2011-2019 Greenhouse Gas Reporting Program Industrial Profile: Power Plants Sector

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POWER PLANTS SECTOR

All emissions presented here are as of 9/26/2020 and exclude biogenic carbon dioxide (CO_2). All greenhouse gas (GHG) emission data displayed in units of carbon dioxide equivalent (CO_2e) reflect the global warming potential (GWP) values from Table A-1 of 40 CFR 98, which is generally based on the Intergovernmental Panel on Climate Change's Fourth Assessment Report (IPCC AR4).

Highlights

- Greenhouse gas (GHG) emissions from the Power Plants Sector have decreased by 25% since 2011.
- The replacement of coal-fired units with natural gas combined-cycle units contributes to the observed decline in emissions from the Power Plants Sector over the period covered by the Greenhouse Gas Reporting Program (GHGRP). During this period, the retirement of coal-fired power plants continued due to flat electricity demand in conjunction with increased competition from natural gas and renewable electricity generating sources.[1]
- According to data from the U.S. Department of Energy's (DOE's) Energy Information Administration (EIA), increased utilization of renewables such as wind and solar assets from 2011 to 2019 continues to contribute to decreased emissions from this sector across the time series.[2]

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 to the GHGRP. The first group includes facilities that are required to report CO_2 mass emissions on a year-round basis to the U.S. Environmental Protection Agency (EPA) under 40 CFR Part 75: facilities subject to the Acid Rain Program (ARP) and facilities in the Regional Greenhouse Gas Initiative (RGGI) (see https://www.rggi.org/). Facilities subject to the ARP have combustion units that serve electricity generators that exceed a 25-MW nameplate capacity and facilities subject to the RGGI have combustion units that serve electricity generators that are equal to or greater than a 25-MW nameplate capacity. These facilities are subject to Subpart D of the GHGRP. For more details on the reporting requirements of power plants subject to Parts 75 and 98, see the following link.

The second group includes combustion units that are located at facilities with primary North American Industry Classification System (NAICS) codes of 221330 (Steam and Air-Conditioning

[1] U.S. Energy Information Administration, "More U.S. coal-fired power plants are decommissioning as retirements continue." July 26, 2019. http://www.eia.gov/todayinenergy/detail.php?id=40212.

[2] U.S. Energy Information Administration, Electricity Data Browser: Net generation for all sectors annual. Available at: http://www.eia.gov/electricity/data/browser/#/topic/0?agg=2.

Supply[3]) and 2211xx (Electric Power Generation, Transmission and Distribution), and emit greater than 25,000 metric tons (MT) CO_2e per year from stationary fuel combustion. These facilities are subject to Subpart C of the GHGRP.

Table 1 includes details of the applicability of each reporter category as well as their corresponding reporting schedules.

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 ARP 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 MT CO_2e per year from stationary fuel combustion	2010

Who Reports?

In 2019, 1,369 facilities in the Power Plants Sector submitted GHG reports. The Power Plants Sector represents 17.9% of the facilities reporting direct emissions (i.e., direct emitters) to the GHGRP. Total reported emissions from the sector were 1,668.7 million metric tons (MMT) CO_2e, which represented 58.5% of total direct emissions reported to the GHGRP. In 2018, facilities reporting to the Power Plants sector represented approximately 27% of total U.S. GHG emissions.[4] Table 2 shows the number of reporters by subsector by year.

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

[4] Total U.S. GHG emissions for 2018 were 6,677 MMT CO_2e, as reported in the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2018. U.S. Environmental Protection Agency. April 13, 2020. EPA 430-R-20-002. Available at: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks.

Table 2: Power Plants Sector – Number of Reporters (2011–2019)

Power Plants Sector	2011	2012	2013	2014	2015	2016	2017	2018	2019
Electricity generation	1,286	1,296	1,276	1,251	1,197	1,153	1,130	1,149	1,125
Other power and steam plants	306	313	303	298	290	258	248	242	244
Total	**1,592**	**1,609**	**1,579[a]**	**1,549**	**1,487[b]**	**1,411**	**1,378**	**1,391**	**1,369**

Note:

[a] Beginning in 2013, facilities became eligible to discontinue reporting if their emissions were less than 15,000 MT CO_2e 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 Facility Level Information on Greenhouse Gases Tool (FLIGHT) by using the drop-down menu titled "Filter by Status."

[b] Beginning in 2015, facilities became eligible to discontinue reporting if their emissions were less than 25,000 MT CO_2e per year for each of the previous five 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."

Reported Emissions

Figure 1 shows the breakdown of emissions by subsector in Reporting Year 2019.

Figure 1: 2019 Total Reported Emissions from the Power Plants Sector, by Subsector

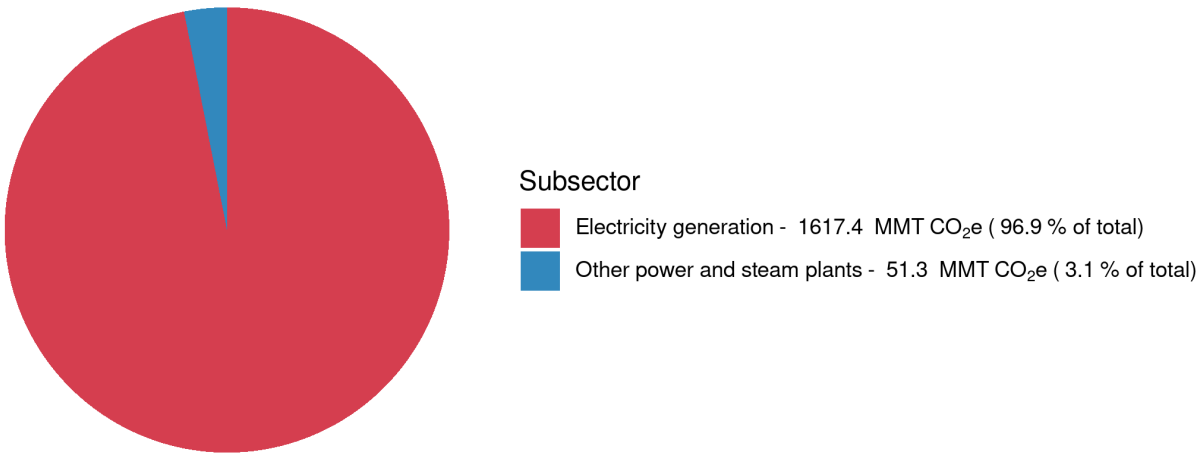


Figure 2 shows the locations of power plant facilities in the continental U.S. Sizes of circles correspond to the quantity of emissions reported by that facility. There are also power plants located in Alaska, Hawaii, Puerto Rico, the U.S. Virgin Islands, and Guam (https://www.epa.gov/ghgreporting/ghgrp-power-plants).

Readers can identify the largest emitting facilities by visiting the FLIGHT website (http://ghgdata.epa.gov/ghgp/main.do).

Figure 2: Power Plants Sector-Emissions by Range and Location (2019)

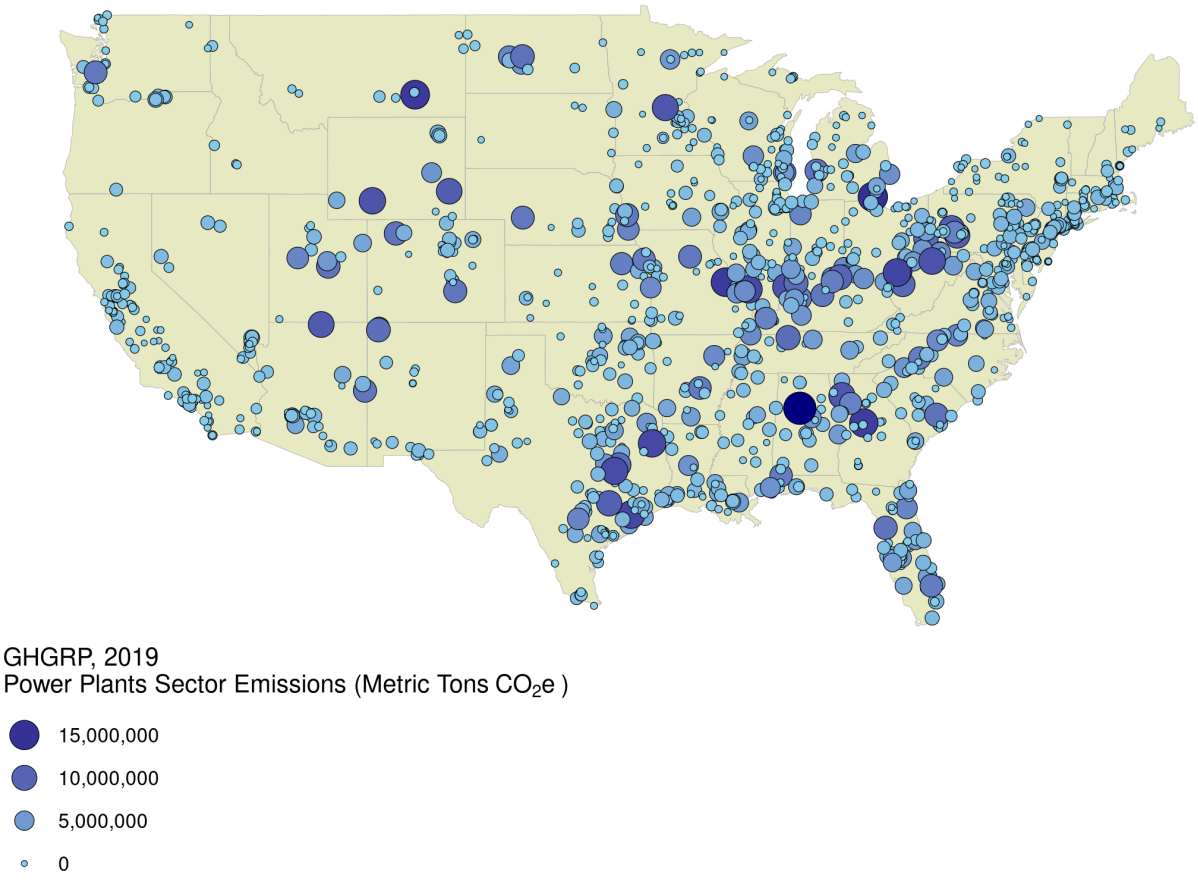
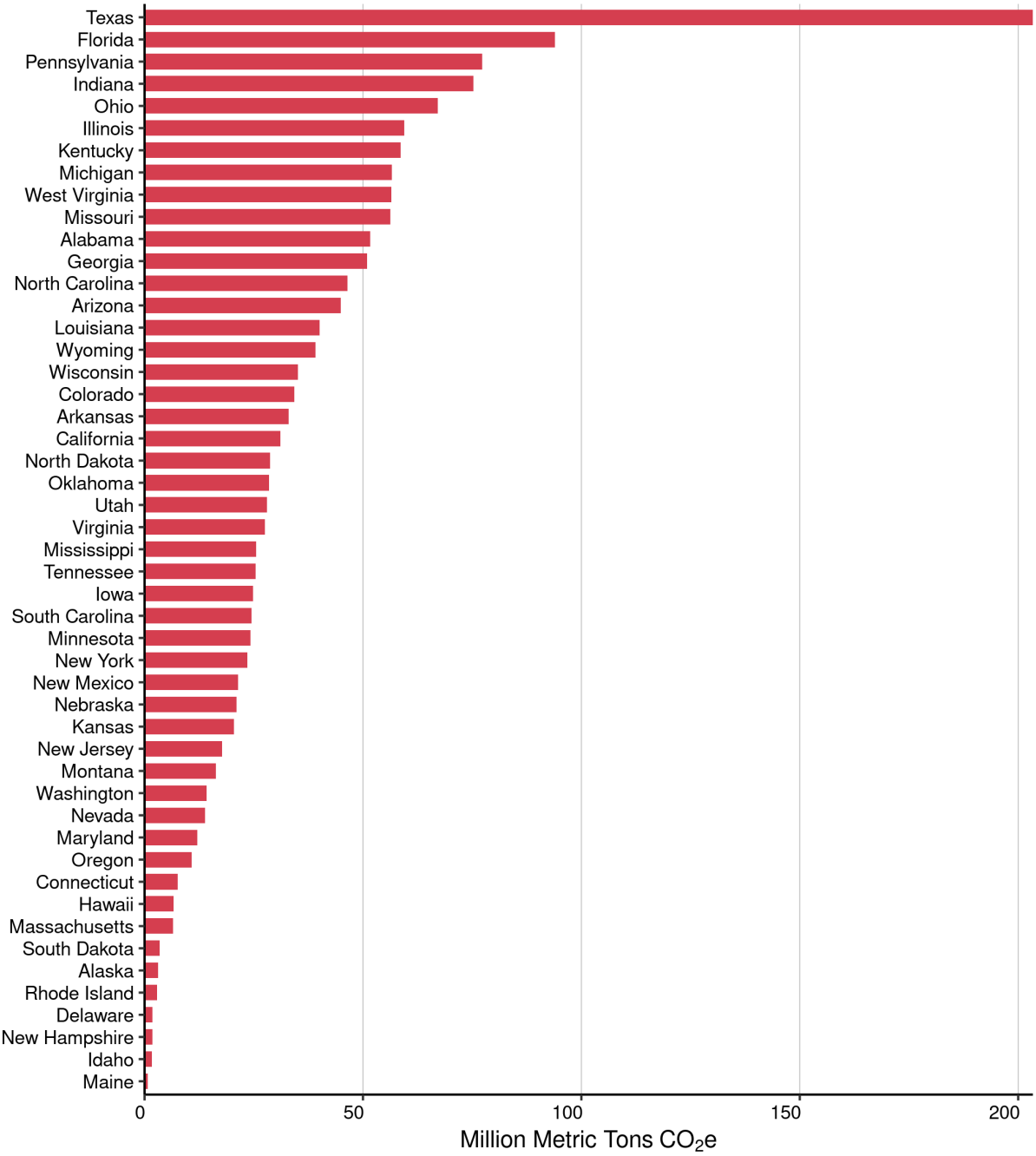


Figure 3 shows the reported direct emissions by state from the Power Plants Sector for 2019. The states with the highest reported emissions from this sector for 2019 were Texas, followed by Florida and Pennsylvania respectively.

Figure 3: Direct Emissions by State from the Power Plants Sector



Note: 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, 2011 to 2019

In general, there is a downward trend in emissions from both of the subsectors (see Table 3). Table 4 breaks down the emissions by the GHG emitted.

Table 3: Power Plants Sector – Emissions by Subsector in MMT CO_2e

Power Plants Subsector	2011	2012	2013	2014	2015	2016	2017	2018	2019
Electricity generation	2,147.4	2,018.8	2,039.3	2,037.9	1,910.9	1,820.6	1,748.9	1,763.1	1,617.4
Other power and steam plants	74.3	70.7	66.5	63.8	61.6	54.8	50.6	51.9	51.3
Total	**2,221.7**	**2,089.5**	**2,105.7**	**2,101.7**	**1,972.5**	**1,875.4**	**1,799.5**	**1,815.0**	**1,668.7**

Note: Totals may not sum due to independent rounding.

Table 4: Power Plants Sector – Emissions by GHG (MMT CO_2e)

Greenhouse Gas	2011	2012	2013	2014	2015	2016	2017	2018	2019
Carbon Dioxide	2,208.3	2,077.6	2,093.6	2,089.3	1,961.5	1,865.3	1,789.7	1,805.5	1,660.5
Methane	4.2	3.7	3.7	4.0	3.6	3.3	3.2	3.1	2.7
Nitrous Oxide	9.2	8.2	8.4	8.4	7.4	6.8	6.6	6.4	5.5
Total	**2,221.7**	**2,089.5**	**2,105.7**	**2,101.7**	**1,972.5**	**1,875.4**	**1,799.5**	**1,815.0**	**1,668.7**

Note: Totals may not sum due to independent rounding.

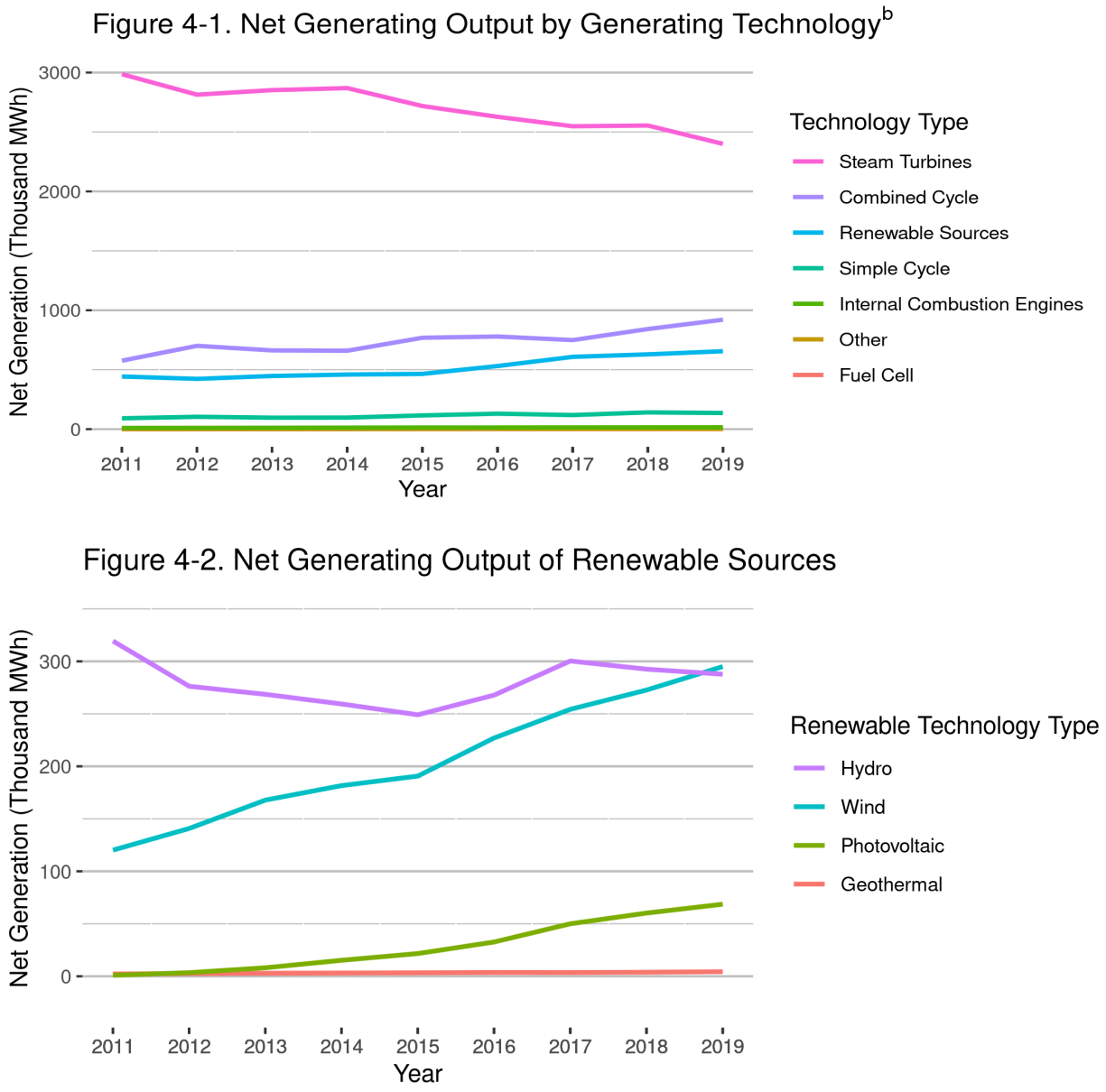
Emissions in the Power Plants Sector decreased 24.9% from 2011 to 2019, from 2,221.7 MMT CO_2e in 2011 to 1,668.7 MMT CO_2e in 2019. This decrease can be largely attributed to a shift to less-CO_2-intensive natural gas to generate electricity and a rapid increase in renewable energy capacity in the electric power sector in recent years. According to the Energy Information Administration (EIA), in 2011, 42.3% of U.S. electricity was produced from coal and 24.7% from natural gas. By 2019, only 23.4% of electricity was produced from coal and 38.4% from natural gas.[5] Nationally, fossil fuel consumption (in terms of Btu) for electricity generation decreased by 15.4% from 2011 to 2019.[6] The number of facilities reporting to the GHGRP in the Power Plants Sector has decreased from a high of 1,609 reporters in 2012 to 1,369 reporters in 2019. Figure 4-1 shows the

[5] U.S. Energy Information Administration, Electricity Data Browser: Net generation for all sectors annual (as of 11/9/2020). Available at: http://www.eia.gov/electricity/data/browser/#/topic/0?agg=2.

[6] Note: 2019 EIA data is preliminary data (as of 11/9/2020). U.S. Energy Information Administration, Electricity Data Browser: Consumption for electricity generation (Btu) for all sectors, annual. Available at: https://www.eia.gov/electricity/data/browser/#/topic/9?agg=2,0,1&fuel=f&geo=g&sec=g&freq=A&start=2001&end=2015&ctype=linechart&ltype=pin&rtype=s&pin=A&rse=0&maptype=0.

progression of total net power generation from 2011 to 2019 by technology type and Figure 4-2 shows a breakdown of this information for renewable sources by renewable technology type.

Figure 4: Net Generating Output by Generating Technology for the Power Plants Sector (2011–2019)[a]

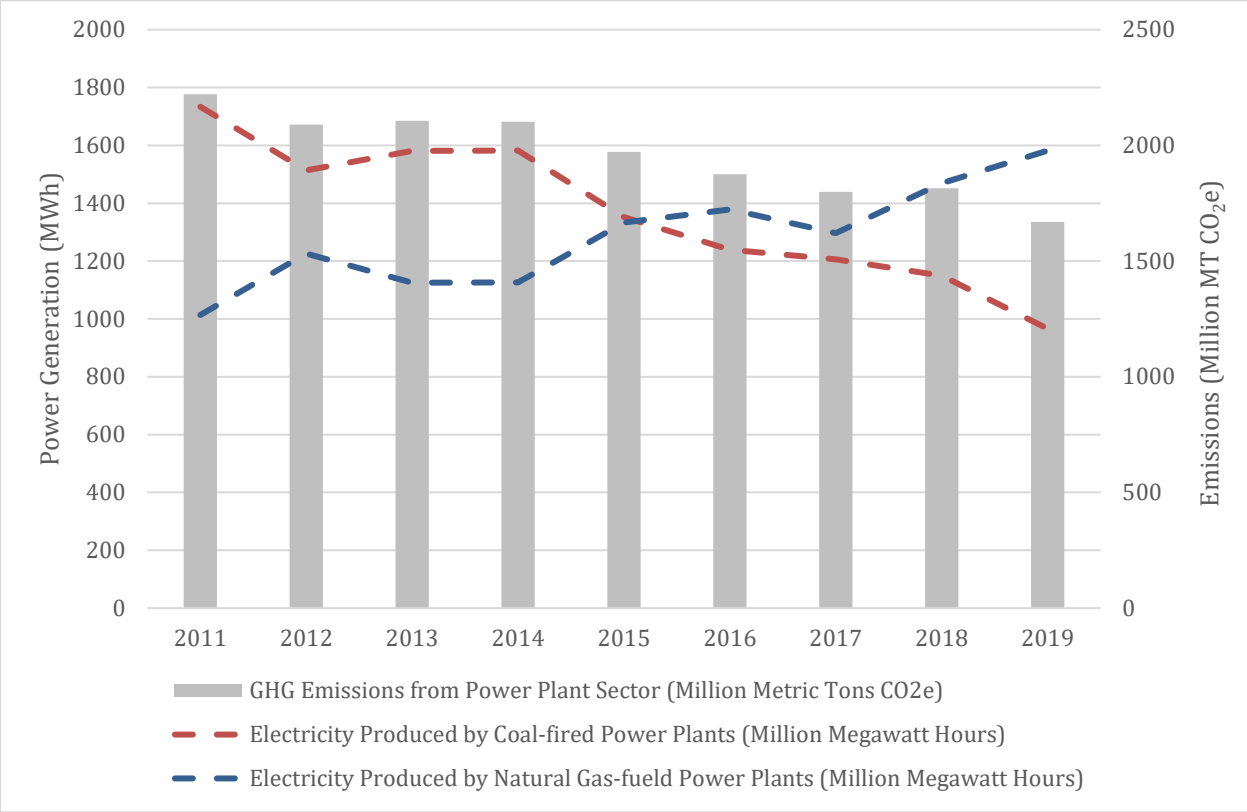


[a] Net generating output data obtained from the EIA Form 923 Reports.
[b] "Steam Turbines" include generators powered by nuclear plants or the combustion of coal, oil, natural gas, or biomass; but do not include combined-cycle steam turbines.

In 2019, coal and natural gas accounted for about 61.8% of U.S. electricity generation by utility-scale generators. In 2019, coal combustion generated 37.4% of the total MWh produced from fossil

fuel combustion, and natural gas combustion generated 61.3%.[7] Figure 5 illustrates the shift between 2011 and 2019 for coal and natural gas electricity generation.

Figure 5: Power Plant GHG Emissions and Electricity Generation by Fuel [a,b]



[a] *Power Plant GHG emissions as reported to the Greenhouse Gas Reporting Program.*
[b] *U.S. Energy Information Administration, Electricity Browser: Net generation for all sectors. Available at: http://www.eia.gov/electricity/data/browser/#/topic/0?agg=2.*

Generally, the Power Plants Sector emits more GHGs per reporter compared with all GHGRP reporters. Figure 6 compares average emissions per reporter of facilities in the power plant subsectors with the average emissions per reporter of all GHGRP reporters (including power plant facilities). Figure 7 and Table 7 show the percentage and number of reporters within each emission range, respectively.

[7] U.S. Energy Information Administration, Electricity Data Browser: Net generation for all sectors. Available at: http://www.eia.gov/electricity/data/browser/#/topic/0?agg=2.

Figure 6: Average Emissions per Reporter from the Power Plants Sector, by Subsector (2019)

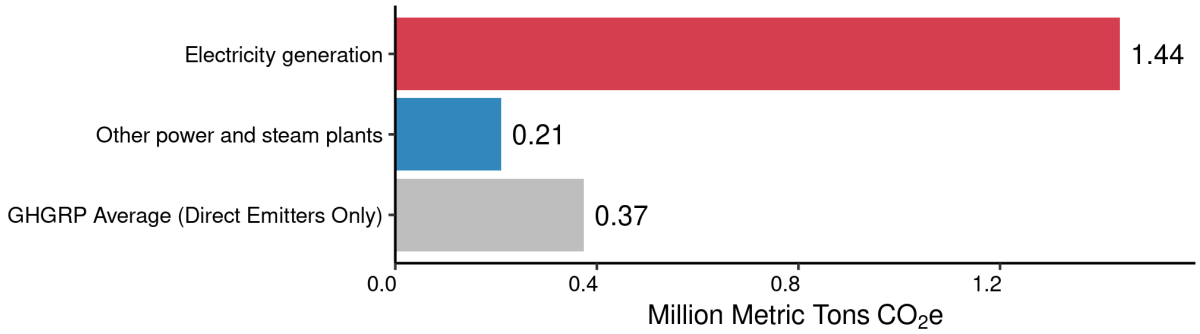
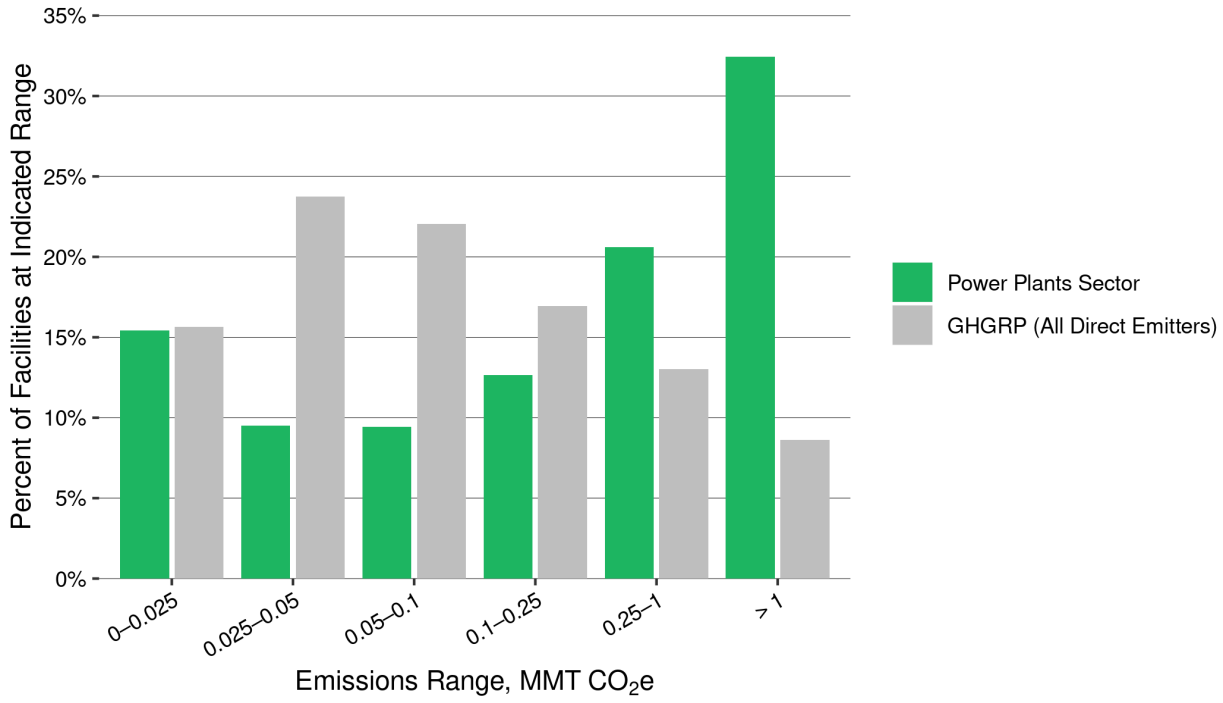


Table 7: Power Plants Sector – Number of Reporters by Emissions Range in MMT CO_2e (2019)

Power Plants Subsector	0–0.025	0.025–0.05	0.05–0.1	0.1–0.25	0.25–1	> 1
Electricity generation	145	81	86	136	241	436
Other power and steam plants	66	49	43	37	41	8
Total	**211**	**130**	**129**	**173**	**282**	**444**

Figure 7: Percentage of Facilities in the Power Plants Sector at Various Emission Ranges



Emission Calculation Methods Available for Use

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 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 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 of 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 for using the LME unit provisions, a unit must be gas-fired or oil-fired, and its sulfur dioxide and/or nitrogen oxide 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 (i.e., tiers) to calculate CO_2 emissions, depending on fuel type and unit size. The calculation methodologies for Subpart C are explained in more detail here.

Units that are not subject to Subpart D but are required by states to monitor emissions according to Part 75 can report their 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 and fuel use).

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

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.

Glossary

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

CEMS means continuous emissions monitoring system.

CFR means the Code of Federal Regulations.

CO_2e means carbon dioxide equivalent, which is a metric used to compare emissions from various GHGs based upon their GWP. The CO_2e for a gas is calculated by multiplying the mass of the gas by the associated GWP.

Direct emitters are facilities that combust fuels or otherwise put GHGs 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 GHGs into the atmosphere.

EIA refers to the Energy Information Administration.

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

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 GHG 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 and sinks of GHGs to meet U.S. government commitments to the United Nations Framework Convention on Climate Change. The GHGRP and GHG 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/greenhouse-gas-reporting-program-and-us-inventory-greenhouse-gas-emissions-and-sinks.

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 CO_2. The GWP for CO_2 is one.

HHV means higher heating value.

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 A. Reisinger (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 ten northeastern states to reduce CO_2 emissions from the power sector through a cap and trade program.