CAMD's Power Sector Emissions Data Guide

This document is an informational guide on how to use and understand the Power Sector Emissions Data collected by EPA's Clean Air Markets Division (CAMD) under the regulations in 40 CFR Part 75. It is not to be used as instructions for reporting or quality assuring data.

The regulations in 40 CFR Part 75 establish requirements for affected electricity generating units (EGUs) to continuously measure emissions and report those measurements, along with facility, operation, and quality assurance (QA) test data, to EPA. EPA and state agencies use these data to assess compliance with emission trading programs and other air quality programs. EPA makes these data, collectively referred to as CAMD's Power Sector Emissions Data, available the public.

What data are collected?

The Clean Air Markets Division began collecting its Power Sector Emissions Data in 1995 at the beginning of the Acid Rain Program. Affected EGUs report the following data to EPA:

- Hourly emissions of sulfur dioxide (SO_2), nitrogen oxides (NO_X), carbon dioxide (CO_2), and mercury (Hg) in short tons[1]
- Facility information, such as unit type (e.g., tangential-fired boiler, combustion turbine, combined cycle), source category (e.g., electric utility, industrial boiler), owner, and location (including latitude and longitude)
- Primary and secondary fuel type and the begin and end dates of use[2]
- Emissions control device(s) used and the begin and end dates of those devices[3]
- Hourly heat input expressed in million British thermal units, or mmBtu
- Hourly gross electricity generation expressed in megawatt-hours, or MWh, or total steam generation of the unit expressed in thousand pounds of steam per hour
- Type of emissions monitoring method and the begin and end dates of use
- QA test information to validate hourly emissions data, such as testing date, test type, and test results (e.g., difference in readings between the emission monitor and the reference test)

Table 1 shows the type of emissions and operations parameters in CAMD's Power Sector Emissions Data based on the different programs. Other facility information listed above (e.g., fuel type, controls) must be reported by all units.

[1] The largest coal-fired EGUs began reporting their SO_2, NO_X, and CO_2 emissions to EPA in 1995, with the remaining fossil fuel-fired EGUs reporting these emissions beginning in 2000. EGUs began reporting mercury emissions to EPA in 2015, with some EGUs receiving extensions to 2017.

[2] Information about fuel burned in each hour is not reported to EPA. For example, if an EGU can burn both coal and natural gas, it does not specify which fuel is used each hour.

[3] Control equipment hourly operating parameters or efficiency is not reported to EPA.

Table 1: Parameters Reported for Each Emission Control Program

Program Code	Program Name	Year(s)	Hourly Parameters
ARP	Acid Rain Program	1995+	Heat input (HI); electricity generation (GLOAD); and CO_2, NO_X, and SO_2 emissions
CSNOX	Cross-State Air Pollution NO_X Annual Program	2015+	Heat input and NO_X emissions
CSOSG1	Cross-State Air Pollution NO_X Ozone Season Group 1 Program	2015+	Heat input and NO_X emissions
CSOSG2	Cross-State Air Pollution NO_X Ozone Season Group 2 Program	2015+	Heat input and NO_X emissions
CSOSG3	Cross-State Air Pollution NO_X Ozone Season Group 3 Program	2015+	Heat input and NO_X emissions
CSSO2G1	Cross-State Air Pollution SO_2 Annual Group 1 Program	2015+	Heat input and SO_2 emissions
CSSO2G2	Cross-State Air Pollution SO_2 Annual Group 2 Program	2015+	Heat input and SO_2 emissions
MATS	Mercury and Air Toxics Standard	2015+	Hg emissions (HCL and HF reporting varies based on monitoring method)
NHNOX	New Hampshire NO_X Program	2003+	Heat input and NO_X emissions
NSPS4T	NSPS Greenhouse Gas Rule (subpart TTTT)	2016+	CO_2 emissions
RGGI	Regional Greenhouse Gas Initiative	2009+	Heat input and CO_2 emissions
SIPNOX/ NBP	SIP Call NO_X Budget Trading Program	2009+/ 2003 – 2008	Heat input and NO_X emissions
TXSO2	Texas SO_2 Trading Program	2018+	Heat input and SO_2 emissions

Note: Many EGUs affected by the Cross-State Air Pollution Rule and other programs also reported data under earlier programs, including the Acid Rain Program and the discontinued Clean Air Interstate Rule.

Who must report?

Most of the programs in Table 1 apply to large EGUs (i.e., nameplate capacity greater than 25 MW) that burn fossil fuel(s) to generate electricity for sale. Some exceptions include:

- Some non-EGUs (e.g., industrial boilers) were required to report hourly emissions and operating data under the NO_X Budget Trading Program (SIPNOX), a NO_X emissions trading program that ran from 2003-2008. However, for certain non-EGUs, the requirement to monitor and report data is still in effect under state requirements, and these non-EGUs data are included in the Power Sector Emissions Data.
- Simple cycle combustion turbines that commenced operation before November 15, 1990 and certain EGUs at qualifying small power production facilities and independent power producers may be exempt from the Acid Rain Program.
- Cogenerating EGUs may be exempt from the Acid Rain Program and Cross-State Air Pollution Rule if they meet certain requirements concerning the purpose of construction, amount of electricity sold, and efficiency thresholds.

CAMD's Power Sector Emissions Data cover approximately 96% of the fossil fuel generation in the U.S. based on 2018 data.

How are emissions and operations monitored?

Generally, emission monitors are installed at the smokestack. Every unit will have at least one stack, and there are a variety of EGU and stack configurations (see Figure 1). Depending on the size and type of unit, amount of operation, and type of fuel combusted, different monitoring options are allowed. Table 2 describes the different monitoring options.

Figure 1: Unit-to-stack configurations

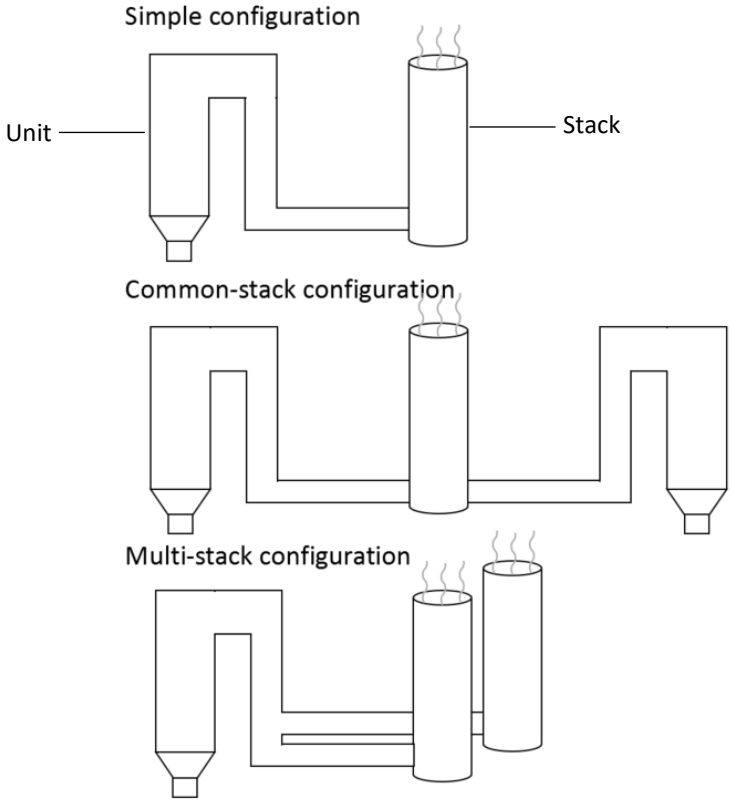


Table 2: EGU Monitoring Options by Fuel Type

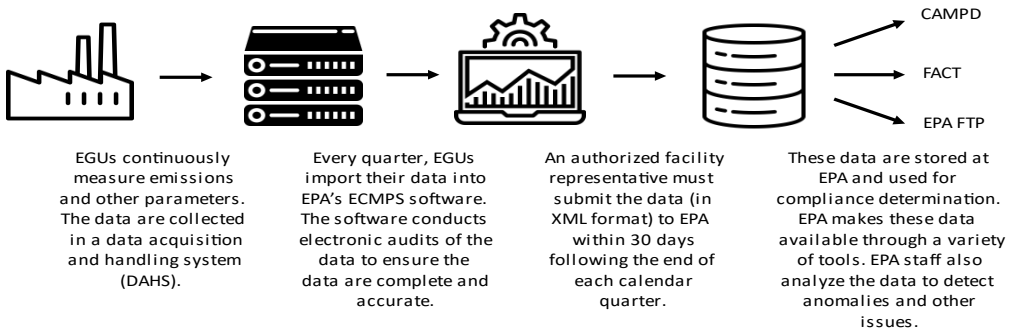
Solid fuel (e.g., coal):	Liquid fuel (e.g., oil or natural gas):
• Continuous emissions monitoring system (CEMS) required • Mass emissions determined based on measured values for pollutant concentration and stack gas flow	• CEMS required for NO_X pollutant concentration unless EGU is eligible for non-CEMS methodology for NO_X (Appendix E) • Non-CEMS methodologies allowed ○ Appendix D: continuous monitoring of the fuel flow rate and periodic sampling of the fuel characteristics to determine heat input and SO_2 and/or CO_2 mass emissions ○ Appendix E: for peaking units only, continuous monitoring of the fuel flow rate and development of a site-specific NO_X emission rate to determine NO_X mass emissions ○ Low-mass emissions (LME): for units with ≤ 25 tons SO_2/year and < 100 tons NO_X/year, fuel-specific default emission rates and hourly heat input (either estimated from fuel usage records or reported as the maximum rated heat input for the unit) to determine SO_2, NO_X, and CO_2 mass emissions

Because the data are used to assess compliance with mass emission limits, it is critical that the data are complete. Part 75 includes provisions to address time periods when monitors are not working properly or providing valid data. During any times when monitors are invalid, EGUs must apply substitute data to fill in the gaps.

How are the data reported?

The flow of data from the EGU to EPA is displayed in Figure 2. EGUs use the Emissions Collection and Monitoring Plan System (ECMPS), a desktop tool, to submit monitoring plans and QA test, emissions, and operating data to EPA. EGUs are required to submit hourly emissions and operating data within 30 days of the end of each calendar quarter (i.e., fourth quarter (October 1 – December 31) data are due by January 30).

Figure 2. Data Flow Diagram



What quality assurance/quality control measures are taken to ensure monitoring equipment is functioning properly?

Requirements for QA tests of emission monitors vary based on monitoring methodology and the frequency of operation. For example, EGUs using CEMS must conduct daily calibration tests, quarterly linearity checks, and annual reference test audits. To conduct these tests, sources use certified calibration gases.

EPA and state environment agencies also conduct periodic field audits at EGUs to verify that emission monitors and data handling systems are performing properly. These checks include visually inspecting the equipment, observing QA tests, reviewing records, and interviewing facility staff.

What quality assurance/quality control measures are taken to ensure the data are accurate and complete?

EPA conducts a variety of checks of emissions and QA test data at various points in the data submission process to ensure that data are complete and accurate. ECMPS conducts thousands of electronic checks before a source submits data to EPA. This includes checks for completion, proper formatting, mathematical accuracy, and consistency with program requirements and the source's monitoring plan. After the data are submitted to EPA, CAMD staff conduct additional checks, including statistical checks to detect anomalous data.

How can I download CAMD's Power Sector Emissions Data?

EPA has created a variety of tools to view and download the data. The following descriptions and tables are designed to help users determine which source best meets their need.

Clean Air Markets Program Data (CAMPD) is a web-based application that allows users to create custom queries and download data for further analysis.

Data available	*First year of data available*	*Can I view data on multiple units?*	*Lowest Level of Data Aggregation*	*Can I download hourly data?*	*Does this tool have information on substitute data?*
• Emissions • Operations • Facility Information	1995	Yes, this tool is recommended for analyses of multiple units.	Monitoring location or unit (Note: Unit-level data are apportioned if its monitoring configuration is common- or multi-stack.)	Yes, though due to size constraints, CAMPD allows the user to pull only 5 million records (~1.5 months of hourly data for the entire country) per query.	No

The Field Audit Checklist Tool (FACT) is a Windows desktop application that allows users to easily view all Power Sector Emissions Data for a single monitoring configuration (e.g., stack).

Data available	*First year of data available*	*Can I view data on multiple units?*	*Lowest Level of Data Aggregation*	*Can I download hourly data?*	*Does this tool have information on substitute data?*
• Emissions • Operations • Facility Information • Monitoring plans • QA test results	2009	No, this tool is recommended for analyses of individual units.	Monitoring location (Note: Unit-level data are unavailable if monitoring configuration is common- or multi-stack.)	Yes	Yes, this tool contains method of determination codes (MODCs) that indicate if a value is valid measured data or substitute data.

***Note**: Please refer to the "Hourly Data" section under "What are some special characteristics of the data that I should understand?" for some important information on using data from FACT.*

The FACT API is a REST API that was created to support the FACT desktop application. All the data that can be accessed with the FACT desktop application is available from the API. The API is intended for users who want to access the data directly from a data tool or programming language.

Data available	*First year of data available*	*Can I view data on multiple units?*	*Lowest Level of Data Aggregation*	*Can I download hourly data?*	*Does this tool have information on substitute data?*
• Emissions • Operations • Facility Information • Monitoring plans • QA test results	2009	Yes, using the API will allow the user to pull all the information available in FACT for multiple units.	Monitoring location (Note: Unit-level data are unavailable if monitoring configuration is common- or multi-stack.)	Yes	Yes, this tool contains method of determination codes (MODCs) that indicate if a value is valid measured data or substitute data.

***Note**: Please refer to the "Hourly Data" section under "What are some special characteristics of the data that I should understand?" for some important information on using data from FACT.*

For easier download of large amounts of data, prepackaged data sets are available on EPA's FTP site. The FTP site has prepackaged emission data files. For users who need large amounts of emission data, the FTP site has files containing hourly data for all facilities by state and year. The FTP site also contains the raw XML files submitted by the regulated sources.

Data available	*First year of data available*	*Can I view data on multiple units?*	*Lowest Level of Data Aggregation*	*Can I download hourly data?*	*Does this tool have information on substitute data?*
• Emissions • Operations	1995	Yes	Unit	Yes	Yes, these datasets contain a field indicating whether the value is measured or substitute.

EPA created the Monitoring Plan Viewer website to easily and quickly view monitoring plan data and other facility information.

Data available	*First year of data available*	*Can I view data on multiple units?*	*Lowest Level of Data Aggregation*	*Can I download hourly data?*	*Does this tool have information on substitute data?*
• Facility information • Monitoring plans	n/a	No	Monitoring location (Note: Unit-level data are unavailable if monitoring configuration is common- or multi-stack.)	n/a	This tool does not include emissions data.

What are some special characteristics of the data that I should understand?

Power plants are complex and, in many cases, unique. Therefore, the emission monitoring regulations are complex and include some flexibilities for different types of EGUs. These complexities can sometimes be seen in CAMD's Power Sector Emissions Data and may depend on the tool used to download the data. The following are key characteristics of the data that are important to understand.

Annual, Monthly, and Hourly Data

- Data is reported at the monitoring location, which is not always at the unit level (e.g., combined stacks, multiple stacks). CAMPD uses apportionment or aggregation to assign values measured at a given monitoring location back to the corresponding EGU(s).
- Certain EGUs are combined cycle combustion turbines, which generate electricity from a traditional gas turbine as well as a steam turbine that is powered by the heat of the gas turbine. These units are not required to report electrical generation from the steam turbine (although many combined cycle EGUs do include the generation from the steam turbine in their electrical generation data).
- EGUs that generate steam have the option to report steam load in thousand pounds of steam per hour (1000lb/hr) instead of electrical generation in MWh.

- A blank in the data (emissions, heat input, load) is not the same thing as a zero. A blank likely indicates that the EGU is not required to report a particular parameter based on the program(s) it is affected by. Checking the program code(s) for the EGU may help explain why certain parameters appear or do not appear in the data. Refer to Table 1 under "What data are collected?" for more information on program reporting requirements.

Hourly Data

- If a monitoring system is unavailable or not providing valid data, an EGU must report substitute data to account for emissions until valid data are available. Substitute data is calculated based on the methodologies described in Table 4A of 40 CFR 75.57 and become increasingly conservative (i.e., likely overestimate emissions) based on the length and frequency of the missing data period and are intended to ensure that underreporting does not occur. CAMPD does not provide the user with information about substitute data, but the FTP site includes a flag indicating whether an hourly value is measured or substitute. FACT provides a value for each hour – method of determination codes (MODC) – indicating whether the hourly emissions value is measured or substitute data and, if substitute data, the specific calculation methodology that was used.
- Sources must report data for all hours of operation, including start up and shutdown. This includes partial hours (i.e., an operating time less than the full clock hour). Because mass emissions, electricity generation, and heat input are hourly rates (e.g., pounds per hour), the hourly values should be multiplied by the operating time to calculate the actual emissions, electricity generation, and heat input. This calculation is performed prior to the data being posted in CAMPD; however, this calculation is not performed for the data displayed in FACT and the FACT API, so the user should make that calculation when using data from FACT.
- In FACT and the FACT API, some measured values are reported as both an adjusted and unadjusted value. The unadjusted values are the direct measurements from the CEMS. The adjusted values include a bias adjustment factor (BAF). The BAF is based on the most recent relative accuracy QA test and is designed to account for possible low bias in the CEMS to ensure an EGU does not underreport emissions. If there isn't a low bias, the adjusted and unadjusted values will be the same.
- EGUs do not report the type of fuel combusted in a given hour. However, the hourly fuel factor or F-factor can, in some cases, provide an indication of the type of fuel (or blend of fuels) used. See Part 75 Appendix F Sections 3.3.5 and 3.3.6 for more information. The F-factor is only available in FACT and the FACT API.

How do I cite the Power Sector Emissions Data?

CAMD suggests the following citation for its Power Sector Emissions Data:

United States Environmental Protection Agency (EPA). "Power Sector Emissions Data." Washington, DC: Office of Atmospheric Programs, Clean Air Markets Division. Available from EPA's Clean Air Markets Programs Data web site: https://campd.epa.gov.

What other data resources are available?

Facility-level data can usually be matched to other data sets by the ORIS code. EPA also has crosswalks between EGU-level IDs for EPA and other data sets (available by email request to huetteman.justine@epa.gov).

Other EPA resources

- EPA's Emissions & Generation Resource Integrated Database (eGRID) combines U.S. Energy Information Administration (EIA) and CAMD's Power Sector Emissions Data in order to determine annual emission rates (lbs/MWh) at various aggregated levels in the U.S. CAMD units can be identified by either the unit level "CAMD Flag" or the data source "CAMD."
- Toxics Release Inventory (TRI), National Emissions Inventory (NEI), and Greenhouse Gas Reporting Program (GHGRP) are other EPA databases which may provide facility attribute and emission data at EGU and non-EGU facilities.

U.S. Energy Information Administration (EIA) resources

- Form EIA-860 includes a wide range of data about the characteristics of electric power plants and the equipment found at those plants. The data are intended to constitute a complete inventory of EGUs located at facilities with a minimum on-site nameplate capacity of 1 MW.
- Form EIA-923 includes a wide range of data about the operations of electric power plants including generation, fuel consumption, fuel characteristics, and environmental-related operating data for steam electric plants.