SPECIFICATION SHEET: ELECTRIC GENERATION UNITS PREPARED USING THE ERTAC EGU EMISSION ESTIMATION TOOL

Description: Large EGU Units, for simulating 2016 and future year U.S. air quality with the ERTAC EGU tool

1. Executive Summary

The ERTAC Electrical Generating Unit (EGU) Committee projects activity and emissions for fossil fuel-fired EGU units located in the continental United States (CONUS) that report emissions to the United States Environmental Protection Agency (USEPA) Clean Air Markets Division (CAMD) under 40 CFR Part 75 *Continuous Emission Monitoring* and, with some exceptions, serve a generator of at least 25 megawatts (MW).

This document details the approach and data sources used to develop emissions for the 2016 base year and select future years for large EGUs. Section 2 **Introduction** describes the source category and the general methodology and sources. Section 3 **Inventory Development Methods** describes the ERTAC EGU tool input files and how they are built from data garnered from a wide variety of sources. Periodic updates of the input files drive creation of new run versions. Key data sources include:

- Hourly nitrogen oxides (NO_X), sulfur dioxide (SO_2), and activity data collected by CAMD
- State agency expert knowledge of facilities and their future plans
- Energy Information Agency (EIA) Annual Energy Outlook (AEO)
- North American Electric Reliability Corporation (NERC)
- CAMD NEEDS database
- EIA Form 860

Section 5 **Emissions Summaries** contains summaries of emissions and generation for each simulation.

2. Introduction

The ERTAC EGU tool projects activity and emissions for fossil fuel-fired EGU units located in the continental United States that report emissions to the USEPA CAMD under 40 CFR Part 75 *Continuous Emission Monitoring* and, with some exceptions, serve a generator of at least 25 MW. The exceptions to the 25 MW size criteria are mostly in the Northeastern United States where some units are sized less than 25 MW but are required to report emissions and activity to CAMD.

These large EGUs are point sources in the inventory with unit identifiers and are located at facilities identified by EIA ORIS numbers. Stack parameters, including release height, temperature and velocity are also tracked. Load and pollutants, including SO_2 and NO_X, are recorded and reported continuously to USEPA. Other pollutants are estimated by the sources or state staff and reported annually to USEPA.

The ERTAC EGU Committee collects data on these units from a wide variety of sources and uses that information to estimate hourly emissions in future years with the ERTAC EGU tool. The committee maintains and distributes reference runs for CONUS, including the hourly input, output, summary, and documentation files for each run. These runs and complete documentation of the ERTAC EGU tool are available upon request.

This run, CONUS16.1, is based on 2016 base year continuous emission monitoring (CEM) data as collected by CAMD and growth factors from the EIA AEO 2019 regional hybrid Reference/High Oil and Gas scenarios projection. EGU unit level adjustments were based on input received by February 2020 from a significant outreach effort to states and stakeholders. Projections for reference case runs have been prepared for years 2020, 2023, and 2028. Other years may be prepared based on the needs of the states. Final v16.1 runs were completed by Virginia DEQ in April 2020. The contact person for questions about these run files is Doris McLeod (804-698-4197). CONUS v16.1 reference runs comply with the Cross State Air Pollution Rule Update (CSAPR Update) Rule (81 FR 74504). Since the changes that prompted the transition from CONUS v16.0 to CONUS v16.1 pertained to the projection years, only the projection year runs were updated for CONUS v16.1.

3. Inventory Development Methods

The ERTAC EGU tool input files are built from a variety of data sources. Periodic updates of the input files drive creation of new run versions. Key data sources include:

- Hourly NO_X, SO_2, and activity data collected by CAMD
- State agency expert knowledge of facilities and their future plans
- EIA AEO
- NERC
- CAMD NEEDS database
- EIA Form 860

Hourly NO_X, SO_2, and activity data are continuously monitored and reported electronically to CAMD by large EGU facilities as required by 40 CFR Part 75 and in certain cases state regulations. CONUSv16.1 utilizes the data set collected for 2016. This data is available on ftp://newftp.epa.gov/DMDnLoad/emissions/hourly/monthly/2016/ and was downloaded by Virginia DEQ on June 20, 2019.

The primary sources of expected future change in generation are the EIA annual projection of future generation and the NERC projection of peak generation rates. This information is available by region and fuel type. Where states have local activity projections, these are preferred over EIA or NERC estimates. The ERTAC EGU growth committee prepares updates to the growth factors when new versions of the EIA AEO become available, blending the national EIA and NERC data with state-specific data where available to create a unified, national growth factor table by electricity market module (EMM) region. The annual change in future generation by unit is estimated by merging these growth files and state knowledge of unit level changes within a generating region. Hourly future emissions of NO_X and SO_2 are calculated by multiplying hourly projected future heat input by future emission rates.

The CAMD NEEDS Database contains the generation unit records used to construct the model plants that represent existing and planned/committed units in EPA modeling applications of the Integrated Planning Model (IPM). NEEDS includes basic geographic information, operating information, air emissions, and other data on these generating units. For the CONUSv16.1 ERTAC tool run, NEEDS v6 (dated 09-14-2018) data were used to assist states in updating unit level input characteristics.

EIA Form 860 contains generator-level specific information about existing and planned generators and associated environmental equipment at electric power plants with one MW or greater of combined nameplate capacity. EIA Form 860 data from 2017 informed state updates to the unit level input characteristics.

Data Collection and Stakeholder Outreach

State agency expert knowledge on facilities and their future plans is collected periodically during coordinated outreach events to state staff. During outreach periods, agencies provide information on new units and controls, fuel switches, shutdowns, and other unit-specific changes. Owners of facilities are encouraged to work with state staff to determine the most appropriate input characteristics for each unit. Future emission rates in projection runs are assumed to be the same as base year rates unless adjusted by state input. Such input may be based on knowledge of expected emissions controls, fuel switches, or other unit-specific considerations.

After projection year development, results are provided to state and multi-jurisdictional organization (MJO) staff for review prior to finalizing the outputs.

ERTAC EGU Input Files Overview

ERTAC EGU tool input files for each run that are created by the ERTAC EGU committee are as follows:

- *ERTAC Base Year Hourly CEM data (camd_hourly_base.csv)* – This comma separated file contains hourly unit level generation and emissions data developed from EPA's CAMD database. This data file was generated by concatenating 2016 hourly information available on EPA's website at ftp://newftp.epa.gov/DMDnLoad/emissions/hourly/monthly/2016/. Virginia DEQ staff downloaded this information on June 20, 2019.
- *ERTAC EGU nonCAMD hourly data (ertac_hourly_noncamd.csv)* – This comma separated file contains updates to the hourly data. These updates include removing negative values contained in the 2016 base year data, updating existing units' data, and appending additional data from other sources.
- *Unit Availability File (ertac_initial_uaf_v2.csv)* – This comma separated file contains descriptions of each generating unit derived from a variety of sources, including the CAMD NEEDS database, state input, EIA Form 860, and NERC data. Each row in the table represents a single generating unit. This file is maintained and updated by the ERTAC committee and provides information on changes to specific units from the base to the future year. For example, the unit availability file (UAF) captures actual or planned changes to usage rates, unit efficiency, capacity, or fuels. Agencies also add information on actual and planned new units and shutdowns.

- *Control File (ertac_control_emissions.csv)* – This optional comma separated file contains known future unit-specific changes to SO_2 or NO_X emission rates in units of pounds per million British thermal units (lbs/mmbtu) and/or control efficiencies (for example, addition of a scrubber or selective catalytic reduction system). This information is provided by agency staff. This file also provides emission rates for units that did not operate in the base year and for new units.
- *Seasonal Controls File (ertac_seasonal_control_emissions.csv)* – This optional comma separated file may be used by 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 (ertac_input_variables_v2.csv)* – This tabular file specifies values for a number of variables used in a particular projection run.
    - <u>Regions and Fuel Characteristics.</u> These fields are not hardwired into the model. Rather, the regions and their characteristics are specified in the input variables file. This file allows agencies to specify variables such as the size, fuel type, and location for new units.
    - <u>Default New Unit Emission Rates</u>**.** These fields allow the user to adjust the percentile of best performing existing unit emission rates used for determining emission rates applied to new units. Default is 90^{th} percentile.
    - <u>New Unit Hourly Profile Characteristics</u>**.** For new planned units and generation deficit units (GDUs), users may specify in this file the percentile ranking of the existing unit (operated in the base year) used to create a representative future profile of activity for new units and GDUs.
    - <u>Calculation Methodology</u>. This field allows the user to specify the methodology for determining emission rates and heat rates. Default (blank) mode is currently used for projections while HOURLY mode is currently used for base year development. The default calculation methodology uses annual average data.
- *Growth Factor File (ertac_growth_rates.csv)* – This comma separated file contains the annual, nonpeak, and peak electrical generation growth factors delineated by geographic region and generating unit type used in a particular run.
- *Demand Transfer File (ertac_demand_transfer.csv)* – This optional file allows users to transfer power, on an hourly basis, from one region/fuel-unit type to another. It also allows transfer to or from other, non-fossil fuel fired systems such as nuclear and renewables.

CAMD HOURLY FILE

ERTAC EGU v16.1 is the second set of runs to use the base year 2016 data. Base year input files were created from EPA files available on the CAMD website (ftp://newftp.epa.gov/DMDnLoad/emissions/hourly/monthly/2016/).[1] Hourly files to create the camd_hourly_base.csv input file were downloaded on June 20, 2019. Hourly data for the v16.1 effort were not adjusted using the CEMCorrect program. The CEMCorrect tool is a

[1] This website has since been replaced by https://gaftp.epa.gov/dmdnload/emissions/hourly/monthly/2016/

program designed to identify and correct anomalous data points in the hourly database that resulted from 40 CFR Part 75 substitution methodology since such data likely do not reflect actual emissions during that hour. The tool also reconciles differences between the reported CEM emissions and annual emission estimates supplied by the state for the same unit and generates hourly emissions estimates for periods when a unit did not report CEM data to CAMD.[2]

The June 20, 2019 download included five units that were not in the previous CAMD hourly data download: ORIS 10649, GT1; ORIS 10650, GT1; ORIS 54768 GT1; and ORIS 57943, CT4 and CT5. These five units were also added to the v16.1 UAF discussed below. Additionally, SO2 and NOx emissions increased at ORIS 55088 in the June 20, 2019 download compared to the base year hourly data used in v16.0.

Non-CAMD Hourly File

This file, which is an optional input, allows for adjustments to abnormal or missing data in the camd hourly file (camd_hourly_base.csv). The file may also be used to append additional data to the camd_hourly_base.csv file. For the v16.1 (base year 2016) effort, a small number of units with abnormal or missing base year hourly data were corrected, including data reflecting a negative value for mass or emission rate that were replaced with blank fields. Where data is missing, units are assigned one hour of reasonable, minimal activity in the non-CAMD hourly file to ensure processing. This improvement has negligible impact on base year emissions or activity.

The file was used to include base year hourly data for the following units:

- ORIS 7991 Units U1 and U2. ORIS 7991 Units U1 and U2 operated during 2016 but had no base year activity in 2016 as reported to CAMD because the units did not fall under Part 75 reporting requirements until 2017. WI requested the use of 2017 hourly data in lieu of 2016 hourly data to ensure that the units had reasonable profiles and activity represented in the base year. Since the 2017 data did not include information for February 29th, the hourly data for this day in the 2016 data were left blank.
- ORIS 50951 Unit ID 1. Heat input and NOx and SO2 emissions calculated from data provided by UT.
- ORIS 10671, Unit IDs 1A, 1B, 2A, and 2B. SO2 emissions calculated from emissions rates provided by OK.

[2] Adelman, Z.E. et al., 2012. "A Detailed Approach for Improving Continuous Emissions Monitoring data for Regulatory Air Quality Modeling." Paper presented at 2012 International Emission Inventory Conference: Emission Inventories – Meeting the Challenges Posed by Emerging Global, Nation, Regional and Local Air Quality Issues, Tampa, Florida.

UNIT AVAILABILITY FILE (UAF)

The UAF includes a record for each generation unit and captures actual or planned changes to utilization fractions, unit efficiency, capacity, or fuels. Agencies also add information on actual and planned new units and shutdowns.

Numerous detailed corrections and adjustments to these files were made based on agency comments regarding the configuration, characteristics, and utilization estimates of their units. As noted above, five units that were new to the June 20, 2019 CAMD Hourly File were added to this UAF: ORIS 10649, GT1; ORIS 10650, GT1; ORIS 54768 GT1; and ORIS 57943, CT4 and CT5.

The file name for the final unit availability file is:

2016BASEUnit_Availability_v16.1_19February62020_code2_1_3.xlsx

For most units, actual 2016 operational data, as recorded in the 2016 CAMD hourly files, were used by the code to estimate unit characteristics. To ensure that this would occur, prior estimates that were obtained from various resources used to build the UAF were deleted to allow the code to use the 2016 data. Deleted characteristics are as follows:

- Nominal_heat_rates for existing units
- Max_annual_ERTAC_UF_state_input for all units, where UF represents the utilization fraction of the unit
- Unit_optimal_load_threshold from all units

After using the code to estimate the 2016 values, in some cases inadequate 2016 operational data was available to the code to estimate unit characteristics. In these cases, the UAF was filled with the reasonable values. For instances where heat rate in units of British thermal units per kilowatt-hour (btu/kw-hr) could not be calculated or heat rate was out of range, the following defaults were applied:

- Boiler gas units – 10,000
- Coal units – 11,000
- Combined Cycle Gas Units – 8,000
- Simple Cycle Gas Units – 10,000
- Oil Units – 12,000

Where optimal load threshold (Column AV) could not be calculated, a default of 50% of the max_unit_heat_input, converted to MW by 10000 btu/kw-hr and 1000 kw/mw, was applied to such units.

Where max_annual_UF_state_input (Column AM) could not be calculated, a default of 0.9 was applied to such units. In many cases such units needed more than one supplied value to run successfully.

In the UAF, units are described in Column S, BY_camd_hourly_data_type, as "Full", "NEW", "Partial", or "non-EGU." "Full" indicates that the unit reported activity and emissions for the entire base year and that growing activity and emissions from the unit using AEO electrical generation growth rates is appropriate. "NEW" indicates that the unit was not on-line during the base year in its present configuration. This moniker is assigned to units that commenced operations after the base year and thus no CAMD data within the base year exists for that unit. It is also applied to units when a fuel switch or process change occurred after the base year. Examples include, but are not limited to, units operating on coal in the base year but natural gas in the future year and units operated as simple cycle units in the base year but combined cycle units in the future year. The moniker "non-EGU" indicates units that are not appropriately grown using AEO electrical generation rates. Such units may include, but not be limited to, units at paper mills, taconite mills, and chemical manufacturing facilities. The moniker "Partial" indicates that the unit only reported activity and emissions a portion of the year to CAMD but that the unit could reasonably be grown using AEO growth rates. For these units, which are identified as such by state staff, hourly data outside of the required CAMD reporting period may be blank or may simply not exist in the base year hourly data set. In these situations, the tool provides a listing of "Partial" year reporters in the preprocessor log and creates any required hourly records in the base year so that the unit has a full set of hourly records for growth estimates. Optionally, users may supply the base year annual heat input for such units in the UAF in Column T (BY_Annual HI for Partials). If this data is supplied, the tool calculates the heat input for the non-reported hours of the year by subtracting the CAMD-reported heat input from the state-supplied heat input in Column T and distributes that heat input uniformly to those non-reported hours. The tool will use average values for heat rate and emission rates to construct necessary hourly information from the heat input estimates.

CONTROLS FILE/SEASONAL CONTROLS FILE

For future year runs, calculated base year emission rates for existing units are used unless data in the controls file or seasonal controls file alter the rates. The controls file may also be used to update or include emission rates for pollutants otherwise not reported to CAMD. For example, in certain instances units may report NO_X to CAMD but not SO_2 emissions. The controls file may be used to include SO_2 emission rates for such units so that base year data reflect a profile of SO_2 emissions consistent with base year unit activity and the state supplied SO_2 emission rate.

The seasonal controls file may be used to enter seasonal or periodic future year emissions rates for specific units for use in future year runs. For example, if a unit is expected in a future year to run a control device during the summer months but not during other times of the year, this file allows the user to provide different emission rates to be applied during future year time periods. This file may be used in addition to, or as an alternative to, the control file. When competing entries are contained in these files, the tool uses the controls file entry. In v16.1, Maryland, Pennsylvania, Indiana, West Virginia, and Georgia included seasonal controls.

The v16.1 controls file and seasonal controls file are based on the documentation file called2016BASEControl File_v16.1_19February62020_code2_1_3.xlsx.

GROWTH RATE INPUT FILE

The following sections explain the development of the regions included in the growth rates input file as well as the development of the growth rates used in the CONUSv16.1 runs.

ERTAC EGU GEOGRAPHIC REGIONAL SYSTEM AND FUEL TYPES

Each EGU unit included in the model is assigned to a geographic region and fuel type bin in the UAF. The geographic regional system provided in Figure 1 is used in the CONUSv16.1 run. The system is identical to the EIA EMM regional system with one adjustment: the EIA regions SPNO and SPSO have been combined into a single region.

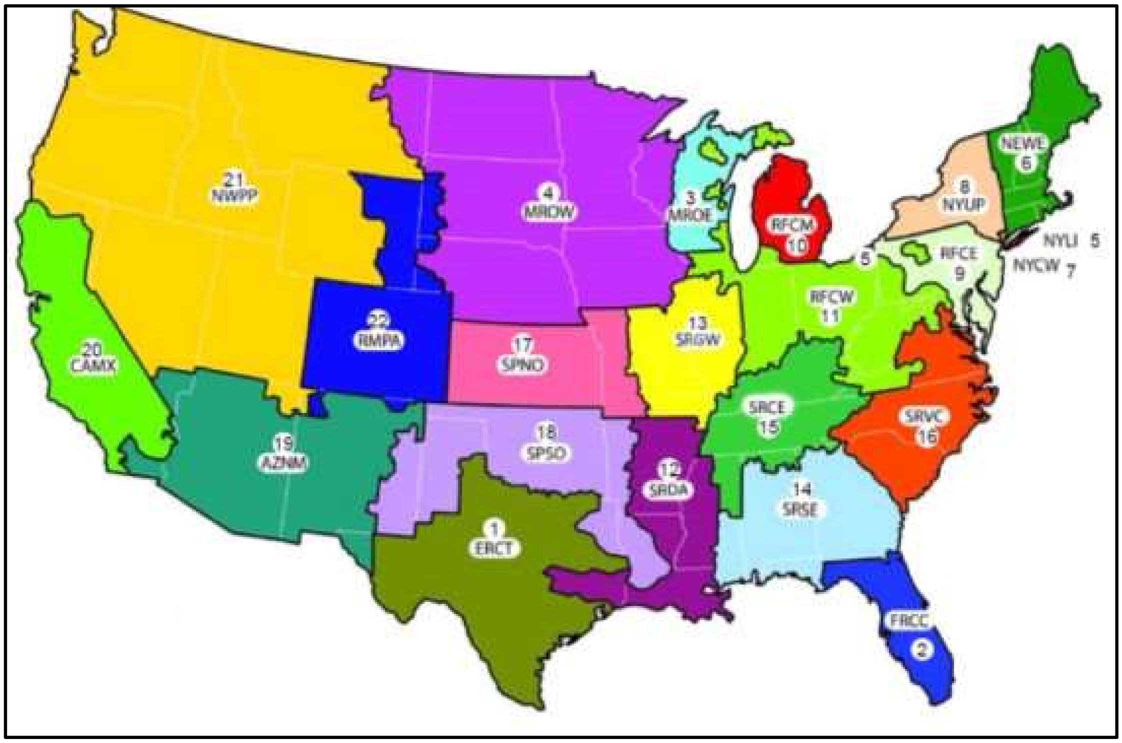

Figure 1: Regional Boundaries for Coal Generation, CONUSv16.1

AEO regions SPSO and SPNO were aggregated into a single region called SPPR**.** The southwest power pool (SPP) operates as a single balancing authority and single wholesale market for the SPPR region. Application of differential growth rates by fuel type between SPPS and SPPN can produce counter-intuitive fuel-specific emissions forecasts. Combining the individual net generation forecasts for a single fuel type allows for an accurate averaging of the growth rates into an integrated whole. The outcome better reflects generation efficiencies and relative fuel balance based on the application of a single, wholesale market construct. The bigger regional footprint rebalances loading for each fuel-unit type.

NERC growth factors using the NERC regional system are used for peak growth. Because the EIA EMM and NERC regions are not identical, 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 relative peak growth rate is assigned to the corresponding EMM region. In more complicated cases, where multiple EMM regions corresponded to a single NERC region, or where regions were organized along substantially different geographic boundaries, the NERC Electricity Supply & Demand (ES&D) data was aggregated and averaged to generate a relative peak growth factor for the (usually larger) corresponding NERC region that was applied to the corresponding ERTAC region (which closely resemble the EMM regions). As an example, the EIA SRVC, RFCW, and RFCE regions corresponds to two NERC regions, PJM and SERC East. In this case, the relative peak growth factors were derived from PJM and SERC East and applied to SRVC, RFCW, and RFCE ERTAC regions. Table 1 provides a crosswalk for these regional identifiers.

Table 1: EMM to NERC Crosswalk - ERTAC EGU v16.1

EMM Fuel Region #	Fuel	EMM Region Name	ERTAC Regional 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 (MROE)	MROE	MISO / SPP / SERC-N
4	Coal, NG, Oil	Midwest Reliability Council / West (MROW)	MROW	MISO / SPP / SERC
5	Coal, NG, Oil	Northeast Power Coordinating Council / Northeast (NEWE)	NEWE	NPCC - NE
6	Coal, NG, Oil	Northeast Power Coordinating Council / NYC Westchester (NYCW)	NYCW	NPCC - NY
7	Coal, NG, Oil	Upstate New York (NYUP)	NYUP	NPCC – NY
8	Coal, NG, Oil	Long Island (NYLI)	NYLI	NPCC - NY
9	Coal, NG, Oil	Reliability First Corporation / East (RFCE)	RFCE	PJM / SERC - E
10	Coal, NG, Oil	Reliability First Corporation / Michigan	RFCM	MISO / SPP / SERC
11	Coal, NG, Oil	Reliability First Corporation / West	RFCW	PJM / SERC - E
12	Coal, NG, Oil	SERC Reliability Corporation / Delta (SRDA)	SRDA	MISO / SPP / SERC
13	Coal, NG, Oil	SERC Reliability Corporation / Gateway (SRGW)	SRGW	MISO / SPP / SERC
14	Coal, NG, Oil	SERC Reliability Corporation / Southeastern (SRSE)	SRSE	SERC - SE
15	Coal, NG, Oil	SERC Reliability Corporation / Central (SRCE)	SRCE	MISO / SPP / SERC
16	Coal, NG, Oil	SERC Reliability Corporation / Virginia Carolina (SRVC)	SRVC	PJM / SERC - E
17+18	Coal, NG, Oil	South West Power Pool / North (SPNO) + South (SPSO)	SPPR	MISO / SPP / SERC
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 EMM 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

Generation for future years by fuel type are based on growth rates differentiated by annual, nonpeak, and peak rates. Average annual regional growth rates are developed by the ERTAC EGU Growth Subcommittee from the EIA AEO. EIA annual average regional growth factors are calculated by dividing AEO future projected generation by base year generation. In certain cases, agencies have developed more refined region-specific growth factors, which are then used to replace the EIA/NERC factors.

Peak growth rates are derived by determining relative peak growth from NERC ES&D data and applying it to the annual growth rates. The derived relative peak growth rates are not delineated by fuel so the ratio of peak to nonpeak growth rates for each fuel within a single region is constant.

Growth factors used in v16.1 reference case were developed based on a region-specific "hybrid" approach combining AEO2019 High Oil and Gas Resource and Technology ("HOG") and Reference Case scenarios. Relative peak factors were derived from 2018 NERC ES&D. The files containing annual and peak growth factors were provided by Steve Lachance (MassDEP) of the ERTAC EGU Growth subcommittee and are named:
SL_NOV_20_19_COMBINED_CASE_CONUSv16.x_2023_ertac_growth_rates.xlsx
SL_NOV_20_19_COMBINED_CASE_CONUSv16.x_2028_ertac_growth_rates.xlsx
SL_NOV_20_19_COMBINED_CASE_CONUXv16.x_2020_ertac_growth_rates.xlxs

These growth factors and default growth curve parameters are used in v16.1 outputs except in regions located within New York and SRSE. New York DEC replaced certain NYCW, NYLI, and NYUP AEO annual growth rates with values based on regional information. The updated local values were developed for years 2017 through 2030.

Nonpeak growth rates are calculated within the ERTAC EGU tool using annual and peak growth rates. Annual average regional growth rates are adjusted to account for the peak hours. Peak and nonpeak growth is assigned to every hour by ordering all hours in the year by base year utilization. The peak growth factor is assigned by fuel to a limited number of hours with the highest utilization in the base year. Growth is then transitioned gradually to non-peak growth rate. The number of peak and transition hours are differentiated by fuel and region and are assigned in the growth rates file. Figure 2 shows graphically the relationship between annual, peak, and nonpeak growth rates.

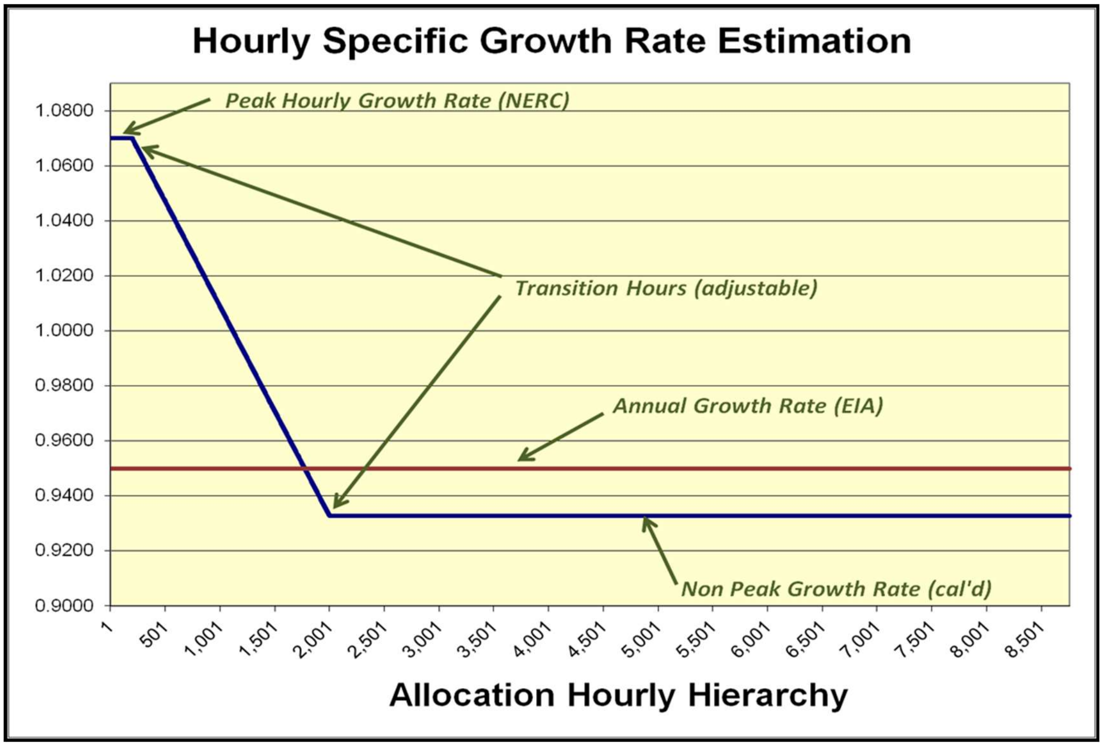

Figure 2: Relationship between the annual, peak, and nonpeak growth rates

Finally, fuel--specific hourly regional growth factors are adjusted to account for activity from new units and shutdowns. The tool then applies the adjusted hourly growth factors to the base year hourly generation data to estimate hourly future generation. This generation is assigned to the units burning the specified fuel within the region. After generation is assigned, the tool confirms that unit capacity is not exceeded. If the available capacity is fully utilized, new GDUs are created to carry demand that exceeds known unit capacity.

DEMAND TRANSFER FILE

Demand transfer is the movement of generation from one fuel bin or region to another system. This file may be used to alleviate the generation of a GDU or to more accurately represent a significant system change not anticipated by the EIA in the AEO. For example, this approach was taken in a previous version to address the retirement of Indian Point, a large nuclear power plant near New York City that was not anticipated in the AEO projections.

For v16.1 demand transfer was used to prevent coal-fired GDUs from being created, with the transfer amounts increasing from 2020 to 2023 to 2028. In most cases the coal demand is transferred to combined cycle or simple cycle, and in a few cases boiler gas. The amount of generation transferred and the number of hours requiring such transfers varied by region and projection year. Table 2 summarizes the MW-hrs transfer information for the v16.1 runs.

Table 2: Demand Transfer (MW-hrs) Summary for v16.1

Year	Transfer Fuel/Unit Type	AZNM	FRCC	MROE	MROW	NYUP	RFWC	SPPR	SRDA	SRGW
2020	Fr: BG		1,455,300							
2020	Fr: Coal			1,079,200		31,200			53,700	
2020	To: BG			134,900		31,200				
2020	To: CC			242,820						
2020	To: SC		1,455,300	701,480					53,700	
2023	Fr: BG		2,977,432							
2023	Fr: Coal	61,500	7,418,300	1,304,520				18,600	280,150	17,550
2023	Fr: CC						5,328,000		5,194,000	
2023	To: BG			155,300					5,474,150	
2023	To: CC		7,418,300	372,720				18,600		17,550
2023	To: SC	61,500	2,977,432	776,500			5,328,000			
2028	Fr: BG		3,257,192							
2028	Fr: Coal	7,847,600	19,936,400	1,424,050	165,000			1,389,200		1,350
2028	Fr: CC						19,805,800		24,960,000	
2028	To: BG								24,960,000	
2028	To: CC	1,706,000	19,936,400	674,550						
2028	To: SC	6,141,600	3,257,192	749,500	165,000		19,805,800	1,389,200		1,350

BG = boiler gas; CC = combined cycle; SC = simple cycle

ERTAC EGU Code Version

Version 16.1 used the ERTAC EGU v2.1.3 code, dated January 28, 2020. Code version 2.1.1 was used for v16.0. Code version 2.1.3 fixed minor bugs in the 2.1.1 version.

For v16.1, units burning predominantly nontraditional fuel types such as biomass and tire derived fuel but reporting to CAMD are not included in these output runs. The January 28, 2020, version of the code does not allow these fuel types. Future code (starting with v16.2) will allow users to create projections for these fuel types.

Additionally, some units located at industrial sources such as mines or paper mills report all or some of the year to CAMD. Units identified by states as unsuitable for application of AEO electrical generation projection factors are identified as "non-EGUs" in the UAF. These units are stripped out of ERTAC tool files such that outputs do not contain information on nonEGUs.

Tool Calculation Approach

For development of base year 2016 modeling input files, the tool was run using the hourly calculation methodology for NOx emission rates (lbs/mmbtu), for SO_2 emission rates (lbs/mmbtu), and for heat rate (btu/kw-hr). The hourly calculation method uses hourly heat input and gross load to determine a heat rate for each hour for each unit. This methodology leaves intact emission rates and heat rate that may be affected by unit upset, malfunction, start up, shutdown, and variations in control applications or feedstock. Outputs from the tool correspond closely to the hourly CAMD data.

For projection years, the tool is run in default mode, which calculates average unit level NO_X emission rates for the ozone season and non-ozone season. In default mode the tool calculates annual average SO_2 emission rates and average annual heat rates for each unit. Use of such averages may ameliorate data that could be impacted by unit upset, malfunction, start up, shutdown, and variations in control applications or feedstock.

For projection year runs, calculated base year emission rates for existing units are adjusted to account for new control equipment or other changes provided in the input files. For new units, two approaches are employed. If a state provides new unit emission rates those are used. Where emission rates are not provided, emission rates based on the 90th percentile best performing existing unit for that fuel type and region are assigned to the new unit. The user may adjust this percentile within the input variables file.

Base year load is grown using hour specific growth rates as described in the Growth Rate Input File section above. This projected hourly load is converted to heat input (MMBtu) using the unit's heat rate. The emission rates are applied to each unit's future year heat input activity to calculate NO_X and SO_2 emissions.

OUTPUT

The ERTAC tool estimates hourly generation and emissions for each unit included in the system. In addition, emissions post processors create summary files to facilitate review of the results, as follows:

- Annual base and future year generation (MW-hrs), heat input (mmbtu), SO_2, NO_X emission (tons) and average emission rate (lbs/mmbtu)
- Ozone season base and future year generation and heat input, NO_X emission (tons) and average emission rate (lbs/mmbtu)

An emissions post processor is also available to generate CO_2 estimates.

Users may also use the ERTAC_for_SMOKE post processor to create SMOKE-ready files for use in air quality modeling. The ERTAC_for_SMOKE post processor requires three additional input files:

- *ertac_pusp_info_file.csv*: This file includes unit specific information such as EPA EIS (Emissions Inventory System) identification information and stack characteristics.[3]
- *ertac_additional_variables.csv*: This file includes stack characteristics that may be used for units without unit-specific information in the ertac_pusp_info_file.csv. Information is categorized by state and fuel/unit type.
- *ertac_base_year_rates_and_additional_controls.csv:* This file includes emission factors for VOC, CO, $PM_{2.5}$, PM_{10}, and NH3 for each unit. Data is categorized by ORIS code and Unit ID as well as start and end dates.

[3] pusp = plant, unit, stack, process

An optional file called *ertac_rpo_listing.csv* may also be included. The optional file will parse the results into separate files based on the states listed in each RPO within the file.

Base Year Outputs

Base year 2016 outputs result from UAF input files that are based on the May 2019 UAF documentation file which included the following update:

- The FIPS code for units HOBB1 and HOBB2 at ORIS 56458 was changed from 36025 to 35025 to correctly reflect New Mexico as the facility location.

Base year 2016 output files in SMOKE-ready format resulting from two separate tool runs are provided. One set uses the hourly methodology for emission rate and heat rate calculations while the other set uses the default approach to calculate these values. The base year 2016 output files run using the default averaging approach for SO_2 emission rate, NO_X emission rate, and heat rate have the following nomenclature:

C2.1.1CONUSv16.0_BYFY_NCD

Base year 2016 output files in SMOKE-ready format are also provided from tool outputs using the hourly calculation approach for SO_2 emission rate, NO_X emission rate, and heat rate. Outputs from this approach reflect start up, shutdown, and malfunction/upset conditions as well as variability in control application and feedstocks. These data closely reflect CAMD hourly data and are best used for model performance. These outputs have the following nomenclature:

C2.1.1CONUSv16.0_BYFYHRLY_NCD

In this nomenclature, "NCD" stands for "new CAMD data", indicating that the most recent (June 2019) hourly data were used as input to the run.

Projection Year Outputs

Outputs for the v16.1 work are available for years 2020, 2023, and 2028. These projection runs were created with the default calculation methodology using annual average data for SO_2 emission rates and heat rates and using ozone season/non ozone season average data for NO_X emission rates. These outputs have the following nomenclature:

C2.1.3CONUSv16.1_2020
C2.1.3CONUSv16.1_2023
C2.1.3CONUSv16.1_2028

Although "NCD" is not included as a suffix in the projection year output nomenclature, the projection year runs use the same hourly data set as the base year "NCD" runs.

4. Integration of ERTAC EGU-File Substitutions

The ERTAC EGU process for the point source inventory involving power generation units requires certain revisions to the modeling platform provided by EPA. In the EPA modeling platform, power generation units are grouped into two major categories for SMOKE modeling: EGUs with and without CEM data (ptegu sector) and all other industrial point sources (ptnonipm sector). Because of differences in the universe and categorization of various point sources, what is considered an EGU by EPA may not be categorized as such by ERTAC, and vice versa. For example, some units are considered non-EGUs in the ERTAC EGU tool even though they report hourly data to CAMD. These units are removed from consideration in a screening step in the ERTAC EGU tool since states consider AEO electrical growth forecasts for fossil fuels to be an unsuitable methodology for projecting emissions from these units. Examples noted in the section entitled ERTAC EGU Code Version include paper mills, mines, and EGUs burning nontraditional fuels such as biomass or tire derived fuel. Therefore, the EPA modeling platform has been revised and point sources regrouped into three sets of input files for modeling: (1) ERTAC EGU with CEM data, (2) EGUs without CEM data and (3) non-EGUs. The three sets of inputs constitute the EGU and nonEGU ERTAC inventory files.

Emissions from the non-EGUs in the ERTAC modeling platform are temporalized in SMOKE by applying default temporal profiles, even though some of those non-EGUs have available hourly CEM measurements. Application of unit-specific CEM-based temporal profiles can have significant impact on air quality modeling results, especially in peak emission hours. In order to use CEM data to the fullest extent and to more closely align the ERTAC platform to the EPA platform, these CEM data were used for a total of 114 non-EGUs in the 2016 platform. Use of CEM data for these sources allows for more accurate temporal allocation of emissions in air quality modeling.

The EPA and ERTAC stakeholders are working to resolve issues with point categorization and crosswalk. Once the issues are resolved and the ERTAC tool has included a new fuel/unit category (for non-EGUs with separate growth rates), the additional adjustment involving non-EGUs may not be necessary in the future.

In order to use the ERTAC inventory without excluding or double counting point source emissions, both the EPA ptegu and ptnonipm sectors must be replaced with the ERTAC ptertac and ptnonertac sectors. Separate runscripts and sectorlist files will be provided for SMOKE processing of the ERTAC sectors. Table 3 and Table 4 show the EGU and nonegu file substitutions for ERTAC inventory use.

Table 3: 2016v1 EGU point source file substitution

EPA ptegu sector – 2016 Base Year	ERTAC ptertac sector – 2016 Base Year
2016fh_proj_from_egunoncems_2016b_POINT_20180612_2016v1_calcyear2014_05aug2019_v0.csv egucems_2016b_POINT_20180612_08jul2020_nf_v7.csv	C2.1.1CONUSv16.0_BYFYHRLY_NCD_fs_ff10_future.csv C2.1.1CONUSv16.0_BYFYHRLY_NCD_fs_ff10_hourly_future.csv egunoncems_2016version1_ERTAC_Platform_POINT_27oct2019.csv

egunoncems_2016b_POINT_20180612_17sep2019_nf_v11.csv HOUR_UNIT_2015_12_31dec_2016fd.txt cemsum_2016v1_3_14_2018.txt	2016fh_proj_from_egunoncems_2016version1_ERTAC_Platform_POINT_calcyear2014_27oct2019.csv
EPA ptegu sector – 2023 Future Year	**ERTAC ptertac sector – 2023 FutureYear**
egucems_epa617_2023_20200105_summer_26mar2020_v0.csv egunoncems_epa617_2023_20200105_summer_26mar2020_v0.csv egucems_epa617_2023_20200105_winter_26mar2020_v0.csv egunoncems_epa617)2023_20200105_winter_26mar2020_v0.csv HOUR_UNIT_2015_12_31dec_2023_adj_final.txt cemsum_2023_3_14_2018_final_summer.txt.fh1 cemsum_2023_3_14_2018_final_winter.txt.fh1	C2.1.3CONUSv16.1_2023_fs_ff10_future.csv C2.1.3CONUSv16.1_2023_fs_ff10_hourly_future.csv egunoncems_epa617_2023_20190612_summer_19sep2019_ERTAC_Platform_15feb2020.csv egunoncems_epa617_2023_20190612_winter_19sep2019_ERTAC_Platform_15feb2020.csv
EPA ptegu sector – 2028 Future Year	**ERTAC ptertac sector – 2028 FutureYear**
egucems_epa617_2028_20200117_summer_14apr2020_v0.csv egunoncems_epa617_2028_20200117_summer_14apr2020_v0.csv egucems_epa617_2028_20200117_winter_14apr2020_v0.csv egunoncems_epa617_2028_20200117_winter_14apr2020_v0.csv HOUR_UNIT_2015_12_31dec_2028_adj_final.txt	C2.1.3CONUSv16.1_2028_fs_ff10_future.csv C2.1.3CONUSv16.1_2028_fs_ff10_hourly_future.csv egunoncems_epa617_2030_20190611_summer_13jun2019_ERTAC_Platform_31may2020.csv egunoncems_epa617_2030_20190611_winter_13jun2019_ERTAC_Platform_31may2020.csv

Table 4: 2016v1 nonEGU point source file substitution

EPA ptnonipm sector – 2016 Base Year	ERTAC ptnonertac sector – 2016 Base Year
nonegu_2016version1_POINT_20180612_17sep2019_nf_v2.csv 2016fh_proj_from_nonegu_2016version1_POINT_20180612_calcyear2014_09aug2019_nf_v1.csv pt_biorefinery_OTAQ_supplemental_2016version1_12aug2019_nf_v1.csv 2016fh_from_nonegu_2016version1_POINT_20180612_biorefinery_calcyear2014_22jul2019_v0.csv point_railyards_2016version1_19jul2019_nf_v2.csv	nonegu_2016version1_ERTAC_Platform_POINT_27oct2019.csv 2016fh_proj_from_nonegu_2016version1_ERTAC_Platform_POINT_calcyear2014_27oct2019.csv pt_biorefinery_OTAQ_supplemental_2016version1_12aug2019_nf_v1.csv 2016fh_from_nonegu_2016version1_POINT_20180612_biorefinery_calcyear2014_22jul2019_v0.csv point_railyards_2016version1_19jul2019_nf_v2.csv nonEGUs_hourlyCEM_2016.csv
EPA ptnonipm sector – 2023 Future Year	**ERTAC ptnonertac sector – 2023 Future Year**
2023fh_proj_nonegu_2016version1_POINT_20180612_27sep2019_v0.csv 2023fh_proj_from_nonegu_2016version1_POINT_20180612_calcyear2014_27sep2019_v0.csv point_railyards_2016version1_2023fh_24sep2019_nf_v1.csv	2023fh_proj_from_nonegu_2016version1_POINT_20180612_biorefinery_calcyear2014_27sep2019_v0.csv 2023fh_proj_from_nonegu_2016version1_POINT_20180612_calcyear2014_27sep2019_ERTAC_Platform_07aug2020.csv 2023fh_proj_nonegu_2016version1_POINT_20180612_27sep2019_ERTAC_PLATFORM_07aug2020.csv

2023fh_proj_pt_biorefinery_OTAQ_supplemental_2016version1_27sep2019_v0.csv 2023fh_proj_from_nonegu_2016version1_POINT_20180612_biorefinery_calcyear2014_27sep2019_v0.csv	2023fh_proj_pt_biorefinery_OTAQ_supplemental_2016version1_27sep2019_v0.csv point_railyards_2016version1_2023fh_24sep2019_nf_v1.csv
EPA ptnonipm sector – 2028 Future Year	**ERTAC ptnonertac sector – 2028 Future Year**
2028fh_proj_from_nonegu_2016version1_POINT_20180612_calcyear2014_26sep2019_v0.csv 2028fh_proj_from_nonegu_2016version1_POINT_20180612_biorefinery_calcyear2014_26sep2019_v0.csv point_railyards_2016version1_2028fh_24sep2019_nf_v1.csv 2028fh_proj_pt_biorefinery_OTAQ_supplemental_2016version1_26sep2019_v0.csv 2028fh_proj_nonegu_2016version1_POINT_20180612_26sep2019_v0.csv	2028fh_proj_from_nonegu_2016version1_POINT_20180612_biorefinery_calcyear2014_26sep2019_v0.csv 2028fh_proj_from_nonegu_2016version1_POINT_20180612_calcyear2014_26sep2019_ERTAC_Platform_07aug2020.csv 2028fh_proj_nonegu_2016version1_POINT_20180612_26sep2019_ERTAC_Platform_07aug2020.csv 2028fh_proj_pt_biorefinery_OTAQ_supplemental_2016version1_26sep2019_v0.csv point_railyards_2016version1_2028fh_24sep2019_nf_v1.csv

5. Emissions Summaries

Figure 3 provides the national generation by fuel/unit type for year 2016 and for ERTAC projection years 2020, 2023, and 2028. Trends show the general reduction in coal fired energy production and the expected increase in production by natural gas-fired combined cycle units.

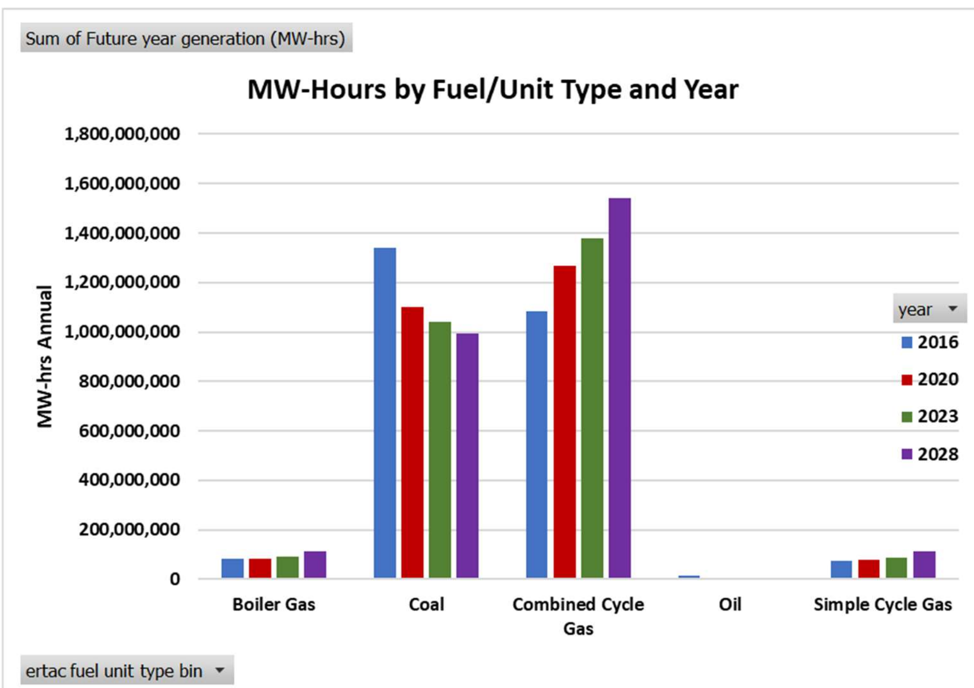

Figure 3: National Generation By Fuel/Unit Type (MW-Hrs) for Base Year and Future Projections

Figure 4 provides NO_X emissions, and Figure 5 provides SO_2 emissions, as derived from the ERTAC tool using the v16.1 inputs.

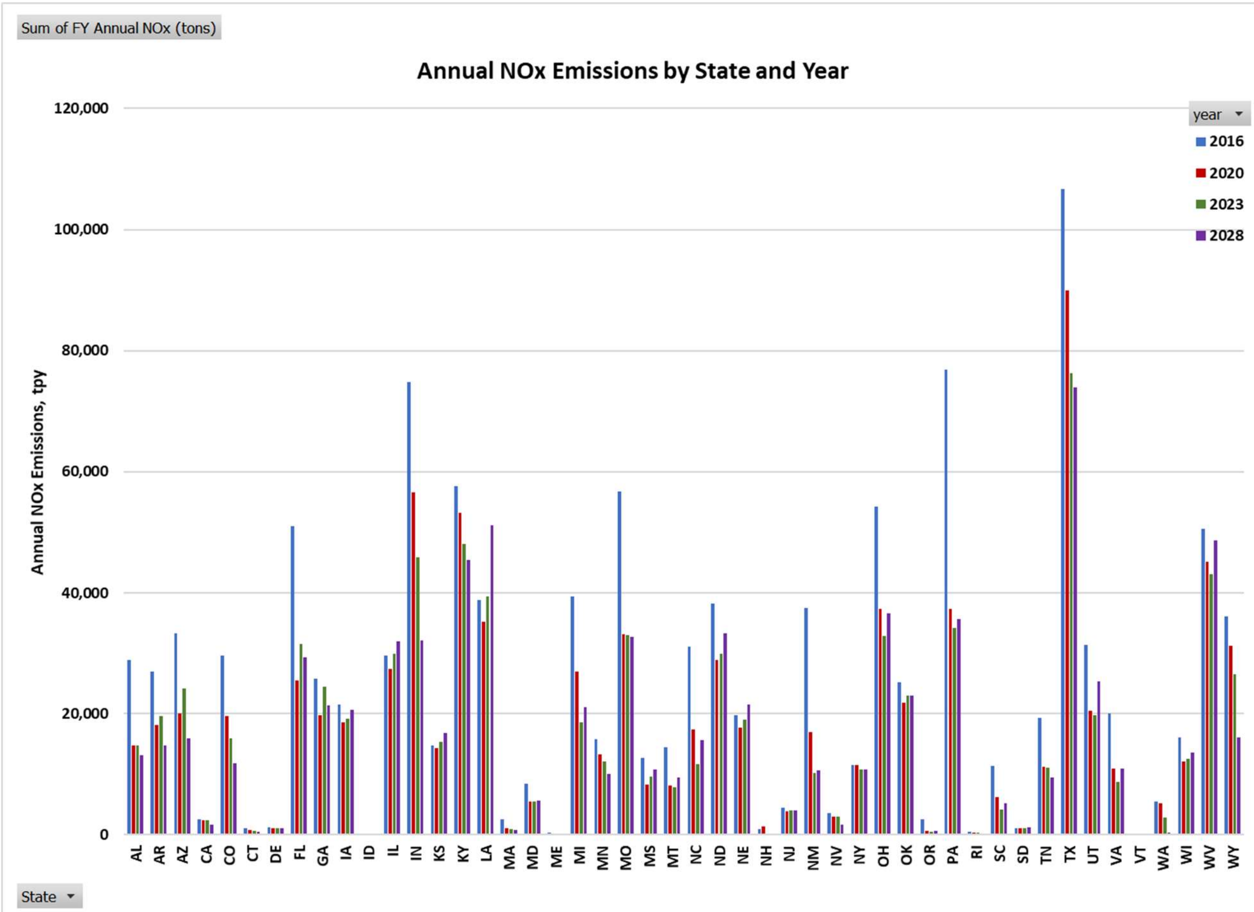

Figure 4: NOX Emissions by State for Base Year 2016 and future projections (TPY)

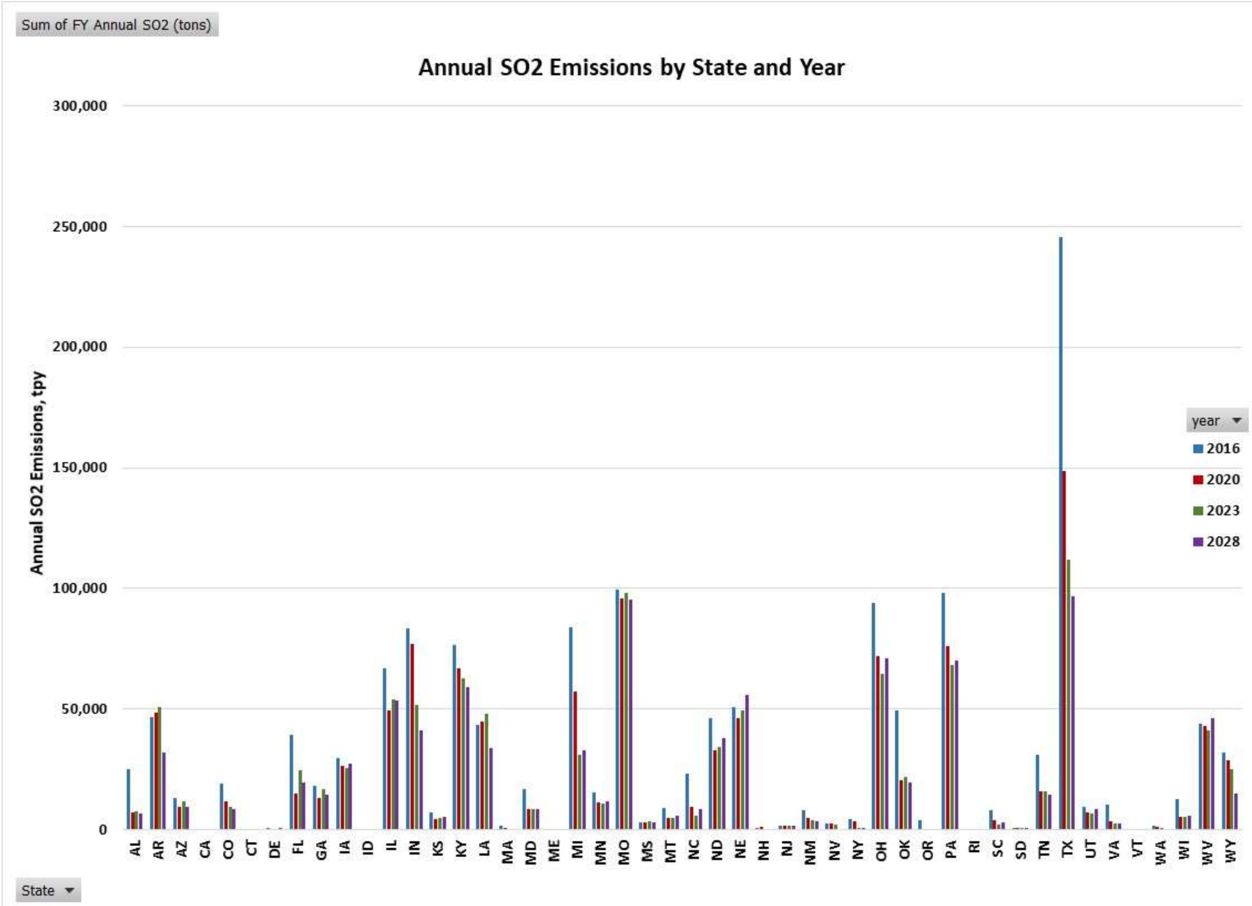

Figure 5: SO2 Emissions by State for Base Year 2016 and future projections (TPY)