POWER PLANTS SECTOR

All emissions presented here are as of 8/13/2016. The reported emissions exclude biogenic CO_2. GHG data displayed here 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 IPCC AR4.

Highlights

- Greenhouse gas (GHG) emissions from the Power Plants Sector have steadily decreased since 2010. 2015 GHG emissions were six percent lower than 2013 and 2014 emissions.
- The replacement of coal-fired units with natural gas combined-cycle units contributes to the observed decline in emissions from the power sector over the period covered by the GHGRP. A plant's cost for electricity generation is a function of fuel price and conversion efficiency. When natural gas prices are low compared to coal, natural gas power production is favored.[1] The natural gas combined-cycle units generate approximately 25% of the GHG emissions per megawatt compared to conventional coal-fired units.
- According to data from the U.S. Department of Energy's (DOE) Energy Information Administration (EIA), increased utilization of renewables such as wind and solar assets from 2010 to 2015 also 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. 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). For more details on the reporting requirements of power plants subject to part 75 and part 98 see the following link.

The second group includes combustion units that are located at facilities with primary NAICS codes of 221330 (Steam and Air-Conditioning Supply[3]) and 2211xx (Electric Power Generation, Transmission and Distribution). These facilities are subject to Subpart C of the GHGRP.

Who Reports?

In 2015, 1,480 facilities in the Power Plants Sector submitted GHG reports. The Power Plants Sector represents 19% of the facilities reporting direct emissions to the GHGRP. Total reported emissions from the sector were 1,969.3 million metric tons CO_2e (MMT CO_2e). In 2015 power plants represented approximately 29% of total U.S. GHG emissions.[4]

---

1 Annual Energy Outlook 2012 with Projections to 2035. DOE/EIA (2012), June 2012.

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.

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 2015 were 6,586.7 MMT CO_2e, as reported in the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015. U.S. Environmental Protection Agency. April 13, 2017. EPA 430-P-17-001.

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_2e/year from stationary fuel combustion.	2010

Table 2: Power Plants Sector – Number of Reporters (2011–2015)

Power Plants Sector	Number of Reporters				
	2011	2012	2013	2014	2015
Total Power Plants Sector	**1,593**	**1,609**	**1,577[a]**	**1,547**	**1,480[b]**
Electricity Generation (Subpart D)	1,287	1,296	1,272	1,247	1,193
Other Power and Steam Plants (Subpart C)	306	313	305	300	287

[a] Beginning in 2013, facilities became eligible to discontinue reporting if emissions were less than 15,000 metric tons 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 FLIGHT by using the drop-down menu titled "Filter by Status."

[b] Beginning in 2015, facilities became eligible to discontinue reporting if emissions were less than 25,000 metric tons 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

Table 3: Power Plants Sector – Emissions by Subsector (2011–2015)

Power Plants Sector	Emissions (MMT CO_2e)[a]				
	2011	2012	2013	2014	2015
Total Power Plants Sector	**2,221.3**	**2,088.4**	**2,103.6**	**2,099.6**	**1,969.3**
Electricity Generators (Subpart D)	2,147.4	2,018.1	2,037.6	2,036.1	1,909.0
Other Power and Steam Plants (Subpart C)	73.8	70.2	66.0	63.5	60.4

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

Figure 1: Power Plants Sector – Emissions by Subsector (2015)

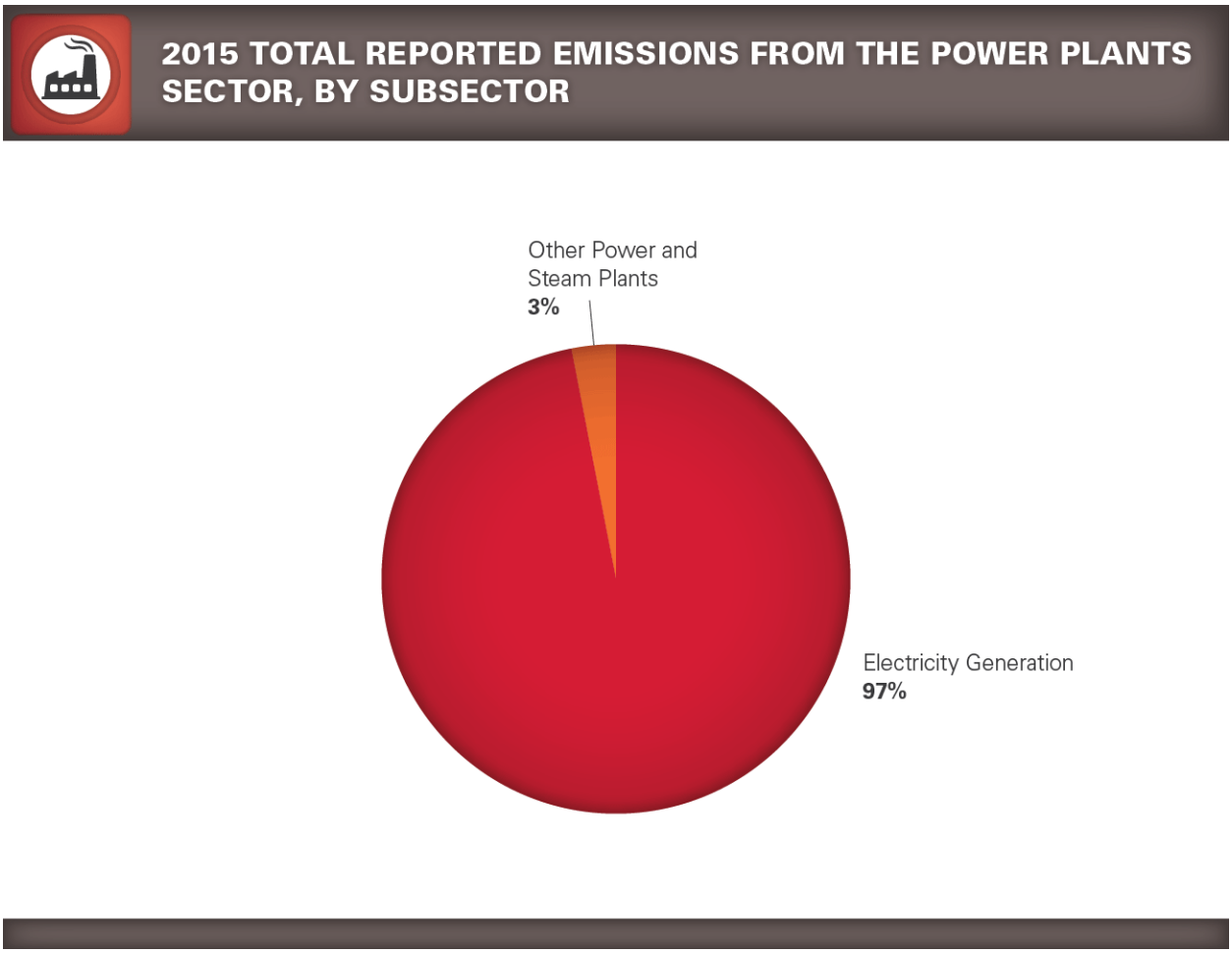
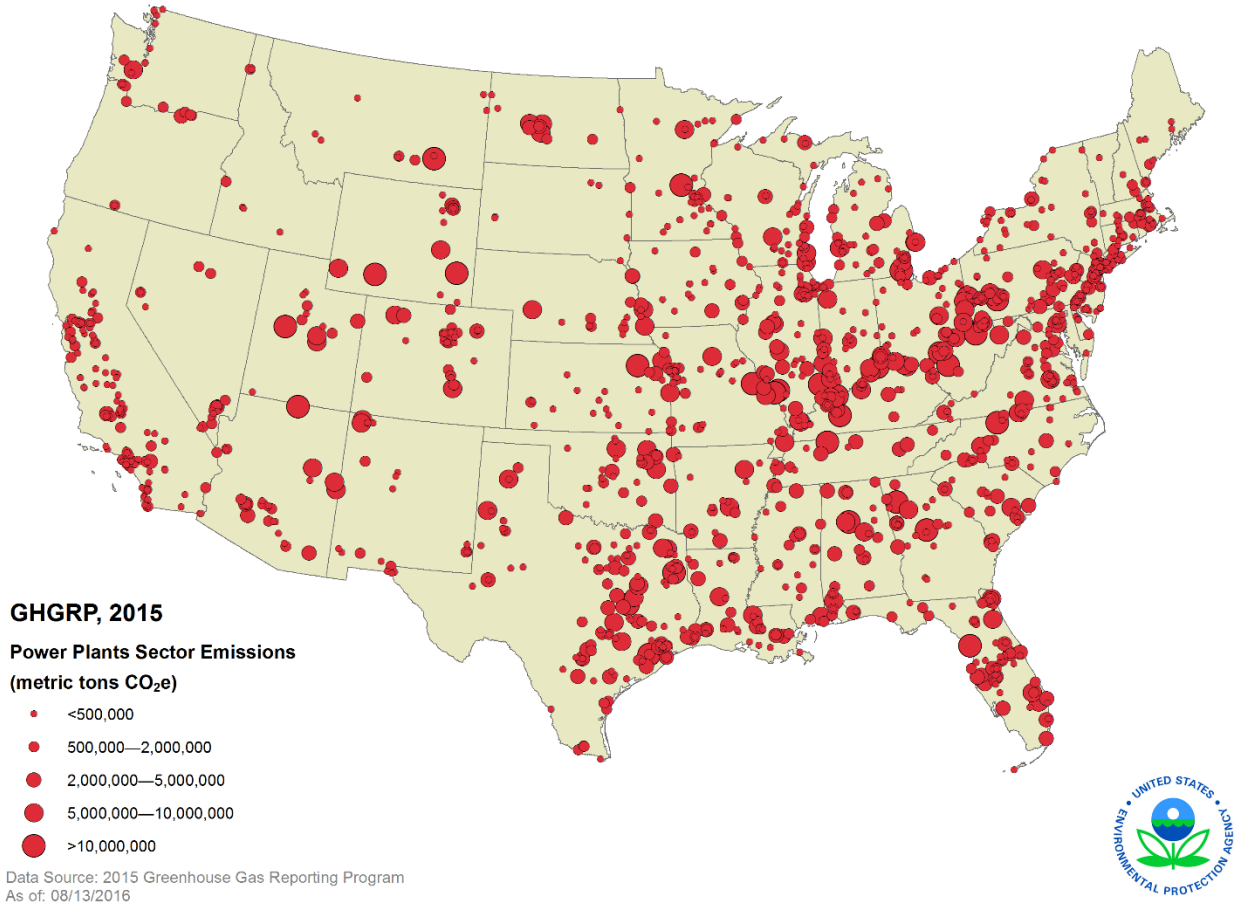


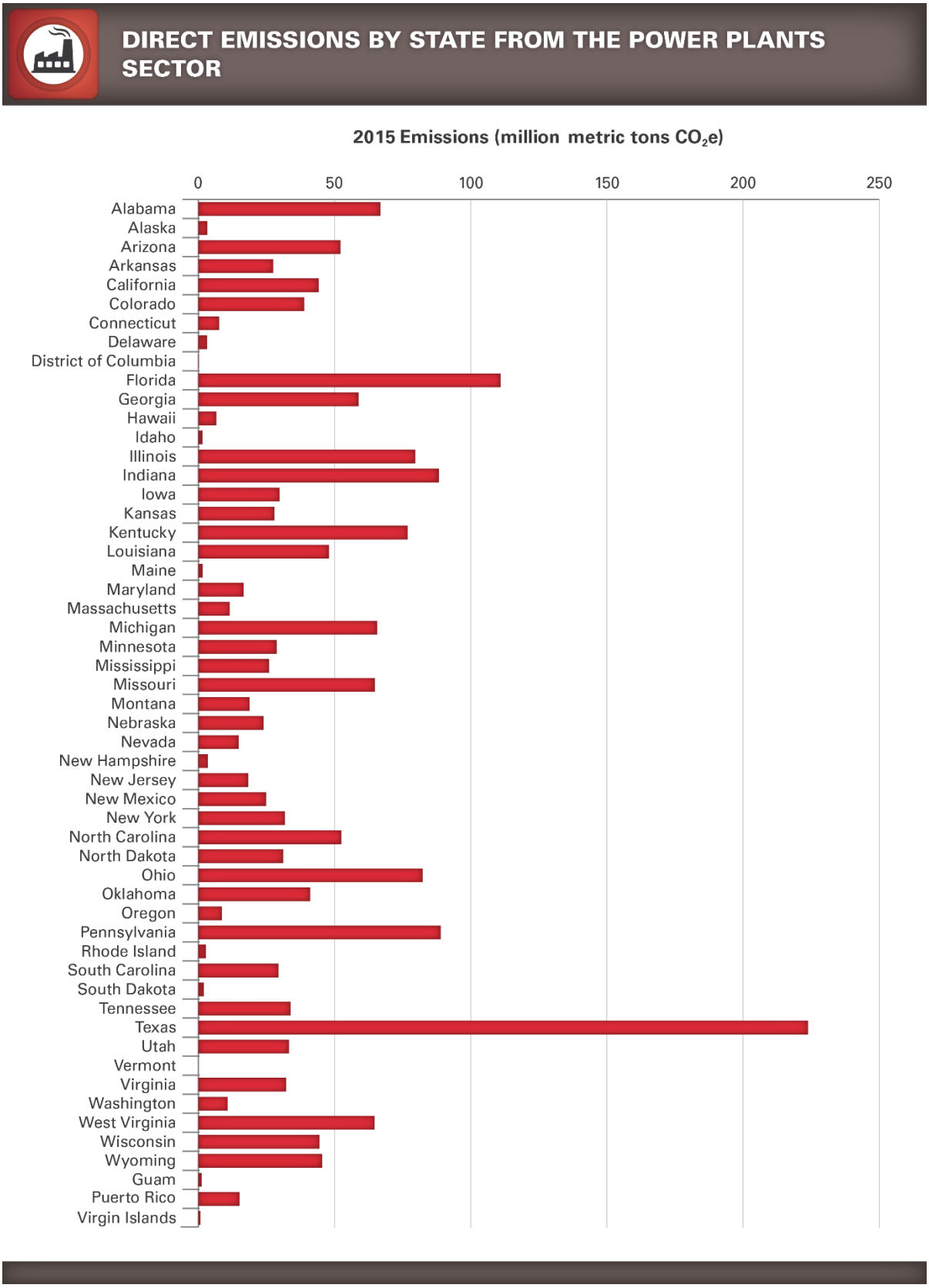
Figure 2: Location and Emissions Range for Each Reporting Facility in the Power Plants Sector (as of 8/13/16)



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 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 Facility Level Information on Greenhouse Gases (FLIGHT) website (http://ghgdata.epa.gov).

Figure 3: Power Plants Sector – Emissions by State (2015)[a]



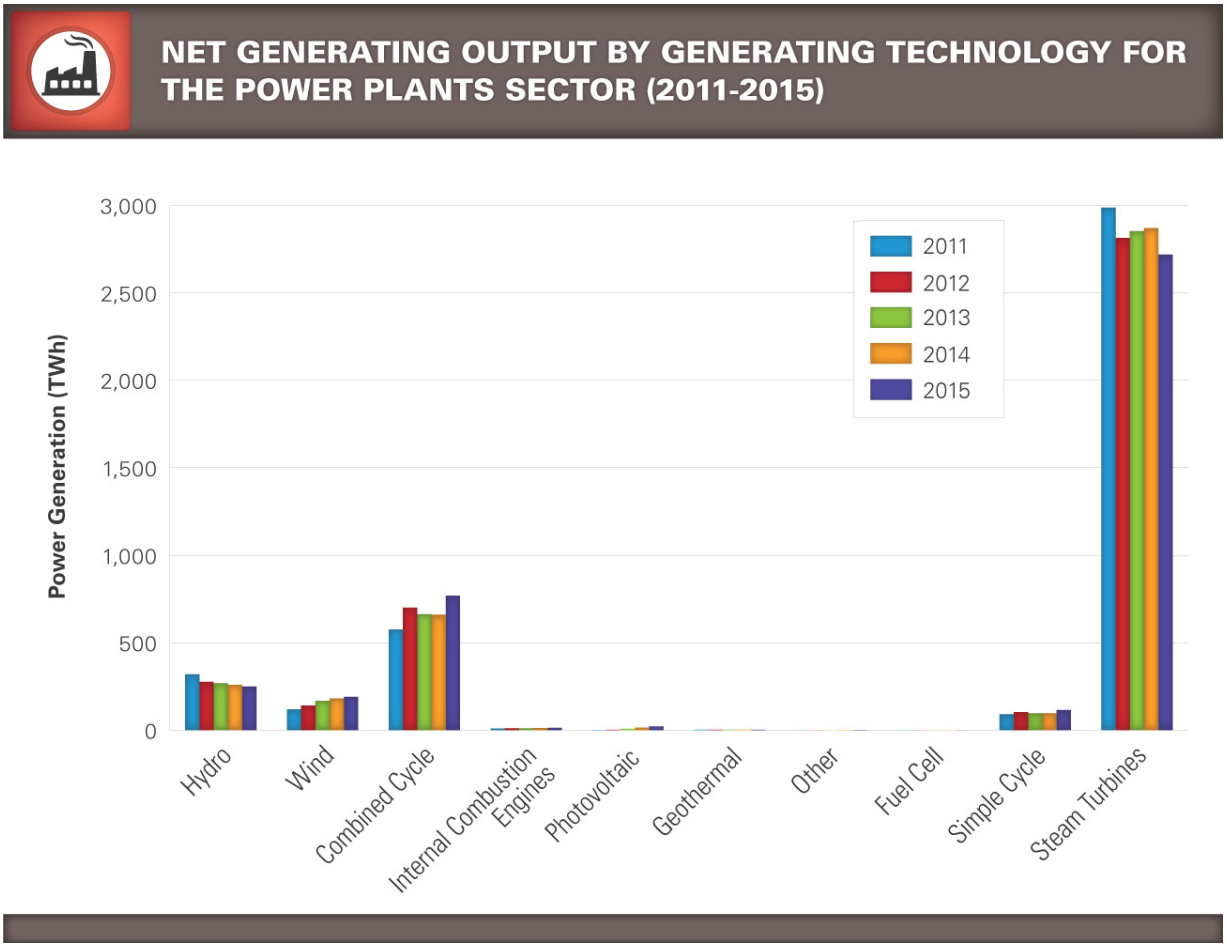
[a] Represents total emissions reported to the GHGRP from this industry. Additional emissions occur at facilities that have not reported, such as those below the reporting threshold.

Click here to view the most current information using FLIGHT.

Power Plants Sector: Emissions Trends 2011 to 2015

Emissions in the Power Plants sector decreased 11.3% from 2011 to 2015, from 2,221 MMT CO_2e in 2011 to 1,969 MMT CO_2e in 2015. Several factors contributed to this reduction, including the increased use of renewable energy sources, historically-low natural gas prices, and increased use of more efficient natural gas combined-cycle generators.[5] Overall, GHG emissions per unit electricity production have decreased from 541.8 to 481.8 MT CO_2e per thousand megawatt-hours (11.1%) since 2011. In 2011, 42.3% of U.S. electricity was produced from coal and 24.7% from natural gas. By 2015, only 33.2% of electricity production was produced from coal and 32.7% from natural gas.[6] Nationally, electricity consumption decreased by 5.7% from 2011 to 2015.[7] The number of facilities has decreased slightly, from a high of 1,609 reporters in 2012 to 1,480 reporters in 2015.

Figure 4: Power Plants Sector – Change in Net Generating Output by Generating Technology (2011–2015)[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.

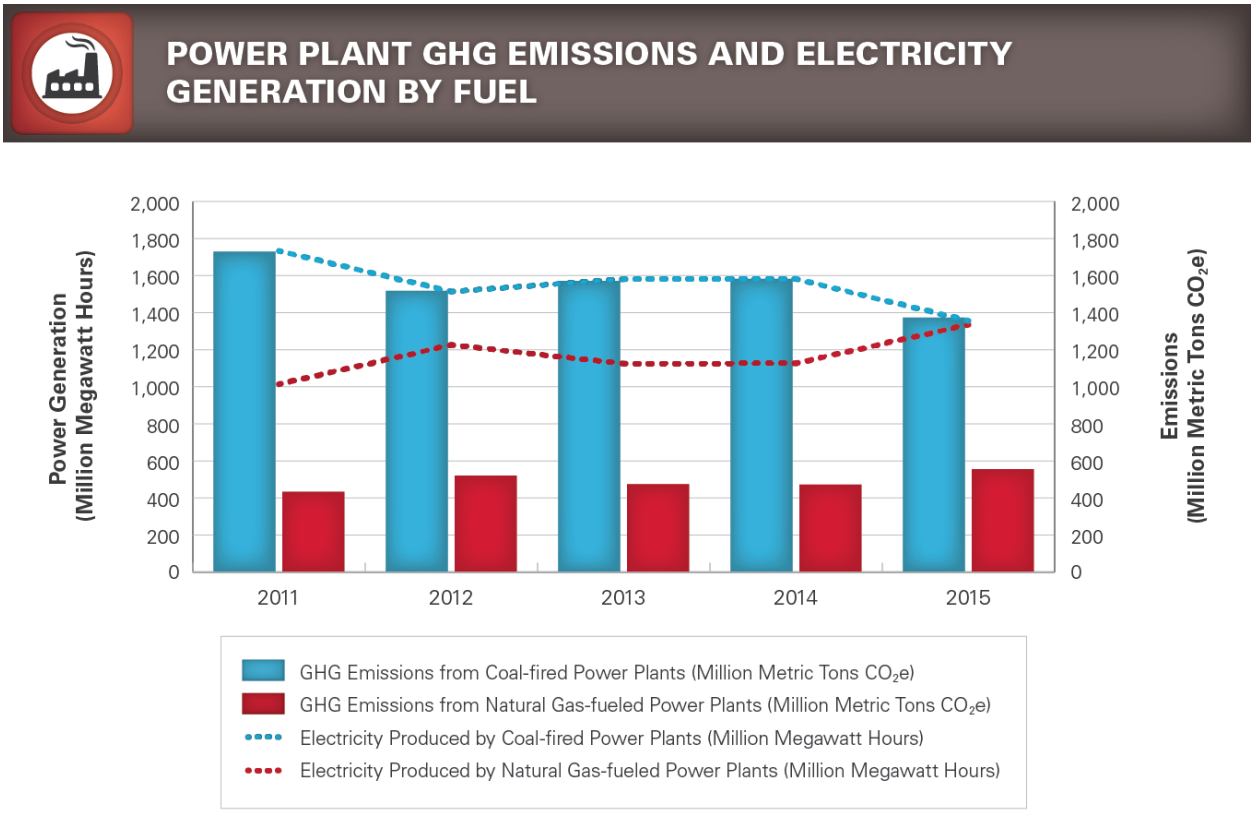
[5] Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015. U.S. Environmental Protection Agency. April 13, 2017. EPA 430-P-17-001. Available at: http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html.

[6] 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.

[7] U.S. Energy Information Administration, Electricity Data Browser: Total consumption (Btu) for all sectors, annual. Available at: http://www.eia.gov/electricity/data/browser/#/topic/8?agg=2,0,1&fuel=f&geo=g&sec=g&freq=A&start=2001&end=2015&ctype=linechart&ltype=pin&rtype=s&maptype=0&rse=0&pin=.

Coal and natural gas account for about 66% of U.S. electricity generation by utility-scale generators. Coal combustion accounted for 69.7% of total reported power plant sector emissions in 2015, natural gas combustion accounted for 28.2% of total emissions, and other fossil fuels accounted for 2.1%. In 2015, coal combustion generated 49.8% of the total megawatt hours produced from fuel combustion, and natural gas combustion generated 49.1%. Due to the higher rate of emissions per MWh of coal, emissions from coal combustion are more than double the emissions from natural gas combustion despite the generation from these fuels being close to parity in 2015.

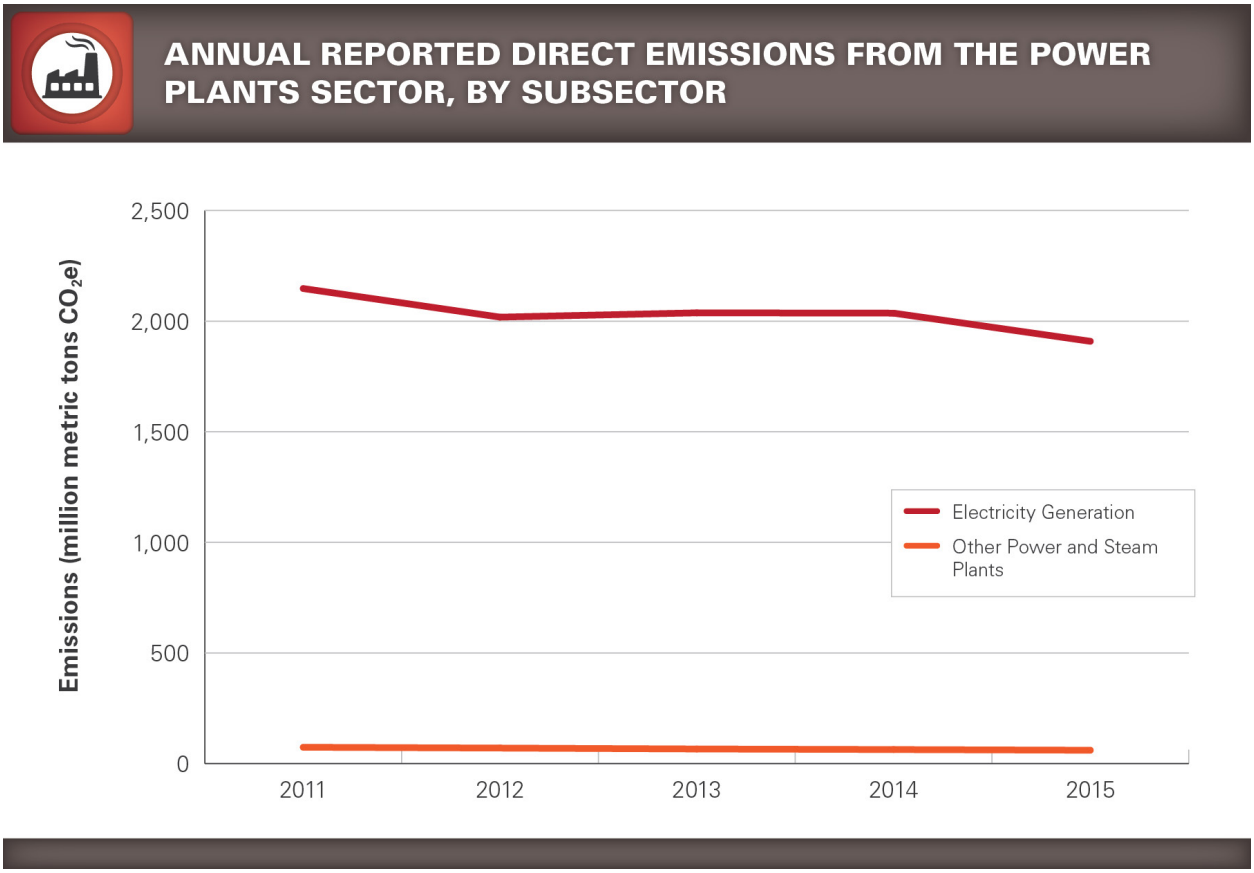
Figure 5: Power Plants Sector – Change in Net Generating Output and GHG Emissions by Fuel Type (2011–2015)[a,b]



[a] Net power generation data based on EIA Form 923 Reports) as updated through 11/28/16.

[b] Fuel-level CO_2e information based on GHGRP data dated 8/13/16. 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 (2011–2015)



Click here to view the most current information using FLIGHT.

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

Power Plants Sector	Reporting Year				
	2011	2012	2013	2014	2015
Number of facilities	1,593	1,609	1,577	1,547	1,480
Total emissions (CO_2e)	2,221.3	2,088.4	2,103.6	2,099.6	1,969.3
Emissions by GHG					
Carbon dioxide (CO_2)	2,207.9	2,076.5	2,091.4	2,087.2	1,958.3
Methane (CH_4)	4.2	3.7	3.7	4.0	3.6
Nitrous oxide (N_2O)	9.2	8.2	8.4	8.4	7.4

Table 5: Power Plants Sector – Combustion Emissions by Fuel Type – Subpart D[a]

Fuel Type	Total Reported Emissions (MMT CO_2e)				
	2011	2012	2013	2014	2015
Coal	1,701.0	1,492.7	1,549.2	1,556.2	1,349.3
Natural Gas	404.6	490.7	446.4	444.5	526.8
Petroleum Products	25.0	17.5	22.7	17.6	14.5
Other Fuels[b]	7.6	8.0	7.5	6.3	6.9

Click here to view the most current information using FLIGHT. Select a Fuel Type from the Emissions by Fuel Type filter. Note that emissions displayed in FLIGHT are for Subpart D power plants plus Subpart C.

[a] In cases where CO_2 emissions were reported at the unit level (i.e. CEMS-monitored sources), fuel level CO_2 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 CO_2.

Table 6: Power Plants Sector – Combustion Emissions by Fuel Type – Subpart C[a]

Fuel Type	Total Reported Emissions (MMT CO_2e)				
	2011	2012	2013	2014	2015
Coal	28.1	25.1	21.9	25.6	22.5
Natural Gas	28.6	30.2	28.6	27.9	28.5
Petroleum Products	22.9	20.6	23.1	17.1	17.9
Other Fuels[b]	3.3	3.5	4.0	4.2	3.1

[a] In cases where CO_2 emissions were reported at the unit level (i.e. CEMS-monitored sources), fuel level CO_2 emissions were estimated by EPA based on other data directly reported by facilities, as well as default emission factors.

[b] Excludes biogenic CO_2.

Figure 7: Power Plants Sector – Average Emissions per Reporter (2015)

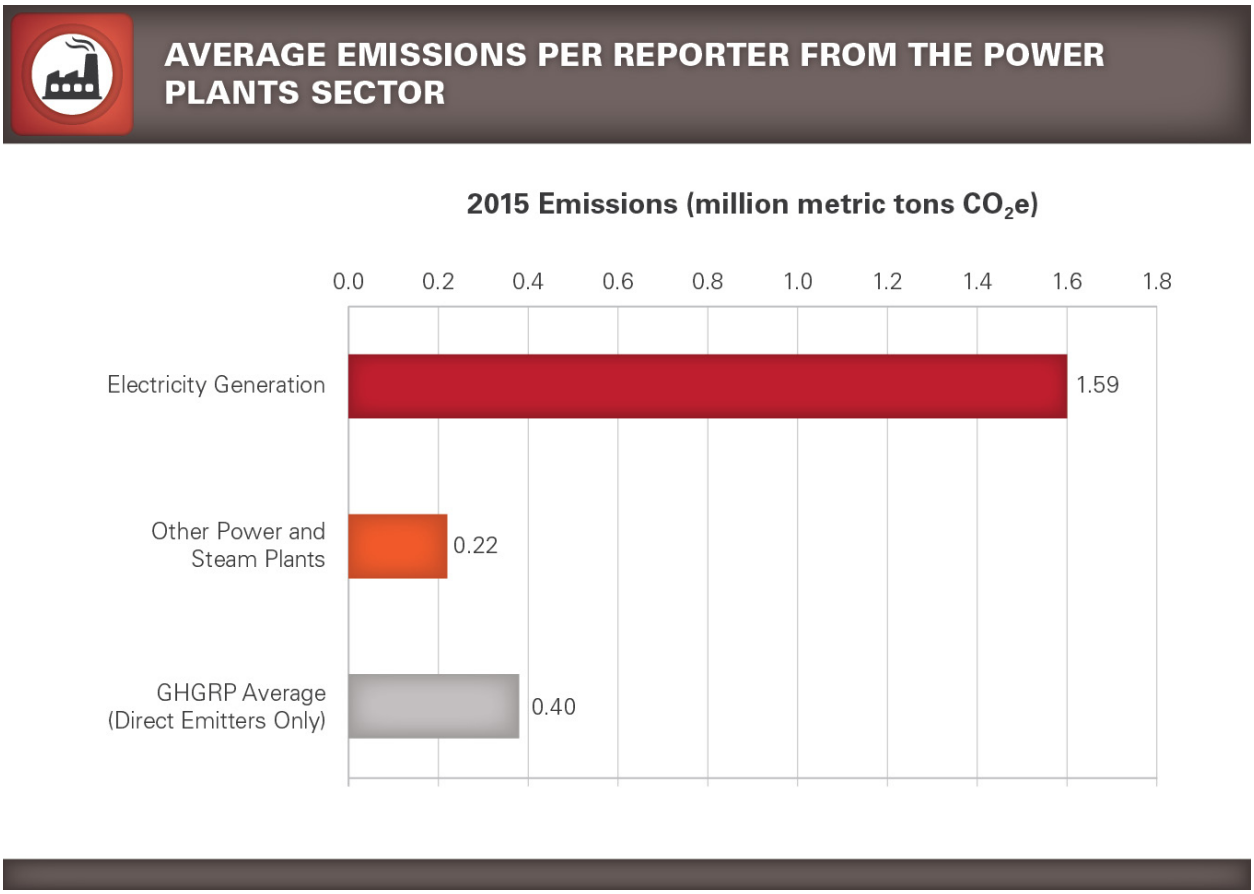


Figure 8: Power Plants Sector – Percentage of Reporters by Range of Emissions (2015)

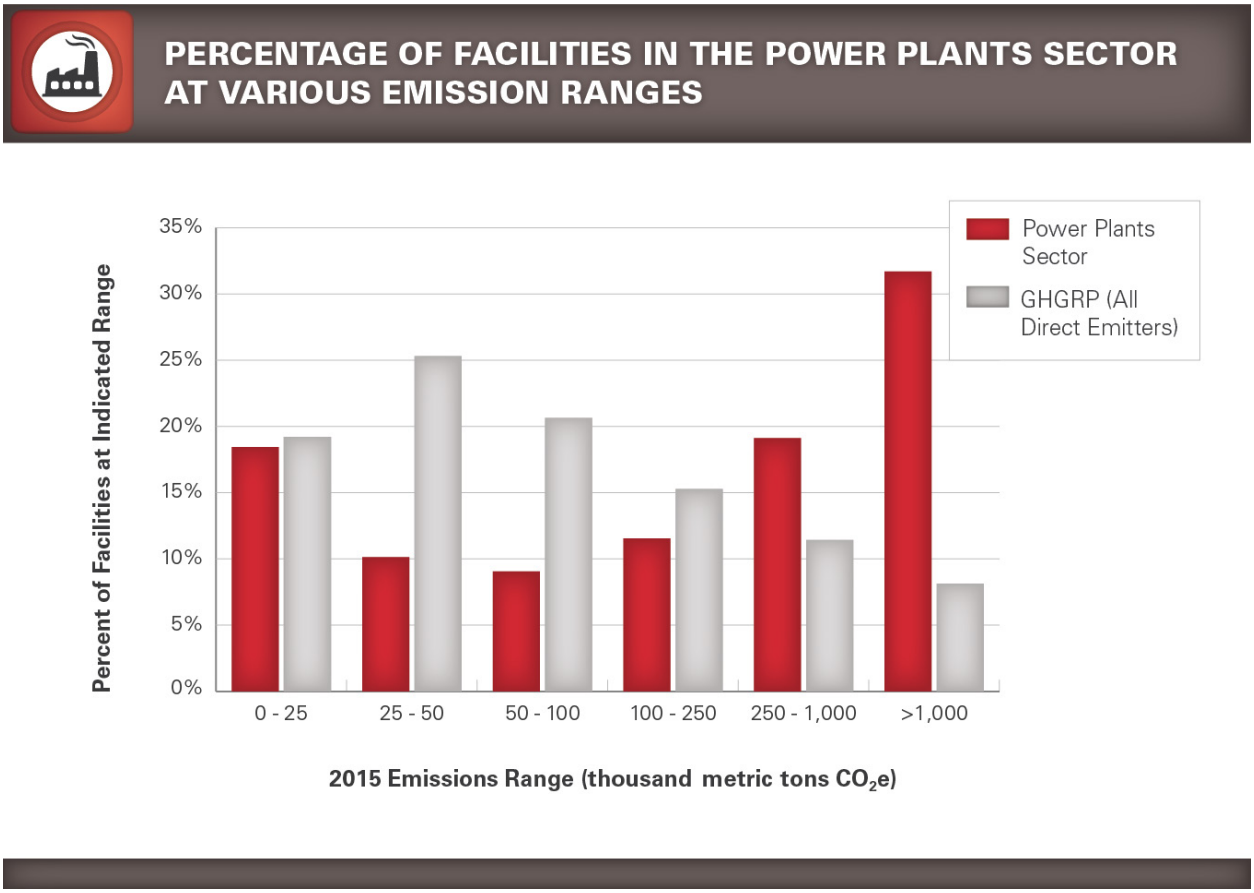


Table 7: Power Plants Sector – Number of Reporters by Emissions Range (2015)

Power Plants Sector	Number of Facilities Within 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	**273**	**150**	**134**	**171**	**283**	**469**
Electricity Generation	179	93	96	131	242	459
Other Power and Steam Plants	94	57	38	40	41	10

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 (shown in Table 8) 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 8), 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 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 (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 8: Power Plants Sector: Combustion Source Calculation Methodologies

Type of Emissions	Methodology	Portion of Emissions Monitored by Method (by Type)				
		2011	2012	2013	2014	2015
Electricity Generation: Combustion Emissions	CEMS (Subpart D)	80.2%	75.6%	77.9%	78.8%	73.9%
	Part 75 Appendix G, Equation G-4	14.4%	18.6%	16.8%	16.0%	20.6%
	Part 75 Appendix G, Equation G-1	0.7%	0.9%	0.7%	0.7%	0.9%
	LME per §75.19(c)(4)(iii)	0.1%	0.1%	0.1%	0.1%	0.1%
	CEMS (Tier 4, Subpart C)	0.8%	0.7%	0.7%	0.7%	0.7%
	Measured carbon content, and, if applicable, molecular weight (Tier 3)	1.6%	1.6%	1.4%	1.3%	1.3%
	Measured high heating values (HHVs) and default emission factors (Tier 2)	1.3%	1.3%	1.3%	1.1%	1.3%
	Default HHVs and emission factors (Tier 1)	0.4%	0.4%	0.5%	0.6%	0.6%
	Alternative Part 75 Methodologies	0.6%	0.8%	0.8%	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.

GLOSSARY

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

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/climatechange/ghgemissions/usinventoryreport.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.

IPCC AR5 refers to the Fifth Assessment Report by the Intergovernmental Panel on Climate Change. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.*

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.