

POWER PLANTS SECTOR

Highlights

- Greenhouse gas (GHG) emissions from the Power Plants Sector for 2013 were less than one percent higher than 2012 and five percent lower than 2011. The lack of a clear trend from 2012 to 2013 indicates that the displacement of coal by gas to power base load generation has dramatically slowed as natural gas prices have increased.
- Fifty one natural gas combined-cycle generating units were put into service in the United States during 2010, 2011, and 2012. These units generate approximately one-fourth of the GHG emissions per megawatt compared to conventional coal-fired units, which is contributing to the observed decline in emissions from the sector over the period covered by the GHGRP.
- According to data from the U.S. Department of Energy's (DOE) Energy Information Administration (EIA), increased utilization of hydro-electric and wind assets from 2010 to 2013 are also contributing to lower emissions from this sector across the time series.

All emissions presented here are as of 8/18/2014 and exclude biogenic CO₂. All GHG emissions data displayed in units of carbon dioxide equivalent (CO₂e) reflect the global warming potential (GWP) values from [IPCC AR4](#).

About this Sector

The Power Plants Sector consists predominantly of facilities that produce electricity by combusting fossil fuels or biomass. The sector also includes facilities that produce steam, heated air, or cooled air by combusting fuels.

Two groups of power plants are required to report. The first group includes facilities that are required to report CO₂ mass emissions on a year-round basis to the EPA under 40 CFR part 75: facilities subject to the Acid Rain Program (ARP) and facilities in the Regional Greenhouse Gas Initiative (RGGI) (see <http://rggi.org>). Facilities subject to the ARP and RGGI have combustion units that serve electricity generators that exceed 25 megawatts. These facilities are subject to Subpart D of the Greenhouse Gas Reporting Program (GHGRP).

The second group includes combustion units that are located at facilities with primary NAICS codes of 221330 (Steam and Air-Conditioning Supply¹) and 2211xx (Electric Power Generation, Transmission and Distribution). These facilities are subject to Subpart C of the GHGRP.

Who Reports?

In 2013, 1,570 facilities in the Power Plants Sector submitted GHG reports. The Power Plants Sector reflects 20% of the facilities reporting direct emissions to the GHGRP. Total reported emissions from the sector were 2,100.9 million metric tons CO₂e (MMT CO₂e). In 2012, power plants represented approximately 32% of total U.S. GHG emissions.²

Emissions in the Power Plants Sector from the combustion of coal accounted for 74.5% of the total reported emissions in 2013. Emissions from natural gas combustion contributed 22.6% of the total emissions and other fossil fuels accounted for 2.8%.

¹ Establishments primarily engaged in providing steam, heated air, or cooled air. The steam distribution may be through main lines.

² The total U.S. GHG emissions are 6,525.6 MMT CO₂e as reported in the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2012. U.S. Environmental Protection Agency. April 15, 2014. EPA 430-R-14-003. ³ Annual Electric Utility data: <http://www.eia.gov/electricity/data/eia923/>

Table 1: Power Plants Sector – Reporting Schedule by Subpart

Subpart	Source Category	Applicability	First Reporting Year
D	Electricity Generation	All electric generating units subject to the Acid Rain Program or otherwise required to report CO ₂ mass emissions to EPA year round under 40 CFR part 75.	2010
C	General Stationary Fuel Combustion	Facilities that reported a primary NAICS code of 221330 or 2211xx and emit ≥ 25,000 metric tons CO ₂ e/year from stationary fuel combustion.	2010

Table 2: Power Plants Sector – Number of Reporters (2011–2013)

Power Plants Sector	Number of Reporters		
	2011	2012	2013
Total Power Plants Sector	1,589	1,601	1,570^a
Electricity Generation (Subpart D)	1,282	1,292	1,268
Other Power and Steam Plants (Subpart C)	307	309	302

^a Beginning in 2013, facilities became eligible to discontinue reporting if emissions were less than 15,000 metric tons CO₂e per year for each of the previous three reporting years. More information on [when a facility is eligible to stop reporting](#) is available. Facilities that have stopped reporting can be identified in FLIGHT by using the drop-down menu titled “Filter by Status.”

Table 3: Power Plants Sector – GHGRP Coverage (as of Reporting Year 2012)^a

Source Category	GHGRP Coverage of Industry	Estimated Percent of Industry Facilities Covered by GHGRP	Estimated Percent of Industry Emissions Covered by GHGRP
Electricity Generation	All electric generating units subject to the Acid Rain Program or that are otherwise required to report CO ₂ mass emissions to EPA year round under 40 CFR part 75.	100%	100%
Other Power and Steam Plants	Facilities that emit ≥ 25,000 metric tons CO ₂ e/year from stationary fuel combustion and that reported a primary NAICS code of 221330 or 2211xx.	20% ^b	95% ^c

^a The reporting universe has evolved since 2012 (see Table 2) however these changes have not significantly impacted the percent of emissions covered by the GHGRP in this sector.

^b Estimate of size of industry based on U.S. EPA eGRID2012 Version 1.0 for 2009 data.

^c Estimate of size of industry emissions based on U.S. EPA eGRID2012 Version 1.0 for 2009 data.

EPA has determined that the GHGRP covered more than 99.8% of the 2012 emissions in the Power Plants Sector. This included 100% of emissions from electricity generating units larger than 25 megawatts and over 95% of emissions from other facilities included in the sector.

Reported Emissions

Table 4: Power Plants Sector – Emissions by Subsector (2011–2013)

Power Plants Sector	Emissions (MMT CO ₂ e) ^a		
	2011	2012	2013
Total Power Plants Sector	2,221.3	2,088.1	2,100.9
Electricity Generators (Subpart D)	2,145.8	2,016.1	2,034.2
Other Power and Steam Plants (Subpart C)	75.5	72.0	66.7

^a Totals may not sum due to independent rounding.

Figure 1: Power Plants Sector – Emissions by Subsector (2013)

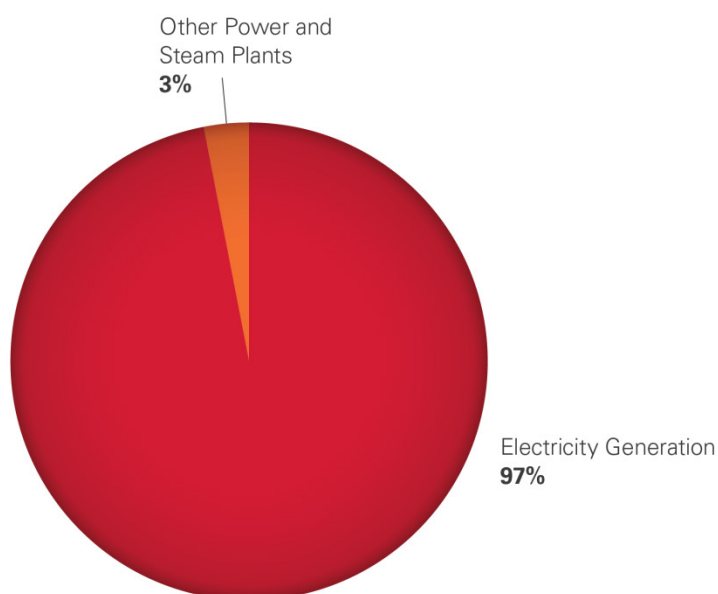
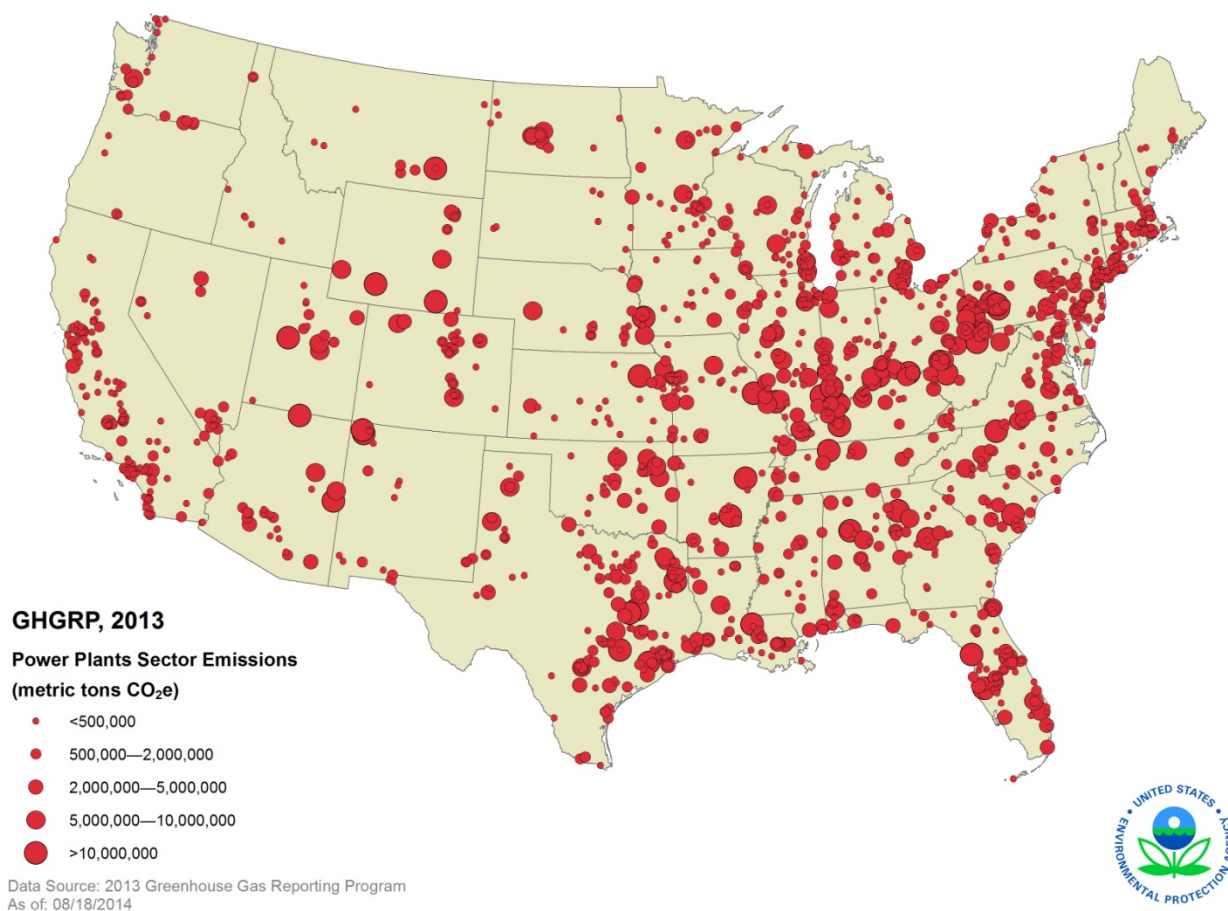
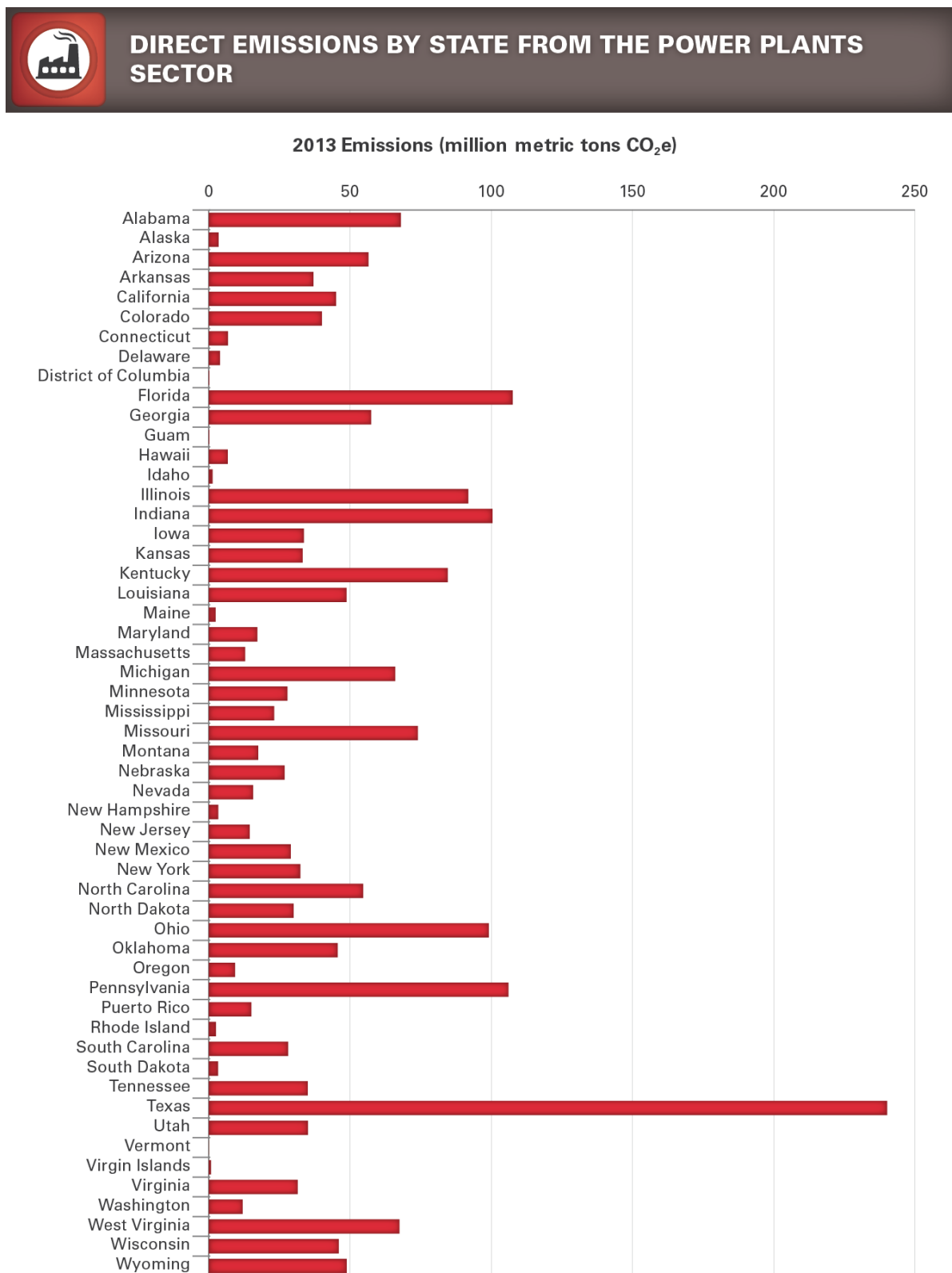


Figure 2: Location and Emissions Range for Each Reporting Facility in the Power Plants Sector (as of 8/18/14)



This map shows the locations of direct-emitting facilities. The size of a circle corresponds to the quantity of emissions reported by that facility. There are also power plant facilities located in Alaska, Hawaii, Puerto Rico, the U.S. Virgin Islands, and Guam (<http://www.epa.gov/ghgreporting/ghgdata/reported/powerplants.html>).

Readers can [identify the largest emitting facilities](#) by visiting the Facility Level Information on Greenhouse Gases (FLIGHT) website (<http://ghgdata.epa.gov>).

Figure 3: Power Plants Sector – Emissions by State (2013)^a

^a Represents total emissions reported to the GHGRP from this industry. Additional emissions occur at facilities that have not reported, such as those below the reporting threshold.

[Click here to view the most current information using FLIGHT.](#)

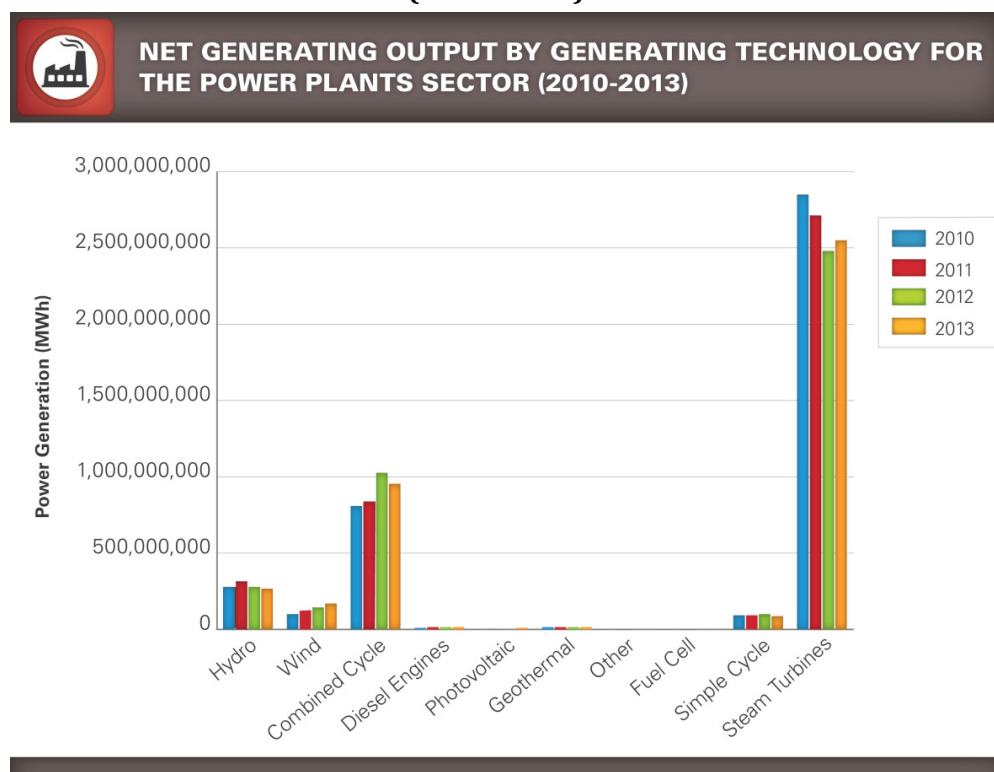
Power Plants Sector: Emissions Trends 2012 to 2013

From 2012 to 2013, emissions in the Power Plants Sector increased by less than one percent. The lack of a clear trend from 2012 to 2013 indicates that the displacement of coal by gas to power base load generation has dramatically slowed.

Power Plants Sector: Longer-Term Emissions Trends

From 2010 to 2013, annual emissions in the Power Plants Sector decreased by about ten percent. Several factors contributed to this reduction, including the increased use of renewable energy sources, historically-low natural gas prices, and increased use of combined-cycle generators. To meet state requirements for control of ozone and fine particles, utilities are retiring older coal-fired units that cannot be cost-effectively retrofitted with air pollution control equipment and replacing these conventional coal generators with natural gas combined-cycle generators. Combined-cycle power plants are approximately twice as efficient as conventional power plants; according to EIA data for 2013, 97.7% of the heat input to combined cycle plants was from combustion of natural gas.³ Combustion of natural gas releases approximately half the mass of GHGs per unit of heat released compared to coal combustion. Therefore, when a conventional coal plant is replaced with a natural gas combined-cycle plant, emissions of GHGs are reduced by about 75% per unit of electrical output. According to the DOE's EIA Form 860 data, 51 new natural gas combined-cycle power blocks came on line during 2010, 2011, and 2012.⁴

Figure 4: Power Plants Sector – Change in Net Generating Output by Generating Technology (2010–2013)^{a,b}



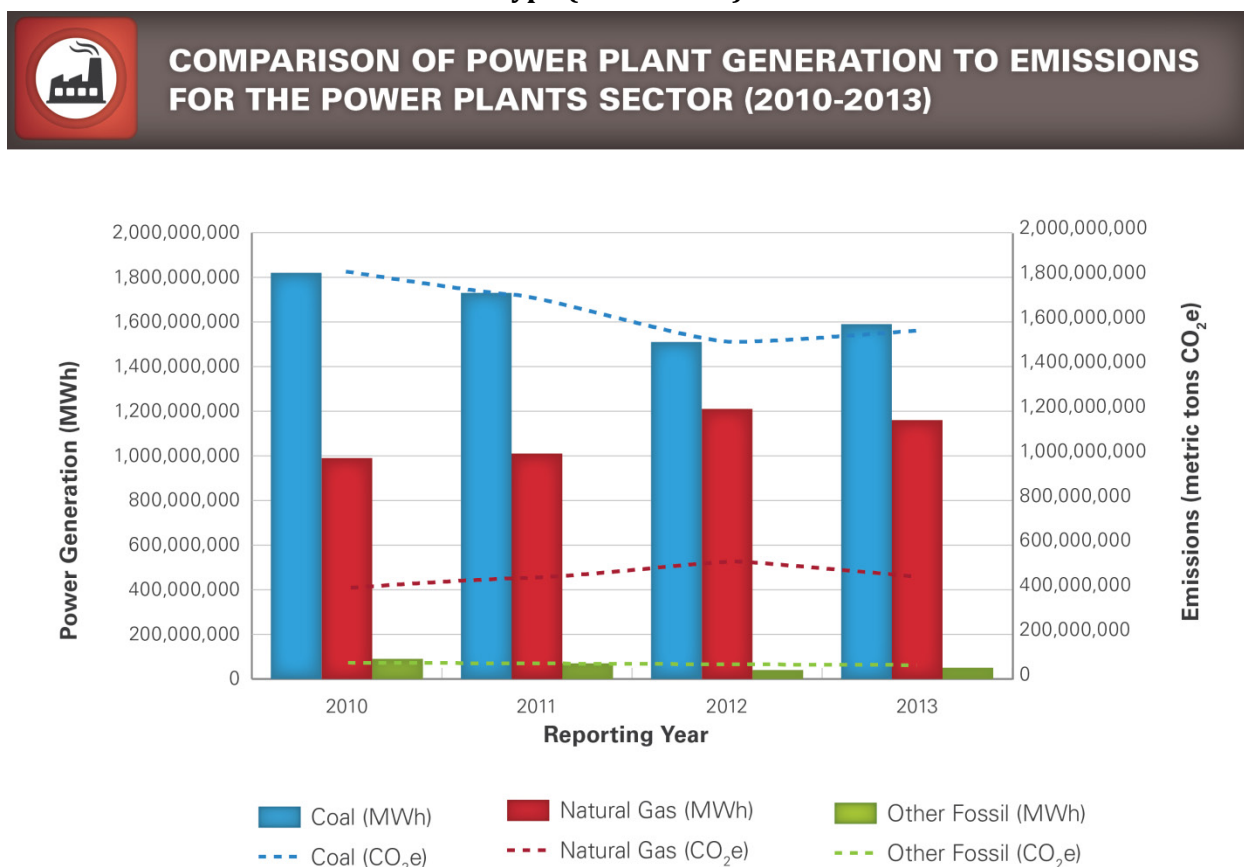
^a Net generating output data obtained from DOE EIA-923 Monthly Time Series File.

^b “Steam Turbines” include generators powered by combustion of coal, nuclear, oil, natural gas or biomass, but do not include combined-cycle steam turbines.

³ Annual Electric Utility data: <http://www.eia.gov/electricity/data/eia923/>

⁴ Ibid, EIA website.

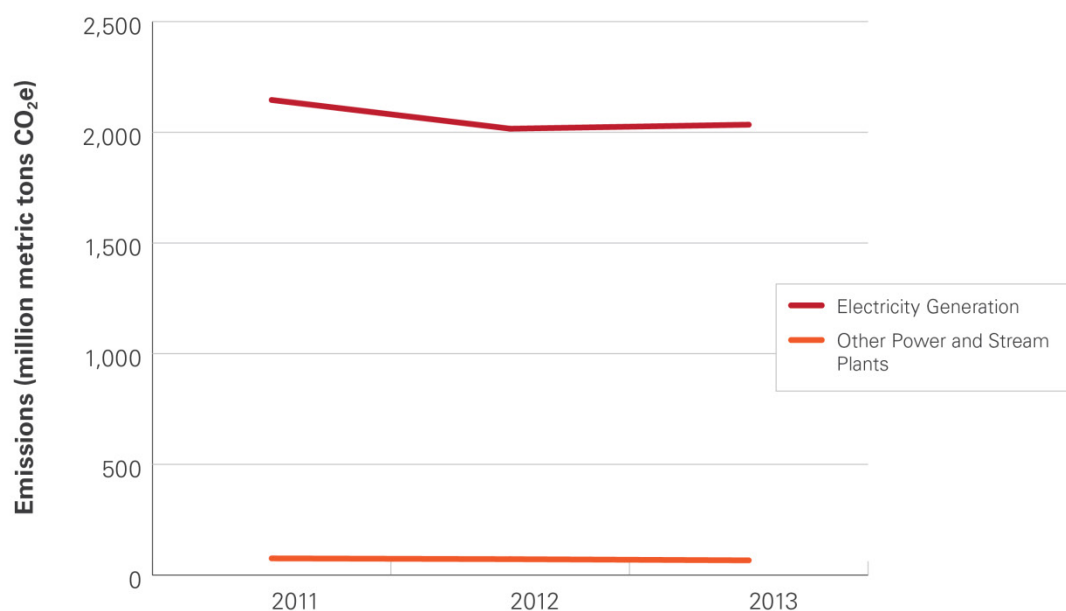
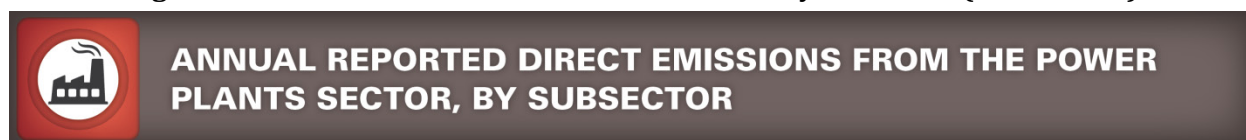
Figure 5: Power Plants Sector – Change in Net Generating Output and GHG Emissions by Fuel Type (2010–2013)^{a,b}



^a Net power generation data based on EIA Form 923 Reports) as updated through 11/5/14.

^b Fuel-level CO₂e information based on GHGRP data dated 8/18/14. Where available, reported emissions by fuel were used, and emissions for multiple fuels reporting under a configuration using CEMS were back-calculated based on available information.

Figure 6: Power Plants Sector – Emissions Trend by Subsector (2011–2013)



[Click here to view the most current information using FLIGHT.](#)

Table 5: Power Plants Sector – Emissions by GHG (MMT CO₂e)

Power Plants Sector	Reporting Year		
	2011	2012	2013
Number of facilities	1,589	1,601	1,570
Total emissions (CO ₂ e)	2,221.3	2,088.1	2,100.9
Emissions by GHG			
Carbon dioxide (CO ₂)	2,208.0	2,076.0	2,089.0
Methane (CH ₄)	4.2	3.7	3.7
Nitrous oxide (N ₂ O)	9.2	8.2	8.4

Table 6: Power Plants Sector – Combustion Emissions by Fuel Type – Subpart D^a

Fuel Type	Total Reported Emissions (MMT CO ₂ e)		
	2011	2012	2013
Coal	1,683.5	1,488.8	1,548.4
Natural Gas	412.8	486.5	443.7
Petroleum Products	34.3	28.0	30.6
Other Fuels ^b	0.1	0.2	0.2

^a In cases where CO₂ emissions were reported at the unit level (i.e. CEMS-monitored sources), fuel level CO₂ emissions were estimated by EPA based on other data directly reported by facilities, as well as default emission factors. **Fuel-level emission values presented may differ slightly from other publicly available GHGRP data due to minor differences in the calculation methodology.**

^b Excludes biogenic carbon dioxide.

Table 7: Power Plants Sector – Combustion Emissions by Fuel Type - Subpart C^a

Fuel Type	Total Reported Emissions (MMT CO ₂ e)		
	2011	2012	2013
Coal	30.0	28.1	21.8
Natural Gas	29.7	33.0	28.5
Petroleum Products	22.0	19.0	20.7
Other Fuels ^b	3.6	3.9	4.9

^a In cases where CO₂ emissions were reported at the unit level (i.e. CEMS-monitored sources), fuel level CO₂ emissions were estimated by EPA based on other data directly reported by facilities, as well as default emission factors.

^b Excludes biogenic CO₂.

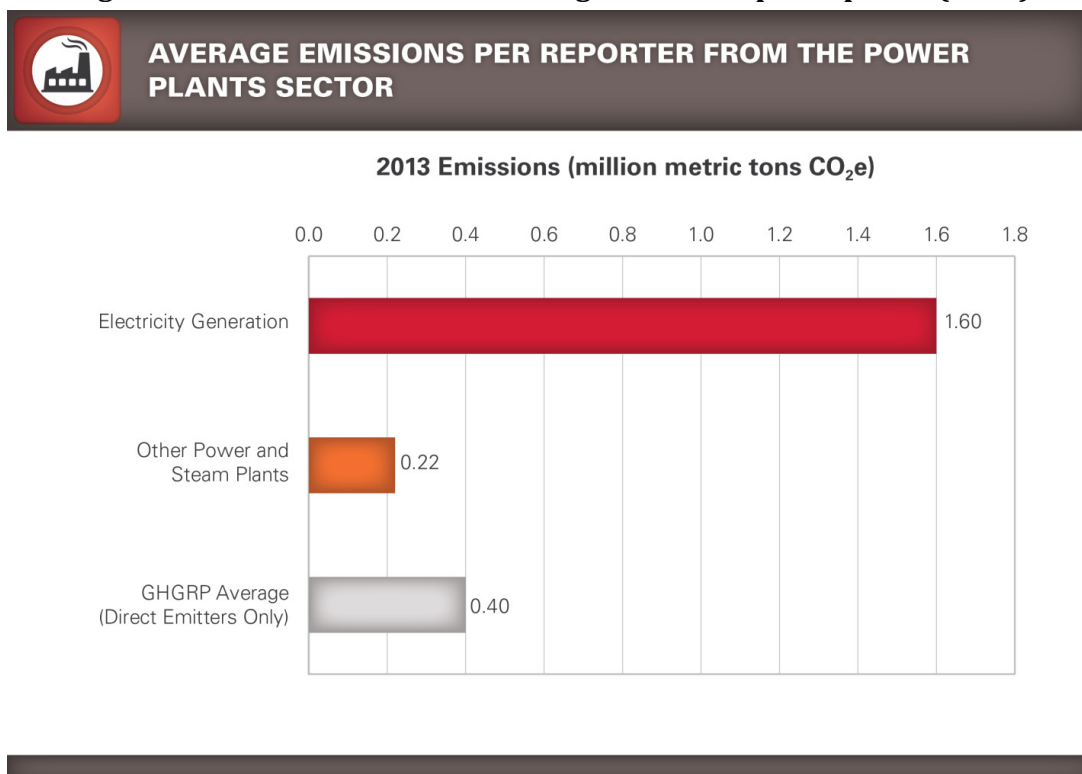
Figure 7: Power Plants Sector – Average Emissions per Reporter (2013)

Figure 8: Power Plants Sector – Percentage of Reporters by Range of Emissions (2013)

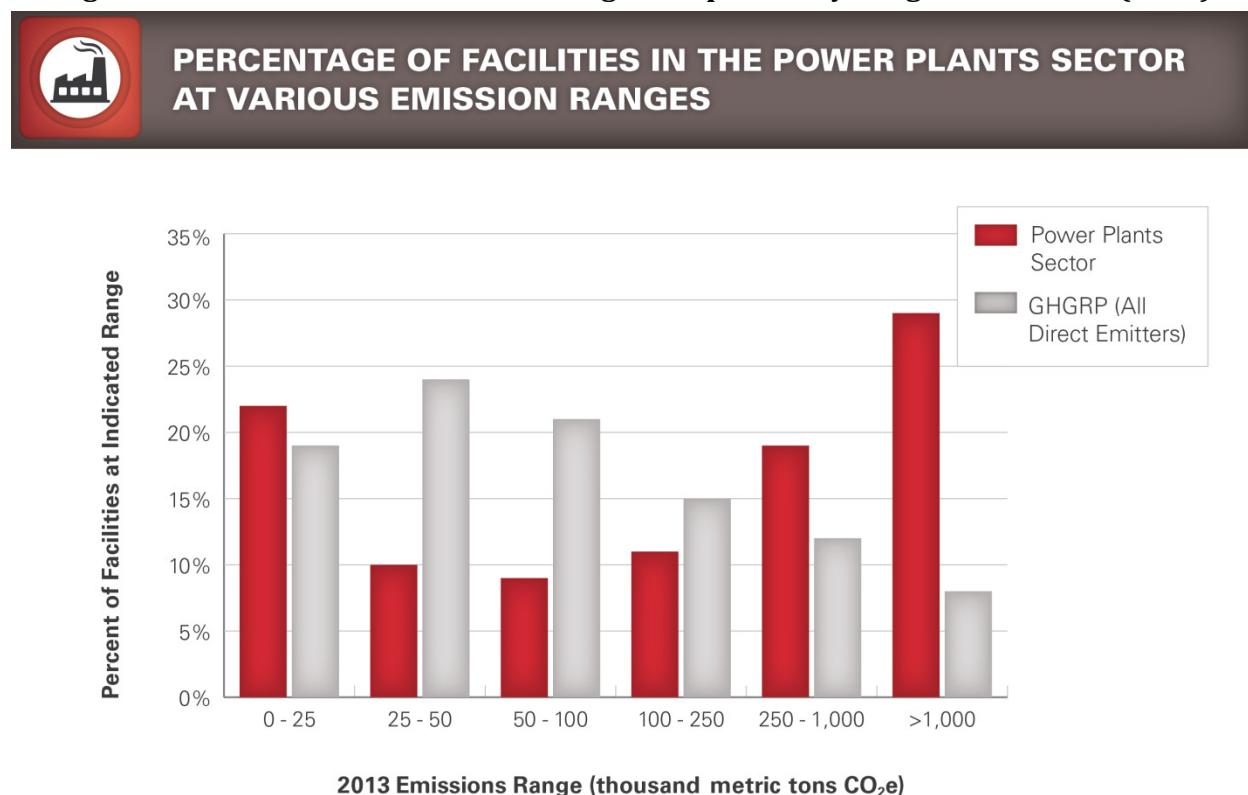


Table 8: Power Plants Sector – Number of Reporters by Emissions Range (2013)

Power Plants Sector	Number of Facilities Within Emissions Range (MMT CO ₂ e)					
	0 - 0.025	0.025 - 0.05	0.05 - 0.1	0.1 - 0.25	0.25 - 1	> 1
Total Power Plants Sector	342	154	150	177	294	453
Electricity Generation	247	102	104	127	254	437
Other Power and Steam Plants	95	52	46	50	40	16

Calculation Methods Used

Facilities in the Power Plants Sector can use several different methodologies to calculate their emissions. Electricity-generating combustion units that are subject to Subpart D must report CO₂ emissions according to the applicable requirements of 40 CFR part 75. Part 75 provides several monitoring options. The options that are available for a unit (Table 9) depend on how the unit is classified. In general, if a unit is coal-fired or combusts any type of solid fuel, the use of a continuous emissions monitoring system (CEMS) is required. If a unit is classified as an oil- or gas-fired unit, it may qualify for an alternative calculation methodology instead of using a CEMS. The four Subpart D options are:

- **CEMS** – Operate a CEMS for CO₂.
- **Equation G-1 of Appendix G (40 CFR part 75)** – Calculate daily CO₂ emissions from company records of fuel usage and periodic fuel sampling and analysis (to determine the percent carbon in the fuel).

- **Equation G-4 of Appendix G (40 CFR part 75)** – Gas and oil-fired units can calculate hourly CO₂ emissions using heat input rate measurements made with certified fuel flow-meters together with fuel-specific, carbon-based “F-factors.”
- **Low Mass Emissions (LME) Units** – Estimate CO₂ emissions using fuel-specific default emission factors and either estimated or reported hourly heat input. To qualify to use the LME unit provisions, a unit must be gas-fired or oil-fired, and its SO₂ and/or NO_x emissions must not exceed certain annual and/or ozone season limits.

Other power and steam plants not subject to Subpart D must report under Subpart C, and the reporter generally must use one of four calculation methodologies (tiers) to calculate CO₂ emissions (Table 9), depending on fuel type and unit size. Units that are not subject to Subpart D but are required by states to monitor emissions according to Part 75 can report CO₂ emissions under Subpart C using Part 75 calculation methods and monitoring data that they already collect under Part 75 (e.g., heat input and fuel use).

For both Subpart C and Subpart D reporters, methane (CH₄) and nitrous oxide (N₂O) mass emissions are also required to be reported for fuels that are included in Table C-2 of Part 98 and are calculated using either an estimated or measured fuel quantity, default or measured HHV, and default emission factors.

For reporting year 2010, some facilities were eligible to use any of the four calculation tiers, but had to start using the required tier in 2011.

Table 9: Power Plants Sector: Combustion Source Calculation Methodologies

Type of Emissions	Methodology	Portion of Emissions Monitored by Method (by Type)		
		2011	2012	2013
Electricity Generation: Combustion Emissions	CEMS (Subpart D)	81.0%	76.4%	78.9%
	Part 75 Appendix G, Equation G-4	14.4%	18.6%	16.8%
	Part 75 Appendix G, Equation G-1	0.7%	0.9%	0.7%
	LME per §75.19(c)(4)(iii)	0.1%	0.1%	0.1%
	CEMS (Tier 4, Subpart C)	0.9%	0.8%	0.8%
	Measured carbon content, and, if applicable, molecular weight (Tier 3)	1.1%	1.1%	0.9%
	Measured high heating values (HHVs) and default emission factors (Tier 2)	1.0%	1.1%	0.8%
	Default HHVs and emission factors (Tier 1)	0.2%	0.3%	0.4%
	Alternative Part 75 Methodologies	0.6%	0.7%	0.7%

Data Verification and Analysis

As a part of the reporting and verification process, EPA evaluates annual GHG reports with electronic checks. EPA contacts facilities regarding potential reporting issues and facilities resubmit reports if errors are identified. Additional information on EPA's verification process is available [here](#).

Electricity generating sources subject to Subpart D report CO₂ mass emissions data to the EPA's Clean Air Markets Division (CAMD). Consistency between the unit-level data submitted through the GHGRP and CAMD are assessed by comparing the two data sets. However, due to differences in the GHG pollutants reported and the universe of reporters subject to each program, the CAMD data is not well-suited for comparison with the GHGRP data for total CO₂e emissions for this sector. As an alternative, EIA data can be used to estimate the CO₂ emissions from the combustion of fossil fuels in the power plants sector, as is performed in the EPA *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2012*. Table 10 shows a comparison of these two datasets for GHG emissions from the power plants sector for 2011 through 2013. The GHGRP emissions from the power plants sector are about 0.4-0.7% less than the estimate provided in the *Inventory*. Given the inventory emissions values are calculated based on the amount of fuel combusted and applying emission factors, this minor difference shows excellent agreement with the GHGRP data that is obtained primarily through the use of CEMS for units in this sector.

Table 10: Power Plants Sector – Comparison of Emissions by Data Source (2011–2013)

Power Plants Sector	Emissions (MMT CO ₂ e)		
	2011	2012	2013
GHGRP ^a	2,145.8	2,016.1	2,034.2
Inventory of U.S. GHG Emissions & Sinks ^b	2,158.1	2,022.2	N/A

^a Totals as shown in Table 4 of this section.

^b Sum of coal, natural gas, and fuel oil emissions from stationary fossil fuel combustion for the electricity generation sector contained in Table 3-9 of *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2012* (<http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html>).

GLOSSARY

ARP means the Acid Rain Program authorized by Title IV of the Clean Air Act.

BAMM means Best Available Monitoring Methods. Facilities approved for BAMM may use best available monitoring methods for any parameter (e.g., fuel use, feedstock rates) that cannot reasonably be measured according to the monitoring and QA/QC requirements of a relevant subpart.

CAMD refers to the Clean Air Markets Division within the EPA Office of Atmospheric Programs. CAMD administers the Acid Rain Program and other market-based air pollution control programs.

CFR means the Code of Federal Regulations.

CO₂e means carbon dioxide equivalent, which is a metric used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). The carbon dioxide equivalent for a gas is calculated by multiplying the tons of the gas by the associated GWP.

Direct emitters are facilities that combust fuels or otherwise put greenhouse gases into the atmosphere directly from their facility. Alternatively, **Suppliers** are entities that supply certain

fossil fuels or fluorinated gases into the economy that—when combusted, released or oxidized—emit greenhouse gases into the atmosphere.

FLIGHT refers to EPA's GHG data publication tool, named Facility Level Information on GreenHouse Gases Tool (<http://ghgdata.epa.gov>).

GHGRP means EPA's Greenhouse Gas Reporting Program (40 CFR part 98).

GHGRP vs. GHG Inventory: EPA's Greenhouse Gas Reporting Program (GHGRP) collects and disseminates annual greenhouse gas data from individual facilities and suppliers across the U.S. economy. EPA also develops the annual Inventory of U.S. Greenhouse Gas Emissions and Sinks (GHG Inventory) to track total national emissions of greenhouse gases to meet U.S. government commitments to the United Nations Framework Convention on Climate Change. The GHGRP and Inventory datasets are complementary and may inform each other over time. However, there are also important differences in the data and approach. For more information, please see <http://www.epa.gov/ghgreporting/ghgdata/reported/inventory.html>.

GWP means global warming potential, which is a measure of the total energy that a gas absorbs over a particular period of time (usually 100 years), compared to carbon dioxide. The GWP for carbon dioxide is one.

IPCC AR4 refers to the Fourth Assessment Report by the Intergovernmental Panel on Climate Change. *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K. and Reisinger, A. (eds)]. IPCC, Geneva, Switzerland, 2007.* The AR4 values also can be found in the current version of Table A-1 in Subpart A of 40 CFR part 98.

MMT means million metric tons.

NAICS means the North American Industry Classification System, the standard used by federal statistical agencies to classify business establishments into industrial categories for collecting and publishing statistical data related to the U.S. economy.

RGGI refers to the Regional Greenhouse Gas Initiative, which is a cooperative regional effort among nine northeastern states to reduce CO₂ emissions from the power sector through a cap and trade program.