>		<b>+7%</b>	<b>-4%</b>	<b>-5%</b>	<b>-5%</b>	<b>-15%</b>
Military Marine (2283)	VA	+7%	-4%	-7%	-7%	-83%	+5%
	<b>Total</b>		<b>+7%</b>	<b>-4%</b>	<b>-7%</b>	<b>-7%</b>	<b>-83%</b>
Locomotives (2285)	AL	+5%	-11%	-24%	-24%	-83%	-6%
	FL	+5%	-11%	-24%	-24%	-83%	-6%
	GA	+4%	-9%	-24%	-24%	-83%	-5%
	KY	+5%	-10%	-23%	-23%	-83%	-6%
	MS	+5%	-11%	-24%	-24%	-83%	-6%
	NC	+5%	-11%	-24%	-24%	-83%	-6%
	SC	+5%	-11%	-24%	-24%	-83%	-6%
	TN	+5%	-7%	-24%	-24%	-83%	-6%
	VA	+4%	-6%	-24%	-24%	-83%	-5%
	WV	+4%	-8%	-24%	-24%	-83%	-5%
	<b>Total</b>		<b>+4%</b>	<b>-9%</b>	<b>-24%</b>	<b>-24%</b>	<b>-83%</b>
<b>Grand Total</b>		<b>+10%</b>	<b>-5%</b>	<b>-4%</b>	<b>-4%</b>	<b>-32%</b>	<b>+5%</b>

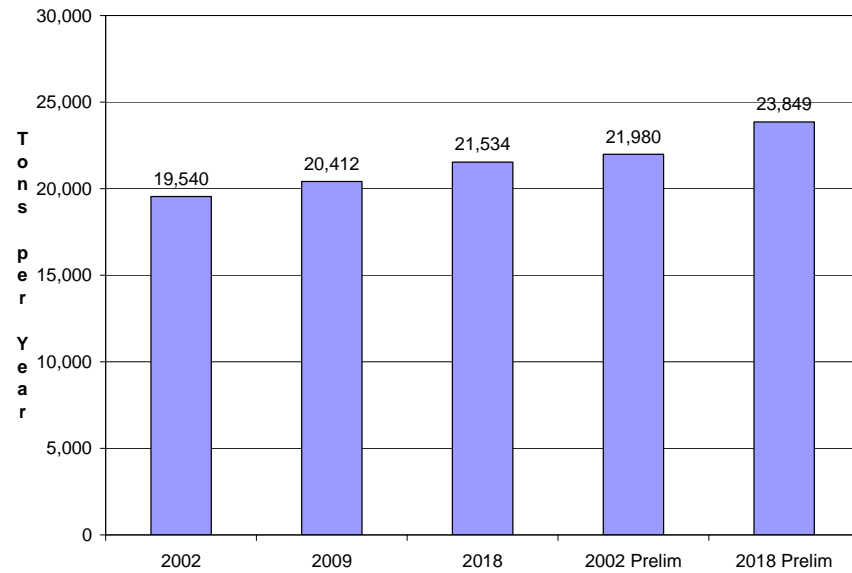
**Table 2.3-17. Change in Emissions between 2018 and 2002 Base F Inventories (Based on Growth Using 1996 and 2020 EPA Inventories)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC	
Aircraft (2275)	AL	+24%	+35%	+53%	+41%	+36%	+25%	
	FL	+34%	+37%	+37%	+37%	+37%	+36%	
	GA	+35%	+37%	+37%	+37%	+37%	+36%	
	KY	+35%	+37%	+37%	+37%	+37%	+36%	
	MS	+25%	+36%	+35%	+35%	+36%	+27%	
	NC	+10%	-6%	-5%	-5%	-6%	0%	
	SC	+30%	+20%	+21%	+21%	+27%	+30%	
	TN	+24%	+27%	+28%	+28%	+31%	+26%	
	VA	+29%	+28%	+20%	+20%	+35%	+33%	
	WV	+26%	+36%	+35%	+35%	+36%	+28%	
	<b>Total</b>		<b>+29%</b>	<b>+31%</b>	<b>+30%</b>	<b>+30%</b>	<b>+33%</b>	<b>+31%</b>
Commercial Marine (2280)	AL	+16%	-8%	-4%	-4%	-19%	+10%	
	FL	+14%	-8%	-4%	-4%	-7%	+9%	
	GA	+13%	-8%	-5%	-5%	-17%	+9%	
	KY	+17%	-10%	-2%	-2%	-13%	+12%	
	MS	+16%	-9%	-3%	-3%	-15%	+11%	
	NC	+13%	-8%	-4%	-4%	-14%	+9%	
	SC	+14%	-9%	-4%	-4%	-15%	+10%	
	TN	+17%	-10%	-2%	-2%	-3%	+12%	
	VA	+17%	-9%	-6%	-6%	-98%	+11%	
	WV	+17%	-10%	-6%	-6%	-98%	+12%	
	<b>Total</b>		<b>+15%</b>	<b>-9%</b>	<b>-3%</b>	<b>-3%</b>	<b>-14%</b>	<b>+11%</b>
Military Marine (2283)	VA	+17%	-10%	-6%	-6%	-98%	+12%	
	<b>Total</b>		<b>+17%</b>	<b>-10%</b>	<b>-6%</b>	<b>-6%</b>	<b>-98%</b>	<b>+12%</b>
Locomotives (2285)	AL	+10%	-24%	-36%	-36%	-98%	-13%	
	FL	+10%	-24%	-36%	-36%	-98%	-13%	
	GA	+10%	-20%	-36%	-36%	-98%	-12%	
	KY	+10%	-23%	-35%	-35%	-98%	-13%	
	MS	+10%	-24%	-36%	-36%	-98%	-13%	
	NC	+10%	-24%	-36%	-36%	-98%	-13%	
	SC	+10%	-24%	-36%	-36%	-98%	-13%	
	TN	+10%	-15%	-36%	-36%	-98%	-13%	
	VA	+10%	-14%	-36%	-36%	-98%	-11%	
	WV	+10%	-18%	-36%	-36%	-98%	-12%	
	<b>Total</b>		<b>+10%</b>	<b>-21%</b>	<b>-36%</b>	<b>-36%</b>	<b>-98%</b>	<b>-12%</b>
<b>Grand Total</b>			<b>+23%</b>	<b>-12%</b>	<b>-1%</b>	<b>-1%</b>	<b>-34%</b>	<b>+11%</b>

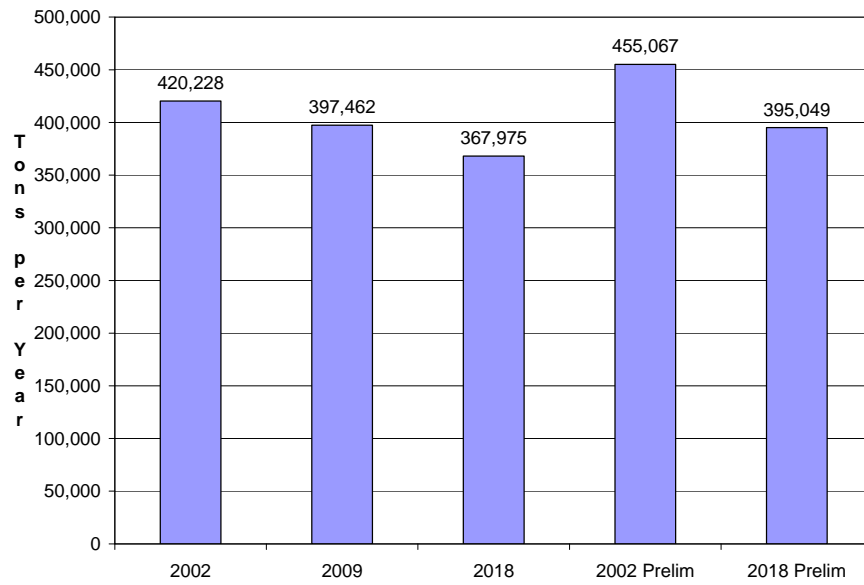
**Figure 2.3-2. Total Aircraft, Locomotive, and CMV CO Emissions (Base F)**



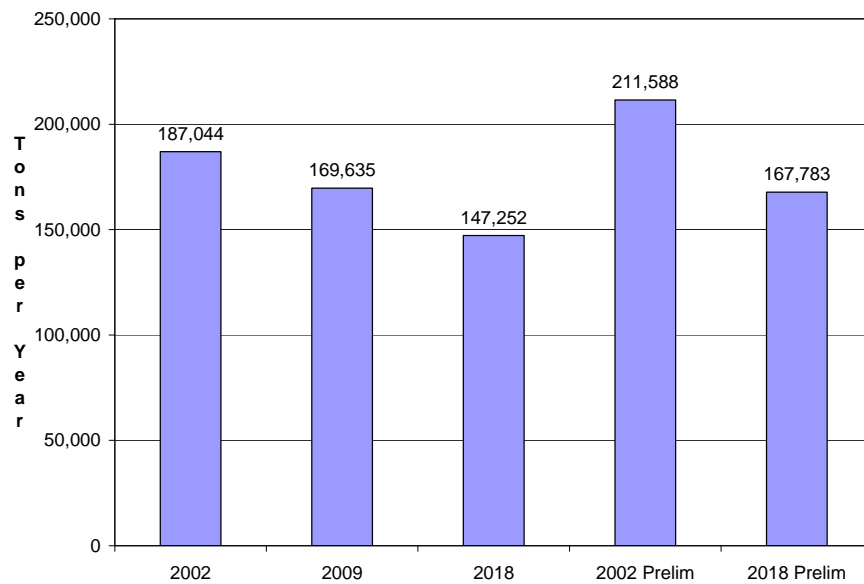
**Figure 2.3-3. Locomotive CO Emissions (Base F)**



**Figure 2.3-4. Total Aircraft, Locomotive, and CMV NO<sub>x</sub> Emissions (Base F)**

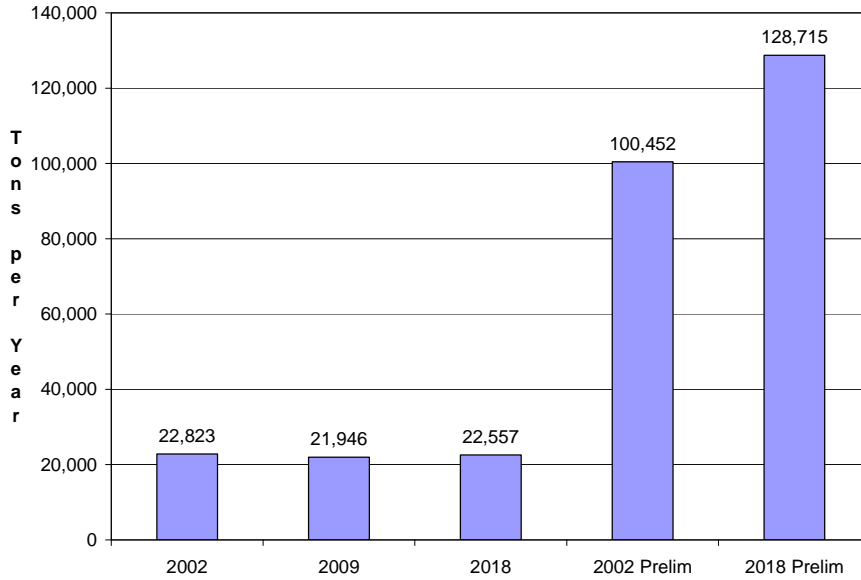


**Figure 2.3-5. Locomotive NO<sub>x</sub> Emissions (Base F)**

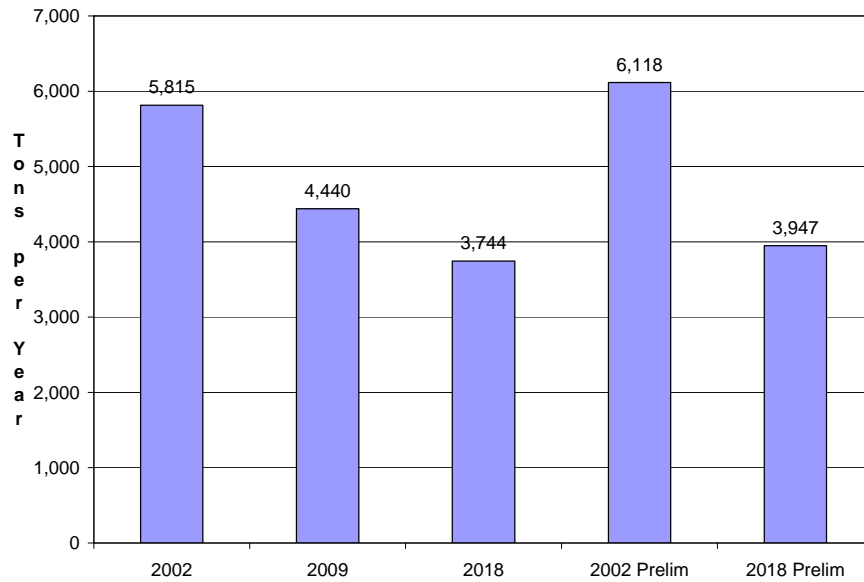




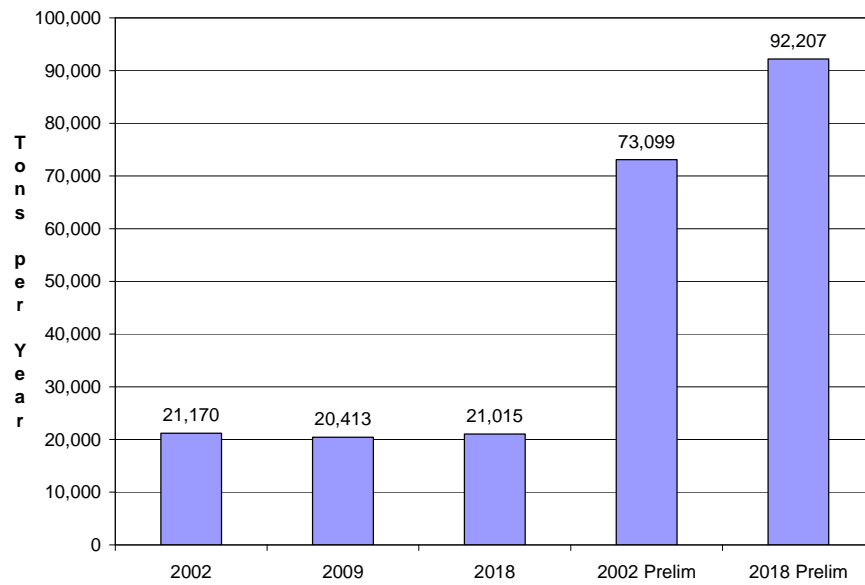
**Figure 2.3-6. Total Aircraft, Locomotive, and CMV PM<sub>10</sub> Emissions (Base F)**



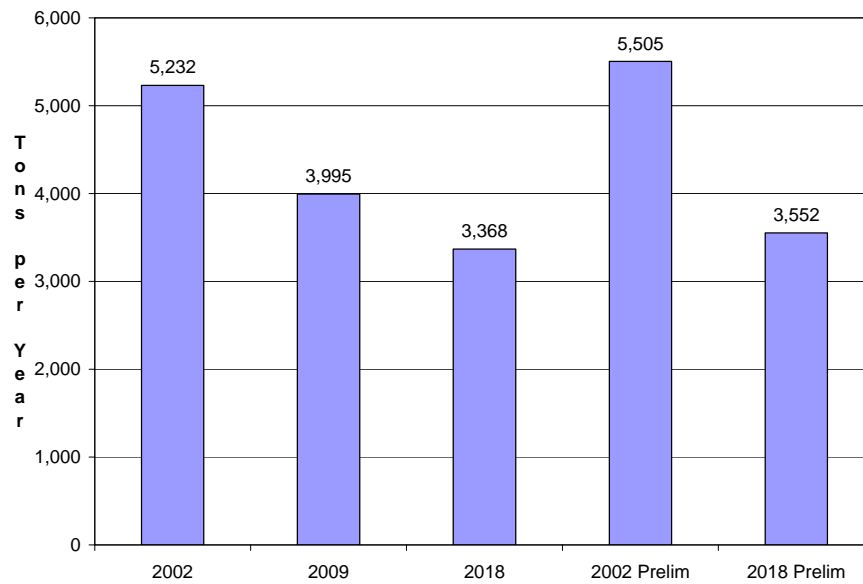
**Figure 2.3-7. Locomotive PM<sub>10</sub> Emissions (Base F)**



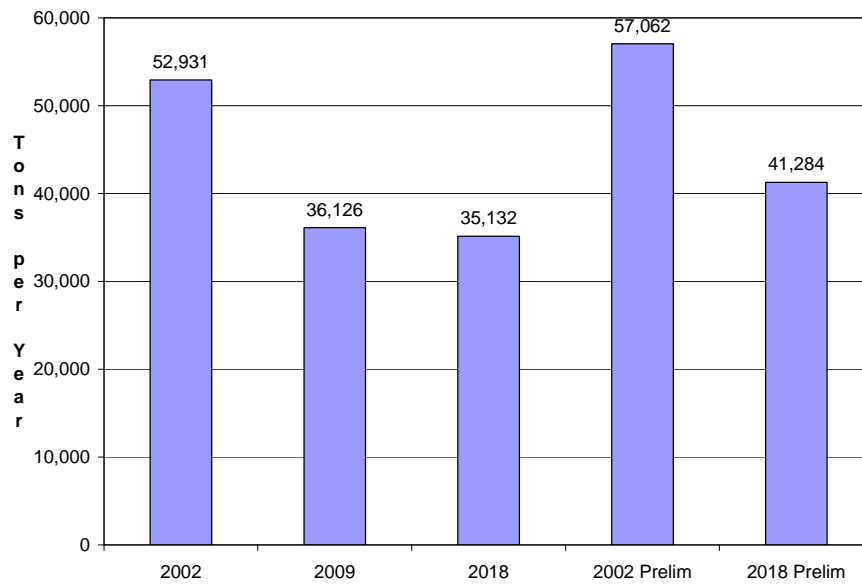
**Figure 2.3-8. Total Aircraft, Locomotive, and CMV PM<sub>2.5</sub> Emissions (Base F)**



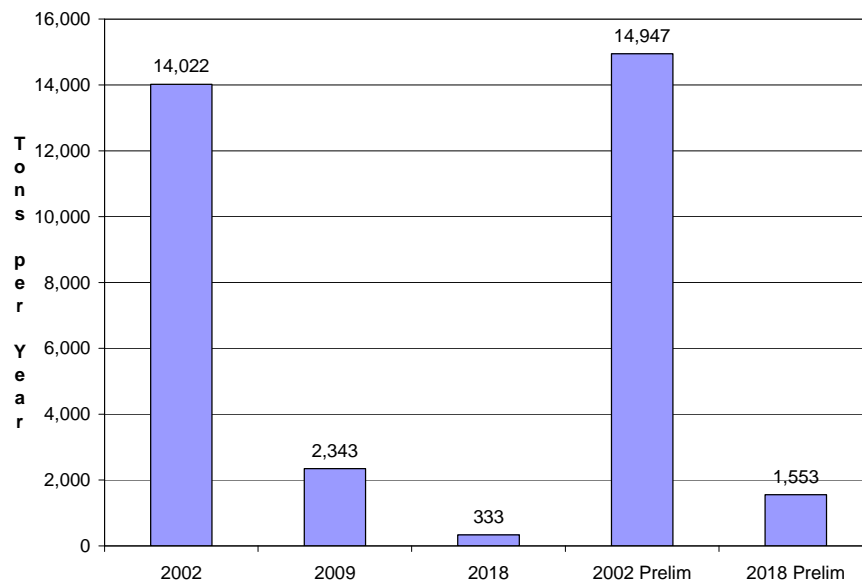
**Figure 2.3-9. Locomotive PM<sub>2.5</sub> Emissions (Base F)**



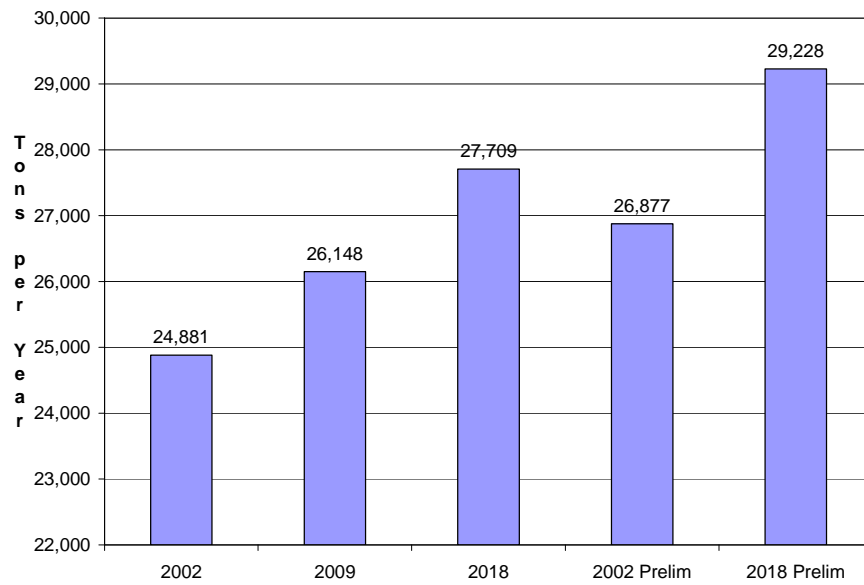
**Figure 2.3-10. Total Aircraft, Locomotive, and CMV SO<sub>2</sub> Emissions (Base F)**



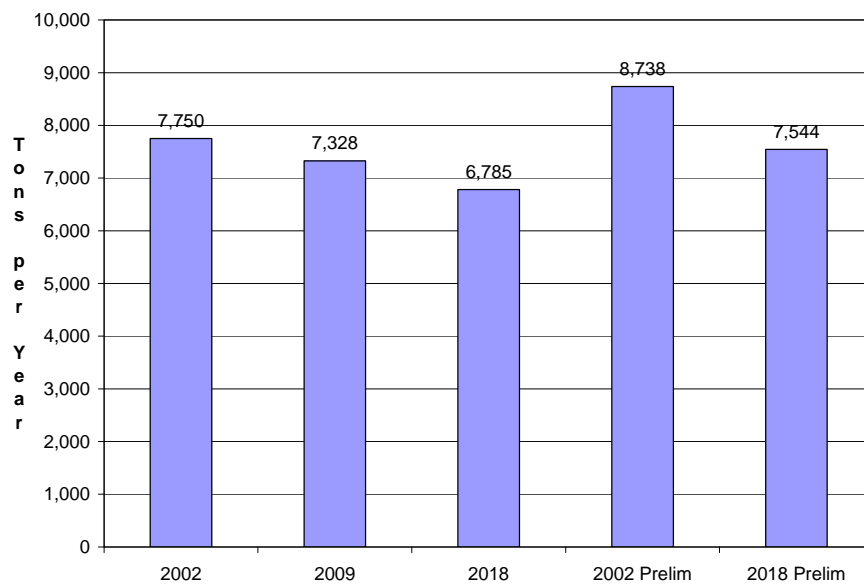
**Figure 2.3-11. Locomotive SO<sub>2</sub> Emissions (Base F)**



**Figure 2.3-12. Total Aircraft, Locomotive, and CMV VOC Emissions (Base F)**



**Figure 2.3-13. Locomotive VOC Emissions (Base F)**



### **Base G Revisions:**

Table 2.3-18 shows the Base G 2002 base year emissions for each State in the VISTAS region for aircraft, locomotives and CMV. Although some of these data are updated relative to those used as the basis of the Base F emissions forecasts, the methodology used to develop 2009 and 2018 emissions forecasts for aircraft, locomotives, and CMV for Base G is identical to that used for Base F (as documented above). The only exceptions are as follows:

- (a) As indicated in the discussion of the Base F forecasts, the CAIR (growth rate) matching criteria were overridden for any record for which States provided local growth data. For Base F, only North Carolina provided such data. However, for Base G, Kentucky regulators provided growth data for aircraft emissions associated with Cincinnati/Northern Kentucky International Airport (located in Boone County, Kentucky). These data were applied to all pollutants and all aircraft types (i.e., military aircraft (SCC 2275001000), commercial aircraft (SCC 2275020000), general aviation aircraft (SCC 2275050000), and air taxi aircraft (SCC 2275060000)). Emissions forecasts for all aircraft operations in counties other than Boone continued to utilize the growth factors developed according to the CAIR matching criteria. Table 2.3-19 presents the locally generated growth factors applied in Kentucky. It should be recognized that although the locally provided growth factors presented in the table are significantly greater than those that would apply under the CAIR matching criteria, this is to be expected as local regulators noted a very significant decline in activity at the Cincinnati/Northern Kentucky International Airport in 2002 (relative to activity in preceding years). Moreover, this downward spike seems to have been alleviated since 2002, so that the provided growth factors represent not only “routine” growth expected between 2002 and the two forecast years, but growth required to offset the temporary decline observed in 2002.

**Table 2.3-18. Base G 2002 Aircraft, Locomotive, and Non-Recreational Marine Emissions  
(annual tons)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	5,595	185	238	99	18	276
	FL	25,431	8,891	2,424	2,375	800	3,658
	GA	6,620	5,372	1,475	1,446	451	443
	KY	5,577	925	251	246	88	397
	MS	1,593	140	44	43	13	96
	NC	6,088	1,548	419	411	148	613
	SC	6,505	515	409	401	88	863
	TN	7,251	2,766	734	719	235	943
	VA	11,873	3,885	2,010	1,970	272	2,825
	WV	1,178	78	25	24	8	66
	<b>Total</b>		<b>77,712</b>	<b>24,305</b>	<b>8,029</b>	<b>7,734</b>	<b>2,121</b>
Commercial Marine (2280)	AL	1,196	9,218	917	844	3,337	737
	FL	5,888	44,817	1,936	1,781	6,683	1,409
	GA	1,038	7,875	334	307	1,173	246
	KY	6,607	50,267	2,246	2,066	9,608	1,569
	MS	5,688	43,233	1,903	1,751	7,719	1,351
	NC	599	4,547	193	178	690	142
	SC	1,067	8,100	343	316	1,205	253
	TN	3,624	27,555	1,217	1,120	4,974	860
	VA	972	2,775	334	307	359	483
	WV	1,528	11,586	487	448	525	362
	<b>Total</b>		<b>28,207</b>	<b>209,972</b>	<b>9,911</b>	<b>9,118</b>	<b>36,275</b>
Military Marine (2283)	VA	110	313	25	23	27	48
	<b>Total</b>		<b>110</b>	<b>313</b>	<b>25</b>	<b>23</b>	<b>48</b>
Locomotives (2285)	AL	3,518	26,623	592	533	1,446	1,365
	FL	1,006	9,969	247	222	605	404
	GA	2,654	26,733	664	598	1,622	1,059
	KY	2,166	21,811	542	488	1,321	867
	MS	2,302	23,267	578	520	1,429	899
	NC	1,638	16,502	410	369	1,001	654
	SC	1,160	11,690	291	261	710	462
	TN	2,626	25,627	633	570	1,439	1,041
	VA	1,186	11,882	1,529	1,375	3,641	492
	WV	1,311	13,224	329	296	808	517
	<b>Total</b>		<b>19,568</b>	<b>187,328</b>	<b>5,815</b>	<b>5,232</b>	<b>14,022</b>
<b>Grand Total</b>		<b>125,597</b>	<b>421,918</b>	<b>23,780</b>	<b>22,107</b>	<b>52,444</b>	<b>25,401</b>

**Table 2.3-19 Locally Generated Growth Factors for Kentucky**

FIP	2009 Factor	2018 Factor
21015	1.31	1.81

**Note:**

Growth factor = Year Emissions/2002 Emissions.

Under CAIR approach, 2009 = 0.99 to 1.17.

Under CAIR approach, 2018 = 0.97 to 1.40.

(b) Because of the additional emissions records added in Alabama, as discussed in the Base G 2002 base year inventory section of this report, the total number of emissions records in the Base G 2009 and 2018 forecasts increased to 23,042 (as compared to 22,838 for Base F). The 23,042 data records for aircraft, locomotives, and CMV were assigned growth factors in accordance with the following breakdown:

72 records matched State-provided growth factors,  
 4,287 records matched using the CAIR-Primary criterion,  
 240 records matched using the CAIR-Secondary criterion,  
 7,511 records matched using the CAIR-Tertiary criterion,  
 720 records matched using the No T4-Primary criterion,  
 3,858 records matched using the No T4-Secondary criterion, and  
 6,354 records matched using the No T4-Tertiary criterion.

Tables 2.3-20 and 2.3-21 present a summary of the resulting Base G 2009 and 2018 inventories, while Tables 2.3-22 and 2.3-23 present the associated change in emissions for each forecast inventory relative to the Base G 2002 base year VISTAS. As was the case with Base F, the larger reduction in CMV SO<sub>2</sub> emissions in 2009 and 2018 (relative to 2002) for Virginia and West Virginia is notable relative to the other VISTAS States, but is attributable to a high diesel contribution to total CMV SO<sub>2</sub> in the 2002 inventories for these two States.

Figures 2.3-14 through 2.3-25 graphically depict the relationships between the various inventories, as revised through Base G. There are two figures for each pollutant, the first of which presents a comparison of total VISTAS regional emission estimates for aircraft, locomotives, and CMV, and the second of which presents total VISTAS region emission estimates for locomotives only. This two figure approach is intended to provide a more robust illustration of the differences between the various inventories, as some of the differences are less distinct when viewed through overall aggregate emissions totals. All of the figures include the following emissions estimates:

- The Base G 2002 base year VISTAS emissions inventory (labeled as “2002”),
- The pre-Base F 2002 base year VISTAS emissions inventory (labeled as “2002 Prelim”),
- The Base G 2009 VISTAS emissions inventory developed using growth rates derived from 1996 and 2020 EPA CAIR data (labeled as “2009”),
- The Base G 2018 VISTAS emissions inventory developed using growth rates derived from 1996 and 2020 EPA CAIR data (labeled as “2018”), and
- The pre-Base F 2018 VISTAS emissions inventory estimates developed using growth rates derived from 1996, 2010, 2015, and 2020 EPA CAIR data (labeled as “2018 Prelim”).

All 12 figures generally illustrate a reduction in emissions estimates between the pre-Base F 2002 emission estimates published in February 2004 and the Base G 2002 base year emission estimates. This reduction generally results from emission updates reflected in the Base F State CERR submittals, although the major differences in aggregate PM emission estimates are driven to a greater extent by modifications in the methodology used to estimate aircraft PM in the Base F revisions to the 2002 Base F base year inventory (as documented under the base year inventory section of this report).



**Table 2.3-20. Base G 2009 Aircraft, Locomotive, and Non-Recreational Marine Emissions  
(annual tons) -- Based on Growth Using 1996 and 2020 EPA Inventories**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	6,265	213	292	116	21	309
	FL	29,258	10,316	2,812	2,756	928	4,235
	GA	7,635	6,233	1,712	1,678	523	512
	KY	6,959	1,135	307	301	108	487
	MS	1,765	162	51	50	16	108
	NC	6,991	1,795	486	477	171	709
	SC	7,372	559	446	437	98	975
	TN	8,020	3,096	824	807	268	1,050
	VA	13,141	4,244	2,124	2,082	306	3,153
	WV	1,312	91	28	28	9	74
	<b>Total</b>		<b>88,716</b>	<b>27,844</b>	<b>9,083</b>	<b>8,732</b>	<b>2,447</b>
Commercial Marine (2280)	AL	1,280	8,888	872	802	2,753	768
	FL	6,236	43,198	1,838	1,691	5,864	1,467
	GA	1,097	7,599	317	291	974	256
	KY	7,087	48,039	2,158	1,985	8,350	1,649
	MS	6,074	41,437	1,821	1,676	6,587	1,415
	NC	634	4,386	184	169	584	148
	SC	1,133	7,796	326	300	1,012	264
	TN	3,887	26,333	1,168	1,074	4,512	904
	VA	1,042	2,662	312	286	61	506
	WV	1,638	11,073	455	419	89	381
	<b>Total</b>		<b>30,108</b>	<b>201,412</b>	<b>9,450</b>	<b>8,693</b>	<b>30,786</b>
Military Marine (2283)	VA	118	299	23	21	5	50
	<b>Total</b>	<b>118</b>	<b>299</b>	<b>23</b>	<b>21</b>	<b>5</b>	<b>50</b>
Locomotives (2285)	AL	3,677	23,783	452	406	242	1,289
	FL	1,052	8,905	189	170	101	382
	GA	2,769	24,398	507	456	271	1,003
	KY	2,264	19,597	415	374	221	819
	MS	2,406	20,785	441	397	239	849
	NC	1,690	14,662	311	279	165	613
	SC	1,213	10,443	222	200	119	437
	TN	2,745	23,924	483	435	240	984
	VA	1,236	11,134	1,167	1,050	608	467
	WV	1,369	12,177	251	226	135	489
	<b>Total</b>		<b>20,420</b>	<b>169,808</b>	<b>4,437</b>	<b>3,993</b>	<b>2,341</b>
<b>Grand Total</b>		<b>139,362</b>	<b>399,364</b>	<b>22,994</b>	<b>21,440</b>	<b>35,578</b>	<b>26,754</b>

**Table 2.3-21. Base G 2018 Aircraft, Locomotive, and Non-Recreational Marine Emissions  
(annual tons) -- Based on Growth Using 1996 and 2020 EPA Inventories**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	7,126	249	361	139	24	352
	FL	34,178	12,147	3,312	3,246	1,093	4,976
	GA	8,939	7,340	2,016	1,976	616	601
	KY	9,078	1,446	391	383	138	623
	MS	1,986	190	60	58	18	122
	NC	8,150	2,114	572	561	202	831
	SC	8,487	616	493	484	112	1,119
	TN	9,009	3,519	939	921	309	1,187
	VA	14,770	4,706	2,271	2,226	349	3,574
	WV	1,484	106	33	33	10	85
	<b>Total</b>	<b>103,206</b>	<b>32,435</b>	<b>10,450</b>	<b>10,027</b>	<b>2,871</b>	<b>13,472</b>
Commercial Marine (2280)	AL	1,388	8,464	880	809	2,715	809
	FL	6,684	41,117	1,853	1,705	6,248	1,543
	GA	1,174	7,246	319	293	976	269
	KY	7,703	45,174	2,199	2,023	8,383	1,752
	MS	6,571	39,129	1,850	1,702	6,556	1,498
	NC	678	4,179	185	170	596	155
	SC	1,217	7,406	329	303	1,027	278
	TN	4,225	24,763	1,190	1,095	4,808	960
	VA	1,133	2,517	314	289	9	537
	WV	1,781	10,412	459	422	13	404
	<b>Total</b>	<b>32,554</b>	<b>190,407</b>	<b>9,578</b>	<b>8,811</b>	<b>31,330</b>	<b>8,205</b>
Military Marine (2283)	VA	128	282	23	21	1	53
	<b>Total</b>	<b>128</b>	<b>282</b>	<b>23</b>	<b>21</b>	<b>1</b>	<b>53</b>
Locomotives (2285)	AL	3,881	20,131	381	343	34	1,192
	FL	1,110	7,538	159	143	14	353
	GA	2,917	21,395	427	385	38	932
	KY	2,389	16,751	352	317	31	757
	MS	2,540	17,594	372	335	34	785
	NC	1,782	12,539	263	237	23	570
	SC	1,280	8,840	187	168	17	404
	TN	2,897	21,735	407	367	34	910
	VA	1,300	10,173	983	885	86	436
	WV	1,444	10,831	212	190	19	453
	<b>Total</b>	<b>21,539</b>	<b>147,527</b>	<b>3,743</b>	<b>3,368</b>	<b>332</b>	<b>6,792</b>
<b>Grand Total</b>		<b>157,427</b>	<b>370,651</b>	<b>23,794</b>	<b>22,227</b>	<b>34,534</b>	<b>28,522</b>

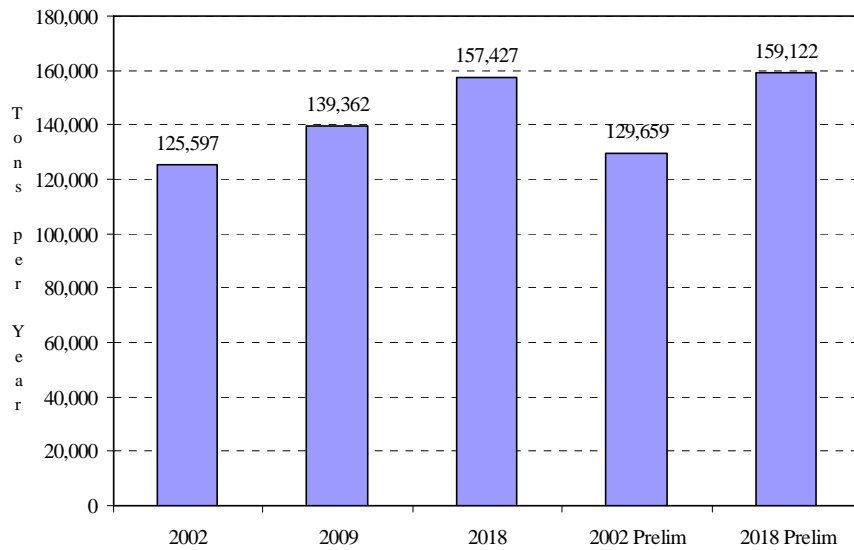
**Table 2.3-22. Change in Emissions between 2009 Base G and 2002 Base F Inventories  
(Based on Growth Using 1996 and 2020 EPA Inventories)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC	
Aircraft (2275)	AL	+12%	+15%	+23%	+18%	+16%	+12%	
	FL	+15%	+16%	+16%	+16%	+16%	+16%	
	GA	+15%	+16%	+16%	+16%	+16%	+16%	
	KY	+25%	+23%	+23%	+23%	+23%	+23%	
	MS	+11%	+16%	+15%	+15%	+16%	+12%	
	NC	+15%	+16%	+16%	+16%	+16%	+16%	
	SC	+13%	+9%	+9%	+9%	+12%	+13%	
	TN	+11%	+12%	+12%	+12%	+14%	+11%	
	VA	+11%	+9%	+6%	+6%	+12%	+12%	
	WV	+11%	+16%	+15%	+15%	+16%	+12%	
	<b>Total</b>		<b>+14%</b>	<b>+15%</b>	<b>+13%</b>	<b>+13%</b>	<b>+15%</b>	<b>+14%</b>
Commercial Marine (2280)	AL	+7%	-4%	-5%	-5%	-18%	+4%	
	FL	+6%	-4%	-5%	-5%	-12%	+4%	
	GA	+6%	-3%	-5%	-5%	-17%	+4%	
	KY	+7%	-4%	-4%	-4%	-13%	+5%	
	MS	+7%	-4%	-4%	-4%	-15%	+5%	
	NC	+6%	-4%	-5%	-5%	-15%	+4%	
	SC	+6%	-4%	-5%	-5%	-16%	+4%	
	TN	+7%	-4%	-4%	-4%	-9%	+5%	
	VA	+7%	-4%	-7%	-7%	-83%	+5%	
	WV	+7%	-4%	-7%	-7%	-83%	+5%	
	<b>Total</b>		<b>+7%</b>	<b>-4%</b>	<b>-5%</b>	<b>-5%</b>	<b>-15%</b>	<b>+5%</b>
Military Marine (2283)	VA	+7%	-4%	-7%	-7%	-83%	+5%	
	<b>Total</b>		<b>+7%</b>	<b>-4%</b>	<b>-7%</b>	<b>-7%</b>	<b>-83%</b>	<b>+5%</b>
Locomotives (2285)	AL	+5%	-11%	-24%	-24%	-83%	-6%	
	FL	+5%	-11%	-24%	-24%	-83%	-6%	
	GA	+4%	-9%	-24%	-24%	-83%	-5%	
	KY	+5%	-10%	-23%	-23%	-83%	-6%	
	MS	+5%	-11%	-24%	-24%	-83%	-6%	
	NC	+3%	-11%	-24%	-24%	-83%	-6%	
	SC	+5%	-11%	-24%	-24%	-83%	-6%	
	TN	+5%	-7%	-24%	-24%	-83%	-6%	
	VA	+4%	-6%	-24%	-24%	-83%	-5%	
	WV	+4%	-8%	-24%	-24%	-83%	-5%	
	<b>Total</b>		<b>+4%</b>	<b>-9%</b>	<b>-24%</b>	<b>-24%</b>	<b>-83%</b>	<b>-6%</b>
<b>Grand Total</b>			<b>+11%</b>	<b>-5%</b>	<b>-3%</b>	<b>-3%</b>	<b>-32%</b>	<b>+5%</b>

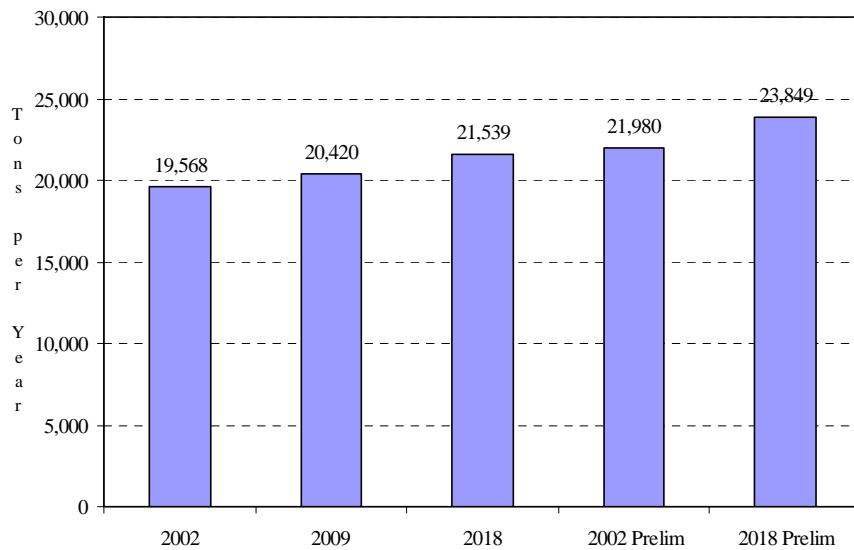
**Table 2.3-23. Change in Emissions between 2018 Base G and 2002 Base F Inventories  
(Based on Growth Using 1996 and 2020 EPA Inventories)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC	
Aircraft (2275)	AL	+27%	+35%	+52%	+41%	+36%	+28%	
	FL	+34%	+37%	+37%	+37%	+37%	+36%	
	GA	+35%	+37%	+37%	+37%	+37%	+36%	
	KY	+63%	+56%	+56%	+56%	+56%	+57%	
	MS	+25%	+36%	+35%	+35%	+36%	+27%	
	NC	+34%	+37%	+36%	+36%	+37%	+36%	
	SC	+30%	+20%	+21%	+21%	+27%	+30%	
	TN	+24%	+27%	+28%	+28%	+31%	+26%	
	VA	+24%	+21%	+13%	+13%	+28%	+27%	
	WV	+26%	+36%	+35%	+35%	+36%	+28%	
	<b>Total</b>		<b>+33%</b>	<b>+33%</b>	<b>+30%</b>	<b>+30%</b>	<b>+35%</b>	<b>+32%</b>
Commercial Marine (2280)	AL	+16%	-8%	-4%	-4%	-19%	+10%	
	FL	+14%	-8%	-4%	-4%	-7%	+9%	
	GA	+13%	-8%	-5%	-5%	-17%	+9%	
	KY	+17%	-10%	-2%	-2%	-13%	+12%	
	MS	+16%	-9%	-3%	-3%	-15%	+11%	
	NC	+13%	-8%	-4%	-4%	-14%	+9%	
	SC	+14%	-9%	-4%	-4%	-15%	+10%	
	TN	+17%	-10%	-2%	-2%	-3%	+12%	
	VA	+17%	-9%	-6%	-6%	-98%	+11%	
	WV	+17%	-10%	-6%	-6%	-98%	+12%	
	<b>Total</b>		<b>+15%</b>	<b>-9%</b>	<b>-3%</b>	<b>-3%</b>	<b>-14%</b>	<b>+11%</b>
Military Marine (2283)	VA	+17%	-10%	-6%	-6%	-98%	+12%	
	<b>Total</b>		<b>+17%</b>	<b>-10%</b>	<b>-6%</b>	<b>-6%</b>	<b>-98%</b>	<b>+12%</b>
Locomotives (2285)	AL	+10%	-24%	-36%	-36%	-98%	-13%	
	FL	+10%	-24%	-36%	-36%	-98%	-13%	
	GA	+10%	-20%	-36%	-36%	-98%	-12%	
	KY	+10%	-23%	-35%	-35%	-98%	-13%	
	MS	+10%	-24%	-36%	-36%	-98%	-13%	
	NC	+9%	-24%	-36%	-36%	-98%	-13%	
	SC	+10%	-24%	-36%	-36%	-98%	-13%	
	TN	+10%	-15%	-36%	-36%	-98%	-13%	
	VA	+10%	-14%	-36%	-36%	-98%	-11%	
	WV	+10%	-18%	-36%	-36%	-98%	-12%	
	<b>Total</b>		<b>+10%</b>	<b>-21%</b>	<b>-36%</b>	<b>-36%</b>	<b>-98%</b>	<b>-12%</b>
<b>Grand Total</b>			<b>+25%</b>	<b>-12%</b>	<b>+0%</b>	<b>+1%</b>	<b>-34%</b>	<b>+12%</b>

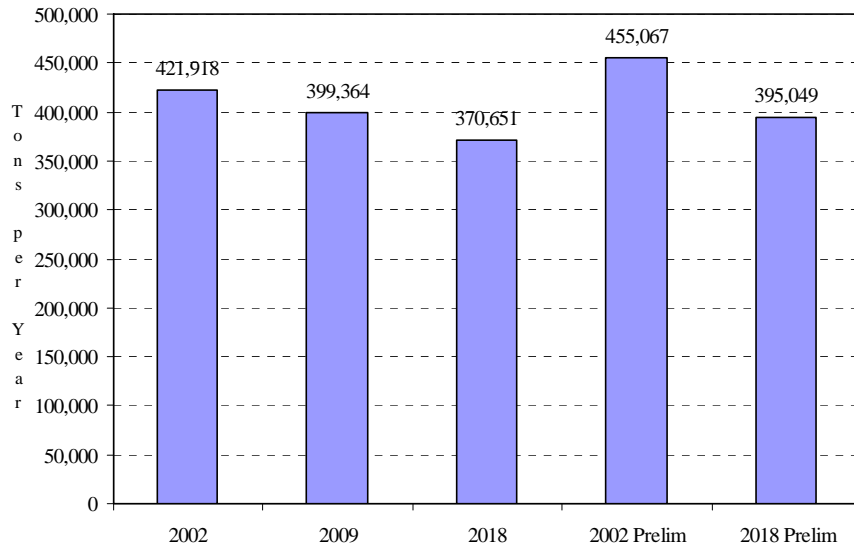
**Figure 2.3-14. Total Aircraft, Locomotive, and CMV CO Emissions (Base G)**



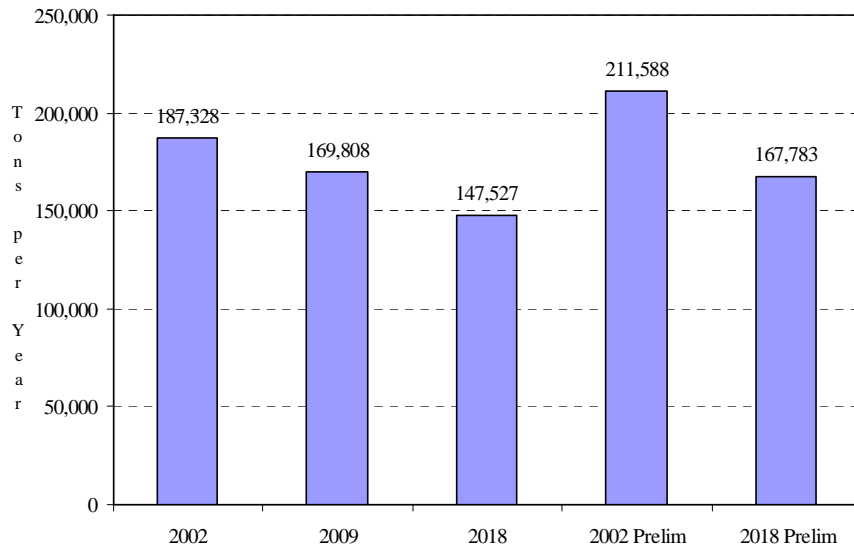
**Figure 2.3-15. Locomotive CO Emissions (Base G)**



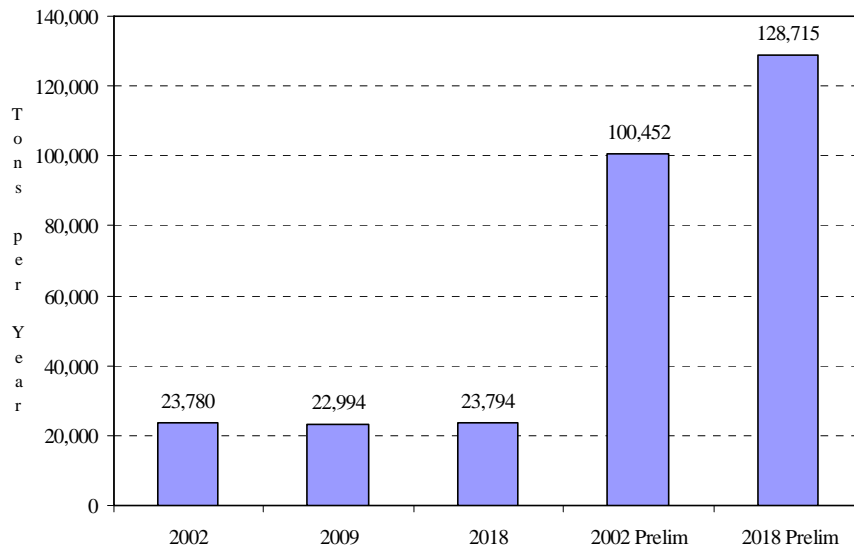
**Figure 2.3-16. Total Aircraft, Locomotive, and CMV NO<sub>x</sub> Emissions (Base G)**



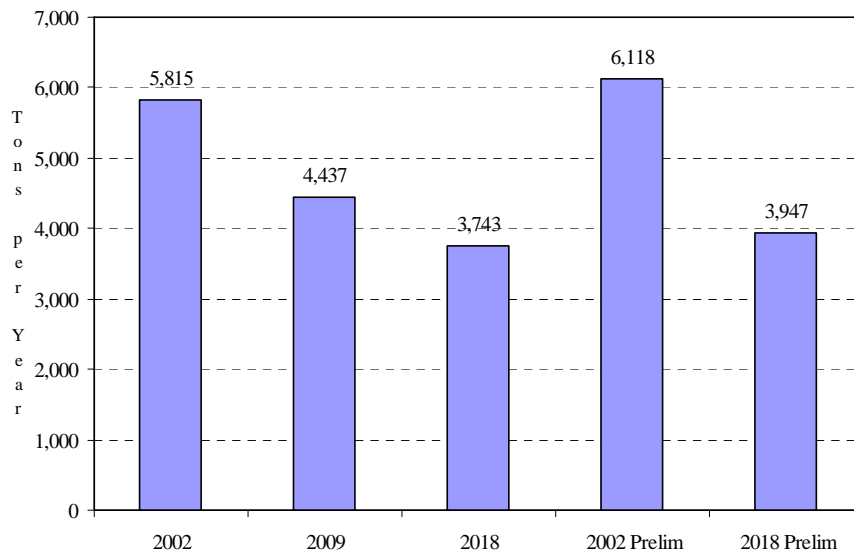
**Figure 2.3-17. Locomotive NO<sub>x</sub> Emissions (Base G)**



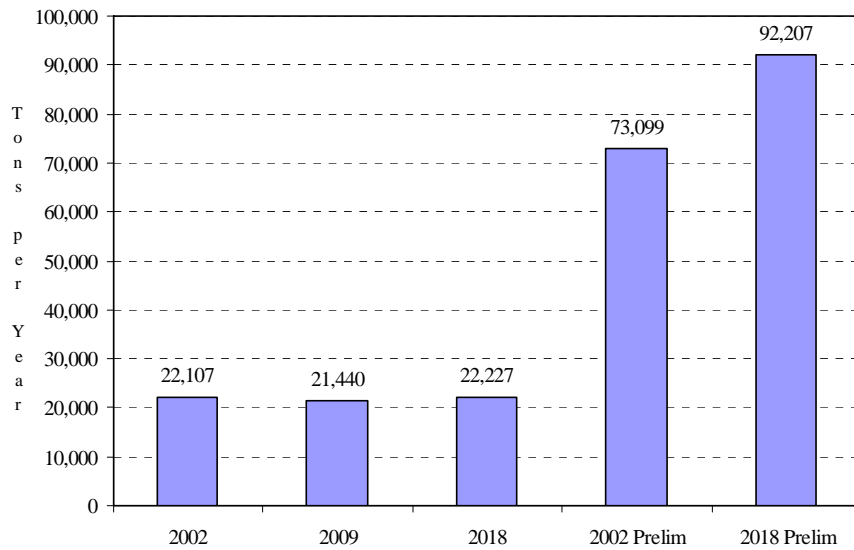
**Figure 2.3-18. Total Aircraft, Locomotive, and CMV PM<sub>10</sub> Emissions (Base G)**



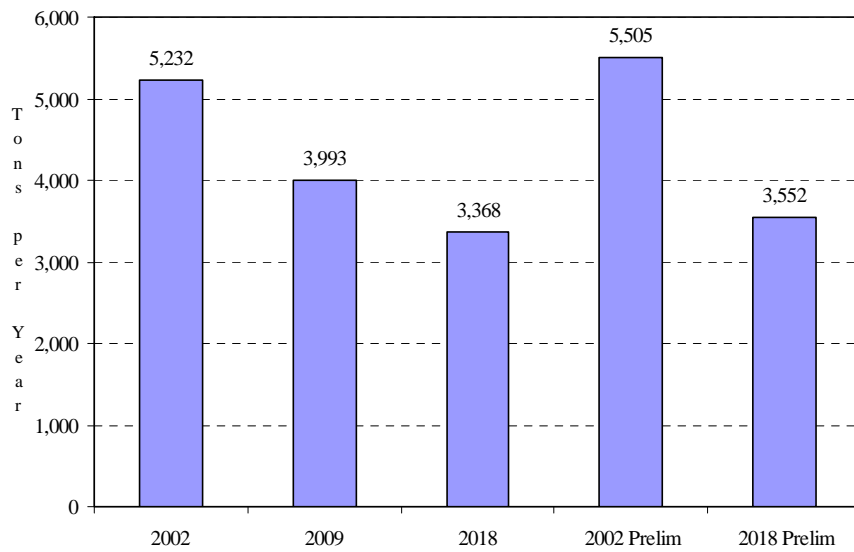
**Figure 2.3-19. Locomotive PM<sub>10</sub> Emissions (Base G)**



**Figure 2.3-20. Total Aircraft, Locomotive, and CMV PM<sub>2.5</sub> Emissions (Base G)**

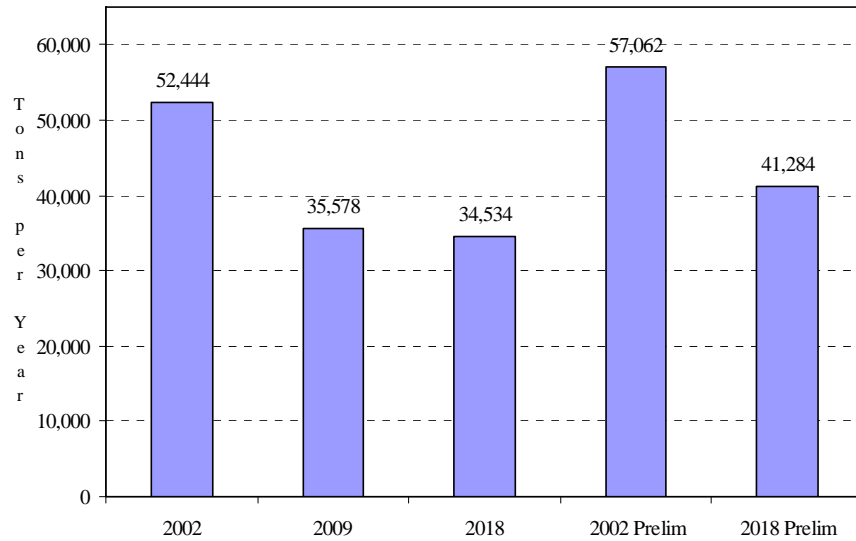


**Figure 2.3-21. Locomotive PM<sub>2.5</sub> Emissions (Base G)**

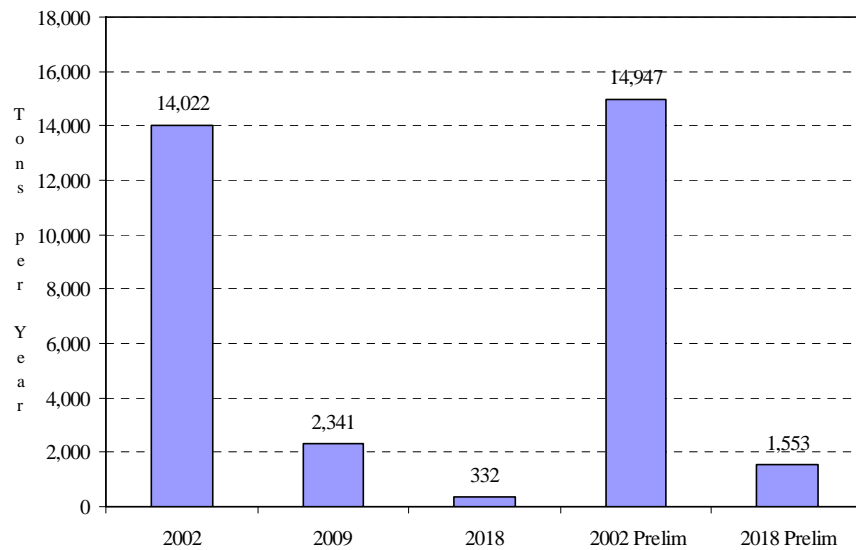




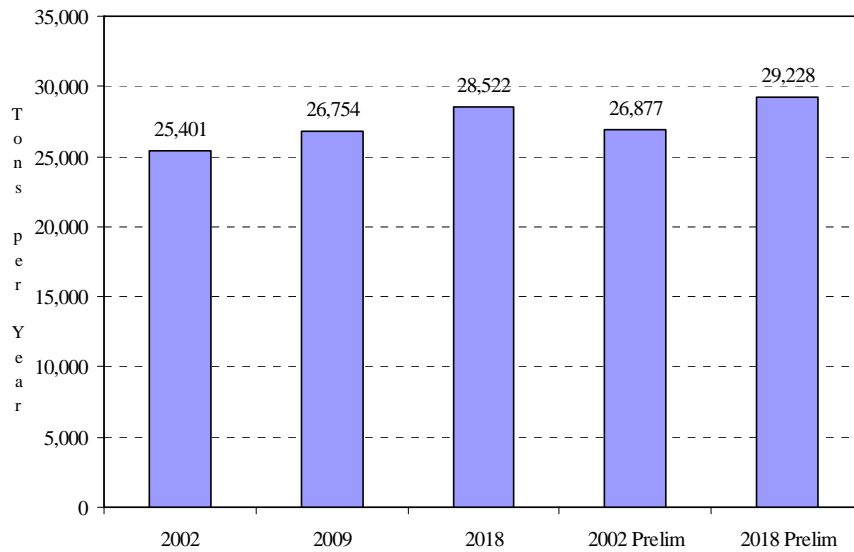
**Figure 2.3-22. Total Aircraft, Locomotive, and CMV SO<sub>2</sub> Emissions (Base G)**



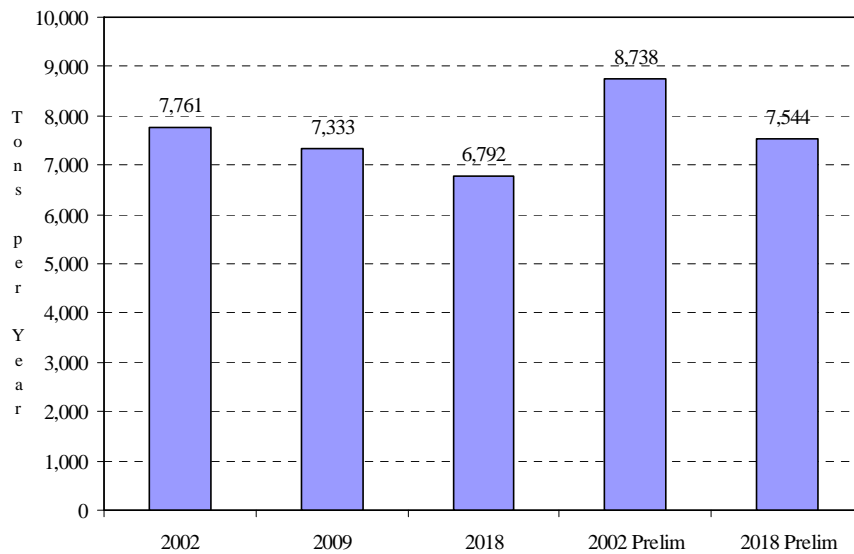
**Figure 2.3-23. Locomotive SO<sub>2</sub> Emissions (Base G)**



**Figure 2.3-24. Total Aircraft, Locomotive, and CMV VOC Emissions (Base G)**



**Figure 2.3-25. Locomotive VOC Emissions (Base G)**



### **2.3.4.3 Emissions from NONROAD Model Sources in Illinois, Indiana, and Ohio**

Base G projection inventories for 2009 and 2018 for NONROAD model sources in the states of Illinois, Indiana, and Ohio were produced using a methodology identical to that employed to develop a Base G 2002 base year inventory for the same states (as documented earlier in this report). This method consists of the extraction of a complete set of county-level input data applicable to each of the three states (in each of the two projection years) from the latest version of the EPA's NMIM model. This includes appropriate consideration of all non-default NMIM input files generated by the Midwest Regional Planning Organization as documented earlier in the discussion of the Base G 2002 base year inventory. These input data were then assembled into appropriate input files for the Final NONROAD2005 model and emission estimates were produced using the same procedure employed for the VISTAS region.

Changes noted between the base year (2002) and forecast year (2009 and 2018) input data extracted from NMIM include differences in gasoline vapor pressure, gasoline sulfur content, and diesel sulfur content in most counties. All temperature data (minimum, maximum, and average daily temperatures) was constant across years.

As described in the discussion of the Base G 2002 base year inventory, counties in the three states were grouped for modeling purposes using a temperature aggregation scheme that allowed for county-specific temperature variations of no more than 2 °F from group average temperatures (for all temperature inputs). The same grouping scheme was applied to projection year modeling, so that Illinois emissions were modeled using 12 county groups, Indiana emissions were modeled using 9 county groups, and Ohio emissions were modeled using 10 county groups. Thus, 31 iterations of NONROAD2002 were required per season per projection year, as compared to the 53 iterations per season per projection year required for the VISTAS region.

As was also described in the discussion of the Base G 2002 base year inventory, several non-default equipment population, growth, activity, seasonal distribution, and county allocation files are assigned by NMIM model inputs for these counties. As was the case for the base year inventory development, these same non-default assignments were retained for both projection inventories.

### **2.3.4.4 Differences between 2009/2018**

Methodologically, there was no difference in the way that 2009 and 2018 emissions were calculated for non-road mobile sources. The actual value of the growth factors were different for each type of mobile source considered, but the calculation methods were identical.

### 2.3.5 *Quality Assurance steps*

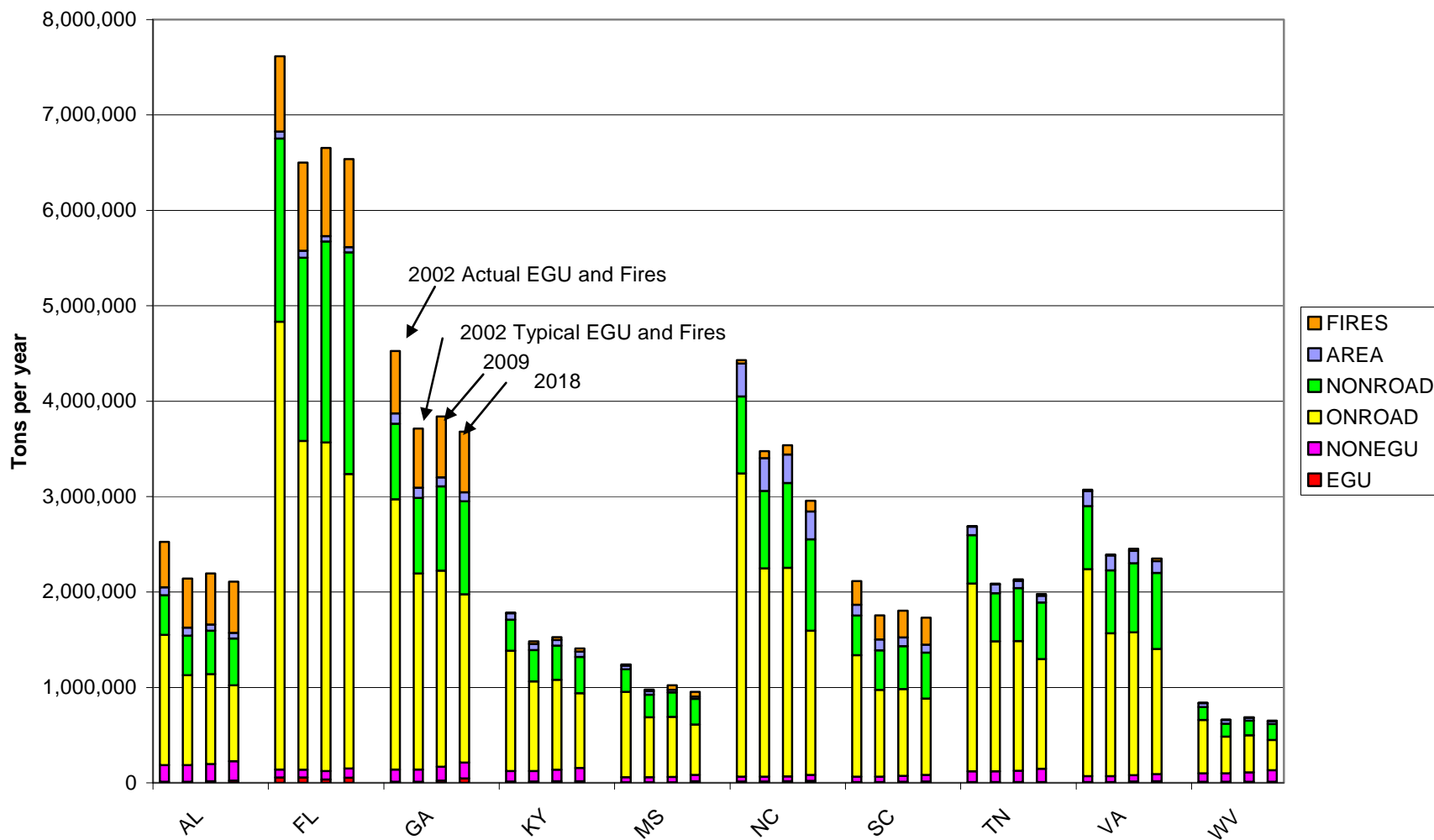
Throughout the inventory development process, quality assurance steps were performed to ensure that no double counting of emissions occurred, to ensure that a full and complete inventory was developed for VISTAS, and to make sure that projection calculations were working correctly. Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on mobile source components of the 2009 and revised 2018 projection inventories:

1. All final files (NONROAD only) were run through EPA's Format and Content checking software. Input data files for MOBILE and VMT growth estimates were reviewed by the corresponding SIWG and by the VISTAS Emission Inventory Technical Advisor.
2. SCC level emission summaries were prepared and evaluated to ensure that emissions were consistent and that there were no missing sources (NONROAD only).
3. Tier comparisons (by pollutant) were developed between the 2002 base year inventory and the 2009 and 2018 projection inventories (NONROAD only). Total VISTAS level summaries by pollutant were developed for these sources to compare Base F and Base G emission levels.
4. Data product summaries were provided to both the VISTAS Emission Inventory Technical Advisor and to the SIWG representatives for review and comment. Changes based on these comments were implemented in the files.
5. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from 1.0 to 2.0. A minor change would cause a version number to go from 1.0 to 1.1. Minor changes resulting from largely editorial changes would result in a change from 1.00 to 1.01.

**APPENDIX A:**

**STATE EMISSION TOTALS BY POLLUTANT AND SECTOR**

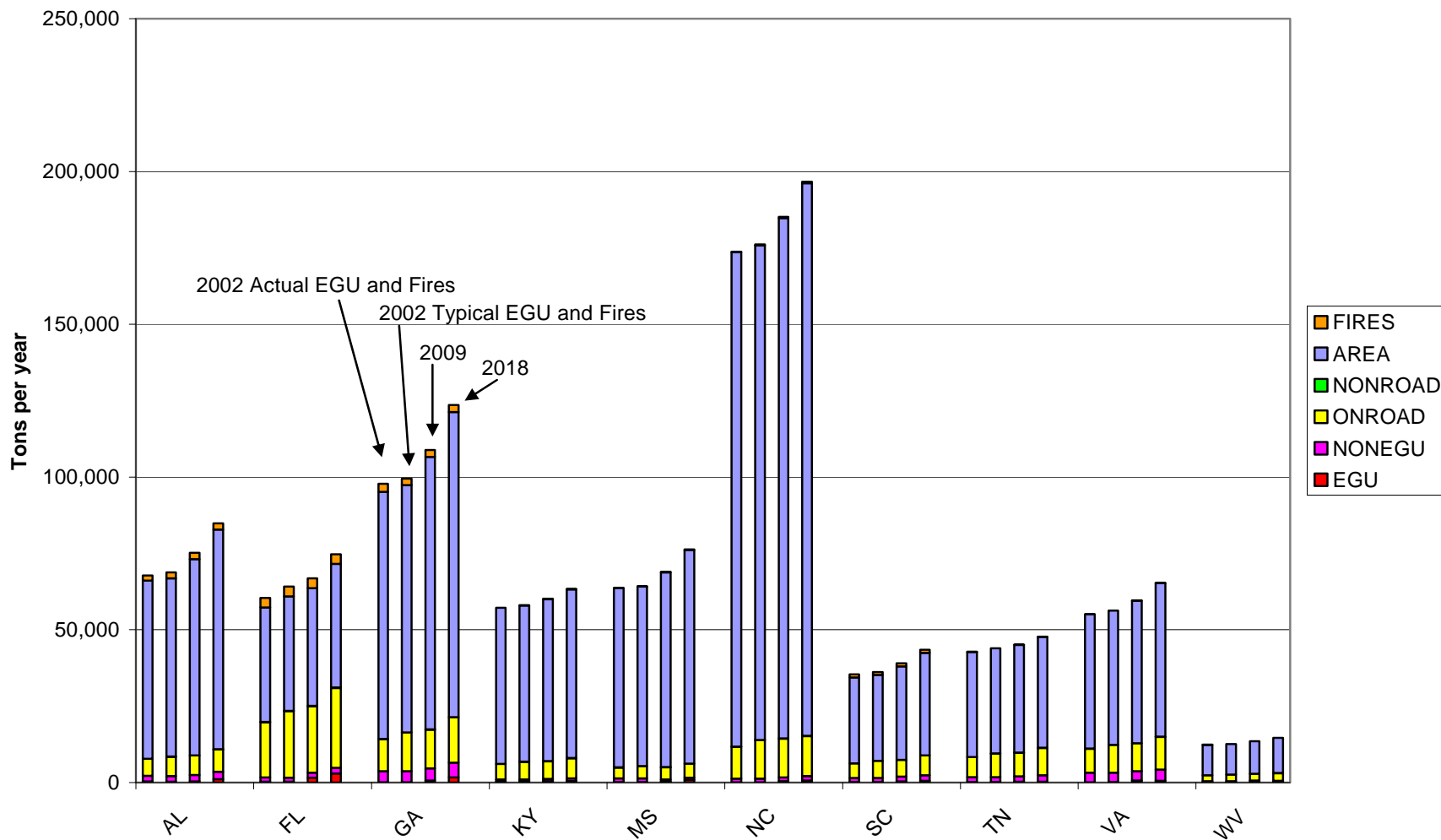
### Annual CO Emissions by Source Sector



## Annual CO Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR
	11,279	174,271	1,366,056	414,385	83,958	474,959	2002 Actual
	11,460	174,260	942,793	414,385	83,958	514,120	2002 Typical
<b>AL</b>	14,986	180,369	942,793	454,686	66,654	534,873	2009
	24,342	201,794	797,966	488,924	59,626	535,658	2018
	57,113	81,933	4,693,893	1,920,729	71,079	790,620	2002 Actual
	55,899	81,928	3,446,095	1,920,729	71,079	923,310	2002 Typical
<b>FL</b>	35,928	87,037	3,446,095	2,104,920	57,011	923,310	2009
	53,772	96,819	3,086,330	2,323,327	53,903	923,310	2018
	9,712	130,656	2,833,468	791,158	108,083	654,411	2002 Actual
	9,650	130,656	2,053,694	791,158	108,083	620,342	2002 Typical
<b>GA</b>	23,721	147,215	2,053,694	882,970	94,130	637,177	2009
	44,476	167,644	1,765,020	973,872	93,827	637,177	2018
	12,619	109,936	1,260,682	325,993	66,752	8,703	2002 Actual
	12,607	109,937	942,350	325,993	66,752	24,900	2002 Typical
<b>KY</b>	15,812	122,024	942,350	357,800	57,887	31,810	2009
	17,144	139,437	782,423	381,215	54,865	33,296	2018
	5,303	54,568	894,639	236,752	37,905	13,209	2002 Actual
	5,219	54,567	628,151	236,752	37,905	14,353	2002 Typical
<b>MS</b>	5,051	57,748	628,151	257,453	27,184	48,160	2009
	15,282	66,858	528,898	270,726	22,099	50,037	2018
	13,885	50,531	3,176,811	808,231	345,315	34,515	2002 Actual
	14,074	50,531	2,184,901	808,231	345,315	71,970	2002 Typical
<b>NC</b>	14,942	53,696	2,184,901	887,605	301,163	96,258	2009
	20,223	62,145	1,510,848	960,709	290,809	111,266	2018
	6,990	56,315	1,275,161	413,964	113,714	248,341	2002 Actual
	6,969	56,315	912,280	413,964	113,714	253,005	2002 Typical
<b>SC</b>	11,135	60,473	912,280	448,625	90,390	282,307	2009
	14,786	68,988	800,619	481,332	83,167	282,307	2018
	7,084	114,681	1,967,658	505,163	89,828	4,302	2002 Actual
	6,787	114,681	1,361,408	505,163	89,828	10,124	2002 Typical
<b>TN</b>	7,214	119,039	1,361,408	554,121	74,189	17,372	2009
	7,723	140,138	1,150,516	593,100	68,809	18,860	2018
	6,892	63,796	2,170,508	660,105	155,873	15,625	2002 Actual
	6,797	63,784	1,495,771	660,105	155,873	12,611	2002 Typical
<b>VA</b>	12,509	68,346	1,495,771	726,815	128,132	21,130	2009
	15,420	76,998	1,310,698	797,683	121,690	26,923	2018
	10,341	89,879	560,717	133,113	39,546	6,738	2002 Actual
	10,117	89,878	385,994	133,113	39,546	2,652	2002 Typical
<b>WV</b>	11,493	100,045	385,994	152,862	31,640	3,949	2009
	11,961	119,332	319,030	167,424	28,773	5,013	2018

### Annual NH<sub>3</sub> Emissions by Source Sector

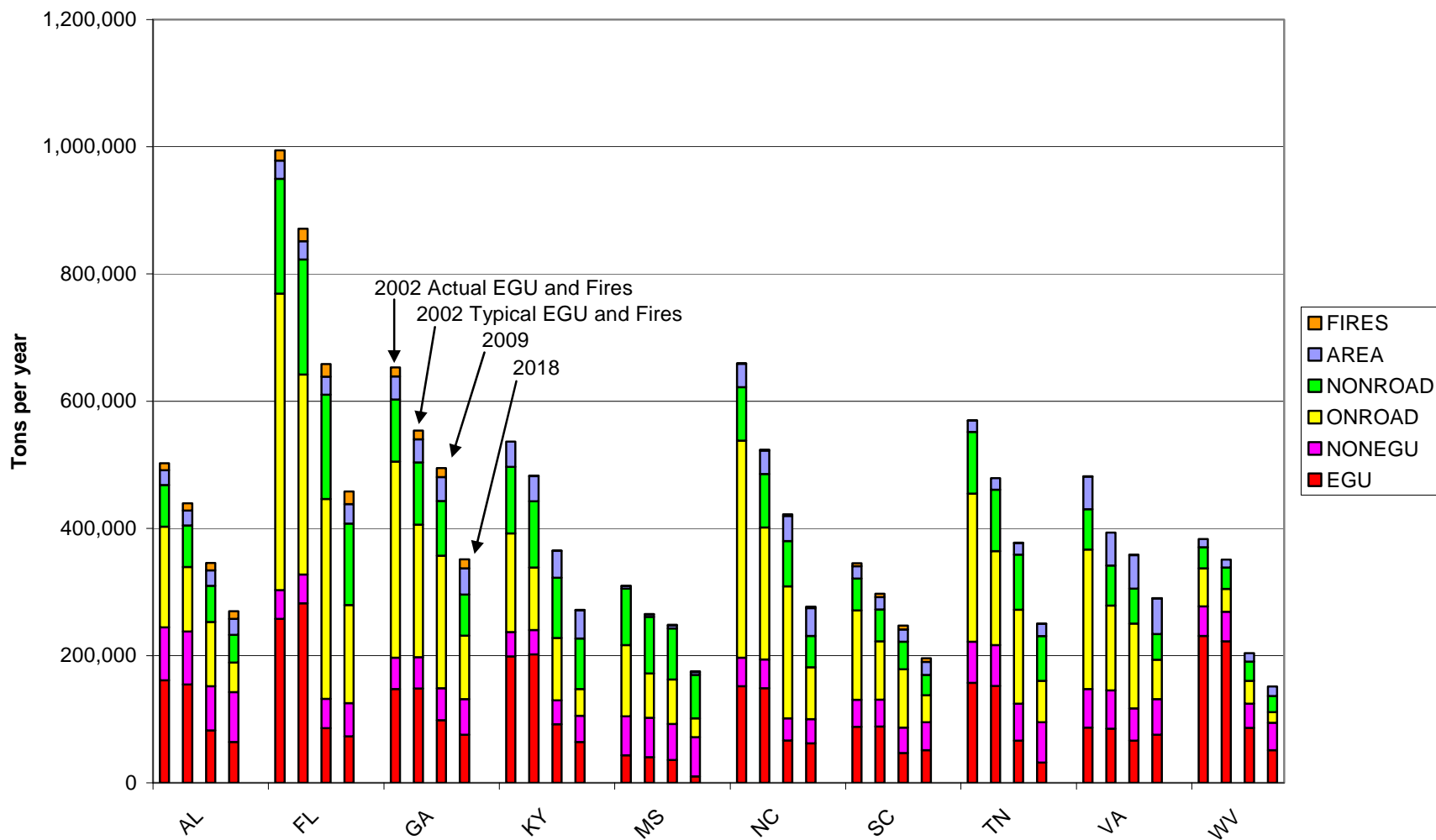




Annual NH<sub>3</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR
	317	1,883	5,576	33	58,318	1,689	2002 Actual
	239	1,883	6,350	33	58,318	1,957	2002 Typical
<b>AL</b>	359	2,132	6,350	36	64,268	2,050	2009
	1,072	2,464	7,296	42	71,915	2,054	2018
	234	1,423	18,078	134	37,446	3,102	2002 Actual
	222	1,423	21,737	134	37,446	3,157	2002 Typical
<b>FL</b>	1,631	1,544	21,737	148	38,616	3,157	2009
	2,976	1,829	26,154	171	40,432	3,157	2018
	83	3,613	10,524	60	80,913	2,578	2002 Actual
	86	3,613	12,660	60	80,913	2,153	2002 Typical
<b>GA</b>	686	3,963	12,660	68	89,212	2,229	2009
	1,677	4,797	14,871	79	99,885	2,229	2018
	326	674	5,044	31	51,135	39	2002 Actual
	321	674	5,795	31	51,135	112	2002 Typical
<b>KY</b>	400	760	5,795	34	53,005	143	2009
	476	901	6,584	40	55,211	150	2018
	190	1,169	3,577	23	58,721	59	2002 Actual
	198	1,169	4,026	23	58,721	65	2002 Typical
<b>MS</b>	334	668	4,026	25	63,708	217	2009
	827	764	4,565	29	69,910	225	2018
	54	1,179	10,455	65	161,860	155	2002 Actual
	55	1,179	12,637	65	161,860	324	2002 Typical
<b>NC</b>	445	1,285	12,637	72	170,314	433	2009
	663	1,465	13,077	83	180,866	501	2018
	142	1,411	4,684	33	28,166	980	2002 Actual
	141	1,411	5,510	33	28,166	908	2002 Typical
<b>SC</b>	343	1,578	5,510	36	30,555	1,039	2009
	617	1,779	6,472	41	33,496	1,039	2018
	204	1,542	6,616	43	34,393	19	2002 Actual
	197	1,542	7,738	43	34,393	46	2002 Typical
<b>TN</b>	227	1,764	7,738	48	35,253	78	2009
	241	2,115	8,962	55	36,291	85	2018
	127	3,104	7,837	48	43,905	70	2002 Actual
	130	3,104	9,066	48	43,905	57	2002 Typical
<b>VA</b>	694	3,049	9,066	53	46,639	95	2009
	622	3,604	10,757	61	50,175	121	2018
	121	332	1,933	9	9,963	30	2002 Actual
	121	332	2,183	9	9,963	12	2002 Typical
<b>WV</b>	330	341	2,183	11	10,625	18	2009
	180	413	2,484	13	11,504	23	2018

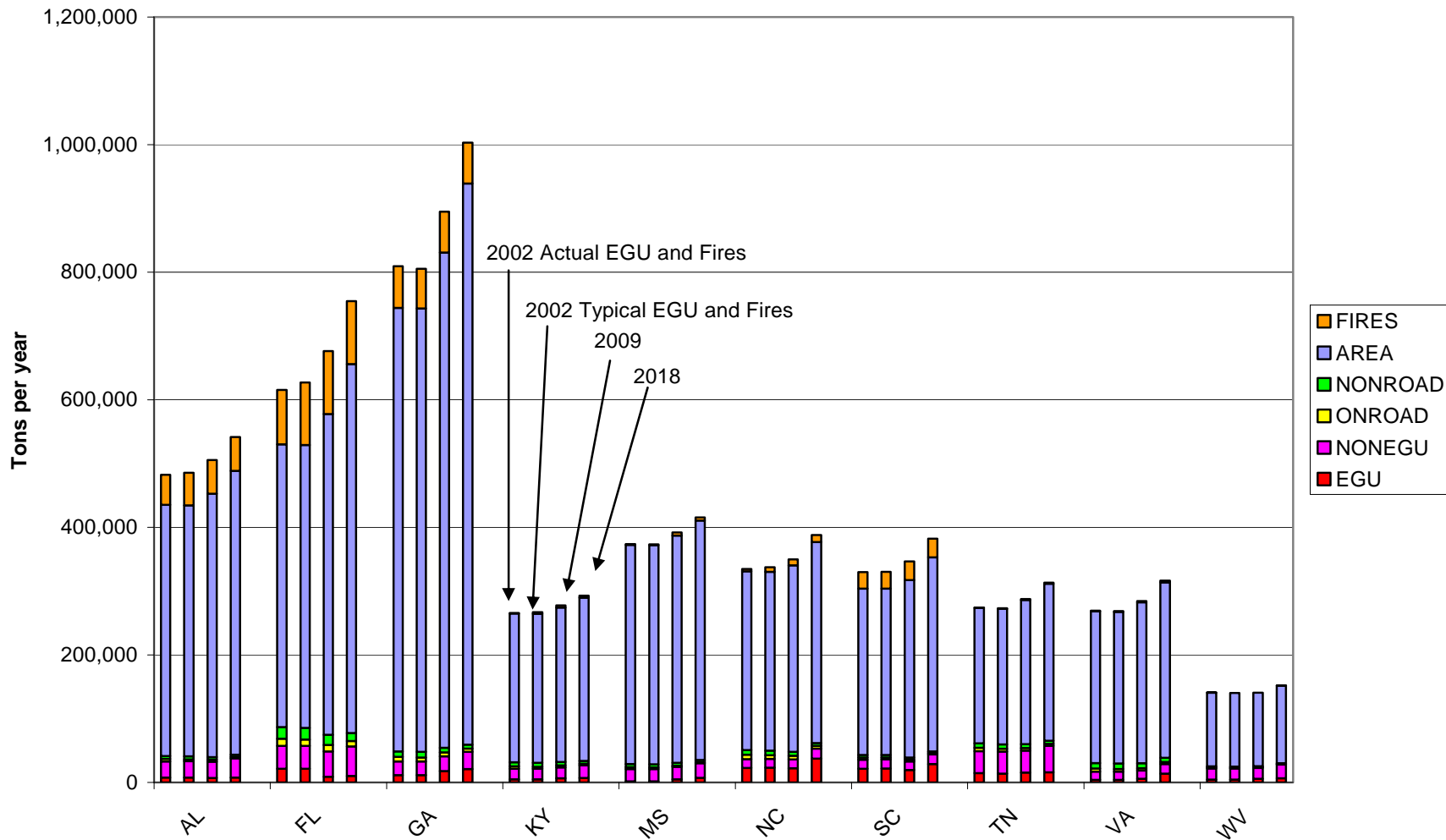
### Annual NOx Emissions by Source Sector



Annual NO<sub>x</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR
	161,038	83,310	158,423	65,366	23,444	10,728	2002 Actual
	154,704	83,302	101,323	65,366	23,444	11,456	2002 Typical
<b>AL</b>	82,305	69,409	101,323	56,862	23,930	11,901	2009
	64,358	78,318	46,222	43,799	25,028	11,918	2018
	257,677	45,156	466,098	180,627	28,872	15,942	2002 Actual
	282,507	45,150	314,307	180,627	28,872	19,791	2002 Typical
<b>FL</b>	86,165	46,020	314,307	163,794	28,187	19,791	2009
	73,125	51,902	154,611	127,885	30,708	19,791	2018
	147,517	49,214	308,013	97,961	36,142	14,203	2002 Actual
	148,126	49,214	208,393	97,961	36,142	13,882	2002 Typical
<b>GA</b>	98,497	50,312	208,393	85,733	37,729	14,243	2009
	75,717	55,775	99,821	64,579	41,332	14,243	2018
	198,817	38,392	154,899	104,571	39,507	187	2002 Actual
	201,928	38,434	97,912	104,571	39,507	534	2002 Typical
<b>KY</b>	92,021	37,758	97,912	94,752	42,088	682	2009
	64,378	41,034	42,104	79,392	44,346	714	2018
	43,135	61,526	111,791	88,787	4,200	283	2002 Actual
	40,433	61,553	69,949	88,787	4,200	308	2002 Typical
<b>MS</b>	36,011	56,398	69,949	80,567	4,249	1,033	2009
	10,271	61,533	29,717	68,252	4,483	1,073	2018
	151,850	44,881	341,198	84,284	36,550	740	2002 Actual
	148,809	44,881	207,648	84,284	36,550	1,544	2002 Typical
<b>NC</b>	66,517	34,719	207,648	70,997	39,954	2,065	2009
	62,346	37,750	81,706	49,046	43,865	2,387	2018
	88,241	42,153	140,428	50,249	19,332	4,932	2002 Actual
	88,528	42,153	91,696	50,249	19,332	5,270	2002 Typical
<b>SC</b>	46,915	40,019	91,696	43,235	19,360	5,899	2009
	51,456	44,021	42,354	31,758	20,592	5,899	2018
	157,307	64,331	233,324	96,827	17,844	92	2002 Actual
	152,137	64,331	147,757	96,827	17,844	217	2002 Typical
<b>TN</b>	66,405	57,869	147,757	86,641	18,499	373	2009
	31,715	63,435	65,242	70,226	19,597	405	2018
	86,886	60,415	219,602	63,219	51,418	335	2002 Actual
	85,081	60,390	133,170	63,219	51,418	271	2002 Typical
<b>VA</b>	66,219	51,046	133,170	54,993	52,618	453	2009
	75,594	55,945	61,881	40,393	56,158	578	2018
	230,977	46,612	59,612	33,239	12,687	145	2002 Actual
	222,437	46,618	36,049	33,239	12,687	57	2002 Typical
<b>WV</b>	86,328	38,031	36,049	30,133	13,439	85	2009
	51,241	43,359	16,274	25,710	14,828	108	2018

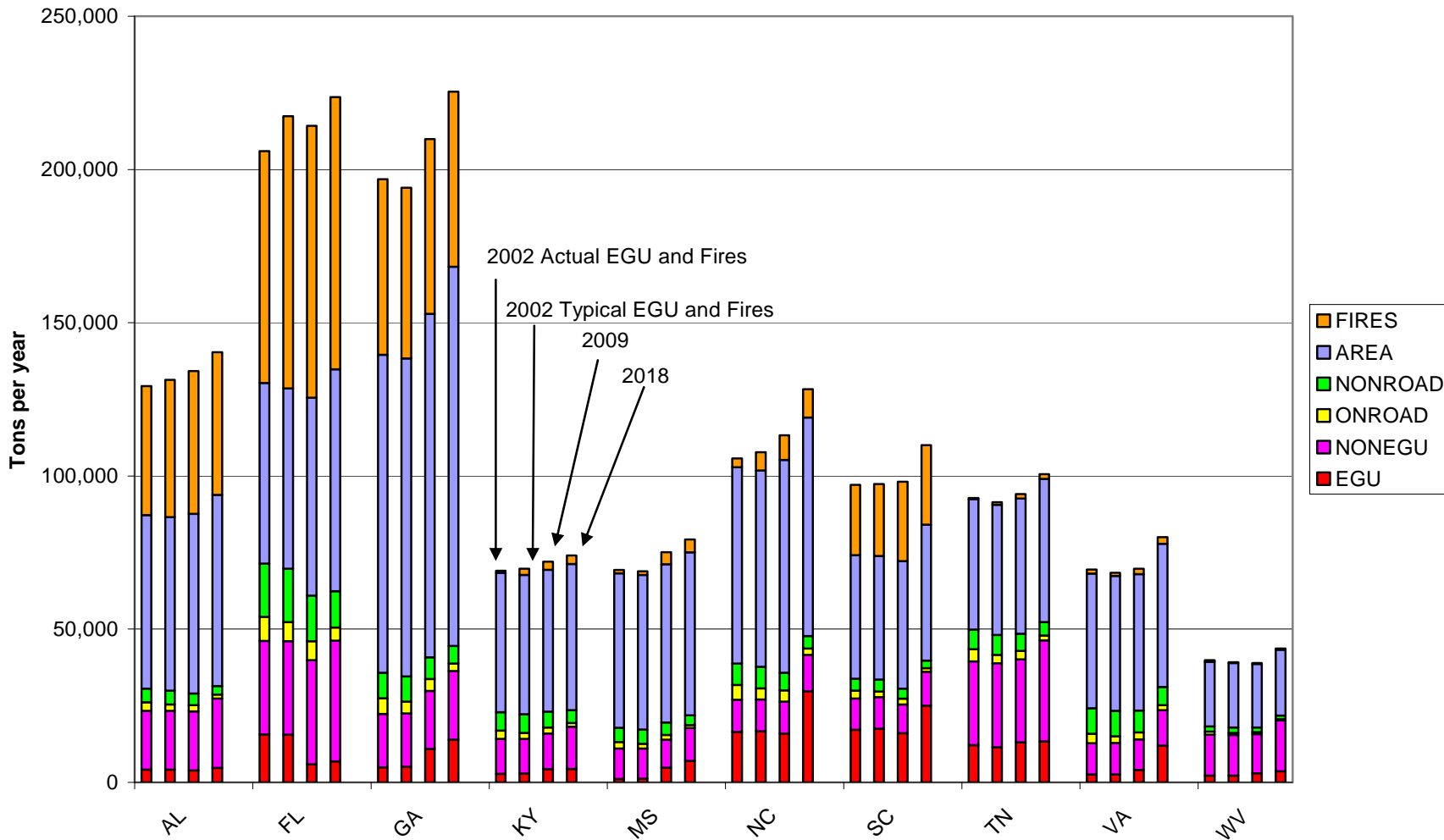
### Annual PM<sub>10</sub> Emissions by Source Sector



Annual PM<sub>10</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR
	7,646	25,240	3,898	4,787	393,588	47,237	2002 Actual
	7,845	25,239	3,188	4,787	393,588	50,833	2002 Typical
<b>AL</b>	6,969	25,421	3,188	4,027	413,020	52,851	2009
	7,822	29,924	2,488	3,041	445,256	52,927	2018
	21,387	35,857	11,253	18,281	443,346	85,263	2002 Actual
	21,391	35,856	9,953	18,281	443,346	98,470	2002 Typical
<b>FL</b>	9,007	39,872	9,953	15,613	503,230	98,470	2009
	9,953	46,456	8,489	12,497	578,516	98,470	2018
	11,224	21,516	7,236	8,618	695,414	65,227	2002 Actual
	11,467	21,516	6,103	8,618	695,414	62,336	2002 Typical
<b>GA</b>	17,891	22,997	6,103	7,521	776,411	63,973	2009
	20,909	27,143	4,995	6,015	880,199	63,973	2018
	4,701	16,626	3,720	6,425	233,559	846	2002 Actual
	4,795	16,626	3,002	6,425	233,559	2,421	2002 Typical
<b>KY</b>	6,463	17,174	3,002	5,544	242,177	3,093	2009
	6,694	20,153	2,283	4,556	256,052	3,237	2018
	1,633	19,472	2,856	5,010	343,377	1,284	2002 Actual
	1,706	19,469	2,290	5,010	343,377	1,396	2002 Typical
<b>MS</b>	4,957	19,245	2,290	4,270	356,324	4,683	2009
	7,187	22,859	1,688	3,452	375,495	4,865	2018
	22,754	13,785	6,905	7,348	280,379	3,356	2002 Actual
	22,994	13,785	5,861	7,348	280,379	6,998	2002 Typical
<b>NC</b>	22,152	13,855	5,861	6,055	292,443	9,359	2009
	37,376	15,678	4,299	4,298	315,294	10,819	2018
	21,400	14,142	3,446	4,152	260,858	25,968	2002 Actual
	21,827	14,142	2,878	4,152	260,858	26,304	2002 Typical
<b>SC</b>	19,395	13,370	2,878	3,471	278,299	29,153	2009
	28,826	15,139	2,258	2,617	304,251	29,153	2018
	14,640	34,534	5,338	6,819	212,554	418	2002 Actual
	13,866	34,534	4,238	6,819	212,554	984	2002 Typical
<b>TN</b>	15,608	34,145	4,238	5,877	226,098	1,689	2009
	15,941	41,397	3,199	4,672	246,252	1,834	2018
	3,960	13,252	4,537	8,728	237,577	1,519	2002 Actual
	3,892	13,252	3,760	8,728	237,577	1,226	2002 Typical
<b>VA</b>	5,508	13,048	3,760	7,510	252,488	2,054	2009
	13,775	15,112	3,343	6,208	275,351	2,618	2018
	4,573	17,503	1,395	1,850	115,346	655	2002 Actual
	4,472	17,503	1,096	1,850	115,346	258	2002 Typical
<b>WV</b>	5,657	17,090	1,096	1,640	115,089	384	2009
	6,349	21,735	844	1,292	121,549	487	2018

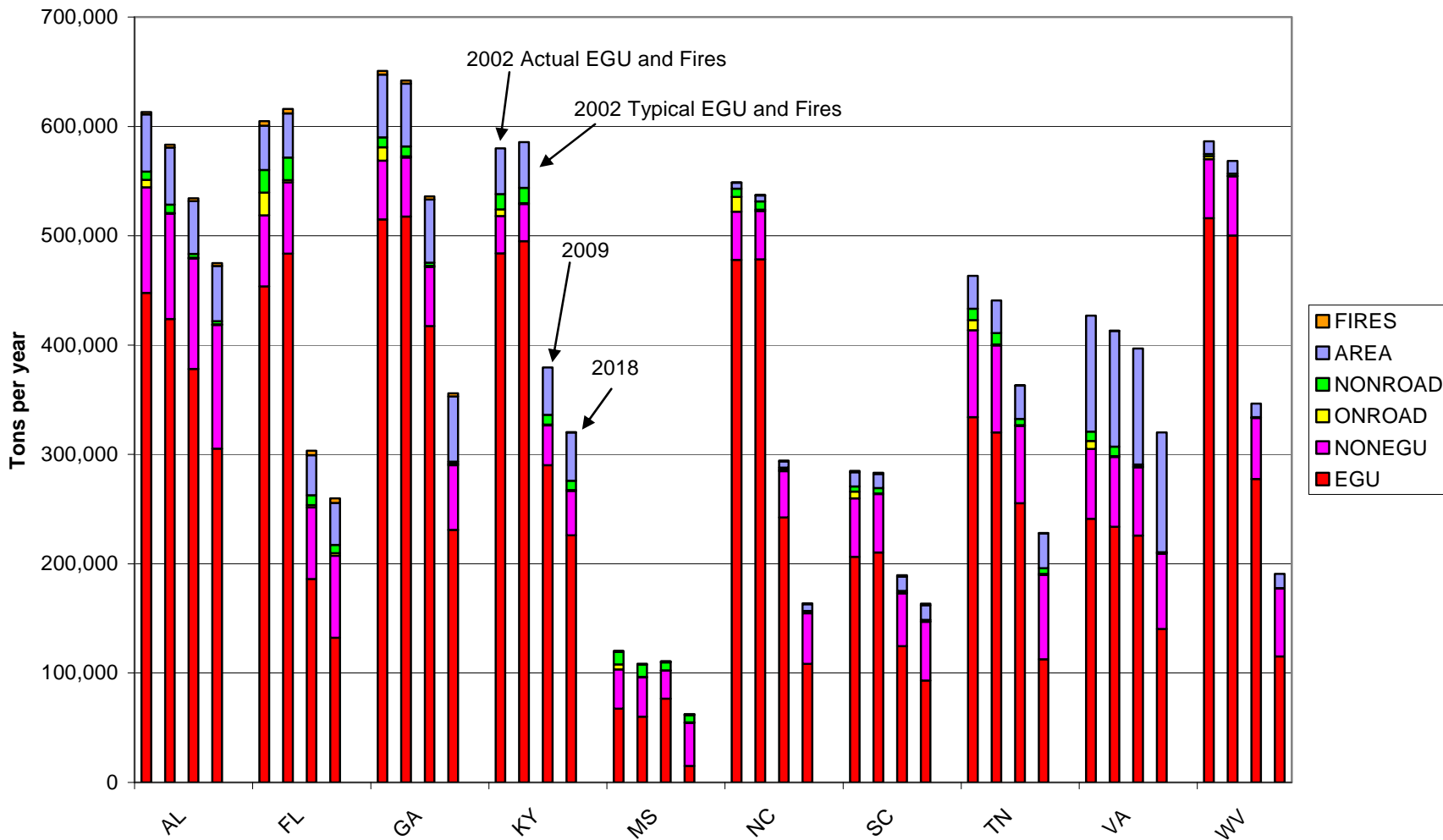
### Annual PM<sub>2.5</sub> Emissions by Source Sector



Annual PM<sub>2.5</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR
	4,113	19,178	2,794	4,502	56,654	42,041	2002 Actual
	4,176	19,177	2,049	4,502	56,654	44,812	2002 Typical
<b>AL</b>	3,921	19,230	2,049	3,776	58,699	46,543	2009
	4,768	22,598	1,262	2,835	62,323	46,608	2018
	15,643	30,504	7,852	17,415	58,878	75,717	2002 Actual
	15,575	30,504	6,216	17,415	58,878	88,756	2002 Typical
<b>FL</b>	5,910	33,946	6,216	14,866	64,589	88,756	2009
	6,843	39,430	4,242	11,868	72,454	88,756	2018
	4,939	17,394	5,158	8,226	103,794	57,293	2002 Actual
	5,070	17,394	3,869	8,226	103,794	55,712	2002 Typical
<b>GA</b>	10,907	18,906	3,869	7,175	112,001	57,116	2009
	13,983	22,323	2,517	5,730	123,704	57,116	2018
	2,802	11,372	2,693	6,046	45,453	726	2002 Actual
	2,847	11,372	1,941	6,046	45,453	2,076	2002 Typical
<b>KY</b>	4,279	11,686	1,941	5,203	46,243	2,653	2009
	4,434	13,739	1,160	4,256	47,645	2,777	2018
	1,138	9,906	2,109	4,690	50,401	1,102	2002 Actual
	1,147	9,902	1,522	4,690	50,401	1,197	2002 Typical
<b>MS</b>	4,777	9,199	1,522	3,985	51,661	4,016	2009
	7,033	10,739	876	3,203	53,222	4,173	2018
	16,498	10,455	4,816	7,005	64,052	2,878	2002 Actual
	16,623	10,455	3,643	7,005	64,052	6,002	2002 Typical
<b>NC</b>	15,949	10,411	3,643	5,760	69,457	8,027	2009
	29,791	11,775	2,158	4,069	71,262	9,279	2018
	17,154	10,245	2,496	3,945	40,291	22,953	2002 Actual
	17,521	10,245	1,870	3,945	40,291	23,511	2002 Typical
<b>SC</b>	16,042	9,390	1,870	3,294	41,613	25,955	2009
	25,032	11,086	1,154	2,474	44,319	25,955	2018
	12,166	27,345	3,919	6,458	42,566	359	2002 Actual
	11,491	27,345	2,782	6,458	42,566	844	2002 Typical
<b>TN</b>	13,092	27,079	2,782	5,557	44,124	1,449	2009
	13,387	32,893	1,643	4,403	46,692	1,573	2018
	2,606	10,165	3,090	8,288	43,989	1,303	2002 Actual
	2,650	10,165	2,254	8,288	43,989	1,052	2002 Typical
<b>VA</b>	4,067	9,988	2,254	7,136	44,514	1,762	2009
	11,976	11,594	1,641	5,891	46,697	2,245	2018
	2,210	13,313	1,003	1,728	21,049	562	2002 Actual
	2,163	13,313	703	1,728	21,049	221	2002 Typical
<b>WV</b>	2,940	12,769	703	1,528	20,664	329	2009
	3,648	16,516	428	1,198	21,490	418	2018

### Annual SO<sub>2</sub> Emissions by Source Sector

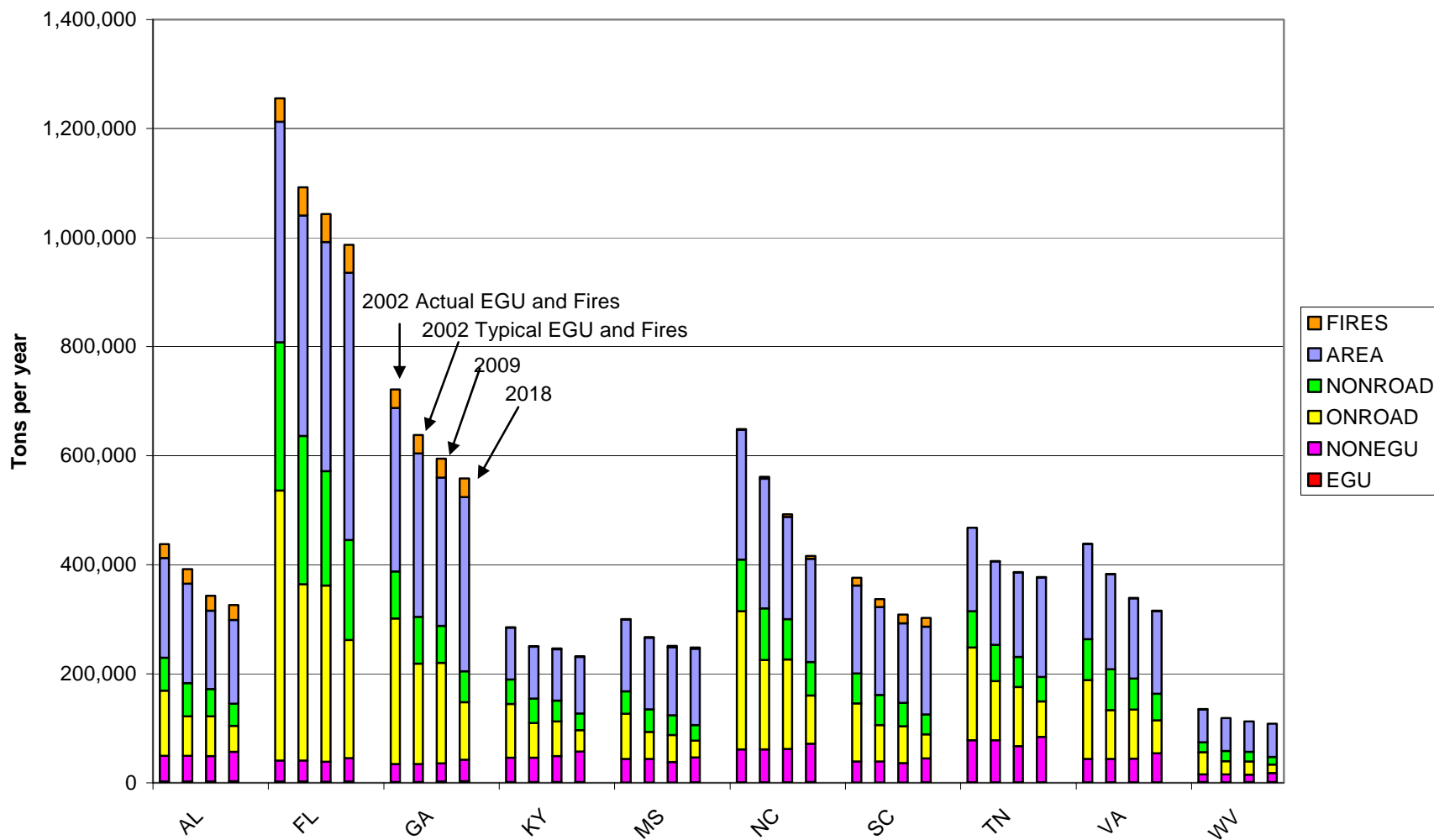




Annual SO<sub>2</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR
	447,828	96,481	6,885	7,584	52,253	2,208	2002 Actual
	423,736	96,481	635	7,584	52,253	2,559	2002 Typical
<b>AL</b>	378,052	101,246	635	3,471	48,228	2,681	2009
	305,262	113,224	720	2,818	50,264	2,686	2018
	453,631	65,090	20,872	20,614	40,491	4,057	2002 Actual
	483,590	65,090	2,120	20,614	40,491	4,129	2002 Typical
<b>FL</b>	186,055	65,511	2,120	8,967	36,699	4,129	2009
	132,177	75,047	2,533	7,536	38,317	4,129	2018
	514,952	53,774	12,155	9,005	57,559	3,372	2002 Actual
	517,633	53,774	1,254	9,005	57,559	2,815	2002 Typical
<b>GA</b>	417,449	53,983	1,254	2,725	57,696	2,914	2009
	230,856	59,343	1,458	1,709	59,729	2,914	2018
	484,057	34,029	5,974	14,043	41,805	51	2002 Actual
	495,153	34,029	585	14,043	41,805	146	2002 Typical
<b>KY</b>	290,193	36,418	585	9,180	43,087	187	2009
	226,062	40,682	651	8,592	44,186	196	2018
	67,429	35,960	4,604	11,315	771	78	2002 Actual
	60,086	35,954	397	11,315	771	84	2002 Typical
<b>MS</b>	76,579	25,564	397	7,191	753	283	2009
	15,146	39,221	441	6,638	746	294	2018
	477,990	44,103	13,343	7,693	5,412	203	2002 Actual
	478,488	44,103	1,311	7,693	5,412	423	2002 Typical
<b>NC</b>	242,286	42,516	1,311	1,892	5,751	566	2009
	108,492	46,292	1,323	905	6,085	655	2018
	206,399	53,518	5,958	4,866	12,900	1,281	2002 Actual
	210,272	53,518	556	4,866	12,900	1,187	2002 Typical
<b>SC</b>	124,608	48,325	556	1,701	13,051	1,359	2009
	93,274	53,577	643	1,198	13,457	1,359	2018
	334,151	79,584	9,184	10,441	29,917	25	2002 Actual
	320,146	79,584	831	10,441	29,917	60	2002 Typical
<b>TN</b>	255,410	70,657	831	5,651	30,577	102	2009
	112,672	77,219	944	5,207	31,962	111	2018
	241,204	63,903	7,218	8,663	105,890	92	2002 Actual
	233,691	63,900	900	8,663	105,890	74	2002 Typical
<b>VA</b>	225,653	62,560	900	1,707	105,984	124	2009
	140,233	68,909	1,059	507	109,380	158	2018
	516,084	54,070	2,489	2,112	11,667	40	2002 Actual
	500,381	54,077	227	2,112	11,667	16	2002 Typical
<b>WV</b>	277,489	55,973	227	359	12,284	23	2009
	115,324	62,193	255	56	12,849	29	2018

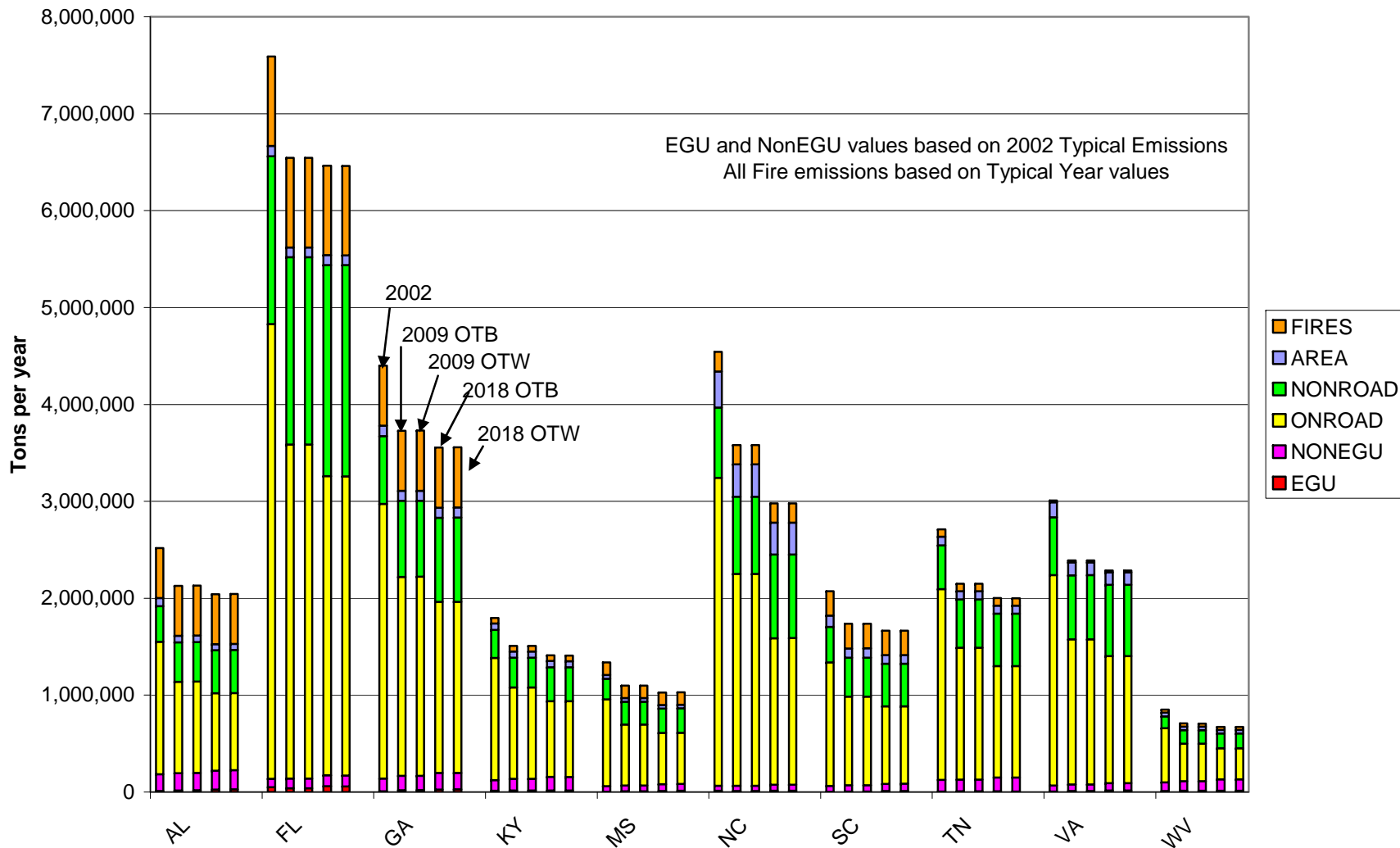
### Annual VOC Emissions by Source Sector



## Annual VOC Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR
	2,295	47,037	119,790	60,487	182,674	25,278	2002 Actual
	2,288	47,035	72,848	60,487	182,674	26,526	2002 Typical
AL	2,473	46,644	72,848	50,249	143,454	27,502	2009
	2,952	54,291	47,296	40,407	153,577	27,539	2018
	2,524	38,471	495,225	272,072	404,302	42,724	2002 Actual
	2,531	38,471	323,290	272,072	404,302	51,527	2002 Typical
FL	1,910	36,880	323,290	209,543	420,172	51,527	2009
	2,376	42,811	216,620	183,452	489,975	51,527	2018
	1,244	33,157	267,378	85,965	299,679	33,979	2002 Actual
	1,256	33,157	184,239	85,965	299,679	33,918	2002 Typical
GA	2,314	33,444	184,239	67,686	272,315	34,710	2009
	2,841	39,485	105,507	56,761	319,328	34,710	2018
	1,487	44,834	98,311	44,805	95,375	410	2002 Actual
	1,481	44,834	63,258	44,805	95,375	1,172	2002 Typical
KY	1,369	47,786	63,258	38,558	94,042	1,497	2009
	1,426	55,861	39,084	30,920	103,490	1,567	2018
	648	43,204	82,810	41,081	131,808	622	2002 Actual
	629	43,203	49,670	41,081	131,808	675	2002 Typical
MS	404	37,747	49,670	36,197	124,977	2,266	2009
	1,114	45,338	30,734	28,842	140,134	2,355	2018
	988	60,496	253,374	94,480	237,926	1,624	2002 Actual
	986	60,496	163,803	94,480	237,926	3,387	2002 Typical
NC	954	61,207	163,803	74,056	187,769	4,530	2009
	1,345	70,100	88,620	61,327	189,591	5,236	2018
	470	38,458	106,792	55,016	161,000	14,202	2002 Actual
	470	38,458	67,281	55,016	161,000	14,666	2002 Typical
SC	660	35,665	67,281	43,061	146,107	16,045	2009
	906	43,656	44,700	36,131	161,228	16,045	2018
	926	77,304	169,914	66,450	153,307	202	2002 Actual
	890	77,304	108,200	66,450	153,307	476	2002 Typical
TN	932	66,538	108,200	55,358	154,377	817	2009
	976	83,573	64,665	45,084	182,222	888	2018
	754	43,152	144,684	74,866	174,116	735	2002 Actual
	747	43,152	89,678	74,866	174,116	593	2002 Typical
VA	778	43,726	89,678	57,009	147,034	994	2009
	997	53,186	60,454	49,052	150,919	1,267	2018
	1,180	14,595	40,066	18,566	60,443	317	2002 Actual
	1,140	14,595	23,907	18,566	60,443	125	2002 Typical
WV	1,361	13,810	23,907	18,069	55,288	186	2009
	1,387	16,565	15,463	14,086	60,747	236	2018

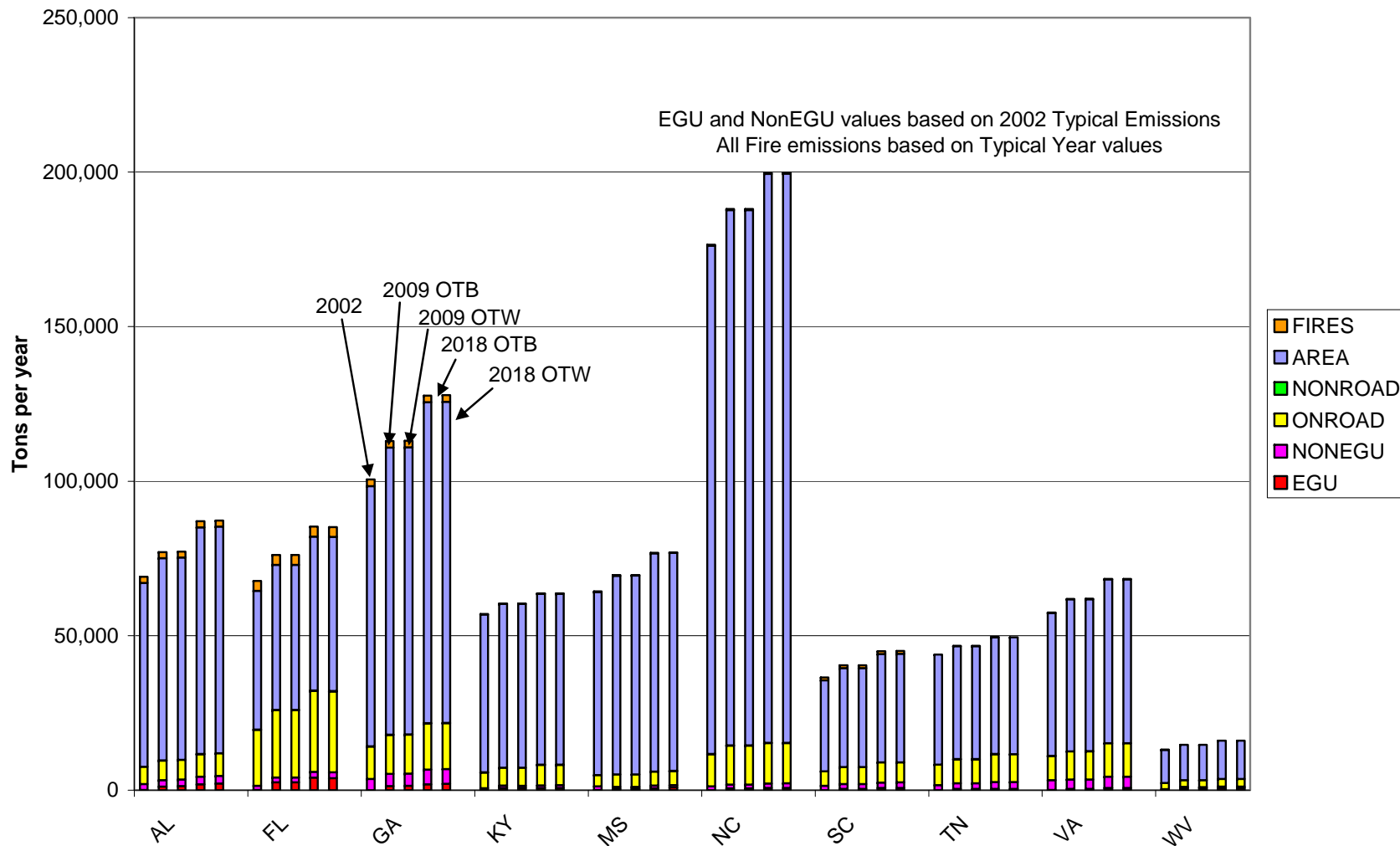
### Annual CO Emissions by Source Sector



## Annual CO Emissions by Source Sector

Name	AREA	EGU	FIRES	NONEGU	NONROAD	ONROAD	YEAR	Basis
	83,958	10,812	514,120	174,306	367,038	1,366,056	2002	OTB - Typical 2002
	68,882	16,494	514,120	177,145	408,424	942,793	2009	OTB - Typical 2002
AL	68,882	19,205	514,120	177,145	408,424	942,793	2009	OTW - Typical 2002
	63,773	26,600	514,120	194,801	443,100	797,966	2018	OTB - Typical 2002
	63,773	29,893	514,120	194,801	443,100	797,966	2018	OTW - Typical 2002
	105,849	51,165	923,310	84,920	1,731,519	4,693,893	2002	OTB - Typical 2002
	101,356	40,642	923,310	98,325	1,934,550	3,446,095	2009	OTB - Typical 2002
FL	101,356	40,641	923,310	98,325	1,934,550	3,446,095	2009	OTW - Typical 2002
	100,952	59,793	923,310	113,923	2,179,296	3,086,330	2018	OTB - Typical 2002
	100,952	57,759	923,310	113,923	2,179,296	3,086,330	2018	OTW - Typical 2002
	107,889	8,098	620,342	131,417	700,427	2,833,468	2002	OTB - Typical 2002
	103,579	19,170	620,342	147,835	783,990	2,053,694	2009	OTB - Typical 2002
GA	103,579	20,024	620,342	147,835	783,990	2,053,694	2009	OTW - Typical 2002
	105,059	27,152	620,342	169,156	868,018	1,765,020	2018	OTB - Typical 2002
	105,059	28,895	620,342	169,156	868,018	1,765,020	2018	OTW - Typical 2002
	66,752	12,888	56,686	110,141	289,967	1,260,682	2002	OTB - Typical 2002
	64,806	15,273	56,686	121,981	306,884	942,350	2009	OTB - Typical 2002
KY	64,806	15,119	56,686	121,981	306,884	942,350	2009	OTW - Typical 2002
	65,297	16,974	56,686	139,395	349,285	782,423	2018	OTB - Typical 2002
	65,297	14,954	56,686	139,395	349,285	782,423	2018	OTW - Typical 2002
	37,905	3,831	128,471	57,711	213,779	894,639	2002	OTB - Typical 2002
	37,161	6,714	128,471	60,709	237,297	628,151	2009	OTB - Typical 2002
MS	37,161	6,954	128,471	60,709	237,297	628,151	2009	OTW - Typical 2002
	36,425	10,553	128,471	70,454	252,658	528,898	2018	OTB - Typical 2002
	36,425	12,928	128,471	70,454	252,658	528,898	2018	OTW - Typical 2002
	373,585	12,027	200,564	52,542	725,734	3,176,811	2002	OTB - Typical 2002
	332,443	11,091	200,564	54,791	797,360	2,184,901	2009	OTB - Typical 2002
NC	332,443	11,170	200,564	54,791	797,360	2,184,901	2009	OTW - Typical 2002
	327,871	13,482	200,564	63,699	863,536	1,510,848	2018	OTB - Typical 2002
	327,871	13,777	200,564	63,699	863,536	1,510,848	2018	OTW - Typical 2002
	113,714	3,675	253,005	59,605	367,575	1,275,161	2002	OTB - Typical 2002
	95,826	6,316	253,005	65,612	402,871	912,280	2009	OTB - Typical 2002
SC	95,826	6,526	253,005	65,612	402,871	912,280	2009	OTW - Typical 2002
	89,343	10,175	253,005	75,209	438,027	800,619	2018	OTB - Typical 2002
	89,343	10,671	253,005	75,209	438,027	800,619	2018	OTW - Typical 2002
	89,235	6,339	78,370	119,405	451,480	1,967,658	2002	OTB - Typical 2002
	82,196	6,750	78,370	121,420	500,186	1,361,408	2009	OTB - Typical 2002
TN	82,196	6,651	78,370	121,420	500,186	1,361,408	2009	OTW - Typical 2002
	81,242	7,074	78,370	143,845	540,143	1,150,516	2018	OTB - Typical 2002
	81,242	6,509	78,370	143,845	540,143	1,150,516	2018	OTW - Typical 2002
	155,873	5,958	19,159	62,534	595,311	2,170,508	2002	OTB - Typical 2002
	133,738	9,811	19,159	69,822	661,295	1,495,771	2009	OTB - Typical 2002
VA	133,738	10,245	19,159	69,822	661,295	1,495,771	2009	OTW - Typical 2002
	129,037	14,788	19,159	77,590	734,294	1,310,698	2018	OTB - Typical 2002
	129,037	14,839	19,159	77,590	734,294	1,310,698	2018	OTW - Typical 2002
	39,546	9,927	32,656	89,928	119,089	560,717	2002	OTB - Typical 2002
	37,704	12,622	32,656	100,292	138,999	385,994	2009	OTB - Typical 2002
WV	37,704	12,328	32,656	100,292	138,999	385,994	2009	OTW - Typical 2002
	36,809	13,064	32,656	119,367	152,932	319,030	2018	OTB - Typical 2002
	36,809	12,992	32,656	119,367	152,932	319,030	2018	OTW - Typical 2002

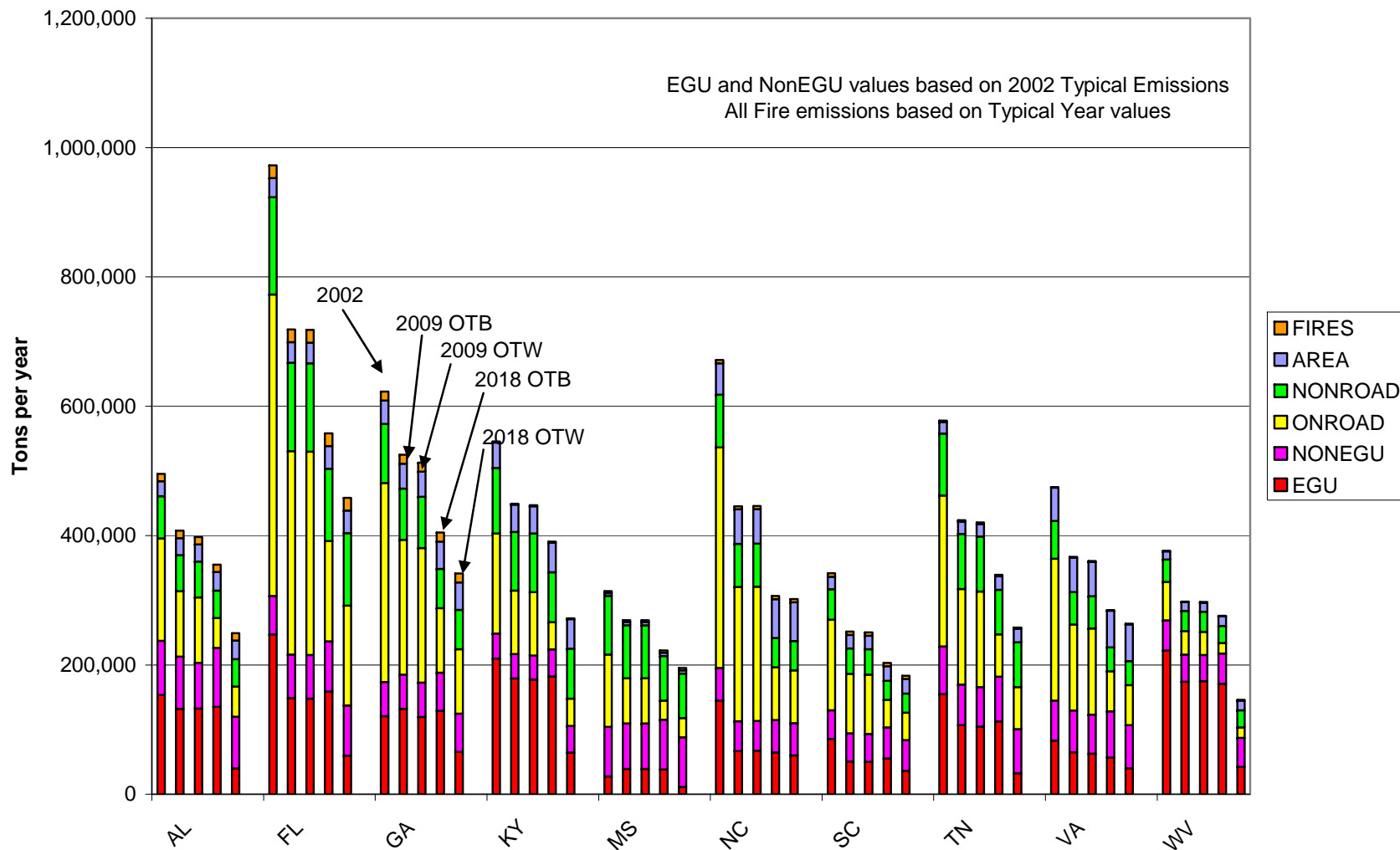
### Annual NH<sub>3</sub> Emissions by Source Sector



Annual NH<sub>3</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	89	1,883	5,576	32	59,486	1,957	2002	OTB - Typical 2002
	1,128	2,112	6,350	35	65,441	1,957	2009	OTB - Typical 2002
AL	1,344	2,112	6,350	35	65,441	1,957	2009	OTW - Typical 2002
	1,909	2,456	7,296	40	73,346	1,957	2018	OTB - Typical 2002
	2,173	2,456	7,296	40	73,346	1,957	2018	OTW - Typical 2002
	53	1,383	18,078	108	44,902	3,157	2002	OTB - Typical 2002
	2,524	1,605	21,737	119	46,950	3,157	2009	OTB - Typical 2002
FL	2,524	1,605	21,737	119	46,950	3,157	2009	OTW - Typical 2002
	4,022	1,905	26,154	138	49,889	3,157	2018	OTB - Typical 2002
	3,865	1,905	26,154	138	49,889	3,157	2018	OTW - Typical 2002
	5	3,613	10,524	54	84,230	2,153	2002	OTB - Typical 2002
	1,305	3,963	12,660	60	92,838	2,153	2009	OTB - Typical 2002
GA	1,376	3,963	12,660	60	92,838	2,153	2009	OTW - Typical 2002
	1,912	4,799	14,871	71	103,911	2,153	2018	OTB - Typical 2002
	2,057	4,799	14,871	71	103,911	2,153	2018	OTW - Typical 2002
	0	674	5,044	28	51,097	110	2002	OTB - Typical 2002
	717	733	5,795	30	53,023	110	2009	OTB - Typical 2002
KY	710	733	5,795	30	53,023	110	2009	OTW - Typical 2002
	763	839	6,584	36	55,356	110	2018	OTB - Typical 2002
	771	839	6,584	36	55,356	110	2018	OTW - Typical 2002
	97	1,169	3,577	23	59,262	177	2002	OTB - Typical 2002
	388	667	4,026	26	64,289	177	2009	OTB - Typical 2002
MS	407	667	4,026	26	64,289	177	2009	OTW - Typical 2002
	686	761	4,565	30	70,565	177	2018	OTB - Typical 2002
	872	761	4,565	30	70,565	177	2018	OTW - Typical 2002
	35	1,171	10,455	61	164,467	324	2002	OTB - Typical 2002
	577	1,255	12,637	68	173,187	324	2009	OTB - Typical 2002
NC	574	1,255	12,637	68	173,187	324	2009	OTW - Typical 2002
	740	1,412	13,077	79	184,167	324	2018	OTB - Typical 2002
	781	1,412	13,077	79	184,167	324	2018	OTW - Typical 2002
	0	1,411	4,684	29	29,447	908	2002	OTB - Typical 2002
	409	1,578	5,510	32	31,966	908	2009	OTB - Typical 2002
SC	422	1,578	5,510	32	31,966	908	2009	OTW - Typical 2002
	702	1,779	6,472	37	35,082	908	2018	OTB - Typical 2002
	742	1,779	6,472	37	35,082	908	2018	OTW - Typical 2002
	0	1,620	6,616	41	35,571	46	2002	OTB - Typical 2002
	406	1,861	7,738	45	36,578	46	2009	OTB - Typical 2002
TN	400	1,861	7,738	45	36,578	46	2009	OTW - Typical 2002
	427	2,240	8,962	53	37,812	46	2018	OTB - Typical 2002
	394	2,240	8,962	53	37,812	46	2018	OTW - Typical 2002
	122	3,097	7,837	44	46,221	159	2002	OTB - Typical 2002
	396	3,057	9,066	48	49,173	159	2009	OTB - Typical 2002
VA	439	3,057	9,066	48	49,173	159	2009	OTW - Typical 2002
	759	3,620	10,757	57	53,023	159	2018	OTB - Typical 2002
	783	3,620	10,757	57	53,023	159	2018	OTW - Typical 2002
	12	331	1,933	10	10,779	12	2002	OTB - Typical 2002
	691	342	2,183	11	11,461	12	2009	OTB - Typical 2002
WV	673	342	2,183	11	11,461	12	2009	OTW - Typical 2002
	722	416	2,484	13	12,390	12	2018	OTB - Typical 2002
	719	416	2,484	13	12,390	12	2018	OTW - Typical 2002

### Annual NOx Emissions by Source Sector

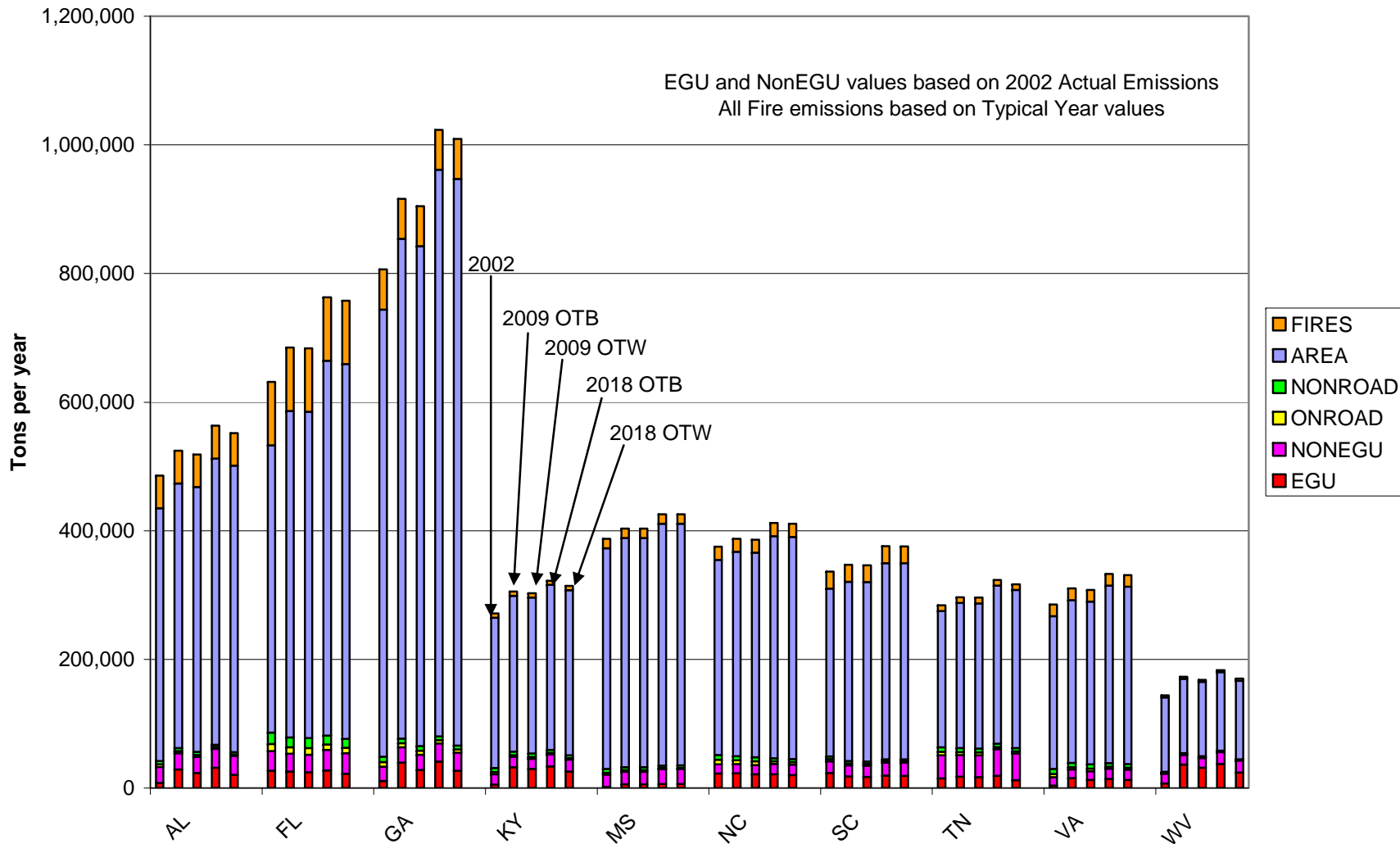




Annual NO<sub>x</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	153,349	83,868	158,423	64,891	23,444	11,456	2002	OTB - Typical 2002
	131,988	80,738	101,323	55,494	26,482	11,456	2009	OTB - Typical 2002
AL	132,323	70,644	101,323	55,494	26,482	11,456	2009	OTW - Typical 2002
	135,010	91,052	46,222	42,573	28,754	11,456	2018	OTB - Typical 2002
	39,942	80,031	46,222	42,573	28,754	11,456	2018	OTW - Typical 2002
	247,099	59,517	466,098	150,519	29,477	19,791	2002	OTB - Typical 2002
	148,522	67,533	314,307	136,851	31,821	19,791	2009	OTB - Typical 2002
FL	147,801	67,533	314,307	136,851	31,821	19,791	2009	OTW - Typical 2002
	159,004	77,551	154,611	111,959	35,047	19,791	2018	OTB - Typical 2002
	59,446	77,551	154,611	111,959	35,047	19,791	2018	OTW - Typical 2002
	120,785	52,425	308,013	91,386	36,105	13,882	2002	OTB - Typical 2002
	131,901	53,008	208,393	79,049	38,876	13,882	2009	OTB - Typical 2002
GA	119,425	53,008	208,393	79,049	38,876	13,882	2009	OTW - Typical 2002
	128,938	59,005	99,821	60,650	42,260	13,882	2018	OTB - Typical 2002
	65,559	59,005	99,821	60,650	42,260	13,882	2018	OTW - Typical 2002
	209,802	38,460	154,899	101,261	39,507	1,460	2002	OTB - Typical 2002
	178,930	37,960	97,912	90,803	42,122	1,460	2009	OTB - Typical 2002
KY	177,272	37,201	97,912	90,803	42,122	1,460	2009	OTW - Typical 2002
	182,192	41,776	42,104	77,295	45,597	1,460	2018	OTB - Typical 2002
	64,674	40,948	42,104	77,295	45,597	1,460	2018	OTW - Typical 2002
	27,254	76,906	111,791	90,686	4,200	3,328	2002	OTB - Typical 2002
	38,911	70,463	69,949	81,780	4,789	3,328	2009	OTB - Typical 2002
MS	38,978	70,463	69,949	81,780	4,789	3,328	2009	OTW - Typical 2002
	38,355	76,738	29,717	68,781	5,230	3,328	2018	OTB - Typical 2002
	11,206	76,738	29,717	68,781	5,230	3,328	2018	OTW - Typical 2002
	144,730	50,393	341,198	81,448	48,730	5,005	2002	OTB - Typical 2002
	66,598	46,242	207,648	66,382	53,550	5,005	2009	OTB - Typical 2002
NC	67,051	46,242	207,648	66,382	53,550	5,005	2009	OTW - Typical 2002
	64,537	50,044	81,706	45,146	60,073	5,005	2018	OTB - Typical 2002
	59,917	50,044	81,706	45,146	60,073	5,005	2018	OTW - Typical 2002
	85,555	44,123	140,428	46,789	19,332	5,270	2002	OTB - Typical 2002
	50,433	43,799	91,696	39,544	20,852	5,270	2009	OTB - Typical 2002
SC	50,128	42,944	91,696	39,544	20,852	5,270	2009	OTW - Typical 2002
	55,103	48,314	42,354	29,512	22,467	5,270	2018	OTB - Typical 2002
	36,264	47,403	42,354	29,512	22,467	5,270	2018	OTW - Typical 2002
	155,028	73,384	233,324	95,968	17,829	2,232	2002	OTB - Typical 2002
	106,979	62,435	147,757	85,084	19,148	2,232	2009	OTB - Typical 2002
TN	104,528	61,176	147,757	85,084	19,148	2,232	2009	OTW - Typical 2002
	112,411	69,374	65,242	69,093	20,928	2,232	2018	OTB - Typical 2002
	32,411	67,999	65,242	69,093	20,928	2,232	2018	OTW - Typical 2002
	82,911	61,528	219,602	58,524	51,418	978	2002	OTB - Typical 2002
	64,950	64,298	133,170	50,120	53,344	978	2009	OTB - Typical 2002
VA	62,810	60,027	133,170	50,120	53,344	978	2009	OTW - Typical 2002
	56,716	71,480	61,881	36,970	56,668	978	2018	OTB - Typical 2002
	40,045	66,931	61,881	36,970	56,668	978	2018	OTW - Typical 2002
	222,090	46,715	59,612	34,442	12,687	944	2002	OTB - Typical 2002
	173,977	42,140	36,049	31,148	13,816	944	2009	OTB - Typical 2002
WV	174,572	40,469	36,049	31,148	13,816	944	2009	OTW - Typical 2002
	170,522	46,846	16,274	26,279	15,079	944	2018	OTB - Typical 2002
	42,227	44,944	16,274	26,279	15,079	944	2018	OTW - Typical 2002

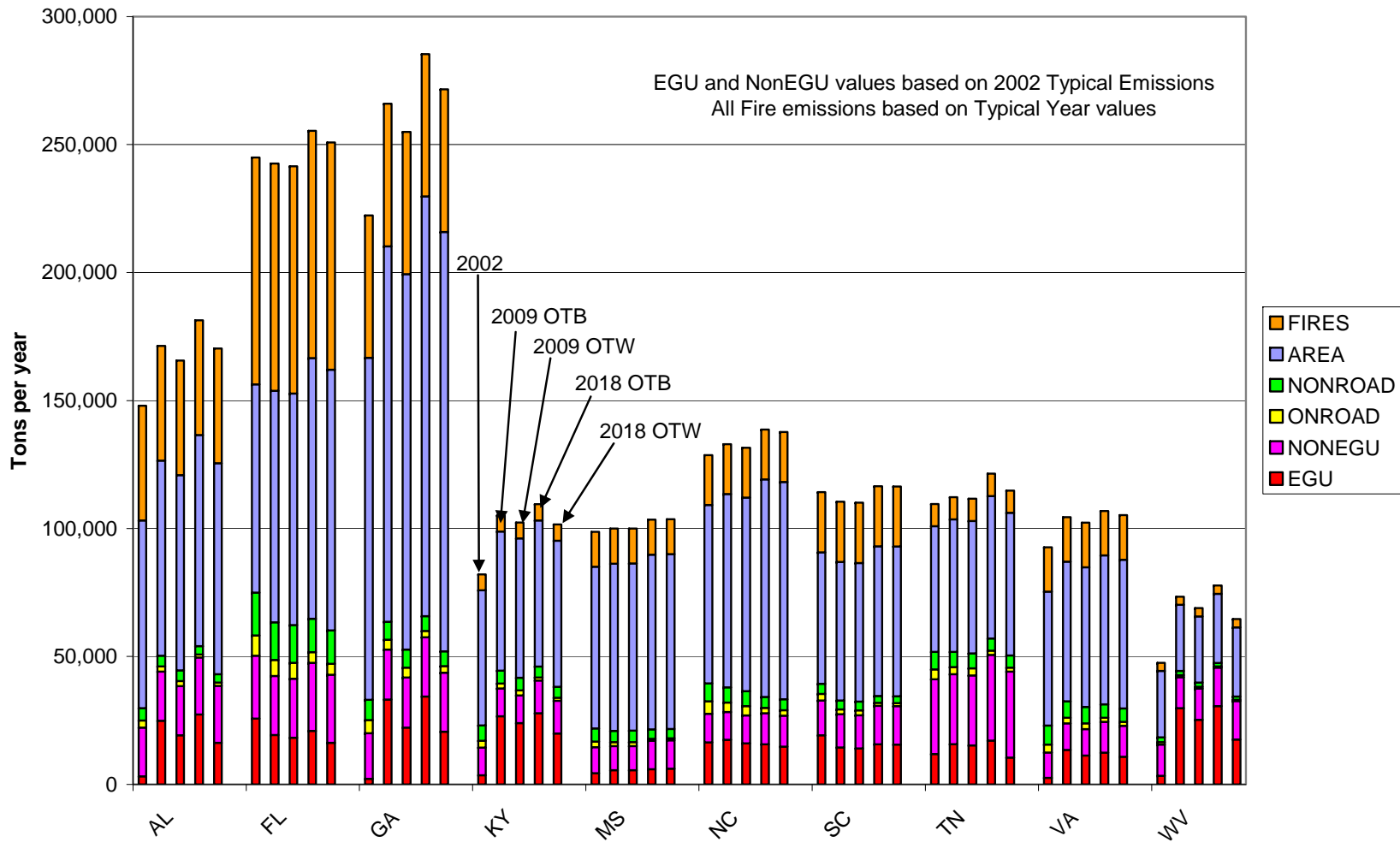
### Annual PM<sub>10</sub> Emissions by Source Sector



Annual PM<sub>10</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	5,737	24,957	3,898	5,331	393,093	50,833	2002	OTB - Typical 2002
	29,053	25,161	3,188	4,597	411,614	50,833	2009	OTB - Typical 2002
AL	23,250	25,161	3,188	4,597	411,614	50,833	2009	OTW - Typical 2002
	31,815	29,278	2,488	3,690	445,168	50,833	2018	OTB - Typical 2002
	20,450	29,278	2,488	3,690	445,168	50,833	2018	OTW - Typical 2002
	33,182	28,882	11,253	17,692	446,821	98,470	2002	OTB - Typical 2002
	25,779	27,531	9,953	15,630	507,515	98,470	2009	OTB - Typical 2002
FL	24,493	27,531	9,953	15,630	507,515	98,470	2009	OTW - Typical 2002
	27,320	31,890	8,489	13,827	582,832	98,470	2018	OTB - Typical 2002
	22,204	31,890	8,489	13,827	582,832	98,470	2018	OTW - Typical 2002
	5,447	22,058	7,236	8,295	695,320	62,336	2002	OTB - Typical 2002
	39,580	23,861	6,103	7,368	776,935	62,336	2009	OTB - Typical 2002
GA	28,118	23,861	6,103	7,368	776,935	62,336	2009	OTW - Typical 2002
	41,221	28,177	4,995	6,068	880,800	62,336	2018	OTB - Typical 2002
	26,905	28,177	4,995	6,068	880,800	62,336	2018	OTW - Typical 2002
	6,000	15,613	3,720	6,389	233,559	6,667	2002	OTB - Typical 2002
	32,406	15,858	3,002	5,312	242,345	6,667	2009	OTB - Typical 2002
KY	29,606	15,858	3,002	5,312	242,345	6,667	2009	OTW - Typical 2002
	33,784	18,587	2,283	4,602	256,544	6,667	2018	OTB - Typical 2002
	25,733	18,587	2,283	4,602	256,544	6,667	2018	OTW - Typical 2002
	4,783	19,680	2,856	5,551	343,377	14,693	2002	OTB - Typical 2002
	5,864	19,439	2,290	4,754	356,516	14,693	2009	OTB - Typical 2002
MS	5,883	19,439	2,290	4,754	356,516	14,693	2009	OTW - Typical 2002
	6,268	23,145	1,688	3,873	375,931	14,693	2018	OTB - Typical 2002
	6,459	23,145	1,688	3,873	375,931	14,693	2018	OTW - Typical 2002
	22,689	14,507	6,905	7,449	303,492	20,488	2002	OTB - Typical 2002
	23,028	14,301	5,861	6,210	317,847	20,488	2009	OTB - Typical 2002
NC	21,459	14,301	5,861	6,210	317,847	20,488	2009	OTW - Typical 2002
	21,417	16,002	4,299	4,474	345,275	20,488	2018	OTB - Typical 2002
	20,258	16,002	4,299	4,474	345,275	20,488	2018	OTW - Typical 2002
	23,492	18,149	3,446	4,211	260,858	26,304	2002	OTB - Typical 2002
	18,023	17,368	2,878	3,593	278,852	26,304	2009	OTB - Typical 2002
SC	17,493	17,368	2,878	3,593	278,852	26,304	2009	OTW - Typical 2002
	19,290	20,272	2,258	2,889	304,940	26,304	2018	OTB - Typical 2002
	19,182	20,272	2,258	2,889	304,940	26,304	2018	OTW - Typical 2002
	14,537	35,982	5,338	7,145	211,903	8,875	2002	OTB - Typical 2002
	17,735	33,838	4,238	6,218	225,650	8,875	2009	OTB - Typical 2002
TN	17,159	33,838	4,238	6,218	225,650	8,875	2009	OTW - Typical 2002
	19,103	41,466	3,199	5,019	245,893	8,875	2018	OTB - Typical 2002
	12,432	41,466	3,199	5,019	245,893	8,875	2018	OTW - Typical 2002
	3,790	12,799	4,537	7,928	237,577	18,160	2002	OTB - Typical 2002
	15,343	13,470	3,760	6,763	252,924	18,160	2009	OTB - Typical 2002
VA	12,804	13,470	3,760	6,763	252,924	18,160	2009	OTW - Typical 2002
	14,390	15,661	3,343	5,564	275,790	18,160	2018	OTB - Typical 2002
	12,653	15,661	3,343	5,564	275,790	18,160	2018	OTW - Typical 2002
	7,145	14,866	1,395	2,072	115,346	3,276	2002	OTB - Typical 2002
	36,442	14,926	1,096	1,819	115,410	3,276	2009	OTB - Typical 2002
WV	31,780	14,926	1,096	1,819	115,410	3,276	2009	OTW - Typical 2002
	37,425	18,433	844	1,381	121,964	3,276	2018	OTB - Typical 2002
	24,253	18,433	844	1,381	121,964	3,276	2018	OTW - Typical 2002

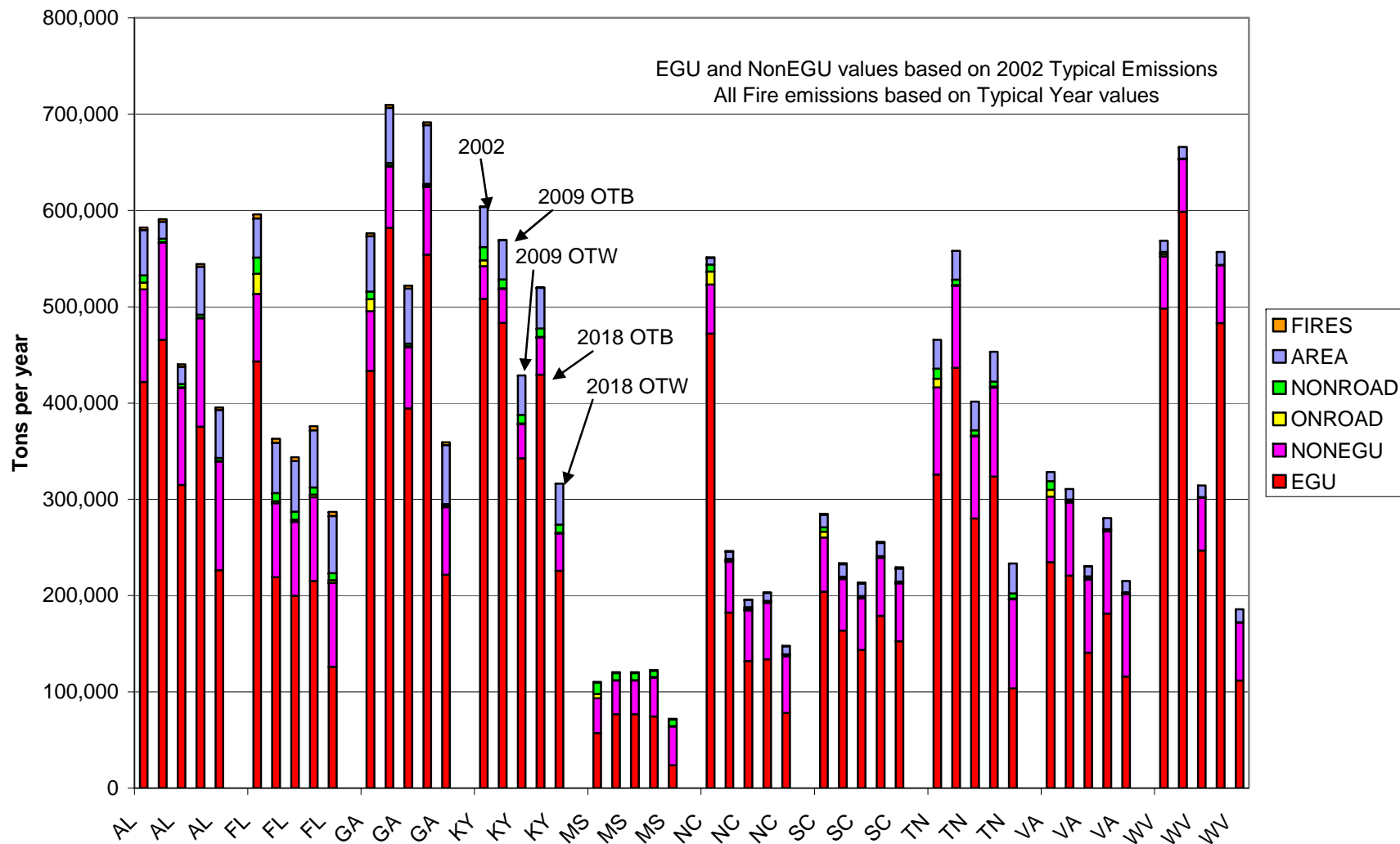
### Annual PM<sub>2.5</sub> Emissions by Source Sector



Annual PM<sub>2.5</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	3,131	19,016	2,794	4,877	73,352	44,812	2002	OTB - Typical 2002
	24,875	19,184	2,049	4,144	76,248	44,812	2009	OTB - Typical 2002
AL	19,190	19,184	2,049	4,144	76,248	44,812	2009	OTW - Typical 2002
	27,280	22,268	1,262	3,231	82,449	44,812	2018	OTB - Typical 2002
	16,279	22,268	1,262	3,231	82,449	44,812	2018	OTW - Typical 2002
	25,761	24,569	7,852	16,739	81,341	88,756	2002	OTB - Typical 2002
	19,307	23,063	6,216	14,786	90,487	88,756	2009	OTB - Typical 2002
FL	18,186	23,063	6,216	14,786	90,487	88,756	2009	OTW - Typical 2002
	20,848	26,622	4,242	13,044	101,872	88,756	2018	OTB - Typical 2002
	16,278	26,622	4,242	13,044	101,872	88,756	2018	OTW - Typical 2002
	2,137	17,893	5,158	7,899	133,542	55,712	2002	OTB - Typical 2002
	33,111	19,562	3,869	7,014	146,691	55,712	2009	OTB - Typical 2002
GA	22,163	19,562	3,869	7,014	146,691	55,712	2009	OTW - Typical 2002
	34,361	23,110	2,517	5,769	163,925	55,712	2018	OTB - Typical 2002
	20,549	23,110	2,517	5,769	163,925	55,712	2018	OTW - Typical 2002
	3,605	10,729	2,693	5,998	52,765	6,310	2002	OTB - Typical 2002
	26,640	10,837	1,941	4,978	54,397	6,310	2009	OTB - Typical 2002
KY	23,915	10,837	1,941	4,978	54,397	6,310	2009	OTW - Typical 2002
	27,857	12,738	1,160	4,289	57,110	6,310	2018	OTB - Typical 2002
	19,915	12,738	1,160	4,289	57,110	6,310	2018	OTW - Typical 2002
	4,384	10,187	2,109	5,200	63,135	13,680	2002	OTB - Typical 2002
	5,511	9,459	1,522	4,440	65,321	13,680	2009	OTB - Typical 2002
MS	5,530	9,459	1,522	4,440	65,321	13,680	2009	OTW - Typical 2002
	5,919	11,068	876	3,597	68,338	13,680	2018	OTB - Typical 2002
	6,110	11,068	876	3,597	68,338	13,680	2018	OTW - Typical 2002
	16,428	11,204	4,816	7,079	69,663	19,491	2002	OTB - Typical 2002
	17,449	10,888	3,643	5,889	75,570	19,491	2009	OTB - Typical 2002
NC	16,034	10,888	3,643	5,889	75,570	19,491	2009	OTW - Typical 2002
	15,636	12,136	2,158	4,215	85,018	19,491	2018	OTB - Typical 2002
	14,702	12,136	2,158	4,215	85,018	19,491	2018	OTW - Typical 2002
	19,238	13,565	2,496	3,985	51,413	23,511	2002	OTB - Typical 2002
	14,471	12,977	1,870	3,396	54,230	23,511	2009	OTB - Typical 2002
SC	14,079	12,977	1,870	3,396	54,230	23,511	2009	OTW - Typical 2002
	15,601	15,092	1,154	2,718	58,441	23,511	2018	OTB - Typical 2002
	15,509	15,092	1,154	2,718	58,441	23,511	2018	OTW - Typical 2002
	11,918	29,130	3,919	6,756	49,131	8,730	2002	OTB - Typical 2002
	15,770	27,313	2,782	5,873	51,753	8,730	2009	OTB - Typical 2002
TN	15,228	27,313	2,782	5,873	51,753	8,730	2009	OTW - Typical 2002
	17,103	33,502	1,643	4,724	55,712	8,730	2018	OTB - Typical 2002
	10,514	33,502	1,643	4,724	55,712	8,730	2018	OTW - Typical 2002
	2,559	9,868	3,090	7,486	52,271	17,361	2002	OTB - Typical 2002
	13,451	10,368	2,254	6,388	54,587	17,361	2009	OTB - Typical 2002
VA	11,237	10,368	2,254	6,388	54,587	17,361	2009	OTW - Typical 2002
	12,366	12,062	1,641	5,241	58,141	17,361	2018	OTB - Typical 2002
	10,755	12,062	1,641	5,241	58,141	17,361	2018	OTW - Typical 2002
	3,356	12,154	1,003	1,941	25,850	3,239	2002	OTB - Typical 2002
	29,773	12,138	703	1,699	25,835	3,239	2009	OTB - Typical 2002
WV	25,251	12,138	703	1,699	25,835	3,239	2009	OTW - Typical 2002
	30,628	15,045	428	1,284	27,088	3,239	2018	OTB - Typical 2002
	17,548	15,045	428	1,284	27,088	3,239	2018	OTW - Typical 2002

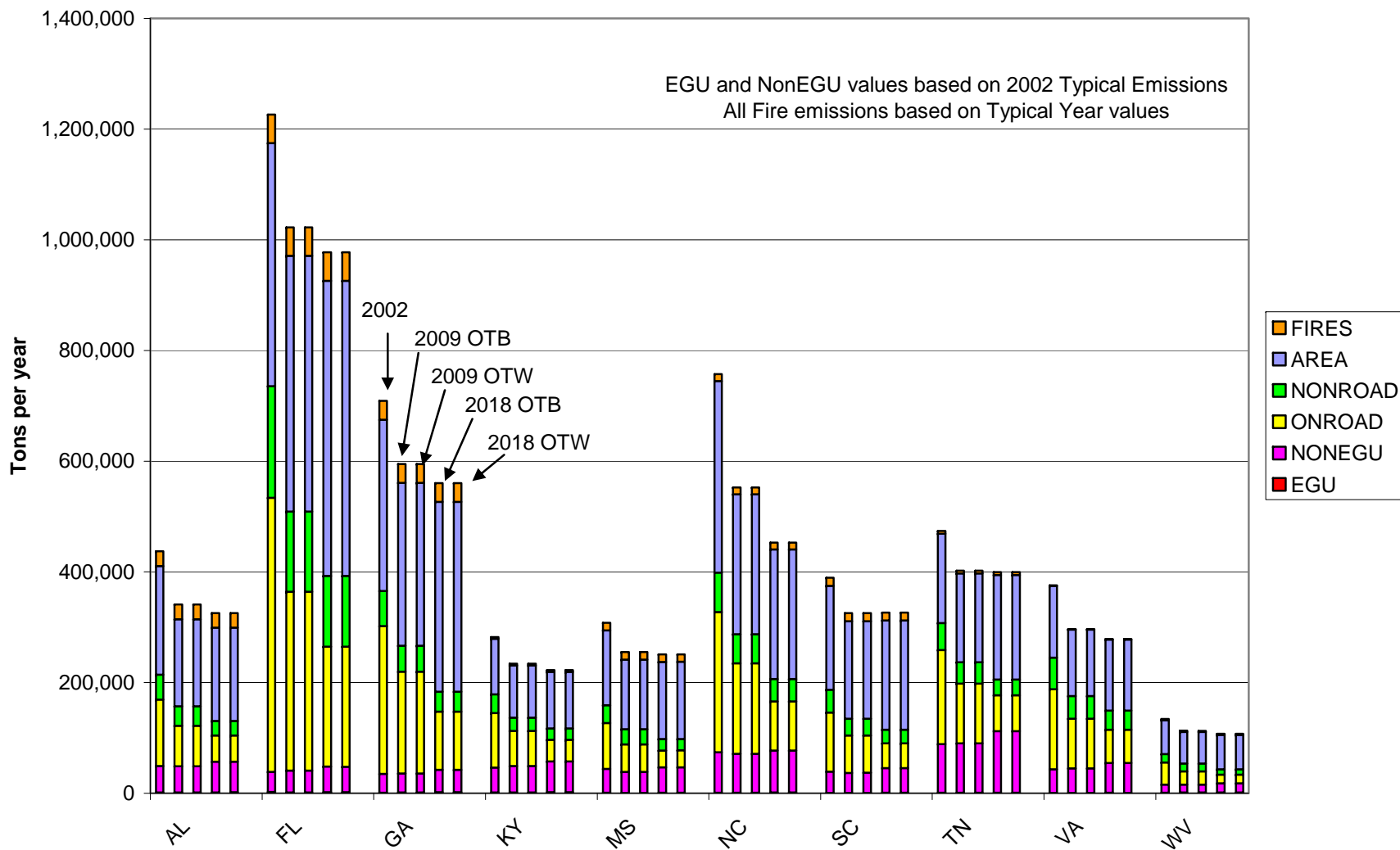
### Annual SO<sub>2</sub> Emissions by Source Sector



Annual SO<sub>2</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
AL	421,734	96,447	6,885	7,539	47,074	2,559	2002	OTB - Typical 2002
AL	465,576	100,845	635	3,463	17,818	2,559	2009	OTB - Typical 2002
AL	314,841	100,845	635	3,463	17,818	2,559	2009	OTW - Typical 2002
AL	375,305	112,771	720	2,815	49,975	2,559	2018	OTB - Typical 2002
AL	226,506	112,771	720	2,815	49,975	2,559	2018	OTW - Typical 2002
FL	443,152	70,165	20,872	17,023	40,537	4,129	2002	OTB - Typical 2002
FL	219,072	76,851	2,120	8,380	52,390	4,129	2009	OTB - Typical 2002
FL	199,834	76,851	2,120	8,380	52,390	4,129	2009	OTW - Typical 2002
FL	215,177	87,065	2,533	7,511	59,413	4,129	2018	OTB - Typical 2002
FL	126,280	87,065	2,533	7,511	59,413	4,129	2018	OTW - Typical 2002
GA	433,513	62,032	12,155	8,145	57,555	2,815	2002	OTB - Typical 2002
GA	582,078	63,348	1,254	2,588	57,377	2,815	2009	OTB - Typical 2002
GA	394,425	63,348	1,254	2,588	57,377	2,815	2009	OTW - Typical 2002
GA	554,013	70,386	1,458	1,702	61,155	2,815	2018	OTB - Typical 2002
GA	221,615	70,386	1,458	1,702	61,155	2,815	2018	OTW - Typical 2002
KY	508,139	34,026	5,974	13,739	41,805	136	2002	OTB - Typical 2002
KY	483,235	35,479	585	9,092	40,779	136	2009	OTB - Typical 2002
KY	342,670	35,479	585	9,092	40,779	136	2009	OTW - Typical 2002
KY	429,418	38,816	651	8,536	42,326	136	2018	OTB - Typical 2002
KY	225,772	38,816	651	8,536	42,326	136	2018	OTW - Typical 2002
MS	57,263	36,071	4,604	11,551	771	100	2002	OTB - Typical 2002
MS	76,855	35,028	397	7,232	637	100	2009	OTB - Typical 2002
MS	76,855	35,028	397	7,232	637	100	2009	OTW - Typical 2002
MS	74,505	40,318	441	6,638	831	100	2018	OTB - Typical 2002
MS	23,768	40,318	441	6,638	831	100	2018	OTW - Typical 2002
NC	472,192	51,049	13,343	7,207	7,096	423	2002	OTB - Typical 2002
NC	182,356	52,693	1,311	1,798	7,607	423	2009	OTB - Typical 2002
NC	132,054	52,693	1,311	1,798	7,607	423	2009	OTW - Typical 2002
NC	133,691	58,671	1,323	838	8,273	423	2018	OTB - Typical 2002
NC	78,205	58,671	1,323	838	8,273	423	2018	OTW - Typical 2002
SC	203,978	56,329	5,958	4,449	12,900	1,187	2002	OTB - Typical 2002
SC	163,560	53,746	556	1,633	12,945	1,187	2009	OTB - Typical 2002
SC	143,492	53,746	556	1,633	12,945	1,187	2009	OTW - Typical 2002
SC	178,938	60,300	643	1,195	13,517	1,187	2018	OTB - Typical 2002
SC	152,457	60,300	643	1,195	13,517	1,187	2018	OTW - Typical 2002
TN	325,779	90,374	9,184	10,413	29,897	59	2002	OTB - Typical 2002
TN	436,453	85,275	831	5,649	29,787	59	2009	OTB - Typical 2002
TN	279,931	85,275	831	5,649	29,787	59	2009	OTW - Typical 2002
TN	323,654	92,396	944	5,205	31,047	59	2018	OTB - Typical 2002
TN	103,602	92,396	944	5,205	31,047	59	2018	OTW - Typical 2002
VA	234,714	68,038	7,218	8,796	9,510	99	2002	OTB - Typical 2002
VA	220,686	76,081	900	2,248	10,619	99	2009	OTB - Typical 2002
VA	140,665	76,081	900	2,248	10,619	99	2009	OTW - Typical 2002
VA	181,338	85,351	1,059	1,217	11,479	99	2018	OTB - Typical 2002
VA	115,987	85,351	1,059	1,217	11,479	99	2018	OTW - Typical 2002
WV	497,991	54,045	2,489	2,305	11,667	16	2002	OTB - Typical 2002
WV	598,555	54,701	227	392	12,156	16	2009	OTB - Typical 2002
WV	246,851	54,701	227	392	12,156	16	2009	OTW - Typical 2002
WV	482,959	60,141	255	56	13,450	16	2018	OTB - Typical 2002
WV	111,937	60,141	255	56	13,450	16	2018	OTW - Typical 2002

### Annual VOC Emissions by Source Sector





## Annual VOC Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	1,501	47,893	119,790	44,978	196,538	26,526	2002	OTB - Typical 2002
	1,261	47,600	72,848	35,498	157,405	26,526	2009	OTB - Typical 2002
<b>AL</b>	1,312	47,600	72,848	35,498	157,405	26,526	2009	OTW - Typical 2002
	1,574	55,373	47,296	26,338	168,507	26,526	2018	OTB - Typical 2002
	1,612	55,373	47,296	26,338	168,507	26,526	2018	OTW - Typical 2002
	2,362	36,301	495,225	201,960	439,019	51,527	2002	OTB - Typical 2002
	1,562	39,255	323,290	144,749	462,198	51,527	2009	OTB - Typical 2002
<b>FL</b>	1,559	39,255	323,290	144,749	462,198	51,527	2009	OTW - Typical 2002
	2,052	46,049	216,620	128,131	533,141	51,527	2018	OTB - Typical 2002
	1,988	46,049	216,620	128,131	533,141	51,527	2018	OTW - Typical 2002
	984	33,753	267,378	63,337	309,411	33,918	2002	OTB - Typical 2002
	1,497	34,153	184,239	46,722	294,204	33,918	2009	OTB - Typical 2002
<b>GA</b>	1,499	34,153	184,239	46,722	294,204	33,918	2009	OTW - Typical 2002
	1,794	40,354	105,507	36,014	342,661	33,918	2018	OTB - Typical 2002
	1,790	40,354	105,507	36,014	342,661	33,918	2018	OTW - Typical 2002
	1,518	44,854	98,311	34,156	100,174	3,338	2002	OTB - Typical 2002
	1,594	47,733	63,258	23,980	94,253	3,338	2009	OTB - Typical 2002
<b>KY</b>	1,580	47,733	63,258	23,980	94,253	3,338	2009	OTW - Typical 2002
	1,635	55,729	39,084	20,795	102,117	3,338	2018	OTB - Typical 2002
	1,616	55,729	39,084	20,795	102,117	3,338	2018	OTW - Typical 2002
	696	43,401	82,810	32,401	135,106	13,625	2002	OTB - Typical 2002
	584	38,119	49,670	27,650	125,382	13,625	2009	OTB - Typical 2002
<b>MS</b>	590	38,119	49,670	27,650	125,382	13,625	2009	OTW - Typical 2002
	766	45,966	30,734	20,576	139,419	13,625	2018	OTB - Typical 2002
	827	45,966	30,734	20,576	139,419	13,625	2018	OTW - Typical 2002
	1,043	72,856	253,374	71,378	346,060	12,499	2002	OTB - Typical 2002
	1,100	70,146	163,803	52,430	252,553	12,499	2009	OTB - Typical 2002
<b>NC</b>	1,093	70,146	163,803	52,430	252,553	12,499	2009	OTW - Typical 2002
	1,183	75,985	88,620	40,576	234,207	12,499	2018	OTB - Typical 2002
	1,172	75,985	88,620	40,576	234,207	12,499	2018	OTW - Typical 2002
	438	38,493	106,792	41,374	187,466	14,666	2002	OTB - Typical 2002
	601	36,410	67,281	30,531	176,104	14,666	2009	OTB - Typical 2002
<b>SC</b>	626	36,410	67,281	30,531	176,104	14,666	2009	OTW - Typical 2002
	745	44,586	44,700	24,989	196,946	14,666	2018	OTB - Typical 2002
	754	44,586	44,700	24,989	196,946	14,666	2018	OTW - Typical 2002
	819	87,975	169,914	49,056	161,069	5,153	2002	OTB - Typical 2002
	866	89,128	108,200	38,686	160,265	5,153	2009	OTB - Typical 2002
<b>TN</b>	854	89,128	108,200	38,686	160,265	5,153	2009	OTW - Typical 2002
	899	111,372	64,665	28,667	188,977	5,153	2018	OTB - Typical 2002
	826	111,372	64,665	28,667	188,977	5,153	2018	OTW - Typical 2002
	672	42,589	144,684	57,050	129,792	912	2002	OTB - Typical 2002
	546	44,359	89,678	40,897	120,022	912	2009	OTB - Typical 2002
<b>VA</b>	503	44,359	89,678	40,897	120,022	912	2009	OTW - Typical 2002
	694	53,968	60,454	34,412	128,160	912	2018	OTB - Typical 2002
	674	53,968	60,454	34,412	128,160	912	2018	OTW - Typical 2002
	1,128	14,599	40,066	14,805	61,490	2,184	2002	OTB - Typical 2002
	1,442	14,015	23,907	14,249	57,082	2,184	2009	OTB - Typical 2002
<b>WV</b>	1,397	14,015	23,907	14,249	57,082	2,184	2009	OTW - Typical 2002
	1,471	16,636	15,463	9,500	62,164	2,184	2018	OTB - Typical 2002
	1,456	16,636	15,463	9,500	62,164	2,184	2018	OTW - Typical 2002

**APPENDIX B:**

**STATE VMT TOTALS**

## State VMT Totals

## Million Miles Per Year

2002	LDGV	LDGT1	LDGT2	HDDV	LDDV	LDDT	HDDV	MC	TOTAL
AL	31,982	12,728	4,347	1,630	63	69	4,709	196	55,723
FL	105,340	40,835	13,945	5,079	206	220	12,465	591	178,681
GA	61,660	24,394	8,331	3,103	121	132	8,673	371	106,785
KY	28,751	12,189	3,366	1,606	55	55	4,827	171	51,020
MS	23,933	6,724	439	1,025	330	125	3,610	92	36,278
NC	51,189	30,339	10,787	4,119	230	230	9,440	461	106,795
SC	26,672	10,750	3,671	1,395	52	58	4,306	171	47,074
TN	30,809	20,272	6,922	2,943	52	111	6,810	397	68,316
VA	36,336	24,784	8,667	2,148	61	139	4,969	369	77,472
WV	9,010	5,931	2,028	732	25	37	1,664	117	19,544
2009	LDGV	LDGT1	LDGT2	HDDV	LDDV	LDDT	HDDV	MC	TOTAL
AL	30,638	18,598	5,511	2,069	65	72	5,976	249	63,178
FL	107,641	62,449	18,697	6,820	215	230	16,743	794	213,590
GA	61,569	36,641	10,933	4,077	126	137	11,374	487	125,343
KY	28,006	16,984	4,428	1,983	58	57	5,983	231	57,729
MS	23,641	10,131	573	1,341	356	135	4,719	120	41,017
NC	48,495	43,484	15,122	4,576	40	224	10,928	527	123,396
SC	26,451	16,119	4,796	1,824	55	61	5,617	223	55,147
TN	28,775	28,650	8,521	3,627	52	111	8,391	490	78,615
VA	33,663	34,814	10,597	2,624	61	137	6,073	451	88,419
WV	8,128	8,205	2,427	878	25	37	1,995	140	21,835
2018	LDGV	LDGT1	LDGT2	HDDV	LDDV	LDDT	HDDV	MC	TOTAL
AL	31,706	23,562	6,990	2,634	67	84	7,607	317	72,966
FL	116,576	83,385	24,996	9,156	221	301	22,491	1,066	258,191
GA	65,214	47,687	14,245	5,332	129	171	14,853	637	148,269
KY	29,353	21,058	5,558	2,463	60	66	7,454	288	66,300
MS	24,787	12,984	736	1,727	372	159	6,076	155	46,996
NC	42,247	51,568	18,260	4,985	279	279	11,396	553	129,566
SC	27,930	20,880	6,220	2,375	57	75	7,306	290	65,133
TN	29,253	35,702	10,629	4,538	52	130	10,500	613	91,417
VA	35,030	44,438	13,543	3,358	62	164	7,770	578	104,944
WV	8,130	10,025	2,969	1,078	25	41	2,451	172	24,891

**APPENDIX C:**

**STATE TIER 1 EMISSION TOTALS**

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
AL	2002	01	FUEL COMB. ELEC. UTIL.	11,460	239	154,704	7,845	4,176	423,736	2,288
AL	2002	02	FUEL COMB. INDUSTRIAL	67,121	234	51,527	6,729	3,791	40,918	2,237
AL	2002	03	FUEL COMB. OTHER	70,498	169	19,237	6,411	5,528	39,606	56,120
AL	2002	04	CHEMICAL & ALLIED PRODUCT	5,721	35	2,032	1,220	888	12,770	7,273
AL	2002	05	METALS PROCESSING	38,247	376	6,011	9,107	7,803	14,039	3,299
AL	2002	06	PETROLEUM & RELATED	13,606	0	878	194	155	22,991	4,024
AL	2002	07	OTHER INDUSTRIAL PROCESSES	47,676	1,468	25,252	22,689	9,516	17,904	25,304
AL	2002	08	SOLVENT UTILIZATION	216	0	226	149	126	3	108,437
AL	2002	09	STORAGE & TRANSPORT	174	0	230	1,086	636	13	16,522
AL	2002	10	WASTE DISPOSAL & RECYCLING	86,302	10	3,465	13,960	13,073	489	11,334
AL	2002	11	HIGHWAY VEHICLES	1,366,056	5,576	158,423	3,898	2,794	6,885	119,790
AL	2002	12	OFF-HIGHWAY	414,385	33	65,366	4,787	4,502	7,584	60,487
AL	2002	14	MISCELLANEOUS	442,778	59,864	9,343	408,115	79,127	2,559	21,686
	<b>2002 Total</b>			<b>2,564,239</b>	<b>68,005</b>	<b>496,695</b>	<b>486,190</b>	<b>132,115</b>	<b>589,499</b>	<b>438,800</b>
AL	2009	01	FUEL COMB. ELEC. UTIL.	14,986	359	82,305	6,969	3,921	378,052	2,473
AL	2009	02	FUEL COMB. INDUSTRIAL	68,146	274	36,301	6,140	3,438	40,651	2,191
AL	2009	03	FUEL COMB. OTHER	52,256	158	19,514	5,904	5,104	36,048	31,403
AL	2009	04	CHEMICAL & ALLIED PRODUCT	6,118	38	2,273	1,257	912	13,660	6,613
AL	2009	05	METALS PROCESSING	38,969	500	6,021	9,062	7,756	16,629	3,305
AL	2009	06	PETROLEUM & RELATED	13,241	0	858	221	177	22,495	3,336
AL	2009	07	OTHER INDUSTRIAL PROCESSES	52,004	1,571	26,340	24,196	10,197	19,383	26,519
AL	2009	08	SOLVENT UTILIZATION	247	0	257	165	139	4	92,631
AL	2009	09	STORAGE & TRANSPORT	192	0	253	1,146	584	14	17,738
AL	2009	10	WASTE DISPOSAL & RECYCLING	87,225	11	3,634	14,504	13,485	590	11,207
AL	2009	11	HIGHWAY VEHICLES	942,793	6,350	101,323	3,188	2,049	635	72,848
AL	2009	12	OFF-HIGHWAY	454,686	36	56,862	4,027	3,776	3,471	50,249
AL	2009	14	MISCELLANEOUS	463,498	65,899	9,788	428,698	82,679	2,681	22,657
	<b>2009 Total</b>			<b>2,194,361</b>	<b>75,195</b>	<b>345,729</b>	<b>505,475</b>	<b>134,217</b>	<b>534,314</b>	<b>343,169</b>
AL	2018	01	FUEL COMB. ELEC. UTIL.	24,342	1,072	64,358	7,822	4,768	305,262	2,952
AL	2018	02	FUEL COMB. INDUSTRIAL	69,198	275	38,781	6,462	3,613	43,170	2,295
AL	2018	03	FUEL COMB. OTHER	43,744	164	20,185	5,641	4,818	37,162	21,215
AL	2018	04	CHEMICAL & ALLIED PRODUCT	7,384	46	2,804	1,523	1,106	16,509	8,040
AL	2018	05	METALS PROCESSING	49,770	674	7,519	11,036	9,423	21,824	4,234
AL	2018	06	PETROLEUM & RELATED	13,002	0	848	258	207	22,242	3,421
AL	2018	07	OTHER INDUSTRIAL PROCESSES	60,452	1,732	30,831	27,727	11,812	21,843	30,267
AL	2018	08	SOLVENT UTILIZATION	301	0	317	200	169	4	112,412
AL	2018	09	STORAGE & TRANSPORT	234	0	307	1,366	699	17	18,900
AL	2018	10	WASTE DISPOSAL & RECYCLING	88,758	13	3,867	15,343	14,143	718	11,938
AL	2018	11	HIGHWAY VEHICLES	797,966	7,296	46,222	2,488	1,262	720	47,296
AL	2018	12	OFF-HIGHWAY	488,924	42	43,799	3,041	2,835	2,818	40,407
AL	2018	14	MISCELLANEOUS	464,235	73,529	9,803	458,551	85,538	2,686	22,686
	<b>2018 Total</b>			<b>2,108,311</b>	<b>84,843</b>	<b>269,643</b>	<b>541,458</b>	<b>140,394</b>	<b>474,974</b>	<b>326,063</b>

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
FL	2002	01	FUEL COMB. ELEC. UTIL.	55,899	222	282,507	21,391	15,575	483,590	2,531
FL	2002	02	FUEL COMB. INDUSTRIAL	64,794	131	45,153	20,442	18,547	42,524	4,219
FL	2002	03	FUEL COMB. OTHER	49,230	99	11,593	8,464	8,074	20,031	16,123
FL	2002	04	CHEMICAL & ALLIED PRODUCT	745	1,101	2,221	1,868	1,488	34,462	3,542
FL	2002	05	METALS PROCESSING	1,404	1	194	449	334	882	82
FL	2002	06	PETROLEUM & RELATED	1,070	0	560	259	129	470	724
FL	2002	07	OTHER INDUSTRIAL PROCESSES	18,586	19	12,325	23,419	11,844	6,515	27,024
FL	2002	08	SOLVENT UTILIZATION	0	0	1	128	110	0	304,582
FL	2002	09	STORAGE & TRANSPORT	161	0	561	1,645	720	38	79,281
FL	2002	10	WASTE DISPOSAL & RECYCLING	175,989	351	6,123	22,142	21,604	659	17,449
FL	2002	11	HIGHWAY VEHICLES	4,693,893	18,078	466,098	11,253	7,852	20,872	495,225
FL	2002	12	OFF-HIGHWAY	1,920,729	134	180,627	18,281	17,415	20,614	272,072
FL	2002	14	MISCELLANEOUS	764,337	40,324	15,083	498,855	115,287	4,129	41,274
	2002 Total			7,746,839	60,460	1,023,045	628,597	218,979	634,786	1,264,128
FL	2009	01	FUEL COMB. ELEC. UTIL.	35,928	1,631	86,165	9,007	5,910	186,055	1,910
FL	2009	02	FUEL COMB. INDUSTRIAL	69,972	146	44,480	16,265	14,827	38,225	4,473
FL	2009	03	FUEL COMB. OTHER	33,014	100	10,800	7,555	7,174	19,882	10,907
FL	2009	04	CHEMICAL & ALLIED PRODUCT	901	1,231	2,461	1,908	1,526	34,961	3,821
FL	2009	05	METALS PROCESSING	1,545	1	176	361	251	993	82
FL	2009	06	PETROLEUM & RELATED	1,190	0	612	304	156	519	748
FL	2009	07	OTHER INDUSTRIAL PROCESSES	18,593	26	13,521	33,084	19,357	6,881	26,413
FL	2009	08	SOLVENT UTILIZATION	0	0	1	132	113	0	319,723
FL	2009	09	STORAGE & TRANSPORT	187	0	621	1,661	727	50	83,880
FL	2009	10	WASTE DISPOSAL & RECYCLING	177,953	342	6,251	22,971	22,364	698	17,241
FL	2009	11	HIGHWAY VEHICLES	3,446,095	21,737	314,307	9,953	6,216	2,120	323,290
FL	2009	12	OFF-HIGHWAY	2,104,920	148	163,794	15,613	14,866	8,967	209,543
FL	2009	14	MISCELLANEOUS	764,004	41,471	15,075	557,331	120,796	4,129	41,290
	2009 Total			6,654,301	66,833	658,265	676,145	214,282	303,479	1,043,321
FL	2018	01	FUEL COMB. ELEC. UTIL.	53,772	2,976	73,125	9,953	6,843	132,177	2,376
FL	2018	02	FUEL COMB. INDUSTRIAL	76,847	156	47,835	17,808	16,255	40,443	4,892
FL	2018	03	FUEL COMB. OTHER	27,094	110	12,344	7,254	6,852	20,975	8,878
FL	2018	04	CHEMICAL & ALLIED PRODUCT	1,200	1,448	3,119	2,367	1,907	41,395	4,739
FL	2018	05	METALS PROCESSING	1,973	2	225	466	323	1,325	106
FL	2018	06	PETROLEUM & RELATED	1,513	0	778	387	198	659	918
FL	2018	07	OTHER INDUSTRIAL PROCESSES	20,748	35	15,855	39,871	23,301	7,741	29,716
FL	2018	08	SOLVENT UTILIZATION	0	0	1	158	135	0	387,657
FL	2018	09	STORAGE & TRANSPORT	226	0	690	2,008	879	58	87,732
FL	2018	10	WASTE DISPOSAL & RECYCLING	180,730	418	6,486	24,140	23,427	769	18,335
FL	2018	11	HIGHWAY VEHICLES	3,086,330	26,154	154,611	8,489	4,242	2,533	216,620
FL	2018	12	OFF-HIGHWAY	2,323,327	171	127,885	12,497	11,868	7,536	183,452
FL	2018	14	MISCELLANEOUS	763,701	43,251	15,068	628,984	127,364	4,129	41,338
	2018 Total			6,537,461	74,720	458,023	754,381	223,592	259,739	986,760

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
GA	2002	01	FUEL COMB. ELEC. UTIL.	9,650	86	148,126	11,467	5,070	517,633	1,256
GA	2002	02	FUEL COMB. INDUSTRIAL	59,492	27	53,039	12,037	7,886	88,791	3,956
GA	2002	03	FUEL COMB. OTHER	63,314	17	14,465	10,142	10,057	10,740	27,226
GA	2002	04	CHEMICAL & ALLIED PRODUCT	5,387	920	2,277	391	305	2,721	2,668
GA	2002	05	METALS PROCESSING	330	0	60	147	94	0	70
GA	2002	06	PETROLEUM & RELATED	41	0	3	69	44	68	175
GA	2002	07	OTHER INDUSTRIAL PROCESSES	27,960	2,666	12,215	39,630	13,073	8,701	26,999
GA	2002	08	SOLVENT UTILIZATION	4	0	22	13	13	0	234,744
GA	2002	09	STORAGE & TRANSPORT	39	0	6	583	360	0	26,334
GA	2002	10	WASTE DISPOSAL & RECYCLING	203,892	16	6,872	29,227	28,311	312	18,964
GA	2002	11	HIGHWAY VEHICLES	2,833,468	10,524	308,013	7,236	5,158	12,155	267,378
GA	2002	12	OFF-HIGHWAY	791,158	60	97,961	8,618	8,226	9,005	85,965
GA	2002	14	MISCELLANEOUS	498,622	83,032	10,279	687,028	116,756	2,815	25,618
	2002 Total			4,493,357	97,349	653,338	806,587	195,354	652,942	721,352
GA	2009	01	FUEL COMB. ELEC. UTIL.	23,721	686	98,497	17,891	10,907	417,449	2,314
GA	2009	02	FUEL COMB. INDUSTRIAL	63,067	28	53,726	11,206	7,390	89,850	4,163
GA	2009	03	FUEL COMB. OTHER	45,184	17	15,347	8,496	8,400	10,981	15,683
GA	2009	04	CHEMICAL & ALLIED PRODUCT	6,044	1,032	2,531	436	341	2,743	2,814
GA	2009	05	METALS PROCESSING	363	0	61	159	100	0	47
GA	2009	06	PETROLEUM & RELATED	50	0	4	83	54	82	154
GA	2009	07	OTHER INDUSTRIAL PROCESSES	29,976	2,902	12,528	45,339	14,758	7,662	28,441
GA	2009	08	SOLVENT UTILIZATION	4	0	25	14	14	0	216,248
GA	2009	09	STORAGE & TRANSPORT	45	0	7	649	401	0	27,821
GA	2009	10	WASTE DISPOSAL & RECYCLING	218,460	18	7,419	31,955	30,900	360	18,711
GA	2009	11	HIGHWAY VEHICLES	2,053,694	12,660	208,393	6,103	3,869	1,254	184,239
GA	2009	12	OFF-HIGHWAY	882,970	68	85,733	7,521	7,175	2,725	67,686
GA	2009	14	MISCELLANEOUS	515,329	91,406	10,637	765,043	125,665	2,914	26,388
	2009 Total			3,838,907	108,817	494,908	894,896	209,973	536,020	594,708
GA	2018	01	FUEL COMB. ELEC. UTIL.	44,476	1,677	75,717	20,909	13,983	230,856	2,841
GA	2018	02	FUEL COMB. INDUSTRIAL	67,067	30	57,232	11,755	7,769	94,403	4,424
GA	2018	03	FUEL COMB. OTHER	39,440	17	17,801	7,722	7,622	11,958	11,482
GA	2018	04	CHEMICAL & ALLIED PRODUCT	7,076	1,208	2,982	517	405	3,436	3,524
GA	2018	05	METALS PROCESSING	421	0	76	185	118	0	55
GA	2018	06	PETROLEUM & RELATED	63	0	5	105	68	104	191
GA	2018	07	OTHER INDUSTRIAL PROCESSES	33,611	3,559	14,460	55,130	17,899	8,748	33,333
GA	2018	08	SOLVENT UTILIZATION	5	0	30	22	22	0	264,326
GA	2018	09	STORAGE & TRANSPORT	54	0	9	764	470	0	29,409
GA	2018	10	WASTE DISPOSAL & RECYCLING	235,690	22	8,120	35,280	34,038	423	20,411
GA	2018	11	HIGHWAY VEHICLES	1,765,020	14,871	99,821	4,995	2,517	1,458	105,507
GA	2018	12	OFF-HIGHWAY	973,872	79	64,579	6,015	5,730	1,709	56,761
GA	2018	14	MISCELLANEOUS	515,220	102,075	10,635	859,835	134,730	2,914	26,368
	2018 Total			3,682,015	123,537	351,467	1,003,235	225,372	356,010	558,631

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
KY	2002	01	FUEL COMB. ELEC. UTIL.	12,607	321	201,928	4,795	2,847	495,153	1,481
KY	2002	02	FUEL COMB. INDUSTRIAL	14,110	182	60,716	2,155	1,463	41,825	1,566
KY	2002	03	FUEL COMB. OTHER	40,806	55	4,997	7,679	7,352	9,647	12,711
KY	2002	04	CHEMICAL & ALLIED PRODUCT	176	214	296	774	581	2,345	3,462
KY	2002	05	METALS PROCESSING	89,197	6	1,082	3,396	2,720	12,328	1,508
KY	2002	06	PETROLEUM & RELATED	4,304	335	2,519	308	205	5,747	2,895
KY	2002	07	OTHER INDUSTRIAL PROCESSES	6,493	78	6,518	31,429	10,394	3,333	25,388
KY	2002	08	SOLVENT UTILIZATION	0	10	9	317	241	1	61,834
KY	2002	09	STORAGE & TRANSPORT	33	8	15	1,920	1,177	3	18,853
KY	2002	10	WASTE DISPOSAL & RECYCLING	20,622	8	1,768	7,229	6,476	606	7,927
KY	2002	11	HIGHWAY VEHICLES	1,260,682	5,044	154,899	3,720	2,693	5,974	98,311
KY	2002	12	OFF-HIGHWAY	325,993	31	104,571	6,425	6,046	14,043	44,805
KY	2002	14	MISCELLANEOUS	25,849	51,026	556	197,402	28,291	146	5,238
	2002 Total			1,800,871	57,318	539,873	267,547	70,486	591,151	285,977
KY	2009	01	FUEL COMB. ELEC. UTIL.	15,812	400	92,021	6,463	4,279	290,193	1,369
KY	2009	02	FUEL COMB. INDUSTRIAL	14,986	195	61,683	2,105	1,456	42,433	1,476
KY	2009	03	FUEL COMB. OTHER	30,045	54	5,178	7,035	6,725	10,123	9,148
KY	2009	04	CHEMICAL & ALLIED PRODUCT	179	249	300	851	633	2,384	3,635
KY	2009	05	METALS PROCESSING	99,428	7	1,156	3,246	2,550	13,735	1,772
KY	2009	06	PETROLEUM & RELATED	4,818	377	2,828	344	230	6,460	3,052
KY	2009	07	OTHER INDUSTRIAL PROCESSES	7,212	84	6,674	32,194	10,912	3,634	27,548
KY	2009	08	SOLVENT UTILIZATION	0	10	11	371	283	1	62,595
KY	2009	09	STORAGE & TRANSPORT	38	9	18	2,064	1,268	3	20,038
KY	2009	10	WASTE DISPOSAL & RECYCLING	22,388	9	1,979	7,770	6,925	733	7,725
KY	2009	11	HIGHWAY VEHICLES	942,350	5,795	97,912	3,002	1,941	585	63,258
KY	2009	12	OFF-HIGHWAY	357,800	34	94,752	5,544	5,203	9,180	38,558
KY	2009	14	MISCELLANEOUS	32,627	52,915	702	206,463	29,601	187	6,335
	2009 Total			1,527,684	60,137	365,214	277,453	72,006	379,651	246,509
KY	2018	01	FUEL COMB. ELEC. UTIL.	17,144	476	64,378	6,694	4,434	226,062	1,426
KY	2018	02	FUEL COMB. INDUSTRIAL	15,692	205	64,533	2,203	1,528	43,772	1,555
KY	2018	03	FUEL COMB. OTHER	24,764	53	5,550	6,469	6,169	9,947	7,479
KY	2018	04	CHEMICAL & ALLIED PRODUCT	219	317	367	1,054	781	2,884	4,384
KY	2018	05	METALS PROCESSING	114,470	9	1,508	3,898	3,065	15,800	2,343
KY	2018	06	PETROLEUM & RELATED	5,495	434	3,244	392	262	7,426	3,394
KY	2018	07	OTHER INDUSTRIAL PROCESSES	8,303	93	7,872	35,349	12,377	4,141	31,394
KY	2018	08	SOLVENT UTILIZATION	0	12	14	464	352	1	73,525
KY	2018	09	STORAGE & TRANSPORT	44	10	21	2,408	1,481	4	21,196
KY	2018	10	WASTE DISPOSAL & RECYCLING	24,677	11	2,256	8,481	7,518	894	8,392
KY	2018	11	HIGHWAY VEHICLES	782,423	6,584	42,104	2,283	1,160	651	39,084
KY	2018	12	OFF-HIGHWAY	381,215	40	79,392	4,556	4,256	8,592	30,920
KY	2018	14	MISCELLANEOUS	33,931	55,118	729	218,725	30,626	196	7,254
	2018 Total			1,408,378	63,361	271,967	292,975	74,010	320,369	232,347



## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
MS	2002	01	FUEL COMB. ELEC. UTIL.	5,219	198	40,433	1,706	1,147	60,086	629
MS	2002	02	FUEL COMB. INDUSTRIAL	22,710	28	48,726	5,007	3,634	9,740	8,023
MS	2002	03	FUEL COMB. OTHER	36,752	34	4,502	5,445	5,414	789	22,923
MS	2002	04	CHEMICAL & ALLIED PRODUCT	15,410	361	1,725	849	440	1,663	2,375
MS	2002	05	METALS PROCESSING	1,031	0	115	122	58	36	371
MS	2002	06	PETROLEUM & RELATED	975	20	1,187	790	335	15,560	20,788
MS	2002	07	OTHER INDUSTRIAL PROCESSES	13,884	747	9,219	27,617	8,051	8,866	15,525
MS	2002	08	SOLVENT UTILIZATION	45	7	105	219	178	1	80,760
MS	2002	09	STORAGE & TRANSPORT	74	0	80	124	38	40	23,327
MS	2002	10	WASTE DISPOSAL & RECYCLING	1,414	9	89	447	324	31	886
MS	2002	11	HIGHWAY VEHICLES	894,639	3,577	111,791	2,856	2,109	4,604	82,810
MS	2002	12	OFF-HIGHWAY	236,752	23	88,787	5,010	4,690	11,315	41,081
MS	2002	14	MISCELLANEOUS	14,529	58,746	312	323,622	43,028	84	708
	2002	Total		1,243,435	63,753	307,072	373,815	69,446	112,814	300,206
MS	2009	01	FUEL COMB. ELEC. UTIL.	5,051	334	36,011	4,957	4,777	76,579	404
MS	2009	02	FUEL COMB. INDUSTRIAL	24,607	30	44,095	3,728	2,787	7,388	8,007
MS	2009	03	FUEL COMB. OTHER	26,023	33	4,514	5,278	5,245	751	17,445
MS	2009	04	CHEMICAL & ALLIED PRODUCT	16,141	405	1,955	941	488	1,880	2,614
MS	2009	05	METALS PROCESSING	1,098	0	128	129	62	37	402
MS	2009	06	PETROLEUM & RELATED	1,101	23	1,262	894	379	7,926	13,317
MS	2009	07	OTHER INDUSTRIAL PROCESSES	14,181	197	8,376	31,381	8,629	8,254	16,282
MS	2009	08	SOLVENT UTILIZATION	50	8	118	239	194	1	80,393
MS	2009	09	STORAGE & TRANSPORT	92	0	100	172	59	49	23,494
MS	2009	10	WASTE DISPOSAL & RECYCLING	1,486	10	95	473	339	32	743
MS	2009	11	HIGHWAY VEHICLES	628,151	4,026	69,949	2,290	1,522	397	49,670
MS	2009	12	OFF-HIGHWAY	257,453	25	80,567	4,270	3,985	7,191	36,197
MS	2009	14	MISCELLANEOUS	48,314	63,886	1,037	337,018	46,695	283	2,295
	2009	Total		1,023,747	68,978	248,207	391,770	75,160	110,767	251,261
MS	2018	01	FUEL COMB. ELEC. UTIL.	15,282	827	10,271	7,187	7,033	15,146	1,114
MS	2018	02	FUEL COMB. INDUSTRIAL	27,056	33	46,929	4,093	3,058	8,169	8,559
MS	2018	03	FUEL COMB. OTHER	20,900	32	4,767	4,964	4,928	726	14,670
MS	2018	04	CHEMICAL & ALLIED PRODUCT	20,175	475	2,337	1,132	588	2,242	3,290
MS	2018	05	METALS PROCESSING	1,357	0	167	160	79	48	461
MS	2018	06	PETROLEUM & RELATED	1,267	26	1,438	1,010	430	19,028	14,407
MS	2018	07	OTHER INDUSTRIAL PROCESSES	16,267	216	9,996	38,494	10,494	9,657	20,301
MS	2018	08	SOLVENT UTILIZATION	60	9	141	301	244	1	98,354
MS	2018	09	STORAGE & TRANSPORT	115	0	124	210	73	62	24,537
MS	2018	10	WASTE DISPOSAL & RECYCLING	1,638	12	114	533	372	34	870
MS	2018	11	HIGHWAY VEHICLES	528,898	4,565	29,717	1,688	876	441	30,734
MS	2018	12	OFF-HIGHWAY	270,726	29	68,252	3,452	3,203	6,638	28,842
MS	2018	14	MISCELLANEOUS	50,160	70,096	1,076	352,321	47,869	294	2,377
	2018	Total		953,900	76,320	175,329	415,546	79,246	62,486	248,517

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
NC	2002	01	FUEL COMB. ELEC. UTIL.	14,074	55	148,809	22,994	16,623	478,488	986
NC	2002	02	FUEL COMB. INDUSTRIAL	23,578	301	48,590	5,596	4,334	33,395	2,540
NC	2002	03	FUEL COMB. OTHER	217,008	2,318	16,460	31,777	26,746	3,971	87,985
NC	2002	04	CHEMICAL & ALLIED PRODUCT	13,952	535	859	866	538	5,736	4,313
NC	2002	05	METALS PROCESSING	5,876	60	201	564	467	1,010	2,512
NC	2002	06	PETROLEUM & RELATED	461	0	174	104	52	283	140
NC	2002	07	OTHER INDUSTRIAL PROCESSES	8,552	480	7,380	25,328	8,924	3,426	18,025
NC	2002	08	SOLVENT UTILIZATION	130	307	229	524	484	26	151,383
NC	2002	09	STORAGE & TRANSPORT	66	46	53	639	354	1	16,120
NC	2002	10	WASTE DISPOSAL & RECYCLING	125,528	247	7,482	2,239	2,218	1,666	15,568
NC	2002	11	HIGHWAY VEHICLES	3,176,811	10,455	341,198	6,905	4,816	13,343	253,374
NC	2002	12	OFF-HIGHWAY	808,231	65	84,284	7,348	7,005	7,693	94,480
NC	2002	14	MISCELLANEOUS	72,673	159,069	1,561	233,551	36,414	423	3,528
	2002	Total		4,466,940	173,937	657,279	338,434	108,975	549,463	650,954
NC	2009	01	FUEL COMB. ELEC. UTIL.	14,942	445	66,517	22,152	15,949	242,286	954
NC	2009	02	FUEL COMB. INDUSTRIAL	24,871	312	38,160	5,159	3,871	30,788	2,509
NC	2009	03	FUEL COMB. OTHER	158,837	2,723	18,441	25,334	19,467	4,060	49,819
NC	2009	04	CHEMICAL & ALLIED PRODUCT	14,732	599	933	981	607	6,286	4,925
NC	2009	05	METALS PROCESSING	6,358	67	207	627	528	1,130	2,790
NC	2009	06	PETROLEUM & RELATED	556	0	212	127	64	349	162
NC	2009	07	OTHER INDUSTRIAL PROCESSES	9,211	507	8,061	28,524	9,788	3,712	18,144
NC	2009	08	SOLVENT UTILIZATION	142	335	246	549	506	28	136,114
NC	2009	09	STORAGE & TRANSPORT	75	51	55	696	380	1	17,367
NC	2009	10	WASTE DISPOSAL & RECYCLING	139,518	307	8,354	2,774	2,750	1,913	17,331
NC	2009	11	HIGHWAY VEHICLES	2,184,901	12,637	207,648	5,861	3,643	1,311	163,803
NC	2009	12	OFF-HIGHWAY	887,605	72	70,997	6,055	5,760	1,892	74,056
NC	2009	14	MISCELLANEOUS	96,825	167,131	2,080	250,912	49,956	566	4,648
	2009	Total		3,538,573	185,185	421,913	349,750	113,268	294,321	492,624
NC	2018	01	FUEL COMB. ELEC. UTIL.	20,223	663	62,346	37,376	29,791	108,492	1,345
NC	2018	02	FUEL COMB. INDUSTRIAL	26,872	341	40,897	5,594	4,222	32,507	2,702
NC	2018	03	FUEL COMB. OTHER	131,365	2,857	20,027	21,847	16,231	4,050	34,104
NC	2018	04	CHEMICAL & ALLIED PRODUCT	18,463	702	1,105	1,175	726	7,414	6,113
NC	2018	05	METALS PROCESSING	7,576	76	255	771	657	1,335	3,516
NC	2018	06	PETROLEUM & RELATED	712	0	272	162	82	448	207
NC	2018	07	OTHER INDUSTRIAL PROCESSES	10,675	559	9,259	34,339	11,601	4,357	20,978
NC	2018	08	SOLVENT UTILIZATION	169	375	277	588	540	31	152,979
NC	2018	09	STORAGE & TRANSPORT	91	59	67	808	430	2	19,511
NC	2018	10	WASTE DISPOSAL & RECYCLING	156,599	387	9,456	3,502	3,474	2,234	19,789
NC	2018	11	HIGHWAY VEHICLES	1,510,848	13,077	81,706	4,299	2,158	1,323	88,620
NC	2018	12	OFF-HIGHWAY	960,709	83	49,046	4,298	4,069	905	61,327
NC	2018	14	MISCELLANEOUS	111,705	177,474	2,399	273,030	54,376	655	5,333
	2018	Total		2,956,008	196,655	277,112	387,788	128,356	163,752	416,523

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
SC	2002	01	FUEL COMB. ELEC. UTIL.	6,969	141	88,528	21,827	17,521	210,272	470
SC	2002	02	FUEL COMB. INDUSTRIAL	31,771	97	38,081	5,308	3,641	44,958	1,338
SC	2002	03	FUEL COMB. OTHER	75,800	65	4,367	6,261	6,166	4,318	49,171
SC	2002	04	CHEMICAL & ALLIED PRODUCT	2,526	173	25	501	318	59	8,784
SC	2002	05	METALS PROCESSING	13,833	0	450	639	408	4,160	660
SC	2002	06	PETROLEUM & RELATED	248	0	283	120	71	170	114
SC	2002	07	OTHER INDUSTRIAL PROCESSES	9,502	1,237	15,145	15,224	6,981	12,128	16,342
SC	2002	08	SOLVENT UTILIZATION	0	1	1	78	60	0	88,878
SC	2002	09	STORAGE & TRANSPORT	10	0	4	1,025	626	0	21,009
SC	2002	10	WASTE DISPOSAL & RECYCLING	67,908	10	4,063	9,172	8,641	625	15,291
SC	2002	11	HIGHWAY VEHICLES	1,275,161	4,684	140,428	3,446	2,496	5,958	106,792
SC	2002	12	OFF-HIGHWAY	413,964	33	50,249	4,152	3,945	4,866	55,016
SC	2002	14	MISCELLANEOUS	221,436	28,903	4,335	262,974	47,136	1,187	12,535
	2002 Total			2,119,129	35,343	345,960	330,728	98,009	288,701	376,401
SC	2009	01	FUEL COMB. ELEC. UTIL.	11,135	343	46,915	19,395	16,042	124,608	660
SC	2009	02	FUEL COMB. INDUSTRIAL	33,201	105	35,660	3,307	2,370	37,792	1,414
SC	2009	03	FUEL COMB. OTHER	49,914	63	4,551	5,264	5,183	4,359	25,073
SC	2009	04	CHEMICAL & ALLIED PRODUCT	2,798	173	26	543	345	60	7,409
SC	2009	05	METALS PROCESSING	15,632	0	449	631	378	4,856	663
SC	2009	06	PETROLEUM & RELATED	302	0	340	145	86	200	131
SC	2009	07	OTHER INDUSTRIAL PROCESSES	10,241	1,403	15,069	18,267	8,045	13,443	15,697
SC	2009	08	SOLVENT UTILIZATION	1	1	1	90	69	0	95,538
SC	2009	09	STORAGE & TRANSPORT	13	0	5	569	352	0	21,989
SC	2009	10	WASTE DISPOSAL & RECYCLING	70,379	11	4,215	9,526	8,977	666	15,998
SC	2009	11	HIGHWAY VEHICLES	912,280	5,510	91,696	2,878	1,870	556	67,281
SC	2009	12	OFF-HIGHWAY	448,625	36	43,235	3,471	3,294	1,701	43,061
SC	2009	14	MISCELLANEOUS	250,690	31,416	4,962	282,480	51,151	1,359	13,906
	2009 Total			1,805,210	39,061	247,124	346,565	98,163	189,601	308,820
SC	2018	01	FUEL COMB. ELEC. UTIL.	14,786	617	51,456	28,826	25,032	93,274	906
SC	2018	02	FUEL COMB. INDUSTRIAL	36,105	113	37,333	4,037	2,855	39,714	1,525
SC	2018	03	FUEL COMB. OTHER	39,627	65	5,135	4,791	4,711	4,469	16,391
SC	2018	04	CHEMICAL & ALLIED PRODUCT	3,296	212	32	664	423	74	9,107
SC	2018	05	METALS PROCESSING	18,853	0	587	773	476	5,920	868
SC	2018	06	PETROLEUM & RELATED	389	0	438	186	110	258	166
SC	2018	07	OTHER INDUSTRIAL PROCESSES	12,136	1,566	17,507	20,215	9,044	15,863	18,636
SC	2018	08	SOLVENT UTILIZATION	1	1	1	116	89	0	120,433
SC	2018	09	STORAGE & TRANSPORT	16	0	6	1,380	842	0	22,742
SC	2018	10	WASTE DISPOSAL & RECYCLING	73,403	13	4,512	10,038	9,443	735	17,167
SC	2018	11	HIGHWAY VEHICLES	800,619	6,472	42,354	2,258	1,154	643	44,700
SC	2018	12	OFF-HIGHWAY	481,332	41	31,758	2,617	2,474	1,198	36,131
SC	2018	14	MISCELLANEOUS	250,637	34,345	4,961	306,342	53,367	1,359	13,896
	2018 Total			1,731,198	43,446	196,081	382,244	110,019	163,509	302,665

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
TN	2002	01	FUEL COMB. ELEC. UTIL.	6,787	197	152,137	13,866	11,491	320,146	890
TN	2002	02	FUEL COMB. INDUSTRIAL	15,257	6	44,510	8,015	6,649	74,146	2,021
TN	2002	03	FUEL COMB. OTHER	77,857	25	15,568	7,967	7,549	16,253	18,346
TN	2002	04	CHEMICAL & ALLIED PRODUCT	36,920	1,518	1,772	3,246	2,201	6,516	24,047
TN	2002	05	METALS PROCESSING	41,371	14	1,182	7,620	7,030	5,818	6,898
TN	2002	06	PETROLEUM & RELATED	543	0	331	314	243	383	1,850
TN	2002	07	OTHER INDUSTRIAL PROCESSES	9,420	44	11,794	30,484	12,867	5,845	27,336
TN	2002	08	SOLVENT UTILIZATION	275	1	5,066	2,103	1,818	58	110,872
TN	2002	09	STORAGE & TRANSPORT	22	24	105	1,249	736	134	21,962
TN	2002	10	WASTE DISPOSAL & RECYCLING	22,143	31	1,839	7,068	6,469	349	15,505
TN	2002	11	HIGHWAY VEHICLES	1,967,658	6,616	233,324	5,338	3,919	9,184	169,914
TN	2002	12	OFF-HIGHWAY	505,163	43	96,827	6,819	6,458	10,441	66,450
TN	2002	14	MISCELLANEOUS	10,824	34,318	225	180,006	25,193	60	2,252
	2002	Total		2,694,242	42,836	564,680	274,095	92,622	449,332	468,342
TN	2009	01	FUEL COMB. ELEC. UTIL.	7,214	227	66,405	15,608	13,092	255,410	932
TN	2009	02	FUEL COMB. INDUSTRIAL	15,943	7	37,369	7,195	6,004	63,511	1,915
TN	2009	03	FUEL COMB. OTHER	61,443	27	14,793	7,134	6,786	16,955	12,781
TN	2009	04	CHEMICAL & ALLIED PRODUCT	35,440	1,719	1,958	3,519	2,400	7,056	15,594
TN	2009	05	METALS PROCESSING	45,183	15	1,245	7,337	6,823	6,537	7,676
TN	2009	06	PETROLEUM & RELATED	615	0	373	356	276	435	1,433
TN	2009	07	OTHER INDUSTRIAL PROCESSES	9,911	62	12,635	32,661	13,737	6,240	28,598
TN	2009	08	SOLVENT UTILIZATION	309	1	5,984	2,431	2,095	65	112,312
TN	2009	09	STORAGE & TRANSPORT	26	31	12	1,218	733	42	23,687
TN	2009	10	WASTE DISPOSAL & RECYCLING	23,810	35	1,993	7,618	6,968	393	14,922
TN	2009	11	HIGHWAY VEHICLES	1,361,408	7,738	147,757	4,238	2,782	831	108,200
TN	2009	12	OFF-HIGHWAY	554,121	48	86,641	5,877	5,557	5,651	55,358
TN	2009	14	MISCELLANEOUS	17,921	35,200	379	192,464	26,830	102	2,814
	2009	Total		2,133,342	45,108	377,545	287,655	94,083	363,228	386,222
TN	2018	01	FUEL COMB. ELEC. UTIL.	7,723	241	31,715	15,941	13,387	112,672	976
TN	2018	02	FUEL COMB. INDUSTRIAL	17,038	7	38,908	7,693	6,447	65,823	2,054
TN	2018	03	FUEL COMB. OTHER	54,486	30	15,503	6,757	6,412	18,091	10,269
TN	2018	04	CHEMICAL & ALLIED PRODUCT	45,455	2,053	2,424	4,443	3,044	9,088	20,071
TN	2018	05	METALS PROCESSING	52,834	17	1,589	9,579	8,953	7,790	9,956
TN	2018	06	PETROLEUM & RELATED	715	0	430	416	324	508	1,636
TN	2018	07	OTHER INDUSTRIAL PROCESSES	10,946	88	14,157	38,250	16,286	7,286	35,587
TN	2018	08	SOLVENT UTILIZATION	380	1	7,675	3,155	2,718	79	140,793
TN	2018	09	STORAGE & TRANSPORT	33	41	14	1,572	939	49	25,493
TN	2018	10	WASTE DISPOSAL & RECYCLING	26,712	42	2,326	8,562	7,828	468	17,530
TN	2018	11	HIGHWAY VEHICLES	1,150,516	8,962	65,242	3,199	1,643	944	64,665
TN	2018	12	OFF-HIGHWAY	593,100	55	70,226	4,672	4,403	5,207	45,084
TN	2018	14	MISCELLANEOUS	19,210	36,213	408	209,058	28,209	111	3,293
	2018	Total		1,979,148	47,749	250,619	313,294	100,592	228,116	377,408

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
VA	2002	01	FUEL COMB. ELEC. UTIL.	6,797	130	85,081	3,892	2,650	233,691	747
VA	2002	02	FUEL COMB. INDUSTRIAL	64,386	100	75,807	18,480	8,453	137,448	5,332
VA	2002	03	FUEL COMB. OTHER	98,788	13	15,648	11,572	11,236	5,508	54,496
VA	2002	04	CHEMICAL & ALLIED PRODUCT	321	2,158	8,062	449	393	2,126	1,530
VA	2002	05	METALS PROCESSING	3,580	0	937	1,575	1,349	5,251	513
VA	2002	06	PETROLEUM & RELATED	23,384	0	182	255	153	170	501
VA	2002	07	OTHER INDUSTRIAL PROCESSES	12,002	726	9,279	33,409	9,795	17,702	13,086
VA	2002	08	SOLVENT UTILIZATION	0	4	0	225	210	2	111,511
VA	2002	09	STORAGE & TRANSPORT	16	7	11	745	505	0	26,121
VA	2002	10	WASTE DISPOSAL & RECYCLING	16,566	109	1,866	3,152	1,277	1,581	4,065
VA	2002	11	HIGHWAY VEHICLES	2,170,508	7,837	219,602	4,537	3,090	7,218	144,684
VA	2002	12	OFF-HIGHWAY	660,105	48	63,219	8,728	8,288	8,663	74,866
VA	2002	14	MISCELLANEOUS	13,225	43,948	285	182,193	21,835	74	706
	2002	Total		3,069,678	55,080	479,980	269,212	69,233	419,436	438,158
VA	2009	01	FUEL COMB. ELEC. UTIL.	12,509	694	66,219	5,508	4,067	225,653	778
VA	2009	02	FUEL COMB. INDUSTRIAL	67,422	105	67,263	18,346	8,345	135,612	5,483
VA	2009	03	FUEL COMB. OTHER	66,037	14	15,966	10,062	9,742	5,258	28,063
VA	2009	04	CHEMICAL & ALLIED PRODUCT	286	2,082	7,790	477	413	1,996	1,419
VA	2009	05	METALS PROCESSING	3,397	0	827	1,563	1,332	4,813	390
VA	2009	06	PETROLEUM & RELATED	26,288	0	197	275	169	187	557
VA	2009	07	OTHER INDUSTRIAL PROCESSES	12,471	733	9,425	33,961	9,984	18,871	13,394
VA	2009	08	SOLVENT UTILIZATION	0	5	0	248	231	3	110,127
VA	2009	09	STORAGE & TRANSPORT	17	7	12	797	544	0	26,456
VA	2009	10	WASTE DISPOSAL & RECYCLING	20,109	119	2,174	3,823	1,515	1,805	4,789
VA	2009	11	HIGHWAY VEHICLES	1,495,771	9,066	133,170	3,760	2,254	900	89,678
VA	2009	12	OFF-HIGHWAY	726,815	53	54,993	7,510	7,136	1,707	57,009
VA	2009	14	MISCELLANEOUS	21,582	46,719	464	198,040	23,990	124	1,077
	2009	Total		2,452,703	59,596	358,500	284,369	69,721	396,929	339,219
VA	2018	01	FUEL COMB. ELEC. UTIL.	15,420	622	75,594	13,775	11,976	140,233	997
VA	2018	02	FUEL COMB. INDUSTRIAL	72,218	114	70,343	19,248	8,892	140,995	5,861
VA	2018	03	FUEL COMB. OTHER	53,171	14	17,852	9,427	9,086	5,369	18,603
VA	2018	04	CHEMICAL & ALLIED PRODUCT	338	2,462	9,211	579	502	2,291	1,708
VA	2018	05	METALS PROCESSING	4,034	0	1,017	1,861	1,592	5,948	469
VA	2018	06	PETROLEUM & RELATED	30,284	0	228	315	194	217	642
VA	2018	07	OTHER INDUSTRIAL PROCESSES	14,029	877	10,836	37,553	11,276	21,294	15,636
VA	2018	08	SOLVENT UTILIZATION	0	6	0	314	293	3	127,953
VA	2018	09	STORAGE & TRANSPORT	21	8	15	949	648	0	27,357
VA	2018	10	WASTE DISPOSAL & RECYCLING	24,293	141	2,595	4,694	1,828	2,171	5,821
VA	2018	11	HIGHWAY VEHICLES	1,310,698	10,757	61,881	3,343	1,641	1,059	60,454
VA	2018	12	OFF-HIGHWAY	797,683	61	40,393	6,208	5,891	507	49,052
VA	2018	14	MISCELLANEOUS	27,223	50,279	584	218,141	26,225	158	1,322
	2018	Total		2,349,413	65,342	290,549	316,406	80,044	320,246	315,875

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
WV	2002	01	FUEL COMB. ELEC. UTIL.	10,117	121	222,437	4,472	2,163	500,381	1,140
WV	2002	02	FUEL COMB. INDUSTRIAL	8,685	97	33,831	1,583	1,332	37,118	1,097
WV	2002	03	FUEL COMB. OTHER	29,480	13	15,220	3,814	3,683	3,990	9,275
WV	2002	04	CHEMICAL & ALLIED PRODUCT MFG	50,835	80	1,627	950	831	9,052	5,755
WV	2002	05	METALS PROCESSING	28,837	143	1,570	8,749	7,515	5,619	1,393
WV	2002	06	PETROLEUM & RELATED INDUSTRIES	1	0	1,086	475	475	7,550	2,163
WV	2002	07	OTHER INDUSTRIAL PROCESSES	2,003	56	5,347	18,751	5,567	2,316	1,803
WV	2002	08	SOLVENT UTILIZATION	15	0	18	49	44	0	35,989
WV	2002	09	STORAGE & TRANSPORT	15	0	3	1,952	947	0	12,432
WV	2002	10	WASTE DISPOSAL & RECYCLING	9,395	8	599	4,153	3,731	100	5,098
WV	2002	11	HIGHWAY VEHICLES	560,717	1,933	59,612	1,395	1,003	2,489	40,066
WV	2002	12	OFF-HIGHWAY	133,113	9	33,239	1,850	1,728	2,112	18,566
WV	2002	14	MISCELLANEOUS	2,811	9,909	61	92,633	10,458	16	157
	2002 Total			836,024	12,371	374,650	140,825	39,478	570,742	134,936
WV	2009	01	FUEL COMB. ELEC. UTIL.	11,493	330	86,328	5,657	2,940	277,489	1,361
WV	2009	02	FUEL COMB. INDUSTRIAL	9,296	104	27,094	1,415	1,220	36,912	998
WV	2009	03	FUEL COMB. OTHER	21,558	13	14,229	3,351	3,216	4,047	6,824
WV	2009	04	CHEMICAL & ALLIED PRODUCT MFG	58,271	82	1,804	987	864	10,166	5,426
WV	2009	05	METALS PROCESSING	30,939	142	1,517	7,985	6,724	5,971	1,380
WV	2009	06	PETROLEUM & RELATED INDUSTRIES	1	0	1,221	535	535	8,495	2,172
WV	2009	07	OTHER INDUSTRIAL PROCESSES	2,288	59	4,995	19,228	5,899	2,570	2,064
WV	2009	08	SOLVENT UTILIZATION	17	0	20	52	47	0	32,305
WV	2009	09	STORAGE & TRANSPORT	17	0	3	2,062	1,003	0	12,997
WV	2009	10	WASTE DISPOSAL & RECYCLING	9,131	8	583	4,050	3,632	97	4,898
WV	2009	11	HIGHWAY VEHICLES	385,994	2,183	36,049	1,096	703	227	23,907
WV	2009	12	OFF-HIGHWAY	152,862	11	30,133	1,640	1,528	359	18,069
WV	2009	14	MISCELLANEOUS	4,116	10,574	89	92,900	10,624	23	219
	2009 Total			685,983	13,508	204,064	140,956	38,933	346,356	112,621
WV	2018	01	FUEL COMB. ELEC. UTIL.	11,961	180	51,241	6,349	3,648	115,324	1,387
WV	2018	02	FUEL COMB. INDUSTRIAL	9,917	111	28,710	1,493	1,290	38,531	1,072
WV	2018	03	FUEL COMB. OTHER	18,891	16	17,254	3,160	3,024	4,065	6,270
WV	2018	04	CHEMICAL & ALLIED PRODUCT MFG	70,252	99	2,183	1,188	1,041	12,280	6,560
WV	2018	05	METALS PROCESSING	36,850	183	2,061	10,944	9,372	7,182	1,790
WV	2018	06	PETROLEUM & RELATED INDUSTRIES	1	0	1,407	616	616	9,786	2,338
WV	2018	07	OTHER INDUSTRIAL PROCESSES	2,756	68	5,949	21,347	6,794	3,101	2,561
WV	2018	08	SOLVENT UTILIZATION	20	0	24	61	55	0	38,023
WV	2018	09	STORAGE & TRANSPORT	19	0	4	2,522	1,225	0	13,394
WV	2018	10	WASTE DISPOSAL & RECYCLING	9,237	10	592	4,134	3,692	98	5,272
WV	2018	11	HIGHWAY VEHICLES	319,030	2,484	16,274	844	428	255	15,463
WV	2018	12	OFF-HIGHWAY	167,424	13	25,710	1,292	1,198	56	14,086
WV	2018	14	MISCELLANEOUS	5,175	11,453	112	98,307	11,316	29	268
	2018 Total			651,532	14,617	151,521	152,256	43,699	190,706	108,484

		CO	NH3	NOX	PM10	PM2.5	SO2	VOC
VISTAS	2002 Total	31,034,756	666,451	5,442,572	3,916,030	1,094,698	4,858,865	5,079,254
VISTAS	2009 Total	25,854,812	722,418	3,721,469	4,155,033	1,119,806	3,454,666	4,118,474
VISTAS	2018 Total	24,357,364	790,588	2,692,309	4,559,582	1,205,324	2,539,907	3,873,273

**APPENDIX D:**

**VISTAS TIER 1 EMISSION TOTALS**



## VISTAS Tier 1 Emission Totals

Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
2002	01	FUEL COMB. ELEC. UTIL.	139,579	1,710	1,524,690	114,256	79,263	3,723,175	12,417
2002	02	FUEL COMB. INDUSTRIAL	371,905	1,204	499,981	85,353	59,731	550,864	32,330
2002	03	FUEL COMB. OTHER	759,534	2,810	122,058	99,532	91,805	114,852	354,375
2002	04	CHEMICAL & ALLIED PRODUCT MFG	131,993	7,093	20,896	11,114	7,982	77,450	63,748
2002	05	METALS PROCESSING	223,705	601	11,801	32,367	27,778	49,143	17,306
2002	06	PETROLEUM & RELATED INDUSTRIES	44,633	355	7,204	2,887	1,863	53,392	33,374
2002	07	OTHER INDUSTRIAL PROCESSES	156,077	7,520	114,474	267,980	97,013	86,736	196,831
2002	08	SOLVENT UTILIZATION	687	331	5,677	3,805	3,284	90	1,288,990
2002	09	STORAGE & TRANSPORT	610	85	1,069	10,968	6,100	230	261,959
2002	10	WASTE DISPOSAL & RECYCLING	729,760	801	34,165	98,788	92,125	6,418	112,088
2002	11	HIGHWAY VEHICLES	20,199,593	74,325	2,193,387	50,584	35,929	88,684	1,778,345
2002	12	OFF-HIGHWAY	6,209,596	477	865,130	72,019	68,302	96,336	813,788
2002	14	MISCELLANEOUS	2,067,084	569,139	42,039	3,066,378	523,524	11,494	113,703
<b>2002 Total</b>			31,034,756	666,451	5,442,572	3,916,030	1,094,698	4,858,865	5,079,254
2009	01	FUEL COMB. ELEC. UTIL.	152,790	5,449	727,384	113,607	81,884	2,473,773	13,155
2009	02	FUEL COMB. INDUSTRIAL	391,510	1,305	445,832	74,864	51,709	523,163	32,629
2009	03	FUEL COMB. OTHER	544,310	3,201	123,331	85,412	77,042	112,463	207,146
2009	04	CHEMICAL & ALLIED PRODUCT MFG	140,910	7,611	22,031	11,898	8,528	81,191	54,270
2009	05	METALS PROCESSING	242,911	732	11,788	31,098	26,505	54,700	18,507
2009	06	PETROLEUM & RELATED INDUSTRIES	48,161	399	7,908	3,283	2,124	47,147	25,061
2009	07	OTHER INDUSTRIAL PROCESSES	166,088	7,545	117,625	298,836	111,304	90,649	203,100
2009	08	SOLVENT UTILIZATION	771	360	6,662	4,290	3,690	100	1,257,986
2009	09	STORAGE & TRANSPORT	702	98	1,087	11,035	6,051	160	275,466
2009	10	WASTE DISPOSAL & RECYCLING	770,459	869	36,697	105,463	97,855	7,287	113,566
2009	11	HIGHWAY VEHICLES	14,353,436	87,703	1,408,206	42,370	26,848	8,817	1,146,174
2009	12	OFF-HIGHWAY	6,827,857	530	767,707	61,528	58,279	42,845	649,786
2009	14	MISCELLANEOUS	2,214,906	606,617	45,212	3,311,350	567,986	12,370	121,629
<b>2009 Total</b>			25,854,812	722,418	3,721,469	4,155,033	1,119,806	3,454,666	4,118,474
2018	01	FUEL COMB. ELEC. UTIL.	225,129	9,351	560,200	154,832	120,895	1,479,499	16,318
2018	02	FUEL COMB. INDUSTRIAL	418,010	1,384	471,501	80,386	55,928	547,527	34,938
2018	03	FUEL COMB. OTHER	453,482	3,358	136,418	78,031	69,853	116,812	149,363
2018	04	CHEMICAL & ALLIED PRODUCT MFG	173,857	9,023	26,564	14,641	10,522	97,612	67,534
2018	05	METALS PROCESSING	288,138	961	15,006	39,673	34,058	67,170	23,798
2018	06	PETROLEUM & RELATED INDUSTRIES	53,442	460	9,088	3,846	2,491	60,676	27,321
2018	07	OTHER INDUSTRIAL PROCESSES	189,922	8,793	136,722	348,275	130,883	104,030	238,409
2018	08	SOLVENT UTILIZATION	936	404	8,480	5,378	4,618	119	1,516,454
2018	09	STORAGE & TRANSPORT	855	119	1,258	13,988	7,686	192	290,271
2018	10	WASTE DISPOSAL & RECYCLING	821,737	1,068	40,324	114,708	105,763	8,545	125,525
2018	11	HIGHWAY VEHICLES	12,052,347	101,223	639,931	33,884	17,080	10,027	713,143
2018	12	OFF-HIGHWAY	7,438,312	612	601,040	48,648	45,927	35,166	546,062
2018	14	MISCELLANEOUS	2,241,196	653,831	45,776	3,623,293	599,620	12,532	124,137
<b>2018 Total</b>			24,357,364	790,588	2,692,309	4,559,582	1,205,324	2,539,907	3,873,273



**APPENDIX E:**

**AIRCRAFT PM EXCERPT FROM 2001 TUCSON REPORT**

**Final Report**

**EMISSIONS INVENTORIES FOR  
THE TUCSON AIR PLANNING AREA**

**VOLUME I. STUDY DESCRIPTION AND RESULTS**

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## **ABBREVIATIONS AND ACRONYMS**

ADEQ	Arizona Department of Environmental Quality
ADWM	Arizona Department of Weights and Measures
ALD2	High Molecular Weight Aldehydes (RCHO, R≠H)
AML	Arc Macro Language
AQM	Air Quality Model
APU	Aircraft Power Unit
ARB	California Air Resources Board
ASC	Area Source Category Code
AT	Air Taxi
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CSF	Chemical Speciation Factor
DM	Davis-Monthan Air Force Base
DOT	Department of Transportation
EDMS	Emissions Dispersion Modeling System
EEA	Energy & Environmental Analysis, Inc.
EIPP	Emission Inventory Preparation Plan
EPA	The U.S. Environmental Protection Agency
ETH	Ethene (CH <sub>2</sub> =CH <sub>2</sub> )
FAA	Federal Aviation Administration
FAEED	FAA Aircraft Engine Emission Database
FIPS	Federal Information Processing System
FIRE	EPA's Factor Information REtrieval Data System
FORM	Formaldehyde (CH <sub>2</sub> =O)
GA	General Aviation
GIS	Geographical Information System
GSE	Ground Support Equipment
ICAO	International Civil Aviation Organization

## **ABBREVIATIONS AND ACRONYMS**

ISOP	Isoprene
LPG	Liquid Petroleum Gas
LTO	Landing and TakeOff
NAD27	North American Datum - 1927
NCDC	National Climatic Data Center
NEI	US EPA National Emission Inventory
NEVES	Nonroad Engine and Vehicle Emission Study
NG	Natural Gas
NO	Nitric Oxide
NO <sub>2</sub>	Nitrogen Dioxide
NO <sub>x</sub>	Oxides of Nitrogen
OLE	Olefinic Carbon Bond (C=C)
ORNL	Oak Ridge National Laboratory
PAG	Pima Association of Governments
PAR	Paraffinic Carbon Bond (C—C)
PDEQ	Pima County Department of Environmental Quality
PM	Particulate Matter
PM <sub>2.5</sub>	Particulate Matter less than 2.5 microns
PM <sub>10</sub>	Particulate Matter less than 10 microns
RASP	Regional Aviation System Plan
RVP	Reid Vapor Pressure
SAF	Spatial Allocation Factor
SCC	Source Category Code
SCF	Standard Cubic Foot
SIC	Standard Industrial Classification
SIP	State Implementation Plan
SO <sub>2</sub>	Sulfur Dioxide
SO <sub>x</sub>	Oxides of Sulfur
TAF	Temporal Allocation Factor



## **ABBREVIATIONS AND ACRONYMS**

TAPA	Tucson Air Planning Area
TAZ	Transportation Analysis Zone
THC	Total Hydrocarbon
TIA	Tucson International Airport
TIM	Time-In-Mode
TOL	Tolulene (C <sub>6</sub> H <sub>5</sub> —CH <sub>3</sub> )
TTN	EPA Technology Transfer Network
UAM	Urban Airshed Model
UP	Union Pacific Railroad
VOC	Volatile Organic Compounds as defined by the 1990 Clean Air Act Amendments
XYL	Xylene (C <sub>6</sub> H <sub>6</sub> —(CH <sub>3</sub> ) <sub>2</sub> )

*(Prior material unrelated to VISTAS modeling is intentionally omitted)*

While emission rates for HC, CO, and NO<sub>x</sub> are routinely measured from (new) commercial air carrier engines under the emissions certification component of International Civil Aviation Organization (ICAO) regulations, measurement of PM emissions is not required. As a result, almost all aircraft engine PM emission rate data have been collected under special studies. Currently, such data exists for only about 20 aircraft engines, with a considerable portion of these data collected by the U.S. Air Force for military aircraft engines. While emission factors for these engines are included in the AP-42 database upon which the FAEED and EDMS emission inventory models were developed, they have not been included in either model due to their limited applicability. To date, it has been standard EPA practice not to estimate PM emissions for aircraft engines. However, since the emissions models maintain a placekeeper for PM emission rates and include PM emission estimates for GSE, it can appear to the uninformed user that aircraft PM emission rates are zero. As a result, aircraft are often incorrectly considered to be insignificant PM sources even though those engines tested for PM have demonstrated significant emission rates. This policy of exclusion by omission is not appropriate in developing an accurate modeling inventory, even in the absence of a large emissions database. While a precise emissions estimate cannot be made with available data, it is clear that a zero emission rate is far from accurate.

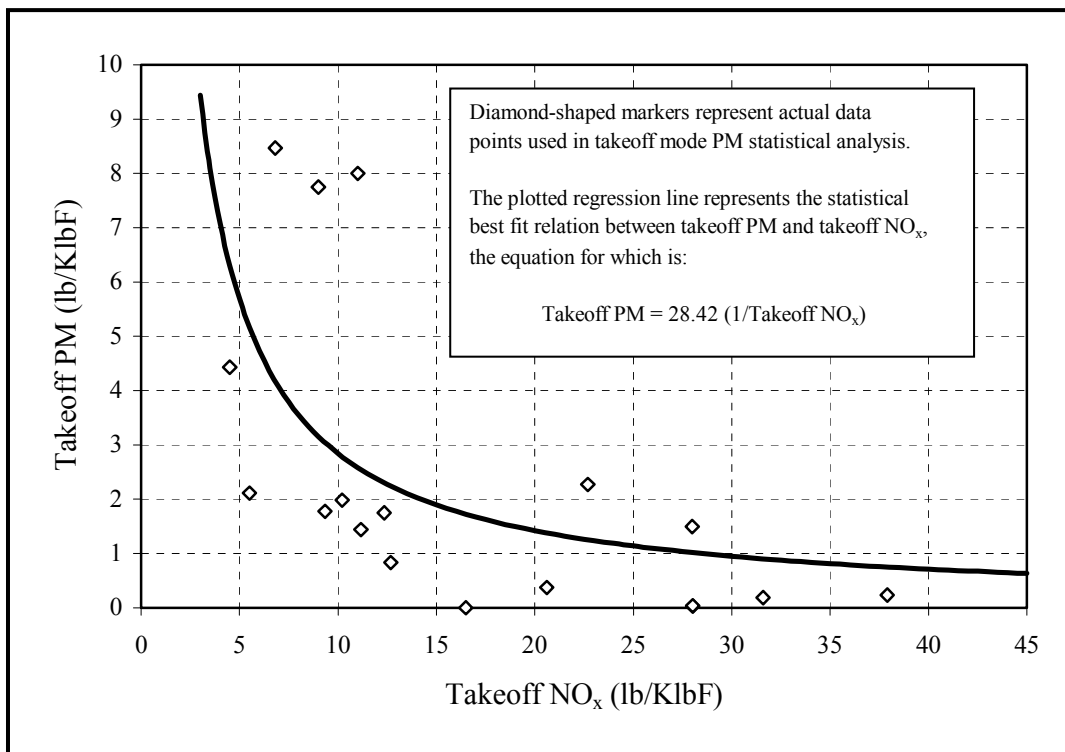
As an alternative for this study, measured emissions data for aircraft engines that have been tested for PM were statistically analyzed to determine whether or not a relationship to other measured emissions parameters could be established. Intuitively, it was hoped that an inverse relationship with NO<sub>x</sub> might be demonstrated, as such a relationship is theoretically attractive. While the level of sophistication of the statistical analysis is constrained by the quantity of data available, simple direct and indirect linear relationships can be examined. Because data are not available for each test engine in each of the four LTO cycle modes and because relationships might be expected to vary by operating mode (due to significant changes in engine and combustion efficiency), all statistical analysis was performed for each operating mode individually.

Statistically significant relationships were found for the direct linear analysis for three of the four LTO cycle modes. Significant in this context means that coefficient t-statistics for one or more of the other measured pollutants (HC, CO, or NO<sub>x</sub>) indicated a direct relationship with measured PM (at a confidence level exceeding 95 percent). In all cases, correlation coefficients were poor (as expected), suggesting a high level of variability and poor predictability of PM emissions for any given engine. Nevertheless, statistics were unbiased and should provide an accurate mechanism to initially assess PM emissions on an aggregate basis (i.e., over a range of aircraft engine models such as those associated with an analysis for an entire set of airport operations). Only at idle was no significant relation found, which is not surprising given relative engine inefficiency in this mode.

The indirect linear analysis revealed a consistent and significant inverse relationship between PM and NO<sub>x</sub> based on calculated t-statistics. Correlation coefficients continue to be poor, but t-statistics are generally improved over those of the direct linear analysis (all developed inverse relations, including idle, were significant at the 99 percent confidence level). In selecting the most appropriate relationship for estimation of PM emission rates for non-tested aircraft engines, the statistical analysis that produced the best combination of a significant t-statistic, a relatively low root mean square error, and an intuitive engineering basis was identified. This was the inverse NO<sub>x</sub> relationship for the takeoff (i.e., full throttle) mode of operation. Figure 4-1 illustrates the selected statistical relationship.

With this relationship established, PM emission rate data for the other aircraft operating modes (i.e., the approach, taxi, and climbout modes) was statistically analyzed against observed PM emission rate data for the takeoff mode. Statistically significant relations were developed for all three modes. Table 4-23 presents the coefficients developed for these PM-to-PM regressions as well as the statistics for the PM-to-NO<sub>x</sub> regression developed for the takeoff mode. These four relations were used to develop a set of fleetwide PM emission factors based on measured takeoff NO<sub>x</sub> emission rates. These emission factors were then input into the EEA aircraft emissions model and used to generate PM emission estimates for TIA aircraft operations.

**FIGURE 4-1. Relationship Used to Estimate Aircraft PM Emission Rates**



**TABLE 4-23. Statistics for Aircraft and APU PM Relations**

Statistical Parameter	Takeoff PM	Climbout PM	Approach PM	Taxi PM
Predictive Parameter	1/Takeoff NO <sub>x</sub>	Takeoff PM	Takeoff PM	Takeoff PM
Coefficient	28.42	1.42	1.53	3.10
Coefficient t-statistic	5.1	11.8	14.9	5.7
Correlation Coefficient	0.30	0.84	0.91	0.56
F-statistic	7.4	86.1	135.7	21.9
Number of Observations	18	17	15	18

*(Subsequent material unrelated to VISTAS modeling is intentionally omitted)*

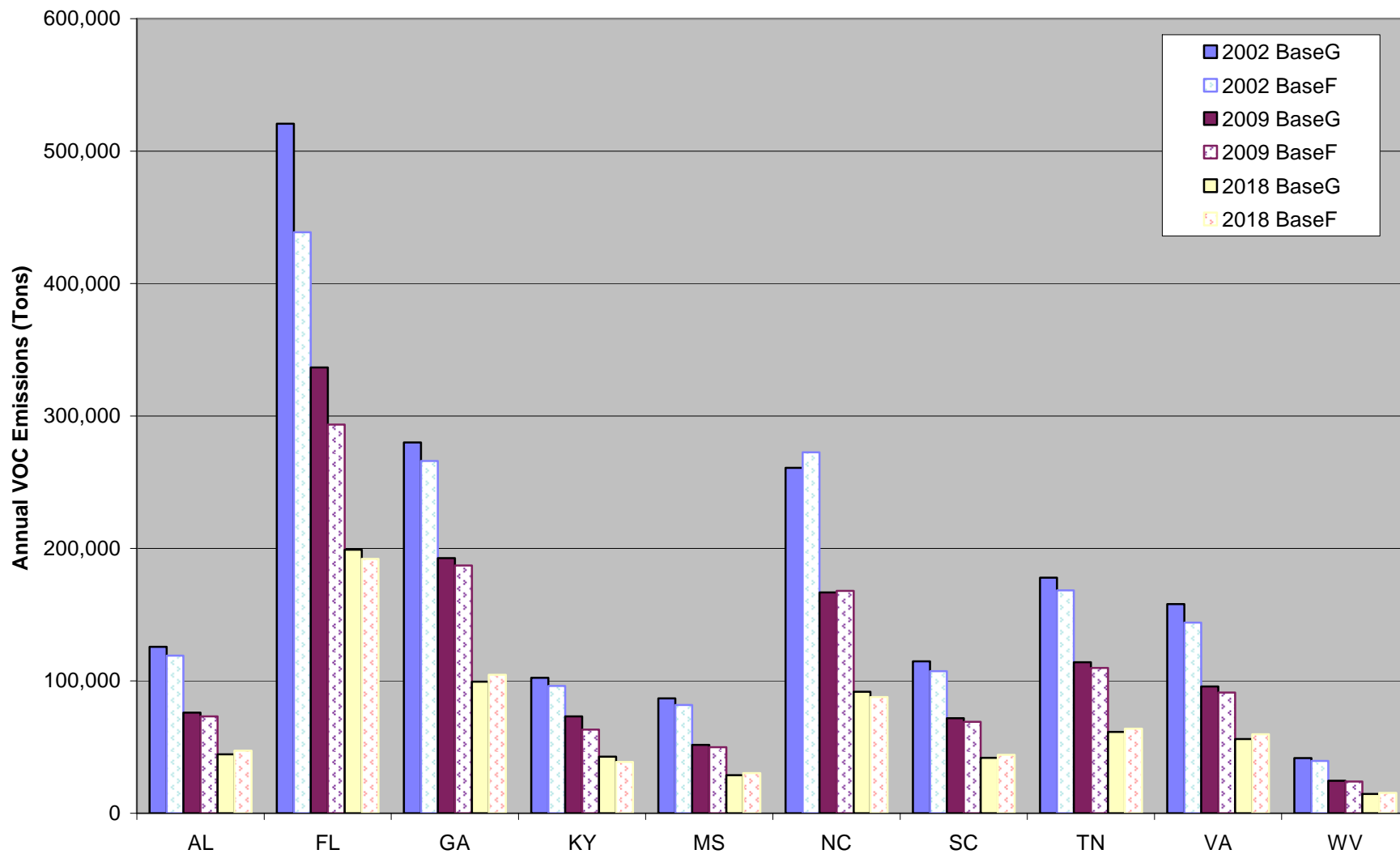
**APPENDIX F:**

**COMPARISON OF BASE F AND BASE G ON-ROAD MOBILE EMISSIONS**

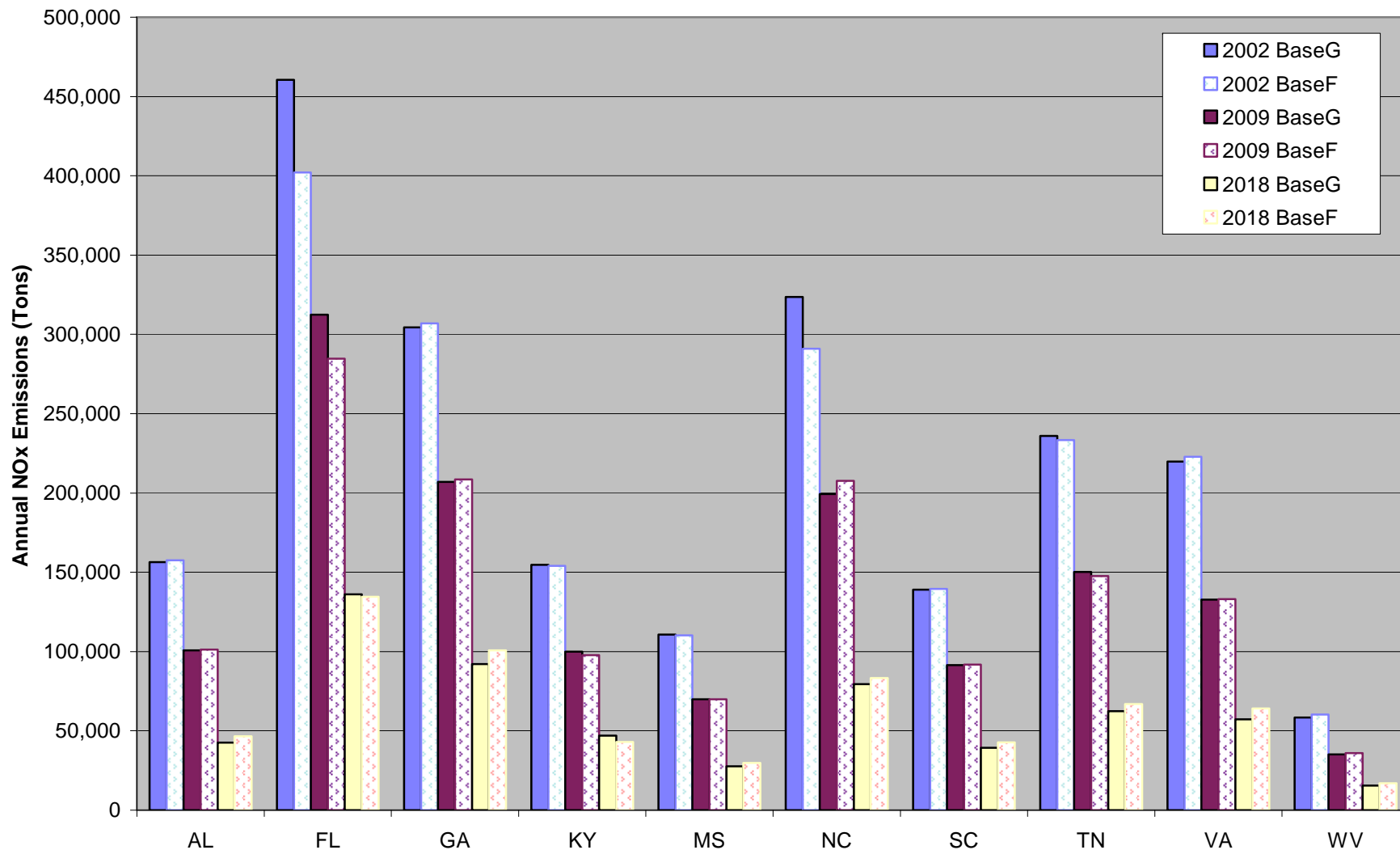
Documentation of the Base G 2002 Base Year, 2009 and 2018, Emission Inventories for VISTAS

Base G Onroad Mobile Emissions (Annual Tons)																					
FIPSST	VOC			NOx			CO			SO2			PM-10			PM-2.5			NH3		
	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018
AL	125,768	76,065	44,503	156,460	100,693	42,622	1,303,508	902,469	594,725	6,827	802	654	3,861	3,136	2,193	2,768	2,010	1,085	5,530	6,298	6,630
FL	520,757	336,707	199,050	460,503	312,321	136,040	4,493,820	3,308,863	2,263,190	20,687	2,584	2,302	11,148	9,801	7,516	7,779	6,104	3,671	17,922	21,549	23,778
GA	279,975	192,773	99,464	304,309	207,024	92,113	2,699,650	1,956,263	1,303,529	12,043	1,568	1,325	7,165	6,005	4,406	5,110	3,797	2,166	10,436	12,554	13,511
KY	102,362	73,142	42,810	154,634	100,025	46,993	1,214,191	950,912	711,211	6,238	751	694	3,682	2,944	2,348	2,667	1,899	1,158	5,003	5,737	7,095
MS	86,811	51,600	28,699	110,672	69,952	27,620	853,774	602,257	394,247	4,566	532	401	2,828	2,250	1,479	2,089	1,491	746	3,549	3,995	4,147
NC	260,895	166,844	91,720	323,606	199,281	79,433	2,839,283	1,966,195	1,207,391	12,286	1,487	1,346	6,505	5,510	3,994	4,571	3,453	1,931	9,601	11,702	12,776
SC	114,861	71,781	41,866	138,940	91,471	39,348	1,226,555	878,825	588,536	5,909	713	584	3,414	2,831	1,986	2,473	1,834	988	4,646	5,466	5,878
TN	177,943	114,032	61,339	235,869	150,179	62,446	1,893,704	1,320,562	863,682	9,127	1,065	862	5,312	4,160	2,813	3,904	2,720	1,405	6,556	7,702	8,196
VA	157,989	95,694	55,992	219,835	132,699	57,192	2,136,288	1,435,359	954,463	8,196	1,067	949	4,499	3,706	2,922	3,067	2,216	1,404	7,770	8,990	9,653
WV	41,703	24,570	14,652	58,340	35,234	15,530	526,841	360,865	243,683	2,438	276	231	1,366	1,057	747	984	676	369	1,889	2,126	2,268
<b>VISTAS</b>	<b>1,869,063</b>	<b>1,203,208</b>	<b>680,096</b>	<b>2,163,168</b>	<b>1,398,879</b>	<b>599,336</b>	<b>19,187,613</b>	<b>13,682,570</b>	<b>9,124,656</b>	<b>88,316</b>	<b>10,844</b>	<b>9,348</b>	<b>49,780</b>	<b>41,400</b>	<b>30,403</b>	<b>35,411</b>	<b>26,200</b>	<b>14,922</b>	<b>72,902</b>	<b>86,118</b>	<b>93,932</b>
Base F Onroad Mobile (Annual Tons)																					
FIPSST	VOC			NOx			CO			SO2			PM-10			PM-2.5			NH3		
	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018
AL	118,978	73,137	47,151	157,626	101,299	46,598	1,300,754	934,442	675,902	6,898	637	720	3,905	3,195	2,488	2,799	2,053	1,262	5,586	6,362	7,296
FL	438,761	293,423	192,096	402,099	284,737	134,465	4,022,000	3,090,443	2,306,759	18,802	1,911	2,289	10,185	9,027	7,691	7,126	5,653	3,848	16,183	19,553	23,595
GA	265,972	187,102	104,678	306,998	208,568	100,707	2,712,473	2,044,169	1,474,029	12,182	1,256	1,458	7,252	6,116	4,995	5,169	3,877	2,517	10,545	12,685	14,870
KY	96,202	63,210	38,814	154,093	97,731	43,014	1,195,656	932,296	669,891	5,988	587	651	3,728	3,008	2,283	2,699	1,946	1,160	5,055	5,807	6,584
MS	81,701	49,986	30,337	110,242	69,949	29,829	849,049	624,575	445,150	4,614	398	441	2,863	2,296	1,688	2,114	1,525	876	3,585	4,035	4,565
NC	272,594	167,894	87,718	290,873	207,670	83,399	2,677,118	2,192,253	1,238,802	12,482	1,314	1,323	6,733	5,874	4,299	4,754	3,651	2,158	9,711	12,663	13,077
SC	107,236	69,026	44,121	139,403	91,832	42,641	1,220,825	921,308	663,597	5,972	558	643	3,454	2,884	2,258	2,502	1,874	1,154	4,694	5,522	6,472
TN	168,389	109,716	63,916	233,324	147,591	66,879	1,881,893	1,359,880	961,929	9,202	833	944	5,349	4,247	3,199	3,927	2,788	1,643	6,629	7,753	8,962
VA	143,969	91,230	59,737	222,830	133,039	64,079	1,996,287	1,483,125	1,091,546	7,234	902	1,059	4,546	3,768	3,343	3,097	2,258	1,641	7,852	9,084	10,757
WV	39,581	23,914	15,375	60,335	36,000	16,940	533,258	379,272	273,900	2,495	228	255	1,399	1,099	844	1,005	705	428	1,938	2,188	2,484
<b>VISTAS</b>	<b>1,733,382</b>	<b>1,128,638</b>	<b>683,942</b>	<b>2,077,822</b>	<b>1,378,416</b>	<b>628,551</b>	<b>18,389,312</b>	<b>13,961,764</b>	<b>9,801,505</b>	<b>85,868</b>	<b>8,622</b>	<b>9,783</b>	<b>49,414</b>	<b>41,513</b>	<b>33,086</b>	<b>35,191</b>	<b>26,330</b>	<b>16,687</b>	<b>71,778</b>	<b>85,652</b>	<b>98,664</b>
Emissions Change (Base G - Base F, Annual Tons) -- Positive Value Indicates Increase from Base F																					
FIPSST	VOC			NOx			CO			SO2			PM-10			PM-2.5			NH3		
	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018
AL	6,789	2,928	-2,647	-1,166	-606	-3,977	2,754	-31,973	-81,178	-71	165	-66	-45	-58	-295	-31	-43	-178	-56	-63	-666
FL	81,997	43,284	6,955	58,404	27,584	1,575	471,820	218,420	-43,569	1,885	672	14	963	774	-175	653	451	-177	1,738	1,996	183
GA	14,003	5,671	-5,214	-2,689	-1,544	-8,594	-12,823	-87,906	-170,500	-139	312	-133	-86	-111	-589	-59	-80	-352	-109	-131	-1,359
KY	6,160	9,933	3,996	541	2,294	3,979	18,534	18,615	41,319	250	164	43	-46	-65	65	-32	-47	-2	-52	-70	512
MS	5,110	1,613	-1,638	430	3	-2,209	4,724	-22,319	-50,903	-48	134	-41	-35	-46	-209	-25	-34	-130	-35	-40	-419
NC	-11,699	-1,049	4,001	32,734	-8,389	-3,966	162,165	-226,057	-31,411	-196	174	23	-228	-364	-304	-183	-198	-226	-111	-961	-302
SC	7,625	2,755	-2,255	-462	-362	-3,293	5,731	-42,483	-75,061	-63	156	-59	-40	-53	-272	-29	-40	-166	-48	-56	-594
TN	9,554	4,316	-2,577	2,545	2,589	-4,433	11,811	-39,318	-98,246	-75	232	-82	-37	-87	-385	-22	-68	-238	-73	-52	-766
VA	14,020	4,464	-3,744	-2,995	-340	-6,887	140,001	-47,766	-137,084	962	165	-110	-47	-62	-420	-30	-42	-237	-83	-94	-1,104
WV	2,122	656	-723	-1,995	-766	-1,410	-6,416	-18,407	-30,217	-57	49	-24	-32	-42	-97	-22	-29	-59	-49	-62	-217
<b>VISTAS</b>	<b>135,680</b>	<b>74,570</b>	<b>-3,846</b>	<b>85,346</b>	<b>20,462</b>	<b>-29,215</b>	<b>798,301</b>	<b>-279,194</b>	<b>-676,850</b>	<b>2,448</b>	<b>2,222</b>	<b>-435</b>	<b>367</b>	<b>-114</b>	<b>-2,683</b>	<b>219</b>	<b>-130</b>	<b>-1,764</b>	<b>1,123</b>	<b>466</b>	<b>-4,732</b>
Emissions Change (Base G - Base F/Base F, Annual %) -- Positive Value Indicates Increase from Base F																					
FIPSST	VOC			NOx			CO			SO2			PM-10			PM-2.5			NH3		
	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018	2002	2009	2018
AL	6%	4%	-6%	-1%	-1%	-9%	0%	-3%	-12%	-1%	26%	-9%	-1%	-2%	-12%	-1%	-2%	-14%	-1%	-1%	-9%
FL	19%	15%	4%	15%	10%	1%	12%	7%	-2%	10%	35%	1%	9%	9%	-2%	9%	8%	-5%	11%	10%	1%
GA	5%	3%	-5%	-1%	-1%	-9%	0%	-4%	-12%	-1%	25%	-9%	-1%	-2%	-12%	-1%	-2%	-14%	-1%	-1%	-9%
KY	6%	16%	10%	0%	2%	9%	2%	2%	6%	4%	28%	7%	-1%	-2%	3%	-1%	-2%	0%	-1%	-1%	8%
MS	6%	3%	-5%	0%	0%	-7%	1%	-4%	-11%	-1%	34%	-9%	-1%	-2%	-12%	-1%	-2%	-15%	-1%	-1%	-9%
NC	-4%	-1%	5%	11%	-4%	-5%	6%	-10%	-3%	-2%	13%	2%	-3%	-6%	-7%	-4%	-5%	-10%	-1%	-8%	-2%
SC	7%	4%	-5%	0%	0%	-8%	0%	-5%	-11%	-1%	28%	-9%	-1%	-2%	-12%	-1%	-2%	-14%	-1%	-1%	-9%
TN	6%	4%	-4%	1%	2%	-7%	1%	-3%	-10%	-1%	28%	-9%	-1%	-2%	-12%	-1%	-2%	-14%	-1%	-1%	-9%
VA	10%	5%	-6%	-1%	0%	-11%	7%	-3%	-13%	13%	18%	-10%	-1%	-2%	-13%	-1%	-2%	-14%	-1%	-1%	-10%
WV	5%	3%	-5%	-3%	-2%	-11%	-1%	-5%	-11%	-2%	21%	-9%	-2%	-4%	-12%	-2%	-4%	-14%	-3%	-3%	-9%
<b>VISTAS</b>	<b>8%</b>	<b>7%</b>	<b>-1%</b>	<b>4%</b>	<b>1%</b>	<b>-5%</b>	<b>4%</b>	<b>-2%</b>	<b>-7%</b>	<b>3%</b>	<b>26%</b>	<b>-4%</b>	<b>1%</b>	<b>0%</b>	<b>-8%</b>	<b>1%</b>	<b>0%</b>	<b>-11%</b>	<b>2%</b>	<b>1%</b>	<b>-5%</b>

### Annual Onroad Emissions Comparison

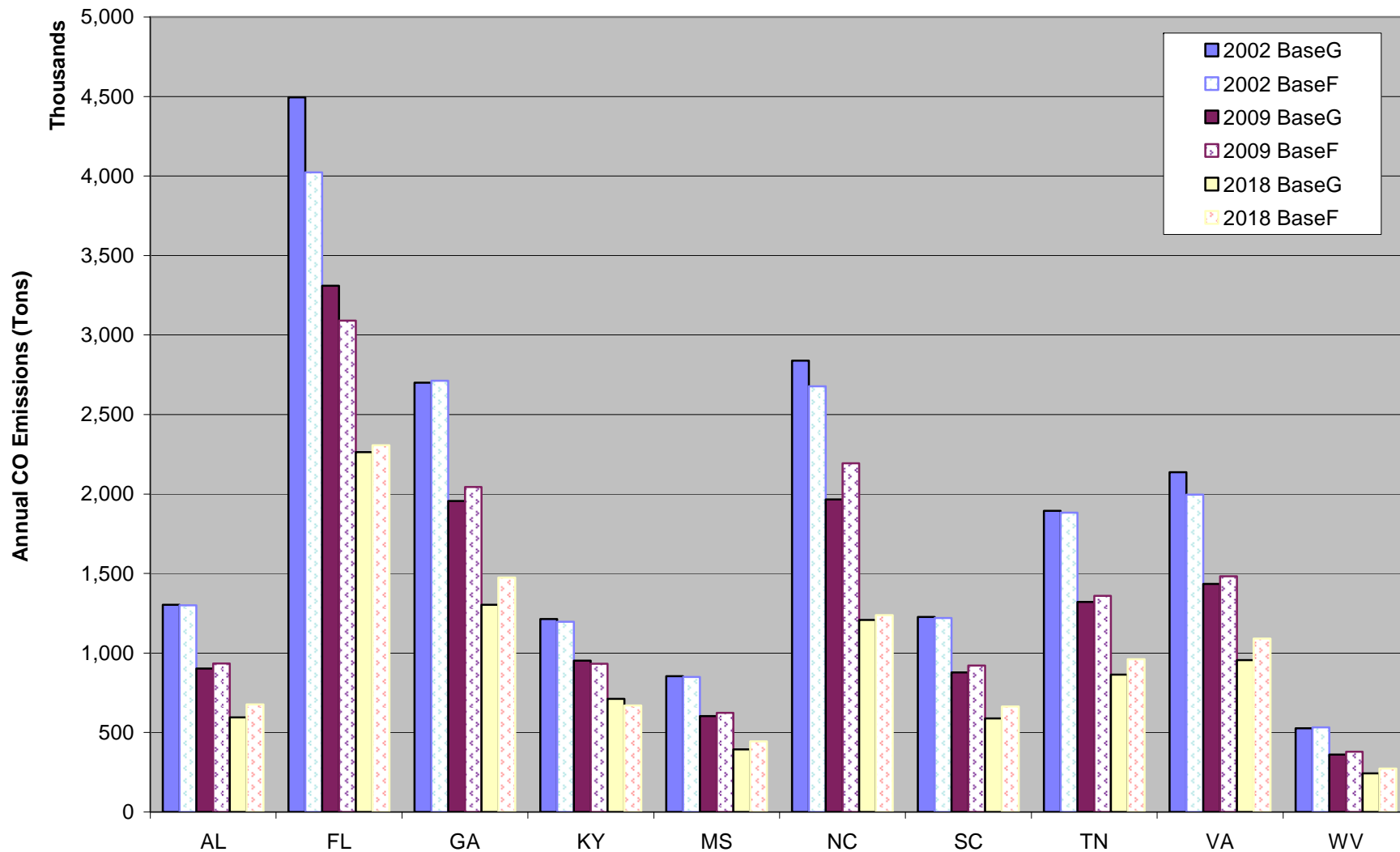


### Annual Onroad Emissions Comparison

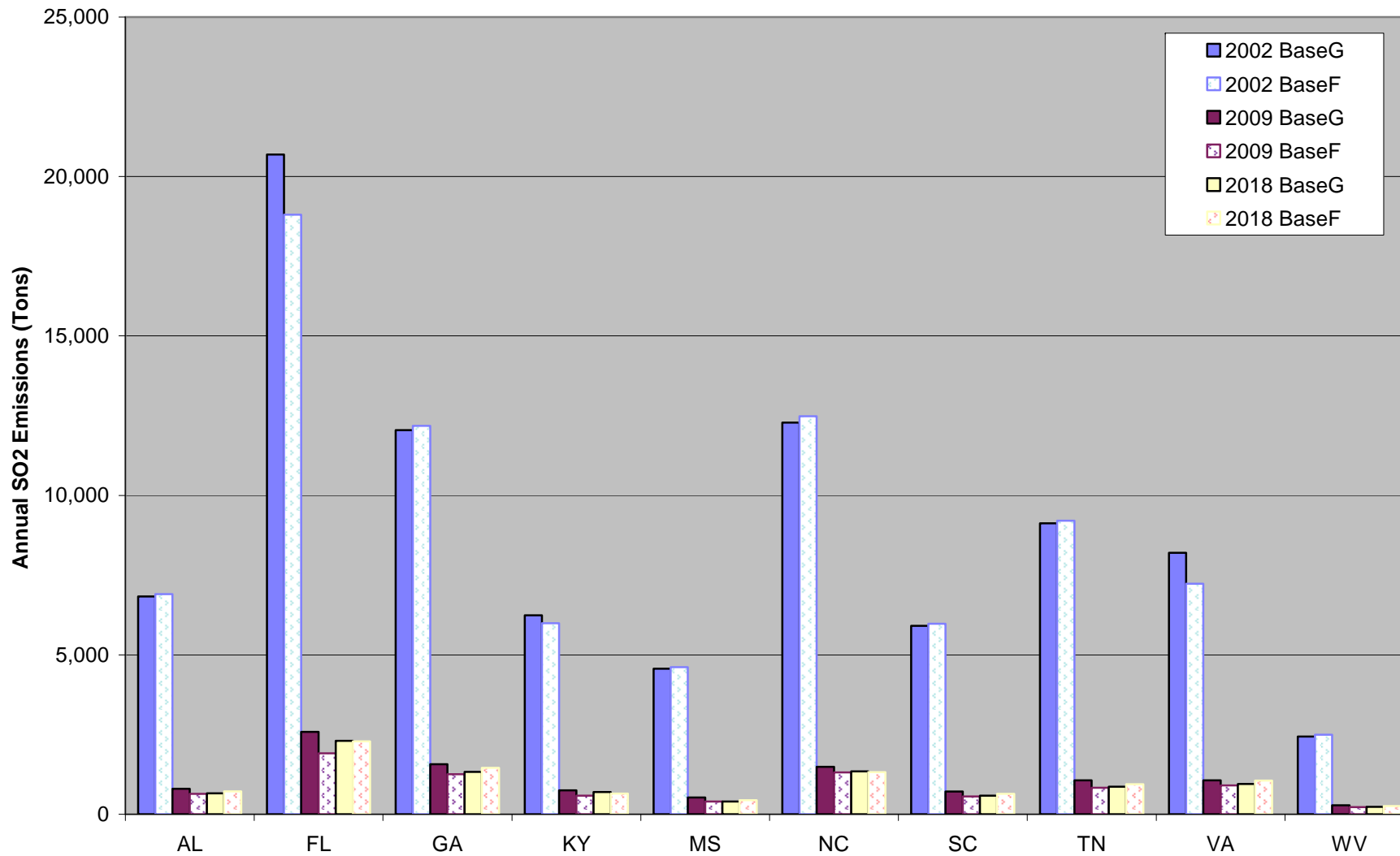




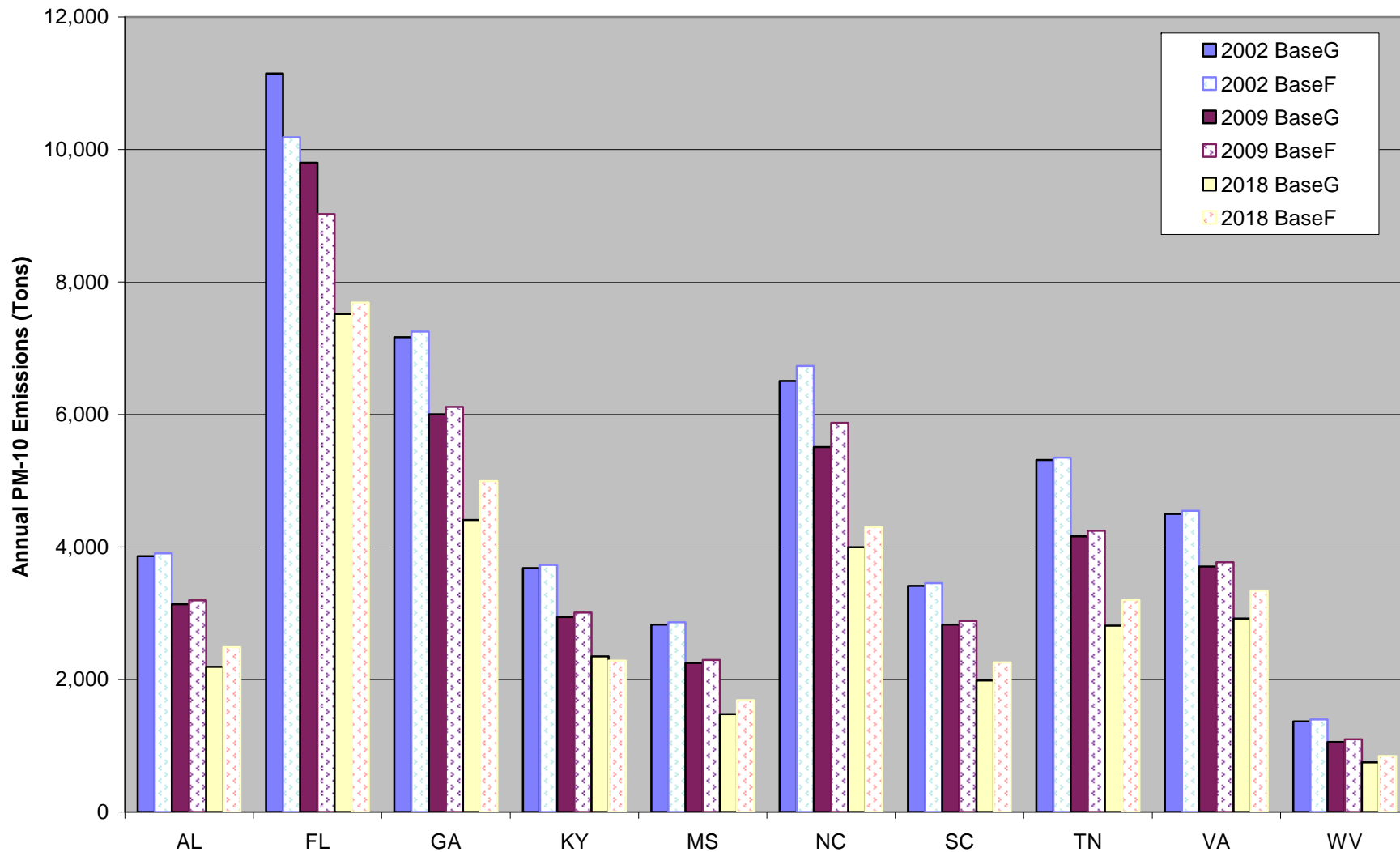
### Annual Onroad Emissions Comparison



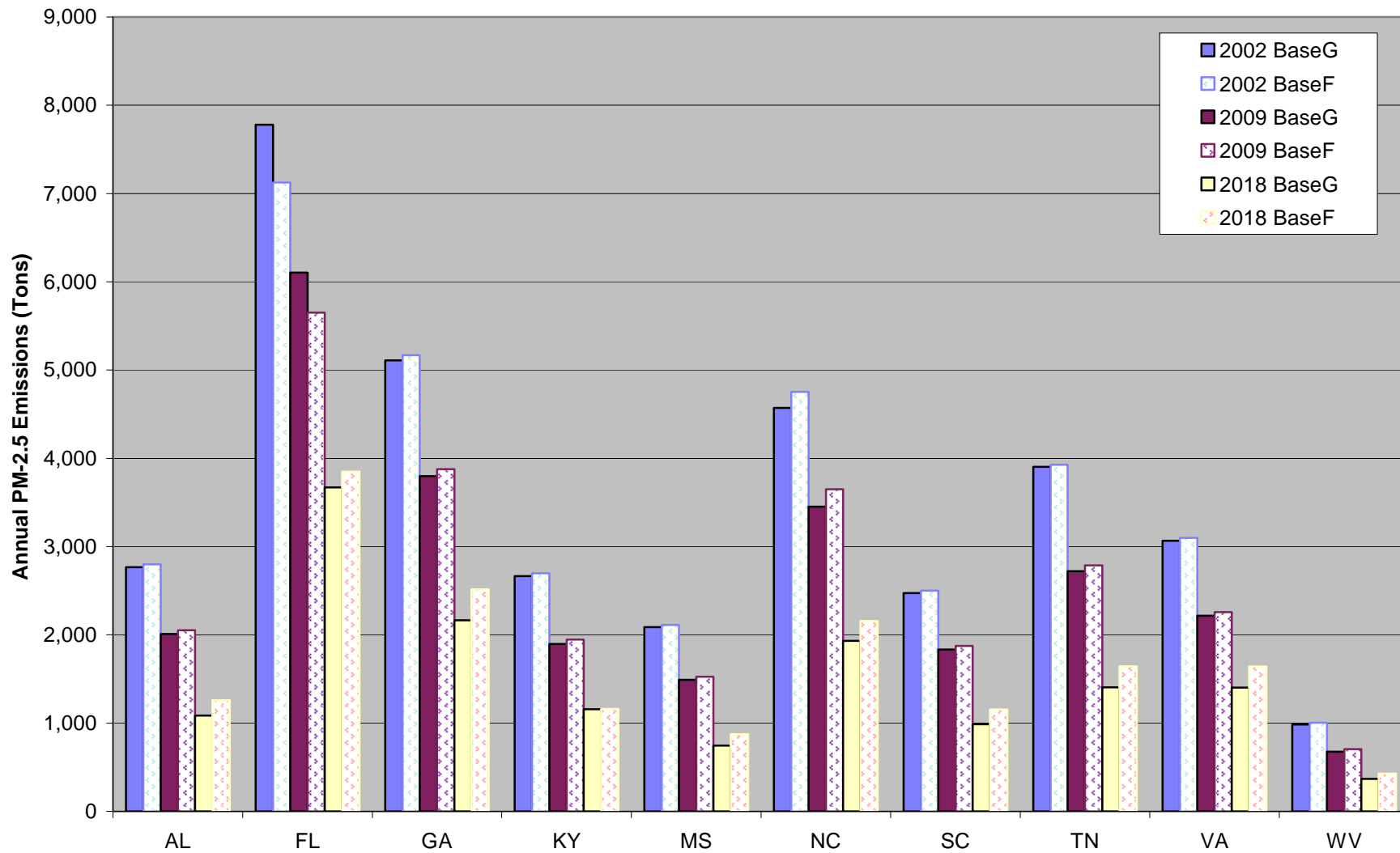
### Annual Onroad Emissions Comparison



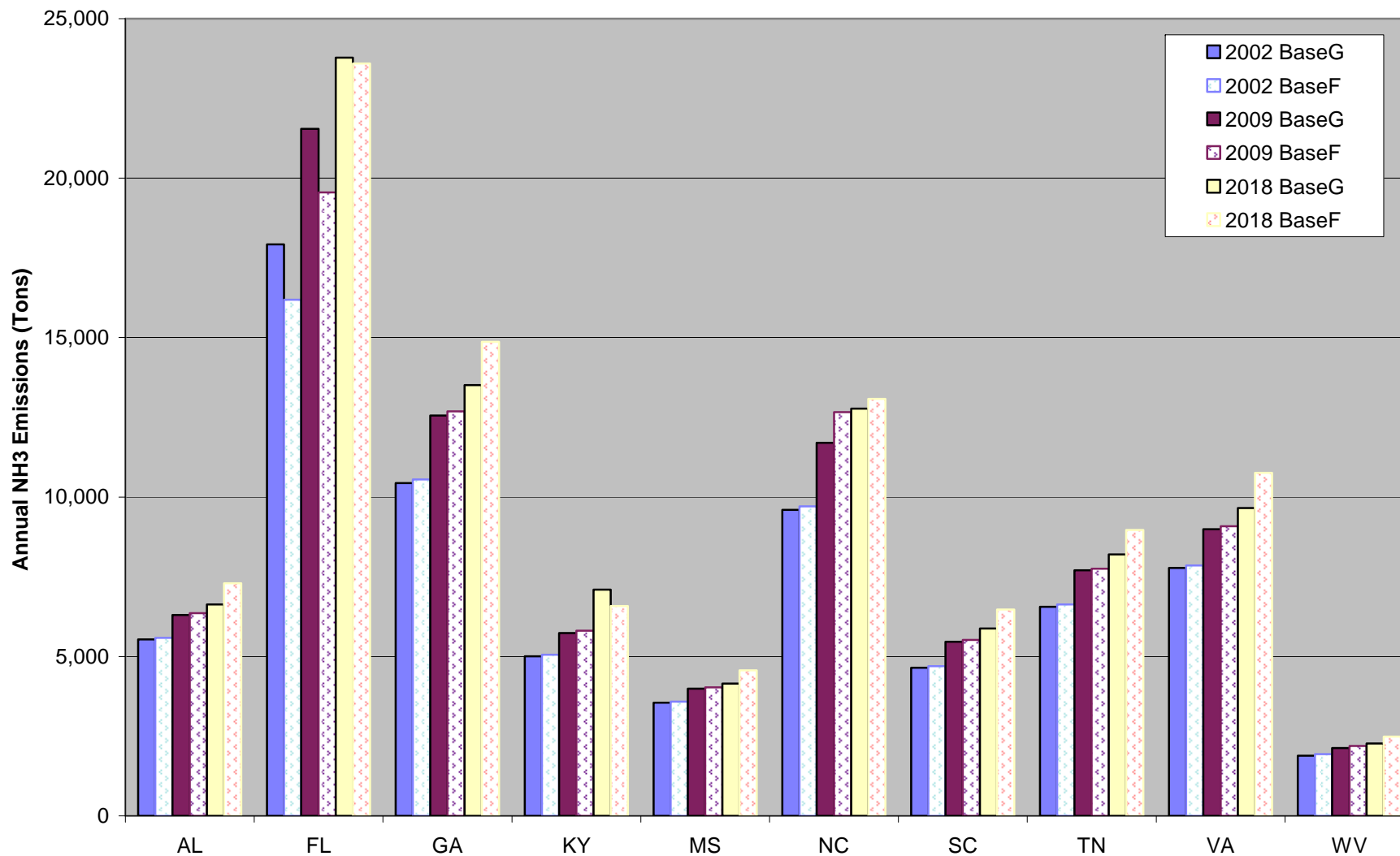
### Annual Onroad Emissions Comparison



### Annual Onroad Emissions Comparison



### Annual Onroad Emissions Comparison



**Development of the Draft 2002 Vistas Emission  
Inventory for Regional Haze Modeling**

**PART 2**

**Development of the Draft 2002 VISTAS  
Emission Inventory for Regional Haze Modeling  
(Point Source Methodology)**

**DRAFT REPORT**

**DEVELOPMENT OF VERSION 2 OF THE  
DRAFT 2002 VISTAS EMISSION INVENTORY  
FOR REGIONAL HAZE MODELING**

**POINT SOURCES**

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## APPENDICES

Appendix A – Emission Summary Report By State and Facility



## **INTRODUCTION**

This report summarizes the procedures used in developing Version 2 of the draft 2002 VISTAS emission inventory for regional haze modeling. The starting point was the Version 1 of the 2002 VISTAS inventory that was released in July, 2003. The following activities were conducted to create Version 2:

1. Correction to the PM data augmentation methodology used in Version 1 to fix a few isolated anomalies where PM<sub>25</sub>-PRI emissions exceeded PM<sub>10</sub>-PRI emissions.
2. Processing of State/local inventory submittals that incorporated State/local responses to Version 1 of the inventory. In general, these submittals resolved issues that were identified in Version 1, identified plants that did not operate in 2002, and provided updated 2002 emissions data for selected facilities.
3. Incorporation of “final” 2002 SO<sub>2</sub> and NO<sub>x</sub> emissions, based on CEM data for utilities as reported to the EPA’s Clean Air Markets Division, for those facilities where States did not supply their own emissions data.
4. Conversion of the database to NIF 3.0 format.
5. Additional QA/QC of the database using the EPA’s Basic Format and Content Checker.
6. Preparation of data summaries and raw data files for review.

Each of these activities is discussed in this report.

## **CORRECTIONS TO PM-RELATED EMISSIONS**

In developing Version 1 of the VISTAS inventory, we used the procedures for augmenting point source PM emissions as documented in Appendix C of *Documentation for the Draft 1999 National Emissions Inventory (Version 3) for Criteria Air Pollutants and Ammonia* (March 2003). Two States (SC and WV) reported anomalous results in Version 1 for certain facilities where the PM<sub>25</sub>-PRI emissions were calculated to be higher than the PM<sub>10</sub>-PRI emissions. We investigated the problem and found an error in our PM augmentation software that caused this miscalculation. We corrected the problem and updated the database with the correct PM<sub>25</sub>-PRI and PM<sub>25</sub>-FIL emissions. We verified that all PM<sub>25</sub>-PRI emission estimates were less than the PM<sub>10</sub>-PRI emission estimate.

## **PROCESSING OF STATE/LOCAL POINT SOURCE SUBMITTALS**

After reviewing Version 1 of the VISTAS 2002 inventory, State and local agencies provided data to resolve issues that were identified in Version 1, identify plants that did not operate in 2002, and provide updated 2002 emissions data for selected facilities. The following paragraphs discuss the specific data submitted by each agency.

## **Alabama**

Alabama identified 76 facilities that ceased operation since 1999 – these were removed from the 2002 database. Alabama reviewed the 2002 utility emissions data and provided updated emission estimates where 2002 data were available. Corrections were made to fugitive release heights for selected sources. Some records that were previously reported as fugitive were changed to provide updated stack data. Several other updates were provided to correct stack data flagged in the Version 1. For ammonia emissions from selected large sources, emission estimates from the Toxic Release Inventory were used instead of the EPA generated estimate for the 1999 NEI.

Alabama also provided updates for Southern Company facilities in the state. These updates consisted of corrections to stack parameters, updated 2002 emission rates, and identification of new units that operated in 2002 but were not included in Version 1 of the VISTAS inventory.

Finally, Alabama provided a draft calendar year 2002 inventory; however, this inventory had numerous referential integrity problems that could not be resolved. This submittal was not included in Version 2 of the VISTAS inventory.

## **Florida**

No specific comments were provided. Florida indicated that they plan on submitting the 2002 CERR inventory in March.

## **Georgia**

In developing Version 1 of 2002 VISTAS inventory, we used the draft Version 3 of the 1999 NEI as the starting point inventory for Georgia. PM emissions were abnormally high and unreasonable when compared to other VISTAS States. Georgia recommended that we use Version 2 of the 1999 NEI to completely replace the data contained in Version 1 of the VISTAS inventory. We obtained that data and then performed several updates to grow the data from 1999 to 2002 and make updates to ammonia records (as described in the Version 1 documentation).

Georgia also provided updated information for three facilities. The 2002 annual emissions were updated for the Shorewood Packaging and Caraustar Industries facilities. A Georgia Pacific source near Savannah was not previously included in Version 1 of the VISTAS inventory and was added during this update..

Georgia also provided updates for Southern Company facilities in the state. These updates consisted of corrections to stack parameters, updated 2002 emission rates, and identification of new units that operated in 2002 but were not included in Version 1 of the VISTAS inventory.

## **Kentucky**

Kentucky sent a complete replacement inventory containing 2001 data for the entire state (except for Jefferson County). These data were submitted in NIF 2.0 format and were used to completely replace the data contained in Version 1 of the VISTAS inventory. We ran the 2001 data through the EPA's QA/QC tool – there were no referential integrity problems and the data passed the QA/QC checks. We then grew the emissions from 2001 to 2002, and performed the ammonia and PM augmentation routines.

## **Kentucky – Louisville Metro**

The Louisville Metro APCD verified the emission rates for the two Louisville Gas & Electric facilities in Jefferson County, provided updated PM emissions for Eckart Aluminum, and provided corrected stack data for stacks flagged in Version 1 of the VISTAS inventory.

## **Mississippi**

Mississippi provided corrections to emission rates and stack parameters for 19 emission units that were flagged in Version 1 of the VISTAS inventory. Mississippi also identified four facilities that closed in 2000/2001 and were removed from the VISTAS 2002 inventory.

Mississippi confirmed the emission rate for the Entergy (Gerald Andrus) facility. The SO<sub>2</sub> and NO<sub>x</sub> emission rates in EPA's 2002 final CEM database differed markedly from the emissions in the VISTAS Version 1 inventory. Mississippi confirmed that the utility used natural gas in 2002 rather than fuel oil as they had been using in the past. Mississippi confirmed that the EPA 2002 final CEM emission rates were correct and should be used in Version 2 of the VISTAS inventory.

Mississippi also provided updates for Southern Company facilities in the state. These updates consisted of corrections to stack parameters, updated 2002 emission rates, and identification of new units that operated in 2002 but were not included in Version 1 of the VISTAS inventory.

## **North Carolina**

North Carolina provided revised stack data for all source in the state. We used these data to completely replace the data in the ER file. North Carolina also provided updated 2002 for the International Paper Riegelwood facility.

We also identified and corrected an error in the emission rates for the Duke Energy Belews Creek Station. SO<sub>2</sub> and NO<sub>x</sub> emissions were inadvertently double-counted in Version 1 of the inventory.

## **North Carolina – Buncombe County**

The Western NC Regional Air Quality Agency sent a complete replacement inventory containing 2001 data for Buncombe County. These data were submitted in NIF 2.0 format and were used to completely replace the data contained in Version 1 of the VISTAS inventory. We ran the 2001 data through the EPA's QA/QC tool – there were no referential integrity problems and the data passed the QA/QC checks. We then grew the emissions from 2001 to 2002, and performed the ammonia and PM augmentation routines.

## **South Carolina**

South Carolina identified several errors in the PM<sub>25</sub>-PRI emissions data in Version 1 of the VISTAS inventory. Most of these errors were corrected when we corrected the PM augmentation methodology as discussed earlier. South Carolina also provided a corrected PM emission estimate for the Santee Cooper Jeffries facility which had abnormally high PM<sub>25</sub>-PRI emissions in Version 1.

South Carolina provided actual 2002 facility level NO<sub>x</sub>, SO<sub>2</sub>, and PM-PRI emissions for seven SCE&G facilities. The NO<sub>x</sub> and SO<sub>2</sub> emissions agreed reasonably well with the EPA CEM emissions. The PM-PRI emissions were used with the PM augmentation routine to calculate PM<sub>10</sub>-PRI and PM<sub>25</sub>-PRI emissions.

South Carolina identified 16 facilities that were closed in 2002 and we removed those facilities from the inventory. Data were provided for 14 new facilities that operated in 2002 but were not in Version 1 of the VISTAS inventory. Revised emissions were provided for the Westvaco Kraft facility which had significant emission reductions since 2000. Revised emissions were also provided for the International Paper Eastover Mill. Missing stack data was provided for two stacks with large emission rates.

## **Tennessee**

Tennessee reviewed the facility-level emission summaries for the TVA plants and indicated that the VISTAS inventory contained the correct values.

## **Virginia**

Virginia indicated that eight facilities should be deleted since they did not operate in 2002. Revised stack data was provided for 36 stacks with large emission rates. Ammonia emissions were added for the Honeywell facility in Hopewell. Revised emissions were provided for an additional 10 plants.

## **West Virginia**

West Virginia provided updated stack data to fill in gaps or missing data in Version 1 of the VISTAS inventory. MACTEC confirmed that the requested changes were made.

## **INCORPORATION OF FINAL 2002 CEM DATA**

We obtained CEM data files that contain summary emissions information for electric utilities regulated by the Acid Rain Program. For Version 1 of the VISTAS inventory, we used the *preliminary* summary data which EPA had not completely quality assured. For Version 2 of the VISTAS inventory, we used the *final* quality assured SO<sub>2</sub> and NO<sub>x</sub> emissions data for 2002.

Three States (AL, GA, and MS) provided updated 2002 emissions data for electric utilities owned and operated by the Southern Company. Two other States (SC and VA) provided emission updates for selected utilities. We used these State-supplied emissions data for these facilities instead of the EPA data, as the States considered these data to be more accurate.

## **CONVERSION OF DATABASE TO NIF 3.0 FORMAT**

Version 1 of the VISTAS database was in NIF 2.0 format, which has subsequently been replaced by NIF 3.0. We converted the database to NIF 3.0 format. This involved minor changes to the database to add a tribal code field, merge the state and county FIPs codes into a single code, changed the length of certain fields, and other minor modifications.

For the ER table, EPA has added several fields describing how the location coordinates were derived. These new fields are mandatory. Lacking State-specific data, we populated these fields in the following manner:

- HORIZONTAL COLLECTION METHOD CODE – used code 027 (information is not known)
- HORIZONTAL ACCURACY MEASURE – used 100 meters as the default value
- HORIZONTAL REFERENCE DATUM CODE – used code 002 (North American Datum of 1983) as the default
- REFERENCE POINT CODE – used code 106 (Point where a substance is released) as the default
- SOURCE MAP SCALE NUMBER – used blanks as the default
- COORDINATE DATA SOURCE CODE – used State FIPS code as the default

## **RESULTS OF QA/QC CHECKS**

We used the EPA's Basic Format & Content Checker 3.0 software to check the database for referential integrity, field properties, acceptable codes, and acceptable numeric ranges. Results from the software are contained in each state's database, which can be accessed on the MACTEC ftp site.

We corrected any referential integrity problems detected by the Checker software. Most of the records flagged by the Checker software contain messages that are inconsequential for emissions modeling (i.e., invalid zip codes, invalid material process codes, etc.).

The only consequential error messages generated were related to stack parameters. After reviewing Version 1 of the VISTAS database, State and local agencies provided corrections to errors in stack parameters for larger sources. However, the Checker software continues to detect numerous missing data elements in stack parameters for smaller sources. Any remaining missing or out-of-range stack parameters will be augmented during the emission modeling process according to EPA's *NEI Quality Assurance and Data Augmentation Steps for Point Sources* ([http://www.epa.gov/ttn/chief/emch/invent/qaaugmentationmemo\\_99nei\\_60603.pdf](http://www.epa.gov/ttn/chief/emch/invent/qaaugmentationmemo_99nei_60603.pdf)).

## **DATA SUMMARY AND FILES**

We prepared a series of tables and figures to show how point source emissions have changed as a result of the activities discussed previously in this report. Tables 1-7 summarize the point source emissions by State for the seven pollutants that will be input to the emission modeling system: SO<sub>2</sub>, NO<sub>x</sub>, VOC, CO, PM<sub>10</sub>-PRI, PM<sub>25</sub>-PRI, and NH<sub>3</sub>. Each table shows the original NEI99V2 emissions that served as the starting point for the VISTAS inventory, the VISTAS Version 1 emission estimates, and the revised Version 2 emission estimates for 2002. Each table shows the total point source emissions and a breakout by utility versus non-utility emissions.

Raw data files, in NIF 3.0 format, are located on MACTEC's ftp site. Summary tables are contained in a spreadsheet on the ftp site. The MACTEC ftp site can be accessed in the following manner:

Address: [ftp.mactec.com](ftp://mactec.com)  
Login ID: externalclient  
Password: sen382  
Directory: \Outgoing\VISTAS Version 2\point

Contact Ed Sabo (703.471.8383) at MACTEC if you have any problems accessing the ftp site.

Stakeholders with specific data requests should contact Mr. Gregory Stella, VISTAS Technical Advisor.

**TABLE 1****SUMMARY OF POINT SOURCE SO2 EMISSIONS BY STATE**

STATE	All Point Sources			Utilities			Non-Utility		
	NEI99V2	VISTAS V1	VISTAS V2	NEI99V2	VISTAS V1	VISTAS V2	NEI99V2	VISTAS V1	VISTAS V2
AL	653,198	566,434	560,060	542,657	448,603	448,248	110,541	117,831	111,812
FL	815,639	534,441	540,169	741,336	467,427	473,155	74,303	67,014	67,014
GA	596,291	607,180	604,894	513,541	512,434	514,277	82,750	94,746	90,617
KY	701,844	528,999	521,590	662,812	493,289	484,434	39,032	35,710	37,156
MS	213,125	157,196	121,944	142,500	91,194	67,545	70,625	66,002	54,399
NC	525,264	615,497	510,459	380,687	468,760	337,900	144,577	146,737	172,559
SC	285,933	263,635	261,498	228,515	207,215	205,842	57,418	56,420	55,656
TN	604,652	436,231	423,709	473,921	334,266	323,036	130,731	101,965	100,673
VA	304,139	313,770	309,716	234,568	244,040	239,991	69,571	69,730	69,725
WV	755,387	572,934	573,137	697,614	510,375	510,579	57,773	62,559	62,558
<b>VISTAS</b>	<b>5,455,472</b>	<b>4,596,317</b>	<b>4,427,176</b>	<b>4,618,151</b>	<b>3,777,603</b>	<b>3,605,007</b>	<b>837,321</b>	<b>818,714</b>	<b>822,169</b>

NEI99V2 – EPA’s 1999 National Emission Inventory, Version 2, Final.

VISTAS V1 – VISTAS’ First Draft 2002 Emission Inventory, with data from EPA’s 2002 CEM Preliminary Summary Emissions Reports. Also includes changes to other facilities resulting from updated 1999/2000/2001 State/local inventories and growth of 1999/2000/2001 emissions to 2002.

VISTAS V2 – VISTAS’ Second Draft 2002 Emission Inventory, with data from EPA’s 2002 CEM Final Summary Emissions Reports. Also includes changes to requested by State/local agencies in response to their review of VISTAS Draft 2002 Emission Inventory.

**TABLE 2****SUMMARY OF POINT SOURCE NO<sub>x</sub> EMISSIONS BY STATE**

STATE	All Point Sources			Utilities			Non-Utility		
	NEI99V2	VISTAS V1	VISTAS V2	NEI99V2	VISTAS V1	VISTAS V2	NEI99V2	VISTAS V1	VISTAS V2
AL	288,834	279,043	265,433	186,387	170,181	163,522	102,447	108,862	101,911
FL	391,589	312,156	329,312	336,362	264,783	281,939	55,227	47,373	47,373
GA	244,631	257,699	220,524	175,996	148,318	148,005	68,635	109,381	72,519
KY	359,896	249,854	244,226	307,077	197,524	198,909	52,819	52,330	45,317
MS	184,415	179,247	167,215	81,394	67,103	56,887	103,021	112,144	110,328
NC	267,689	248,834	203,342	139,160	150,558	98,321	128,529	98,276	105,021
SC	138,236	135,242	133,876	93,227	89,020	88,220	45,009	46,222	45,656
TN	286,098	255,628	257,882	189,137	163,257	165,685	96,961	92,371	92,197
VA	174,564	143,563	150,867	103,783	79,697	87,024	70,781	63,866	63,843
WV	339,371	308,926	283,295	287,444	253,955	228,324	51,927	54,971	54,971
<b>VISTAS</b>	<b>2,675,323</b>	<b>2,370,192</b>	<b>2,255,972</b>	<b>1,899,967</b>	<b>1,584,396</b>	<b>1,516,836</b>	<b>775,356</b>	<b>785,796</b>	<b>739,136</b>

NEI99V2 – EPA’s 1999 National Emission Inventory, Version 2, Final.

VISTAS V1 – VISTAS’ First Draft 2002 Emission Inventory, with data from EPA’s 2002 CEM Preliminary Summary Emissions Reports. Also includes changes to other facilities resulting from updated 1999/2000/2001 State/local inventories and growth of 1999/2000/2001 emissions to 2002.

VISTAS V2 – VISTAS’ Second Draft 2002 Emission Inventory, with data from EPA’s 2002 CEM Final Summary Emissions Reports. Also includes changes to requested by State/local agencies in response to their review of VISTAS Draft 2002 Emission Inventory.



**TABLE 3****SUMMARY OF POINT SOURCE VOC EMISSIONS BY STATE**

STATE	All Point Sources			Utilities			Non-Utility		
	NEI99V2	VISTAS V1	VISTAS V2	NEI99V2	VISTAS V1	VISTAS V2	NEI99V2	VISTAS V1	VISTAS V2
AL	70,359	77,267	69,136	2,235	2,378	2,160	68,124	74,889	66,976
FL	49,003	47,633	47,632	2,519	2,556	2,556	46,484	45,077	45,076
GA	36,069	44,939	39,214	1,009	1,221	1,212	35,060	43,718	38,002
KY	66,892	63,979	54,700	1,401	1,467	1,490	65,491	62,512	53,210
MS	60,732	76,964	70,081	2,134	3,650	3,294	58,598	73,314	66,787
NC	87,675	86,691	86,270	808	976	980	86,867	85,715	85,290
SC	35,386	44,918	44,821	418	497	500	34,968	44,421	44,321
TN	120,993	110,915	110,915	1,068	1,396	1,396	119,925	109,519	109,519
VA	49,716	46,205	46,102	735	785	785	48,981	45,420	45,317
WV	22,433	20,814	20,814	1,162	1,188	1,188	21,271	19,626	19,626
<b>VISTAS</b>	<b>599,258</b>	<b>620,325</b>	<b>589,685</b>	<b>13,489</b>	<b>16,114</b>	<b>15,561</b>	<b>585,769</b>	<b>604,211</b>	<b>574,124</b>

NEI99V2 – EPA’s 1999 National Emission Inventory, Version 2, Final.

VISTAS V1 – VISTAS’ First Draft 2002 Emission Inventory, with data from EPA’s 2002 CEM Preliminary Summary Emissions Reports. Also includes changes to other facilities resulting from updated 1999/2000/2001 State/local inventories and growth of 1999/2000/2001 emissions to 2002.

VISTAS V2 – VISTAS’ Second Draft 2002 Emission Inventory, with data from EPA’s 2002 CEM Final Summary Emissions Reports. Also includes changes to requested by State/local agencies in response to their review of VISTAS Draft 2002 Emission Inventory.

**TABLE 4****SUMMARY OF POINT SOURCE CO EMISSIONS BY STATE**

STATE	All Point Sources			Utilities			Non-Utility		
	NEI99V2	VISTAS V1	VISTAS V2	NEI99V2	VISTAS V1	VISTAS V2	NEI99V2	VISTAS V1	VISTAS V2
AL	168,456	189,715	184,309	11,515	12,694	12,042	156,941	177,021	172,267
FL	172,444	151,962	151,961	48,648	59,105	59,105	123,796	92,857	92,856
GA	178,723	223,644	198,539	8,404	10,574	10,502	170,319	213,070	188,037
KY	105,054	111,480	124,678	11,973	12,411	12,879	93,081	99,069	111,799
MS	70,401	82,083	75,857	17,300	28,459	26,017	53,101	53,624	49,840
NC	79,461	85,703	83,822	8,753	11,380	11,375	70,708	74,323	72,447
SC	58,907	74,042	70,223	6,656	7,594	7,728	52,251	66,448	62,495
TN	108,030	135,212	135,212	7,219	10,426	10,426	100,811	124,786	124,786
VA	76,011	76,775	76,715	7,244	9,213	9,213	68,767	67,562	67,502
WV	112,572	112,442	112,842	10,154	10,398	10,398	102,418	102,044	102,444
<b>VISTAS</b>	<b>1,130,059</b>	<b>1,243,058</b>	<b>1,214,158</b>	<b>137,866</b>	<b>172,254</b>	<b>169,685</b>	<b>992,193</b>	<b>1,070,804</b>	<b>1,044,473</b>

NEI99V2 – EPA’s 1999 National Emission Inventory, Version 2, Final.

VISTAS V1 – VISTAS’ First Draft 2002 Emission Inventory, with data from EPA’s 2002 CEM Preliminary Summary Emissions Reports. Also includes changes to other facilities resulting from updated 1999/2000/2001 State/local inventories and growth of 1999/2000/2001 emissions to 2002.

VISTAS V2 – VISTAS’ Second Draft 2002 Emission Inventory, with data from EPA’s 2002 CEM Final Summary Emissions Reports. Also includes changes to requested by State/local agencies in response to their review of VISTAS Draft 2002 Emission Inventory.

**TABLE 5****SUMMARY OF POINT SOURCE PM10-PRI EMISSIONS BY STATE**

STATE	All Point Sources			Utilities			Non-Utility		
	NEI99V2	VISTAS V1	VISTAS V2	NEI99V2	VISTAS V1	VISTAS V2	NEI99V2	VISTAS V1	VISTAS V2
AL	37,128	38,974	35,627	3,764	3,962	3,870	33,364	35,012	31,757
FL	70,583	75,541	75,541	31,883	28,401	28,401	38,700	47,140	47,140
GA	55,495	371,588	53,752	9,493	5,368	4,035	46,002	366,220	49,717
KY	28,816	29,014	25,757	6,184	4,957	5,123	22,632	24,057	20,634
MS	41,156	45,434	45,340	7,438	9,430	10,627	33,718	36,004	34,713
NC	34,866	42,922	42,496	15,762	16,459	16,689	19,104	26,463	25,807
SC	17,897	32,590	32,555	8,729	22,075	22,460	9,168	10,515	10,095
TN	35,718	46,356	46,356	9,219	3,245	3,245	26,499	43,111	43,111
VA	18,364	17,512	17,681	3,558	4,220	4,058	14,806	13,292	13,623
WV	17,169	27,541	27,541	895	3,782	3,782	16,274	23,759	23,759
<b>VISTAS</b>	<b>357,192</b>	<b>727,472</b>	<b>402,646</b>	<b>96,925</b>	<b>101,899</b>	<b>102,290</b>	<b>260,267</b>	<b>625,573</b>	<b>300,356</b>

PM10-PRI – Primary PM10, including PM10-filterables and PM-condensibles.

NEI99V2 – EPA’s 1999 National Emission Inventory, Version 2, Final.

VISTAS V1 – VISTAS’ First Draft 2002 Emission Inventory, with changes resulting from updated State/local inventories for 1999/2000/2001, growth of 1999/2000/2001 emissions to 2002, and augmentation of PM10/PM25 emissions using EPA’s NEI PM data augmentation procedures.

VISTAS V2 – VISTAS’ Second Draft 2002 Emission Inventory, with corrections to the PM augmentation methodology and changes requested by State/local agencies in response to their review of VISTAS Draft 2002 Emission Inventory.

**TABLE 6****SUMMARY OF POINT SOURCE PM25-PRI EMISSIONS BY STATE**

STATE	All Point Sources			Utilities			Non-Utility		
	NEI99V2	VISTAS V1	VISTAS V2	NEI99V2	VISTAS V1	VISTAS V2	NEI99V2	VISTAS V1	VISTAS V2
AL	27,149	28,881	26,423	1,743	1,833	1,840	25,406	27,048	24,583
FL	54,238	60,769	60,590	22,847	20,508	20,508	31,391	40,261	40,082
GA	41,645	291,996	41,123	4,929	2,109	1,380	36,716	289,887	39,743
KY	17,553	19,159	17,109	3,571	2,904	3,054	13,982	16,255	14,055
MS	29,793	33,457	33,638	6,974	8,918	10,271	22,819	24,539	23,367
NC	22,519	28,635	27,971	9,454	11,415	11,498	13,065	17,220	16,473
SC	11,941	38,579	24,961	4,770	18,940	17,743	7,171	19,639	7,218
TN	27,241	35,326	35,302	7,732	1,342	1,342	19,509	33,984	33,960
VA	12,657	11,545	11,594	2,157	2,105	2,007	10,500	9,440	9,587
WV	12,128	20,066	18,138	435	1,379	1,379	11,693	18,687	16,759
<b>VISTAS</b>	<b>256,864</b>	<b>568,413</b>	<b>296,849</b>	<b>64,612</b>	<b>71,453</b>	<b>71,022</b>	<b>192,252</b>	<b>496,960</b>	<b>225,827</b>

PM10-PRI – Primary PM10, including PM10-filterables and PM-condensibles.

NEI99V2 – EPA’s 1999 National Emission Inventory, Version 2, Final.

VISTAS V1 – VISTAS’ First Draft 2002 Emission Inventory, with changes resulting from updated State/local inventories for 1999/2000/2001, growth of 1999/2000/2001 emissions to 2002, and augmentation of PM10/PM25 emissions using EPA’s NEI PM data augmentation procedures.

VISTAS V2 – VISTAS’ Second Draft 2002 Emission Inventory, with corrections to the PM augmentation methodology and changes requested by State/local agencies in response to their review of VISTAS Draft 2002 Emission Inventory.

**TABLE 12****SUMMARY OF POINT SOURCE NH3 EMISSIONS BY STATE**

STATE	All Point Sources			Utilities			Non-Utility		
	NEI99V2	VISTAS V1	VISTAS V2	NEI99V2	VISTAS V1	VISTAS V2	NEI99V2	VISTAS V1	VISTAS V2
AL	4,015	4,275	947	16	4	50	3,999	4,271	897
FL	1,677	2,191	2,190	1,176	863	863	501	1,328	1,327
GA	15,794	5,167	5,147	35	37	76	15,759	5,130	5,071
KY	579	772	729	16	13	6	563	759	723
MS	27,867	1,156	1,207	5,618	266	327	22,249	890	880
NC	950	1,854	1,815	14	33	36	936	1,821	1,779
SC	1,053	1,237	1,386	9	1	1	1,044	1,236	1,385
TN	113	2,452	2,452	10	1	1	103	2,451	2,451
VA	777	1,637	3,783	86	68	68	691	1,569	3,715
WV	486	576	576	16	4	4	470	572	572
<b>VISTAS</b>	<b>53,311</b>	<b>21,317</b>	<b>20,232</b>	<b>6,996</b>	<b>1,290</b>	<b>1,432</b>	<b>46,315</b>	<b>20,027</b>	<b>18,800</b>

NEI99V2 – EPA’s 1999 National Emission Inventory, Version 2, Final.

VISTAS V1 – VISTAS’ First Draft 2002 Emission Inventory, with changes resulting from updated State/local inventories for 1999/2000/2001, changes made in response to the comparison with the emission estimates reported in EPA’s Toxic Release Inventory, and growth of 1999/2000/2001 emissions to 2002.

VISTAS V2 – VISTAS’ Second Draft 2002 Emission Inventory, with corrections and changes requested by State/local agencies in response to their review of VISTAS Draft 2002 Emission Inventory.

## **APPENDIX A**

### **EMISSIONS BY STATE AND FACILITY**

Raw data files, in NIF 3.0 format, are located on MACTEC's ftp site. Summary tables are contained in a spreadsheet on the ftp site. The MACTEC ftp site can be accessed in the following manner:

Address: [ftp.mactec.com](ftp://ftp.mactec.com)

Login ID: externalclient

Password: sen382

Directory: \Outgoing\VISTAS Version 2\point

Contact Ed Sabo (703.471.8383) at MACTEC if you have any problems accessing the ftp site.

**Development of the Draft 2002 Vistas Emission  
Inventory for Regional Haze Modeling**

**PART 3**

**Development of the Draft 2002 VISTAS  
Emission Inventory for Regional Haze Modeling  
(Area Source Methodology)**

**DRAFT REPORT**

**DEVELOPMENT OF THE  
DRAFT 2002 VISTAS EMISSION INVENTORY  
FOR REGIONAL HAZE MODELING**

**AREA SOURCE METHODOLOGY**

*Prepared for:*

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## APPENDICES

Appendix A — NH3 Growth Factors for Livestock Operations

Appendix B — Fire Fuel Loading Values

Appendix C — Emission Factors Used for Fire Emission Calculations

## OVERVIEW

Under contract with VISTAS, MACTEC was tasked to develop the 2002 base year inventory for both point and area source sectors. This document details the methods used to develop the area source component of the inventory.

Work to develop the area source inventory was performed using a stepwise process. The steps in this process were:

1. Receive area source data from State and local agencies within the VISTAS region.
2. Evaluate the data received by the State and local agencies to determine whether or not the data were usable and if so which pollutants and categories were covered by the submitted data. This included a quality assurance step performed to ensure that the submitted data contained all necessary information needed to develop 2002 emission estimates.
3. Prepare growth factors for projecting emissions from State/local supplied data.
4. Run the Carnegie Mellon University (CMU) ammonia model to produce ammonia emissions for large area source categories (livestock, fertilizers, etc.).
5. Obtain State specific animal populations to use to grow CMU model estimates to 2002.
6. Obtain data on wildfires, prescribed burns, agricultural burning and waste/land clearing burning activities from State and Federal fire officials. Data on acres burned, fuel loadings and emission factors were sought from these officials.
7. Quality assured the data submitted by fire officials for completeness and for location information.
8. Develop fire emission estimates.
9. Updated the National Emission Inventory Input Files (NIF) for the VISTAS States to include the updated emission data.

Once these steps were completed, the preliminary version of the inventory was provided to the State/local agencies for review.

Version 1 of the inventory was then submitted to the States for review and comment. Several changes were made to Version 1 of the inventory based on these reviews as well as the re-runs of the CMU model in order to update from version 3.0 to 3.1 and to update prescribed fires data for AL, FL, GA, MS, and SC, and to add wildfire data for FL that was inadvertently left out of version 1. Finally Version 2 of the VISTAS base year inventory was converted from NIF 2 to NIF 3.

### **Submittal of State/Local/Tribal Agency Emissions Data**

VISTAS solicited emissions data from all State, local and Tribal air quality entities within the VISTAS region. The request specified that if these entities had 2002 emissions data to provide that, otherwise data from 1999, 2000 or 2001 were acceptable and that if possible the submittal format should be NIF version 2. The request also

indicated that the default data that would be used should State, local or Tribal agencies not submit data would be the 1999 National Emission Inventory (NEI) version 2.

Data were submitted by almost all of the States in the VISTAS region as well as several local agencies. No Tribes submitted data directly. Data received for the initial version of the VISTAS area source emission inventory is summarized in Table 1.

The general procedure we used for updating data in the database is provided below. Most States only provided VOC, CO and NO<sub>x</sub> emissions however some states provided additional pollutants.

We generated all Version 1 data files in NIF version 2.0 format. Version 2 files were generated in NIF version 3.0 format. The information that follows describes the general procedure we used to process each individual file in the NIF format.

The emission process file (EP file type) was processed to add records for processes not found in the NEI version 2 (but submitted by the State in their submittal). Then corresponding records in each data set were matched and the State supplied data fields were updated. All new and changed records had the NAICS field marked with “SS” which stands for State Supplied. Generally, we preferred to use “blank” fields to mark State supplied records, however the Access version of the NIF version 2.0 (and version 3.0) format does not provide a blank field for the EP table. We found no entries in the NAICS field for any of the VISTAS states in the 1999 NEI version 2 file, thus we used this field for this table to mark changed or updated records.

For the control table (CE table), we appended new records that did not exist in the current NEI version 2 to ensure that SCCs and pollutants that didn’t exist in the NEI had corresponding records in the final file. We then updated matching records with the State supplied data and marked all new and updated records with “SS” in the blank field. Finally we performed a “widow” check to make sure that no widowed records existed after all the updates.

Similar operations were performed for the emissions period table (PE table). Non-matching records were appended to the current NEI version 2 table, then updates were made for matching records to update the data fields to the State supplied values. We then updated the blank field to SS on new and updated records to designate that they were supplied by the State. Finally we deleted orphan records.

Finally for the emissions table (EM table), each State was handled somewhat differently. When States had submitted only VOC, CO, and NO<sub>x</sub> records, we deleted all VOC, NO<sub>x</sub> and CO records. We treated the State supplied data as if it was a full and complete inventory for those pollutants. We then appended the State supplied data for VOC, CO and NO<sub>x</sub> to the emissions table. If a State supplied all pollutants, we completely replaced the EM table. For other States, more involved updates specific to those States were performed. For those States that only submitted VOC, CO, and NO<sub>x</sub> data, we provided them with a list of missing SCCs found in their submittal and in the 1999 NEI version 2.0

so they could determine if the missing SCCs needed additional pollutants. Specific details on the processing of each of the sets of inventory data provided by State/local agencies are given below.

**TABLE 1**  
**SUMMARY OF STATE AND LOCAL AGENCY AREA SOURCE SUBMITTALS**

<b>State</b>	<b>Agency</b>	<b>Comments on Original Submittal</b>	<b>Year</b>	<b>Response to Initial QA/QC Checks</b>
AL	AL DEM	Sent 1999 NEI data, with some minor corrections.	1999	Data passed cleanly through EPA's QA/QC software, except for a few minor issues. AL DEM personnel provided corrections and responses to issues in the QA/QC report.
FL	FL DEP	Florida supplied area source emissions for several source categories including (for 1999) commercial fuel use, auto refinishing, dry cleaners, industrial coatings, industrial fuel use, agricultural pesticides, residential fuel use, solvent cleaning, (and for 2000) bakeries, asphalt batching, architectural coatings, consumer and commercial solvents, graphic arts, stage 1 and stage 2 controls, tank breathing loss, traffic markings, and transit losses.	1999 2000	The data were provided in spreadsheets and included activity data and annual and seasonal emissions. The format was not NIF format so it could not be QA/QC'ed using the EPA QA/QC tool.
FL	West Palm Beach	Supplied emission inventory information in a spreadsheet for 2001. The spreadsheet provided annual emissions only from point, area and mobile sources (including nonroad).	2001	The data provided was summarized in broad categories, not by source classification code (SCC). For example one of the categories was Residential Fuel Combustion but contained no information on emissions by type of fuel for the residential fuel combustion category. These data were not processed for use in the inventory

**TABLE 1 (cont.)**

<b>State</b>	<b>Agency</b>	<b>Comments on Original Submittal</b>	<b>Year</b>	<b>Response to Initial QA/QC Checks</b>
GA	GA DNR	Sent 1999 data for 13 counties in the Atlanta area (VOC, NOx, CO only). Indicated that the 1999 NEI should be used for other counties.	1999	Data passed cleanly through EPA's QA/QC software, with a few minor problems concerning field lengths of numeric values, throughput units and seasonal percentages. These were updated in concurrence with GA DNR personnel.
KY	KY DEP	Kentucky supplied data for 11 counties (Oldham, Bullitt, Boyd, Greenup, Fayette, Scott, Edmonson, Daviess, Hancock, Livingston, and Marshall).	1999 2000	They provided emissions for VOC, CO, and NOx, both annual and summer day emissions. The file format was ASCII NIF format. The data were a mixture of 1999 and 2000 emissions. The data were imported into Access and submitted to the EPA QA/QC tool. One minor problem with duplicate records was fixed by MACTEC with KY DEQ concurrence.
MS	MS DEQ	Mississippi sent an area source file in MS Access NIF format.	1999	The file sent included only records for fireplaces and woodstoves for CO, NOx, PM10-PRI, VOC and SO2.
NC	NC DENR	NC indicated that the current versions of the NEI (1999 version 2) was suitable for their submission without change.	1999	Used 1999 NEI version 2.
SC	SC DHEC	No data submitted	1999	Used 1999 NEI version 2.

**TABLE 1 (cont.)**

<b>State</b>	<b>Agency</b>	<b>Comments on Original Submittal</b>	<b>Year</b>	<b>Response to Initial QA/QC Checks</b>
TN	TN DEC	Tennessee provided annual NH <sub>3</sub> values for area sources for all counties. These values were supplied in an Excel format and were developed by the University of Tennessee. They recommended using the 1999 NEI version 2 for all other area sources. They also recommend that all emissions from livestock be maintained at current levels since levels over the last 20 years have remained essentially constant with the exception of hogs where activity levels have been declining. They also recommended that hog activity levels remain constant.	1999	TN supplied NH <sub>3</sub> values used for all matching categories. 1999 NEI version 2 used for all remaining inventory categories.
TN	Memphis-Shelby County	The Memphis and Shelby County Health Department sent area source emission inventory data in MS Access NIF format.	1999	EPA's QA/QC software identified a number of issues with the data submitted. MACTEC worked with Shelby County to resolve many of these issues but not all could be resolved.
VA	VA DEQ	Virginia submitted a MS Access database in NIF format that contained VOC, NO <sub>x</sub> , and CO emissions with both annual and ozone season emissions included.	1999	Data passed fairly cleanly through EPA's QA/QC software, except for a few out-of-range or other types of messages. One independent city set of records was found to no longer be a legitimate FIPS code, but emissions for that city were added to the corresponding county emissions.
WV	WV DEP	West Virginia initially provided only county fire statistics (both number of fires and acres burned) by county for 2000 and 2001 (both spring and fall). They later provided a NIF format file of records to delete from the 1999 NEI version 2 for WV.	1999	Records provided in NIF format for deletion processed. Records were marked for deletion and removed from NIF version 2.0 for WV



## Alabama

Alabama supplied a version of the 1999 NEI that had been updated for a couple of source categories. We processed the data through the QA/QC tool, found some minor problems which were corrected by Alabama DEM personnel and then their data were inserted into the database. Their data included all pollutants.

## Florida

Florida's submittal was in an Excel spreadsheet format and included emissions for separate years (1999 and 2000). The data were provided in spreadsheets and included activity data and annual and seasonal emissions. The format was not NIF format so it could not be QA/QC'ed using the EPA QA/QC tool. We then identified all SCCs provided by Florida that were not in the current NEI and determined whether or not those sources could be added to the inventory. In some cases, addition of those sources would have resulted in double counting of emissions so not all of the data could be used.

For 1999, the following data sources were added to the inventory:

2102011000	external fuel combustion, kerosene
2401050000	sheet, strip and coil metal coating – added but data from NEI for 2401045000 was removed to avoid double counting
2415030000	electronics coatings
2415045000	manufacturing coatings
2415065000	auto repair
2420010000	dry cleaning added to replace 2420010055 and 2420010379 to avoid double counting

Data for 2461850000, agricultural pesticides was not added since the NEI already included 2461800000 all pesticides and no good method existed to ensure that double counting did not occur.

For the 2000 data, the following sources were added:

2401002000	architectural surface coating, solvent based added and 2401001000 architectural solvents all solvent types was removed to avoid double counting
2401003000	architectural surface coating water based solvents added and 2401001000 all solvent types was removed to avoid double counting
2460000000	consumer/commercial solvents all processes all solvent types was added and six separate SCCs in the NEI were removed to avoid double counting
2461022000	asphalt paving emulsified
2501060053	gasoline service stations stage 1 balanced submerged filling added with a control effectiveness of 95 percent and a rule effectiveness of 80 percent
2501070051	diesel service stations stage 1 submerged filling added with a rule effectiveness of 80 percent for all counties except 061 and 103

- 2501070053 diesel service stations stage 1 balanced submerged filling added with rule effectiveness of 80 percent except for county 105
- 2501070201 underground storage tanks breathing and emptying – diesel added

Data for 2501070100 diesel service stations stage 2 records were not added since those emissions were covered in the on-road and non-road inventories. In addition, 2505030090 distillate tank trucks in transit were not added since they would have resulted in double counting.

In addition to these specific updates, all SCCs provided by Florida that were identical matches to NEI sources were updated to include the Florida supplied parameters (activity data, throughput, control efficiency, etc.).

### **Florida – West Palm Beach County**

West Palm Beach County submitted data for very broad sources that were insufficient to be utilized in producing emissions for use in the VISTAS inventory. Double counting would have resulted from the use of the spreadsheet provided by West Palm Beach County so the 1999 NEI was used in producing emission from West Palm Beach.

### **Georgia**

Georgia also only submitted VOC, CO and NO<sub>x</sub> for 13 counties in the Atlanta area in NIF format. Our examination of the original NIF file using the EPA QA/QC tool found some problems with seasonal throughputs not summing to 100 percent, some issues with the emission factor units in the EM table, and some numeric values that were too long for the fields. The seasonal throughputs were adjusted based on emails with GA DNR personnel. In all cases if an adjustment had to be made to make the final value sum to 100, the winter value was changed to cause the sum to reach 100. This was only necessary when the correction method instituted to update each seasonal value ended up rounding to a number one percent above or below 100.

Data for only the 13 counties submitted for VOC, CO and NO<sub>x</sub> were updated. All other GA data is reflective of the 1999 NEI version 2.

### **Kentucky**

Kentucky submitted data for 11 counties. The data received from Kentucky was in an ASCII NIF format and had a few problems when run through the EPA QA/QC tool. Duplicate records were found in the CE table for SCC 2275900101 for VOC and widowed records were found in the PE table for SCC 2660000000. Those problems were corrected and the data were resubmitted to the QA/QC program and no further problems were identified. One further modification was made to the EP table. Records identified as commercial aircraft refueling were converted to aircraft refueling in order to keep 1999 NEI records for PM and SO<sub>2</sub> after the corresponding VOC, CO and NO<sub>x</sub> records were deleted.

## Memphis - Shelby County Tennessee

Shelby County initially provided a NIF format Access database. When we submitted the file to EPA's QA/QC software it identified a number of issues with the data submitted. Shelby County provided an updated spreadsheet file several months later that corrected some but not all of the errors found in the first version. MACTEC worked with Shelby County to resolve many of these issues but not all could be resolved. The data that were processed included SCCs which matched the 1999 NEI version 2 and new SCCs not included in the 1999 NEI version 2. For those SCCs that matched, the relevant information and emissions were updated. The information detailed below describes how the SCCs that weren't in the 1999 NEI version 2 were handled.

- 2104008000 residential wood combustion total all wood stoves. These data were inserted into the inventory database and SCCs that would have resulted in double counting were removed. However, the original SCCs for this category for pollutants not submitted were maintained in the database.
- 2401050000 solvent utilization surface coating miscellaneous finished metal parts all solvents. These emissions were added to the database.
- 2401065000 solvent surface coating electronic parts all solvents. Emission were added to the database
- 2415000000 solvent degreasing all processes/all industries all solvents. These emissions were added to the data base and emissions from 18 separate SCCs found in the 1999 NEI were deleted to avoid double counting.
- 2420000000 solvent usage dry cleaning all processes all solvents. These emissions were added and three SCCs were removed from the 1999 NEI to avoid double counting
- 2461000000 solvents miscellaneous non-industrial commercial all processes all solvents was added and 2461800000 pesticides was removed from the 1999 NEI to avoid double counting
- 2465000000 solvents miscellaneous non-industrial consumer all products/processes all solvents was added and four SCCs from the 1999 NEI were removed to avoid double counting.
- 2501060000 storage and transport petroleum products gasoline service stations, total all gasoline/processes was added and SCCs from the 1999 NEI were removed to avoid double counting.
- 2505030000 storage and transport petroleum products trucks total all products was added and 2505030120 was deleted to avoid double counting
- 2610000000 waste disposal open burning all categories total was added and 2610000500, land clearing of debris was replaced to avoid double counting
- 2620000000 waste disposal landfills all total was added and 2620030000 landfills municipal total was removed from the 1999 NEI to avoid double counting
- 2630000000 waste disposal, waste water treatment, all total was added and 2630020000 publicly owned treatment works were removed with the exception of NH3 emissions

There were several records for PM that could not be added for Shelby County because the pollutant codes were unclear as to whether they were PM10 or PM2.5 or whether they were primary or filterable emissions. MACTEC requested verification from Shelby County several times but no information was received to reconcile these records prior to the deadline for delivering the draft emission inventory.

### **Mississippi**

Mississippi submitted NIF format records but the file sent included only records for fireplaces and woodstoves for CO, NO<sub>x</sub>, PM10-PRI, VOC and SO<sub>2</sub>. We deleted the records for the corresponding categories in the NEI and replaced them with the records from Mississippi. We added records for PM2.5-PRI which were set equal to the PM10-PRI values.

### **Virginia**

As indicated in Table 1, Virginia provided a NIF format file for CO, VOC, and NO<sub>x</sub>. In examining the file submitted we found that there were non-road mobile source records in the file. We deleted all records for SCCs that started with 22750 and 228. After that we processed each file type in the NIF format.

For the EP file, only seasonal throughputs, days per week, and weeks per year that were supplied by the State were updated. All other NEI field values were maintained.

In the CE file, Virginia had included the text “Must Code Each County” and “Individually for CE and Device type” in the blank and Control System Description fields. These appeared to be file instructions and had no bearing on the final inventory file so they were deleted.

### **West Virginia**

West Virginia only supplied records that should be deleted from the 1999 NEI version 2. MACTEC deleted those records so that the 1999 NEI version 2 for West Virginia only included records that West Virginia had reviewed for EPA.

## **GROWTH OF EMISSIONS TO 2002**

With the exception of NH<sub>3</sub> categories that were calculated using the CMU Ammonia model and for forest wildfires and prescribed burning, all other emissions were grown from the base year submitted to 2002. The growth factors were developed using the Economic Growth Analysis System (EGAS) version 4.0.

Three different sets of EGAS based growth factors were used to project the emissions to 2002. The first set was taken directly from EGAS. They represent growth factors for a particular State, County, and SCC. Values were determined for 1996, 1999, 2000, 2001, and 2002. EGAS growth factors are based on a 1996 base year so in order to determine a

growth factor for projecting from 1999 to 2002 you must take the ratio of the values for 2002/1999 in order to obtain the growth factor. We calculated all of the growth factors on the fly for two reasons. First we could simply calculate the growth factors from the raw EGAS growth factors while calculating the projected emissions rather than calculating actual values from the values generated from EGAS and then using those values. Second, some States provided 2000 emissions, thus similarly, the 2002/2000 ratio would provide the growth factor value. We used the year portion of the start date field to determine which ratio (2002/1999 or 2002/2000) should be used for the emission factor. Once the emissions were calculated, then the blank field was marked with either a G9 or a G0 to signify that the record was grown from 1999 or 2000 NEI data respectively. For State supplied data, the SS value in the blank field was modified to be either S9 or S0 to represent that the emissions were grown from 1999 or 2000 State-supplied data respectively.

In some cases, the State/County/SCC level growth factors weren't available for a particular State/County/SCC combination. In that case we developed a State-wide growth factor for each SCC. We then used those factors to perform the emission growth using the same ratio method. The State level growth factors were generated at the State/SCC level by taking the average of all county level growth factors for that State. In some cases, we still didn't have a growth factor for that State/SCC combination. After attempting to perform the growth with the State/County/SCC and the State/SCC growth factor files, we then used a VISTAS region file at the SCC level. That file was developed from the State/County/SCC level file by averaging the growth factor by SCC for all States in the VISTAS region. Again records were grown on the fly using the ratios of the growth factors and all records were marked as grown where applicable. If after these three attempts were made to grow the emissions no growth factor was available, the 1999 value was maintained (i.e., growth factor = 1).

We solicited additional information from the State/Local/Tribal agencies on control programs and changes in rule penetration and rule effectiveness for 2002 but no information was provided by these agencies for 2002. Thus no additional controls were assumed in growing emissions from 1999 (or 2000) to 2002.

There was one exception to the above approach and that was for Stage 2 refueling emissions. Emissions for Stage 2 refueling were developed by the VISTAS on-road/non-road emissions contractor and provided to MACTEC for inclusion in the emission inventory. This was done to ensure that the emissions for Stage 2 refueling were calculated consistently. As a consequence, any State submitted Stage 2 refueling emission estimates were removed from the inventory. Stage 1 estimates were left in.

### **NH<sub>3</sub> EMISSIONS ESTIMATES**

Ammonia is a pollutant of particular interest to VISTAS in this inventory. We obtained a draft version of the Carnegie Mellon University (CMU) Ammonia Tool (version 3.0). That emission estimation software was used to develop emission estimates for Version 1 of the VISTAS inventory. Categories other than livestock were developed from the

CMU model and used directly in the emission inventory. As such those estimates may actually be representative of emission years other than 2002, but for the purposes of this inventory, they are treated as if they are 2002 emission estimates. The categories developed directly from the CMU model included:

Fertilizer Application	Anhydrous Ammonia
Fertilizer Application	Aqua Ammonia
Fertilizer Application	Nitrogen Solutions
Fertilizer Application	Urea
Fertilizer Application	Ammonium Nitrate
Fertilizer Application	Ammonium Sulfate
Fertilizer Application	Ammonium Thiosulfate
Fertilizer Application	N-P-K
Fertilizer Application	Calcium Ammonium Nitrate
Fertilizer Application	Potassium Nitrate
Fertilizer Application	Diammonium Phosphate
Fertilizer Application	Monoammonium Phosphate
Fertilizer Application	Liquid Ammonium Polyphosphate
Fertilizer Application	Miscellaneous Fertilizers
Goats Waste Emissions	Angora Goats
Goats Waste Emissions	Milk Goats
Cats	Total
Dogs	Total
Bears	Black Bears
Bears	Grizzly Bears
Elk	Total
Deer	Total
Human Perspiration	Total

In addition to these categories that were developed directly from the model using default inputs, we also developed projected emission estimates for the following categories:

Cattle and Calves Waste Emissions	Milk Cows
Cattle and Calves Waste Emissions	Beef Cows
Cattle and Calves Waste Emissions	Heifers and Heifer Calves
Cattle and Calves Waste Emissions	Steers, Steer Calves, Bulls, and Bull Calves
Hogs and Pigs Composite	Total
Poultry Waste Emissions	Pullet Chicks and Pullets less than 13 weeks old
Poultry Waste Emissions	Pullets 13 weeks old and older but less than 20 weeks old
Poultry Waste Emissions	Layers
Poultry Waste Emissions	Broilers
Poultry Waste Emissions	Ducks
Poultry Waste Emissions	Geese
Poultry Waste Emissions	Turkeys



Horses and Ponies Composite	Total
Sheep and Lambs Composite	Total

The default activity data used to develop emission estimates for these categories were taken from the 1997 Census of Agriculture. We investigated the potential availability of the 2002 Census of Agriculture (the Census of Agriculture, which is updated every five years, serves as the data source for activity data for both the CMU tool and the NEI), however data from the 2002 Census of Agriculture will not be available until February 2004. We did find that many States had State (and in a couple of cases) county level data for 2002 on their individual State agriculture department websites. As a consequence we decided to use State animal populations to project the emissions from 1997 to 2002. We decided to use State level data (rather than county level when available) for all animal types in order to keep the methodology consistent from State-to-State. Using this approach we were able to develop growth factors for each livestock category listed above with the exception of West Virginia. No State data for 2002 was found on their website, nor was it provided following email requests from the State department of agriculture personnel contact listed on their website. We kept growth factors for all livestock categories for West Virginia as one, so their values for these categories are the same as produced by the CMU model (using 1997 data).

In some cases, States had data for all of the subcategories (beef cows, milk cows, heifers and calves, etc.). In other cases, they only had total values (e.g., cattle). If the specific data were available for the category, then we calculated specific growth factors. If not then the more general category (cattle or pig or chicken) growth factor was used for all subcategories for that State. The values used to grow the livestock categories in each State for ammonia are provided in Appendix A.

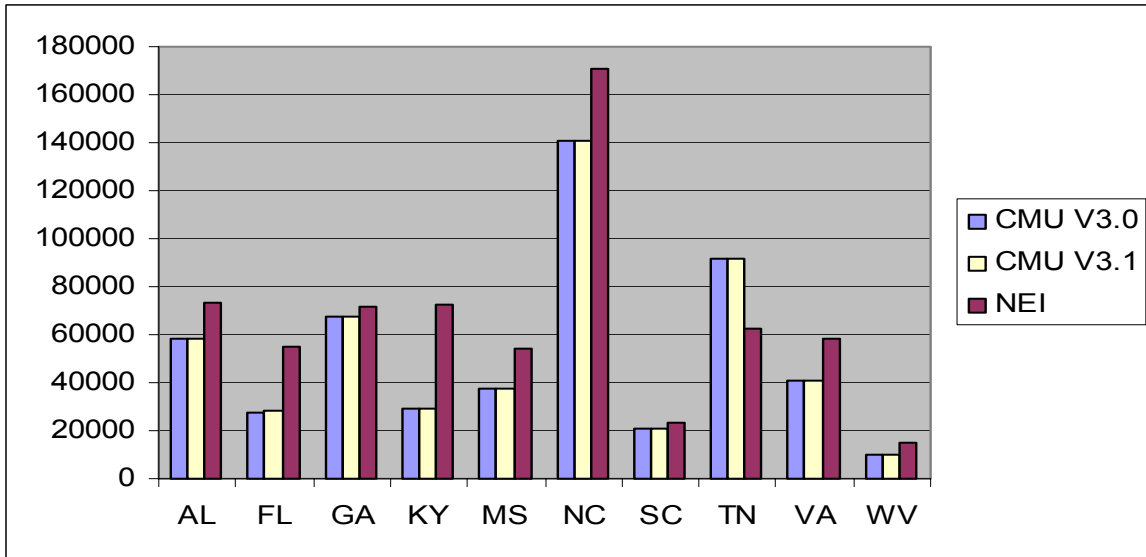
There was one exception to this approach. Tennessee had provided 1999 data by county and livestock type for the entire State. In their data submittal, Tennessee had also recommended that the 1999 data not be projected to 2002 since animal populations had been fairly constant since that time. Thus, we used their data as provided with the exception that we did not include their information for NH<sub>3</sub> from fires and we added the CMU model values for categories that they did not include (i.e., cats, dogs, bears, etc.). Figure 1 shows the difference between CMU and 1999 NEI version 2 ammonia emissions for livestock operations. Figure 2 shows the difference between fertilizer ammonia emissions from the CMU model and the 1999 NEI version 2.

In order to keep track of the database records that were developed using the CMU model, the blank fields of the NIF format tables were updated with “CMU” to indicate that the data were derived from the CMU model.

For Version 2 of the VISTAS area source inventory, we developed updated values for NH<sub>3</sub> from version 3.1 of the CMU model. Changes resulting from use of version 3.1 of the CMU model only affected dairy cattle emissions. All other procedures used for the inventory development were identical to what is described above.

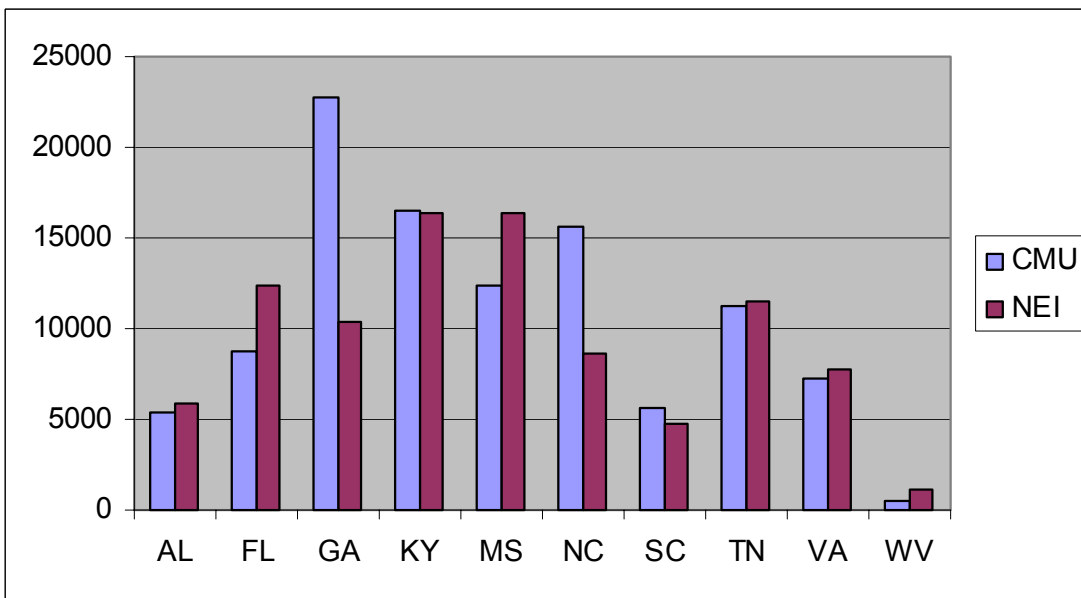
**FIGURE 1.**

**COMPARISON OF AMMONIA EMISSION ESTIMATES FOR LIVESTOCK CATEGORIES BY STATE BETWEEN THE CMU MODEL (VERSIONS 3.0 AND 3.1) AND 1999 NEI VERSION 2.**



**FIGURE 2.**

**COMPARISON OF AMMONIA EMISSION ESTIMATES FOR FERTILIZER USAGE BY STATE BETWEEN THE CMU MODEL AND 1999 NEI VERSION 2.**





## **FIRE EMISSION ESTIMATES**

### **Data Requested**

In early 2003, VISTAS requested that State forestry personnel provide information necessary to calculate fire emissions from wildfires, prescribed burning, agricultural fires and land clearing of debris. Specifically, VISTAS requested the following information:

#### **Wildfires:**

- Number of acres burned
- Date of fire – Actual days were preferred with information on the month that the fire occurred in being the minimum information provided
- Type of material burned (pine, oak, etc.)
- Fuel loading (tons/acre)
- Location of fire – Latitude/longitude information was preferred, but if not available, the minimum acceptable information was the county in which the fire was located. For fires that spanned counties, VISTAS requested a breakdown of the acres per county.

#### **Prescribed fires:**

- Number of acres burned
- Date of fire – Actual days were preferred with information on the month that the fire occurred in being the minimum information provided
- Type of material burned (short needle conifer, long needle conifer, logging slash debris, hardwood, palmetto, etc.)
- Fuel loading (tons/acre)
- Location of fire - Latitude/longitude information was preferred, but if not available, the minimum acceptable information was the county in which the fire was located. For fires that spanned counties, VISTAS requested a breakdown of the acres per county.

In addition for each of these fire types, VISTAS requested an estimate regarding the percentage of the fire that occurred in the flaming, smoldering and actual fire stages.

#### **Agricultural burning:**

- Number of acres burned
- Date of fire – Actual days were preferred with information on the month that the fire occurred in being the minimum information provided Type of material burned (crop type)
- Fuel loading (tons/acre)
- Location of fire - Latitude/longitude information was preferred, but if not available, the minimum acceptable information was the county in which the fire was located. For fires that spanned counties, VISTAS requested a breakdown of the acres per county.

### **Land clearing of debris:**

- Number of acres burned
- Date of fire – Actual days were preferred with information on the month that the fire occurred in being the minimum information provided Type of material burned (grass, wood debris, etc.)
- Fuel loading (tons/acre)
- Location of fire - Latitude/longitude information was preferred, but if not available, the minimum acceptable information was the county in which the fire was located. For fires that spanned counties, VISTAS requested a breakdown of the acres per county.

### **Data Supplied**

Data returned from the State forestry contacts varied by State both in the types of fire information returned (e.g., wildfires, prescribed, agricultural or land clearing) and in the detail provided. Some States provided information on each fire by latitude and longitude while others provided only the county location. In other cases very detailed information was provided on the fire date (including reported date, control date and fire out date, for example) while others only provided the month the fire occurred. For States that only provided the month the fire occurred we set the date to the first of the month. Some States provided fairly detailed information on the fuel type and loading while others provided no data at all on the fuel type (or loading). No States provided estimates on the smoldering or flaming stages of the fire. Finally most States provided information in electronic format; however several only provided hard copy. For those that provided hard copy data, we scanned the data and inserted it into spreadsheets. The spreadsheets were reviewed against the original materials to ensure that the data were translated correctly.

VISTAS also requested information from Federal agencies on fires on Federal lands. The following Federal agencies were requested to submit data:

- Forest Service;
- Fish and Wildlife Service;
- National Park Service;
- Bureau of Land Management; and
- Bureau of Indian Affairs.

Data for wildfires was provided by all Federal agencies. However, prescribed burning data were only provided by the U.S. Forest Service. No other Federal agencies provided prescribed burning data to VISTAS.

Tables 2 and 3 provide an overview of the data supplied by State and Federal agencies for fires for VISTAS.

**TABLE 2.**

**FIRES DATA PROVIDED BY STATE AGENCIES BY FIRE TYPE**

State	Agriculture	Prescribed	Silviculture	Land Clearing	Waste Burning	Wildfires
AL	✓	✓		✓		✓
FL	✓	✓	✓	✓		✓
GA	✓		✓	✓		✓
KY						✓
MS		✓				
NC						✓
SC	✓			✓	✓	✓
TN						✓
VA						✓
WV						✓

**TABLE 3.**

**FIRES DATA PROVIDED BY FEDERAL AGENCIES BY FIRE TYPE**

Agency	Agriculture	Prescribed	Silviculture	Land Clearing	Waste Burning	Wildfires
USFS		✓				✓
FWS						✓
NPS						✓
BLM						✓
BIA						✓

## Data Manipulation/Augmentation

Once all the data had been provided by the State and Federal agencies, MACTEC compiled the data into a master database containing common pieces of information necessary to identify the fire location and date as well as the data necessary to calculate emissions. That database was used to calculate fires on a fire-by-fire basis for all data submitted.

Prior to inserting data into the master database however, separate databases for each State and Federal submittal were developed. The first step in completing these databases was to ensure that sufficient location information was available so that the emissions could eventually be summed at the county level for the annual inventory.

For those data submittals that provided only latitude and longitude, we imported the data into a geographic information system (GIS) program and used the GIS program to add information on the State and county where the fire was located. In many cases this involved converting the data on latitude and longitude. Data on latitude and longitude were submitted in both hours:minutes:seconds format as well as decimal degrees. All data were converted to decimal degrees. For some of these records, the data either 1) fell outside of the State that the submittal was for or 2) fell in the ocean. Fires that fell outside of the State, in the ocean, or in the wrong State were dropped. This resulted in less than three percent of the acreage submitted for any State being deleted. Some State agencies submitted section, township and range data, however converting these data to latitude/longitude was too labor intensive for the current scope of work so we simply used the county information provided to locate these fires.

For data submitted with only State and county information, we placed the fires at the county centroid location. For that work we used a file on the EPA website that listed the location of the county centroid in decimal degrees. All records where the location information was the county centroid were marked in the database.

Once the location information was completed for all data, we then proceeded to augment the fuel loading information in the database. The general approach used for augmenting fuel loading was as follows:

- State-supplied data – if provided, these values were always used
- National Fire Danger Rating System (NFDRS) Model value assigned fuel loading
- Material burned type (a NFDRS value was assigned if the material burned could be easily matched to a NFDRS fuel model)
- State specific defaults calculated where no material burned type was provided
- AP-42 values for fires other than wildfires or prescribed burns

Values for fuel loading were then assigned to each individual fire (either State or Federal) based on this priority scheme. If the State supplied a value for fuel loading (even if the value was for the whole State) that value was used for all fires of that type (e.g., wildfires, prescribed fires, etc.). Similarly, if the Federal agency supplied fuel loading

data for the fire, it was always used. Where no State or Federal value was provided but a NFDRS fire model designation was provided, the default value for that fire model designation was used for the fuel loading. If the data included the type of material burned and it could be matched with a similar material described by the vegetation type of a NFDRS fire model category, then the fuel loading for that NFDRS category was used. If the material could not be matched or was not provided, then an average State fuel loading based on a State-wide average of different NFDRS fuel models was used. Finally, for some fire types (e.g., agricultural burning or land clearing of debris), AP-42 fuel loadings were utilized. For those fire types, AP-42 was the primary source of fuel loading information unless information was provided by the State. In a few cases, we also used values from the 1999 NEI based on the NEI documentation.

The default values for the NFDRS fuel models were provided by Bruce Bayle, USFS. NFDRS classifies fuel models using an alphabetic system that describes the general type of material that is consumed in the fire. Table 4 shows the list of NFDRS fuel models and the vegetative types associated with each model.

**TABLE 4.**

**NFDRS FUEL MODEL DESIGNATIONS AND VEGETATION TYPES**

<b>NFDRS Fuel Model</b>	<b>Vegetation</b>
A	Annual grass and forbs
B	Mature chaparral
C	Open timber/grass
D	Southern rough
E	Hardwoods (winter)
F	Intermediate brush
G	Closed, short-needle conifer (heavy dead)
H	Closed, short-needle conifer (normal dead)
I	Heavy slash
J	Medium slash
K	Light slash
L	Perennial grass
N	Sawgrass
O	Pocosin
P	Southern plantation
Q	Alaskan black spruce
R	Hardwoods (summer)
S	Alaskan tundra
T	Sagebrush/grass
U	Western, long-needle conifer

The information provided by Bruce Bayle was in the form of fuel loadings, by size class of fuel, for each NFDRS fuel model. Data on the fuel size class were provided for one hour, 10 hour, 100 hour, and 1000 hour fuels. The one hour fuel designation means that the fuel is of a size that will burn in the first hour of the fire. Similar meanings can be assigned to the other size class categories. In addition, information was provided on live

woody and live herbaceous materials. Totaling the fuel loading for each size class (along with the live woody and herbaceous material) provided an overall average fuel loading for each NFDRS fuel model type. These values were summed to provide the fuel loadings for each fuel model.

The summation of these values was performed using a weighting scheme provided by Bruce Bayle. For each respective southern fuel model, we used the following percentages to calculate a typical tonnage per acre:

Include 100% of the 1 and 10 hour fuels (1h + 10h).

Include 50% of the 100 hour fuels (100h).

Include 10% of the 1,000 hour fuels (1,000h).

Include 40% of the "live woody" fuels.

Include 10% of the "live herbaceous" fuels.

The above percentages represent an average/typical wildfire and average/typical weather conditions/environmental factors in the southeast.

The values calculated using this weighting scheme were then compared to the default State fuel loadings from Table 4 of the report entitled "Data Needs and Availability for Wildland Fire Emission Inventories - Short-term Improvements to the Wildland Fire Component of the National Emissions Inventory" June 5, 2003, prepared under EPA Contract No. 68-D-02-064, Work Assignment No. I-08 for Tom Pace (known as the Pace Report). A spreadsheet was prepared with the summarized fuel loading values provided by Bruce Bayle along with those from the Pace Report. That spreadsheet was then reviewed by Bruce Bayle, Mark Clere (Fire Planning Specialist, National Forests in Florida, Tallahassee, FL), and Charlie Kerr (Fire Management Officer, Francis Marion & Sumter National Forests, Columbia, SC) to ensure that the data used were optimal for southeastern forests. Suggestions for modifying the values in the spreadsheet were made by the reviewers and implemented as the standard values for use with the different NFDRS fuel models. Appendix B contains a table with the initial values for each NFDRS fuel model calculated using the weighting scheme, the default EPA values from the Pace report and the final values used based on the review of both the initial calculated values and the Pace report defaults.

When the type of material burned wasn't known, default values had to be calculated. Table 3 of the Pace report provides a State-wide method for calculating fuel loadings based on the fraction of total state acreage in each NFDRS model. These fractions were used with the Bayle revised fuel loading values discussed above to calculate a State default value when the type of material burned could not be determined. For example in KY, 0.001 of State land is classified as NFDRS model C, 0.199 as L, 0.048 as P and 0.752 as R. This yields a State default for wildfires (where the fuel type was not specified) of 1.69. These values were used whenever there was insufficient information to assign an actual value based either on the NFDRS model or the type of vegetation (material) burned.

Once the fuel loading had been assigned to each fire, the remaining information necessary to calculate emissions was emission factors. Each fire was assigned a “fire model” designation for the purposes of assigning an emission factor to the fire. In the cases where the fires had designated NFDRS fire models already, the “fire model” designation was identical to the NFDRS letter designation. There were other designations that were assigned to other fire types (agricultural burning fires, etc.). In some cases the material burned type was used to assign the “fire model” emission factor assignment. Emission factors were assigned for all fire types.

The basis for the emission factors for many of these fires was Table 2 of the Pace report. The emission factors used differ from Table 2 of the Pace report slightly for a few of the “fire models”. This is because per note 3 for Table 2 in the Pace report, emission factors for fuel models other than NFDRS types A, B, C, F, and L should be augmented by 17% and 8.5% for wildfires and prescribed fires respectively. We did augment the values by those percentages.

The emission factors for each fuel model are provided in Appendix C.

Once all of the data required to calculate emissions were acquired or assigned, we then put all of the State data into the master database. The master database contains the following data fields:

StateFIPS	State FIPS code
CountyFIPS	County FIPS code
SCC	Source Classification Code
Date	Date of Fire
Acres	Number of Acres burned
Latitude	Latitude in decimal degrees
Longitude	Longitude in decimal degrees
LatLongIsCountyCent	True/False field indicating whether the latitude and longitude value is the county centroid – value is “True” if it is
FireType	Type of fire - prescribed and silviculture burning were both assigned the prescribed burning SCC, waste burning and land clearing of debris burning were both assigned the waste burning SCC
Material	Type of material burned if known
Fuel Loading	Fuel loading value in tons/acre
Default Fuel Loading	True/false field indicating if the fuel loading value is a default value – “True” if it is
Default Material	True/false field indicating if the material field value is a default value – “True” if it is
Fuel Loading Source	Source for the fuel loading value
Emission Factor Code	Code used to look up emission factor values in the emission factor table - NFDRS fuel model if available
Pollutant	Pollutant for emissions

Emissions	Emissions value in tons
Emission Factor	Emission factor in lbs/ton of material burned
Agency	Agency that submitted data
DataSource	Who supplied the data (State or Federal or other)
StateFederal	One character indicator field that indicates if the record is a State (S) or federal (F) data record.

The master database file contains the raw fire-by-fire information used to estimate most (but not all) emissions in versions 1 and 2 of the VISTAS area source inventory. Summing emissions for the individual fires in the master database will not provide the same annual values found in the inventory in all cases. This is because of the replacement scheme used to determine fire emissions for the annual inventory. Because Federal agencies did not all submit prescribed fire acreage, some values for prescribed fire emissions from the 1999 NEI Version 2 were maintained if that county had federal land in it. This was done to avoid double counting of emissions. Following publication of Version 1 of the VISTAS inventory, AL, FL, GA, MS and SC fire contacts indicated that the prescribed fire data submitted included Federal and State lands. For those States, the prescribed fire emission values in the master fire database match the NIF version. For those States that did not include Federal lands in their submittals, MACTEC obtained a GIS file that contained federal land information in it. We used that data to determine which counties contained federal lands. If the county contained federal lands, then the 1999 NEI version 2 prescribed fire emissions were maintained for that county in order to avoid double counting.

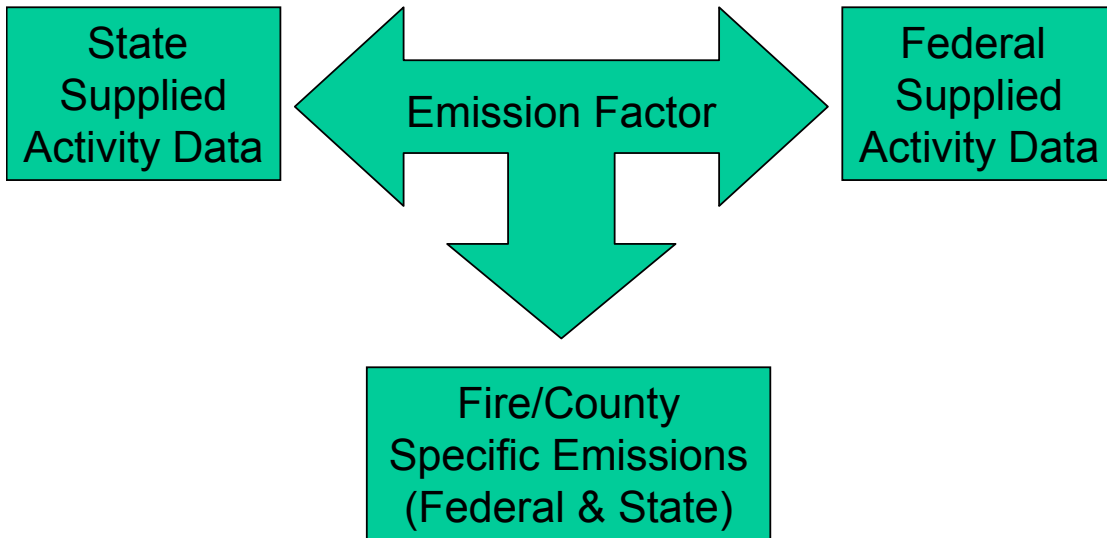
Similarly, one State (MS) did not submit wildfire information. For that State, the data in the master fire database file will not match the annual emission inventory values. For MS, the 1999 NEI version 2 values were maintained, again to avoid double counting or underestimating.

Figures 3 through 6 provide an overview of the replacement process used to allocate fire emissions from either the master fire database or maintained from the 1999 NEI version 2.



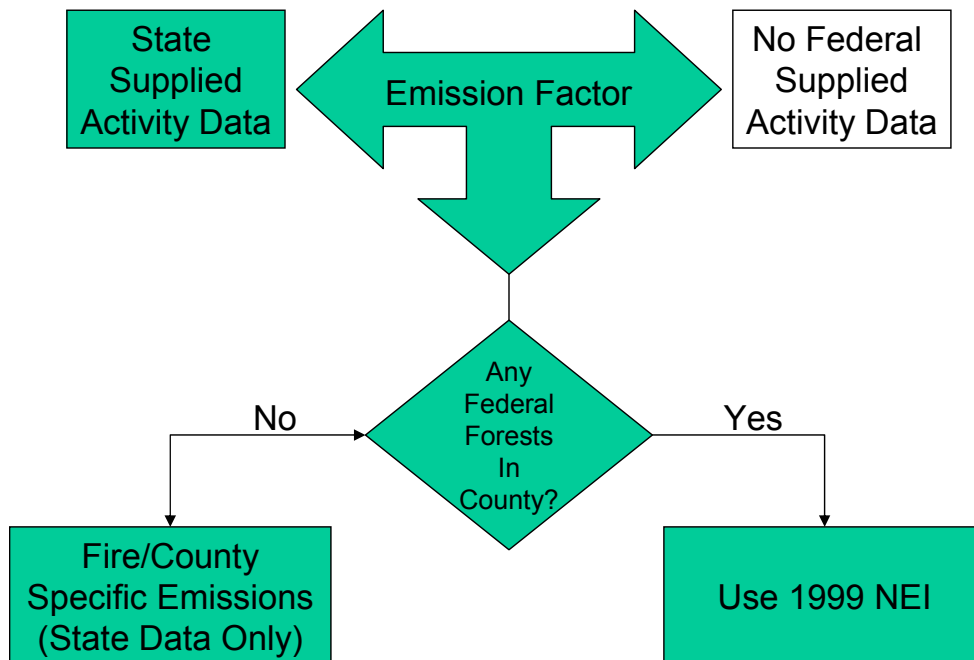
**FIGURE 3.**

**GENERAL APPROACH TO ESTIMATING EMISSIONS FOR FIRES (APPLIES TO WILDFIRES AND PRESCRIBED FIRES).**



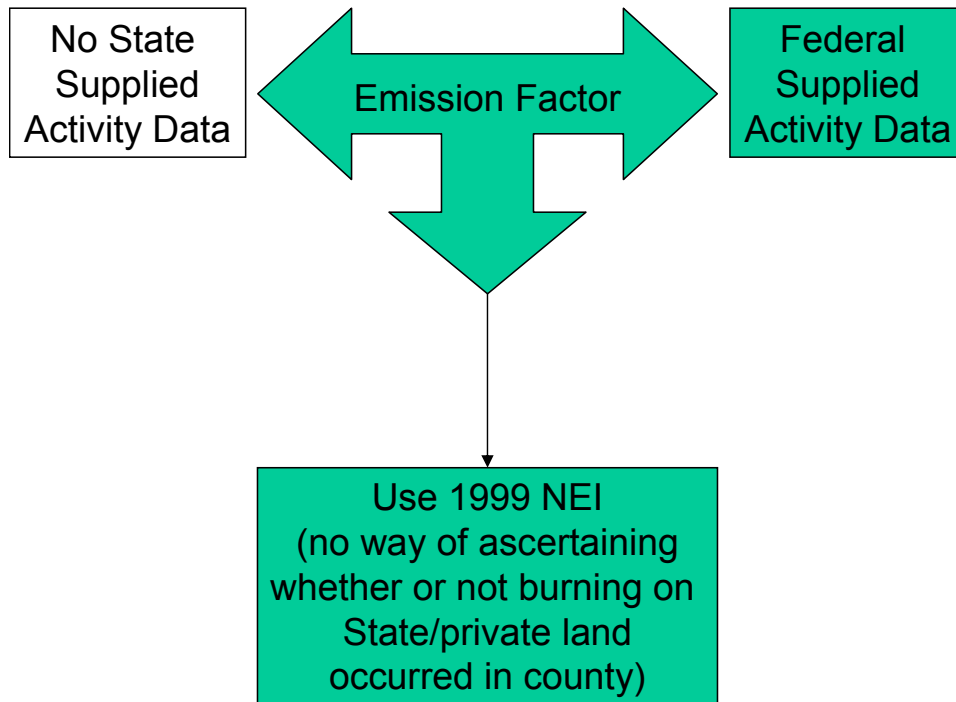
**FIGURE 4.**

**APPROACH USED FOR CALCULATING FIRES IF FEDERAL DATA WERE MISSING.**



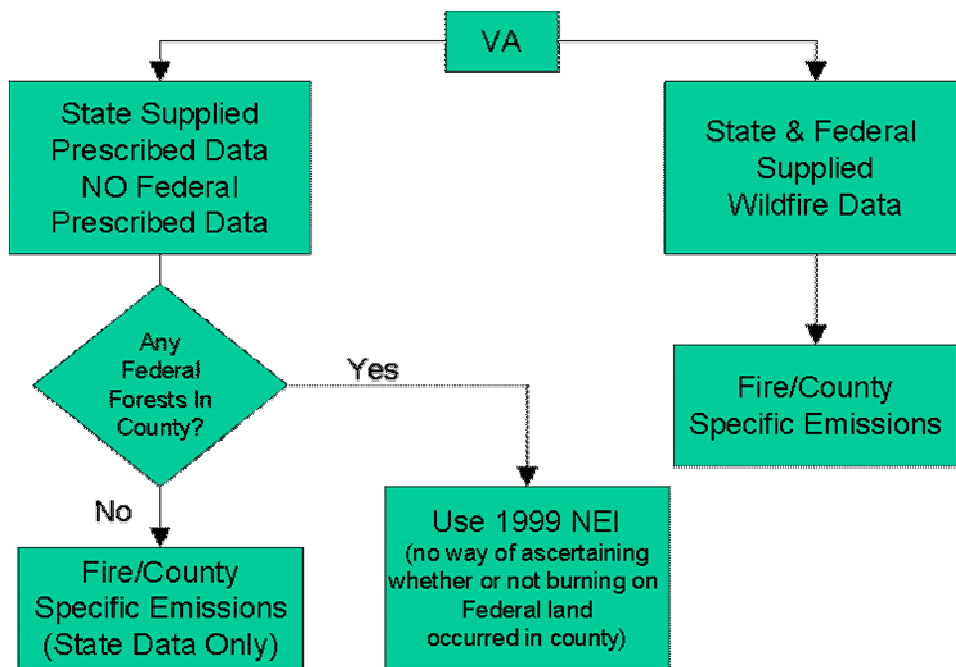
**FIGURE 5.**

**APPROACH USED FOR CALCULATING FIRES IF STATE DATA WERE MISSING.**



**FIGURE 6.**

**EXAMPLE OF THE APPROACH USED FOR VA COUNTIES BASED ON ACTUAL REPORTED DATA.**



## RESULTS

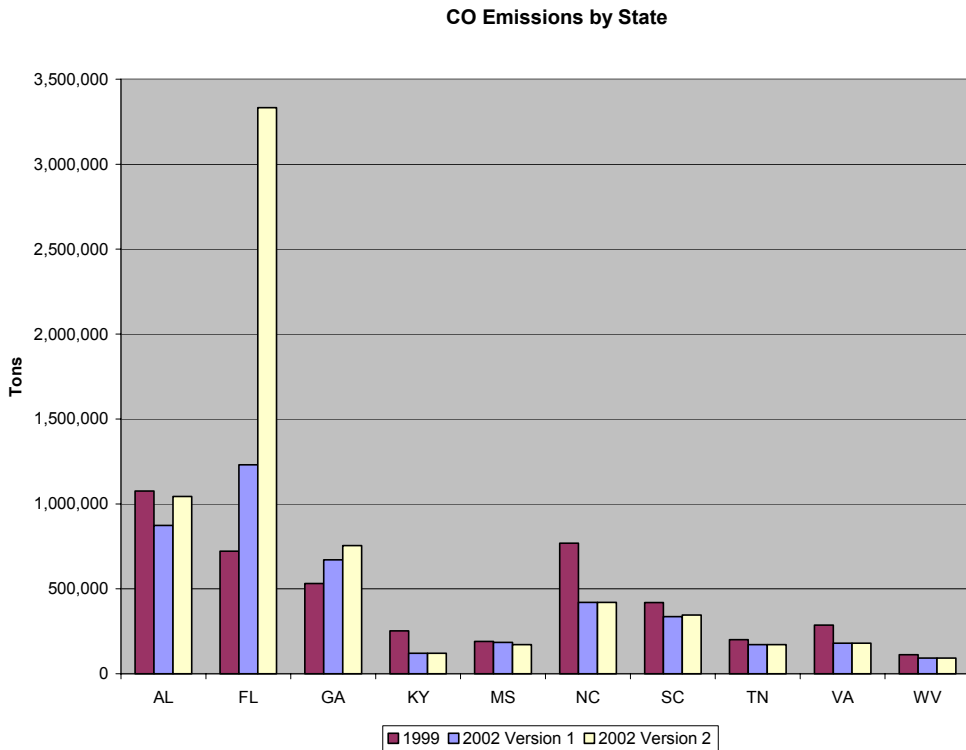
Tables 5 through 11 and figures 7 through 13 provide an overview of the emissions for both versions of the draft 2002 VISTAS emission inventory (Version 1 and Version 2) and the 1999 NEI Version 2 that was used as the starting point for the VISTAS inventory, by State and pollutant.

Table 5 shows that the CO emissions for the VISTAS region decreased by approximately 600,000 tons for 2002 compared with 1999 levels for Version 1 of the VISTAS inventory. However, Version 2 shows an increase of over 2 million tons compared to Version 1. This is due to the inclusion of the prescribed burning emissions calculated from the data submitted by AL, FL, GA, MS, and SC rather than using the State supplied/NEI V2 blended approach used for Version 1 of the VISTAS inventory. The majority of the increase is for fires in FL. Similarly, Table 6 shows a decrease of approximately 58,000 tons of NO<sub>x</sub> from 1999 to 2002 Version 1 but only a 21,000 ton decrease relative to 2002 Version 2. Table 7 indicates that SO<sub>2</sub> emissions have increased over the 1999-2002 period by 20,000 tons for Version 1 and 37,000 tons for Version 2. VOC emissions (Table 8) are showing a slight increase (3,000 tons) from 1999 to 2002 Version 1, but a substantially larger increase (65,000 tons) for Version 2. PM emissions increase by 200,000 and 41,000 tons for PM-10 and PM-2.5 respectively (Tables 9 and 10) for Version 1 but increases for Version 2 are 425,000 and 230,000 tons (respectively) for Version 2. Finally, NH<sub>3</sub> emissions decreased slightly (9,000 tons) from 1999 to 2002 Version 1 but show a slight increase for Version 2 (produced by the use of the updated CMU Version 3.1 model).

**TABLE 5.**  
**AREA SOURCE CO EMISSIONS (ALL VALUES IN TONS)**

	1999 NEI V2	VISTAS 2002 Draft Version 1	VISTAS 2002 Draft Version 2
AL	1,075,786	873,217	1,043,657
FL	721,708	953,784	3,332,231
GA	531,628	671,607	755,489
KY	252,902	120,848	120,847
MS	191,706	156,747	171,436
NC	769,251	420,198	420,198
SC	419,406	336,945	346,668
TN	200,639	171,912	171,912
VA	287,071	180,077	180,076
WV	112,027	93,496	93,496
<b>Total</b>	<b>4,562,124</b>	<b>3,978,831</b>	<b>6,636,010</b>

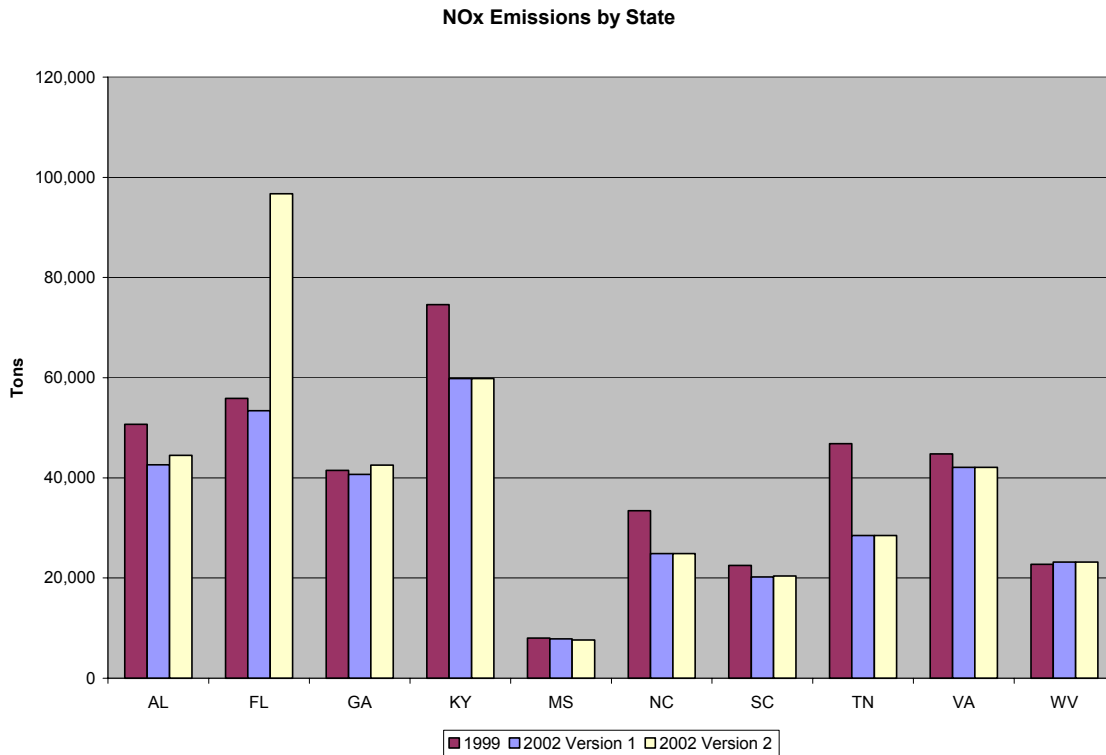
**FIGURE 7.**  
**CO EMISSIONS BY STATE FOR 2002 AND 1999 NEI VERSION 2.**



**TABLE 6.**  
**AREA SOURCE NOX EMISSIONS (ALL VALUES IN TONS)**

	1999 NEI V2	VISTAS 2002 Draft Version 1	VISTAS 2002 Draft Version 2
AL	50,694	42,603	44,484
FL	55,882	53,411	96,723
GA	41,505	40,664	42,529
KY	74,603	59,843	59,843
MS	8,034	7,853	7,636
NC	33,443	24,880	24,879
SC	22,534	20,197	20,423
TN	46,843	28,479	28,479
VA	44,778	42,106	42,106
WV	22,726	23,167	23,167
<b>Total</b>	<b>401,041</b>	<b>343,203</b>	<b>390,269</b>

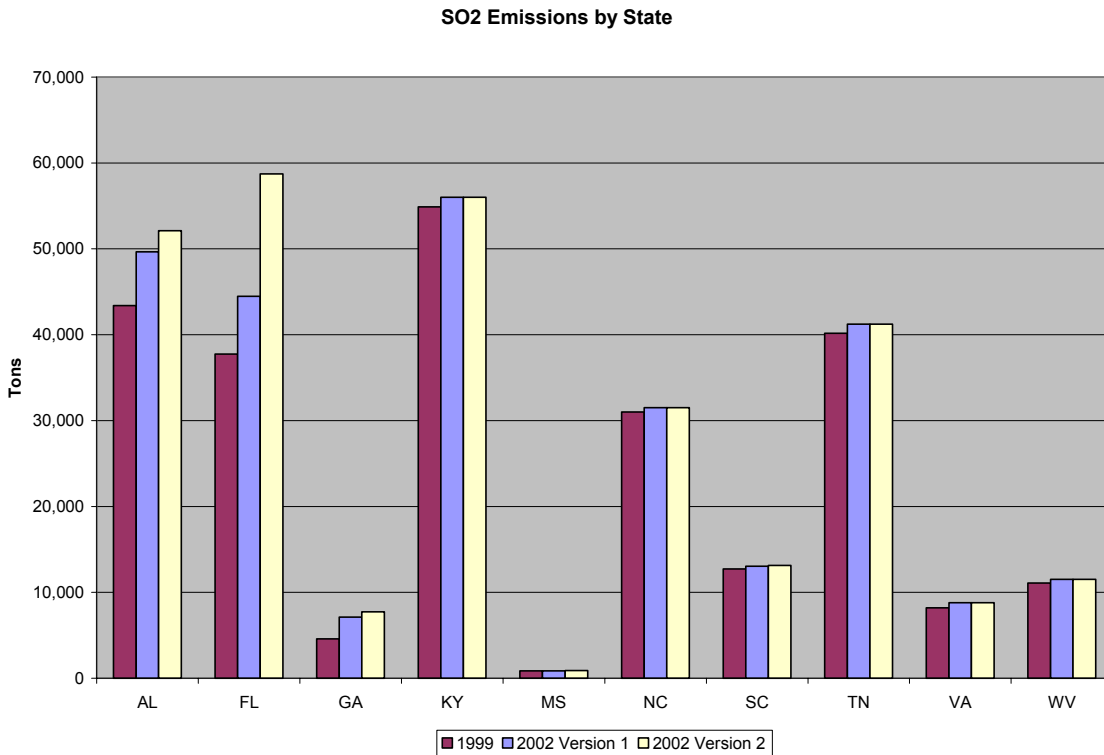
**FIGURE 8.**  
**NOX EMISSIONS BY STATE FOR 2002 AND 1999 NEI VERSION 2.**



**TABLE 7.**  
**AREA SOURCE SO<sub>2</sub> EMISSIONS (ALL VALUES IN TONS)**

	1999 NEI V2	VISTAS 2002 Draft Version 1	VISTAS 2002 Draft Version 2
AL	43,394	49,653	52,110
FL	37,736	44,469	58,728
GA	4,583	7,120	7,737
KY	54,909	56,003	56,003
MS	840	848	901
NC	31,009	31,500	31,500
SC	12,705	13,037	13,128
TN	40,186	41,230	41,230
VA	8,206	8,783	8,782
WV	11,087	11,517	11,517
<b>Total</b>	<b>244,654</b>	<b>264,161</b>	<b>281,636</b>

**FIGURE 9.**  
**SO<sub>2</sub> EMISSIONS BY STATE FOR 2002 AND 1999 NEI VERSION 2.**

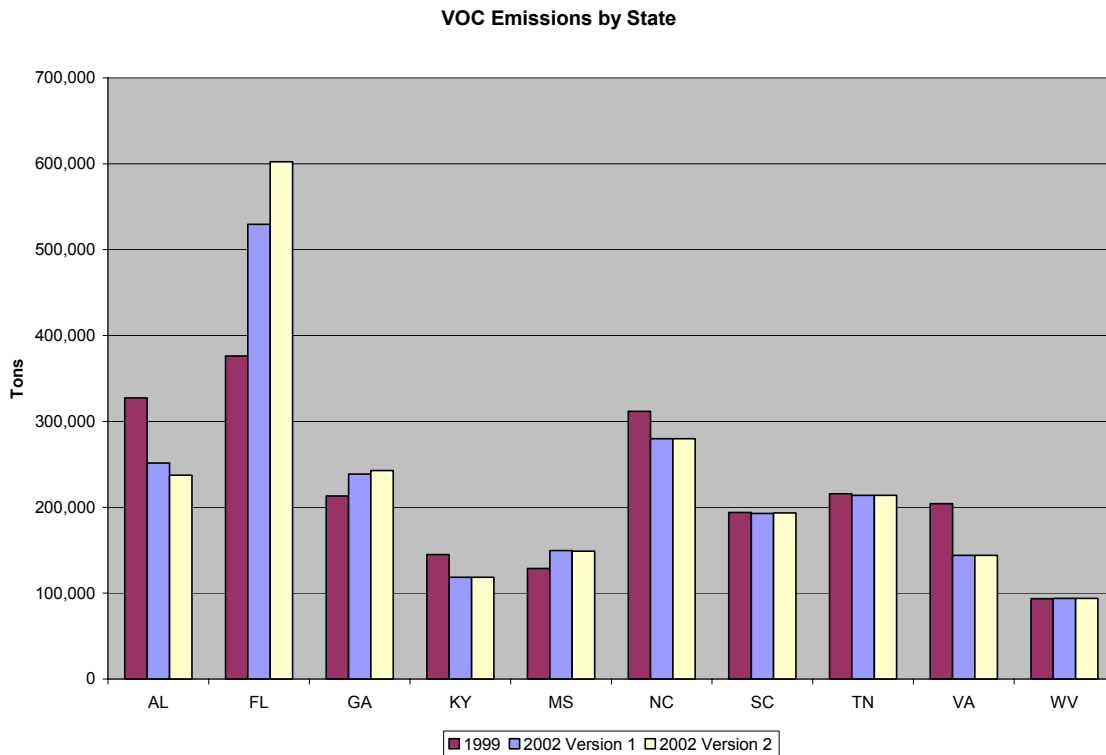


**TABLE 8.**  
**AREA SOURCE VOC EMISSIONS (ALL VALUES IN TONS)**

	1999 NEI V2	VISTAS 2002 Draft Version 1	VISTAS 2002 Draft Version 2
AL	327,400	251,368	237,264
FL	376,173	529,506	602,458
GA	213,204	238,690	242,622
KY	144,764	118,453	118,453
MS	128,694	149,610	148,969
NC	311,716	279,897	279,896
SC	193,951	192,833	193,285
TN	215,671	213,886	213,885
VA	204,245	143,908	143,908
WV	93,644	93,937	93,938
<b>Total</b>	<b>2,209,462</b>	<b>2,212,088</b>	<b>2,274,618</b>

**FIGURE 10.**

**VOC EMISSIONS BY STATE FOR 2002 AND 1999 NEI VERSION 2.**

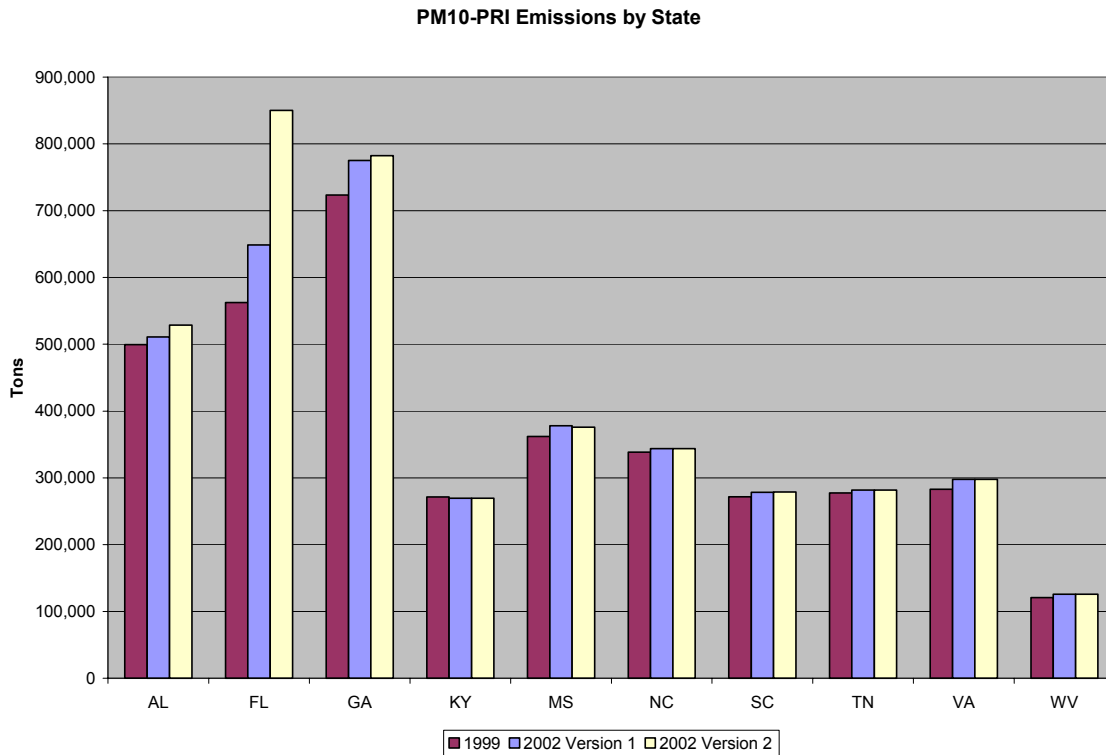


**TABLE 9.**  
**AREA SOURCE PM10-PRI EMISSIONS (ALL VALUES IN TONS)**

	1999 NEI V2	VISTAS 2002 Draft Version 1	VISTAS 2002 Draft Version 2
AL	499,591	511,026	528,690
FL	562,376	648,848	850,288
GA	723,576	775,212	782,352
KY	271,436	269,497	269,497
MS	361,991	378,091	375,747
NC	338,368	343,761	343,761
SC	271,671	278,217	278,881
TN	277,322	281,620	281,620
VA	282,905	297,891	297,891
WV	120,622	125,656	125,656
<b>Total</b>	<b>3,709,857</b>	<b>3,909,820</b>	<b>4,134,383</b>

**FIGURE 11.**

**PM10-PRI EMISSIONS BY STATE FOR 2002 AND 1999 NEI VERSION 2.**





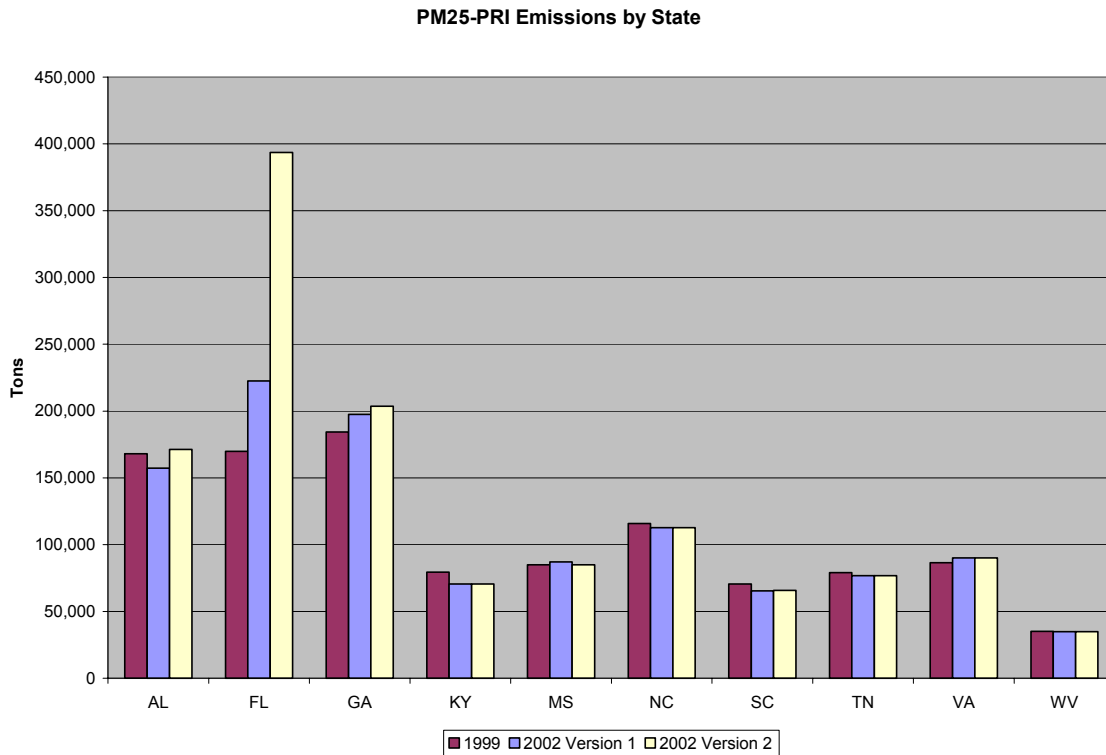
**TABLE 10.**

**AREA SOURCE PM2.5-PRI EMISSIONS (ALL VALUES IN TONS)**

	1999 NEI V2	VISTAS 2002 Draft Version 1	VISTAS 2002 Draft Version 2
AL	168,103	157,235	171,171
FL	169,910	222,539	393,600
GA	184,224	197,549	203,532
KY	79,396	70,432	70,431
MS	84,982	87,057	84,901
NC	115,722	112,691	112,690
SC	70,553	65,296	65,827
TN	79,053	76,762	76,762
VA	86,499	90,157	90,156
WV	35,023	34,764	34,764
<b>Total</b>	<b>1,073,466</b>	<b>1,114,482</b>	<b>1,303,835</b>

**FIGURE 12.**

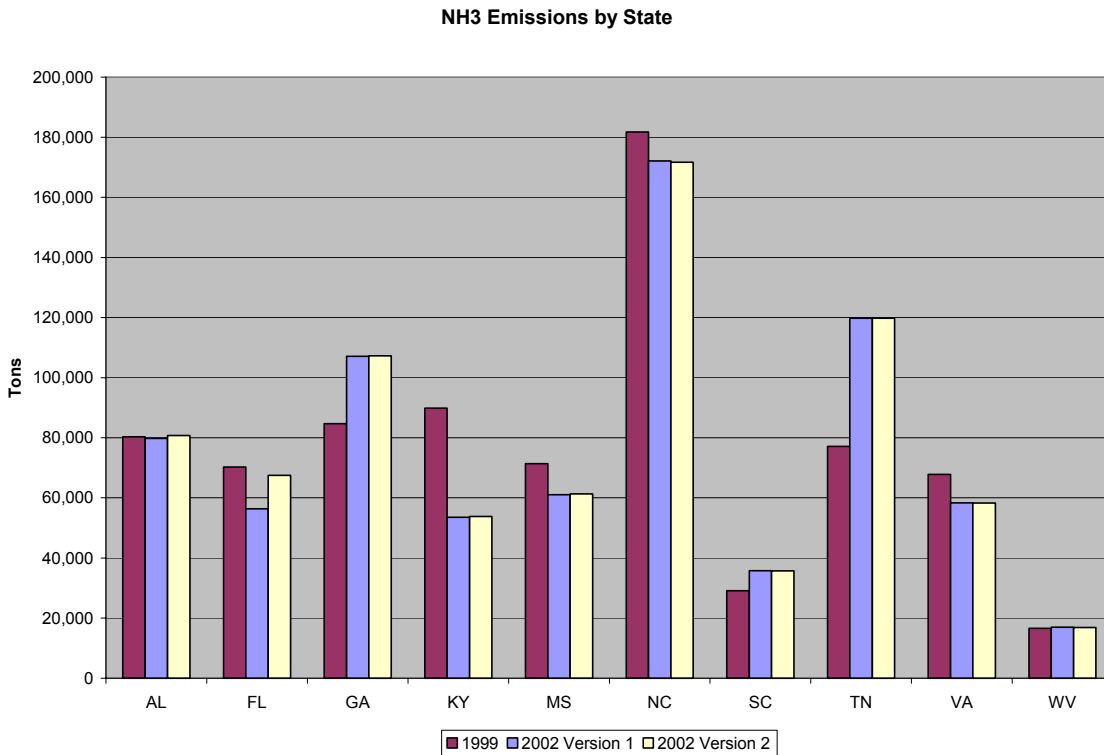
**PM2.5-PRI EMISSIONS BY STATE FOR 2002 AND 1999 NEI VERSION 2.**



**TABLE 11.**  
**AREA SOURCE NH3 EMISSIONS (ALL VALUES IN TONS)**

	1999 NEI V2	VISTAS 2002 Draft Version 1	VISTAS 2002 Draft Version 2
AL	80,343	79,807	80,736
FL	70,313	56,412	67,493
GA	84,683	107,089	107,271
KY	89,851	53,553	53,810
MS	71,346	61,023	61,279
NC	181,801	172,085	171,734
SC	29,124	35,782	35,700
TN	77,141	119,790	119,790
VA	67,814	58,343	58,241
WV	16,602	16,979	16,864
<b>Total</b>	<b>769,020</b>	<b>760,864</b>	<b>772,917</b>

**FIGURE 13.**  
**NH3 EMISSIONS BY STATE FOR 2002 AND 1999 NEI VERSION 2.**





## **Appendix A**

### **NH<sub>3</sub> Growth Factors for Livestock Operations**

**TABLE A-1. LIVESTOCK NH3 GROWTH FACTORS AND ANIMAL POPULATIONS**

State	FIPST	SCC	Category	2002 Population (1000s)	1997 Population (1000s)	Growth Factor
AL	01	2805020003	All Cattle/calves	1370	1,531	0.89484
AL	01	2805020003	Cows and Heifers that have Calved			0.89484
AL	01	2805020002	Beef Cows	750	832	0.90144
AL	01	2805020001	Milk Cows			0.89484
AL	01	2805020003	Heifers 500 lbs or over			0.89484
AL	01	2805020002	For beef cow replacement			0.89484
AL	01	2805020001	For milk cow replacement			0.89484
AL	01	2805020003	Other heifers			0.89484
AL	01	2805020004	Steers 500 lbs+			0.89484
AL	01	2805020004	Bulls 500 lbs +			0.89484
AL	01	2805020004	Calves < 500 lbs			0.89484
AL	01	2805020003	Cattle and calves on feed			0.89484
AL	01	2805025000	All Hogs and Pigs			1.00000
AL	01	2805025000	Breeding stock hogs and pigs			1.00000
AL	01	2805025000	Market Hogs/Pigs			1.00000
AL	01	2805030003	All Chickens	15256	18605	0.81999
AL	01	2805030003	Hens and Pullets - laying age	9645	13433	0.71801
AL	01	2805030002	Pullets 13-19 weeks		2729	0.71801
AL	01	2805030001	Pullets < 13 weeks		2443	0.71801
AL	01	2805030004	Other Chickens	1051303	871123	1.20684
AL	01	2805040000	Sheep			1.00000
AL	01	2805040000	Breeding Ewes			1.00000
AL	01	2805040000	Lamb Crop			1.00000
FL	12	2805020003	All Cattle/calves	1780	1,970	0.90355
FL	12	2805020003	Cows and Heifers that have Calved			0.90355
FL	12	2805020002	Beef Cows	958	1,072	0.89366
FL	12	2805020001	Milk Cows	152	158	0.96203
FL	12	2805020003	Heifers 500 lbs or over			0.90355
FL	12	2805020002	For beef cow replacement			0.90355
FL	12	2805020001	For milk cow replacement			0.90355
FL	12	2805020003	Other heifers			0.90355
FL	12	2805020004	Steers 500 lbs+			0.90355
FL	12	2805020004	Bulls 500 lbs +			0.90355
FL	12	2805020004	Calves < 500 lbs			0.90355
FL	12	2805020003	Cattle and calves on feed			0.90355
FL	12	2805025000	All Hogs and Pigs	35	65	0.53846
FL	12	2805025000	Breeding stock hogs and pigs			0.53846
FL	12	2805025000	Market Hogs/Pigs			0.53846
FL	12	2805030003	All Chickens	125331	142265	0.88097
FL	12	2805030003	Hens and Pullets - laying age	10631	9865	1.07765
FL	12	2805030002	Pullets 13-19 weeks			1.07765
FL	12	2805030001	Pullets < 13 weeks			1.07765
FL	12	2805030004	Other Chickens	114700	132400	0.86631
FL	12	2805040000	Sheep			1.00000
FL	12	2805040000	Breeding Ewes			1.00000
FL	12	2805040000	Lamb Crop			1.00000

State	FIPST	SCC	Category	2002 Population (1000s)	1997 Population (1000s)	Growth Factor
GA	13	2805020003	All Cattle/calves	1240	1,390	0.89209
GA	13	2805020003	Cows and Heifers that have Calved			0.89209
GA	13	2805020002	Beef Cows			0.89209
GA	13	2805020001	Milk Cows			0.89209
GA	13	2805020003	Heifers 500 lbs or over			0.89209
GA	13	2805020002	For beef cow replacement			0.89209
GA	13	2805020001	For milk cow replacement			0.89209
GA	13	2805020003	Other heifers			0.89209
GA	13	2805020004	Steers 500 lbs+			0.89209
GA	13	2805020004	Bulls 500 lbs +			0.89209
GA	13	2805020004	Calves < 500 lbs			0.89209
GA	13	2805020003	Cattle and calves on feed			0.89209
GA	13	2805025000	All Hogs and Pigs	345	514	0.67121
GA	13	2805025000	Breeding stock hogs and pigs			0.67121
GA	13	2805025000	Market Hogs/Pigs			0.67121
GA	13	2805030003	All Chickens	29553	30318	0.97477
GA	13	2805030003	Hens and Pullets - laying age	20900	19869	1.05189
GA	13	2805030002	Pullets 13-19 weeks			1.05189
GA	13	2805030001	Pullets < 13 weeks			1.05189
GA	13	2805030004	Other Chickens	1290500	1017521	1.26828
GA	13	2805040000	Sheep			1.00000
GA	13	2805040000	Breeding Ewes			1.00000
GA	13	2805040000	Lamb Crop			1.00000
KY	21	2805020003	All Cattle/calves	2430	2,600	0.93462
KY	21	2805020003	Cows and Heifers that have Calved	1240	1,330	0.93233
KY	21	2805020002	Beef Cows	1120	1,180	0.94915
KY	21	2805020001	Milk Cows	120	150	0.80000
KY	21	2805020003	Heifers 500 lbs or over	350	367	0.95368
KY	21	2805020002	For beef cow replacement	175	195	0.89744
KY	21	2805020001	For milk cow replacement	45	57	0.78947
KY	21	2805020003	Other heifers	130	115	1.13043
KY	21	2805020004	Steers 500 lbs+	220	205	1.07317
KY	21	2805020004	Bulls 500 lbs +	75	78	0.96154
KY	21	2805020004	Calves < 500 lbs	540	620	0.87097
KY	21	2805020003	Cattle and calves on feed	10	20	0.50000
KY	21	2805025000	All Hogs and Pigs	370	570	0.64912
KY	21	2805025000	Breeding stock hogs and pigs	40	70	0.57143
KY	21	2805025000	Market Hogs/Pigs	330	500	0.66000
KY	21	2805030003	All Chickens	6195	4939	1.25430
KY	21	2805030003	Hens and Pullets - laying age	4350	3501	1.24250
KY	21	2805030002	Pullets 13-19 weeks	845	678	1.24631
KY	21	2805030001	Pullets < 13 weeks	805	760	1.05921
KY	21	2805030004	Other Chickens	195	16378	0.01191
KY	21	2805040000	Sheep	22	22	1.00000
KY	21	2805040000	Breeding Ewes	14	15	0.93333
KY	21	2805040000	Lamb Crop	16	18	0.88889
MS	28	2805020003	All Cattle/calves	1100	1,260	0.87302
MS	28	2805020003	Cows and Heifers that have Calved			0.87302

State	FIPST	SCC	Category	2002 Population (1000s)	1997 Population (1000s)	Growth Factor
MS	28	2805020002	Beef Cows	576	632	0.91139
MS	28	2805020001	Milk Cows	34	48	0.70833
MS	28	2805020003	Heifers 500 lbs or over			0.87302
MS	28	2805020002	For beef cow replacement			0.87302
MS	28	2805020001	For milk cow replacement			0.87302
MS	28	2805020003	Other heifers			0.87302
MS	28	2805020004	Steers 500 lbs+			0.87302
MS	28	2805020004	Bulls 500 lbs +			0.87302
MS	28	2805020004	Calves < 500 lbs			0.87302
MS	28	2805020003	Cattle and calves on feed			0.87302
MS	28	2805025000	All Hogs and Pigs	275	220	1.25000
MS	28	2805025000	Breeding stock hogs and pigs			1.25000
MS	28	2805025000	Market Hogs/Pigs			1.25000
MS	28	2805030003	All Chickens	10814	11073	0.97661
MS	28	2805030003	Hens and Pullets - laying age			0.97661
MS	28	2805030002	Pullets 13-19 weeks			0.97661
MS	28	2805030001	Pullets < 13 weeks			0.97661
MS	28	2805030004	Other Chickens			0.97661
MS	28	2805040000	Sheep			1.00000
MS	28	2805040000	Breeding Ewes			1.00000
MS	28	2805040000	Lamb Crop			1.00000
NC	37	2805020003	All Cattle/calves	920	941	0.97768
NC	37	2805020003	Cows and Heifers that have Calved			0.97768
NC	37	2805020002	Beef Cows	417	435	0.95862
NC	37	2805020001	Milk Cows	63	78	0.80769
NC	37	2805020003	Heifers 500 lbs or over			0.97768
NC	37	2805020002	For beef cow replacement			0.97768
NC	37	2805020001	For milk cow replacement			0.97768
NC	37	2805020003	Other heifers			0.97768
NC	37	2805020004	Steers 500 lbs+			0.97768
NC	37	2805020004	Bulls 500 lbs +			0.97768
NC	37	2805020004	Calves < 500 lbs			0.97768
NC	37	2805020003	Cattle and calves on feed			0.97768
NC	37	2805025000	All Hogs and Pigs	9800	9624	1.01829
NC	37	2805025000	Breeding stock hogs and pigs			1.01829
NC	37	2805025000	Market Hogs/Pigs			1.01829
NC	37	2805030003	All Chickens	17042	16162	1.05445
NC	37	2805030003	Hens and Pullets - laying age			1.05445
NC	37	2805030002	Pullets 13-19 weeks			1.05445
NC	37	2805030001	Pullets < 13 weeks			1.05445
NC	37	2805030004	Other Chickens	735200	591248	1.24347
NC	37	2805040000	Sheep			1.00000
NC	37	2805040000	Breeding Ewes			1.00000
NC	37	2805040000	Lamb Crop			1.00000
SC	45	2805020003	All Cattle/calves	435	454	0.95815
SC	45	2805020003	Cows and Heifers that have Calved			0.95815
SC	45	2805020002	Beef Cows	210	229	0.91703
SC	45	2805020001	Milk Cows	20	25	0.80000

State	FIPST	SCC	Category	2002 Population (1000s)	1997 Population (1000s)	Growth Factor
SC	45	2805020003	Heifers 500 lbs or over			0.95815
SC	45	2805020002	For beef cow replacement			0.95815
SC	45	2805020001	For milk cow replacement			0.95815
SC	45	2805020003	Other heifers			0.95815
SC	45	2805020004	Steers 500 lbs+			0.95815
SC	45	2805020004	Bulls 500 lbs +			0.95815
SC	45	2805020004	Calves < 500 lbs			0.95815
SC	45	2805020003	Cattle and calves on feed			0.95815
SC	45	2805025000	All Hogs and Pigs	300	305	0.98361
SC	45	2805025000	Breeding stock hogs and pigs			0.98361
SC	45	2805025000	Market Hogs/Pigs			0.98361
SC	45	2805030003	All Chickens	5372	5711	0.94064
SC	45	2805030003	Hens and Pullets - laying age			0.94064
SC	45	2805030002	Pullets 13-19 weeks			0.94064
SC	45	2805030001	Pullets < 13 weeks			0.94064
SC	45	2805030004	Other Chickens	192900	158679	1.21566
SC	45	2805040000	Sheep			1.00000
SC	45	2805040000	Breeding Ewes			1.00000
SC	45	2805040000	Lamb Crop			1.00000
TN	47	2805020003	All Cattle/calves	2270	2,145	1.05828
TN	47	2805020003	Cows and Heifers that have Calved	1190	1,151	1.03388
TN	47	2805020002	Beef Cows	1106	1,039	1.06449
TN	47	2805020001	Milk Cows	84	112	0.75000
TN	47	2805020003	Heifers 500 lbs or over			1.05828
TN	47	2805020002	For beef cow replacement			1.05828
TN	47	2805020001	For milk cow replacement			1.05828
TN	47	2805020003	Other heifers			1.05828
TN	47	2805020004	Steers 500 lbs+			1.05828
TN	47	2805020004	Bulls 500 lbs +			1.05828
TN	47	2805020004	Calves < 500 lbs			1.05828
TN	47	2805020003	Cattle and calves on feed			1.05828
TN	47	2805025000	All Hogs and Pigs			1.00000
TN	47	2805025000	Breeding stock hogs and pigs			1.00000
TN	47	2805025000	Market Hogs/Pigs			1.00000
TN	47	2805030003	All Chickens	2200	2478	0.88781
TN	47	2805030003	Hens and Pullets - laying age	1256	1654	0.75937
TN	47	2805030002	Pullets 13-19 weeks	317	567	0.55908
TN	47	2805030001	Pullets < 13 weeks	453	257	1.76265
TN	47	2805030004	Other Chickens	186400	120830	1.54266
TN	47	2805040000	Sheep			1.00000
TN	47	2805040000	Breeding Ewes			1.00000
TN	47	2805040000	Lamb Crop			1.00000
VA	51	2805020003	All Cattle/calves	1,650	1,780	0.92697
VA	51	2805020003	Cows and Heifers that have Calved	810	850	0.95294
VA	51	2805020002	Beef Cows	690	725	0.95172
VA	51	2805020001	Milk Cows	120	125	0.96000
VA	51	2805020003	Heifers 500 lbs or over	250	270	0.92593
VA	51	2805020002	For beef cow replacement	120	130	0.92308



State	FIPST	SCC	Category	2002 Population (1000s)	1997 Population (1000s)	Growth Factor
VA	51	2805020001	For milk cow replacement	60	65	0.92308
VA	51	2805020003	Other heifers	70	75	0.93333
VA	51	2805020004	Steers 500 lbs+	175	195	0.89744
VA	51	2805020004	Bulls 500 lbs +	40	45	0.88889
VA	51	2805020004	Calves < 500 lbs	375	420	0.89286
VA	51	2805020003	Cattle and calves on feed	27	30	0.90000
VA	51	2805025000	All Hogs and Pigs	410	400	1.02500
VA	51	2805025000	Breeding stock hogs and pigs			1.02500
VA	51	2805025000	Market Hogs/Pigs			1.02500
VA	51	2805030003	All Chickens	4554	4660	0.97725
VA	51	2805030003	Hens and Pullets - laying age			0.97725
VA	51	2805030002	Pullets 13-19 weeks			0.97725
VA	51	2805030001	Pullets < 13 weeks			0.97725
VA	51	2805030004	Other Chickens	271500	259400	1.04665
VA	51	2805040000	Sheep			1.00000
VA	51	2805040000	Breeding Ewes			1.00000
VA	51	2805040000	Lamb Crop			1.00000
WV	54	2805020003	All Cattle/calves			1.00000
WV	54	2805020003	Cows and Heifers that have Calved			1.00000
WV	54	2805020002	Beef Cows			1.00000
WV	54	2805020001	Milk Cows			1.00000
WV	54	2805020003	Heifers 500 lbs or over			1.00000
WV	54	2805020002	For beef cow replacement			1.00000
WV	54	2805020001	For milk cow replacement			1.00000
WV	54	2805020003	Other heifers			1.00000
WV	54	2805020004	Steers 500 lbs+			1.00000
WV	54	2805020004	Bulls 500 lbs +			1.00000
WV	54	2805020004	Calves < 500 lbs			1.00000
WV	54	2805020003	Cattle and calves on feed			1.00000
WV	54	2805025000	All Hogs and Pigs			1.00000
WV	54	2805025000	Breeding stock hogs and pigs			1.00000
WV	54	2805025000	Market Hogs/Pigs			1.00000
WV	54	2805030003	All Chickens			1.00000
WV	54	2805030003	Hens and Pullets - laying age			1.00000
WV	54	2805030002	Pullets 13-19 weeks			1.00000
WV	54	2805030001	Pullets < 13 weeks			1.00000
WV	54	2805030004	Other Chickens			1.00000
WV	54	2805040000	Sheep			1.00000
WV	54	2805040000	Breeding Ewes			1.00000
WV	54	2805040000	Lamb Crop			1.00000

\* WV had no data available on 2002 populations so all growth factors = 1.0000

**Appendix B –  
Fire Fuel Loading Values**

**TABLE B-1. FUEL LOADING VALUES USED TO PRODUCE FIRE EMISSION VALUES FOR NFDRS CLASSIFIED FIRES**

NFDRS Fuel Model	Vegetation	1h	10h	100h	1000h	live woody	live herb.	Average fuel loading	EPA	EPA	Bayle revised*
									wildfire fuel loading	prescribed fuel loading	
A	Annual grass and forbs	0.2					0.3	0.23	0.5	0.5	0.5
B	Mature chaparral	3.5	4	0.5		11.5		12.35	19.5	19.5	12.35
C	Open timber/grass	0.4	1			0.5	0.8	1.68	4.7	4.7	2
D	Southern rough	2	1			3	0.75	4.275	15.6	10.6	4.275
E	Hardwoods (winter)	1.5	0.5	0.25		0.5	0.5	2.375			2.375
F	Intermediate brush	2.5	2	1.5		9		8.85	3.8	3.8	8.85
G	Closed, short-needle conifer (heavy dead)	2.5	2	5	12	0.5	0.5	8.45	73.5	25.6	8.45
H	Closed, short-needle conifer (normal dead)	1.5	1	2	2	0.5	0.5	3.95	27.5	15	3.95
I	Heavy slash	12	12	10	12			30.2	55.1	49.1	30.2
J	Medium slash	7	7	6	5.5			17.55	34	31.2	12
K	Light slash	2.5	2.5	2	2.5			6.25	14.4	13.1	6.25
L	Perennial grass	0.25					0.5	0.3	0.8	0.8	0.3
N	Sawgrass	1.5	1.5			2		3.8	5	5	3.8
O	Pocosin	2	3	3	2	7		9.5	46.1	45.1	9.5
P	Southern plantation	1	1	0.5		0.5	0.5	2.5	16.4	10.2	2.5
Q	Alaskan black spruce	2	2.5	2	1	4	0.5	7.25	57.6	48.8	7.25
R	Hardwoods (summer)	0.5	0.5	0.5		0.5	0.5	1.5	3.1	3.1	2
S	Alaskan tundra	0.5	0.5	0.5	0.5	0.5	0.5	1.55			1.55
T	Sagebrush/grass	1	0.5			2.5	0.5	2.55	4.5	4.5	2.55
U	Western, long-needle conifer	1.5	1.5	1		0.5	0.5	3.75	19.1	10.3	3.75

\* Bayle revised values were the values used to produce the emission inventory.

## **Appendix C**

### **Emission Factors Used for Fire Emission Calculations**

**TABLE C-1. FIRE EMISSION FACTORS (LB/TON OF FUEL CONSUMED)**

<b>Fuel Model<sup>1</sup></b>	<b>Vegetation</b>	<b>Pollutant</b>	<b>Wildfires<sup>2</sup></b>	<b>Prescribed - piled fuel</b>	<b>Prescribed - nonpiled</b>	<b>Source</b>
A	Annual grass and forbs	CH4	13.6	7.7	13.6	Table 2 Data Needs and Availability - Pace Report
A	Annual grass and forbs	CO	289	74.3	289	Table 2 Data Needs and Availability - Pace Report
A	Annual grass and forbs	EC	1.5	0.6	1.5	Table 2 Data Needs and Availability - Pace Report
A	Annual grass and forbs	NH3	1.3	0.5	1.3	Table 2 Data Needs and Availability - Pace Report
A	Annual grass and forbs	NOX	6.2	6.2	6.2	Table 2 Data Needs and Availability - Pace Report
A	Annual grass and forbs	OC	11.6	4.3	11.6	Table 2 Data Needs and Availability - Pace Report
A	Annual grass and forbs	PM10	28.1	8	28.1	Table 2 Data Needs and Availability - Pace Report
A	Annual grass and forbs	PM25	24.1	8	24.1	Table 2 Data Needs and Availability - Pace Report
A	Annual grass and forbs	SO2	1.7	1.7	1.7	Table 2 Data Needs and Availability - Pace Report
A	Annual grass and forbs	TSP	34.1	12	34.1	Table 2 Data Needs and Availability - Pace Report
A	Annual grass and forbs	VOC	13.6	6.3	13.6	Table 2 Data Needs and Availability - Pace Report
AGGRAIN	Agriculture-Grain	CH4	5.43	5.43	5.43	AP-42 Table 2.5-5 Avg of Oat/Barley/Wheat
AGGRAIN	Agriculture-Grain	CO	140.66	140.66	140.66	AP-42 Table 2.5-5 Avg of Oat/Barley/Wheat
AGGRAIN	Agriculture-Grain	PM10	29.33	29.33	29.33	AP-42 Table 2.5-5 Avg of Oat/Barley/Wheat
AGGRAIN	Agriculture-Grain	PM25	29.33	29.33	29.33	AP-42 Table 2.5-5 Avg of Oat/Barley/Wheat
AGGRAIN	Agriculture-Grain	VOC	18	18	18	AP-42 Table 2.5-5 Avg of Oat/Barley/Wheat
AGHAY	Agriculture-Hay (pasture/range)	CH4	5	5	5	AP-42 Table 2.5-5 Hay
AGHAY	Agriculture-Hay (pasture/range)	CO	139	139	139	AP-42 Table 2.5-5 Hay
AGHAY	Agriculture-Hay (pasture/range)	PM10	32	32	32	AP-42 Table 2.5-5 Hay
AGHAY	Agriculture-Hay (pasture/range)	PM25	32	32	32	AP-42 Table 2.5-5 Hay
AGHAY	Agriculture-Hay (pasture/range)	VOC	17	17	17	AP-42 Table 2.5-5 Hay
AGSC	Agriculture-Hay (pasture/range)	CH4	2.5	2.5	2.5	AP-42 Table 2.5-5 Hay
AGSC	Agriculture-Sugar Cane	CO	70.5	70.5	70.5	AP-42 Table 2.5-5 Sugar Cane
AGSC	Agriculture-Sugar Cane	PM10	7.2	7.2	7.2	AP-42 Table 2.5-5 Sugar Cane
AGSC	Agriculture-Sugar Cane	PM25	7.2	7.2	7.2	AP-42 Table 2.5-5 Sugar Cane
AGSC	Agriculture-Sugar Cane	VOC	8	8	8	AP-42 Table 2.5-5 Sugar Cane
AGUNSP	Agriculture-Unspecified	CH4	5.4	5.4	5.4	AP-42 Table 2.5-5 Unspecified
AGUNSP	Agriculture-Unspecified	CO	117	117	117	AP-42 Table 2.5-5 Unspecified
AGUNSP	Agriculture-Unspecified	PM10	21	21	21	AP-42 Table 2.5-5 Unspecified
AGUNSP	Agriculture-Unspecified	PM25	21	21	21	AP-42 Table 2.5-5 Unspecified
AGUNSP	Agriculture-Unspecified	VOC	18	18	18	AP-42 Table 2.5-5 Unspecified
B	Mature chaparral	CH4	13.6	7.7	13.6	Table 2 Data Needs and Availability - Pace Report

Fuel Model <sup>1</sup>	Vegetation	Pollutant	Wildfires <sup>2</sup>	Prescribed - piled fuel	Prescribed - nonpiled	Source
B	Mature chaparral	CO	289	74.3	289	Table 2 Data Needs and Availability - Pace Report
B	Mature chaparral	EC	1.5	0.6	1.5	Table 2 Data Needs and Availability - Pace Report
B	Mature chaparral	NH3	1.3	0.5	1.3	Table 2 Data Needs and Availability - Pace Report
B	Mature chaparral	NOX	6.2	6.2	6.2	Table 2 Data Needs and Availability - Pace Report
B	Mature chaparral	OC	11.6	4.3	11.6	Table 2 Data Needs and Availability - Pace Report
B	Mature chaparral	PM10	28.1	8	28.1	Table 2 Data Needs and Availability - Pace Report
B	Mature chaparral	PM25	24.1	8	24.1	Table 2 Data Needs and Availability - Pace Report
B	Mature chaparral	SO2	1.7	1.7	1.7	Table 2 Data Needs and Availability - Pace Report
B	Mature chaparral	TSP	34.1	12	34.1	Table 2 Data Needs and Availability - Pace Report
B	Mature chaparral	VOC	13.6	6.3	13.6	Table 2 Data Needs and Availability - Pace Report
C	Open timber/grass	CH4	13.6	7.7	13.6	Table 2 Data Needs and Availability - Pace Report
C	Open timber/grass	CO	289	74.3	289	Table 2 Data Needs and Availability - Pace Report
C	Open timber/grass	EC	1.5	0.6	1.5	Table 2 Data Needs and Availability - Pace Report
C	Open timber/grass	NH3	1.3	0.5	1.3	Table 2 Data Needs and Availability - Pace Report
C	Open timber/grass	NOX	6.2	6.2	6.2	Table 2 Data Needs and Availability - Pace Report
C	Open timber/grass	OC	11.6	4.3	11.6	Table 2 Data Needs and Availability - Pace Report
C	Open timber/grass	PM10	28.1	8	28.1	Table 2 Data Needs and Availability - Pace Report
C	Open timber/grass	PM25	24.1	8	24.1	Table 2 Data Needs and Availability - Pace Report
C	Open timber/grass	SO2	1.7	1.7	1.7	Table 2 Data Needs and Availability - Pace Report
C	Open timber/grass	TSP	34.1	12	34.1	Table 2 Data Needs and Availability - Pace Report
C	Open timber/grass	VOC	13.6	6.3	13.6	Table 2 Data Needs and Availability - Pace Report
D	Southern rough	CH4	15.912	8.3545	14.756	Table 2 Data Needs and Availability - Pace Report
D	Southern rough	CO	338.13	80.6155	313.565	Table 2 Data Needs and Availability - Pace Report
D	Southern rough	EC	1.755	0.651	1.6275	Table 2 Data Needs and Availability - Pace Report
D	Southern rough	NH3	1.521	0.5425	1.4105	Table 2 Data Needs and Availability - Pace Report
D	Southern rough	NOX	7.254	6.727	6.727	Table 2 Data Needs and Availability - Pace Report
D	Southern rough	OC	13.572	4.6655	12.586	Table 2 Data Needs and Availability - Pace Report
D	Southern rough	PM10	32.877	8.68	30.4885	Table 2 Data Needs and Availability - Pace Report
D	Southern rough	PM25	28.197	8.68	26.1485	Table 2 Data Needs and Availability - Pace Report
D	Southern rough	SO2	1.989	1.8445	1.8445	Table 2 Data Needs and Availability - Pace Report
D	Southern rough	TSP	39.897	13.02	36.9985	Table 2 Data Needs and Availability - Pace Report
D	Southern rough	VOC	15.912	6.8355	14.756	Table 2 Data Needs and Availability - Pace Report
E	Hardwoods (winter)	CH4	15.912	8.3545	14.756	Table 2 Data Needs and Availability - Pace Report

Fuel Model <sup>1</sup>	Vegetation	Pollutant	Wildfires <sup>2</sup>	Prescribed - piled fuel	Prescribed - nonpiled	Source
E	Hardwoods (winter)	CO	338.13	80.6155	313.565	Table 2 Data Needs and Availability - Pace Report
E	Hardwoods (winter)	EC	1.755	0.651	1.6275	Table 2 Data Needs and Availability - Pace Report
E	Hardwoods (winter)	NH3	1.521	0.5425	1.4105	Table 2 Data Needs and Availability - Pace Report
E	Hardwoods (winter)	NOX	7.254	6.727	6.727	Table 2 Data Needs and Availability - Pace Report
E	Hardwoods (winter)	OC	13.572	4.6655	12.586	Table 2 Data Needs and Availability - Pace Report
E	Hardwoods (winter)	PM10	32.877	8.68	30.4885	Table 2 Data Needs and Availability - Pace Report
E	Hardwoods (winter)	PM25	28.197	8.68	26.1485	Table 2 Data Needs and Availability - Pace Report
E	Hardwoods (winter)	SO2	1.989	1.8445	1.8445	Table 2 Data Needs and Availability - Pace Report
E	Hardwoods (winter)	TSP	39.897	13.02	36.9985	Table 2 Data Needs and Availability - Pace Report
E	Hardwoods (winter)	VOC	15.912	6.8355	14.756	Table 2 Data Needs and Availability - Pace Report
F	Intermediate brush	CH4	13.6	7.7	13.6	Table 2 Data Needs and Availability - Pace Report
F	Intermediate brush	CO	289	74.3	289	Table 2 Data Needs and Availability - Pace Report
F	Intermediate brush	EC	1.5	0.6	1.5	Table 2 Data Needs and Availability - Pace Report
F	Intermediate brush	NH3	1.3	0.5	1.3	Table 2 Data Needs and Availability - Pace Report
F	Intermediate brush	NOX	6.2	6.2	6.2	Table 2 Data Needs and Availability - Pace Report
F	Intermediate brush	OC	11.6	4.3	11.6	Table 2 Data Needs and Availability - Pace Report
F	Intermediate brush	PM10	28.1	8	28.1	Table 2 Data Needs and Availability - Pace Report
F	Intermediate brush	PM25	24.1	8	24.1	Table 2 Data Needs and Availability - Pace Report
F	Intermediate brush	SO2	1.7	1.7	1.7	Table 2 Data Needs and Availability - Pace Report
F	Intermediate brush	TSP	34.1	12	34.1	Table 2 Data Needs and Availability - Pace Report
F	Intermediate brush	VOC	13.6	6.3	13.6	Table 2 Data Needs and Availability - Pace Report
G	Closed, short-needle conifer (heavy dead)	CH4	15.912	8.3545	14.756	Table 2 Data Needs and Availability - Pace Report
G	Closed, short-needle conifer (heavy dead)	CO	338.13	80.6155	313.565	Table 2 Data Needs and Availability - Pace Report
G	Closed, short-needle conifer (heavy dead)	EC	1.755	0.651	1.6275	Table 2 Data Needs and Availability - Pace Report
G	Closed, short-needle conifer (heavy dead)	NH3	1.521	0.5425	1.4105	Table 2 Data Needs and Availability - Pace Report
G	Closed, short-needle conifer (heavy dead)	NOX	7.254	6.727	6.727	Table 2 Data Needs and Availability - Pace Report
G	Closed, short-needle conifer (heavy dead)	OC	13.572	4.6655	12.586	Table 2 Data Needs and Availability - Pace Report
G	Closed, short-needle conifer (heavy dead)	PM10	32.877	8.68	30.4885	Table 2 Data Needs and Availability - Pace Report
G	Closed, short-needle conifer (heavy dead)	PM25	28.197	8.68	26.1485	Table 2 Data Needs and Availability - Pace Report
G	Closed, short-needle conifer (heavy dead)	SO2	1.989	1.8445	1.8445	Table 2 Data Needs and Availability - Pace Report
G	Closed, short-needle conifer (heavy dead)	TSP	39.897	13.02	36.9985	Table 2 Data Needs and Availability - Pace Report
G	Closed, short-needle conifer (heavy dead)	VOC	15.912	6.8355	14.756	Table 2 Data Needs and Availability - Pace Report
H	Closed, short-needle conifer (normal dead)	CH4	15.912	8.3545	14.756	Table 2 Data Needs and Availability - Pace Report

<b>Fuel Model<sup>1</sup></b>	<b>Vegetation</b>	<b>Pollutant</b>	<b>Wildfires<sup>2</sup></b>	<b>Prescribed - piled fuel</b>	<b>Prescribed - nonpiled</b>	<b>Source</b>
H	Closed, short-needle conifer (normal dead)	CO	338.13	80.6155	313.565	Table 2 Data Needs and Availability - Pace Report
H	Closed, short-needle conifer (normal dead)	EC	1.755	0.651	1.6275	Table 2 Data Needs and Availability - Pace Report
H	Closed, short-needle conifer (normal dead)	NH3	1.521	0.5425	1.4105	Table 2 Data Needs and Availability - Pace Report
H	Closed, short-needle conifer (normal dead)	NOX	7.254	6.727	6.727	Table 2 Data Needs and Availability - Pace Report
H	Closed, short-needle conifer (normal dead)	OC	13.572	4.6655	12.586	Table 2 Data Needs and Availability - Pace Report
H	Closed, short-needle conifer (normal dead)	PM10	32.877	8.68	30.4885	Table 2 Data Needs and Availability - Pace Report
H	Closed, short-needle conifer (normal dead)	PM25	28.197	8.68	26.1485	Table 2 Data Needs and Availability - Pace Report
H	Closed, short-needle conifer (normal dead)	SO2	1.989	1.8445	1.8445	Table 2 Data Needs and Availability - Pace Report
H	Closed, short-needle conifer (normal dead)	TSP	39.897	13.02	36.9985	Table 2 Data Needs and Availability - Pace Report
H	Closed, short-needle conifer (normal dead)	VOC	15.912	6.8355	14.756	Table 2 Data Needs and Availability - Pace Report
I	Heavy slash	CH4	15.912	8.3545	14.756	Table 2 Data Needs and Availability - Pace Report
I	Heavy slash	CO	338.13	80.6155	313.565	Table 2 Data Needs and Availability - Pace Report
I	Heavy slash	EC	1.755	0.651	1.6275	Table 2 Data Needs and Availability - Pace Report
I	Heavy slash	NH3	1.521	0.5425	1.4105	Table 2 Data Needs and Availability - Pace Report
I	Heavy slash	NOX	7.254	6.727	6.727	Table 2 Data Needs and Availability - Pace Report
I	Heavy slash	OC	13.572	4.6655	12.586	Table 2 Data Needs and Availability - Pace Report
I	Heavy slash	PM10	32.877	8.68	30.4885	Table 2 Data Needs and Availability - Pace Report
I	Heavy slash	PM25	28.197	8.68	26.1485	Table 2 Data Needs and Availability - Pace Report
I	Heavy slash	SO2	1.989	1.8445	1.8445	Table 2 Data Needs and Availability - Pace Report
I	Heavy slash	TSP	39.897	13.02	36.9985	Table 2 Data Needs and Availability - Pace Report
I	Heavy slash	VOC	15.912	6.8355	14.756	Table 2 Data Needs and Availability - Pace Report
J	Medium slash	CH4	15.912	8.3545	14.756	Table 2 Data Needs and Availability - Pace Report
J	Medium slash	CO	338.13	80.6155	313.565	Table 2 Data Needs and Availability - Pace Report
J	Medium slash	EC	1.755	0.651	1.6275	Table 2 Data Needs and Availability - Pace Report
J	Medium slash	NH3	1.521	0.5425	1.4105	Table 2 Data Needs and Availability - Pace Report
J	Medium slash	NOX	7.254	6.727	6.727	Table 2 Data Needs and Availability - Pace Report
J	Medium slash	OC	13.572	4.6655	12.586	Table 2 Data Needs and Availability - Pace Report
J	Medium slash	PM10	32.877	8.68	30.4885	Table 2 Data Needs and Availability - Pace Report
J	Medium slash	PM25	28.197	8.68	26.1485	Table 2 Data Needs and Availability - Pace Report
J	Medium slash	SO2	1.989	1.8445	1.8445	Table 2 Data Needs and Availability - Pace Report
J	Medium slash	TSP	39.897	13.02	36.9985	Table 2 Data Needs and Availability - Pace Report
J	Medium slash	VOC	15.912	6.8355	14.756	Table 2 Data Needs and Availability - Pace Report
K	Light slash	CH4	15.912	8.3545	14.756	Table 2 Data Needs and Availability - Pace Report



Fuel Model <sup>1</sup>	Vegetation	Pollutant	Wildfires <sup>2</sup>	Prescribed - piled fuel	Prescribed - nonpiled	Source
K	Light slash	CO	338.13	80.6155	313.565	Table 2 Data Needs and Availability - Pace Report
K	Light slash	EC	1.755	0.651	1.6275	Table 2 Data Needs and Availability - Pace Report
K	Light slash	NH3	1.521	0.5425	1.4105	Table 2 Data Needs and Availability - Pace Report
K	Light slash	NOX	7.254	6.727	6.727	Table 2 Data Needs and Availability - Pace Report
K	Light slash	OC	13.572	4.6655	12.586	Table 2 Data Needs and Availability - Pace Report
K	Light slash	PM10	32.877	8.68	30.4885	Table 2 Data Needs and Availability - Pace Report
K	Light slash	PM25	28.197	8.68	26.1485	Table 2 Data Needs and Availability - Pace Report
K	Light slash	SO2	1.989	1.8445	1.8445	Table 2 Data Needs and Availability - Pace Report
K	Light slash	TSP	39.897	13.02	36.9985	Table 2 Data Needs and Availability - Pace Report
K	Light slash	VOC	15.912	6.8355	14.756	Table 2 Data Needs and Availability - Pace Report
L	Perennial grass	CH4	13.6	7.7	13.6	Table 2 Data Needs and Availability - Pace Report
L	Perennial grass	CO	289	74.3	289	Table 2 Data Needs and Availability - Pace Report
L	Perennial grass	EC	1.5	0.6	1.5	Table 2 Data Needs and Availability - Pace Report
L	Perennial grass	NH3	1.3	0.5	1.3	Table 2 Data Needs and Availability - Pace Report
L	Perennial grass	NOX	6.2	6.2	6.2	Table 2 Data Needs and Availability - Pace Report
L	Perennial grass	OC	11.6	4.3	11.6	Table 2 Data Needs and Availability - Pace Report
L	Perennial grass	PM10	28.1	8	28.1	Table 2 Data Needs and Availability - Pace Report
L	Perennial grass	PM25	24.1	8	24.1	Table 2 Data Needs and Availability - Pace Report
L	Perennial grass	SO2	1.7	1.7	1.7	Table 2 Data Needs and Availability - Pace Report
L	Perennial grass	TSP	34.1	12	34.1	Table 2 Data Needs and Availability - Pace Report
L	Perennial grass	VOC	13.6	6.3	13.6	Table 2 Data Needs and Availability - Pace Report
LC	Land Clearing - All types	CO	169	169	169	Table 2 Data Needs and Availability - Pace Report
LC	Land Clearing - All types	NOX	5	5	5	Table 2 Data Needs and Availability - Pace Report
LC	Land Clearing - All types	PM10	17	17	17	Table 2 Data Needs and Availability - Pace Report
LC	Land Clearing - All types	PM25	17	17	17	Table 2 Data Needs and Availability - Pace Report
LC	Land Clearing - All types	VOC	11.6	11.6	11.6	Table 2 Data Needs and Availability - Pace Report
N	Sawgrass	CH4	15.912	8.3545	14.756	Table 2 Data Needs and Availability - Pace Report
N	Sawgrass	CO	338.13	80.6155	313.565	Table 2 Data Needs and Availability - Pace Report
N	Sawgrass	EC	1.755	0.651	1.6275	Table 2 Data Needs and Availability - Pace Report
N	Sawgrass	NH3	1.521	0.5425	1.4105	Table 2 Data Needs and Availability - Pace Report
N	Sawgrass	NOX	7.254	6.727	6.727	Table 2 Data Needs and Availability - Pace Report
N	Sawgrass	OC	13.572	4.6655	12.586	Table 2 Data Needs and Availability - Pace Report
N	Sawgrass	PM10	32.877	8.68	30.4885	Table 2 Data Needs and Availability - Pace Report

Fuel Model <sup>1</sup>	Vegetation	Pollutant	Wildfires <sup>2</sup>	Prescribed - piled fuel	Prescribed - nonpiled	Source
N	Sawgrass	PM25	28.197	8.68	26.1485	Table 2 Data Needs and Availability - Pace Report
N	Sawgrass	SO2	1.989	1.8445	1.8445	Table 2 Data Needs and Availability - Pace Report
N	Sawgrass	TSP	39.897	13.02	36.9985	Table 2 Data Needs and Availability - Pace Report
N	Sawgrass	VOC	15.912	6.8355	14.756	Table 2 Data Needs and Availability - Pace Report
O	Pocosin	CH4	15.912	8.3545	14.756	Table 2 Data Needs and Availability - Pace Report
O	Pocosin	CO	338.13	80.6155	313.565	Table 2 Data Needs and Availability - Pace Report
O	Pocosin	EC	1.755	0.651	1.6275	Table 2 Data Needs and Availability - Pace Report
O	Pocosin	NH3	1.521	0.5425	1.4105	Table 2 Data Needs and Availability - Pace Report
O	Pocosin	NOX	7.254	6.727	6.727	Table 2 Data Needs and Availability - Pace Report
O	Pocosin	OC	13.572	4.6655	12.586	Table 2 Data Needs and Availability - Pace Report
O	Pocosin	PM10	32.877	8.68	30.4885	Table 2 Data Needs and Availability - Pace Report
O	Pocosin	PM25	28.197	8.68	26.1485	Table 2 Data Needs and Availability - Pace Report
O	Pocosin	SO2	1.989	1.8445	1.8445	Table 2 Data Needs and Availability - Pace Report
O	Pocosin	TSP	39.897	13.02	36.9985	Table 2 Data Needs and Availability - Pace Report
O	Pocosin	VOC	15.912	6.8355	14.756	Table 2 Data Needs and Availability - Pace Report
P	Southern plantation	CH4	15.912	8.3545	14.756	Table 2 Data Needs and Availability - Pace Report
P	Southern plantation	CO	338.13	80.6155	313.565	Table 2 Data Needs and Availability - Pace Report
P	Southern plantation	EC	1.755	0.651	1.6275	Table 2 Data Needs and Availability - Pace Report
P	Southern plantation	NH3	1.521	0.5425	1.4105	Table 2 Data Needs and Availability - Pace Report
P	Southern plantation	NOX	7.254	6.727	6.727	Table 2 Data Needs and Availability - Pace Report
P	Southern plantation	OC	13.572	4.6655	12.586	Table 2 Data Needs and Availability - Pace Report
P	Southern plantation	PM10	32.877	8.68	30.4885	Table 2 Data Needs and Availability - Pace Report
P	Southern plantation	PM25	28.197	8.68	26.1485	Table 2 Data Needs and Availability - Pace Report
P	Southern plantation	SO2	1.989	1.8445	1.8445	Table 2 Data Needs and Availability - Pace Report
P	Southern plantation	TSP	39.897	13.02	36.9985	Table 2 Data Needs and Availability - Pace Report
P	Southern plantation	VOC	15.912	6.8355	14.756	Table 2 Data Needs and Availability - Pace Report
PREMISC	Prescribed - Miscellaneous types	CH4	14.230545	14.23054545	14.230545	Average of all used fuel models
PREMISC	Prescribed - Miscellaneous types	CO	302.39909	302.3990909	302.39909	Average of all used fuel models
PREMISC	Prescribed - Miscellaneous types	EC	1.5695455	1.569545455	1.5695455	Average of all used fuel models
PREMISC	Prescribed - Miscellaneous types	NH3	1.3602727	1.360272727	1.3602727	Average of all used fuel models
PREMISC	Prescribed - Miscellaneous types	NOX	6.4874545	6.487454545	6.4874545	Average of all used fuel models
PREMISC	Prescribed - Miscellaneous types	OC	12.137818	12.13781818	12.137818	Average of all used fuel models
PREMISC	Prescribed - Miscellaneous types	PM10	29.402818	29.40281818	29.402818	Average of all used fuel models

<b>Fuel Model<sup>1</sup></b>	<b>Vegetation</b>	<b>Pollutant</b>	<b>Wildfires<sup>2</sup></b>	<b>Prescribed - piled fuel</b>	<b>Prescribed - nonpiled</b>	<b>Source</b>
PREMISC	Prescribed - Miscellaneous types	PM25	25.217364	25.21736364	25.217364	Average of all used fuel models
PREMISC	Prescribed - Miscellaneous types	SO2	1.7788182	1.778818182	1.7788182	Average of all used fuel models
PREMISC	Prescribed - Miscellaneous types	TSP	35.681	35.681	35.681	Average of all used fuel models
PREMISC	Prescribed - Miscellaneous types	VOC	14.230545	14.23054545	14.230545	Average of all used fuel models
Q	Alaskan black spruce	CH4	15.912	8.3545	14.756	Table 2 Data Needs and Availability - Pace Report
Q	Alaskan black spruce	CO	338.13	80.6155	313.565	Table 2 Data Needs and Availability - Pace Report
Q	Alaskan black spruce	EC	1.755	0.651	1.6275	Table 2 Data Needs and Availability - Pace Report
Q	Alaskan black spruce	NH3	1.521	0.5425	1.4105	Table 2 Data Needs and Availability - Pace Report
Q	Alaskan black spruce	NOX	7.254	6.727	6.727	Table 2 Data Needs and Availability - Pace Report
Q	Alaskan black spruce	OC	13.572	4.6655	12.586	Table 2 Data Needs and Availability - Pace Report
Q	Alaskan black spruce	PM10	32.877	8.68	30.4885	Table 2 Data Needs and Availability - Pace Report
Q	Alaskan black spruce	PM25	28.197	8.68	26.1485	Table 2 Data Needs and Availability - Pace Report
Q	Alaskan black spruce	SO2	1.989	1.8445	1.8445	Table 2 Data Needs and Availability - Pace Report
Q	Alaskan black spruce	TSP	39.897	13.02	36.9985	Table 2 Data Needs and Availability - Pace Report
Q	Alaskan black spruce	VOC	15.912	6.8355	14.756	Table 2 Data Needs and Availability - Pace Report
R	Hardwoods (summer)	CH4	15.912	8.3545	14.756	Table 2 Data Needs and Availability - Pace Report
R	Hardwoods (summer)	CO	338.13	80.6155	313.565	Table 2 Data Needs and Availability - Pace Report
R	Hardwoods (summer)	EC	1.755	0.651	1.6275	Table 2 Data Needs and Availability - Pace Report
R	Hardwoods (summer)	NH3	1.521	0.5425	1.4105	Table 2 Data Needs and Availability - Pace Report
R	Hardwoods (summer)	NOX	7.254	6.727	6.727	Table 2 Data Needs and Availability - Pace Report
R	Hardwoods (summer)	OC	13.572	4.6655	12.586	Table 2 Data Needs and Availability - Pace Report
R	Hardwoods (summer)	PM10	32.877	8.68	30.4885	Table 2 Data Needs and Availability - Pace Report
R	Hardwoods (summer)	PM25	28.197	8.68	26.1485	Table 2 Data Needs and Availability - Pace Report
R	Hardwoods (summer)	SO2	1.989	1.8445	1.8445	Table 2 Data Needs and Availability - Pace Report
R	Hardwoods (summer)	TSP	39.897	13.02	36.9985	Table 2 Data Needs and Availability - Pace Report
R	Hardwoods (summer)	VOC	15.912	6.8355	14.756	Table 2 Data Needs and Availability - Pace Report
S	Alaskan tundra	CH4	15.912	8.3545	14.756	Table 2 Data Needs and Availability - Pace Report
S	Alaskan tundra	CO	338.13	80.6155	313.565	Table 2 Data Needs and Availability - Pace Report
S	Alaskan tundra	EC	1.755	0.651	1.6275	Table 2 Data Needs and Availability - Pace Report
S	Alaskan tundra	NH3	1.521	0.5425	1.4105	Table 2 Data Needs and Availability - Pace Report
S	Alaskan tundra	NOX	7.254	6.727	6.727	Table 2 Data Needs and Availability - Pace Report
S	Alaskan tundra	OC	13.572	4.6655	12.586	Table 2 Data Needs and Availability - Pace Report
S	Alaskan tundra	PM10	32.877	8.68	30.4885	Table 2 Data Needs and Availability - Pace Report

Fuel Model <sup>1</sup>	Vegetation	Pollutant	Wildfires <sup>2</sup>	Prescribed - piled fuel	Prescribed - nonpiled	Source
S	Alaskan tundra	PM25	28.197	8.68	26.1485	Table 2 Data Needs and Availability - Pace Report
S	Alaskan tundra	SO2	1.989	1.8445	1.8445	Table 2 Data Needs and Availability - Pace Report
S	Alaskan tundra	TSP	39.897	13.02	36.9985	Table 2 Data Needs and Availability - Pace Report
S	Alaskan tundra	VOC	15.912	6.8355	14.756	Table 2 Data Needs and Availability - Pace Report
T	Sagebrush/grass	CH4	15.912	8.3545	14.756	Table 2 Data Needs and Availability - Pace Report
T	Sagebrush/grass	CO	338.13	80.6155	313.565	Table 2 Data Needs and Availability - Pace Report
T	Sagebrush/grass	EC	1.755	0.651	1.6275	Table 2 Data Needs and Availability - Pace Report
T	Sagebrush/grass	NH3	1.521	0.5425	1.4105	Table 2 Data Needs and Availability - Pace Report
T	Sagebrush/grass	NOX	7.254	6.727	6.727	Table 2 Data Needs and Availability - Pace Report
T	Sagebrush/grass	OC	13.572	4.6655	12.586	Table 2 Data Needs and Availability - Pace Report
T	Sagebrush/grass	PM10	32.877	8.68	30.4885	Table 2 Data Needs and Availability - Pace Report
T	Sagebrush/grass	PM25	28.197	8.68	26.1485	Table 2 Data Needs and Availability - Pace Report
T	Sagebrush/grass	SO2	1.989	1.8445	1.8445	Table 2 Data Needs and Availability - Pace Report
T	Sagebrush/grass	TSP	39.897	13.02	36.9985	Table 2 Data Needs and Availability - Pace Report
T	Sagebrush/grass	VOC	15.912	6.8355	14.756	Table 2 Data Needs and Availability - Pace Report
U	Western, long-needle conifer	CH4	15.912	8.3545	14.756	Table 2 Data Needs and Availability - Pace Report
U	Western, long-needle conifer	CO	338.13	80.6155	313.565	Table 2 Data Needs and Availability - Pace Report
U	Western, long-needle conifer	EC	1.755	0.651	1.6275	Table 2 Data Needs and Availability - Pace Report
U	Western, long-needle conifer	NH3	1.521	0.5425	1.4105	Table 2 Data Needs and Availability - Pace Report
U	Western, long-needle conifer	NOX	7.254	6.727	6.727	Table 2 Data Needs and Availability - Pace Report
U	Western, long-needle conifer	OC	13.572	4.6655	12.586	Table 2 Data Needs and Availability - Pace Report
U	Western, long-needle conifer	PM10	32.877	8.68	30.4885	Table 2 Data Needs and Availability - Pace Report
U	Western, long-needle conifer	PM25	28.197	8.68	26.1485	Table 2 Data Needs and Availability - Pace Report
U	Western, long-needle conifer	SO2	1.989	1.8445	1.8445	Table 2 Data Needs and Availability - Pace Report
U	Western, long-needle conifer	TSP	39.897	13.02	36.9985	Table 2 Data Needs and Availability - Pace Report
U	Western, long-needle conifer	VOC	15.912	6.8355	14.756	Table 2 Data Needs and Availability - Pace Report
WASTE	Waste Burning (all categories)	CH4	13	13	13	NEI values
WASTE	Waste Burning (all categories)	CO	85	85	85	NEI values
WASTE	Waste Burning (all categories)	NOX	6	6	6	NEI values
WASTE	Waste Burning (all categories)	PM10	38	38	38	NEI values
WASTE	Waste Burning (all categories)	PM25	34.8	34.8	34.8	NEI values
WASTE	Waste Burning (all categories)	VOC	30	30	30	NEI values
PREHARD	Prescribed - Hardwoods	CH4	15.912	8.3545	14.756	Hardwood fuel model values

<b>Fuel Model<sup>1</sup></b>	<b>Vegetation</b>	<b>Pollutant</b>	<b>Wildfires<sup>2</sup></b>	<b>Prescribed - piled fuel</b>	<b>Prescribed - nonpiled</b>	<b>Source</b>
PREHARD	Prescribed - Hardwoods	CO	338.13	80.6155	313.565	Hardwood fuel model values
PREHARD	Prescribed - Hardwoods	EC	1.755	0.651	1.6275	Hardwood fuel model values
PREHARD	Prescribed - Hardwoods	NH3	1.521	0.5425	1.4105	Hardwood fuel model values
PREHARD	Prescribed - Hardwoods	NOX	7.254	6.727	6.727	Hardwood fuel model values
PREHARD	Prescribed - Hardwoods	OC	13.572	4.6655	12.586	Hardwood fuel model values
PREHARD	Prescribed - Hardwoods	PM10	32.877	8.68	30.4885	Hardwood fuel model values
PREHARD	Prescribed - Hardwoods	PM25	28.197	8.68	26.1485	Hardwood fuel model values
PREHARD	Prescribed - Hardwoods	SO2	1.989	1.8445	1.8445	Hardwood fuel model values
PREHARD	Prescribed - Hardwoods	TSP	39.897	13.02	36.9985	Hardwood fuel model values
PREHARD	Prescribed - Hardwoods	VOC	15.912	6.8355	14.756	Hardwood fuel model values
SILVI	Silviculture-All types	CH4	14.230545	14.23054545	14.230545	Average of all used fuel models
SILVI	Silviculture-All types	CO	302.39909	302.3990909	302.39909	Average of all used fuel models
SILVI	Silviculture-All types	EC	1.5695455	1.569545455	1.5695455	Average of all used fuel models
SILVI	Silviculture-All types	NH3	1.3602727	1.360272727	1.3602727	Average of all used fuel models
SILVI	Silviculture-All types	NOX	6.4874545	6.487454545	6.4874545	Average of all used fuel models
SILVI	Silviculture-All types	OC	12.137818	12.13781818	12.137818	Average of all used fuel models
SILVI	Silviculture-All types	PM10	29.402818	29.40281818	29.402818	Average of all used fuel models
SILVI	Silviculture-All types	PM25	25.217364	25.21736364	25.217364	Average of all used fuel models
SILVI	Silviculture-All types	SO2	1.7788182	1.778818182	1.7788182	Average of all used fuel models
SILVI	Silviculture-All types	TSP	35.681	35.681	35.681	Average of all used fuel models
SILVI	Silviculture-All types	VOC	14.230545	14.23054545	14.230545	Average of all used fuel models
WILDUNSP	Wildfire-Unspecified	CH4	14.861091	14.86109091	14.861091	Average of all used fuel models
WILDUNSP	Wildfire-Unspecified	CO	315.79818	315.7981818	315.79818	Average of all used fuel models
WILDUNSP	Wildfire-Unspecified	EC	1.6390909	1.639090909	1.6390909	Average of all used fuel models
WILDUNSP	Wildfire-Unspecified	NH3	1.4205455	1.420545455	1.4205455	Average of all used fuel models
WILDUNSP	Wildfire-Unspecified	NOX	6.7749091	6.774909091	6.7749091	Average of all used fuel models
WILDUNSP	Wildfire-Unspecified	OC	12.675636	12.67563636	12.675636	Average of all used fuel models
WILDUNSP	Wildfire-Unspecified	PM10	30.705636	30.70563636	30.705636	Average of all used fuel models
WILDUNSP	Wildfire-Unspecified	PM25	26.334727	26.33472727	26.334727	Average of all used fuel models
WILDUNSP	Wildfire-Unspecified	SO2	1.8576364	1.857636364	1.8576364	Average of all used fuel models
WILDUNSP	Wildfire-Unspecified	TSP	37.262	37.262	37.262	Average of all used fuel models
WILDUNSP	Wildfire-Unspecified	VOC	14.861091	14.86109091	14.861091	Average of all used fuel models
WILDLEAF	Wildfire-Leaf and needle mix	CH4	15.912	15.912	15.912	Average of fuel models E & H

<b>Fuel Model<sup>1</sup></b>	<b>Vegetation</b>	<b>Pollutant</b>	<b>Wildfires<sup>2</sup></b>	<b>Prescribed - piled fuel</b>	<b>Prescribed - nonpiled</b>	<b>Source</b>
WILDLEAF	Wildfire-Leaf and needle mix	CO	338.13	338.13	338.13	Average of fuel models E & H
WILDLEAF	Wildfire-Leaf and needle mix	EC	1.755	1.755	1.755	Average of fuel models E & H
WILDLEAF	Wildfire-Leaf and needle mix	NH3	1.521	1.521	1.521	Average of fuel models E & H
WILDLEAF	Wildfire-Leaf and needle mix	NOX	7.254	7.254	7.254	Average of fuel models E & H
WILDLEAF	Wildfire-Leaf and needle mix	OC	13.572	13.572	13.572	Average of fuel models E & H
WILDLEAF	Wildfire-Leaf and needle mix	PM10	32.877	32.877	32.877	Average of fuel models E & H
WILDLEAF	Wildfire-Leaf and needle mix	PM25	28.197	28.197	28.197	Average of fuel models E & H
WILDLEAF	Wildfire-Leaf and needle mix	SO2	1.989	1.989	1.989	Average of fuel models E & H
WILDLEAF	Wildfire-Leaf and needle mix	TSP	39.897	39.897	39.897	Average of fuel models E & H
WILDLEAF	Wildfire-Leaf and needle mix	VOC	15.912	15.912	15.912	Average of fuel models E & H
DE	Southern Rough/Hardwood (winter)	CH4	15.912	8.3545	14.756	Same as Emission Factors for D and E
DE	Southern Rough/Hardwood (winter)	CO	338.13	80.6155	313.565	Same as Emission Factors for D and E
DE	Southern Rough/Hardwood (winter)	EC	1.755	0.651	1.6275	Same as Emission Factors for D and E
DE	Southern Rough/Hardwood (winter)	NH3	1.521	0.5425	1.4105	Same as Emission Factors for D and E
DE	Southern Rough/Hardwood (winter)	NOX	7.254	6.727	6.727	Same as Emission Factors for D and E
DE	Southern Rough/Hardwood (winter)	OC	13.572	4.6655	12.586	Same as Emission Factors for D and E
DE	Southern Rough/Hardwood (winter)	PM10	32.877	8.68	30.4885	Same as Emission Factors for D and E
DE	Southern Rough/Hardwood (winter)	PM25	28.197	8.68	26.1485	Same as Emission Factors for D and E
DE	Southern Rough/Hardwood (winter)	SO2	1.989	1.8445	1.8445	Same as Emission Factors for D and E
DE	Southern Rough/Hardwood (winter)	TSP	39.897	13.02	36.9985	Same as Emission Factors for D and E
DE	Southern Rough/Hardwood (winter)	VOC	15.912	6.8355	14.756	Same as Emission Factors for D and E

<sup>1</sup> Single Character Fuel Models correspond to the same value NFDRS models

<sup>2</sup> Emission factors listed in the wildfire and prescribed emission factor columns for other fire types are all identical. They do not truly represent wildfire or prescribed emission factors but rather the emission factors for that type of fire.

**Development of the Draft 2002 Vistas Emission  
Inventory for Regional Haze Modeling**

**PART 4**

**Development of the VISTAS Draft 2002 Mobile  
Source Emission Inventory  
(February 2004 Version)**

**Development of the  
VISTAS Draft 2002  
Mobile Source  
Emission Inventory  
(February 2004  
Version)**

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**February 9, 2004**

**Pechan Rpt. No. 04.01.002/9440.000**



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## ACRONYMS AND ABBREVIATIONS

ATADS	Air Traffic Activity Data System
ATP	anti-tampering program
BTS	Bureau of Transportation Statistics
BTU	British thermal unit
CMV	commercial marine vessels
CNG	compressed natural gas
CO	carbon monoxide
DOT	Department of Transportation
EIA	Energy Information Administration
EPA	U.S. Environmental Protection Agency
FHWA	Federal Highway Administration
FIPS	Federal Information Processing Standards
GF	growth factor
HDDV	heavy-duty diesel vehicle
HDGV	heavy-duty gasoline vehicle
HPMS	Highway Performance Monitoring System
I/M	inspection and maintenance
LDDT	light-duty diesel truck
LDDV	light-duty diesel vehicle
LDGT	light-duty gasoline truck
LDGV	light-duty gasoline vehicle
LPG	liquified petroleum gas
LTO	landing and takeoff
MC	motorcycle
mg	milligram
NAPAP	National Acid Precipitation Assessment Program
NEI	National Emission Inventory
NH <sub>3</sub>	ammonia
NO <sub>x</sub>	oxides of nitrogen
OTAQ	Office of Transportation and Air Quality
Pechan	E.H. Pechan & Associates, Inc.
PM <sub>2.5</sub>	particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers
PM <sub>10</sub>	particulate matter with an aerodynamic diameter less than or equal to 10 micrometers
ppmv	parts per million volume
RFG	reformulated gasoline
RVP	Reid vapor pressure
SCC	source classification code
S/L/T	State/Local/Tribal
SO <sub>2</sub>	sulfur dioxide
USACE	U.S. Army Corps of Engineers
VISTAS	Visibility Improvement-State and Tribal Association of the Southeast
VMT	vehicle miles traveled
VOC	volatile organic compound

## I. INTRODUCTION/BACKGROUND

The Visibility Improvement – State and Tribal Association of the Southeast (VISTAS) has contracted with E.H. Pechan & Associates, Inc. (Pechan) to prepare a 2002 mobile source emissions inventory. The purpose of this emissions inventory is to support the modeling and assessment of speciated particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers (PM<sub>2.5</sub>). Through this contract, Pechan first prepared an inventory review document. This document summarized several regional and national emission inventory efforts and identified strengths and weaknesses associated with the use of these inventories in regional haze modeling. This document also summarized data submittals by State and local air agencies within the VISTAS region that could be used in the VISTAS 2002 mobile source emissions inventory.

Since that time, the State and local air agencies have updated their submittals for the mobile source sectors, including both onroad vehicles and nonroad engines. In July of 2003, Pechan delivered sets of inputs to the NONROAD model option files and MOBILE6.2 input files and vehicle miles traveled (VMT) data for each State and local agency to review. For the onroad sector, the MOBILE6.2 input files and VMT data represented Pechan's processing of the State and local inputs in a consistent manner for use in calculating the 2002 onroad emissions inventory. The MOBILE6.2 input files and VMT data included as much of the local data supplied by the State and local agencies as possible, with missing information filled in with appropriate default data. The data delivered by Pechan for the State and local agencies to review related to the nonroad sector was primarily in the form of temperature and fuel data that would be used as inputs to the NONROAD model. It should be noted that the nonroad sector inputs were completed first and did not include some of the later temperature and fuel updates that did get incorporated in the onroad data.

The State and local agencies were given a brief period to review, comment upon, and make updated submittals to the onroad and nonroad inputs that were delivered in July 2003. After receiving these comments and updated data, Pechan updated the appropriate MOBILE6.2 input files, VMT data, and nonroad inputs with the revised State and local data. Pechan then calculated 2002 onroad and nonroad emissions from these inputs. Pechan presented the preliminary results of these emission inventories at a VISTAS meeting on August 28, 2003. These draft August 2003 emission estimates, including inputs and methodology, were documented in a draft report circulated to VISTAS in October 2003. This October 2003 report also included documentation of draft 2002 refueling emissions from onroad and nonroad sources. The VISTAS States were asked to review this document, as well as the supporting files provided by Pechan, and provide comments or revisions by December 2003. Onroad and nonroad 2002 emissions for the VISTAS States have since been calculated based on the updates provided by the States. This report documents the inputs and methodologies used in the February 2004 version of the VISTAS 2002 onroad and nonroad mobile source emission inventories.

## **II. ONROAD METHODS AND DATA**

### **A. 2002 VMT DEVELOPMENT**

Table II-1 summarizes the type of VMT data submitted by each agency. Depending upon the data submitted by the individual State or agency, up to three different procedures were performed on the data. First, VMT data that were not provided at the annual level were converted from daily VMT to annual VMT. Second, VMT provided for years other than 2002 were grown from the base year provided. Finally, the VMT were allocated by vehicle type, if not already at that level of detail. The section discusses each of these procedures in more detail.

It should be noted that although the format and content of the VMT provided by the VISTAS State and Local agencies varied significantly from agency to agency, this draft 2002 VISTAS inventory is based at a minimum on county/roadway type specific VMT, as provided by the individual agencies. This is a significant improvement over the spatial allocation methods used in the U.S. Environmental Protection Agency's (EPA's) National Emission Inventory (NEI) for onroad vehicles.

#### **1. Conversion to Annual VMT**

For use in the emission calculations, Pechan's ultimate goal with the VMT data was to develop an annual 2002 VMT database by county, roadway type, and vehicle type. As indicated in Table II-1, the VMT data were submitted using three different time periods: annual, average annual day, and summer day. No temporal adjustments were applied to VMT data submitted as annual VMT. VMT data submitted as average annual day VMT were multiplied by 365 to convert from an average day to the annual time period. The Jefferson County, Kentucky VMT were submitted as summer day VMT. All annual VMT values were converted to units of millions of miles per year. Therefore, any VMT values submitted as miles were divided by a factor of 1,000,000 and VMT values submitted in units of 1,000 miles were divided by a factor of 1,000.

The Jefferson County, Kentucky VMT submittal included a single factor for converting the summer day VMT to average annual day VMT. Thus, the Jefferson County summer day VMT data were first multiplied by a factor of 0.97752 (the temporal conversion factor provided by Jefferson County) to obtain average annual day VMT. The VMT data were then multiplied by 365 to obtain the annual VMT.

**Table II-1. VMT Data Provided by State/Local Agencies**

State/Area	Time Period	2002 Actual VMT by County/Road Type/Vehicle Type	2002 Actual VMT by County/Road Type	2002 Projected VMT by County/Road Type	2002 VMT from TDM by County/Road Type/Vehicle Type	1999 Actual VMT by County/Road Type/Vehicle Type
Alabama	AAD		X			
Florida	AAD		X			
Georgia	AAD		X			
Kentucky	AAD			X		
Jefferson County, KY	SD				X	
Mississippi	ANN	X				
North Carolina	AAD		X			
South Carolina	ANN		X			
Tennessee	AAD		X			
Virginia	ANN					X
West Virginia	ANN	X				X

Time Period Codes: AAD=Average Annual Day, SD=Summer Day, ANN=Annual

## 2. Projection to 2002

As indicated in Table II-1, the Virginia VMT submittal was for a base year of 1999 rather than 2002. Thus, these VMT data needed to be projected to 2002 before calculating emissions. For Virginia, growth factors were developed by roadway type for the period from 1999 to 2001 based on historical VMT data by roadway type from Table VM-2 “Functional System Travel” in DOT’s *Highway Statistics* series (DOT, 1999 and 2001). The growth factors, presented in Table II-2, were calculated by dividing Virginia’s 2001 VMT for each of the 12 roadway types from *Highway Statistics 2001* by the corresponding 1999 VMT from *Highway Statistics 1999*. For the period from 2001 to 2002, the growth factors were developed using data obtained from the U.S. Department of Transportation’s Traffic Volume Trends report (DOT, 2002). This monthly publication provides a comparison of preliminary 2002 VMT estimates with comparable 2001 VMT. For several roadway types, these data are provided only at a national level. However, for the combined rural interstates and arterials, these data are presented by State. The resultant data, used to project the 2001 Virginia VMT to 2002, are shown in Table II-2. The 2001 to 2002 growth factors represent the 2002 VMT divided by the 2001 VMT, based on the data Virginia for the rural interstates and arterials and on the national data for the remaining roadway types. Once the growth factors were developed, the Virginia 1999 VMT data were first multiplied by the appropriate 1999 to 2001 growth factor and then by the appropriate 2001 to 2002 growth factor.

**Table II-2. VMT Growth Factors Used for Virginia**

<b>Roadway Type</b>	<b>Roadway Type Portion of SCC</b>	<b>Virginia 1999 to 2001 VMT Growth Factor</b>	<b>Virginia 2001 to 2002 VMT Growth Factor</b>
Rural Interstate	110	1.043	1.035
Rural Other Principal Arterial	130	1.050	1.035
Rural Major Arterial	150	1.130	1.035
Rural Major Collector	170	0.982	1.011
Rural Minor Collector	190	1.032	1.011
Rural Local	210	0.923	1.011
Urban Interstate	230	1.050	1.024
Urban Other Freeway & Expressway	250	0.984	1.011
Urban Other Principal Arterial	270	1.061	1.011
Urban Minor Arterial	290	0.991	1.011
Urban Collector	310	0.925	1.013
Urban Local	330	0.690	1.013

Sources: U.S. Department of Transportation, Federal Highway Administration, "Traffic Volume Trends, December 2002", (<http://www.fhwa.dot.gov/ohim/tvtw/tvtpage.htm>); *Highway Statistics 1999*, and *Highway Statistics 2001* (<http://www.fhwa.dot.gov/policy/ohpi/hss/hsspubs.htm>)

### **3. Splitting VMT by Road Type**

The final step in developing a consistent 2002 VMT data base was to allocate VMT from the county and roadway type level of detail to the county/roadway type/vehicle type level of detail. As shown in Table II-1, the Jefferson County, Kentucky; Mississippi; Virginia; and West Virginia VMT data supplied for these jurisdictions already included the vehicle type level of detail, so this final adjustment was not needed for these areas. For the remaining areas, some provided VMT mix by vehicle type fractions while others provided no information on the allocation of VMT by vehicle. In this latter case, default VMT fraction data from EPA's MOBILE6 model were used.

The States for which MOBILE6 default VMT mix data were used are: Alabama, Florida, Georgia, Kentucky (excluding Boone County, Campbell County, Kenton County, and Jefferson County), and South Carolina. It should be noted that Georgia initially provided VMT fractions based on Georgia's HPMS classification count data, but after review of ten years of these data determined that they are not reflecting the trend towards increasing travel by light trucks. Georgia therefore decided it was more conservative to assume MOBILE6 default VMT fractions.

#### ***a. Allocation of VMT to Vehicle Type using Default VMT Mix Data***

To calculate 2002 VMT at the county/roadway type/vehicle type level using national default data, the VMT totals by county and roadway type need to be allocated among the 28 MOBILE6 vehicle types. This was done based on the distribution of the 2001 rural and urban VMT among the six Highway Performance Monitoring Systems (HPMS) vehicle types found in Table VM-1 ("Annual Vehicle Distance Traveled in Miles and Related Data - 1999 - by Highway Category and Vehicle Type") of the Federal Highway Administration's (FHWA's) *Highway Statistics*



2001 (<http://www.fhwa.dot.gov/ohim/hs01/index.htm>) and a mapping of these HPMS vehicle categories to the 28 MOBILE6 vehicle types. This mapping of the MOBILE6 vehicle types to the HPMS vehicle types was developed by EPA's Office of Transportation and Air Quality (OTAQ) and is used in the development of the NEI. The data first needed to be expanded to the 28 vehicle type level of detail to obtain the proper cross reference between the HPMS and MOBILE6 vehicle types since the eight vehicle types used in the final VISTAS VMT data base cannot be directly mapped to the HPMS vehicle categories. First, the VMT totals for each of the six HPMS vehicle categories were calculated as a fraction of the total VMT. This calculation was performed separately for the rural VMT and the urban VMT. The resulting 2001 VMT fractions for rural VMT and urban VMT are shown in Table II-3. Note that 2002 VMT are not yet available at this level of detail. Using the default MOBILE6 VMT fractions for 2001 (since the HPMS data represents 2001), taken from a MOBILE6 output file for 2001, the MOBILE6 VMT fractions were renormalized among all MOBILE6 vehicle types mapped to a given HPMS vehicle category. This renormalization is shown in the final column of Table II-3.

**Table II-3. Allocation of VMT from HPMS Vehicle Categories to MOBILE6 Vehicle Types for 2001**

<b>HPMS Vehicle Category</b>	<b>HPMS 2001 Rural VMT Fractions</b>	<b>HPMS 2001 Urban VMT Fractions</b>	<b>MOBILE6 Vehicle Category</b>	<b>MOBILE6 2001 VMT Fractions by HPMS Category</b>
Passenger Cars	0.5454	0.6065	LDGV	0.9980
			LDDV	0.0020
Motorcycles	0.0039	0.0031	MC	1.0000
Other 2-Axle 4-Tire Vehicles	0.3368	0.3375	LDGT1	0.1565
			LDGT2	0.5211
			LDGT3	0.1585
			LDGT4	0.0729
			LDDT12	0.0005
			LDDT34	0.0032
			HDGV2B	0.0658
			HDDV2B	0.0216
Single-Unit 2-Axle 6-Tire or More Trucks	0.0332	0.0212	HDGV3	0.0376
			HDGV4	0.0206
			HDGV5	0.0436
			HDGV6	0.0934
			HDGV7	0.0437
			HDDV3	0.1023
			HDDV4	0.0867
			HDDV5	0.0380
			HDDV6	0.2138
			HDDV7	0.3205
Combination Trucks	0.0770	0.0300	HDGV8A	0.0001
			HDGV8B	0.0000
			HDDV8A	0.2191
			HDDV8B	0.7808
Buses	0.0037	0.0017	HDGB	0.1920
			HDDBT	0.3258
			HDDBS	0.4822
<b>Total</b>	<b>1.0000</b>	<b>1.0000</b>		

To calculate VMT by vehicle type, each VMT value representing a given county and road type was multiplied by the product of the HPMS VMT fraction (selected depending upon whether the road type represent VMT on rural or urban roads) and the corresponding MOBILE6 VMT fraction by HPMS category. This process resulted in 28 VMT values at the county/roadway type/vehicle type level of detail for each county/roadway type VMT value in the original VMT file.

As an example, Table II-3 shows that the HPMS Passenger Car vehicle category accounts for 54.54 percent of the total VMT on rural road types and that the MOBILE6 LDGV category accounts for 99.8 percent of the VMT in the HPMS Passenger Car category. Therefore, a VMT value representing rural interstates would be multiplied by 0.5454 times 0.9980 (0.5443), to obtain the VMT total on rural interstates from LDGVs. Once all county/roadway type VMT values were expanded to the corresponding set of values of VMT at the county/roadway type/28 MOBILE6 vehicle type level of detail, the VMT data base was then totaled at the eight vehicle type level of detail (LDGV, LDGT1, LDGT2, HDGV, LDDV, LDDT, HDDV, MC).

***b. Allocation of VMT to Vehicle Type using State-Provided VMT Mix Data***

Both North Carolina and Tennessee provided VMT mix data at the eight vehicle type level of detail. The Tennessee data was provided for ten different county groupings, with a VMT mix provided for six aggregated roadway type categories. North Carolina provided statewide VMT mix fractions for each of the 12 roadway types. Since the VMT mix data for these two States were already at the eight vehicle type level, the procedure for allocating VMT by vehicle type was simpler than the procedure described above using the default data. Each county/roadway type VMT value was matched to the corresponding VMT mix for that county and roadway type and then separately multiplied by each of the eight VMT mix fractions to create eight VMT values by county/roadway type/vehicle type that would sum to the original VMT value at the county/roadway type level of detail.

***c. Allocation of VMT by Month***

The resulting annual county-level, vehicle, and roadway type-specific VMT data were temporally allocated to months during the emission calculations. National Acid Precipitation Assessment Program (NAPAP) temporal allocation factors were used to apportion the VMT to the four seasons. Monthly VMT data were obtained using a ratio between the number of days in a month and the number of days in the corresponding season. These temporal factors are shown in Table II-4. Several States provided some level of information on temporal adjustment factors for their VMT. These data were not used in this draft version of the 2002 VISTAS emission inventory due to time constraints. However, any State or locally supplied temporal adjustment factors will be included in the final version of the 2002 VISTAS onroad emission inventory.

**Table II-4. Default VMT Seasonal and Monthly Temporal Allocation Factors**

<b>Roadway Seasonal VMT Factors</b>					
Vehicle Type	Roadway Type	Winter	Spring	Summer	Fall
LDV,LDT,MC	Rural	0.2160	0.2390	0.2890	0.2560
LDV,LDT,MC	Urban	0.2340	0.2550	0.2650	0.2450
HDV	All	0.2500	0.2500	0.2500	0.2500

<b>Monthly VMT Factors</b>													
Vehicle Type	Roadway Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
LDV,LDT,MC	Rural	0.0744	0.0672	0.0805	0.0779	0.0805	0.0942	0.0974	0.0974	0.0844	0.0872	0.0844	0.0744
LDV,LDT,MC	Urban	0.0806	0.0728	0.0859	0.0832	0.0859	0.0864	0.0893	0.0893	0.0808	0.0835	0.0808	0.0806
HDV	All	0.0861	0.0778	0.0842	0.0815	0.0842	0.0815	0.0842	0.0842	0.0842	0.0852	0.0824	0.0861

## **B. 2002 ONROAD EMISSION FACTOR DEVELOPMENT USING MOBILE6.2**

The onroad emission factors used in the calculation of the VISTAS 2002 onroad emission inventory were generated using EPA's MOBILE6.2 emission factor model. In the development of the MOBILE6.2 input files, Pechan attempted to include as much of the relevant data supplied by the State and local agencies as possible, while at the same time, maintaining a generally similar overall structure to the MOBILE6.2 input files, such that the output emission factors could easily be matched to the appropriate VMT values. This section first discusses the overall general structure of the MOBILE6.2 input files. This is followed by details explaining how this general structure was adapted to include the State and local agency data and summaries of the types of data provided by each agency.

### **1. General MOBILE6.2 File Structure**

Each MOBILE6.2 input file is divided into three sections: the header section, the run data section, and the scenario section. Information contained in the header section is primarily related to defining the output format and content desired by the user. For the processing of the VISTAS emission calculations, the database output format, aggregated to the daily level, was the desired output format. In addition, for proper modeling of the VOC emissions, it was desired to calculate the exhaust VOC emissions separately from the evaporative VOC emissions. However, within the constraints of MOBILE6.2 in the daily aggregated database output format, it is not possible to obtain evaporative and exhaust VOC emission factors broken out separately within each scenario. It is also not possible to obtain emission factors for both PM<sub>10</sub> and PM<sub>2.5</sub> within a single MOBILE6.2 scenario. Therefore, two sets of MOBILE6.2 input files were created—one set to model VOC exhaust, NO<sub>x</sub>, CO, SO<sub>2</sub>, PM<sub>10</sub>, and NH<sub>3</sub> emission factors and a second set to model VOC evaporative and PM<sub>2.5</sub> emission factors. Figure II-1 illustrates the header section of a sample VISTAS MOBILE6.2 input file used to generate the VOC exhaust, NO<sub>x</sub>, CO, SO<sub>2</sub>, PM<sub>10</sub>, and NH<sub>3</sub> emission factors. Similarly, Figure II-2 illustrates the header section of a sample VISTAS MOBILE6.2 input file used to generate the VOC evaporative and PM<sub>2.5</sub> emission factors. The primary difference between these two header sections is in the selection of the emission types included, using the DATABASE EMISSIONS command and in the selection of the pollutants to be included in the output. In Figure II-1, having the first two flags set to "2" following the DATABASE EMISSIONS command indicates that the startup and running exhaust emission factor components will be included in the output emission factor table. In Figure II-2, the last six flags of the DATABASE EMISSIONS command line are set to "2" to obtain the evaporative emission factor components in the emission factor output file. In Figure II-2, the pollutants SO<sub>2</sub> and NH<sub>3</sub> are eliminated from the PARTICULATES command line, as the emission factors for these pollutants will be reported in the output file resulting from the file shown in Figure II-1.

### Figure II-1. Header Section of MOBILE6.2 Input File Including VOC Exhaust and PM<sub>10</sub> Emission Factors

```
MOBILE6 INPUT FILE :
> HEADER 01 0012002 - EXHAUST - PM 10.0

REPORT FILE          : Vistas02/Output02/V0100110.TXT REPLACE
DATABASE OUTPUT     :
WITH FIELDNAMES     :
DAILY OUTPUT        :
DATABASE EMISSIONS  : 2211 1111
PARTICULATES        : SO4 OCARBON ECARBON GASPM LEAD SO2 NH3 BRAKE TIRE
AGGREGATED OUTPUT   :
EMISSIONS TABLE    : Vistas02/TB1_02/V0100110.TB1 REPLACE
```

### Figure II-2. Header Section of MOBILE6.2 Input File Including VOC Evaporative and PM<sub>2.5</sub> Emission Factors

```
MOBILE6 INPUT FILE :
> HEADER 01 0012002 - EVAPORATIVE - PM 2.50

REPORT FILE          : Vistas02/Output02/V0100125.TXT REPLACE
DATABASE OUTPUT     :
WITH FIELDNAMES     :
DAILY OUTPUT        :
DATABASE EMISSIONS  : 1122 2222
POLLUTANTS          : HC
PARTICULATES        : ECARBON SO4 OCARBON GASPM LEAD BRAKE TIRE
AGGREGATED OUTPUT   :
EMISSIONS TABLE    : Vistas02/TB1_02/V0100125.TB1 REPLACE
```

The next section of the MOBILE6 input files is the run data section. This section includes data that applies to all scenarios in the input file. Figure II-3 shows an example of this section for a county using default data. The only commands included in this example tell MOBILE6 that the HC emission factors should be expressed in terms of VOC and that refueling emission factors should be excluded from the output. It should be noted that refueling emissions were calculated using a separate set of input files, but were excluded from the onroad input files here since refueling emissions are included in the area source inventory rather than the onroad inventory. Chapter IV discusses the onroad refueling MOBILE6 input files and emission calculations. Comments in Figure II-3 indicate that this input file is using default registration distributions and diesel sales fractions. For any input files that represent counties for which registration distribution, diesel sales fractions, or trip length distributions have been provided or that have an inspection and maintenance (I/M) program, anti-tampering program (ATP), or low emission vehicle program in place in 2002, additional inputs are required in the run data section of the MOBILE6.2 input file. Figure II-4 shows an example of an input file including all of these data. Some of these data inputs are included directly in the MOBILE6.2 input file, while other data are contained in external text files that are named by the commands in the run data section. For questions regarding the specifics of any of the MOBILE6 input commands listed, the MOBILE6 User's Guide should be consulted.

### Figure II-3. Run Data Section of a MOBILE6.2 Input File

```
RUN DATA          :
>

EXPRESS HC AS VOC  :
NO REFUELING       :

* MOBILE6 Default Registration Distributions Applied
* MOBILE6 Default Diesel Sales Fractions Applied
```

### Figure II-4. Run Data Section of a MOBILE6.2 Input File with Significant Local Inputs

```
RUN DATA          :
>

EXPRESS HC AS VOC  :
NO REFUELING       :

REG DIST           : Vistas02\ExtFiles\R02_ARLI.RDT

* Diesel Sales Fractions Source File -
E:\TrendsM6_New\Vistas02\ExtFiles\D02_ARLI.DSF
DIESEL FRACTIONS   :
0.0012 0.0023 0.0026 0.0027 0.0029 0.0015 0.0008 0.0011 0.0001 0.0006
0.0013 0.0015 0.0006 0.0014 0.0006 0.0099 0.0087 0.0446 0.0685 0.0857
0.1922 0.1481 0.1132 0.0959 0.0126
0.0056 0.0221 0.0167 0.0235 0.0126 0.0119 0.0206 0.0136 0.0155 0.0127
0.0246 0.0206 0.0222 0.0184 0.0227 0.0115 0.0310 0.0568 0.0508 0.1211
0.1077 0.2126 0.0711 0.0286 0.0176
0.0056 0.0221 0.0167 0.0235 0.0126 0.0119 0.0206 0.0136 0.0155 0.0127
0.0246 0.0206 0.0222 0.0184 0.0227 0.0115 0.0310 0.0568 0.0508 0.1211
0.1077 0.2126 0.0711 0.0286 0.0176
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
0.0256 0.0013 0.0006 0.0011 0.0001
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
0.0256 0.0013 0.0006 0.0011 0.0001
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.2578 0.2515 0.3263
0.2784 0.2963 0.2384 0.2058 0.1756 0.1958 0.2726 0.2743 0.3004 0.2918
0.2859 0.0138 0.0000 0.0000 0.0000
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.7715 0.7910 0.8105
0.8068 0.8280 0.8477 0.7940 0.7488 0.7789 0.7842 0.6145 0.5139 0.5032
0.4277 0.0079 0.0000 0.0000 0.0001
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8473 0.8048 0.8331
0.7901 0.7316 0.7275 0.7158 0.5647 0.3178 0.2207 0.1968 0.1570 0.0738
0.0341 0.0414 0.0003 0.0000 0.0000
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4384 0.3670 0.4125
0.3462 0.2771 0.2730 0.2616 0.1543 0.0615 0.0383 0.0333 0.0255 0.0111
0.0049 0.0060 0.0000 0.0000 0.0000
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6078 0.5246 0.5767
```

0.5289 0.5788 0.5617 0.4537 0.4216 0.4734 0.4705 0.4525 0.4310 0.3569  
0.3690 0.4413 0.3094 0.1679 0.1390  
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8443 0.7943 0.8266  
0.7972 0.8279 0.8177 0.7440 0.7184 0.7588 0.7567 0.7431 0.7261 0.6602  
0.6717 0.7344 0.6107 0.4140 0.3610  
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9989 0.9987 0.9989  
0.9977 0.9984 0.9982 0.9979 0.9969 0.9978 0.9980 0.9979 0.9976 0.9969  
0.9978 0.9982 0.9974 0.9965 0.9964  
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000  
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000  
1.0000 1.0000 1.0000 1.0000 1.0000  
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.8857 0.8525 0.8795  
0.9900 0.9105 0.8760 0.7710 0.7502 0.7345 0.6733 0.5155 0.3845 0.3238  
0.3260 0.2639 0.0594 0.0460 0.0291

> ANTI-TAMP PROG : E:\TrendsM6\_New\Vistas02\ExtFiles\VA\_ATP2002.ATP  
ANTI-TAMP PROG :  
89 68 50 22222 21111111 1 12 098. 22112222

> Exhaust I/M - IDLE test program #1  
I/M PROGRAM : 1 1983 2050 2 TRC 2500/IDLE  
I/M MODEL YEARS : 1 1968 1980  
I/M VEHICLES : 1 22222 21111111 1  
I/M STRINGENCY : 1 35.0  
I/M COMPLIANCE : 1 98.0  
I/M WAIVER RATES : 1 2.0 2.0

> Exhaust I/M - ASM final program #2  
I/M PROGRAM : 2 1983 2050 2 TRC ASM 2525/5015 PHASE-IN  
I/M MODEL YEARS : 2 1981 2050  
I/M VEHICLES : 2 22222 11111111 1  
I/M STRINGENCY : 2 35.0  
I/M COMPLIANCE : 2 98.0  
I/M WAIVER RATES : 2 2.0 2.0  
I/M EFFECTIVENESS : 0.94 0.94 0.94

> Exhaust I/M - IDLE test program #1  
I/M PROGRAM : 3 1983 2050 2 TRC 2500/IDLE  
I/M MODEL YEARS : 3 1981 2050  
I/M VEHICLES : 3 11111 21111111 1  
I/M STRINGENCY : 3 35.0  
I/M COMPLIANCE : 3 98.0  
I/M WAIVER RATES : 3 2.0 2.0

> Evap I/M - Gas Cap test program #3  
I/M PROGRAM : 4 1998 2050 2 TRC GC  
I/M MODEL YEARS : 4 1973 2050  
I/M VEHICLES : 4 22222 21111111 1  
I/M COMPLIANCE : 4 98.0  
I/M WAIVER RATES : 4 2.0 2.0

94+ LDG IMP : Vistas02\ExtFiles\NLEVNE.D

> WeekDay Trip Length Distribution  
WE DA TRI LEN DI : Vistas02\ExtFiles\WeekTLD2.wdt

The third and final section of the MOBILE6.2 input files contains the scenario data. For this VISTAS inventory, each speed and road type combination or speed distribution were modeled in twelve consecutive scenarios representing the temperature and fuel properties applicable in each month. Thus, if a State agency supplied an average speed/road type combination for each of the 12 HPMS road categories, the corresponding MOBILE6.2 input file would have 144 scenarios. The first scenario would represent January temperature and fuel conditions at the speed and MOBILE6 roadway type for the first speed/roadway type provided (typically rural interstates). This would be followed by the February scenario modeled for the same speed and roadway type, and so on through the twelfth scenario representing December conditions for the same speed and roadway type combination.

Figure II-5 illustrates a sample scenario from one of the VISTAS MOBILE6.2 input files. This is the first scenario in the file—therefore, it represents January temperature and fuel conditions. The month of a given scenario in the VISTAS MOBILE6.2 input files can be determined by the last two digits of the SCENARIO RECORD command line. In this case, the last two digits are “01” indicating January. It should be noted that the only options for the EVALUATION MONTH command are “1” indicating January or “7” indicating July. For the VISTAS input files, the EVALUATION MONTH was set to “1” for all months from January through June and to 7 for months from July through December. When this flag is set to “1”, it indicates that MOBILE6 will use a January registration distribution. When the flag is set to “7”, MOBILE6 ages the registration by a half year, applying a half year of fleet turnover to the distribution. The EVALUATION MONTH setting can also affect the reductions from reformulated gas programs. However, by including the SEASON command, as shown in Figure II-5, the EVALUATION MONTH flag setting will not affect reformulated gasoline reductions. With the SEASON flag set to “2”, winter reformulated gasoline rules will be applied in areas with a reformulated gas program modeled (using the FUEL PROGRAM command). Summer reformulated gas rules and reductions will be applied when the SEASON flag is set to “1” if reformulated gas has been modeled. In all of the VISTAS input files, the SEASON flag was included for all areas, whether or not a reformulated gasoline program was modeled. This flag has no effect when the FUEL PROGRAM command is not used. The SEASON flag was set to “1” for the months of May through September and to “2” for the remaining months.

**Figure II-5. Sample Scenario for a Typical MOBILE6.2 Input File**

```

SCENARIO RECORD      : 010010215.0_M01
>FV FILE:           SCENARIO: 1
CALENDAR YEAR       : 2002
EVALUATION MONTH    : 1
MIN/MAX TEMPERATURE: 38.0 60.0
ALTITUDE            : 1
PARTICULATE EF      : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV
PMDDR2.CSV
SEASON              : 2
AVERAGE SPEED      : 15.0 Arterial
FUEL RVP            : 12.5
PARTICLE SIZE       : 10.0
DIESEL SULFUR       : 500.0

```



Local speed data were provided by the agencies in Georgia, Kentucky, North Carolina, Tennessee, and Virginia. A set of 12 monthly scenarios was developed for each speed input for these States, with one exception. The Northern Kentucky (Boone County, Campbell County, and Kenton County) and Jefferson County, Kentucky inputs were speed distribution files, rather than average speeds by individual roadway types (one for Northern Kentucky and one for Jefferson County, Kentucky). In this case, only 12 scenarios were modeled in total in the Jefferson County and Northern Kentucky input files, with the Jefferson County or Northern Kentucky speed distribution referenced in each scenario, respectively. No speed information was provided for Alabama, Florida, Mississippi, South Carolina, or West Virginia. The average speeds modeled in these files were the default speeds used in the NEI. These speeds are shown in Table II-5 and vary by both roadway type and vehicle category. It should be noted that several agencies provided speed information for ramps. Since the VMT data file is organized by SCC and no SCC currently exists for ramp VMT, the ramp speed information could not be used directly. In some cases, the fraction of VMT occurring on ramps was provided. In these cases, this information was combined with the freeway speeds, following the guidance in the MOBILE6 user's guide to determine the overall freeway speed including the ramp speed, at 34.6 mph (the assumed value for ramp speeds in MOBILE6), and the fraction of VMT occurring on the ramps.

**Table II-5. Default Speeds Modeled by Road Type and Vehicle Type (mph)**

HPMS Road Type	Speed (mph) and MOBILE6 Road Type		
	Light Duty Vehicles	Light Duty Trucks	Heavy Duty Trucks
Rural Interstate	60 Freeway	55 Freeway	40 Freeway
Rural Principal Arterial	45 Arterial	45 Arterial	35 Arterial
Rural Minor Arterial	40 Arterial	40 Arterial	30 Arterial
Rural Major Collector	35 Arterial	35 Arterial	25 Arterial
Rural Minor Collector	30 Arterial	30 Arterial	25 Arterial
Rural Local	30 Arterial	30 Arterial	25 Arterial
Urban Interstate	45 Freeway	45 Freeway	35 Freeway
Urban Other Freeway and Expressway	45 Freeway	45 Freeway	35 Freeway
Urban Principal Arterial	20 Arterial	20 Arterial	15 Arterial
Urban Minor Arterial	20 Arterial	20 Arterial	15 Arterial
Urban Collector	20 Arterial	20 Arterial	15 Arterial
Urban Local	Local	Local	Local

Another optional input included in the scenario section of the MOBILE6 input files is the VMT mix by 16 MOBILE6 vehicle categories. These vehicle categories are based on the 28 MOBILE6 vehicle categories, but with gasoline and diesel vehicles of the same weight class combined together. When no information was provided on VMT mix, the MOBILE6 defaults were used. Local VMT mix information provided by Tennessee, Virginia, and Jefferson County, Kentucky were included in the MOBILE6.2 input files. In some cases, the same VMT mix was applied to all scenarios. In other cases, the VMT mixes were specific to roadway type, so the VMT mix would vary according to the roadway type being represented in the scenario.

## **C. 2002 ONROAD EMISSION INVENTORY CALCULATIONS**

Once the MOBILE6.2 input files were set up and run through the MOBILE6.2 model, onroad emissions were calculated by multiplying the monthly VMT for a given county, roadway type, and vehicle type by the emission factor modeled for the same month, county, vehicle type and roadway type. Because the MOBILE6.2 input files were set up to create output files in the form of database tables, the output is provided by each of the 28 MOBILE6 vehicle types. Thus, the emission factors first were aggregated to the eight vehicle categories included in the VMT files. This was done using the VMT Fraction data provided in each of the MOBILE6 output files. For each of the MOBILE6 vehicle types included in one of the eight vehicle types needed, the VMT fractions were renormalized within that category. These eight vehicle categories are sometimes referred to as the MOBILE5 vehicle categories. For example, the LDGT1 and LDGT2 MOBILE6 vehicle categories are both included in the MOBILE5 LDGT1 category. In this case, the MOBILE6 LDGT1 VMT fraction was divided by the sum of the MOBILE6 LDGT1 and LDGT2 VMT fractions. The same was done with the MOBILE6 LDGT2 VMT fraction, so that the renormalized MOBILE6 LDGT1 and LDGT2 VMT fractions should now sum to 1. Next, these normalized VMT fractions were multiplied by the corresponding MOBILE6 emission factor and all of these weighted emission factors for a given scenario, within a MOBILE5 vehicle category were summed to obtain the weighted emission factors at the MOBILE5 vehicle category level. The VMT fractions included in the MOBILE6 output files are affected by the registration distribution, diesel sales fractions, and VMT mixes supplied in the MOBILE6.2 input files. Areas that used the MOBILE6 defaults for each of these inputs should all have the same VMT fractions, although even in these cases, there are two sets of VMT fractions—one for the months from January through June and another for the months July through December. This occurs due to the aging of the registration distribution caused by the use of the EVALUATION MONTH flag, as discussed above. These emission factors, now at the MOBILE5 vehicle category level, were multiplied by the corresponding VMT values to obtain monthly emissions by county, roadway type, and vehicle category.

## **D. DATA PROVIDED BY STATE AND LOCAL AGENCIES**

The sections above describe some of the data that was supplied by the VISTAS State and local agencies for use in the development of the 2002 onroad emission inventory. Tables II-6 through II-15 summarize the data supplied by each agency in a consistent fashion. These tables primarily list the data that were actually used in this analysis. This section provides additional information on the data supplied by these agencies as well discussing why some of the data supplied could not be used.

**Table II-6. Summary of Onroad Data Provided by Alabama**

<b>Data Element</b>	<b>Data Supplied by Responsible Agency</b>
VMT Data	2002 actual daily VMT by county/road type
MOBILE6 Input Files	
MOBILE5 Input Files	
VMT Mix Information	
Counties by Temperature Region	
Monthly Temperatures	Monthly 2002 temperatures by county
RVP Data	March-September RVP values
Speed Data	
Registration Data	
Fuel Information	
I/M Program Information	N/A
Other	

**Table II-7. Summary of Onroad Data Provided by Florida**

<b>Data Element</b>	<b>Data Supplied by Responsible Agency</b>
VMT Data	2002 actual daily VMT by county/road type
MOBILE6 Input Files	
MOBILE5 Input Files	
VMT Mix Information	
Counties by Temperature Region	Supplied counties in each of 3 temperature regions
Monthly Temperatures	
RVP Data	Summer RVP values provided
Speed Data	
Registration Data	
Fuel Information	
I/M Program Information	N/A
Other	

**Table II-8. Summary of Onroad Data Provided by Georgia**

<b>Data Element</b>	<b>Data Supplied by Responsible Agency</b>
VMT Data	2002 actual average annual daily VMT by county and functional classification prepared by Georgia DOT
MOBILE6 Input Files	Provided MOBILE6 sample input files
MOBILE5 Input Files	
VMT Mix Information	
Counties by Temperature Region	
Monthly Temperatures	
RVP Data	Provided summer RVP values
Speed Data	Provided 2002 statewide speeds by road type (speeds based on VMT-weighted average speeds, from a 2002 loaded highway network for the 13-county Atlanta area)
Registration Data	Provided one MOBILE6 registration distribution for 13-county Atlanta area and one MOBILE6 registration distribution for rest-of-state
Fuel Information	Provided information on Georgia gasoline program, applied to 25 counties
I/M Program Information	Provided I/M inputs for 13-county Atlanta area in MOBILE6 format
Other	Provided VMT temporal adjustment factors by month and day of week for each road type (not used in the 01/04 inventory)

**Table II-9. Summary of Onroad Data Provided by Kentucky**

<b>Data Element</b>	<b>Data Supplied by Responsible Agency</b>
VMT Data	2002 actual daily VMT by county/road type
MOBILE6 Input Files	Provided sample MOBILE6 input files for several counties
MOBILE5 Input Files	
VMT Mix Information	
Counties by Temperature Region	Provided temperature stations to be used for several counties
Monthly Temperatures	
RVP Data	Provided summer RVP for several counties
Speed Data	Provided average speed by road type for several county groupings
Registration Data	
Fuel Information	Verified counties in reformulated gasoline program
I/M Program Information	I/M program information provided
Other	
<b>Jefferson County, Kentucky</b>	
<b>Data Element</b>	<b>Data Supplied by Responsible Agency</b>
VMT Data	2002 summer day VMT from TDM by county/road type/vehicle type
MOBILE6 Input Files	Provided MOBILE6 input files representing the four different vehicle control combinations found in Jefferson County
MOBILE5 Input Files	
VMT Mix Information	Provided Jefferson County VMT mix in MOBILE6 format
Counties by Temperature Region	
Monthly Temperatures	Provided 2002 actual monthly temperature data for Louisville area
RVP Data	Provided summer and winter RVP values
Speed Data	Provided speed distribution file for Jefferson County
Registration Data	Provided registration distribution for Jefferson County in MOBILE6 format
Fuel Information	Reformulated gasoline modeled
I/M Program Information	I/M program information provided
Other	Provided absolute humidity data
<b>Boone County, Campbell County, and Kenton County, Kentucky</b>	
<b>Data Element</b>	<b>Data Supplied by Responsible Agency</b>
VMT Data	2002 actual daily VMT by county/road type
MOBILE6 Input Files	
MOBILE5 Input Files	Provided MOBILE5 input file for Northern Kentucky counties
VMT Mix Information	
Counties by Temperature Region	
Monthly Temperatures	
RVP Data	Provided summer and winter RVP values
Speed Data	Provided speed distribution file for Northern Kentucky
Registration Data	Provided registration distribution for Northern Kentucky in MOBILE6 format—LDGVs and LDGT1s only
Fuel Information	Reformulated gasoline modeled
I/M Program Information	I/M program information extracted from MOBILE5 input file
Other	Provided Northern Kentucky VMT distributions by facility type and by hour in MOBILE6 format

**Table II-10. Summary of Onroad Data Provided by Mississippi**

<b>Data Element</b>	<b>Data Supplied by Responsible Agency</b>
VMT Data	Provided 2002 actual annual VMT by county/road type/vehicle type
MOBILE6 Input Files	
MOBILE5 Input Files	
VMT Mix Information	
Counties by Temperature Region	
Monthly Temperatures	
RVP Data	
Speed Data	
Registration Data	N/A
Fuel Information	
I/M Program Information	
Other	

**Table II-11. Summary of Onroad Data Provided by North Carolina**

<b>Data Element</b>	<b>Data Supplied by Responsible Agency</b>
VMT Data	2002 actual daily VMT by county/road type
MOBILE6 Input Files	
MOBILE5 Input Files	
VMT Mix Information	
Counties by Temperature Region	Indicated counties within each of several temperature regions in state
Monthly Temperatures	
RVP Data	
Speed Data	Provided average speed data by road type for several groups of counties and rest-of-state
Registration Data	Provided registration data for several groups of counties and rest-of-state based on 2001 data
Fuel Information	Provided written description of I/M program
I/M Program Information	
Other	

**Table II-12. Summary of Onroad Data Provided by South Carolina**

<b>Data Element</b>	<b>Data Supplied by Responsible Agency</b>
VMT Data	2002 actual annual VMT by county/road type
MOBILE6 Input Files	
MOBILE5 Input Files	
VMT Mix Information	
Counties by Temperature Region	Supplied counties in each of 7 temperature regions
Monthly Temperatures	
RVP Data	
Speed Data	
Registration Data	
Fuel Information	
I/M Program Information	N/A
Other	

**Table II-13. Summary of Onroad Data Provided by Tennessee**

<b>Data Element</b>	<b>Data Supplied by Responsible Agency</b>
VMT Data	2002 actual daily VMT by county/road type
MOBILE6 Input Files	Provided MOBILE6 input files for groups of counties covering state
MOBILE5 Input Files	
VMT Mix Information	Provided VMT mix fractions by road type
Counties by Temperature Region	
Monthly Temperatures	
RVP Data	Provided summer RVP information
Speed Data	Provided average speed data by road type for groups of counties
Registration Data	Provided registration data for most counties
Fuel Information	
I/M Program Information	Provided in MOBILE6 input files
Other	

**Table II-14. Summary of Onroad Data Provided by Virginia**

<b>Data Element</b>	<b>Data Supplied by Responsible Agency</b>
VMT Data	1999 actual annual VMT by county/road type/vehicle type
MOBILE6 Input Files	Provided MOBILE6 input files for representative counties
MOBILE5 Input Files	
VMT Mix Information	
Counties by Temperature Region	Provided listing of counties within each of several temperature regions
Monthly Temperatures	
RVP Data	Provided summer RVP data
Speed Data	Speed data provided for each VMT record
Registration Data	2002 county-level registration data provided for nonattainment counties
Fuel Information	Verified counties in reformulated gasoline program
I/M Program Information	I/M and ATP inputs provided in MOBILE6 formats; verified counties that implement I/M
Other	LEV program modeled statewide; provided diesel sales fractions

**Table II-15. Summary of Onroad Data Provided by West Virginia**

<b>Data Element</b>	<b>Data Supplied by Responsible Agency</b>
VMT Data	2002 actual annual VMT by county/road type/vehicle type
MOBILE6 Input Files	Supplied several sample MOBILE6 input files
MOBILE5 Input Files	
VMT Mix Information	VMT data included vehicle type splits
Counties by Temperature Region	Supplied counties in each of 4 temperature regions
Monthly Temperatures	
RVP Data	Supplied summer RVP value statewide
Speed Data	Supplied speed data in MOBILE6 input files--speed data determined to be inappropriate for this analysis
Registration Data	
Fuel Information	
I/M Program Information	N/A
Other	



## **1. Temperature**

The default average daily maximum and minimum temperature data for each month used in this analysis was obtained from the National Climatic Data Center. This temperature data was actual 2002 data. It should be noted that a number of agencies provided information on ozone season or summer temperatures. This information could not be used in this analysis, as the ozone season temperature data are based on several years of temperature data and do not represent the average daily minimum and maximum monthly temperatures that were needed for this analysis. Information was provided by Alabama, Kentucky, North Carolina, South Carolina, Virginia, and West Virginia related to monthly temperature. In some cases, this data divided the counties within the State into several temperature regions and listing a city that should be used for obtaining the temperature data. In these cases, a temperature station from the National Climatic Data Center database was selected from the desired city, and this corresponding temperature set was applied to the counties listed by the States. Several of the States provided their own full set of 2002 temperature data either Statewide or by county. These data were included in the analysis, replacing the default temperature data for those States.

## **2. I/M and ATP Programs**

Several agencies provided I/M and ATP inputs in the form of MOBILE5 input files. Pechan converted these inputs to MOBILE6 inputs, following the guidance in the MOBILE6 user's guide. Agencies that provided the data in MOBILE5 format should review the MOBILE6 I/M and ATP inputs carefully to make sure that the conversions fully capture the actual programs as they were implemented in 2002. In addition, from information provided by North Carolina, Tennessee, and Jefferson County, Kentucky, the I/M and ATP programs should only be applied to a portion of the VMT in the corresponding counties. For the North Carolina and Tennessee I/M counties, duplicate MOBILE6.2 input files were created that eliminate the I/M and ATP programs. The VMT from these counties was divided according to the fraction of the VMT subject to I/M and the fraction of the VMT not subject to I/M. These fractions were provided by the corresponding agencies in North Carolina and Tennessee. The VMT data for each I/M county was then divided according to these VMT fractions to obtain one set of VMT for the portion of vehicles subject to I/M and another set for those not subject to I/M. The emission factors from the I/M files were multiplied by the portion of the VMT subject to I/M while the emission factors from the files without the I/M were multiplied by the remaining portion of the VMT. In Jefferson County, Kentucky, a similar procedure was followed. However, in this case, the county also has a significant portion of VMT from vehicles registered in Indiana that are not subject to I/M or that do not have reformulated gasoline. Thus, the Jefferson County VMT was divided into four subsets and four MOBILE6 input files were developed representing the four groups of vehicle types traveling in the county.

## **3. RVP and Fuel Programs**

Default RVP by county and month were obtained from the data used in the 2002 NEI. The NEI fuel data are based on year 2000 fuel survey data for January and July, with data for intermediate months calculated by interpolation. RVP data for July were applied from May through September, the months when Phase II RVP regulations are in effect. For States that supplied

July, summer, or ozone season RVP values, these values were also applied from May through September. If winter RVP values were supplied, these values were applied directly in each of the remaining months. As mentioned above, reformulated gasoline programs were modeled where appropriate. Georgia provided additional fuel inputs to capture the RVP and sulfur content values of its low sulfur gasoline program.

### III. NONROAD METHODS AND DATA

#### A. NONROAD MODEL CATEGORIES

Pechan used EPA’s draft NONROAD2002a model to generate 2002 annual emissions for the majority of nonroad engines. To improve the accuracy of these model runs, we asked State/Local/Tribal (S/L/T) contacts to provide seasonal or monthly gasoline Reid Vapor Pressure (RVP) and temperature; appropriate data on reformulated gasoline (RFG), oxygenated fuel and Stage II programs, and diesel fuel sulfur levels. In addition, to improve the activity data inputs, we asked whether S/L/T agencies had collected information on equipment populations or activity (e.g., hours of use or load factors) to use in place of default populations in the NONROAD model. No S/L/T agencies provided activity data to replace the model defaults.

Seasonal average RVP and average, maximum and minimum temperature values were calculated based on the county-level, monthly RVP and temperature data set prepared for onroad mobile sources. Information on RFG programs and oxygenated fuels programs obtained for the onroad mobile sector was also used. In July 2003, Pechan distributed the input values (RVP, percent O2, temperature, and Stage II control efficiency) to be used for the draft NONROAD model 2002 inventory for review and comment by the VISTAS S/L/T agencies. Pechan obtained comments from the S/L/T agencies listed in Table III-1.

**Table III-1. Summary of Comments by S/L/T Agencies on NONROAD Model Input Values Distributed in July 2003**

State	Comment
Alabama	Provided region specific data to replace the statewide default values for RVP and ambient temperature
Georgia	Changed oxygen weight percent to zero for all counties
Kentucky	No Stage II programs in Bullitt and Oldham Counties
Tennessee	Revised RVP value for Davidson County
Mississippi	Revised statewide RVP by season
Virginia	No Stage II program in Charles City County

Additional comments on the August 2003 NONROAD model temperature and RVP inputs were incorporated for consistency with data submitted for the onroad mobile modeling (e.g., North Carolina). In addition, the State of West Virginia provided revised geographic allocation files for certain nonroad categories to improve upon the NONROAD model’s default county allocation.

Using the inputs shown in the file “VISTAS NONROAD County Inputs.xls,” Pechan prepared seasonal option files for each of four seasons (winter, spring, summer, and autumn), and ran the

NONROAD model at the county level. Model default values were used for all other inputs, with the exception of diesel fuel sulfur. A value of 2,500 parts per million volume (ppmv) was used instead of the default 2,318 ppm, since the default represented a national average including California’s lower diesel fuel sulfur level. Pechan summed the seasonal results, and then processed the model output to develop a county-level, SCC-level annual emissions inventory for all pollutants except NH<sub>3</sub>.

The NH<sub>3</sub> emissions for NONROAD model categories were developed using the following procedures. OTAQ recently reviewed the basis of NH<sub>3</sub> data summarized in a report entitled, “A Study of the Potential Impact of Some Unregulated Motor Vehicle Emissions” (Harvey, 1983). In conducting this review, OTAQ performed an analysis of the available light-duty noncatalyst engine data to develop defensible gasoline nonroad emission factors on a mg/gallon basis (Harvey, 2003). For both gasoline noncatalyst and diesel engines, fuel based emission factors were developed from emission factors expressed on a gram/mile basis by accounting for the reported fuel economy of each tested engine. For gasoline non-catalyst engines, this resulted in a value of 115.8 mg/gallon, which is applied to county-level fuel consumption estimates for 2-stroke gasoline, 4-stroke gasoline and liquified petroleum gas (LPG) equipment. From the diesel engine test data, a value of 83.3 mg/gallon was derived, which is applied to diesel fuel consumption estimates. County-level fuel consumption for these engines, expressed in gallons, is an output from EPA’s NONROAD model.

## **B. AIRCRAFT, COMMERCIAL MARINE VESSELS AND LOCOMOTIVES**

For 2002 aircraft, commercial marine vessels (CMVs), and locomotives, Pechan used 1999 emission estimates developed for EPA’s 1999 NEI Version 2 as base year estimates for the VISTAS region. These categories are not included in the NONROAD model, and are hereafter referred to as “other nonroad.” Pechan then incorporated revised S/L/T estimates summarized in Table III-2, using the replacement procedures summarized in Tables III-3a through III-3d. Pechan tracked changes by labeling the default 1999 NEI records as Version 2 (V2) and the revised S/L/T records as Version 3 (V3). In cases where PM<sub>2.5</sub> estimates were not provided, they were developed using the following category-specific fractions applied to the available PM<sub>10</sub> emission estimates: 1) Aircraft: 0.69; 2) Locomotive: 0.90; and 3) CMV: 0.92 (EPA, 2002). Commercial marine adjustments are described in detail in the following section.

**Table III-2. Summary of S/L/T Agency Data Incorporated into the Draft VISTAS 2002 Other Nonroad Inventory**

<b>State</b>	<b>Description of Inventory</b>	<b>Pollutants</b>
Alabama	1999 Locomotive emissions for Pickens and Tuscaloosa counties	VOC, NO <sub>x</sub> , and CO
Florida	2001 Aircraft, Locomotive and Commercial Marine Vessel emissions for Palm Beach County	VOC, NO <sub>x</sub> , CO, PM <sub>10</sub> , and SO <sub>x</sub>
Tennessee	1999 Aircraft and Locomotive emissions for Davidson County	VOC, NO <sub>x</sub> , CO, SO <sub>x</sub> , and primary PM <sub>10</sub>
Virginia	1999 Statewide Inventory for Aircraft, Locomotive and Commercial Marine Vessels	VOC, NO <sub>x</sub> , CO

**Table III-3a. Replacement Procedures for 1999 Locomotive Emissions for  
Pickens and Tuscaloosa County, Alabama**

STATE_ FIPS	COUNTY_ FIPS	SCC	Version	Notes	START_ DATE	END_ DATE	VOC	NOX	CO
01	107	2285002005	V3				7.73	179.7	22.81
01	107	2285002005	V2	Replace VOC, NOx, and CO emissions	19990101	19991231	1962.9	45643	5794.5
01	107	2285002010	V3				5.39	53.48	9.47
01	107	2285002010	V2	Replace VOC, NOx, and CO emissions	19990101	19991231	5.39	53.48	9.48
01	125	2285002005	V3				16.31	379.15	48.13
01	125	2285002005	V2	Replace VOC, NOx, and CO emissions	19990101	19991231	3384.9	78711.4	9992.6
01	125	2285002010	V3				9.29	92.15	16.33
01	125	2285002010	V2	Replace VOC, NOx, and CO emissions	19990101	19991231	9.29	92.15	16.33

**Table III-3b. Replacement Procedures for 1999 Aircraft, Locomotive, and Commercial Marine Vessel Emissions for Palm Beach County, Florida**

STATE_FIPS	COUNTY_FIPS	SCC	Version	Notes	START_DATE	END_DATE	VOC	NOX	CO	SO2	PM10-PRI	PM25-PRI
12	099	2275000000	V3	Apply a Growth Factor to 2001 state-supplied aircraft emissions to backcast to 1999 Estimate PM2.5-PRI off PM10-PRI	19990101	19991231	470.39	805.94	4,121.41	1.98	0.00	
12	099	2275001000	V2	Delete all records for this SCC	19990101	19991231	0.44	0.05	9.03	0	0.19	0.13
12	099	2275020000	V2	Delete all records for this SCC	19990101	19991231	79.1	275.5	330.6	26.34		
12	099	2275050000	V2	Delete all records for this SCC	19990101	19991231	13.93	2.37	437.43	0.36	8.62	5.95
12	099	2275060000	V2	Delete all records for this SCC	19990101	19991231	9.23	1.19	212.32	0.11	4.55	3.14
12	099	2280000000	V3	Apply a Growth Factor to 2001 state-supplied cmv emissions to backcast to 1999 Estimate PM2.5-PRI off PM10-PRI	19990101	19991231	10.42	115.60	0.97	9.94	33.91	
12	099	2280002100	V2	Delete all records for this SCC	19990101	19991231	25.5	815.4	107.51	36.95	34.3	31.55
12	099	2280002200	V2	Delete all records for this SCC	19990101	19991231	0.22	7.05	0.93	0.32	0.3	0.27
12	099	2280003100	V2	Delete all records for this SCC	19990101	19991231	6.8	217.5	28.63	115.6	9.48	8.73
12	099	2280003200	V2	Delete all records for this SCC	19990101	19991231	0.06	1.93	0.25	1.43	0.11	0.1
12	099	2285002000	V3	Apply a Growth Factor to 2001 state-supplied locomotive emissions to backcast to 1999 Estimate PM2.5-PRI off PM10-PRI	19990101	19991231	28.19	658.78	83.64	48.09	15.50	
12	099	2285002006	V2	Delete all records for this SCC	19990101	19991231	6.11	164.1	16.17	10.26	4.07	3.66
12	099	2285002008	V2	Delete all records for this SCC	19990101	19991231	0.45	12.15	1.2	0.76	0.3	0.27
12	099	2285002009	V2	Delete all records for this SCC	19990101	19991231	6.78	182.2	17.95	11.39	4.52	4.07
12	099	2285002010	V2	Delete all records for this SCC	19990101	19991231	3.75	64.36	6.77	3	1.64	1.47

<sup>1</sup> Palm Beach County provided emission estimates corresponding to 2001; as such, 2001 emission estimates were backcast to 1999 using growth factors presented in this report before incorporation.

**Table III-3c. Replacement Procedures for 1999 Aircraft and Locomotive Emissions for Davidson County, Tennessee**

STATE_FIPS	COUNTY_FIPS	SCC	Version	Notes	START_DATE	END_DATE	VOC	NOX	CO	SO2	PM10-PRI	PM25-PRI
47	037	2275000000	V3	Estimate PM2.5-PRI off PM10-PRI	19990101	19991231	232.125	634.35	1766	32.13	39.25	
47	037	2275001000	V2	Delete all records for this SCC	19990101	19991231	1.7	0.2	35	0.02	0.75	0.52
47	037	2275020000	V2	Delete all records for this SCC	19990101	19991231	187.45	649.92	782.93	62.34		
47	037	2275050000	V2	Delete all records for this SCC	19990101	19991231	4.72	0.8	148.3	0.12	2.92	2.02
47	037	2275060000	V2	Delete all records for this SCC	19990101	19991231	15.22	1.97	349.97	0.19	7.51	5.18
47	037	2285002000	V3	Estimate PM2.5-PRI off PM10-PRI	19990101	19991231	20.803	363.117	50.701	26.36	8.893	
47	037	2285002006	V2	Delete all records for this SCC	19990101	19991231	31.91	857.26	84.46	53.6	21.27	19.15
47	037	2285002010	V2	Delete all records for this SCC	19990101	19991231	19.6	336.23	35.39	15.68	8.54	7.69

**Table III-3d. Replacement Procedures for 1999 Aircraft, Locomotive, and Commercial Marine Vessel Emissions for Sample Counties in Virginia**

STATE_FIPS	COUNTY_FIPS	SCC	Version	Notes	START_DATE	END_DATE	VOC	NOX	CO	SO2	PM10-PRI	PM25-PRI
51	001	2275001000	V3		19990101	19991231	3.47	0.78	3.74			
51	001	2275001000	V2	Replace VOC, NOx, and CO emissions Keep SO2, PM10-PRI, and PM2.5-PRI emissions	19990101	19991231	0.31	0.04	6.38	0	0.14	0.09
51	013	2275020000	V3		19990101	19991231	145.821	992.23	1634.2			
51	013	2275020000	V2	Replace VOC, NOx, and CO emissions Keep SO2 emissions	19990101	19991231	271.17	940.36	1132.7	90.2		
51	001	2275050000	V3		19990101	19991231	1.25	0.21	39.34			
51	001	2275050000	V2	Replace VOC, NOx, and CO emissions Keep SO2, PM10-PRI, and PM2.5-PRI emissions	19990101	19991231	0.25	0.04	7.81	0.01	0.15	0.11
51	001	2275060000	V3		19990101	19991231	0.05	0.01	1.26			
51	001	2275060000	V2	Replace VOC, NOx, and CO emissions Keep SO2, PM10-PRI, and PM2.5-PRI emissions	19990101	19991231	1.47	0.19	33.8	0.02	0.72	0.5
51	670	2280002000	V3	Add SCC to the Inventory	19990101	19991231	3.3	18.16	6.94			
51	670	2280002100	V2	Sum up SO2, PM10-PRI, and PM2.5-PRI emissions for SCCs 2280002100 and 2280002200 and add to SCC 280002000. After that, delete all records for SCC 2280002100 and 2280002200	19990101	19991231	10.12	323.52	42.66	14.7	13.61	12.52
51	670	2280002200	V2	Sum up SO2, PM10-PRI, and PM2.5-PRI emissions for SCCs 2280002100 and 2280002200 and add to SCC 2280002000. After that, delete all records for SCC 2280002100 and 2280002200	19990101	19991231	0.17	5.39	0.71	0.24	0.23	0.21
51	670	2280003000	V3	Add SCC to the Inventory	19990101	19991231	0.14	1.64	0			
51	670	2280003100	V2	Sum up SO2, PM10-PRI, and PM2.5-PRI emissions for SCCs 2280003100 and 2280003200 and add to SCC 2280003000. After that, delete all records for SCC 2280003100 and 2280003200	19990101	19991231	2.7	86.31	11.36	45.9	3.76	3.46
51	670	2280003200	V2	Sum up SO2, PM10, and PM2.5 Emissions for SCCs 2280003100 and 2280003200 and add to SCC 2280003000. After that, delete all records for SCC 2280003100 and 2280003200	19990101	19991231	0.05	1.48	0.19	1.09	0.08	0.08
51	199	2283002000	V3		19990101	19991231	8.46	53.47	15.51			
51	199	2283002000	V2	Replace VOC, NOx, and CO emissions	19990101	19991231	7.43	47.26	13.63			
51	740	2285002005	V3	Add SCC to the Inventory	19990101	19991231	3.76	100.99	9.95			
51	740	2285002006	V2	Sum up SO2, PM10-PRI, and PM2.5-PRI emissions for SCCs 2285002006 and 2285002007 and add to SCC 285002005. After that, delete all records for SCC 2285002006 and 2285002007. <sup>1</sup>	19990101	19991231	0.7	18.77	1.85	1.17	0.47	0.42
51	740	2285002007	V2	Sum up SO2, PM10-PRI, and PM2.5-PRI emissions for SCCs 2285002006 and 2285002007 and add to SCC 285002005. After that, delete all records for SCC 2285002006 and 2285002007. <sup>1</sup>	19990101	19991231	0.08	2.26	0.22	0.14	0.06	0.05
51	036	2285002010	V3		19990101	19991231	0.59	10.13	1.06			
51	036	2285002010	V2	Replace VOC, NOx, and CO emissions Keep SO2, PM10-PRI, and PM2.5-PRI emissions	19990101	19991231	1.99	34.15	3.59	1.59	0.87	0.78

<sup>1</sup> Other counties may also have emissions for SCCs 2285002008 and 2285002009. In these cases, sum up SO2, PM10-PRI, and PM2.5-PRI emissions for SCCs 2285002006, 2285002007, 2285002008, and 2285002009 and add to SCC 2285002005. After that, delete all records for SCC 2285002006, 2285002007, 2285002008, and 2285002009.

## 2. CMV Improvements

This section describes procedures for improving the spatial distribution of CMV emission estimates for the VISTAS region. States that share borders with non-VISTAS States along the Mississippi and Ohio Rivers have expressed concern about the representativeness of port emission estimates at a county-level. Revising the county-level emissions estimates would allow more accurate modeling of emissions in the VISTAS States.

Ideally, CMV emission estimates would be developed using local activity data that account for vessel type, engine type and mode of operation (cruise, maneuvering, and hotelling). Creating this type of “bottom-up” emission inventory requires a large amount of effort. Therefore, Pechan utilized port-specific emission estimates developed for the 1999 NEI, distributed using a revised allocation methodology, which incorporates information on the number of port facilities in each county.

### a. Current Allocation Method

The current 2002 VISTAS commercial marine inventory is based on EPA’s 1999 NEI Version 2.0, projected to 2002 using appropriate growth factors. State-supplied data were incorporated by EPA or by Pechan for some VISTAS States for this category, including Alabama, Virginia, West Virginia, and Palm Beach County, Florida.

The 1999 NEI estimated emissions for these categories according to the following SCCs:

SCC	Descriptor 1	Descriptor 3	Descriptor 6	Descriptor 8
2280002100	Mobile Sources	Marine Vessels, Commercial	Diesel	Port emissions
2280002200	Mobile Sources	Marine Vessels, Commercial	Diesel	Underway emissions
2280003100	Mobile Sources	Marine Vessels, Commercial	Residual	Port emissions
2280003200	Mobile Sources	Marine Vessels, Commercial	Residual	Underway emissions

For the 1999 NEI, commercial marine diesel emissions were developed by obtaining 2000 emission estimates for all pollutants except SO<sub>2</sub> from OTAQ’s marine diesel regulatory background documentation (*Draft Regulatory Impact Analysis - Control of Emissions from Compression-Ignition Marine Engines*). To estimate emissions for 1999, 2000 estimates were backcast using growth factors obtained from the draft RIA cited above. Steam-powered residual CMV emission estimates were developed by obtaining fuel usage data from OTAQ and applying fuel-based emission factors (EPA, 1989). A similar method was used for diesel SO<sub>2</sub> emissions. National diesel usage was estimated assuming a sulfur content of 0.25 percent and EPA emission factors (EPA, 2002).

National diesel emissions were disaggregated into port and underway emissions estimates based on the assumption that 75 percent of distillate fuel is consumed within the port, while the remaining fuel is consumed while underway, consistent with EPA guidance. National residual emissions were disaggregated into port and underway emissions estimates based on the assumption that 25 percent of residual fuel is consumed within the port, while the remaining fuel is consumed while underway (EPA, 1989).



To allocate to counties, port emissions were assigned to the 150 largest U.S. ports based on activity obtained from the U.S. Army Corps of Engineers (USACE). The percentage of total traffic for each port was calculated by dividing the port-level traffic by the total traffic. Emissions for each port were then assigned to a single county.

Underway emissions are assigned to counties based on a county's shipping lane traffic. The Bureau of Transportation Statistics' (BTS') *National Transportation Atlas Databases-1999* contains data on the thousand tons per mile traveled for each shipping lane link in the United States (BTS-CD26). Where navigable rivers form a county or State boundary, the shipping lane traffic is proportioned to individual counties based on the length of shoreline that is shared. For example, if two counties share a navigable river, and both counties have the same length of shoreline, the shipping traffic is split evenly between the two counties. Shipping lanes that are not within counties, for example in the ocean, are associated to States based on BTS assignments. These waterway weights are then evenly distributed among the counties within these States that have navigable waterways. All shipping activity is summed at the county-level and compared with national shipping activity to determine what portion of activity can be attributed to individual counties. These proportions were used in disaggregating the national CMV emission estimates to the county level.

***b. Revised Port Allocation Method***

Figures III-1 and III-2 present emission maps for CMV port and underway NO<sub>x</sub> emissions created from the 1999 NEI Version 2.0 data. For underway emissions, Pechan believes that the allocation procedure results in a reasonable distribution of county-level emissions. However, the methodology to allocate port emissions results in all the emissions being assigned to a single county. For example, Cabell County in West Virginia is assigned all emissions for Huntington Port, but no emissions are allocated to Lawrence County in Ohio, the county on the opposite river bank.

Port areas encompass multiple States and counties and in some cases, multiple waterways. Therefore, the emissions allocation process must incorporate all counties in the vicinity of the port where activity is occurring. This is especially true for inland rivers where activity takes place on both riverbanks and for 10 river miles or more outside the port city. The revised methodology allocates port emissions based on a surrogate for port-related activity in each county, rather than using a single county to define the port.

Figure III-1. VISTAS Region and Surrounding States, *Underway NO<sub>x</sub> Emissions*

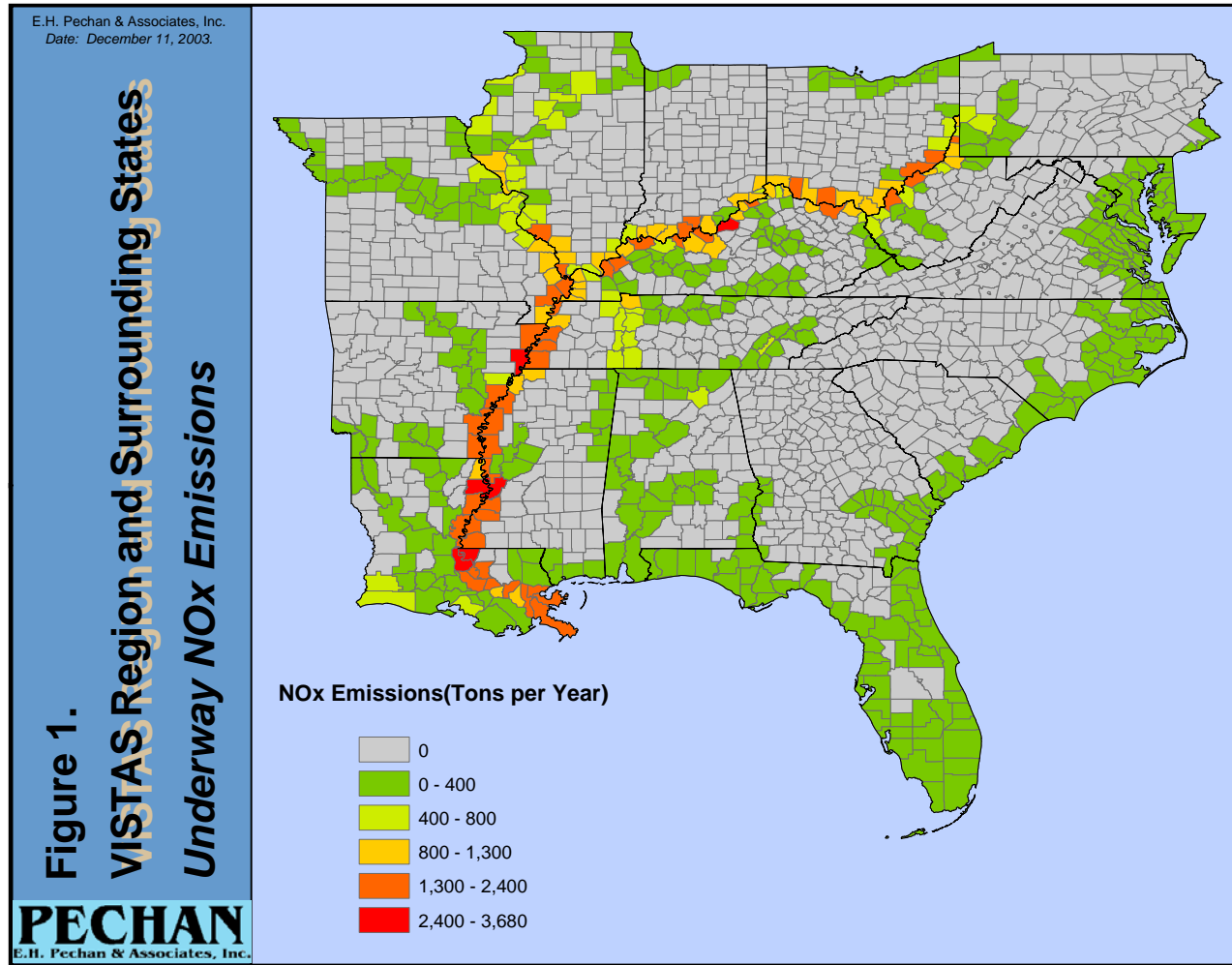
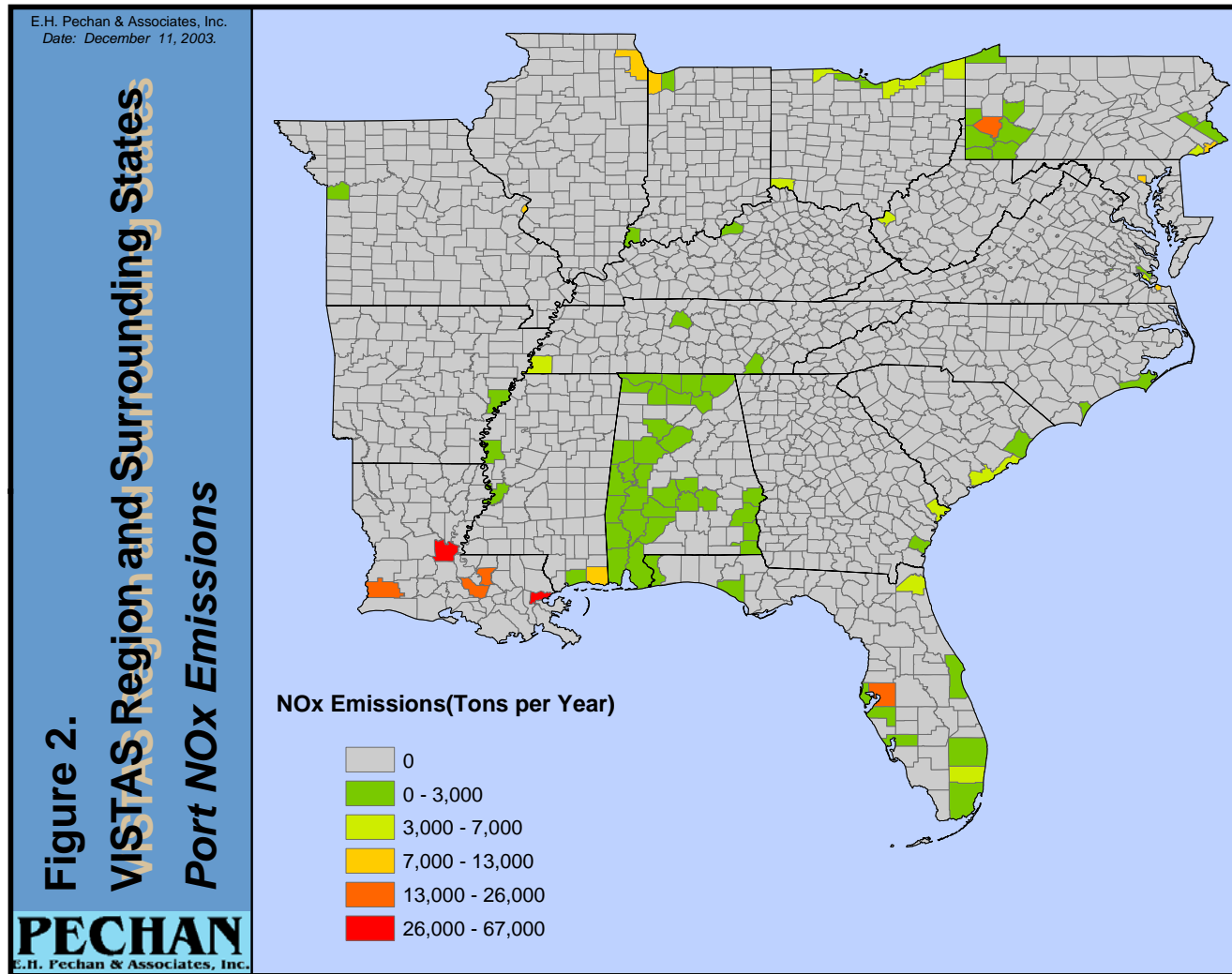


Figure III-2. VISTAS Region and Surrounding States, Port NO<sub>x</sub> Emissions



The report, *Waterborne Commerce of the United States, Calendar Year 1999* (USACE, 2000), hereafter referred to as *Waterborne Commerce*, presents the cargo tonnage and number of vessel trips in major waterways of the United States. The report defines port areas, which USACE uses to develop the Top 150 Ports in the United States by amount of cargo tonnage. As discussed in the previous section, the 1999 NEI allocates all the port emissions to these 150 ports based on the cargo tonnage handled by the port.

Pechan uses this allocation of emissions to each port area as the starting point of its revised allocation process. Table III-4 presents the ports that are located in VISTAS and adjoining States, which are part of the Top 150 Ports.

**Table III-4. Port Areas Located in VISTAS and Adjoining States**

Port	State	Port	State
Mobile	AL	Pascagoula	MS
Guntersville	AL	Vicksburg	MS
Helena	AR	Biloxi	MS
Port Everglades	FL	Greenville	MS
Jacksonville	FL	Gulfport	MS
Miami	FL	Wilmington	NC
Port Canaveral	FL	Morehead City	NC
Palm Beach	FL	Cincinnati	OH
Panama City	FL	Pittsburgh	PA
Pensacola	FL	Charleston	SC
Tampa	FL	Georgetown	SC
Port Manatee	FL	Memphis	TN
Weedon Island	FL	Nashville	TN
Savannah	GA	Chattanooga	TN
Brunswick	GA	Norfolk Harbor	VA
Mount Vernon	IN	Newport News	VA
Louisville	KY	Hopewell	VA
New Orleans	LA	Huntington	WV
Baton Rouge	LA		

The next step was to develop a list of counties that make up the port area. Port area definitions were obtained from *Waterborne Commerce*. Table III-6 presents the port definitions for the VISTAS States and adjoining States. Using the port definitions by river mile, Pechan established which counties are included in each port area. In many cases, these port areas encompass multiple counties. For example, Pittsburgh is defined in *Waterborne Commerce* as:

Ohio River from Pittsburgh, PA to mile 40 (Pennsylvania/Ohio State Line);  
 Allegheny River from Pittsburgh, PA to mile 72 (to head of project);  
 Monongahela River from Pittsburgh, PA to mile 91 (to head of project).

Therefore, the Port of Pittsburgh includes the following counties in Pennsylvania; Allegheny, Westmoreland, Armstrong, Washington, Fayette, Greene, Beaver. This process was repeated for all the port areas listed in Table III-4.

The next step in allocating emissions is to develop a surrogate for the amount of CMV activity in each county of the port area. Pechan assumed that the activity of vessels in each county is related to the number of port facilities operating in a given county. Port facilities include terminals, piers, wharves, and docks that are involved in all types of commercial activity and support services. Pechan obtained the number of port facilities in each county from *The Port Series Reports* (USACE, 2003). The USACE periodically surveys the commercial marine industry to obtain information on port facilities and publishes it in *The Port Series Reports*. The reports give the name, location, operations, and describe the physical and inter-modal characteristics of the facilities. The data includes the location of the facility by river mile, State, and county.

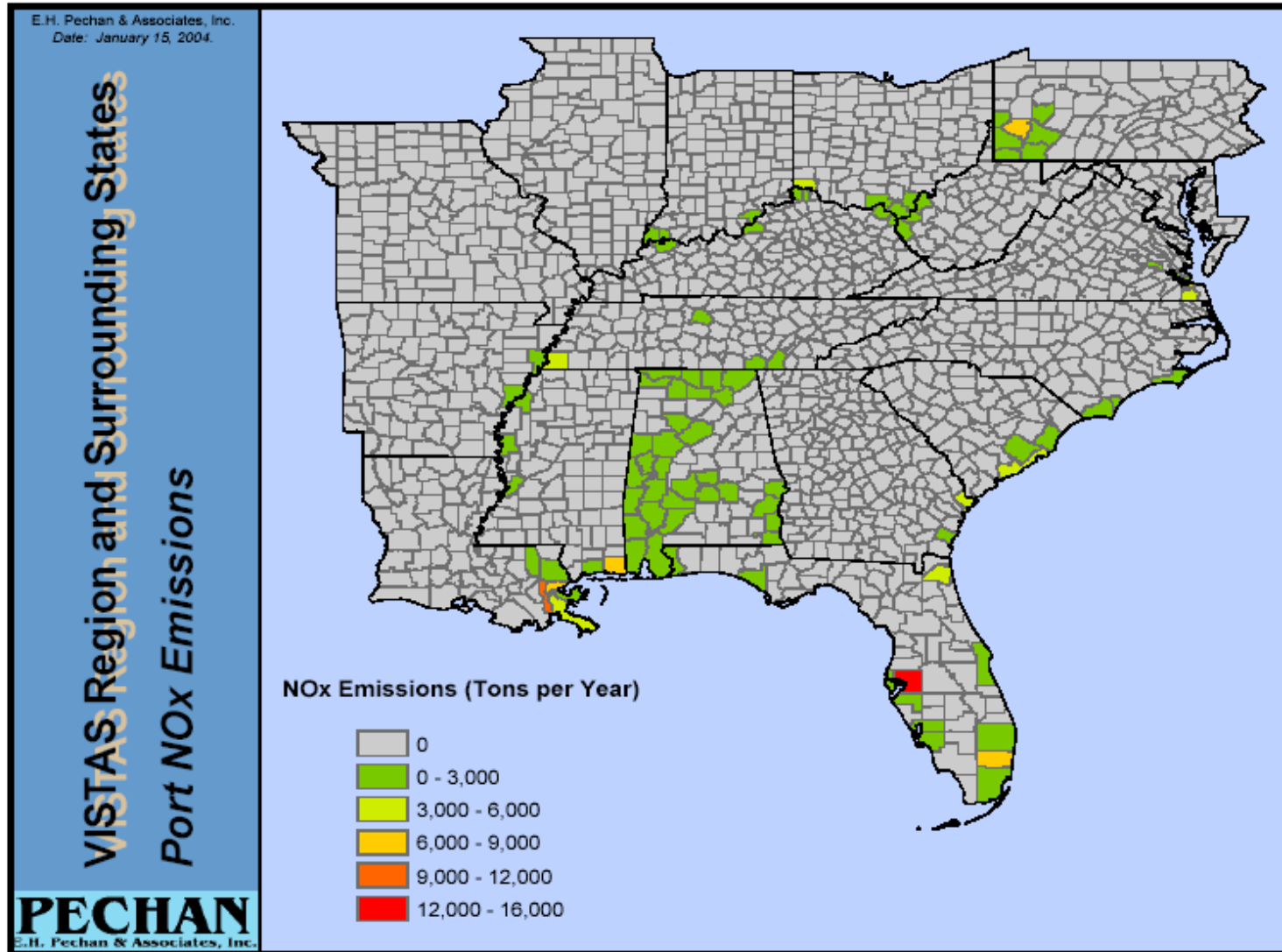
For each port area, Pechan calculated the ratio between the number of port facilities in each county to the total number of facilities in all counties that make up the port area. This ratio was used to allocate emissions for each port area to the county-level. Table III-5 presents the allocation ratios for each county in the port areas. Some port areas were still encompassed by one county using the definition of the port from *Waterborne Commerce*. However, a number of port areas include multiple counties. Note that New Orleans and Pittsburgh do not include any counties in VISTAS States.

**Table III-5. List of VISTAS Ports and Ports of Adjoining States**

Port	State	County	Ratio	Port	State	County	Ratio	Port	State	County	Ratio
Port Everglades	FL	Broward	1.0	Helena	AR	Phillips	0.7778	Chattanooga	TN	Hamilton	0.7692
Jacksonville	FL	Duval	1.0		MS	Coahoma	0.2222		TN	Marion	0.2308
Miami	FL	Miami-Dade	1.0		FL	Charlotte	0.7500		VA	Norfolk City	0.5568
Port Canaveral	FL	Brevard	1.0	Charlotte	FL	Lee	0.2500	Norfolk	VA	Chesapeake City	0.3068
Palm Beach	FL	Palm Beach	1.0		IN	Vanderburgh	0.3182		VA	Portsmouth	0.1364
Panama City	FL	Bay	1.0	Mount Vernon	IN	Posey	0.4773	Newport News	VA	Newport News	0.6500
Pensacola	FL	Escambia	1.0		KY	Henderson	0.2045		VA	Hampton	0.3500
Tampa	FL	Hillborough	1.0	Louisville	KY	Jefferson	0.6596	Hopewell	VA	Hopewell	0.5000
Port Manatee	FL	Manatee	1.0		IN	Clark	0.3404		VA	Charles City	0.5000
Weedon Island	FL	Pinellas	1.0		LA	St. Bernard	0.0858		PA	Allegheny	0.5206
Savannah	GA	Chatham	1.0		LA	Plaquemines	0.1231		PA	Westmoreland	0.0412
Brunswick	GA	Glynn	1.0		LA	Orleans	0.3284		PA	Armstrong	0.0309
Pascagoula	MS	Jackson	1.0		LA	Jefferson	0.4366	Pittsburgh	PA	Washington	0.1340
Vicksburg	MS	Warren	1.0		LA	St. Tammany	0.0224		PA	Fayette	0.0412
Biloxi	MS	Harrison	1.0		LA	Tangipahoa	0.0037		PA	Greene	0.0567
Greenville	MS	Washington	1.0		NC	New Hanover	0.8974		PA	Beaver	0.1753
Gulfport	MS	Harrison	1.0	Wilmington	NC	Brunswick	0.1026		KY	Greenup	0.0795
Morehead City	NC	Carteret	1.0		OH	Hamilton	0.7931		KY	Boyd	0.1023
Georgetown	SC	Georgetown	1.0	Cincinnati	KY	Kenton	0.0862		OH	Gallia	0.1136
Nashville	TN	Davidson	1.0		KY	Boone	0.1207	Huntington	OH	Lawrence	0.2273
Mobile	AL	Mobile	1.0	Charleston	SC	Charleston	0.7097		OH	Scioto	0.1364
Guntersville	AL	Marshall	1.0		SC	Berkeley	0.2903		WV	Wayne	0.1136
				Memphis	TN	Shelby	0.9123		WV	Cabell	0.0795
					AR	Crittenden	0.0877		WV	Mason	0.1477

Pechan was directed to perform the reallocation for all VISTAS ports. Figure III-3 presents the reallocation of port emissions in all States except Alabama. Alabama's CMV data were provided to EPA and already incorporated into the 1999 NEI Version 2, and Pechan did not have access to the default 1999 NEI estimates for this State and category. Since State data take precedence, the inventory prepared by Pechan reflects the incorporation of State data for those areas that developed independent CMV emission estimates, including Virginia and Palm Beach County, Florida. In addition, West Virginia provided their own county fractions to allocate emissions for the Port of Huntington, using District-level data from the Army Corps of Engineers on tonnage of freight shipped and received. West Virginia also requested that residual-fueled CMV activity/emissions be zeroed out for their State. States providing their own data are encouraged to review the allocations Pechan developed for their port areas, and to provide further comment or direction as needed.

Figure III-3. VISTAS Region and Surrounding States, *Revised Port Emissions of NO<sub>x</sub>*



**Table III-6. Definition of Port Areas Obtained from Waterborne Commerce  
(USACE, 2000)**

<b><i>VISTAS PORTS</i></b>
<i>MOBILE, AL</i> Entrance, bay and river channels, and channels into Chickasaw and Three Mile Creeks; Branch Channels; Theodore Ship Channel.
<i>GUNTERSVILLE, AL</i> Both banks of the Tennessee River at mile 358 to mile 363.
<i>JACKSONVILLE HARBOR, FL</i> Atlantic Ocean to the Florida East Coast Railway Bridge at Jacksonville, 26.8 miles.
<i>TAMPA, FL</i> Gulf of Mexico to and including the channels of upper Tampa Harbor, 49.8 miles; Channel to Port Tampa and thence to Courtney Campbell Parkway, 17.5 miles; Natural channel leading from Port Tampa Channel toward St. Petersburg, 1.8 miles; Alafia River Channel, 3.6 miles; Hillsborough River to City Waterworks Dam, 10 miles; Channels in "Little Manatee River, Fl; Port Manatee, Fl Harbor."
<i>MIAMI HARBOR, FL</i> Atlantic Ocean to inner end of turning basin at Miami, 6 miles; Meloy Channel and thence natural channels along the easterly side of Biscayne Bay to Bakers Haulover Inlet, FL, about 11 miles; channel from turning basin to mouth of Miami River, 1.1 miles; existing Florida East Coast Railway Channel, Fishermans Channel from mouth of Miami River to Government Cut, 3.8 miles; and the channels reported under "Miami River, FL."
<i>EVERGLADES HARBOR, COLLIER COUNTY, FL</i> - No definition given
<i>CANAVERAL HARBOR, FL</i> Entrance Channel (Atlantic Ocean) to Barrier Beach inner channel and Turning Basins, thence a Barge canal through a lock in the perimeter dike and continuing to the Intracoastal Waterway, Jacksonville to Miami.
<i>CHARLOTTE HARBOR, FL</i> Gulf of Mexico to Municipal Terminal at Punta Gorda, about 29.5 miles; waterfront on Gasparilla Island from Port Boca Grande to Boca Grande, 4.5 miles; and Myakka River to El Jobean, 4 miles.
<i>PALM BEACH HARBOR, FL</i> Atlantic Ocean to Port of Palm Beach Terminals, 1.7 miles; Lake Worth from Riviera Bridge to Southern Boulevard Bridge at West Palm Beach, 7.5 miles; and "Palm Beach, FL side channel and basin."
<i>PORT MANATEE, FL</i> 40 feet deep by 400 feet wide entrance channel and basin. The entrance channel extends approximately 3 miles in length from the turning basin to its intersection with Tampa Harbor main channel. Controlling Depth: 40 feet in entrance channel and turning basin.
<i>PANAMA CITY HARBOR, FL</i> Entrance channel, inside bay and Watson Bayou. Project Depth: Approach channel, 34 feet; across Lands End, 32 feet; Watson Bayou, 10 feet.



**Table III-6. Definition of Port Areas Obtained from Waterborne Commerce  
(USACE, 2000)**

<p><i>PENSACOLA HARBOR, FL</i> Entrance channel and entire harbor, including Bayou Chico. Project Depth: entrance, 35 feet; Inner Harbor, 33 feet; Bayou Chico, 15 and 14 feet.</p>
<p><i>WEEDON ISLAND, FL</i> – no definition</p>
<p><i>BRUNSWICK HARBOR, GA</i> From 32-foot contour in the ocean across the Barthrough St. Simon Sound, Brunswick River, and Turtle River to the upper end of the Allied Chemical Company's Wharf, formerly Atlantic Refining Company Wharf, 20.4 miles; from Brunswick River through East River, to the upper end of the project in Academy Creek, 2.7 miles; from St. Simon Sound through Back River to Mill Creek, the upper end of Back River improvement, 2.9 miles; from Back River through Terry Creek to the Glynn Canning Company's Wharf, 1.8 miles; a total distance of 27.8 miles.</p>
<p><i>SAVANNAH HARBOR, GA</i> From the 40-foot contour in the ocean to the Continental Can Company Plant, 32.15 miles.</p>
<p><i>LOUISVILLE, KY</i> Both banks of the Ohio River from mile 606 to mile 616 Controlling Depth: 9 feet. Project Depth: 9 feet at low water stages.</p>
<p><i>BILOXI HARBOR, MS</i> Mississippi Sound, Biloxi Bay, Back Bay, and land cut to Gulfport Lake. Project Depth: East entrance channel, Mississippi Sound to Gulfport Lake, 12 feet: West entrance channel, Mississippi Sound to Biloxi Harbor, 10 feet; Ott Bayou, 12 feet.</p>
<p><i>GREENVILLE, MS</i> From Mississippi River mile 537 AHP left descending bank in an easterly direction, an entrance channel, 8,000 feet long and 250 feet wide transitioning into the harbor and port area 10,000 feet long and 500 feet wide, then transitioning into Lake Ferguson, a channel 5,700 feet long and 250 feet wide.</p>
<p><i>GULFPORT HARBOR, MS</i> Mississippi Sound Channel, Ship Island Pass Channel, and Small Craft Harbor about 4,300 feet long west of the anchorage basin. Project Depth: Mississippi Sound, 30 feet; Ship Island Pass, 32 feet; Small Craft Harbor, 8 feet.</p>
<p><i>PASCAGOULA HARBOR, MS</i> Lower 4 miles of Dog River and lower 6.8 miles of Pascagoula River, Mississippi Sound, Bayou Casotte, and Horn Island Pass Channels.</p>
<p><i>VICKSBURG, MS</i> From Mississippi River mile 437 AHP on left descending bank in a northerly direction, a channel 14,500 feet long by 150 feet wide in the Yazoo Diversion Canal, thence a dredged entrance channel 4,800 feet long and 150 feet wide, transitioning into a 300-foot wide dredged slack water harbor and turning basin 10,700 feet long.</p>
<p><i>MOREHEAD CITY HARBOR, NC</i> Morehead City Harbor, NC.</p>

**Table III-6. Definition of Port Areas Obtained from Waterborne Commerce  
(USACE, 2000)**

<p><i>PORT OF WILMINGTON, NC</i> (see also Wilmington Harbor NC for waterway data) Both banks of the Cape Fear River extending from a point about 18 miles below the foot of Castle St. in Wilmington to a point about 2 miles above the Railroad Bridge at Navassa, and both banks of Northeast (Cape Fear) River from its mouth to a point about 1.67 miles above the Hilton Railroad Bridge.</p>
<p><i>CHARLESTON HARBOR, SC</i> (Including Ashley River, Cooper River, Shem Creek And Shipyard River, SC) Ocean to Goose Creek via Cooper River and Town Creek; to the Standard Wharf on Ashley River; to the Mount Pleasant Memorial Highway Bridge on Shem Creek; to the Airco Alloys Wharf on Shipyard River; Wando River to Cainhoy.</p>
<p><i>GEORGETOWN HARBOR, SC (Winyah Bay)</i> Atlantic Ocean Entrance to Winyah Bay, SC, to and including turning basin in Sampit River at the City of Georgetown, SC.</p>
<p><i>MEMPHIS, TN</i> Section Included: From mile 715.5 to mile 741.0 on Lower Mississippi River and includes Memphis Harbor (McKellar Lake) and Wolf River Harbor, Tennessee. Controlling Depth: 9 feet. Project Depth: 9 feet at low water stages.</p>
<p><i>PORT OF NASHVILLE, TN</i> (included in traffic of Cumberland River, TN and KY) Both banks of Cumberland River, mile 182 to mile 194 Controlling Depth: 9 feet. Project Depth: 9 feet at low water stages.</p>
<p><i>CHATTANOOGA, TN</i> Section Included: Both banks of the Tennessee River at mile 454 to 471. Controlling Depth: 9 feet. Project Depth: 9 feet at low water stages.</p>
<p><i>PORT OF RICHMOND, VA</i> (Included in James River, VA Consolidated Report)</p>
<p><i>PORT OF NEWPORT NEWS, VA</i> (Including Newport News Creek, VA) Lower east shore of James River from mouth to 1.8 miles, and portion of north shore of Hampton Roads covering approximately 15,000 linear feet of waterfront at Newport News; and Newport News Creek.</p>
<p><i>PORT OF HOPEWELL, VA</i> (Included In James River VA Consolidated Report) South side of James River, from City Point, at mouth of Appomattox River, 2 miles downstream to the mouth of Baileys Creek. Controlling Depth: 25 feet at mean low water. Project Depth: 35 feet, maintained to 25 feet.</p>
<p><i>NORFOLK HARBOR, VA</i> From 55-foot contour in Hampton Roads to Norfolk &amp; Western (formerly Virginia) Railway Bridge Crossing Southern Branch of Elizabeth River, 14.78 miles; thence upstream in Southern Branch, 4.61 miles. In Eastern Branch, 2.54 miles upstream from the mouth of that branch; in Western Branch, 1.78 miles upstream from the mouth of that branch; and 0.73 miles in Scotts Creek.</p>
<p><i>HUNTINGTON, WV</i> Both banks of the Ohio River from mile 303 to mile 317 Controlling Depth: 9 feet. Project Depth: 9 feet at low water stages.</p>

**Table III-6. Definition of Port Areas Obtained from Waterborne Commerce  
(USACE, 2000)**

<b><i>NON-VISTAS PORTS</i></b>
<p><i>HELENA, AR</i> Mile 659 through mile 663 on the Lower Mississippi River. The project provides for maintenance of an off-river harbor with dimensions of 9 feet deep and 450 feet wide for a length of 3,200 feet.</p>
<p><i>MOUNT VERNON, IN</i> Section Included: Right Bank of Ohio River from mile 151 to mile 154. Controlling Depth: 9 feet. Project Depth: 9 feet at low water stages.</p>
<p><i>CINCINNATI, OH</i> Both banks of the Ohio River from mile 465 to mile 491. Controlling Depth: 9 feet. Project Depth: 9 feet at low water stages.</p>
<p><i>PORT OF PITTSBURGH, PA</i> Ohio River from Pittsburgh, PA to mile 40 (Pennsylvania/Ohio State Line); Allegheny River from Pittsburgh, PA to mile 72(to head of project); Monongahela River from Pittsburgh, PA to mile 91(to head of project). Includes Aliquippa-Rochester, Pittsburgh, Clairton-Elizabeth. Controlling Depth: 9 feet. Project Depth: 9 feet.</p>
<p><i>PORT OF PLAQUEMINES, LA</i> Both banks of Mississippi River from mile 0 A.H.P. through mile 81.2 A.H.P Controlling and Project Depths: 45 feet.</p>
<p><i>PORT OF BATON ROUGE, LA</i> Both banks of Mississippi River from mile 168.5 A.H.P. through mile 253 A.H.P; including the Baton Rouge Barge Canal from a point on the east bank of the Mississippi River at mile 234.5 A.H.P., for a distance of 5 miles.</p>
<p><i>PORT OF NEW ORLEANS, LA</i> Both banks of the Mississippi River from mile 81.2 A.H.P. through mile 114.9 A.H.P.; Innerharbor Navigation Canal, 5.5 miles; Mississippi River-Gulf Outlet from its junction with the Innerharbor Navigation Canal to Bayou Bienvenue, 7 miles; and Harvey Canal, 5.5 miles.</p>
<p><i>PORT OF SOUTH LOUISIANA (LA)</i> Both banks of Mississippi River from mile 114.9 A.H.P. through mile 168.5 A.H.P. Controlling and Project Depths: 45 feet.</p>

### 3. Projection Methods

Pechan then projected the revised 1999 inventory to 2002 using surrogate growth indicators. For the aircraft category, 1999 and 2002 approach operations by airport and aircraft type were compiled from the Federal Aviation Administration's Air Traffic Activity Data System (ATADS). The airport-level landing and takeoffs (LTOs) were assigned to counties and summed for the county. For counties with aircraft emissions without a county match in ATADS, State-average growth factors were calculated and applied. The county-level growth factors are not presented in this report, but could be provided to VISTAS S/L/Ts if requested.

For locomotives, projected emissions were developed in two steps as described below. For 1999 to 2001, State-level vessel bunkering and rail fuel consumption was obtained from the Energy Information Administration's (EIA's) *Fuel Oil and Kerosene Sales*. For 2001 to 2002, Pechan applied national growth factors developed from fuel consumption projections in EIA's *Annual Energy Outlook*. Table III-7a lists the growth factors for locomotives that were applied to the 1999 emissions to first develop 2001 emissions. Table III-7b lists the growth factors used to generate 2002 emissions. Locomotive emissions were not revised from the August 2003 draft VISTAS 2002 inventory.

**Table III-7a. Growth Factors for Railroad Distillate Fuel Oil Use**

FIPSST	State	Rail Distillate Fuel Oil Sales (Thousand Gallons)		Growth Factor (GF)
		1999	2001	
01	Alabama	42,137	55,777	1.3
12	Florida	127,269	107,084	0.8
13	Georgia	73,494	70,538	1.0
21	Kentucky	98,941	99,812	1.0
28	Mississippi	14,267	24,812	1.7
37	North Carolina	53,900	77,762	1.4
45	South Carolina	13,051	15,936	1.2
47	Tennessee	44,083	91,363	2.1
51	Virginia	32,202	61,154	1.9
54	West Virginia	9,160	8,787	1.0

Source: Department of Energy, Energy Information Administration Fuel Oil and Kerosene Sales 1999 & Fuel Oil and Kerosene Sales 2001 Table 23. Adjusted Sales for Transportation Use: Distillate Fuel Oil and Residual Fuel Oil (<http://tonto.eia.doe.gov/FTPROOT/pertroleum/053599.pdf>), (<http://tonto.eia.doe.gov/FTPROOT/pertroleum/053501.pdf>)

**Table III-7b. 2002 National Rail Transportation Energy Use by Fuel Type  
(Trillion BTU)**

	<b>2001</b>	<b>2002</b>	<b>Growth Factor (GF)</b>
Intercity Rail (Electric)	10.17	10.40	1.0226
Intercity Rail (Diesel)	16.60	16.88	1.0169
Transit Rail (Electric)	46.36	47.40	1.0224
<b>INTERCITY/TRANSIT RAIL AVERAGE (SCC 2285002008)</b>			<b>1.0206</b>
Commuter Rail (Electric)	16.13	16.49	1.0223
Commuter Rail (Diesel)	26.31	26.76	1.0171
<b>COMMUTER RAIL AVERAGE (SCC 2285002009)</b>			<b>1.0197</b>
Freight Rail (Distillate) (SCCs 2285002000, 2285002005, 2285002006, 2285002007, 2285002010)	512.81	492.32	<b>0.9600</b>

Source: Department of Energy, Energy Information Administration, Annual Energy Outlook 2003: Table 34. Transportation Sector Energy Use by Fuel Type Within a Mode ([http://www.eia.doe.gov/oiaf/aeo/supplement/sup\\_tran.pdf](http://www.eia.doe.gov/oiaf/aeo/supplement/sup_tran.pdf))

Since the CMV emissions were revised for the 1999 base year, these emissions were projected using 2002 *Fuel Oil and Kerosene Sales* data, which became available in November 2003. Table III-8 lists the growth factors for CMVs that were applied to 1999 emissions to generate 2002 emissions. The same regional growth factor that accounts for an average regional growth rate was applied to CMV emissions for all VISTAS States. Because the State-level data represents sales and not use, and CMV activity spans State borders, a regional growth factor was deemed more appropriate. Pechan could make a similar adjustment for the locomotive growth factors, which are also based on fuel sales for 1999 to 2001, if requested by VISTAS.

**Table III-8. Growth Factors for Commercial Marine Vessel Distillate and Residual Fuel Oil Use**

FIPSST	State	Fuel Oil Sales (Thousand Gallons)		Growth Factor (GF)
		1999	2002	
<b><i>DISTILLATE</i></b>				
01	Alabama	67,455	73,400	<b>1.1</b>
12	Florida	139,809	143,577	<b>1.0</b>
13	Georgia	17,697	22,327	<b>1.3</b>
21	Kentucky	81,811	56,169	<b>0.7</b>
28	Mississippi	12,749	68,668	<b>5.4</b>
37	North Carolina	11,279	10,057	<b>0.9</b>
45	South Carolina	12,732	19,782	<b>1.6</b>
47	Tennessee	43,867	112,364	<b>2.6</b>
51	Virginia	29,444	28,235	<b>1.0</b>
54	West Virginia	54,560	46,981	<b>0.9</b>
<b>Regional Distillate GF</b>		<b>471,403</b>	<b>581,560</b>	<b>1.2</b>
<b><i>RESIDUAL</i></b>				
01	Alabama	46,093	93,487	<b>2.0</b>
12	Florida	404,228	460,600	<b>1.1</b>
13	Georgia	40,117	79,191	<b>2.0</b>
21	Kentucky <sup>1</sup>		69	<b>1.2</b>
28	Mississippi	48,644	54,031	<b>1.1</b>
37	North Carolina	6,989	35,210	<b>5.0</b>
45	South Carolina	20,056	22,758	<b>1.1</b>
47	Tennessee <sup>1</sup>		124	<b>1.2</b>
51	Virginia	60,090	36,445	<b>0.6</b>
54	West Virginia			<b>1.2</b>
<b>Regional Residual GF</b>		<b>626,217</b>	<b>781,915</b>	<b>1.2</b>

<sup>1</sup> For Kentucky, Tennessee and West Virginia, Pechan summed the 1999 and 2002 CMV residual fuel oil use to develop a total VISTAS State growth factor, which was then applied to the three States.

Source: Department of Energy, Energy Information Administration, Fuel Oil and Kerosene Sales 1999 & Fuel Oil and Kerosene Sales 2002, Table 23. Adjusted Sales for Transportation Use: Distillate Fuel Oil and Residual Fuel Oil.

## IV. ONROAD REFUELING METHODS

Emissions were separately calculated from onroad refueling, also known as Stage II emissions. Since refueling is a category of evaporative rather than exhaust emissions, VOC is the only criteria pollutant of concern for this category. This chapter discusses the controls modeled for this emission category and the methods used to calculate these emissions. Refueling emissions for onroad sources were updated in February 2004 to account for the VMT updates provided by several States.

### A. CONTROLS

Based on default information from the NEI as well as some information provided by VISTAS agencies, portions of five of the VISTAS States have onroad Stage II refueling controls in place. These States, along with the specific counties with onroad Stage II controls, are listed in Table IV-1. This table also shows information about the Stage II control program in each State including the year a Stage II program began, the number of years that the program was phased-in over, and the control efficiency of the program in reducing VOC emissions from Stage II

refueling for the LDGV, LDGT, and HDGV vehicle categories. These are the inputs required for modeling a Stage II control program using MOBILE6. States with Stage II programs should review this information and provide any corrections for the next round of emissions modeling.

**Table IV-1. Onroad Stage II Control Programs**

State	Start Year	Phase-In Years	Control Efficiency	Counties
Florida	1993	2	95%	Broward, Miami-Dade, Palm Beach
Georgia	1992	3	81%	Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding, Rockdale
Kentucky	1999	2	86%	Boone, Campbell, Kenton
Kentucky	1992	2	95%	Jefferson
Tennessee	1993	3	95%	Davidson, Rutherford, Sumner, Williamson, Wilson
Virginia	1993	2	95%	Counties: Arlington, Chesterfield, Fairfax, Hanover, Henrico, Loudoun, Prince William, Stafford Independent Cities: Alexandria, Colonial Heights, Fairfax, Falls Church, Hopewell, Manassas, Manassas Park, Richmond

## B. METHODS

A simplified set of MOBILE6.2 input files was created to simulate the onroad refueling emission factors. These input files were simplified because several of the inputs used for calculating the onroad exhaust and evaporative emission factors do not affect the refueling emission factors. For example, the refueling emission factors are unaffected by vehicle speed or I/M program. Thus, for each group of counties in a State with the same fuel parameters, temperature parameters, fleet characteristics (registration distribution, diesel sales fractions), and Stage II control program parameters, a MOBILE6.2 input file was created to model the onroad refueling emission factors. As mentioned above, speed does not affect the refueling emission factors, so each input file contained only 12 scenarios—one for each month of the year. Within each scenario, the temperature and fuel parameters were varied, using the same temperature and fuel data modeled in the onroad exhaust and evaporative MOBILE6.2 input files. Other fleet characteristics, such as registration distributions and diesel sales fractions, were included in the input files where applicable. The inputs shown in Table IV-1 were included for the input files representing counties with Stage II control programs. The header section of the MOBILE6.2 input files was set up so that only refueling emission factors would be included in the tabular output file.

After the MOBILE6.2 input files were generated, they were run through the MOBILE6.2 model to obtain refueling VOC emission factors in the database table format. These emission factors are produced for the 28 MOBILE6 vehicle types. The emission factors were then weighted using the VMT fraction information included in the MOBILE6 output tables to obtain VOC refueling emission factors for the 8 vehicle types included in the VISTAS VMT database. The VMT fraction information contained in the MOBILE6 input files is based on the default MOBILE6 registration distributions, diesel sales fractions, and VMT fractions, or, when this information is

provided in the input files, based on area-specific fleet parameters. A database of emission factors by month, county, and 8 vehicle types was then prepared. In calculating monthly onroad refueling emissions, the VISTAS annual VMT data were temporally allocated by month in the same manner as described in Chapter II for the onroad exhaust and evaporative emission calculations. These VMT were then multiplied by the corresponding monthly emission factor (in terms of grams per mile) to obtain refueling emissions from onroad vehicles. The monthly emissions for each county were then summed to obtain annual refueling emissions. Also, since refueling emissions are included in the area source inventory and are not distinguished by vehicle type, all refueling emissions from onroad vehicles were summed for each county in the VISTAS region. Summaries of the refueling emissions from onroad vehicles are presented in Chapter VI.

## **V. NONROAD REFUELING METHODS**

The NONROAD model accounts for refueling emissions from nonroad equipment under two separate components, vapor displacement and spillage. Vapor displacement emissions result when new liquid fuel being added to a fuel tank displaces fuel vapors already present in the tank. Spillage emissions result when fuel is spilled during the refueling process.

Nonroad equipment may be fueled from a gasoline pump or a portable container. Refueling nonroad equipment from a portable container results in different emissions for both spillage and vapor displacement compared to refueling from a gasoline pump. In addition, the use of portable containers also results in extra refueling events. Both spillage and displacement emissions will also occur when the container is filled from a gasoline pump. However, due to lack of data, the NONROAD2002 model does not attempt to quantify this set of refueling emissions. As such, the NONROAD model refueling emissions associated with nonroad equipment being filled directly at the gasoline pumps will be used to represent the nonroad Stage II emission component. Stage II control factors listed in Table IV-1 were input in the county-specific NONROAD model option files. Once the model runs were performed, Pechan extracted the refueling and spillage emissions corresponding only to those engines (typically the larger horsepower engines) within each SCC assumed to be refueled at the pump. The list of SCC and horsepower ranges associated with pump versus container refueling is specified in the model since different emission rates are assumed for these two types of refueling.

Table V-1 presents draft annual Stage II VOC emission estimates by State. These emissions were combined with the onroad vehicle Stage II estimates described in Section IV of this report.



**Table V-1. 2002 Draft Stage II Refueling Emissions by State**

<b>FIPSST</b>	<b>NAME</b>	<b>VOC Emissions, tpy</b>
01	Alabama	167.25
12	Florida	842.60
13	Georgia	209.01
21	Kentucky	112.65
28	Mississippi	147.18
37	North Carolina	298.49
45	Tennessee	197.81
47	South Carolina	155.33
51	Virginia	174.70
54	West Virginia	39.33

## **VI. SUMMARY OF RESULTS**

This chapter presents the emission results from the February 2004 draft version of the 2002 mobile source emissions inventory for the VISTAS region. These emissions result from the data and procedures described in the preceding chapters of this report.

### **A. ONROAD RESULTS**

Table VI-1 summarizes the latest 2002 VISTAS onroad emissions inventory by State. This table also summarizes the total VMT for each State. Tables VI-2 and VI-3 are provided here for the purpose of comparing this inventory with another existing onroad inventory. The emissions shown in Table VI-2 are taken from Version 2 of EPA's 1999 NEI. Table VI-3 then shows the percentage change from the 1999 NEI to the 2002 draft VISTAS inventory. If the two inventories had been developed using comparable data, one would generally expect to see reductions in the onroad emissions from 1999 to 2002 due to fleet turnover resulting in the replacement of older, dirtier vehicles with vehicles meeting more stringent emission standards. However, this reduction in per-vehicle emissions also needs to overcome increases in VMT for the overall emissions to decrease. All of the VISTAS States show increases in VMT from 1999 to 2002, except North Carolina. This decrease in VMT needs to be further investigated by the State agency. States that were modeled with significant State or locally supplied inputs in the VISTAS modeling, such as Virginia and Georgia, would be expected to have more significant differences from the NEI data than States with no State-supplied information other than VMT. Some of the State inputs that cause significant deviations from the NEI estimates are registration distributions, VMT mixes by vehicle type, and speeds by road type. In addition, some of the pollutants are more affected by these inputs, while others (such as NH<sub>3</sub>) are minimally affected by these inputs. The 2002 VISTAS onroad emissions will continue to undergo review. Any comments or questions on these emissions by the State or local agencies will be investigated as part of this review.

**Table VI-1. 2002 VISTAS Onroad Emissions and VMT by State  
(February 2004 Version)**

State	2002 Annual Emissions (tons per year)							2002 Annual VMT (million miles)
	VOC	NOx	CO	SO2	PM10	PM2.5	NH3	
Alabama	99,650	154,908	1,275,969	6,515	4,344	3,231	5,619	55,723
Florida	457,309	463,419	4,678,471	19,739	12,666	9,232	18,240	178,681
Georgia	215,035	311,125	2,601,785	11,487	8,038	5,942	10,612	106,785
Kentucky	79,110	164,231	1,196,211	5,718	4,083	3,048	5,103	51,020
Mississippi	68,508	107,047	845,990	4,354	3,152	2,399	3,603	36,278
North Carolina	147,977	278,265	2,116,829	9,953	6,374	4,741	7,868	80,166
South Carolina	92,491	136,569	1,192,894	5,647	3,825	2,867	4,719	47,074
Tennessee	126,959	255,090	1,785,136	8,115	5,445	4,059	6,855	68,316
Virginia	115,044	182,513	1,858,629	6,110	4,413	3,032	7,937	76,566
West Virginia	34,197	57,941	512,592	2,361	1,550	1,155	1,947	19,544
<b>VISTAS Total</b>	<b>1,436,279</b>	<b>2,111,108</b>	<b>18,064,506</b>	<b>79,999</b>	<b>53,890</b>	<b>39,705</b>	<b>72,504</b>	<b>720,153</b>

**Table VI-2. 1999 NEI Version 2 Onroad Emissions and VMT by State**

State	1999 Annual Emissions (tons per year)							1999 Annual VMT (million miles)
	VOC	NOx	CO	SO2	PM10	PM2.5	NH3	
Alabama	121,201	163,024	1,412,343	6,280	4,712	3,599	5,249	52,914
Florida	328,412	424,969	3,379,563	16,581	12,259	9,318	14,162	141,903
Georgia	207,562	313,568	2,526,592	12,028	9,263	7,139	9,787	98,859
Kentucky	97,286	162,160	1,225,414	6,006	4,772	3,715	4,703	47,816
Mississippi	74,579	126,344	830,477	4,478	3,908	3,106	3,406	34,955
North Carolina	187,346	285,380	2,252,671	10,829	8,462	6,552	8,663	87,759
South Carolina	98,010	153,346	1,207,336	5,616	4,515	3,527	4,330	44,146
Tennessee	138,629	211,133	1,697,778	7,876	6,108	4,716	6,392	64,570
Virginia	150,528	238,515	1,861,417	8,972	6,892	5,307	7,320	73,904
West Virginia	40,060	68,580	539,578	2,471	2,023	1,589	1,859	19,033
<b>VISTAS Total</b>	<b>1,443,613</b>	<b>2,147,019</b>	<b>16,933,170</b>	<b>81,137</b>	<b>62,913</b>	<b>48,567</b>	<b>65,871</b>	<b>665,859</b>

**Table VI-3. Change in Onroad Emissions and VMT from 1999 NEI Version 2 to VISTAS 2002 Inventory (February 2004 Version)**

State	Change from 1999 NEI V2 to 2002 VISTAS Draft Inventory							VMT
	VOC	NOx	CO	SO2	PM10	PM2.5	NH3	
Alabama	-18%	-5%	-10%	4%	-8%	-10%	7%	5%
Florida	39%	9%	38%	19%	3%	-1%	29%	26%
Georgia	4%	-1%	3%	-4%	-13%	-17%	8%	8%
Kentucky	-19%	1%	-2%	-5%	-14%	-18%	9%	7%
Mississippi	-8%	-15%	2%	-3%	-19%	-23%	6%	4%
North Carolina	-21%	-2%	-6%	-8%	-25%	-28%	-9%	-9%
South Carolina	-6%	-11%	-1%	1%	-15%	-19%	9%	7%
Tennessee	-8%	21%	5%	3%	-11%	-14%	7%	6%
Virginia	-24%	-23%	0%	-32%	-36%	-43%	8%	4%
West Virginia	-15%	-16%	-5%	-4%	-23%	-27%	5%	3%
<b>VISTAS Total</b>	<b>-1%</b>	<b>-2%</b>	<b>7%</b>	<b>-1%</b>	<b>-14%</b>	<b>-18%</b>	<b>10%</b>	<b>8%</b>

Table VI-4 presents the latest 2002 VISTAS onroad refueling emission estimates by State. These refueling emissions are NOT included in the emissions shown in Tables VI-1 through VI-3.

**Table VI-4. 2002 VISTAS Annual Onroad Refueling Emissions**

State	2002 Annual Onroad VOC Refueling Emissions (tons per year)
Alabama	8,408
Florida	28,367
Georgia	12,329
Kentucky	6,885
Mississippi	6,057
North Carolina	15,320
South Carolina	8,926
Tennessee	9,901
Virginia	8,657
West Virginia	3,383
<b>VISTAS Total</b>	<b>108,233</b>

## B. NONROAD RESULTS

Table VI-5 provides a summary of draft 2002 nonroad sector annual emissions by State, including Stage II refueling emission estimates. Table VI-6 provides a summary of the draft 2002 NONROAD model emission estimates by State, and compares the values to 2001 NONROAD model NEI Version 2 estimates by showing the percent difference. A similar comparison is shown in Table VI-7 for other nonroad emission estimates compared to the 1999 NEI Version 2.

For the NONROAD model categories, SO<sub>2</sub>, PM<sub>10</sub>, PM<sub>2.5</sub>, and NH<sub>3</sub> decrease consistently across all States. SO<sub>2</sub> emissions decrease due in part to a lower diesel fuel sulfur content input for the NONROAD model runs, which also contributes to decreases in particulate emissions. The decrease in NH<sub>3</sub> is due primarily to corrections made to compressed natural gas (CNG) engine NH<sub>3</sub> emissions, which involved zeroing out the estimates. The 1999 NEI erroneously applied emission factors on a grams per gallon basis to CNG fuel consumption. Although reported as uncompressed gallons in the NONROAD model, the CNG fuel consumption estimates represent a gaseous, not liquid, volume. Based on OTAQ's recommendations, CNG NH<sub>3</sub> emissions are now reported as zero. CO and NO<sub>x</sub> show little change for all States, and changes in VOC vary by State and are dependent on the contribution of specific equipment categories (detail not shown).

For other nonroad categories, the increase in PM<sub>10</sub> and PM<sub>2.5</sub> is due to the addition of commercial aircraft PM emissions. Commercial aircraft PM<sub>10</sub> and PM<sub>2.5</sub> emissions were zero in the 1999 NEI; hence, the large percent increase. To gap fill this portion of the inventory, Pechan calculated and applied an average air taxi PM/NO<sub>x</sub> emission ratio to commercial aircraft NO<sub>x</sub> emissions. States with a higher proportion of commercial aircraft show significant PM increases (e.g., FL, TN, VA). In addition, NO<sub>x</sub> emissions decrease due to new State data for other nonroad from AL and VA.

**Table VI-5. Summary of Draft 2002 Nonroad Sector Annual Emissions by State, tons per year**

FIPSST	STATE	VOC	NOX	CO	PM10-PRI	PM25-PRI	SO2	NH3
01	Alabama	46,788	64,367	373,634	5,504	4,895	7,529	32
12	Florida	211,006	153,396	1,765,539	61,426	45,849	17,453	109
13	Georgia	66,712	87,053	712,159	10,411	8,666	7,914	55
21	Kentucky	35,537	100,989	294,929	8,538	7,249	13,771	28
28	Mississippi	33,443	90,190	217,407	5,795	5,194	11,537	23
37	North Carolina	75,020	81,264	742,822	12,814	10,379	7,281	62
45	South Carolina	43,231	46,518	375,469	4,115	3,678	4,465	29
47	Tennessee	52,333	118,690	461,976	14,727	11,692	12,478	41
51	Virginia	61,655	69,668	614,958	21,580	16,497	11,068	44
54	West Virginia	15,497	36,613	120,029	2,293	2,034	2,388	10

**Table VI-6. Summary of Draft 2002 NONROAD Model Emission Estimates by State**

<b>2002 DRAFT VISTAS NONROAD Model Inventory, tpy</b>								
<b>FIPSST</b>	<b>STATE</b>	<b>VOC_ANN</b>	<b>NOX_ANN</b>	<b>CO_ANN</b>	<b>PM10_ANN</b>	<b>PM25_ANN</b>	<b>SO2_ANN</b>	<b>NH3_ANN</b>
01	Alabama	44,501.18	28,635.48	365,161.12	3,306.84	3,044.48	2,729.32	31.92
12	Florida	205,489.66	86,654.40	1,730,125.77	12,890.06	11,862.13	9,113.26	109.02
13	Georgia	65,054.02	51,452.93	705,292.75	5,493.33	5,057.34	5,025.11	54.97
21	Kentucky	32,836.91	28,253.72	283,488.53	3,152.29	2,901.82	2,777.69	28.00
28	Mississippi	31,097.14	23,549.89	207,824.23	2,761.65	2,542.05	2,375.53	23.37
37	North Carolina	73,610.93	58,667.62	734,496.85	6,095.96	5,613.11	5,442.35	62.06
45	South Carolina	41,652.41	26,212.76	366,737.16	3,028.92	2,788.66	2,461.79	29.29
47	Tennessee	48,626.66	39,833.95	446,461.43	4,240.53	3,904.21	3,810.11	41.22
51	Virginia	56,973.85	40,914.48	594,020.13	4,739.47	4,362.61	4,103.01	44.22
54	West Virginia	14,498.68	9,502.33	115,652.49	1,038.29	955.70	980.17	10.31
<b>2001 NONROAD Model NEI Version 2, tpy</b>								
<b>FIPSST</b>	<b>STATE</b>	<b>VOC_ANN</b>	<b>NOX_ANN</b>	<b>CO_ANN</b>	<b>PM10_ANN</b>	<b>PM25_ANN</b>	<b>SOX_ANN</b>	<b>NH3_ANN</b>
01	Alabama	43,602.83	28,786.95	360,439.36	3,422.60	3,150.91	3,110.79	581.69
12	Florida	188,868.96	86,835.32	1,713,539.62	13,243.04	12,186.78	10,456.05	1,305.25
13	Georgia	63,927.85	51,521.66	698,868.77	5,678.55	5,227.63	5,749.47	989.31
21	Kentucky	31,662.34	28,350.32	279,283.79	3,274.35	3,014.06	3,127.88	463.74
28	Mississippi	29,037.96	23,671.70	205,664.64	2,877.28	2,648.40	2,668.55	359.21
37	North Carolina	69,671.36	58,742.13	724,908.46	6,300.02	5,800.72	6,196.92	1,223.82
45	South Carolina	39,310.79	26,304.57	363,112.01	3,130.17	2,881.75	2,817.02	507.81
47	Tennessee	47,193.97	39,916.38	440,915.76	4,395.90	4,047.06	4,337.42	749.51
51	Virginia	55,459.80	41,082.63	585,850.58	4,887.90	4,499.09	4,677.52	627.60
54	West Virginia	13,912.53	9,568.82	113,766.38	1,076.32	990.67	1,113.21	179.75
<b>Percent Difference</b>								
<b>FIPSST</b>	<b>STATE</b>	<b>VOC_ANN</b>	<b>NOX_ANN</b>	<b>CO_ANN</b>	<b>PM10_ANN</b>	<b>PM25_ANN</b>	<b>SOX_ANN</b>	<b>NH3_ANN</b>
01	Alabama	2.06%	-0.53%	1.31%	-3.38%	-3.38%	-12.26%	-94.51%
12	Florida	8.80%	-0.21%	0.97%	-2.67%	-2.66%	-12.84%	-91.65%
13	Georgia	1.76%	-0.13%	0.92%	-3.26%	-3.26%	-12.60%	-94.44%
21	Kentucky	3.71%	-0.34%	1.51%	-3.73%	-3.72%	-11.20%	-93.96%
28	Mississippi	7.09%	-0.51%	1.05%	-4.02%	-4.02%	-10.98%	-93.50%
37	North Carolina	5.65%	-0.13%	1.32%	-3.24%	-3.23%	-12.18%	-94.93%
45	South Carolina	5.96%	-0.35%	1.00%	-3.23%	-3.23%	-12.61%	-94.23%
47	Tennessee	3.04%	-0.21%	1.26%	-3.53%	-3.53%	-12.16%	-94.50%
51	Virginia	2.73%	-0.41%	1.39%	-3.04%	-3.03%	-12.28%	-92.95%
54	West Virginia	4.21%	-0.69%	1.66%	-3.53%	-3.53%	-11.95%	-94.26%

**Table VI-7. Summary of Draft 2002 Other Nonroad\* Emission Estimates by State**

<b>2002 DRAFT VISTAS Other Nonroad Inventory, tpy</b>							
<b>FIPSST</b>	<b>STATE</b>	<b>VOC_ANN</b>	<b>NOX_ANN</b>	<b>CO_ANN</b>	<b>PM10_ANN</b>	<b>PM25_ANN</b>	<b>SO2_ANN</b>
01	Alabama	2,286.81	35,731.80	8,473.33	2,196.87	1,850.82	4,799.75
12	Florida	5,516.71	66,741.52	35,413.13	48,536.33	33,987.28	8,340.05
13	Georgia	1,657.99	35,599.76	6,865.94	4,917.40	3,609.14	2,889.06
21	Kentucky	2,699.92	72,735.57	11,440.23	5,385.61	4,346.83	10,992.91
28	Mississippi	2,345.96	66,640.48	9,582.89	3,033.69	2,652.14	9,161.66
37	North Carolina	1,409.01	22,596.53	8,325.56	6,718.49	4,766.12	1,838.68
45	South Carolina	1,578.34	20,304.80	8,732.26	1,086.01	889.24	2,002.78
47	Tennessee	3,706.17	78,855.60	15,514.17	10,486.01	7,787.92	8,667.84
51	Virginia	4,681.39	28,753.43	20,938.22	16,840.30	12,134.84	6,965.04
54	West Virginia	998.41	27,110.49	4,376.64	1,254.86	1,077.93	1,408.05
<b>1999 Other Nonroad NEI Version 2, tpy</b>							
<b>FIPSST</b>	<b>STATE</b>	<b>VOC_ANN</b>	<b>NOX_ANN</b>	<b>CO_ANN</b>	<b>PM10_ANN</b>	<b>PM25_ANN</b>	<b>SO2_ANN</b>
01	Alabama	7,309.83	152,338.93	25,075.50	1,315.93	1,176.15	3,854.54
12	Florida	3,945.18	56,197.72	25,350.10	2,110.74	1,881.95	6,878.28
13	Georgia	2,594.07	39,245.14	12,198.09	1,072.08	953.43	3,070.41
21	Kentucky	2,676.93	62,930.31	12,388.06	2,370.31	2,153.93	8,965.67
28	Mississippi	1,755.99	48,927.22	8,072.51	1,917.16	1,747.89	7,051.91
37	North Carolina	1,447.95	17,999.44	8,739.21	540.09	470.85	1,508.40
45	South Carolina	2,470.03	18,034.10	13,291.47	561.99	503.60	1,858.19
47	Tennessee	2,426.97	51,133.47	11,127.02	1,786.06	1,616.72	6,266.91
51	Virginia	2,682.78	51,592.64	13,083.30	1,632.38	1,462.82	4,769.97
54	West Virginia	1,133.03	30,991.75	4,858.71	1,151.55	1,048.38	4,097.15
<b>Percent Difference</b>							
<b>FIPSST</b>	<b>STATE</b>	<b>VOC_ANN</b>	<b>NOX_ANN</b>	<b>CO_ANN</b>	<b>PM10_ANN</b>	<b>PM25_ANN</b>	<b>SO2_ANN</b>
01	Alabama	-69%	-77%	-66%	67%	57%	25%
12	Florida	40%	19%	40%	2199%	1706%	21%
13	Georgia	-36%	-9%	-44%	359%	279%	-6%
21	Kentucky	1%	16%	-8%	127%	102%	23%
28	Mississippi	34%	36%	19%	58%	52%	30%
37	North Carolina	-3%	26%	-5%	1144%	912%	22%
45	South Carolina	-36%	13%	-34%	93%	77%	8%
47	Tennessee	53%	54%	39%	487%	382%	38%
51	Virginia	74%	-44%	60%	932%	730%	46%
54	West Virginia	-12%	-13%	-10%	9%	3%	-66%

\*Includes emissions from aircraft, commercial marine and locomotive SCCs

## **VII. OBSERVATIONS AND RECOMMENDATIONS FOR IMPROVEMENT**

This chapter lists several areas where the onroad and nonroad emission inventories could be improved. Some of these improvements require a long lead-time for the States and would not likely be available for the final 2002 VISTAS modeling, but could improve future State and regional inventory efforts.

### **A. ONROAD SECTOR IMPROVEMENTS**

In the onroad sector, significant improvements have been made to the inventory due to the State and local agencies providing 2002 VMT data by county and roadway type. For this February 2004 version of the VISTAS onroad inventory, only the Virginia VMT were projected by Pechan. It is anticipated that this States will be able to provide 2002 VMT data for use in the next revision of the inventory.

Local registration distribution data were provided by fewer than half of the VISTAS States. In many cases, registration data can be obtained from State Departments of Motor Vehicles. States that do not already do so should request a download of the data summarizing registrations by model year and vehicle class from their appropriate motor vehicle agency. Although it is probably too late in many cases to obtain 2002 data, 2003 registration data could be used with some adjustments in developing the 2002 emission inventories. Registration data will become even more important as VISTAS prepares to project a 2018 onroad emission inventory, since the 2018 projections will be affected by the number of vehicles that are subject to the Tier 2 emission standards and the new heavy duty vehicle standards. The registration distributions directly determine the proportion of vehicles subject to these new emission standards.

A relatively small amount of data was obtained regarding the distribution of VMT by season or month. Many State Departments of Transportation collect data that could be used to better distribute VMT by season or month. States should check to see what is available. These distributions will affect the episodic modeling that will be conducted by VISTAS. Pechan is currently performing a VMT scoping study for VISTAS to determine what data are available for better allocating VMT and emissions by month, day, and hour. These temporal improvements are expected to be incorporated into the next update of the VISTAS onroad emission inventory.

Due to the direct relationship between the VMT mix by vehicle type and the overall emissions, States should investigate potential sources of information for this data to replace the default data used here in most States.

EPA is currently in the process of preparing guidance on estimating emissions from heavy duty vehicles during long-term idling (sometimes referred to as hotelling). While these emissions are theoretically included in the MOBILE6 HDDV emission factors, they are not currently accounted for in the appropriate locations. For example, these emissions would typically occur at rest stops, trucking centers, and warehouse and distribution centers. With the current modeling, these emissions are spread over all counties, based on the VMT traveled by HDDVs in each county. If significant sources of truck idling emissions occur in or near Class I areas, the

current modeling may be underestimating the effect of these emissions. If States are able to obtain data on the locations and utilization of truck rest stops, some of this emissions effect could be more appropriately accounted for in future versions of VISTAS modeling.

## **B. NONROAD SECTOR IMPROVEMENTS**

NH<sub>3</sub> emissions for aircraft, commercial marine and locomotives are still reported as zero. As a result of recent communications with OTAQ, Pechan would suggest applying the updated nonroad diesel NH<sub>3</sub> emission factors used for the NONROAD model categories to activity data for commercial marine vessels and locomotives. To develop ammonia from commercial marine vessels and locomotives, Pechan would need to obtain or compile the county-level fuel consumption estimates used as the basis for 1999 emissions for these categories to use as the activity data for calculating updated NH<sub>3</sub> emissions. The presence of State or local data in the 1999 NEI does not allow for this to be determined easily by backing out the reported emission factors, and in some cases (e.g., diesel commercial marine), actual emissions (instead of activity) were obtained at a national level and allocated to counties (EPA, 2002). Alternatively, Pechan could use county level fuel consumption estimates developed for these categories for 2000 or 2001. These activity data were used by Pechan to estimate dioxin/furan emission estimates for the 2000 and 2001 NEI. Pechan could normalize the 2000 or 2001 county distribution to national level fuel consumption estimates for 1999. Due to the characteristics of aircraft jet and piston engines, Pechan does not recommend estimating aircraft NH<sub>3</sub> emissions using the available NH<sub>3</sub> emission factors.

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**Development of the Draft 2002 Vistas Emission  
Inventory for Regional Haze Modeling**

**PART 5**

**Documentation of the Revised 2002 Base Year,  
Revised 2018, and Initial 2009 Emission  
Inventories for VISTAS**

**Documentation of the Revised 2002 Base Year,  
Revised 2018, and**

**Initial 2009 Emission Inventories for VISTAS**

**Prepared for:**

**Visibility Improvement State and Tribal Association of the Southeast  
(VISTAS)**

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## Acronyms and Abbreviations

APCD	Air Pollution Control District
ATP	Anti-Tampering Program
CEER	Consolidated Emissions Reporting Rule
CERR	Consolidated Emission Reporting Rule
CMU	Carnegie Mellon University
EGU	Electric Generating Unit
FIP	Federal Implementation Plan
HDD	Heavy Duty Diesel
HDD RULE	Heavy Duty Diesel Rule
LTO	Landing and take off
MOBILE 6	MOBILE emissions estimation model version 6
NH <sub>3</sub>	Ammonia
NIF	National Emission Inventory Format
NONROAD	no acronym (model name)
NO <sub>x</sub>	Oxides of nitrogen
PM10-FIL	Particulate matter less than or equal to 10 microns in diameter that can be captured on a filter
PM10-PRI	Particulate matter less than or equal to 10 microns in diameter that includes both the filterable and condensable components of particulate matter
PM25-FIL	Particulate matter less than or equal to 2.5 microns in diameter that can be captured on a filter
PM25-PRI	Particulate matter less than or equal to 2.5 microns in diameter that includes both the filterable and condensable components of particulate matter
PM-CON	Particulate matter created by the condensation of hot materials to form particulates, usually less than 2.5 microns in diameter
RFG	Reformulated gasoline
RVP	Reid Vapor Pressure
SCC	Source Classification Code
SIWG	Special Interest Workgroup
SMOKE	Sparse Matrix Operator Kernel Emissions (SMOKE) Modeling System
SO <sub>2</sub>	Oxides of sulfur
VISTAS	Visibility Improvement State and Tribal Association of the Southeast
VMT	Vehicle Miles Traveled
VOC	Volatile organic compounds

# Documentation of the Revised 2002 Base Year, Revised 2018, and Initial 2009 Emission Inventories for VISTAS

## 1.0 Revised 2002 Base Year Inventory Development

### 1.1 Point Sources

This section details the development of the revised 2002 base year inventory for point sources. There were two major components to the development of the point source sector of the inventory. The first component was the incorporation of data submitted by the VISTAS States and local (S/L) agencies to the United States Environmental Protection Agency (EPA) as part of the Consolidated Emissions Reporting Rule (CERR). Work on incorporating the CERR data into the revised base year involved: 1) obtaining the data from EPA or the S/L agency, 2) evaluating the emissions and pollutants reported in the submittal, 3) augmenting CERR data with annual emission estimates for PM10-PRI and PM25-PRI; 4) evaluating the emissions from electric generating units, and 5) completing quality assurance reviews for each component of the point source inventory. The processes used to perform those operations are described in the first portion of this section.

The second component was the development of a “typical” year inventory for electric generating units (EGUs). VISTAS determined that a typical year EGU inventory was necessary to smooth out any anomalies in emissions from the EGU sector due to meteorology, economic, and outage factors in 2002. The typical year EGU inventory is intended to represent the five year (2000-2004) period that will be used for regional haze regulatory purposes. The second part of this section of the report discusses the development of the typical year EGU inventory. VISTAS developed a typical year 2002 emission inventory to avoid anomalies in emissions due to variability in meteorology, economic, and outage factors in 2002 and to represent the five year (2000-2004) starting period that would be used to determine the regional haze reasonable progress goals.

#### 1.1.1 Development of 2002 Point Source Inventory

The first task in preparing the point source component of the revised 2002 base year inventory was the incorporation of data submitted by the VISTAS S/L agencies as part of the CERR. The revised 2002 point source inventory included both EGUs and non-EGUs.

**1.1.1.1 Data Sources**

Data from several sources were used: 1) the inventories that the S/L submitted to EPA from May through July 2004; 2) supplemental data supplied by the S/L agencies that may have been revised or finalized after submittal to EPA, and 3) the original VISTAS 2002 inventory in cases where S/L CERR data were not available. Table 1.1-1 summarizes the data used as the starting point for the updated 2002 inventory. Once all of the files were obtained, MACTEC ran the files through the EPA NIF Basic Format and Content checking tool to ensure that the files were submitted in standard NIF format and that there were no referential integrity issues with those files. In a couple of cases small errors were found. For example, in one case non-standard pollutant designations were used for PM and ammonia emissions. MACTEC contacted each VISTAS State point source contact person to resolve the issues with the files and corrections were made. Once all corrections to the native files were made, MACTEC continued with the incorporation of the data into the VISTAS point source files.

**Table 1.1-1. Summary of State Data Submittals for the Revised 2002 VISTAS Point Source Inventory.**

State / Local Program	Point Source Emissions Data Source
AL	C
FL	B
GA	B
KY	C
MS	B
NC	C
SC	C
TN	C
VA	B
WV	B
Davidson County, TN	B
Hamilton County, TN	A
Memphis/Shelby County, TN	B
Knox County, TN	B
Jefferson County, AL	B
Jefferson County, KY	B
Buncombe County, NC	B
Forsyth County, NC	B
Mecklenburg County, NC	B

**Key**

A = VISTAS 2002 (version 3.1)

B = CERR Submittal from EPA's ftp site

C = Other (CERR or other submittal sent directly from State to MACTEC)

### 1.1.1.2 Initial Data Evaluation

We conducted an initial review of the 2002 point source CERR data in accordance with the QA procedures specified in the QAPP for this project. The following evaluations were completed to identify potential data quality issues associated with the CERR data:

- Compared the number of sites in the CERR submittal to the number of sites in the VISTAS draft 2002 inventory; for all States, the number of sites in the CERR submittal was less than in the VISTAS draft 2002 inventory, since the CERR data was limited to major sources, while the VISTAS draft 2002 inventory contained data for both major and minor sources; verified with S/L contacts that minor sources not included in the CERR point source inventory were included in the CERR area source inventory.
- Checked for correct pollutant codes and corrected to make them NIF-compliant; for example, some S/L agencies reported ammonia emissions using the CAS Number or as “ammonia”, rather than the NIF-compliant “NH<sub>3</sub>” code.
- Checked for types of particulate matter codes reported (i.e., PM-FIL, PM-CON, PM-PRI, PM10-PRI, PM10-FIL, PM25-PRI, PM25-FIL); corrected codes with obvious errors (i.e., changed PMPRI to PM-PRI). (The PM augmentation process for filling in missing PM pollutants is discussed later in Section 1.1.1.3)
- Converted all emission values that weren’t in tons to tons to allow for preparation of emission summaries using consistent units.
- Checked start and end dates in the PE and EM tables to confirm consistency with the 2002 base year.
- Compared annual and daily emissions when daily emissions were reported; in some cases, the daily value was non-zero (but very small) but the annual value was zero. This was generally the result of rounding in a S/L agency’s submittal.
- Compared ammonia emissions as reported in the CERR submittals and the 2002 Toxics Release Inventory; worked with S/L agencies to resolve any outstanding discrepancies.
- Compared SO<sub>2</sub> and NO<sub>x</sub> emissions for EGUs to EPA’s Clean Air Markets Division continuous emission monitoring (CEM) database to identify any outstanding discrepancies. (A full discussion of the EGU emissions analysis is discussed later in Section 1.1.1.4)

- Prepared State-level emission summaries by pollutant for both the EGU and non-EGU sectors to allow S/L agencies to compare emissions as reported in the 1999 NEI Version 2, the VISTAS draft 2002 inventory, and the CERR submittals.
- Prepared facility-level emission summaries by pollutant to allow S/L agencies to review facility level emissions for reasonableness and accuracy.

We communicated the results of these analyses through email/telephone exchanges with the S/L point source contacts as well as through Excel summary spreadsheets.

### 1.1.1.3 PM Augmentation

Particulate matter emissions can be reported in many different forms, as follows:

<b>PM Category</b>	<b>Description</b>
PM-PRI	Primary PM (includes filterable and condensable)
PM-CON	Primary PM, condensable portion only (all less than 1 micron)
PM-FIL	Primary PM, filterable portion only
PM10-PRI	Primary PM10 (includes filterable and condensable)
PM10-FIL	Primary PM10, filterable portion only
PM25-PRI	Primary PM25 (includes filterable and condensable)
PM25-FIL	Primary PM25, filterable portion only

State/local agencies did not report PM emissions in a consistent manner. The State/local inventories submitted for VISTAS included emissions data for either PM-FIL, PM-PRI, PM10-FIL, PM10-PRI, PM25-FIL, PM25-PRI, and/or PM-CON. From any one of these pollutants, EPA has developed augmentation procedures to estimate PM10-PRI, PM10-FIL, PM25-PRI, PM25-FIL, and PM-CON. If not included in a State/local inventory, PM10-PRI and PM25-PRI were calculated by adding PM10-FIL and PM-CON or PM25-FIL and PM-CON, respectively.

The procedures for augmenting point source PM emissions are documented in detail in Appendix C of *Documentation for the Final 1999 National Emissions Inventory {Version 3} for Criteria Air Pollutants and Ammonia – Point Sources*, January 31, 2004). Briefly, the PM data augmentation procedure includes the following five steps:

- Step 1: Prepare S/L/T PM and PM10 Emissions for Input to the PM Calculator
- Step 2: Develop and Apply Source-Specific Conversion Factors

- Step 3: Prepare Factors from PM Calculator
- Step 4: Develop and Apply Algorithms to Estimate Emissions from S/L/T Inventory Data
- Step 5: Review Results and Update the NEI with Emission Estimates and Control Information.

Please refer to the EPA documentation for a complete description of the PM augmentation procedures

Table 1.1-2 compares the original PM emission estimates from the S/L CERR submittals and the revised 2002 VISTAS emissions estimates calculated using the above methodology. This table is intended to show that we took whatever States provided in the way of PM and filled in gaps to add in PM-CON where emissions were missing in order to calculate PM10-PRI and PM25-PRI for all processes to get a complete set of particulate data. We did not compare any other pollutants besides PM, since for other pollutants CERR emissions equal VISTAS emissions.

**Table 1.1-2. Comparison of Particulate Matter Emissions from the S/L Data Submittals and the Revised 2002 VISTAS Point Source Inventory**

State	Database	PM-PRI	PM-FIL	PM-CON	PM10-PRI	PM10-FIL	PM25-PRI	PM25-FIL
AL	CERR	28,803	9,174	0	16,522	6,548	8,895	4,765
	VISTAS	43,368	33,336	10,129	32,791	22,661	23,290	13,328
FL	CERR	0	33,732	0	0	32,254	0	0
	VISTAS	61,728	37,325	24,403	57,243	32,840	46,147	21,744
GA	CERR	42,846	0	0	27,489	0	15,750	0
	VISTAS	44,835	37,088	7,799	33,202	25,403	22,777	15,085
KY	CERR	0	3,809	0	19,748	1,360	0	0
	VISTAS	27,719	22,349	5,329	21,326	15,963	14,173	8,749
MS	CERR	23,925	0	0	20,968	0	10,937	0
	VISTAS	23,928	17,632	6,296	21,089	14,793	11,044	5,739
NC	CERR	48,110	0	0	36,222	0	24,159	0
	VISTAS	48,114	41,407	6,708	36,992	30,284	27,512	21,113
SC	CERR	0	43,837	0	0	32,656	0	21,852
	VISTAS	50,663	42,289	8,375	41,572	33,198	32,727	24,352
TN	CERR	1,660	25,500	21,482	43,413	22,164	34,167	12,140
	VISTAS	56,797	32,085	24,715	50,937	26,269	41,442	16,774
VA	CERR	0	0	0	17,065	0	12,000	0
	VISTAS	40,856	36,414	4,442	17,065	12,623	12,771	8,607
WV	CERR	0	29,277	0	0	14,778	0	8445
	VISTAS	36,188	29,392	6,795	22,053	15,258	15,523	8,733

Note 1: CERR refers to data as submitted by S/L agencies; VISTAS refers to data calculated by MACTEC using the PM augmentation methodologies described in this document.

Note 2: KY DEP's initial CERR submittal reported particulate matter emissions using only PM-PRI pollutant code. MACTEC used this pollutant code during the PM augmentation routine. In February 2005, KY DEP indicated that data reported using the PM-PRI code should actually have been reported using the PM10-PRI code. MACTEC performed a subsequent PM augmentation in April 2005 using the PM10-PRI code. The numbers in the above table reflect the current VISTAS inventory as of May 2005.

After the PM augmentation process was performed, we executed a series of checks to identify potential inconsistencies in the PM inventory. These checks included:

- PM-PRI less than PM10-PRI, PM25-PRI, PM10-FIL, PM25-FIL, or PM-CON;
- PM-FIL less than PM10-FIL, PM25-FIL;
- PM10-PRI less than PM25-PRI, PM10-FIL, PM25-FIL or PM-CON;
- PM10-FIL less than PM25-FIL;

- PM25-PRI less than PM25-FIL or PM-CON;
- The sum of PM10-FIL and PM-CON not equal to PM10-PRI; and
- The sum of PM25-FIL and PM-CON not equal to PM25-PRI.

S/L agencies were asked to review this information and provide corrections where the inconsistencies were significant. In general, corrections (or general directions) were provided in the case of the potential inconsistency issues. In other cases, the agency provided specific process level pollutant corrections.

#### **1.1.1.4 EGU Analysis**

We made a comparison of the annual SO<sub>2</sub> and NO<sub>x</sub> emissions for EGUs as reported in the S/L agencies CERR submittals and the data from EPA's Clean Air Markets Division (CAMD) continuous emission monitoring (CEM) database to identify any outstanding discrepancies. Facilities report hourly CEM data to EPA for units that are subject to CEM reporting requirements of the NO<sub>x</sub> SIP Call rule and Title IV of the Clean Air Act (CAA). EPA sums the hourly CEM emissions to the annual level, and we compared these annual CEM emissions to those in the S/L inventories. The 2002 CEM inventory containing NO<sub>x</sub> and SO<sub>2</sub> emissions and heat input data were downloaded from the EPA/Clean Air Markets Division's (CAMD) web site ([www.epa.gov/airmarkets](http://www.epa.gov/airmarkets)). The data were provided by quarter and emission unit.

The first step in the EGU analysis involved preparing a crosswalk file to match facilities and units in the CAMD inventory to facilities and units in the S/L inventories. In the CAMD inventory, the Office of Regulatory Information Systems (ORIS) identification (ID) code identifies unique facilities and the unit ID identifies unique boilers and internal combustion engines (i.e., turbines and reciprocating engines). In the S/L inventories, the State and county FIPS and State facility ID together identify unique facilities and the emission unit ID identifies unique boilers or internal combustion engines. In most cases, there is a one-to-one correspondence between the CAMD identifiers and the S/L identifiers. However, in some of the S/L inventories, the emissions for multiple emission units are summed and reported under one emission unit ID. We created an Excel spreadsheet that contained an initial crosswalk with the ORIS ID and unit ID in the CEM inventory matched to the State and county FIPS, State facility ID, and emission unit ID in the S/L inventory. The initial crosswalk contained both the annual emissions summed from the CAMD database as well as the S/L emission estimate. It should be noted that the initial matching of the IDs in both inventories was based on previous crosswalks that had been developed for the preliminary VISTAS 2002 inventory and in-house information compiled by MACTEC and Alpine Geophysics. The matching at the facility level was nearly



complete. In some cases, however, S/L agency or stakeholder assistance was needed to match some of the CEM units to emission units in the S/L inventories.

The second step in the EGU analysis was to prepare an Excel spreadsheet that compared the annual emissions from the hourly CAMD inventory to the annual emissions reported in the S/L inventory. The facility-level comparison of CEM to emission inventory NO<sub>x</sub> and SO<sub>2</sub> emissions found that for most facilities, the annual emissions from the S/L inventory equaled the CAMD CEM emissions. Minor differences could be explained because the facility in the S/L inventory contained additional small or emergency units that were not included in the CAMD database.

The final step in the EGU analysis was to compare the SO<sub>2</sub> and NO<sub>x</sub> emissions for select Southern Company units in the VISTAS region. Southern Company is a super-regional company that owns EGUs in four VISTAS States – Alabama, Florida, Georgia, and Mississippi – and participates in VISTAS as an industry stakeholder. Southern Company independently provided emission estimates for 2002 as part of the development of the preliminary VISTAS 2002 inventory. In most cases, these estimates were reviewed by the States and incorporated into the States CERR submittal. The exception to this was a decision made by Georgia’s Department of Environmental Protection to utilize CEM-based emissions for the actual 2002 emissions inventory for sources within the State when Southern Company also provided data. There were no major inconsistencies between the Southern Company data, the CAMD data, and the S/L CERR data.

The minor inconsistencies found included small differences in emission estimates (<2% difference), exclusion/inclusion of small gas-fired units in the different databases, and grouping of emission units in S/L CERR submittals where CAMD listed each unit individually. We compared SO<sub>2</sub> and NO<sub>x</sub> emissions on a unit by unit basis and did not find any major inconsistencies.

#### **1.1.1.5 QA Review of Final Inventory**

Final QA checks were run on the revised point source inventory data set to ensure that all corrections provided by the S/L agencies and stakeholders were correctly incorporated into the S/L inventories and that there were no remaining QA issues. After exporting the inventory to ASCII text files in NIF 3.0, the EPA QA program was run on the ASCII files and the QA output was reviewed to verify that all QA issues that could be addressed were resolved

Throughout the inventory development process, QA steps were performed to ensure that no double counting of emissions occurred, and to ensure that a full and complete inventory was developed for VISTAS. QA was an important component to the inventory development process

and MACTEC performed the following QA steps on the point source component of the VISTAS revised 2002 base year inventory:

1. Facility level emission summaries were prepared and evaluated to ensure that emissions were consistent and that there were no missing sources.
2. State-level EGU and non-EGU comparisons (by pollutant) were developed between the revised 2002 base year inventory, the preliminary VISTAS 2002 inventory, and the 1999 NEI Version 2 inventory.
3. Data product summaries and raw NIF 3.0 data files were provided to the VISTAS Emission Inventory Technical Advisor and to the Point Source, EGU, and non-EGU Special Interest Work Group representatives for review and comment. Changes based on these comments were reviewed and approved by the S/L point source contact prior to implementing the changes in the files.
4. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from 1.0 to 2.0. A minor change would cause a version number to go from 1.0 to 1.1. Minor changes resulting from largely editorial changes would result in a change from 1.00 to 1.01.

#### **1.1.1.6 Summary of Revised 2002 Base Year Inventory**

Tables 1.1-3 through 1.1-9 summarize the revised 2002 base year inventory. All values are in tons.

**Table 1.1-3. Revised 2002 VISTAS Point Source Inventory for SO<sub>2</sub>.**

	All Point Sources	EGUs	Non-EGUs
<b>AL</b>	544,309	447,862	96,447
<b>FL</b>	518,721	448,046	70,675
<b>GA</b>	575,310	513,266	62,044
<b>KY</b>	518,086	484,059	34,027
<b>MS</b>	103,388	67,339	36,049
<b>NC</b>	522,112	471,030	51,082
<b>SC</b>	259,916	203,587	56,329
<b>TN</b>	424,309	333,934	90,375
<b>VA</b>	305,107	232,747	72,360
<b>WV</b>	570,153	516,109	54,044
<b>Total</b>	<b>4,341,411</b>	<b>3,717,979</b>	<b>623,432</b>

**Table 1.1-4. Revised 2002 VISTAS Point Source Inventory for NO<sub>x</sub>.**

	All Point Sources	EGUs	Non-EGUs
<b>AL</b>	244,348	160,480	83,868
<b>FL</b>	306,679	244,541	62,138
<b>GA</b>	198,531	146,143	52,388
<b>KY</b>	237,209	198,726	38,483
<b>MS</b>	104,661	29,976	74,685
<b>NC</b>	196,782	146,465	50,317
<b>SC</b>	130,393	86,264	44,129
<b>TN</b>	229,193	155,762	73,431
<b>VA</b>	147,300	82,435	64,865
<b>WV</b>	277,660	230,950	46,710
<b>Total</b>	<b>2,072,756</b>	<b>1,481,742</b>	<b>591,014</b>

**Table 1.1-5. Revised 2002 VISTAS Point Source Inventory for VOC.**

	All Point Sources	EGUs	Non-EGUs
AL	49,331	1,438	47,893
FL	40,995	2,295	38,700
GA	34,914	1,178	33,736
KY	46,320	1,464	44,856
MS	43,852	473	43,379
NC	73,987	1,042	72,945
SC	38,927	434	38,493
TN	88,892	833	88,059
VA	43,906	679	43,227
WV	15,775	1,176	14,599
<b>Total</b>	<b>476,899</b>	<b>11,012</b>	<b>465,887</b>

**Table 1.1-6. Revised 2002 VISTAS Point Source Inventory for CO.**

	All Point Sources	EGUs	Non-EGUs
AL	185,549	11,243	174,306
FL	141,248	51,278	89,970
GA	140,661	9,248	131,413
KY	122,555	12,374	110,181
MS	59,872	2,714	57,158
NC	64,461	11,922	52,539
SC	63,304	3,699	59,605
TN	125,867	6,414	119,453
VA	70,689	6,294	64,395
WV	100,220	10,303	89,917
<b>Total</b>	<b>1,074,426</b>	<b>125,489</b>	<b>948,937</b>

**Table 1.1-7. Revised 2002 VISTAS Point Source Inventory for PM10-PRI.**

	All Point Sources	EGUs	Non-EGUs
<b>AL</b>	32,791	7,834	24,957
<b>FL</b>	57,243	26,912	30,331
<b>GA</b>	33,203	11,148	22,055
<b>KY</b>	21,326	5,711	15,615
<b>MS</b>	21,089	1,467	19,622
<b>NC</b>	36,991	22,480	14,511
<b>SC</b>	41,572	23,423	18,149
<b>TN</b>	50,937	14,954	35,983
<b>VA</b>	17,066	3,824	13,242
<b>WV</b>	22,053	7,188	14,865
<b>Total</b>	<b>334,271</b>	<b>124,941</b>	<b>209,330</b>

**Table 1.1-8. Revised 2002 VISTAS Point Source Inventory for PM25-PRI.**

	All Point Sources	EGUs	Non-EGUs
<b>AL</b>	23,290	4,274	19,016
<b>FL</b>	46,147	20,305	25,842
<b>GA</b>	22,778	4,888	17,890
<b>KY</b>	14,173	3,443	10,730
<b>MS</b>	11,044	912	10,132
<b>NC</b>	27,512	16,305	11,207
<b>SC</b>	32,727	19,162	13,565
<b>TN</b>	41,442	12,311	29,131
<b>VA</b>	12,771	2,560	10,211
<b>WV</b>	15,523	3,369	12,154
<b>Total</b>	<b>247,407</b>	<b>87,529</b>	<b>159,878</b>

**Table 1.1-9. Revised 2002 VISTAS Point Source Inventory for NH<sub>3</sub>.**

	All Point Sources	EGUs	Non-EGUs
AL	1,973	90	1,883
FL	1,490	58	1,432
GA	3,618	5	3,613
KY	674	0	674
MS	1,233	64	1,169
NC	1,207	36	1,171
SC	1,411	0	1,411
TN	1,628	0	1,628
VA	3,231	127	3,104
WV	344	13	331
<b>Total</b>	<b>16,809</b>	<b>393</b>	<b>16,416</b>

### 1.1.2 Development of Typical Year EGU inventory

VISTAS developed a typical year 2002 emission inventory to avoid anomalies in emissions due to variability in meteorology, economic, and outage factors in 2002 and to represent the five year (2000-2004) starting period that would be used to determine the regional haze reasonable progress goals.

Data from EPA's CAMD were used to develop normalization factors for producing a 2002 typical year inventory for electric generating units (EGUs). The approach used the ratio of the 2002 actual heat input to the 2000-2002 heat input to normalize the 2002 actual emissions. MACTEC obtained data from EPA's CAMD for utilities regulated by the Acid Rain program. Annual data for the period 1997 to 2002 were obtained from the CAMD web site ([www.epa.gov/airmarkets](http://www.epa.gov/airmarkets)). The parameters available were the SO<sub>2</sub> and NO<sub>x</sub> emission rates, heat input, and operating hours.

We used the actual 2002 heat input and the average heat input for the 3-year period from 2000-2002 as the normalization factor, as follows:

$$\text{Normalization Factor: } \frac{\text{2000-2002 average heat input}}{\text{2002 actual heat input}}$$

If the unit did not operate for all three years, then the 2000-2002 average heat input was calculated for the one or two years in which the unit did operate. For example, if the unit operated only during 2002, then the normalization factor would be 1.0.

The annual actual emissions were multiplied by the normalization factor to determine the typical emissions for 2002, as follows:

$$\text{Typical Emissions} = \text{2002 actual emissions} \times \text{Normalization Factor}$$

After applying the normalization factor, some adjustments were needed for special circumstances. For example, a unit may not have operated in 2002 and thus have zero emissions. If the unit had been permanently retired prior to 2002, then we used zero emissions for the typical year. If the unit had not been permanently retired and would normally operate in a typical year, then we used the 2001 (or 2000) heat input and emission rate to calculate the typical year emissions.

The Southern Company provided “typical year” data for their sources. Hourly emissions data for criteria pollutants were provided. MACTEC aggregated the hourly emissions into annual values. Further documentation of how Southern Company created the typical year inventory for their units can be found in *Developing Southern Company Emissions and Flue Gas Characteristics for VISTAS Regional Haze Modeling (April 2005, presented at 14<sup>th</sup> International Emission Inventory Conference)*. A copy of this paper can be found at <http://www.epa.gov/ttn/chief/conference/ei14/session9/kandasamy.pdf>

Since Southern Company only supplied filterable particulate emissions, we ran the PM10/PM2.5 augmentation routine to calculate annual emission estimates for PM10-PRI and PM25-PRI.

The final step was to merge the “typical year” data described above with the final version of the 2002 VISTAS emission inventory which was completed in September, 2004. This step replaced the actual 2002 emissions data with the “typical year” emissions values developed in the previous steps.

Table 1.1-10 summarizes emissions by State and pollutant for the actual 2002 EGU inventory and the “typical year” inventory.

**Table 1.1-10. Comparison of SO<sub>2</sub> and NO<sub>x</sub> Emissions for EGUs from the Actual 2002 Inventory and Typical 2002 Inventory.**

State	SO <sub>2</sub> Emissions (tons/year)		NO <sub>x</sub> Emissions (tons/year)	
	Actual 2002	Typical 2002	Actual 2002	Typical 2002
AL	447,862	421,734	160,480	153,349
FL	448,046	443,152	244,541	247,099
GA	513,266	433,513	146,143	120,785
KY	484,059	508,139	198,726	209,802
MS	67,339	57,263	29,976	27,254
NC	471,030	472,192	146,465	144,730
SC	203,587	203,978	86,264	85,555
TN	333,934	325,779	155,762	155,028
VA	232,747	234,714	82,435	82,911
WV	516,109	497,991	230,950	222,090
<b>Total</b>	<b>3,717,979</b>	<b>3,598,455</b>	<b>1,481,742</b>	<b>1,448,603</b>

The biggest differences shown in this table appear to be in AL, GA, and MS, where Southern Company provided “typical” year data using a different methodology than what MACTEC used for non-Southern Company units. This probably explains the majority of the differences shown in Table 1.1-10.

## 1.2 Area Sources

This section details the development of the revised 2002 base year inventory for area sources. There were three major components to the development of the area source sector of the inventory. The first component was the development of a “typical” year fire inventory. That development covered wildfire, prescribed burning, agricultural fires and land clearing fires. Since fire emissions are not easily grown or projected, in order to effectively represent fires in both the base and future year inventories, VISTAS determined that a typical year fire inventory



was necessary. The first part of this section of the report discusses the development of the typical year fire inventory.

The second component of the area source inventory was the incorporation of data submitted by the VISTAS States to the United States Environmental Protection Agency (EPA) as part of the CERR. Work on incorporating the CERR data into the revised base year involved: 1) obtaining the data from EPA, 2) evaluating the emissions and pollutants reported in order to avoid double counting and 3) backfilling from the existing VISTAS 2002 base year inventory for missing sources/pollutants. The processes used to perform those operations are described in the second portion of this section.

The final component was related to the development of NH<sub>3</sub> emission estimates for livestock and fertilizers and paved road PM emissions. For the NH<sub>3</sub> emission estimates for livestock and fertilizers we used version 3.6 of the Carnegie Mellon University (CMU) NH<sub>3</sub> model. For the paved road PM emissions, we used the most recent estimates developed by EPA as part of the National Emission Inventory (NEI) development effort. EPA had developed an improved methodology for estimating paved road emissions so those values were substituted directly into the inventory after receiving consensus from all of the VISTAS States to perform the replacement. Details on these methods are provided in the third portion of this section of the document.

Finally, quality assurance steps for each component of the area source inventory are discussed.

### **1.2.1 Development of a “typical” year fire inventory**

In order to effectively characterize fire emissions in the VISTAS region, a typical (as opposed to strictly 2002 year based inventory) was required. Development of a typical year fire inventory provided the capability of using a comparable data set for both the base year and future years. Thus fire emissions would remain the same for air quality and visibility modeling in both the base and any future years. MACTEC originally proposed five different methods for developing the typical fire year to the VISTAS Fire Special Interest Work Group (SIWG) and requested their feedback and preference for developing the final typical year inventory. The method that was selected by SIWG members was to use a method similar to that used for the 2018 preliminary inventory. For that inventory, State level ratios of acres over a longer term record (three or more years) were developed for each fire type relative to 2002. The 2002 acreage was then scaled up or down based on these ratios to develop a typical year for use in the preliminary 2018 inventory. For this work, the decision of the VISTAS Fire SIWG was to base the ratio on county level data for States that supplied long term fire-by-fire acreage data rather than State-level ratios. Where States did not supply long term fire-by-fire acreage data, MACTEC would maintain the data in the preliminary 2018 inventory (which was based on State-level ratios) or

would update the State ratios if longer term updated State level acreage estimates were provided. With one broad exception (wildfires) this method was implemented for all fires. MACTEC solicited long term fire-by-fire acreage data by fire type from each VISTAS State. A minimum of three or more years of data were used to develop the ratios. Those data were then used to develop a ratio for each county based on the number of acres burned in each county for each fire type relative to 2002.

Thus if we had long term county prescribed fire data from a State, we developed a county acreage ratio of:

$$\text{Ratio} = \frac{\text{Long term average county level Rx acres}}{\text{2002 actual county level Rx acreage}}$$

This ratio was then multiplied times the actual 2002 acreage to get a typical value (basically the long term average county level acres). Wherever possible this calculation was performed on a fire by fire basis. The acreage calculated using the ratio was then used with the fuel loading and emission factor values that we already had (and had been reviewed by the SIWG) to calculate emissions using the same method used for the 2002 actual values (which were previously documented).

There were three exceptions to this method.

#### Exception 1: Use of State Ratios for Wildfires

The first exception was that wildfires estimates were developed using State ratios rather than county ratios. This change was made after initial quality assurance of the draft estimates revealed that some counties were showing unrealistic values created by very short term data records or missing data that created unrealistic ratios. In addition, exceptionally large and small fires were removed from the database since they were felt to be atypical. For example the Blackjack Complex fire in Georgia was removed from the dataset because the number of acres burned was “atypical” in that fire. We also removed all fires less than 0.1 acres from the dataset.

#### Exception 2: Correction for Blackened Acres on Forest Service Lands

Following discussions with the United States Forest Service (Forest Service), it was determined that the acres submitted by the Forest Service for wildfires and prescribed fires represented perimeter acres rather than “blackened” acres. Thus for wildfires and prescribed fires on Forest Service lands, a further correction was implemented to correct the perimeter acre values to blackened acres. The correction was made based on the size of the fire. For prescribed fires

over 100 acres in size the acreage was adjusted to be 80 percent of the initial reported value. For prescribed fires of 100 acres or less the acreage values were maintained as reported. For wildfires, all reported acreage values were adjusted to be 66 percent of their initially reported values. These changes were made to all values reported for Forest Service managed lands.

### Exception 3: Missing/Non-reported data

When we did not receive data from a VISTAS State for a particular fire type, a composite average for the entire VISTAS region was used to determine the typical value for that type fire. For example, if no agricultural burning long term acreage data was reported for a particular State, MACTEC determined an overall VISTAS regional average ratio that was used to multiply times the 2002 values to produce the “typical” values. This technique was applied to all fire types when data was missing.

In addition, for wildfires and prescribed burning, ratios were developed for “northern” and “southern” tier States within the VISTAS region and those ratios were applied to each State with missing data depending upon whether they were considered a “northern” or “southern” tier State. Development of “southern” and “northern” tier data was an attempt to account for a change from a predominantly pine/evergreen ecosystem (southern) to a pine/deciduous ecosystem (northern).

Finally for land clearing and agricultural fires, there are now NH<sub>3</sub> and SO<sub>2</sub> emissions. This is due to the lack of emission factors for these pollutants for these fire types.

Table 1.2-1 shows fire emissions from the original base year emission inventory (VISTAS 3.1), the actual 2002 emissions and the typical year emissions for the entire VISTAS region.

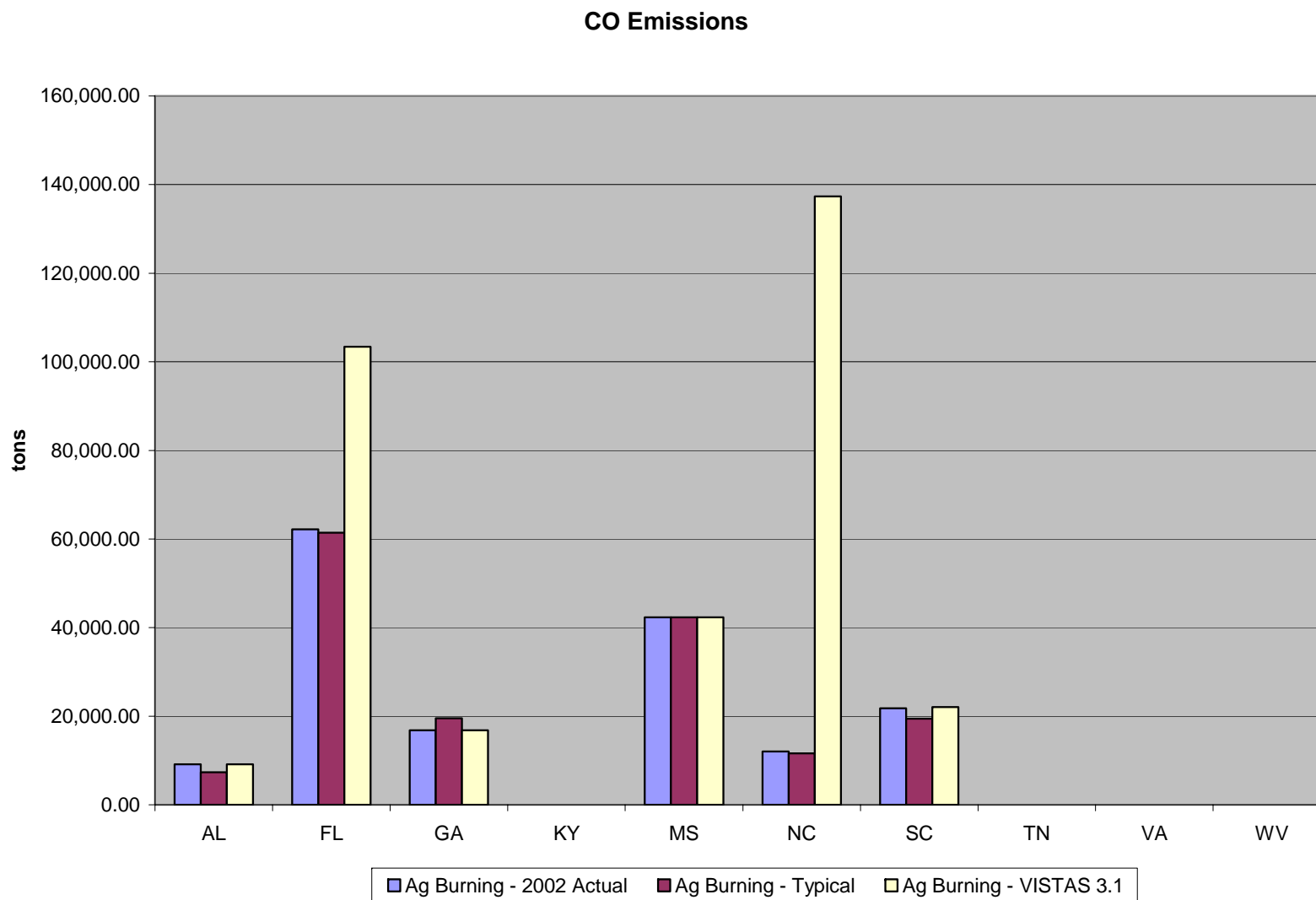
Figures 1.2-1 through 1.2-4 show the State by State changes in emissions between the original 2002 base year fire inventories, the actual 2002 and the typical year inventories for carbon monoxide (CO) by fire type. Due to the relative magnitude of CO emissions compared to other criteria and PM pollutants from fires, this pollutant is normally chosen to represent the distribution of fires in the example plots.

**Table 1.2-1. Emissions from Fires in the VISTAS Region – Comparison between Original Base Year 2002, 2002 Actual, and 2002 Typical Year Emissions.**

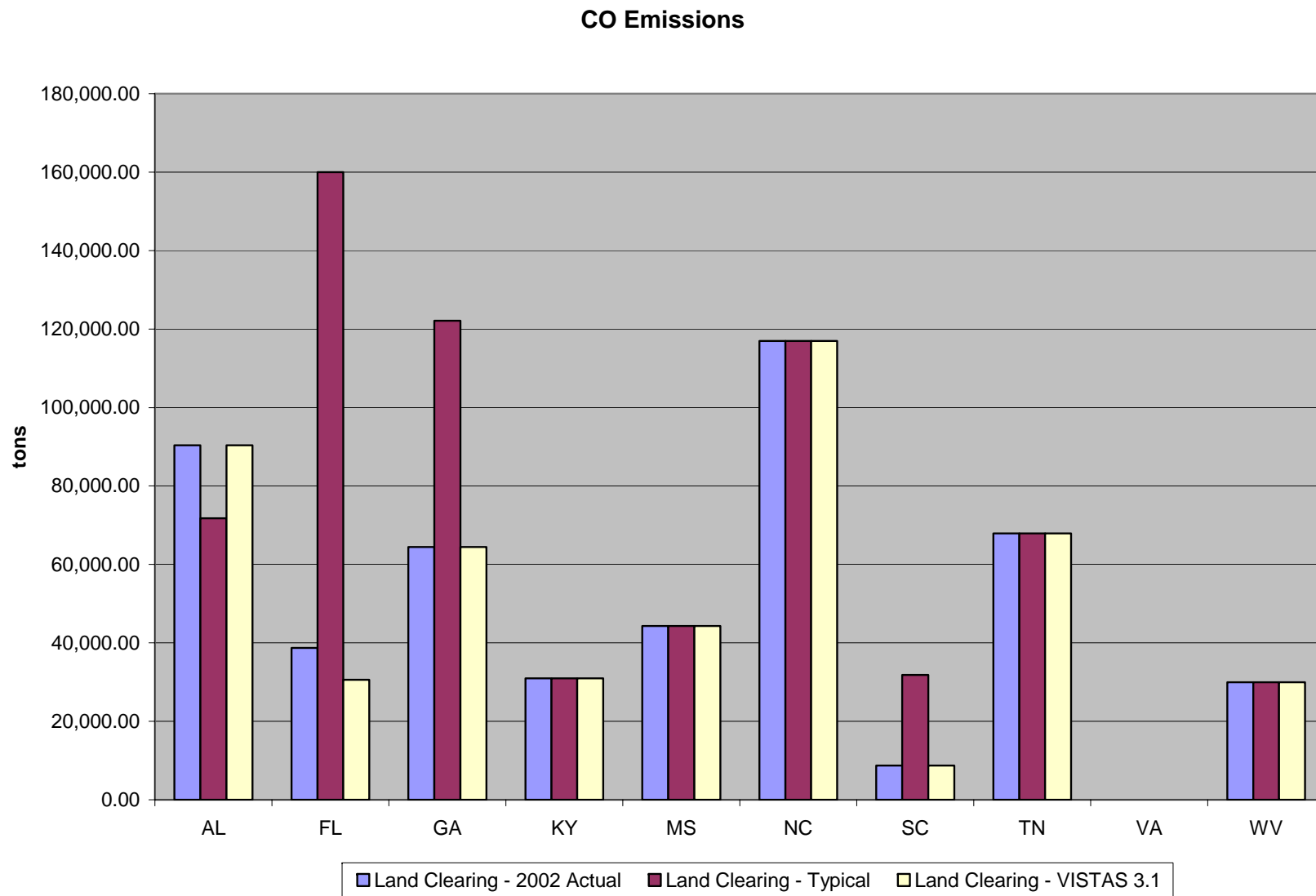
		CO	NH <sub>3</sub>	NO <sub>x</sub>	PM <sub>10</sub> -FIL	PM <sub>10</sub> -PRI	PM <sub>2.5</sub> -FIL	PM <sub>2.5</sub> -PRI	SO <sub>2</sub>	VOC
<b>Total LC</b>	Actual	492,409	0	14,568	62,146	62,146	62,146	62,146	0	33,799
	Typical	675,838	0	19,995	80,598	80,598	80,598	80,598	0	46,389
	VISTAS 3.1	484,240	0	14,327	61,325	61,325	61,325	61,325	0	33,238
<b>Total Ag</b>	Actual	164,273	0	903	30,958	30,958	30,385	30,385	0	21,946
	Typical	161,667	0	903	30,465	30,465	29,892	29,892	0	21,595
	VISTAS 3.1	331,073	0	903	41,480	41,480	40,192	40,192	0	41,875
<b>Total WF</b>	Actual	298,835	1,333	6,628	28,923	28,923	24,926	24,926	1,611	16,804
	Typical	547,174	2,451	11,955	53,070	53,070	45,635	45,635	3,072	28,491
	VISTAS 3.1	275,766	1,230	6,133	26,680	26,680	23,002	23,002	1,476	15,718
<b>Total RX</b>	Actual	1,678,216	7,616	36,561	168,938	168,938	145,175	145,175	9,839	78,988
	Typical	1,635,776	7,425	35,650	164,811	164,811	141,636	141,636	9,590	76,990
	VISTAS 3.1	1,724,940	7,822	37,556	173,590	173,590	149,181	149,181	10,101	81,188

Key: LC = Land Clearing; Ag = Agricultural burning; WF = wildfires; RX = prescribed burning

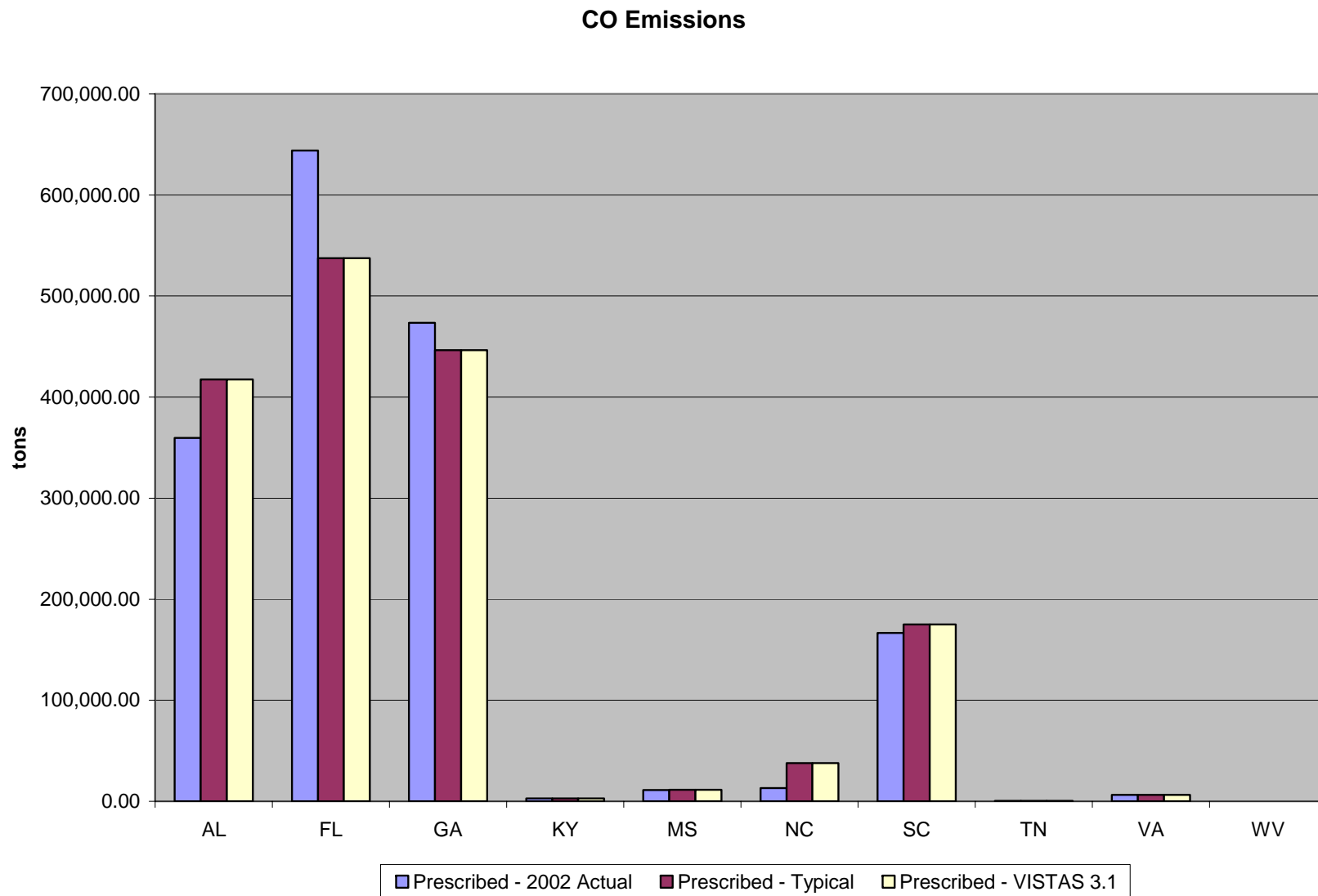
**Figure 1.2-1. CO Emissions from Agricultural Burning for the Original Base Year, 2002 Actual, and 2002 Typical Inventories.**



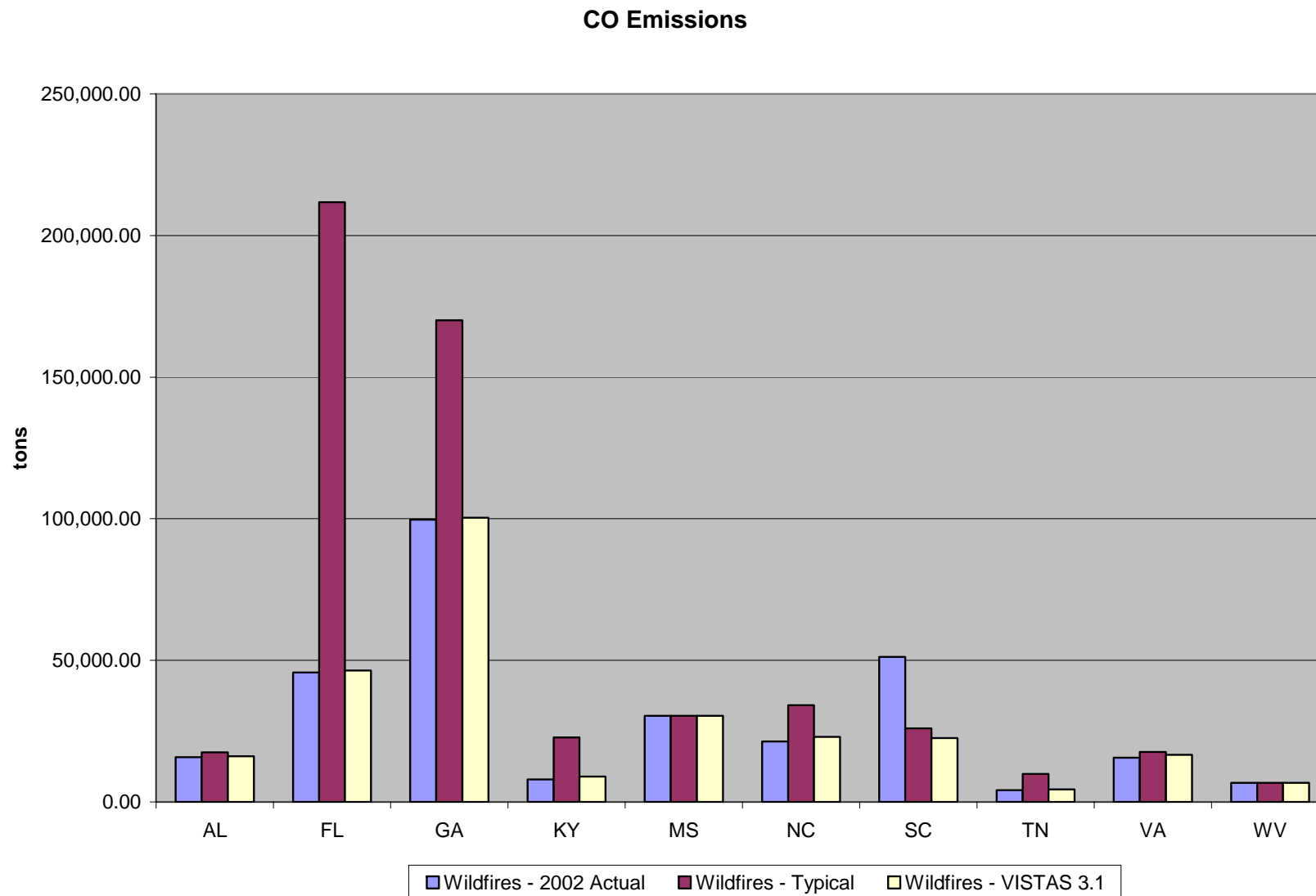
**Figure 1.2-2. CO Emissions from Land Clearing Burning for the Original Base Year, 2002 Actual and 2002 Typical Inventories.**



**Figure 1.2-3. CO Emissions from Prescribed Burning for the Original Base Year, 2002 Actual and 2002 Typical Inventories.**



**Figure 1.2-4. CO Emissions from Wildfire Burning for the Original Base Year, 2002 Actual and 2002 Typical Inventories.**





### 1.2.2 Development of non-fire inventory

The second task in preparing the area source component of the updated 2002 base year inventory was the incorporation of data submitted by the VISTAS States to the EPA as part of the CERR. Work on incorporating the CERR data into the revised base year involved: 1) obtaining the data from EPA, 2) evaluating the emissions and pollutants reported in order to avoid double counting and 3) backfilling from the earlier version of the VISTAS 2002 base year inventory for missing sources/pollutants. The processes used to perform those operations are described below. This work did not include any of the fire emission estimates described above. In addition it did not include emission estimates for ammonia from agricultural and fertilizer sources. Finally it did not include PM emissions from paved roads. Each of those categories was estimated separately.

Data on the CERR submittals was obtained from EPA's FTP site. The data submitted in National Emission Inventory Format (NIF) was downloaded from that site. Once all of the files were obtained, MACTEC ran the files through the EPA NIF Format and Content checking tool to ensure that the files were submitted in standard NIF format and that there were no issues with those files. In a couple of cases small errors were found. For example, in one case a county FIPs code that was no longer in use was found. MACTEC contacted each VISTAS State area source contact person to resolve the issues with the files and corrections were made. Once all corrections to the native files were made, MACTEC continued with the incorporation of the data into the VISTAS area source files.

Our general assumption was that unless we determined otherwise, the CERR submittals represented full and complete inventories. Where a State submitted a complete inventory, our plan was to simply delete the previous 2002 base year data and replace it with the CERR submittal. Prior to this replacement however, we stripped out the following emissions:

1. All wildfire, prescribed burning, land clearing and agricultural burning emissions submitted to EPA by the States as part of the CERR process were removed since they were to be replaced with emissions estimated using methods described earlier.
2. All fertilizer and agricultural ammonia emission records submitted to EPA by the States as part of the CERR process were removed. These were to be replaced with the estimates developed using the CMU Ammonia model.
3. All emissions from paved roads submitted to EPA by the States as part of the CERR process were removed. These emissions were to be replaced with updated emissions developed by U.S. EPA as part of their 2002 NEI development effort.

This approach was used for most State and Local emission submittals. There were a few cases where alternative data was used. In general, these alternatives involved submittal of alternative

files to the CERR data. Table 1.2-2 below summarizes the data used. In general the data were derived from one of the following sources:

1. CERR submittal obtained from EPA FTP site as directed by VISTAS States;
2. State submitted file (either revised from CERR submittal or separate format);
3. VISTAS original 2002 base year (VISTAS version 3.1 base year file); or
4. EPA's preliminary 2002 NEI.

**Table 1.2-2. Summary of State Data Submittals for the Revised 2002 VISTAS Area Source Inventory**

State / Local Program	Area Source Emissions Data Source
AL	B
FL	B
GA	C
KY	A
MS	B
NC	C
SC	B
TN	B
VA	B
WV	A/C
Davidson County, TN	B
Hamilton County, TN	C
Memphis/Shelby County, TN	A
Knox County, TN	B
Jefferson County, AL	* so B from State
Jefferson County, KY	B
Buncombe County, NC	* so C from State
Forsyth County, NC	* so C from State
Mecklenburg County, NC	* so C from State

A = VISTAS 2002 (version 3.1)

B = CERR Submittal from EPA's ftp site

C = Other (CERR or other submittal sent directly from State to MACTEC)

\* = No response

In order to track the sources of data in the final NIF files, a field was added to the NIF format files developed for VISTAS to track each data source. A field named Data\_Source was added to the EM table. A series of codes were added to this field to mark the source of each emissions value. Values in this field are detailed in Table 1.2-3.

**Table 1.2-3: Data Source Codes and Data Sources for VISTAS Revised 2002 Area Source Emissions Inventory.**

Data Source Codes	Data Source
CMU Model	CMU Ammonia model v 3.6
E-02-X or E-99-F or L-02-X or S-02-X	EPA CERR submittal (from FTP site)
EPA Paved	EPA Paved Road emissions estimates
EPAPRE02NEI	EPA Preliminary 2002 NEI
STATEFILE	State submitted file
VISTBAS31	VISTAS 2002 Base Year version 3.1
VISTRATIO	Developed from VISTAS Ratios (used only for missing pollutants)

Most States submitted complete inventories. Virginia's inventory required a two stage update. Virginia's CERR submittal only contained ozone precursor pollutants (including CO). For Virginia, MACTEC's original plan was to maintain the previous 2002 VISTAS base year emissions for non-ozone pollutants and then do a simple replacement for ozone pollutants. However during the QA phase of the work, MACTEC discovered that there were categories that had ozone precursor or CO emissions in the submittal that weren't in the original 2002 VISTAS base year inventory that should have PM or SO<sub>2</sub> emissions. For those records, MACTEC used an emissions ratio to build records for emissions of these pollutants. Data for Virginia PM and SO<sub>2</sub> emissions were generated by developing SCC level ratios to NO<sub>x</sub> from the VISTAS 2002 base year inventory (version 3.1) or from emission factors and then calculating the emissions based on that ratio.

### 1.2.3 Ammonia and paved road emissions

The final component of inventory development was estimation of NH<sub>3</sub> emission estimates for livestock and fertilizers and paved road PM emissions. For the NH<sub>3</sub> emission estimates for livestock and fertilizers we used version 3.6 of the Carnegie Mellon University (CMU) NH<sub>3</sub> model (<http://www.cmu.edu/ammonia/>). Results from this model were used for all VISTAS States. The CMU model version 3.6 was used in large part because it had been just recently been updated to include the latest (2002) Census of Agriculture animal population statistics. Prior to inclusion of the CMU model estimates, MACTEC removed any ammonia records for agricultural livestock or fertilizer emissions from the VISTAS 2002 initial base year inventory. MACTEC also generated emissions from human perspiration and from wildlife using the CMU model and added those emissions for each State.

For the paved road PM emissions, we used the most recent estimates developed by EPA as part of the NEI development effort (Roy Huntley, U.S. EPA, email communication, 8/30/2004). EPA had developed an improved methodology for estimating paved road emissions for 2002 and had used that method to calculate emissions for that source category. MACTEC obtained those emissions from EPA and those values were substituted directly into the inventory after receiving consensus from all of the VISTAS States to perform the replacement. These files were obtained in March of 2004 in NIF format from the EPA FTP site.

#### **1.2.4 Quality Assurance steps**

Throughout the inventory development process, quality assurance steps were performed to ensure that no double counting of emissions occurred, and to ensure that a full and complete inventory was developed for VISTAS. Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on the area source component of the 2002 base year revised:

1. All CERR and NIF format State supplied data submittals were run through EPA's Format and Content checking software.
2. SCC level emission summaries were prepared and evaluated to ensure that emissions were consistent and that there were no missing sources.
3. Tier comparisons (by pollutant) were developed between the revised 2002 base year inventory and the previous (version 3.1) base year inventory.
4. Fields were either added or used within each NIF data table to track the sources of data for each emission record.
5. Data product summaries were provided to both the VISTAS Emission Inventory Technical Advisor and to Area Source and Fires SIWG representatives for review and comment. Changes based on these comments were implemented in the files.
6. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from 1.0 to 2.0. A minor change would cause a version number to go from 1.0 to 1.1. Minor changes resulting from largely editorial changes would result in a change from 1.00 to 1.01.

In addition, for the fires inventory, data related to fuel loading and fuel consumption was reviewed and approved by the VISTAS Fire SIWG to ensure that values used for each type of fire and each individual fire were appropriate. Members of the VISTAS Fire SIWG included representatives from most State Divisions of Forestry (or equivalent) as well as U.S. Forest Service and National Park Service personnel.

### **1.3 Mobile Sources**

This section describes the revisions made to the initial 2002 VISTAS Base Year emission inventory on-road mobile source input files. For this work actual emission estimates were not made, rather data files consistent with MOBILE6 were developed and provided to the VISTAS modeling contractor. These input data files were then run during the VISTAS modeling to generate on-road mobile source emissions using episodic and meteorological specific conditions configured in the SMOKE emissions processor.

During initial discussions with the VISTAS Mobile Source SIWG, some States indicated a desire to use CERR mobile source emissions data in place of the VISTAS 2002 inventories generated by E.H. Pechan and Associates, Inc. (the initial VISTAS 2002 Base Year inventory files).

However, the CERR emissions data by itself were not sufficient for an inventory process that includes both base and future year inventories. MACTEC needed to be able to replicate the CERR data rather than simply obtain CERR emissions estimates. The reason for this is that only input files were being prepared to provide revised 2002 estimates during the VISTAS modeling process, rather than the actual emission estimates and that the 2002 input data files would be used as a starting point for the projected emission estimates. This meant that the appropriate VMT, MOBILE6, and/or NONROAD model input data needed to be provided. If these data were provided with the CERR emissions estimates we used it as the starting point for revision of the 2002 Base Year inventory. However MACTEC did not have access to the on-road mobile CERR submissions from EPA, so resubmittal of these data directly to MACTEC was requested in order to begin compiling the appropriate input file data.

In those cases where States did not provide CERR on-road mobile source input data files, our default approach was to maintain the data input files and VMT estimates for the initial 2002 Base Year inventory prepared by Pechan.

#### **1.3.1 Development of on-road mobile source input files and VMT estimates**

Development of the 2002 on-road input files and VMT was a multi-step process depending upon what the State mobile source contacts instructed us to use as their data. In general the process involved one of three steps.

1. The first step was to evaluate the initial 2002 base year files and make any non-substantive changes (i.e., changes only to confirm that the files posted for 2002 by Pechan were executable and that all the necessary external files needed to run MOBILE6 were present). This approach was taken for AL, FL, GA, MS, SC, and WV. For these States the determination was made that the previous files would be okay to use as originally prepared. For SC, the VMT file was updated, but that did not affect the MOBILE6 input files.

2. For other States, modification to the input files was required. The information below indicates what changes were made for other States in the VISTAS region.

KY – For Kentucky, the I/M records in the input files for Jefferson County were updated in order to better reflect the actual I/M program in the Louisville metropolitan area.

NC - Substantial revisions were implemented to these input files based on input from the State. The modifications necessary to reflect the desires of the State led to complete replacement of the previous input files. Among the changes made were:

- The regrouping of counties (including the movement of some counties from one county group to another and the creation of new input files for previously grouped counties). There were originally 32 input files; after the changes there were 49. The pointer file was corrected to reflect these changes.
- Travel speeds were updated in over 3000 scenarios.
- All I/M records were updated.
- All registration distributions were updated.
- I/M VMT fractions were updated (which only affected the pointer file).
- VMT estimates were updated (which has no direct effect on the MOBILE6 input files but does ultimately effect emissions).

3. VA and TN – For these States, new input files were provided due to substantive changes that the State wanted to make relative to the 2002 initial base year input files. In addition, revised VMT data were developed for each State.

### **1.3.2 Development of non-road emission estimates**

Emissions from non-road sources were estimated in two steps. First, emissions for non-road sources that are included in the NONROAD model were developed. Second, emissions from sources not included in the NONROAD model were estimated. The sections below detail the procedures used for each group of sources.

#### **1.3.2.1 Emissions from NONROAD model sources**

An initial 2002 base year emissions inventory for nonroad engines and equipment covered by the EPA NONROAD model was prepared for VISTAS in early 2004. The methods and assumptions used to develop the inventory are presented in a February 9, 2004 report “*Development of the VISTAS Draft 2002 Mobile Source Emission Inventory (February 2004 Version)*” as prepared by E.H. Pechan & Associates, Inc. Except as otherwise stated below, all aspects of the preparation

methodology documented in that report continue to apply to the revised NONROAD modeling discussed in this section.

Revisions to the preliminary 2002 NONROAD emissions inventory were implemented to ensure that the latest State and local data were considered, as well as to more accurately reflect gasoline sulfur contents for 2002 and correct other State-specific discrepancies. This section details the specific revisions made to the NONROAD model input files for the revised 2002 VISTAS base year inventory, and provides insight into some key differences between the version of the NONROAD model employed for this inventory and the previous version employed for the initial 2002 base year inventory.

Three VISTAS States provided detailed data revisions for consideration in developing model inputs. These States were:

1. North Carolina
2. Tennessee (including a separate submission for Davidson County), and
3. Virginia.

The remaining seven VISTAS States indicated that the preliminary 2002 VISTAS input files continued to reflect the most recent data available. These States were:

1. Alabama,
2. Florida,
3. Georgia,
4. Kentucky,
5. Mississippi,
6. South Carolina, and
7. West Virginia.

However, it should be recognized that the NONROAD input files for *all* ten VISTAS States were updated to reflect gasoline sulfur content revisions for the revised 2002 base year inventory.

Before presenting the specific implemented revisions, it is important to note that the revised 2002 base year inventory utilizes a newer release of the NONROAD model than was used for the initial 2002 base year inventory. The revised 2002 base year inventory is based on the Draft NONROAD2004 model, which was released by the EPA in May of 2004. (The model can be downloaded from: <http://www.epa.gov/otaq/nonrdmdl.htm#model>.) The initial 2002 base year inventory was based on the Draft NONROAD2002a version of the model. Key differences between the models are as follows:



- Draft NONROAD2004 includes the effects of the Tier 4 nonroad engine and equipment standards (this did not impact 2002 inventory estimates, but does affect future year forecasts).
- Draft NONROAD2004 includes the *exhaust* emission impacts of the large spark-ignition engine standards; the evaporative impacts of these standards are *not* incorporated (this does not impact 2002 inventory estimates, but does affect future year forecasts).
- Draft NONROAD2004 includes revised equipment population estimates.
- The PM<sub>2.5</sub> fraction for *diesel* equipment in Draft NONROAD2004 has been updated from 0.92 to 0.97.
- Draft NONROAD2004 includes revisions to recreational marine activity, useful life, and emission rates.

To the extent that these revisions affect 2002 emissions estimates, they will be reflected as differentials between the initial and revised 2002 VISTAS base year inventories. It is perhaps important to identify that the EPA recognizes the Draft NONROAD2004 model as an appropriate mechanism for State Implementation Plan (SIP) development. Although the model continues to be designated as a draft update, it reflects the latest and most accurate NONROAD planning data, as evidenced by the EPA's use of the version for the Tier 4 Final Rulemaking.

For the initial 2002 base year inventory, all NONROAD modeling runs for VISTAS were performed utilizing a gasoline sulfur content of 339 parts per million by weight (ppmW) and a diesel sulfur content of 2,500 ppmW. Although the EPA-recommended nonroad diesel fuel sulfur content for 2002 is 2,283 ppmW, the 2,500 ppmW sulfur content used for the initial 2002 base year VISTAS inventory was designed to remove the effect of lower nonroad diesel fuel sulfur limits applicable only in California. (The EPA recommended inputs can be found in "*Diesel Fuel Sulfur Inputs for the Draft NONROAD2004 Model used in the 2004 Nonroad Diesel Engine Final Rule*," EPA, April 27, 2004.) This correction is appropriate and has been retained for the final 2002 inventory. Thus, the final inventory continues to assume diesel fuel sulfur content of 2,500 ppmW across the VISTAS region.

However, 339 ppmW is not the EPA recommended 2002 gasoline sulfur content for either eastern conventional gasoline areas or Federal Reformulated Gasoline (RFG) areas. The recommended sulfur content for eastern conventional gasoline is 279 ppmW year-round, while the recommended sulfur content for RFG areas is 129 ppmW during the summer season and 279 ppmW during the winter season. (Conventional gasoline and RFG sulfur contents for 2002 can be found in "*User's Guide to MOBILE6.1 and MOBILE6.2, Mobile Source Emission Factor Model*," EPA420-R-03-010, U.S. EPA, August 2003 [pages 149-155] and in the source code for



MOBILE6.2 at Block Data BD05.) Given the differences in the EPA-recommended values and the value used to generate the initial 2002 base year inventory, the input files for *all* VISTAS areas were updated to reflect revised gasoline sulfur content assumptions.

Since the VISTAS NONROAD modeling is performed on a seasonal basis, and since gasoline sulfur content in RFG areas varies with the RFG season, seasonal-specific gasoline sulfur content values were estimated for use in RFG area modeling. In addition, 25 counties in Georgia are subject to a summertime gasoline sulfur limit of 150 ppmW, so that seasonal sulfur content estimates were also estimated for these counties. The initial 2002 base year NONROAD inventory for these Georgia counties was based on a year-round 339 ppmW gasoline sulfur content, but that oversight was corrected in the revised 2002 base year inventory. Based on the seasonal definitions employed in the NONROAD model, monthly sulfur contents were averaged to estimate seasonal gasoline sulfur contents as follows:

Month/Season	RFG Areas	Conventional Gasoline Areas	Georgia Gasoline Control Areas
March	279 ppmW	279 ppmW	279 ppmW
April	279 ppmW	279 ppmW	279 ppmW
May	129 ppmW	279 ppmW	150 ppmW
Spring	229 ppmW	279 ppmW	236 ppmW
June	129 ppmW	279 ppmW	150 ppmW
July	129 ppmW	279 ppmW	150 ppmW
August	129 ppmW	279 ppmW	150 ppmW
Summer	129 ppmW	279 ppmW	150 ppmW
September	129 ppmW	279 ppmW	150 ppmW
October	279 ppmW	279 ppmW	279 ppmW
November	279 ppmW	279 ppmW	279 ppmW
Fall	229 ppmW	279 ppmW	236 ppmW
December	279 ppmW	279 ppmW	279 ppmW
January	279 ppmW	279 ppmW	279 ppmW
February	279 ppmW	279 ppmW	279 ppmW
Winter	279 ppmW	279 ppmW	279 ppmW

Note that the seasonal data are based on simple arithmetic averages and do not consider any monthly variation in activity (and fuel sales), and that the transition between summer and winter seasons is also not considered. Additionally, the summer fuel control season is treated as though it applies from May through September, while the summer RFG season actually ends on September 15 and the Georgia fuel control season does not officially begin until June 1. This

treatment is consistent with the treatment of both fuel control programs in the VISTAS onroad vehicle modeling. Each of these influences will result in some error in the estimated sulfur content estimates, but it is expected that this error is small relative to the overall correction from a year-round sulfur content estimate of 339 ppmW.

The specific NONROAD modeling revisions implemented for each VISTAS area are presented in Table 1.3-2. Due to the more involved updates in several areas, the number of NONROAD input files as well as sequence numbers used to represent these files was also updated in a few instances. These structural revisions are presented in Table 1.3-3, and are provided solely for the benefit of NONROAD modelers as the indicated revisions have no impact on generated emission estimates.

**Table 1.3-2. Summary of NONROAD Modeling Revisions**

State	Revisions Implemented
AL	(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).
FL	(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).
GA	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all seasons for conventional gasoline counties.</p> <p>(2) Gasoline sulfur content changed from 339 ppmW to 150 ppmW in the summer for all gasoline control counties.</p> <p>(3) Gasoline sulfur content changed from 339 ppmW to 236 ppmW in the spring and fall for all gasoline control counties.</p> <p>(4) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in the winter for all gasoline control counties.</p> <p><i>Gasoline control counties: Barrow, Bartow, Butts, Carroll, Cherokee (a), Clayton (a), Cobb (a), Coweta (a), Dawson, De Kalb (a), Douglas (a), Fayette (a), Forsyth (a), Fulton (a), Gwinnett (a), Hall, Haralson, Henry (a), Jackson, Newton, Paulding (a), Pickens, Rockdale (a), Spalding, and Walton</i></p>
KY	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all seasons for conventional gasoline counties.</p> <p>(2) Gasoline sulfur content changed from 339 ppmW to 129 ppmW in the summer for all gasoline control counties.</p> <p>(3) Gasoline sulfur content changed from 339 ppmW to 229 ppmW in the spring and fall for all gasoline control counties.</p> <p>(4) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in the winter for all gasoline control counties.</p> <p><i>Gasoline control counties: Boone, Bullitt (b), Campbell, Jefferson, Kenton, and Oldham (b)</i></p>
MS	(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).
NC	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).</p> <p>(2) Utilize revised (i.e., local) allocation files for three equipment categories.</p> <p>(3) Utilize revised (i.e., local) seasonal activity data.</p>
SC	(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).
TN	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).</p> <p>(2) Gasoline RVP values changed in accordance with local recommendations.</p> <p>(3) Temperature data changed in accordance with local recommendations.</p> <p>(4) Counties regrouped in accordance with local recommendations.</p>

- continued -

**Table 1.3-2. Summary of NONROAD Modeling Revisions (continued)**

State	Revisions Implemented
VA	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all seasons for conventional gasoline counties.</p> <p>(2) Gasoline sulfur content changed from 339 ppmW to 129 ppmW in the summer for all gasoline control counties.</p> <p>(3) Gasoline sulfur content changed from 339 ppmW to 229 ppmW in the spring and fall for all gasoline control counties.</p> <p>(4) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in the winter for all gasoline control counties.</p> <p>(5) Gasoline RVP values changed in accordance with local recommendations.</p> <p>(6) Counties regrouped in accordance with local recommendations.</p> <p>(7) The control effectiveness for counties subject to Stage II controls revised to 77 percent in accordance with local recommendations.</p> <p><i>Gasoline control counties: Arlington Co., Fairfax Co., Loudoun Co., Prince William Co., Stafford Co., Alexandria City, Fairfax City, Falls Church City, Manassas City, Manassas Park City, Chesterfield Co., Hanover Co., Henrico Co., Colonial Heights City, Hopewell City, Richmond City, James City, York Co., Chesapeake City, Hampton City, Newport News City, Norfolk City, Poquoson City, Portsmouth City, Suffolk City, Virginia Beach City, and Williamsburg City (c)</i></p>
WV	<p>(1) Gasoline sulfur content changed from 339 ppmW to 279 ppmW in all counties and all seasons (all are conventional gasoline areas).</p> <p>(2) Continue to utilize local allocation files for nine equipment categories.</p>

**Note:**

- (a) County is subject to local control currently, but is scheduled to join the RFG program in January 2005.
- (b) Control area is a portion of the county, but modeling id performed as though the control applies countywide.
- (c) The EPA also lists Charles City County as an RFG area, but local planners indicate that Charles City County is a conventional gasoline area and it is modeled as such.

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**Table 1.3-3. NONROAD Modeling Sequencing and Structural Input File Revisions**

State	Initial 2002 Base Year Inventory Input File Sequence Numbers	Revised 2002 Inventory Input File Sequence Numbers	Reason(s) for Change	Number of Final 2002 Inventory NONROAD Input Files
AL	01-08	01-08	No Structural Changes	32 (at 8 per season)
FL	09-10	09-10	No Structural Changes	8 (at 2 per season)
GA	11-13	11-13	No Structural Changes	12 (at 3 per season)
KY	14-22	14-22	No Structural Changes	36 (at 9 per season)
MS	48	48	No Structural Changes	4 (at 1 per season)
NC	23-25	23-25	No Structural Changes	12 (at 3 per season)
SC	26-32	26-32	No Structural Changes	28 (at 7 per season)
TN	33-34	33-34, 49-52	Counties Regrouped	24 (at 6 per season)
VA	35-43	35-38, 40-43	Counties Regrouped	32 (at 8 per season)
WV	44-47	44-47	No Structural Changes	16 (at 4 per season)
<b>All</b>	<b>01-48</b>	<b>01-38, 40-52</b>		<b>204 (at 51 per season)</b>

- Note:**
- (1) All files include internal revisions to reflect the data changes summarized in Table 1.3-2 above. This table is intended to present structural revisions that are of interest in assembling the NONROAD model input files into a complete VISTAS region inventory. The indicated revisions do not (in and of themselves) result in emission estimate changes.
  - (2) The NONROAD model imposes an eight digit input file name limit, so all input files for the revised 2002 base year inventory follow a modified naming convention to allow each to be distinguished from the input files for the initial 2002 base year inventory. For the initial 2002 base year inventory, the naming convention was:

**ss02aaqq**, where: ss = the two character State abbreviation,  
 aa = a two character season indicator as follows: AU = autumn,  
 WI = winter, SP = spring, and SU = summer, and  
 qq = the two digit sequence number indicated above.

For the revised 2002 inventory, the naming convention was modified to:

**ss02aFqq**, where: ss = the two character State abbreviation,  
 a = a one character season indicator as follows: A = autumn,  
 W = winter, S = spring, and X = summer, and

### 1.3.2.2 Emissions from Commercial Marine Vessels, Locomotives, and Airplanes

An initial 2002 base year emissions inventory for aircraft, locomotives, and commercial marine vessels (CMV) was prepared for VISTAS in early 2004. The methods used to develop the inventory are presented in a February 9, 2004 report “*Development of the VISTAS Draft 2002 Mobile Source Emission Inventory (February 2004 Version)*” as prepared by E.H. Pechan & Associates, Inc. A summary of the initial 2002 base year emissions inventory is presented in Table 1.3-4. Except as otherwise stated below, all aspects of the preparation methodology continue to apply to the revised emissions inventory.

Revisions to the initial 2002 base year emissions inventory were implemented to ensure that the latest State and local data were incorporated as well as to correct an overestimation of particulate matter (PM) emissions from aircraft. Seven of the ten VISTAS States provided revised inventory data in the form of emissions reported to the EPA under the CERR. States providing CERR data were Alabama, Georgia, Mississippi, North Carolina, Tennessee (excluding Davidson, Hamilton, Knox, and Shelby Counties), Virginia, and West Virginia.

In many cases, the CERR data were only marginally different than the initial 2002 base year inventory data, but there were several instances where significant updates were evident. The remaining three VISTAS States (Florida, Kentucky, and South Carolina), plus Davidson, Hamilton, Knox, and Shelby counties in Tennessee, indicated that the preliminary 2002 VISTAS inventory continued to reflect the most recent data available. Florida did provide updated aircraft emissions data for one county (Miami-Dade) and these data were incorporated into the revised 2002 inventory as described below.

Since several States recommended retaining the initial 2002 base year inventory data, the initial step toward revising the 2002 inventory consisted of modifying the estimated aircraft PM emissions of the preliminary inventory. The overestimation of aircraft PM became evident shortly after the release of the initial 2002 base year inventory, when it was determined that VISTAS region airports would constitute the top seven, and 11 of the top 15, PM sources in the nation. Moreover, PM emissions for one airport (Miami International) were a full order of magnitude larger than *all* other modeled elemental carbon PM emission sources. In addition, unexpected relationships across airports were also observed, with emissions for Atlanta’s Hartsfield International being substantially less than those of Miami International, even though Atlanta handles over twice as many aircraft operations annually. Given the pervasiveness of this problem, and since the CERR data submitted by States was based on the preliminary 2002 VISTAS inventory data, aircraft PM emissions for the entire VISTAS region were recalculated.

**Table 1.3-4. Initial 2002 Base Year Aircraft, Locomotive, and Non-Recreational Marine Emissions as Reported in February 2004 (annual tons)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	3,787	175	688	475	17	196
	FL	28,518	11,955	46,352	31,983	1,050	3,703
	GA	3,175	992	3,919	2,704	94	353
	KY	2,666	657	2,597	1,792	63	263
	MS	1,593	140	553	381	13	96
	NC	6,088	1,548	6,115	4,219	148	613
	SC	6,505	515	452	312	88	863
	TN	6,854	2,665	7,986	5,510	225	920
	VA	17,676	5,607	14,476	9,988	234	3,229
	WV	1,178	78	310	214	8	66
	<b>Total</b>	<b>78,040</b>	<b>24,332</b>	<b>83,448</b>	<b>57,578</b>	<b>1,940</b>	<b>10,302</b>
Commercial Marine (2280)	AL	1,195	9,217	917	843	3,337	736
	FL	5,888	44,817	1,936	1,781	6,683	1,409
	GA	1,038	7,874	334	307	1,173	246
	KY	6,607	50,267	2,246	2,066	9,608	1,569
	MS	5,687	43,233	1,903	1,750	7,719	1,351
	NC	599	4,547	193	178	690	142
	SC	1,067	8,100	343	316	1,205	253
	TN	4,129	31,397	1,390	1,278	5,753	980
	VA	1,198	3,426	929	855	3,258	596
	WV	2,094	15,882	668	614	720	497
	<b>Total</b>	<b>29,503</b>	<b>218,760</b>	<b>10,858</b>	<b>9,989</b>	<b>40,146</b>	<b>7,779</b>
Military Marine (2283)	VA	136	387	28	26	30	59
	<b>Total</b>	<b>136</b>	<b>387</b>	<b>28</b>	<b>26</b>	<b>30</b>	<b>59</b>
Locomotives (2285)	AL	3,490	26,339	592	533	1,446	1,354
	FL	1,006	9,969	247	222	605	404
	GA	2,654	26,733	664	598	1,622	1,059
	KY	2,166	21,811	542	488	1,321	867
	MS	2,302	23,267	578	520	1,429	899
	NC	1,638	16,502	410	369	1,001	654
	SC	1,160	11,690	291	261	710	462
	TN	4,530	44,793	1,110	999	2,689	1,805
	VA	1,928	19,334	1,407	1,266	3,443	798
	WV	1,105	11,150	277	249	681	436
	<b>Total</b>	<b>21,980</b>	<b>211,588</b>	<b>6,118</b>	<b>5,505</b>	<b>14,947</b>	<b>8,738</b>
<b>Grand Total</b>		<b>129,659</b>	<b>455,067</b>	<b>100,452</b>	<b>73,099</b>	<b>57,062</b>	<b>26,877</b>

Aircraft do emit PM while operating. However, official EPA inventory procedures for aircraft generally do not include PM emission factors and, therefore, aircraft PM is generally erroneously reported as zero. In an effort to overcome this deficiency, the developers of the initial VISTAS 2002 base year aircraft inventory estimated PM emission rates for aircraft using estimated  $\text{NO}_x$  emissions and an unreported PM-to- $\text{NO}_x$  ratio (i.e.,  $\text{PM} = \text{NO}_x$  times a PM-to- $\text{NO}_x$  ratio). According to the initial 2002 base year inventory documentation, this approach was applied only to commercial aircraft  $\text{NO}_x$ , but a review of that inventory indicates that the technique was also applied to military, general aviation, and air taxi aircraft in many, but not all, instances. Although there is nothing inherently incorrect with this approach, the accuracy and inconsistent application of the assumed PM-to- $\text{NO}_x$  ratio results in grossly overestimated aircraft PM.

Through examination of the initial 2002 base year aircraft inventory, it is apparent that the commercial aircraft PM-to- $\text{NO}_x$  ratio used to generate PM emission estimates was approximately equal to 3.95 (i.e.,  $\text{PM} = \text{NO}_x$  times 3.95). While the majority of observed commercial aircraft PM-to- $\text{NO}_x$  ratios in that inventory are equal to 3.95, a few range as low as 3.00. If all aircraft estimates are included (i.e., commercial plus military, general aviation, and air taxi), observed PM-to- $\text{NO}_x$  ratios range from 0 to 123.0, and average 3.43 as illustrated in Table 1.3-5.

**Table 1.3-5 PM-to- $\text{NO}_x$  ratios by aircraft type.**

Aircraft Type	Average PM-to- $\text{NO}_x$	Range of PM-to- $\text{NO}_x$	Average $\text{PM}_{2.5} / \text{PM}_{10}$	Range of $\text{PM}_{2.5} / \text{PM}_{10}$
Undefined <sup>(1)</sup>	0.046	0-0.062	0.690	0.690-0.690
Military	0.073	0-92.3	0.688	0.333-1.000
Commercial	3.953	3.00-3.953	0.690	0.667-0.696
General Aviation	2.059	0-9.00	0.689	0.500-1.000
Air Taxi	2.734	0-123.0	0.690	0.500-1.000
Aggregate	3.427	0-123.0	0.690	0.333-1.000

**Note:** (1) Two counties report aircraft emissions as SCC 2275000000 "all aircraft."

As indicated, the aggregate PM-to- $\text{NO}_x$  ratio is similar in magnitude to the ratio for commercial aircraft. This results from the dominant nature of commercial aircraft  $\text{NO}_x$  emissions relative to  $\text{NO}_x$  from other aircraft types. It is surmised that ratios that deviate from 3.95 are based on PM emission estimates generated by local planners, which were retained without change in the PM



estimation process (although a considerable number of unexplained “zero PM” records also exist in the initial 2002 base year inventory dataset). Regardless, based on previous statistical analyses performed in support of aircraft emissions inventory development outside the VISTAS region, a PM-to-NO<sub>x</sub> ratio of 3.95 is too large by over an order of magnitude.

In analyses performed for the Tucson, Arizona planning area, PM-to-NO<sub>x</sub> ratios for aircraft over a standard aircraft landing and takeoff (LTO) cycle are estimated to be as follows: (“Emissions Inventories for the Tucson Air Planning Area, Volume I., Study Description and Results,” prepared for the Pima Association of Governments, Tucson, AZ, November 2001.)

**Table 1.3-6 Tucson, AZ PM-to-NO<sub>x</sub> ratios by aircraft type.**

Aircraft Type	PM-to-NO <sub>x</sub>
Commercial Aircraft	0.26
Military Aircraft	0.88
Air Taxi Aircraft	0.50
General Aviation Aircraft	1.90

**Note:**

The PM and NO<sub>x</sub> emission estimates presented in the Tucson study are for local aircraft operating mode times. For this work, emission estimates for Tucson were recalculated for a standard LTO cycle, so that the ratios presented are applicable to the standard LTO cycle and not a Tucson-specific cycle. Thus, the ratios presented herein vary somewhat from those associated with the emission estimates presented in the Tucson study report.

In reviewing these data, it should be considered that they apply to a standard (i.e., EPA-defined) LTO cycle. Aircraft PM-to-NO<sub>x</sub> ratios vary with operating mode, so that aircraft at airports with mode times that differ from the standard cycle will exhibit varying ratios. However, conducting an airport-specific analysis for all airports in the VISTAS region was beyond the scope of this work. While local PM-to-NO<sub>x</sub> ratios could vary somewhat from the indicated standard cycle ratios, any error due to this variation will be significantly less than the order of magnitude error associated with the 3.95 commercial aircraft ratio used for the initial 2002 base year inventory.

It should be recognized that while the Tucson area is far removed from the VISTAS region, the data analyzed to generate the PM-to-NO<sub>x</sub> ratios is standard aircraft emission factor data routinely employed for inventory purposes throughout the United States. With the exception of aircraft operating conditions, there are no inherent geographic implications associated with the use of data from the Tucson study. As indicated above, issues associated with local operating conditions have been eliminated by recalculating the Tucson study ratios for a standard LTO cycle.

To implement the revised PM-to-NO<sub>x</sub> ratios, *all* aircraft PM records were removed from the initial 2002 base year inventory. This includes records for which local planners may have

estimated PM emissions. This approach was taken for two reasons. First, there is no way to distinguish which records may have been generated by local planners. Second, the data available to local planners may be no better than that used to generate the presented PM-to-NO<sub>x</sub> ratio data, so the consistent application of these data to the entire VISTAS region was determined to be the most appropriate approach to generating consistent inventories throughout the region. In undertaking this removal, it became apparent that there was an imbalance in the aircraft NO<sub>x</sub> and PM records in the initial 2002 base year inventory. Whereas there were 1,531 NO<sub>x</sub> records in the NIF emission data sets for this source category, there were only 1,212 PM records. The imbalance was distributed between three States, South Carolina, Tennessee, and Virginia as follows:

**Table 1.3-7 Aircraft records with no corresponding pollutant records.**

*Aircraft NO<sub>x</sub> records with no corresponding PM record:*

Aircraft Type	South Carolina	Virginia	Total
Military Aircraft	8	100	108
General Aviation Aircraft	14	94	108
Air Taxi Aircraft	5	99	104
Aggregate	27	293	320

*Aircraft PM records with no corresponding NO<sub>x</sub> record:*

Aircraft Type	Tennessee	Total
Air Taxi Aircraft	1	1
Aggregate	1	1

The unmatched PM record was for Hamilton County (Chattanooga), Tennessee and when removed, was not replaced since there was no corresponding NO<sub>x</sub> record with which to estimate revised PM emissions. It is unclear how this orphaned record originated, but clearly there can be no air taxi PM emissions without other combustion-related emissions. Thus, the removal of the PM<sub>10</sub> and PM<sub>2.5</sub> records for Hamilton County permanently reduced the overall size of the 2002 initial base year inventory database by two records.

Of the 320 unmatched NO<sub>x</sub> records, 269 were records for which the reported emission rate was zero. Therefore, even though associated PM records were missing, the overall inventory was not affected. However, the 51 missing records for which NO<sub>x</sub> emissions were non-zero, did impact PM estimates for the overall inventory.

Replacement PM<sub>10</sub> records were calculated for all aircraft NO<sub>x</sub> records using the PM-to-NO<sub>x</sub> ratios presented above. Aircraft type-specific ratios were utilized in all cases, except for two

counties where aircraft emissions were reported under the generic aircraft SCC 2275000000. For these counties (Palm Beach County, Florida and Davidson County, Tennessee), the commercial aircraft PM-to-NO<sub>x</sub> ratio was applied since both contain commercial airports (Palm Beach International and Nashville International).

Replacement aircraft PM<sub>2.5</sub> records were also developed. The initial 2002 base year inventory assumed that aircraft PM<sub>2.5</sub> was 69 percent of aircraft PM<sub>10</sub>. The origin of this fraction is not clear, but it is very low for combustion related particulate matter. The majority of internal combustion engine related particulate matter is typically 1 micron or smaller (PM-1.0), so that typical internal combustion engine PM<sub>2.5</sub> fractions approach 100 percent. For example, the EPA NONROAD model assumes 92 percent for gasoline engine particulate and 97 percent for diesel engine particulate. Based on recent correspondence from the EPA, it appears that the agency is preparing to recommend a PM<sub>2.5</sub> fraction of 98 percent for aircraft. (August 12, 2004 e-mail correspondence from U.S. EPA to Gregory Stella of Alpine Geophysics.) This is substantially more consistent with expectations based on emissions test data for other internal combustion engine sources and was used as the basis for the recalculated aircraft PM<sub>2.5</sub> emission estimates in the revised 2002 base year inventory.

Although a substantial portion of the initial 2002 base year inventory was ultimately replaced with data prepared by State and local planners under CERR requirements, it was necessary to first revise the initial 2002 base year aircraft inventory as described so that that records extracted from the inventory for areas not relying on CERR data would be accurate. Therefore, in *no case* is the aggregated State data reported for the revised 2002 base year inventory identical to that of the initial 2002 base year inventory. Even areas relying on the initial 2002 base year inventory will reflect updates due to changes in emissions of PM<sub>10</sub> and PM<sub>2.5</sub> from aircraft.

Table 1.3-8 presents the revised 2002 base year inventory estimates. These estimates do not reflect any changes related to updated CERR data, but instead indicate the impacts associated with the recalculation of aircraft PM emissions alone. Table 1.3-9 presents a summary of the net impacts of these changes, where an over 90 percent reduction in aircraft PM is observed for all VISTAS areas except South Carolina and Virginia. The reasons for the lesser changes in these two States is that the overall aircraft NO<sub>x</sub> inventories for both include a large share of military aircraft NO<sub>x</sub> to which no (or very low) particulate estimates were assigned in the initial 2002 base year inventory. Since these operations are assigned non-zero PM emissions under the revised approach, the increase in military aircraft PM offsets a portion of the reduction in commercial aircraft PM. In Virginia, zero (or near zero) PM military operations were responsible for about 35 percent of total aircraft NO<sub>x</sub>, while the corresponding fraction in South Carolina was almost 70 percent. As indicated, aggregate aircraft, locomotive, and commercial marine vessel PM is 70-75 percent lower in the revised 2002 base year inventory.

**Table 1.3-8. Initial 2002 Base Year Aircraft, Locomotive, and Non-Recreational Marine Emissions with Modified Aircraft PM Emission Rates (annual tons)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	3,787	175	64	62	17	196
	FL	28,518	11,955	3,193	3,129	1,050	3,703
	GA	3,175	992	269	264	94	353
	KY	2,666	657	179	175	63	263
	MS	1,593	140	44	43	13	96
	NC	6,088	1,548	419	411	148	613
	SC	6,505	515	409	401	88	863
	TN	6,854	2,665	707	692	225	920
	VA	17,676	5,607	2,722	2,667	234	3,229
	WV	1,178	78	25	24	8	66
	<b>Total</b>	<b>78,040</b>	<b>24,332</b>	<b>8,030</b>	<b>7,870</b>	<b>1,940</b>	<b>10,302</b>
Commercial Marine (2280)	AL	1,195	9,217	917	843	3,337	736
	FL	5,888	44,817	1,936	1,781	6,683	1,409
	GA	1,038	7,874	334	307	1,173	246
	KY	6,607	50,267	2,246	2,066	9,608	1,569
	MS	5,687	43,233	1,903	1,750	7,719	1,351
	NC	599	4,547	193	178	690	142
	SC	1,067	8,100	343	316	1,205	253
	TN	4,129	31,397	1,390	1,278	5,753	980
	VA	1,198	3,426	929	855	3,258	596
	WV	2,094	15,882	668	614	720	497
	<b>Total</b>	<b>29,503</b>	<b>218,760</b>	<b>10,858</b>	<b>9,989</b>	<b>40,146</b>	<b>7,779</b>
Military Marine (2283)	VA	136	387	28	26	30	59
	<b>Total</b>	<b>136</b>	<b>387</b>	<b>28</b>	<b>26</b>	<b>30</b>	<b>59</b>
Locomotives (2285)	AL	3,490	26,339	592	533	1,446	1,354
	FL	1,006	9,969	247	222	605	404
	GA	2,654	26,733	664	598	1,622	1,059
	KY	2,166	21,811	542	488	1,321	867
	MS	2,302	23,267	578	520	1,429	899
	NC	1,638	16,502	410	369	1,001	654
	SC	1,160	11,690	291	261	710	462
	TN	4,530	44,793	1,110	999	2,689	1,805
	VA	1,928	19,334	1,407	1,266	3,443	798
	WV	1,105	11,150	277	249	681	436
	<b>Total</b>	<b>21,980</b>	<b>211,588</b>	<b>6,118</b>	<b>5,505</b>	<b>14,947</b>	<b>8,738</b>
<b>Grand Total</b>		<b>129,659</b>	<b>455,067</b>	<b>25,034</b>	<b>23,390</b>	<b>57,062</b>	<b>26,877</b>

**Table 1.3-9. Change in Initial 2002 Base Year Emissions due to Aircraft PM Emission Rate Modifications.**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	0%	0%	-91%	-87%	0%	0%
	FL	0%	0%	-93%	-90%	0%	0%
	GA	0%	0%	-93%	-90%	0%	0%
	KY	0%	0%	-93%	-90%	0%	0%
	MS	0%	0%	-92%	-89%	0%	0%
	NC	0%	0%	-93%	-90%	0%	0%
	SC	0%	0%	-9%	+29%	0%	0%
	TN	0%	0%	-91%	-87%	0%	0%
	VA	0%	0%	-81%	-73%	0%	0%
	WV	0%	0%	-92%	-89%	0%	0%
	Total	0%	0%	-90%	-86%	0%	0%
Commercial Marine (2280)	AL	0%	0%	0%	0%	0%	0%
	FL	0%	0%	0%	0%	0%	0%
	GA	0%	0%	0%	0%	0%	0%
	KY	0%	0%	0%	0%	0%	0%
	MS	0%	0%	0%	0%	0%	0%
	NC	0%	0%	0%	0%	0%	0%
	SC	0%	0%	0%	0%	0%	0%
	TN	0%	0%	0%	0%	0%	0%
	VA	0%	0%	0%	0%	0%	0%
	WV	0%	0%	0%	0%	0%	0%
Total	0%	0%	0%	0%	0%	0%	
Military Marine (2283)	VA	0%	0%	0%	0%	0%	0%
	Total	0%	0%	0%	0%	0%	0%
Locomotives (2285)	AL	0%	0%	0%	0%	0%	0%
	FL	0%	0%	0%	0%	0%	0%
	GA	0%	0%	0%	0%	0%	0%
	KY	0%	0%	0%	0%	0%	0%
	MS	0%	0%	0%	0%	0%	0%
	NC	0%	0%	0%	0%	0%	0%
	SC	0%	0%	0%	0%	0%	0%
	TN	0%	0%	0%	0%	0%	0%
	VA	0%	0%	0%	0%	0%	0%
	WV	0%	0%	0%	0%	0%	0%
Total	0%	0%	0%	0%	0%	0%	
Grand Total		0%	0%	-75%	-68%	0%	0%

As indicated above, for the revised 2002 base year inventory, data for all or portions of seven VISTAS States were replaced with corresponding data from recent CERR submissions for 2002. Before replacing these data, however, an analysis of the CERR data was performed to ensure consistency with VISTAS inventory methods. It should perhaps also be noted that three of the CERR datasets provided for the revised 2002 base year inventory (specifically those for Tennessee, Virginia, and West Virginia) included both annual and daily emissions data. Only the annual data were used.

Several important observations resulted from this analysis. First, it was clear that all of the CERR data continued to rely on the inaccurate aircraft PM estimation approach employed for the initial 2002 base year inventory. Therefore, an identical aircraft PM replacement procedure as described above for the revised 2002 base year inventory was undertaken. As a result, the CERR data for *all* VISTAS States has been modified for inclusion in the revised 2002 VISTAS base year inventory.

As was the case with the initial VISTAS 2002 base year inventory, there were a substantial number of aircraft NO<sub>x</sub> records without corresponding PM records, so that the number of recalculated PM records added to the CERR dataset is greater than the number of PM records removed. The aggregated CERR inventory data, reflecting data for all or parts of seven States, consisted of 13,656 records, of which 1,211 were aircraft NO<sub>x</sub> records. However, the number of corresponding aircraft PM records was 662 (662 PM<sub>10</sub> records and 662 PM<sub>2.5</sub> records). This imbalance was distributed as follows:

**Table 1.3-10 CERR Aircraft NO<sub>x</sub> records with no corresponding PM record.**

Aircraft Type	Georgia	Tennessee	Virginia	Total
Military Aircraft			136	136
Commercial Aircraft		4	136	140
General Aviation Aircraft	1		136	137
Air Taxi Aircraft			136	136
Aggregate	1	4	544	549

From this tabulation, it is clear that virtually the entire imbalance is associated with the Virginia CERR submission, with minor imbalances in Georgia and Tennessee. Of the 549 unmatched NO<sub>x</sub> records, 461 were records for which the reported emission rate was zero. Therefore, even though the associated PM records were missing, the overall inventory was not affected. However, the 88 missing records for which NO<sub>x</sub> emissions were non-zero do impact PM emission estimates for the overall inventory.

Replacement aircraft PM records (both PM<sub>10</sub> and PM<sub>2.5</sub>) were generated for the CERR dataset using procedures identical to those described above for the initial 2002 base year inventory.

Further analysis revealed that the CERR data for Virginia included only VOC, CO, and NO<sub>x</sub> emissions for all aircraft, locomotives, and non-recreational marine vessels. Since SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> records are included in the 2002 VISTAS inventory, an estimation method was developed for these emission species and applied to the Virginia CERR data. For PM, the

developed methodology was only employed for locomotive and marine vessel data since aircraft PM was estimated using the PM-to-NO<sub>x</sub> ratio methodology described above.

Consideration was given to simply adding the Virginia SO<sub>2</sub> and non-aircraft PM records from the revised 2002 VISTAS dataset, but it is very unlikely that either the source distribution or associated emission rates are identical across the CERR and preliminary VISTAS inventories. This was confirmed through a comparative analysis of dataset CO records. Therefore, an estimation methodology was developed using Virginia source-specific SO<sub>2</sub>/CO, PM<sub>10</sub>/CO, and PM<sub>2.5</sub>/PM<sub>10</sub> ratios from the initial 2002 base year VISTAS inventory. The calculated ratios were then applied to the source-specific CERR CO emission estimates to derive associated source-specific SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> emissions.

Initially, the development of the emissions ratios from the initial 2002 base year inventory was performed at the State (i.e., Virginia), county, and SCC level of detail. However, it readily became clear that there were substantial inconsistencies in ratios for identical SCCs across counties. For example, in one county, the SO<sub>2</sub>/CO ratio might be 0.2, while in the next county it would be 2.0. Since the sources in question are virtually identical (e.g., diesel locomotives) and since the fueling infrastructure for these large nonroad equipment sources is regional as opposed to local in nature, such variations in emission rates are not realistic. Therefore, a more aggregated approach was employed in which SCC-specific emission ratios were developed for the State as a whole. Through this approach county-to-county variation is eliminated, but the underlying variation does continue to influence the resulting aggregate emission estimates (but across all counties equally). The calculated emission ratios are as follows:

**Table 1.3-11 Calculated emission rates for VA.**

Source	SCC	SO <sub>2</sub> /CO	PM <sub>10</sub> /CO	PM <sub>2.5</sub> /CO	PM <sub>2.5</sub> /PM <sub>10</sub>
Military Aircraft	2275001000	0.0215			
Commercial Aircraft	2275020000	0.3292			
General Aviation Aircraft	2275050000	0.0002			
Air Taxi Aircraft	2275060000	0.0015			
Aircraft Refueling	2275900000	0.0000	0.0000	0.0000	
Diesel Commercial Marine	2280002000	0.3697	0.3434	0.3157	0.92
Residual Commercial Marine	2280003000	0.3697	0.3434	0.3157	0.92
Diesel Military Marine	2283002000	0.2422	0.2248	0.2068	0.92
Line Haul Locomotives	2285002005	3.2757	1.2999	1.1696	0.90
Yard Locomotives	2285002010	2.2908	1.2461	1.1205	0.90

*Emissions estimated using  
PM-to-NO<sub>x</sub> ratios as  
described previously.*



It is important to recognize that the inconsistency of emissions ratios across Virginia counties for sources of virtually identical design, which utilize a regional rather than local fueling infrastructure, has potential implications for other VISTAS States. There is no immediately obvious reason to believe that such inconsistencies would be isolated to Virginia.

One final revision to the CERR dataset was undertaken, and that was the removal of two records for unpaved airstrip particulate (SCC 2275085000) in Alabama. Otherwise identical records for these emissions were reported both in terms of filterable and primary particulate. The filterable particulate records were removed as all other particulate emissions in the VISTAS inventories are in terms of primary particulate. It is also perhaps worth noting that a series of aircraft refueling records (SCC 2275900000) for Virginia were left in place, even though typically such emissions would be reported under SCC 2501080XXX in the area source inventory. If additional VISTAS aircraft refueling emissions are reported under SCC 2501080XXX, then it may be desirable to recode these records.

Finally, data for areas of the VISTAS region not represented in the CERR dataset were added to the CERR data by extracting the appropriate records from the initial 2002 base year inventory (with revisions for PM). Specifically, records applicable to the States of Florida, Kentucky, South Carolina, and the Tennessee counties of Davidson, Hamilton, Knox, and Shelby were extracted from the initial 2002 inventory and added to the CERR dataset.

Following this aggregation, one last dataset revision was implemented. As indicated in the introduction of this section, the initial 2002 base year emission estimates for Miami International Airport were determined to be excessive. Although the reason for this inaccuracy was not apparent, revised estimates for aircraft emissions in Miami-Dade County were obtained from Florida planners and used to overwrite the erroneous estimates. (Aircraft emission estimates were provided in an August 10, 2004 e-mail transmittal from Bruce Coward of Miami-Dade County to Martin Costello of the Florida Department of Environmental Protection.)

Table 1.3-12 presents a summary of the resulting revised VISTAS 2002 base year inventory estimates for aircraft, locomotives, and non-recreational marine vessels. Table 1.3-13 provides a comparison of the revised 2002 base year inventory estimates to those of the initial 2002 base year inventory. As indicated, total emissions for VOC, CO, NO<sub>x</sub>, and SO<sub>2</sub> are generally within 10 percent, but final PM emissions are reduced by 70-80 percent due to the approximate 90 percent reductions in aircraft PM estimates. In addition, the significant changes in Georgia aircraft emissions are due to the CERR correction of Atlanta Hartsfield International Airport emissions, which were significantly underestimated in the initial 2002 base year inventory. The reduction in Florida aircraft emissions due to the correction of Miami International estimates is also apparent.



Lastly, Table 1.3-14 provides a direct comparison of emission estimates from the initial and revised 2002 base year inventories for all 16 VISTAS region airports with estimated annual NO<sub>x</sub> emissions of 200 tons or greater. The table entries are sorted in order of decreasing NO<sub>x</sub> and once again, the dramatic reduction in PM emissions is evident. However, in addition, the appropriate reversal of the relationship between Atlanta's Hartsfield and Miami International Airport is also depicted. As a rough method of quality assurance, Table 1.3-14 also includes a *gross* estimate of expected airport NO<sub>x</sub> emissions using detailed NO<sub>x</sub> estimates developed for Tucson International Airport in conjunction with the ratio of local to Tucson LTOs. (The Tucson NO<sub>x</sub> estimates are revised to reflect a standard LTO cycle rather than the Tucson-specific LTO cycle. This should provide for a more realistic comparison to VISTAS estimates.) This is not meant to serve as anything other than a crude indicator of the propriety of the developed VISTAS estimates, and it is clear that the range of estimated-to-expected NO<sub>x</sub> emissions has been substantially narrowed in the revised 2002 base year inventory. Whereas estimated-to-expected ratios varied from about 0.2 to over 3.5 in the initial 2002 base year inventory, the range of variation is tightened on both ends, from about 0.5 to 1.75 for the revised 2002 base year inventory. In effect, all estimates are now within a factor of two of the expected estimates, which is quite reasonable given likely variation in local and standard LTO cycles and variations in aircraft fleet mix across airports.

It is perhaps important to note that some shifting in county emissions assignments is evident between the initial and revised 2002 base year aircraft inventories. For example, for the initial 2002 base year inventory, Atlanta Hartsfield estimates were assigned to Fulton County (FIP 13121), while they are assigned to Clayton County (FIP 13063) for the revised 2002 base year inventory. Similarly, Dulles International Airport emissions were assigned solely to Fairfax County, Virginia (FIP 51059) in the initial 2002 base year inventory, but are split between Fairfax and Loudoun County (FIP 51107) for the revised inventory. Such shifts reflect local planner decision-making and are not an artifact of the revisions described above.

**Table 1.3-12. Revised 2002 Base Year Aircraft, Locomotive, and Non-Recreational Marine Emissions (tons/year)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	3,787	175	226	87	17	196
	FL	25,431	8,891	2,424	2,375	800	3,658
	GA	6,622	5,372	1,475	1,446	451	443
	KY	2,666	657	179	175	63	263
	MS	1,593	140	44	43	13	96
	NC	6,088	1,548	419	411	148	613
	SC	6,505	515	409	401	88	863
	TN	7,251	2,766	734	719	235	943
	VA	9,763	2,756	1,137	1,115	786	2,529
	WV	1,178	78	25	24	8	66
	<b>Total</b>	<b>70,884</b>	<b>22,899</b>	<b>7,072</b>	<b>6,797</b>	<b>2,607</b>	<b>9,670</b>
Commercial Marine (2280)	AL	1,196	9,218	917	844	3,337	737
	FL	5,888	44,817	1,936	1,781	6,683	1,409
	GA	1,038	7,875	334	307	1,173	246
	KY	6,607	50,267	2,246	2,066	9,608	1,569
	MS	5,688	43,233	1,903	1,751	7,719	1,351
	NC	599	4,547	193	178	690	142
	SC	1,067	8,100	343	316	1,205	253
	TN	3,624	27,555	1,217	1,120	4,974	860
	VA	972	2,775	334	307	359	483
	WV	1,528	11,586	487	448	525	362
	<b>Total</b>	<b>28,207</b>	<b>209,972</b>	<b>9,911</b>	<b>9,118</b>	<b>36,275</b>	<b>7,413</b>
Military Marine (2283)	VA	110	313	25	23	27	48
	<b>Total</b>	<b>110</b>	<b>313</b>	<b>25</b>	<b>23</b>	<b>27</b>	<b>48</b>
Locomotives (2285)	AL	3,490	26,339	592	533	1,446	1,354
	FL	1,006	9,969	247	222	605	404
	GA	2,725	27,453	682	614	1,667	1,086
	KY	2,166	21,811	542	488	1,321	867
	MS	2,302	23,267	578	520	1,429	899
	NC	1,638	16,502	410	369	1,001	654
	SC	1,160	11,690	291	261	710	462
	TN	2,626	25,627	633	570	1,439	1,041
	VA	1,186	11,882	1,529	1,375	3,641	492
	WV	1,311	13,224	329	296	808	517
	<b>Total</b>	<b>19,611</b>	<b>187,764</b>	<b>5,833</b>	<b>5,248</b>	<b>14,066</b>	<b>7,777</b>
<b>Grand Total</b>		<b>118,812</b>	<b>420,948</b>	<b>22,841</b>	<b>21,186</b>	<b>52,976</b>	<b>24,908</b>

**Table 1.3-13. Change in 2002 Emissions, Revised Inventory Relative to Initial Inventory**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	0%	0%	-67%	-82%	0%	0%
	FL	-11%	-26%	-95%	-93%	-24%	-1%
	GA	+109%	+442%	-62%	-47%	+379%	+26%
	KY	0%	0%	-93%	-90%	0%	0%
	MS	0%	0%	-92%	-89%	0%	0%
	NC	0%	0%	-93%	-90%	0%	0%
	SC	0%	0%	-9%	+29%	0%	0%
	TN	+6%	+4%	-91%	-87%	+4%	+2%
	VA	-45%	-51%	-92%	-89%	+236%	-22%
	WV	0%	0%	-92%	-89%	0%	0%
	<b>Total</b>	<b>-9%</b>	<b>-6%</b>	<b>-92%</b>	<b>-88%</b>	<b>+34%</b>	<b>-6%</b>
Commercial Marine (2280)	AL	+0%	+0%	+0%	+0%	+0%	+0%
	FL	0%	0%	0%	0%	0%	0%
	GA	+0%	+0%	+0%	+0%	+0%	+0%
	KY	0%	0%	0%	0%	0%	0%
	MS	+0%	+0%	+0%	+0%	+0%	+0%
	NC	+0%	+0%	+0%	+0%	+0%	+0%
	SC	0%	0%	0%	0%	0%	0%
	TN	-12%	-12%	-12%	-12%	-14%	-12%
	VA	-19%	-19%	-64%	-64%	-89%	-19%
	WV	-27%	-27%	-27%	-27%	-27%	-27%
	<b>Total</b>	<b>-4%</b>	<b>-4%</b>	<b>-9%</b>	<b>-9%</b>	<b>-10%</b>	<b>-5%</b>
Military Marine (2283)	VA	-19%	-19%	-12%	-12%	-12%	-19%
	<b>Total</b>	<b>-19%</b>	<b>-19%</b>	<b>-12%</b>	<b>-12%</b>	<b>-12%</b>	<b>-19%</b>
Locomotives (2285)	AL	0%	0%	0%	0%	0%	0%
	FL	0%	0%	0%	0%	0%	0%
	GA	+3%	+3%	+3%	+3%	+3%	+3%
	KY	0%	0%	0%	0%	0%	0%
	MS	0%	0%	0%	0%	0%	0%
	NC	0%	0%	0%	0%	0%	0%
	SC	0%	0%	0%	0%	0%	0%
	TN	-42%	-43%	-43%	-43%	-46%	-42%
	VA	-38%	-39%	+9%	+9%	+6%	-38%
	WV	+19%	+19%	+19%	+19%	+19%	+19%
	<b>Total</b>	<b>-11%</b>	<b>-11%</b>	<b>-5%</b>	<b>-5%</b>	<b>-6%</b>	<b>-11%</b>
<b>Grand Total</b>		<b>-8%</b>	<b>-7%</b>	<b>-77%</b>	<b>-71%</b>	<b>-7%</b>	<b>-7%</b>

**Table 1.3-14. Comparison of Airport Emissions (Airports with NO<sub>x</sub> > 200 tons per year)**

Airport	FIP	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC	Approx. LTOs	Predicted NO <sub>x</sub>	VISTAS to Predicted
<i>Initial 2002 Base Year Inventory</i>										
Miami	12086	9,757	5,997	23,706	16,357	525	1,641	150,000	1,680	3.57
Orlando	12095	3,456	2,170	8,578	5,919	204	642	150,000	1,680	1.29
Memphis	47157	3,462	1,934	7,645	5,275	185	603	125,000	1,400	1.38
Reagan	51013	3,892	1,806	7,138	4,925	164	302	100,000	1,120	1.61
Hampton	51650	2,690	1,705	0	0	0	611	Military		
Dulles	51059	2,032	1,330	5,246	3,620	0	272	75,000	840	1.58
Orlando-Sanford	12117	3,615	1,225	4,837	3,337	100	351			
Atlanta	13121	1,457	913	3,608	2,490	86	274	420,000	4,704	0.19
Fort Lauderdale	12011	1,930	809	3,196	2,206	75	257	75,000	840	0.96
Charlotte	37119	1,643	788	3,113	2,148	75	255	150,000	1,680	0.47
Tampa	12057	1,399	785	3,101	2,140	74	240	75,000	840	0.93
Nashville	47037	1,819	653	40	28	33	239	60,000	672	0.97
Raleigh	37183	1,584	592	2,338	1,613	56	204	75,000	840	0.70
Louisville	21111	1,073	468	1,851	1,277	45	155	60,000	672	0.70
Jacksonville	12031	871	325	1,284	886	31	112	30,000	336	0.97
Palm Beach	12099	1,156	226	0	0	1	132	30,000	336	0.67
Aggregate		41,836	21,724	75,682	52,220	1,655	6,290			0.19-3.57
<i>Revised 2002 Base Year Inventory</i>										
Atlanta	13063	4,121	5,288	1,435	1,406	443	337	420,000	4,704	1.12
Miami	12086	6,670	2,933	805	789	274	1,596	150,000	1,680	1.75
Orlando	12095	3,456	2,170	568	556	204	642	150,000	1,680	1.29
Memphis	47157	3,462	1,934	506	495	185	603	125,000	1,400	1.38
Orlando-Sanford	12117	3,615	1,225	338	332	100	351			
Fort Lauderdale	12011	1,930	809	217	212	75	257	75,000	840	0.96
Charlotte	37119	1,643	788	206	202	75	255	150,000	1,680	0.47
Tampa	12057	1,399	785	206	202	74	240	75,000	840	0.93
Nashville	47037	1,819	653	170	166	33	239	60,000	672	0.97
Reagan	51013	1,269	635	171	168	193	97	100,000	1,120	0.57
Dulles 1	51107	1,807	595	164	161	252	153	37,500	420	1.42
Raleigh	37183	1,584	592	156	153	56	204	75,000	840	0.70
Dulles 2	51059	1,095	591	156	153	252	115	37,500	420	1.41
Hampton	51650	858	535	471	461	18	305	Military		
Louisville	21111	1,073	468	123	121	45	155	60,000	672	0.70
Jacksonville	12031	871	325	87	85	31	112	30,000	336	0.97
Palm Beach	12099	1,156	226	59	58	1	132	30,000	336	0.67
Aggregate		37,829	20,550	5,838	5,721	2,312	5,793			0.47-1.75
Net Change		-10%	-5%	-92%	-89%	+40%	-8%			

Note: For the revised inventory, Dulles International Airport emissions are split between two Virginia counties. Predicted NO<sub>x</sub> is based on the ratio of airport LTOs to test airport (Tucson International Airport) LTOs and NO<sub>x</sub>. This is not a rigorous comparison, but rather an approximate indicator of expected magnitude.

### 1.3.3 Quality Assurance steps

Throughout the inventory development process, quality assurance steps were performed to ensure that no double counting of emissions occurred, and to ensure that a full and complete inventory was developed for VISTAS. Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on the area source component of the 2002 base year revised:

1. All CERR and NIF format State supplied data submittals were run through EPA's Format and Content checking software.
2. SCC level emission summaries were prepared and evaluated to ensure that emissions were consistent and that there were no missing sources.
3. Tier comparisons (by pollutant) were developed between the revised 2002 base year inventory and the initial base year inventory.
4. Data product summaries were provided to both the VISTAS Emission Inventory Technical Advisor and to Mobile Source SIWG representatives for review and comment. Changes based on these comments were implemented in the files.
5. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from 1.0 to 2.0. A minor change would cause a version number to go from 1.0 to 1.1. Minor changes resulting from largely editorial changes would result in a change from 1.00 to 1.01.

## 2.0 Projection Inventory Development

### 2.1 Point Sources

We used different approaches for different sectors of the point source inventory. For the electric generating units (EGUs), VISTAS used the Integrated Planning Model (IPM) to both project future activity as well as to calculate the impact of future control programs. For non-EGUs, we used recently updated growth and control data consistent with the data used in EPA's Clean Air Interstate Rule analyses, and supplemented these data with available stakeholder input. For both sectors, we generated 2009 and 2018 inventories for two control scenarios: on-the-books (OTB) controls (also referred to as Base 1 controls), and on-the-way (OTW) controls (also referred to as Base 2 controls). The OTB control scenario accounts for post-2002 emission reductions from promulgated federal, State, local, and site-specific control programs as of July 1, 2004. The OTW control scenario accounts for proposed (but not final) control programs that are reasonably anticipated to result in post-2002 emission reductions. Section 2.1.1 discusses the EGU projection inventory development, while Section 2.1.2 discusses the non-EGU projection inventory development.

#### 2.1.1 EGU sources

Three options were considered for developing the final VISTAS 2009/2018 projection inventories for EGUs:

- Option 1 – Use the results of IPM modeling conducted in support of the proposed Clean Air Interstate Rule (CAIR) base and control case analyses as the starting point and refine the projections with readily available inputs from stakeholders; these IPM runs were conducted for 2010 and 2015, which VISTAS would use to represent projected emissions in 2009 and 2018 respectively.
- Option 2 – Use the VISTAS 2002 typical year as the starting point, apply growth factors from the Energy Information Administration, and refine future emission rates with stakeholder input regarding utilization rates, capacity, retirements, and new unit information.
- Option 3 – Use the results of a new round of IPM modeling sponsored by VISTAS and the Midwest Regional Planning Organization (MRPO). These runs incorporated VISTAS specific unit and regulation modified parameters, and generate results for 2009 and 2018 explicitly.

An additional consideration for each of the three options was the inclusion of emission projections developed by the Southern Company specifically for their units. Southern Company is a super-regional company which owns EGUs in Alabama, Florida, Georgia, and Mississippi

and participates in VISTAS as an industry stakeholder. Southern Company used their energy budget forecast to project net generation and heat input for every existing and future Southern Company EGU for the years 2009 and 2018. Further documentation of how Southern Company created the 2009/2018 inventory for their units can be found in *Developing Southern Company Emissions and Flue Gas Characteristics for VISTAS Regional Haze Modeling (April 2005, presented at 14<sup>th</sup> International Emission Inventory Conference)*.

Each of these three options was discussed in a series of conference calls with the VISTAS EGU Special Interest Work Group (SIWG) during the fall of 2004. During a conference call on December 6, 2004, the VISTAS EGU SIWG approved the use of the latest VISTAS/MRPO sponsored IPM runs (Option 3) to represent the 2009 and 2018 EGU forecasts of emissions for the OTB and OTW cases. During the call, Alabama and Georgia specified that they did not wish to use Southern Company provided emissions forecasts of 2009 and 2018 to represent the sources in their States. Mississippi decided to utilize the Southern Company projections to represent activity at Southern Company facilities in Mississippi. After the call, Florida decided against using Southern Company provided emissions forecasts of 2009 and 2018 to represent the sources in their State.

The Option 3 IPM modeling resulted from a joint agreement by VISTAS and MRPO to work together to develop future year utility emissions based on IPM modeling. The decision to use IPM modeling was based in part on a study of utility forecast methods by E.H. Pechan and Associates, Inc. (Pechan) for MRPO, which recommended IPM as a viable methodology (see *Electricity Generating Unit {EGU} Growth Modeling Method Task 2 Evaluation*, February 11, 2004). Although EPA used IPM recently to support their rulemaking for the Clean Air Interstate Rule (CAIR), VISTAS stakeholders felt that certain model inputs needed to be improved. Thus, VISTAS and MRPO decided to hire contractors to conduct new IPM modeling and to post-process the IPM results. Southern Company projections in 2009 were roughly comparable with IPM. For 2018, Southern Company projections were generally less than IPM because of assumptions made by Southern Company on which units would be economical to control and incorrect data in the NEEDS database which feeds IPM.

In August, VISTAS contracted with ICF to run IPM to provide utility forecasts for 2009 and 2018 for two scenarios: a base, referred to as “on the books” controls, and EPA’s proposed CAIR rule, referred to as “on the way” controls. Also in August, MRPO contracted with E.H. Pechan to do the post-processing of these new IPM outputs to provide model-ready emission files. The IPM output files were delivered by ICF in November, and the post-processed data files were delivered by Pechan in December. A brief summary of the VISTAS/MRPO IPM modeling and post-processing of the IPM output is presented in the following subsections.

### 2.1.1.1 VISTAS/MRPO IPM runs for EGU sources

The following summary of the VISTAS/MRPO IPM modeling is based on ICF's documentation *Future Year Electricity Generating Sector Emission Inventory Development Using the Integrated Planning Model (IPM<sup>®</sup>) in Support of Fine Particulate Mass and Visibility Modeling in the VISTAS and Midwest RPO Regions*, April 2005. The ICF documentation is to be used as an extension to EPA's proposed CAIR modeling runs documented in *Documentation Supplement for EPA Modeling Applications (V.2.1.6) Using the Integrated Planning Model*, EPA 430/R-03-007, July 2003.

According to the IPM documentation, the model provides “forecasts of least-cost capacity expansion, electricity dispatch, and emission control strategies for meeting energy demand and environmental, transmission, dispatch, and reliability constraints.” The underlying database in this modeling is U.S. EPA's National Electric Energy Data System (NEEDS) released with the CAIR Notice of Data Availability (NODA). The NEEDS database contains the existing and planned/committed unit data in EPA modeling applications of IPM. NEEDS includes basic geographic, operating, air emissions, and other data on these generating units. VISTAS States and stakeholders provided changes for:

- NO<sub>x</sub> post-combustion control on existing units
- SO<sub>2</sub> scrubbers on existing units
- SO<sub>2</sub> emission limitations
- PM controls on existing units
- Summer net dependable capacity
- Heat rate for existing units
- Unit ID
- SO<sub>2</sub> and NO<sub>x</sub> control plans for North Carolina Clean Smokestacks Rule

The analysis covers the period between 2007 and 2030. To make the model size and run time tractable, IPM is run for a number of selected years within the study horizon known as run years. Each run year represents several calendar years in the study horizon, and all calendar years within the study horizon are mapped to their representative run years. The years 2009 and 2018 were explicitly modeled in this set of runs.

The Duke Power and Progress Energy SO<sub>2</sub> and NO<sub>x</sub> control technology investment strategies for complying with North Carolina's Clean Smokestacks Rule were explicitly hardwired in the analysis.



The CAIR rule implemented as part of this analysis is broadly consistent with the *Supplemental Proposal for the Rule to Reduce Interstate Transport of Fine Particulate Matter and Ozone (Clean Air Interstate Rule)*, proposed on June 10, 2004. The CAIR plants affected by the annual NO<sub>x</sub> policy are capped at 1.6 million tons starting 2010 and 1.33 million tons starting 2015. The power plants affected by the CAIR SO<sub>2</sub> policy have to surrender 2 Title IV SO<sub>2</sub> allowances for every ton of SO<sub>2</sub> emitted starting 2010 and 3 Title IV SO<sub>2</sub> allowances for every ton of SO<sub>2</sub> emitted starting 2015. It is important to remember that all EGU emission projections presented below are based on requirements of CAIR *as proposed* on June 10, 2004. The final CAIR (which was promulgated after our analyses) moved the NO<sub>x</sub> compliance date from 2010 to 2009. Future versions of the VISTAS projection emission inventory will likely reflect the Final CAIR requirements.

ICF ran IPM under two future scenarios – Base Case and CAIR Case. The Base Case represents the current operation of the power system under currently known laws and regulations, including those that come into force in the study horizon. The CAIR Case is the Base Case with the proposed CAIR rule superimposed. The run results were parsed at the unit level for the 2009 and 2018 run years.

#### **2.1.1.2 Post-Processing of IPM Parsed Files**

The following summary of the VISTAS/MRPO IPM modeling is based on Pechan's documentation *LADCO IPM Model Parsed File Post-Processing Methodology and File Preparation*, February 8, 2005.

The essence of the IPM model post-processing methodology is to take an initial IPM model output file and transform it into air quality model input files. ICF via VISTAS/MRPO provides an initial spreadsheet file containing unit-level records of both

- (1) "existing" units and
- (2) committed or new generic aggregates.

All records have unit and fuel type data; existing, retrofit (for SO<sub>2</sub> and NO<sub>x</sub>), and separate NO<sub>x</sub> control information; annual SO<sub>2</sub> and NO<sub>x</sub> emissions and heat input; summer season (May-September) NO<sub>x</sub> and heat input; July day NO<sub>x</sub> and heat input; coal heat input by coal type; nameplate capacity (MW), and State FIPS code. Existing units also have county FIPS code, a unique plant identifier (ORISPL) and unit ID (also called boiler ID) (BLRID); generic units do not have these data. The processing includes estimating various types of emissions and adding in control efficiencies, stack parameters, latitude-longitude coordinates, and State identifiers (plant ID, point ID, stack ID, process ID). Additionally, the generic units are sited in a county and given appropriate IDs. This processing is described in more detail below.

The data are prepared by transforming the generic aggregates into units similar to the existing units in terms of the available data. The generic aggregates are split into smaller generic units based on their unit types and capacity, are provided a dummy ORIS unique plant and boiler ID, and are given a county FIPS code based on an algorithm that sites each generic by assigning a sister plant that is in a county based on its attainment/nonattainment status. Within a State, plants (in county then ORIS plant code order) in attainment counties are used first as sister sites to generic units, followed by plants in PM nonattainment counties, followed by plants in 8-hour ozone nonattainment counties. Note that no LADCO or VISTAS States provided us with blackout counties that would not be considered when siting generics, so this process is identical to the one used for EPA IPM post-processing.

SCCs were assigned for all units; unit/fuel/firing/bottom type data were used for existing units' assignments, while only unit and fuel type were used for generic units' assignments. Latitude-longitude coordinates were assigned, first using the EPA-provided data files, secondly using the September 17, 2004 Pechan in-house latitude-longitude file, and lastly using county centroids. These data were only used when the data were not provided in the 2002 NIF files. Stack parameters were attached, first using the EPA-provided data files, secondly using a March 9, 2004 Pechan in-house stack parameter file based on previous EIA-767 data, and lastly using an EPA June 2003 SCC-based default stack parameter file. These data were only used when the data were not provided in the 2002 NIF files.

Additional data were required for estimating VOC, CO, filterable primary PM10 and PM2.5, PM condensable, and NH<sub>3</sub> emissions for all units. Thus, ash and sulfur contents were assigned by first using 2002 EIA-767 values for existing units or SCC-based defaults; filterable PM10 and PM2.5 efficiencies were obtained from the 2002 EGU NEI that were based on 2002 EIA-767 control data and the PM Calculator program (a default of 99.2% is used for coal units if necessary); fuel use was back calculated from the given heat input and a default SCC-based heat content; and emission factors were obtained from an EPA-approved October 7, 2004 Pechan emission factor file based on AP-42 emission factors. Note that this updated file is not the one used for estimating emissions for previous EPA post-processed IPM files. Emissions for 28 temporal-pollutant combinations were estimated since there are seven pollutants (VOC, CO, primary PM10 and PM2.5, NH<sub>3</sub>, SO<sub>2</sub> and NO<sub>x</sub>) and four temporal periods (annual, summer season, winter season, July day).

The next step was to match the IPM unit IDs with the identifiers in VISTAS 2002 inventory. A crosswalk file was used to obtain FIPS State and county, plant ID (within State and county), and point ID. If the FIPS State and county, plant ID and point ID are in the 2002 VISTAS NIF tables, then the process ID and stack ID are obtained from the NIF; otherwise, defaults, described above, were used.

Pechan provided the post-processed files in NIF 3.0 format. Two sets of tables were developed: “NIF files” for IPM units that have a crosswalk match and are in the 2002 VISTAS inventory, and “NoNIF files” for IPM units that are not in the 2002 VISTAS inventory (which includes existing units with or without a crosswalk match as well as generic units).

### **2.1.1.3 Eliminating Double Counting of EGU Units**

To avoid double counting of EGU emissions in the 2009/2018 point source inventory, all IPM matched units were removed from the 2009/2018 point source inventory. The initial set of 2009/2018 point source inventories included both EGUs and non-EGUs, which were created by applying growth and control factors to the 2002 base year inventory. These initial inventories were modified to remove any EGU that was included in the IPM modeling. This was done on a site-by-site basis. If a site was contained in the NIF files created by Pechan from the IPM output, then that site was removed from the initial 2009/2018 point source inventory. Thus, for 2009/2018, separate sets of NIF files were created for EGUs and non-EGUs.

### **2.1.1.4 Quality Assurance steps**

Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on the EGU component of the VISTAS revised 2009/2018 EGU inventory:

1. Provided parsed files (i.e., Excel spreadsheets that provide unit-level results derived from the model plant projections obtained by the IPM) to the VISTAS EGU SIWG for review and comment.
2. Provided facility level emission summaries for 2009/2018 for both the base case and CAIR case to the VISTAS EGU SIWG to ensure that emissions were consistent and that there were no missing sources.
3. Compared, at the State-level, emissions from the IPM parsed files and the post-processed NIF files to verify that the post-processed NIF files were consistent with the IPM parsed file results.

### **2.1.1.5 Summary of Revised 2009/2018 EGU Point Source Inventories**

Tables 2.1-1 through 2.1-7 compare the revised 2002 base year inventory to the 2009/2018 projection inventories. Note that there is a discrepancy between the base year 2002 and 2009/2018 emissions for PM<sub>10</sub>-PRI, PM<sub>25</sub>-PRI, and NH<sub>3</sub>. The 2002 emissions were provided directly by the S/L agencies and were estimated using a variety of techniques (i.e., EPA emission factors, S/L emission factors, site-specific emission factors, and source test data). The 2009/2018 emissions, on the other hand, were estimated by Pechan using an emission factor file based solely on AP-42 emission factors.

**Table 2.1-2 EGU Point Source SO<sub>2</sub> Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS	IPM Base 1 OTB Control (without CAIR)	IPM Base 2 OTW Control (with CAIR)	IPM Base 1 OTB Control (without CAIR)	IPM Base 2 OTW Control (with CAIR)
AL	447,862	465,576	314,841	375,305	226,506
FL	448,046	219,073	199,834	215,178	126,280
GA	513,266	582,078	394,426	554,013	221,615
KY	484,059	483,235	342,670	429,418	225,772
MS	67,339	76,855	76,855	74,505	23,769
NC	471,030	182,356	132,053	133,691	78,205
SC	203,587	163,560	143,492	178,939	152,457
TN	333,934	436,453	279,931	323,654	103,602
VA	232,747	220,685	140,665	181,337	115,988
WV	516,109	598,555	246,850	482,959	111,937
<b>Total</b>	<b>3,717,979</b>	<b>3,428,426</b>	<b>2,271,617</b>	<b>2,948,999</b>	<b>1,386,131</b>

**Table 2.1-3 EGU Point Source NO<sub>x</sub> Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS	IPM Base 1 OTB Control (without CAIR)	IPM Base 2 OTW Control (with CAIR)	IPM Base 1 OTB Control (without CAIR)	IPM Base 2 OTW Control (with CAIR)
AL	160,480	131,988	132,323	135,009	39,942
FL	244,541	148,522	147,800	159,003	59,446
GA	146,143	131,900	119,425	128,938	65,560
KY	198,726	178,930	177,272	182,192	64,673
MS	29,976	38,910	38,978	38,355	11,206
NC	146,465	66,598	67,051	64,537	59,917
SC	86,264	50,433	50,128	55,103	36,264
TN	155,762	106,979	104,528	112,411	32,411
VA	82,435	64,949	62,810	56,715	40,045
WV	230,950	173,977	174,572	170,522	42,227
<b>Total</b>	<b>1,481,742</b>	<b>1,093,186</b>	<b>1,074,887</b>	<b>1,102,785</b>	<b>451,691</b>

It is important to remember that all EGU emission projections presented are based on requirements of CAIR *as proposed* on June 10, 2004. The final CAIR (which was promulgated after our analyses) moved the NO<sub>x</sub> compliance date from 2010 to 2009. Future versions of the VISTAS projection emission inventory will likely reflect the Final CAIR requirements.

**Table 2.1-3 EGU Point Source VOC Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS	IPM Base 1 OTB Control (without CAIR)	IPM Base 2 OTW Control (with CAIR)	IPM Base 1 OTB Control (without CAIR)	IPM Base 2 OTW Control (with CAIR)
AL	1,438	1,261	1,312	1,574	1,612
FL	2,295	1,562	1,559	2,052	1,988
GA	1,178	1,497	1,499	1,794	1,790
KY	1,464	1,595	1,580	1,635	1,616
MS	473	585	590	766	827
NC	1,042	1,100	1,093	1,183	1,171
SC	434	601	625	745	754
TN	833	866	854	899	826
VA	679	547	502	694	674
WV	1,176	1,442	1,397	1,471	1,456
<b>Total</b>	<b>11,012</b>	<b>11,056</b>	<b>11,011</b>	<b>12,813</b>	<b>12,714</b>

**Table 2.1-3 EGU Point Source CO Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS	IPM Base 1 OTB Control (without CAIR)	IPM Base 2 OTW Control (with CAIR)	IPM Base 1 OTB Control (without CAIR)	IPM Base 2 OTW Control (with CAIR)
AL	11,243	16,494	19,205	26,601	29,893
FL	51,278	40,643	40,641	59,794	57,758
GA	9,248	19,169	20,023	27,152	28,894
KY	12,374	15,273	15,120	16,974	14,954
MS	2,714	6,713	6,954	10,552	12,927
NC	11,922	11,090	11,169	13,482	13,777
SC	3,699	6,316	6,526	10,175	10,670
TN	6,414	6,750	6,651	7,074	6,509
VA	6,294	9,811	10,245	14,788	14,839
WV	10,303	12,622	12,328	13,065	12,993
<b>Total</b>	<b>125,489</b>	<b>144,881</b>	<b>148,862</b>	<b>199,657</b>	<b>203,214</b>

It is important to remember that all EGU emission projections presented are based on requirements of CAIR *as proposed* on June 10, 2004. The final CAIR (which was promulgated after our analyses) moved the NO<sub>x</sub> compliance date from 2010 to 2009. Future versions of the VISTAS projection emission inventory will likely reflect the Final CAIR requirements.

**Table 2.1-3 EGU Point Source PM10-PRI Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS	IPM Base 1 OTB Control (without CAIR)	IPM Base 2 OTW Control (with CAIR)	IPM Base 1 OTB Control (without CAIR)	IPM Base 2 OTW Control (with CAIR)
AL	7,834	29,053	23,250	31,815	20,450
FL	26,912	25,778	24,494	27,321	22,204
GA	11,148	39,579	28,118	41,221	26,905
KY	5,711	32,406	29,606	33,784	25,733
MS	1,467	5,864	5,883	6,268	6,459
NC	22,480	23,028	21,459	21,417	20,259
SC	23,423	18,023	17,492	19,290	19,182
TN	14,954	17,735	17,159	19,103	12,432
VA	3,824	15,343	12,805	14,389	12,652
WV	7,188	36,442	31,780	37,424	24,253
<b>Total</b>	<b>124,941</b>	<b>243,251</b>	<b>212,046</b>	<b>252,032</b>	<b>190,529</b>

**Table 2.1-3 EGU Point Source PM<sub>2.5</sub>-PRI Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS	IPM Base 1 OTB Control (without CAIR)	IPM Base 2 OTW Control (with CAIR)	IPM Base 1 OTB Control (without CAIR)	IPM Base 2 OTW Control (with CAIR)
AL	4,274	24,876	19,190	27,280	16,279
FL	20,305	19,306	18,186	20,847	16,278
GA	4,888	33,111	22,164	34,361	20,549
KY	3,443	26,640	23,915	27,857	19,915
MS	912	5,510	5,530	5,919	6,111
NC	16,305	17,449	16,034	15,636	14,701
SC	19,162	14,471	14,079	15,601	15,510
TN	12,311	15,770	15,228	17,103	10,514
VA	2,560	13,452	11,238	12,365	10,755
WV	3,369	29,772	25,251	30,628	17,548
<b>Total</b>	<b>87,529</b>	<b>200,357</b>	<b>170,815</b>	<b>207,597</b>	<b>148,160</b>

It is important to remember that all EGU emission projections presented are based on requirements of CAIR *as proposed* on June 10, 2004. The final CAIR (which was promulgated after our analyses) moved the NO<sub>x</sub> compliance date from 2010 to 2009. Future versions of the VISTAS projection emission inventory will likely reflect the Final CAIR requirements.

**Table 2.1-3 EGU Point Source NH<sub>3</sub> Emission Comparison for 2002/2009/2018.**

	2002	2009		2018	
State	2002 VISTAS	IPM Base 1 OTB Control (without CAIR)	IPM Base 2 OTW Control (with CAIR)	IPM Base 1 OTB Control (without CAIR)	IPM Base 2 OTW Control (with CAIR)
AL	90	1,129	1,344	1,909	2,172
FL	58	2,524	2,524	4,022	3,865
GA	5	1,305	1,376	1,912	2,057
KY	0	717	711	763	772
MS	64	388	407	686	872
NC	36	577	574	740	781
SC	0	409	422	702	742
TN	0	406	400	427	394
VA	127	396	440	759	784
WV	13	691	673	722	719
<b>Total</b>	<b>393</b>	<b>8,542</b>	<b>8,871</b>	<b>12,642</b>	<b>13,158</b>

### 2.1.2 Non-EGU Sources

The general approach for assembling future year data was to use recently updated growth and control data consistent with the data used in EPA's Clean Air Interstate Rule analyses, supplement these data with available stakeholder input, and provide the results for stakeholder review to ensure credibility. To assemble growth/control data needed for the final 2009 and 2018 inventories, MACTEC performed the following activities:

- Used the revised 2002 VISTAS base year inventory, based on the 2002 CERR submittals as the starting point for the non-EGU projection inventories;
- Obtained, reviewed, and applied the most current growth factors developed by EPA, based on forecasts from an updated Regional Economic Models, Inc. (REMI) model (version 5.5) and the latest *Annual Energy Outlook* published by the Department of Energy (DOE);
- Obtained, reviewed, and applied any State-specific or sector-specific growth factors submitted by stakeholders;
- Obtained and incorporated information regarding sources that have shut down after 2002 and set the emissions to zero in the projection inventories;
- Obtain, review, and apply control assumptions for programs “on-the-books” and “on-the-way”; and
- Provided data files in NIF3.0 format and emission summaries in EXCEL format for review and comment.

The following sections discuss each of these steps.

#### 2.1.2.1 Growth assumptions for non-EGU sources

In developing the preliminary 2018 inventory for VISTAS, we used the EPA's Economic Growth Analysis System (Version 4.0) (EGAS) projection factors by 2-digit SIC code. These growth factors used historical data no more recent than 1996. Although a project was underway to create an updated EGAS (version 5.0) that would ultimately supply more up-to-date factors, this software was not available in time for use in developing the 2009/2018 VISTAS inventories. However, EPA had completed an effort to provide growth factors that can be used in the interim period before EGAS 5.0 is available.

The development of the new growth factor data was used in developing the CAIR analyses and is fully documented in the reports entitled *Development of Growth Factors for Future Year Modeling Inventories* (dated April 30, 2004) and *CAIR Emission Inventory Overview* (dated July 23, 2004). Three sources of data were used in developing the growth factors:

- State-specific growth rates from the Regional Economic Model, Inc. (REMI) Policy Insight® model, version 5.5 (being used in the development of the EGAS Version 5.0).



The REMI socioeconomic data (output by industry sector, population, farm sector value added, and gasoline and oil expenditures) are available by 4-digit SIC code at the State level.

- Energy consumption data from the DOE's Energy Information Administration's (EIA) *Annual Energy Outlook 2004, with Projections through 2025* for use in generating growth factors for non-EGU fuel combustion sources. These data include regional or national fuel-use forecast data that were mapped to specific SCCs for the non-EGU fuel use sectors (e.g., commercial coal, industrial natural gas). Growth factors for the residential natural gas combustion category, for example, are based on residential natural gas consumption forecasts that are reported at the Census division level. These Census divisions represent a group of States (e.g., the South Atlantic division includes eight southeastern States and the District of Columbia). Although one would expect different growth rates in each of these States due to unique demographic and socioeconomic trends, all States within each division received the same growth rate.
- Specific changes for sectors (e.g., plastics, synthetic rubber, carbon black, cement manufacturing, primary metals, fabricated metals, motor vehicles and equipment) where the REMI-based rates were unrealistic or highly uncertain. Growth projections for these sectors were based on industry group forecasts, Bureau of Labor Statistics (BLS) projections and Bureau of Economic Analysis (BEA) historical growth from 1987-2002.

Note that in developing the preliminary 2018 inventory, we adjusted the projected emissions for combustion sources in the industrial/commercial/institutional sector by assuming increases in fuel efficiencies for future years. These adjustments were no longer necessary because the EIA data already considers these changes.

In addition to the growth data described above, we received two sets of growth projections from VISTAS stakeholders. The NCDENR supplied recent projections for three key sectors in North Carolina where declining production was anticipated – SIC 22xx Textile Mill Products, 23xx Apparel and Other Fabrics, and 25xx Furniture and Fixtures. The NCDENR supplied the following specific growth factors for these industrial sectors:

SIC Code	Sector	NC Growth Factor	
		2002 to 2009	2002 to 2018
22xx	Textile Mill Products	0.6239	0.2792
23xx	Apparel and Other Fabrics	0.5867	0.2247
25xx	Furniture and Fixtures	0.8970	0.7647

The American Forest and Paper Association (AF&PA) supplied growth projections for the pulp and paper sector, which were applied to SIC 26xx Paper and Allied Products. The AF&PA projection factors are for the U.S. industry and apply to all States equally. The numbers come from the 15-year forecast for world pulp and recovered paper prepared by Resource Information Systems Inc. (RISI).

SIC Code	Sector	AF&PA Growth Factor	
		2002 to 2009	2002 to 2018
2611	Pulp Mills	1.067	1.169
2621	Paper Mills	1.067	1.169
2631	Paperboard Mills	1.067	1.169

For the above SIC Codes, we used the NCDENR and AF&PA growth factors instead of the factors obtained from EPA. No documentation was provided with these growth factors. Readers should contact NCDENR or AF&PA for more information on their development.

### 2.1.2.2 Source Shutdowns

Davidson County (Nashville) indicated that significant source shutdowns have occurred since data were submitted for the 2002 CERR. Source number 47-037-00002 (Dupont) shut down a portion of their facility, which was permanently taken out of service. Source 47-037-00050 (Nashville Thermal Transfer Corp.) shut down their municipal waste combustors and replaced them with natural gas fired boilers with propane stand by.

Georgia indicated that the former Blue Circle (now LaFarge) facility in downtown Atlanta will likely shut down before 2009. The facility has two cement kilns, one of which is already shut down. The second kiln will continue to operate until the new facility in Alabama has enough milling capacity, after which the entire Atlanta facility will be completely closed down.

South Carolina provided a list of facilities that were identified as closing down on or after Jan. 1, 2003. The emissions for these facilities were set to zero in the 2009 and 2018 projection inventories.

### 2.1.2.3 Control Programs applied to non-EGU sources

We used the same control programs for both the 2009 and 2018 non-EGU point inventory. Two control scenarios were developed: on-the-books (OTB) controls (also referred to as Base 1 controls), and on-the-way (OTW) controls (also referred to as Base 2 controls). The OTB control scenario accounts for post-2002 emission reductions from recently promulgated federal, State, local, and site-specific control programs. The OTW control scenario accounts for proposed (but not final) control programs that are reasonably anticipated to result in post-2002 emission reductions.

**Table 2.1-8. Non-EGU Point Source Control Programs Included in 2009/2018 Projection Inventories.**

<p><b>Base 1 – On-the-Books (Cut-off of July 1, 2004 for Base 1 adoption)</b></p> <ul style="list-style-type: none"> <li>• Atlanta / Northern Kentucky / Birmingham 1-hr SIPs</li> <li>• Industrial Boiler/Process Heater/RICE MACT</li> <li>• NO<sub>x</sub> RACT in 1-hr NAA SIPs</li> <li>• NO<sub>x</sub> SIP Call (Phase I- except where States have adopted II already e.g. NC)</li> <li>• Petroleum Refinery Initiative (October 1, 2003 notice; MS &amp; WV)</li> <li>• RFP 3% Plans where in place for one hour plans</li> <li>• VOC 2-, 4-, 7-, and 10-year MACT Standards</li> <li>• Combustion Turbine MACT</li> </ul> <p><b>Base 2a – On-the-Way</b></p> <ul style="list-style-type: none"> <li>• NO<sub>x</sub> SIP Call (Phase II – remaining States &amp; IC engines)</li> </ul>
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#### 2.1.2.3.1 OTB - NO<sub>x</sub> SIP Call (Phase I)

Phase I of the NO<sub>x</sub> SIP call applies to certain large non-EGUs, including large industrial boilers and turbines, and cement kilns. States in the VISTAS region affected by the NO<sub>x</sub> SIP call have developed rules for the control of NO<sub>x</sub> emissions that have been approved by EPA. We reviewed the available State rules and guidance documents to determine the affected sources and ozone season allowances. We also obtained and reviewed information in the EPA's CAMD NO<sub>x</sub>

Allowance Tracking System – Allowances Held Report. Since these controls are to be in effect by the year 2007, we capped the emissions for NO<sub>x</sub> SIP call affected sources at 2007 levels and carried forward the capped levels for the 2009/2018 future year inventories. Since the NO<sub>x</sub> SIP call allowances are given in terms of tons per ozone season (5 months May to September), we calculated annual emissions by multiplying the 5-month allowances by a factor of 12 divided by 5.

#### **2.1.2.3.2 OTB - Industrial Boiler/Process Heater MACT**

EPA anticipates reductions in PM and SO<sub>2</sub> as a result of the Industrial Boiler/Process Heater MACT standard. The methods used to account for these reductions are the same as those used for the CAIR analysis. Reductions were included for existing units firing solid fuel (coal, wood, waste, biomass) which had a design capacity greater than 10 mmBtu/hr. EPA prepared a list of SCCs for solid fuel industrial and commercial/ institutional boilers and process heaters. We identified boilers greater than 10 mmBtu/hr using either the boiler capacity from the VISTAS 2002 inventory, or if the boiler capacity was missing, a default capacity based on a methodology developed by EPA for assigning default capacities based on SCC code. The applied MACT control efficiencies were 4 percent for SO<sub>2</sub> and 40 percent for PM<sub>10</sub> and PM<sub>2.5</sub>.

#### **2.1.2.3.3 OTB - 2, 4, 7, and 10-year MACT Standards**

Maximum achievable control technology (MACT) requirements were also applied, as documented in the report entitled *Control Packet Development and Data Sources*, dated July 14, 2004. The point source MACTs and associated emission reductions were designed from Federal Register (FR) notices and discussions with EPA's Emission Standards Division (ESD) staff. We did not apply reductions for MACT standards with an initial compliance date of 2001 or earlier, assuming that the effects of these controls are already accounted for in the 2002 inventories supplied by the States. Emission reductions were applied only for MACT standards with an initial compliance date of 2002 or greater.

#### **2.1.2.3.4 OTB Combustion Turbine MACT**

The projection inventories do not include the NO<sub>x</sub> co-benefit effects of the MACT regulations for Gas Turbines or stationary Reciprocating Internal Combustion Engines, which EPA estimates to be small compared to the overall inventory.

#### **2.1.2.3.5 OTB - Petroleum Refinery Initiative (MS and WV)**

Three refineries in the VISTAS region are affected by two October 2003 Clean Air Act settlements under the EPA Petroleum Refinery Initiative. The refineries are: (1) the Chevron refinery in Pascagoula, MS; (2) the Ergon refinery in Vicksburg, MS; and (3) the Ergon refinery in Newell, WV.

The first consent decree pertained to Chevron refineries in Richmond and El Segundo, CA; Pascagoula, MS; Salt Lake City, UT; and Kapolei, HI. Actions required under the Consent Decree will reduce annual emissions of NO<sub>x</sub> by 3,300 tons and SO<sub>2</sub> by 6,300 tons. The consent decree requires a program to reduce NO<sub>x</sub> emissions from refinery heaters and boilers through the installation of NO<sub>x</sub> controls that meet at least an SNCR level of control. The refineries are to eliminate fuel oil burning in any combustion unit. The consent decree also requires reductions of NO<sub>x</sub> and SO<sub>2</sub> from the fluid catalytic cracking unit and control of acid gas flaring incidents. The consent decree does not provide sufficient information to calculate emission reductions for the FCCU or flaring at the Pascagoula refinery. Therefore, we calculated a general percent reduction for NO<sub>x</sub> and SO<sub>2</sub> by dividing the expected emission reductions at the five Chevron refineries by the total emissions from these five refineries (as reported in the 1999 NEI). This resulted in applying percent reductions of 45% for SO<sub>2</sub> and 28% for NO<sub>x</sub> to FCCU and flaring emissions at the Chevron Pascagoula refinery.

The second consent decree pertained to the Ergon-West Virginia refinery in Newell, WV; and the Ergon Refining facility in Vicksburg, MS. The consent decree requires the two facilities to implement a 6-year program to reduce NO<sub>x</sub> emission from all heaters and boilers greater than 40 mmBtu/hr, and to eliminate fuel oil burning in any combustion unit (except during periods of natural gas curtailment). Specifically, ultra low NO<sub>x</sub> burners are required on Boilers A and B at Newell, a low NO<sub>x</sub>-equivalent level of control for heater H-101 at Newell and heaters H-1 and H-3 at Vicksburg, and an ultra low NO<sub>x</sub> burner level of control for heater H-451 at Vicksburg.

#### **2.1.2.3.6 OTW - NO<sub>x</sub> SIP Call (Phase II)**

The final Phase II NO<sub>x</sub> SIP call rule was finalized on April 21, 2004. States have until April 21, 2005, to submit SIPs meeting the Phase II NO<sub>x</sub> budget requirements. The Phase II rule applies to large IC engines, which are primarily used in pipeline transmission service at compressor stations.

The NCDENR has already established emissions caps for three facilities affected by the Phase II NO<sub>x</sub> SIP call rule, as follows:

- SiteID 3705700300 – permit limits for engines 1, 2, 3, 4, 5, and 6 cap emissions at 1.941 tons/day during the ozone season.
- SiteID 3709700225 – permit limits for engines 12, 13, 14, and 15 cap emissions at 0.497 tons/day during the ozone season.
- SiteID 3715700131 – permit limits for engines 11, 12, 13, 14, and 15 limit emission to a total of 0.974 tons/day during the ozone season.

The other States have not yet prepared their Phase II SIPs, so we have identified affected units using the same methodology as was used by EPA in the proposed Phase II rule (i.e., a large IC

engine is one that emitted, on average, more than 1 ton per day during 2002). The final rule reflects a control level of 82 percent for natural gas-fired IC engines and 90 percent for diesel or dual fuel categories.

#### **2.1.2.3.7 Clean Air Interstate Rule**

CAIR does not require or assume additional emission reductions from non-EGU boilers and turbines.

#### **2.1.2.4 Quality Assurance steps**

Final QA checks were run on the revised projection inventory data set to ensure that all corrections provided by the S/L agencies and stakeholders were correctly incorporated into the S/L inventories and that there were no remaining QA issues that could be addressed during the duration of the project. After exporting the inventory to ASCII text files in NIF 3.0, the EPA QA program was run on the ASCII files and the QA output was reviewed to verify that all QA issues that could be addressed were resolved

Throughout the inventory development process, quality assurance steps were performed to ensure that no double counting of emissions occurred, and to ensure that a full and complete inventory was developed for VISTAS. Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on the point source component of the VISTAS revised 2002 base year inventory:

1. Facility level emission summaries were prepared and evaluated to ensure that emissions were consistent and reasonable. The summaries included base year 2002 emissions, 2009/2018 projected emissions accounting only for growth, 2009/2018 projected emissions accounting for both growth and emission reductions from OTB and OTW controls.
2. State-level non-EGU comparisons (by pollutant) were developed for the base year 2002 emissions, 2009/2018 projected emissions accounting only for growth, 2009/2018 projected emissions accounting for both growth and emission reductions from OTB and OTW controls..
3. Data product summaries and raw NIF 3.0 data files were provided to the VISTAS Emission Inventory Technical Advisor and to the Point Source, EGU, and non-EGU Special Interest Work Group representatives for review and comment. Changes based on these comments were reviewed and approved by the S/L point source contact prior to implementing the changes in the files.
4. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For

example, a major change would result in a version going from 1.0 to 2.0 for example. A minor change would cause a version number to go from 1.0 to 1.1. Minor changes resulting from largely editorial changes would result in a change from 1.00 to 1.01 for example.

### 2.1.2.5 Summary of Revised 2009/2018 non-EGU Point Source Inventories

Tables 2.1-9 through 2.1-15 summarize the revised 2009/2018 non-EGU point source inventories. The “growth only” column does not include the shutdowns (section 2.1.2.2) or control factors (section 2.1.2.3), only the growth factors described in section 2.1.2.1.

**Table 2.1-9 Non-EGU Point Source SO<sub>2</sub> Emission Comparison for 2002/2009/2018.**

State	2002	2009			2018		
	2002 CERR	Growth Only	Growth plus Base 1 OTB Control	Growth plus Base 1 plus Base 2 OTW Control	Growth Only	Growth plus Base 1 OTB Control	Growth plus Base 1 plus Base 2 OTW Control
AL	96,447	101,684	100,845	100,845	113,671	112,771	112,771
FL	70,675	77,234	76,851	76,851	87,480	87,065	87,065
GA	62,044	66,359	63,348	63,348	73,900	70,386	70,386
KY	34,027	35,725	35,479	35,479	39,069	38,816	38,816
MS	36,049	38,031	35,028	35,028	43,519	40,318	40,318
NC	51,082	56,187	52,693	52,693	62,464	58,671	58,671
SC	56,329	60,351	53,746	53,746	67,053	60,300	60,300
TN	90,375	87,795	85,275	85,275	95,024	92,396	92,396
VA	72,360	77,085	76,081	76,081	86,401	85,351	85,351
WV	54,044	55,658	54,701	54,701	61,109	60,141	60,141
<b>Total</b>	<b>623,432</b>	<b>656,109</b>	<b>634,047</b>	<b>634,047</b>	<b>729,690</b>	<b>706,215</b>	<b>706,215</b>

**Table 2.1-10 Non-EGU Point Source NO<sub>x</sub> Emission Comparison for 2002/2009/2018.**

State	2002	2009			2018		
	2002 CERR	Growth Only	Growth plus Base 1 OTB Control	Growth plus Base 1 plus Base 2 OTW Control	Growth Only	Growth plus Base 1 OTB Control	Growth plus Base 1 plus Base 2 OTW Control
AL	83,868	90,783	80,738	70,644	102,632	91,052	80,031
FL	62,138	68,364	67,533	67,533	78,479	77,551	77,551
GA	52,388	56,465	53,008	53,008	62,916	59,005	59,005
KY	38,483	41,045	37,960	37,201	45,235	41,776	40,948
MS	74,685	80,238	70,463	70,463	87,134	76,738	76,738
NC	50,317	53,546	46,242	46,242	58,424	50,044	50,044
SC	44,129	47,164	43,799	43,799	52,580	48,314	47,403
TN	73,431	74,543	62,435	61,176	83,260	69,374	67,999
VA	64,865	68,536	64,298	60,027	76,554	71,480	66,931
WV	46,710	49,924	42,140	40,469	55,206	46,846	44,944
<b>Total</b>	<b>591,014</b>	<b>630,608</b>	<b>568,616</b>	<b>549,707</b>	<b>702,420</b>	<b>632,180</b>	<b>611,595</b>

**Table 2.1-11 Non-EGU Point Source VOC Emission Comparison for 2002/2009/2018.**

State	2002	2009			2018		
	2002 CERR	Growth Only	Growth plus Base 1 OTB Control	Growth plus Base 1 plus Base 2 OTW Control	Growth Only	Growth plus Base 1 OTB Control	Growth plus Base 1 plus Base 2 OTW Control
AL	47,893	52,500	47,600	47,600	61,204	55,373	55,373
FL	38,700	41,550	39,255	39,255	48,794	46,049	46,049
GA	33,736	37,566	34,153	34,153	44,458	40,354	40,354
KY	44,856	49,649	47,733	47,733	57,996	55,729	55,729
MS	43,379	49,173	38,119	38,119	58,467	45,966	45,966
NC	72,945	75,644	70,146	70,146	82,135	75,985	75,985
SC	38,493	43,924	36,410	36,410	53,546	44,586	44,586
TN	88,059	100,946	89,129	89,129	126,207	111,373	111,373
VA	43,227	47,706	44,359	44,359	57,959	53,968	53,968
WV	14,599	15,705	14,015	14,015	18,601	16,636	16,636
<b>Total</b>	<b>465,887</b>	<b>514,363</b>	<b>460,919</b>	<b>460,919</b>	<b>609,367</b>	<b>546,018</b>	<b>546,018</b>



**Table 2.1-12 Non-EGU Point Source CO Emission Comparison for 2002/2009/2018.**

State	2002	2009			2018		
	2002 CERR	Growth Only	Growth plus Base 1 OTB Control	Growth plus Base 1 plus Base 2 OTW Control	Growth Only	Growth plus Base 1 OTB Control	Growth plus Base 1 plus Base 2 OTW Control
AL	174,306	177,145	177,145	177,145	194,801	194,801	194,801
FL	89,970	98,325	98,325	98,325	113,924	113,923	113,923
GA	131,413	147,876	147,835	147,835	169,206	169,156	169,156
KY	110,181	121,981	121,981	121,981	139,395	139,395	139,395
MS	57,158	61,783	60,709	60,709	71,630	70,454	70,454
NC	52,539	56,019	54,791	54,791	65,044	63,699	63,699
SC	59,605	65,720	65,612	65,612	75,323	75,209	75,209
TN	119,453	126,260	121,420	121,420	150,098	143,845	143,845
VA	64,395	69,823	69,822	69,822	77,590	77,590	77,590
WV	89,917	100,292	100,292	100,292	119,367	119,367	119,367
<b>Total</b>	<b>948,937</b>	<b>1,025,224</b>	<b>1,017,931</b>	<b>1,017,931</b>	<b>1,176,378</b>	<b>1,167,440</b>	<b>1,167,440</b>

**Table 2.1-13 Non-EGU Point Source PM10-PRI Emission Comparison for 2002/2009/2018.**

State	2002	2009			2018		
	2002 CERR	Growth Only	Growth plus Base 1 OTB Control	Growth plus Base 1 plus Base 2 OTW Control	Growth Only	Growth plus Base 1 OTB Control	Growth plus Base 1 plus Base 2 OTW Control
AL	24,957	26,780	25,161	25,161	31,195	29,278	29,278
FL	30,331	33,403	27,531	27,531	38,805	31,890	31,890
GA	22,055	24,906	23,861	23,861	29,351	28,177	28,177
KY	15,615	16,938	15,858	15,858	19,937	18,587	18,587
MS	19,622	22,073	19,439	19,439	26,160	23,145	23,145
NC	14,511	15,560	14,301	14,301	17,415	16,002	16,002
SC	18,149	19,777	17,368	17,368	22,949	20,272	20,272
TN	35,983	37,661	33,838	33,838	46,166	41,466	41,466
VA	13,242	14,335	13,470	13,470	16,646	15,661	15,661
WV	14,865	15,465	14,926	14,926	19,096	18,433	18,433
<b>Total</b>	<b>209,330</b>	<b>226,898</b>	<b>205,753</b>	<b>205,753</b>	<b>267,720</b>	<b>242,911</b>	<b>242,911</b>

**Table 2.1-14 Non-EGU Point Source PM<sub>2.5</sub>-PRI Emission Comparison for 2002/2009/2018.**

	2002	2009			2018		
State	2002 CERR	Growth Only	Growth plus Base 1 OTB Control	Growth plus Base 1 plus Base 2 OTW Control	Growth Only	Growth plus Base 1 OTB Control	Growth plus Base 1 plus Base 2 OTW Control
AL	19,016	20,360	19,184	19,184	23,673	22,268	22,268
FL	25,842	28,415	23,063	23,063	32,939	26,622	26,622
GA	17,890	20,347	19,562	19,562	23,997	23,110	23,110
KY	10,730	11,690	10,837	10,837	13,816	12,738	12,738
MS	10,132	11,283	9,459	9,459	13,141	11,068	11,068
NC	11,207	11,985	10,888	10,888	13,364	12,136	12,136
SC	13,565	14,759	12,977	12,977	17,081	15,136	15,136
TN	29,131	30,600	27,313	27,313	37,542	33,502	33,502
VA	10,211	11,037	10,368	10,368	12,827	12,062	12,062
WV	12,154	12,608	12,138	12,138	15,636	15,045	15,045
<b>Total</b>	<b>159,878</b>	<b>173,084</b>	<b>155,789</b>	<b>155,789</b>	<b>190,213</b>	<b>183,687</b>	<b>183,687</b>

**Table 2.1-15 Non-EGU Point Source NH<sub>3</sub> Emission Comparison for 2002/2009/2018.**

	2002	2009			2018		
State	2002 CERR	Growth Only	Growth plus Base 1 OTB Control	Growth plus Base 1 plus Base 2 OTW Control	Growth Only	Growth plus Base 1 OTB Control	Growth plus Base 1 plus Base 2 OTW Control
AL	1,883	2,112	2,112	2,112	2,457	2,456	2,456
FL	1,432	1,605	1,605	1,605	1,905	1,905	1,905
GA	3,613	3,965	3,963	3,963	4,801	4,799	4,799
KY	674	733	733	733	839	839	839
MS	1,169	1,267	667	667	1,419	761	761
NC	1,171	1,255	1,255	1,255	1,413	1,412	1,412
SC	1,411	1,578	1,578	1,578	1,779	1,779	1,779
TN	1,628	1,861	1,861	1,861	2,240	2,240	2,240
VA	3,104	3,057	3,057	3,057	3,620	3,620	3,620
WV	331	342	342	342	416	416	416
<b>Total</b>	<b>16,416</b>	<b>17,775</b>	<b>17,173</b>	<b>17,173</b>	<b>20,889</b>	<b>20,227</b>	<b>20,227</b>

## **2.2 Area Sources**

This section describes the methodology used to develop the 2009 and revised 2018 projection inventories. This section describes two approaches to these projections. Separate methods for projecting emissions were used for non-agricultural (stationary area) and agricultural area sources (predominantly NH<sub>3</sub> emissions). The two methods used for these sectors are described in the sections that follow.

### **2.2.1 Stationary area sources**

The general approach used to calculate projected emissions for stationary area sources was as follows:

1. Use the VISTAS revised 2002 base year inventory as the starting point for projections.
2. MACTEC then worked with the VISTAS States (via the Stationary Area Source SIWG) to obtain any State specific growth factors and/or future controls from the States to use in developing the projections.
3. MACTEC then back calculated uncontrolled emissions from the revised 2002 base year inventory based on existing controls reported in the 2002 revised base year inventory.
4. Controls (including control efficiency, rule effectiveness and rule penetration) provided by the States or originally developed for use in estimating projected emissions for U.S. EPA's Heavy Duty Diesel (HDD) rulemaking emission projections and used in the Clean Air Interstate Rule (CAIR) projections were then used to calculate controlled emissions. State submitted controls had precedence over the U.S. EPA developed controls.
5. Growth factors supplied from the States or the U.S. EPA's CAIR emission projections were then applied to project the controlled emissions to the appropriate year.
6. MACTEC then provided the final draft inventory for review and comment by the VISTAS States.

For stationary area sources, no State-supplied growth or control factors were provided. Thus for all of the sources in this sector of the inventory, growth and controls were applied based on controls initially identified for the CAIR and growth factors identified for the CAIR projections.

#### **2.2.1.1 Stationary area source controls**

The controls obtained by MACTEC for the HDD rulemaking were controls for the years 2007, 2020, and 2030. Since MACTEC was preparing 2009 and 2018 projections, control values for intermediate years were prepared using a straight line interpolation of control level between 2007 and 2020. The equation used to calculate the control level was as follows:

$$CE = (((2020\ CE - 2007\ CE)/13)*YRS) + 2007\ CE$$

Where:

- CE = Control Efficiency for either 2009 or 2018
- 2020 CE = HDD Control Efficiency value for 2020
- 2007 CE = HDD Control Efficiency value for 2007
- 13 = Number of years between 2020 and 2007
- YRS = Number of years beyond 2007 to VISTAS Projection year

For 2009 the value of YRS would be two (2) and for 2018 the value would be eleven (11). Control efficiency values were determined for VOC, CO and PM. Rule penetration values for each year in the HDD controls tables obtained by MACTEC were always 100 percent so those values were maintained for the VISTAS projections.

Prior to performing the linear interpolation of the controls, MACTEC evaluated controls from the IAQTR projections. Those controls appeared to be identical to those used for the HDD rulemaking. In addition, MACTEC received some additional information on some controls for area source solvents (email from Jim Wilson, E.H. Pechan and Associates, Inc. to Gregory Stella, VISTAS Emission Inventory Technical Advisor, 3/5/04) that were used to check against the controls in the HDD rulemaking files. Where those controls proved to be more stringent than the HDD values, MACTEC updated the control file with those values (which were then used in the interpolation to develop 2009 and 2018 values). Finally, for VOC the HDD controls were initially provided at the State-county-SCC level. However, upon direction from the VISTAS Emission Inventory Technical advisor, the VOC controls were consolidated at the SCC level and applied across all counties within the VISTAS region (email from Gregory Stella, Alpine Geophysics, 3/3/2004) to ensure that no controls were missed due to changes in county FIPS codes and/or SCC designations between the time the HDD controls were developed and 2002.

The equation below indicates how VOC emissions were projected for stationary area sources.

$$VOC_{2018} = VOC_{2002} \times \left( 1 - \left( \frac{VOC\_CE_{2018}}{100} \right) \left( \frac{VOC\_RE_{2018}}{100} \right) \left( \frac{VOC\_RP_{2018}}{100} \right) \right)$$

where:

- VOC<sub>2018</sub> = VOC emissions for 2018
- VOC<sub>2002</sub> = Uncontrolled VOC emissions for 2002

VOC\_CE<sub>2018</sub> = Control Efficiency for VOC (in this example for 2018)

VOC\_RE<sub>2018</sub> = Rule Effectiveness for VOC (in this example for 2018)

VOC\_RP<sub>2018</sub> = Rule Penetration for VOC (in this example for 2018)

A similar equation could be constructed for either PM or CO. It should be noted that the control efficiencies calculated based on the HDD rulemaking were only applied if they were greater than any existing 2002 base year controls. No controls were found for SO<sub>2</sub> or NO<sub>x</sub>.

In the preliminary 2018 emission estimates, an energy efficiency factor was applied to energy related stationary area sources. That factor was not applied to the revised projections since information supplied by U.S. EPA related to the CAIR growth factors indicated that growth values for those categories were derived from U.S. Department of Energy (DOE) and were felt to account for changes in projected energy efficiency.

#### **2.2.1.2 Stationary area source growth**

As indicated above, growth factors for 2009 and the revised 2018 inventories were obtained from the U.S. EPA and are linear interpolations of the growth factors used for the Clean Air Interstate Rule (CAIR) projections. The growth factors for the CAIR obtained by MACTEC were developed using a base year of 2001 and provided growth factors for 2010 and 2015. MACTEC used the TREND function in Microsoft Excel™ to calculate 2002, 2009 and 2018 values from the 2001, 2010 and 2015 values. The TREND function provides a linear interpolation of intermediate values from a known series of data points (in this case the 2001, 2010 and 2015 values) based on the equation for a straight line. These values were calculated at the State and SCC level with the exception of paved road emissions (SCC = 2294000000). The growth factors for paved roads were available in the CAIR data set at the State, county and SCC level so they were applied at that level.

Prior to utilizing the growth factors from the CAIR projections, MACTEC confirmed that all SCCs found in the VISTAS 2002 revised base year inventory were in the CAIR file. Some SCCs were not found in the CAIR file. For those SCCs, the growth factors used were derived in one of five ways. First where possible, they were taken from a beta version of EGAS 5.0. In other cases, the growth factor was set to one (i.e., no growth). In other cases, a similar SCC that had a CAIR growth factor was used. In a few cases a growth factor based on an average CAIR growth at the 6 digit SCC level was calculated. Finally a number of records used population as the growth surrogate. A comment field in the growth factor file was used to mark those records that were not taken directly from the CAIR projection growth factors.

### **2.2.1.3 Stage II refueling**

In the revised 2002 VISTAS base year inventory, Stage II refueling emissions were included in the area source files. This was done because the units generated from MOBILE and NONROAD are not compatible when combined. In addition, the on-road mobile emissions were to be projected within the model and only input files were being prepared. As a consequence, Stage II refueling emissions were projected to 2009 and 2018 using growth factors and controls, similarly to stationary area sources. As with stationary area sources the growth factors were derived from the CAIR values. Controls for Stage II were developed using linear interpolations of values developed for the HDD rulemaking effort. Counties with confirmed Stage II programs had the controls applied to them for both 2009 and 2018 based on a database of counties having Stage II programs developed by MACTEC for EPA. Refueling emissions were taken out of all emission estimates developed for NONROAD to ensure no double counting.

#### **2.2.1.3.1 Differences between 2009/2018**

Methodologically, there was no difference in the way that 2009 and 2018 emissions were calculated for stationary area sources (or Stage II refueling). The individual control and growth factors were different (due to the linear interpolation used to calculate the values) but the calculation methods were identical.

### **2.2.2 Agricultural area sources**

The general approach used to calculate projected emissions for agricultural area sources (predominantly NH<sub>3</sub> emission sources) was as follows:

1. MACTEC used the revised 2002 base year inventory data (which was based on the CMU ammonia model version 3.6).
2. MACTEC worked with the VISTAS States (via the Agricultural Sources SIWG) to obtain any State specific growth and/or future controls from the States for agricultural sources.
3. Since the base year emissions were uncontrolled, and no future controls for these sources were identified, MACTEC projected the agricultural emissions using State-specific growth if available, otherwise the U.S. EPA's IAQTR/Ammonia inventory was used to develop the growth factors used to project the revised 2002 base year inventory to 2009 or 2018.
4. MACTEC then provided the final draft inventory for review and comment by the VISTAS States.

### **2.2.2.1 Control assumptions for agricultural area sources**

No controls were identified either by the individual VISTAS States or in the information provided in the EPA's IAQTR Ammonia inventory document. Thus all projected emissions for agricultural area sources represent simple growth with no controls.

### **2.2.2.2 Growth assumptions for non-agricultural area sources**

Growth for several agricultural area source livestock categories was developed using the actual emission estimates developed by the EPA as part of the NEI. That work included projections for the years 2002, 2010, 2015, 2020, and 2030. The actual emissions themselves were not used other than to develop growth factors since the 2002 NEI upon which the growth projections were based was prepared prior to the release of the 2002 Census of Agriculture which was included in the CMU model (version 3.6) which was used to develop the revised 2002 VISTAS base year inventory. Thus VISTAS Agricultural Sources SIWG decided to use the NEI ammonia inventory projected emissions to develop the 2009 and revised 2018 growth factors used to project emission for VISTAS. Details on the NEI inventory and projections can be found at:

[http://www.epa.gov/ttn/chief/ap42/ch09/related/nh3inventorydraft\\_jan2004.pdf](http://www.epa.gov/ttn/chief/ap42/ch09/related/nh3inventorydraft_jan2004.pdf). The actual data files for the projected emissions can be found at:

[http://www.epa.gov/ttn/chief/ap42/ch09/related/nh3output01\\_23\\_04.zip](http://www.epa.gov/ttn/chief/ap42/ch09/related/nh3output01_23_04.zip).

In order to use the NEI projected emissions as growth factors, several steps were required. These steps were as follows:

1. NEI projected emissions were only available for the years 2002, 2010, 2015, 2020, and 2030, thus the first task was to calculate intermediate year emissions for 2009 and 2018. These values were calculated based on linear interpolation of the existing data.
2. Once the intermediate emissions were calculated, MACTEC developed emission ratios to provide growth factors for 2009 and 2018. Ratios of emissions were established relative to the 2002 NEI emissions.
3. Once the growth factors were established, MACTEC then evaluated whether or not all agricultural SCCs within the revised 2002 base year inventory had corresponding growth factors. MACTEC established that not all SCCs within the base year inventory had growth factors. These SCCs fell into one of two categories:
  - a. SCCs that had multiple entries in the NEI but only a single SCC in the 2002 VISTAS base year inventory. The NEI was established using a process model and for some categories of animals, emissions were calculated for several aspects of the process. The CMU model version 3.6 which was the basis for

the VISTAS 2002 revised base year inventory did not use a process model. As a consequence a mapping of SCCs in the NEI projections and corresponding SCCs in the CMU inventory was made and for those SCCs an average growth factor was calculated from the NEI projections for use with the corresponding SCC in the CMU based 2002 base year inventory.

- b. There were also State, county, SCC trios in the 2002 VISTAS revised base year inventory which had no corresponding emissions in the NEI files. For these instances, MACTEC first developed State level average growth factors from the NEI projections for use in growing these records. Even after developing State level average growth factors there were still some State/SCC pairs that did not have matching growth. For these records, MACTEC developed VISTAS regional average growth factors at the SCC level from the NEI data.
4. Once all of the growth factors were developed, they were used to project the emissions to 2009 and 2018. Growth factors were first applied at the State, county and SCC level. Then remaining records were grown with the State/SCC specific growth factors. Finally, any remaining ungrown records were projected at the SCC level using the VISTAS regional growth factor.

For the livestock categories, the NEI emission projections only had data for beef and dairy cattle, poultry and swine. Thus for other livestock categories and for fertilizers alternative growth factors were required.

The growth factors for other livestock categories and fertilizers were obtained from growth factors used for the IAQTR projections made by the U.S. EPA. The methodology for these categories was identical to that used for dairy, beef, poultry and swine with the exception that State/SCC and VISTAS/SCC growth factors were not required for these categories since the IAQTR data contained State, county and SCC level growth factors. The IAQTR data provided growth factors for 1996, 2007, 2010, 2015 and 2020. Linear interpolation was used to develop the growth factors for the intermediate years 2009 and 2018 required for the VISTAS projections.

There were a few exceptions to the methods used for projecting agricultural sources for the VISTAS projections. These exceptions were:

1. All swine emissions for North Carolina were maintained at 2002 levels for each projection year to capture a moratorium on swine production in that State.



2. Ammonia growth factors for a few categories (mainly feedlots) were assigned to be the same as growth factors for PM emissions from the NEI projections. This assignment was made because the CMU model showed emissions from these categories but the NEI projections did not show ammonia emissions but did show PM emissions.
3. No growth factors were found for horse and pony emissions. These emissions were held constant at 2002 levels.

#### **2.2.2.2.1 Differences between 2009/2018**

Methodologically, there was no difference in the way that 2009 and 2018 emissions were calculated for agricultural area sources. The growth factors were different (due to the linear interpolation used to calculate the values) but the calculation methods were identical.

#### **2.2.3 Quality Assurance steps**

Throughout the inventory development process, quality assurance steps were performed to ensure that no double counting of emissions occurred, to ensure that a full and complete inventory was developed for VISTAS, and to make sure that projection calculations were working correctly. Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on the stationary and agricultural area source components of the 2009 and revised 2018 projection inventories:

1. All final files were run through EPA's Format and Content checking software.
2. SCC level emission summaries were prepared and evaluated to ensure that emissions were consistent and that there were no missing sources.
3. Tier comparisons (by pollutant) were developed between the revised 2002 base year inventory and the 2009 and 2018 projection inventories.
4. Data product summaries were provided to both the VISTAS Emission Inventory Technical Advisor and to the SIWG representatives for review and comment. Changes based on these comments were implemented in the files.
5. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from 1.0 to 2.0. A minor change would cause a version number to go from 1.0 to 1.1. Minor changes resulting from largely editorial changes would result in a change from 1.00 to 1.01.

## 2.3 Mobile Sources

Our general approach for assembling data was to use as much existing data from the preliminary projections as possible for these inventories, supplement these data with easily available stakeholder input, and provide the results for stakeholder review to ensure credibility. To develop the “base case” projections, MACTEC originally assembled data to develop two 2009 and 2018 base case inventories: 1) an inventory that included all “on-the-books” control programs and 2) an “on-the-way” inventory that included controls that were likely to be “on-the-way”. For the revised emission forecasts to the mobile source sector, “on-the-books” and “on-the-way” are defined with the same strategies and therefore only a single projection scenario was developed for each forecast year.

To ensure consistency across evaluation years, the 2009 and 2018 base case inventories were developed, to the maximum extent practical, using methodologies identical to those employed in developing the 2002 on-road portion of the revised 2002 VISTAS base year inventory. All modifications to the 2002 inventory methods were developed in consultation with the Mobile Source Special Interest Workgroup (MSSIWG). Generally, modifications were only made to properly account for actual changes expected in the intervening period (i.e., between 2002 and 2009 and between 2002 and 2018), but the underlying inventory development methodology was identical, except to the extent requested by VISTAS or the MSSIWG.

MACTEC developed a preliminary 2018 inventory in early 2004. That inventory was designed to 1) be used for modeling sensitivity evaluations and 2) help establish the methods that would be used for the final 2018 inventory and the initial 2009 inventory. Since that work took place prior to the revision of the 2002 base year inventory data files, MACTEC provided a review of the data and methods used to develop on-road mobile source input files for the initial 2002 base year inventory prior to developing the preliminary 2018 inventory. Through this review, MACTEC determined the following:

- Onroad VMT. Most States provided local data for 2002 (or a neighboring year that was converted to 2002 using appropriate VMT growth surrogates). Since these data were not applicable to 2018 due to intervening growth, input for 2018 was solicited from the MSSIWG. At the same time we researched county-specific growth rate data utilized for recent national rulemakings as a backstop approach to State supplied VMT projections.
- Modeling Temperatures. Actual 2002 temperatures were used for the initial 2002 base year inventory.
- Vehicle Registration Mix (age fractions by type of vehicle). A mix of State, local, and MOBILE6 default data were used for the 2002 initial base year inventory.

Forecast data were solicited from the States, with a fallback position that we hold the fractions constant at their 2002 values.

- **Vehicle Speed by Roadway Type.** For the 2002 initial base year inventory, speeds varying by vehicle and road type were used.
- **VMT Mixes (fraction of VMT by vehicle type).** A mix of State, local, and quasi MOBILE6 default (i.e., MOBILE6 defaults normalized to better reflect local conditions) data were used for the 2002 initial base year inventory. Forecast data were solicited from the States.
- **Diesel Sales Fractions.** As with the VMT mix data, the diesel sales fraction data employed for the 2002 initial base year inventory represents a mix of State, local, and quasi MOBILE6 default data. The issues related to updating these data to 2018 are also similar, but are complicated by the fact that MOBILE6 treats diesel sales fraction on a model year, rather than age specific basis. Therefore, diesel sales fractions generally cannot be held constant across time. Once again, we solicited any local projections, with a fallback position that we would keep the data for 2002 and earlier model years constant for the forecast inventory, supplemented with MOBILE6 default data for 2003 and newer model years.
- **State/Local Fuel Standards.** For the 2002 initial base year inventory, these data were based on appropriate local requirements and updated data for 2018 was only required if changes were expected between 2002 and 2018. There are some national changes in required fuel quality for both onroad and nonroad fuels that are expected to occur between 2002 and 2018 and these would be reflected in the 2018 inventory in the absence of more stringent local fuel controls. Expected changes in local fuel control programs were solicited.
- **Vehicle Standards.** The 2002 initial base year inventory assumed NLEV applicability. This was altered to reflect Tier 2 for 2018, unless a State indicated a specific plan to adopt the California LEV II program. If so, we made the required changes to implement those plans for the preliminary 2018 inventory.
- **Other Local Controls.** This includes vehicle emissions inspection (i.e., I/M) programs, Stage II vapor recovery programs, anti tampering programs, etc. By nature, the assumptions used for the 2002 initial base year inventory vary across the VISTAS region, but our presumption is that these data accurately reflected each State's situation as it existed in 2002. If a State had no plans to change program requirements between 2002 and 2018, we proposed to maintain the 2002 program descriptions without change. However, if a State planned changes, we requested

information on those plans. In the final implementation of the inventory, Stage II controls were exercised in the area source component of the inventory, since the units used to develop Stage II refueling estimates are different between MOBILE6 and the NONROAD models.

Once the preliminary 2018 base case projection inventory data were compiled, MACTEC applied the data and methods selected and proceeded to develop the preliminary base case 2018 projection inventories. The resulting inventories were provided to the MSSIWG in a user-friendly format for review. After stakeholder review and comment, the final preliminary 2018 base case inventories and input files were provided to VISTAS in formats identified by the VISTAS Technical Advisor (in this case, MOBILE input files and VMT, NONROAD input files and annual inventory files for NONROAD in NIF 3.0 format). Annual inventory files for MOBILE were not developed as part of this work, only input files and VMT forecasts. MOBILE emissions were calculated by VISTAS air quality modeling contractor using the provided files.

### **2.3.1 Development of on-road mobile source input files**

As indicated above, MACTEC prepared a preliminary version of the 2018 base case mobile inventory input data files. These files were then updated to provide a final set of 2018 base case inventory input data files as well as a set of input files for 2009. The information below describes the updates performed on the preliminary 2018 files and the development of the 2009 input data files.

Our default approach to preparing the revised 2018 and initial 2009 projection inventories for on-road mobile sources was to estimate the emissions by using either:

1. the revised 2002 data provided by each State coupled with the projection methods employed for the preliminary 2018 inventory, or
2. the same data and methods used to generate the preliminary 2018 inventory.

We also investigated whether or not there was more recent VMT forecasting data available (e.g., from the CAIR and if appropriate revised the default VMT growth rates accordingly. This did not affect any State that provided local VMT forecasting data, but would alter the VMT estimates used for other areas.

Since no preliminary 2009 inventory was developed there did not exist an option (2) above for 2009. As a consequence, MACTEC crafted the 2009 initial inventory for on-road mobile sources using methods identical to those employed for the 2018 preliminary inventories coupled with any changes/revisions provided by the States during the review of the revised 2002 base year and the 2018 preliminary inventories. Therefore, as was the case for 2018, we obtained

from the States any input data revisions, methodological revisions, and local control program specifications (to the extent that they differed from 2002/2018).

### 2.3.1.1 Preparation of revised 2018 input data files

Preparation of the revised 2018 inventories required the following updates:

1. The evaluation year was updated to 2018 in all files.
2. The diesel fuel sulfur content was revised from 500 ppm to 11 ppm, consistent with EPA data for 2018 in all files.
3. Since the input data is model year, rather than age, specific for diesel sales fractions (with data for the newest 25 model years required), we updated all files that included diesel sales fractions. In the revised 2002 base year files, the data included applied to model years 1978-2002. For 2018, the data included would reflect model years 1994-2018. To forecast the 2002 data, MACTEC took the data for 1994-2002 from the 2002 files and added data for 2003-2018. To estimate the data for these years, we employed the assumption employed by "default" in MOBILE6 -- namely that diesel sales fractions for 1996 and later are constant. Therefore, we set the diesel sales fractions for 2003-2018 at the same value as 2002.
4. VMT mix fractions must be updated to reflect expected changes in sales patterns between 2002 and 2018. If explicit VMT mix fractions are not provided, these changes are handled internally by MOBILE6 or externally through absolute VMT distributions. However, files that include explicit VMT mix fractions override the default MOBILE6 update and may or may not be consistent with external VMT distributions. MACTEC updated the VMT mix in such files as follows:

First, we calculated the VMT fractions for LDV, LDT1, LDT2, HDV, and MC from the external VMT files for 2018. This calculation was performed in accordance with section 5.3.2 of the MOBILE6 Users Guide which indicates:

$$LDV = LDGV + LDDV$$

$$LDT1 = LDGT1 + LDDT$$

$$LDT2 = LDGT2$$

$$HDV = HDGV + HDDV$$

$$MC = MC$$

The resulting five VMT fractions were then split into the 16 fractions required by MOBILE6 using the distributions for 2018 provided in Appendix D of the MOBILE6 Users Guide. This approach ensures that explicit input file VMT fractions are consistent with the absolute VMT distributions prepared by MACTEC. These changes were made to all files that included VMT mixes.

5. All other input data were retained at 2002 values, except as otherwise instructed by the States. This includes all control program descriptions (I/M, ATP, Stage II, etc.), all other fuel qualities (RVP, oxy content, etc.), all other vehicle descriptive data (registrations age distributions, etc.), and all scenario descriptive data.

In addition to the updates described above that were applied to all VISTAS-region inputs, the following additional State-specific updates were performed:

### **Kentucky:**

MACTEC revised the 2018 input files for the Louisville, Kentucky area (Louisville APCD) based on comments received relative to several components of MOBILE input data. Based on these comments, the input files for Jefferson County, Kentucky were updated accordingly as follows:

- a) I/M and tampering program definitions were removed since the program was discontinued at the end of 2003.
- b) The "Speed VMT", "Facility VMT" and "Registration Age Distribution" file pointers were updated to reflect revised 2002 files provided by the Louisville APCD.
- c) The "VMT Mix" data, which was previously based on the default approach of "growing" 2002 data, was replaced by 2018-specific data provided by the Louisville APCD.

### **North Carolina:**

North Carolina provided a wide range of revised input data, including complete MOBILE6 input files for July modeling. MACTEC did not use the provided input files directly as they did not match the 2002 NC input files for critical elements such as temperature distributions and gasoline RVP (while they were close, they were slightly different). To maintain continuity between 2002 and 2018 modeling, MACTEC instead elected to revise the 2002 input files to reflect all control program and vehicle-related changes implied by the new 2018 files, while retaining the basic temperature and gasoline RVP assumptions at their 2002 values. Under this approach, the following changes were made:

- a) NC provided a county cross reference file specific to 2018 that differed from that used for 2002. We removed files that were referenced in the 2002 input data and replaced those files with those referenced in the 2018 data. In addition, since NC only provided 2018 input files for July, we estimated the basic data for these new files for the other months by cross referencing the target files for 2002 by county against the target files for 2018 by county.
- b) We then revised the 2002 version of each input file to reflect the 2018 "header" data included in the NC-provided 2018 files. These data are exclusively limited to I/M and ATP program descriptions, so that the 2002 I/M and ATP data were replaced with 2018 I/M and ATP data.
- c) We retained the registration age fractions at their 2002 "values" (external file pointers) as per NC instructions.
- d) We retained all scenario-specific data (i.e., temperatures, RVP, etc.) at 2002 values, which (as indicated above), were slightly different in most cases from data included in the 2018 files provided by NC. We believe these differences were due to small deviations between the data assembled to support VISTAS 2002 and the process used to generate the 2018 files provided by NC, and that revising the VISTAS 2002 data to reflect these variations was not appropriate given the resulting inconsistencies that would be reflected between VISTAS 2002 and VISTAS 2018.
- e) NC also provided non-I/M versions of the 2018 input files that would generally be used to model the non-I/M portion of VMT. While these files were retained they were not used for the 2018 input data preparation.

Finally, NC also provided a speed profile file and a speed profile cross reference file for 2018. We did not use these in our updates as they have no bearing on the MOBILE6 input files, but they were maintained in case they needed to be included in SMOKE control files for a future year control strategy scenario.

### **Virginia:**

In accordance with instructions from VA, the input files that referenced an external I/M descriptive program file (VAIM02.IM) were revised to reference an alternative external file (VAIM05.IM). This change was to make the I/M program more relevant to the year 2018.

One additional important difference was made with respect to the revised 2018 and initial 2009 on-road mobile source input data files. MACTEC developed updated SMOKE ready input files rather than MOBILE6 files so that the input data could be used directly by the VISTAS modeling contractor to estimate on-road mobile source emissions during modeling runs.



### 2.3.1.2 Preparation of initial 2009 input data files

The methodology used to develop the 2009 on-road input files was based on forecasting the previously developed revised 2002 base year input files and is identical to that previously described for the revised 2018 methodology except as follows:

1. The evaluation year was updated to 2009.
2. Diesel fuel sulfur content was revised from 500 ppm to 29 ppm. The 29 ppm value was derived from an EPA report entitled "Summary and Analysis of the Highway Diesel Fuel 2003 Pre-compliance Reports" (EPA420-R-03-013, October 2003), which includes the Agency's estimates for the year-to-year fuel volumes associated with the transition from 500 ppm to 15 ppm diesel fuel. According to Table 2 of the report, there will be 2,922,284 barrels per day of 15 ppm diesel distributed in 2009 along with 110,488 barrels per day of 500 ppm diesel. Treating the 15 ppm diesel as 11 ppm on average (consistent with EPA assumptions and assumptions employed for the 2018 input files) and sales weighting the two sulfur content fuels results in an average 2009 diesel fuel sulfur content estimate of 29 ppm.
3. Diesel sales fractions were updated identically to 2018 except that the diesel sales fractions for 2003-2009 were set at the same value as those for 2002 (rather than 2003-2018).
4. VMT mix fractions were updated to 2009 using an identical method to that described for 2018.
5. All other input data were retained at 2002 values, except as otherwise instructed by individual States (see below). This includes all control program descriptions (I/M, ATP, Stage II, etc.), all other fuel qualities (RVP, oxy content, etc.), all other vehicle descriptive data (registration age distributions, etc.), and all scenario descriptive data.

In addition to the updates described above that were applied to all VISTAS-region inputs, the following additional State-specific updates were performed:

**KY** – Identical changes to those made for 2018 (but specific to 2009) were made for the 2009 input files.

**NC** – Identical changes to those made for 2018 (but specific to 2009) were made for the 2009 input files.

**VA** – Identical changes to those made for 2018 were made for 2009.



### 2.3.2 VMT Data

The basic methodology used to generate the 2009 and 2018 VMT for use in estimating on-road mobile source emissions was as follows:

1. All estimates start from the final VMT estimates used for the 2002 revised base year inventory.
2. Initial 2009 and 2018 VMT estimates were based on linear growth rates for each State, county, and vehicle type as derived from the VMT data assembled by the U.S. EPA for their most recent HDD (heavy duty diesel) rulemaking. The methodology used to derive the growth factors is identical to that employed for the preliminary 2018 VMT estimates (which is described in the next section).
3. For States that provided no independent forecast data, the estimates derived in step 2 are also the final estimates. These States are: Alabama, Florida, Georgia, Kentucky, Mississippi, and West Virginia. For States that provided forecast data, the provided data were used to either replace or augment the forecast data based on the HDD rule. These States, and the specific approaches employed, are detailed following the growth method description.

The steps involved in performing the growth estimates for VMT were as follows:

1. Linear growth estimates were used (although MACTEC investigated the potential use of nonlinear factors and presented that information to the MSSIWG, the decision was made to use linear growth factors instead of nonlinear).
2. Estimates were developed at the vehicle class (i.e., LDGV, LDGT1, LDGT2, etc.) level of detail since the base year 2002 estimates were presented at that level of resolution. In effect, the county and vehicle class specific growth factors were applied to the 2002 VMT estimates for each vehicle and road class.
3. Overall county-specific VMT estimates for each year (developed by summing the vehicle and road class specific forecasts) were then compared to overall county-specific growth. Since overall county growth is a more appropriate controlling factor as it includes the combined impacts of all vehicle classes, the initial year-specific vehicle and road class VMT forecasts were normalized so that they matched the overall county VMT growth. Mathematically, this process is as follows:

$$(\text{Est}_{rv\_f}) = (\text{Est}_{rv\_i}) * (\text{C}_{20XX} / \text{Sum}(\text{Est}_{rv\_i}))$$

where:

$\text{Est}_{rv\_f}$  = the final road/vehicle class-specific estimates,

Est<sub>rv\_i</sub> = the initial road/vehicle class-specific estimates, and

C<sub>20XX</sub> = the county-specific growth target for year 20XX.

Table 2.3-1 presents a basic summary of the forecasts for the preliminary 2018 inventory for illustrative purposes:

**Table 2.3-1 2002 vs 2018 VMT (million miles per year)**

State	2002	2018	Growth Factor
Alabama	55,723	72,966	1.309
Florida	178,681	258,191	1.445
Georgia	106,785	148,269	1.388
Kentucky	51,020	66,300	1.299
Mississippi	36,278	46,996	1.295
North Carolina	80,166	110,365	1.377
South Carolina	47,074	63,880	1.357
Tennessee	68,316	91,647	1.342
Virginia	76,566	102,971	1.345
West Virginia	19,544	24,891	1.274

The following States provided some types of forecast data for VMT. The information presented below indicates how those data were processed by MACTEC for use in the VISTAS projection inventories.

**Kentucky:**

Revised 2009 and 2018 VMT mix data were provided by the Louisville APCD. Therefore, the distribution of Jefferson County VMT by vehicle type within the KY VMT file was revised to reflect the provided mix. This did not affect the total forecasted VMT for either Jefferson County or the State, but does alter the fraction of that VMT accumulated by each of the eight vehicle types reflected in the VMT file. The following procedure was employed to make the VMT estimates consistent with the provided 2009/2018 VMT mix:

- a) The 16 MOBILE6 VMT mix fractions were aggregated into the following five vehicle types: LDV, LDT1, LDT2, HDV, and MC.
- b) The 8 VMT mileage classes were aggregated into the same five vehicle types (across all roadway types) and converted to fractions by normalizing against the total Jefferson County VMT.

- c) The ratio of the "desired" VMT fraction (i.e., that provided in the Louisville APCD VMT mix) to the "forecasted" VMT fraction (i.e., that calculated on the basis of the forecasted VMT data) was calculated for each of the five vehicle classes.
- d) All forecasted VMT data for Jefferson County were multiplied by the applicable ratio from step c as follows:

$$\begin{aligned} \text{new LDGV} &= \text{old LDGV} * \text{LDV ratio} \\ \text{new LDGT1} &= \text{old LDGT1} * \text{LDT1 ratio} \\ \text{new LDGT2} &= \text{old LDGT2} * \text{LDT2 ratio} \\ \text{new HDGV} &= \text{old HDGV} * \text{HDV ratio} \\ \text{new LDDV} &= \text{old LDDV} * \text{LDV ratio} \\ \text{new LDDT} &= \text{old LDDT} * \text{LDT1 ratio} \\ \text{new HDDV} &= \text{old HDDV} * \text{HDV ratio} \\ \text{new MC} &= \text{old MC} * \text{MC ratio} \end{aligned}$$

The total forecasted VMT for Jefferson County was then checked to ensure that it was unchanged.

**North Carolina:**

North Carolina provided both VMT and VMT mix data by county and roadway type for 2018. Therefore, these data replaced the data developed for North Carolina using HDD rule growth rates in their entirety. Similar data were submitted for 2009. Table 2.3-2 presents the resulting VMT estimates which differ from the "default" HDD rule estimates as follows:

**Table 2.3-2 VMT and HDD Rule Estimates for North Carolina (million miles per year)**

North Carolina		
2002	106,795	
	State Data	HDD Data
2009	123,396	124,626
2018	129,552	146,989

As indicated, there are substantial reductions in the State-provided forecast data relative to that derived from the HDD rule. The growth rates for both 2009 and 2018 are only about half that implied by the HDD data (1.15 versus 1.17 for 2009 and 1.21 versus 1.38 for 2018). The resulting growth rates are the lowest in the VISTAS region.

NC did not provide VMT mix data for 2009. Therefore, the VMT mix fractions estimated using the "default" HDD rule growth rates were applied to the State-provided VMT estimates to

generate vehicle-specific VMT. Essentially, the default HDD methodology produces VMT estimates at the county-road type-vehicle type level of detail, and these data can be converted into VMT fractions at that same level of detail. Note that these are not HDD VMT fractions, but VMT fractions developed from 2002 NC data using HDD vehicle-specific growth rates. In effect, they are 2002 NC VMT fractions "grown" to 2009.

The default VMT mix fraction was applied to the State-provided VMT data at the county and road type level of detail to generate VMT data at the county-road type-vehicle type level of detail. The one exception was for county 063, road 110, for which no VMT data were included in the HDD rule. For this single county/road combination, State-aggregate VMT mix fractions (using the HDD growth methodology) were applied to the county/road VMT data. The difference between road 110 VMT fractions across all NC counties is minimal, so there is no effective difference in utilizing this more aggregate approach vis-a-vis the more resolved county/road approach.

**South Carolina:**

South Carolina provided county and roadway type-specific VMT data for several future years. Data for 2018 was included and was used directly. Data for 2009 was not included, but was linearly interpolated from data provided for 2007 and 2010. The data were disaggregated into vehicle type-specific VMT using the VMT mixes developed for South Carolina using the HDD rule VMT growth rates. Table 2.3-3 presents the resulting VMT estimates which differ from the "default" HDD rule estimates as follows:

**Table 2.3-3 VMT and HDD Rule Estimates for North Carolina (million miles per year)**

South Carolina		
2002	47,074	
	State Data	HDD Data
2009	55,147	54,543
2018	65,133	63,880

**Tennessee:**

In general, Tennessee estimates are based on the HDD rule growth rate as described in step two. However, Knox County provided independent VMT estimates for 2018 and these were used in place of the HDD rule-derived estimates. The Knox County estimates were total county VMT data only, so these were disaggregated into roadway and vehicle-type VMT using the distributions developed for Knox County in step two using the HDD rule VMT growth rates. No data for Knox County were provided for 2009, so the estimates derived using the HDD rule growth factors were adjusted by the ratio of "Knox County provided 2018 VMT" to "Knox

County HDD Rule-derived 2018 VMT." Table 2.3-4 presents the resulting VMT estimates which differ from the "default" HDD rule estimates as follows:

**Table 2.3-4 VMT and HDD Rule Estimates for Tennessee (million miles per year)**

Tennessee		
2002	68,316	
	State Data	HDD Data
2009	78,615	78,813
2018	91,417	91,647

**Virginia:**

Virginia provided county and roadway type-specific annual VMT growth rates and these data were applied to Virginia -provided VMT data for 2002 to estimate VMT in both 2009 and 2018. Virginia provided VMT mix data for 2002, but not 2009 or 2018. Therefore, the estimated VMT data for both 2009 and 2018 were disaggregated into vehicle type-specific VMT using the VMT mixes developed for VA using the HDD rule VMT growth rates. Table 2.3-5 presents the resulting VMT estimates which differ from the "default" HDD rule estimates as follows:

**Table 2.3-5 VMT and HDD Rule Estimates for Virginia (million miles per year)**

Virginia		
2002	77,472	
	State Data	HDD Data
2009	88,419	89,196
2018	104,944	104,164

**2.3.3 Development of non-road emission estimates**

The sections that follow describe the projection process used to develop 2009 and revised 2018 nonroad projection estimates for sources found in the NONROAD model and those sources estimated outside of the model (locomotives, airplanes and commercial marine vessels).

**2.3.3.1 NONROAD model sources**

NONROAD model input files were prepared based on those prepared for the 2002 revised base year inventory with appropriate updates for the projection years. In large part the updates for the projection years for NONROAD model sources were to:

1. Revise the emission inventory year in the model to be reflective of the projection year.
2. Revise the fuel sulfur content for diesel powered vehicles.

Item 2 is discussed briefly below.

To correctly account for diesel fuel sulfur content differences, we prepared two sets of input and output files for each year, one set for land-based equipment and one set for marine equipment.

The specific diesel fuel sulfur contents modeled are as follows:

<b>Diesel S (ppm)</b>	<b>2002</b>	<b>2009</b>	<b>2018</b>
Land-Based	2500	348	11
Marine-Based	2500	408	56

The NONROAD model was run with both sets of input files and the output file results were then combined to produce a single NONROAD output set.

#### **2.3.3.1.1 Differences between 2009/2018**

Other than diesel fuel sulfur content and the year of the projections, there are no differences in the methodology used to estimate emissions from NONROAD model sources.

#### **2.3.3.2 Non-NONROAD model sources**

Using the revised 2002 base year emissions inventory for aircraft, locomotives, and commercial marine vessels (CMV) prepared as described earlier in this document, corresponding emission projections for 2009 and 2018 were developed. This section describes the procedures employed in developing those inventories. The information presented is intended to build off of that presented in the section describing the 2002 revised base year inventory.

Table 2.3-6 shows the final 2002 emissions for each State in the VISTAS region for aircraft, locomotives and CMV.

**Table 2.3-6. Final 2002 Aircraft, Locomotive, and Non-Recreational Marine Emissions  
(annual tons)**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	3,787	175	226	87	17	196
	FL	25,431	8,891	2,424	2,375	800	3,658
	GA	6,620	5,372	1,475	1,446	451	443
	KY	2,666	657	179	175	63	263
	MS	1,593	140	44	43	13	96
	NC	6,088	1,548	419	411	148	613
	SC	6,505	515	409	401	88	863
	TN	7,251	2,766	734	719	235	943
	VA	9,763	2,756	1,137	1,115	786	2,529
	WV	1,178	78	25	24	8	66
	<b>Total</b>		<b>70,882</b>	<b>22,899</b>	<b>7,072</b>	<b>6,797</b>	<b>2,607</b>
Commercial Marine (2280)	AL	1,196	9,218	917	844	3,337	737
	FL	5,888	44,817	1,936	1,781	6,683	1,409
	GA	1,038	7,875	334	307	1,173	246
	KY	6,607	50,267	2,246	2,066	9,608	1,569
	MS	5,688	43,233	1,903	1,751	7,719	1,351
	NC	599	4,547	193	178	690	142
	SC	1,067	8,100	343	316	1,205	253
	TN	3,624	27,555	1,217	1,120	4,974	860
	VA	972	2,775	334	307	359	483
	WV	1,528	11,586	487	448	525	362
	<b>Total</b>		<b>28,207</b>	<b>209,972</b>	<b>9,911</b>	<b>9,118</b>	<b>36,275</b>
Military Marine (2283)	VA	110	313	25	23	27	48
	<b>Total</b>	<b>110</b>	<b>313</b>	<b>25</b>	<b>23</b>	<b>27</b>	<b>48</b>
Locomotives (2285)	AL	3,490	26,339	592	533	1,446	1,354
	FL	1,006	9,969	247	222	605	404
	GA	2,654	26,733	664	598	1,622	1,059
	KY	2,166	21,811	542	488	1,321	867
	MS	2,302	23,267	578	520	1,429	899
	NC	1,638	16,502	410	369	1,001	654
	SC	1,160	11,690	291	261	710	462
	TN	2,626	25,627	633	570	1,439	1,041
	VA	1,186	11,882	1,529	1,375	3,641	492
	WV	1,311	13,224	329	296	808	517
	<b>Total</b>		<b>19,540</b>	<b>187,044</b>	<b>5,815</b>	<b>5,232</b>	<b>14,022</b>
<b>Grand Total</b>		<b>118,739</b>	<b>420,228</b>	<b>22,823</b>	<b>21,170</b>	<b>52,931</b>	<b>24,881</b>

Although some of the data utilized was updated, the methodology used to develop the 2009 and 2018 emissions forecasts for aircraft, locomotives, and CMV is identical to that used in the spring of 2004 to develop the preliminary 2018 Base 1 (“On the Books”) and 2018 Base 2 (“On the Way”) inventories. Briefly, the methodology relies on growth and control factors developed from inventories used in support of recent EPA rulemakings, and consists of the following steps:

- (a) Begin with the 2002 revised base year emission estimates for aircraft, locomotive, and CMV as described above (at the State-county-SCC-pollutant level of detail).
- (b) Detailed inventory data (both before and after controls) for these same emission sources for 1996, 2010, 2015, and 2020 were obtained from the EPA's Clean Air Interstate Rule (CAIR) Technical Support Document. Using these data, combined growth and control factors for the period 2002-2009 and 2002-2018 were estimated using straight line interpolation between 1996 and 2010 (for 2009) and 2105 and 2020 (for 2018). This is done at the State-county-SCC-pollutant level of detail.
- (c) The EPA growth and control data are matched against the 2002 VISTAS revised base year data using State-county-SCC-pollutant as the match key. Ideally, there would be a one-to-one match and the process would end at this point. Unfortunately, actual match results were not always ideal, so additional matching criteria were required. For subsequent reference, this initial (highest resolution) matching criterion is denoted as the “CAIR-Primary” criterion.
- (d) A second matching criterion is applied that utilizes a similar, but higher-level SCC (lower resolution) matching approach. For example, SCC 2275020000 (commercial aircraft) in the 2002 revised base year inventory data would be matched with SCC 2275000000 (all aircraft) in the CAIR data. This criterion is applied to records in the 2002 revised base year emissions file that are not matched using the “CAIR-Primary” criterion, and is also performed at the State-county-SCC-pollutant level of detail. For subsequent reference, this is denoted as the “CAIR-Secondary” criterion. At the end of this process, a number of unmatched records continued to remain, so a third level matching criterion was required.
- (e) In the third matching step, the most frequently used SCC in the EPA CAIR files for each of the aircraft, locomotive, and commercial marine sectors is averaged at the State level to produce a “default” State and pollutant-specific growth and control factor for the sector. The resulting factor is used as a “default” growth factor for all unmatched county-SCC-pollutant level data in each State. In effect, State-specific growth data are applied to county level data for which an explicit match between the VISTAS 2002 revised base year data and EPA CAIR data could not be developed. The default growth



and control SCCs are 2275020000 (commercial aircraft) for the aircraft sector, 2280002000 (commercial marine diesel total) for the CMV sector, and 2285002000 (railroad equipment diesel total) for the locomotive sector. Matches made using this criterion are denoted as “CAIR-Tertiary” matches.

- (f) According to EPA documentation, the CAIR baseline emissions include the impacts of the (then proposed) Tier 4 (T4) nonroad diesel rulemaking, which implements a low sulfur fuel requirement that affects both future CMV and locomotive emissions. However, the impacts of this rule were originally intended to be excluded from the initial VISTAS 2018 forecast, which was to include only “on-the-books” controls. (The T4 rule was finalized subsequent to the development of the preliminary 2018 inventory in March of 2004.) Given its final status, T4 impacts have now been moved into the “on the books” inventory for nonroad equipment. In addition, since there are no other proposed rules affecting the nonroad sector between 2002 and 2018, there is no difference between the 2018 “on the books” and 2018 “on the way” inventories for the sector; so that only a single forecast inventory (for each evaluation year) was developed. Nevertheless, since the algorithms developed to produce the VISTAS forecasts were developed when there was a distinction between the “on the books” and “on the way” inventories, the distinct algorithms used to produce the two inventories have been maintained even though the conceptual distinctions have been lost. This approach was taken for two reasons. First, it allowed the previously developed algorithms to be utilized without change. Second, it allowed for separate treatment of the T4 emissions impact which was important as those impacts have changed between the proposed and final T4 rules. Thus, previous EPA inventories that include the proposed T4 impacts would not be accurate. Therefore, the procedural discussion continues to reflect the distinctions between non-T4 and T4 emissions, as these distinctions continue to be intrinsically important to the forecasting process. Therefore, a second set of EPA CAIR files that excluded the Tier 4 diesel impacts was obtained and the same matching exercise described above in steps (b) through (e) was performed using these “No T4” files. It is important to note that the matching exercise described in steps (b) through (e) cannot simply be replaced because the “No T4” files obtained from the EPA include only those SCCs specifically affected by the T4 rule (i.e., diesel CMV and locomotives). So in effect, the matching exercise was augmented (rather than replaced) with an additional three criteria analogous to those described in steps (c) through (e), and these are denoted as the “No T4-Primary,” “No T4-Secondary,” and “No T4-Tertiary” criteria. Because they exclude the impacts of the proposed T4 rule, matches using the “No T4” criteria supersede matches made using the basic CAIR criteria (as described in steps (c) through (e) above).

- (g) The CAIR matching criteria were overridden for any record for which States provided local growth data. Only North Carolina provided these forecasts, as that State has provided specific growth factors for airport emissions in four counties. Because the provided data were based on forecasted changes in landings and takeoffs at major North Carolina airports, the factors were applied only to commercial (SCC 2275020000) and air taxi (SCC 2275060000) emissions. Emissions forecasts for military and general aviation aircraft operations, as well as all aircraft operations in counties other than the four identified in the North Carolina growth factor submission, continued to utilize the growth factors developed according to steps (b) through (f) above. Table 2.3-7 presents the locally generated growth factors applied in North Carolina are as follows:

**Table 2.3-7 Locally Generated Growth Factors for North Carolina**

FIP	2009 Factor	2018 Factor
37067	0.71	0.84
37081	0.97	0.89
37119	1.15	1.01
37183	0.88	0.81

**Note:**

Growth factor = Year Emissions/2002 Emissions.

Under CAIR approach, 2009 = 1.16 to 1.17 for all 4 counties.

Under CAIR approach, 2018 = 1.36 to 1.37 for all 4 counties.

- (h) Using this approach, each State-county-SCC-pollutant was assigned a combined growth and control factor using the EPA CAIR forecast or locally provided data. The 22,838 data records for aircraft, locomotives, and CMV in the 2002 revised base year emissions file were assigned growth factors in accordance with the following breakdown:

48 records matched State-provided growth factors,

4,179 records matched using the CAIR-Primary criterion,

240 records matched using the CAIR-Secondary criterion,

7,463 records matched using the CAIR-Tertiary criterion,

720 records matched using the No T4-Primary criterion,

3,858 records matched using the No T4-Secondary criterion, and

6,330 records matched using the No T4-Tertiary criterion.

- (i) Finally, the impacts of the T4 rule as adopted were applied to the grown “non T4” emission estimates. The actual T4 emission standards do not affect aircraft, locomotive,

or CMV directly, but associated diesel fuel sulfur requirements do affect locomotives and CMV. Lower fuel sulfur content affects both SO<sub>2</sub> and PM emissions. Expected fuel sulfur contents were obtained for each evaluation year from the EPA technical support document for the final T4 rule (*Final Regulatory Analysis: Control of Emissions from Nonroad Diesel Engines*, EPA420-R-04-007, May 2004). According to that document, the average diesel fuel sulfur content for locomotives and CMV is expected to be 408 ppmW in 2009 and 56 ppmW in 2018. These compare to expected non-T4 fuel sulfur levels of 2599 ppmW in 2009 and 2336 ppmW in 2018. Table 2.3-8 uses calculated emissions estimates for base and T4 control scenarios to estimate emission reduction impacts.

**Table 2.3-8 Estimated Emission Reduction Impacts based on T-4 Rule**

				2009	2018
CMV SO <sub>2</sub>	=	Non-T4 SO <sub>2</sub>	×	0.1569	0.0241
Locomotive SO <sub>2</sub>	=	Non-T4 SO <sub>2</sub>	×	0.1569	0.0241
CMV PM	=	Non-T4 PM	×	0.8962	0.8762
Locomotive PM	=	Non-T4 PM	×	0.8117	0.7734

However, since the diesel fuel sulfur content assumed for the 2002 VISTAS revised base year inventory, upon which both the 2009 and 2018 inventories were based, is 2500 ppmW, a small adjustment to the emission reduction multipliers calculated from the T4 rule is appropriate since they are measured relative to modestly different sulfur contents (2599 ppmW for 2009 and 2336 ppmW for 2018). Correcting for these modest differences produces the emission reduction impact estimates relative to forecasts based on the VISTAS 2002 inventory shown in Table 2.3-9.

**Table 2.3-9 Estimated Emission Reduction Impacts Relative to VISTAS 2002 Base Year Values**

				2009	2018
CMV SO <sub>2</sub>	=	Non-T4 SO <sub>2</sub>	×	0.1632	0.0225
Locomotive SO <sub>2</sub>	=	Non-T4 SO <sub>2</sub>	×	0.1632	0.0225
CMV PM	=	Non-T4 PM	×	0.9004	0.8685
Locomotive PM	=	Non-T4 PM	×	0.8187	0.7610

These factors were applied directly to the non-T4 emission forecasts to produce the final VISTAS 2009 and 2018 emissions inventories for aircraft, locomotive, and CMV.

The only exception is for Palm Beach County, Florida, where CMV emissions are reported as “all fuels” rather than separately by residual and diesel fuel components. To estimate T4 impacts in Palm Beach County, the ratio of diesel CMV emissions to total CMV emissions in the remainder of Florida was calculated and the T4 impact estimates for Palm Beach County were adjusted to reflect that ratio. Table 2.3-10 shows the calculated diesel CMV ratios.

**Table 2.3-10 Diesel CMV Adjustment Ratios for Palm Beach County, FL**

GROWTH BASIS	SO <sub>2</sub>	PM
2009 (1996, 2020 Growth Basis)	0.2410	0.7861
2009 (1996, 2010, 2015, and 2020 Growth Basis)	0.1279	0.7875
2018 (1996, 2020 Growth Basis)	0.2432	0.7925
2018 (1996, 2010, 2015, and 2020 Growth Basis)	0.2624	0.7918

*The differences between the growth bases are discussed in detail below.*

Combining these ratios with the T4 impact estimates for diesel engines, as presented above, yields the following impact adjustment factors for Palm Beach County:

**Table 2.3-11 Overall Adjustment Factors for Palm Beach County, FL**

GROWTH BASIS		
2009 SO <sub>2</sub> (19, 20 Growth Basis)	0.7894	[0.1632×0.2410+(1-0.2410)]
2009 SO <sub>2</sub> (96, 10, 15, and 20 Growth Basis)	0.8930	[0.1632×0.1279+(1-0.1279)]
2018 SO <sub>2</sub> (96, 20 Growth Basis)	0.7623	[0.0225×0.2432+(1-0.2432)]
2018 SO <sub>2</sub> (96, 10, 15, and 20 Growth Basis)	0.7436	[0.0225×0.2624+(1-0.2624)]
2009 PM (19, 20 Growth Basis)	0.9217	[0.9004×0.7861+(1-0.7861)]
2009 PM (96, 10, 15, and 20 Growth Basis)	0.9216	[0.9004×0.7875+(1-0.7875)]
2018 PM (96, 20 Growth Basis)	0.8958	[0.8685×0.7925+(1-0.7925)]
2018 PM (96, 10, 15, and 20 Growth Basis)	0.8959	[0.8685×0.7918+(1-0.7918)]

*The differences between the growth bases are discussed in detail below.*

Utilizing this approach, emission inventory forecasts for both 2009 and 2018 were developed. As indicated in step (b) above, basic growth factors were developed using EPA CAIR inventory data for 1996, 2010, 2015, and 2020. From these data, equivalent EPA CAIR inventories for 2002 and 2009 were developed through linear interpolation of the 1996 and 2010 inventories, while an equivalent CAIR inventory for 2018 was developed through linear interpolation of the 2015 and 2020 inventories. Growth factors for 2009 and 2018 were then estimated as the ratios of the CAIR 2009 and 2018 inventories to the CAIR 2002 inventory.

During the development of the preliminary 2018 VISTAS inventory in March 2004, this process yielded reasonable results and exhibited no particular systematic concerns. However, when the 2009 inventory was developed, significant concerns related to SO<sub>2</sub> and PM were encountered. Essentially, what was revealed by the 2009 forecast was a series of apparent inconsistencies in the CAIR 2010 and 2015 emission inventories (as compared to the 1996 and 2020 CAIR inventories) that were masked during the construction of the “longer-term” 2018 inventory.

The apparent inconsistencies are best illustrated by looking at the actual data extracted from the CAIR inventory files. Note that although a limited example is being presented, the same general issue applies throughout the CAIR files. For FIP 01001 (Autauga County, Alabama) and SCC 2285002000 (Diesel Rail), the CAIR inventories indicate SO<sub>2</sub> emission estimates as shown in Table 2.3-12.

**Table 2.3-12 SO<sub>2</sub> Emissions for Diesel Rail in Autauga County, AL from the CAIR Projections**

YEAR	TONS
1996:	15.3445
2010:	2.7271
2015:	2.8178
2020:	16.6232

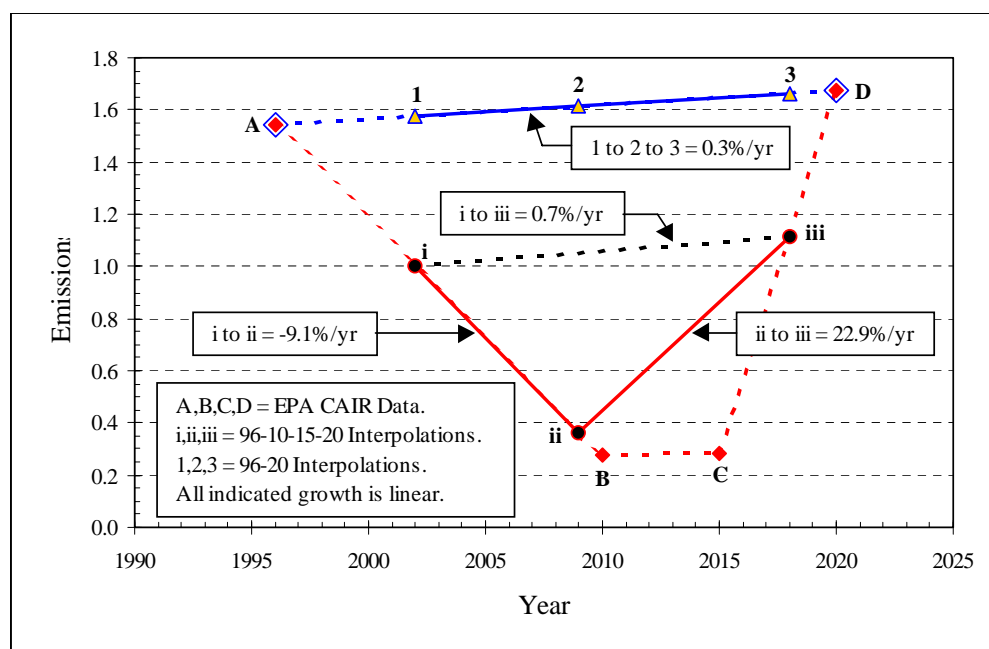
Clearly, there is a major drop in emissions between 1996 and 2010, followed by a major increase in emissions between 2015 and 2020. Several observations regarding these changes are important. First, the CAIR data were reported to exclude the T4 rule, so that the drop in emissions should be related to something other than simply a change in diesel fuel sulfur content. Second, if the T4 rule impacts were “accidentally” included in the estimates, there should be a resultant 90 percent drop in diesel sulfur between 2010 and 2015; so such inclusion is unlikely. Third, the rate of growth between 2015 and 2020 (43 percent *per year* compound or 97 percent *per year* linear) is well beyond any reasonable expectations for rail service; and fuel sulfur content during this period is constant both with and without T4. In short, there appeared to be no rational explanation for the data, yet the same basic relations are observed for thousands of CAIR inventory records.

For the most part, the issue seems to be centered on SO<sub>2</sub> and PM records, which are those records primarily affected by the T4 rule. But, as noted above, there does not seem to be any pattern of consistency that would indicate that either inclusion or exclusion of T4 rule impacts is the underlying cause. Moreover, where they occur, the observed growth extremes generally affect both SO<sub>2</sub> and PM equally, while one would expect PM effects to be buffered if the T4 rule

was the underlying cause, since changes in diesel fuel sulfur content will only affect a fraction of PM (i.e., sulfate), while directly reducing SO<sub>2</sub>.

The data presented in Figure 2.3-1 illustrates what this meant to the VISTAS forecasting process. Figure 2.3-1 depicts the same data presented above for Autauga County, Alabama, but normalized so that the interpolated 2002 CAIR emissions estimate was equal to unity. The “raw” CAIR data is depicted by the markers labeled A, B, C, and D. Interpolated data for 2002 and 2009, based on 1996 and 2010 CAIR data, is depicted by the markers labeled i and ii. Interpolated data for 2018, based on 2015 and 2020 CAIR data is depicted by the marker labeled iii. The relationship between marker iii and marker i is exactly the relationship used to construct the preliminary 2018 VISTAS inventory (i.e., a linear growth rate equal to 0.7 percent per year). Thus, it is easy to see that although there is a major “dip and rise” between 2002 and 2018, it is essentially masked unless data for intervening years are examined. Since no intervening year was examined for the preliminary 2018 inventory, the “dip and rise” was not discovered. However, upon the development of the 2009 inventory forecast, the issue became obvious, as the marker labeled ii readily illustrates. In effect, the 2009 inventory reflected very low negative “growth rates” for some SCCs and pollutants relative to the 2002 inventory, while the 2018 inventory reflected very high and positive growth rates for those same SCCs and pollutants. In effect, the path between 2002 and 2018 that previously looked like the dotted line connecting markers i and iii, now looks like the solid line connecting markers i, ii, and iii. For reference purposes, this path is hereafter referred to as the 1996, 2010, 2015, and 2020 growth basis, since all interpolated data is based on CAIR data for those four years.

**Figure 2.3-1. Impacts of the Apparent CAIR Inventory Discrepancy**



In light of the apparent discrepancies inherent in the 1996, 2010, 2015, and 2020 growth basis data and the inconsistencies its use would impart into the 2009 and 2018 VISTAS inventories, a secondary forecasting method was developed. This second method relies on the apparent consistency between the 1996 and 2020 non-T4 CAIR inventories, interpolating equivalent 2002, 2009, and 2018 inventories solely from these two inventories. In effect, the CAIR inventories for 2010 and 2015 are ignored. In Figure 2.3-1, this secondary approach is depicted by the data points that lie along the lines connecting markers A and D. Markers A and D represent the 1996 and 2020 CAIR inventories, and the markers labeled 1, 2, and 3 represent the interpolated 2002, 2009, and 2018 CAIR equivalent inventories. The growth rate between 2009 and 2002 is then equal to the ratio of the 2009 and 2002 CAIR inventories, while that between 2018 and 2002 is equal to the ratio of the 2018 and 2002 CAIR inventories. For the example data, the resulting linear growth estimate is 0.3 percent per year. For reference purposes, this path is hereafter referred to as the 1996-2020 growth basis, since all interpolated data is based on CAIR data for only those two years.

It is perhaps worth noting that the only elements of Figure 2.3-1 that have any bearing on the VISTAS inventories are the growth rates. The absolute CAIR data are of importance only in determining those rates, as all VISTAS inventories were developed on the basis of the VISTAS 2002 revised base year inventory, not any of the CAIR inventories. So referring to Figure 2.3-1, the two growth options are summarized in Table 2.3-13.

**Table 2.3-13 Growth Options based on CAIR Data**

GROWTH BASIS	PERCENT PER YEAR
1996, 2010, 2015, 2020 Growth Basis:	-9.1% per year (linear) between 2002 and 2009
1996-2020 Growth Basis:	+0.3% per year (linear) between 2002 and 2009
1996, 2010, 2015, 2020 Growth Basis:	+22.9% per year (linear) between 2009 and 2018
1996-2020 Growth Basis:	+0.3% per year (linear) between 2009 and 2018
1996, 2010, 2015, 2020 Growth Basis:	+0.7% per year (linear) between 2002 and 2018
1996-2020 Growth Basis:	+0.3% per year (linear) between 2002 and 2018

Of course, these specific rates are applicable only to the example case (i.e., diesel rail SO<sub>2</sub> in Autauga County, Alabama), but there are thousands of additional CAIR records that are virtually identical from a growth viewpoint.

While MACTEC developed forecast inventories for aircraft, locomotives, and CMV for 2009 and 2018 using both growth methods in the end the decision was made to utilize the 1996-2020



growth basis since it seemed to provide more reasonable growth rates for 2009. Tables 2.3-2 and 2.3-3 present a summary of each inventory, while Tables 2.3-4 and 2.3-5 present the associated change in emissions for each forecast inventory relative to the final 2002 VISTAS inventory. The larger reduction in CMV SO<sub>2</sub> emissions in 2009 and 2018 (relative to 2002) for Virginia and West Virginia is notable relative to the other VISTAS States, but this has been checked and is attributable to a high diesel contribution to total CMV SO<sub>2</sub> in the 2002 inventories for these two States.

Figures 2.3-2 through 2.3-13 graphically depict the relationships between the various inventories. There are two figures for each pollutant, the first of which presents a comparison of total VISTAS regional emission estimates for aircraft, locomotives, and CMV, and the second of which presents total VISTAS region emission estimates for locomotives only. This two figure approach is intended to provide a more robust illustration of the differences between the various inventories, as some of the differences are less distinct when viewed through overall aggregate emissions totals. All of the figures include the following emissions estimates:

- The 2002 revised base year VISTAS emissions inventory (labeled as “2002”),
- The 2002 initial base year VISTAS emissions inventory (labeled as “2002 Prelim”),
- The final 2009 VISTAS emissions inventory as developed using growth rates derived from 1996 and 2020 EPA CAIR data (labeled as “2009”),
- The revised 2018 VISTAS emissions inventory as developed using growth rates derived from 1996 and 2020 EPA CAIR data (labeled as “2018”), and
- The preliminary 2018 VISTAS emissions inventory estimates as developed in the spring of 2004 using growth rates derived from 1996, 2010, 2015, and 2020 EPA CAIR data (labeled as “2018 Prelim”).

All 12 figures generally illustrate a reduction in emissions estimates between the 2002 emission estimates published in February 2004 and the revised 2002 base year emission estimates. This reduction generally results from emission updates reflected in State CERR submittals, although the major differences in aggregate PM emission estimates are driven to a greater extent by modifications in the methodology used to estimate aircraft PM in the revised 2002 base year inventory.



**Table 2.3-2. 2009 Aircraft, Locomotive, and Non-Recreational Marine Emissions (annual tons) -- Based on Growth Using 1996 and 2020 EPA Inventories**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	4,178	202	278	102	19	217
	FL	29,258	10,316	2,812	2,756	928	4,235
	GA	7,635	6,233	1,712	1,678	523	512
	KY	3,075	762	207	203	73	304
	MS	1,765	162	51	50	16	108
	NC	6,551	1,601	436	427	153	644
	SC	7,372	559	446	437	98	975
	TN	8,020	3,096	824	807	268	1,050
	VA	10,994	3,094	1,239	1,214	907	2,892
	WV	1,312	91	28	28	9	74
	<b>Total</b>	<b>80,159</b>	<b>26,116</b>	<b>8,033</b>	<b>7,704</b>	<b>2,993</b>	<b>11,011</b>
Commercial Marine (2280)	AL	1,280	8,888	872	802	2,753	768
	FL	6,236	43,198	1,838	1,691	5,864	1,467
	GA	1,097	7,599	317	291	974	256
	KY	7,087	48,039	2,158	1,985	8,350	1,649
	MS	6,074	41,437	1,821	1,676	6,587	1,415
	NC	634	4,386	184	169	584	148
	SC	1,133	7,796	326	300	1,012	264
	TN	3,887	26,333	1,168	1,074	4,512	904
	VA	1,042	2,662	312	286	61	506
	WV	1,638	11,073	455	419	89	381
	<b>Total</b>	<b>30,109</b>	<b>201,412</b>	<b>9,450</b>	<b>8,693</b>	<b>30,786</b>	<b>7,759</b>
Military Marine (2283)	VA	118	299	23	21	5	50
	<b>Total</b>	<b>118</b>	<b>299</b>	<b>23</b>	<b>21</b>	<b>5</b>	<b>50</b>
Locomotives (2285)	AL	3,648	23,529	452	406	242	1,279
	FL	1,052	8,905	189	170	101	382
	GA	2,769	24,398	507	456	271	1,003
	KY	2,264	19,597	415	374	221	819
	MS	2,406	20,785	441	397	239	849
	NC	1,712	14,741	313	282	167	618
	SC	1,213	10,443	222	200	119	437
	TN	2,745	23,924	483	435	240	984
	VA	1,236	11,134	1,167	1,050	608	467
	WV	1,369	12,177	251	226	135	489
	<b>Total</b>	<b>20,412</b>	<b>169,635</b>	<b>4,440</b>	<b>3,995</b>	<b>2,343</b>	<b>7,328</b>
<b>Grand Total</b>		<b>130,798</b>	<b>397,462</b>	<b>21,946</b>	<b>20,413</b>	<b>36,126</b>	<b>26,148</b>

**Table 2.3-3. 2018 Aircraft, Locomotive, and Non-Recreational Marine Emissions (annual tons) -- Based on Growth Using 1996 and 2020 EPA Inventories**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
Aircraft (2275)	AL	4,681	236	345	122	23	245
	FL	34,178	12,147	3,312	3,246	1,093	4,976
	GA	8,939	7,340	2,016	1,976	616	601
	KY	3,602	898	244	239	86	357
	MS	1,986	190	60	58	18	122
	NC	6,728	1,454	400	392	139	615
	SC	8,487	616	493	484	112	1,119
	TN	9,009	3,519	939	921	309	1,187
	VA	12,578	3,528	1,370	1,342	1,063	3,358
	WV	1,484	106	33	33	10	85
	<b>Total</b>	<b>91,670</b>	<b>30,035</b>	<b>9,213</b>	<b>8,814</b>	<b>3,468</b>	<b>12,666</b>
Commercial Marine (2280)	AL	1,388	8,464	880	809	2,715	809
	FL	6,684	41,117	1,853	1,705	6,248	1,543
	GA	1,174	7,246	319	293	976	269
	KY	7,703	45,174	2,199	2,023	8,383	1,752
	MS	6,571	39,129	1,850	1,702	6,556	1,498
	NC	679	4,179	185	170	596	155
	SC	1,217	7,406	329	303	1,027	278
	TN	4,225	24,763	1,190	1,095	4,808	960
	VA	1,133	2,517	314	289	9	537
	WV	1,781	10,412	459	422	13	404
	<b>Total</b>	<b>32,554</b>	<b>190,407</b>	<b>9,578</b>	<b>8,811</b>	<b>31,330</b>	<b>8,205</b>
Military Marine (2283)	VA	128	282	23	21	1	53
	<b>Total</b>	<b>128</b>	<b>282</b>	<b>23</b>	<b>21</b>	<b>1</b>	<b>53</b>
Locomotives (2285)	AL	3,850	19,917	381	343	34	1,183
	FL	1,110	7,538	159	143	14	353
	GA	2,917	21,395	427	385	38	932
	KY	2,389	16,751	352	317	31	757
	MS	2,540	17,594	372	335	34	785
	NC	1,807	12,478	264	237	24	571
	SC	1,280	8,840	187	168	17	404
	TN	2,897	21,735	407	367	34	910
	VA	1,300	10,173	983	885	86	436
	WV	1,444	10,831	212	190	19	453
	<b>Total</b>	<b>21,534</b>	<b>147,252</b>	<b>3,744</b>	<b>3,368</b>	<b>333</b>	<b>6,785</b>
<b>Grand Total</b>		<b>145,885</b>	<b>367,975</b>	<b>22,557</b>	<b>21,015</b>	<b>35,132</b>	<b>27,709</b>

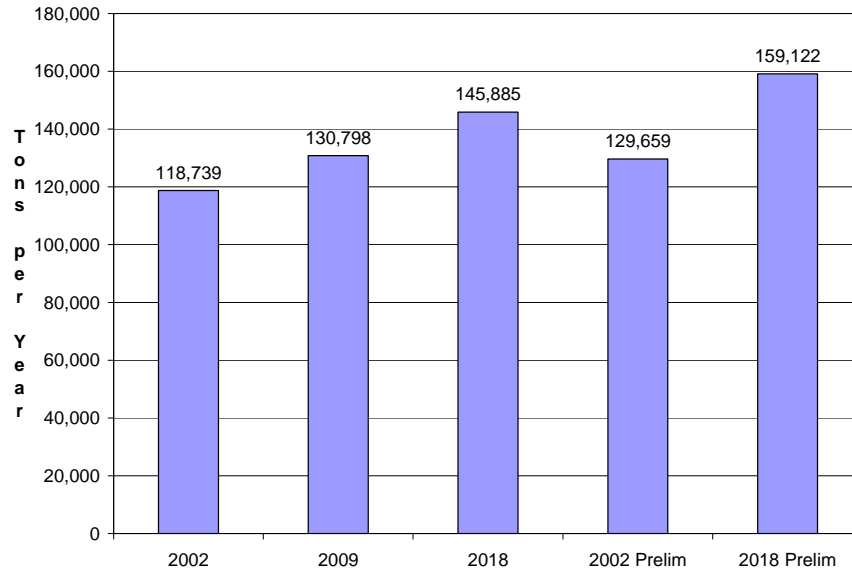
**Table 2.3-4. Change in 2009 Emissions (Based on Growth Using 1996 and 2020 EPA Inventories) from Revised 2002 Base Year Emissions**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC	
Aircraft (2275)	AL	+10%	+15%	+23%	+18%	+16%	+11%	
	FL	+15%	+16%	+16%	+16%	+16%	+16%	
	GA	+15%	+16%	+16%	+16%	+16%	+16%	
	KY	+15%	+16%	+16%	+16%	+16%	+16%	
	MS	+11%	+16%	+15%	+15%	+16%	+12%	
	NC	+8%	+3%	+4%	+4%	+3%	+5%	
	SC	+13%	+9%	+9%	+9%	+12%	+13%	
	TN	+11%	+12%	+12%	+12%	+14%	+11%	
	VA	+13%	+12%	+9%	+9%	+15%	+14%	
	WV	+11%	+16%	+15%	+15%	+16%	+12%	
	<b>Total</b>		<b>+13%</b>	<b>+14%</b>	<b>+14%</b>	<b>+13%</b>	<b>+15%</b>	<b>+14%</b>
Commercial Marine (2280)	AL	+7%	-4%	-5%	-5%	-18%	+4%	
	FL	+6%	-4%	-5%	-5%	-12%	+4%	
	GA	+6%	-3%	-5%	-5%	-17%	+4%	
	KY	+7%	-4%	-4%	-4%	-13%	+5%	
	MS	+7%	-4%	-4%	-4%	-15%	+5%	
	NC	+6%	-4%	-5%	-5%	-15%	+4%	
	SC	+6%	-4%	-5%	-5%	-16%	+4%	
	TN	+7%	-4%	-4%	-4%	-9%	+5%	
	VA	+7%	-4%	-7%	-7%	-83%	+5%	
	WV	+7%	-4%	-7%	-7%	-83%	+5%	
	<b>Total</b>		<b>+7%</b>	<b>-4%</b>	<b>-5%</b>	<b>-5%</b>	<b>-15%</b>	<b>+5%</b>
Military Marine (2283)	VA	+7%	-4%	-7%	-7%	-83%	+5%	
	<b>Total</b>		<b>+7%</b>	<b>-4%</b>	<b>-7%</b>	<b>-7%</b>	<b>-83%</b>	<b>+5%</b>
Locomotives (2285)	AL	+5%	-11%	-24%	-24%	-83%	-6%	
	FL	+5%	-11%	-24%	-24%	-83%	-6%	
	GA	+4%	-9%	-24%	-24%	-83%	-5%	
	KY	+5%	-10%	-23%	-23%	-83%	-6%	
	MS	+5%	-11%	-24%	-24%	-83%	-6%	
	NC	+5%	-11%	-24%	-24%	-83%	-6%	
	SC	+5%	-11%	-24%	-24%	-83%	-6%	
	TN	+5%	-7%	-24%	-24%	-83%	-6%	
	VA	+4%	-6%	-24%	-24%	-83%	-5%	
	WV	+4%	-8%	-24%	-24%	-83%	-5%	
	<b>Total</b>		<b>+4%</b>	<b>-9%</b>	<b>-24%</b>	<b>-24%</b>	<b>-83%</b>	<b>-5%</b>
<b>Grand Total</b>			<b>+10%</b>	<b>-5%</b>	<b>-4%</b>	<b>-4%</b>	<b>-32%</b>	<b>+5%</b>

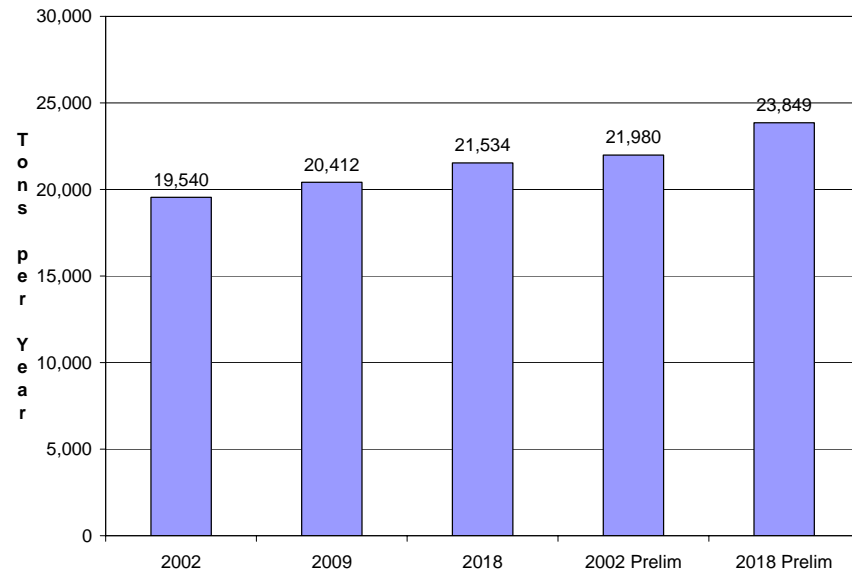
**Table 2.3-5. Change in 2018 Emissions (Based on Growth Using 1996 and 2020 EPA Inventories) from Revised 2002 Base Year Emissions**

Source	State	CO	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC	
Aircraft (2275)	AL	+24%	+35%	+53%	+41%	+36%	+25%	
	FL	+34%	+37%	+37%	+37%	+37%	+36%	
	GA	+35%	+37%	+37%	+37%	+37%	+36%	
	KY	+35%	+37%	+37%	+37%	+37%	+36%	
	MS	+25%	+36%	+35%	+35%	+36%	+27%	
	NC	+10%	-6%	-5%	-5%	-6%	0%	
	SC	+30%	+20%	+21%	+21%	+27%	+30%	
	TN	+24%	+27%	+28%	+28%	+31%	+26%	
	VA	+29%	+28%	+20%	+20%	+35%	+33%	
	WV	+26%	+36%	+35%	+35%	+36%	+28%	
	<b>Total</b>		<b>+29%</b>	<b>+31%</b>	<b>+30%</b>	<b>+30%</b>	<b>+33%</b>	<b>+31%</b>
Commercial Marine (2280)	AL	+16%	-8%	-4%	-4%	-19%	+10%	
	FL	+14%	-8%	-4%	-4%	-7%	+9%	
	GA	+13%	-8%	-5%	-5%	-17%	+9%	
	KY	+17%	-10%	-2%	-2%	-13%	+12%	
	MS	+16%	-9%	-3%	-3%	-15%	+11%	
	NC	+13%	-8%	-4%	-4%	-14%	+9%	
	SC	+14%	-9%	-4%	-4%	-15%	+10%	
	TN	+17%	-10%	-2%	-2%	-3%	+12%	
	VA	+17%	-9%	-6%	-6%	-98%	+11%	
	WV	+17%	-10%	-6%	-6%	-98%	+12%	
	<b>Total</b>		<b>+15%</b>	<b>-9%</b>	<b>-3%</b>	<b>-3%</b>	<b>-14%</b>	<b>+11%</b>
Military Marine (2283)	VA	+17%	-10%	-6%	-6%	-98%	+12%	
	<b>Total</b>		<b>+17%</b>	<b>-10%</b>	<b>-6%</b>	<b>-6%</b>	<b>-98%</b>	<b>+12%</b>
Locomotives (2285)	AL	+10%	-24%	-36%	-36%	-98%	-13%	
	FL	+10%	-24%	-36%	-36%	-98%	-13%	
	GA	+10%	-20%	-36%	-36%	-98%	-12%	
	KY	+10%	-23%	-35%	-35%	-98%	-13%	
	MS	+10%	-24%	-36%	-36%	-98%	-13%	
	NC	+10%	-24%	-36%	-36%	-98%	-13%	
	SC	+10%	-24%	-36%	-36%	-98%	-13%	
	TN	+10%	-15%	-36%	-36%	-98%	-13%	
	VA	+10%	-14%	-36%	-36%	-98%	-11%	
	WV	+10%	-18%	-36%	-36%	-98%	-12%	
	<b>Total</b>		<b>+10%</b>	<b>-21%</b>	<b>-36%</b>	<b>-36%</b>	<b>-98%</b>	<b>-12%</b>
<b>Grand Total</b>			<b>+23%</b>	<b>-12%</b>	<b>-1%</b>	<b>-1%</b>	<b>-34%</b>	<b>+11%</b>

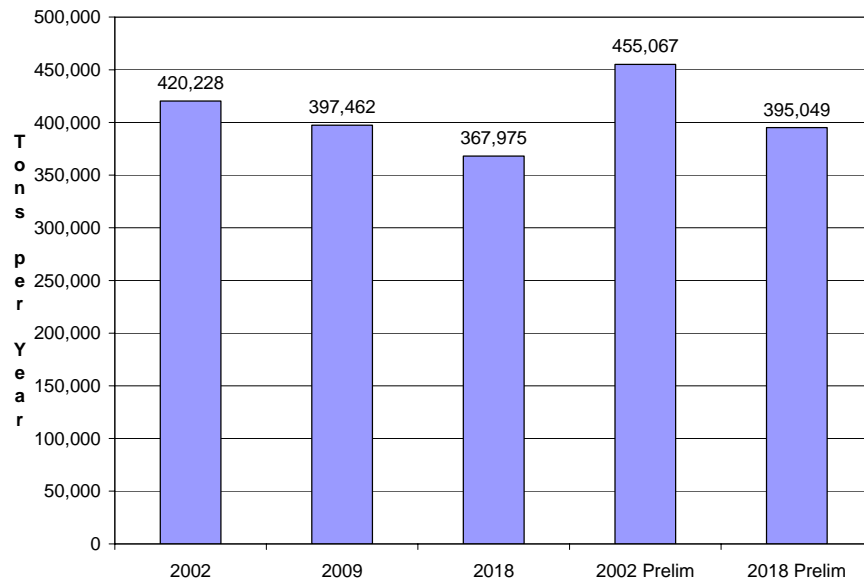
**Figure 2.3-2. Total Aircraft, Locomotive, and CMV CO Emissions**



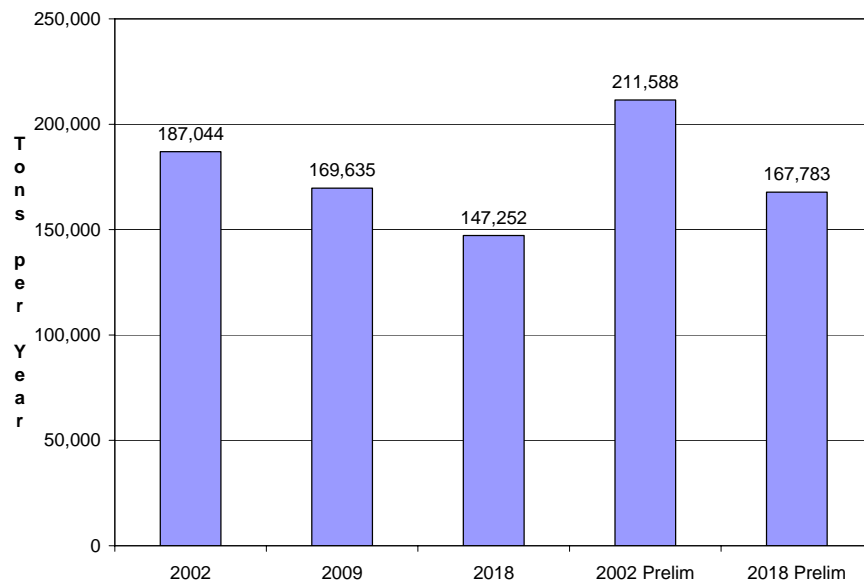
**Figure 2.3-3. Locomotive CO Emissions**



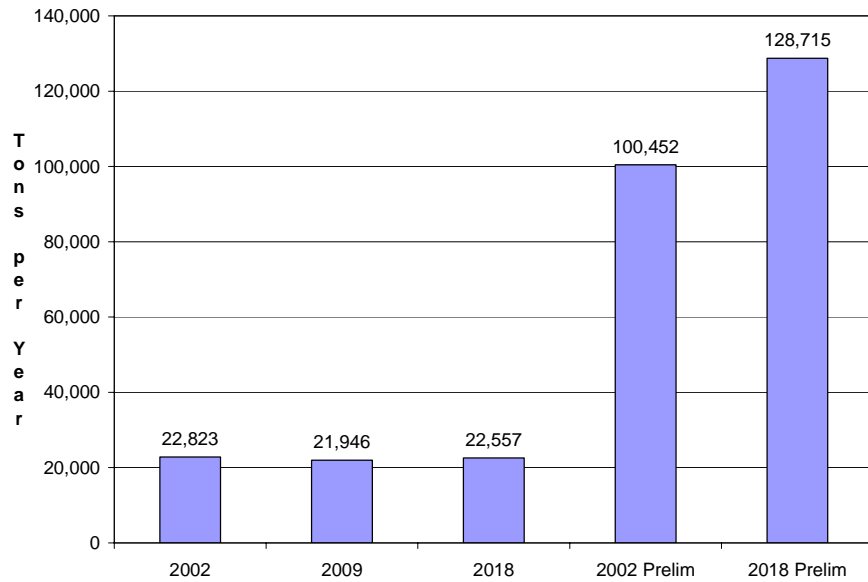
**Figure 2.3-4. Total Aircraft, Locomotive, and CMV NO<sub>x</sub> Emissions**



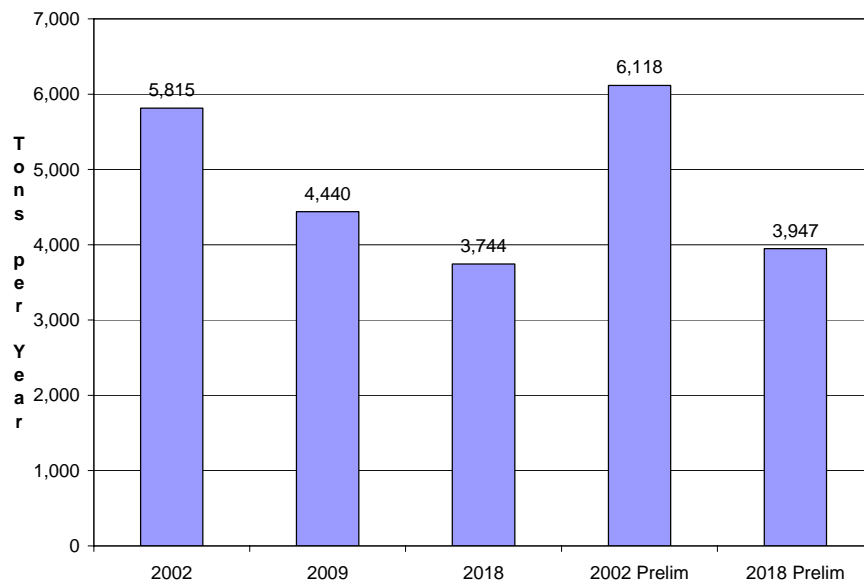
**Figure 2.3-5. Locomotive NO<sub>x</sub> Emissions**



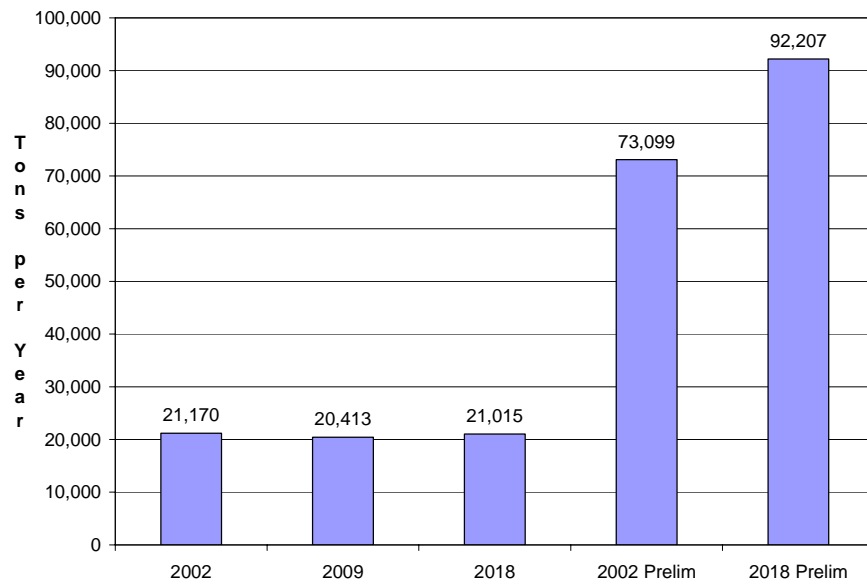
**Figure 2.3-6. Total Aircraft, Locomotive, and CMV PM<sub>10</sub> Emissions**



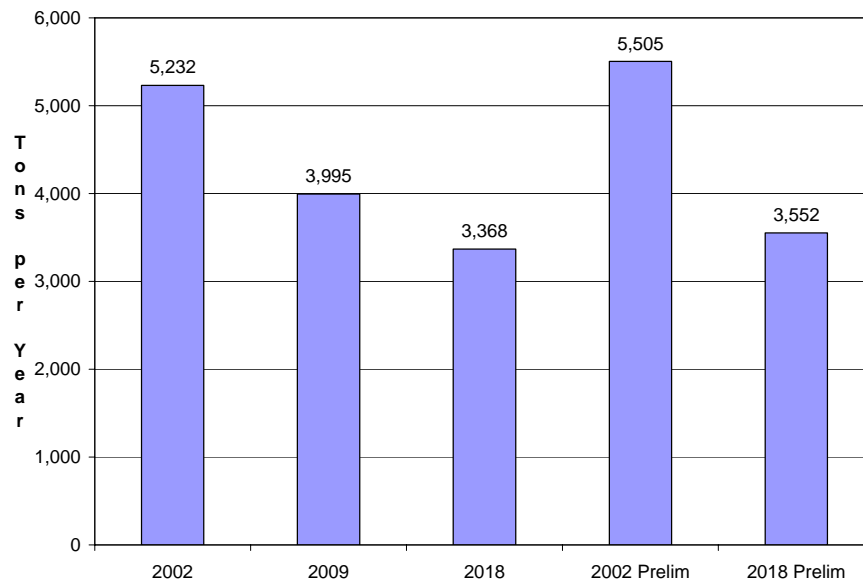
**Figure 2.3-7. Locomotive PM<sub>10</sub> Emissions**



**Figure 2.3-8. Total Aircraft, Locomotive, and CMV PM<sub>2.5</sub> Emissions**

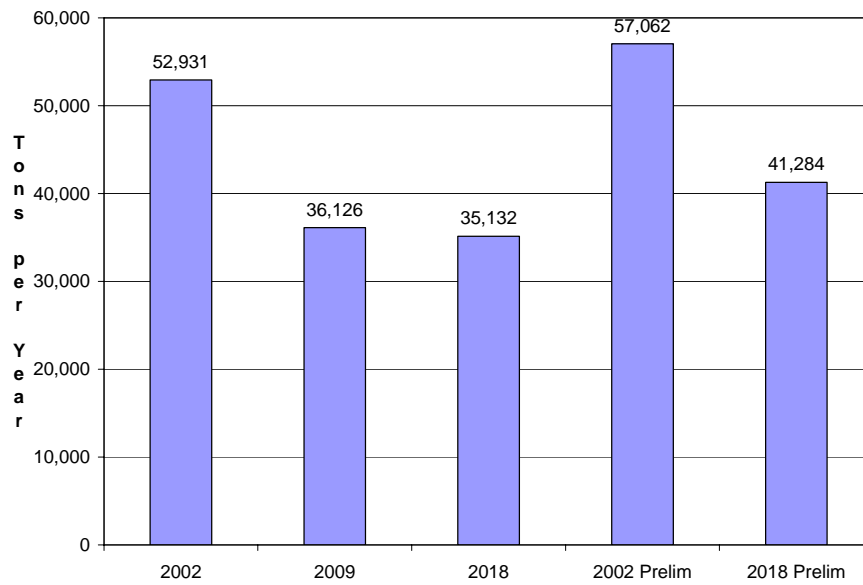


**Figure 2.3-9. Locomotive PM<sub>2.5</sub> Emissions**

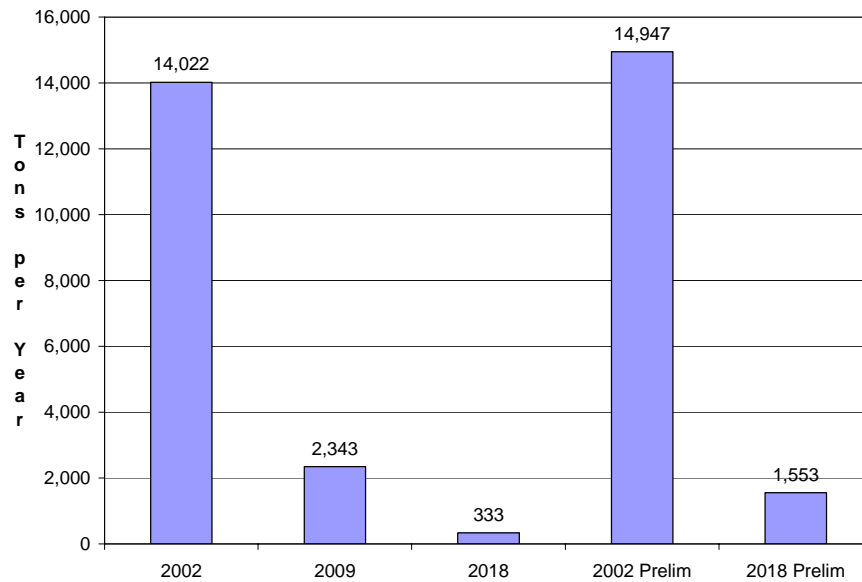




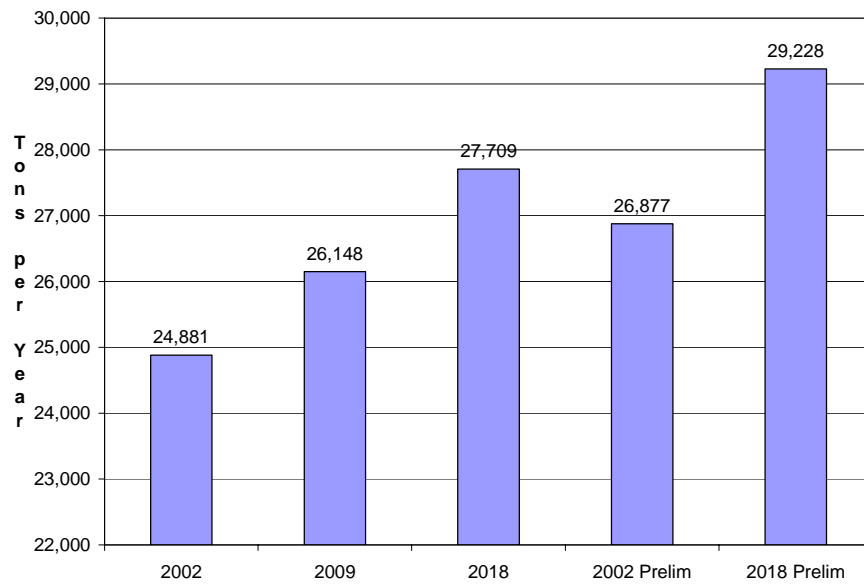
**Figure 2.3-10. Total Aircraft, Locomotive, and CMV SO<sub>2</sub> Emissions**



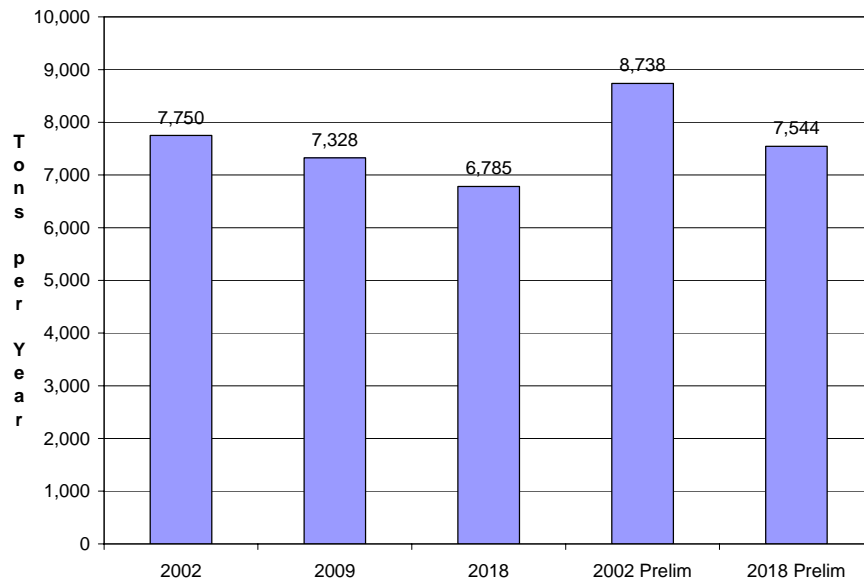
**Figure 2.3-11. Locomotive SO<sub>2</sub> Emissions**



**Figure 2.3-12. Total Aircraft, Locomotive, and CMV VOC Emissions**



**Figure 2.3-13. Locomotive VOC Emissions**



### **2.3.3.3 Differences between 2009/2018**

Methodologically, there was no difference in the way that 2009 and 2018 emissions were calculated for mobile sources. The actual value of the growth factors were different for each type of mobile source considered, but the calculation methods were identical.

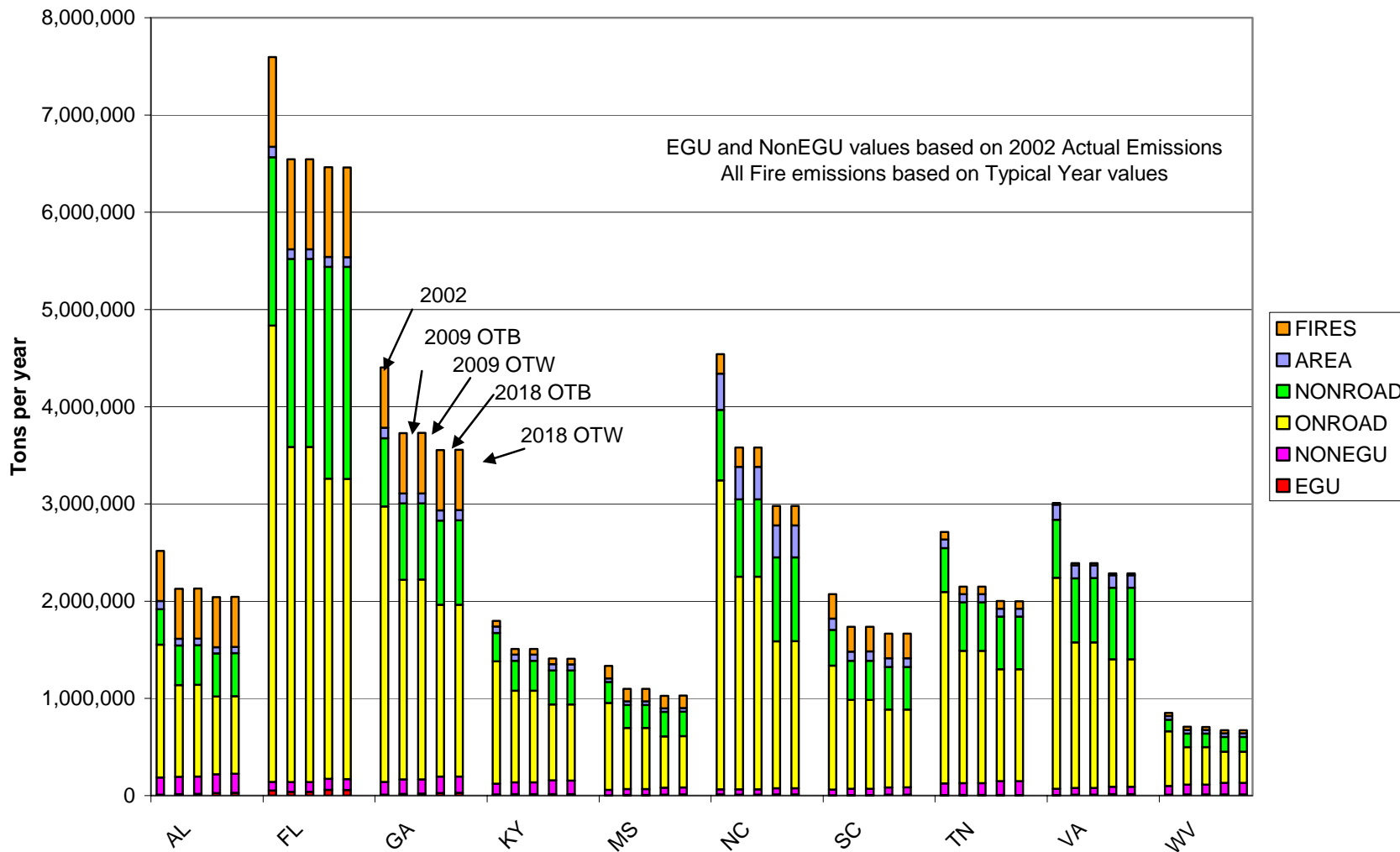
### **2.3.4 Quality Assurance steps**

Throughout the inventory development process, quality assurance steps were performed to ensure that no double counting of emissions occurred, to ensure that a full and complete inventory was developed for VISTAS, and to make sure that projection calculations were working correctly. Quality assurance was an important component to the inventory development process and MACTEC performed the following QA steps on mobile source components of the 2009 and revised 2018 projection inventories:

1. All final files (NONROAD only) were run through EPA's Format and Content checking software. Input data files for MOBILE and VMT growth estimates were reviewed by the corresponding SIWG and by the VISTAS Emission Inventory Technical Advisor.
2. SCC level emission summaries were prepared and evaluated to ensure that emissions were consistent and that there were no missing sources (NONROAD only).
3. Tier comparisons (by pollutant) were developed between the revised 2002 base year inventory and the 2009 and 2018 projection inventories (NONROAD only)
4. Data product summaries were provided to both the VISTAS Emission Inventory Technical Advisor and to the SIWG representatives for review and comment. Changes based on these comments were implemented in the files.
5. Version numbering was used for all inventory files developed. The version numbering process used a decimal system to track major and minor changes. For example, a major change would result in a version going from 1.0 to 2.0. A minor change would cause a version number to go from 1.0 to 1.1. Minor changes resulting from largely editorial changes would result in a change from 1.00 to 1.01.

**Appendix A: State Emission Totals by Pollutant and Sector**

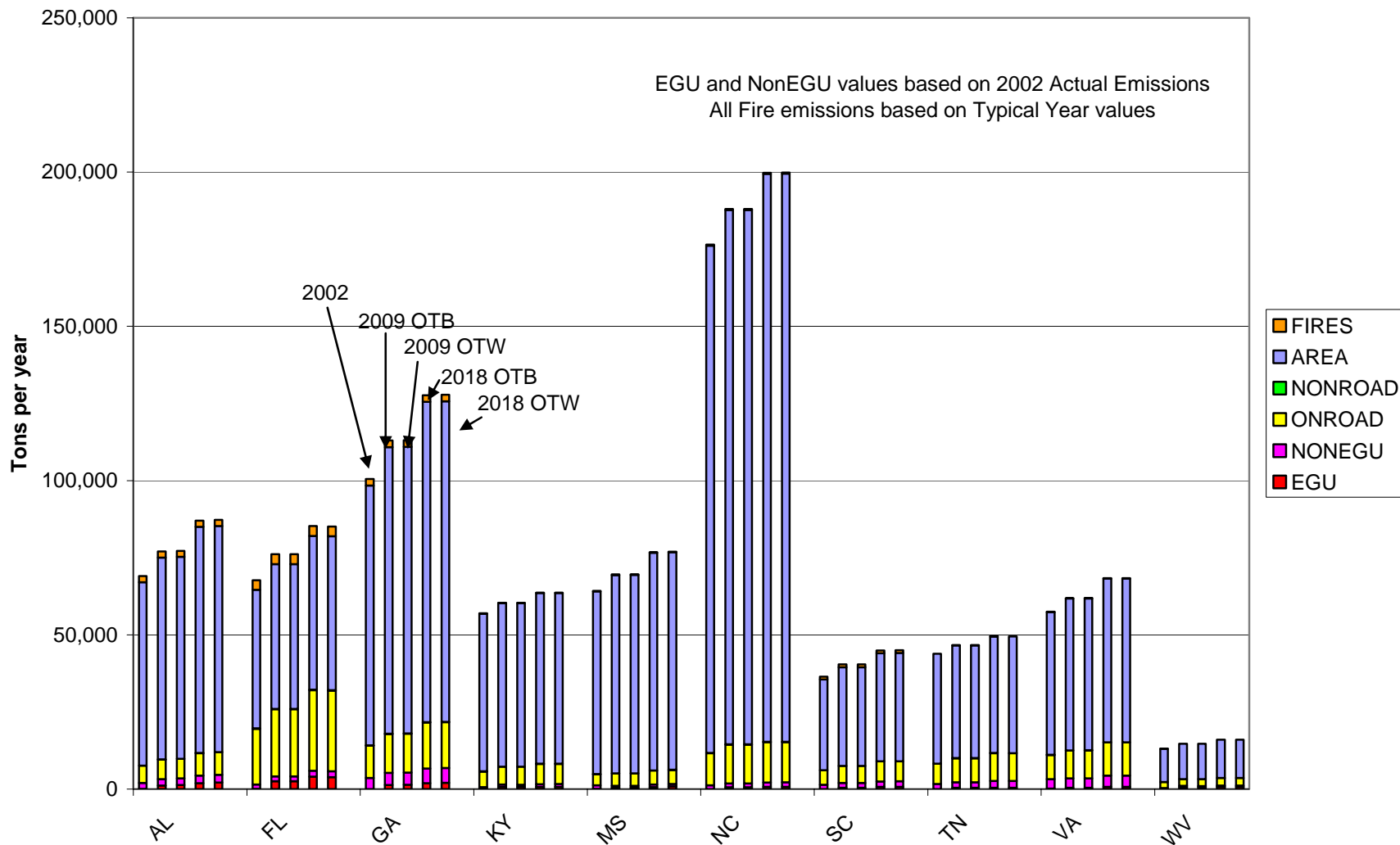
### Annual CO Emissions by Source Sector



## Annual CO Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	11,243	174,306	1,366,056	367,038	83,958	514,120	2002	OTB - Actual 2002
	16,494	177,145	942,793	408,424	68,882	514,120	2009	OTB - Actual 2002
AL	19,205	177,145	942,793	408,424	68,882	514,120	2009	OTW - Actual 2002
	26,600	194,801	797,966	443,100	63,773	514,120	2018	OTB - Actual 2002
	29,893	194,801	797,966	443,100	63,773	514,120	2018	OTW - Actual 2002
	51,278	89,970	4,693,893	1,731,519	105,849	923,310	2002	OTB - Actual 2002
	40,642	98,325	3,446,095	1,934,550	101,356	923,310	2009	OTB - Actual 2002
FL	40,641	98,325	3,446,095	1,934,550	101,356	923,310	2009	OTW - Actual 2002
	59,793	113,923	3,086,330	2,179,296	100,952	923,310	2018	OTB - Actual 2002
	57,759	113,923	3,086,330	2,179,296	100,952	923,310	2018	OTW - Actual 2002
	9,248	131,413	2,833,468	700,427	107,889	620,342	2002	OTB - Actual 2002
	19,170	147,835	2,053,694	783,990	103,579	620,342	2009	OTB - Actual 2002
GA	20,024	147,835	2,053,694	783,990	103,579	620,342	2009	OTW - Actual 2002
	27,152	169,156	1,765,020	868,018	105,059	620,342	2018	OTB - Actual 2002
	28,895	169,156	1,765,020	868,018	105,059	620,342	2018	OTW - Actual 2002
	12,374	110,181	1,260,682	289,967	66,752	56,686	2002	OTB - Actual 2002
	15,273	121,981	942,350	306,884	64,806	56,686	2009	OTB - Actual 2002
KY	15,119	121,981	942,350	306,884	64,806	56,686	2009	OTW - Actual 2002
	16,974	139,395	782,423	349,285	65,297	56,686	2018	OTB - Actual 2002
	14,954	139,395	782,423	349,285	65,297	56,686	2018	OTW - Actual 2002
	2,714	57,158	894,639	213,779	37,905	128,471	2002	OTB - Actual 2002
	6,714	60,709	628,151	237,297	37,161	128,471	2009	OTB - Actual 2002
MS	6,954	60,709	628,151	237,297	37,161	128,471	2009	OTW - Actual 2002
	10,553	70,454	528,898	252,658	36,425	128,471	2018	OTB - Actual 2002
	12,928	70,454	528,898	252,658	36,425	128,471	2018	OTW - Actual 2002
	11,922	52,539	3,176,811	725,734	373,585	200,564	2002	OTB - Actual 2002
	11,091	54,791	2,184,901	797,360	332,443	200,564	2009	OTB - Actual 2002
NC	11,170	54,791	2,184,901	797,360	332,443	200,564	2009	OTW - Actual 2002
	13,482	63,699	1,510,848	863,536	327,871	200,564	2018	OTB - Actual 2002
	13,777	63,699	1,510,848	863,536	327,871	200,564	2018	OTW - Actual 2002
	3,699	59,605	1,275,161	367,575	113,714	253,005	2002	OTB - Actual 2002
	6,316	65,612	912,280	402,871	95,826	253,005	2009	OTB - Actual 2002
SC	6,526	65,612	912,280	402,871	95,826	253,005	2009	OTW - Actual 2002
	10,175	75,209	800,619	438,027	89,343	253,005	2018	OTB - Actual 2002
	10,671	75,209	800,619	438,027	89,343	253,005	2018	OTW - Actual 2002
	6,414	119,453	1,967,658	451,480	89,235	78,370	2002	OTB - Actual 2002
	6,750	121,420	1,361,408	500,186	82,196	78,370	2009	OTB - Actual 2002
TN	6,651	121,420	1,361,408	500,186	82,196	78,370	2009	OTW - Actual 2002
	7,074	143,845	1,150,516	540,143	81,242	78,370	2018	OTB - Actual 2002
	6,509	143,845	1,150,516	540,143	81,242	78,370	2018	OTW - Actual 2002
	6,294	64,395	2,170,508	595,311	155,873	19,159	2002	OTB - Actual 2002
	9,811	69,822	1,495,771	661,295	133,738	19,159	2009	OTB - Actual 2002
VA	10,245	69,822	1,495,771	661,295	133,738	19,159	2009	OTW - Actual 2002
	14,788	77,590	1,310,698	734,294	129,037	19,159	2018	OTB - Actual 2002
	14,839	77,590	1,310,698	734,294	129,037	19,159	2018	OTW - Actual 2002
	10,303	89,917	560,717	119,089	39,546	32,656	2002	OTB - Actual 2002
	12,622	100,292	385,994	138,999	37,704	32,656	2009	OTB - Actual 2002
WV	12,328	100,292	385,994	138,999	37,704	32,656	2009	OTW - Actual 2002
	13,064	119,367	319,030	152,932	36,809	32,656	2018	OTB - Actual 2002
	12,992	119,367	319,030	152,932	36,809	32,656	2018	OTW - Actual 2002

### Annual NH<sub>3</sub> Emissions by Source Sector

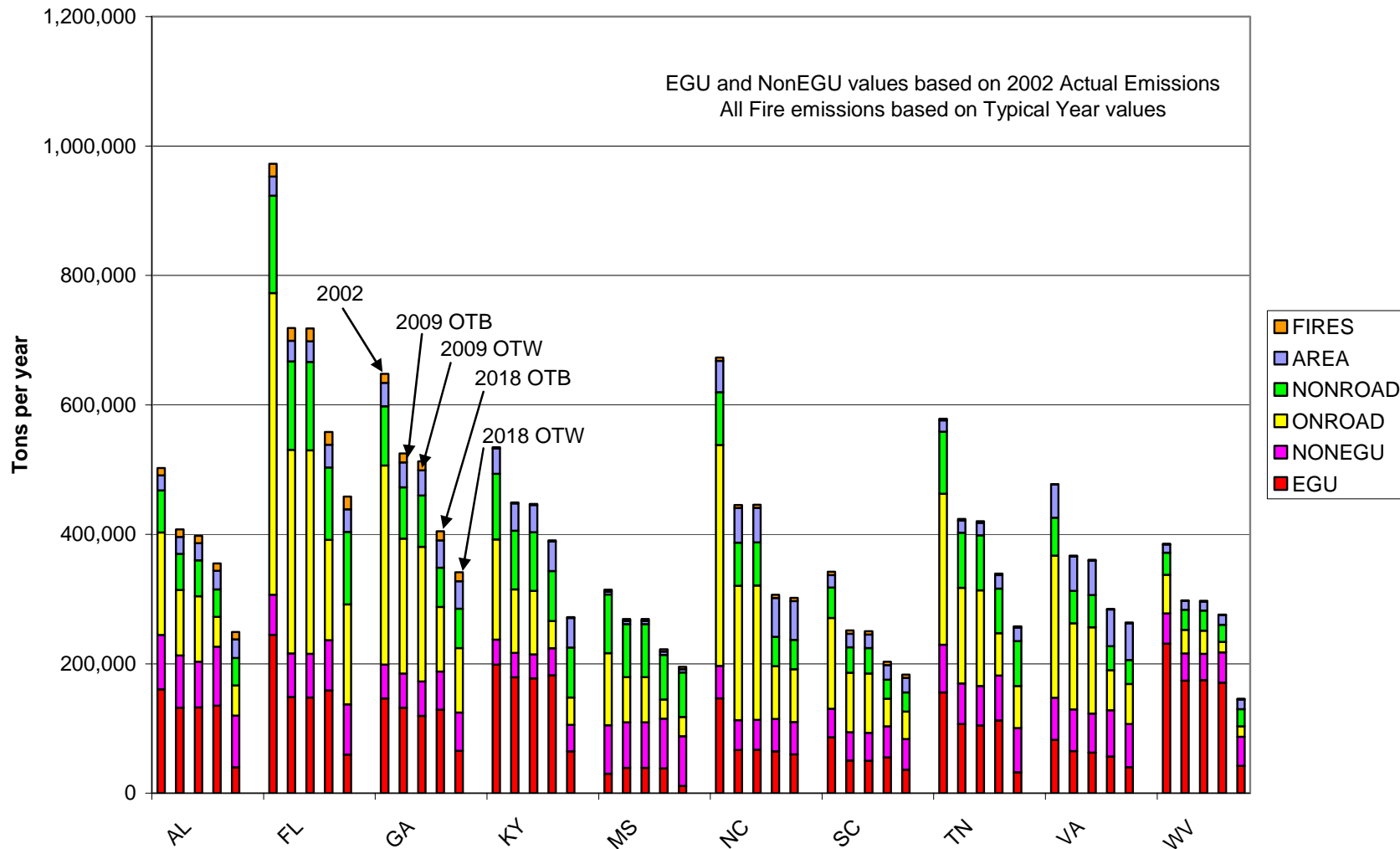


Annual NH<sub>3</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	90	1,883	5,576	32	59,486	1,957	2002	OTB - Actual 2002
	1,128	2,112	6,350	35	65,441	1,957	2009	OTB - Actual 2002
AL	1,344	2,112	6,350	35	65,441	1,957	2009	OTW - Actual 2002
	1,909	2,456	7,296	40	73,346	1,957	2018	OTB - Actual 2002
	2,173	2,456	7,296	40	73,346	1,957	2018	OTW - Actual 2002
	58	1,432	18,078	108	44,902	3,157	2002	OTB - Actual 2002
	2,524	1,605	21,737	119	46,950	3,157	2009	OTB - Actual 2002
FL	2,524	1,605	21,737	119	46,950	3,157	2009	OTW - Actual 2002
	4,022	1,905	26,154	138	49,889	3,157	2018	OTB - Actual 2002
	3,865	1,905	26,154	138	49,889	3,157	2018	OTW - Actual 2002
	5	3,613	10,524	54	84,230	2,153	2002	OTB - Actual 2002
	1,305	3,963	12,660	60	92,838	2,153	2009	OTB - Actual 2002
GA	1,376	3,963	12,660	60	92,838	2,153	2009	OTW - Actual 2002
	1,912	4,799	14,871	71	103,911	2,153	2018	OTB - Actual 2002
	2,057	4,799	14,871	71	103,911	2,153	2018	OTW - Actual 2002
	0	674	5,044	28	51,097	110	2002	OTB - Actual 2002
	717	733	5,795	30	53,023	110	2009	OTB - Actual 2002
KY	710	733	5,795	30	53,023	110	2009	OTW - Actual 2002
	763	839	6,584	36	55,356	110	2018	OTB - Actual 2002
	771	839	6,584	36	55,356	110	2018	OTW - Actual 2002
	64	1,169	3,577	23	59,262	177	2002	OTB - Actual 2002
	388	667	4,026	26	64,289	177	2009	OTB - Actual 2002
MS	407	667	4,026	26	64,289	177	2009	OTW - Actual 2002
	686	761	4,565	30	70,565	177	2018	OTB - Actual 2002
	872	761	4,565	30	70,565	177	2018	OTW - Actual 2002
	36	1,171	10,455	61	164,467	324	2002	OTB - Actual 2002
	577	1,255	12,637	68	173,187	324	2009	OTB - Actual 2002
NC	574	1,255	12,637	68	173,187	324	2009	OTW - Actual 2002
	740	1,412	13,077	79	184,167	324	2018	OTB - Actual 2002
	781	1,412	13,077	79	184,167	324	2018	OTW - Actual 2002
	0	1,411	4,684	29	29,447	908	2002	OTB - Actual 2002
	409	1,578	5,510	32	31,966	908	2009	OTB - Actual 2002
SC	422	1,578	5,510	32	31,966	908	2009	OTW - Actual 2002
	702	1,779	6,472	37	35,082	908	2018	OTB - Actual 2002
	742	1,779	6,472	37	35,082	908	2018	OTW - Actual 2002
	0	1,628	6,616	41	35,571	46	2002	OTB - Actual 2002
	406	1,861	7,738	45	36,578	46	2009	OTB - Actual 2002
TN	400	1,861	7,738	45	36,578	46	2009	OTW - Actual 2002
	427	2,240	8,962	53	37,812	46	2018	OTB - Actual 2002
	394	2,240	8,962	53	37,812	46	2018	OTW - Actual 2002
	127	3,104	7,837	44	46,221	159	2002	OTB - Actual 2002
	396	3,057	9,066	48	49,173	159	2009	OTB - Actual 2002
VA	439	3,057	9,066	48	49,173	159	2009	OTW - Actual 2002
	759	3,620	10,757	57	53,023	159	2018	OTB - Actual 2002
	783	3,620	10,757	57	53,023	159	2018	OTW - Actual 2002
	13	331	1,933	10	10,779	12	2002	OTB - Actual 2002
	691	342	2,183	11	11,461	12	2009	OTB - Actual 2002
WV	673	342	2,183	11	11,461	12	2009	OTW - Actual 2002
	722	416	2,484	13	12,390	12	2018	OTB - Actual 2002
	719	416	2,484	13	12,390	12	2018	OTW - Actual 2002



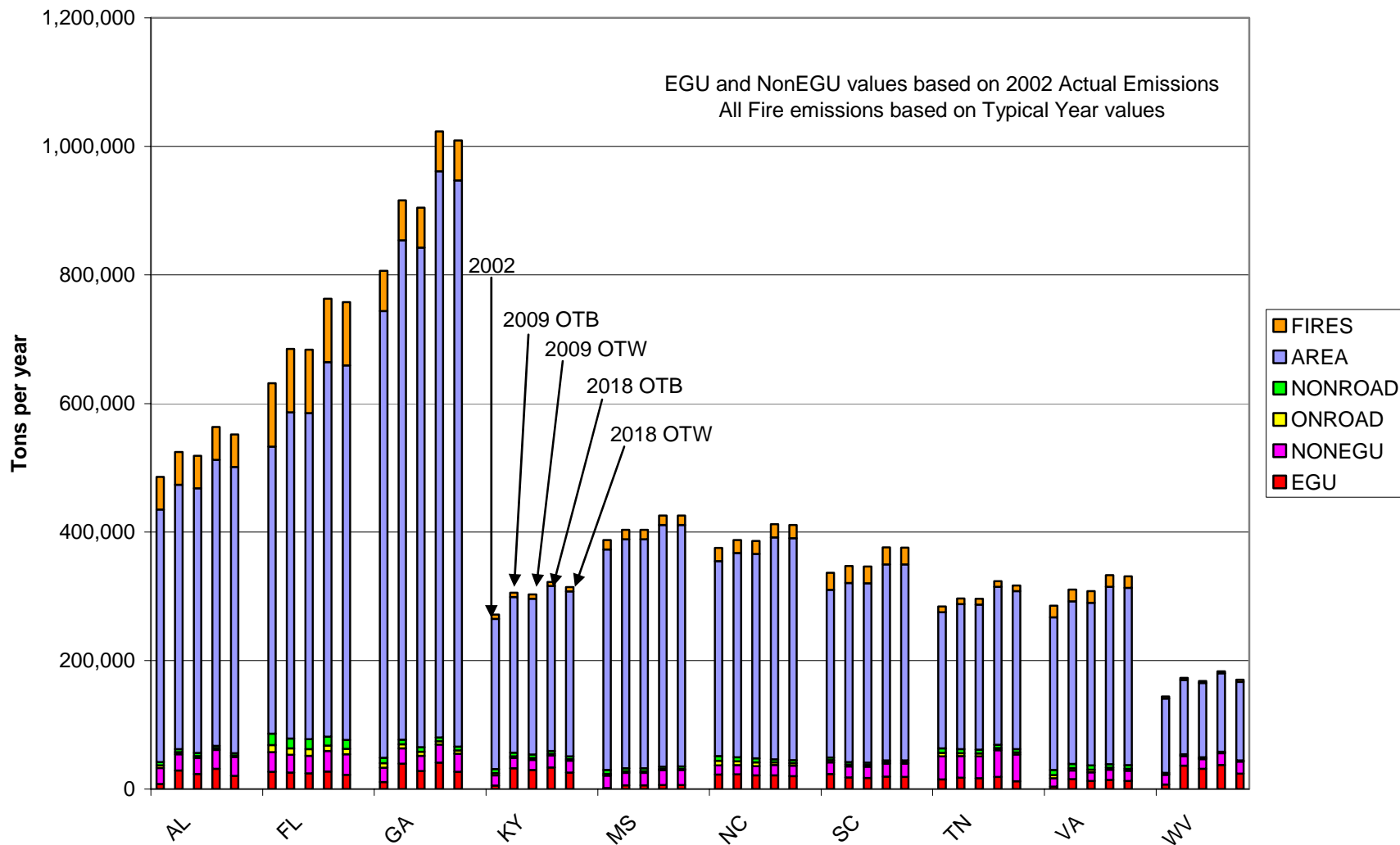
### Annual NOx Emissions by Source Sector



Annual NO<sub>x</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	160,480	83,868	158,423	64,891	23,444	11,456	2002	OTB - Actual 2002
	131,988	80,738	101,323	55,494	26,482	11,456	2009	OTB - Actual 2002
AL	132,323	70,644	101,323	55,494	26,482	11,456	2009	OTW - Actual 2002
	135,010	91,052	46,222	42,573	28,754	11,456	2018	OTB - Actual 2002
	39,942	80,031	46,222	42,573	28,754	11,456	2018	OTW - Actual 2002
	244,541	62,138	466,098	150,519	29,477	19,791	2002	OTB - Actual 2002
	148,522	67,533	314,307	136,851	31,821	19,791	2009	OTB - Actual 2002
FL	147,801	67,533	314,307	136,851	31,821	19,791	2009	OTW - Actual 2002
	159,004	77,551	154,611	111,959	35,047	19,791	2018	OTB - Actual 2002
	59,446	77,551	154,611	111,959	35,047	19,791	2018	OTW - Actual 2002
	146,143	52,388	308,013	91,386	36,105	13,882	2002	OTB - Actual 2002
	131,901	53,008	208,393	79,049	38,876	13,882	2009	OTB - Actual 2002
GA	119,425	53,008	208,393	79,049	38,876	13,882	2009	OTW - Actual 2002
	128,938	59,005	99,821	60,650	42,260	13,882	2018	OTB - Actual 2002
	65,559	59,005	99,821	60,650	42,260	13,882	2018	OTW - Actual 2002
	198,726	38,483	154,899	101,261	39,507	1,460	2002	OTB - Actual 2002
	178,930	37,960	97,912	90,803	42,122	1,460	2009	OTB - Actual 2002
KY	177,272	37,201	97,912	90,803	42,122	1,460	2009	OTW - Actual 2002
	182,192	41,776	42,104	77,295	45,597	1,460	2018	OTB - Actual 2002
	64,674	40,948	42,104	77,295	45,597	1,460	2018	OTW - Actual 2002
	29,976	74,685	111,791	90,686	4,200	3,328	2002	OTB - Actual 2002
	38,911	70,463	69,949	81,780	4,789	3,328	2009	OTB - Actual 2002
MS	38,978	70,463	69,949	81,780	4,789	3,328	2009	OTW - Actual 2002
	38,355	76,738	29,717	68,781	5,230	3,328	2018	OTB - Actual 2002
	11,206	76,738	29,717	68,781	5,230	3,328	2018	OTW - Actual 2002
	146,465	50,317	341,198	81,448	48,730	5,005	2002	OTB - Actual 2002
	66,598	46,242	207,648	66,382	53,550	5,005	2009	OTB - Actual 2002
NC	67,051	46,242	207,648	66,382	53,550	5,005	2009	OTW - Actual 2002
	64,537	50,044	81,706	45,146	60,073	5,005	2018	OTB - Actual 2002
	59,917	50,044	81,706	45,146	60,073	5,005	2018	OTW - Actual 2002
	86,264	44,129	140,428	46,789	19,332	5,270	2002	OTB - Actual 2002
	50,433	43,799	91,696	39,544	20,852	5,270	2009	OTB - Actual 2002
SC	50,128	42,944	91,696	39,544	20,852	5,270	2009	OTW - Actual 2002
	55,103	48,314	42,354	29,512	22,467	5,270	2018	OTB - Actual 2002
	36,264	47,403	42,354	29,512	22,467	5,270	2018	OTW - Actual 2002
	155,762	73,431	233,324	95,968	17,829	2,232	2002	OTB - Actual 2002
	106,979	62,435	147,757	85,084	19,148	2,232	2009	OTB - Actual 2002
TN	104,528	61,176	147,757	85,084	19,148	2,232	2009	OTW - Actual 2002
	112,411	69,374	65,242	69,093	20,928	2,232	2018	OTB - Actual 2002
	32,411	67,999	65,242	69,093	20,928	2,232	2018	OTW - Actual 2002
	82,435	64,865	219,602	58,524	51,418	978	2002	OTB - Actual 2002
	64,950	64,298	133,170	50,120	53,344	978	2009	OTB - Actual 2002
VA	62,810	60,027	133,170	50,120	53,344	978	2009	OTW - Actual 2002
	56,716	71,480	61,881	36,970	56,668	978	2018	OTB - Actual 2002
	40,045	66,931	61,881	36,970	56,668	978	2018	OTW - Actual 2002
	230,950	46,710	59,612	34,442	12,687	944	2002	OTB - Actual 2002
	173,977	42,140	36,049	31,148	13,816	944	2009	OTB - Actual 2002
WV	174,572	40,469	36,049	31,148	13,816	944	2009	OTW - Actual 2002
	170,522	46,846	16,274	26,279	15,079	944	2018	OTB - Actual 2002
	42,227	44,944	16,274	26,279	15,079	944	2018	OTW - Actual 2002

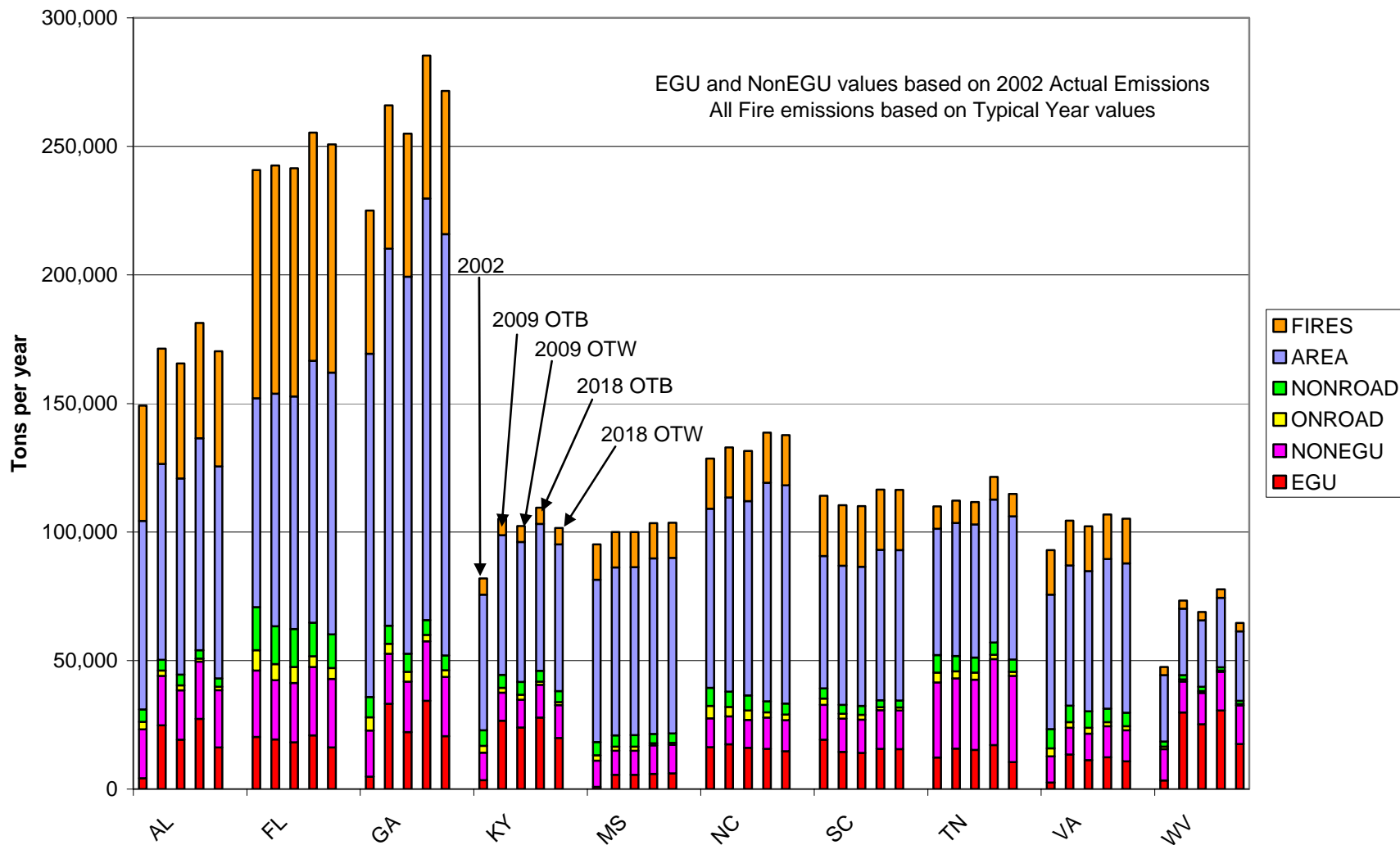
### Annual PM<sub>10</sub> Emissions by Source Sector



Annual PM<sub>10</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	7,834	24,957	3,898	5,331	393,093	50,833	2002	OTB - Actual 2002
	29,053	25,161	3,188	4,597	411,614	50,833	2009	OTB - Actual 2002
AL	23,250	25,161	3,188	4,597	411,614	50,833	2009	OTW - Actual 2002
	31,815	29,278	2,488	3,690	445,168	50,833	2018	OTB - Actual 2002
	20,450	29,278	2,488	3,690	445,168	50,833	2018	OTW - Actual 2002
	26,912	30,331	11,253	17,692	446,821	98,470	2002	OTB - Actual 2002
	25,779	27,531	9,953	15,630	507,515	98,470	2009	OTB - Actual 2002
FL	24,493	27,531	9,953	15,630	507,515	98,470	2009	OTW - Actual 2002
	27,320	31,890	8,489	13,827	582,832	98,470	2018	OTB - Actual 2002
	22,204	31,890	8,489	13,827	582,832	98,470	2018	OTW - Actual 2002
	11,148	22,055	7,236	8,295	695,320	62,336	2002	OTB - Actual 2002
	39,580	23,861	6,103	7,368	776,935	62,336	2009	OTB - Actual 2002
GA	28,118	23,861	6,103	7,368	776,935	62,336	2009	OTW - Actual 2002
	41,221	28,177	4,995	6,068	880,800	62,336	2018	OTB - Actual 2002
	26,905	28,177	4,995	6,068	880,800	62,336	2018	OTW - Actual 2002
	5,711	15,615	3,720	6,389	233,559	6,667	2002	OTB - Actual 2002
	32,406	15,858	3,002	5,312	242,345	6,667	2009	OTB - Actual 2002
KY	29,606	15,858	3,002	5,312	242,345	6,667	2009	OTW - Actual 2002
	33,784	18,587	2,283	4,602	256,544	6,667	2018	OTB - Actual 2002
	25,733	18,587	2,283	4,602	256,544	6,667	2018	OTW - Actual 2002
	1,467	19,622	2,856	5,551	343,377	14,693	2002	OTB - Actual 2002
	5,864	19,439	2,290	4,754	356,516	14,693	2009	OTB - Actual 2002
MS	5,883	19,439	2,290	4,754	356,516	14,693	2009	OTW - Actual 2002
	6,268	23,145	1,688	3,873	375,931	14,693	2018	OTB - Actual 2002
	6,459	23,145	1,688	3,873	375,931	14,693	2018	OTW - Actual 2002
	22,480	14,511	6,905	7,449	303,492	20,488	2002	OTB - Actual 2002
	23,028	14,301	5,861	6,210	317,847	20,488	2009	OTB - Actual 2002
NC	21,459	14,301	5,861	6,210	317,847	20,488	2009	OTW - Actual 2002
	21,417	16,002	4,299	4,474	345,275	20,488	2018	OTB - Actual 2002
	20,258	16,002	4,299	4,474	345,275	20,488	2018	OTW - Actual 2002
	23,423	18,149	3,446	4,211	260,858	26,304	2002	OTB - Actual 2002
	18,023	17,368	2,878	3,593	278,852	26,304	2009	OTB - Actual 2002
SC	17,493	17,368	2,878	3,593	278,852	26,304	2009	OTW - Actual 2002
	19,290	20,272	2,258	2,889	304,940	26,304	2018	OTB - Actual 2002
	19,182	20,272	2,258	2,889	304,940	26,304	2018	OTW - Actual 2002
	14,954	35,983	5,338	7,145	211,903	8,875	2002	OTB - Actual 2002
	17,735	33,838	4,238	6,218	225,650	8,875	2009	OTB - Actual 2002
TN	17,159	33,838	4,238	6,218	225,650	8,875	2009	OTW - Actual 2002
	19,103	41,466	3,199	5,019	245,893	8,875	2018	OTB - Actual 2002
	12,432	41,466	3,199	5,019	245,893	8,875	2018	OTW - Actual 2002
	3,824	13,242	4,537	7,928	237,577	18,160	2002	OTB - Actual 2002
	15,343	13,470	3,760	6,763	252,924	18,160	2009	OTB - Actual 2002
VA	12,804	13,470	3,760	6,763	252,924	18,160	2009	OTW - Actual 2002
	14,390	15,661	3,343	5,564	275,790	18,160	2018	OTB - Actual 2002
	12,653	15,661	3,343	5,564	275,790	18,160	2018	OTW - Actual 2002
	7,188	14,865	1,395	2,072	115,346	3,276	2002	OTB - Actual 2002
	36,442	14,926	1,096	1,819	115,410	3,276	2009	OTB - Actual 2002
WV	31,780	14,926	1,096	1,819	115,410	3,276	2009	OTW - Actual 2002
	37,425	18,433	844	1,381	121,964	3,276	2018	OTB - Actual 2002
	24,253	18,433	844	1,381	121,964	3,276	2018	OTW - Actual 2002

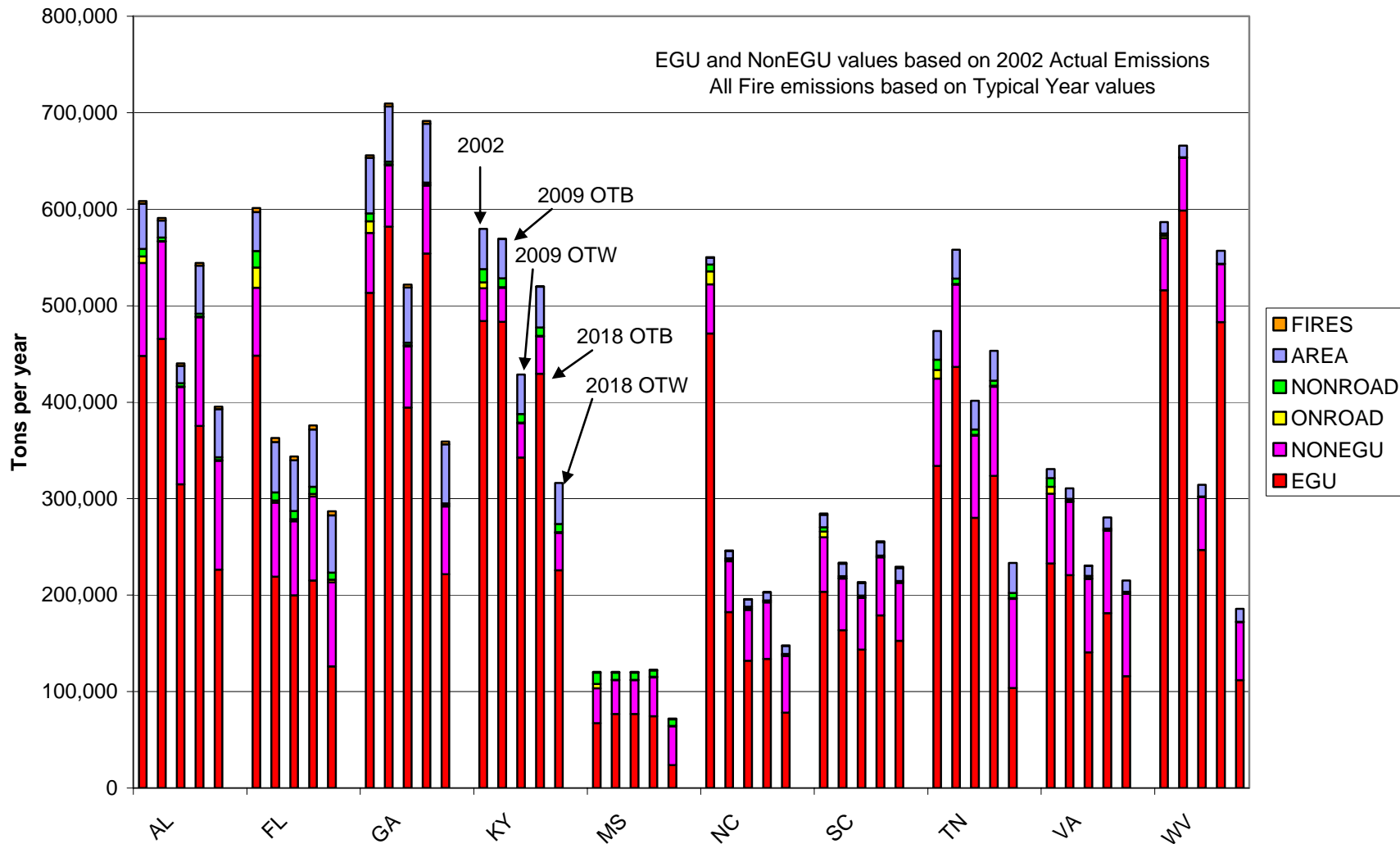
### Annual PM<sub>2.5</sub> Emissions by Source Sector



Annual PM<sub>2.5</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	4,274	19,016	2,794	4,877	73,352	44,812	2002	OTB - Actual 2002
	24,875	19,184	2,049	4,144	76,248	44,812	2009	OTB - Actual 2002
AL	19,190	19,184	2,049	4,144	76,248	44,812	2009	OTW - Actual 2002
	27,280	22,268	1,262	3,231	82,449	44,812	2018	OTB - Actual 2002
	16,279	22,268	1,262	3,231	82,449	44,812	2018	OTW - Actual 2002
	20,305	25,842	7,852	16,739	81,341	88,756	2002	OTB - Actual 2002
	19,307	23,063	6,216	14,786	90,487	88,756	2009	OTB - Actual 2002
FL	18,186	23,063	6,216	14,786	90,487	88,756	2009	OTW - Actual 2002
	20,848	26,622	4,242	13,044	101,872	88,756	2018	OTB - Actual 2002
	16,278	26,622	4,242	13,044	101,872	88,756	2018	OTW - Actual 2002
	4,888	17,890	5,158	7,899	133,542	55,712	2002	OTB - Actual 2002
	33,111	19,562	3,869	7,014	146,691	55,712	2009	OTB - Actual 2002
GA	22,163	19,562	3,869	7,014	146,691	55,712	2009	OTW - Actual 2002
	34,361	23,110	2,517	5,769	163,925	55,712	2018	OTB - Actual 2002
	20,549	23,110	2,517	5,769	163,925	55,712	2018	OTW - Actual 2002
	3,443	10,730	2,693	5,998	52,765	6,310	2002	OTB - Actual 2002
	26,640	10,837	1,941	4,978	54,397	6,310	2009	OTB - Actual 2002
KY	23,915	10,837	1,941	4,978	54,397	6,310	2009	OTW - Actual 2002
	27,857	12,738	1,160	4,289	57,110	6,310	2018	OTB - Actual 2002
	19,915	12,738	1,160	4,289	57,110	6,310	2018	OTW - Actual 2002
	912	10,132	2,109	5,200	63,135	13,680	2002	OTB - Actual 2002
	5,511	9,459	1,522	4,440	65,321	13,680	2009	OTB - Actual 2002
MS	5,530	9,459	1,522	4,440	65,321	13,680	2009	OTW - Actual 2002
	5,919	11,068	876	3,597	68,338	13,680	2018	OTB - Actual 2002
	6,110	11,068	876	3,597	68,338	13,680	2018	OTW - Actual 2002
	16,305	11,207	4,816	7,079	69,663	19,491	2002	OTB - Actual 2002
	17,449	10,888	3,643	5,889	75,570	19,491	2009	OTB - Actual 2002
NC	16,034	10,888	3,643	5,889	75,570	19,491	2009	OTW - Actual 2002
	15,636	12,136	2,158	4,215	85,018	19,491	2018	OTB - Actual 2002
	14,702	12,136	2,158	4,215	85,018	19,491	2018	OTW - Actual 2002
	19,162	13,565	2,496	3,985	51,413	23,511	2002	OTB - Actual 2002
	14,471	12,977	1,870	3,396	54,230	23,511	2009	OTB - Actual 2002
SC	14,079	12,977	1,870	3,396	54,230	23,511	2009	OTW - Actual 2002
	15,601	15,092	1,154	2,718	58,441	23,511	2018	OTB - Actual 2002
	15,509	15,092	1,154	2,718	58,441	23,511	2018	OTW - Actual 2002
	12,311	29,131	3,919	6,756	49,131	8,730	2002	OTB - Actual 2002
	15,770	27,313	2,782	5,873	51,753	8,730	2009	OTB - Actual 2002
TN	15,228	27,313	2,782	5,873	51,753	8,730	2009	OTW - Actual 2002
	17,103	33,502	1,643	4,724	55,712	8,730	2018	OTB - Actual 2002
	10,514	33,502	1,643	4,724	55,712	8,730	2018	OTW - Actual 2002
	2,560	10,211	3,090	7,486	52,271	17,361	2002	OTB - Actual 2002
	13,451	10,368	2,254	6,388	54,587	17,361	2009	OTB - Actual 2002
VA	11,237	10,368	2,254	6,388	54,587	17,361	2009	OTW - Actual 2002
	12,366	12,062	1,641	5,241	58,141	17,361	2018	OTB - Actual 2002
	10,755	12,062	1,641	5,241	58,141	17,361	2018	OTW - Actual 2002
	3,369	12,154	1,003	1,941	25,850	3,239	2002	OTB - Actual 2002
	29,773	12,138	703	1,699	25,835	3,239	2009	OTB - Actual 2002
WV	25,251	12,138	703	1,699	25,835	3,239	2009	OTW - Actual 2002
	30,628	15,045	428	1,284	27,088	3,239	2018	OTB - Actual 2002
	17,548	15,045	428	1,284	27,088	3,239	2018	OTW - Actual 2002

### Annual SO<sub>2</sub> Emissions by Source Sector

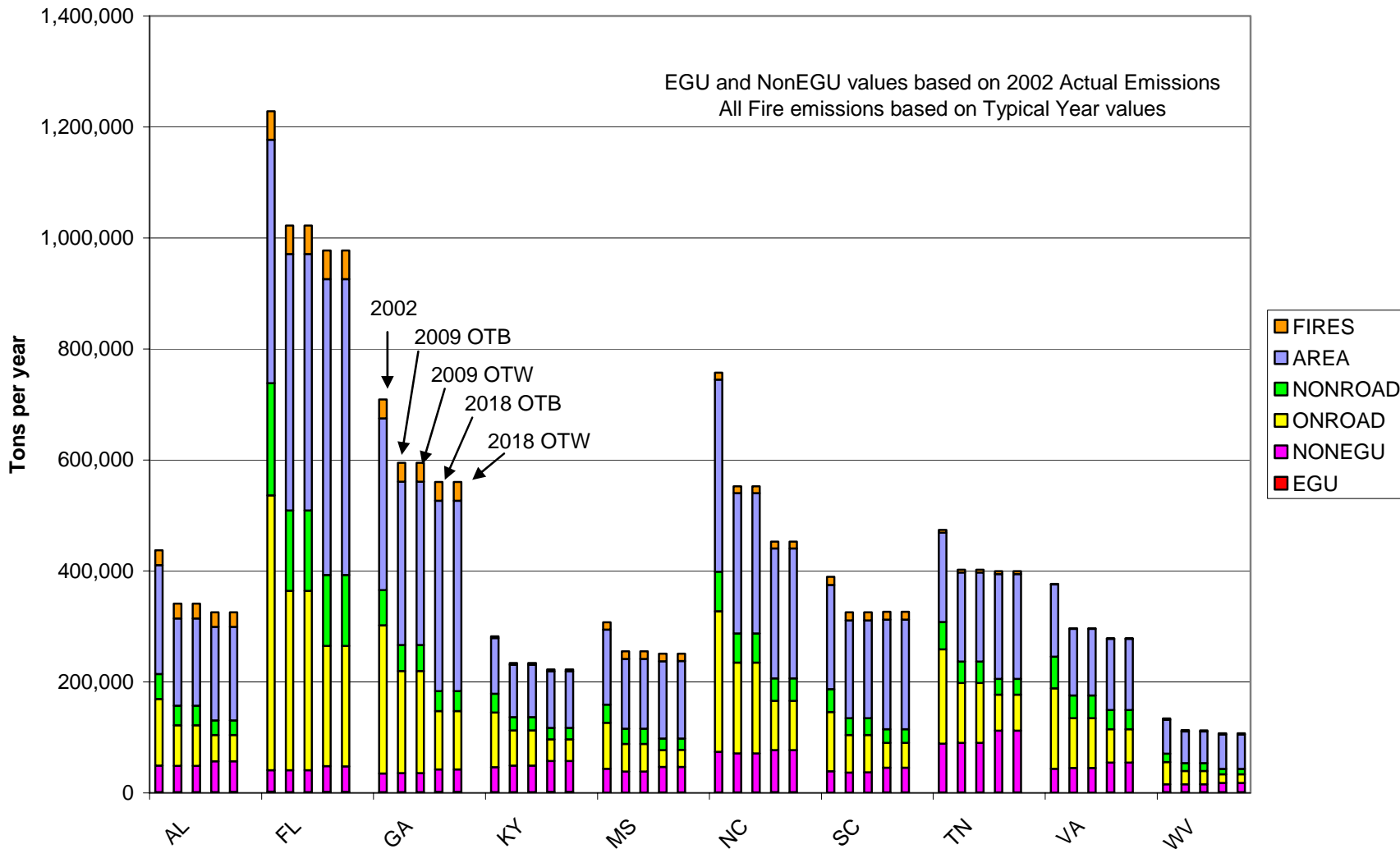


Annual SO<sub>2</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	447,862	96,447	6,885	7,539	47,074	2,559	2002	OTB - Actual 2002
	465,576	100,845	635	3,463	17,818	2,559	2009	OTB - Actual 2002
AL	314,841	100,845	635	3,463	17,818	2,559	2009	OTW - Actual 2002
	375,305	112,771	720	2,815	49,975	2,559	2018	OTB - Actual 2002
	226,506	112,771	720	2,815	49,975	2,559	2018	OTW - Actual 2002
	448,046	70,675	20,872	17,023	40,537	4,129	2002	OTB - Actual 2002
	219,072	76,851	2,120	8,380	52,390	4,129	2009	OTB - Actual 2002
FL	199,834	76,851	2,120	8,380	52,390	4,129	2009	OTW - Actual 2002
	215,177	87,065	2,533	7,511	59,413	4,129	2018	OTB - Actual 2002
	126,280	87,065	2,533	7,511	59,413	4,129	2018	OTW - Actual 2002
	513,266	62,044	12,155	8,145	57,555	2,815	2002	OTB - Actual 2002
	582,078	63,348	1,254	2,588	57,377	2,815	2009	OTB - Actual 2002
GA	394,425	63,348	1,254	2,588	57,377	2,815	2009	OTW - Actual 2002
	554,013	70,386	1,458	1,702	61,155	2,815	2018	OTB - Actual 2002
	221,615	70,386	1,458	1,702	61,155	2,815	2018	OTW - Actual 2002
	484,059	34,027	5,974	13,739	41,805	136	2002	OTB - Actual 2002
	483,235	35,479	585	9,092	40,779	136	2009	OTB - Actual 2002
KY	342,670	35,479	585	9,092	40,779	136	2009	OTW - Actual 2002
	429,418	38,816	651	8,536	42,326	136	2018	OTB - Actual 2002
	225,772	38,816	651	8,536	42,326	136	2018	OTW - Actual 2002
	67,339	36,049	4,604	11,551	771	100	2002	OTB - Actual 2002
	76,855	35,028	397	7,232	637	100	2009	OTB - Actual 2002
MS	76,855	35,028	397	7,232	637	100	2009	OTW - Actual 2002
	74,505	40,318	441	6,638	831	100	2018	OTB - Actual 2002
	23,768	40,318	441	6,638	831	100	2018	OTW - Actual 2002
	471,030	51,082	13,343	7,207	7,096	423	2002	OTB - Actual 2002
	182,356	52,693	1,311	1,798	7,607	423	2009	OTB - Actual 2002
NC	132,054	52,693	1,311	1,798	7,607	423	2009	OTW - Actual 2002
	133,691	58,671	1,323	838	8,273	423	2018	OTB - Actual 2002
	78,205	58,671	1,323	838	8,273	423	2018	OTW - Actual 2002
	203,587	56,329	5,958	4,449	12,900	1,187	2002	OTB - Actual 2002
	163,560	53,746	556	1,633	12,945	1,187	2009	OTB - Actual 2002
SC	143,492	53,746	556	1,633	12,945	1,187	2009	OTW - Actual 2002
	178,938	60,300	643	1,195	13,517	1,187	2018	OTB - Actual 2002
	152,457	60,300	643	1,195	13,517	1,187	2018	OTW - Actual 2002
	333,934	90,375	9,184	10,413	29,897	59	2002	OTB - Actual 2002
	436,453	85,275	831	5,649	29,787	59	2009	OTB - Actual 2002
TN	279,931	85,275	831	5,649	29,787	59	2009	OTW - Actual 2002
	323,654	92,396	944	5,205	31,047	59	2018	OTB - Actual 2002
	103,602	92,396	944	5,205	31,047	59	2018	OTW - Actual 2002
	232,747	72,360	7,218	8,796	9,510	99	2002	OTB - Actual 2002
	220,686	76,081	900	2,248	10,619	99	2009	OTB - Actual 2002
VA	140,665	76,081	900	2,248	10,619	99	2009	OTW - Actual 2002
	181,338	85,351	1,059	1,217	11,479	99	2018	OTB - Actual 2002
	115,987	85,351	1,059	1,217	11,479	99	2018	OTW - Actual 2002
	516,109	54,044	2,489	2,305	11,667	16	2002	OTB - Actual 2002
	598,555	54,701	227	392	12,156	16	2009	OTB - Actual 2002
WV	246,851	54,701	227	392	12,156	16	2009	OTW - Actual 2002
	482,959	60,141	255	56	13,450	16	2018	OTB - Actual 2002
	111,937	60,141	255	56	13,450	16	2018	OTW - Actual 2002



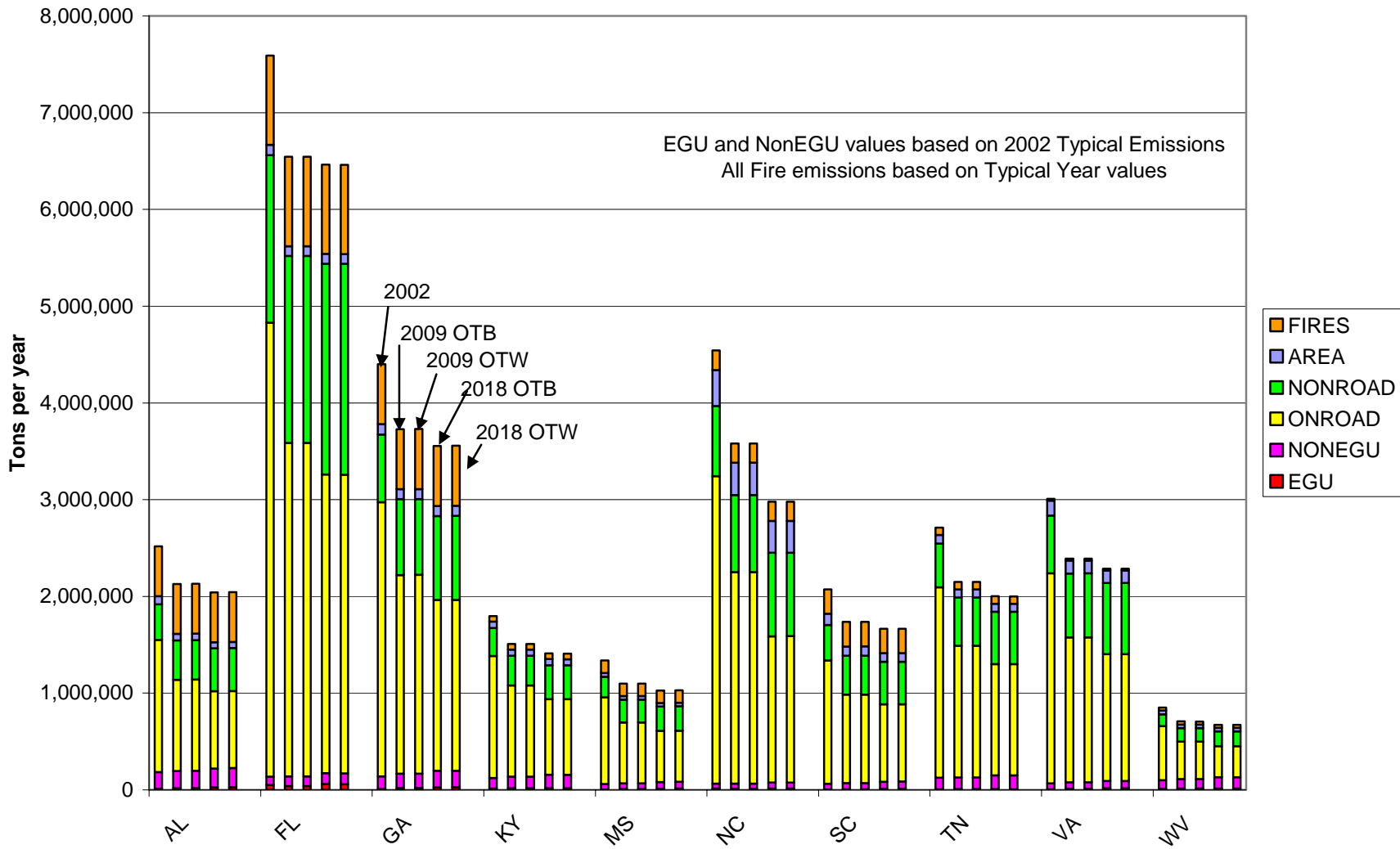
### Annual VOC Emissions by Source Sector



## Annual VOC Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	1,438	47,893	119,790	44,978	196,538	26,526	2002	OTB - Actual 2002
	1,261	47,600	72,848	35,498	157,405	26,526	2009	OTB - Actual 2002
AL	1,312	47,600	72,848	35,498	157,405	26,526	2009	OTW - Actual 2002
	1,574	55,373	47,296	26,338	168,507	26,526	2018	OTB - Actual 2002
	1,612	55,373	47,296	26,338	168,507	26,526	2018	OTW - Actual 2002
	2,295	38,700	495,225	201,960	439,019	51,527	2002	OTB - Actual 2002
	1,562	39,255	323,290	144,749	462,198	51,527	2009	OTB - Actual 2002
FL	1,559	39,255	323,290	144,749	462,198	51,527	2009	OTW - Actual 2002
	2,052	46,049	216,620	128,131	533,141	51,527	2018	OTB - Actual 2002
	1,988	46,049	216,620	128,131	533,141	51,527	2018	OTW - Actual 2002
	1,178	33,736	267,378	63,337	309,411	33,918	2002	OTB - Actual 2002
	1,497	34,153	184,239	46,722	294,204	33,918	2009	OTB - Actual 2002
GA	1,499	34,153	184,239	46,722	294,204	33,918	2009	OTW - Actual 2002
	1,794	40,354	105,507	36,014	342,661	33,918	2018	OTB - Actual 2002
	1,790	40,354	105,507	36,014	342,661	33,918	2018	OTW - Actual 2002
	1,464	44,856	98,311	34,156	100,174	3,338	2002	OTB - Actual 2002
	1,594	47,733	63,258	23,980	94,253	3,338	2009	OTB - Actual 2002
KY	1,580	47,733	63,258	23,980	94,253	3,338	2009	OTW - Actual 2002
	1,635	55,729	39,084	20,795	102,117	3,338	2018	OTB - Actual 2002
	1,616	55,729	39,084	20,795	102,117	3,338	2018	OTW - Actual 2002
	473	43,379	82,810	32,401	135,106	13,625	2002	OTB - Actual 2002
	584	38,119	49,670	27,650	125,382	13,625	2009	OTB - Actual 2002
MS	590	38,119	49,670	27,650	125,382	13,625	2009	OTW - Actual 2002
	766	45,966	30,734	20,576	139,419	13,625	2018	OTB - Actual 2002
	827	45,966	30,734	20,576	139,419	13,625	2018	OTW - Actual 2002
	1,042	72,945	253,374	71,378	346,060	12,499	2002	OTB - Actual 2002
	1,100	70,146	163,803	52,430	252,553	12,499	2009	OTB - Actual 2002
NC	1,093	70,146	163,803	52,430	252,553	12,499	2009	OTW - Actual 2002
	1,183	75,985	88,620	40,576	234,207	12,499	2018	OTB - Actual 2002
	1,172	75,985	88,620	40,576	234,207	12,499	2018	OTW - Actual 2002
	434	38,493	106,792	41,374	187,466	14,666	2002	OTB - Actual 2002
	601	36,410	67,281	30,531	176,104	14,666	2009	OTB - Actual 2002
SC	626	36,410	67,281	30,531	176,104	14,666	2009	OTW - Actual 2002
	745	44,586	44,700	24,989	196,946	14,666	2018	OTB - Actual 2002
	754	44,586	44,700	24,989	196,946	14,666	2018	OTW - Actual 2002
	833	88,059	169,914	49,056	161,069	5,153	2002	OTB - Actual 2002
	866	89,128	108,200	38,686	160,265	5,153	2009	OTB - Actual 2002
TN	854	89,128	108,200	38,686	160,265	5,153	2009	OTW - Actual 2002
	899	111,372	64,665	28,667	188,977	5,153	2018	OTB - Actual 2002
	826	111,372	64,665	28,667	188,977	5,153	2018	OTW - Actual 2002
	679	43,227	144,684	57,050	129,792	912	2002	OTB - Actual 2002
	546	44,359	89,678	40,897	120,022	912	2009	OTB - Actual 2002
VA	503	44,359	89,678	40,897	120,022	912	2009	OTW - Actual 2002
	694	53,968	60,454	34,412	128,160	912	2018	OTB - Actual 2002
	674	53,968	60,454	34,412	128,160	912	2018	OTW - Actual 2002
	1,176	14,599	40,066	14,805	61,490	2,184	2002	OTB - Actual 2002
	1,442	14,015	23,907	14,249	57,082	2,184	2009	OTB - Actual 2002
WV	1,397	14,015	23,907	14,249	57,082	2,184	2009	OTW - Actual 2002
	1,471	16,636	15,463	9,500	62,164	2,184	2018	OTB - Actual 2002
	1,456	16,636	15,463	9,500	62,164	2,184	2018	OTW - Actual 2002

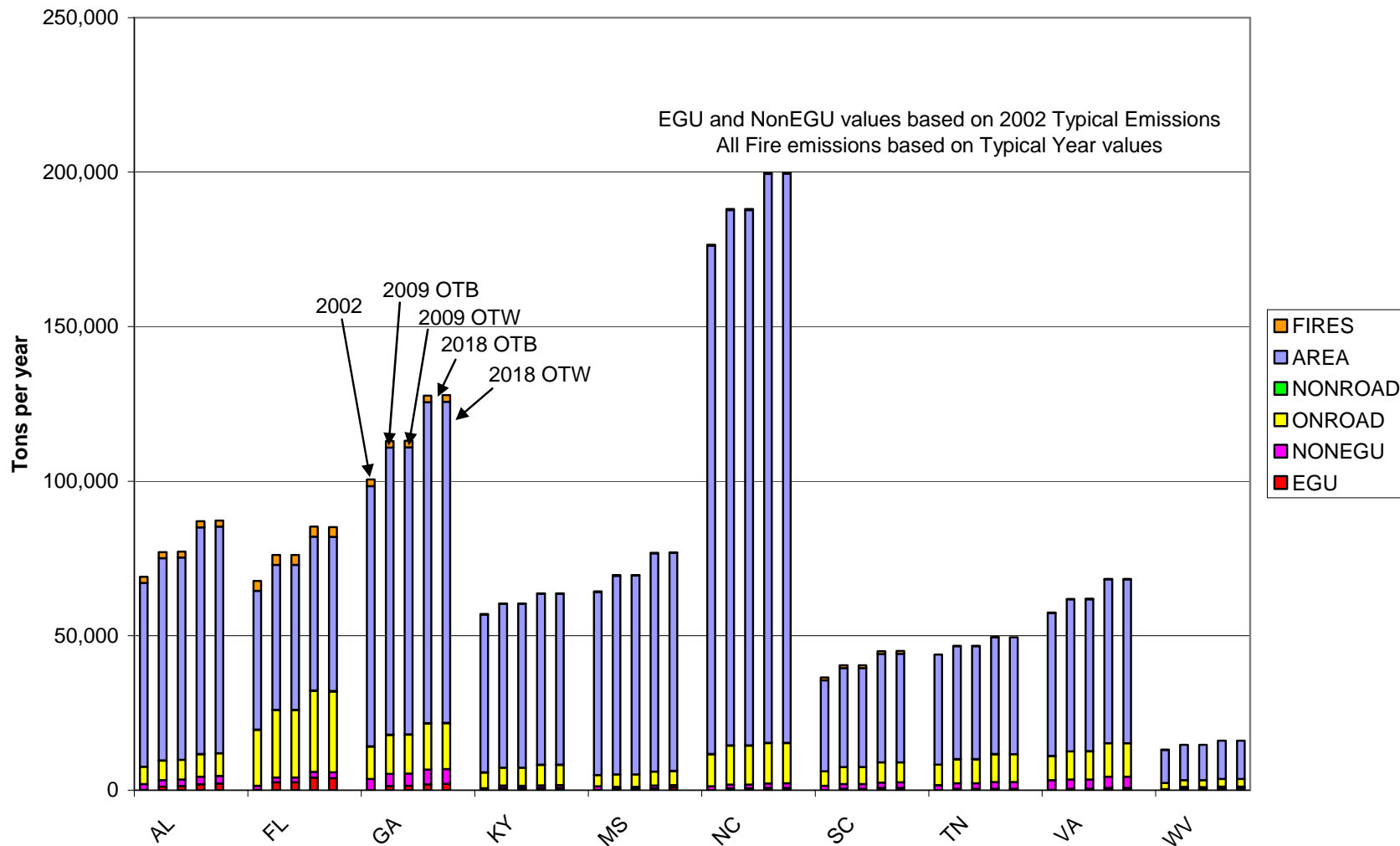
### Annual CO Emissions by Source Sector



## Annual CO Emissions by Source Sector

Name	AREA	EGU	FIRES	NONEGU	NONROAD	ONROAD	YEAR	Basis
	83,958	10,812	514,120	174,306	367,038	1,366,056	2002	OTB - Typical 2002
	68,882	16,494	514,120	177,145	408,424	942,793	2009	OTB - Typical 2002
AL	68,882	19,205	514,120	177,145	408,424	942,793	2009	OTW - Typical 2002
	63,773	26,600	514,120	194,801	443,100	797,966	2018	OTB - Typical 2002
	63,773	29,893	514,120	194,801	443,100	797,966	2018	OTW - Typical 2002
	105,849	51,165	923,310	84,920	1,731,519	4,693,893	2002	OTB - Typical 2002
	101,356	40,642	923,310	98,325	1,934,550	3,446,095	2009	OTB - Typical 2002
FL	101,356	40,641	923,310	98,325	1,934,550	3,446,095	2009	OTW - Typical 2002
	100,952	59,793	923,310	113,923	2,179,296	3,086,330	2018	OTB - Typical 2002
	100,952	57,759	923,310	113,923	2,179,296	3,086,330	2018	OTW - Typical 2002
	107,889	8,098	620,342	131,417	700,427	2,833,468	2002	OTB - Typical 2002
	103,579	19,170	620,342	147,835	783,990	2,053,694	2009	OTB - Typical 2002
GA	103,579	20,024	620,342	147,835	783,990	2,053,694	2009	OTW - Typical 2002
	105,059	27,152	620,342	169,156	868,018	1,765,020	2018	OTB - Typical 2002
	105,059	28,895	620,342	169,156	868,018	1,765,020	2018	OTW - Typical 2002
	66,752	12,888	56,686	110,141	289,967	1,260,682	2002	OTB - Typical 2002
	64,806	15,273	56,686	121,981	306,884	942,350	2009	OTB - Typical 2002
KY	64,806	15,119	56,686	121,981	306,884	942,350	2009	OTW - Typical 2002
	65,297	16,974	56,686	139,395	349,285	782,423	2018	OTB - Typical 2002
	65,297	14,954	56,686	139,395	349,285	782,423	2018	OTW - Typical 2002
	37,905	3,831	128,471	57,711	213,779	894,639	2002	OTB - Typical 2002
	37,161	6,714	128,471	60,709	237,297	628,151	2009	OTB - Typical 2002
MS	37,161	6,954	128,471	60,709	237,297	628,151	2009	OTW - Typical 2002
	36,425	10,553	128,471	70,454	252,658	528,898	2018	OTB - Typical 2002
	36,425	12,928	128,471	70,454	252,658	528,898	2018	OTW - Typical 2002
	373,585	12,027	200,564	52,542	725,734	3,176,811	2002	OTB - Typical 2002
	332,443	11,091	200,564	54,791	797,360	2,184,901	2009	OTB - Typical 2002
NC	332,443	11,170	200,564	54,791	797,360	2,184,901	2009	OTW - Typical 2002
	327,871	13,482	200,564	63,699	863,536	1,510,848	2018	OTB - Typical 2002
	327,871	13,777	200,564	63,699	863,536	1,510,848	2018	OTW - Typical 2002
	113,714	3,675	253,005	59,605	367,575	1,275,161	2002	OTB - Typical 2002
	95,826	6,316	253,005	65,612	402,871	912,280	2009	OTB - Typical 2002
SC	95,826	6,526	253,005	65,612	402,871	912,280	2009	OTW - Typical 2002
	89,343	10,175	253,005	75,209	438,027	800,619	2018	OTB - Typical 2002
	89,343	10,671	253,005	75,209	438,027	800,619	2018	OTW - Typical 2002
	89,235	6,339	78,370	119,405	451,480	1,967,658	2002	OTB - Typical 2002
	82,196	6,750	78,370	121,420	500,186	1,361,408	2009	OTB - Typical 2002
TN	82,196	6,651	78,370	121,420	500,186	1,361,408	2009	OTW - Typical 2002
	81,242	7,074	78,370	143,845	540,143	1,150,516	2018	OTB - Typical 2002
	81,242	6,509	78,370	143,845	540,143	1,150,516	2018	OTW - Typical 2002
	155,873	5,958	19,159	62,534	595,311	2,170,508	2002	OTB - Typical 2002
	133,738	9,811	19,159	69,822	661,295	1,495,771	2009	OTB - Typical 2002
VA	133,738	10,245	19,159	69,822	661,295	1,495,771	2009	OTW - Typical 2002
	129,037	14,788	19,159	77,590	734,294	1,310,698	2018	OTB - Typical 2002
	129,037	14,839	19,159	77,590	734,294	1,310,698	2018	OTW - Typical 2002
	39,546	9,927	32,656	89,928	119,089	560,717	2002	OTB - Typical 2002
	37,704	12,622	32,656	100,292	138,999	385,994	2009	OTB - Typical 2002
WV	37,704	12,328	32,656	100,292	138,999	385,994	2009	OTW - Typical 2002
	36,809	13,064	32,656	119,367	152,932	319,030	2018	OTB - Typical 2002
	36,809	12,992	32,656	119,367	152,932	319,030	2018	OTW - Typical 2002

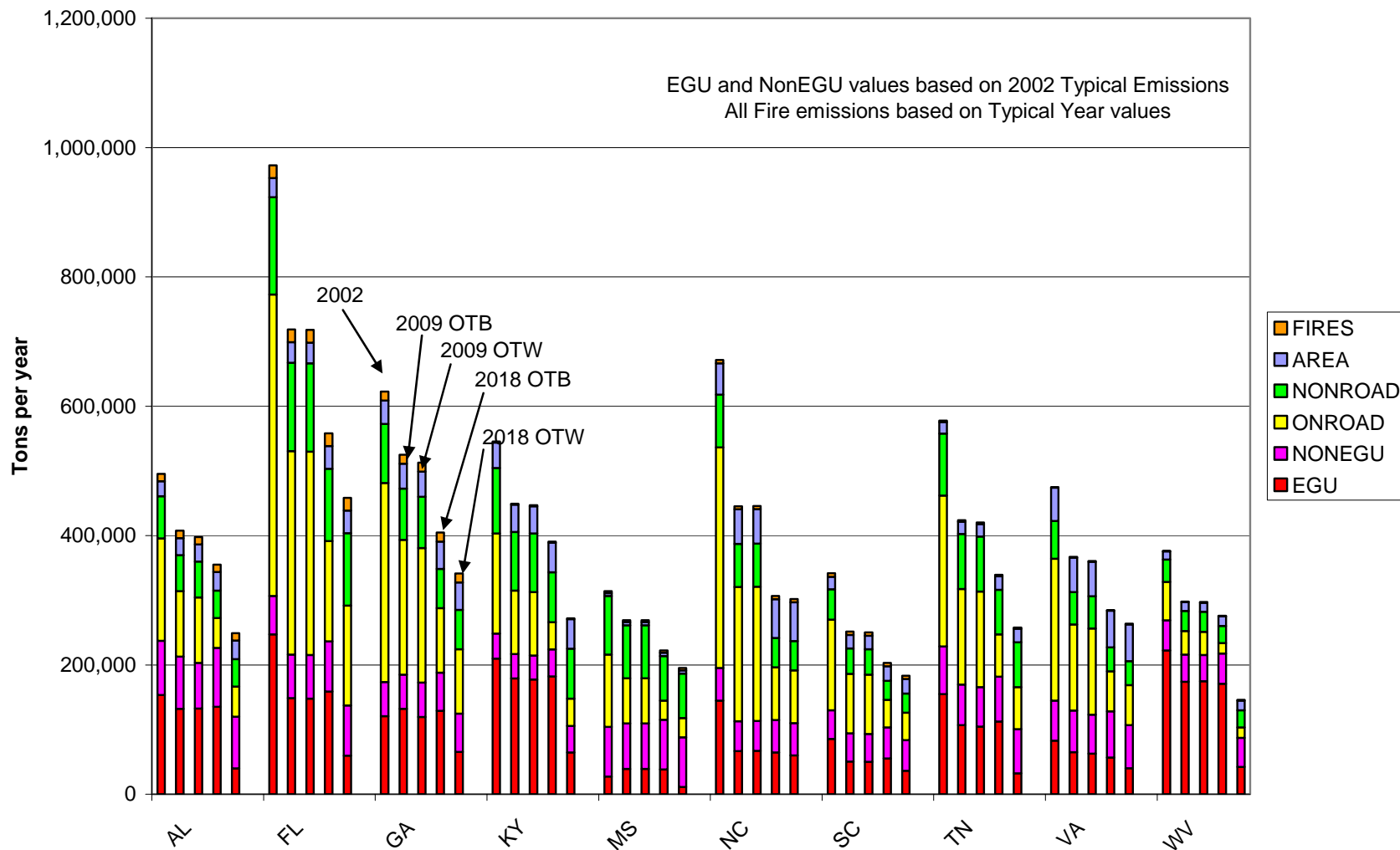
### Annual NH<sub>3</sub> Emissions by Source Sector



Annual NH<sub>3</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	89	1,883	5,576	32	59,486	1,957	2002	OTB - Typical 2002
	1,128	2,112	6,350	35	65,441	1,957	2009	OTB - Typical 2002
AL	1,344	2,112	6,350	35	65,441	1,957	2009	OTW - Typical 2002
	1,909	2,456	7,296	40	73,346	1,957	2018	OTB - Typical 2002
	2,173	2,456	7,296	40	73,346	1,957	2018	OTW - Typical 2002
	53	1,383	18,078	108	44,902	3,157	2002	OTB - Typical 2002
	2,524	1,605	21,737	119	46,950	3,157	2009	OTB - Typical 2002
FL	2,524	1,605	21,737	119	46,950	3,157	2009	OTW - Typical 2002
	4,022	1,905	26,154	138	49,889	3,157	2018	OTB - Typical 2002
	3,865	1,905	26,154	138	49,889	3,157	2018	OTW - Typical 2002
	5	3,613	10,524	54	84,230	2,153	2002	OTB - Typical 2002
	1,305	3,963	12,660	60	92,838	2,153	2009	OTB - Typical 2002
GA	1,376	3,963	12,660	60	92,838	2,153	2009	OTW - Typical 2002
	1,912	4,799	14,871	71	103,911	2,153	2018	OTB - Typical 2002
	2,057	4,799	14,871	71	103,911	2,153	2018	OTW - Typical 2002
	0	674	5,044	28	51,097	110	2002	OTB - Typical 2002
	717	733	5,795	30	53,023	110	2009	OTB - Typical 2002
KY	710	733	5,795	30	53,023	110	2009	OTW - Typical 2002
	763	839	6,584	36	55,356	110	2018	OTB - Typical 2002
	771	839	6,584	36	55,356	110	2018	OTW - Typical 2002
	97	1,169	3,577	23	59,262	177	2002	OTB - Typical 2002
	388	667	4,026	26	64,289	177	2009	OTB - Typical 2002
MS	407	667	4,026	26	64,289	177	2009	OTW - Typical 2002
	686	761	4,565	30	70,565	177	2018	OTB - Typical 2002
	872	761	4,565	30	70,565	177	2018	OTW - Typical 2002
	35	1,171	10,455	61	164,467	324	2002	OTB - Typical 2002
	577	1,255	12,637	68	173,187	324	2009	OTB - Typical 2002
NC	574	1,255	12,637	68	173,187	324	2009	OTW - Typical 2002
	740	1,412	13,077	79	184,167	324	2018	OTB - Typical 2002
	781	1,412	13,077	79	184,167	324	2018	OTW - Typical 2002
	0	1,411	4,684	29	29,447	908	2002	OTB - Typical 2002
	409	1,578	5,510	32	31,966	908	2009	OTB - Typical 2002
SC	422	1,578	5,510	32	31,966	908	2009	OTW - Typical 2002
	702	1,779	6,472	37	35,082	908	2018	OTB - Typical 2002
	742	1,779	6,472	37	35,082	908	2018	OTW - Typical 2002
	0	1,620	6,616	41	35,571	46	2002	OTB - Typical 2002
	406	1,861	7,738	45	36,578	46	2009	OTB - Typical 2002
TN	400	1,861	7,738	45	36,578	46	2009	OTW - Typical 2002
	427	2,240	8,962	53	37,812	46	2018	OTB - Typical 2002
	394	2,240	8,962	53	37,812	46	2018	OTW - Typical 2002
	122	3,097	7,837	44	46,221	159	2002	OTB - Typical 2002
	396	3,057	9,066	48	49,173	159	2009	OTB - Typical 2002
VA	439	3,057	9,066	48	49,173	159	2009	OTW - Typical 2002
	759	3,620	10,757	57	53,023	159	2018	OTB - Typical 2002
	783	3,620	10,757	57	53,023	159	2018	OTW - Typical 2002
	12	331	1,933	10	10,779	12	2002	OTB - Typical 2002
	691	342	2,183	11	11,461	12	2009	OTB - Typical 2002
WV	673	342	2,183	11	11,461	12	2009	OTW - Typical 2002
	722	416	2,484	13	12,390	12	2018	OTB - Typical 2002
	719	416	2,484	13	12,390	12	2018	OTW - Typical 2002

### Annual NOx Emissions by Source Sector

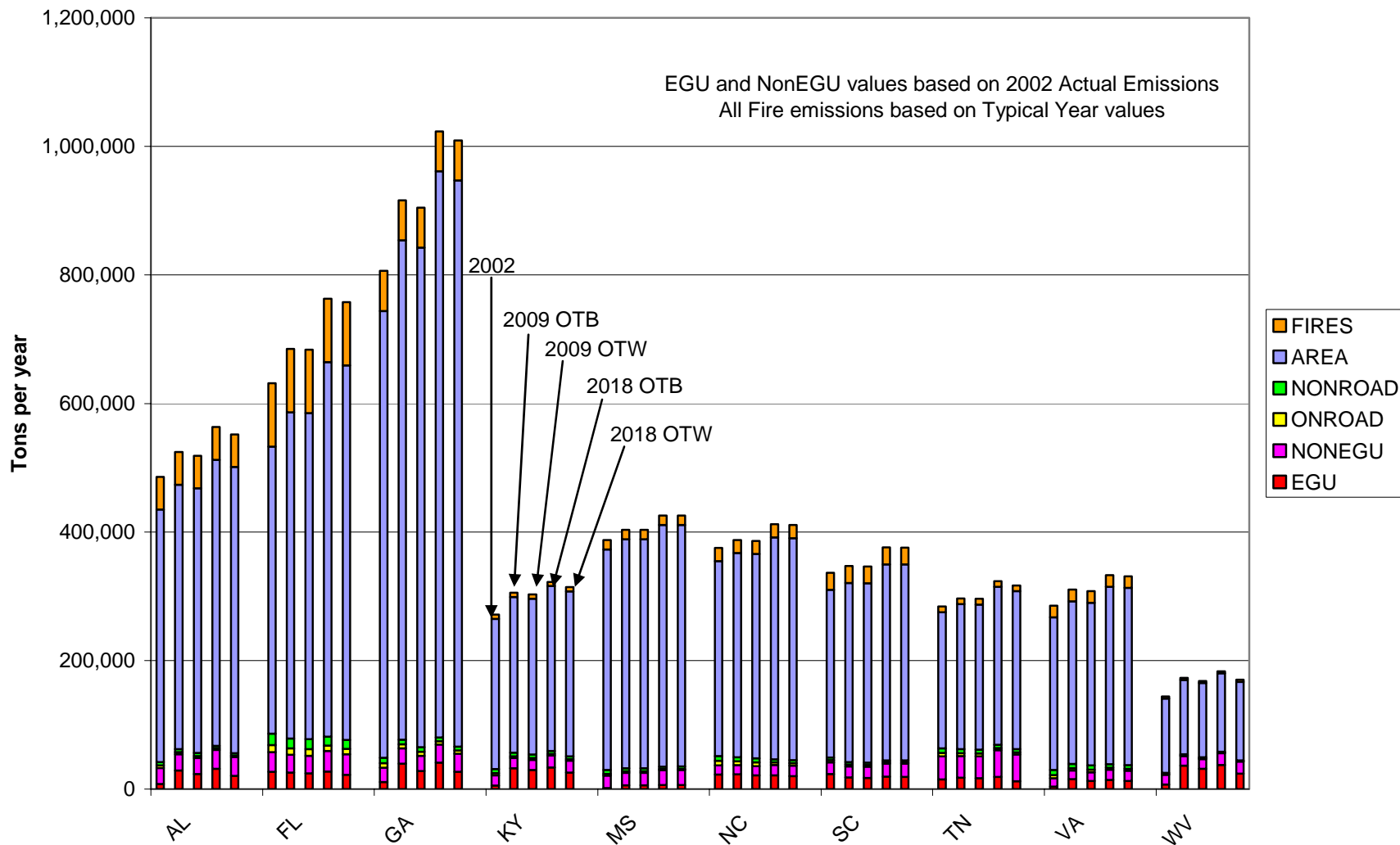


Annual NO<sub>x</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	153,349	83,868	158,423	64,891	23,444	11,456	2002	OTB - Typical 2002
	131,988	80,738	101,323	55,494	26,482	11,456	2009	OTB - Typical 2002
AL	132,323	70,644	101,323	55,494	26,482	11,456	2009	OTW - Typical 2002
	135,010	91,052	46,222	42,573	28,754	11,456	2018	OTB - Typical 2002
	39,942	80,031	46,222	42,573	28,754	11,456	2018	OTW - Typical 2002
	247,099	59,517	466,098	150,519	29,477	19,791	2002	OTB - Typical 2002
	148,522	67,533	314,307	136,851	31,821	19,791	2009	OTB - Typical 2002
FL	147,801	67,533	314,307	136,851	31,821	19,791	2009	OTW - Typical 2002
	159,004	77,551	154,611	111,959	35,047	19,791	2018	OTB - Typical 2002
	59,446	77,551	154,611	111,959	35,047	19,791	2018	OTW - Typical 2002
	120,785	52,425	308,013	91,386	36,105	13,882	2002	OTB - Typical 2002
	131,901	53,008	208,393	79,049	38,876	13,882	2009	OTB - Typical 2002
GA	119,425	53,008	208,393	79,049	38,876	13,882	2009	OTW - Typical 2002
	128,938	59,005	99,821	60,650	42,260	13,882	2018	OTB - Typical 2002
	65,559	59,005	99,821	60,650	42,260	13,882	2018	OTW - Typical 2002
	209,802	38,460	154,899	101,261	39,507	1,460	2002	OTB - Typical 2002
	178,930	37,960	97,912	90,803	42,122	1,460	2009	OTB - Typical 2002
KY	177,272	37,201	97,912	90,803	42,122	1,460	2009	OTW - Typical 2002
	182,192	41,776	42,104	77,295	45,597	1,460	2018	OTB - Typical 2002
	64,674	40,948	42,104	77,295	45,597	1,460	2018	OTW - Typical 2002
	27,254	76,906	111,791	90,686	4,200	3,328	2002	OTB - Typical 2002
	38,911	70,463	69,949	81,780	4,789	3,328	2009	OTB - Typical 2002
MS	38,978	70,463	69,949	81,780	4,789	3,328	2009	OTW - Typical 2002
	38,355	76,738	29,717	68,781	5,230	3,328	2018	OTB - Typical 2002
	11,206	76,738	29,717	68,781	5,230	3,328	2018	OTW - Typical 2002
	144,730	50,393	341,198	81,448	48,730	5,005	2002	OTB - Typical 2002
	66,598	46,242	207,648	66,382	53,550	5,005	2009	OTB - Typical 2002
NC	67,051	46,242	207,648	66,382	53,550	5,005	2009	OTW - Typical 2002
	64,537	50,044	81,706	45,146	60,073	5,005	2018	OTB - Typical 2002
	59,917	50,044	81,706	45,146	60,073	5,005	2018	OTW - Typical 2002
	85,555	44,123	140,428	46,789	19,332	5,270	2002	OTB - Typical 2002
	50,433	43,799	91,696	39,544	20,852	5,270	2009	OTB - Typical 2002
SC	50,128	42,944	91,696	39,544	20,852	5,270	2009	OTW - Typical 2002
	55,103	48,314	42,354	29,512	22,467	5,270	2018	OTB - Typical 2002
	36,264	47,403	42,354	29,512	22,467	5,270	2018	OTW - Typical 2002
	155,028	73,384	233,324	95,968	17,829	2,232	2002	OTB - Typical 2002
	106,979	62,435	147,757	85,084	19,148	2,232	2009	OTB - Typical 2002
TN	104,528	61,176	147,757	85,084	19,148	2,232	2009	OTW - Typical 2002
	112,411	69,374	65,242	69,093	20,928	2,232	2018	OTB - Typical 2002
	32,411	67,999	65,242	69,093	20,928	2,232	2018	OTW - Typical 2002
	82,911	61,528	219,602	58,524	51,418	978	2002	OTB - Typical 2002
	64,950	64,298	133,170	50,120	53,344	978	2009	OTB - Typical 2002
VA	62,810	60,027	133,170	50,120	53,344	978	2009	OTW - Typical 2002
	56,716	71,480	61,881	36,970	56,668	978	2018	OTB - Typical 2002
	40,045	66,931	61,881	36,970	56,668	978	2018	OTW - Typical 2002
	222,090	46,715	59,612	34,442	12,687	944	2002	OTB - Typical 2002
	173,977	42,140	36,049	31,148	13,816	944	2009	OTB - Typical 2002
WV	174,572	40,469	36,049	31,148	13,816	944	2009	OTW - Typical 2002
	170,522	46,846	16,274	26,279	15,079	944	2018	OTB - Typical 2002
	42,227	44,944	16,274	26,279	15,079	944	2018	OTW - Typical 2002



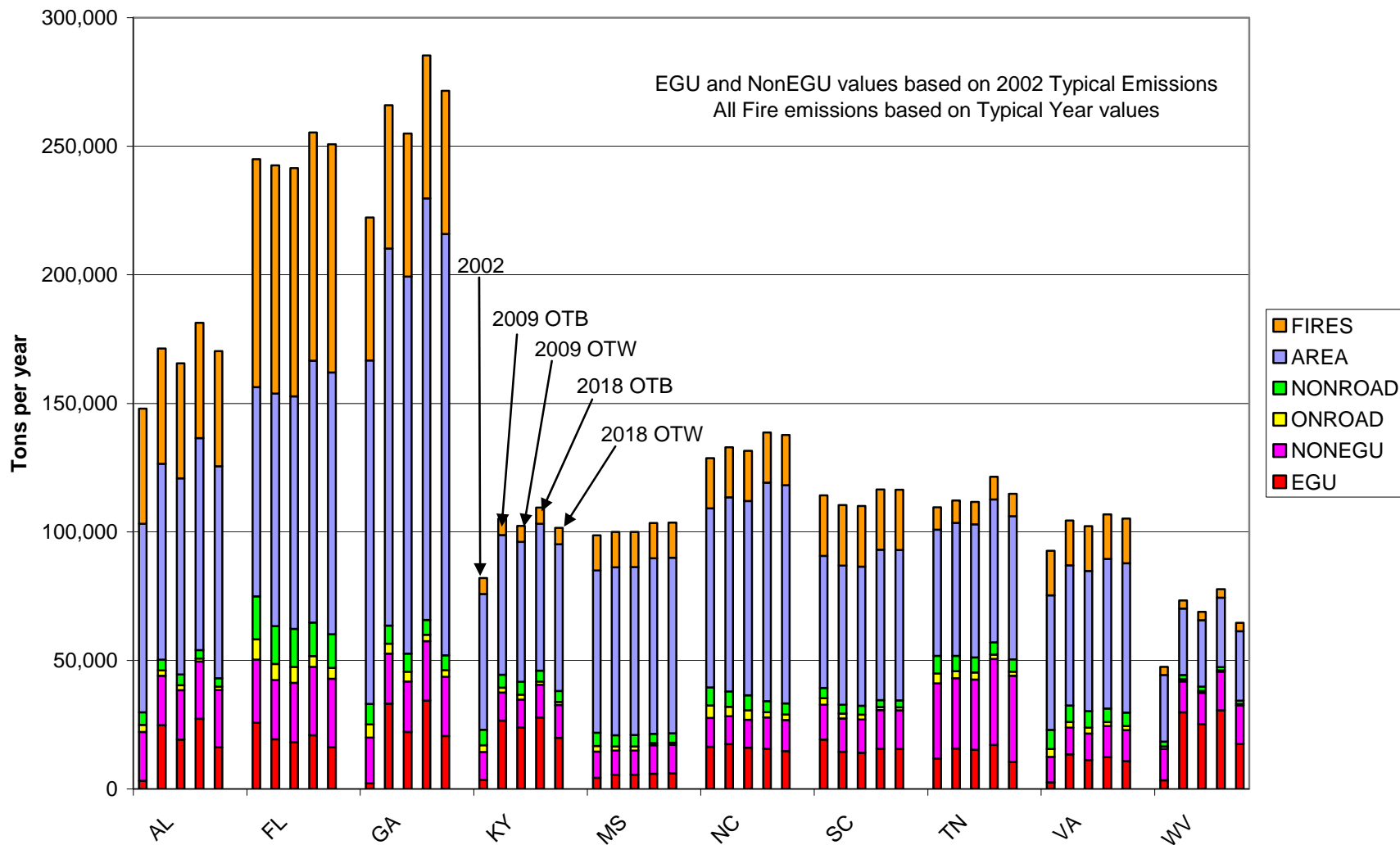
### Annual PM<sub>10</sub> Emissions by Source Sector



Annual PM<sub>10</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	5,737	24,957	3,898	5,331	393,093	50,833	2002	OTB - Typical 2002
	29,053	25,161	3,188	4,597	411,614	50,833	2009	OTB - Typical 2002
AL	23,250	25,161	3,188	4,597	411,614	50,833	2009	OTW - Typical 2002
	31,815	29,278	2,488	3,690	445,168	50,833	2018	OTB - Typical 2002
	20,450	29,278	2,488	3,690	445,168	50,833	2018	OTW - Typical 2002
	33,182	28,882	11,253	17,692	446,821	98,470	2002	OTB - Typical 2002
	25,779	27,531	9,953	15,630	507,515	98,470	2009	OTB - Typical 2002
FL	24,493	27,531	9,953	15,630	507,515	98,470	2009	OTW - Typical 2002
	27,320	31,890	8,489	13,827	582,832	98,470	2018	OTB - Typical 2002
	22,204	31,890	8,489	13,827	582,832	98,470	2018	OTW - Typical 2002
	5,447	22,058	7,236	8,295	695,320	62,336	2002	OTB - Typical 2002
	39,580	23,861	6,103	7,368	776,935	62,336	2009	OTB - Typical 2002
GA	28,118	23,861	6,103	7,368	776,935	62,336	2009	OTW - Typical 2002
	41,221	28,177	4,995	6,068	880,800	62,336	2018	OTB - Typical 2002
	26,905	28,177	4,995	6,068	880,800	62,336	2018	OTW - Typical 2002
	6,000	15,613	3,720	6,389	233,559	6,667	2002	OTB - Typical 2002
	32,406	15,858	3,002	5,312	242,345	6,667	2009	OTB - Typical 2002
KY	29,606	15,858	3,002	5,312	242,345	6,667	2009	OTW - Typical 2002
	33,784	18,587	2,283	4,602	256,544	6,667	2018	OTB - Typical 2002
	25,733	18,587	2,283	4,602	256,544	6,667	2018	OTW - Typical 2002
	4,783	19,680	2,856	5,551	343,377	14,693	2002	OTB - Typical 2002
	5,864	19,439	2,290	4,754	356,516	14,693	2009	OTB - Typical 2002
MS	5,883	19,439	2,290	4,754	356,516	14,693	2009	OTW - Typical 2002
	6,268	23,145	1,688	3,873	375,931	14,693	2018	OTB - Typical 2002
	6,459	23,145	1,688	3,873	375,931	14,693	2018	OTW - Typical 2002
	22,689	14,507	6,905	7,449	303,492	20,488	2002	OTB - Typical 2002
	23,028	14,301	5,861	6,210	317,847	20,488	2009	OTB - Typical 2002
NC	21,459	14,301	5,861	6,210	317,847	20,488	2009	OTW - Typical 2002
	21,417	16,002	4,299	4,474	345,275	20,488	2018	OTB - Typical 2002
	20,258	16,002	4,299	4,474	345,275	20,488	2018	OTW - Typical 2002
	23,492	18,149	3,446	4,211	260,858	26,304	2002	OTB - Typical 2002
	18,023	17,368	2,878	3,593	278,852	26,304	2009	OTB - Typical 2002
SC	17,493	17,368	2,878	3,593	278,852	26,304	2009	OTW - Typical 2002
	19,290	20,272	2,258	2,889	304,940	26,304	2018	OTB - Typical 2002
	19,182	20,272	2,258	2,889	304,940	26,304	2018	OTW - Typical 2002
	14,537	35,982	5,338	7,145	211,903	8,875	2002	OTB - Typical 2002
	17,735	33,838	4,238	6,218	225,650	8,875	2009	OTB - Typical 2002
TN	17,159	33,838	4,238	6,218	225,650	8,875	2009	OTW - Typical 2002
	19,103	41,466	3,199	5,019	245,893	8,875	2018	OTB - Typical 2002
	12,432	41,466	3,199	5,019	245,893	8,875	2018	OTW - Typical 2002
	3,790	12,799	4,537	7,928	237,577	18,160	2002	OTB - Typical 2002
	15,343	13,470	3,760	6,763	252,924	18,160	2009	OTB - Typical 2002
VA	12,804	13,470	3,760	6,763	252,924	18,160	2009	OTW - Typical 2002
	14,390	15,661	3,343	5,564	275,790	18,160	2018	OTB - Typical 2002
	12,653	15,661	3,343	5,564	275,790	18,160	2018	OTW - Typical 2002
	7,145	14,866	1,395	2,072	115,346	3,276	2002	OTB - Typical 2002
	36,442	14,926	1,096	1,819	115,410	3,276	2009	OTB - Typical 2002
WV	31,780	14,926	1,096	1,819	115,410	3,276	2009	OTW - Typical 2002
	37,425	18,433	844	1,381	121,964	3,276	2018	OTB - Typical 2002
	24,253	18,433	844	1,381	121,964	3,276	2018	OTW - Typical 2002

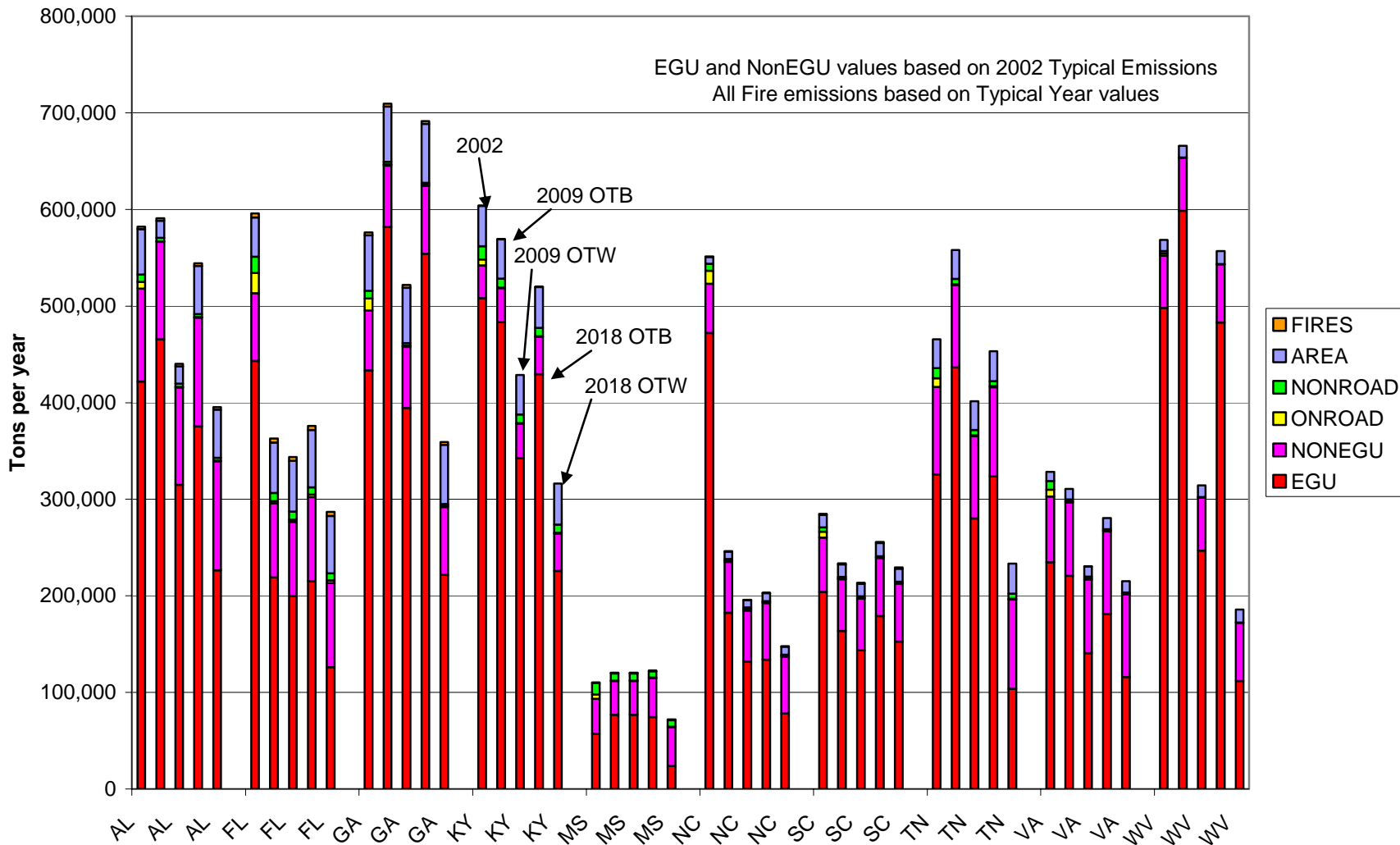
### Annual PM<sub>2.5</sub> Emissions by Source Sector



Annual PM<sub>2.5</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
	3,131	19,016	2,794	4,877	73,352	44,812	2002	OTB - Typical 2002
	24,875	19,184	2,049	4,144	76,248	44,812	2009	OTB - Typical 2002
AL	19,190	19,184	2,049	4,144	76,248	44,812	2009	OTW - Typical 2002
	27,280	22,268	1,262	3,231	82,449	44,812	2018	OTB - Typical 2002
	16,279	22,268	1,262	3,231	82,449	44,812	2018	OTW - Typical 2002
	25,761	24,569	7,852	16,739	81,341	88,756	2002	OTB - Typical 2002
	19,307	23,063	6,216	14,786	90,487	88,756	2009	OTB - Typical 2002
FL	18,186	23,063	6,216	14,786	90,487	88,756	2009	OTW - Typical 2002
	20,848	26,622	4,242	13,044	101,872	88,756	2018	OTB - Typical 2002
	16,278	26,622	4,242	13,044	101,872	88,756	2018	OTW - Typical 2002
	2,137	17,893	5,158	7,899	133,542	55,712	2002	OTB - Typical 2002
	33,111	19,562	3,869	7,014	146,691	55,712	2009	OTB - Typical 2002
GA	22,163	19,562	3,869	7,014	146,691	55,712	2009	OTW - Typical 2002
	34,361	23,110	2,517	5,769	163,925	55,712	2018	OTB - Typical 2002
	20,549	23,110	2,517	5,769	163,925	55,712	2018	OTW - Typical 2002
	3,605	10,729	2,693	5,998	52,765	6,310	2002	OTB - Typical 2002
	26,640	10,837	1,941	4,978	54,397	6,310	2009	OTB - Typical 2002
KY	23,915	10,837	1,941	4,978	54,397	6,310	2009	OTW - Typical 2002
	27,857	12,738	1,160	4,289	57,110	6,310	2018	OTB - Typical 2002
	19,915	12,738	1,160	4,289	57,110	6,310	2018	OTW - Typical 2002
	4,384	10,187	2,109	5,200	63,135	13,680	2002	OTB - Typical 2002
	5,511	9,459	1,522	4,440	65,321	13,680	2009	OTB - Typical 2002
MS	5,530	9,459	1,522	4,440	65,321	13,680	2009	OTW - Typical 2002
	5,919	11,068	876	3,597	68,338	13,680	2018	OTB - Typical 2002
	6,110	11,068	876	3,597	68,338	13,680	2018	OTW - Typical 2002
	16,428	11,204	4,816	7,079	69,663	19,491	2002	OTB - Typical 2002
	17,449	10,888	3,643	5,889	75,570	19,491	2009	OTB - Typical 2002
NC	16,034	10,888	3,643	5,889	75,570	19,491	2009	OTW - Typical 2002
	15,636	12,136	2,158	4,215	85,018	19,491	2018	OTB - Typical 2002
	14,702	12,136	2,158	4,215	85,018	19,491	2018	OTW - Typical 2002
	19,238	13,565	2,496	3,985	51,413	23,511	2002	OTB - Typical 2002
	14,471	12,977	1,870	3,396	54,230	23,511	2009	OTB - Typical 2002
SC	14,079	12,977	1,870	3,396	54,230	23,511	2009	OTW - Typical 2002
	15,601	15,092	1,154	2,718	58,441	23,511	2018	OTB - Typical 2002
	15,509	15,092	1,154	2,718	58,441	23,511	2018	OTW - Typical 2002
	11,918	29,130	3,919	6,756	49,131	8,730	2002	OTB - Typical 2002
	15,770	27,313	2,782	5,873	51,753	8,730	2009	OTB - Typical 2002
TN	15,228	27,313	2,782	5,873	51,753	8,730	2009	OTW - Typical 2002
	17,103	33,502	1,643	4,724	55,712	8,730	2018	OTB - Typical 2002
	10,514	33,502	1,643	4,724	55,712	8,730	2018	OTW - Typical 2002
	2,559	9,868	3,090	7,486	52,271	17,361	2002	OTB - Typical 2002
	13,451	10,368	2,254	6,388	54,587	17,361	2009	OTB - Typical 2002
VA	11,237	10,368	2,254	6,388	54,587	17,361	2009	OTW - Typical 2002
	12,366	12,062	1,641	5,241	58,141	17,361	2018	OTB - Typical 2002
	10,755	12,062	1,641	5,241	58,141	17,361	2018	OTW - Typical 2002
	3,356	12,154	1,003	1,941	25,850	3,239	2002	OTB - Typical 2002
	29,773	12,138	703	1,699	25,835	3,239	2009	OTB - Typical 2002
WV	25,251	12,138	703	1,699	25,835	3,239	2009	OTW - Typical 2002
	30,628	15,045	428	1,284	27,088	3,239	2018	OTB - Typical 2002
	17,548	15,045	428	1,284	27,088	3,239	2018	OTW - Typical 2002

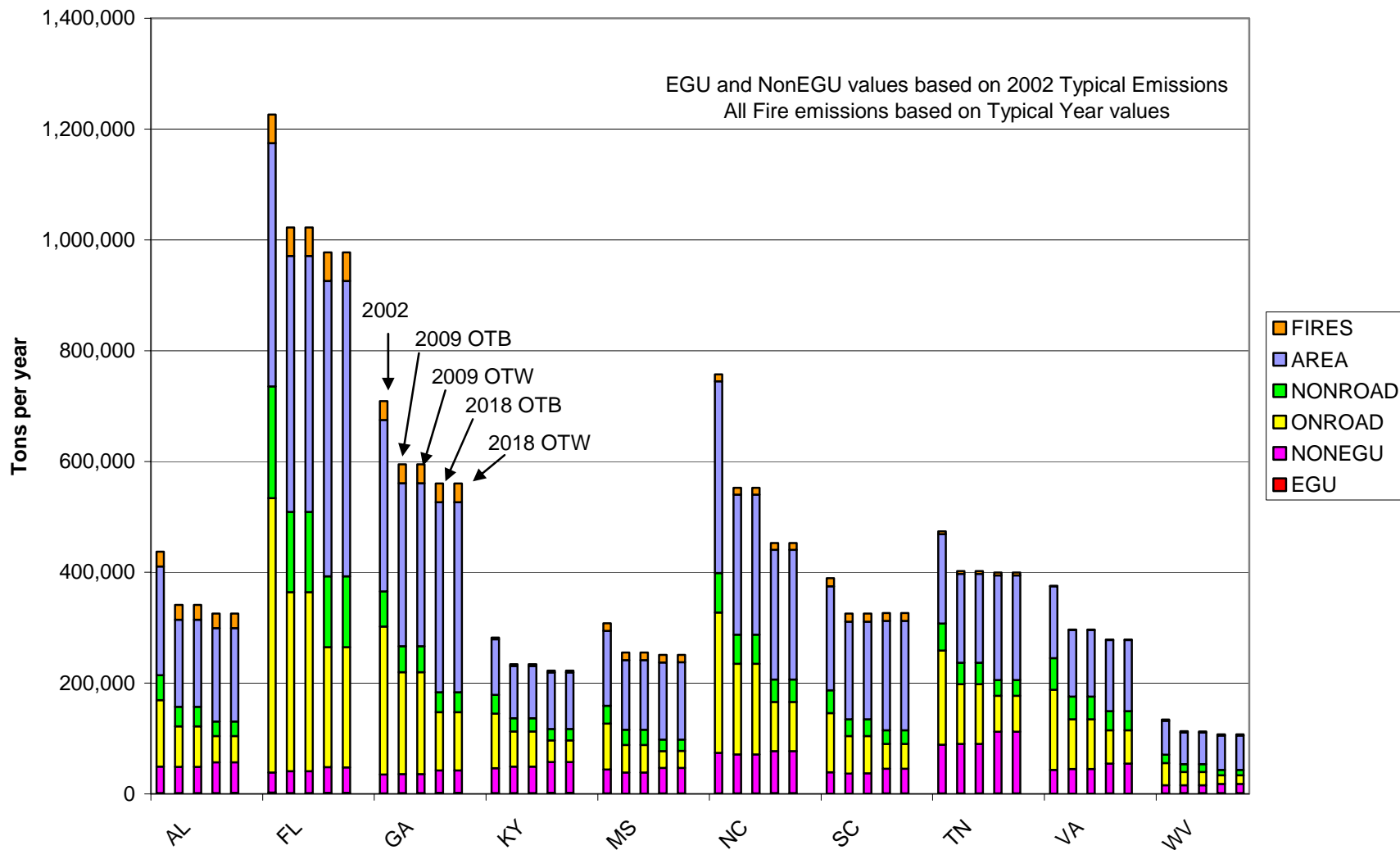
### Annual SO<sub>2</sub> Emissions by Source Sector



Annual SO<sub>2</sub> Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
AL	421,734	96,447	6,885	7,539	47,074	2,559	2002	OTB - Typical 2002
AL	465,576	100,845	635	3,463	17,818	2,559	2009	OTB - Typical 2002
AL	314,841	100,845	635	3,463	17,818	2,559	2009	OTW - Typical 2002
AL	375,305	112,771	720	2,815	49,975	2,559	2018	OTB - Typical 2002
AL	226,506	112,771	720	2,815	49,975	2,559	2018	OTW - Typical 2002
FL	443,152	70,165	20,872	17,023	40,537	4,129	2002	OTB - Typical 2002
FL	219,072	76,851	2,120	8,380	52,390	4,129	2009	OTB - Typical 2002
FL	199,834	76,851	2,120	8,380	52,390	4,129	2009	OTW - Typical 2002
FL	215,177	87,065	2,533	7,511	59,413	4,129	2018	OTB - Typical 2002
FL	126,280	87,065	2,533	7,511	59,413	4,129	2018	OTW - Typical 2002
GA	433,513	62,032	12,155	8,145	57,555	2,815	2002	OTB - Typical 2002
GA	582,078	63,348	1,254	2,588	57,377	2,815	2009	OTB - Typical 2002
GA	394,425	63,348	1,254	2,588	57,377	2,815	2009	OTW - Typical 2002
GA	554,013	70,386	1,458	1,702	61,155	2,815	2018	OTB - Typical 2002
GA	221,615	70,386	1,458	1,702	61,155	2,815	2018	OTW - Typical 2002
KY	508,139	34,026	5,974	13,739	41,805	136	2002	OTB - Typical 2002
KY	483,235	35,479	585	9,092	40,779	136	2009	OTB - Typical 2002
KY	342,670	35,479	585	9,092	40,779	136	2009	OTW - Typical 2002
KY	429,418	38,816	651	8,536	42,326	136	2018	OTB - Typical 2002
KY	225,772	38,816	651	8,536	42,326	136	2018	OTW - Typical 2002
MS	57,263	36,071	4,604	11,551	771	100	2002	OTB - Typical 2002
MS	76,855	35,028	397	7,232	637	100	2009	OTB - Typical 2002
MS	76,855	35,028	397	7,232	637	100	2009	OTW - Typical 2002
MS	74,505	40,318	441	6,638	831	100	2018	OTB - Typical 2002
MS	23,768	40,318	441	6,638	831	100	2018	OTW - Typical 2002
NC	472,192	51,049	13,343	7,207	7,096	423	2002	OTB - Typical 2002
NC	182,356	52,693	1,311	1,798	7,607	423	2009	OTB - Typical 2002
NC	132,054	52,693	1,311	1,798	7,607	423	2009	OTW - Typical 2002
NC	133,691	58,671	1,323	838	8,273	423	2018	OTB - Typical 2002
NC	78,205	58,671	1,323	838	8,273	423	2018	OTW - Typical 2002
SC	203,978	56,329	5,958	4,449	12,900	1,187	2002	OTB - Typical 2002
SC	163,560	53,746	556	1,633	12,945	1,187	2009	OTB - Typical 2002
SC	143,492	53,746	556	1,633	12,945	1,187	2009	OTW - Typical 2002
SC	178,938	60,300	643	1,195	13,517	1,187	2018	OTB - Typical 2002
SC	152,457	60,300	643	1,195	13,517	1,187	2018	OTW - Typical 2002
TN	325,779	90,374	9,184	10,413	29,897	59	2002	OTB - Typical 2002
TN	436,453	85,275	831	5,649	29,787	59	2009	OTB - Typical 2002
TN	279,931	85,275	831	5,649	29,787	59	2009	OTW - Typical 2002
TN	323,654	92,396	944	5,205	31,047	59	2018	OTB - Typical 2002
TN	103,602	92,396	944	5,205	31,047	59	2018	OTW - Typical 2002
VA	234,714	68,038	7,218	8,796	9,510	99	2002	OTB - Typical 2002
VA	220,686	76,081	900	2,248	10,619	99	2009	OTB - Typical 2002
VA	140,665	76,081	900	2,248	10,619	99	2009	OTW - Typical 2002
VA	181,338	85,351	1,059	1,217	11,479	99	2018	OTB - Typical 2002
VA	115,987	85,351	1,059	1,217	11,479	99	2018	OTW - Typical 2002
WV	497,991	54,045	2,489	2,305	11,667	16	2002	OTB - Typical 2002
WV	598,555	54,701	227	392	12,156	16	2009	OTB - Typical 2002
WV	246,851	54,701	227	392	12,156	16	2009	OTW - Typical 2002
WV	482,959	60,141	255	56	13,450	16	2018	OTB - Typical 2002
WV	111,937	60,141	255	56	13,450	16	2018	OTW - Typical 2002

### Annual VOC Emissions by Source Sector



## Annual VOC Emissions by Source Sector

Name	EGU	NONEGU	ONROAD	NONROAD	AREA	FIRES	YEAR	Basis
AL	1,501	47,893	119,790	44,978	196,538	26,526	2002	OTB - Typical 2002
	1,261	47,600	72,848	35,498	157,405	26,526	2009	OTB - Typical 2002
	1,312	47,600	72,848	35,498	157,405	26,526	2009	OTW - Typical 2002
	1,574	55,373	47,296	26,338	168,507	26,526	2018	OTB - Typical 2002
	1,612	55,373	47,296	26,338	168,507	26,526	2018	OTW - Typical 2002
FL	2,362	36,301	495,225	201,960	439,019	51,527	2002	OTB - Typical 2002
	1,562	39,255	323,290	144,749	462,198	51,527	2009	OTB - Typical 2002
	1,559	39,255	323,290	144,749	462,198	51,527	2009	OTW - Typical 2002
	2,052	46,049	216,620	128,131	533,141	51,527	2018	OTB - Typical 2002
	1,988	46,049	216,620	128,131	533,141	51,527	2018	OTW - Typical 2002
GA	984	33,753	267,378	63,337	309,411	33,918	2002	OTB - Typical 2002
	1,497	34,153	184,239	46,722	294,204	33,918	2009	OTB - Typical 2002
	1,499	34,153	184,239	46,722	294,204	33,918	2009	OTW - Typical 2002
	1,794	40,354	105,507	36,014	342,661	33,918	2018	OTB - Typical 2002
	1,790	40,354	105,507	36,014	342,661	33,918	2018	OTW - Typical 2002
KY	1,518	44,854	98,311	34,156	100,174	3,338	2002	OTB - Typical 2002
	1,594	47,733	63,258	23,980	94,253	3,338	2009	OTB - Typical 2002
	1,580	47,733	63,258	23,980	94,253	3,338	2009	OTW - Typical 2002
	1,635	55,729	39,084	20,795	102,117	3,338	2018	OTB - Typical 2002
	1,616	55,729	39,084	20,795	102,117	3,338	2018	OTW - Typical 2002
MS	696	43,401	82,810	32,401	135,106	13,625	2002	OTB - Typical 2002
	584	38,119	49,670	27,650	125,382	13,625	2009	OTB - Typical 2002
	590	38,119	49,670	27,650	125,382	13,625	2009	OTW - Typical 2002
	766	45,966	30,734	20,576	139,419	13,625	2018	OTB - Typical 2002
	827	45,966	30,734	20,576	139,419	13,625	2018	OTW - Typical 2002
NC	1,043	72,856	253,374	71,378	346,060	12,499	2002	OTB - Typical 2002
	1,100	70,146	163,803	52,430	252,553	12,499	2009	OTB - Typical 2002
	1,093	70,146	163,803	52,430	252,553	12,499	2009	OTW - Typical 2002
	1,183	75,985	88,620	40,576	234,207	12,499	2018	OTB - Typical 2002
	1,172	75,985	88,620	40,576	234,207	12,499	2018	OTW - Typical 2002
SC	438	38,493	106,792	41,374	187,466	14,666	2002	OTB - Typical 2002
	601	36,410	67,281	30,531	176,104	14,666	2009	OTB - Typical 2002
	626	36,410	67,281	30,531	176,104	14,666	2009	OTW - Typical 2002
	745	44,586	44,700	24,989	196,946	14,666	2018	OTB - Typical 2002
	754	44,586	44,700	24,989	196,946	14,666	2018	OTW - Typical 2002
TN	819	87,975	169,914	49,056	161,069	5,153	2002	OTB - Typical 2002
	866	89,128	108,200	38,686	160,265	5,153	2009	OTB - Typical 2002
	854	89,128	108,200	38,686	160,265	5,153	2009	OTW - Typical 2002
	899	111,372	64,665	28,667	188,977	5,153	2018	OTB - Typical 2002
	826	111,372	64,665	28,667	188,977	5,153	2018	OTW - Typical 2002
VA	672	42,589	144,684	57,050	129,792	912	2002	OTB - Typical 2002
	546	44,359	89,678	40,897	120,022	912	2009	OTB - Typical 2002
	503	44,359	89,678	40,897	120,022	912	2009	OTW - Typical 2002
	694	53,968	60,454	34,412	128,160	912	2018	OTB - Typical 2002
	674	53,968	60,454	34,412	128,160	912	2018	OTW - Typical 2002
WV	1,128	14,599	40,066	14,805	61,490	2,184	2002	OTB - Typical 2002
	1,442	14,015	23,907	14,249	57,082	2,184	2009	OTB - Typical 2002
	1,397	14,015	23,907	14,249	57,082	2,184	2009	OTW - Typical 2002
	1,471	16,636	15,463	9,500	62,164	2,184	2018	OTB - Typical 2002
	1,456	16,636	15,463	9,500	62,164	2,184	2018	OTW - Typical 2002



**Appendix B: State VMT Totals****Million Miles Per Year**

<b>2002</b>	<b>LDGV</b>	<b>LDGT1</b>	<b>LDGT2</b>	<b>HDDV</b>	<b>LDDV</b>	<b>LDDT</b>	<b>HDDV</b>	<b>MC</b>	<b>TOTAL</b>
AL	31,982	12,728	4,347	1,630	63	69	4,709	196	55,723
FL	105,340	40,835	13,945	5,079	206	220	12,465	591	178,681
GA	61,660	24,394	8,331	3,103	121	132	8,673	371	106,785
KY	28,751	12,189	3,366	1,606	55	55	4,827	171	51,020
MS	23,933	6,724	439	1,025	330	125	3,610	92	36,278
NC	51,189	30,339	10,787	4,119	230	230	9,440	461	106,795
SC	26,672	10,750	3,671	1,395	52	58	4,306	171	47,074
TN	30,809	20,272	6,922	2,943	52	111	6,810	397	68,316
VA	36,336	24,784	8,667	2,148	61	139	4,969	369	77,472
WV	9,010	5,931	2,028	732	25	37	1,664	117	19,544
<b>2009</b>	<b>LDGV</b>	<b>LDGT1</b>	<b>LDGT2</b>	<b>HDDV</b>	<b>LDDV</b>	<b>LDDT</b>	<b>HDDV</b>	<b>MC</b>	<b>TOTAL</b>
AL	30,638	18,598	5,511	2,069	65	72	5,976	249	63,178
FL	107,641	62,449	18,697	6,820	215	230	16,743	794	213,590
GA	61,569	36,641	10,933	4,077	126	137	11,374	487	125,343
KY	28,006	16,984	4,428	1,983	58	57	5,983	231	57,729
MS	23,641	10,131	573	1,341	356	135	4,719	120	41,017
NC	48,495	43,484	15,122	4,576	40	224	10,928	527	123,396
SC	26,451	16,119	4,796	1,824	55	61	5,617	223	55,147
TN	28,775	28,650	8,521	3,627	52	111	8,391	490	78,615
VA	33,663	34,814	10,597	2,624	61	137	6,073	451	88,419
WV	8,128	8,205	2,427	878	25	37	1,995	140	21,835
<b>2018</b>	<b>LDGV</b>	<b>LDGT1</b>	<b>LDGT2</b>	<b>HDDV</b>	<b>LDDV</b>	<b>LDDT</b>	<b>HDDV</b>	<b>MC</b>	<b>TOTAL</b>
AL	31,706	23,562	6,990	2,634	67	84	7,607	317	72,966
FL	116,576	83,385	24,996	9,156	221	301	22,491	1,066	258,191
GA	65,214	47,687	14,245	5,332	129	171	14,853	637	148,269
KY	29,353	21,058	5,558	2,463	60	66	7,454	288	66,300
MS	24,787	12,984	736	1,727	372	159	6,076	155	46,996
NC	42,247	51,568	18,260	4,985	279	279	11,396	553	129,566
SC	27,930	20,880	6,220	2,375	57	75	7,306	290	65,133
TN	29,253	35,702	10,629	4,538	52	130	10,500	613	91,417
VA	35,030	44,438	13,543	3,358	62	164	7,770	578	104,944
WV	8,130	10,025	2,969	1,078	25	41	2,451	172	24,891

## Appendix C: State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH <sub>3</sub>	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
AL	2002	01	FUEL COMB. ELEC. UTIL.	11,212	90	161,055	7,572	4,081	447,814	2,260
AL	2002	02	FUEL COMB. INDUSTRIAL	67,198	234	51,518	6,472	3,600	35,754	2,274
AL	2002	03	FUEL COMB. OTHER	70,498	169	19,237	6,411	5,527	39,605	56,120
AL	2002	04	CHEMICAL & ALLIED PRODUCT MFG	5,721	35	2,032	1,220	888	12,770	9,430
AL	2002	05	METALS PROCESSING	38,246	376	6,011	8,019	7,214	14,039	3,299
AL	2002	06	PETROLEUM & RELATED	13,606	0	878	194	155	22,991	4,024
AL	2002	07	OTHER INDUSTRIAL PROCESSES	47,676	1,468	25,252	22,544	9,471	17,904	25,304
AL	2002	08	SOLVENT UTILIZATION	216	0	226	149	126	3	116,945
AL	2002	09	STORAGE & TRANSPORT	174	0	230	1,086	636	13	19,720
AL	2002	10	WASTE DISPOSAL & RECYCLING	86,302	10	3,465	13,960	13,073	489	11,334
AL	2002	11	HIGHWAY VEHICLES	1,366,056	5,576	158,423	3,898	2,794	6,885	119,790
AL	2002	12	OFF-HIGHWAY	367,038	32	64,891	5,170	4,852	7,539	44,978
AL	2002	14	MISCELLANEOUS	442,778	61,032	9,343	409,252	96,706	2,559	21,686
	<b>2002 Total</b>			2,516,722	69,023	502,563	485,946	149,124	608,366	437,164
AL	2009	01	FUEL COMB. ELEC. UTIL.	18,761	1,267	133,210	23,315	19,214	314,899	2,326
AL	2009	02	FUEL COMB. INDUSTRIAL	65,503	331	36,986	5,748	3,241	35,173	2,104
AL	2009	03	FUEL COMB. OTHER	54,427	82	21,707	5,107	4,836	10,651	32,373
AL	2009	04	CHEMICAL & ALLIED PRODUCT MFG	5,930	38	2,265	1,137	842	13,655	9,346
AL	2009	05	METALS PROCESSING	39,082	500	6,056	8,041	7,225	16,643	3,322
AL	2009	06	PETROLEUM & RELATED	13,238	0	858	219	175	22,492	3,353
AL	2009	07	OTHER INDUSTRIAL PROCESSES	52,004	1,571	26,340	24,043	10,157	19,383	26,519
AL	2009	08	SOLVENT UTILIZATION	247	0	257	164	139	4	105,208
AL	2009	09	STORAGE & TRANSPORT	192	0	253	995	532	14	15,408
AL	2009	10	WASTE DISPOSAL & RECYCLING	87,224	11	3,631	14,502	13,483	588	11,203
AL	2009	11	HIGHWAY VEHICLES	942,793	6,350	101,323	3,188	2,049	635	72,848
AL	2009	12	OFF-HIGHWAY	408,424	35	55,494	4,393	4,113	3,463	35,498
AL	2009	14	MISCELLANEOUS	442,746	67,055	9,342	427,791	99,621	2,559	21,680
	<b>2009 Total</b>			2,130,569	77,239	397,721	518,644	165,626	440,161	341,188
AL	2018	01	FUEL COMB. ELEC. UTIL.	29,062	2,061	40,822	20,515	16,293	226,575	2,750
AL	2018	02	FUEL COMB. INDUSTRIAL	63,927	390	40,397	6,188	3,564	37,093	2,319
AL	2018	03	FUEL COMB. OTHER	47,774	188	23,314	6,253	5,320	42,515	22,989
AL	2018	04	CHEMICAL & ALLIED PRODUCT MFG	7,163	46	2,795	1,383	1,024	16,503	11,570
AL	2018	05	METALS PROCESSING	49,219	674	7,349	9,456	8,458	21,754	4,147
AL	2018	06	PETROLEUM & RELATED	13,000	0	848	255	205	22,231	3,436
AL	2018	07	OTHER INDUSTRIAL PROCESSES	60,452	1,732	30,831	27,545	11,764	21,843	30,267
AL	2018	08	SOLVENT UTILIZATION	301	0	317	200	169	4	127,227
AL	2018	09	STORAGE & TRANSPORT	234	0	307	1,172	626	17	13,707
AL	2018	10	WASTE DISPOSAL & RECYCLING	88,757	13	3,863	15,342	14,142	716	11,933
AL	2018	11	HIGHWAY VEHICLES	797,966	7,296	46,222	2,488	1,262	720	47,296
AL	2018	12	OFF-HIGHWAY	443,100	40	42,573	3,430	3,193	2,815	26,338
AL	2018	14	MISCELLANEOUS	442,697	74,827	9,341	457,680	104,283	2,559	21,672
	<b>2018 Total</b>			2,043,654	87,268	248,978	551,907	170,302	395,346	325,652

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
FL	2002	01	FUEL COMB. ELEC. UTIL.	59,315	67	261,523	21,387	15,643	453,631	2,524
FL	2002	02	FUEL COMB. INDUSTRIAL	64,798	131	45,157	20,442	18,547	42,524	4,219
FL	2002	03	FUEL COMB. OTHER	75,306	99	11,923	11,939	11,549	20,078	23,273
FL	2002	04	CHEMICAL & ALLIED PRODUCT MFG	745	1,101	2,221	1,868	1,488	34,462	15,156
FL	2002	05	METALS PROCESSING	1,404	1	194	449	334	882	82
FL	2002	06	PETROLEUM & RELATED	1,070	0	560	259	129	470	724
FL	2002	07	OTHER INDUSTRIAL PROCESSES	18,586	19	12,325	17,873	6,967	6,515	27,002
FL	2002	08	SOLVENT UTILIZATION	0	0	1	128	110	0	304,582
FL	2002	09	STORAGE & TRANSPORT	161	0	561	1,645	720	38	93,009
FL	2002	10	WASTE DISPOSAL & RECYCLING	175,989	351	6,123	22,142	21,604	659	17,449
FL	2002	11	HIGHWAY VEHICLES	4,693,893	18,078	466,098	11,253	7,852	20,872	495,225
FL	2002	12	OFF-HIGHWAY	1,731,519	108	150,519	17,692	16,739	17,023	201,960
FL	2002	14	MISCELLANEOUS	773,032	47,781	15,361	504,401	139,150	4,129	43,522
	<b>2002 Total</b>			7,595,820	67,736	972,564	631,479	240,834	601,283	1,228,727
FL	2009	01	FUEL COMB. ELEC. UTIL.	50,304	2,528	168,872	25,226	18,756	206,857	2,012
FL	2009	02	FUEL COMB. INDUSTRIAL	70,622	148	46,923	16,769	15,093	48,829	4,503
FL	2009	03	FUEL COMB. OTHER	67,324	118	11,699	11,482	10,993	25,574	16,930
FL	2009	04	CHEMICAL & ALLIED PRODUCT MFG	943	1,231	2,658	2,101	1,674	38,282	19,832
FL	2009	05	METALS PROCESSING	1,730	1	200	409	282	1,133	92
FL	2009	06	PETROLEUM & RELATED	1,354	0	708	328	164	594	814
FL	2009	07	OTHER INDUSTRIAL PROCESSES	19,156	26	13,580	19,933	7,668	7,013	27,581
FL	2009	08	SOLVENT UTILIZATION	0	0	1	144	124	0	340,232
FL	2009	09	STORAGE & TRANSPORT	199	0	606	1,126	482	42	81,438
FL	2009	10	WASTE DISPOSAL & RECYCLING	178,075	396	6,307	22,998	22,382	750	17,276
FL	2009	11	HIGHWAY VEHICLES	3,446,095	21,737	314,307	9,953	6,216	2,120	323,290
FL	2009	12	OFF-HIGHWAY	1,934,550	119	136,851	15,630	14,786	8,380	144,749
FL	2009	14	MISCELLANEOUS	773,925	49,786	15,392	557,494	142,875	4,129	43,830
	<b>2009 Total</b>			6,544,277	76,092	718,104	683,592	241,494	343,703	1,022,578
FL	2018	01	FUEL COMB. ELEC. UTIL.	69,462	3,869	84,504	23,018	16,904	133,713	2,529
FL	2018	02	FUEL COMB. INDUSTRIAL	81,092	160	51,703	19,215	17,279	55,813	5,140
FL	2018	03	FUEL COMB. OTHER	62,302	132	12,529	11,028	10,502	27,734	14,059
FL	2018	04	CHEMICAL & ALLIED PRODUCT MFG	1,252	1,448	3,352	2,599	2,089	44,470	26,697
FL	2018	05	METALS PROCESSING	2,220	2	255	530	363	1,512	119
FL	2018	06	PETROLEUM & RELATED	1,721	0	900	417	208	755	1,002
FL	2018	07	OTHER INDUSTRIAL PROCESSES	21,376	35	15,912	23,708	8,938	7,806	31,108
FL	2018	08	SOLVENT UTILIZATION	0	0	1	168	145	0	412,784
FL	2018	09	STORAGE & TRANSPORT	241	0	671	1,357	582	48	76,578
FL	2018	10	WASTE DISPOSAL & RECYCLING	180,978	484	6,570	24,175	23,451	906	18,381
FL	2018	11	HIGHWAY VEHICLES	3,086,330	26,154	154,611	8,489	4,242	2,533	216,620
FL	2018	12	OFF-HIGHWAY	2,179,296	138	111,959	13,827	13,044	7,511	128,131
FL	2018	14	MISCELLANEOUS	775,300	52,686	15,439	629,180	153,068	4,129	44,308
	<b>2018 Total</b>			6,461,570	85,109	458,405	757,712	250,813	286,931	977,456

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
GA	2002	01	FUEL COMB. ELEC. UTIL.	9,712	5	147,517	11,224	4,939	514,952	1,244
GA	2002	02	FUEL COMB. INDUSTRIAL	59,492	27	53,039	12,002	7,883	88,791	3,923
GA	2002	03	FUEL COMB. OTHER	63,314	17	14,465	10,263	10,168	10,740	27,226
GA	2002	04	CHEMICAL & ALLIED PRODUCT MFG	5,387	920	2,277	409	320	2,721	6,507
GA	2002	05	METALS PROCESSING	330	0	60	147	94	0	70
GA	2002	06	PETROLEUM & RELATED	41	0	3	69	44	68	175
GA	2002	07	OTHER INDUSTRIAL PROCESSES	28,060	2,666	13,979	39,894	13,326	15,280	26,993
GA	2002	08	SOLVENT UTILIZATION	4	0	22	13	13	0	234,744
GA	2002	09	STORAGE & TRANSPORT	39	0	6	583	360	0	32,779
GA	2002	10	WASTE DISPOSAL & RECYCLING	203,892	16	6,872	29,227	28,311	312	18,964
GA	2002	11	HIGHWAY VEHICLES	2,833,468	10,524	308,013	7,236	5,158	12,155	267,378
GA	2002	12	OFF-HIGHWAY	700,427	54	91,386	8,295	7,899	8,145	63,337
GA	2002	14	MISCELLANEOUS	498,622	86,349	10,279	687,028	146,572	2,815	25,618
	<b>2002 Total</b>			4,402,788	100,579	647,917	806,389	225,088	655,980	708,956
GA	2009	01	FUEL COMB. ELEC. UTIL.	20,497	1,376	120,878	28,195	22,216	396,199	1,570
GA	2009	02	FUEL COMB. INDUSTRIAL	62,117	29	53,722	11,143	7,325	89,174	4,049
GA	2009	03	FUEL COMB. OTHER	55,617	20	16,503	9,556	9,437	11,509	17,422
GA	2009	04	CHEMICAL & ALLIED PRODUCT MFG	6,044	1,032	2,531	454	356	2,743	7,785
GA	2009	05	METALS PROCESSING	363	0	61	159	100	0	47
GA	2009	06	PETROLEUM & RELATED	50	0	4	83	54	82	155
GA	2009	07	OTHER INDUSTRIAL PROCESSES	30,089	2,902	13,766	45,634	15,040	15,083	28,439
GA	2009	08	SOLVENT UTILIZATION	4	0	25	14	14	0	232,675
GA	2009	09	STORAGE & TRANSPORT	45	0	7	650	401	0	27,323
GA	2009	10	WASTE DISPOSAL & RECYCLING	218,460	18	7,419	31,955	30,900	360	18,711
GA	2009	11	HIGHWAY VEHICLES	2,053,694	12,660	208,393	6,103	3,869	1,254	184,239
GA	2009	12	OFF-HIGHWAY	783,990	60	79,049	7,368	7,014	2,588	46,722
GA	2009	14	MISCELLANEOUS	498,495	94,954	10,276	763,407	158,285	2,815	25,595
	<b>2009 Total</b>			3,729,465	113,050	512,634	904,720	255,010	521,808	594,733
GA	2018	01	FUEL COMB. ELEC. UTIL.	29,480	2,057	67,241	27,000	20,613	223,548	1,877
GA	2018	02	FUEL COMB. INDUSTRIAL	66,498	31	57,560	11,649	7,673	95,546	4,289
GA	2018	03	FUEL COMB. OTHER	51,990	21	18,492	9,004	8,878	12,667	13,291
GA	2018	04	CHEMICAL & ALLIED PRODUCT MFG	7,076	1,208	2,982	541	426	3,436	10,186
GA	2018	05	METALS PROCESSING	421	0	76	185	118	0	55
GA	2018	06	PETROLEUM & RELATED	63	0	5	105	68	104	195
GA	2018	07	OTHER INDUSTRIAL PROCESSES	33,743	3,559	15,909	55,469	18,226	17,432	33,335
GA	2018	08	SOLVENT UTILIZATION	5	0	30	22	22	0	284,594
GA	2018	09	STORAGE & TRANSPORT	54	0	9	764	471	0	24,912
GA	2018	10	WASTE DISPOSAL & RECYCLING	235,736	22	8,128	35,280	34,038	423	20,411
GA	2018	11	HIGHWAY VEHICLES	1,765,020	14,871	99,821	4,995	2,517	1,458	105,507
GA	2018	12	OFF-HIGHWAY	868,018	71	60,650	6,068	5,769	1,702	36,014
GA	2018	14	MISCELLANEOUS	498,386	106,021	10,274	858,198	172,762	2,815	25,576
	<b>2018 Total</b>			3,556,490	127,861	341,177	1,009,280	271,581	359,132	560,243

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
KY	2002	01	FUEL COMB. ELEC. UTIL.	12,619	0	198,817	4,700	2,802	484,057	1,487
KY	2002	02	FUEL COMB. INDUSTRIAL	14,109	182	60,674	2,154	1,463	41,825	1,565
KY	2002	03	FUEL COMB. OTHER	40,806	55	4,997	7,679	7,352	9,647	12,711
KY	2002	04	CHEMICAL & ALLIED PRODUCT MFG	176	214	296	774	581	2,345	3,462
KY	2002	05	METALS PROCESSING	89,197	6	1,082	3,394	2,718	12,328	1,508
KY	2002	06	PETROLEUM & RELATED	4,304	335	2,519	308	205	5,747	2,895
KY	2002	07	OTHER INDUSTRIAL PROCESSES	6,493	78	6,517	29,410	9,144	3,333	25,388
KY	2002	08	SOLVENT UTILIZATION	0	10	9	317	241	1	61,833
KY	2002	09	STORAGE & TRANSPORT	33	8	15	1,920	1,177	3	23,652
KY	2002	10	WASTE DISPOSAL & RECYCLING	51,579	8	2,684	11,267	10,515	605	10,052
KY	2002	11	HIGHWAY VEHICLES	1,260,682	5,044	154,899	3,720	2,693	5,974	98,311
KY	2002	12	OFF-HIGHWAY	289,967	28	101,261	6,389	5,998	13,739	34,156
KY	2002	14	MISCELLANEOUS	26,677	50,986	566	199,630	37,050	136	5,279
	<b>2002 Total</b>			1,796,641	56,954	534,335	271,661	81,938	579,740	282,299
KY	2009	01	FUEL COMB. ELEC. UTIL.	15,374	710	177,560	29,637	23,934	342,678	1,606
KY	2009	02	FUEL COMB. INDUSTRIAL	14,763	190	60,573	2,077	1,447	39,796	1,462
KY	2009	03	FUEL COMB. OTHER	37,124	59	5,648	7,264	6,968	9,924	9,416
KY	2009	04	CHEMICAL & ALLIED PRODUCT MFG	179	249	300	841	633	2,384	3,643
KY	2009	05	METALS PROCESSING	99,428	7	1,156	3,234	2,527	13,735	1,772
KY	2009	06	PETROLEUM & RELATED	4,572	351	2,655	310	218	6,039	2,908
KY	2009	07	OTHER INDUSTRIAL PROCESSES	7,212	84	6,674	29,709	9,357	3,634	27,547
KY	2009	08	SOLVENT UTILIZATION	0	10	11	364	279	1	63,592
KY	2009	09	STORAGE & TRANSPORT	38	9	18	1,582	973	3	19,057
KY	2009	10	WASTE DISPOSAL & RECYCLING	53,355	9	2,898	11,810	10,964	735	9,850
KY	2009	11	HIGHWAY VEHICLES	942,350	5,795	97,912	3,002	1,941	585	63,258
KY	2009	12	OFF-HIGHWAY	306,884	30	90,803	5,312	4,978	9,092	23,980
KY	2009	14	MISCELLANEOUS	26,545	52,899	563	207,648	38,160	136	6,051
	<b>2009 Total</b>			1,507,826	60,401	446,770	302,789	102,379	428,740	234,142
KY	2018	01	FUEL COMB. ELEC. UTIL.	15,232	771	65,008	25,770	19,937	225,781	1,646
KY	2018	02	FUEL COMB. INDUSTRIAL	15,890	209	65,166	2,231	1,571	41,008	1,599
KY	2018	03	FUEL COMB. OTHER	35,209	61	6,145	6,987	6,698	9,959	8,069
KY	2018	04	CHEMICAL & ALLIED PRODUCT MFG	219	317	367	1,040	775	2,884	4,389
KY	2018	05	METALS PROCESSING	114,470	9	1,508	3,882	3,053	15,800	2,343
KY	2018	06	PETROLEUM & RELATED	4,914	373	2,835	327	227	6,433	3,053
KY	2018	07	OTHER INDUSTRIAL PROCESSES	8,303	93	7,872	32,497	10,596	4,141	31,393
KY	2018	08	SOLVENT UTILIZATION	0	12	14	459	351	1	74,808
KY	2018	09	STORAGE & TRANSPORT	44	10	21	1,840	1,129	4	18,080
KY	2018	10	WASTE DISPOSAL & RECYCLING	55,685	11	3,185	12,524	11,559	902	10,518
KY	2018	11	HIGHWAY VEHICLES	782,423	6,584	42,104	2,283	1,160	651	39,084
KY	2018	12	OFF-HIGHWAY	349,285	36	77,295	4,602	4,289	8,536	20,795
KY	2018	14	MISCELLANEOUS	26,364	55,211	559	219,973	40,175	136	6,901
	<b>2018 Total</b>			1,408,039	63,697	272,077	314,416	101,521	316,236	222,678

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
MS	2002	01	FUEL COMB. ELEC. UTIL.	5,390	64	44,557	1,750	1,255	67,440	674
MS	2002	02	FUEL COMB. INDUSTRIAL	22,624	28	47,278	4,893	3,521	9,734	7,999
MS	2002	03	FUEL COMB. OTHER	36,752	34	4,502	5,445	5,414	789	22,923
MS	2002	04	CHEMICAL & ALLIED PRODUCT MFG	15,410	361	1,725	849	440	1,663	2,381
MS	2002	05	METALS PROCESSING	1,031	0	115	122	58	36	371
MS	2002	06	PETROLEUM & RELATED	975	20	1,187	790	335	15,560	20,788
MS	2002	07	OTHER INDUSTRIAL PROCESSES	13,880	747	9,201	27,451	7,955	8,863	15,524
MS	2002	08	SOLVENT UTILIZATION	45	7	105	219	178	1	80,760
MS	2002	09	STORAGE & TRANSPORT	74	0	80	124	38	40	26,618
MS	2002	10	WASTE DISPOSAL & RECYCLING	45,709	9	1,399	4,886	4,780	31	3,926
MS	2002	11	HIGHWAY VEHICLES	894,639	3,577	111,791	2,856	2,109	4,604	82,810
MS	2002	12	OFF-HIGHWAY	213,779	23	90,686	5,551	5,200	11,551	32,401
MS	2002	14	MISCELLANEOUS	84,357	59,400	2,040	332,631	63,885	103	10,618
	<b>2002 Total</b>			1,334,666	64,274	314,666	387,568	95,167	120,414	307,794
MS	2009	01	FUEL COMB. ELEC. UTIL.	9,660	407	53,580	6,305	5,922	76,961	812
MS	2009	02	FUEL COMB. INDUSTRIAL	24,846	30	43,502	3,673	2,723	9,351	8,210
MS	2009	03	FUEL COMB. OTHER	36,030	36	5,118	5,481	5,449	651	18,052
MS	2009	04	CHEMICAL & ALLIED PRODUCT MFG	16,141	405	1,955	941	488	1,880	2,622
MS	2009	05	METALS PROCESSING	1,098	0	128	129	62	37	402
MS	2009	06	PETROLEUM & RELATED	1,087	22	1,254	882	372	15,300	13,254
MS	2009	07	OTHER INDUSTRIAL PROCESSES	14,175	197	8,355	31,183	8,499	8,251	16,281
MS	2009	08	SOLVENT UTILIZATION	50	8	118	239	194	1	80,975
MS	2009	09	STORAGE & TRANSPORT	92	0	100	112	35	49	22,712
MS	2009	10	WASTE DISPOSAL & RECYCLING	45,782	10	1,405	4,912	4,795	37	3,783
MS	2009	11	HIGHWAY VEHICLES	628,151	4,026	69,949	2,290	1,522	397	49,670
MS	2009	12	OFF-HIGHWAY	237,297	26	81,780	4,754	4,440	7,232	27,650
MS	2009	14	MISCELLANEOUS	84,335	64,424	2,042	342,674	65,452	103	10,613
	<b>2009 Total</b>			1,098,743	69,592	269,287	403,575	99,952	120,249	255,036
MS	2018	01	FUEL COMB. ELEC. UTIL.	15,639	872	25,831	6,887	6,503	23,882	1,049
MS	2018	02	FUEL COMB. INDUSTRIAL	27,939	33	47,460	4,194	3,087	9,327	9,131
MS	2018	03	FUEL COMB. OTHER	35,269	37	5,593	5,419	5,377	828	15,997
MS	2018	04	CHEMICAL & ALLIED PRODUCT MFG	20,175	475	2,337	1,132	588	2,242	3,300
MS	2018	05	METALS PROCESSING	1,357	0	167	160	79	48	461
MS	2018	06	PETROLEUM & RELATED	1,224	23	1,409	974	409	18,827	14,221
MS	2018	07	OTHER INDUSTRIAL PROCESSES	16,260	216	9,970	38,233	10,335	9,653	20,302
MS	2018	08	SOLVENT UTILIZATION	60	9	141	301	244	1	99,021
MS	2018	09	STORAGE & TRANSPORT	115	0	124	137	42	62	21,837
MS	2018	10	WASTE DISPOSAL & RECYCLING	45,933	12	1,425	4,973	4,827	43	3,910
MS	2018	11	HIGHWAY VEHICLES	528,898	4,565	29,717	1,688	876	441	30,734
MS	2018	12	OFF-HIGHWAY	252,658	30	68,781	3,873	3,597	6,638	20,576
MS	2018	14	MISCELLANEOUS	84,305	70,699	2,046	357,818	67,704	104	10,608
	<b>2018 Total</b>			1,029,833	76,970	195,000	425,790	103,669	72,096	251,146

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
NC	2002	01	FUEL COMB. ELEC. UTIL.	13,885	27	151,849	22,650	16,498	477,990	988
NC	2002	02	FUEL COMB. INDUSTRIAL	52,826	651	60,748	32,238	26,827	34,983	3,465
NC	2002	03	FUEL COMB. OTHER	218,096	2,309	16,649	30,369	1,776	4,107	186,654
NC	2002	04	CHEMICAL & ALLIED PRODUCT MFG	13,952	535	859	866	538	5,736	4,313
NC	2002	05	METALS PROCESSING	5,876	60	201	564	467	1,010	2,512
NC	2002	06	PETROLEUM & RELATED	461	0	174	104	52	283	140
NC	2002	07	OTHER INDUSTRIAL PROCESSES	8,552	479	7,380	25,305	8,903	3,427	17,819
NC	2002	08	SOLVENT UTILIZATION	484	308	229	1,036	998	26	157,781
NC	2002	09	STORAGE & TRANSPORT	66	46	53	639	354	1	30,912
NC	2002	10	WASTE DISPOSAL & RECYCLING	240,120	249	10,812	11,904	12,934	1,646	23,349
NC	2002	11	HIGHWAY VEHICLES	3,176,811	10,455	341,198	6,905	4,816	13,343	253,374
NC	2002	12	OFF-HIGHWAY	725,734	61	81,448	7,449	7,079	7,207	71,378
NC	2002	14	MISCELLANEOUS	84,292	161,334	1,562	235,295	47,319	423	4,612
	<b>2002 Total</b>			4,541,154	176,515	673,163	375,323	128,560	550,182	757,296
NC	2009	01	FUEL COMB. ELEC. UTIL.	13,348	575	70,137	21,866	16,415	139,515	1,174
NC	2009	02	FUEL COMB. INDUSTRIAL	56,184	699	60,161	34,792	28,866	35,236	3,509
NC	2009	03	FUEL COMB. OTHER	159,959	2,711	18,687	23,803	1,890	4,217	105,369
NC	2009	04	CHEMICAL & ALLIED PRODUCT MFG	14,732	599	933	981	607	6,286	4,956
NC	2009	05	METALS PROCESSING	6,360	67	208	630	532	1,131	2,784
NC	2009	06	PETROLEUM & RELATED	575	0	217	129	65	353	166
NC	2009	07	OTHER INDUSTRIAL PROCESSES	9,163	479	8,001	28,123	9,451	3,701	17,219
NC	2009	08	SOLVENT UTILIZATION	554	331	216	952	914	24	140,694
NC	2009	09	STORAGE & TRANSPORT	75	52	55	644	343	1	30,746
NC	2009	10	WASTE DISPOSAL & RECYCLING	253,860	307	11,671	11,889	13,240	1,889	25,084
NC	2009	11	HIGHWAY VEHICLES	2,184,901	12,637	207,648	5,861	3,643	1,311	163,803
NC	2009	12	OFF-HIGHWAY	797,360	68	66,382	6,210	5,889	1,798	52,430
NC	2009	14	MISCELLANEOUS	84,155	169,521	1,559	250,281	49,661	423	4,588
	<b>2009 Total</b>			3,581,226	188,045	445,877	386,164	131,514	195,886	552,523
NC	2018	01	FUEL COMB. ELEC. UTIL.	16,303	782	63,239	20,706	15,120	86,385	1,268
NC	2018	02	FUEL COMB. INDUSTRIAL	64,314	801	66,143	40,755	33,879	38,813	3,937
NC	2018	03	FUEL COMB. OTHER	132,462	2,847	20,242	20,161	1,988	4,171	71,844
NC	2018	04	CHEMICAL & ALLIED PRODUCT MFG	18,463	702	1,105	1,175	726	7,414	6,162
NC	2018	05	METALS PROCESSING	7,578	76	256	775	661	1,336	3,482
NC	2018	06	PETROLEUM & RELATED	739	0	279	166	83	454	213
NC	2018	07	OTHER INDUSTRIAL PROCESSES	10,609	511	9,174	33,841	11,177	4,345	19,761
NC	2018	08	SOLVENT UTILIZATION	658	368	218	859	820	23	154,195
NC	2018	09	STORAGE & TRANSPORT	91	60	67	727	367	2	30,915
NC	2018	10	WASTE DISPOSAL & RECYCLING	270,665	387	12,759	11,914	13,693	2,208	27,515
NC	2018	11	HIGHWAY VEHICLES	1,510,848	13,077	81,706	4,299	2,158	1,323	88,620
NC	2018	12	OFF-HIGHWAY	863,536	79	45,146	4,474	4,215	838	40,576
NC	2018	14	MISCELLANEOUS	84,027	180,150	1,556	270,941	52,831	423	4,567
	<b>2018 Total</b>			2,980,293	199,840	301,890	410,793	137,718	147,735	453,056



## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
SC	2002	01	FUEL COMB. ELEC. UTIL.	6,990	0	88,241	23,511	19,269	206,399	470
SC	2002	02	FUEL COMB. INDUSTRIAL	31,771	97	38,081	5,582	4,218	44,958	1,338
SC	2002	03	FUEL COMB. OTHER	75,800	65	4,367	6,320	6,244	4,318	49,171
SC	2002	04	CHEMICAL & ALLIED PRODUCT MFG	2,526	173	25	589	343	59	29,914
SC	2002	05	METALS PROCESSING	13,833	0	450	1,434	1,188	4,160	660
SC	2002	06	PETROLEUM & RELATED	248	0	283	62	15	170	114
SC	2002	07	OTHER INDUSTRIAL PROCESSES	9,502	1,237	15,145	18,463	9,099	12,128	16,338
SC	2002	08	SOLVENT UTILIZATION	0	1	1	110	97	0	88,878
SC	2002	09	STORAGE & TRANSPORT	10	0	4	489	247	0	26,345
SC	2002	10	WASTE DISPOSAL & RECYCLING	67,908	10	4,063	9,190	8,666	625	15,291
SC	2002	11	HIGHWAY VEHICLES	1,275,161	4,684	140,428	3,446	2,496	5,958	106,792
SC	2002	12	OFF-HIGHWAY	367,575	29	46,789	4,211	3,985	4,449	41,374
SC	2002	14	MISCELLANEOUS	221,436	30,183	4,335	262,984	58,265	1,187	12,535
	<b>2002 Total</b>			2,072,760	36,478	342,212	336,391	114,132	284,411	389,220
SC	2009	01	FUEL COMB. ELEC. UTIL.	10,051	422	52,638	17,643	14,216	146,505	664
SC	2009	02	FUEL COMB. INDUSTRIAL	34,607	104	37,437	4,109	3,190	39,631	1,427
SC	2009	03	FUEL COMB. OTHER	55,315	72	5,068	5,891	5,817	4,821	27,844
SC	2009	04	CHEMICAL & ALLIED PRODUCT MFG	2,798	173	26	629	364	60	34,270
SC	2009	05	METALS PROCESSING	15,632	0	449	1,479	1,222	4,856	663
SC	2009	06	PETROLEUM & RELATED	302	0	340	73	18	200	131
SC	2009	07	OTHER INDUSTRIAL PROCESSES	10,480	1,403	14,637	20,333	9,800	13,443	15,838
SC	2009	08	SOLVENT UTILIZATION	1	1	1	126	111	0	96,484
SC	2009	09	STORAGE & TRANSPORT	13	0	5	515	260	0	21,957
SC	2009	10	WASTE DISPOSAL & RECYCLING	70,383	11	4,260	9,579	9,025	668	15,998
SC	2009	11	HIGHWAY VEHICLES	912,280	5,510	91,696	2,878	1,870	556	67,281
SC	2009	12	OFF-HIGHWAY	402,871	32	39,544	3,593	3,396	1,633	30,531
SC	2009	14	MISCELLANEOUS	221,389	32,688	4,333	279,641	60,774	1,187	12,527
	<b>2009 Total</b>			1,736,120	40,415	250,434	346,487	110,062	213,560	325,615
SC	2018	01	FUEL COMB. ELEC. UTIL.	14,550	742	38,871	19,348	15,661	155,780	797
SC	2018	02	FUEL COMB. INDUSTRIAL	38,470	112	39,773	4,503	3,498	42,474	1,558
SC	2018	03	FUEL COMB. OTHER	45,775	75	5,624	5,566	5,489	5,167	19,062
SC	2018	04	CHEMICAL & ALLIED PRODUCT MFG	3,296	212	32	780	452	74	44,389
SC	2018	05	METALS PROCESSING	18,853	0	587	1,858	1,561	5,920	867
SC	2018	06	PETROLEUM & RELATED	389	0	438	94	23	257	166
SC	2018	07	OTHER INDUSTRIAL PROCESSES	12,136	1,566	17,174	24,154	11,553	15,863	18,771
SC	2018	08	SOLVENT UTILIZATION	1	1	1	163	144	0	121,585
SC	2018	09	STORAGE & TRANSPORT	16	0	6	630	319	0	20,070
SC	2018	10	WASTE DISPOSAL & RECYCLING	73,407	13	4,567	10,095	9,491	738	17,166
SC	2018	11	HIGHWAY VEHICLES	800,619	6,472	42,354	2,258	1,154	643	44,700
SC	2018	12	OFF-HIGHWAY	438,027	37	29,512	2,889	2,718	1,195	24,989
SC	2018	14	MISCELLANEOUS	221,335	35,790	4,332	303,507	64,362	1,187	12,517
	<b>2018 Total</b>			1,666,873	45,020	183,271	375,844	116,426	229,299	326,637



## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
TN	2002	01	FUEL COMB. ELEC. UTIL.	7,090	0	157,314	14,637	12,165	334,140	927
TN	2002	02	FUEL COMB. INDUSTRIAL	15,629	7	47,674	8,959	7,420	79,164	2,067
TN	2002	03	FUEL COMB. OTHER	77,814	26	16,040	8,270	7,552	17,252	18,327
TN	2002	04	CHEMICAL & ALLIED PRODUCT MFG	36,910	1,518	1,242	3,064	2,154	6,516	34,313
TN	2002	05	METALS PROCESSING	42,625	14	1,216	7,590	7,036	6,050	7,229
TN	2002	06	PETROLEUM & RELATED	481	0	305	199	231	385	1,843
TN	2002	07	OTHER INDUSTRIAL PROCESSES	11,738	56	16,243	30,647	13,466	10,156	30,044
TN	2002	08	SOLVENT UTILIZATION	279	1	5,065	2,102	1,831	60	111,246
TN	2002	09	STORAGE & TRANSPORT	22	24	105	1,101	727	134	26,633
TN	2002	10	WASTE DISPOSAL & RECYCLING	89,697	34	3,818	14,958	14,356	350	20,193
TN	2002	11	HIGHWAY VEHICLES	1,967,658	6,616	233,324	5,338	3,919	9,184	169,914
TN	2002	12	OFF-HIGHWAY	451,480	41	95,968	7,145	6,756	10,413	49,056
TN	2002	14	MISCELLANEOUS	11,186	35,567	231	180,190	32,364	59	2,295
	<b>2002 Total</b>			2,712,610	43,903	578,545	284,198	109,977	473,862	474,085
TN	2009	01	FUEL COMB. ELEC. UTIL.	7,426	400	106,141	17,223	15,283	280,195	936
TN	2009	02	FUEL COMB. INDUSTRIAL	15,917	7	39,479	7,352	6,150	74,251	1,939
TN	2009	03	FUEL COMB. OTHER	70,255	31	15,657	7,387	7,043	17,217	13,170
TN	2009	04	CHEMICAL & ALLIED PRODUCT MFG	35,431	1,719	1,389	3,383	2,386	7,062	40,011
TN	2009	05	METALS PROCESSING	46,541	15	1,307	6,686	6,270	6,802	8,889
TN	2009	06	PETROLEUM & RELATED	559	0	343	226	264	436	1,428
TN	2009	07	OTHER INDUSTRIAL PROCESSES	9,764	77	12,473	32,394	13,789	8,424	30,505
TN	2009	08	SOLVENT UTILIZATION	307	1	5,976	2,486	2,161	67	115,148
TN	2009	09	STORAGE & TRANSPORT	27	31	115	983	630	145	21,061
TN	2009	10	WASTE DISPOSAL & RECYCLING	91,375	39	3,973	15,509	14,855	393	19,795
TN	2009	11	HIGHWAY VEHICLES	1,361,408	7,738	147,757	4,238	2,782	831	108,200
TN	2009	12	OFF-HIGHWAY	500,186	45	85,084	6,218	5,873	5,649	38,686
TN	2009	14	MISCELLANEOUS	11,035	36,566	229	191,894	34,195	59	2,519
	<b>2009 Total</b>			2,150,230	46,669	419,926	295,979	111,680	401,532	402,287
TN	2018	01	FUEL COMB. ELEC. UTIL.	7,456	394	34,434	12,513	10,583	103,927	929
TN	2018	02	FUEL COMB. INDUSTRIAL	17,411	8	41,611	8,030	6,782	76,017	2,121
TN	2018	03	FUEL COMB. OTHER	67,959	35	17,092	7,309	6,938	18,652	11,107
TN	2018	04	CHEMICAL & ALLIED PRODUCT MFG	45,446	2,053	1,709	4,320	3,039	9,095	51,613
TN	2018	05	METALS PROCESSING	54,391	17	1,663	8,865	8,346	8,093	11,353
TN	2018	06	PETROLEUM & RELATED	667	0	397	265	312	509	1,639
TN	2018	07	OTHER INDUSTRIAL PROCESSES	11,102	105	14,320	38,040	16,403	10,028	37,790
TN	2018	08	SOLVENT UTILIZATION	378	1	7,669	3,231	2,806	81	144,613
TN	2018	09	STORAGE & TRANSPORT	33	41	139	1,272	803	174	19,686
TN	2018	10	WASTE DISPOSAL & RECYCLING	94,286	50	4,308	16,460	15,719	468	22,547
TN	2018	11	HIGHWAY VEHICLES	1,150,516	8,962	65,242	3,199	1,643	944	64,665
TN	2018	12	OFF-HIGHWAY	540,143	53	69,093	5,019	4,724	5,205	28,667
TN	2018	14	MISCELLANEOUS	10,835	37,788	227	208,363	36,726	59	2,932
	<b>2018 Total</b>			2,000,624	49,507	257,905	316,884	114,825	233,252	399,662

## State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
VA	2002	01	FUEL COMB. ELEC. UTIL.	6,892	127	86,886	3,943	2,606	241,204	754
VA	2002	02	FUEL COMB. INDUSTRIAL	64,398	100	75,831	18,467	8,453	42,670	5,332
VA	2002	03	FUEL COMB. OTHER	98,788	13	15,648	11,569	11,236	3,909	11,119
VA	2002	04	CHEMICAL & ALLIED PRODUCT MFG	321	2,158	8,062	447	392	2,126	1,530
VA	2002	05	METALS PROCESSING	3,580	0	937	1,511	1,334	5,251	513
VA	2002	06	PETROLEUM & RELATED	23,384	0	182	255	153	170	501
VA	2002	07	OTHER INDUSTRIAL PROCESSES	12,002	726	9,279	33,161	9,661	17,702	13,086
VA	2002	08	SOLVENT UTILIZATION	0	4	0	225	210	2	107,977
VA	2002	09	STORAGE & TRANSPORT	16	7	11	731	505	0	29,835
VA	2002	10	WASTE DISPOSAL & RECYCLING	16,566	109	1,866	13,839	11,964	1,581	4,065
VA	2002	11	HIGHWAY VEHICLES	2,170,508	7,837	219,602	4,537	3,090	7,218	144,684
VA	2002	12	OFF-HIGHWAY	595,311	44	58,524	7,928	7,486	8,796	55,922
VA	2002	14	MISCELLANEOUS	19,773	46,367	993	188,655	35,889	99	1,025
	<b>2002 Total</b>			3,011,538	57,491	477,822	285,267	92,979	330,730	376,343
VA	2009	01	FUEL COMB. ELEC. UTIL.	11,117	439	68,855	13,019	11,352	150,039	577
VA	2009	02	FUEL COMB. INDUSTRIAL	66,307	112	68,921	17,900	8,395	44,573	5,380
VA	2009	03	FUEL COMB. OTHER	72,984	14	17,692	11,166	10,815	4,586	6,703
VA	2009	04	CHEMICAL & ALLIED PRODUCT MFG	310	2,082	7,790	483	420	2,159	1,448
VA	2009	05	METALS PROCESSING	3,622	0	869	1,502	1,321	4,826	414
VA	2009	06	PETROLEUM & RELATED	25,955	0	212	286	172	201	561
VA	2009	07	OTHER INDUSTRIAL PROCESSES	12,898	733	9,636	33,825	9,931	19,172	13,539
VA	2009	08	SOLVENT UTILIZATION	0	5	0	251	234	3	107,823
VA	2009	09	STORAGE & TRANSPORT	20	7	14	751	513	0	24,916
VA	2009	10	WASTE DISPOSAL & RECYCLING	20,142	119	2,181	14,515	12,206	1,808	4,799
VA	2009	11	HIGHWAY VEHICLES	1,495,771	9,066	133,170	3,760	2,254	900	89,678
VA	2009	12	OFF-HIGHWAY	661,295	48	50,120	6,763	6,388	2,248	39,538
VA	2009	14	MISCELLANEOUS	19,611	49,317	989	203,661	38,194	99	995
	<b>2009 Total</b>			2,390,030	61,943	360,450	307,882	102,195	230,612	296,371
VA	2018	01	FUEL COMB. ELEC. UTIL.	15,862	782	47,155	12,906	10,889	127,501	759
VA	2018	02	FUEL COMB. INDUSTRIAL	72,349	129	72,866	18,637	8,958	48,007	5,762
VA	2018	03	FUEL COMB. OTHER	61,004	15	19,380	10,769	10,394	4,816	4,928
VA	2018	04	CHEMICAL & ALLIED PRODUCT MFG	366	2,462	9,211	587	511	2,484	1,744
VA	2018	05	METALS PROCESSING	4,309	0	1,070	1,794	1,580	5,963	498
VA	2018	06	PETROLEUM & RELATED	28,375	0	245	328	198	231	628
VA	2018	07	OTHER INDUSTRIAL PROCESSES	14,505	878	11,079	37,410	11,226	21,635	15,815
VA	2018	08	SOLVENT UTILIZATION	0	6	0	317	297	3	124,505
VA	2018	09	STORAGE & TRANSPORT	25	8	18	894	610	0	23,932
VA	2018	10	WASTE DISPOSAL & RECYCLING	24,370	141	2,613	15,390	12,522	2,177	5,833
VA	2018	11	HIGHWAY VEHICLES	1,310,698	10,757	61,881	3,343	1,641	1,059	60,454
VA	2018	12	OFF-HIGHWAY	734,294	57	36,970	5,564	5,241	1,217	32,756
VA	2018	14	MISCELLANEOUS	19,459	53,164	985	223,231	41,135	99	967
	<b>2018 Total</b>			2,285,617	68,399	263,472	331,170	105,202	215,193	278,581

State Tier 1 Emission Totals

State	Year	TIER1	TIER 1 NAME	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
WV	2002	01	FUEL COMB. ELEC. UTIL.	10,341	12	230,977	4,573	2,210	516,084	1,180
WV	2002	02	FUEL COMB. INDUSTRIAL	8,685	97	33,825	1,561	1,332	37,111	1,097
WV	2002	03	FUEL COMB. OTHER	29,480	13	15,220	3,813	3,683	3,990	9,275
WV	2002	04	CHEMICAL & ALLIED PRODUCT MFG	50,835	80	1,627	950	831	9,052	5,755
WV	2002	05	METALS PROCESSING	28,837	143	1,641	7,275	6,685	5,619	1,393
WV	2002	06	PETROLEUM & RELATED	1	0	1,086	475	475	7,550	2,163
WV	2002	07	OTHER INDUSTRIAL PROCESSES	2,003	56	5,347	17,363	4,872	2,316	1,803
WV	2002	08	SOLVENT UTILIZATION	15	0	18	49	44	0	35,989
WV	2002	09	STORAGE & TRANSPORT	15	0	3	1,952	947	0	13,479
WV	2002	10	WASTE DISPOSAL & RECYCLING	39,383	8	1,487	7,169	6,748	100	7,156
WV	2002	11	HIGHWAY VEHICLES	560,717	1,933	59,612	1,395	1,003	2,489	40,066
WV	2002	12	OFF-HIGHWAY	119,089	10	34,442	2,072	1,941	2,305	14,805
WV	2002	14	MISCELLANEOUS	2,828	10,725	61	95,496	16,785	16	157
	<b>2002 Total</b>			852,228	13,079	385,346	144,143	47,556	586,631	134,320
WV	2009	01	FUEL COMB. ELEC. UTIL.	12,371	673	174,608	31,783	25,254	246,854	1,401
WV	2009	02	FUEL COMB. INDUSTRIAL	9,179	101	28,092	1,384	1,203	35,304	987
WV	2009	03	FUEL COMB. OTHER	27,941	15	15,864	3,698	3,563	4,293	7,613
WV	2009	04	CHEMICAL & ALLIED PRODUCT MFG	58,271	82	1,804	986	863	10,166	5,426
WV	2009	05	METALS PROCESSING	30,939	142	1,666	7,110	6,489	5,953	1,376
WV	2009	06	PETROLEUM & RELATED	1	0	1,218	533	533	8,471	2,168
WV	2009	07	OTHER INDUSTRIAL PROCESSES	2,288	59	4,995	17,500	5,076	2,570	2,064
WV	2009	08	SOLVENT UTILIZATION	17	0	20	52	47	0	34,996
WV	2009	09	STORAGE & TRANSPORT	17	0	3	846	545	0	11,532
WV	2009	10	WASTE DISPOSAL & RECYCLING	39,119	8	1,470	7,066	6,649	97	6,957
WV	2009	11	HIGHWAY VEHICLES	385,994	2,183	36,049	1,096	703	227	23,907
WV	2009	12	OFF-HIGHWAY	138,999	11	31,148	1,819	1,699	392	14,249
WV	2009	14	MISCELLANEOUS	2,836	11,405	61	94,433	16,241	16	159
	<b>2009 Total</b>			707,972	14,682	296,999	168,307	68,866	314,342	112,833
WV	2018	01	FUEL COMB. ELEC. UTIL.	13,042	719	42,269	24,257	17,551	111,941	1,461
WV	2018	02	FUEL COMB. INDUSTRIAL	9,938	114	29,599	1,455	1,261	36,885	1,062
WV	2018	03	FUEL COMB. OTHER	26,891	18	18,097	3,577	3,439	4,461	7,041
WV	2018	04	CHEMICAL & ALLIED PRODUCT MFG	70,252	99	2,183	1,188	1,041	12,280	6,560
WV	2018	05	METALS PROCESSING	36,850	183	2,153	9,062	8,314	7,182	1,790
WV	2018	06	PETROLEUM & RELATED	1	0	1,378	603	603	9,581	2,325
WV	2018	07	OTHER INDUSTRIAL PROCESSES	2,756	68	5,949	19,353	5,844	3,101	2,561
WV	2018	08	SOLVENT UTILIZATION	20	0	24	60	55	0	41,450
WV	2018	09	STORAGE & TRANSPORT	19	0	4	1,041	682	0	10,701
WV	2018	10	WASTE DISPOSAL & RECYCLING	39,225	10	1,479	7,151	6,708	98	7,331
WV	2018	11	HIGHWAY VEHICLES	319,030	2,484	16,274	844	428	255	15,463
WV	2018	12	OFF-HIGHWAY	152,932	13	26,279	1,381	1,284	56	9,500
WV	2018	14	MISCELLANEOUS	2,830	12,326	61	100,179	17,422	16	158
	<b>2018 Total</b>			673,787	16,035	145,748	170,151	64,632	185,853	107,402
<b>VISTAS</b>	<b>2002 Total</b>			<b>30,836,927</b>	<b>686,030</b>	<b>5,429,133</b>	<b>4,008,366</b>	<b>1,285,356</b>	<b>4,791,599</b>	<b>5,096,205</b>
<b>VISTAS</b>	<b>2009 Total</b>			<b>25,576,458</b>	<b>748,128</b>	<b>4,118,204</b>	<b>4,318,140</b>	<b>1,388,778</b>	<b>3,210,593</b>	<b>4,137,307</b>
<b>VISTAS</b>	<b>2018 Total</b>			<b>24,106,779</b>	<b>819,705</b>	<b>2,667,922</b>	<b>4,663,948</b>	<b>1,436,690</b>	<b>2,441,073</b>	<b>3,902,513</b>

## Appendix D: VISTAS Tier 1 Emission Totals

Year	TIER1	TIER 1 NAME	CO	NH <sub>3</sub>	NO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	VOC
2002	01	FUEL COMB. ELEC. UTIL.	143,446	393	1,528,735	115,948	81,468	3,743,710	12,505
2002	02	FUEL COMB. INDUSTRIAL	401,531	1,554	513,824	112,771	83,263	457,515	33,280
2002	03	FUEL COMB. OTHER	786,654	2,801	123,049	102,079	70,500	114,434	416,799
2002	04	CHEMICAL & ALLIED PRODUCT MFG	131,983	7,093	20,366	11,035	7,976	77,450	112,761
2002	05	METALS PROCESSING	224,959	601	11,907	30,504	27,128	49,376	17,637
2002	06	PETROLEUM & RELATED INDUSTRIES	44,572	355	7,178	2,714	1,795	53,393	33,366
2002	07	OTHER INDUSTRIAL PROCESSES	158,490	7,533	120,669	262,110	92,864	97,623	199,300
2002	08	SOLVENT UTILIZATION	1,044	332	5,675	4,347	3,848	92	1,300,735
2002	09	STORAGE & TRANSPORT	610	85	1,069	10,268	5,711	230	322,983
2002	10	WASTE DISPOSAL & RECYCLING	1,017,145	805	42,589	138,543	132,951	6,398	131,779
2002	11	HIGHWAY VEHICLES	20,199,593	74,325	2,193,387	50,584	35,929	88,684	1,778,345
2002	12	OFF-HIGHWAY	5,561,919	429	815,915	71,903	67,936	91,168	609,367
2002	14	MISCELLANEOUS	2,164,979	589,725	44,770	3,095,561	673,984	11,525	127,347
<b>2002 Total</b>			<b>30,836,927</b>	<b>686,030</b>	<b>5,429,133</b>	<b>4,008,366</b>	<b>1,285,356</b>	<b>4,791,599</b>	<b>5,096,205</b>
2009	01	FUEL COMB. ELEC. UTIL.	168,910	8,797	1,126,479	214,213	172,561	2,300,703	13,078
2009	02	FUEL COMB. INDUSTRIAL	420,044	1,752	475,797	104,947	77,632	451,318	33,569
2009	03	FUEL COMB. OTHER	636,976	3,158	133,644	90,837	66,810	93,441	254,891
2009	04	CHEMICAL & ALLIED PRODUCT MFG	140,778	7,611	21,651	11,935	8,633	84,677	129,338
2009	05	METALS PROCESSING	244,795	732	12,101	29,378	26,029	55,115	19,761
2009	06	PETROLEUM & RELATED INDUSTRIES	47,692	372	7,809	3,069	2,034	54,169	24,938
2009	07	OTHER INDUSTRIAL PROCESSES	167,229	7,531	118,457	282,677	98,768	100,673	205,534
2009	08	SOLVENT UTILIZATION	1,180	356	6,625	4,791	4,216	99	1,317,828
2009	09	STORAGE & TRANSPORT	717	98	1,176	8,203	4,713	255	276,149
2009	10	WASTE DISPOSAL & RECYCLING	1,057,774	928	45,215	144,736	138,498	7,325	133,456
2009	11	HIGHWAY VEHICLES	14,353,436	87,703	1,408,206	42,370	26,848	8,817	1,146,174
2009	12	OFF-HIGHWAY	6,171,856	474	716,257	62,060	58,577	42,476	454,034
2009	14	MISCELLANEOUS	2,165,071	628,615	44,788	3,318,923	703,456	11,526	128,557
<b>2009 Total</b>			<b>25,576,458</b>	<b>748,128</b>	<b>4,118,204</b>	<b>4,318,140</b>	<b>1,388,778</b>	<b>3,210,593</b>	<b>4,137,307</b>
2018	01	FUEL COMB. ELEC. UTIL.	226,089	13,049	509,373	192,921	150,054	1,419,033	15,064
2018	02	FUEL COMB. INDUSTRIAL	457,828	1,985	512,278	116,856	87,553	480,983	36,918
2018	03	FUEL COMB. OTHER	566,637	3,429	146,507	86,073	65,023	130,971	188,386
2018	04	CHEMICAL & ALLIED PRODUCT MFG	173,709	9,023	26,072	14,745	10,671	100,881	166,610
2018	05	METALS PROCESSING	289,668	961	15,085	36,567	32,534	67,608	25,116
2018	06	PETROLEUM & RELATED INDUSTRIES	51,093	396	8,733	3,534	2,336	59,383	26,879
2018	07	OTHER INDUSTRIAL PROCESSES	191,241	8,763	138,189	330,251	116,061	115,846	241,103
2018	08	SOLVENT UTILIZATION	1,423	397	8,415	5,781	5,052	113	1,584,784
2018	09	STORAGE & TRANSPORT	875	120	1,367	9,833	5,631	307	260,418
2018	10	WASTE DISPOSAL & RECYCLING	1,109,042	1,142	48,896	153,303	146,150	8,680	145,545
2018	11	HIGHWAY VEHICLES	12,052,347	101,223	639,931	33,884	17,080	10,027	713,143
2018	12	OFF-HIGHWAY	6,821,290	555	568,258	51,127	48,075	35,713	368,343
2018	14	MISCELLANEOUS	2,165,538	678,662	44,820	3,629,072	750,469	11,526	130,205
<b>2018 Total</b>			<b>24,106,779</b>	<b>819,705</b>	<b>2,667,922</b>	<b>4,663,948</b>	<b>1,436,690</b>	<b>2,441,073</b>	<b>3,902,513</b>

## Changes made to VISTASv2 2002 Inventory to make it a Georgia CERR 2002 Inventory

1. Incorporated Hartsfield Inventory Data from the Hartsfield-Jackson Atlanta International Airport Aircraft/Ground Support Equipment (GSE) Emission Inventories 2002, 2004, 2005. Prepared for City of Atlanta Department of Aviation by Environmental Science Associates (ESA) January 2004. EPD substituted the CO, NO<sub>x</sub>, SO<sub>2</sub> and VOC emissions for SCC 227502000 (commercial aircraft), 2275001000 (military aircraft), 2275050000 (general aviation, or GA) and 2275060000 (air taxi). EPD placed a zero for PM<sub>2.5</sub> and PM<sub>10</sub> because no estimates for them were available, and also changed the county for the airport from Fulton County (13121) to Clayton County (13063) since the vast majority of the airport is in Clayton County. For Fulton County (13121), EPD used 1999 NO<sub>x</sub>, CO, and VOC (no SO<sub>2</sub> or PM) emissions for year 2002 all in GA 2275050000.

EPD put Hartsfield's GSE emissions in the diesel slot (2270008005) in Clayton County and zeroed out the diesel emissions in Fulton County. All other GSE emissions were left the same because they were nominal.

2. EPD updated the VISTAS nonroad inventory to include Industrial Residual Oil (2102005000), Industrial Natural Gas (2102006000), Residential Natural Gas (2104006000), Industrial Coal (2102002000), Industrial Distillate Oil (2102004000), Commercial Natural Gas (2103006000), Architectural Surface Coating (2401002000), (2401003000), Pesticide Application (2461800000), Dry Cleaning (2420010000), Small Industrial Surface Coating (2401015000), (2401040000), (2401045000), (2401055000), (2401060000), (2401065000), (2401070000), (2401080000), (2401090000), (2401100000), and Other Special Purpose Coatings (2401200000). EPD did not include SCCs (2401020000), (2401025000), (2401075000), and (2401085000) in the small industrial surface coating category because those SCCs had been previously combined and EPD did not want to separate them. EPD both appended records and updated records in the VISTAS file. All SCCs were represented in the VISTAS file, EPD simply had more county SCC combinations than the VISTAS file so an append was done.
3. The mobile source emissions that EPD submitted for the 25 Georgia counties with vehicle inspection/maintenance and/or state fuel controls differ somewhat from those calculated by the VISTAS contractor. These counties are listed below:

13013	Barrow
13015	Bartow
13035	Butts
13045	Carroll
13057	Cherokee
13063	Clayton
13067	Cobb
13077	Coweta
13085	Dawson
13089	DeKalb
13097	Douglas
13113	Fayette
13117	Forsyth
13121	Fulton

13135	Gwinnett
13139	Hall
13143	Haralson
13151	Henry
13157	Jackson
13217	Newton
13223	Paulding
13227	Pickens
13247	Rockdale
13255	Spalding
13297	Walton

The contractor had a need for "processing of the State and local inputs in a consistent manner," but Georgia's mobile source inventory methodology for these 25 counties differed in the following ways:

#### Temperature, Humidity, and Barometric Pressure

Default absolute humidity was used in earlier MOBILE6 emissions modeling for Georgia. As reflected in the emissions submitted for these 25 counties, EPD later switched to hourly input of average temperature and relative humidity data. The information used for these inventories, obtained from National Weather Service Local Climatological Data for Hartsfield-Atlanta International Airport, is the hourly average temperature and relative humidity for each month of 2002. Average daily barometric pressure ("station pressure") for each month was used.

#### MOBILE6 Driving Cycle

Another departure from the VISTAS methodology is the use of the AVERAGE SPEED command. For emission modeling in these 25 counties EPD overrode the default VMT-by-facility-type (a.k.a. driving cycle) fractions, and instead produced emission factors for travel that occurs entirely in one driving cycle. For example, interstate emission factors were modeled as 100% non-ramp freeway, arterial factors as 100% arterial/collector, etc. For these county-and-functional-classification-level (as opposed to link-level) inventories in the 25-county area, emissions from ramp travel were calculated using the MOBILE6 default assumption that 8% of interstate, freeway, and rural principal arterial travel is on ramps.

Finally, the emissions and activity data for these 25 counties were reported at a more aggregate SCC level than was used by the VISTAS contractor. EPD used 96 SCC codes, one for each of 12 roadway functional classifications and eight vehicle types.