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Appendix E

Emissions Inventory Documentation

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Appendix E.1

MARAMA Alpha2 Technical Support Document

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EMISSION INVENTORY DEVELOPMENT FOR 2011, 2018 AND 2028 FOR THE NORTHEASTERN U.S. ALPHA2 VERSION

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ACRONYMS

AEO	Annual Energy Outlook
APU	Auxiliary Power Unit
CAMD	EPA Clean Air Markets Division
CAP	Criteria Air Pollutant
CDB	County Database
CEM	Continuous Emission Monitoring
CMV	Commercial Marine Vessel
CO	Carbon Monoxide
CoST	Control Strategy Tool
CSAPR	Cross-state Air Pollution Rule
EGU	Electric Generating Unit
EIA	Energy Information Agency
EIS	Emission Inventory System
EMF	Emission Modeling Framework
EPA	Environmental Protection Agency
ERTAC	Eastern Regional Technical Advisory Committee
FAA	Federal Aviation Administration
GSE	Ground Support Equipment
HAP	Hazardous Air Pollutant
ICI	Industrial/commercial/institutional
IPM	Integrated Planning Model
LTO	Landing Takeoff
MACT	Maximum Achievable Control Technology
MANE-VU	Mid-Atlantic/Northeast Visibility Union
MARAMA	Mid-Atlantic Regional Air Management Association
mmBtu	Million British Thermal Units
NAAQS	National Ambient Air Quality Standard
NAICS	North American Industrial Classification System
NCD	National County Database
NEI	National Emission Inventory
NEI2011v1	Version 1 of the 2011 National Emission Inventory
NEI2011v2	Version 2 of the 2011 National Emission Inventory
NEI2018v1	Version 1 of the 2018 National Emission Inventory
NEMS	National Energy Modeling System
NERC	North American Electric Reliability Corporation
NH3	Ammonia
NMIM	National Mobile Inventory Model
NOx	Oxides of Nitrogen
OTC	Ozone Transport Commission

PM10	Particles with diameter less than or equal to 10 micrometers
PM2.5	Particles with diameter less than or equal to 2.5 micrometers
RICE	Reciprocating Internal Combustion Engines
RWC	Residential Wood Combustion
S/L/T	State/local/tribal
SCC	Source Classification Code
SIP	State Implementation Plan
SMOKE	Sparse Matrix Operator Kernel Emissions
SO2	Sulfur Dioxide
TAF	Terminal Area Forecast
TSD	Technical Support Document
UAF	Unit Availability File
VMT	Vehicle Miles Travelled
VOC	Volatile Organic Compound

1. INTRODUCTION

The Mid-Atlantic Regional Air Management Association (MARAMA) is coordinating the development of Northeastern regional emissions inventories for air quality modeling. This Technical Support Document (TSD) describes the development of a comprehensive Northeastern regional emission inventory for 2011 and emission projections for 2018 and 2028[1]. State, Local, and Tribal (S/L/T) air agencies may use these inventories to address State Implementation Plan (SIP) requirements for attaining national ambient air quality standards (NAAQS) for ozone and fine particles, to evaluate progress towards long-term regional haze goals, and to support a single integrated, one-atmosphere air quality modeling platform.

Key inventory attributes include:

- **Base Year**: 2011
- **Projection Years**: 2018 and 2028
- **Source Category Sectors**: electric generating unit (EGU) point sources, other point sources, nonpoint sources, nonroad mobile sources included in the NONROAD model, other nonroad sources (aircraft, locomotives, commercial marine vessels), onroad mobile sources included in the MOVES model, fire events, and biogenic sources
- **Pollutants**: ammonia (NH3), carbon monoxide (CO), oxides of nitrogen (NOx), filterable plus condensable particles with diameter less than or equal to 10 and 2.5 micrometers (PM10 and PM25), sulfur dioxide (SO2), and volatile organic compounds (VOC)
- **Temporal Resolution**: Annual
- **Geographic Area**: 15 jurisdictions in the Northeastern U.S. (CT, DC, DE, MA, MD, ME, NC, NH, NJ, NY, PA, RI, VA, VT, WV); additional states, Canadian provinces, and off-shore sources are included in the complete modeling inventory for the Northeastern domain, however, this detailed documentation is only for the states in the Northeastern US in this document.

The guiding philosophy behind the development of the 2011 inventory was to rely as much as possible on the collaborative work performed by the S/L/T air agencies and the U.S. Environmental Protection Agency (EPA) in developing a 2011-based Modeling Platform. The EPA's 2011 Modeling Platform consists of emissions inventory data, supporting data, and methods used to process the 2011 National Emissions Inventory (NEI) and related data into a form useful for air quality modeling. EPA compiles the NEI primarily using data submitted by S/L/T agencies via the Emissions Inventory System (EIS). These S/L/T agencies collaborated extensively with EPA to avoid duplication of effort, use consistent data and methodologies, avoid duplication between categories, ensure completeness and improve data quality.

S/L/T agencies and EPA continue to refine the 2011 Modeling Platform. EPA released Version 1 of the 2011 NEI (referred to as 2011NEIv1) on November 27, 2013. EPA published extensive

[1] MARAMA intends to develop a 2017 inventory in response to the court ruling that resulted in the 2008 NAAQS attainment deadlines being moved up by one year.

documentation and asked S/L/T agencies and stakeholders to provide any necessary updates to the inventory or the model inputs used to develop mobile source emission inventories. EPA addressed comments and released a preliminary Version 2 (NEI2011v2) for most stationary source categories in October 2014. They then updated this preliminary Version 2 and provided updated files to MARAMA in December 2014.

For the 2018 and 2028 inventories, the guiding philosophy was to use a combination of S/L/T data and methods for projecting emissions from stationary sources and to rely on EPA's 2018/2028 Modeling Platform for mobile source emission projections. EPA released NEI2018v1 on January 14, 2014. EPA developed emission projections for EGUs using the Integrated Planning Model (IPM). Over the past few years, S/L/T agencies have developed an alternative EGU modeling approach under the direction of the Eastern Regional Technical Advisory Committee (ERTAC). Northeastern S/L/T agencies plan to use the ERTAC tool for forecasting EGU emissions to substitute for EPA IPM-based forecasts. In earlier versions of the NEI2011, EPA used a "no-growth" approach that essentially flat-lines future year emissions for many non-EGU point and nonpoint stationary source categories. Northeastern S/L/T agencies prefer to use growth and control factors developed by MARAMA within the Emission Modeling Framework (EMF) tool to project emissions as a better representation of future year emissions. EPA has now adopted the MARAMA state-supplied growth factors for most categories.[2] For mobile sources, the Northeastern S/L/T agencies have coordinated with EPA in developing the model inputs that EPA uses with the NONROAD and MOVES models to project future emissions.

The development of the 2011 inventory and emission projections is an iterative process. Northeastern S/L/T agencies have developed this ALPHA2 version of the 2011/2018/2028 inventories using the best data currently available. Figure 1 summarizes the data sources used for each source sector of the ALPHA2 inventory. Figure 1 shows the date when MARAMA received each of the files used in this inventory. Updates to the inventory made by USEPA after that point are not reflected in this inventory. MARAMA and S/L/T agencies may develop future versions of the Northeastern regional emission inventory when significant revisions are necessary.

This TSD contains the following Sections:

- **Section 1** is an introduction to the TSD
- **Section 2** documents the development of the 2011 inventory for all source sectors
- **Section 3** documents the development of the 2018 and 2028 inventories for all source sectors
- **Section 4** summarizes the quality assurance and quality control (QA/QC) activities
- **Section 5** identifies the data files that make up the inventory
- **Section 6** provides data summaries

Note that the guiding philosophy for this effort was to take advantage of available EPA data and to avoid duplication of effort. Thus, this TSD does not attempt to duplicate documentation that is already available in EPA reports. Rather, it provides a brief summary of existing EPA documentation with references to the

[2] One exception is Oil and Gas sources where USEPA used a uniform approach across all states.

appropriate EPA sections. The referenced documents are available on the MARAMA website (http://www.marama.org/technical-center/emissions-inventory/2011-inventory-and-projections).

Figure 1: Data Sources for 2011, 2018 and 2028 Inventories by Source Sector

MARAMA Sector	Source for 2011 Inventory	Source for 2018 Inventory	Source for 2028 Inventory
Point - ERTAC EGUs	ERTAC V2.3 with growth factors set at 1.0 for NOx and SO2. State provided emission rates for other pollutants	ERTAC V2.3 for NOx and SO2, with state provided emission rates for other pollutants	ERTAC V2.3 for NOx and SO2, with state provided emission rates for other pollutants
Point – Small EGUs	NEI2011v2	NEI2011v2 projected to 2018 using growth and control factors within the EMF tool	NEI2011v2 projected to 2028 using growth and control factors within the EMF tool
Point – Aircraft Engines, Ground Support Equipment, Auxiliary Power Units	NEI2011v2	NEI2011v2 projected to 2018 using FAA growth factors within the EMF tool	NEI2011v2 projected to 2018 using FAA growth factors within the EMF tool
Point - Other Sources	NEI2011v2	NEI2011v2 projected to 2018 using growth and control factors within the EMF tool	NEI2011v2 projected to 2028 using growth and control factors within the EMF tool
Nonpoint – Area Sources	NEI2011v2	NEI2011v2 projected to 2018 using growth and control factors within the EMF tool	NEI2011v2 projected to 2028 using growth and control factors within the EMF tool
Nonroad – Commercial Marine Vessels and Railroad Locomotives	NEI2011v2	NEI2011v2 projected to 2018 using growth and control factors within the EMF tool	NEI2011v2 projected to 2028 using growth and control factors within the EMF tool
Nonroad – NONROAD Model	NEI2011v1 NONROAD Model	NEI2018v1 NONROAD Model	NEI2025v2 NONROAD Model
Onroad – MOVES Model	NEI2011v2 MOVES Model	NEI2018v2 MOVES Model	NEI2025v2 MOVES Model
Fire Events	NEI2011v2	NEI2011v2 (using 2011 inventory for 2018)	NEI2011v2 (using 2011 inventory for 2028)
Biogenic	EPA BEIS	EPA BEIS (using 2011 inventory for 2018)	EPA BEIS (using 2011 inventory for 2018)
Canadian Sources	Canada 2010	Applied the average change in emissions that is expected to occur in the Eastern modeling domain between 2011 and 2018 by pollutant and sector	Applied the average change in emissions that is expected to occur in the Eastern modeling domain between 2011 and 2028 by pollutant and sector

Note: the specific files used for each sector and year are provided in Section 6.

2. 2011 BASE YEAR INVENTORY DEVELOPMENT

The 2011 Northeastern emission inventory relies extensively on the 2011 NEI. The NEI is prepared every three years by the EPA based primarily upon emission estimates and emission model inputs provided by S/L/T air agencies for sources in their jurisdictions. EPA supplements the S/L/T data with data from emissions trading programs such as the Acid Rain Program and other data collected as part of EPA regulatory development projects. EPA executes various emission estimation models, blends data from these multiple sources, and performs quality assurance steps that further enhance and augment the S/L/T data.

The Northeastern regional emission inventory includes all air pollution sources categorized into eight sectors. MARAMA defined these sectors to be consistent with the historical way in which S/L/T agencies have organized past inventories and to allow consistent comparison of base year and future year inventories. These sectors include:

- **ERTAC EGU Point Sources**. This sector includes emission units located primarily at electric power plants that are included in the ERTAC EGU forecasting tool. These sources are required to report continuous emission monitoring (CEM) data to EPA's Clean Air Market Division (CAMD) under 40 CFR Part 75. Generally, these units burn fossil fuel and serve a generator of more than 25 MW. They are required to report emissions and activity data at an hourly resolution as required by Part 75 and are included in the ERTAC EGU forecasting tool output. Air quality modeling uses the hourly emissions data for these units to accurately reflect the temporal variation in emissions.
- **Small EGU Point Sources**. This sector includes EGUs that are NOT included in the ERTAC EGU Projection Tool but are included in EPA's IPM scenarios.
- **NonEGU Point Sources**. This sector includes facilities and sources located at a fixed, stationary location. Other point sources include larger industrial, commercial and institutional facilities.
- **Aircraft/GSE/APU Point Sources**. This sector includes emissions from aircraft engines, ground support equipment (GSE) and auxiliary power units (APUs) that are identified as point sources (e.g., emissions are located at specific airport locations).
- **Nonpoint Sources**. This sector includes sources which individually are too small in magnitude or too numerous to inventory as individual point sources. Nonpoint sources include smaller industrial, commercial and institutional facilities, as well as residential sources. S/L/T agencies and EPA estimate nonpoint emissions at the county level. This sector does not include locomotive emissions outside of the rail yards and commercial marine vessel emissions, which are included in the nonroad sector described below.
- **Nonroad Sources in the NONROAD Model**. This category contains mobile sources included in NONROAD model within the National Mobile Inventory Model (NMIM). Nonroad emissions result from the use of fuel in a diverse collection of vehicles and equipment such as construction equipment, recreational vehicles, and landscaping equipment.
- **Rail/CMV Nonroad Sources**. This category includes internal combustion engines used to propel commercial marine vessels (CMV) and locomotives.
- **Onroad Sources**. This category contains mobile sources included in the MOVES model. Onroad emissions result from the combustion and evaporation of fuel used by motorized

vehicles that are normally operated on public roadways. This includes passenger cars, motorcycles, minivans, sport-utility vehicles, light-duty trucks, heavy-duty trucks, and buses.

- **Fire Sources**. This source category includes sources of pollution caused by the inadvertent or intentional burning of biomass including forest, rangeland (e.g., grasses and shrubs), and agricultural vegetative residue.
- **Biogenic Sources**. This category includes emissions from vegetation and soils that are computed via a model that utilizes spatial information on vegetation and land use, and environmental conditions of temperature and solar radiation.

See Section 5 of this TSD for a discussion of how these sectors relate to the individual inventory datasets included in the EMF.

The development of the 2011 Northeastern regional emission inventory is an ongoing, iterative process. In 2012, S/L/T agencies submitted emissions data or model inputs representative of 2011 for each source sector. EPA provided feedback to the S/L/T agencies on data quality such as suspected outliers and missing data by comparing to previously established emissions ranges and past inventories. In addition, EPA augmented the S/L/T data using various sources of data and augmentation procedures.

In late 2013, EPA provided notice that Version 1 of the 2011 inventory was available for public review and comment. S/L/T agencies and other stakeholders submitted comments on Version 1 of the 2011 NEI in March of 2014.

EPA addressed S/L/T agency and stakeholder comments and released a preliminary Version 2 (NEI2011v2) for most stationary source categories in October/November 2014, which is the basis for this inventory. EPA provided documentation of the NEI2011v2 (EPA, 2015a) and documentation of the 2011 Emission Modeling Platform (EPA, 2015b) in August 2015.

2.1. Point Sources

Point sources are emission sources for which specific geographic coordinates (e.g., latitude/longitude) are specified, as in the case of an individual facility. A facility may have multiple emission release points such as boilers, furnaces, spray booths, kilns, etc. A unit may have multiple processes (e.g., a boiler that sometimes burns residual oil and sometimes burns natural gas).

S/L/T agencies are primarily responsible for developing the point source inventory using annual emissions statement reports submitted by the owners of the source of air pollution. Individual S/L/T agencies compile and quality assure the industry submittals, and maintain substantial databases of both small and large air emission sources. Individual S/L/T agencies maintain full documentation on point sources and emissions located in their jurisdictions. Please consult the individual S/L/T agency website for detailed documentation on how S/L/T agencies develop their point source emission inventories.

S/L/T agencies submitted their 2011 point source data to EPA's EIS, which stores the S/L/T data in a common format and includes hundreds of automated QA checks to help improve data quality. EPA collaborated extensively with S/L/T agencies to ensure a very high quality of data in the 2011 inventory. EPA reviewed the S/L/T submittals and provided feedback on data quality such as suspected outliers and missing data by comparing to previously established emissions ranges and past inventories. EPA augmented the S/L/T data to fill gaps. In some cases data for gap filling came from other emission reporting programs including the CAMD CEM database under 40 CFR Part 75 and from EPA's regulatory development projects.

The APLHA2 Version of the Northeast regional emission inventory relies upon NEI2011v2. The point source inventory is sub-divided into several inventory files to facilitate emission projections and summarization. Section 5 provides a discussion of how the individual inventory files are associated with the MARAMA emission summary sectors.

2.1.1.ERTAC EGUs

This subsector generally includes boilers, combustion gas turbines, combined cycle units, and reciprocating engines used for turning an electrical generator that is connected to the electrical grid that report emissions to the CAMD CEM database. In general, the unit size cut off for inclusion in this subsector is 25 MW. Smaller units may be included upon state request. There were two primary sources of data for the EGU sector: the S/L/T submitted data included in the NEI and data from EPA's continuous emission monitoring (CEMs) database. This data is regularly and extensively reviewed and updated by S/L/T staff.

For the Northeastern regional emission inventory, point sources are assigned to the EGU sector based on the methodology used to project emissions. The Northeastern S/L/T agencies decided on this categorization to allow for an apples-to-apples comparison of base year emissions to future year projections. The Northeastern S/L/T agencies are using the ERTAC emission projection methodology to grow base year hourly EGU air emissions inventories into future projection years. The ERTAC forecasting tool is an alternative to the IPM that EPA uses to forecast emissions from EGUs.

While both the ERTAC forecasting tool and IPM project emissions from EGUs, the emission units included in each model are not identical. The ERTAC forecasting tool uses data reported to CAMD at an hourly resolution to develop future year activity and emissions profiles for EGUs required to report hourly data under 40 CFR Part 75. These are generally fossil fuel fired units serving a generator of at least 25 MW. The IPM model provides estimates of activity for units in the NEEDS database, which is a larger universe of sources that use fossil fuels as well as renewable fuels and includes non-emitting power sources such as nuclear and hydro-electric generating units. Units modeled by IPM may be much smaller than 25 MW. However, the IPM model provides only annual and seasonal resolutions for projections. The EPA NEI 2011 classifies point sources as EGUs included in IPM and all other nonIPM point sources. The ERTAC forecasting tool and the Northeast regional emission inventory as either use different classification schemes – certain units included in the ERTAC forecasting tool's Unit Availability File (UAF) and all other point sources.

SRA developed a cross-reference file (see Appendix A) to match units in the ERTAC UAF (see Appendix B) with records in the NEI2011v2 for each of the jurisdictions covered by the Northeast regional emissions inventory. ORIS facility and boiler identifiers are used to link units in the ERTAC UAF to the matching units in the EPA point source files. SRA also compared the facility names and counties for agreement, and compared the magnitudes of the SO_2 and NO_x emissions for all preliminary matches. S/L/T agencies reviewed the crosswalk and made revisions to correct discrepancies.

SRA used the final cross-reference file to re-distribute the NEI2011v2 point source files into two Northeast regional point source files – one file containing point sources included in the ERTAC EGU forecasting tool, and a second file containing all other units. Note that although the ERTAC UAF contains units flagged as either EGU or nonEGU, only the units flagged as EGU are included in the EGU forecasting tool projections. As a result, the units flagged as nonEGU in the UAF were moved to the "other" point source file.

The ERTAC EGU forecasting tool uses the CEM data as a starting point. The CEM data includes hourly emissions variability from two sources: (1) variability in emission rate due to changes in fuel quality or control devise performance and (2) variability in emissions due to change in load. ERTAC EGU forecasting tool preserves variability due to change in load. Emission rate changes are not preserved, rather an average Ozone Season and Non-Ozone season rate are used. Therefore, to estimate base year 2011 emissions on the same basis as future year emissions, the ERTAC tool was run where Future Year = Base Year = 2011 to estimate 2011 emissions. For this run growth factors were set to 1 and retirements and fuel switches were removed. This allowed the code to project a "future" year that was identical to the base year (2011).

2.1.2. Other Point Sources

Once the NEI2011v2 point source inventory was distributed into ERTAC and non-ERTAC sources, we further subdivided the non-ERTAC inventory and augmented it with additional sources that EPA identified as missing from the NEI2011v2 point source inventory. The following sub-sections describe the individual inventory files that make up the non-ERTAC portion of the point source inventory.

2.1.2.1. "Small EGU" Sources

ERTAC staff members further redistributed the non-ERTAC sources to separate "small EGU" sources and the remaining non-ERTAC sources. The "small EGU" file contains sources that are included in EPA's IPM modeling but not included in the ERTAC forecasting tool. Examples of these "small EGU" are sources such as EGUs fueled by wood, municipal waste combustors, and non-EGUs such as combustion units at smelters, paper mills, and petroleum refineries. These "small EGUs" were identified so that an "apples-to-apples" comparison could be made between the IPM and ERTAC projections.

2.1.2.2. On-Shore Oil & Gas Production Facilities

Larger oil and gas production facilities are included in the point source inventories, and are subtracted from the total calculated using the nonpoint Oil and Gas tool to avoid double counted emissions. EPA extracted point source processes from the NEI2011v2 and included them in a separate inventory file to assist the S/L/T agencies with the point source subtraction. EPA extracted oil and gas production processes based on the NAICS codes corresponding to the oil and gas sector. This was done differently in 2011v2 than in the 2011v1 platform and resulted in more sources and emissions in the point source oil and gas sector and fewer sources and emissions in the other point source sectors. Thus, the emissions and other source characteristics in the point oil and gas sector are entirely state-submitted data. See Section 2.1.2 of the EPA 2011 Modeling Platform TSD (EPA, 2015b) for additional documentation of the on-shore oil and gas production point source inventory.

2.1.2.3. Other S/L/T Sources

This subsector includes the point sources that remained after the redistribution of the ERTAC EGUs, small EGUs, and oil and gas production facilities into separate point source files. Sources included in this sector include industrial/commercial/institutional boilers and engines; industrial processes such as cement manufacturing and petroleum refining; surface coating facilities; organic liquids storage and transfer; and waste disposal facilities. The inventory for these sources primarily uses data collected from the affected sources by the applicable S/L/T agencies.

Note that EPA includes certain mobile sources located at airports and rail yards as point sources. EPA does this to locate the emission sources geographically by latitude and longitude. Later sections of this document describe the methodology for estimating emissions from airports and rail yards.

2.1.2.4. Ethanol Production Facilities

As part of its rule development work, EPA developed a list of corn ethanol facilities for 2011. Many of these ethanol facilities were included in the 2011NEIv2. EPA believes that some of these sources were not included in the NEI as point sources because they did not meet the 100 ton/year potential-to-emit threshold for NEI point sources. EPA added these sources to the 2011NEIv2. Most of these additional corn ethanol facilities were located in the Midwestern states, but two were located in New York (Western New York Energy LLC and Sunoco Fulton Ethanol Plant). See Section 2.1.3 of the EPA 2011 Modeling Platform TSD (EPA, 2015b) for further documentation.

2.1.2.5. Offshore Oil & Gas Drilling Platforms

EPA augments the point source sector by including point source offshore oil and gas drilling platforms that are beyond U.S. state-county boundaries in the Gulf of Mexico. Since the sources are not adjacent to the Northeast regional emission inventory domain, no further discussion of EPA's augmentation procedures is presented here.

2.1.2.6. Portable Sources

Some S/L/T agencies include portable equipment used primarily in the construction industry in their point source inventories. This includes processes such as portable aggregate crushers and asphalt hot mix plants. These sources tend to move throughout the year and S/L/T agencies cannot precisely locate them by latitude/longitude or county. Emissions from these sources are assigned to "777" counties since their precise location changes through the year. There were no emissions from sources in "777" counties in the Northeastern U.S. domain; all emissions from "777" counties were outside of the Northeastern U.S. domain and were very small compared to the emissions from other point sources.

2.1.3. EPA Pollutant Augmentation

EPA augmented the S/L/T point source submissions using various sources of data and augmentation procedures to ensure consistent and complete accounting of all pollutants. The following subsections summarize EPA's augmentation procedures for point sources.

2.1.3.1. PM Augmentation

S/L/T agencies may report particulate matter (PM) emissions in several forms:

- Condensable PM (PM-CON). Material that is vapor phase at stack conditions, but which condenses and/or reacts upon cooling and dilution in the ambient air to form solid or liquid PM immediately after discharge from the stack.
- Filterable PM10 (PM10-FIL). Particles with an aerodynamic diameter equal to or less than 10 micrometers that are directly emitted by a source as a solid or liquid at stack or release conditions and captured on the filter of a stack test train.
- Primary PM10 (PM10-PRI). Includes both filterable PM10 and condensable particles, PM10-PRI = PM10-FIL + PM-CON
- Filterable PM2.5 (PM25-FIL). Particles with an aerodynamic diameter equal to or less than 2.5 micrometers that are directly emitted by a source as a solid or liquid at stack or release conditions and captured on the filter of a stack test train.
- Primary PM2.5 (PM25-PRI). Includes both filterable PM2.5 and condensable particles, PM10-PRI = PM10-FIL + PM-CON

EPA needed to augment the S/L/T PM components to ensure completeness of the PM components and to ensure that S/L/T agency data did not contain inconsistencies. An example of an inconsistency is if the S/L/T agency submitted a primary PM2.5 value that was greater than a primary PM10 value for the same process. Commonly, the augmentation added condensable PM or PM filterable (PM10-FIL and/or PM25-FIL) where none was provided, or primary PM2.5 where only primary PM10 was provided.

In general, EPA gap-filled emissions for PM species missing from S/L/T agency inventories by applying factors to the PM emissions data supplied by the S/L/T agencies. The resulting methodology allows EPA to derive missing PM10-FIL or PM25-FIL emissions from incomplete S/L/T agency submissions based on the SCC and PM controls that describe the emissions process. In cases where condensable emissions are not reported, conversion factors developed are applied to S/L/T agency reported PM species or species derived from the PM Calculator databases. See Section 3.1.2 of the EPA 2011 NEIv2 TSD (EPA, 2015a) for further documentation.

2.1.3.2. HAP Augmentation

EPA also performs extensive augmentation of S/L/T submissions to "gap fill" pollutants and sources of hazardous air pollutants (HAPs). EPA uses data from the Toxic Release Inventory (TRI) and regulatory development projects to perform the HAP augmentation. Since HAPs are not a focus of the Northeastern regional emission inventory, no further discussion of EPA's HAP augmentation procedures is presented here.

2.2. Nonpoint Sources

Nonpoint sources are small stationary sources that may not individually emit significant amounts of air pollution, but when aggregated can make an appreciable contribution to the emission inventory. The main reason not to treat them as point sources is that the effort required to gather data and estimate emissions for each individual source is great although emissions per source are generally small. S/L/T agencies and EPA group emissions from these sources into broad categories, such as residential fuel combustion or consumer solvent usage. Each of these broad groups of processes contains a number of more specific subgroups that share similar emission processes and emission estimation methods. There are literally hundreds of area source processes included in the nonpoint source inventory.

For the 2011 NEI, S/L/T agencies collaborated with EPA in developing the nonpoint source inventory. The collaboration, referred to as the ERTAC "Area Source Comparability" project, facilitated agreement on emission estimation methodologies, data source, emission factors, and SCCs for a number of important nonpoint sectors, allowing EPA to prepare the emissions estimates for all states using the group's final approaches. During the 2011 NEI inventory development cycle, S/L/T agencies could accept the ERTAC/EPA estimates to fulfill their nonpoint emissions reporting requirements. EPA encouraged S/L/T agencies that did not use EPA's estimates or tools to improve upon these "default" methodologies and submit further improved data.

The ALPHA2 Version of the Northeast regional emission inventory relies upon NEI2011v2. EPA provided NEI2011v2 nonpoint source files in October 2014. EPA has compiled extensive documentation of the nonpoint source inventory. Section 3.1.7 of the NEIv2 2011 TSD (EPA, 2015a) outlines the general approach that S/L/T agencies and EPA used in developing the nonpoint source inventory, while Sections 3.2 through 3.30 provide additional details. EPA has provided the detailed activity data and emissions factors on its Nonpoint Emissions Tools and Methods ftp site(EPA, 2015c).

For emission modeling and summarization purposes, the 2011NEIv2 nonpoint inventory are sub-divided into several inventory files, as described in the following subsections. Although EPA includes locomotives and commercial marine vessels in the 2011NEIv2 nonpoint inventory, these sources are nonroad mobile sources that are described later in this document as part of the nonroad sector. See Section 5 for a discussion of how the individual inventory files are associated with the MARAMA emission summary sectors.

2.2.1. Fugitive Dust

The nonpoint source fugitive dust inventory contains PM10 and PM2.5 emission estimates for nonpoint SCCs identified by EPA staff as dust sources. Categories included in this sector are paved roads, unpaved roads and airstrips, construction (residential, industrial, road and total), agriculture production, and mining and quarrying. The sector does not include fugitive dust from grain elevators, coal handling at coal mines, or vehicular traffic on paved or unpaved roads at industrial facilities because these are treated as point sources so they are properly located.

The fugitive dust sector is separated from other nonpoint sectors to allow for the application of a "transport fraction" and meteorological/precipitation reductions. Emission modelers apply these adjustments with a script that applies land use-based gridded transport fractions followed by another script that zeroes out emissions for days on which at least 0.01 inches of precipitation occurs or there is snow cover on the ground. The land use data used to reduce the NEI emissions determines the amount of emissions that are subject to transport. The purpose of applying the transport fraction and meteorological adjustments is to reduce the overestimation of fugitive dust in the grid modeling as compared to ambient observations.

Refer to section 2.2.1 of the 2011 Modeling Platform TSD (EPA, 2015b) for further information.

2.2.2. Agricultural Ammonia

The nonpoint source agricultural ammonia inventory contains NH3 emission estimates for nonpoint SCCs identified by EPA staff. This sector includes fertilizer - any nitrogen-based compound or mixture - that is applied to land to improve plant fitness. This category also accounts for emissions from livestock waste from domesticated animals intentionally reared for the production of food, fiber, or other goods or for the use of their labor. The livestock included in the EPA–estimated emissions include beef cattle, dairy cattle, ducks, geese, goats, horses, poultry, sheep, and swine. Refer to sections 3.3 and 3.4 of the 2011 NEIv2 TSD (EPA, 2015a) and section 2.2.2 of the 2011 Modeling Platform TSD(EPA, 2015b) for further information.

2.2.3. Oil and Gas Production

The nonpoint oil and gas sector contains emission estimates for onshore and offshore oil and gas production processes. Offshore emissions for all states and regions in this inventory are identical to the USEPA V2 estimate.

Onshore nonpoint oil and gas emissions were estimated using the new Oil and Gas ACCESS database tool. The tool is designed estimate nonpoint emissions associated with the exploration and drilling at oil and gas wells including the equipment used at the well sites to extract the product and deliver it to a central collection point or processing facility. The types of sources covered include drill rigs, workover rigs, artificial lift, hydraulic fracturing engines, pneumatic pumps and other devices, storage tanks, flares, truck loading, compressor engines, and dehydrators. EPA estimated emissions for all counties with 2011 oil and gas activity data with the Oil and Gas Tool, and many S/L/T agencies also submitted nonpoint oil and gas data.

In some cases states replaced the tool estimates with their own state estimates. In the 15 state region covered by this TSD both Pennsylvania and West Virginia used their own state estimates. These state specific estimates were also provided to USEPA for the 2011NEIv2 inventory. Pennsylvania replaced most tool emissions with source reported data. West Virginia collected improved West Virginia input data and re-ran the tool for their state and submitted that data.

For more information on the development of the oil and gas emissions in the 2011NEIv2, see Section 3.21 of the 2011NEIv2 TSD (EPA, 2015a).

2.2.4. Portable Fuel Containers

EPA developed emission estimates for portable fuel containers using the ERTAC “Area Source Comparability” methodology. It appears that the EPA/ERTAC methodology accounts for state control programs that were enacted prior to the Federal rule adoption in 2007. EPA extracted the portable fuel container segment of the nonpoint inventory into a separate file because of their methodology for projecting emissions. Refer to section 3.1.7 of the 2011 NEIv2 TSD (EPA, 2015a) for further information.

2.2.5. Equipment Refueling

EPA developed emission estimates for service station Stage 1 fuel transfers (e.g., transferring fuel from tanker trucks into underground storage tanks) and underground storage tank evaporative losses using the ERTAC “Area Source Comparability” methodology. EPA extracted the Stage 1 and underground tank segment of the nonpoint inventory into a separate file to facilitate review of this segment of the inventory by S/L/T agencies. Refer to section 3.1.7 of the 2011 NEIv2 TSD (EPA, 2015a) for further information. Note that Stage 2 fuel transfers (e.g., transfer of fuel into the vehicles’ fuel tank) is included in the onroad inventory since the emissions are calculated using the MOVES model.

2.2.6. Residential Wood Combustion

The residential wood combustion sector includes residential wood burning devices such as fireplaces, fireplaces with inserts (inserts), free standing woodstoves, pellet stoves, outdoor hydronic heaters (also known as outdoor wood boilers), indoor furnaces, and outdoor burning in firepots and chimeneas. Free-standing woodstoves and inserts are further differentiated into three categories: conventional (not EPA certified); EPA certified, catalytic; and EPA certified, noncatalytic. Generally speaking, the conventional units were constructed prior to 1988. Units constructed after 1988 had to meet EPA emission standards and they are either catalytic or non-catalytic. For more information on the development of the residential wood combustion emissions, see Section 3.14 of the 2011 NEIv2 TSD (EPA, 2015a).

2.2.7. Other Nonpoint Sources

This sector includes all stationary nonpoint sources that were not subdivided into the nonpoint sectors discussed above. Locomotives and commercial marine vessel (CMV) mobile sources included in the 2011NEIv1 nonpoint inventory are described later in this document. There are hundreds of individual processes in this category that are grouped into the following categories:

- Industrial and commercial fuel combustion not included in the point source sector
- Residential fuel combustion other than wood combustion;
- Chemical manufacturing not included in the point source sector
- Industrial processes not included in the point source sector, such as commercial cooking, metal production, mineral processes, petroleum refining, wood products, fabricated metals, and refrigeration
- Solvent utilization for surface coatings such as architectural coatings, auto refinishing, traffic marking, textile production, furniture finishing, and coating of paper, plastic, metal, appliances, and motor vehicles.
- Solvent utilization for degreasing of furniture, metals, auto repair, electronics, and manufacturing
- Solvent utilization for dry cleaning, graphic arts, plastics, industrial processes, personal care products, household products, adhesives and sealants
- Solvent utilization for asphalt application and roofing, and pesticide application
- Waste disposal, treatment, and recovery via incineration, open burning, landfills, and composting
- Miscellaneous area sources such as cremation, hospitals, lamp breakage, and automotive repair shops

Refer to section 3.2 through 3.30 of the 2011 NEIv2 TSD (EPA, 2015a) and section 2.2.6 of the 2011 Modeling Platform TSD (EPA, 2015b) for further information.

2.3. Aircraft, Locomotives, and Commercial Marine Vessels

Traditionally, the Northeastern S/L/T agencies have included emissions from aircraft, locomotives and commercial marine vessels as a separate inventory section since the NONROAD model does not include emissions from these nonroad mobile sources. In the NEI2011v2 inventory, these sources are included in either the point source inventory or the nonpoint source inventory. The following sections described how emissions for these source categories were estimated and the inventory files in which they are located.

2.3.1. Aircraft and Related Equipment

The aircraft and related equipment sector accounts for fuel combustion in all aircraft types used for public, private, and military purposes. This includes four types of aircraft:

- **Commercial aircraft** tend to be larger aircraft powered with jet engines and are used for transporting passengers, freight, or both
- **Air Taxis** carry passengers, freight, or both, but usually are smaller aircraft and operate on a more limited basis than the commercial aircraft
- **General Aviation** includes most other aircraft used for recreational flying and personal transportation.
- **Military aircraft** are associated with military installations, but they sometimes have activity at non-military airports.

The 2011 NEIv2 also includes emission estimates for aircraft auxiliary power units (APUs) and aircraft ground support equipment (GSE) typically found at airports, such as aircraft refueling vehicles, baggage handling vehicles, and equipment, aircraft towing vehicles, and passenger buses.

This sector includes exhaust emissions from aircraft, GSE and APUs. These sources are located at specific airport facilities and are characterized as point sources in the NEI because they are geographically located by latitude/longitude. This sector does not include other emission sources at airports that are unrelated to fuel combustion by aircraft, GSE and APUs. For example, stationary sources such as fuel combustion for airport heating or solvent use for aircraft maintenance are included in the point source inventory. Similarly, emissions from jet fuel storage or aircraft refueling are excluded from this category.

EPA, in consultation with S/L/T agencies, estimated emissions related to aircraft activity for all known US airports, including seaplane ports and heliports, in the U.S. As part of the development process, S/L/T agencies had the opportunity to provide both activity data as well emissions to the NEI. When S/L/T agencies provided activity data, EPA used that data to calculate EPA's emissions estimates using the Federal Aviation Administration's Emissions and Dispersion Modeling System.

See Section 4.2 of EPA's 2011 NEIv2 TSD (EPA, 2015a) for further information on how aircraft, GSE and APU emissions were calculated.

2.3.2. Locomotives and Rail Yards

The locomotive sector includes railroad locomotives powered by diesel-electric engines. A diesel-electric locomotive uses 2-stroke or 4-stroke diesel engines and an alternator or a generator to produce the electricity required to power its traction motors. The locomotive source category is sub-divided into sub-categories based on railroad revenues and type of service:

- **Class I** line haul locomotives carry freight long distances and are operated by national railroad companies with large carrier operating revenues. There were seven Class I freight operators in 2008.
- **Class II/III** line haul locomotives are operated by companies with smaller revenues. Class II railroads operate on a regional basis. Class III railroads are typically local short-line railroads

serving a small number of towns and industries. In 2008, there were about 12 Class II and 530 Class III Railroads.

- **Passenger railroads** operated by AMTRAK providing intercity passenger train service in the United States.
- **Commuter railroads** operate locomotives that provide a passenger rail transport service that primarily operates between a city center and the middle to outer suburbs.
- **Rail yards** include switcher locomotives engaged in splitting and joining rail cars.

EPA based the 2011 NEIv2 rail inventory on the recommendations of the ERTAC Rail Subcommittee for a methodology that (1) standardized S/L/T agencies' inventory development methods, (2) improved the quality of data received and the resulting emission inventories, and (3) reduced the administrative burden on railroad companies of providing data. EPA, in consultation with ERTAC, developed a comprehensive rail inventory for the 2008 NEI.

For the 2011 NEIv2, EPA developed 2011 national rail estimates by applying growth factors to the 2008 NEI values based on railroad freight traffic data from the 2008 and 2011 submitted by all Class I rail lines to the Surface Transportation Board and employment statistics from the American Short Lines and Regional Railroad Association for class II and III. EPA identified 95 rail yard locations in the Northeastern region for inclusion in the point source inventory using a database from the Federal Railroad Administration. EPA estimated CAP emissions using yard-specific emission factors and on national fuel values allocated to rail yards using an approximation of line haul activity within the yard. EPA allocated the emissions to line haul shape IDs and yard locations based on 2008 allocations.
Emissions from specific rail yards are included in the point source inventory; all other emissions from locomotives are stored in the nonpoint inventory. EPA allocated the nonpoint emissions to line haul shape IDs and yard locations based on 2008 allocations.

See Section 4.4 of EPA's 2011 NEIv2 TSD (EPA, 2015a) for further information on how locomotive emissions were calculated.

2.3.3. Commercial Marine Vessels

The commercial marine vessel (CMV) sector includes boats and ships used either directly or indirectly in the conduct of commerce or military activity. The majority of vessels in this category are powered by diesel engines that are fueled either with distillate or residual fuel oil blends. The CMV inventory is divided into three sub-sectors:

- **Category 1 and 2 (C1/C2) marine diesel engines** typically range in size from about 700 to 11,000 horsepower (hp). These engines are used to provide propulsion power on many kinds of vessels including tugboats, pushboats, supply vessels, fishing vessels, and other commercial vessels in and around ports. C1/C2 vessels (C1 and C2) vessels typically use distillate fuels.
- **Category 3 (C3) marine engines** includes vessels with engines having displacement above 30 liters per cylinder. C3 vessels typically use residual oil.

The CMV source category does not include recreational marine vessels, which are generally less than 100 feet in length, most being less than 30 feet, and powered by either inboard or outboard engines. These emissions are included in those calculated by the NONROAD model and are accounted for there.

Geographically, the inventories include port and interport emissions that occur within the area that extends 200 nautical miles (nm) from the official U.S. shoreline, which is roughly equivalent to the border of the U.S. Exclusive Economic Zone. EPA allocates only some of these emissions to counties based on official state boundaries that typically extend 3 miles offshore.

EPA estimated CMV emission estimates as a collaborative effort between the Office of Transportation and Air Quality (OTAQ) and Office of Air Quality Planning and Standards (OAQPS). For C1/C2 marine diesel engines, the emission estimates were consistent with the 2011 Locomotive and Marine federal rule making. For C3 engines, EPA developed the 2011 emission estimates by applying regional adjustment factors to account for growth to the previously developed emission estimates for a base year of 2002. In addition, EPA developed and applied NOx adjustment factors to account for implementation of the NOx Tier 1 standard.

EPA then allocated these emissions to individual GIS polygons using methods that varied by operating mode (i.e., hotelling, maneuvering, reduced speed zone, and underway). For example, port emissions appear only in port polygons, federal water emissions in federal waters.

See Section 4.3 of EPA's 2011 NEIv2 TSD (EPA, 2015a) for further information on how CMV emissions were calculated and geographically allocated.

2.4. NONROAD EQUIPMENT

This sector includes non-highway vehicles, equipment and emissions processes that are included in EPA's NONROAD model. NONROAD calculates emissions for a diverse collection of equipment, including:

- Recreational
- Construction
- Industrial and Commercial
- Logging
- Underground Mining
- Pleasure Craft (excludes commercial marine vessels)
- Railroad Equipment (excludes locomotives).

NONROAD estimates emissions from these sources for four fuel types: gasoline, diesel, compressed natural gas, and liquefied petroleum gas.

The NONROAD model is embedded in EPA's National Mobile Inventory Model (NMIM) and allows EPA to produce nonroad mobile emissions in a consistent and automated way for the entire country. The primary input to the NONROAD model is the National County Database (NCD), which contains all the county-specific information needed to run NONROAD. EPA initially populates the NCD with default inputs and distributes the NCD to S/L/T agencies who are able to update the data within the NCD to create emissions estimates that accurately reflect local conditions and equipment usage. Some S/L/T agencies in the Northeast accepted the EPA NCD defaults and NONROAD modeling results. Others provided updates to the NCD that EPA used in its national NONROAD model run. Still other states executed the NONROAD model on their own and provided NONROAD results to EPA to replace the EPA-generated NONROAD model results.

See Section 4.5 of EPA's 2011 NEIv1 TSD (EPA, 2014) for further information the S/L/T agency inputs to the NONROAD model and other information on how EPA executed the NONROAD model.

2.5. Onroad Vehicles

The onroad mobile source sector includes emissions from gasoline and diesel vehicles that are normally operated on public roadways. This includes passenger cars, motorcycles, minivans, sport-utility vehicles, light-duty trucks, heavy-duty trucks, and buses.

EPA generated emissions using the latest publically released version of the EPA highway emissions model, MOVES2010b (20120410 version). The primary input to the MOVES model is the MOVES County Database (CDB), which contains all the county-specific information needed to run MOVES, such as vehicle miles travelled, vehicle type and age distributions, fuel types, emission inspection and maintenance programs, and many other parameters. EPA initially populates the CDB with default inputs and distributes the CDB to S/L/T agencies who update the data within the CDB to create emissions estimates that accurately reflect local conditions. Most of the Northeastern S/L/T agencies submitted a subset of state specific CDB inputs (for example, only data related to inspection/maintenance programs, or population data for a subset of source types); EPA used national defaults as CDB data not provided by states.

EPA used the county-specific inputs and tools that integrated the MOVES model with the SMOKE emission inventory model to take advantage of the gridded hourly temperature information available from meteorology modeling used for air quality modeling. This "SMOKE-MOVES" tool requires emission rate "lookup" tables generated by MOVES that differentiate emissions by process (running, start, vapor venting, etc.), vehicle type, road type, temperature, speed, hour of day, etc. EPA used an automated process to run MOVES to produce emission factors by temperature and speed for "representative counties" to which every other county could be mapped. Using the MOVES emission rates, SMOKE selected appropriate emissions rates for each county, hourly temperature, SCC, and speed bin and multiplied the emission rate by activity (VMT or vehicle population) to produce emissions. EPA performed these calculations for every county, grid cell, and hour in the continental U.S.

See Section 4.6 of EPA's 2011 NEIv2 TSD (EPA, 2015a) for further information on how onroad emissions were calculated and geographically allocated.

2.6. Fires

Fire sources in this section are sources of pollution caused by the inadvertent or intentional burning of biomass including forest, rangeland (e.g., grasses and shrubs), and agricultural vegetative residue. This sector is specifically categorized into three sub-sectors: wildfires, prescribed burning, and agricultural burning. Other types of fires, such as residential wood combustion and yard waste/refuse burning, are included in the nonpoint sector.

EPA uses the SMARTFIRE2 system together with local activity data (acres burned, types of fuels, fuel consumption values, etc.) to make emission estimates for both wild and prescribed fires. All S/L/T agencies in the Northeast relied upon EPA's SMARTFIRE methodology for estimating emissions for wild and prescribed fires.

Most of the S/L/T agencies in the Northeast relied upon EPA's methodology for calculating emissions from agricultural burning activities. The EPA method relies mainly on satellite-based methods to develop the burned area and then uses an assigned crop type to estimate final emissions.

See Section 5 of EPA's 2011 NEIv2 TSD (EPA, 2015a) for further information on how emissions were calculated and geographically allocated.

2.7. BIOGENIC SOURCES

Biogenic emission sources are emissions that come from natural sources. They must be accounted for in photochemical grid models, as most types are widespread and ubiquitous contributors to background air chemistry. Biogenic emissions from vegetation and soils are computed using a model that utilizes spatial information on vegetation, land use and environmental conditions of temperature and solar radiation. The model inputs are typically horizontally allocated (gridded) data, and the outputs are gridded biogenic emissions that can be speciated and utilized as input to photochemical grid models.

The biogenic emissions for the 2011 NEIv2 were computed based on 2011 meteorology data from the Weather Research and Forecasting (WRF) Model using the Biogenic Emission Inventory System, version 3.14 (BEIS3.14) model within SMOKE. The BEIS3.14 model creates gridded, hourly, model-species emissions from vegetation and soils. The 12-kilometer gridded hourly data are summed to monthly and annual level, and are mapped from 12-kilometer grid cells to counties using a standard mapping file.

See Section 6 of EPA's 2011 NEIv2 TSD (EPA, 2015a) for further information on how emissions were calculated and geographically allocated.

3. FUTURE YEAR INVENTORY DEVELOPMENT

3.1. OVERVIEW OF INVENTORY PROJECTION METHODOLOGY

Projection of emissions to future years is key to air quality technical and policy support work. S/L/T agencies consult with MARAMA, ERTAC, and EPA to prepare emission projections reflecting anticipated changes in energy use, economic and population growth, and new air pollution control measures. The future year projection methodologies vary by inventory sector. Figure 2 provides an overview of the emission projection methodology used for each source sector.

Figure 2: Overview of Emission Projection Methodology for Each Source Sector

MARAMA Sector	Emission Projection Methodology
ERTAC EGUs (Section 3.2)	Uses ERTAC EGU Forecasting Tool: • Uses 2011 hourly emissions as the starting point • Applies regional projections of electric generation growth using Annual Energy Outlook and North American Reliability Council growth rates • Accounts for known future shutdowns, new units, emission controls, and fuel switches • Ensures available capacity is matched to projected demand • Ensures unit capacity is never exceeded • Uses base year activity as the profile for future activity • Calculates hourly future year emissions for each unit
Other Point Sources (Section 3.3) Nonpoint Sources (Section 3.4) Other Nonroad Sources (Section 3.5)	Uses MARAMA-developed growth and control factors within the Emission Modeling Framework tool: • Uses 2011 annual emissions as the starting point • Applies national, regional, or local projections of surrogate activity parameters (energy use, employment, population, etc.) • Accounts for emission reductions from all national rules • Accounts for emission reductions from Ozone Transport Commission model rules that have been implemented by the States • Accounts for emission reductions from consent decrees and settlements • Accounts for emission reductions from any other State-specific emission control programs • Calculates annual future year emissions
Nonroad – NONROAD Model (Section 3.6)	Uses EPA's NONROAD model: • Accounts for increases in activity (based on NONROAD model default growth estimates of future-year equipment population) • Accounts for changes in fuels and engines that reflect implementation of national regulations that impact each year differently due to engine turnover • Accounts for local control programs and other parameters • Calculates monthly exhaust, evaporative and refueling emissions by county
Onroad – MOVES Model (Section 3.7)	Uses EPA's SMOKE-MOVES model: • Accounts for increases in vehicle miles travelled • Accounts for changes in fuels and engines that reflect implementation of national regulations that impact each year differently due to engine turnover and fuel requirements • Accounts for local control programs and other parameters • Calculates hourly exhaust, evaporative and refueling emissions by grid cell
Fire Events (Section 3.8)	Uses NEI2011v2 inventory (e.g., assumes no change from the base year)
Biogenic (Section 3.9)	Uses BEIS 2011 inventory (e.g., assumes no change from the base year)

S/L/T agencies, in consultation with ERTAC and MARAMA, developed two new and innovative emission projection methodologies and tools for this round of inventory projections. The first is the ERTAC EGU Forecasting Tool. The second is a set of growth and control factors used within the Emission Modeling Framework (EMF).

MARAMA is using the ERTAC EGU Forecasting Tool (ERTAC, 2015) to project electricity generation and emissions from EGUs. Its development was a collaborative effort among the Northeastern, Mid-Atlantic, Southeastern, and Lake Michigan area states; other member states; industry representatives; and multi-jurisdictional planning organization representatives. The methodology calculates future emissions of NOx and SO2 based on projections of future generation, the 2011 base year emission rates, and known future year emission controls, fuel switches, retirements, and new units. The future year emissions for other pollutants (CO, NH3, PM10, PM2.5, and VOC) are calculated using the generation projections from the ERTAC tool and a file of emission factors for each unit. Section 3.2.1 describes the ERTAC forecasting tool, while Section 3.2.2 documents how emission factors were established for pollutants other than NOx and SO2.

MARAMA is using the Emissions Modeling Framework (EMF) software system to manage and assure the quality of emissions inventories and emissions modeling-related data. One of the modules within the EMF system is the Control Strategy Tool (CoST) module (UNC, 2013), which is used to project emissions for future years using growth and control factors developed specifically for this effort. The CoST module required the following inputs needed to project a base-year inventory to a future-year inventory:

- A set of parameters that control how the strategy is run
- One or more emissions inventory datasets
- Projection Packet(s) to specify growth factors or other inventory adjustments
- Plant Closure Packet(s) to identify facilities, emission units or processes to close
- Control Packet(s) to specify specific emission control factors

The EMF CoST module applies the projection and control factors to the base year emission estimates to create the projected inventory.

To facilitate S/L/T agency review of the growth factors (e.g., EMF Projection Packet), we developed user-friendly spreadsheets that provide the surrogate growth parameters, match the growth parameters to inventory records, and configure the growth factors into the required EMF format. Since the states may be using a base year inventory other than 2011 or doing projections for future years other than 2018, there is a function that allows users to select the base year and the future year to compute the projection factor for that combination of years.

There are three spreadsheets: nonpoint, point nonipm (point sources not included in the ERTAC tool), and aircraft engines/support equipment. The spreadsheets allow the user to create a projection packet for any combination of base year and future year for the 2007 to 2040 period. Each of these three spreadsheets contains four tabs:

- The "**General Methodology**" tab outlines the general data sources and methodology used and defines the individual columns of the remaining three tabs.

- The "**Growth Raw Data**" tab provides the surrogate growth parameter data for all years from 2007 to 2040, along with code that uniquely defines each surrogate parameter and a brief description of the source of the surrogate data.
- The "**NEI to Growth Factor XWALK**" tab maps a specific facility or emission process to one of the surrogate growth parameters. We obtained the list of facilities and emission processes from the NEI2011v2. Since the states may be using a base year inventory other than 2011 or doing projections for future years other than 2018, there is a function that allows users to select the base year and the future year to compute the projection factor for that combination of years. There is also a function to cap the growth factor to prevent unreasonably low or high growth.
- The "**EMF Projection Packet**" tab simply re-configures the previous tab into the EMF *Table Format for Projection Packet Extended Dataset Type*. The user must export this tab to a comma-separated-value (.csv) file for input to the CoST module.

Sections 3.3, 3.4, and 3.5 provide a detailed discussion of the surrogate parameters used to project emissions for the other point, nonpoint, and other nonroad sectors.

We also assembled the EMF Closure and Control packets. The Closure packet identified the facilities and/or emission processes that have closed or will be closed after 2011. Emissions from the closed facilities and/or emission processes are set to zero after the effective date of the closure. The Control packet reflects the expected 2018 emissions effects due to a variety of national, regional, and state rules, regulations, consent decrees and settlements. EPA provided control packets to account for national rules. We developed control factors to account for state implementation of OTC and MANE-VU emission control recommendations as well as for state-specific rules. Sections 3.3, 3.4, and 3.5 provide a detailed discussion of the surrogate parameters used to project emissions for the other point, nonpoint, and other nonroad sectors.

3.2. ERTAC EGU EMISSIONS

The ERTAC committee has developed a methodology to project electricity generation and emissions from EGUs. The ERTAC EGU Forecast Tool uses base year hourly USEPA Clean Air Markets Division (CAMD) data and fuel specific growth rates and other information to estimate future activity and emissions. The tool uses base year activity as a pattern for future activity, so that the future year temporal profile matches meteorology.

Future estimates of unit generation rates from the ERTAC tool are used in conjunction with a post processor to develop emissions estimates for other pollutants needed for air quality modeling. Section 3.2.1 provides an overview of the ERTAC forecasting tool, Section 3.2.2 describes the model runs used for this ALPHA2 inventory, while Section 3.2.3 documents how the ERTAC tool results were used in air quality modeling.

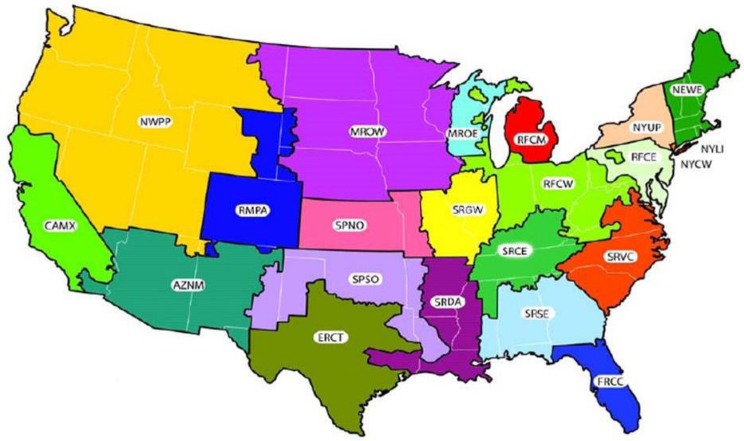
3.2.1. ERTAC Forecast Tool – Overview of tool

The ERTAC EGU Forecast Tool methodology starts with base year generation and emissions as reported to CAMD. Base year emission rates are calculated from this data. Future generation by unit is estimated by combining Energy Information Agency (EIA) regional average growth rates by fuel type, National Energy Reliability Corporation (NERC) regional peak growth rates by fuel type, and state knowledge of unit changes. Future emission rates are developed from base year emission rates adjusted to account for state knowledge of known future year emission controls, fuel switches, retirements, and new units. Hourly future emissions of NOx and SO2 are calculated by multiplying hourly projected future generation by future emission rates.

The input files, which drive the ERTAC EGU Forecast Tool, are built by the ERTAC committee from a wide variety of existing data and the information is subject to periodic quality assurance by S/L/T agency staff. In addition, S/L/T agencies provide information on new units, new controls, fuel switches, shutdowns and other unit-specific changes. Periodic updates of these input files drives creation of new run versions. These input files are as follows:

- **Base Year Hourly CEM data** – This file contains hourly generation and emissions data extracted from EPA's CAMD database. In unit-specific situations where base year hourly data needs modification, the tool allows the user to provide a nonCAMD hourly file, which may be used to adjust or add data to the base year hourly CEM file.
- **Unit Availability File (UAF)** – This file is a table of base year unit specific information derived from CAMD NEEDS database, state input, EIA Form 860, and NERC data. This file is maintained by the ERTAC committee and provides information on changes to specific units from the base year to the future year. For example, the UAF captures actual or planned changes to utilization fractions, unit efficiency, capacity, or fuels. S/L/T agencies have also added information on actual and planned new units and shutdowns.
- **Control File** – This file contains a table of known future unit specific changes to SO2 or NOx emission rates (in terms of lbs/mmBtu) or control efficiencies (for example, addition of a scrubber or selective catalytic reduction system). This information is provided by S/L/T agency staff. This file also provides emission rates for units that did not operate in the base year. Controls can be differentiated seasonally, monthly, weekly, or using other time spans. For example, a unit may employ more effective controls during the ozone season.
- **Input Variables File** – A table of variables used in the modeling run. This file allows the S/L/T agencies to specify variables such as the size, fuel type and location for new units. In addition, the regional scheme and fuel types are specified in this file.
- **Annual Growth Factor File** – A table of growth factors developed from the EIA Annual Energy Outlook (AEO) and NERC estimates. Electrical generation growth is delineated by geographic region and generating unit type. Regions and fuels are not hardwired into the model. Rather, the regions and their characteristics are specified in the Input Variables File. The geographic regional system currently in use in the tool is the EIA Electricity Market Module (EMM) regional system shown in Figure 3. The EIA and NERC regions are not identical, so some adjustment is required to align annual and peak growth rates. To match EIA and NERC, a "best fit" NERC regional growth factor is assigned to each EMM region. In the simplest case, where a clear match between EIA and NERC regional schemes exists, for example NPCC-New England, the NERC peak growth rate is assigned to the corresponding EMM region. In more complicated cases, where multiple NERC regions corresponded to a single EMM region, or where regions were organized along substantially different geographic boundaries, the NERC peak growth factors were averaged to generate a growth factor for the (usually larger) corresponding EMM region. As an example, the EIA CAMx region corresponds to two NERC regions, WECC-CALN and WECC-CALS. In this case, the WECC-CALN and WECC-CALS growth factors were averaged and applied to the EIA-CAMx region. The resulting assignments are shown in Figure 4.

***Figure 3:* - Location of the Electricity Market Module (EMM) Regions**



1 – Texas Regional Entity (ERCT)
2 - Florida Reliability Coordinating Council (FRCC)
3 - Midwest Reliability Council – East (MROE)
4 - Midwest Reliability Council - West (MROW)
5 - Northeast Power Coordinating Council / Northeast (NEWE)
6 - Northeast Power Coordinating Council / NYC-Westchester (NYCW)
7 - Northeast Power Coordinating Council / Long Island (NYLI)
8 - Northeast Power Coordinating Council / Upstate New York (NYUP)
9 - Reliability First Corporation / East (RFCE)
10 - Reliability First Corporation / Michigan (RFCM)
11 - Reliability First Corporation / West (RFCW)
12 - SERC Reliability Corporation / Delta (SRDA)
13 - SERC Reliability Corporation / Gateway (SRGW)
14 - SERC Reliability Corporation / Southeastern (SRSE)
15 - SERC Reliability Corporation / Central (SRCE)
16 - SERC Reliability Corporation / Virginia-Carolina (SRVC)
17 - Southwest Power Pool / North (SPNO)
18 - Southwest Power Pool / South (SPSO)
19 - Western Electricity Coordinating Council / Southwest (AZNM)
20 - Western Electricity Coordinating Council / California (CAMX)
21 - Western Electricity Coordinating Council / Northwest Power Pool Area (NWPP)
22 - Western Electricity Coordinating Council / Rockies (RMPA)

Figure 4: EMM to NERC Crosswalk Version 1

EMM Region Number	EMM Region Name	EMM-ERTAC Region Code	Single "Best-Fit" NERC Subregion Peak Growth Code
1	Texas Regional Entity (ERCT)	ERCT	ERCOT
2	Florida Reliability Coordinating Council (FRCC)	FRCC	FRCC
3	Midwest Reliability Council – East (MROE)	MROE	MISO
4	Midwest Reliability Council West (MROW)	MROW	MRO-MAPP
5	Northeast Power Coordinating Council / Northeast (NEWE)	NYLI	New York
6	Northeast Power Coordinating Council / NYC Westchester (NYCW)	NEWE	New England
7	Northeast Power Coordinating Council / Long Island (NYLI)	NYCW	New York
8	Northeast Power Coordinating Council / Upstate New York (NYUP)	NYUP	New York
9	Reliability First Corporation / East (RFCE)	RFCE	PJM
10	Reliability First Corporation / Michigan (RFCM)	RFCM	MISO
11	Reliability First Corporation / West (RFCW)	RFCW	PJM
12	SERC Reliability Corporation / Delta (SRDA)	SRDA	SERC-W
13	SERC Reliability Corporation / Gateway (SRGW)	SRGW	MISO
14	SERC Reliability Corporation / Southeastern (SRSE)	SRSE	SERC-SE
15	SERC Reliability Corporation / Central (SRCE)	SRCE	SERC-N
16	SERC Reliability Corporation / Virginia Carolina (SRVC)	SRVC	SERC-E/PJM avg
17	SouthWest Power Pool / North (SPNO)	SPNO	SPP
18	SouthWest Power Pool / South (SPSO)	SPSO	SPP
19	Western Electricity Coordinating Council / SouthWest (AZNM)	AZNM	DSW
20	Western Electricity Coordinating Council / California (CAMX)	CAMX	CALS/CALN avg
21	Western Electricity Coordinating Council / NW Power Pool (NWPP)	NWPP	BASN/NORW avg
22	Western Electricity Coordinating Council / Rockies (RMPA)	RMPA	Rock

Within each region, individual generation units are further delineated into five unit types as follows:

- Coal;
- Oil;
- Natural Gas – Combined Cycle;
- Natural Gas – Single Cycle;
- Natural Gas – Boiler gas.

Growth factors for each individual fuel type are provided by EIA. NERC peak growth rates are not delineated by fuel. Each electricity generating unit included in the model is assigned to a region and fuel type bin in the Unit Availability File. Annual growth factors are developed by dividing AEO future by base year generation.

Hourly generation - The tool uses these input files to estimate hourly growth factors for each region and fuel type which account for regional average and peak growth and unit shutdowns. The tool then applies the hourly growth factors to the hourly base year hourly generation data to estimate hourly future generation.

The tool confirms that unit capacity is never exceeded. Future generation is assigned to units as long as they have capacity available. When available known capacity is fully utilized new units are created if future demand exceeds known capacity.

NO_X and SO_2 Emissions - Base year emission rates for existing units are adjusted to account for new control equipment or other changes provided in the input files. New unit emissions, for which states do not provide emission rate data, are estimated based on the 90th percentile best performing existing unit for that fuel type and region. These rates are applied to each unit's future generation to calculate NOx and SO2 emissions.

Output – The ERTAC tool generates files of hourly generation and emissions for each unit included in the system. In addition, summary files of this hourly data are generated, to facilitate review of the results, as follows:

- Base and future year annual generation (MW-hrs) and heat input (mmbtu)
- Base and future year ozone season generation and heat input
- Base and future year annual NOx emission (tons) and average emission rate (lbs/mmbtu)
- Base and future year ozone season NOx emission and average emission rate
- Base and future year annual SO2 emissions and average emission rate

Run Documentation - The ERTAC EGU committee maintains and distributes reference runs for the continental United States (CONUS), including the hourly input and output files, summary files, and a documentation file for each run. These reference runs and complete documentation of the ERTAC Forecast Tool is located on the MARAMA web site(ERTAC, 2015).

3.2.2. Forecast Tool – ERTAC EGU V2.3 was used in this inventory

ERTAC EGU V2.3 was run in October, 2014. This run built on improvements to prior versions and included updates to the UAF and control file from states as of August 2014. A major improvement was an adjustment to the gas growth rates for all regions. Gas growth rates are applied to three gas unit types: Single cycle, combined cycle and boiler gas. The gas growth rates were adjusted to apply all the growth to combined cycle and "no growth" to single cycle and boiler gas. Peak growth rates were reduced and transition hours adjusted for some regions. Some small regions were combined to allow generation growth to flow to units in the combined regions. The inputs used to develop the ERTAC EGU v2.3 run for the continental United States are shown in Figure 5

Figure 5: Summary of Inputs to ERTAC EGU v2.3 Model Run

ERTAC File Name	Description	Run Notes
	Version: 2.3 Code: 1.01 Base Year: 2011 Future Years: 201/18/19/28	Scenarios run by ERTAC EGU leadership Overview of improvements over previous runs: Major update to UAF and Controls.
camd_hourly_base.csv	Hourly CAMD CEM data	
ertac_initial_uaf.csv	Unit Availability File	UAF_2.3_10-28-2014.csv
ertac_control_emissions.csv	Control File	Con_2.3-10-28-2014.csv; ConS_2.3_10-28-2014.csv
ertac_growth_rates.csv	Growth File	Gro_2.3_2017.csv, Gro_2.3_2018.csv, Gro_2.3_2019.csv, Gro_2.3_2028.csv
NA	Average Annual Growth Source	AEO 2014
NA	Peak Growth Source: Gro_2.3_2018.csv - The growth rates were found in the calculation spreadsheet Gas_Adj_AEO2014_NERC2013 Growth Rates v4 method 1 and method2.xlsx, tab Gas-Adj Ref 2014 M1 with the following exceptions: • NYLI and NYCW growth rates based on the same spreadsheet but used the tab New GR. • MROZ and RFWZ annual growth rates were based on the 2018 growth rates in the spreadsheet called FullTranslationWI_Regions_AdjustmentAEO2014.xlsx, tab Core Index for MROZ &. • RFCM, MROZ, and MROW peak growth rates for combined cycle were set to 1.3 based on LADCO, Wisconsin, and Michigan input. • SRGW peak growth rate for oil was set to 2.0 to ameliorate an extremely high peak rate, per LADCO. • RFCM, MROZ, and MROW combined cycle transition hours peak->formula set to 200; formula-> nonpeak set to 2000 based on LADCO, WI, and MI input. All other transition hours remain at default levels. • For the 2028 estimates, to reduce the number of GDUs created solely for peak hour demand deficits, the following additional changes were made to the growth file: • The following regions/fuel-unit types had their peak rates set to 1.3 and their transition hours set to 200 and 2000: CAMX, combined cycle; NWPP, combined cycle; RFWZ, combined cycle; SRCE, combined cycle; SRGW, combined cycle • NYUP Coal had the peak rate set at 1.3.	
NA	EMM to NERC Crosswalk	Version1
ertac_input_variables.csv	Input Variables File	IV_2.3_2017_10-28-2014.csv, IV_2.3_2018_10-28-2014.csv, IV_2.3_2019_10-28-2014.csv, IV_2.3_2028_10-28-2014.csv
ertac_hourly_noncamd.csv	Hourly CEM data replacing data in CAMD	nonCAMD_2.3_10-28-2014.xlsx
group_total_listing.csv	Aggregation scheme for multi-state caps	State_2.3_10-28-2014.csv
state_total_listing.csv	Aggregation scheme for state level caps	State_2.3_10-28-2014.csv

3.2.3. ERTAC to SMOKE Conversion

The outputs from the ERTAC EGU tool are converted to FF10 model inputs suitable for air quality modeling using the ERTAC to SMOKE tool. The tool adds hourly emissions for pollutants other than NO_X and SO_2 and stack characteristics. We used the following data sources to develop emission factors for other pollutants for the ERTAC sources:

- The NEI2011v2 2011 annual emissions for criteria air pollutants and NH3.
- As described earlier, We and the S/L/T agencies developed a cross-reference file (Appendix A) to match units in the ERTAC UAF (Appendix B) with records in the NEI2011v2 for each of the jurisdictions covered by the Northeast regional emissions inventory.
- The EPA CAMD unit level file (Appendix C) contains data collected as part of EPA's emission trading programs. It contains descriptive information about emission units and period totals for heat input and CO2, NOx and SO2 mass emissions. This inventory is referred to as CAMD2011. Most units are required to report data for the entire year, so that the period totals are annual totals. Other units reported data for less than 12 months, depending on when the unit began or ceased operation during 2011.
- The EPA AP-42 emission factor documents for natural gas, coal, fuel oil, and stationary gas turbines (Appendices D-G) which contains uncontrolled and controlled emission factors for criteria air pollutants for various types and sizes of combustion devices and fuel types.

The NEI2011v2 includes emission unit identifiers to link the units to the units in the CAMD2011 database and the units in the ERTAC UAF. Data elements from these three data sources were merged into a spreadsheet. States reviewed and improved these linkages and SRA updated the linkages to redistribute the units in the NEI2011v2 into two groups: units included in the ERTAC methodology and all other units.

The methodology for calculating the emission factors varied depending on the availability of annual heat input:

- Full year reporters that have annual generation, heat input and SO2/NOx emissions available from the CAMD2011 database
- Partial year reporters that have less than 12-months of generation, heat input and SO2/NOx emissions data available in the CAMD2011 database
- New/proposed units and existing units that did not operate in 2011 (e.g., no heat input reported in CAMD2011)

Note that we did not calculate emission factors for units identified as "nonEGU" in the UAF since these units are not included in the ERTAC projections.

For full year reporters, we extracted the 2011 annual emissions of CO, NH3, PM10, PM2.5 and VOC from the NEI2011v2. We also extracted the annual heat input from the CAMD2011 database. We calculated the emission factors using the following formulas:

$$EF_i \text{ (lbs/mmBtu)} = TONS2011_i \text{ (tons)} * \text{(2000 lbs/ton)} / HI2011\_CAMD \text{ (mmBtu)}$$

Where: EF_i = Emission factor for pollutant i
$TONS2011_i$ = Annual 2011 emissions for pollutant i from NEI2011v2
HI2011_CAMD = Annual 2011 heat input from CAMD2011

We used this formula when there was a one-to-one correspondence between a NEI2011v2 unit and a CAMD2011 unit. In a few cases, multiple CAMD2011 units were associated with a single NEI2011v2 unit. For example, CAMD2011 may have multiple identical combustion turbines listed individually with annual heat input for each turbine, whereas the NEI2011v2 has these same turbines grouped as a single emission unit with annual emissions representing the total emissions for all turbines in the group. For these cases, we calculated the term HI2011_CAMD in the above equation as the sum of the heat input for all CAMD2011 units associated with the NEI2011v2 unit.

For partial full year reporters, the annual heat input was not available since the CAMD2011 only has heat input for the period that was reported. Most of these units either began operation in 2011 or ceased operation in 2011, so that the heat input for these units in effect represents the "annual" heat input. We extracted the 2011 annual emissions of CO, NH3, PM10, PM2.5 and VOC from the NEI2011v2 annual emission inventory. We calculated the emission factors using the following formulas:

$$EF_i \text{ (lbs/mmBtu)} = TONS2011_i \text{ (tons)} * \text{(2000 lbs/ton)} / HI2011\_CAMD \text{ (mmBtu)}$$

Where: EF_i = Emission factor for pollutant i
$TONS2011_i$ = Annual 2011 emissions for pollutant i from NEI2011v2
HI2011_CAMD = Period 2011 heat input from CAMD2011

For both existing and new units that did not operate in 2011, there is no heat input available to calculate emission factors. We extracted emission factors from AP-42 for the appropriate fuel type and combustion type, as shown in Figure 6. For three facilities that have experienced post-2011 fuel switches (BL England, Bremo Power Station, and Clinch River), we obtained unit-specific emission factors from the responsible state agency. For new facilities, we also solicited emission factors and stack parameters from states. For example, Virginia provided emission factors and stack characteristics for the combined cycle units at Warren and the coal-fired Virginia City Energy Center.

Figure 6: EPA Emission Factors from AP-42

Fuel / Unit Type	AP42 Reference	Pollutant	Emission Factor (lbs/mmBtu)
Coal – Dry-bottom Wall-fired	Table 1.1-3 Table 1.1-20 n/a Table 1.1-6 (with cyclones) Table 1.1-6 (with cyclones) Table 1.1-19	CO CO2 NH3 PM10-PRI PM25-PRI VOC	0.019 232 n/a 0.388 0.023 0.0023
Diesel or Distillate Oil – Combustion Turbine	Table 3.1-1 Table 3.1-2a n/a Table 3.1-2a (assume all PM<2.5) Table 3.1-2a (assume all PM<2.5) Table 3.1-2a	CO CO2 NH3 PM10-PRI PM25-PRI VOC	0.076 157 n/a 0.012 0.012 0.0004
Natural Gas – Dry Bottom Wall-fired Boiler	Table 1.4-1 (controlled) Table 1.4-2 n/a Table 1.4-2 (assume all PM<2.5) Table 1.4-2 (assume all PM<2.5)	CO CO2 NH3 PM10-PRI PM25-PRI	0.082 118 n/a 0.0075 0.0075

Fuel / Unit Type	AP42 Reference	Pollutant	Emission Factor (lbs/mmBtu)
	Table 1.4-2	VOC	0.0054
Natural Gas – Tangentially Fired Boiler	Table 1.4-1 (controlled) Table 1.4-2 n/a Table 1.4-2 (assume all PM<2.5) Table 1.4-2 (assume all PM<2.5) Table 1.4-2	CO CO2 NH3 PM10-PRI PM25-PRI VOC	0.096 118 n/a 0.0075 0.0075 0.0054
Natural Gas – Combustion Turbine and Combined Cycle	Table 3.1-1 Table 3.1-2a n/a Table 3.1-2a (assume all PM<2.5) Table 3.1-2a (assume all PM<2.5) Table 3.1-2a	CO CO2 NH3 PM10-PRI PM25-PRI VOC	0.030 110 n/a 0.0066 0.0066 0.0021

We reviewed the emission factors for each unit and pollutant to make an assessment of the reasonableness of each factor by comparing the calculated emission factors for each combustion/fuel type (e.g., simple cycle gas, tangentially coal-fired boiler). We found very few occurrences of factors that were egregiously out-of-range, and in those few occasions, we provided a revised emission factor based on our best judgment. We also provided the results of the above calculations for S/L/T review and approval (see Appendix H). We formatted the emission factors into the ERTAC Control File format (see Appendix I).

3.3. Other Point Sources

S/L/T agencies have traditionally used economic, energy, and demographic parameters as surrogates for projecting future emissions. While recognizing that these surrogates may not track exactly with emissions, states consider these surrogates to be the "best available" data for projecting emissions for non-EGU point sources. S/L/T agencies also account for the effect of emission control programs in reducing future year emissions. MARAMA issued a contract to SRA International, Inc. (SRA) to assist states in developing growth and control factors for use within the Emission Modeling Framework (EMF) tool.

3.3.1. Growth Factors

For the nonERTAC point source sector, S/L/T agencies have traditionally developed growth factors either from projections of energy use by fuel type for fuel combustion sources and/or projections of employment by industrial category. In developing these growth factors, we followed to the extent possible EPA guidance(EPA, 2007) on developing emission projections to be used with models and other analyses for demonstrating attainment of air quality goals for ozone, fine particles, and regional haze.

3.3.1.1. Energy Projections

The U.S. Energy Information Administration (EIA) publishes the AEO (EIA, 2014) each year. AEO2014 presents long-term projections of energy supply, demand, and prices through 2040, based on results from EIA's National Energy Modeling System (NEMS). NEMS projects the production, imports, conversion, consumption, and prices of energy, subject to assumptions on macroeconomic and financial factors, world energy markets, resource availability and costs, behavioral and technological choice criteria, energy technology cost and performance characteristics, and demographics.

AEO2014 provides regional fuel-use forecasts for various fuel types (e.g., coal, residual oil, distillate oil, natural gas, renewables) by end use sector (e.g., residential, commercial, industrial, transportation, and electric power). We mapped these forecasts to specific source classification codes as described later in the document.

AEO2014 projects energy use at the Census division level that groups states as follows:

- New England region includes CT, MA, ME, NH, RI and VT
- Mid-Atlantic region includes NJ, NY, and PA
- South Atlantic region includes DC, DE, MD, NC, VA and WV (as well as a few other states not in the MARAMA study area)

Appendices J, K and L contain the AEO2014 data for the three regions.

We used the reference case projections, which are a business-as-usual trend estimates, given known technology and technological and demographic trends. AEO also accounts for most current laws and regulations, including those associated with air pollution control. Please refer to the AEO web site for a complete description of the methodologies, data sources, and assumptions made by EIA in developing the energy projections.

AEO2014 provides data for the each of the years from 2011 to 2040. We used previous versions of AEO to obtain data for 2007-2010. We used AEO2013 to obtain 2010 energy consumption, AEO2012 for 2009 data, AEO2011 for 2008 data, and AEO2010 for 2007 data. While there are slight differences in the methods used to produce the earlier versions of AEO, MARAMA states decided to use the combined data set to produce a cohesive data set that covered all required years (2007 to 2040).

Figures 7 to 9 show the AEO projections for commercial energy consumption in the three regions. AEO projects increases in residual oil consumption in all three regions, which is unexpected and may require further investigation in states where residual oil is widely used in commercial facilities. AEO also projects declines in distillate oil consumption in all three regions compared to 2011 consumption. Coal consumption by commercial sources decreased from 2007 to 2011, but AEO projects coal consumption to remain relatively constant after 2011. AEO projects positive growth in natural gas consumption.

Figures 10 to 12 show the AEO projections for industrial energy consumption in the three regions. In all three regions, AEO projects an upward trend in renewable energy and natural gas consumption, and relatively small changes in distillate and residual oil consumption. In the Mid-Atlantic region, AEO projects small increases in coal consumption from 2012 through 2021 and a downward trend after 2021. AEO is projecting upward trend in industrial coal combustion in the South Atlantic region after 2011.

Figures 13 to 15 show the AEO projections for electric power energy consumption in the three regions. We used these projections for EGUs that are not included in the ERTAC EGU forecasting tool. In New England, AEO projects dramatic decreases in distillate and residual oil consumption, and very little change in other fuel sources. In the Mid-Atlantic region, AEO projects dramatic decreases in residual oil consumption, virtually eliminating its use by 2019. Other fuels are projected to have modest changes compared to 2011. In the South Atlantic region, AEO projects large decreases in residual oil consumption and significant increases in renewable energy sources. AEO also projects a noticeable increase in nuclear energy.

Figure 7: AEO Commercial Energy Consumption Projections – New England States

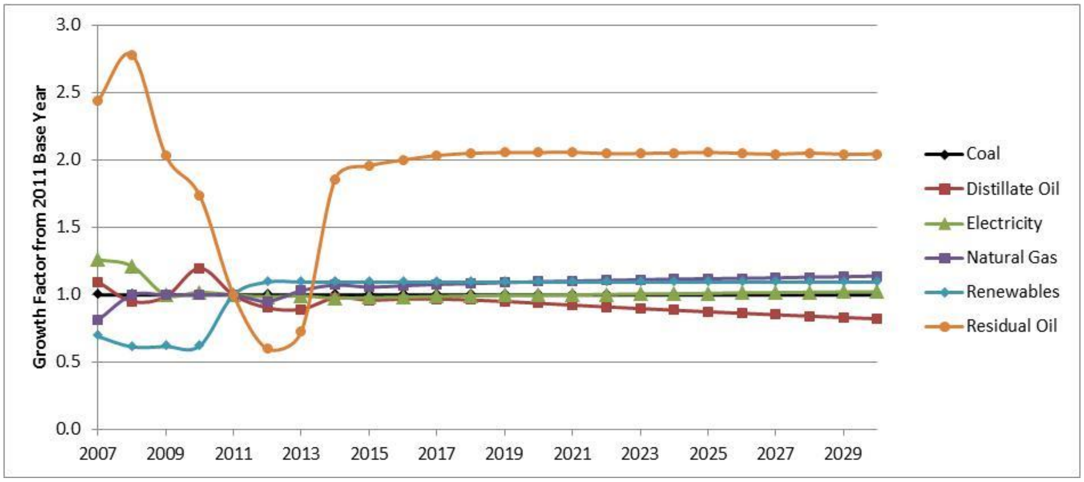


Figure 8: AEO Commercial Energy Consumption Projections – Mid-Atlantic States

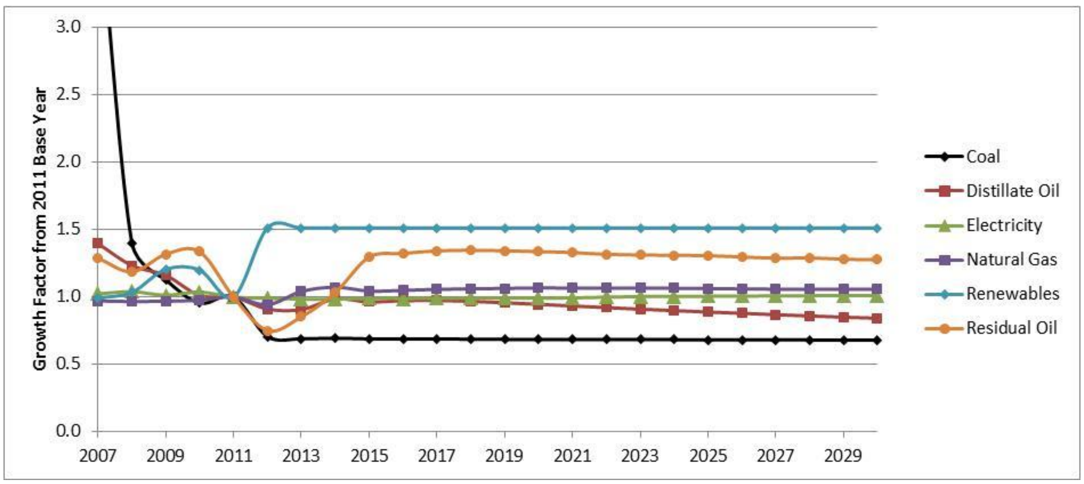


Figure 9: AEO Commercial Energy Consumption Projections – South-Atlantic Jurisdictions

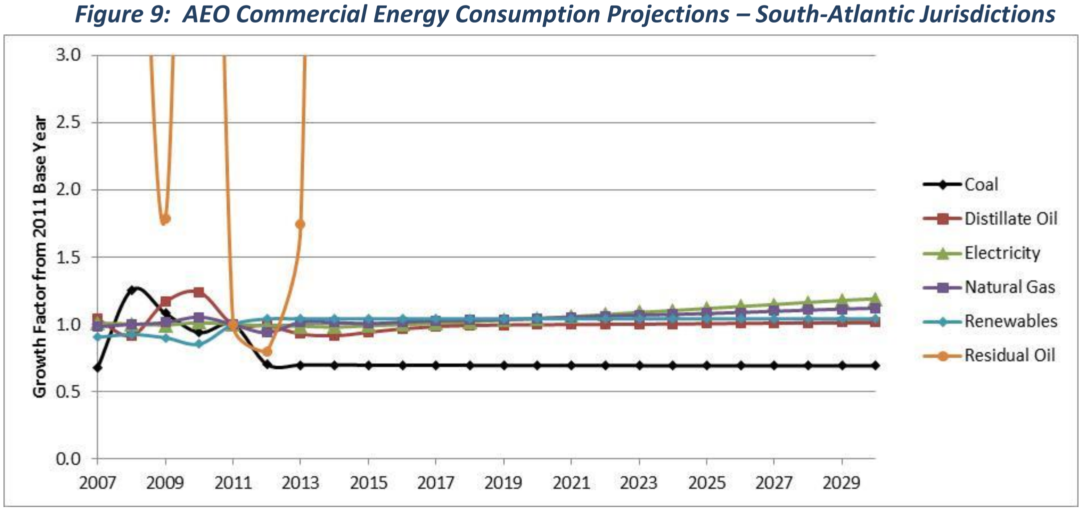


Figure 10: AEO Industrial Energy Consumption Projections – New England States

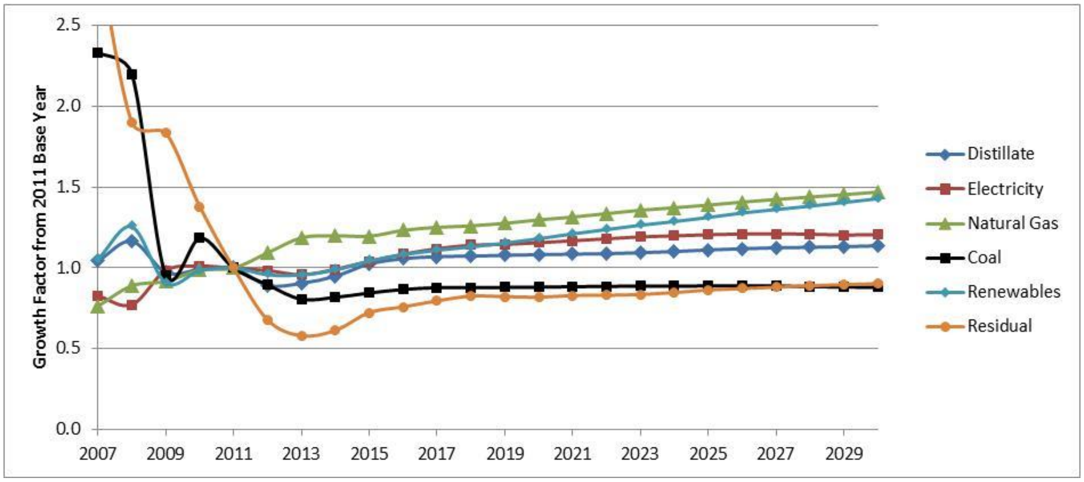


Figure 11: AEO Industrial Energy Consumption Projections – Mid-Atlantic States

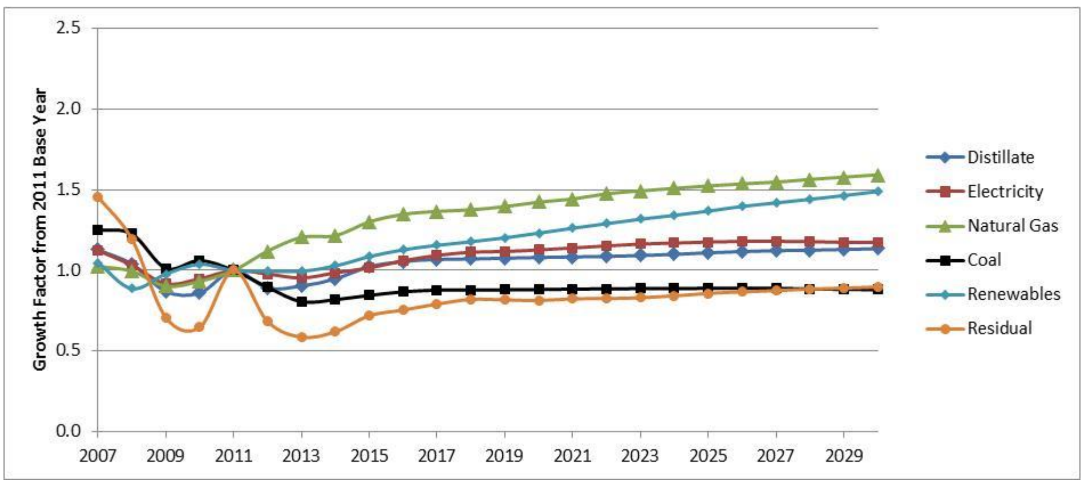


Figure 12: AEO Industrial Energy Consumption Projections – South-Atlantic Jurisdictions

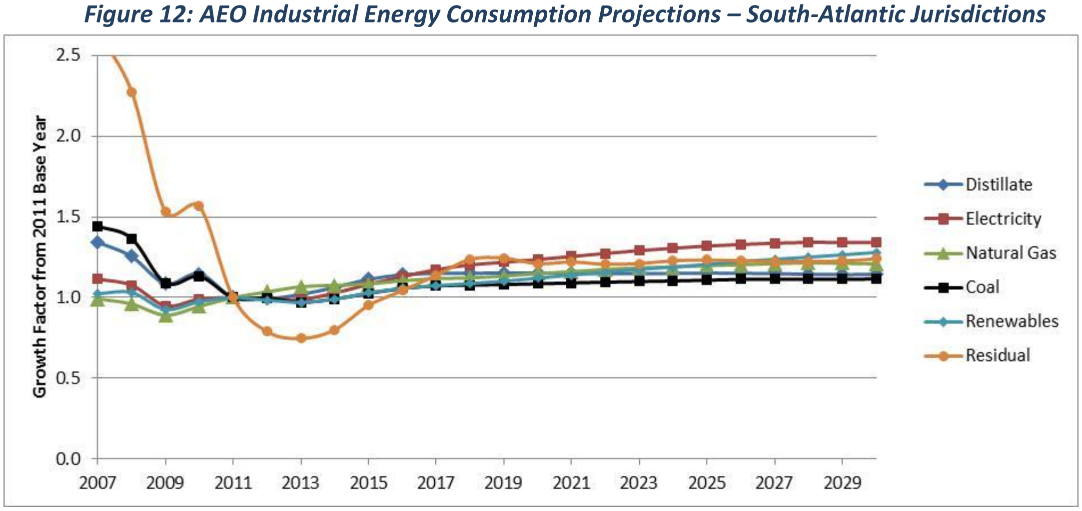


Figure 13: AEO Electric Power Energy Consumption Projections – New England States

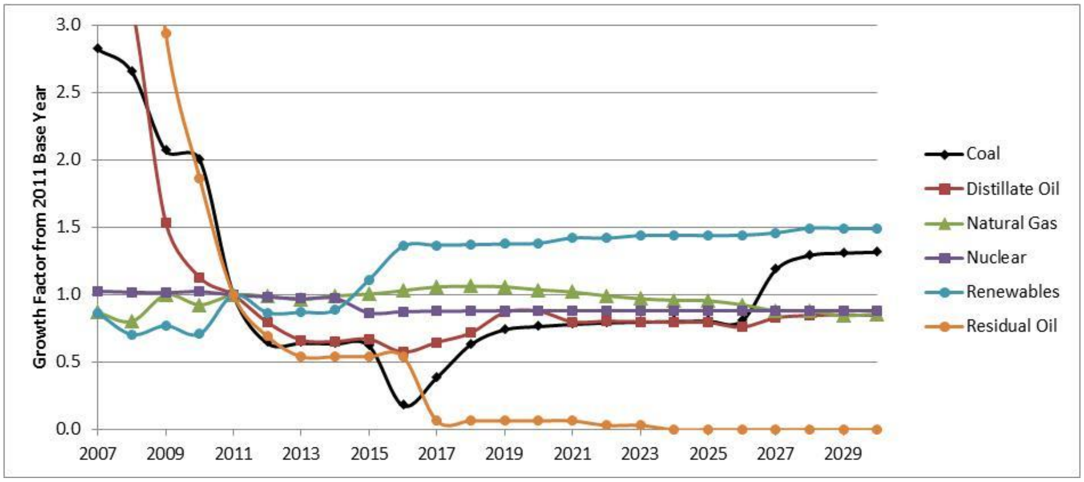


Figure 14: AEO Electric Power Energy Consumption Projections – Mid-Atlantic States

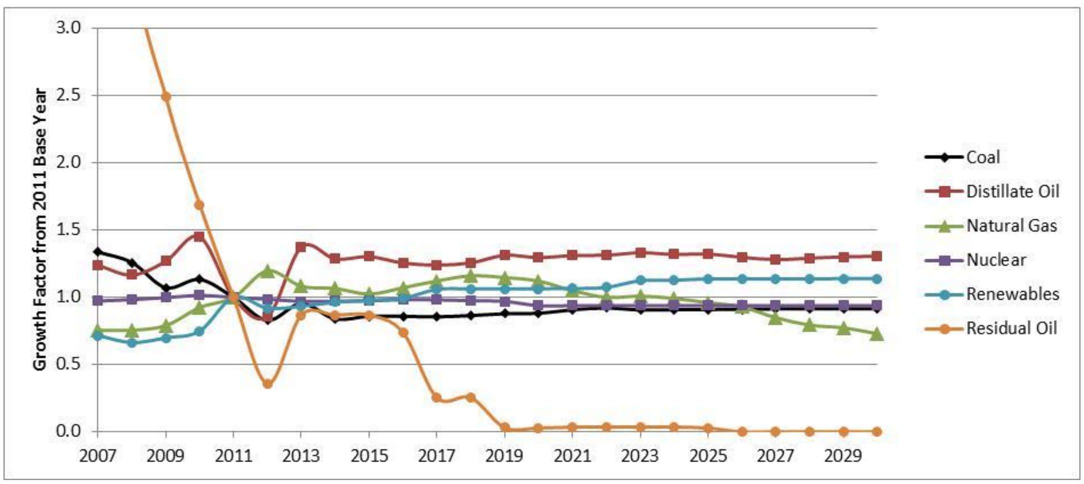
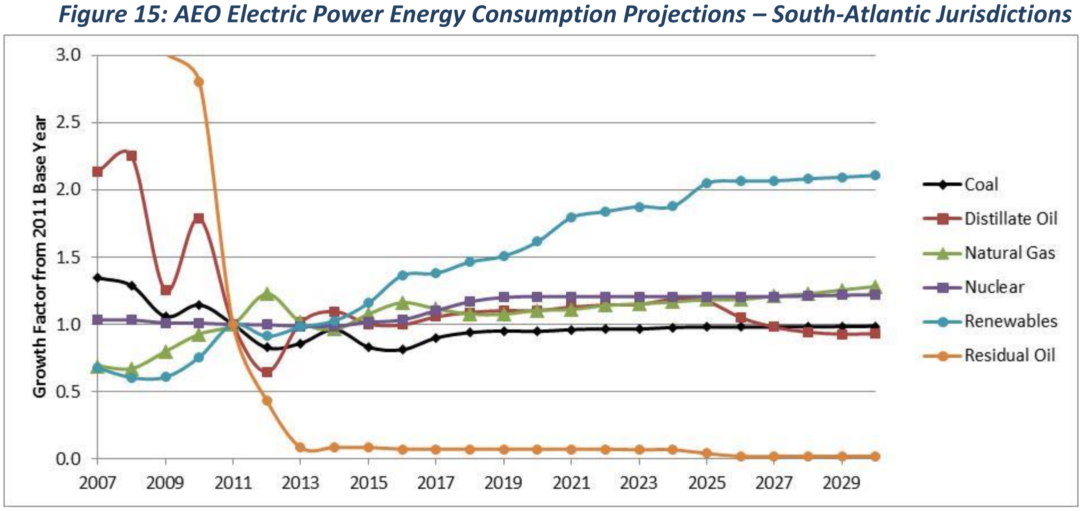


Figure 15: AEO Electric Power Energy Consumption Projections – South-Atlantic Jurisdictions



3.3.1.2. Employment Projections

We obtained employment projections by 3- or 4-digit NAICS code from each state using the references shown in Figure 16 (also included as Appendix M). Every two years, each individual state department of labor produces long-term industry employment forecasts for 10 years into the future. The employment projections are available by state and Workforce Investment Areas (individual counties or groups of counties). For most states, the most recent data are for two years - 2010 and 2020. Massachusetts provided employment data for 2012 and 2022.

Figure 16: Employment Data Sources

State	Reference
CT	2010 and 2020 statewide data from Department of Labor Office of Research's *State of Connecticut Occupational Projections: 2010-2020*; retrieved 10/3/13 from: http://www1.ctdol.state.ct.us/lmi/projections.asp
DC	2010 and 2020 statewide data from Department of Employment Services' *DC Industry and Occupational Projections 2010-2020*; retrieved 10/3/13 from: http://does.dc.gov/publication/dc-industry-and-occupational-projections-2010-2020
DE	2010 and 2020 statewide data from Department of Labor, Office of Labor Market Information's *Delaware Occupation And Industry Projections*; retrieved on 10/3/13 from: http://www.delawareworks.com/oolmi/Information/LMIData/Projections.aspx
MA	2012 and 2022 statewide data from Labor and Workforce Development's *Long-Term Industry Projections*; retrieved 10/3/13 from: http://lmi2.detma.org/lmi/projections.asp
MD	2010 and 2020 statewide data from Department of Labor, Licensing, and Regulation's *Maryland Industry Projections*; retrieved 10/3/13 from: http://www.dllr.state.md.us/lmi/iandoproj/
ME	2010 and 2020 statewide data from Center for Workforce Research and Information's *Job Outlook to 2020*; retrieved 10/3/13 from: http://www.maine.gov/labor/cwri/outlook.html
NC	2010 and 2020 statewide data from Department of Commerce's *NC Statewide Industry Projections*; retrieved 10/3/13 from: http://www.nccommerce.com/lead/data-tools/industry/projections and used for nonpoint source projections; Also provided AEO projections of industrial output by NAICS code for use in projection nonEGU point source emissions.
NH	2010 and 2020 statewide data from New Hampshire Employment Security's *Employment Projections by Industry and Occupation, 2010-2020*; retrieved on 10/3/13 from: http://www.nhes.nh.gov/elmi/products/proj.htm
NJ	2010 and 2020 statewide data from New Jersey Department of Labor and Workforce Development's *Industry and Occupational Employment Projections*; retrieved 10/3/13 from: http://lwd.dol.state.nj.us/labor/lpa/employ/indoccpj/st_index.html
NY	2010 and 2020 statewide data from Department of Labor's *Long-Term Industry Employment Projections*; retrieved 10/3/13 from: http://www.labor.ny.gov/stats/lsproj.shtm
PA	2010 and 2020 statewide data from Department of Labor and Industry's *Long Term Industry Employment Projections*; retrieved 10/3/13 from: http://www.portal.state.pa.us/portal/server.pt?open=514&objID=809913&mode=2
RI	2010 and 2020 statewide data from Department of Labor and Training's *Employment Projections 3-Digit Industry NAICS*; retrieved 10/4/13 from: http://www.dlt.ri.gov/lmi/proj.htm
VA	2010 and 2020 statewide data from Virginia Workforce Connection's *Industry Employment and Projections (Long Term)*; retrieved 10/4/13 from: https://www.vawc.virginia.gov/analyzer/session/session.asp?CAT=HST_EMP_WAGE_IND
VT	2010 and 2020 statewide data from Vermont Department of Labor's *Vermont Industry Projections 2010-2020*; retrieved 10/4/13 from: http://www.vtlmi.info/industry.cfm
WV	2010 and 2020 statewide data from Work Force West Virginia's *Industry Employment Projections 2010-2020*; retrieved 10/3/13 from: http://www.workforcewv.org/lmi/IndProj/longterm/WV.html

To estimate employment in years between 2010 and 2020, we performed a linear interpolation of the available data. For years 2007 to 2009, we used a trend function as is available in the EXCEL software package to estimate employment. This procedure may not accurately estimate employment for 2007 to 2009 since it does not account for short-term recession job losses in those years. If the recession period is judged to be important for inventory development, states should attempt to identify whether actual employment is available for 2007, 2008, and 2009 so that a more realistic representation can be made. For years after 2020, we assumed no additional growth due to the lack of forecast data in those years and the uncertainty in continuing a linear trend beyond 2020.

Figure 17 shows the employment data for agricultural crop production (NAICS=111). This sector encompasses activities associated with crop production, such as soil preparation, soil fertilization, planting, harvesting, and management. Two states (NC and WV) are projecting a large decrease in the number of employees in this sector, while two states (CT and MD) are projecting a large increase. The remaining states show smaller employment losses or gains.

Figure 18 shows the employment data for oil and gas extraction (NAICS=211). This sector includes establishments engaged in (1) the exploration, development and/or the production of petroleum or natural gas from wells, (2) the production of crude petroleum from surface shale and (3) the recovery of liquid hydrocarbons from oil and gas field gases. Only five states (ME, NY, PA, VA, WV) report employment data for the oil and gas extraction industry. New York and Pennsylvania project large increases in employment in this sector, while the three other states report more modest employment gains.

Figure 19 shows the employment data for a group of manufacturing industries (NAICS=31x) that primarily produce finished consumer goods. The sector includes plants, factories, or mills that produce finished products such as food, beverages, textiles, and apparel. Most states report a decline in employment in this sector, with New York and Maine showing the largest declines. Two states (DE, VT) show modest employment gains for this sector.

Figure 20 shows the employment data for a group of manufacturing industries (NAICS=32x) that primarily transform raw materials into semi-finished products that are an inputs for an establishment engaged in further manufacturing. The sector includes refineries, chemical plants, factories, or mills that produce semi-finished goods such as wood products, paper, petroleum products, chemicals, plastics and nonmetallic mineral products. Four states (ME, NJ, NY, WV) report large employment declines for this sector.

Figure 21 shows the employment data for a group of manufacturing industries (NAICS=33x) that primarily produce both semi-finished products that are an input for an establishment engaged in further manufacturing as well as finished products ready for utilization or consumption. The sector includes plants, factories, or mills that produce semi-finished goods such as metal products and finished goods such as machinery, transportation equipment, appliances, and furniture. There is no clear trend in this sector. Delaware projects an employment gain of 12 percent from 2010 to 2020, while West Virginia projects an employment loss of 11 percent. Half of the remaining states project employment gains and half project employment losses.

Figure 22 shows the employment data for repair and maintenance (NAICS=811), which includes automotive body, paint, and interior repair and maintenance. All jurisdictions except the District of Columbia project employment increases for this sector.

Figure 17: Employment Projections for Crop Production (NAICS=111)

State	2010 Estimated Employment	2020 Estimated Employment	Net Change 2010-2020	Annualized Growth Rate (% per year)	Total Percentage Change (%)
CT	3,469	3,958	489	1.3	14.1
DC	0	0	0	0.0	0.0
DE	2,460	2,400	-60	-0.2	-2.4
MA	n/a	n/a	n/a	n/a	n/a
MD	2,525	3,005	480	1.8	19.0
ME	5,858	6,196	338	0.6	5.8
NC	8,300	6,760	-1,540	-2.0	-18.6
NH	2,994	3,159	165	0.5	5.5
NJ	n/a	n/a	n/a	n/a	n/a
NY	16,660	15,530	-1,130	-0.7	-6.8
PA	40,770	41,300	530	0.1	1.3
RI	519	520	1	0.0	0.2
VA	54,211	50,044	-4,167	-0.8	-7.7
VT	541	575	34	0.6	6.3
WV	551	416	-135	-2.8	-24.5

Figure 18: Employment Projections for Oil & Gas Extraction (NAICS=211)

State	2010 Estimated Employment	2020 Estimated Employment	Net Change 2010-20	Annualized Growth Rate (% per year)	Total Percentage Change (%)
CT	0	0	0	0.0	0.0
DC	0	0	0	0.0	0.0
DE	0	0	0	0.0	0.0
MA	0	0	0	0.0	0.0
MD	0	0	0	0.0	0.0
ME	179	202	23	1.2	12.8
NC	0	0	0	0.0	0.0
NH	0	0	0	0.0	0.0
NJ	0	0	0	0.0	0.0
NY	450	1,180	730	10.1	162.2
PA	3,810	7,030	3,220	6.3	84.5
RI	0	0	0	0.0	0.0
VA	446	512	66	1.4	14.8
VT	0	0	0	0.0	0.0
WV	2,260	2,482	222	0.9	9.8

Figure 19: Employment Projections for Manufacturing (NAICS=31x)
Food, Beverage, Textiles, Apparel

State	2010 Estimated Employment	2020 Estimated Employment	Net Change 2010-2020	Annualized Growth Rate (% per year)	Total Percentage Change (%)
CT	9,894	9,604	-290	-0.3	-2.9
DC	n/a	n/a	n/a	n/a	n/a
DE	9,911	10,081	170	0.2	1.7
MA	36,616	36,048	-568	-0.2	-1.6
MD	21,651	20,271	-1,380	-0.7	-6.4
ME	10,290	8,997	-1,293	-1.3	-12.6
NC	111,010	104,730	-6,280	-0.6	-5.7
NH	5,123	4,822	-301	-0.6	-5.9
NJ	44,100	41,700	-2,400	-0.6	-5.4
NY	85,240	71,590	-13,650	-1.7	-16.0
PA	88,530	80,930	-7,600	-0.9	-8.6
RI	6,180	5,850	-330	-0.5	-5.3
VA	45,676	42,998	-2,678	-0.6	-5.9
VT	4,976	5,193	217	0.4	4.4
WV	4,061	3,755	-306	-0.8	-7.5

Figure 20: Employment Projections for Manufacturing (NAICS=32x)
Wood, Paper, Petroleum, Chemicals, Plastics

State	2010 Estimated Employment	2020 Estimated Employment	Net Change 2010-20	Annualized Growth Rate (% per year)	Total Percentage Change (%)
CT	31,188	31,474	286	0.1	0.9
DC	n/a	n/a	n/a	n/a	n/a
DE	7,120	7,040	-80	-0.1	-1.1
MA	56,924	55,872	-1,052	-0.2	-1.8
MD	37,180	35,500	-1,680	-0.5	-4.5
ME	18,710	14,973	-3,737	-2.2	-20.0
NC	127,640	131,380	3,740	0.3	2.9
NH	13,938	14,382	444	0.3	3.2
NJ	131,100	116,700	-14,400	-1.2	-11.0
NY	125,630	105,720	-19,910	-1.7	-15.8
PA	178,320	173,970	-4,350	-0.2	-2.4
RI	9,213	9,930	717	0.8	7.8
VA	72,442	76,490	4,048	0.5	5.6
VT	7,272	7,610	338	0.5	4.6
WV	22,953	20,136	-2,817	-1.3	-12.3

Figure 21: Employment Projections for Manufacturing (NAICS=33x)
Metals, Machinery, Electronics, Transportation Equipment, Furniture

State	2010 Estimated Employment	2020 Estimated Employment	Net Change 2010-2020	Annualized Growth Rate (% per year)	Total Percentage Change (%)
CT	124,083	120,173	-3,910	-0.3	-3.2
DC	n/a	n/a	n/a	n/a	n/a
DE	8,800	9,910	1,110	1.2	12.6
MA	157,685	136,287	-21,398	-1.4	-13.6
MD	52,026	48,456	-3,570	-0.7	-6.9
ME	21,658	20,017	-1,641	-0.8	-7.6
NC	192,740	197,640	4,900	0.3	2.5
NH	46,707	46,793	86	0.0	0.2
NJ	82,000	79,100	-2,900	-0.4	-3.5
NY	246,240	235,770	-10,470	-0.4	-4.3
PA	293,590	302,860	9,270	0.3	3.2
RI	24,454	24,870	416	0.2	1.7
VA	110,697	114,979	4,282	0.4	3.9
VT	18,124	17,829	-295	-0.2	-1.6
WV	21,399	19,078	-2,321	-1.1	-10.8

Figure 22: Employment Projections for Repair and Maintenance (NAICS=811)
including Automobile Repair and Maintenance

State	2010 Estimated Employment	2020 Estimated Employment	Net Change 2010-20	Annualized Growth Rate (% per year)	Total Percentage Change (%)
CT	13,342	14,508	1,166	0.8	8.7
DC	596	538	-58	-1.0	-9.7
DE	3,320	3,650	330	1.0	9.9
MA	24,462	24,826	364	0.1	1.5
MD	22,840	24,215	1,375	0.6	6.0
ME	4,779	4,918	139	0.3	2.9
NC	31,470	32,580	1,110	0.3	3.5
NH	6,225	6,680	455	0.7	7.3
NJ	32,100	35,500	3,400	1.0	10.6
NY	55,800	63,240	7,440	1.3	13.3
PA	48,470	54,090	5,620	1.1	11.6
RI	3,936	4,300	364	0.9	9.2
VA	32,064	41,212	9,148	2.5	28.5
VT	2,442	2,759	317	1.2	13.0
WV	7,149	7,442	293	0.4	4.1

3.3.1.3. State Preferences

S/L/T agencies were provided the choice of using (1) the AEO energy projections for fuel burning sources and employment projections for process sources, (2) only employment projections for all nonERTAC point sources, or (3) using a no growth projection.

Some of the growth factors used to project emissions for non-EGU sources show declining trends. For example, AEO projects negative growth for many fuel consumption sectors. Similarly, the employment projections show declines in the predicted number of employees for many sectors of the economy. This is particularly true for the manufacturing sector, which is of interest because this sector is often associated with higher emissions than those for other sectors. By contrast, the employment projections show increasing trends in retail and service-related sectors. However, these sectors are not typically associated with significant emissions.

Predicted declines in fuel use and employment resulted in growth factors less than unity (i.e., represent negative growth) for many non-EGU point source categories. Consequently, for some categories, emissions will be projected to be lower in future years compared to the base year, even before the application of emission control programs. The MARAMA emissions inventory workgroup was polled as to whether or not they felt that the negative growth factors were realistic for their state. Some state representatives mentioned that they have observed historic state-specific data that supports the negative trends. Other representatives mentioned that they feel comfortable with the negative growth factors and do not have a technical basis to change them or suggest others. Still other states recommended a conservative approach for addressing negative growth by setting a minimum growth rate of 1 (no growth). As a result of these discussions, each state provided guidance on how to handle projections when negative growth is indicated.

Some of the growth factors used to project emissions for non-EGU sources showed very large increasing trends. S/L/T agencies were polled to determine whether factors with large positive growth should be capped so that unrealistically high growth would not occur. Initially, we established a cumulative growth cap of +25% over the 2011 to 2018 period. S/L/T agencies reviewed the growth factors that exceeded the +25% cap and provided their recommendations for adjusting the cap. In nearly all cases, the S/L/T agencies agreed that the +25% growth factor cap was appropriate.

Figure 23 summarizes the state recommendations for the growth factors to use for the nonERTAC point source sector. Appendix N contains further details on each state's recommendation.

Figure 23: State Preferences for nonERTAC Point Source Growth Factors

State	AEO 2014 Energy Projections	Employment Projections
CT	Do not use AEO energy projections, use employment for all processes	Use employment projections for all SCCs for positive growth; use no growth when employment growth is negative
DC	Use AEO projections for Fuel Burning SCCs; use no growth when AEO growth is negative	Use employment projections for Process SCCs; use no growth when employment growth is negative
DE	Use AEO projections for Fuel Burning SCCs; use no growth when AEO growth is negative	Use employment projections for Process SCCs; use no growth when employment growth is negative
MA	Use AEO projections for Fuel Burning SCCs; use no growth when AEO growth is negative	Use employment projections for Process SCCs; use no growth when employment growth is negative

State	AEO 2014 Energy Projections	Employment Projections
MD	Do not use AEO energy projections, use employment for all processes	Use employment projections for all SCCs for positive growth; use no growth when employment growth is negative
ME	Use AEO projections for Fuel Burning SCCs; use no growth when AEO growth is negative	Use employment projections for Process SCCs; use no growth when employment growth is negative
NC	Do not use AEO energy projections, use employment for all processes	Use employment projections for all SCCs for positive growth; use no growth when employment growth is negative; use no-growth for small sources included in NEI2011v2 that were not in NEI2011v1
NH	Use AEO projections for Fuel Burning SCCs; use no growth when AEO growth is negative	Use employment projections for Process SCCs; use no growth when employment growth is negative
NJ	Do not use AEO energy projections, use employment for all processes	Use employment projections for all SCCs for positive growth; use no growth when employment growth is negative
NY	Use AEO projections for Fuel Burning SCCs; use no growth when AEO growth is negative	Use employment projections for Process SCCs; use no growth when employment growth is negative
PA	Use AEO projections for Fuel Burning SCCs; use no growth when AEO growth is negative	Use employment projections for Process SCCs; use no growth when employment growth is negative
RI	Use AEO projections for Fuel Burning SCCs; use no growth when AEO growth is negative	Use employment projections for Process SCCs; use no growth when employment growth is negative
VA	Use AEO projections for Fuel Burning SCCs; use no growth when AEO growth is negative	Use employment projections for Process SCCs; use no growth when employment growth is negative
VT	Use AEO projections for Fuel Burning SCCs; use no growth when AEO growth is negative	Use employment projections for Process SCCs; use no growth when employment growth is negative
WV	Use no growth for all nonERTAC point sources	Use no growth for all nonERTAC point sources

3.3.1.4. Growth Factor Spreadsheet and EMF Packet

To facilitate state review of the growth factors, SRA developed user-friendly spreadsheets that provide the surrogate growth parameters, match the growth parameters to inventory records, and configure the growth factors into the required EMF format. The spreadsheets allow the user to create a projection packet for any combination of base year and future year for the 2007 to 2040 period.

The spreadsheet contains four tabs as described in Section 3.1. It is included as Appendix O. Instructions for using the spreadsheet are contained in the "Methodology" tab. The "Growth Raw Data" tab contains the AEO and employment data described in the previous section. The "NEI to Growth Factor XWALK" tab is a list of list of facilities or emission processes that we initially obtained from the NEI2011v1. We excluded the 11 aircraft/GSE/APU SCCs from the list and moved them to a separate spreadsheet as described in Section 3.5.2. For states that chose to project all emission processes at a given facility using the same growth code (NAICS employment), there is only one record per facility. Other states chose to project emissions by individual emission process and there is one record for each emission process in the NEI. We updated this list in January 2015 to include additional sources that were included in NEI2011v2. For example, North Carolina asked EPA to include a large number of small point sources in Version 2 that were left out of Version 1. We also updated the list to include those small EGUs and nonEGUs that are in the ERTAC UAF but not included in the ERTAC Forecast Tool.

3.3.2. NonEGU Control Factors

This section describes how we compiled emission control information for nonERTAC point sources. We developed emission control factors relative to a 2011 base year emissions inventory We initially obtained data from EPA's NEI2011v1 Version 6.0 modeling platform (EPA, 2014) which includes a set of EMF/CoST model control and closure records specific to stationary nonEGU point sources. These EPA control factors and closure records are included as Appendix P.

S/L/T agencies reviewed the EPA control packets and provided guidance on any adjustments needed to the EPA factors and any state rules not included in the EPA control packets. We augmented the EPA control factors with additional factors for state-specific measures not included in the EPA control packets and modified some of the EPA control factors in response to state requests. We consolidated the revised control factors into a single EMF pack for controls and a single EMF packet for closures (see Appendices Q and R). We organized the following sub-sections to address the specific types of controls used to calculate future year emission reductions from nonERTAC point sources.

3.3.2.1. OTC and MANE-VU Control Measures

For the past 20 years, the Ozone Transport Commission (OTC) has identified strategies to achieve cost-effective reductions of ozone-forming pollutants. Similarly, the Mid-Atlantic/Northeast Visibility Union (MANE-VU) coordinated the development of emission management strategies to assure reasonable progress toward remedying any existing impairment of visibility and preventing future impairment. Each S/L/T agency can pursue rulemakings or other implementation methods to establish the OTC/MANE-VU recommended emission reductions, emission rates or emission control technologies as appropriate and necessary.

Individual states are in various stages of adopting the OTC/MANE-VU recommendations into the rules and SIPs. We reviewed the OTC's status reports to identify each state's adoption status (see Appendices S, T, and U). To obtain further clarification about each state's status with respect to the OTC/MANE-VU measures, we polled the states to determine whether they have adopted a rule that would achieve reductions equivalent to the OTC/MANE-VU recommendation. We obtained information on the effective date of the rule, whether credit for each rule was reflected in the 2011 inventory and what additional post-2011 reductions are expected. Appendix V contains each state's recommendations for accounting for each OTC control measure recommendation. The following subsections discuss the control measures with post-2011 effective dates.

3.3.2.2. State NOx Rules and Control Requirements

The OTC developed NOx control measures for industrial, commercial, and institutional (ICI) boilers and distributed generation units in 2001. We reviewed the OTC's status reports and state feedback to identify states status in adopting this recommendation. Most states have rules in place with compliance dates in 2007 or earlier. As a result, we concluded that the emission reductions are already reflected in the 2011 inventory and no post- 2011 reductions were applied.

In 2006, the OTC introduced new or more stringent requirements for several NOx source categories (asphalt production plants, cement kilns, glass/fiberglass furnaces, and ICI boilers). The OTC recommendations during 2009 to 2014 did not include any measures affecting NOx emissions from nonEGU point sources. Several states have adopted rules reflecting the recommendations of the OTC with compliance dates after 2011. We developed control factors for the following state rules affecting point sources with post-2011 compliance dates:

- Delaware identified that the Delaware City refinery is subject to an enforceable emission cap for NOx. Delaware estimated that a 23% reduction in NOx emissions beginning in 2016.
- Maine provided comments to EPA that identified facility-wide NOx reductions at three facilities: McCain Foods Easton, FLP Energy Wyman LLC, and Bath Iron Works Bath Facility.
- New Jersey adopted a rule limiting the NOx emissions from glass furnaces. New Jersey identified the affected units and estimated a 45% reduction in NOx emissions effective in 2012.
- New York adopted a rule that became effective in July 2014 further limiting NOx emissions from ICI boilers. We estimated the percent reduction in NOx emissions by comparing the pre-2014 emission limits to the 2014 limits. The percent reduction varied by boiler size and fuel type. See Appendix V for the specific percent reductions applied to each SCC.
- Virginia provided comments to EPA that identified facility-wide NOx reductions at three facilities: GP Big Island, Honeywell Hopewell, and Invista Waynesboro.

The percent reductions shown above were either provided directly by the individual state agency or obtained from the OTC Control Measures TSD (OTC, 2007).

3.3.2.3. State VOC Rules and Control Requirements

The OTC developed VOC control measures for two point source categories. The OTC established VOC content limits and other restrictions on adhesives used in industrial and commercial settings. The OTC also established control requirements for high vapor pressure VOCs, such as gasoline and crude oil, stored in large aboveground stationary storage tanks, which are typically located at refineries, terminals and pipeline breakout stations. The following states have adopted rules reflecting the recommendations of the OTC with compliance dates after 2011.

- Massachusetts adopted a rule limiting the VOC content of adhesives and sealants. The rule has a compliance date of May 1, 2016 and is expected to result in a 64% reduction.
- New Jersey adopted a rule requiring additional controls on petroleum storage tanks. New Jersey identified the affected SCCs and estimated the VOC percent reduction for individual years between 2012 and 2020.
- Pennsylvania adopted a rule limiting the VOC content of adhesives and sealants. The rule has a compliance date of January 1, 2012 and is expected to result in a 64% reduction.
- Virginia revised its rule limiting the VOC content of adhesives and sealants to include the Richmond VOC Control Area. The rule had a compliance date of March 1, 2014 and is expected to result in a 64% reduction in VOC emissions.

The percent reductions shown above were either provided directly by the individual state agency or obtained from the OTC Control Measures TSD (OTC, 2007).

3.3.2.4. State Fuel Oil Sulfur Rules

MANE-VU developed a low sulfur fuel oil strategy to help states develop Regional Haze SIPs. The sulfur in fuel oil recommendations vary by state, type of fuel oil, and year of implementation. We polled states regarding the status of state rules implementing the low sulfur fuel oil strategy and reviewed state rules to determine enforceable sulfur limits and compliance dates. Figure 24 shows the status for each jurisdiction's rule development.

We calculated state specific control factors for distillate, residual, and #4 fuel oil using each state's baseline sulfur contents and the sulfur contents in the state's recently adopted rules. In general, the baseline sulfur content was 3000 ppm for distillate oil, and 2.25% for residual and #4 oil. However, many states had lower baseline sulfur contents for residual oil, which varied by state and county. We used state- or county-specific baseline residual oil sulfur contents to calculate a state- or county-specific control factors for residual oil. See Appendix Q for the specific reductions by state/county and fuel type.

Figure 24: Status of State Fuel Oil Sulfur Rules (as of February 2015)

State	Reference
CT	Section 22a-174-19a. Control of sulfur dioxide emissions from power plants and other large stationary sources of air pollution: Distillate and Residual: 3000 ppm effective April 15, 2014. Section 22a – 174 - 19b. Fuel Sulfur Content Limitations for Stationary Sources (except for sources subject to Section 22a-174-19a). Distillate: 500 ppm effective July 1, 2014; 15 ppm effective July 1, 2018 Residual: 1.0% effective July 1, 2014; 0.3% effective July 1, 2018 Connecticut General Statute 16a-21a. Sulfur content of home heating oil and off-road diesel fuel. Number 2 heating oil and off-road diesel fuel: 500 ppm effective July 1, 2014; 15 ppm effective July 1, 2018
DC	No rule in place
DE	1108 Sulfur Dioxide Emissions from Fuel Burning Equipment Distillate: 15 ppm effective July 1, 2017 Residual: 0.5% effective July 1, 2017 #4 Oil: 0.25% effective July 1, 2017
MA	310 CMR 7.05 (1)(a)1: Table 1 : Sulfur Content Limit of Liquid Fossil Fuel Distillate: 500 ppm effective July 1, 2014; 15 ppm effective July 1, 2018 Residual: 1.0% effective July 1, 2014; 0.5% effective July 1, 2018
MD	No rule in place
ME	Chapter l06: Low Sulfur Fuel Distillate: 500 ppm effective July 1, 2014; 15 ppm effective July 1, 2018 Residual: 0.5% effective July 1, 2018
NC	No rule in place
NH	No rule in place
NJ	Title 7, Chapter 27, Subchapter 9 Sulfur in Fuels Distillate: 500 ppm effective July 1, 2014; 15 ppm effective July 1, 2016 Residual: 0.5% or 0.3%, depending on county, effective July 1, 2014 #4 Oil: 0.25% effective July 1, 2014
NY	Subpart 225-1 Fuel Composition and Use - Sulfur Limitations Distillate: 15 ppm effective July 1, 2016 Residual: 0.3% in New York City effective July 1, 2014; 0.37% in Nassau, Rockland and Westchester counties effective July 1, 2014; 0.5% remainder of state effective July 1, 2016
PA	§ 123.22. Combustion units Distillate: 500 ppm effective July 1, 2016 Residual: 0.5% effective July 1, 2016

State	Reference
	#4 Oil: 0.25% effective July 1, 2016
RI	Air Pollution Control Regulations No. 8 Sulfur Content of Fuels Distillate: 500 ppm effective July 1, 2014; 15 ppm effective July 1, 2018 Residual: 0.5% effective July 1, 2018
VA	No rule in place
VT	5-221(1) Sulfur Limitations in Fuel Distillate: 500 ppm effective July 1, 2014; 15 ppm effective July 1, 2018 Residual: 0.5% effective July 1, 2018 #4 Oil: 0.25% effective July 1, 2018
WV	No rule in place

3.3.2.5. Facility and Unit Closures

We obtained EPA's NEI2011v1 Version 6.0 modeling platform closure records and provided these to S/L/T agencies for review and approval. EPA provided two closure packets. EPA identified one set of closures from a September 11, 2013 Emissions Inventory System report of post-2011 permanent facility shutdowns, based on facility status code "PS". EPA identified a second set of closures based on previous facility and unit-level closure information used in the 2008 NEI-based emissions modeling platform. After states reviewed the EPA closure information, Massachusetts and North Carolina provided additional information on plant/unit closures.

3.3.2.6. Boiler MACT Rules

The Industrial/Commercial/Institutional Boilers and Process Heaters MACT Rule promulgates national emission standards for the control of hazardous air pollutants for new and existing industrial, commercial, and institutional (ICI) boilers and process heaters at major sources of HAPs. The expected co-benefit for CAPs at these facilities is significant and greatest for SO2 with lesser impacts for direct PM, CO and VOC.

SRA relied upon EPA's estimates of the expected emission reductions from the boiler MACT standards. EPA developed control factors that varied by pollutant, SCC, and facility. The EPA's control factor file does not include a compliance date. The final rule was published in the Federal Register in January 2013 and requires existing major sources to comply with the standards by January 2016. See section 4.2.7 of the 2011 Modeling Platform Version 6.0 TSD (EPA, 2014) for additional information.

3.3.2.7. RICE MACT Standards

EPA developed control factors for three rulemakings for National Emission Standards for Hazardous Air Pollutants (NESHAP) for Reciprocating Internal Combustion Engines (RICE). These rules reduce HAPs from existing and new RICE sources. In order to meet the standards, existing sources with certain types of engines will need to install controls. In addition to reducing HAPs, these controls have co-benefits that also reduce CAPs, specifically, CO, NOX, VOC, PM, and SO2. In 2014 and beyond, compliance dates have passed for all three rules; thus all three rules are included in the emissions projection. These RICE reductions also reflect the recent (proposed January, 2012) Reconsideration Amendments, which results in significantly less stringent NOX controls (fewer reductions) than the 2010 final rules.

SRA relied upon EPA's estimates of the expected emission reductions from the RICE standards. EPA developed control factors that varied by pollutant and SCC. See section 4.2.5 of the 2011 Modeling Platform Version 6.0 TSD (EPA, 2014) for additional information.

3.3.2.8. Consent Decrees

EPA developed control factors that contain information about the expected emission reductions that have been agreed to between EPA (and the Department of Justice) and the affected companies. The following consent decrees affected sources in the project study area:

- EPA estimated reductions needed to achieve post year-2008 emissions values from the Cross State Air Pollution Rule (CSAPR) response to comments. These reductions reflect fuel switching, cleaner fuels, and permit targets via specific information on control equipment in the following states: New York (LaFarge Albany County), and Virginia (Virginia Tech, GP Big Island).
- EPA estimated the emission reductions from enforcement settlements with Lafarge Company and St. Gobain Containers, Inc. These settlements are the first system-wide settlements for these sectors under the Clean Air Act and require pollution control upgrades, acceptance of enforceable emission limits, and payment of civil penalties. The settlements require various NOx controls. Affected facilities are located in Massachusetts, North Carolina, and Pennsylvania.

EPA estimated the NOx and SO2 emission reductions from an enforcement settlement with the Holcim (US), Inc. cement plant in Maryland. The settlement specifies a NOx reduction of 92 tons per year and an SO2 reduction of 230 tons per year.

3.3.2.9. Regional Haze Plan Controls

EPA estimated the expected NOx and SO2 emission reductions associated with controls (Best Available Retrofit Technology) in regional haze plans. These controls affect expected emission reductions and future year caps for individual facilities in various industries (cement, taconite, steel, pulp and paper, and mining). EPA included two facilities in the project study area: Lehigh Northeast Cement in New York and Meadwestvaco Packaging in Covington, Virginia. EPA provided the estimated compliance dates and control efficiencies by pollutant, SCC, and facility.

3.3.3. Stand Alone Inventories

Stand-alone future year inventories contain units that are new to the future year because they did not exist in 2011 but that EPA projected to be necessary to cover increased future year production. See section 4.2.5 of the 2011 Modeling Platform Version 6.2 TSD (EPA, 2015b).

For 2028, the EPA files were included without change states outside the 15 states covered by this inventory. For the 15 states covered by this inventory, only North Carolina and Pennsylvania were affected by these new stand-alone future year inventories. After review of these files, North Carolina instructed us to include the EPA files unchanged for 2028, while Pennsylvania chose to exclude these files from the 2028 inventory.

3.4. NONPOINT SOURCES

S/L/T agencies have traditionally used economic, energy, and demographic parameters as surrogates for projecting future emissions. While recognizing that these surrogates may not track exactly with emissions, states consider these surrogates to be the "best available" data for projecting emissions for nonpoint sources. S/L/T agencies also account for the effect of emission control programs in reducing future year emissions. SRA assisted states in developing growth and control factors for use within the EMF tool.

3.4.1. Growth Factors

We relied on EPA guidance, an EPA-developed crosswalk, and state recommendations to match the surrogate growth parameters to the nonpoint point sources in the NEI2011v2. We selected surrogate growth data for each emission source after considering several criteria:

- Is the surrogate parameter readily available in a publicly available, non-proprietary data source?
- How well is methodology and data used to develop the surrogate parameter documented?
- How closely does the surrogate parameter relate to the activity indicator used to develop the base year emission?
- How closely does the surrogate data approximate changes in the emission generating activity?
- How well does it characterize the activity in a given geographic area and during the time frame of interest?

The specific surrogate growth parameter used for the nonpoint sector are described in the following subsections.

3.4.1.1. Energy Projections

We used the AEO2014 projections for commercial and industrial nonpoint fuel burning sources as previously described in Section 3.3.1.1. In addition, we used AEO2014 projections for residential and transportation fuel consumption. See Appendices J, K and L for the AEO data by region, year and fuel type.

Residential energy consumption - Figures 25 to 27 show the AEO projections for residential energy consumption in the three regions. AEO projects a 20 to 25 percent reduction in heating oil consumption by 2025 in all three regions. In New England, AEO projects all other residential energy sources to have only a small change in consumption. In the Mid-Atlantic region, AEO projects a downward trend in natural gas consumption and an upward trend in renewable energy sources. In the South Atlantic region, AEO is projecting upward trends in electricity, renewable, and natural gas. These upward trends are presumably due in part to the growing populations in this region. There are big swings in residential coal consumption in the years 2007 to 2011. However, the total amount of residential energy derived from coal is very small compared to other energy sources, and this volatility should have very little if any impact on future year emission totals.

Transportation energy consumption - Figures 28 to 30 show the AEO projections for transportation energy consumption in the three regions. AEO projects increases in alternative fuel vehicle (electricity, CNG/LPG) in all three regions. AEO also projects the gasoline consumption will decrease after 2011 in all three regions. These AEO projections are used for certain types of sources such as the marketing and distribution of petroleum products.

Figure 25: AEO Residential Energy Consumption Projections – New England States

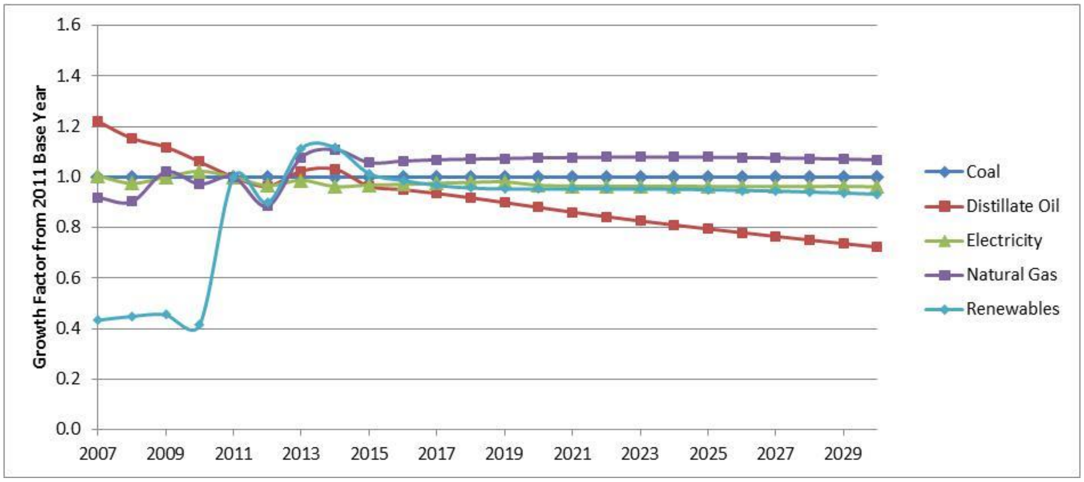


Figure 26: AEO Residential Energy Consumption Projections – Mid-Atlantic States

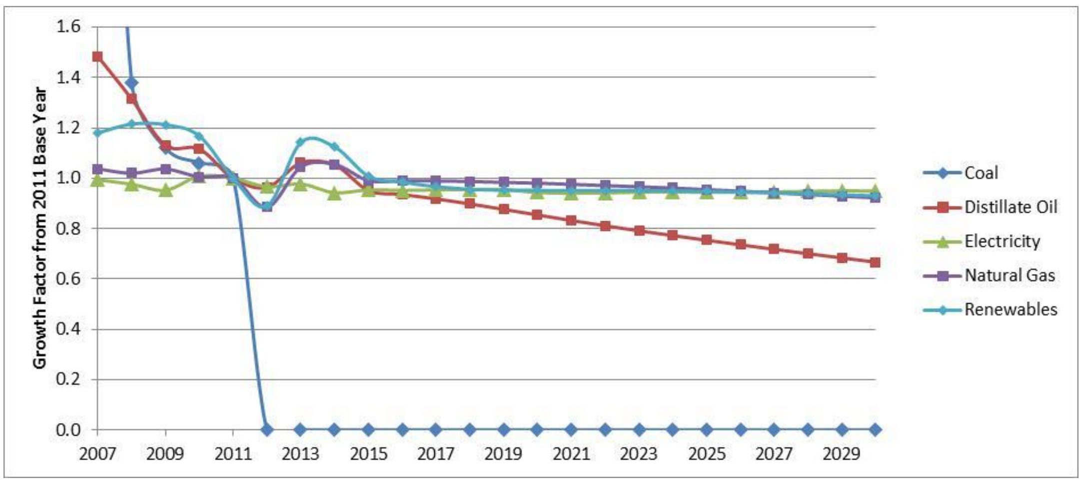


Figure 27: AEO Residential Energy Consumption Projections – South-Atlantic Jurisdictions

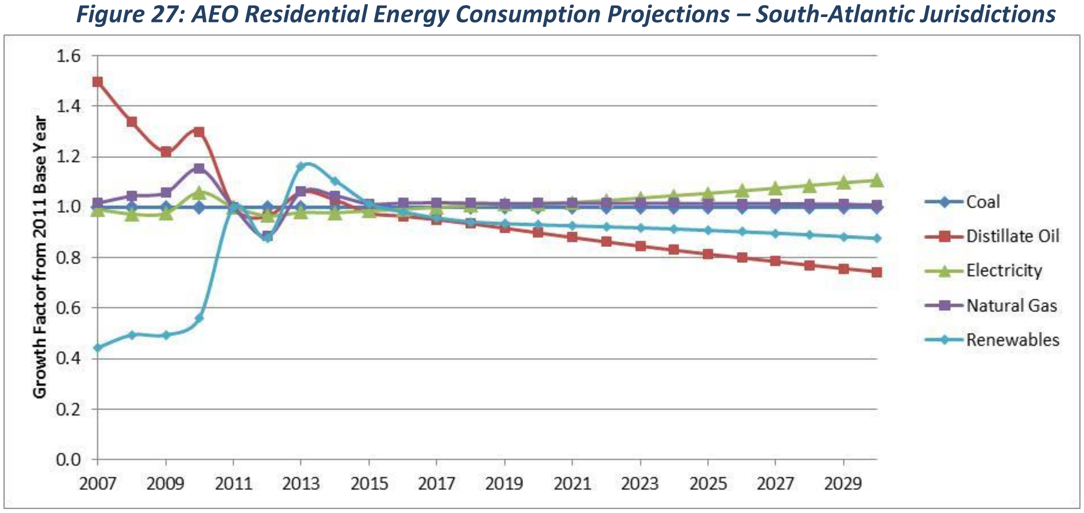


Figure 28: AEO Transportation Energy Consumption Projections – New England States

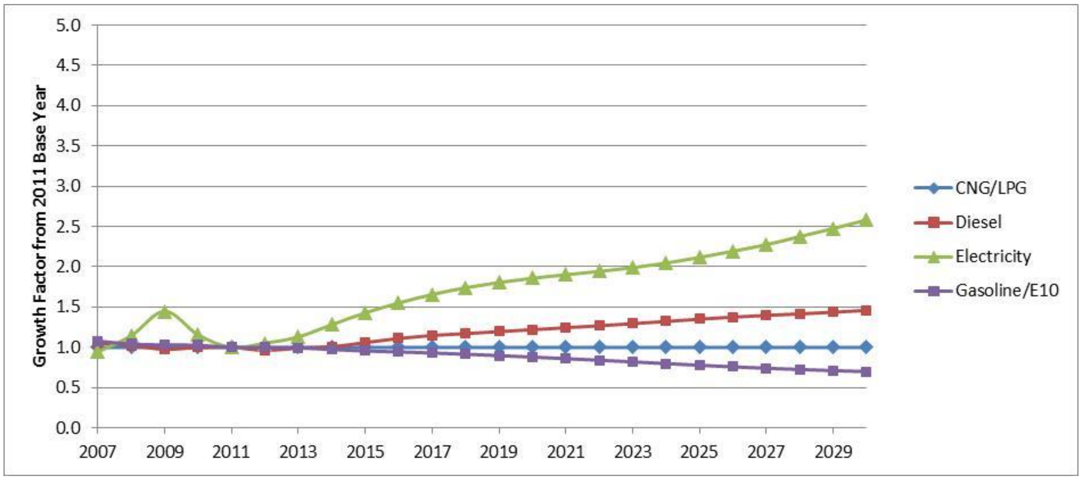


Figure 29: AEO Transportation Energy Consumption Projections – Mid-Atlantic States

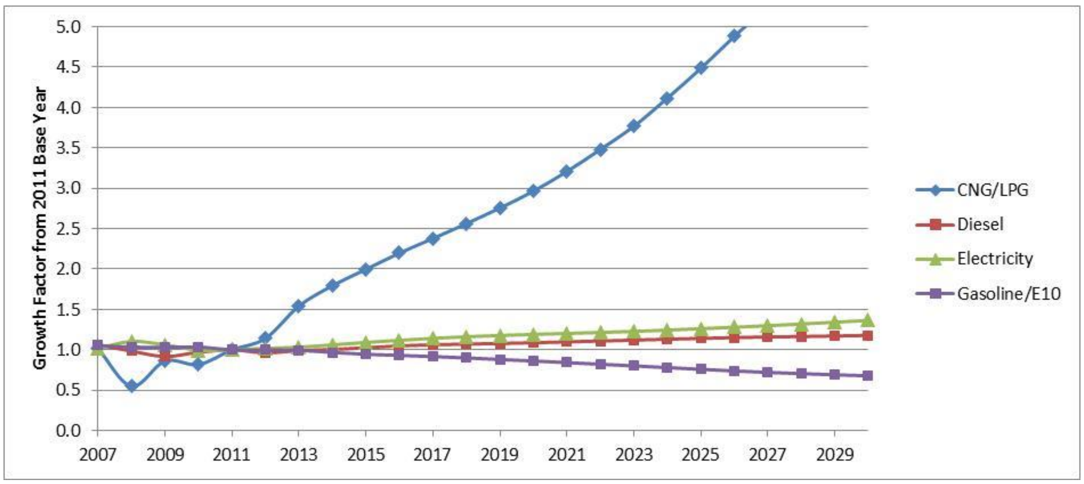
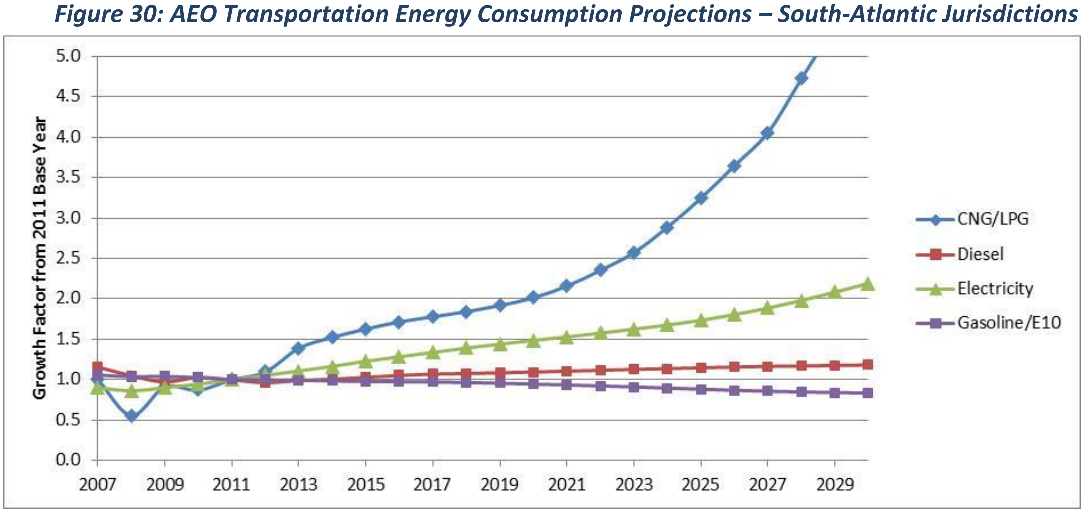


Figure 30: AEO Transportation Energy Consumption Projections – South-Atlantic Jurisdictions



3.4.1.2. Population

We obtained historical population counts by county for the years 2000 to 2010 from the U.S. Census Bureau. We obtained population projections by county for available future years from each state's population data center. See Figure 31 for references and Appendix W for the actual data. For years where published values were not available, we estimated the population by interpolating between years with published values. For any projection year beyond the last year of each state's population growth data sets, we assumed no additional growth after the last year of published data.

Figure 31: Population Data Sources

State	Reference
All	Historical data for 2000 to 2010 obtained from U.S. Census Bureau. *Intercensal Estimates of the Resident Population by County: July 1, 2001 to July 1, 2010*. Accessed on November 21, 2013. http://www.census.gov/popest/data/intercensal/county/CO-EST00INT-01.html
CT	Connecticut State Data Center at the University of Connecticut Libraries Map and Geographic Information Center - MAGIC. *2015-2025 Population Projections for Connecticut at State, County, Regional Planning Organization, and Town levels - November 1, 2012 edition*. retrieved on 10/2/13 from: http://ctsdc.uconn.edu/2015_2025_projections/
DC	DC Office of Planning, *Metropolitan Washington Council of Governments Population Forecast Round 8.0*; retrieved 10/3/13 from: http://planning.dc.gov/DC/Planning/DC+Data+and+Maps/DC+Data
DE	Delaware Census State Data Center, *The Delaware Population Consortium Annual Projections, October 25, 2012, Version 2012.0;* retrieved on 10/2/13 from: http://stateplanning.delaware.gov/information/dpc_projections.shtml
MA	Massachusetts Department of Transportation, *Massachusetts Population Projections from MassDOT Planning*; retrieved on 10/2/13 from: www.massdot.state.ma.us/Portals/17/docs/Demographics/MunicipalDemographics-Population.csv
MD	Department of Planning, *Historical and Projected Total Population for Maryland's Jurisdictions*; retrieved 10/3/2012 from: http://www.mdp.state.md.us/msdc/s3_projection.shtml
ME	Office of Policy and Management, *Maine state and county population outlook to 2030*; retrieved on 10/3/13 from: http://www.maine.gov/economist/econdemo/article.shtml?id=501734
NC	Office and State Budget and Management, *County/State Population Projections*; retrieved on 10/3/13 from: http://www.osbm.state.nc.us/ncosbm/facts_and_figures/socioeconomic_data/population_estimates/county_projections.shtm
NH	Office of Energy and Planning, *Population projections for New Hampshire counties, cities and towns*, retrieved on 11/21/13 from: http://www.nh.gov/oep/data-center/population-projections.htm
NJ	Department of Labor and Workforce Development, *Projections of Total Population by County: New Jersey, 2010 to 2030*; retrieved 10/3/13 from http://lwd.dol.state.nj.us/labor/lpa/dmograph/lfproj/lfproj_index.html
NY	Department of Labor, *New York State and County Population Projections by Age and Sex*; retrieved on 10/3/13 from: http://www.labor.ny.gov/stats/nys/statewide-population-data.shtm
PA	Pennsylvania State Data Center, *Total population projections for Pennsylvania Counties, 2000-2030*; retrieved 10/3/13 from: http://pasdc.hbg.psu.edu/Data/Projections/tabid/1013/Default.aspx
RI	Division of Planning, *City and Town Population Projections*; retrieved on 10/3/13 from: http://www.planning.ri.gov/geodeminfo/data/popprojections.php
VA	Virginia Employment Commission, *Total Population Projections for Virginia and its Localities, 2020-2040*; retrieved 10/3/13 from: http://www.coopercenter.org/demographics/virginia-population-projections
VT	Vermont Agency of Commerce and Community Development's *Vermont Population Projections – 2010 - 2030*; retrieved 10/3/13 from: http://accd.vermont.gov/business/strategic_planning
WV	Bureau for Business and Economic Research's *Population Projection for West Virginia Counties*; retrieved 10/3/13 from: http://www.be.wvu.edu/demographics/populationprojection.htm

Figure 32 shows the population growth factors for the six states in New England AEO region. Population in the New England region is projected to grow from 14.5 million in 2011 to 14.8 million in 2017 and 15.2 million in 2025. Population growth is relatively modest (2 – 3 percent over the six year period from 2011 to 2017) in Connecticut, Massachusetts, New Hampshire and Vermont. Essentially no growth in population is projected for Maine from 2011 to 2017. Rhode Island is projected to have a small decrease in population.

Figure 33 shows the population growth factors for the three states in Mid-Atlantic AEO region. Population in these three states is projected to grow from 40.0 million in 2011 to 41.5 million in 2017 and 42.3 million in 2025. Population in New Jersey is projected to grow by about 3 percent from 2011 to 2017. Population in New York and Pennsylvania is project to grow by about 1 percent from 2011 to 2017.

Figure 34 shows that population in the southern part of the study area is projected to grow much faster than the middle/northern part of the region. Population in these jurisdictions is projected to grow from 27.0 million in 2011 to 28.4 million in 2017 and 30.4 million in 2025. These jurisdictions (except West Virginia) have population growth rates that range from 4 to 7½ percent from 2011 to 2017.

3.4.1.3. Employment Projections

We used the same state employment projections by 3-digit NAICS code for nonpoint industrial process as previously described in Section 3.3.1.2.

3.4.1.4. Reentrained Road Dust

Vehicle miles traveled (VMT) data are used as the growth factor for projecting emissions from re-entrained road dust from travel on paved roads (SCC 22-94-000-000). A few states (CT, DC, MA, NH, NJ, VT, VA) were able to provide VMT by county. For states that were unable to provide state-specific VMT, we used national VMT projections from AEO2014.

3.4.1.5. Agricultural Fertilizer and Livestock Waste

We used EPA's NEI2011v1 Version 6.0 approach to develop projection factors for agricultural activities including fertilizer and pesticide application, agricultural tilling/harvesting, and livestock waste processing. Since EPA developed projection factors only for 2018, we developed projection factors for all remaining years via interpolation or extrapolation. See Section 4.2.2 of the 2011 Modeling Platform Version 6.0 TSD (EPA, 2014) for additional information.

3.4.1.6. Residential Wood Combustion

SRA used EPA's Modeling Platform Version 6.0 approach to develop projection factors for residential wood combustion (RWC) activities. See Section 4.2.3 the 2011 Modeling Platform Version 6.0 TSD (EPA, 2014) for or details of the methodology. EPA used a "business as usual" approach to RWC projections that does not account for national New Source Performance Standards (NSPS) for wood stoves, since the revised NSPS was not finalized at the time the ALPHA2 inventory was prepared. EPA projected emissions to the year 2018 based on expected increases and decreases in various residential wood burning appliances. As newer, cleaner woodstoves replace some older, higher-polluting wood stoves, there will be an overall reduction of the emissions from older "dirty" stoves but an overall increase in total RWC due to population and sales trends in all other types of wood burning devices such as indoor furnaces and outdoor hydronic heaters. Since EPA developed projection factors only for 2018, we developed projection factors for all remaining years via interpolation or extrapolation.

Figure 32: Population Projections – New England States

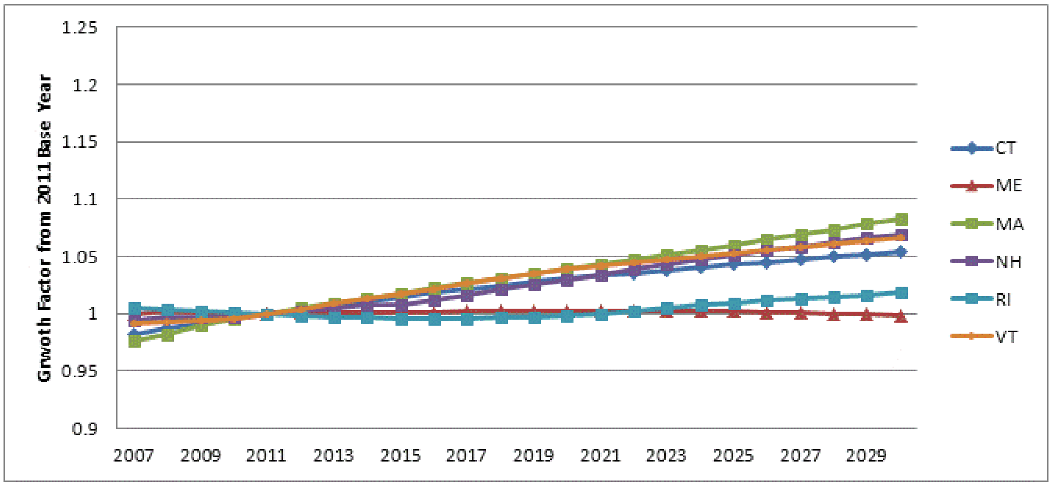


Figure 33: Population Projections – Mid-Atlantic States

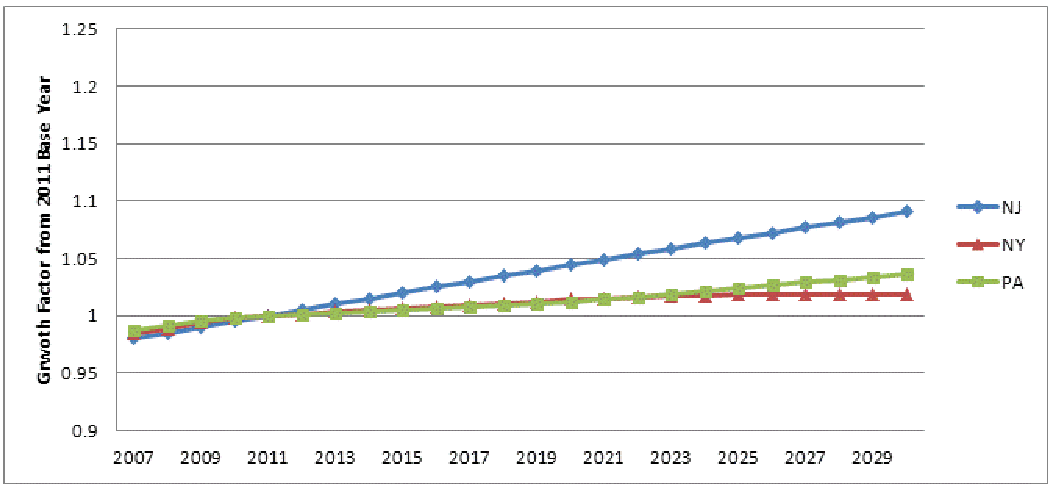
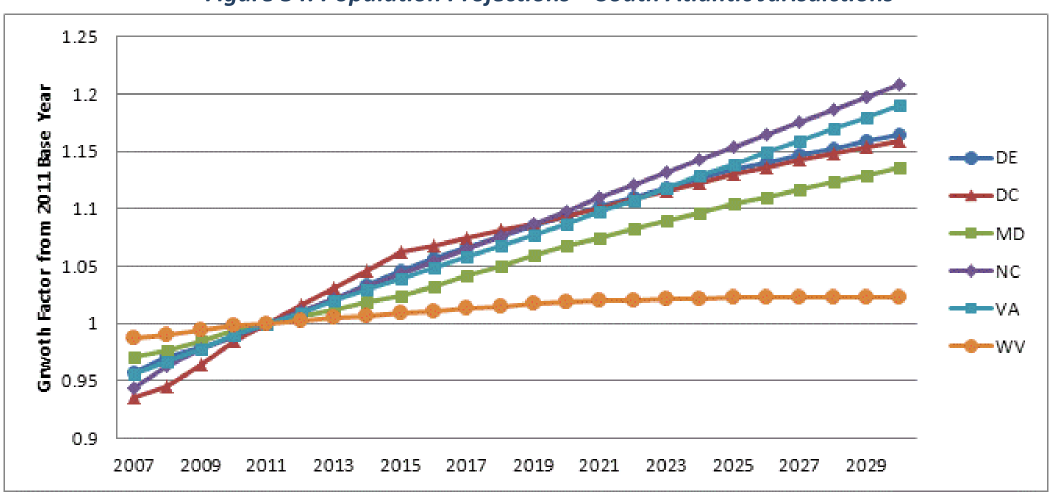


Figure 34: Population Projections – South Atlantic Jurisdictions



3.4.1.7. Oil and Gas Production

SRA used EPA's NEI2011v1 Version 6.0 approach to develop projection factors for oil and gas development activities. See Section 4.2.4 the 2011 Modeling Platform Version 6.0 TSD (EPA, 2014) for additional details on the methodology. The EPA approach is to combine regional-level oil/gas projections with estimated VOC reduction factors for sources subject to the Oil and Gas NSPS. EPA used AEO2013 for their projections. SRA used more recent data from AEO2014 to develop growth factors for all years between 2007 and 2040 (see Appendices X and Y).

3.4.1.8. State Preferences

As discussed in Section 3.2.1.3 of this TSD, some of the growth factors used to project emissions for nonpoint sources show declining trends. For example, AEO projects negative growth for many fuel consumption sectors. Similarly, the employment projections show declines in the predicted number of employees for many sectors of the economy. Each state provided guidance on how to handle projections when negative growth is indicated. Delaware and Maryland chose to set a minimum growth rate of 1 (no growth) for nonpoint sources when the chosen growth indicator was estimating negative growth. New Jersey provided specific growth factor guidance for each category based on state specific data, caps or no growth on negative growth, and no growth on certain employment categories where the employment activity was not a specific indicator of the actual emissions. New Jersey also specified no growth in employment categories after 2020. All other states accepted the estimated projection data as is and made no adjustments for negative growth.

3.4.1.9. Growth Factor Spreadsheet and EMF Packet

To facilitate state review of the growth factors, SRA developed user-friendly spreadsheets that provide the surrogate growth parameters, match the growth parameters to inventory records, and configure the growth factors into the required EMF format. The spreadsheets allow the user to create a projection packet for any combination of base year and future year for the 2007 to 2040 period. See Section 3.1 of this TSD for a description of the spreadsheet format. Appendix Z is the nonpoint growth factor spreadsheet.

3.4.2. NonPoint Control Factors

This section describes how was compiled emission control information for nonpoint sources. Emission control factors were developed relative to a 2011 base year emissions inventory. SRA initially used data from EPA's NEI2011v1 modeling platform(EPA, 2014), which includes a set of EMF/CoST model control records specific to stationary nonpoint sources. These EPA control records are included as Appendix P.

S/L/T agencies reviewed the EPA control packets and provided guidance on any adjustments needed to the EPA factors and any state rules not included in the EPA control packets. SRA augmented the EPA control factors with additional factors for state-specific measures not included in the EPA control packets and modified some of the EPA control factors in response to state requests. The revised control factors were consolidated into a single EMF packet for controls (see Appendix Q). The following sub-sections were organized to address the specific types of controls used to calculate future year emission reductions from nonERTAC point sources.

3.4.2.1. OTC and MANE-VU Control Measures

For the past 20 years, the OTC has identified strategies to achieve cost-effective reductions of ozone-forming pollutants. Similarly, MANE-VU coordinated the development of emission management strategies to assure reasonable progress toward remedying any existing impairment of visibility and preventing future impairment. Each S/L/T agency can pursue rulemakings or other implementation methods to establish the OTC/MANE-VU recommended emission reductions, emission rates, or emission control technologies as appropriate and necessary.

Individual states are in various stages of adopting the OTC/MANE-VU recommendations into the rules and SIPs. We reviewed the OTC's status reports to identify each state's adoption status (see Appendices S, T, and U). To obtain further clarification about each state's status with respect to the OTC/MANE-VU measures. States were polled to determine whether they have adopted a rule that would achieve reductions equivalent to the OTC/MANE-VU recommendation. SRA obtained information on the effective date of the rule, whether credit for each rule was reflected in the 2011 inventory, and what additional post-2011 reductions are expected. Appendix V contains each state's recommendations for accounting for each OTC control measure recommendation. The following subsections discuss the control measures with post-2011 effective dates.

3.4.2.2. State Specific NOx Rules

Several states have adopted rules reflecting the recommendations of the OTC with compliance dates after 2011. SRA worked with states to develop control factors for the following state rules with post-2011 compliance dates:

- New Jersey adopted a rule requiring tune-ups for small boilers (<50 mmBtu/hr) effective in 2012. New Jersey estimated a 25% reduction in NOx emissions from this rule. New Jersey also adopted NOx rules for larger boilers (>50 mmBtu/hr), but the compliance date for these limits were 2011 or earlier.
- New York adopted rules lowering the NOx emission limits for boilers. The specific limits vary by fuel type, boiler size, and type of combustion unit. Control factors were calculated for each type of fuel, boiler size, and firing type. The emission limits became effective July 1, 2014.

3.4.2.3. State Specific VOC Rules

Several states have adopted rules reflecting the recommendations of the OTC with compliance dates after 2011. SRA developed control factors for the following state rules with post-2011 compliance dates:

- Delaware's auto refinishing rule is expected to result in a 39% reduction in VOCs from the nonpoint auto refinishing sector beginning in 2012.
- Massachusetts adopted a rule limiting the VOC content of adhesives and sealants. The rule has a compliance date of May 1, 2016 and is expected to result in a 64% reduction in VOC emissions.
- New Jersey adopted a rule requiring additional controls on petroleum storage tanks. New Jersey identified the affected SCCs and estimated the VOC percent reduction for individual years between 2012 and 2020.

- Pennsylvania adopted a rule limiting the VOC content of adhesives and sealants. The rule has a compliance date of January 1, 2012 and is expected to result in a 64% reduction in VOC emissions.
- Virginia revised five rules to expand coverage to the Richmond VOC Control Area with an effective date of March 1, 2014. Previously these rules only applied to the northern Virginia counties that are part of the Ozone Transport Region. These rules included architectural and industrial maintenance coatings, portable fuel containers, consumer products, motor vehicle and mobile equipment coatings/solvents, and adhesives/sealants.

The percent reductions shown above were either provided directly by the individual state agency or obtained from the OTC Control Measures TSD (OTC, 2007).

3.4.2.4. State Fuel Oil Sulfur Rules

The MANE-VU low sulfur fuel oil strategy described in Section 3.3.2.3 of the TSD also applies to certain nonpoint source categories. Please refer to Section 3.3.2.3 for further information.

3.4.2.5. Portable Fuel Container Rules

Many states have adopted the OTC model rule for limiting VOC emissions from portable fuel containers. These state-specific rules have different compliance dates depending on when the state completed its rulemaking. The remaining states are relying on federal requirements that became effective on January 1, 2009. Both the state and federal rules apply to new containers, and thus the anticipated reductions depend on the turnover of older non-compliant containers to new, lower-emitting containers. The emission reduction calculations assume a 10-year turnover period. Emission reduction percentage were calculated for each state and year, depending on the individual state's compliance date or the compliance date for the federal rule.

For example, states relying on the federal rule anticipate that hydrocarbon emissions from uncontrolled fuel containers will be reduced by approximately 75 percent at full implementation. Assuming a 10-year turnover to compliant containers beginning in 2009, only 10 percent of the existing inventory of PFCs will comply with the new requirements in 2010. Therefore, only 10 percent of the full emission benefit estimated by USEPA will occur by 2010 – the incremental reduction will be about 7.5 percent in 2010. In 2013, there will be a 40 percent turnover to compliant cans, resulting in an incremental reduction of about 30 percent. By 2017, there will be 80 percent penetration to compliant PFCs, resulting in an incremental reduction of 60 percent in 2018. By 2020, there will be 100 percent penetration to compliant PFCs, resulting in an incremental reduction of 75 percent in 2020. Appendix AA documents the percent reduction calculations for each by year.

3.4.2.6. Boiler MACT Rules

The Boiler MACT rules described in Section 3.3.2.2 of this TSD also apply to certain nonpoint source categories. See section 4.2.7 of the 2011 Modeling Platform Version 6.0 TSD (EPA, 2014) for additional information.

3.4.2.7. RICE MACT Rules

The RICE MACT rules described in Section 3.3.2.4 of this TSD also apply to certain nonpoint source categories. See section 4.2.5 of the 2011 Modeling Platform Version 6.0 TSD (EPA, 2014) for additional information.

3.5. Aircraft, Locomotives, and Commercial Marine Vessels

3.5.1. Locomotives and Commercial Marine Vessels

SRA used the NEI2011v1 EMP methodology for developing projection factors for locomotive and Category 1 and Category 2 marine diesel engines. EPA classifies locomotive engines into five types: Line Haul Class I operations, Line Haul Class II/III operations, passenger trains (AMTRAK), commuter trains, and yard locomotives. C1/C2 marine vessel engines typically range in size from about 500 to 8,000 kW (700 to 11,000 hp). These engines provide propulsion power on many kinds of vessels including tugboats, pushboats, supply vessels, fishing vessels, and other commercial vessels in and around ports. They are also used as stand-alone generators for auxiliary electrical power on vessels.

EPA developed national emission inventories for locomotives and C1/C2 vessels for calendar years 2002 through 2040 as part of its effort to develop emission standards for these vessels. EPA documented the methodologies used to develop the emission projections (for both a baseline and controlled scenario) in a regulatory impact assessment (EPA, 2008). SRA used the EPA data and methodologies to develop a projection factor (combined growth and control factor) for locomotives and C1/C2 vessels. See Appendix BB for the data and calculations.

EPA estimated future-year emissions to account for increased fuel consumption based on Energy Information Administration (EIA) fuel consumption projections, and emissions reductions resulting from emissions standards promulgated in 2009. These standards lowered diesel sulfur content and tightened emission standards for existing and new locomotive/vessel emissions to lower future-year PM, SO2, and NOx. Using the EPA data, SRA computed projection (combined growth and control) factors for all years from 2007 to 2040 for each year for each type of engine and each pollutant.

Note that the EPA approach is based on the growth predictions of AEO2006 together with the phase-in of cleaner diesel engines. A few states commented that using AEO2006 overpredicts emissions compared to AEO2014 for future years. This over prediction of growth applies to Class I, II, and III railroads and rail yards as well as C1/C2 commercial marine vessels. States have requested that EPA adjust their projections to use AEO2014 in the NEI2011v2.

3.5.2. Aircraft Engines, GSE, and APUs

SRA followed EPA's approach to develop aircraft growth factors using the Federal Aviation Administration's (FAA's) Terminal Area Forecast (TAF) system (FAA, 2013). The TAF is the official forecast of aviation activity at FAA facilities. The TAF includes forecasts for 452 airports in the MARAMA study area, including historical data (1990–2011) and forecasts (2012–2040) for the following activities:

- Air carrier operations representing landings and take-offs (LTOs) of commercial aircraft with seating capacity of more than 60 seats.
- Commuter/air taxi operations is a single category. Commuter operations include LTOs by aircraft with 60 or fewer seats that transport regional passengers on scheduled commercial flights. Air taxi operations include LTO by aircraft with 60 or fewer seats conducted on non-scheduled or for-hire flights.
- General aviation itinerant operations represent all civil aviation aircraft LTOs not classified as commercial.
- General aviation local operations represent all civil aviation aircraft practice LTOs and low approaches.

- Military itinerant operations represent LTOs by military aircraft.
- Military local operations represent military aircraft practice LTOs and low approaches.

Both the FAA TAF data and the 2011 NEI point source emission inventory are by airport. However, the 2011 NEI nonpoint source inventory contains emission estimates for aviation gasoline refueling operation on a county basis.

To illustrate LTO growth patterns, three graphical summaries of FAA's projections are presented for the 15 busiest commercial airports are provided in Figure 35. Over the 2011 to 2017 period, LTOs at three airports (Charlotte, JFK, Newark) are projected to grow by more than 10 percent. FAA projects that four airports (Hartford, Providence, Boston, Norfolk) will have fewer commercial LTOs in 2017 than in 2011. For the remaining top 15 airports, FAA projects modest growth between 2.5 and 7 percent.

Figures 36 and 37 show the projections for air carrier (> 60 passenger aircraft) and air taxi/ commuter flights (≤ 60 passenger aircraft). For all of the top 15 commercial airports, FAA projects a shift in LTOs from smaller air taxi commuter aircraft to larger air carrier aircraft. For some airports, such as La Guardia and Boston Logan, FAA projects that air carrier LTOs will increase by about 40 percent from 2011 to 2017, while FAA projects that air taxi/commuter LTOs will decrease by about 60 percent during the same period.

To facilitate state review of the growth factors, SRA developed user-friendly spreadsheets that provide the surrogate growth parameters, match the growth parameters to inventory records, and configure the growth factors into the required EMF format. The spreadsheets allow the user to create a projection packet for any combination of base year and future year for the 2007 to 2040 period. See Section 3.1 of this TSD for a description of the spreadsheet format. Appendix CC is the growth factor spreadsheet for aircraft, GSE, and APUs.

3.6. Nonroad Equipment

For the ALPHA2 inventory, MARAMA used the EPA NEI2018v1 for 2018 and the EPA NEI2025v2 for 2028.

3.7. Onroad Equipment

For the ALPHA2 inventory, MARAMA used the EPA NEI2018v2 for 2018 and the EPA NEI2025v2 for 2028.

3.8. Fires

MARAMA used the EPA NEI2011v2 inventory for all future years.

3.9. Biogenic Sources

MARAMA used the EPA NEI2011v2 inventory for all future years.

Figure 35: All Commercial LTO Projections for Top 15 Commercial Airports

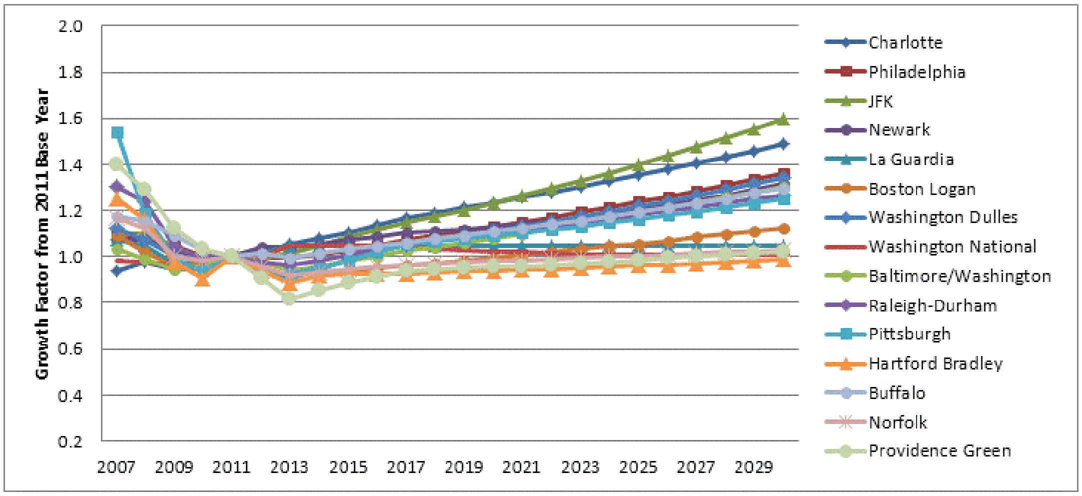


Figure 36: Air Carrier (> 60 Passengers) LTO Projections for Top 15 Commercial Airports

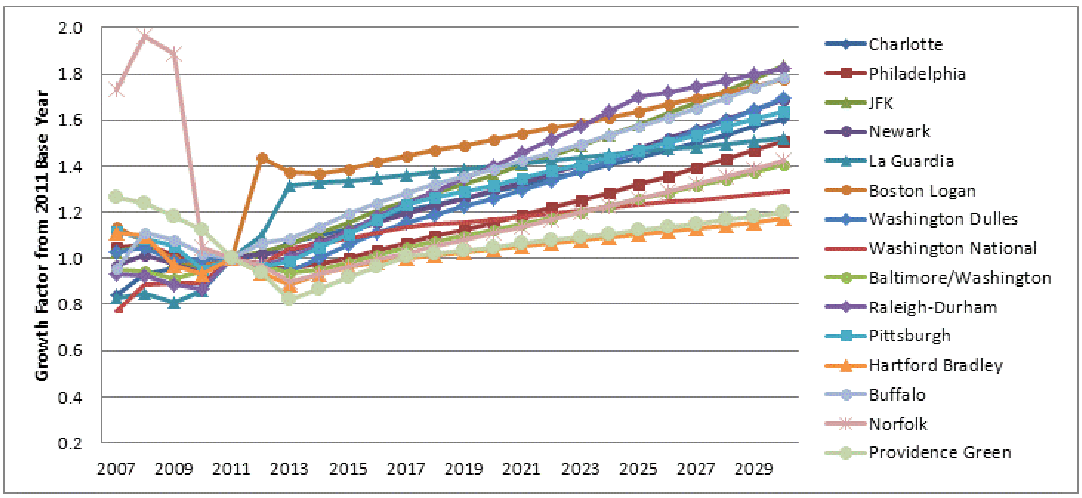
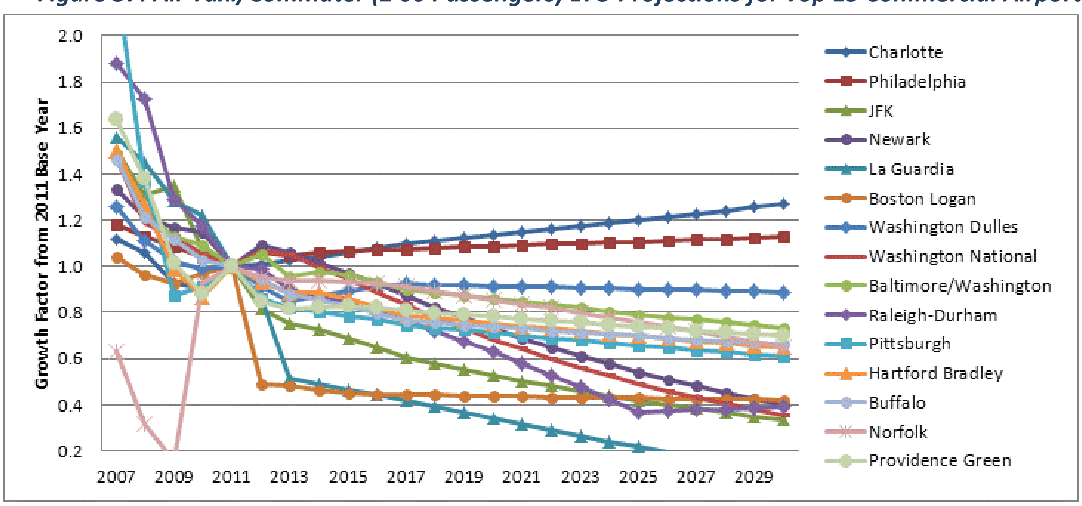


Figure 37: Air Taxi/Commuter (≤ 60 Passengers) LTO Projections for Top 15 Commercial Airports



4. QUALITY ASSURANCE PROCEDURES

Quality assurance (QA) and quality control (QC) procedures were part of the entire inventory development process and were performed by S/L/T agencies, EPA, SRA, and MARAMA. The following sections summarize the QA/QC activities carried out in developing the 2011 and future year inventories.

4.1. QA OF 2011 INVENTORY

S/L/T agencies are responsible for the collection, processing, analysis, and quality assurance of annual emission inventories. S/L/T agencies perform the initial QA/QC activities using their QA/QC plan that defines systematic procedures that:

- ensure the inventory is complete
- ensure the emission inventory is accurate and of the highest quality possible
- secure the reasonableness of the emissions inventory
- confirm the emissions inventory is in compliance with EPA reporting requirements

Each S/L/T agency carries out systematic procedures that incorporate four basic elements: task planning, data collection and analysis, data handling, and data reporting. Refer to each agencies' emission inventory web site for the specifics of their annual inventory QA/QC activities.

S/L/T agencies perform a second set of QA/QC activities as part of the process of submitting their annual inventory to EPA's EIS. The EIS contains hundreds of automated QA/QC checks of the data provided by the S/L/T agencies (see Appendix DD). S/L/T agencies must resolve any QA/QC issue before the data is accepted by EIS.

EPA performs a number of QA/QC activities in developing the NEI (see Appendix EE). See also Section 7 of the 2011 NEI Version 2 documentation (EPA, 2015a).

Once EPA compiled a draft of the 2011 inventory, they issued a Federal Register notice stating that the inventory and supporting data were available for public review and comment. EPA received 47 comments from S/L/T agencies, stakeholders and other interested parties. EPA considered these comments in developing the NEI2011v2.

MARAMA conducted additional QA/QC activities when it loaded the 2011 NEI inventory files into the EMF system. The EMF provides integrated quality control processes to foster high quality data handling, organization, and summarization.

4.2. QA OF 2018 AND 2028 INVENTORIES

The following activities were completed in assuring the quality of the 2018 and 2028 inventories:

- EPA performed a number of QA/QC activities in developing the projection and control factors used in developing NEI2018v1
- EPA compiled a draft of the 2018 inventory and issued a Federal Register notice stating that the inventory and supporting data were available for public review and comment.
- S/L/T agencies reviewed EPA's draft 2018 inventory and provided MARAMA with guidance on how to adjust EPA's projections to incorporate state specific data. The state guidance was used to replace EPA's projections with state-specific data where available.

- S/L/T agencies conducted QA/QC of the data used by the ERTAC EGU Projection Tool, including activities to ensure that all sources were accounted for and no sources were double-counted. S/L/T agencies reviewed annual and peak growth rates for reasonableness. S/L/T agencies also reviewed ERTAC data files with information on future year shutdowns, fuel-switches, and new/improved control equipment.
- S/L/T agencies reviewed all projection factor spreadsheets for reasonableness.
- MARAMA used the CoST model to perform numerous automated quality assurance routines.
- MARAMA prepared emission summary reports by state, sector, pollutant and year. These summaries were reviewed for reasonableness, completeness, and accuracy.
- S/L/T emission modelers used the QA/QC routines built into the SMOKE emission modeling system to assess reasonableness, completeness, and accuracy.

5. DATA FILES

MARAMA and S/L/T agencies use a variety of databases and tools to prepare the data files needed to run the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system to prepare emissions input data for air quality modeling. These databases and tools include:

- The Emissions Modeling Framework (EMF) software system to manage and assure the quality of emissions inventories and emissions modeling-related data. One of the modules within the EMF system is the Control Strategy Tool (CoST) module.
- NEI2011v2 annual emission inventory files. EPA provides these files in the Flat File 2010, also known as the FF10 format, for various subsectors in order to facilitate processing by SMOKE.
- The ERTAC Forecast Tool with associated input databases to project emissions from EGUs.
- Various EMF projection, closure and control packets to project emissions from nonERTAC point sources, nonpoint sources, and aircraft engines/GSE/APUs.
- Other models (NMIM/NONROAD, MOVES, SMARTFIRE, BEIS) with associated input databases to project emissions from nonroad equipment, onroad vehicles, fires and biogenic sources. For this inventory, S/L/T agencies are collaborating with EPA in developing the model input files and reviewing the modeling results. See EPA documentation for the input files used by these models for 2011, 2018, and 2025 (used for 2028).
- NEI2018v1 annual emission inventory files with the results of the NONROAD modeling for 2018 and NEI2025v2 annual emission inventory files with the results of NONROAD and MOVES.
- FF10 annual emission inventory files with the results of the EMF projections for nonERTAC point sources, nonpoint sources, and aircraft engines/GSE/APUs.
- Annual emission summary and hourly emission files with the results of the ERTAC Forecast Tool modeling for 2018 and 2028.

Figures 38 - 40 list the annual emission inventory files for 2011. Figure 41 lists the various projection, control and other files used as input to the ERTAC, EMF, NONROAD, MOVES, SMARTFIRE, and BEIS models.

Annual inventory files for 2018 and 2028 are embedded within the EMF tool and are documented elsewhere. Other auxiliary files needed to run the SMOKE emission modeling system are documented elsewhere. Contact MARAMA to obtain access to the annual 2018 and 2028 emission inventory and SMOKE files.

Figure 38: Annual Emission Inventory Files for 2011

MARAMA Sector	2011 Inventory File	Notes
Point – ERTAC EGUs	CENSARA_2011_ERTACEGUv23_150227_TXOKNEKSIAARLAMO.csv LADCO_2011_ERTACEGUv23_150227_MIOHINILWIMN.csv OTC_2011_ERTACEGUv23_150227_MENHVTMARICTNYNJDEPAMDDCVA.csv SESARM_2011_ERTACEGUv23_150227_WVNCSCGAKYTNALMS.csv	NEI2011v2 point sources included in the ERTAC EGU projection tool; hourly NOX and SO2 CEMS data replaces annual NOX and SO2 NEI data in the air quality model inputs.
Point – NonEGUs	MARAMA_Alpha_output_for_NEI_smallEGUpt_from_NEI_EGU_.csv	NEI2011v2 point sources included in the ERTAC UAF but not included in the ERTAC EGU projection tool; and any IPM units not included in the ERTAC forecasting tool.
	MARAMA_Alpha_ptnonipm_2011NEIv2_POINT_20140913_revised _20141007_08oct2014_nf_v1_csv_23oct2014_v0	NEI2011v2 non EGU point sources
	Ethanol_plants_2011_OTAQ_17oct2014_v6.csv	2011 ethanol plant facilities from EPA's Office of Transportation and Air Quality (OTAQ) that were not identified in the NEI2011v1.
	othpt_offshore_oil_2011NEIv2_POINT_20140913_16sep2014_v0.csv	EPA augmentation to include U.S. offshore oil production platforms outside the typical 3-10 nautical mile boundary defining state waters
	pt_oilgas_2011NEIv2_POINT_20140913_17oct2014_v2.csv	Onshore oil & gas production point sources with SCCs 31000101 through 31000506, 31088801 through 31088811, and 31700101
	refueling_refueling_2011NEIv2_POINT_20140913_23sep2014_v0.csv	Gasoline refueling processes at point source facilities
	ptnonipm_fips_XX777_2011NEIv2_POINT_20140913_02oct2014_nf_v1.csv	Portable engines/construction equipment reported as point sources but not at a specific location; not included in SMOKE since there is no information on the specific geographic location within a state
NonPoint	nonpt_2011NEIv2_NONPOINT_20141108_11nov2014_v1.csv	NEI2011v2 for all nonpoint source SCCs not included in the individual tables below.
	afdust_2011NEIv2_NONPOINT_20141108_11nov2014_v1.csv EPA_2011_afdust_no_precipadj_paved_unpaved_noNEIv2RPOstates_23sep2014_v0.csv	NEI2011v2 PM emissions for paved roads, unpaved roads and airstrips, construction (residential, industrial, road and total), agriculture production, and mining and quarrying
	ag_2011NEIv2_NONPOINT_20141108_11nov2014_v0.csv	NEI2011v2 NH3 emissions from 2011NEIv1 nonpoint livestock and fertilizer application, county and annual

MARAMA Sector	2011 Inventory File	Notes
		resolution
	np_oilgas_2011NEIv2_NONPOINT_20141108_11nov2014_v0.csv	NEI2011v2 nonpoint sources from oil and gas-related processes
	pfc_2011NEIv2_NONPOINT_20141108_11nov2014_v0.csv	NEI2011v2 portable fuel container nonpoint sources
	refueling_2011NEIv2_NONPOINT_20141108_11nov2014_v0.csv	NEI2011v2 Stage I and Stage II gasoline refueling nonpoint sources
	rwc_2011NEIv2_NONPOINT_20141108_11nov2014_v0.csv	NEI2011v2 residential wood combustion nonpoint sources
Nonroad – CMV, Aircraft, Locomotives	c1c2_offshore_2011NEIv2_NONPOINT_20141108_11nov2014_v0.csv	C1/C2 commercial marine vessel (CMV) emissions sources from the 2011NEIv2 nonpoint inventory located outside of state territorial waters
	c1c2rail_2011NEIv2_NONPOINT_20141108_11nov2014_v1.csv	Locomotives (except those at rail yards) and C1/C2 CMV emissions sources from the 2011NEIv2 nonpoint inventory located within state territorial waters
	eca_imo_nonUS_nonCANADA_caps_vochaps_2011_16jun2015_v1_orl_MARAMA.txt	C3 CMV emissions sources projected from the2002 ECA-IMO point inventory located outside of state territorial waters
	c3marine_2011NEIv2_NONPOINT_20141108_14nov2014_v1.csv	C3 CMV emissions sources from the NEI2011v2 nonpoint inventory located within state territorial waters
	MARAMA_Alpha_ptnonipm_2011NEIv2_POINT_20140913_revised _20141007_08oct2014_nf_v1_csv_23oct2014_v0	Aircraft, GSE and APU sources are included in the NEI2011v2 point source inventory with the following SCCs: 2265xxxxxx, 2267xxxxxx, 2268xxxxxx, 2270xxxxxx, and 2275xxxxxx
Nonroad – NONROAD Model Sources	2011NEIv1_nonroad_20130621_04sep2013_v4.csv	2011NEIv1 nonroad equipment emissions developed using the NMIM/NONROAD model
Onroad – MOVES Model Sources	2011eh_onroad_SMOKE_MOVES_MOVES2014_no_speciated_pm_MARAMA	2011 NEIv2 onroad equipment emissions developed using the MOVES2014 model
Fires	agburn_monthly_2011NEIv2_NONPOINT_20141108_11nov2014_v0.csv	NEI2011v2 annual and monthly emissions for agricultural burning activities
	2011eh_v6_11g_inputs_ptfire.zip	NEI2011v2 prescribed and wild fire events
Biogenics	biogenic_2011NEIv2_NONPOINT_20141108_11nov2014_v0.csv	County-level biogenic emissions from NEI2011v2

Figure 39: Annual Emission Inventory Files for 2018

MARAMA Sector	2018 Inventory File	Notes
Point – ERTAC EGUs	CENSARA_2018_ERTACEGUv23_150227_TXOKNEKSIAARLAMO.csv LADCO_2018_ERTACEGUv23_150227_MIOHINILWIMN.csv OTC_2018_ERTACEGUv23_150227_MENHVTMARICTNYNJDEPAMDDCVA.csv SESARM_2018_ERTACEGUv23_150227_WVNCSCGAFLKYTNALMS_2018.csv	NEI2011v2 point sources included in the ERTAC EGU projection tool; ERTAC EGU v2.3 runs were used. Details of which are summarized in Figure 5 of this document.
Point – NonEGUs	MARAMA_Alpha_2018_MARAMA_Alpha_output_for_NEI_smallEGUpt_from_NEI_EGU__csv_ v0_01feb2015_nf_v1	NEI2011v2 point sources included in the ERTAC UAF but not included in the ERTAC EGU projection tool; and any IPM units not included in the ERTAC forecasting tool. Projected using MARAMA V1 growth factors.
	MARAMA_Alpha_2018_MARAMA_Alpha_ptnonipm_2011NEIv2_POINT_20140913_revised_20141007_ 08oct2014_nf_v1_csv_23oct2014_v0_mar_v0_01feb2015_nf_v1	NEI2011v2 non EGU point sources. Projected using MARAMA V1 growth factors.
	MARAMA_Alpha_2018_Ethanol_plants_2011_OTAQ_17oct2014_v6_csv_06nov2014_v0_v0_ 01feb2015_nf_v1	2011 ethanol plant facilities from EPA's Office of Transportation and Air Quality (OTAQ) that were not identified in the NEI2011v1.
	MARAMA_Alpha_2018_othpt_offshore_oil_2011NEIv2_POINT_20140913_16sep2014_v0_csv_ v0_01feb2015_v0	EPA augmentation to include U.S. offshore oil production platforms outside the typical 3-10 nautical mile boundary defining state waters. Projected using MARAMA V1 growth factors.
	MARAMA_Alpha_2018_pt_oilgas_2011NEIv2_POINT_20140913_17oct2014_v2_csv_v0_ 01feb2015_nf_v1	Onshore oil & gas production point sources with SCCs 31000101 through 31000506, 31088801 through 31088811, and 31700101. Projected using MARAMA V1 growth factors.
	MARAMA_Alpha_2018_refueling_refueling_2011NEIv2_POINT_20140913_23sep2014_v0_csv_v0_ 02feb2015_nf_v1	Gasoline refueling processes at point source facilities. Projected using MARAMA V1 growth factors.
	MARAMA_Alpha_2018_ptnonipm_fips_XX777_2011NEIv2_POINT_20140913_02oct2014_nf_v1	Portable engines/construction equipment reported as point sources but not at a specific location; not included in SMOKE since there is no information on the specific geographic location within a state. Projected using MARAMA V1 growth factors.
NonPoint	MARAMA_Alpha_2018_nonpt_2011NEIv2_NONPOINT_20141108_11nov2014_v1_csv_v0_ 21jan2015_nf_v1	NEI2011v2 for all nonpoint source SCCs not included in the individual tables below.. Projected using MARAMA V1 growth factors.
	MARAMA_Alpha_2018_afdust_2011NEIv2_NONPOINT_20141108_11nov2014_v1 MARAMA_Alpha_2018_EPA_2011_afdust_no_precipadj_paved_unpaved_noNEIv2RPOstates_23sep20	NEI2011v2 PM emissions for paved roads, unpaved roads and airstrips, construction (residential, industrial,

MARAMA Sector	2018 Inventory File	Notes
	14_ v0_csv_v0_20jan2015_nf_v1	road and total), agriculture production, and mining and quarrying. Projected using MARAMA V1 growth factors.
	MARAMA_Alpha_2018_ag_2011NEIv2_NONPOINT_20141108_11nov2014_v0_csv_v0_14jan2015_nf_v1	NEI2011v2 NH3 emissions from 2011NEIv1 nonpoint livestock and fertilizer application, county and annual resolution. Projected using MARAMA V1 growth factors.
	MARAMA_Alpha_2018_np_oilgas_2011NEIv2_NONPOINT_20141108_11nov2014_v0_csv_v0_21jan2015_nf_v1	NEI2011v2 nonpoint sources from oil and gas-related processes. Projected using MARAMA V1 growth factors.
	MARAMA_Alpha_2018_pfc_2011NEIv2_NONPOINT_20141108_11nov2014_v0_csv_21jan2015_nf_v1	NEI2011v2 portable fuel container nonpoint sources. Projected using MARAMA V1 growth factors.
	MARAMA_Alpha_2018_refueling_2011NEIv2_NONPOINT_20141108_11nov2014_v0_csv_v0_21jan2015_nf_v1	NEI2011v2 Stage I and Stage II gasoline refueling nonpoint sources. Projected using MARAMA V1 growth factors.
	MARAMA_Alpha_2018_rwc_2011NEIv2_NONPOINT_20141108_11nov2014_v0_csv_v0_21jan2015_nf_v1	NEI2011v2 residential wood combustion nonpoint sources. Projected using MARAMA V1 growth factors.
Nonroad – CMV, Aircraft, Locomotives	NMARAMA_Alpha_2018_c1c2_offshore_2011NEIv2_NONPOINT_20141108_11nov2014_v0_csv_v0_20jan2015_v0	C1/C2 commercial marine vessel (CMV) emissions sources from the 2011NEIv2 nonpoint inventory located outside of state territorial waters
	MARAMA_Alpha_2018_c1c2rail_2011NEIv2_NONPOINT_20141108_11nov2014_v1_csv_v0_20jan2015_nf_v1	Locomotives (except those at rail yards) and C1/C2 CMV emissions sources from the 2011NEIv2 nonpoint inventory located within state territorial waters
	eca_imo_nonUS_nonCANADA_caps_vochaps_2018_04dec2013_v0	C3 CMV emissions sources projected from the 2002 ECA-IMO point inventory located outside of state territorial waters
	MARAMA_Alpha_2018_c3marine_2011NEIv2_NONPOINT_20141108_14nov2014_v1_csv	C3 CMV emissions sources from the NEI2011v2 nonpoint inventory located within state territorial waters
	MARAMA_Alpha_2018_MARAMA_Alpha_ptnonipm_2011NEIv2_POINT_20140913_revised_20141007_08oct2014_nf_v1_csv_23oct2014_v0_mar_v0_01feb2015_nf_v1	Aircraft, GSE and APU sources are included in the NEI2011v2 point source inventory with the following SCCs: 2265xxxxxx, 2267xxxxxx, 2268xxxxxx, 2270xxxxxx, and 2275xxxxxx
Nonroad – NONROAD	2018_nonroad_20130829_30oct2013_v2.csv	2018NEIv1 nonroad equipment emissions developed using the NMIM/NONROAD model

MARAMA Sector	2018 Inventory File	Notes
Model Sources		
Onroad – MOVES Model Sources	2018eh_onroad_SMOKE_MOVES_MOVES2014_no_speciated_pm_MARAMA	2011 NEIv2 onroad equipment emissions developed using the MOVES2014 model
Fires	MARAMA_Alpha_2018_agburn_monthly_2011NEIv2_NONPOINT_20141108_11nov2014_v0_csv_v0_20jan2015_nf_v1	NEI2011v2 annual and monthly emissions for agricultural burning activities
	2011eh_v6_11g_inputs_ptfire.zip	NEI2011v2 prescribed and wild fire events
Biogenics	biogenic_2011NEIv2_NONPOINT_20141108_11nov2014_v0.csv	County-level biogenic emissions from NEI2011v2

Figure 40: Annual Emission Inventory Files for 2028

MARAMA Sector	2028 Inventory File	Notes
Point – ERTAC EGUs	CENSARA_2028_ERTACEGUv23_150611_TXOKNEKSIAARLAMO.csv LADCO_2028_ERTACEGUv23_150611_MIOHINILWIMN.csv OTC_2028_ERTACEGUv23_150611_MENHVTMARICTNYNJDEPAMDDCVA.csv SESARM_2028_ERTACEGUv23_150611_WVNCSCGAFLKYTNALMS.csv	NEI2011v2 point sources included in the ERTAC EGU projection tool; hourly NOX and SO2 CEMS data replaces annual NOX and SO2 NEI data in the air quality model inputs.
Point – NonEGUs	MARAMA_Alpha_2028_output_for_NEI_smallEGUpt_from_NEI_EGU_v0	NEI2011v2 point sources included in the ERTAC UAF but not included in the ERTAC EGU projection tool; and any IPM units not included in the ERTAC forecasting tool.
	MARAMA_Alpha_2028_ptnonipm_2011NEIv2_POINT_20140913_revised_20141007_08oct2014_nf_v1	NEI2011v2 non EGU point sources
	MARAMA_Alpha_2028_Ethanol_plants_2011_OTAQ_17oct2014_v6	2011 ethanol plant facilities from EPA's Office of Transportation and Air Quality (OTAQ) that were not identified in the NEI2011v1.
	MARAMA_Alpha_2028_othpt_offshore_oil_2011NEIv2_POINT_20140913_16sep2014_v0.csv	EPA augmentation to include U.S. offshore oil production platforms outside the typical 3-10 nautical mile boundary defining state waters
	MARAMA_Alpha_2028_pt_oilgas_2011NEIv2_POINT_20140913_17oct2014_v2	Onshore oil & gas production point sources with SCCs 31000101 through 31000506, 31088801 through 31088811, and 31700101

MARAMA Sector	2028 Inventory File	Notes
	MARAMA_Alpha_2028_refueling_refueling_2011NEIv2_POINT_20140913_23sep2014_v0	Gasoline refueling processes at point source facilities
	MARAMA_Alpha_2028_ptnonipm_fips_XX777_2011NEIv2_POINT_20140913_02oct2014_nf_v1	Portable engines/construction equipment reported as point sources but not at a specific location; not included in SMOKE since there is no information on the specific geographic location within a state
NonPoint	MARAMA_Alpha_2028_nonpt_2011NEIv2_NONPOINT_20141108_11nov2014_v1	NEI2011v2 for all nonpoint source SCCs not included in the individual tables below.
	MARAMA_Alpha_2028_afdust_2011NEIv2_NONPOINT_20141108_11nov2014_v1 MARAMA_Alpha_2028_EPA_2011_afdust_no_precipadj_paved_unpaved_noNEIv2RPOstates_23sep2014_v0	NEI2011v2 PM emissions for paved roads, unpaved roads and airstrips, construction (residential, industrial, road and total), agriculture production, and mining and quarrying
	MARAMA_Alpha_2028_ag_2011NEIv2_NONPOINT_20141108_11nov2014_v0	NEI2011v2 NH3 emissions from 2011NEIv1 nonpoint livestock and fertilizer application, county and annual resolution
	MARAMA_Alpha_2028_np_oilgas_2011NEIv2_NONPOINT_20141108_11nov2014_v0	NEI2011v2 nonpoint sources from oil and gas-related processes
	MARAMA_Alpha_2028_pfc_2011NEIv2_NONPOINT_20141108_11nov2014_v0	NEI2011v2 portable fuel container nonpoint sources
	MARAMA_Alpha_2028_refueling_2011NEIv2_NONPOINT_20141108_11nov2014_v0	NEI2011v2 Stage I and Stage II gasoline refueling nonpoint sources
	MARAMA_Alpha_2028_rwc_2011NEIv2_NONPOINT_20141108_11nov2014_v0	NEI2011v2 residential wood combustion nonpoint sources
Nonroad – CMV, Aircraft, Locomotives	MARAMA_Alpha_2028_c1c2_offshore_2011NEIv2_NONPOINT_20141108_11nov2014_v0	C1/C2 commercial marine vessel (CMV) emissions sources from the 2011NEIv2 nonpoint inventory located outside of state territorial waters
	MARAMA_Alpha_2028_c1c2rail_2011NEIv2_NONPOINT_20141108_11nov2014_v1	Locomotives (except those at rail yards) and C1/C2 CMV emissions sources from the 2011NEIv2 nonpoint inventory located within state territorial waters
	eca_imo_nonUS_nonCANADA_caps_haps_2025_07mar2014_v0	C3 CMV emissions sources projected from the 2002 ECA-IMO inventory located outside of state territorial waters
	MARAMA_Alpha_2028_c3marine_2011NEIv2_NONPOINT_20141108_14nov2014_v1	C3 CMV emissions sources from the NEI2011v2 nonpoint inventory located within state territorial waters
	MARAMA_Alpha_2028_ptnonipm_2011NEIv2_POINT_20140913_revised_20141007_08oct2014_nf_v1	Aircraft, GSE and APU sources are included in the NEI2011v2 point source inventory with the following

MARAMA Sector	2028 Inventory File	Notes
		SCCs: 2265xxxxxx, 2267xxxxxx, 2268xxxxxx, 2270xxxxxx, and 2275xxxxxx
Nonroad – NONROAD Model Sources	2028_from_NEI2025_nonroad_ff10_NCD20130831_23feb2015_v3_MARAMA	2025NEIv2 nonroad equipment emissions developed using the NMIM/NONROAD model
Onroad – MOVES Model Sources	2028_from_2025eh_onroad_SMOKE_MOVES_MOVES2014_no_speciated_pm_v0_MARAMA	2025 NEIv2 onroad equipment emissions developed using the MOVES2014 model
Fires	MARAMA_Alpha_2028_agburn_monthly_2011NEIv2_NONPOINT_20141108_11nov2014_v0	NEI2011v2 annual and monthly emissions for agricultural burning activities
	2011eh_v6_11g_inputs_ptfire.zip	NEI2011v2 prescribed and wild fire events
Biogenics	biogenic_2011NEIv2_NONPOINT_20141108_11nov2014_v0.csv	County-level biogenic emissions from NEI2011v2
Stand-alone Future Year Inventories	cement_newkilns_year_2025_from_ISIS2013_NEI2011v1_30jan2015_v1 Biodiesel_Plants_2018_ff10_11apr2013_v0 2018_cellulosic_inventory_06jan2014_v1_MARAMA cellulosic_new_Iowa_plants_from2018docket_2011v6_2_ff10_28jan2015_v0 cement_newkilns_year_2025_from_ISIS2013_NEI2011v1_NONPOINT_12feb2015_v1_MARAMA	Future-year inventories new to the future year; not generated via EMF/CoST

Figure 41: Files Associated with Emission Projections

MARAMA Sector	Projection Files	Notes
ERTAC Forecast Tool Point Sources	xOutreach_UAF_02-18-2015.xls	Unit Availability File (UAF) for the CONUSv2.3 run
	xOutreach_Control_file_02-10-2015.xls	Control File for the CONUSv2.3 run
	Gro_2.3_2018.csv	Growth File for the CONUSv2.3 run
	IV_2.3_2018_10-28-2014.csv	Input Variable File for the CONUSv2.3 run
	ERTAC_Controls_File_MARAMA_Other_Pollutants_2014_11_20.csv	Emission factors for CO, NH3, PM10, PM2.5 and VOC in the Growth File format
Other nonERTAC Point Sources	Projection Factors PointNonIPM 2015_01_22.xlsx	Spreadsheet for nonERTAC point sources (except aircraft, GSE and APUs); includes projection data 2007-2040, inventory-to-growth factor cross-reference, and EMF projection packet data
	MARAMA 2011 to 2018 Projection PointNonIPM.csv MARAMA 2011 to 2028 Projection PointNonIPM 2015_01_22.csv	EMF projection packets for nonERTAC point sources for projecting 2011 to 2018 and 2028. EMF Dataset Type = Projection Packet Extended.
	EMF Closures Packet 2014_08_27.csv	EMF closure packet for nonERTAC point sources.

MARAMA Sector	Projection Files	Notes
		EMF Dataset Type = Plant Closure (csv).
	EMF Controls Packet 2014_08_27.csv	EMF control packet, includes nonERTAC point sources. EMF Dataset Type = Control Packet.
Nonpoint Sources	Projection Factors NonPoint 2015_01_22.xlsx	Spreadsheet for nonpoint sources (includes CMV and locomotives); includes projection data 2007-2040, inventory-to-growth factor cross-reference, and EMF projection packet data
	MARAMA 2011 to 2018 Projection NonPoint 2015_05_07.csv MARAMA 2011 to 2028 Projection NonPoint 2015_01_22.csv	EMF projection packet for nonpoint sources for projecting 2011 to 2018 and 2028. EMF Dataset Type = Projection Packet Extended.
	EMF Controls Packet 2014_08_27.csv	EMF control packet, includes nonpoint, CMV, and locomotive sources. EMF Dataset Type = Control Packet.
Aircraft Engines, GSE and APUs	Projection Factors Point Aircraft Engine_GSE_APU 2015_01_22.xlsx	Spreadsheet for aircraft, GSE and APU; includes projection data 2007-2040, inventory-to-growth factor cross-reference, and EMF projection formatted data
	MARAMA 2011 to 2018 Projection Point Aircraft Engine_GSE_APU.csv MARAMA 2011 to 2028 Projection Point Aircraft Engine_GSE_APU 2015_01_22.csv	EMF projection packet for aircraft, GSE and APU point sources for projecting 2011 to 2018 and 2028. EMF Dataset Type = Projection Packet Extended.

6. DATA SUMMARIES

This section provides emission summary graphs for each pollutant by state, year and sector. Additional numerical summaries in tabular format are provided in Appendix FF. The sectors shown in the following figures are defined below. Appendix GG lists how SCCs were assigned to sectors. a

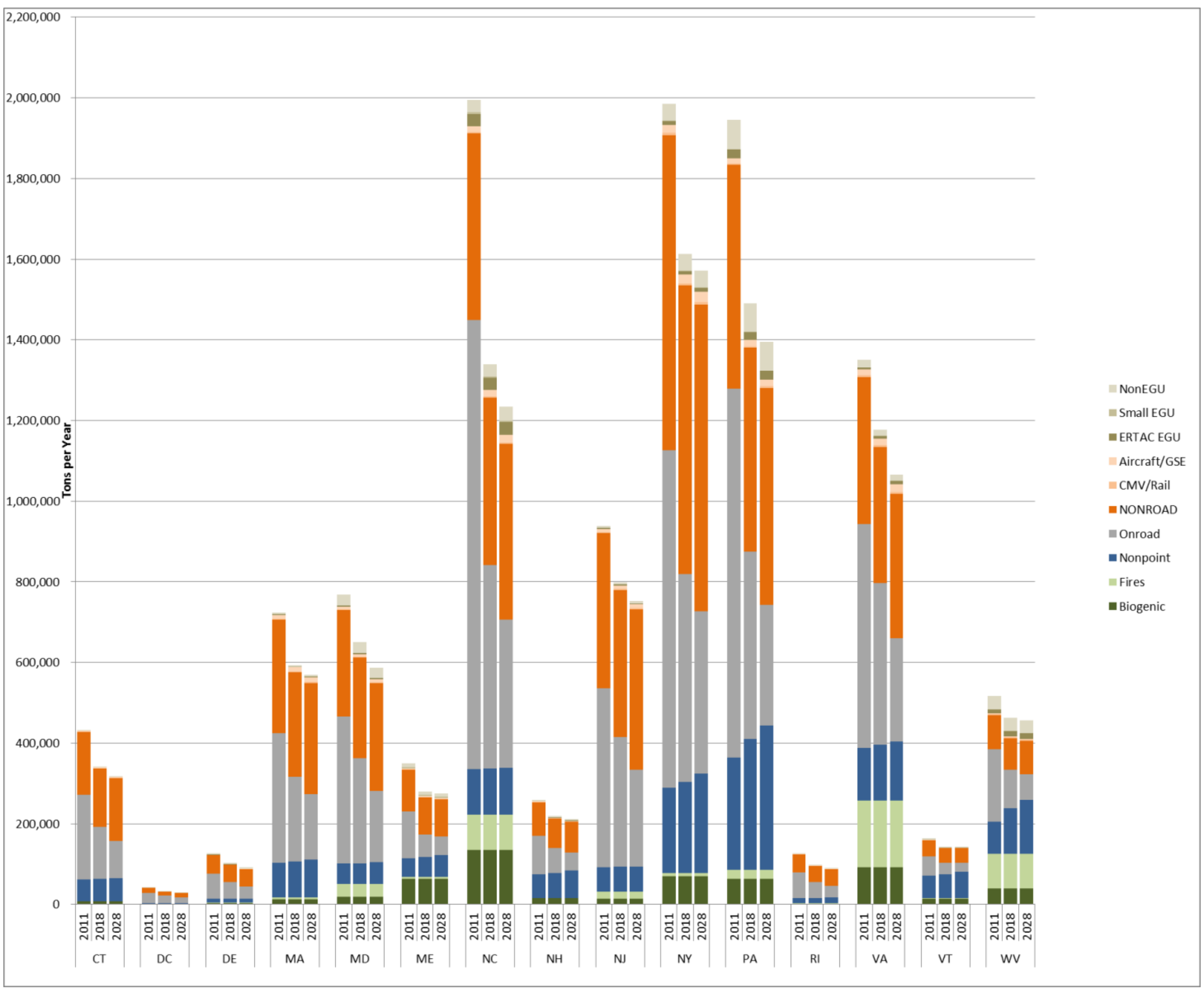
- **ERTAC EGU Point Sources**. This sector includes emission units located primarily at electric power plants that are included in the ERTAC EGU forecasting tool. These sources are required to report continuous emission monitoring data to EPA's Clean Air Market Division (CAMD). Air quality modeling uses the hourly emissions data for these units to accurately reflect the temporal variation in emissions
- **Small EGU Point Sources**. This sector includes emission units that are NOT included in the ERTAC EGU Projection Tool but are included in EPA's IPM scenarios.
- **NonEGU Point Sources**. This sector includes facilities and sources located at a fixed, stationary location. Other point sources include larger industrial, commercial and institutional facilities.
- **Aircraft/GSE/APU Point Sources**. This sector included emissions from aircraft engines, ground support equipment and auxiliary power units that are identified as point sources (e.g., emissions are located at specific airport locations).
- **Nonpoint Sources**. This sector includes sources which individually are too small in magnitude or too numerous to inventory as individual point sources. Nonpoint sources include smaller industrial, commercial and institutional facilities, as well as residential sources and Stage 1 refueling emissions from the filling of underground storage tanks. S/L/T agencies and EPA estimate nonpoint emissions at the county level. This sector does not include locomotive emissions outside of the rail yards and commercial marine vessel emissions, which are included in the other nonroad sector described below.
- **Rail/CMV Nonroad Sources**. This category includes internal combustion engines used to propel marine vessels and locomotives.
- **Nonroad Sources in the NONROAD Model**. This category contains mobile sources included in NONROAD model within the National Mobile Inventory Model (NMIM). Nonroad emissions result from the use of fuel in a diverse collection of vehicles and equipment such as construction equipment, recreational vehicles, and landscaping equipment.
- **Onroad Sources**. This category contains mobile sources included in the MOVES model. Onroad emissions result from the combustion and evaporation of fuel used by motorized vehicles, including vehicle refueling (Stage 2) emissions that are normally operated on public roadways. This includes passenger cars, motorcycles, minivans, sport-utility vehicles, light-duty trucks, heavy-duty trucks, and buses.
- **Fire Sources**. This source category includes sources of pollution caused by the inadvertent or intentional burning of biomass including forest, rangeland (e.g., grasses and shrubs), and agricultural vegetative residue.

- **Biogenic Sources**. This category includes emissions from vegetation and soils that are computed via a model that utilizes spatial information on vegetation and land use, and environmental conditions of temperature and solar radiation.

6.1. Carbon Monoxide

Figure 42 summarizes CO emissions by state, year and sector. For the 15-state region, CO emissions are projected to decrease by 20 percent from 11.7 to 9.3 million tons between 2011 and 2018 and to 8.8 million tons for a 25 percent decrease between 2011 and 2028. The reduction is associated with the significant reductions in emissions from the onroad and nonroad sectors resulting from national emissions standards for highway vehicle and nonroad engines.

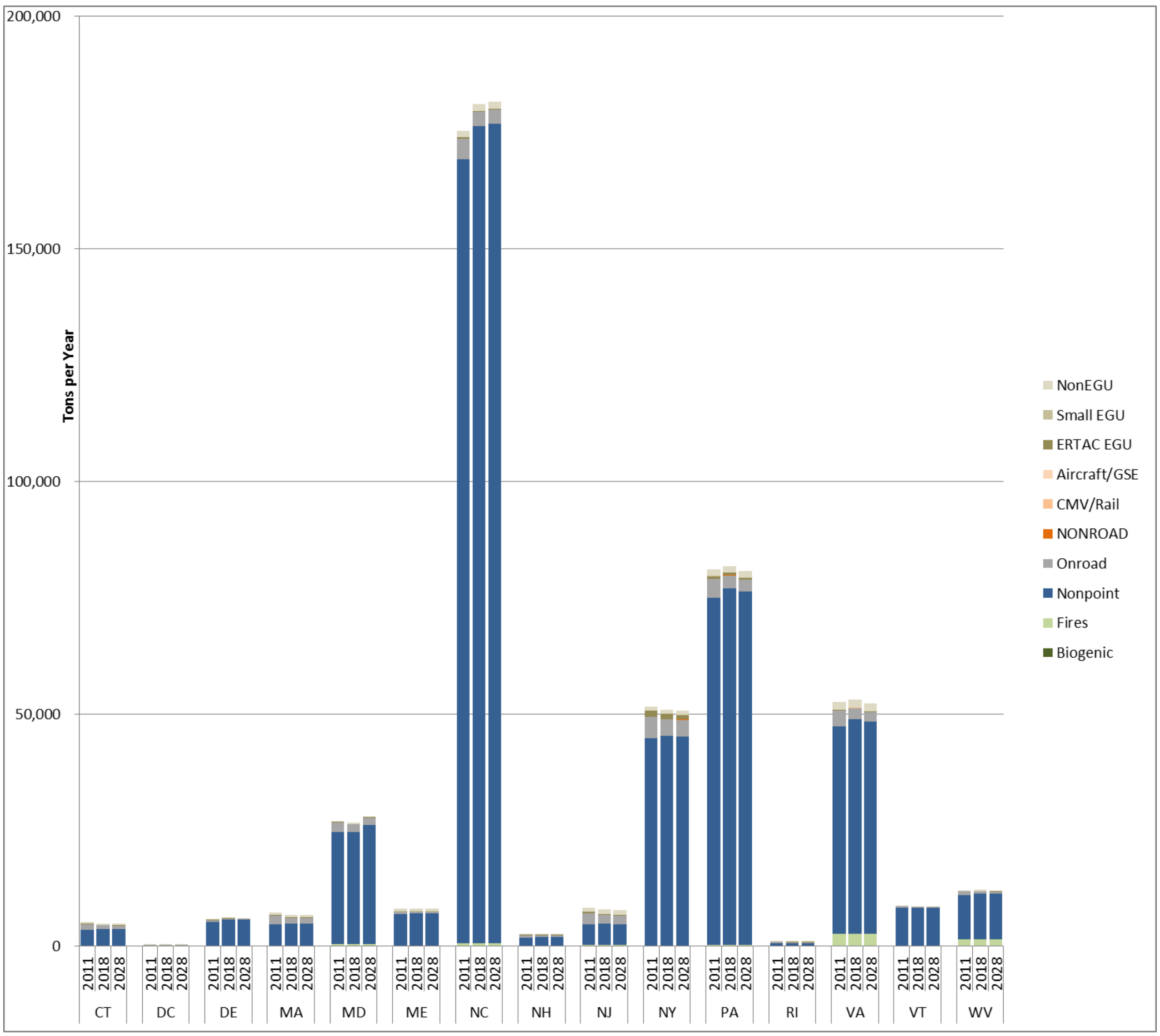
Figure 42: Annual Emission Summary for Carbon Monoxide



6.2. AMMONIA

Figure 43 summarizes NH3 emissions by state, year and sector. For the 15-state region, NH3 emissions are projected to increase by 1 percent from 447,000 to for 452,000 tons between 2011 and 2018 and then decrease slightly by 2028. Nearly all of the NH3 emissions are from the nonpoint sector, primarily agricultural fertilizer application and livestock waste operations.

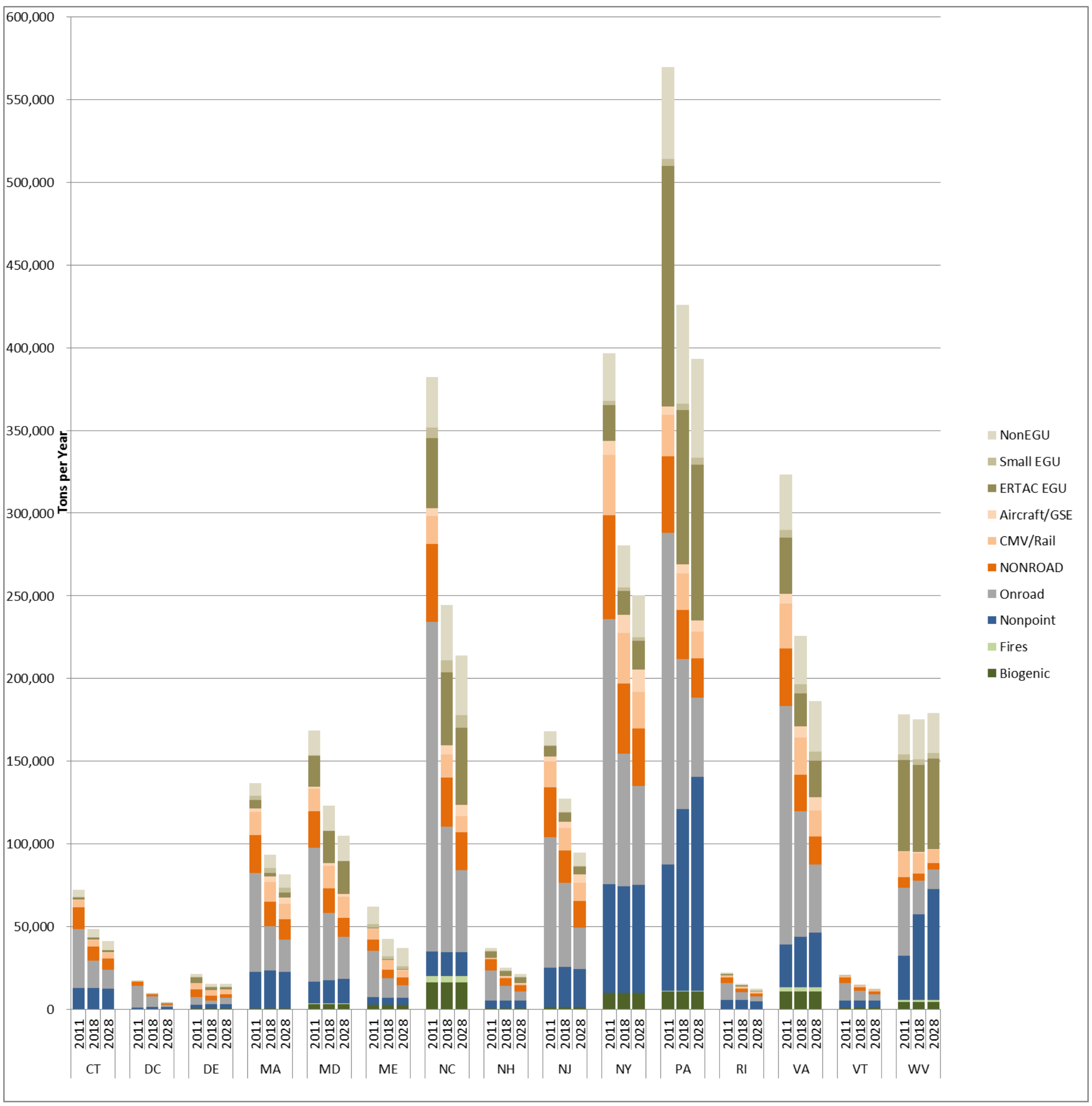
Figure 43: Annual Emission Summary for Ammonia



6.3. Oxides of Nitrogen

Figure 44 summarizes NOx emissions by state, year and sector. For the 15-state region, NOx emissions are projected to decrease by 27 percent from 2.6 to 1.9 million tons between 2011 and 2018 and to 1.6 million tons for a 36 percent decrease between 2011 and 2028. Three sectors show significant reductions in emissions between 2011 and 2018 – onroad emissions decrease by 52 percent, nonroad emissions decrease by 35 percent, and ERTAC EGU emissions decrease by 24 percent. Onroad and nonroad emissions continue to decrease between 2018 and 2028, but ERTAC EGU emissions begin to increase. Two sectors show significant increases – nonpoint emissions (in particular, emissions from oil & gas exploration) are projected to increase by 21 percent and aircraft emission increase by 19 percent between 2011 and 2018 with the increases continuing to 2028. NOx emissions from nonEGUs are projected to change very little between 2011 and 2018 and to begin increasing slightly by 2028.

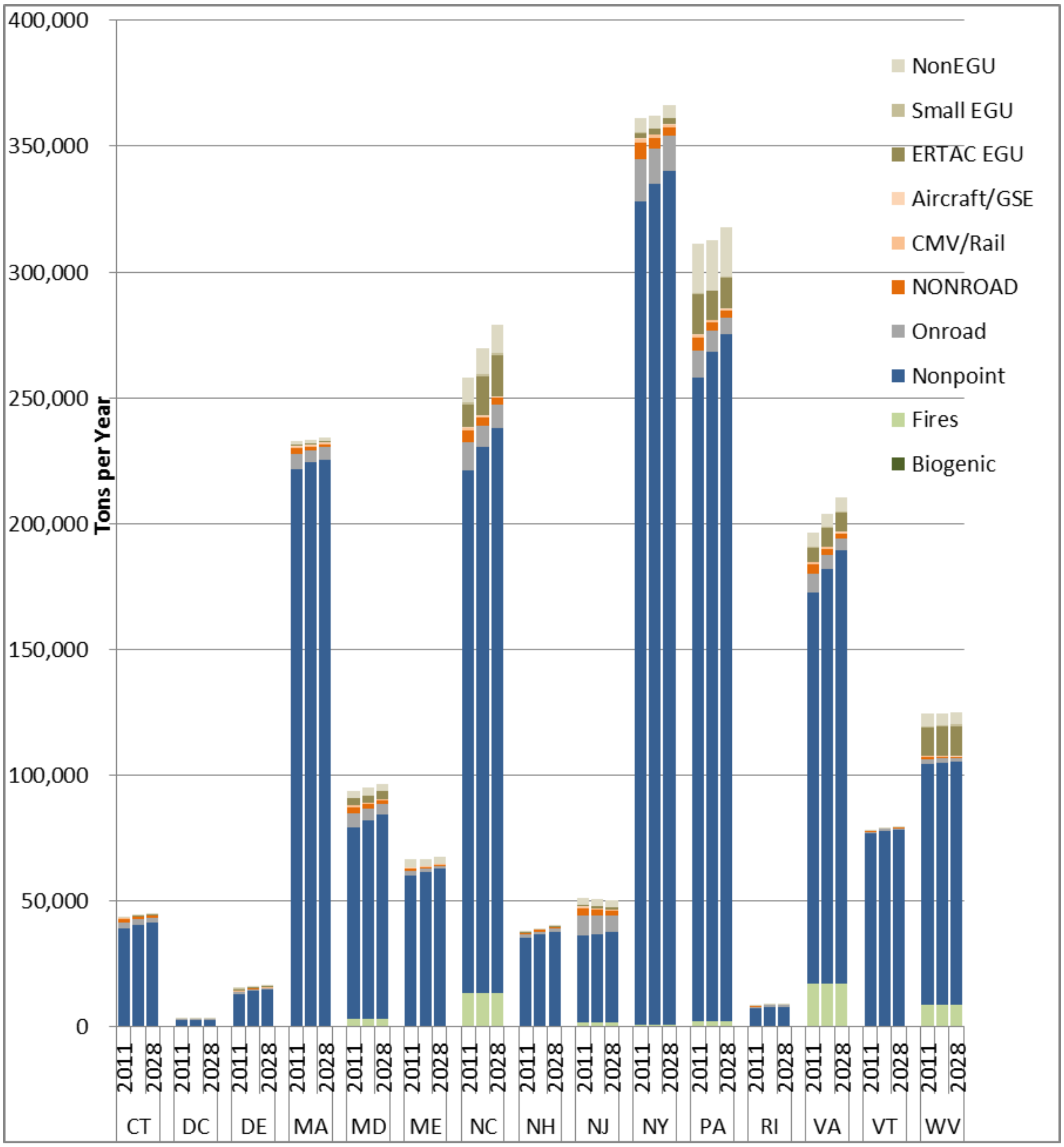
Figure 44: Annual Emission Summary for Oxides of Nitrogen



6.4. PM10+

Figure 45 summarizes unadjusted PM10 emissions by state, year and sector. For the 15-state region, PM10 emissions are projected to remain relative unchanged at 1.9 million tons in both 2011 and 2018 with a slight increase in 2028. Most of the PM10 emissions resulted from dust that is re-entrained by vehicles traveling on paved roads.

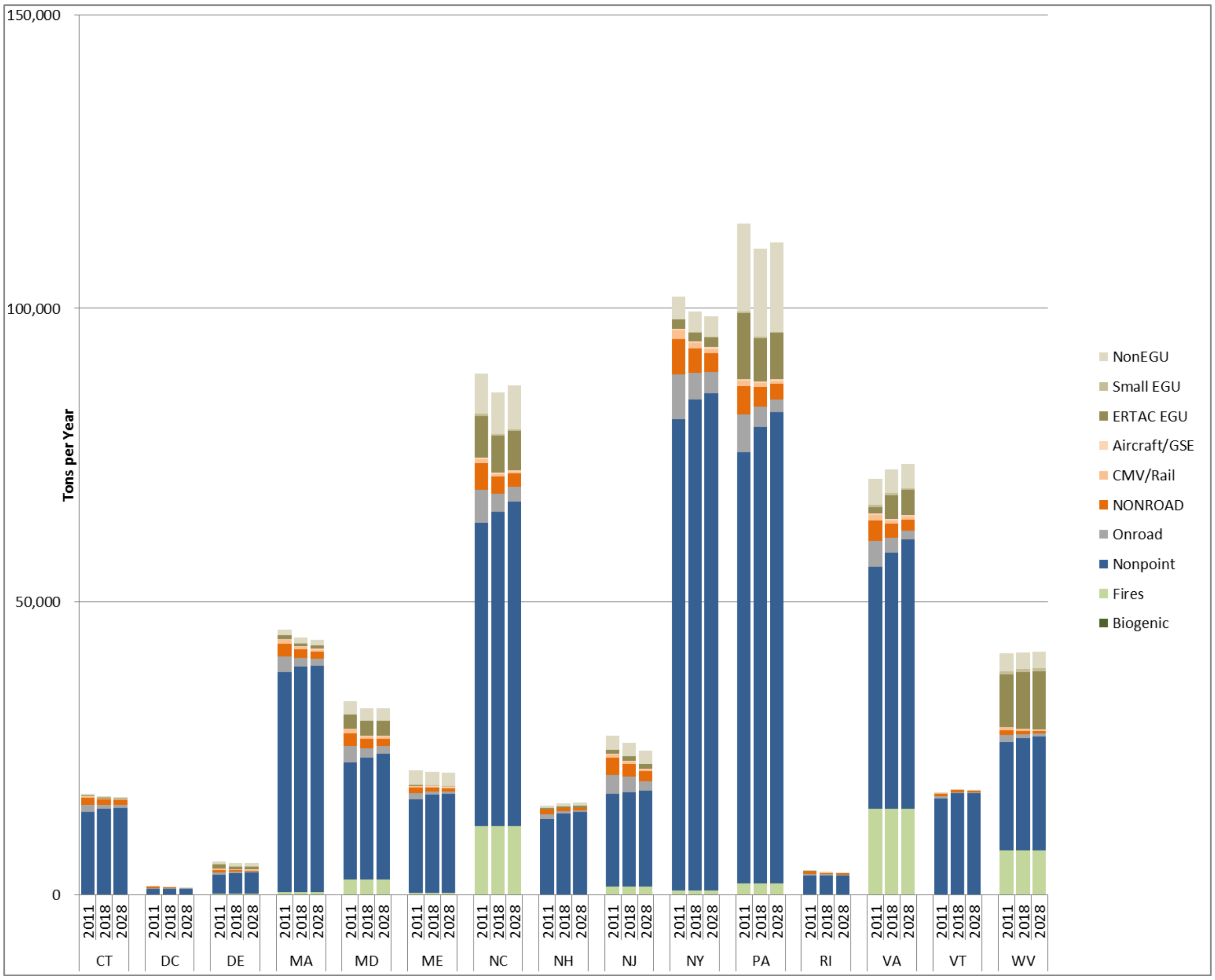
Figure 45: Annual Emission Summary for PM10



6.5. PM2.5

Figure 46 summarizes unadjusted PM2.5 emissions by state, year and sector. For the 15-state region, PM2.5 emissions are projected to remain relative unchanged at approximately 0.6 million tons in 2011, 2018 and 2028. Most of the PM2.5 emissions resulted from dust that is re-entrained by vehicles traveling on paved roads and from residential/commercial/industrial fuel combustion. Residential wood combustion is also a significant source of PM2.5 in the region.

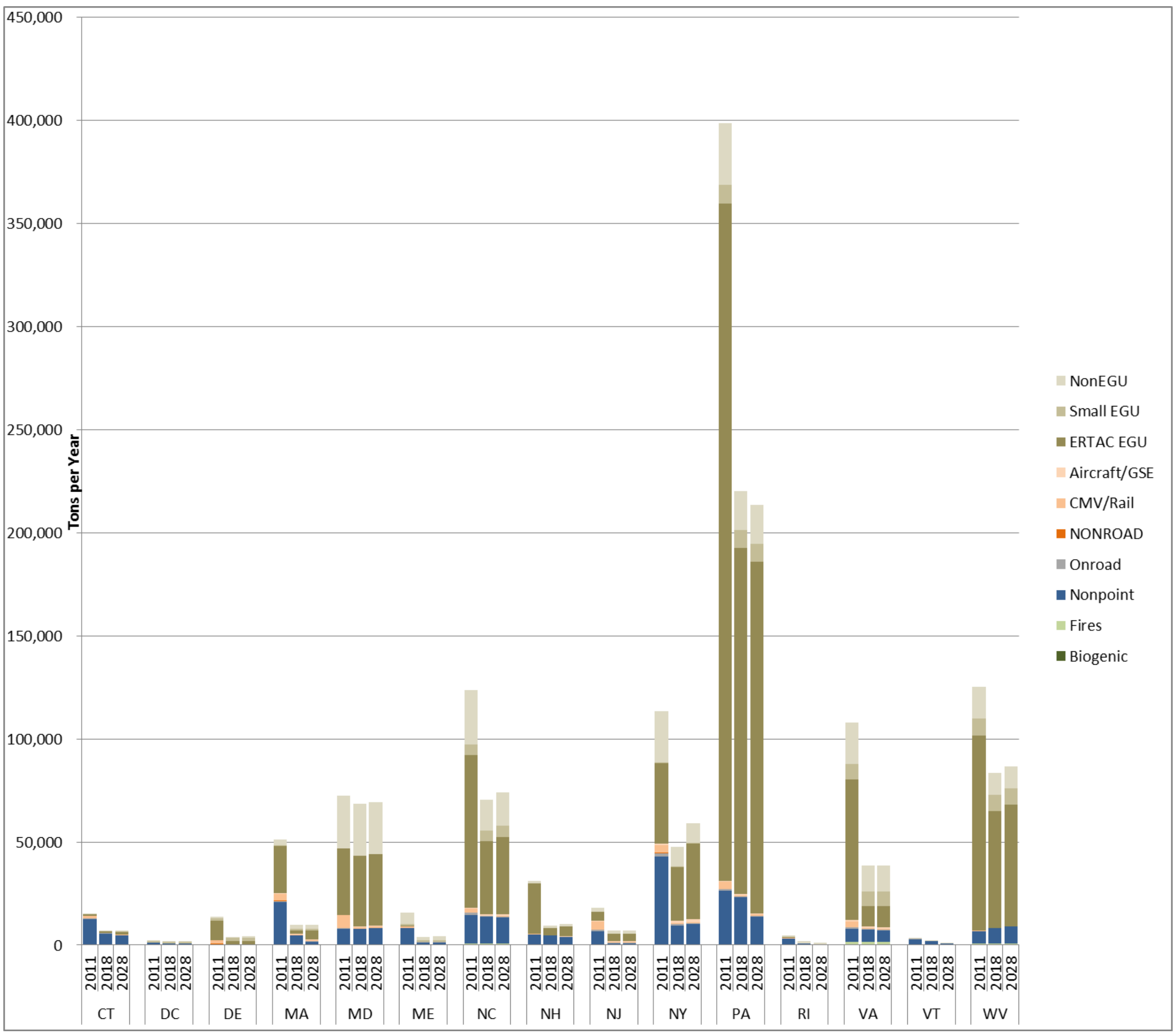
Figure 46: Annual Emission Summary for PM2.5



6.6. SULFUR DIOXIDE

Figure 47 summarizes SO2 emissions by state, year and sector. For the 15-state region, SO2 emissions are projected to decrease by 47 percent from 1.1 to 0.6 million tons from 2011 and 2018 and to increase slightly between 2018 and 2028. The emissions from ERTAC EGUs are projected to decrease by about 50 percent. Significant SO2 reductions are projected for the onroad and nonroad sectors due to lower sulfur content limits for gasoline and diesel fuels. Additional SO2 reductions are projected from the nonpoint sector due to more stringent sulfur content limits for home heating oil and other distillate/residual fuel oils.

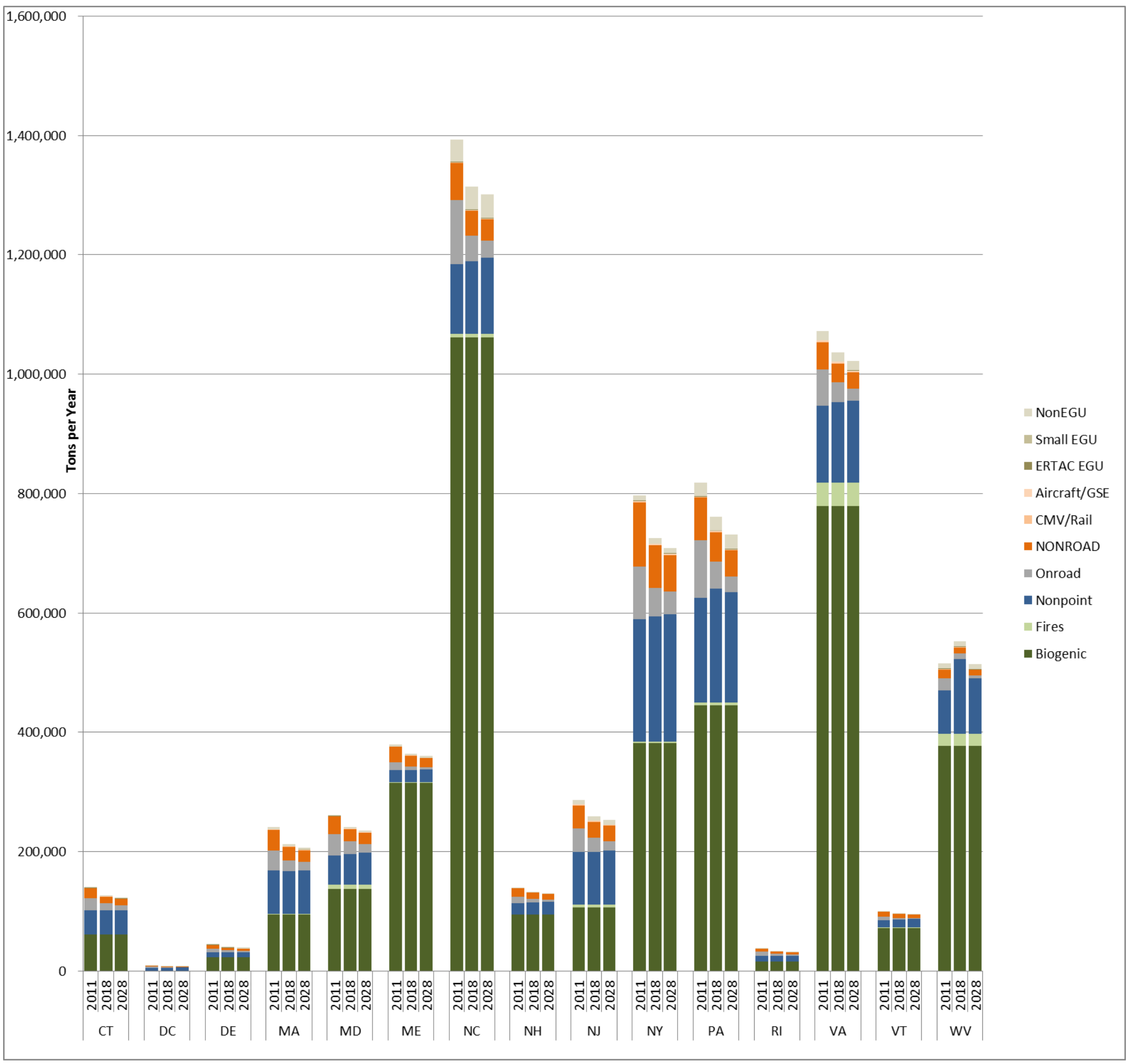
Figure 47: Annual Emission Summary for Sulfur Dioxide



6.7. Volatile Organic Compounds

Figure 48 summarizes VOC emissions by state, year and sector. For the 15-state region, VOC emissions are projected to decrease by 5 percent from 6.2 to 5.9 million tons from 2011 and 2018 and to 5.8 million tons for an 8 percent decrease between 2011 and 2028. Biogenic emissions represent about 64 percent of the total VOC emissions and are projected to remain unchanged between 2011 and 2018. Man-made VOC emissions are project to decrease by 15 percent, due primarily to reductions in the onroad and nonroad sectors.

Figure 48: Annual Emission Summary for Volatile Organic Compounds



6.8. Canadian Emissions

The Canadian government provided USEPA with a 2010 emissions inventory. This is the most current inventory available for that country. No projections to future years were provided by Canadian officials. This inventory was shared with the NE regional modeling group.

These 2010 Canadian emissions are used to represent their 2011 emissions in both USEPA and NE regional modeling. To estimate Canadian emissions in 2018 and 2028, the OTC modeling committee decided to apply the average change in emissions between base year 2011 and 2018 and between 2011 and 2028 expected to occur in our own modeling domain, by pollutant sector. Figure 49 shows the adjustments and resulting multiplicative factors for 2018 and 2028 applied to the Canadian 2010 inventory.

The Canadian inventory groups all point sources together, rather than splitting out EGU emissions, as is done in this inventory. Total point source reductions were estimated by proportionately weighing regional EGU and non-EGU point emissions to calculate a combined reduction. This reduction was then applied to all Canadian emissions.

Figure 49: Adjustments to Project Canadian 2010 Inventory to 2018

Sector	CO	NH3	NOx	PM2.5	SO2	VOC
	Percent Change 2010 to 2018					
Onroad	-43	-29	-51	-42	-58	-50
Nonroad	-7	17	-30	-31	-52	-31
Point	-2	1	-13	-3	-45	2
Area	0	0	0	0	-31	-6
	Percent Change 2010 to 2028					
Onroad	-60	-31	-71	-61	-59	-68
Nonroad	-4	39	-52	-53	-49	-42
Point	1	2	-9	-2	-44	6
Area	0	0	-1	1	-38	1

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Appendix E.2

ERTAC 2.4 Documentation

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Documentation of ERTAC EGU CONUS 2.4

September, 2015

The ERTAC EGU committee develops reference runs for the continental United States (CONUS). CONUS 2.4 is the current reference run for base year 2011. This run was complete in August, 2015, using input files current as of July 2015, and run by VA DEQ. As occurred with V2.3, growth factors are based on AEO2014. The contact person for questions about the run is Doris McLeod (804-698-4197).

ERTAC Input Files

The ERTAC EGU Tool input files are built by the ERTAC leadership committee from a wide variety of existing data. These input files are subject to periodic quality assurance and updating by state agency staff. In addition, agencies provide information on new units, new controls, fuel switches, shutdowns and other unit-specific changes. Periodic updates of these input files drives creation of new run versions. The ERTAC EGU tool projects fossil fuel fired units that report emissions to CAMD and serve a generator of at least 25 MW.

A key data source are the hourly reports of generation and emissions collected by facilities by continuous emission monitors (CEM) and electronically reported to the USEPA Clean Air Markets Division (CAMD) for the base year, in this case 2011. Base year SO_2 and NO_X emission rates (lb/mmbtu) are calculated from this data. Future emission rates are developed from base year rates adjusted to account for state knowledge of expected emission controls, fuel switches, retirements, and new units.

A key source of expected future change in generation is the Energy Information Agency (EIA) projection of future generation and the National Energy Reliability Corporation (NERC) projection of peak generation rates. This information is available by region and fuel type. Future generation by unit is estimated by merging these regional data files with state knowledge of unit level changes. Hourly future emissions of NOx and SO2 are calculated by multiplying hourly projected future generation by future emission rates.

ERTAC EGU Tool input files are as follows:

- **Base Year Hourly CEM data** – This file contains hourly generation and emissions data extracted from EPA's CAMD database. In unit-specific situations where base year hourly data needs modification, the tool allows the user to provide a non-CAMD hourly file, which may be used to adjust or add data to the base year hourly CEM file.
- **Unit Availability File (UAF)** – This file is a table of base year unit specific information derived from CAMD NEEDS database, state input, EIA Form 860, and NERC data. This file is maintained by the ERTAC committee and provides information on changes to specific units

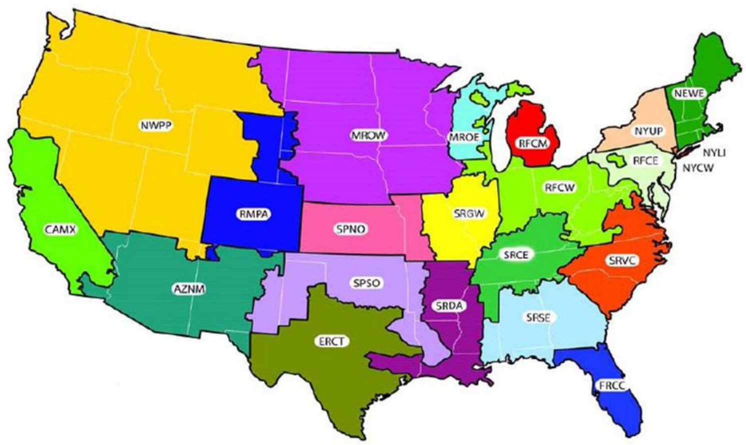
from the base year to the future year. For example, the UAF captures actual or planned changes to utilization fractions, unit efficiency, capacity, or fuels. S/L/T agencies have also added information on actual and planned new units and shutdowns.

- **Control File** – This file contains a table of known future unit specific changes to SO_2 or NO_x emission rates (in terms of lbs/mmBtu) or control efficiencies (for example, addition of a scrubber or selective catalytic reduction system). This information is provided by S/L/T agency staff. This file also provides emission rates for units that did not operate in the base year. Controls can be differentiated seasonally, monthly, weekly, or using other time spans. For example, a unit may employ more effective controls during the ozone season.
- **Seasonal Controls File** – This optional file may be used by S/L/T agencies to enter seasonal or periodic future year emissions rates for specific units for use in future year runs. This file may be used in addition to, or as an alternative to, the Control File.
- **Input Variables File** – A table of variables used in the modeling run. Regions and fuels are not hardwired into the model. Rather, the regions and their characteristics are specified in the Input Variables File. This file allows the S/L/T agencies to specify variables such as the size, fuel type and location for new units. In addition, the regional scheme and fuel types are specified in this file.
- **Growth Factor File** – A table of growth factors developed from the EIA Annual Energy Outlook (AEO) and NERC projections. Electrical generation growth is delineated by geographic region and generating unit type.

Geographic Regional System

The geographic regional system used in V2.4 is a modified version of the EIA Electricity Market Module (EMM) regional system as shown in Figure 1.

Figure 1: **- Location of the Electricity Market Module (EMM) Regions**



1 – Texas Regional Entity (ERCT)
2 - Florida Reliability Coordinating Council (FRCC)
3 - Midwest Reliability Council – East (MROE)
4 - Midwest Reliability Council - West (MROW)
5 - Northeast Power Coordinating Council / Northeast (NEWE)
6 - Northeast Power Coordinating Council / NYC-Westchester (NYCW)
7 - Northeast Power Coordinating Council / Long Island (NYLI)
8 - Northeast Power Coordinating Council / Upstate New York (NYUP)
9 - Reliability First Corporation / East (RFCE)
10 - Reliability First Corporation / Michigan (RFCM)
11 - Reliability First Corporation / West (RFCW)
12 - SERC Reliability Corporation / Delta (SRDA)
13 - SERC Reliability Corporation / Gateway (SRGW)
14 - SERC Reliability Corporation / Southeastern (SRSE)
15 - SERC Reliability Corporation / Central (SRCE)
16 - SERC Reliability Corporation / Virginia-Carolina (SRVC)
17 - Southwest Power Pool / North (SPNO)
18 - Southwest Power Pool / South (SPSO)
19 - Western Electricity Coordinating Council / Southwest (AZNM)
20 - Western Electricity Coordinating Council / California (CAMX)
21 - Western Electricity Coordinating Council / Northwest Power Pool Area (NWPP)
22 - Western Electricity Coordinating Council / Rockies (RMPA)

Because the EIA and NERC regions are not identical, an adjustment is required to align these regional systems to develop annual and peak growth rates. To match EIA and NERC, a "best fit" NERC regional growth factor is assigned to each EMM region. In the simplest case, where a clear match between EIA and NERC regional schemes exists, for example NPCC-New England, the NERC peak growth rate is assigned to the corresponding EMM region. In more complicated cases, where multiple NERC regions corresponded to a single EMM region, or where regions were organized along substantially different geographic boundaries, the NERC peak growth factors were averaged to generate a growth factor for the (usually larger) corresponding EMM region. As an example, the EIA CAMx region corresponds to two NERC regions, WECC-CALN and WECC-CALS. In this case, the WECC-CALN and WECC-CALS growth factors were averaged and applied to the EIA-CAMx region. The resulting assignments are shown in Figure 2.

Figure 2: EMM to NERC Crosswalk – ERTAC EGU V2.4

EMM Region Number	Fuel	EMM Region Name	EMM-ERTAC Region Code	Single "Best-Fit" NERC Subregion Peak Growth Code
1	Coal, NG, Oil	Texas Regional Entity (ERCT)	ERCT	ERCOT
2	Coal, NG, Oil	Florida Reliability Coordinating Council (FRCC)	FRCC	FRCC
3	Coal, NG, Oil	Midwest Reliability Council – East (MORE adjusted to include additional Michigan plants from RFCW)	MROZ	MRO-MAPP / MISO /SPP
4 (adjusted)	Coal, NG, Oil	Midwest Reliability Council West (MROW adjusted to include additional Michigan plants from assigned by EMM to RFCM)	MROW	MRO-MAPP / MISO /SPP
5+7+8	Coal, NG, Oil	Northeast Power Coordinating Council / Northeast (NEWE), Upstate New York (NYUP), and Long Island (NYLI) combined	NELU	NPCC - NE
6	Coal, NG, Oil	Northeast Power Coordinating Council / NYC Westchester (NYCW)	NEWW	NPCC - NY
9	Coal, NG, Oil	Reliability First Corporation / East (RFCE)p	RFCE	PJM / SERC - E
10	Coal, NG, Oil	Reliability First Corporation / Michigan (RFCM)	RFCM	MRO-MAPP / MISO /SPP
11 (adjusted)	Coal, NG, Oil	Reliability First Corporation / West (RFCW adjusted to move Michigan plants to MROW)	RFWZ	PJM / SERC - E
12	NG, Oil	SERC Reliability Corporation / Delta (SRDA)	SRDA	MRO-MAPP / MISO /SPP
13	Coal, NG, Oil	SERC Reliability Corporation / Gateway (SRGW)	SRGW	MRO-MAPP / MISO /SPP
14	Coal, NG, Oil	SERC Reliability Corporation / Southeastern (SRSE)	SRSE	SERC - SE
15	Coal, NG, Oil	SERC Reliability Corporation / Central (SRCE)	SRCE	MRO-MAPP / MISO /SPP
16	Coal, NG, Oil	SERC Reliability Corporation / Virginia Carolina (SRVC)	SRVC	PJM / SERC - E
17+18	Coal, NG, Oil	SouthWest Power Pool / North (SPNO) + South (SPSO)	SPPR	MRO-MAPP / MISO /SPP
12+17+18	Coal	SouthWest Power Pool / North (SPNO) + South (SPSO) + Delta (SRDA)	SPDA	MRO-MAPP / MISO /SPP

EMM Region Number	Fuel	EMM Region Name	EMM-ERTAC Region Code	Single "Best-Fit" NERC Subregion Peak Growth Code
19	Coal, NG, Oil	Western Electricity Coordinating Council / SouthWest (AZNM)	AZNM	WECC-WECC-SWSG
20	Coal, NG, Oil	Western Electricity Coordinating Council / California (CAMX)	CAMX	WECC-CAMX US
21	Coal, NG, Oil	Western Electricity Coordinating Council / Northwest Power Pool Area (NWPP)	NWPP	WECC-NWPP US
22	Coal, NG, Oil	Western Electricity Coordinating Council / Rockies (RMPA)	RMPA	WECC-WECC-RMRG

Within each region, individual generation units are further delineated into five unit types as follows:

- Coal;
- Oil;
- Natural Gas – Combined Cycle;
- Natural Gas – Single Cycle;
- Natural Gas – Boiler gas.

Each electricity generating unit included in the model is assigned to a region and fuel type bin in the Unit Availability File.

Growth factors

Generation for future years by fuel type are provided by EIA in their annual energy outlook (AEO). Annual average regional growth factors are calculated by dividing AEO future year by base year generation. The NERC peak growth rates are not delineated by fuel so each fuel has the same peak growth factor. Hourly growth factors are developed from the regional factors by adjusted to account for activity from new units and shutdowns. The tool then applies the hourly growth factors to the base year hourly generation data to estimate hourly future generation.

The tool confirms that unit capacity is never exceeded. Future generation is assigned to units as long as they have capacity available. When available known capacity is fully utilized new units are created if future demand exceeds known capacity.

NO_X and SO_2 Emissions - Base year emission rates for existing units are adjusted to account for new control equipment or other changes provided in the input files. New unit emissions, for which states do not provide emission rate data, are estimated based on the 90th percentile best performing existing unit for that fuel type and region. These rates are applied to each unit's future generation to calculate NOx and SO2 emissions.

Output – The ERTAC tool generates files of hourly generation and emissions for each unit included in the system. In addition, summary files of this hourly data are generated, to facilitate review of the results, as follows:

- Base and future year annual generation (MW-hrs) and heat input (mmbtu)
- Base and future year ozone season generation and heat input
- Base and future year annual NOx emission (tons) and average emission rate (lbs/mmbtu)
- Base and future year ozone season NOx emission and average emission rate
- Base and future year annual SO2 emissions and average emission rate

Run Documentation - The ERTAC EGU committee maintains and distributes reference runs for the continental United States (CONUS), including the hourly input and output files, summary files, and a documentation file for each run. These reference runs and complete documentation of the ERTAC Forecast Tool is located on the MARAMA web site.

ERTAC EGU V2.4 is built on improvements to prior versions and included updates to the UAF and control file from states as of August 2015. New adjustments made in V2.4 include the following:

- The single gas growth rate for each region provided by EIA was adjusted to apply all the gas growth to combined cycle and "no growth" to units identified as single cycle and boiler gas.
- Peak growth rates were reduced and transition hours adjusted for some regions.
- Some small regions were combined to allow generation growth to flow to units in the combined regions.

The inputs used to develop the ERTAC EGU v2.4 run for the continental United States are shown in Figure 3.

Figure 3: Summary of Inputs to ERTAC EGU v2.4 Model Run

ERTAC File Name	Description	Run Notes
	Version: 2.4	Scenarios run by ERTAC EGU leadership
	Code: 1.01	
	Base Year: 2011	Major update to UAF and Controls. Deadline for submittal: August, 2015.
	Future Years: 2017. 2018, 2019, 2023, 2028	
camd_hourly_base.csv	Hourly CAMD CEM data	
ertac_initial_uaf.csv	Unit Availability File	CONUSv2.4ref_08052015_ertac_initial_uaf.csv
ertac_seasonal_control_emissions.csv	Seasonal Control File	CONUSv2.4ref_08052015_ertac_seasonal_control_emissions.csv
ertac_control_emissions.csv	Annual Control File	CONUSv2.4ref_08052015_ertac_control_emissions.csv
ertac_growth_rates.csv	Growth Files - 2017	CONUSv2.4ref_2017_08052015_ertac_growth_rates.csv
	Growth Files - 2018	CONUSv2.4ref_2018_08052015_ertac_growth_rates.csv
	Growth Files - 2019	CONUSv2.4ref_2019_08052015_ertac_growth_rates.csv
	Growth Files - 2023	CONUSv2.4ref_2023_08052015_ertac_growth_rates.csv
	Growth Files - 2028	CONUSv2.4ref_2028_08052015_ertac_growth_rates.csv
NA	Average Annual Growth Source	AEO 2014
Peak Growth Source: Gro_2.3_2017.csv - The growth rates were found in the calculation spreadsheet Gas_Adj_AEO2014_NERC2013 Growth Rates v4 method 1 and method2.xlsx, tab Gas-Adj Ref 2014 M1 with the following exceptions:		
	NYLI and NYCW growth rates based on the same spreadsheet but used the tab New GR.	
	MROZ and RFWZ annual growth rates were based on the 2017 growth rates in the spreadsheet called FullTranslationWI_Regions_AdjustmentAEO2014.xlsx, tab Core Index for MROZ	
	RFCM, MROZ, and MROW peak growth rates for combined cycle were set to 1.3 based on LADCO, Wisconsin, and Michigan input.	
	SRGW peak growth rate for oil was set to 2.0 to ameliorate an extremely high peak rate, per LADCO.	
	RFCM, MROZ, and MROW combined cycle transition hours peak->formula set to 200; formula-> nonpeak set to 2000 based on LADCO, WI, and MI input. All other transition hours remain at default levels.	
For the 2028 estimates, to reduce the number of GDUs created solely for peak hour demand deficits, additional changes were made to the growth file:		
	Regions/fuel-unit types had peak rates set to 1.3 and transition hours set to 200 and 2000: CAMX, combined cycle; NWPP, combined cycle; RFWZ, combined cycle; SRCE, combined cycle; SRGW, combined cycle	
	NYUP Coal had the peak rate set at 1.3.	
NA	EMM to NERC Crosswalk	Version1
ertac_input_variables.csv	Input Variables File	IV_2.3_2017_10-28-2014.csv, IV_2.3_2017_10-28-2014.csv, IV_2.3_2019_10-28-2014.csv, IV_2.3_2028_10-28-2014.csv
	Input Variables File - 2017	CONUSv2.4ref_2017_08052015_ertac_input_variables.csv
	Input Variables File - 2018	CONUSv2.4ref_2018_08052015_ertac_input_variables.csv
	Input Variables File - 2019	CONUSv2.4ref_2019_08052015_ertac_input_variables.csv
	Input Variables File - 2023	CONUSv2.4ref_2023_08052015_ertac_input_variables.csv
	Input Variables File - 2028	CONUSv2.4ref_2028_08052015_ertac_input_variables.csv
ertac_hourly_noncamd.csv	Hourly CEM data replacing data in CAMD	nonCAMD_2.3_10-28-2014.xlsx
group_total_listing.csv	Aggregation scheme for multi-state caps	CONUSv2.4ref_08052015_group_total_listing.csv
state_total_listing.csv	Aggregation scheme for state level caps	CONUSv2.4ref_08052015_group_total_listing.csv
NA	Notes	Run complete in October 2015

- UAF: The documentation UAF is:
  2011BASEUnit_Availability_v2.4_14June 92015_code1_01.zip

- Controls File: The documentation controls file is:
  2011BASEControl File_v2.4_14June92015_code1_01.zip

- Seasonal controls are the same as 2.3 (GA and VA units).
- AEO regional changes

- **MROE [3]** becomes **MROZ [3]**, by adding in the disconnected areas of **RFCW [11]** in WI and MI Upper Pennisula. The disconnected areas represent WE Energies facilities which participate in the MISO wholesale market and are integral to the WI utility system even though it is formally part of the Reliability First council. Residual RFCW is renamed **RFWZ [11].** This change affects all fuels. The essential doubling in capacity in MROZ reduces levels of gas GDU formation and provides more realistic coal forecasts.
- **SRDA [12]** is combined with **SPPR [18.5**]. (SPPR is a prior v2.3 aggregation of **SPPN [17]** and **SPPS [18]).** The aggregated set of three AEO regions so far has only been used for the preliminary coal runs, but if adjusted to address coal growth, should also be applied for gas and oil forecasts in order to retain system balance. The new aggregated Southwest Power Pool and SERC Delta (aka SERC West) has been given a letter code of **SPDA** and a number code of **[17.5].** Much of the aggregated region is linked or at least coordinated for reliability and power wholesaling into MISO and is being referred to as MISO South. The primary utility causing the regional footprint adjustments is Entergy. It has one controlled grid connection with the rest of MISO and much better integration with SPP (OK and KS).
- In the Northeast, 4 regions are consolidated into 2 regions. The 4 AEO regions are **NYUP [8], NEWE [6], NYLI [5], and NYWC [7]. NYWC [7]** remain as it is, the other three are consolidated into a new region called **NEUP [8.5].** Peak forecasts from the two involved ISOs [NY-ISO and NE-ISO] are very similar and are relatively straightforward to allocate. The purpose of this consolidation is to deal with the very small coal facility growth patterns and to address gas and oil boiler GDU issues. The agencies involved agree that NYWC should be grown uniquely to address the GDU issues.
- Other regions that have a lower potential in the future to get integrated include the **SRGW [13]** region involving downstate IL and eastern MO, which wholesales with MISO for the most part but is formally part of the SERC reliability council, and, **RFCM [10]** which includes almost all of lower MI, and has displayed chronic CC and/or CT GDU creation due to growth forecasts exceeding capacity forecasts – most especially at peak. RFCM also participates in MISO markets. Discussions with EIA this fall should facilitate any region consolidation issues.

- Growth Rate File: Growth rates were based on AEO 2014, as they were in CONUS2.3. Growth factor development is documented in spreadsheet **Gas_Adj_AEO2014_NERC2013 Growth Rates v4 method 1 and method2.xlsx,** tab **Gas-Adj Ref 2014 M1** were used with the following adjustments:
  - **<u>Adjustments to SPPR and SRDA</u>**
    - SPDA (combination of coal units from SPPR and SRDA) coal growth rates were taken from the file called **Simple Tables Growth for combined SPP plus SRDA.xlsx**

- The SPPR and SRDA coal lines were removed.

- **<u>Adjustments to New York regions (NYUP, NYLI, NYCWE)</u>**
  - The 2017, 2018, 2019, 2023, and 2028 growth rates for coal and oil fuel/unit types in NELU were updated using the spreadsheet called "Northeast_Composite_AEO2014_2015 07282015.xlsx", tab "Index Compare AEO2014-2015." Rows #3, and #4 were used for annual data and Rows #22 and #23 were used for peak rates.
  - The 2017, 2018, 2019, 2023, and 2028 growth rates were updated for combined cycle, simple cycle, and boiler gas in NELU using the spreadsheet called "Northeast_Composite_AEO2014-2015 07282015.xlsx", tab "3 Region Growth Factor Summary". Rows #5, #6, and #7 were for annual and rows #14, #15, and #16 were used for peak rates. Peak rate TPs were set at 50/1000 for Boiler gas.
- **<u>Adjustments to RFCM</u>**
  - For RFCM, the file "Updated AEO2014 GR for RFCM CC and RFCM AEO2015 GR.xlsx", tab "RFCM AEO2015" was used for all annual growth rates and for peak growth rates for BG, CC, and SC. Annual growth rates for boiler gas and simple cycle units are 1. The peak growth rates for coal and oil remained the same as 2.3. TPs for combined cycle were set at 1000 and 7000.
- **<u>Adjustment to SRVC</u>**
  - For SRVC, I used the annual and peak growth rates in the June 30, 2015 memo from the SC, NC, VA, and WV air directors to ERTAC. The TPs for combined cycle were set at 200 and 5000 to reflect the base load nature of combined cycle. The TPs were set at 10/2000 for boiler gas to push the huge increase into the middle range of the hours. In 2028, the boiler gas peak growth rate was reduced from 3.069 to 3.067 to reflect the retirement of two small coal-to-gas converted boilers.
- **<u>Adjustment to SRSE</u>**
  - For SRSE, the following peak rates were used, for all years, based on the 7/20/2015 email from Bob Lopez to Byeong Kim with the subject "SRSE Peak Growth Rates":

Fuel/unit type in SRSE	Peak growth rate	Transition hrs
Coal	0.8	400/4000
Combined cycle	1.45	400/4000
Simple cycle	1.00	10/50
Boiler gas	1.45	200/4000

- **Adjustment to MROZ and RFWZ**
    - Growth for MROZ and RFWZ, came from the spreadsheet called “Summary for MROZ and RFWZ for CONUS2.4.xlsx, tab “Summary MROZ&RFWZ.” For RFWZ, lines 52 through 56 were used for annual rates. For peak rates, line 58 was multiplied by the annual value to determine the peak value. Peak rates above 1.3 was set back to 1.3. For MROZ, lines 16 through 20 were used for annual. Line 22 was multiplied by the annual rate to determine the peak rate. Peak rates above 1.3 were set at 1.3 based on Bob’s email dated 7/23/2015, subject: MROZ forecast starter using AEO2015. Also, for RFWZ, CC, in 2018 the TPs was set to 200/4000 because of the very large difference between the peak and annual growth rates.
- **Adjustment to CAMX**
    - For CAMX, the CC peak rates were set equal to the annual rates in all years.

- Input Variables:
    - The specified facilities for new units from SRVC were removed.
    - Changed CAMX, SRVC, SRSE, FRCC, and NEWE to 75th percentile for new CCs and SCs (NEWE CC was already at 75th for 2.2).
    - Added MROZ and RFWZ, and deleted MROE and RFCW.
    - Changed capacity Demand Deficit Review from 400 to 3000 for all regions and fuel/unit types.
- NonCAMD Hourly File:
    - Replaced all negative emissions values and load values with zero.
    - Added a full year of data for the ORIS 8906 (Astoria) Unit IDs 30, 40, and 50—summed the reheat and superheat reported data to create the pseudo units.
    - Added a full year of data for 7839 (Ladysmith) Unit 5, which is equivalent to that reported in 2011 for 7838 (Remington) Unit 5. 7838, 5 does not exist and this was a 2011 CAMD reporting error.

PRIOR ADJUSTMENTS

The adjustments made to prior runs that still pertain to the current run are re-iterated here. Prior reference runs for 2011 were as follows:

2.3 – Run in October 2014. Same as 2.1 This run included major updates to the UAF and Control files received as of August 24, 2014. This is the first use of growth rates from AEO2014.

2.2 – Run in June 2014. Same as 2.1 This run included major updates to the UAF and Control files received as of March 31, 2014. This is the first use of the new code 1.01. Growth rates were from AEO2013.

2.1L1 – Run in April 2014. Same as 2.1 except this run included updates from Midwest to UAF and control file for Indiana, Illinois, Wisconsin, Michigan and Ohio primarily for coal fired units received dated March 3, 2014.

2.1 – Run in March 2014. This run included updates to the UAF and control file from SE, MW, NE: NY (including NY Astoria (ORIS 8905), RACT and other rule changes) CT, NH, MD, NJ, VA, KY (including new information on the federal TVA consent agreement). UAF updated with adequate data to calculate an ertac heat rate. Negative values in CAMD replaced with zero. An adjustment to implement zero growth for the Boiler gas was included. Combustion turbines and combined cycle units were adjusted in the 2.1 factors to account for the boiler-gas generation.

2.0 – Run in January 2014. This run was the first using base year 2011. In addition, the Midwest states provided updates to the UAF and control files. These updates were completed by the Northeast in prior runs.

2.3 – Run in October 2014. Base year 2011 using of growth factors from AEO2014.

A single reference run using base year 2007 was created and titled 1.7.

Changes included on previous 2011 base ERTAC EGU inventories that are repeated for this run include the following:

- UAF:
  - For the 2.3 Reference case the documentation UAF called **2011BASEUnit_Availability_v2.4_14June 92015_code1_01.zip** was used.
  - Significant changes were made to address units without enough base year data to calculate variables and other issues. These fixes are detailed in the document

My changes for 2_3 from Wendys file.docx. The following are the major changes:

- Deleted ORIS 2723 IDs 11C and 12C for NC.
- Added in ORIS/Unit ID information for the following facility/units for states that don't typically report: ORIS 465, ID 4 (CO); ORIS 1248, IDs CT-1, CT-2, CT-3, CT-4 (KS); ORIS 2790, CT6 (ND); ORIS 56237, CT03, CT04 (UT)
- Changed ORIS 6253, IDs P30 through P37 to nonEGUs as they caused a crash in MROZ for the Oil category.
- Deleted ORIS 994802 and 994804 for TX as they are on hold. Changed 994803 ORIS codes to 58001 and changed 1 and 2 to CTG1 and CTG2. Changed 994801 ORIS code to 58005 (all TX units)
- Changed 993404 to 56963 and renumbered 1 and 2 to E101 and E102.
- Changed 992601, Unit IDs N2601 and N2602 to ORIS 58427, Unit IDs 100 and 200.
- Changed 4937 U1 and U2 to CT-1 and CT-2.
- Removed the coal-to-gas conversion units for the nonEGU ORIS 992 as they caused a crash.
- Removed 994810 as it was a biomass unit and wouldn't be grown.
- Updated the RFCW and MROE regional boundaries to RFWZ and MROZ according to the files sent by R. Lopez called **ERTAC_MROE corrected Region_adjustment_Summary2.xlsx.**
- Updated the following MI new combined cycle units' HR to 7,500 btu/kw-hr from 10,000 btu/kw-hr: ORIS 10745, N2604, N2605; ORIS 992601, N2601, N2602; ORIS 992603, N2603; ORIS 992605, N2608, N2909.
- Changed the fuel/unit type from SC to CC for the following ORIS/Unit IDs based on info from MI: 55088 GT2100 and GT3100.

- Controls File:
  - For the 2.3 Reference case, the documentation controls file called **2011BASEControl File v2.3_13_14September 82014_code1_01.zip** was used.
  - Edits were made to state data that seemed to be typos and a detailed listing may be found in **My changes for 2_3 from Wendys files.docx.**
  - Major changes are as follows:
    - Moved the NOx controls from the controls file to the seasonal controls file for the following GA units: ORIS 703: 1BLR, 2BLR, 3BLR, 4BLR; ORIS 708: 4; ORIS 710: 4A, 4B, 5A, 5B, 6A, 6B; ORIS 6052: 1, 2; ORIS 6257: 1, 2, 3, 4. Also, did this for 2 VA units: ORIS 3797: 4, 5.

- Added 2790, unit ID CT6, with a NOx rate of 0.044 lbsl/mmbtu based on information from ND.
- Deleted out the following ORIS as they are no longer in the UAF; 994802, 994804; Deleted the following ORIS/Units as they are no longer in the UAF: 2723, 11C & 12C; Deleted the following ORIS/Units as they are already controlled in 2011 and appear to have the incorrect ORIS assigned, based on the facility name (NCEMC-Hamlet): ORIS 2712, IDs ES-6-A, ES-6-B
- Changed the NOx rates for the units listed in NY's email attachment called **CONUS_V2 2 2018_NYSDEC_revisions.xlsx.**

ORIS	Unit ID	Facility	NY Revised NOx Rate
2516	4	Northport	**0.0573**
2490	20	Arthur Kill	**0.0894**
2516	3	Northport	**0.1094**
2511	10	E F Barrett	**0.0798**
2490	30	Arthur Kill	**0.0906**
2500	10	Ravenswood Generating Station	**0.0662**
2516	2	Northport	**0.1006**
2500	30	Ravenswood Generating Station	**0.0822**
2516	1	Northport	**0.0977**
2500	20	Ravenswood Generating Station	**0.0700**
2511	20	E F Barrett	**0.0481**
2517	4	Port Jefferson Energy Center	**0.0573**
2517	3	Port Jefferson Energy Center	**0.1094**

- Growth Rate File:
  - For the 2.3 Reference case, growth rates found in spreadsheet **Gas_Adj_AEO2014_NERC2013 Growth Rates v4 method 1 and method2.xlsx,** tab **Gas-Adj Ref 2014 M1** were used with the following exceptions:
    - NYLI and NYCW growth rates were based on the same spreadsheet but used the tab called **New GR.**
    - MROZ and RFWZ annual growth rates were based on the 2018 growth rates in the spreadsheet called **FullTranslationWI_Regions_AdjustmentAEO2014.xlsx**, tab **Core Index for MROZ &**.
    - RFCM, MROZ, and MROW peak growth rates for combined cycle were set to 1.3 based on LADCO, Wisconsin, and Michigan input.
    - SRGW peak growth rate for oil was set to 2.0 to ameliorate an extremely high peak rate, per LADCO.
  - RFCM, MROZ, and MROW combined cycle transition hours peak->formula set to 200; formula-> nonpeak set to 2000 based on LADCO, WI, and MI input. All other transition hours remain at default levels.
  - For the 2028 estimates, to reduce the number of GDUs created solely for peak hour demand deficits, the following additional changes were made to the growth file:
    - The following regions/fuel-unit types had their peak rates set to 1.3 and their transition hours set to 200 and 2000: CAMX, combined cycle; NWPP, combined cycle; RFWZ, combined cycle; SRCE, combined cycle; SRGW, combined cycle
    - NYUP Coal had the peak rate set at 1.3.
- Input Variables:
  - Removed the specified facilities for new units from SRVC.
  - Changed CAMX, SRVC, SRSE, FRCC, and NEWE to 75^{th} percentile for new CCs and SCs (NEWE CC was already at 75^{th} for 2.2).
  - Added MROZ and RFWZ, and deleted MROE and RFCW.
  - Changed capacity Demand Deficit Review from 400 to 3000 for all regions and fuel/unit types.
- NonCAMD Hourly File:
  - Replaced all negative emissions values and load values with zero.
  - Added a full year of data for the ORIS 8906 (Astoria) Unit IDs 30, 40, and 50—summed the reheat and superheat reported data to create the pseudo units.

    - Added a full year of data for 7839 (Ladysmith) Unit 5, which is equivalent to that reported in 2011 for 7838 (Remington) Unit 5. 7838, 5 does not exist and this was a 2011 CAMD reporting error.
- Group and State Files are unchanged from 2.2 (Group contains both CAIR and CSAPR levels)

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