POWER PLANT SECTOR

All emissions presented here are as of 9/1/2013 and exclude biogenic CO_2.

Highlights

- Greenhouse gas (GHG) emissions from the Power Plant Sector for 2012 were six percent lower than 2011 and 10% lower than 2010. This trend is primarily related to decreased use of coal and increased use of natural gas.
- Thirty-two natural gas combined-cycle generating units were placed into service in the United States during 2010 and 2011. These units generate approximately one-fourth of the GHG emissions per megawatt compared to conventional coal-fired units.
- According to data from the Department of Energy's (DOE) Energy Information Administration (EIA), increased utilization of hydro-electric and wind assets from 2010 to 2012 also contributed to the decreased emissions in this sector.

About this Sector

The Power Plant 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 CO_2 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 Supply[a]) and 2211xx (Electric Power Generation, Transmission and Distribution). These facilities are subject to "Subpart C" of the GHGRP.

Who Reports?

In 2012, 1,611 facilities in the Power Plant Sector submitted GHG reports. The Power Plant Sector reflects 21% of the facilities reporting direct emissions to the GHGRP. Total reported emissions from the sector were 2,090.0 million metric tons CO_2e (MMT CO_2e), which represents 67% of reported GHG emissions and approximately 32% of total U.S. GHG emissions.[b]

Emissions in the Power Plant Sector from the combustion of coal accounted for 72.9% of the total reported emissions in 2012. Emissions from natural gas combustion contributed 24.7% of the total emissions and other fossil fuels accounted for 2.4%.

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

[b] The total U.S. GHG emissions are 6,225.6 MMT CO_2e 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. Available at: http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Main-Text.pdf.

Table 1: Power Plant 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_2e/year from stationary fuel combustion.	2010

Table 2: Power Plant Sector – Number of Reporters (2010–2012)

Power Plant Sector	Number of Reporters		
	2010	2011	2012
Total Power Plant Sector	**1,587**	**1,593**	**1,611**
Electricity Generation (Subpart D)	1,290	1,288	1,311
Other Power and Steam Plants (Subpart C)	297	305	300

Table 3: Power Plant Sector – GHGRP Coverage

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_2e/year from stationary fuel combustion and that reported a primary NAICS code of 221330 or 2211xx.	20%[a]	95%[b]

[a] Estimate of size of industry based on U.S. EPA eGRID2012 Version 1.0 for 2009 data.

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

EPA has determined that the GHGRP covers more than 99.8% of the 2012 emissions in the Power Plant Sector. This includes 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

All GHG emissions data, displayed in units of carbon dioxide equivalent (CO_2e) reflect the global warming potential (GWP) values from the Intergovernmental Panel on Climate Change (IPCC), Climate Change 1995: The Science of Climate Change (Second Assessment Report (SAR), Cambridge, United Kingdom: Cambridge University Press). The SAR values also can be found in the version of Table A-1 to 40 CFR part 98, published in the Federal Register on October 30, 2009 (74 FR 56395).

Table 4: Power Plant Sector – Emissions by Subsector (2010–2012)

Power Plant Sector	Emissions (MMT CO_2e)[a,b]		
	2010	2011	2012
Total Power Plant Sector	**2,330.8**	**2,221.9**	**2,090.0**
Electricity Generators (Subpart D)	2,249.9	2,146.6	2,019.6
Other Power and Steam Plants (Subpart C)	80.6	75.3	70.5

[a] Totals may not sum due to independent rounding.

[b] Represents total emissions reported to the GHGRP from this industry. Additional emissions may occur at facilities that have not reported, for example, those below the reporting threshold.

Figure 1: Power Plant Sector – Emissions by Subsector (2012)

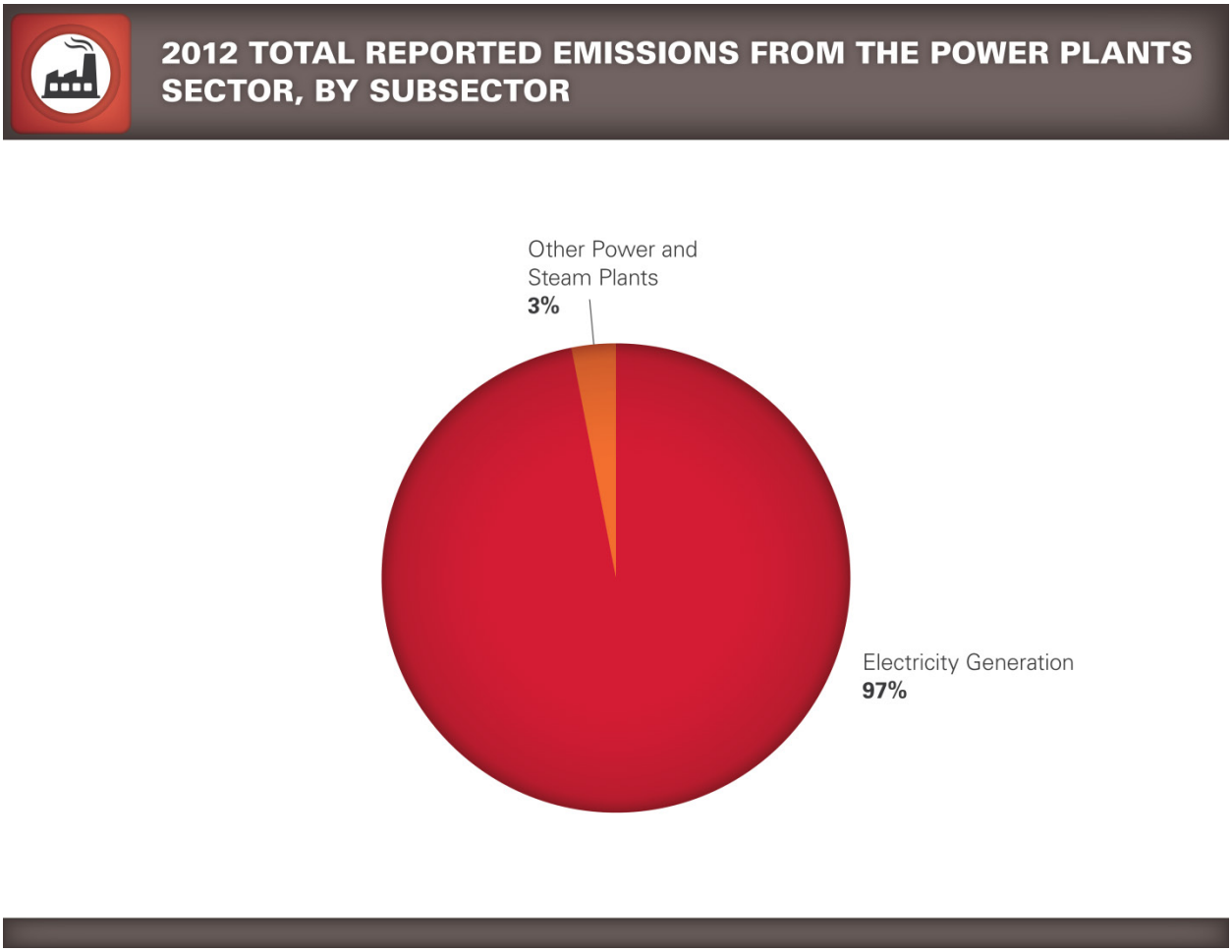
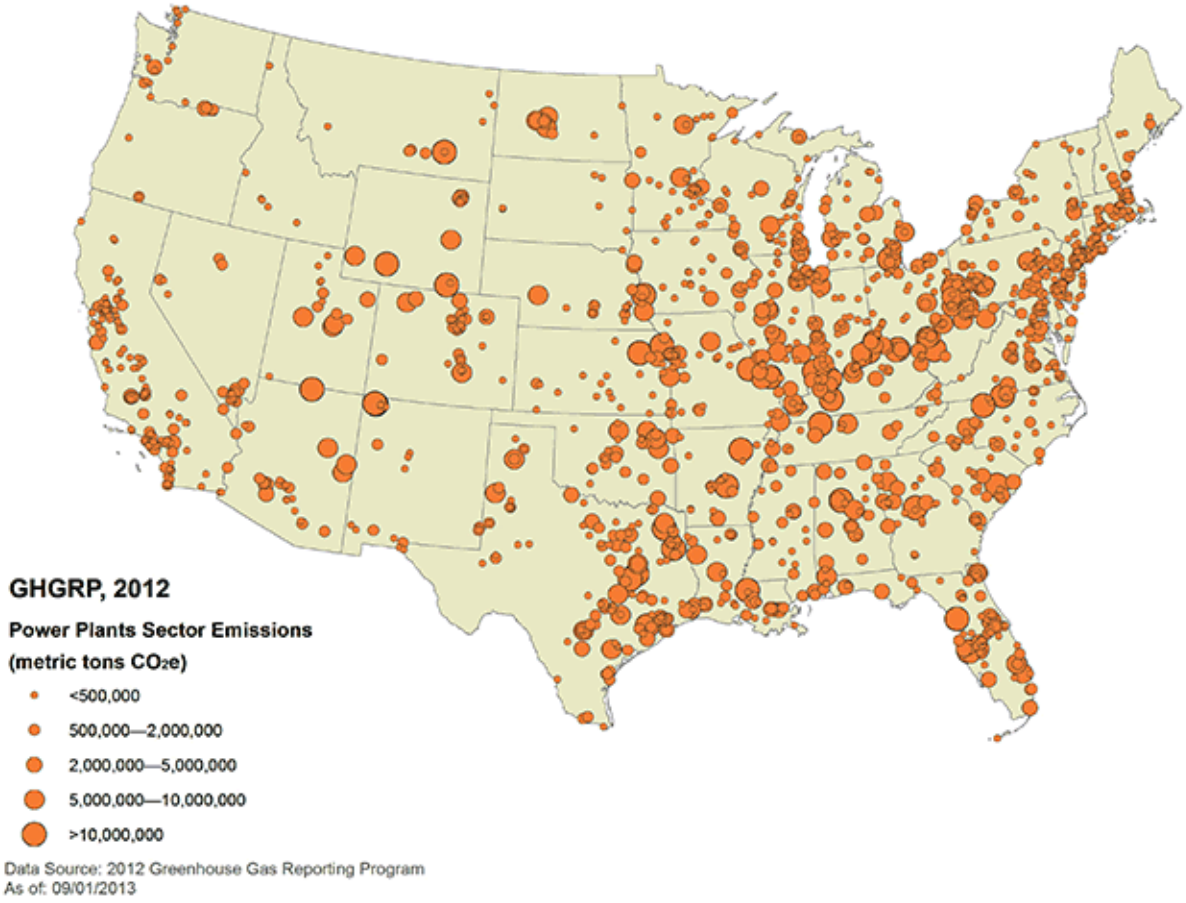


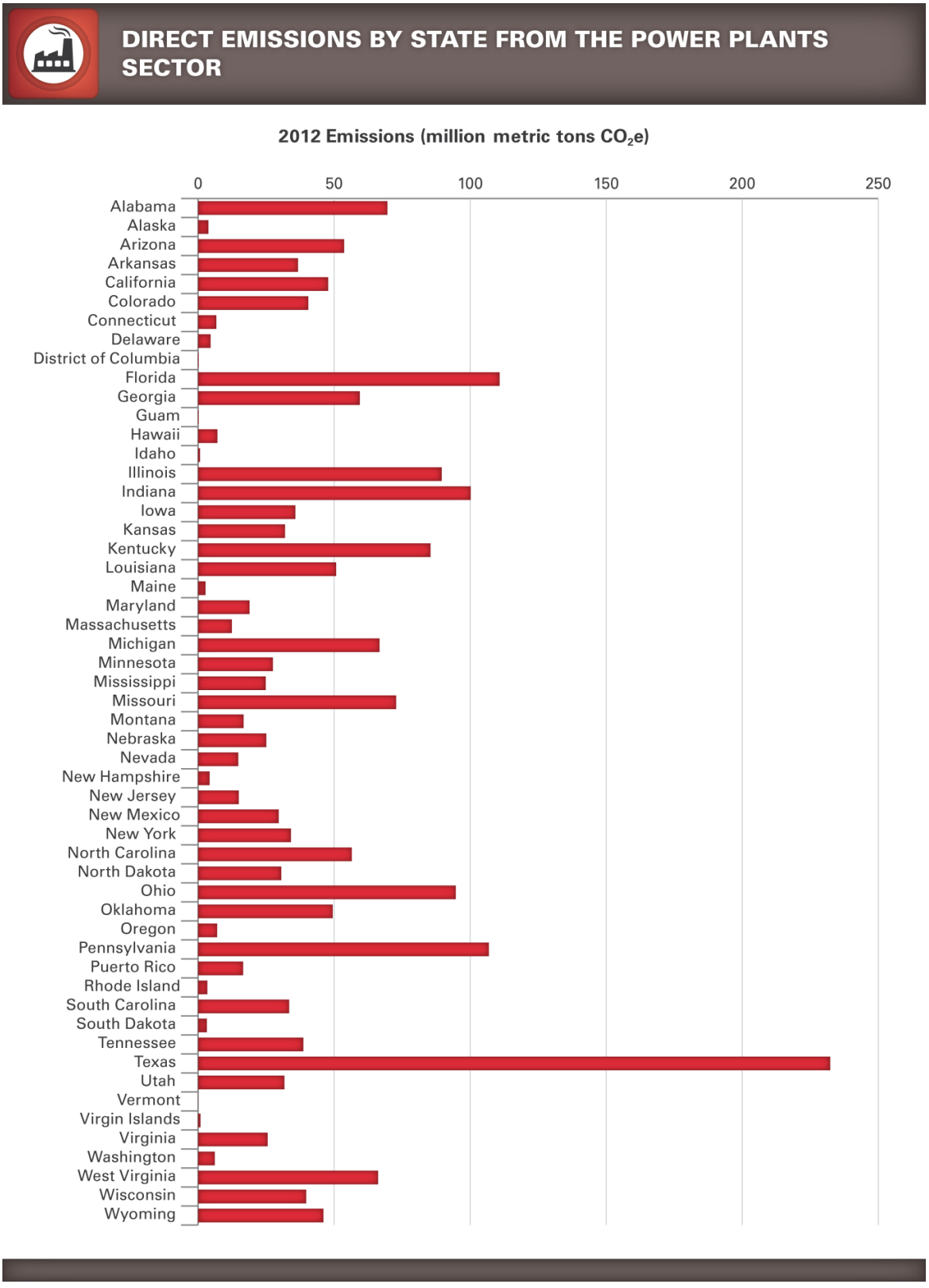
Figure 2: Location and Emissions Range for Each Reporting Facility in the Power Plant Sector (as of 9/1/13)



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 and 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 Plant Sector – Emissions by State (2012)[a]



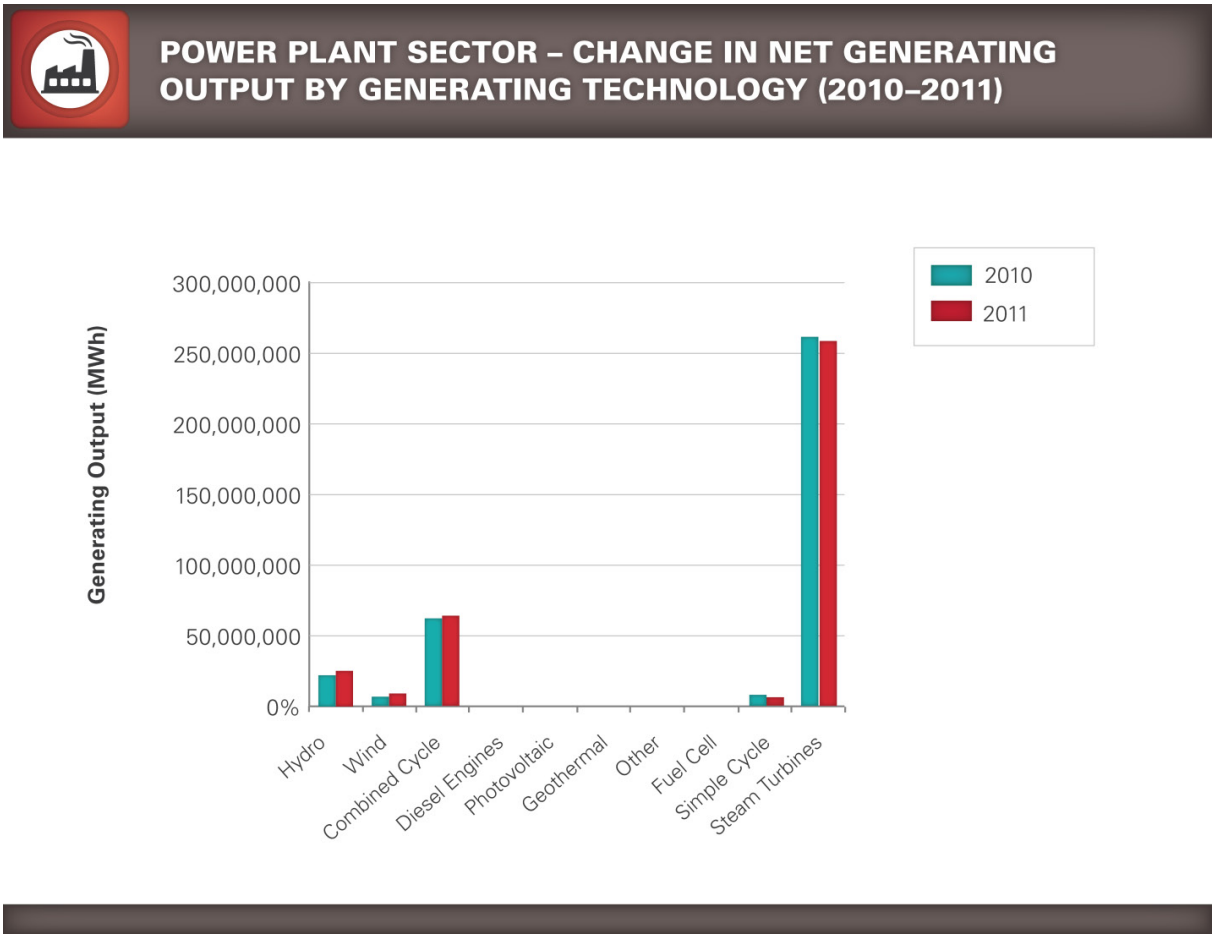
[a] Represents total emissions reported to the GHGRP from this industry. Additional emissions occur at facilities that have not reported, for example those below the reporting threshold.

Click here to view the most current information using FLIGHT.

Power Plant Sector Emissions Trends 2010 to 2011

From 2010 to 2011, annual emissions in the Power Plant Sector decreased by about four 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, and according to EIA data[c] for 2011, 98.7% of the heat input to combined cycle plants was from combustion of natural gas. 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 923 data[d], 32 new natural gas combined-cycle power blocks came on line during 2010 and 2011.

Figure 4: Power Plant Sector – Change in Net Generating Output by Generating Technology (2010–2011)[a,b]



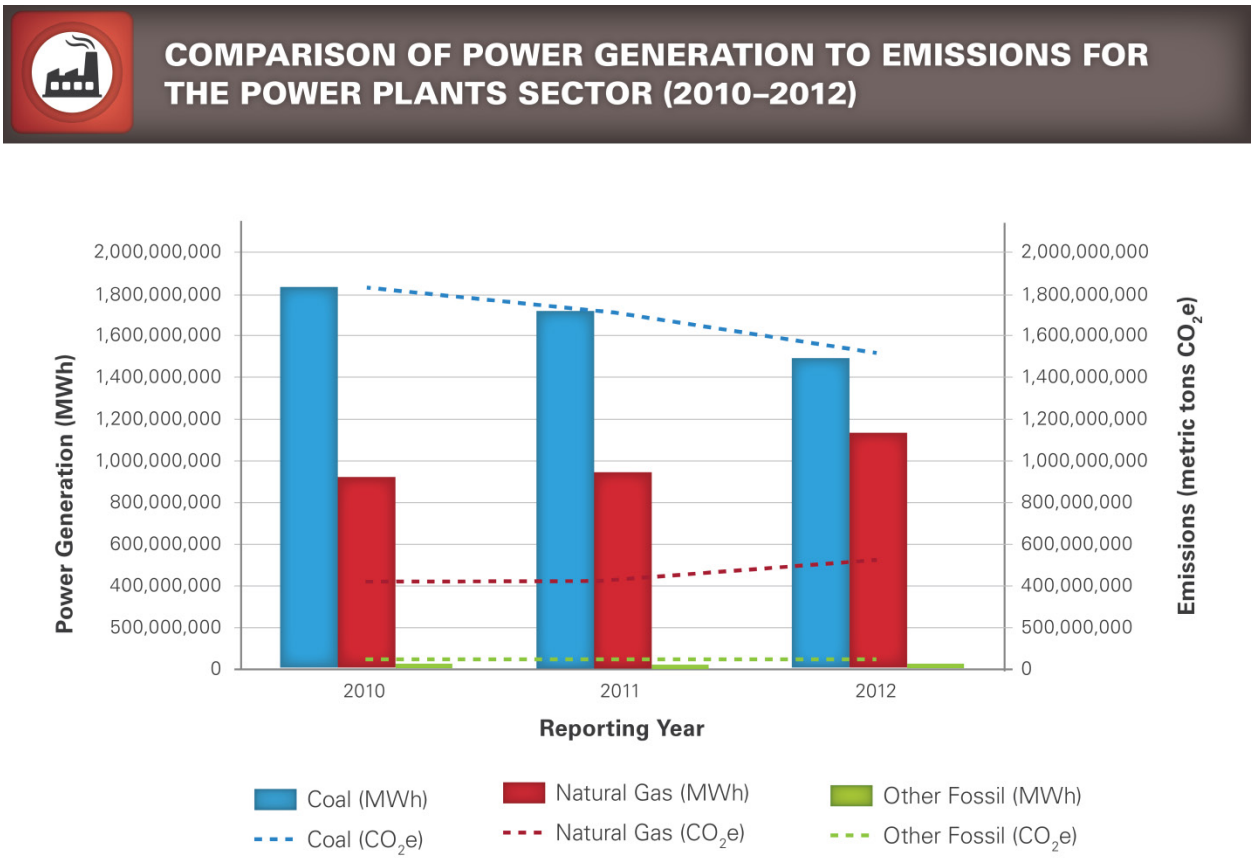
[a] Net generating output data obtained from DOE EIA 2011 December EIA-923 Monthly Time Series File, http://www.eia.gov/electricity/data/eia923/.

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

[c] Annual Electric Utility data: http://www.eia.gov/electricity/data/eia923/

[d] Ibid, EIA website.

Figure 5: Power Plant Sector – Change in Net Generating Output and GHG Emissions by Fuel Type (2010–2012)



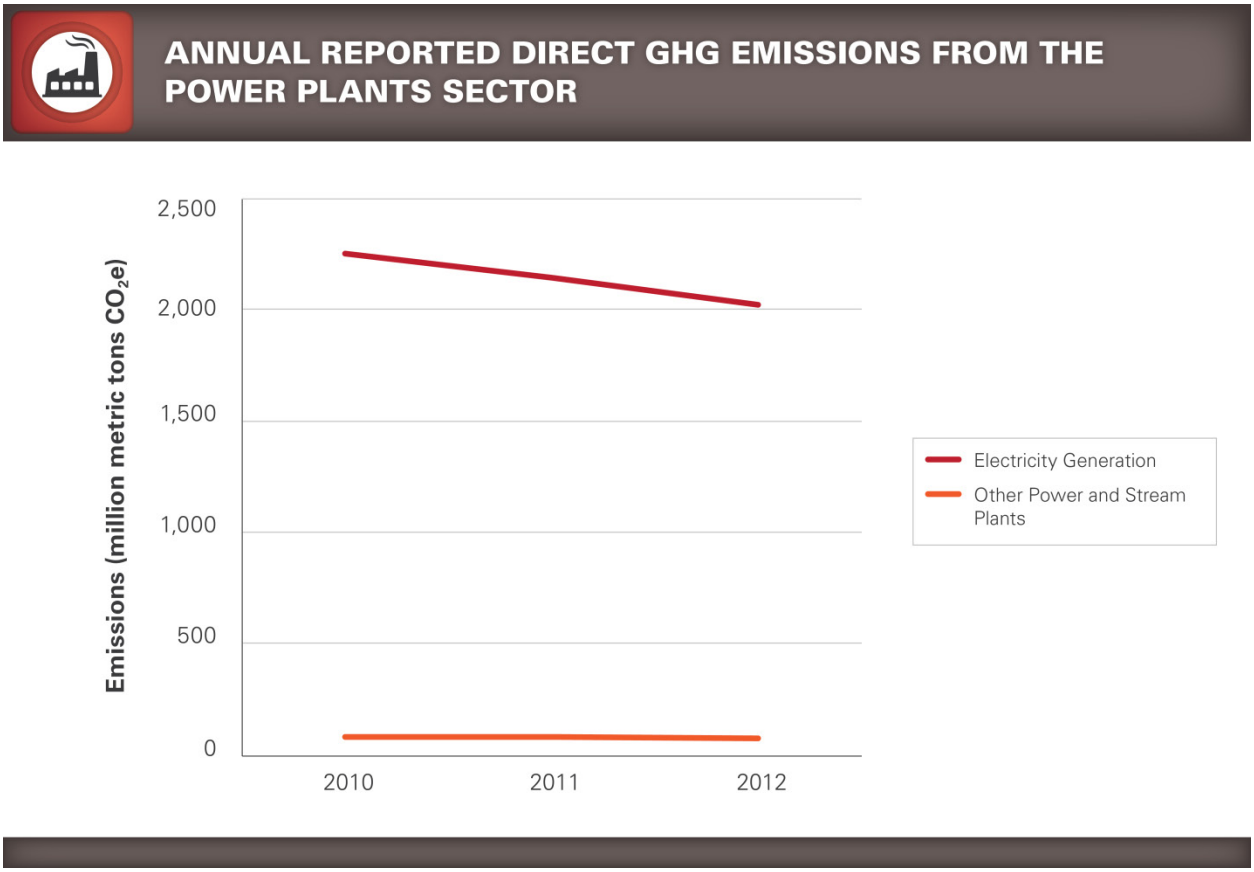
[a] Power generation data based on EPA Clean Air Markets Division (CAMD) data as of 8/9/13.

[b] Fuel-level CO_2e information based on GHGRP data dated 7/26/13. 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.

Power Plant Sector Emissions Trends 2011 to 2012

From 2011 to 2012, emissions in the Power Plant Sector decreased by an additional six percent. This reduction was also due to historically low natural gas prices and the macro trend in the utility sector converting from conventional coal to natural gas combined-cycle plants.

Figure 6: Power Plant Sector – Emissions Trend by Subsector (2010–2012)



Click here to view the most current information using FLIGHT.

Table 5: Power Plant Sector – Emissions by GHG (MMT CO_2e)[a]

Petroleum Refineries Sector	Reporting Year		
	2010	**2011**	**2012**
Number of facilities	1,587	1,593	1,611
Total emissions (CO_2e)	2,330.8	2,221.9	2,090.0
Emissions by GHG			
Carbon dioxide (CO_2)	2,316.8	2,208.9	2,078.4
Methane (CH_4)	3.8	3.5	3.1
Nitrous oxide (N_2O)	10.2	9.5	8.5

[a] Represents total emissions reported to the GHGRP in these industries. Additional emissions occur at facilities that have not reported, for example those below the 25,000 metric ton CO_2e reporting threshold in industries that have this threshold.

Figure 7: Power Plant Sector – Average Emissions per Reporter (2012)

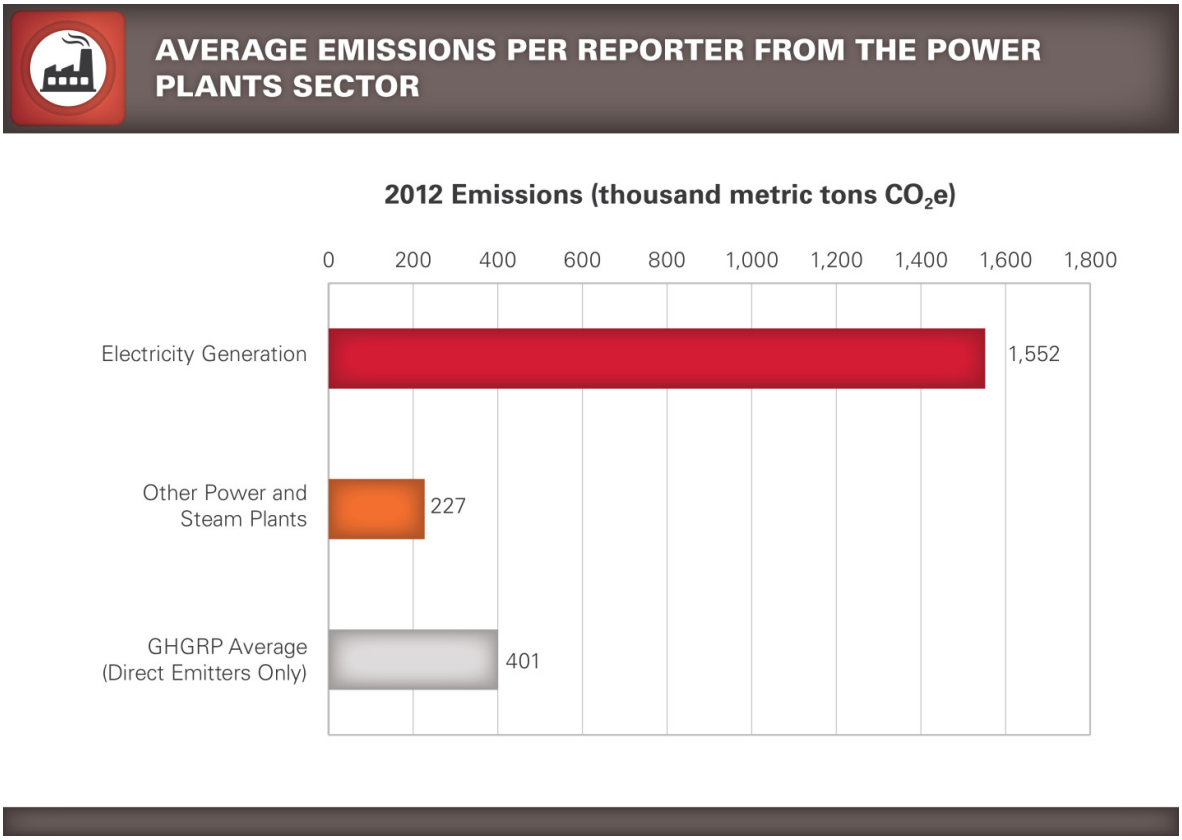


Figure 8: Power Plant Sector – Percentage of Reporters by Range of Emissions (2012)

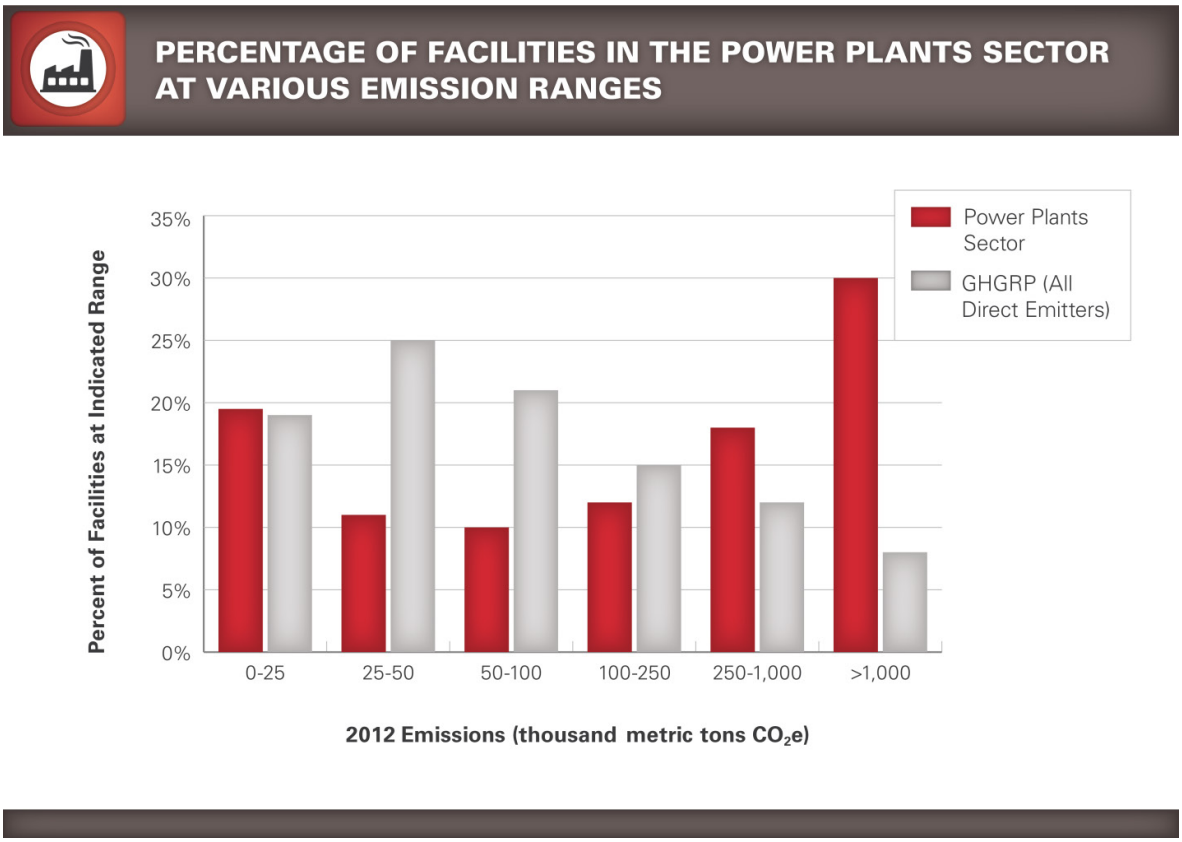


Table 6: Power Plant Sector – Number of Reporters by Emissions Range (2012)

Subsector	Emissions Range (MMT CO_2e)					
	0 - 0.025	0.025 - 0.05	0.05 - 0.1	0.1 - 0.25	0.25 - 1	> 1
Total Power Plants Sector	**307**	**171**	**160**	**198**	**297**	**478**
Electricity Generation	218	108	115	141	255	463
Other Power and Steam Plants	89	63	45	57	42	15

Calculation Methods Used

Facilities in the Power Plant Sector can use several different methodologies to calculate their emissions. Electricity generating combustion units that are subject to subpart D must report CO_2 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 7) 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 CO_2.
- **Equation G-1 of Appendix G (40 CFR part 75)** – Calculate daily CO_2 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 CO_2 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 CO_2 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 SO_2 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 CO_2 emissions (Table 7), depending on fuel type and unit size. Units that are not subject to subpart D but that are required by states to monitor emissions according to Part 75 can report CO_2 emissions under subpart C using Part 75 calculation methods and monitoring data that they already collect under Part 75 (e.g., heat input, fuel use).

For both subpart C and subpart D reporters, methane (CH_4) and nitrous oxide (N_2O) 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 7: Power Plants Sector: Combustion Source Calculation Methodologies

Type of Emissions	Methodology	Portion of Emissions Monitored by Method (by Type)		
		2010	2011	2012
Electricity Generation: Combustion Emissions	CEMS (Subpart D)	81.8%	81.0%	76.5%
	Part 75 Appendix G, Equation G-4	13.2%	14.3%	18.5%
	Part 75 Appendix G, Equation G-1	0.7%	0.7%	0.9%
	LME per §75.19(c)(4)(iii)	0.1%	0.1%	0.1%
	Measured carbon content, and, if applicable, molecular weight (Tier 3)	1.0%	1.1%	1.1%
	Measured high heating values (HHVs) and default emission factors (Tier 2)	1.0%	1.1%	1.1%
	CEMS (Tier 4, Subpart C)	0.7%	0.9%	0.9%
	Alternative Part 75 Methodologies	0.6%	0.6%	0.6%
	Default HHVs and emission factors (Tier 1)	0.2%	0.2%	0.3%
	Abbreviated reporting[a]	0.6%	0.0%	0.0%

[a] Abbreviated reporting was only allowed for RY2010.

Data Verification and Analysis

Electricity generating sources subject to subpart D report CO_2 mass emissions data to the EPA's 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 CO_2e emissions for this sector. As an alternative, EIA data can be used to estimate the CO_2 emissions from the combustion of fossil fuels in the power plant sector, as is performed in the EPA *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2012*. Table 8 shows a comparison of these two datasets for GHG emissions from the power plant sector for 2010 through 2012. The GHGRP emissions from the power plant sector are about 2-3% more 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 8: Power Plant Sector – Comparison of Emissions by Data Source (2010–2012)

Power Plant Sector	Emissions (MMT CO_2e)		
	2010	2011	2012
GHGRP[a]	2,330.8	2,221.9	2,090.0
Inventory of U.S. GHG Emissions & Sinks[b]	2,284.1	2,158.1	2,023.2

[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).

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.

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.

CO_2e 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.

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 CO_2 emissions from the power sector through a cap and trade program.