

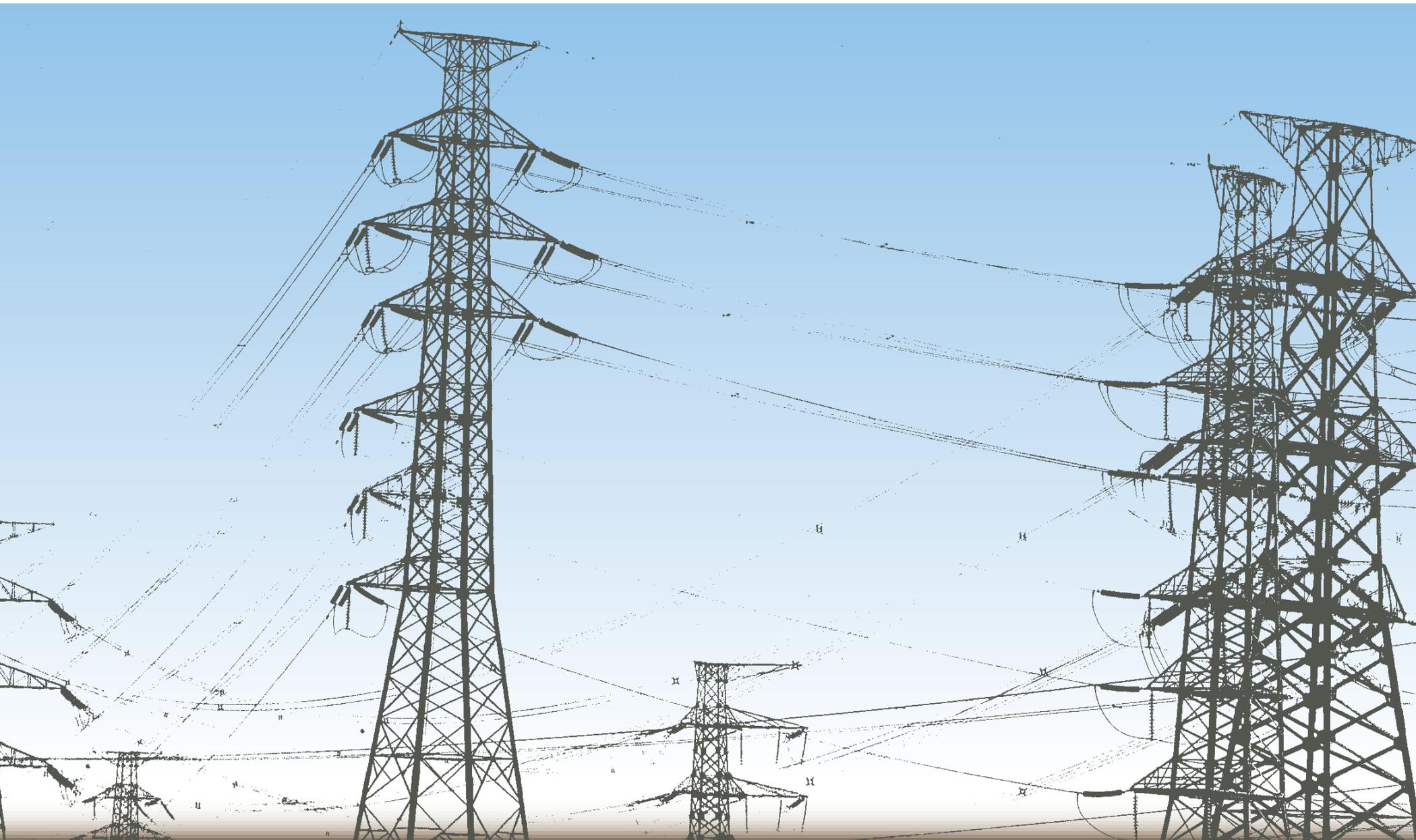


# BENCHMARKING AIR EMISSIONS

OF THE  
100 LARGEST ELECTRIC POWER PRODUCERS  
IN THE UNITED STATES

JUNE 2017







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# Acknowledgments

This report is the product of a collaborative effort among Bank of America, Calpine, Entergy, Exelon, Tenaska, Ceres, and the Natural Resources Defense Council (NRDC). The project partners would like to acknowledge and thank the following people who made this report possible. Ceres' participation in this effort was made possible by a grant from the Bank of America Charitable Foundation.

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When citing this report, the following format is recommended:

M.J. Bradley & Associates. (2017). *Benchmarking Air Emissions of the 100 Largest Electric Power Producers in the United States*.

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# Preface

The 2017 Benchmarking report is the thirteenth collaborative effort highlighting environmental performance and progress in the nation's electric power sector. The Benchmarking series began in 1997 and uses publicly reported data to compare the emissions performance of the 100 largest power producers in the United States. The current report is based on 2015 generation and emissions data.

Data on U.S. power plant generation and air emissions are available to the public through several databases maintained by state and federal agencies. Publicly- and privately-owned electric generating companies are required to report fuel and generation data to the U.S. Energy Information Administration (EIA). Most power producers are also required to report air pollutant emissions data to the U.S. Environmental Protection Agency (EPA). These data are reported and recorded at the boiler, generator, or plant level, and must be combined and presented so that company-level comparisons can be made across the industry.

The Benchmarking report facilitates the comparison of emissions performance by combining generation and fuel consumption data compiled by EIA with emissions data on sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), carbon dioxide (CO<sub>2</sub>), and mercury (Hg) compiled by EPA; error checking the data; and presenting emissions information for the nation's 100 largest power producers in a graphic format that aids in understanding and evaluating the data. The report is intended for a wide audience, including electric industry executives, environmental advocates, financial analysts, investors, journalists, power plant managers, and public policymakers.

Plant and company level data used in this report are available at [www.mjbradley.com](http://www.mjbradley.com).

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# Emissions of the 100 Largest Electric Power Producers

This report examines and compares the stack air pollutant emissions of the 100 largest power producers in the United States based on their 2015 generation, plant ownership, and emissions data. Table 1 lists the 100 largest power producers featured in this report ranked by their total electricity generation from fossil fuel, nuclear, and renewable energy facilities. These producers include public and private entities<sup>1</sup> (collectively referred to as “companies” or “producers” in this report) that own roughly 2,900 power plants and account for 85 percent of reported electric generation and 86 percent of the industry’s reported emissions.

The report focuses on four power plant pollutants for which public emissions data are available: sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), mercury (Hg), and carbon dioxide (CO<sub>2</sub>). At sufficient concentrations, these

TABLE 1

## 100 Largest Electric Power Producers in the U.S. (in order of 2015 net electric generation)

RANK	PRODUCER NAME	2015 MWh (million)	RANK	PRODUCER NAME	2015 MWh (million)	RANK	PRODUCER NAME	2015 MWh (million)	RANK	PRODUCER NAME	2015 MWh (million)
1	Duke	217.7	26	AES	28.9	51	Puget Holdings	13.1	76	El Paso Electric	9.5
2	NextEra Energy	194.0	27	LS Power	28.8	52	Municipal Elec. Auth. of GA	12.9	77	Energy Capital Partners	9.5
3	Southern	185.9	28	Salt River Project	28.4	53	JEA	12.8	78	PUD No 1 of Chelan County	9.1
4	Exelon	180.0	29	Pinnacle West	27.8	54	Tenaska	12.6	79	Brookfield	9.0
5	Tennessee Valley Authority	138.5	30	New York Power Authority	26.0	55	Lower CO River Authority	12.3	80	E.ON	8.6
6	AEP	137.8	31	CMS Energy	25.6	56	CLECO	12.3	81	Austin Energy	8.5
7	Entergy	130.4	32	ArcLight Capital	24.6	57	Edison International	12.2	82	J-Power	8.5
8	NRG	120.2	33	Oglethorpe	24.2	58	Portland General Electric	12.1	83	Energy Northwest	8.5
9	Berkshire Hathaway Energy	116.2	34	Great Plains Energy	23.7	59	NiSource	11.9	84	Dow Chemical	8.4
10	Calpine	109.8	35	SCANA	23.2	60	Ares	11.7	85	Sempra	8.1
11	Dynegy	109.7	36	Westar	23.0	61	EDP	11.5	86	TransCanada	8.1
12	Dominion	98.3	37	EDF	22.9	62	Invenery	11.5	87	Brazos Electric Power Coop	7.8
13	FirstEnergy	86.5	38	CPS Energy	22.5	63	Exxon Mobil	11.1	88	Arkansas Electric Coop	7.8
14	Xcel	73.5	39	Santee Cooper	21.7	64	Tri-State	10.9	89	Buckeye Power	7.6
15	Talen Energy	69.6	40	OGE	20.9	65	ALLETE	10.9	90	Avista	7.3
16	US Corps of Engineers	69.1	41	Basin Electric Power Coop	20.2	66	Intermountain Power Agency	10.9	91	The Blackstone Group	7.2
17	Energy Future Holdings	62.5	42	TECO	18.5	67	Fortis	10.9	92	BP	7.0
18	PSEG	56.2	43	Alliant Energy	18.3	68	PNM Resources	10.5	93	South Mississippi Electric	7.0
19	DTE Energy	42.8	44	Avangrid	17.4	69	The Carlyle Group	10.5	94	International Paper	6.9
20	Ameren	42.4	45	NE Public Power District	17.1	70	Great River Energy	10.5	95	NC Public Power	6.9
21	US Bureau of Reclamation	39.5	46	General Electric	16.5	71	Entegra Power	10.4	96	Sacramento Municipal Util Dist	6.8
22	WEC Energy Group	36.8	47	Associated Electric Coop	15.5	72	Seminole Electric Coop	10.2	97	Grand River Dam Authority	6.7
23	ENGIE	34.9	48	Omaha Public Power District	15.4	73	Occidental	9.9	98	East Kentucky Power Coop	6.7
24	PPL	34.9	49	IDACORP	13.5	74	PUD No 2 of Grant County	9.6	99	PowerSouth Energy Coop	6.7
25	PG&E	30.6	50	Los Angeles City	13.2	75	Panda Power Funds	9.6	100	Oaktree Capital	6.2

pollutants are associated with significant environmental and public health problems, including acid deposition, mercury deposition, nitrogen deposition, global warming, ground-level ozone, regional haze, and fine particle air pollution, which can trigger asthma attacks and lead to other respiratory illnesses. The report benchmarks, or ranks, each company's absolute emissions and its emission rate (determined by dividing emissions by electricity produced) for each pollutant.

The 100 largest power producers emitted in aggregate approximately 1.91 million tons of SO<sub>2</sub>, 1.17 million tons of NO<sub>x</sub>, 12.56 tons of mercury, and 1.8 billion tons of CO<sub>2</sub>. Across the industry, power plant emissions of SO<sub>2</sub> and NO<sub>x</sub> have decreased dramatically, while CO<sub>2</sub> emissions are slightly above 1990 levels. CO<sub>2</sub> emissions peaked in 2007, and have declined steadily since then. In 2015, power plant SO<sub>2</sub> and NO<sub>x</sub> emissions were 87 percent and 79 percent lower, respectively, than they were in 1990. In 2015, power plant CO<sub>2</sub> emissions were 6 percent higher than they were in 1990. However, in recent years, power plant CO<sub>2</sub> emissions have declined significantly. In 2015, power plant CO<sub>2</sub> emissions were 20 percent below 2005 levels. Emissions rates have also dropped, with 2015 power plant SO<sub>2</sub>, NO<sub>x</sub>, and CO<sub>2</sub> emissions rates 90 percent, 84 percent, and 21 percent lower, respectively, than they were in 1990. Mercury emissions from power plants have decreased 69 percent since 2000 (the first year that mercury emissions were reported by the industry under the Toxics Release Inventory). The mercury emission rate decreased by 55 percent between 2000 and 2015.

Collectively, power plants are responsible for a declining share of U.S. air pollution emissions. In 2015, power plants were responsible for about 59 percent of SO<sub>2</sub> emissions, 13 percent of NO<sub>x</sub> emissions, and 38 percent of CO<sub>2</sub> emissions. Power plants accounted for 44 percent of

FIGURE 1

## Environmental Concerns Associated with Power Plant Emissions



## CO<sub>2</sub>

- Extreme weather
- Sea level rise and impacts to natural systems



## Hg

- Bioaccumulation
- Toxic to humans



## NO<sub>x</sub>

- Excess nitrogen loading in sensitive water bodies
- Harms aquatic plants & animals
- Respiratory harm
- Crop damage



## NO<sub>x</sub> + SO<sub>2</sub>

- Premature mortality
- Lung & heart disease
- Acidifies lakes & streams
- Forest damage
- Reduced visibility in areas of national interest, such as national parks

mercury emissions in 2014, the most recent year that economy-wide data are available. Figure 2 shows the electric sector's contribution to total U.S. emissions of SO<sub>2</sub>, NO<sub>x</sub>, and CO<sub>2</sub> in 2010 and 2015, and mercury in 2011 and 2014.<sup>3</sup> As the electric sector has reduced its emissions, the sector has contributed a declining share of total emissions.

Electric power producers' emission levels and emission rates vary significantly by company due to the amount of power produced, the efficiency of the technology used in producing the power, the fuel used to generate the power, and installed pollution controls. The average and median emission levels (ton) and emission rates (lb/MWh) shown in Table 2 provide benchmark measures of overall industry emissions that can be used as reference points to evaluate the emissions performance of individual power producers.

FIGURE 2

**Change in U.S. Electric Industry Contribution to Total Emissions**  
% Share of Air Emissions

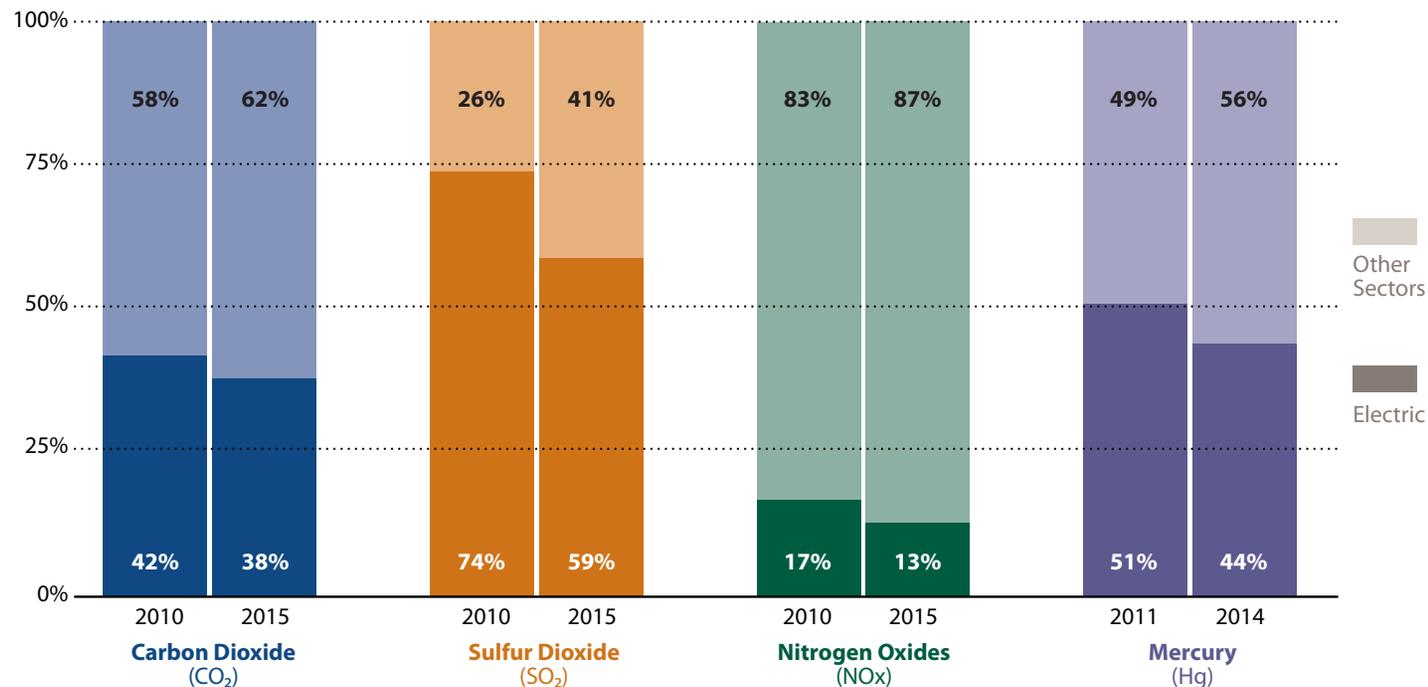


TABLE 2

**Emissions Data for 100 Largest Power Producers**  
 in order of 2015 net generation

Rank	Owner	Ownership Type*	2015 Generation (MWh)			2015 Emissions (ton)				Emission Rates (lb/MWh)									
			Total	Fossil Fuel	Coal	SO <sub>2</sub>	NO <sub>x</sub>	CO <sub>2</sub>	Hg**	All Generating Sources			Fossil Fuel Plants <sup>†</sup>			Coal Plants <sup>††</sup>			
										SO <sub>2</sub>	NO <sub>x</sub>	CO <sub>2</sub>	SO <sub>2</sub>	NO <sub>x</sub>	CO <sub>2</sub>	SO <sub>2</sub>	NO <sub>x</sub>	CO <sub>2</sub>	Hg <sup>†††</sup>
1	Duke	investor-owned corp.	217,660,843	136,310,151	76,702,725	101,918	78,257	107,913,913	0.31	0.9	0.7	992	1.5	1.1	1,583	2.6	1.8	2,077	0.01
2	NextEra Energy	investor-owned corp.	194,000,657	112,761,721	4,659,630	4,742	17,088	52,793,763	0.03	0.0	0.2	544	0.1	0.3	936	0.7	2.2	2,250	0.01
3	Southern	investor-owned corp.	185,909,900	149,053,014	62,640,702	112,626	60,083	106,727,972	0.93	1.2	0.6	1,148	1.5	0.8	1,430	3.6	1.8	2,189	0.03
4	Exelon	investor-owned corp.	180,032,937	14,734,425	208,813	1,317	2,356	7,397,355	0.00	0.0	0.0	82	0.2	0.1	1,004	2.7	2.1	2,604	0.00
5	Tennessee Valley Authority	federal power authority	138,535,807	71,173,126	50,397,085	125,685	42,896	64,859,916	0.38	1.8	0.6	936	3.5	1.2	1,823	5.0	1.6	2,204	0.02
6	AEP	investor-owned corp.	137,800,140	120,153,643	95,413,466	157,954	80,786	114,367,661	1.20	2.3	1.2	1,660	2.6	1.3	1,904	3.3	1.6	2,133	0.03
7	Entergy	investor-owned corp.	130,443,218	54,681,616	8,936,490	29,355	38,895	35,307,478	0.26	0.5	0.6	541	1.1	1.4	1,272	6.5	2.7	2,387	0.06
8	NRG	investor-owned corp.	120,230,848	102,592,804	64,734,314	196,168	55,072	92,194,596	0.84	3.3	0.9	1,534	3.8	1.1	1,797	6.0	1.5	2,252	0.03
9	Berkshire Hathaway Energy	privately held corp.	116,157,574	89,523,853	59,015,752	55,880	66,348	79,448,020	0.36	1.0	1.1	1,368	1.2	1.5	1,775	1.9	2.2	2,232	0.01
10	Calpine	investor-owned corp.	109,780,918	103,702,814	-	395	7,925	46,885,542	-	0.0	0.1	854	0.0	0.1	900	-	-	-	-
11	Dynegy	investor-owned corp.	109,701,569	109,701,569	54,597,219	69,535	34,700	85,882,790	0.19	1.3	0.6	1,566	1.3	0.6	1,566	2.5	1.2	2,247	0.01
12	Dominion	investor-owned corp.	98,306,504	52,308,403	22,416,997	14,278	16,874	37,020,735	0.21	0.3	0.3	753	0.5	0.6	1,415	1.0	1.1	2,086	0.02
13	FirstEnergy	investor-owned corp.	86,464,896	54,550,388	49,258,091	62,861	59,461	56,402,591	0.44	1.5	1.4	1,305	2.3	2.2	2,068	2.5	2.4	2,156	0.02
14	Xcel	investor-owned corp.	73,504,981	58,445,730	41,710,610	49,652	37,875	55,431,775	0.27	1.4	1.0	1,508	1.7	1.3	1,897	2.4	1.6	2,249	0.01
15	Talen Energy	investor-owned corp.	69,649,204	50,211,921	24,898,664	40,046	37,272	39,223,989	0.12	1.1	1.1	1,126	1.6	1.5	1,562	3.2	2.6	2,160	0.01
16	US Corps of Engineers	federal power authority	69,144,860	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	Energy Future Holdings	privately held corp.	62,503,772	42,549,648	41,689,054	118,483	26,275	51,297,759	1.63	3.8	0.8	1,641	5.6	1.2	2,411	5.7	1.2	2,433	0.08
18	PSEG	investor-owned corp.	56,152,089	25,921,234	5,571,415	7,609	8,459	15,020,632	0.02	0.3	0.3	535	0.6	0.7	1,159	2.7	2.6	2,081	0.01
19	DTE Energy	investor-owned corp.	42,785,264	32,993,330	30,933,978	67,067	25,347	35,791,324	0.46	3.1	1.2	1,673	4.1	1.5	2,144	4.3	1.6	2,213	0.03
20	Ameren	investor-owned corp.	42,416,038	30,275,721	30,094,812	61,238	17,455	30,950,554	0.33	2.9	0.8	1,459	4.0	1.2	2,045	4.1	1.2	2,050	0.02
21	US Bureau of Reclamation	federal power authority	39,518,143	3,298,181	3,293,716	916	3,380	3,523,406	0.01	0.0	0.2	178	0.6	2.0	2,137	0.6	2.1	2,137	0.01
22	WEC Energy Group	investor-owned corp.	36,836,447	34,869,724	25,757,714	15,944	14,232	33,329,184	0.11	0.9	0.8	1,810	0.9	0.8	1,912	1.2	1.0	2,268	0.01
23	ENGIE	foreign-owned corp.	34,918,747	33,564,637	3,268,784	8,630	5,013	17,747,754	0.05	0.5	0.3	1,017	0.5	0.3	1,057	5.2	1.3	2,151	0.03
24	PPL	investor-owned corp.	34,898,613	34,526,895	29,901,277	33,842	24,384	34,929,436	0.25	1.9	1.4	2,002	2.0	1.4	2,023	2.3	1.6	2,183	0.02
25	PG&E	investor-owned corp.	30,645,128	7,299,267	-	16	161	3,182,890	-	0.0	0.0	208	0.0	0.0	872	-	-	-	-
26	AES	investor-owned corp.	28,850,337	26,896,526	23,908,916	51,788	24,206	28,192,158	0.14	3.6	1.7	1,954	3.9	1.8	2,096	4.3	2.0	2,182	0.01
27	LS Power	privately held corp.	28,761,204	27,876,951	4,532,412	2,625	3,826	15,300,177	0.03	0.2	0.3	1,064	0.2	0.3	1,098	1.1	0.6	2,178	0.01
28	Salt River Project	power district	28,437,166	22,637,194	13,780,426	4,896	16,081	19,095,626	0.08	0.3	1.1	1,343	0.4	1.4	1,687	0.7	2.3	2,216	0.01
29	Pinnacle West	investor-owned corp.	27,773,025	17,858,479	11,075,570	6,931	22,331	15,025,666	0.11	0.5	1.6	1,082	0.8	2.5	1,683	1.2	3.9	2,153	0.02
30	New York Power Authority	state power authority	25,957,048	4,321,494	-	11	258	1,999,266	-	0.0	0.0	154	0.0	0.1	925	-	-	-	-
31	CMS Energy	investor-owned corp.	25,578,222	23,169,123	16,031,464	47,234	12,260	22,279,165	0.34	3.7	1.0	1,742	4.0	1.0	1,858	5.8	1.3	2,228	0.04
32	ArLight Capital	privately held corp.	24,614,485	20,421,155	8,053,885	12,509	12,641	14,929,226	0.03	1.0	1.0	1,213	1.2	1.2	1,462	3.1	2.9	2,026	0.01
33	Oglethorpe	cooperative	24,220,429	14,068,890	6,436,547	1,383	4,613	10,942,535	0.04	0.1	0.4	904	0.2	0.7	1,556	0.4	1.3	2,291	0.01
34	Great Plains Energy	investor-owned corp.	23,746,869	19,149,437	18,825,867	15,071	11,255	20,259,006	0.22	1.3	0.9	1,706	1.6	1.2	2,116	1.6	1.2	2,123	0.02
35	SCANA	investor-owned corp.	23,214,639	17,771,345	9,614,462	5,057	6,314	13,175,804	0.01	0.4	0.5	1,135	0.6	0.7	1,483	1.0	1.2	1,960	0.00
36	Westar	investor-owned corp.	23,009,860	18,531,332	17,290,692	6,509	10,909	21,168,739	0.30	0.6	0.9	1,840	0.7	1.2	2,285	0.8	1.2	2,359	0.03
37	EDF	foreign-owned corp.	22,942,456	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38	CPS Energy	municipality	22,527,995	14,767,774	7,696,120	10,197	5,290	12,022,643	0.05	0.9	0.5	1,067	1.4	0.7	1,628	2.6	1.0	2,255	0.01
39	Santee Cooper	state power authority	21,746,554	19,046,207	12,789,101	5,194	5,755	16,730,609	0.06	0.5	0.5	1,539	0.5	0.6	1,757	0.8	0.8	2,103	0.01
40	OGE	investor-owned corp.	20,882,206	19,454,775	10,169,283	27,223	12,236	16,332,605	0.16	2.6	1.2	1,564	2.8	1.3	1,679	5.3	1.8	2,307	0.03
41	Basin Electric Power Coop	cooperative	20,196,902	19,151,435	17,688,510	19,033	20,558	21,532,279	0.34	1.9	2.0	2,132	2.0	2.1	2,249	2.2	2.3	2,356	0.04
42	TECO	investor-owned corp.	18,451,359	18,451,359	8,484,308	8,037	6,137	13,617,791	0.02	0.9	0.7	1,476	0.8	0.6	1,476	1.7	1.2	2,126	0.00
43	Alliant Energy	investor-owned corp.	18,292,020	16,313,542	11,545,303	21,449	8,857	15,435,364	0.07	2.3	1.0	1,688	2.6	1.1	1,892	3.7	1.5	2,301	0.01
44	Avangrid	foreign-owned corp.	17,367,800	2,758,143	-	6	167	1,137,308	-	0.0	0.0	131	0.0	0.1	825	-	-	-	-
45	NE Public Power District	power district	17,089,645	9,958,875	9,731,375	27,616	9,597	10,791,214	0.26	3.2	1.1	1,263	5.5	1.9	2,167	5.7	2.0	2,192	0.05
46	General Electric	investor-owned corp.	16,462,982	16,048,550	9,287,956	100,070	18,828	12,984,208	0.22	12.2	2.3	1,577	12.5	2.3	1,618	21.5	4.0	2,138	0.05
47	Associated Electric Coop	cooperative	15,514,977	15,514,977	10,960,429	21,927	12,780	13,659,097	0.13	2.8	1.6	1,761	2.8	1.6	1,761	4.0	2.3	2,127	0.02
48	Omaha Public Power District	power district	15,398,333	11,825,350	11,740,810	32,440	11,926	12,928,115	0.24	4.2	1.5	1,679	5.5	2.0	2,187	5.5	2.0	2,195	0.04
49	IDACORP	investor-owned corp.	13,479,131	7,506,027	5,419,830	6,324	6,104	7,038,889	0.03	0.9	0.9	1,044	1.7	1.6	1,876	2.3	2.2	2,251	0.01
50	Los Angeles City	municipality	13,172,413	10,671,886	2,873,530	827	3,191	6,995,320	0.01	0.1	0.5	1,062	0.2	0.6	1,311	0.6	2.1	2,137	0.01
51	Puget Holdings	privately held corp.	13,092,506	10,681,311	4,876,335	3,202	5,641	8,244,775	0.02	0.5	0.9	1,259	0.6	1.1	1,544	1.3	2.2	2,289	0.01
52	Municipal Elec. Auth. of GA	municipality	12,898,612	5,942,144	3,239,729	693	2,224	4,884,566	0.02	0.1	0.3	757	0.2	0.7	1,644	0.4	1.3	2,291	0.01

\* Breakdown of ownership categories provided in endnote 2 ■ privately/investor owned ■ public power ■ cooperative

\*\* Mercury emissions are based on 2015 TRI data for coal plants

† Fossil fuel emission rate = pounds of pollution per MWh of electricity produced from fossil fuel

†† Coal emission rate = pounds of pollution per MWh of electricity produced from coal

††† Mercury emissions rate = pounds of mercury per gigawatt hour (GWh) of electricity produced from coal

Rank	Owner	Ownership Type*	2015 Generation (MWh)			2015 Emissions (ton)				Emission Rates (lb/MWh)									
			Total	Fossil Fuel	Coal	SO <sub>2</sub>	NO <sub>x</sub>	CO <sub>2</sub>	Hg**	All Generating Sources			Fossil Fuel Plants†			Coal Plants††			
										SO <sub>2</sub>	NO <sub>x</sub>	CO <sub>2</sub>	SO <sub>2</sub>	NO <sub>x</sub>	CO <sub>2</sub>	SO <sub>2</sub>	NO <sub>x</sub>	CO <sub>2</sub>	Hg†††
53	JEA	municipality	12,823,553	12,823,553	5,838,120	6,522	11,942	10,823,644	0.03	1.0	1.9	1,688	1.0	1.9	1,688	2.2	3.6	2,211	0.01
54	Tenaska	privately held corp.	12,623,396	12,321,984	-	29	853	5,556,635	-	0.0	0.1	880	0.0	0.1	902	-	-	-	-
55	Lower CO River Authority	state power authority	12,335,667	12,285,227	5,930,127	792	3,829	9,622,504	0.09	0.1	0.6	1,560	0.1	0.6	1,567	0.3	1.1	2,284	0.03
56	CLECO	investor-owned corp.	12,274,269	12,274,269	2,961,681	13,743	4,477	9,557,597	0.07	2.2	0.7	1,557	2.2	0.7	1,557	7.9	1.9	2,392	0.05
57	Edison International	investor-owned corp.	12,188,485	5,935,329	-	13	196	2,624,784	-	0.0	0.0	431	0.0	0.1	884	-	-	-	-
58	Portland General Electric	investor-owned corp.	12,088,398	8,832,216	4,171,103	5,463	4,726	6,697,175	0.01	0.9	0.8	1,108	1.2	1.1	1,517	2.6	2.1	2,231	0.01
59	NiSource	investor-owned corp.	11,874,544	11,835,292	8,417,704	12,359	7,129	11,625,432	0.10	2.1	1.2	1,958	2.1	1.2	1,965	2.9	1.7	2,409	0.02
60	Ares	investor-owned corp.	11,721,859	11,640,646	1,212,572	1,256	3,640	5,336,813	0.00	0.2	0.6	911	0.2	0.6	917	2.0	4.8	2,332	0.00
61	EDP	foreign-owned corp.	11,508,222	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
62	Invernergy	privately held corp.	11,458,744	3,917,171	-	9	362	1,497,939	-	0.0	0.1	261	0.0	0.2	765	-	-	-	-
63	Exxon Mobil	investor-owned corp.	11,091,160	9,843,616	-	33	1,099	4,581,629	-	0.0	0.2	826	0.0	0.1	786	-	-	-	-
64	Tri-State	cooperative	10,914,243	10,914,243	10,100,098	6,243	13,170	11,714,035	0.05	1.1	2.4	2,147	1.1	2.4	2,147	1.2	2.5	2,227	0.01
65	ALLETE	investor-owned corp.	10,863,973	7,401,896	7,391,151	6,418	5,003	8,463,716	0.10	1.2	0.9	1,558	1.7	1.3	2,287	1.7	1.3	2,288	0.03
66	Intermountain Power Agency	power district	10,860,909	10,860,909	10,854,078	3,768	20,775	10,898,926	0.00	0.7	3.8	2,007	0.7	3.8	2,007	0.7	3.8	2,007	0.00
67	Fortis	foreign-owned corp.	10,850,186	10,708,031	7,383,425	4,719	9,282	9,839,523	0.05	0.9	1.7	1,814	0.9	1.7	1,838	1.3	2.4	2,283	0.01
68	PNM Resources	investor-owned corp.	10,535,900	7,062,850	5,481,158	2,569	10,431	7,023,907	0.01	0.5	2.0	1,333	0.7	3.0	1,989	0.9	3.7	2,253	0.00
69	The Carlyle Group	privately held corp.	10,471,075	10,412,220	32,870	218	556	4,650,595	-	0.0	0.1	888	0.0	0.1	893	11.8	4.8	2,896	-
70	Great River Energy	cooperative	10,462,127	10,332,418	10,094,879	17,676	10,352	11,745,326	0.26	3.4	2.0	2,245	3.4	2.0	2,273	3.5	2.0	2,293	0.05
71	Entegra Power	privately held corp.	10,394,963	10,394,963	-	34	625	6,748,035	-	0.0	0.1	1,298	0.0	0.1	1,298	-	-	-	-
72	Seminole Electric Coop	cooperative	10,238,369	10,238,369	7,725,626	10,192	2,391	8,974,602	0.06	2.0	0.5	1,753	2.0	0.5	1,753	2.6	0.5	2,033	0.02
73	Occidental	investor-owned corp.	9,907,066	9,793,384	-	2	525	4,746,543	-	0.0	0.1	958	0.0	0.1	955	-	-	-	-
74	PUD No 2 of Grant County	power district	9,615,304	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	Panda Power Funds	privately held corp.	9,555,661	9,541,677	-	22	240	4,351,133	-	0.0	0.1	911	0.0	0.1	912	-	-	-	-
76	El Paso Electric	investor-owned corp.	9,497,500	4,358,456	708,951	520	4,597	2,953,746	0.00	0.1	1.0	622	0.2	2.1	1,355	1.4	5.1	2,090	0.01
77	Energy Capital Partners	privately held corp.	9,464,117	4,314,908	255,963	378	563	2,313,000	0.00	0.1	0.1	489	0.2	0.3	1,072	2.9	2.5	3,099	0.01
78	PUD No 1 of Chelan County	power district	9,105,250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
79	Brookfield	foreign-owned corp.	8,973,021	307,320	-	1	37	157,859	-	0.0	0.0	35	0.0	0.2	1,027	-	-	-	-
80	E.ON	foreign-owned corp.	8,590,046	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81	Austin Energy	municipality	8,541,594	5,437,506	3,170,201	350	2,512	4,824,813	0.05	0.1	0.6	1,130	0.1	0.9	1,775	0.2	1.2	2,285	0.03
82	J-Power	foreign-owned corp.	8,513,198	8,513,198	276,938	154	930	4,054,166	0.00	0.0	0.2	952	0.0	0.2	952	1.0	1.0	2,216	0.00
83	Energy Northwest	municipality	8,459,842	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
84	Dow Chemical	investor-owned corp.	8,418,055	7,431,714	-	7	357	3,874,957	-	0.0	0.1	921	0.0	0.1	919	-	-	-	-
85	Sempra	investor-owned corp.	8,088,176	5,278,661	-	12	159	2,288,624	-	0.0	0.0	566	0.0	0.1	867	-	-	-	-
86	TransCanada	foreign-owned corp.	8,056,993	6,364,887	-	94	1,615	3,586,937	-	0.0	0.4	890	0.0	0.5	1,127	-	-	-	-
87	Brazos Electric Power Coop	cooperative	7,848,351	7,848,351	873,133	416	695	4,077,358	0.00	0.1	0.2	1,039	0.1	0.2	1,039	0.9	0.5	2,270	0.01
88	Arkansas Electric Coop	cooperative	7,784,183	7,286,059	5,875,937	15,748	8,194	7,330,938	0.15	4.0	2.1	1,884	4.3	2.2	2,012	5.4	2.6	2,256	0.05
89	Buckeye Power	cooperative	7,625,675	7,625,675	7,523,903	8,101	4,354	7,851,832	0.04	2.1	1.1	2,059	2.1	1.1	2,059	2.2	1.1	2,069	0.01
90	Avista	investor-owned corp.	7,252,153	3,497,354	1,523,610	992	1,683	2,568,802	0.01	0.3	0.5	708	0.6	1.0	1,469	1.3	2.2	2,289	0.01
91	The Blackstone Group	privately held corp.	7,194,450	7,194,450	-	16	1,056	3,127,742	-	0.0	0.3	869	0.0	0.3	869	-	-	-	-
92	BP	foreign-owned corp.	7,032,491	2,259,999	-	7	155	1,323,712	-	0.0	0.0	376	0.0	0.1	1,052	-	-	-	-
93	South Mississippi Electric	cooperative	6,982,037	5,810,578	244,244	235	1,133	2,975,662	0.01	0.1	0.3	852	0.1	0.4	1,024	1.8	4.8	2,368	0.09
94	International Paper	investor-owned corp.	6,920,053	1,667,010	170,973	-	2,142	765,720	-	-	0.6	221	-	2.6	919	-	14.9	1,881	-
95	NC Public Power	municipality	6,892,803	1,255	-	-	-	1,938	-	-	-	1	-	-	3,089	-	-	-	-
96	Sacramento Municipal Util Dist	municipality	6,785,777	5,717,687	-	13	141	2,426,423	-	0.0	0.0	715	0.0	0.0	849	-	-	-	-
97	Grand River Dam Authority	state power authority	6,718,304	5,845,488	2,985,359	8,782	2,966	5,194,093	0.09	2.6	0.9	1,546	3.0	1.0	1,777	5.9	1.9	2,606	0.06
98	East Kentucky Power Coop	cooperative	6,671,243	6,546,011	6,083,108	5,109	3,613	7,038,831	0.02	1.5	1.1	2,110	1.6	1.1	2,151	1.7	1.2	2,207	0.01
99	PowerSouth Energy Coop	cooperative	6,666,690	6,652,746	2,356,797	2,550	3,392	4,671,748	0.02	0.8	1.0	1,402	0.8	1.0	1,404	2.2	2.6	2,293	0.02
100	Oaktree Capital	investor-owned corp.	6,202,005	6,202,005	-	15	331	2,604,108	-	0.0	0.1	840	0.0	0.1	840	-	-	-	-
	Total (in thousands)		3,432,620	2,261,530	1,161,798	1,910	1,167	1,797,427	0.01										
	Average									1.1	0.8	1,171	1.4	1.0	1,539	3.0	2.2	2,241	0.02
	Average (weighted by MWh)									1.2	0.7	1,092	1.7	1.0	1,586	3.3	1.8	2,200	0.02
	Median									0.5	0.6	1,130	0.7	1.0	1,566	2.3	1.9	2,228	0.01

\* Breakdown of ownership categories provided in endnote 2 ■ privately/investor owned ■ public power ■ cooperative

## Generation by Fuel Type

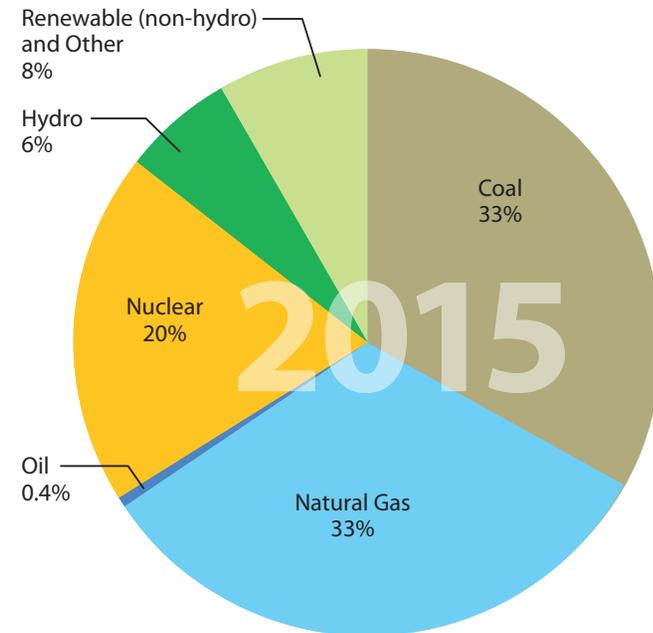
The 100 largest power producers in the U.S. accounted for 85 percent of the electricity produced in 2015. Coal accounted for 34 percent of the power produced by the 100 largest companies, followed by natural gas (32 percent), nuclear (23 percent), hydroelectric power (6 percent), oil (<1 percent), and non-hydroelectric renewables and other fuel sources such as non-biogenic municipal solid waste, tire-derived fuel, manufactured and waste gases, etc. (5 and 1 percent, respectively). This is a dramatic shift from a decade ago (2006), when coal and natural gas accounted for 52 percent and 17 percent of power production, respectively, of the 100 largest producers. In 2006, non-hydroelectric renewables accounted for less than 1 percent of the power produced by the 100 largest power producers. Among smaller companies (i.e., those not within the top 100), natural gas was the source of 37 percent of the power produced, followed by coal (29 percent), non-hydroelectric renewables/other (23 percent), hydroelectric power (6 percent), nuclear power (3 percent), and oil (2 percent).

As a portion of total electric power production, the 100 largest producers accounted for 87 percent of all coal-fired power, 82 percent of natural gas-fired power, 43 percent of oil-fired power, 97 percent of nuclear power, 85 percent of hydroelectric power, and 71 percent of non-hydroelectric renewable power.

Figure 4 presents the in-service year and fuel type of the existing electric generating fleet in the U.S. Figure 5 illustrates the 2015 electricity generation by fuel for each of the 100 largest power producers. The generation levels, expressed in million megawatt hours (MWh), show production from facilities wholly and partially owned by each producer and reported to the EIA. Coal or nuclear accounted for over

FIGURE 3

Total U.S. Electricity Generation by Fuel Type (2015)



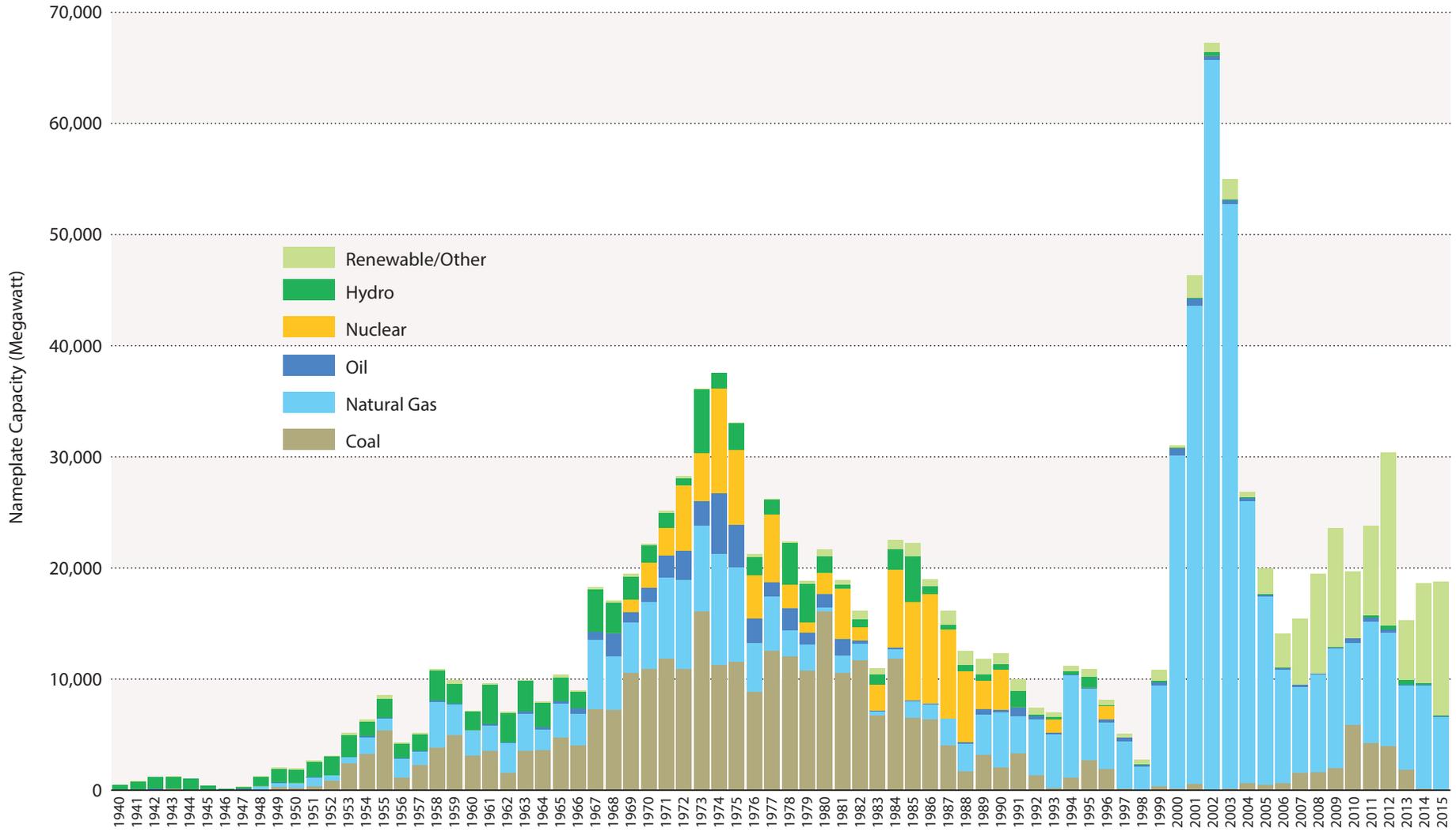
SOURCE: U.S. ENERGY INFORMATION ADMINISTRATION, EIA-923  
MONTHLY GENERATION AND FUEL CONSUMPTION 2015 FINAL RELEASE

half of the output of the largest producers. The exceptions are a handful of generating companies whose assets are dominated by hydroelectric or natural gas-fired plants.

Table 3 shows the 2015 fuel-mix for each of the 100 largest power producers. The share of each major fuel type—coal, gas, oil, nuclear, hydro, and renewable/other—is shown as a percentage share of total generation from facilities wholly and partially owned by each producer and reported to the EIA.

These data reflect the mix of generating facilities that are directly owned by the 100 largest power producers, not the energy purchases that some utility companies rely on to meet their customers' electricity needs. For example, some utility companies have signed long-term supply contracts for the output of renewable energy projects. In this report, the output of these facilities would be attributed to the owner of the project, not the buyer of the output.

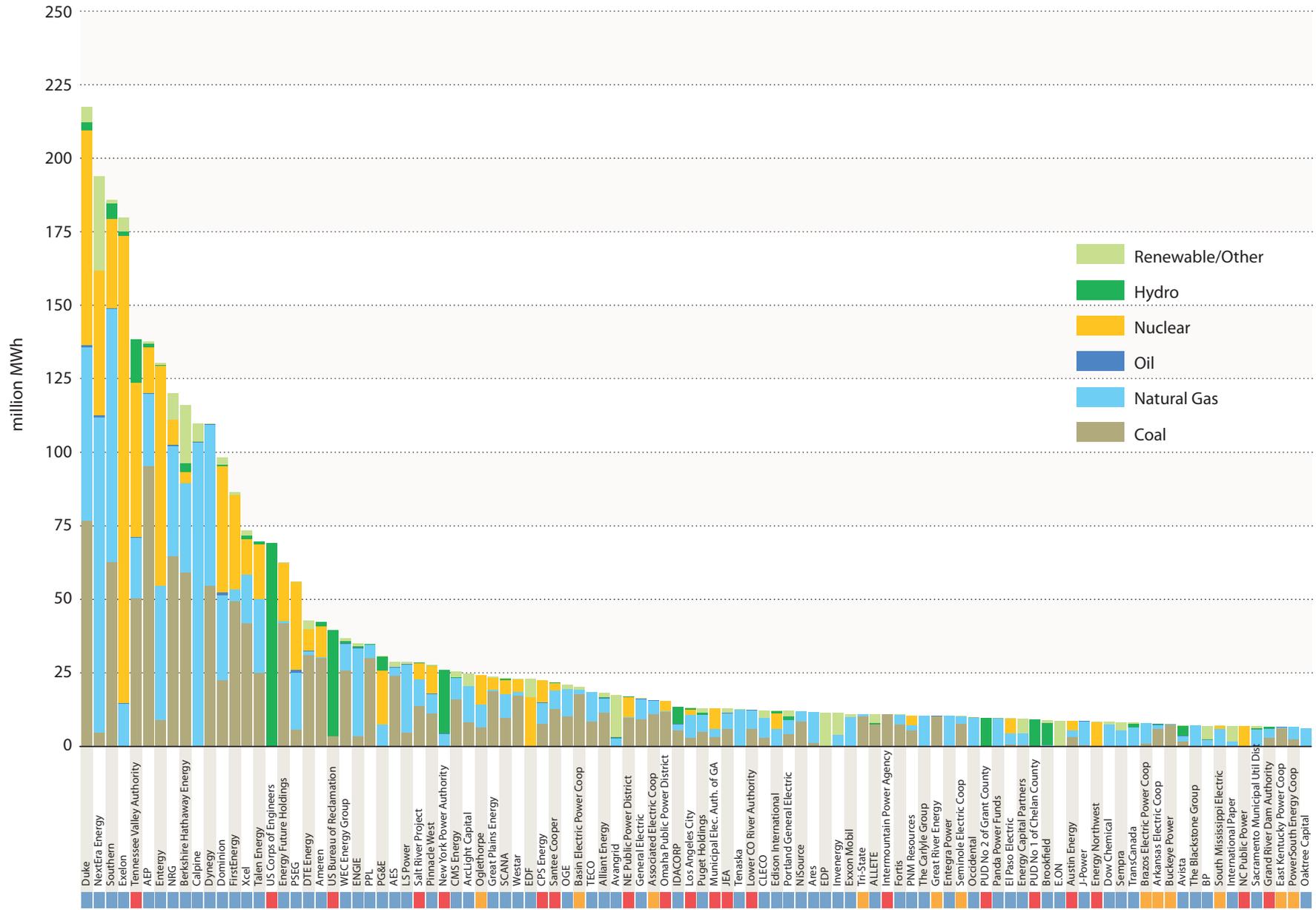
**FIGURE 4**  
**U.S. Electric Generating Capacity by In Service Year: 1940 - 2015**



SOURCE: U.S. ENERGY INFORMATION ADMINISTRATION. EIA-860 ANNUAL ELECTRIC GENERATOR REPORT. OCTOBER 6, 2016.

FIGURE 5

Net Generation of 100 Largest Power Producers by Fuel Type (2015)



\* Breakdown of ownership categories provided in endnote 2

privately/investor owned public power cooperative

TABLE 3

**Fuel Mix of 100 Largest Power Producers**  
in order of 2015 net generation

Rank	Owner	Ownership Type*	Total (million MWh)	Coal	Natural Gas	Oil	Nuclear	Hydro	Renewable/ Other
1	Duke	investor-owned corp.	217.7	35%	27%	0.2%	34%	1%	2%
2	NextEra Energy	investor-owned corp.	194.0	2%	55%	0.5%	25%	0%	17%
3	Southern	investor-owned corp.	185.9	34%	46%	0.1%	16%	3%	1%
4	Exelon	investor-owned corp.	180.0	0%	8%	0.2%	88%	1%	3%
5	Tennessee Valley Authority	federal power authority	138.5	36%	15%	0.1%	38%	11%	0%
6	AEP	investor-owned corp.	137.8	69%	18%	0.1%	11%	1%	1%
7	Entergy	investor-owned corp.	130.4	7%	35%	0.1%	57%	0%	1%
8	NRG	investor-owned corp.	120.2	54%	31%	0.5%	7%	0%	8%
9	Berkshire Hathaway Energy	privately held corp.	116.2	51%	26%	0.1%	3%	3%	17%
10	Calpine	investor-owned corp.	109.8	0%	94%	0.4%	0%	0%	6%
11	Dynegy	investor-owned corp.	109.7	50%	50%	0.2%	0%	0%	0%
12	Dominion	investor-owned corp.	98.3	23%	29%	0.9%	44%	1%	2%
13	FirstEnergy	investor-owned corp.	86.5	57%	5%	0.1%	37%	0%	1%
14	Xcel	investor-owned corp.	73.5	57%	23%	0.0%	16%	2%	3%
15	Talen Energy	investor-owned corp.	69.6	36%	36%	0.3%	27%	1%	0%
16	US Corps of Engineers	federal power authority	69.1	0%	0%	0.0%	0%	100%	0%
17	Energy Future Holdings	privately held corp.	62.5	67%	1%	0.1%	32%	0%	0%
18	PSEG	investor-owned corp.	56.2	10%	35%	1.7%	53%	0%	0%
19	DTE Energy	investor-owned corp.	42.8	72%	3%	0.1%	17%	0%	7%
20	Ameren	investor-owned corp.	42.4	71%	0%	0.0%	25%	4%	0%
21	US Bureau of Reclamation	federal power authority	39.5	8%	0%	0.0%	0%	92%	0%
22	WEC Energy Group	investor-owned corp.	36.8	70%	25%	0.0%	0%	2%	3%
23	ENGIE	foreign-owned corp.	34.9	9%	86%	0.5%	0%	2%	2%
24	PPL	investor-owned corp.	34.9	86%	13%	0.0%	0%	1%	0%
25	PG&E	investor-owned corp.	30.6	0%	24%	0.0%	60%	15%	1%
26	AES	investor-owned corp.	28.9	83%	10%	0.2%	0%	0%	7%
27	LS Power	privately held corp.	28.8	16%	81%	0.1%	0%	0%	3%
28	Salt River Project	power district	28.4	48%	31%	0.1%	20%	0%	0%
29	Pinnacle West	investor-owned corp.	27.8	40%	24%	0.0%	34%	0%	2%
30	New York Power Authority	state power authority	26.0	0%	16%	0.4%	0%	83%	0%
31	CMS Energy	investor-owned corp.	25.6	63%	28%	0.2%	0%	2%	8%
32	ArcLight Capital	privately held corp.	24.6	33%	50%	0.2%	0%	0%	17%
33	Oglethorpe	cooperative	24.2	27%	31%	0.0%	42%	0%	0%
34	Great Plains Energy	investor-owned corp.	23.7	79%	1%	0.2%	17%	0%	2%
35	SCANA	investor-owned corp.	23.2	41%	35%	0.3%	20%	2%	1%
36	Westar	investor-owned corp.	23.0	75%	5%	0.1%	18%	0%	2%
37	EDF	foreign-owned corp.	22.9	0%	0%	0.0%	73%	0%	27%
38	CPS Energy	municipality	22.5	34%	31%	0.0%	34%	0%	0%
39	Santee Cooper	state power authority	21.7	59%	29%	0.2%	11%	1%	0%
40	OGE	investor-owned corp.	20.9	49%	44%	0.0%	0%	0%	7%
41	Basin Electric Power Coop	cooperative	20.2	88%	7%	0.1%	0%	0%	5%
42	TECO	investor-owned corp.	18.5	46%	54%	0.0%	0%	0%	0%
43	Alliant Energy	investor-owned corp.	18.3	63%	26%	0.1%	0%	2%	9%
44	Avangrid	foreign-owned corp.	17.4	0%	16%	0.1%	0%	2%	82%
45	NE Public Power District	power district	17.1	57%	1%	0.0%	40%	1%	1%
46	General Electric	investor-owned corp.	16.5	56%	41%	0.3%	0%	0%	2%
47	Associated Electric Coop	cooperative	15.5	71%	29%	0.1%	0%	0%	0%
48	Omaha Public Power District	power district	15.4	76%	1%	0.0%	23%	0%	0%
49	IDACORP	investor-owned corp.	13.5	40%	15%	0.1%	0%	44%	0%
50	Los Angeles City	municipality	13.2	22%	59%	0.0%	14%	3%	2%
51	Puget Holdings	privately held corp.	13.1	37%	44%	0.0%	0%	5%	13%
52	Municipal Elec. Auth. of GA	municipality	12.9	25%	21%	0.0%	54%	0%	0%

\* Breakdown of ownership categories provided in endnote 2 ■ privately/investor owned ■ public power ■ cooperative

Rank	Owner	Ownership Type*	Total (million MWh)	Coal	Natural Gas	Oil	Nuclear	Hydro	Renewable/ Other
53	JEA	municipality	12.8	46%	42%	0.1%	0%	0%	12%
54	Tenaska	privately held corp.	12.6	0%	98%	0.0%	0%	0%	2%
55	Lower CO River Authority	state power authority	12.3	48%	51%	0.1%	0%	0%	0%
56	CLECO	investor-owned corp.	12.3	24%	54%	0.0%	0%	0%	22%
57	Edison International	investor-owned corp.	12.2	0%	48%	0.2%	42%	8%	1%
58	Portland General Electric	investor-owned corp.	12.1	35%	38%	0.1%	0%	12%	15%
59	NiSource	investor-owned corp.	11.9	71%	29%	0.0%	0%	0%	0%
60	Ares	investor-owned corp.	11.7	10%	88%	0.5%	0%	0%	1%
61	EDP	foreign-owned corp.	11.5	0%	0%	0.0%	0%	0%	100%
62	Invenergy	privately held corp.	11.5	0%	34%	0.0%	0%	0%	66%
63	Exxon Mobil	investor-owned corp.	11.1	0%	89%	0.0%	0%	0%	11%
64	Tri-State	cooperative	10.9	93%	7%	0.1%	0%	0%	0%
65	ALLETE	investor-owned corp.	10.9	68%	0%	0.0%	0%	4%	28%
66	Intermountain Power Agency	power district	10.9	100%	0%	0.1%	0%	0%	0%
67	Fortis	foreign-owned corp.	10.9	68%	31%	0.1%	0%	0%	1%
68	PNM Resources	investor-owned corp.	10.5	52%	15%	0.3%	31%	0%	1%
69	The Carlyle Group	privately held corp.	10.5	0%	99%	0.0%	0%	0%	1%
70	Great River Energy	cooperative	10.5	96%	2%	0.1%	0%	0%	1%
71	Entegra Power	privately held corp.	10.4	0%	100%	0.0%	0%	0%	0%
72	Seminole Electric Coop	cooperative	10.2	75%	24%	0.2%	0%	0%	0%
73	Occidental	investor-owned corp.	9.9	0%	99%	0.0%	0%	0%	1%
74	PUD No 2 of Grant County	power district	9.6	0%	0%	0.0%	0%	100%	0%
75	Panda Power Funds	privately held corp.	9.6	0%	100%	0.0%	0%	0%	0%
76	El Paso Electric	investor-owned corp.	9.5	7%	38%	0.0%	54%	0%	0%
77	Energy Capital Partners	privately held corp.	9.5	3%	43%	0.1%	0%	0%	54%
78	PUD No 1 of Chelan County	power district	9.1	0%	0%	0.0%	0%	100%	0%
79	Brookfield	foreign-owned corp.	9.0	0%	3%	0.0%	0%	85%	11%
80	E.ON	foreign-owned corp.	8.6	0%	0%	0.0%	0%	0%	100%
81	Austin Energy	municipality	8.5	37%	26%	0.1%	36%	0%	0%
82	J-Power	foreign-owned corp.	8.5	3%	96%	0.3%	0%	0%	0%
83	Energy Northwest	municipality	8.5	0%	0%	0.0%	96%	1%	2%
84	Dow Chemical	investor-owned corp.	8.4	0%	88%	0.0%	0%	0%	12%
85	Sempra	investor-owned corp.	8.1	0%	65%	0.0%	0%	0%	35%
86	TransCanada	foreign-owned corp.	8.1	0%	78%	0.8%	0%	17%	4%
87	Brazos Electric Power Coop	cooperative	7.8	11%	89%	0.0%	0%	0%	0%
88	Arkansas Electric Coop	cooperative	7.8	75%	18%	0.2%	0%	6%	0%
89	Buckeye Power	cooperative	7.6	99%	1%	0.3%	0%	0%	0%
90	Avista	investor-owned corp.	7.3	21%	27%	0.0%	0%	47%	4%
91	The Blackstone Group	privately held corp.	7.2	0%	100%	0.0%	0%	0%	0%
92	BP	foreign-owned corp.	7.0	0%	32%	0.0%	0%	0%	67%
93	South Mississippi Electric	cooperative	7.0	3%	80%	0.0%	17%	0%	0%
94	International Paper	investor-owned corp.	6.9	2%	21%	1.1%	0%	0%	76%
95	NC Public Power	municipality	6.9	0%	0%	0.0%	100%	0%	0%
96	Sacramento Municipal Util Dist	municipality	6.8	0%	84%	0.0%	0%	7%	8%
97	Grand River Dam Authority	state power authority	6.7	44%	43%	0.0%	0%	13%	0%
98	East Kentucky Power Coop	cooperative	6.7	91%	7%	0.3%	0%	0%	2%
99	PowerSouth Energy Coop	cooperative	6.7	35%	64%	0.1%	0%	0%	0%
100	Oaktree Capital	investor-owned corp.	6.2	0%	100%	0.5%	0%	0%	0%
Total (top-100 producers)			3,432.6	34%	32%	0.2%	23%	6%	6%
Total (all U.S. producers)			4,053.7	33%	33%	0.4%	20%	6%	8%

\* Breakdown of ownership categories provided in endnote 2 ■ privately/investor owned ■ public power ■ cooperative

## Emissions Rankings

Table 4 shows the relative ranking of the 100 largest power producers by several measures—their contribution to total generation (MWh), total emissions, and emission rates (emissions per unit of electricity output). These rankings help to evaluate and compare emissions performance.

Figures 6 through 9 illustrate SO<sub>2</sub>, NO<sub>x</sub>, CO<sub>2</sub>, and mercury emissions levels (expressed in tons for SO<sub>2</sub>, NO<sub>x</sub>, and CO<sub>2</sub>, and pounds for mercury) and emission rates for each of the 100 largest producers. These comparisons illustrate the relative emissions performance of each producer based on the company's ownership stake in power plants with reported emissions information. For SO<sub>2</sub> and NO<sub>x</sub>, the report presents comparisons of total emissions levels and rates for fossil fuel-fired facilities. For CO<sub>2</sub>, the report presents comparisons of total emissions levels and rates for all generating sources (e.g., fossil, nuclear, and renewable). For mercury, the report presents comparisons of total emissions levels and rates for coal-fired generating facilities only.

The mercury emissions shown in this report were obtained from EPA's Toxic Release Inventory (TRI). The TRI contains facility-level information on the use and environmental release of chemicals classified as toxic under the Clean Air Act. While the TRI includes data on total facility chemical releases, this report uses the "air releases" section to calculate mercury emissions. Because coal plants are the primary source of mercury emissions within the electric industry, the mercury emissions and emission rates presented in this report reflect the emissions associated with each producer's fleet of coal plants only. Other toxic air pollutant emissions, such as hydrogen chloride and hydrogen fluoride (acid gases), are also reported to EPA under the TRI program. However, we have not included these air toxics because of

### A NOTE ON EMISSIONS RANKING

In order to apply a uniform methodology to all power producers, this report assigns electricity generation and associated emissions to power producers according to their known generating asset ownership as of December 31, 2015.

Generation and emissions are assigned in this manner even if a generating facility is part of one or more contractual agreements (e.g., power purchase or sales, operating, tolling, conversion services, lease, etc.) with another entity for the sale of generation output or capacity of that asset. Publicly available data does not provide a straightforward means to accurately and exhaustively track such agreements. Consequently, the fuel mix and emissions associated with the electricity produced by a utility's own generating facilities may be different from that of the electricity delivered by the utility to its customers.

As a result, a utility that owns a large fossil generating fleet but also delivers purchased renewable energy to its customers might have lower average emission rates than reflected in this report, if the renewable energy purchases are factored into its performance. By the same token, the utility's emissions or emission rate would increase if it contracts with a higher emitting facility or relies on market purchases that have associated emissions.

uncertainties about the quality of the data submitted to EPA. We will continue to evaluate whether these pollutants might be included in future benchmarking efforts. In general, there is a strong correlation between SO<sub>2</sub> reductions and co-reductions in acid gas emissions.

The charts present both the total emissions by company as well as their average emission rates. The evaluation of emissions performance by both emission levels and emission rates provides a more complete picture of relative emissions performance than viewing these measures in isolation. Total emission levels are useful for understanding each producer's contribution to overall emissions loading, while emission rates are useful for assessing how electric power producers compare according to emissions per unit of energy produced when size is eliminated as a performance factor.

The charts illustrate significant differences in the total emission levels and emission rates of the 100 largest power producers. For example, the tons of CO<sub>2</sub> emissions range from zero to over 114 million tons per year. The NO<sub>x</sub> emission rates range from zero to 3.8 pounds of emissions per megawatt hour of generation. The total tons of emissions from any producer are influenced by the total amount of generation that a producer owns and by the fuels and technologies used to generate electricity.

TABLE 4

Company Rankings for 100 Largest Power Producers (2015)

in alphabetical order

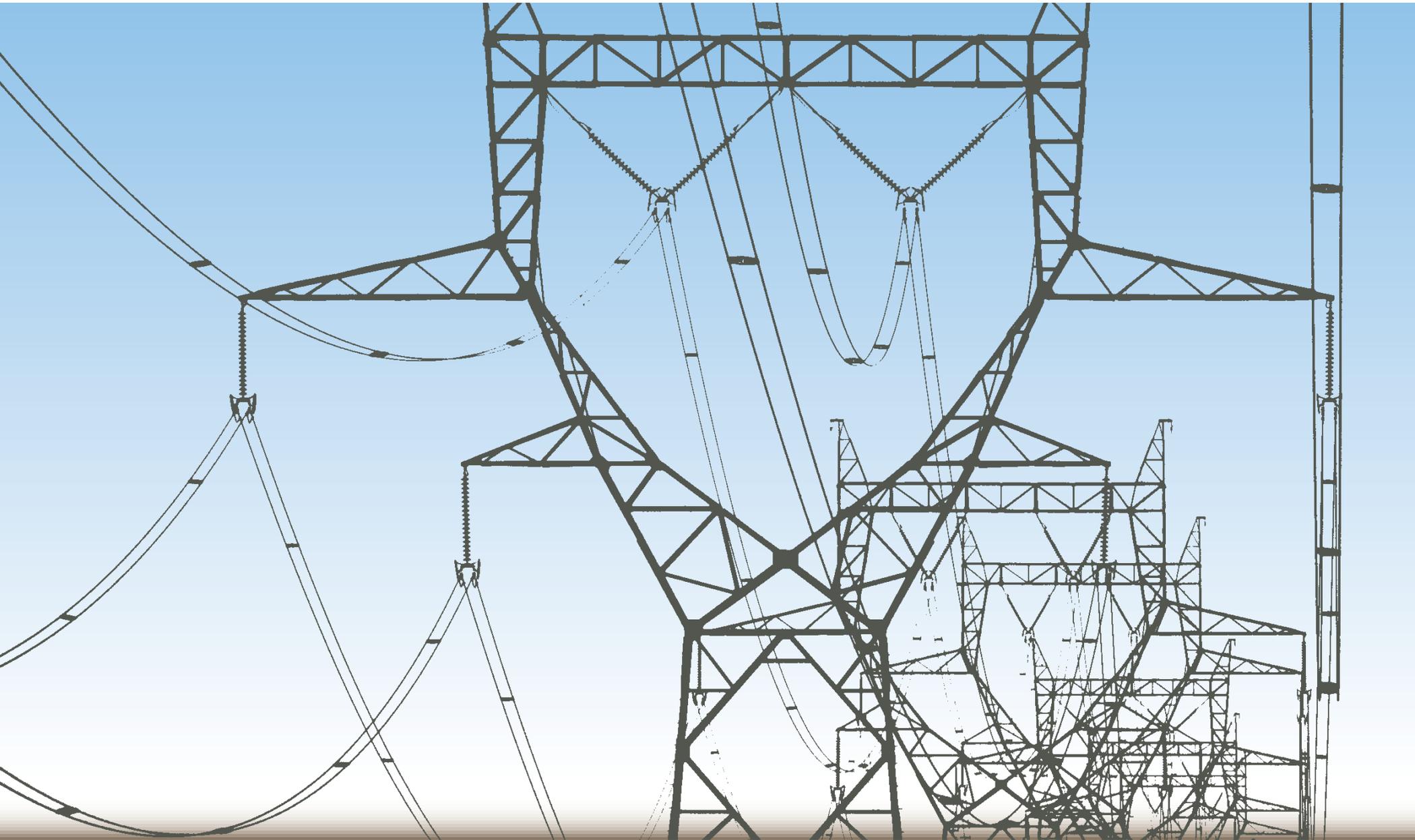
Owner	Ownership Type*	By Generation			By Tons of Emissions				By Emission Rates											
		Total	Fossil	Coal	SO <sub>2</sub>	NO <sub>x</sub>	CO <sub>2</sub>	Hg	All Generating Sources			Fossil Fuel Plants			Coal Plants					
									SO <sub>2</sub>	NO <sub>x</sub>	CO <sub>2</sub>	SO <sub>2</sub>	NO <sub>x</sub>	CO <sub>2</sub>	SO <sub>2</sub>	NO <sub>x</sub>	CO <sub>2</sub>	Hg		
AEP	investor-owned corp.	6	3	1	2	1	1	2	16	18	22	17	26	24	22	45	58	22		
AES	investor-owned corp.	26	22	16	13	15	20	26	6	10	9	9	16	14	16	35	49	45		
ALLETE	investor-owned corp.	65	67	42	43	50	51	32	30	34	28	25	29	3	46	54	21	20		
Alliant Energy	investor-owned corp.	43	35	25	23	38	29	37	15	29	19	16	40	26	19	49	14	44		
Ameren	investor-owned corp.	20	20	12	11	20	19	11	11	40	35	8	36	17	17	63	68	26		
Arclight Capital	privately held corp.	32	26	38	31	27	33	51	34	27	44	37	30	56	24	11	70	62		
Ares	investor-owned corp.	60	47	65	60	58	63	68	57	48	63	60	59	80	42	4	12	67		
Arkansas Electric Coop	cooperative	88	69	47	27	40	55	25	3	4	10	5	7	19	11	14	27	7		
Associated Electric Coop	cooperative	47	37	27	22	26	34	27	12	11	14	14	18	35	18	22	59	24		
Austin Energy	municipality	81	81	59	70	64	66	41	65	53	47	67	48	34	72	61	22	14		
Avangrid	foreign-owned corp.	44	89	-	89	87	90	-	89	90	90	83	79	91	-	-	-	-		
Avista	investor-owned corp.	90	87	64	61	69	83	64	55	59	76	52	47	55	50	27	20	51		
Basin Electric Power Coop	cooperative	41	28	19	24	18	22	9	22	5	3	23	9	6	41	21	11	12		
Berkshire Hathaway Energy	privately held corp.	9	8	5	12	3	6	8	35	20	37	35	22	33	43	26	35	38		
BP	foreign-owned corp.	92	90	-	87	90	89	-	84	84	84	76	86	69	-	-	-	-		
Brazos Electric Power Coop	cooperative	87	63	66	67	76	72	65	64	71	55	68	76	70	61	73	25	48		
Brookfield	foreign-owned corp.	79	92	-	91	92	92	-	91	92	92	77	73	71	-	-	-	-		
Buckeye Power	cooperative	89	64	41	37	55	53	45	18	21	5	20	38	16	40	64	67	47		
Calpine	investor-owned corp.	10	6	-	68	41	12	-	74	74	69	74	77	83	-	-	-	-		
CLECO	investor-owned corp.	56	44	61	30	54	49	36	17	43	29	19	52	49	3	38	7	8		
CMS Energy	investor-owned corp.	31	24	21	15	28	21	10	5	31	16	7	46	28	7	50	37	10		
CPS Energy	municipality	38	38	40	33	48	39	42	38	57	51	33	53	43	29	68	28	34		
Dominion	investor-owned corp.	12	13	17	29	22	14	22	54	63	74	55	61	58	58	66	64	28		
Dow Chemical	investor-owned corp.	84	66	-	88	82	74	-	85	81	61	89	85	78	-	-	-	-		
DTE Energy	investor-owned corp.	19	19	11	9	13	15	5	10	17	21	6	20	11	15	46	41	18		
Duke	investor-owned corp.	1	2	2	6	2	2	12	37	44	57	32	37	45	30	39	66	56		
Dynergy	investor-owned corp.	11	5	6	8	11	5	23	28	47	25	34	57	47	33	58	34	59		
E.ON	foreign-owned corp.	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
East Kentucky Power Coop	cooperative	98	73	45	48	59	57	56	24	24	4	30	39	9	47	62	43	64		
EDF	foreign-owned corp.	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Edison International	investor-owned corp.	57	77	-	82	86	81	-	83	87	83	84	88	85	-	-	-	-		
EDP	foreign-owned corp.	61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
El Paso Electric	investor-owned corp.	76	83	67	66	53	80	66	62	30	77	58	10	60	49	2	63	57		
Energy Capital Partners	privately held corp.	77	85	69	69	78	85	69	66	77	82	63	72	67	26	18	1	55		
Energy Future Holdings	privately held corp.	17	15	10	4	12	11	1	4	39	23	2	31	2	8	55	5	2		
Energy Northwest	municipality	83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
ENGIE	foreign-owned corp.	23	18	57	36	49	26	43	47	67	56	56	69	68	13	53	54	19		
Entegra Power	privately held corp.	71	54	-	75	77	60	-	75	76	41	75	80	62	-	-	-	-		
Entergy	investor-owned corp.	7	11	35	19	8	16	17	51	52	80	39	25	63	4	12	8	4		
Exelon	investor-owned corp.	4	39	71	59	66	54	70	73	88	91	64	67	73	27	30	4	69		
Exxon Mobil	investor-owned corp.	63	58	-	76	72	70	-	76	70	72	88	87	92	-	-	-	-		
FirstEnergy	investor-owned corp.	13	12	8	10	5	8	6	25	15	40	18	8	15	34	20	52	30		
Fortis	foreign-owned corp.	67	50	43	52	37	47	44	41	9	12	42	17	29	52	19	24	39		
General Electric	investor-owned corp.	46	36	34	7	19	37	20	1	3	24	1	6	44	1	6	55	9		
Grand River Dam Authority	state power authority	97	78	60	35	63	64	34	13	37	30	13	45	32	6	37	3	3		
Great Plains Energy	investor-owned corp.	34	29	18	28	32	24	21	27	33	17	29	35	13	48	59	61	25		
Great River Energy	cooperative	70	55	31	25	35	40	16	7	7	1	12	13	5	21	33	16	6		
IDACORP	investor-owned corp.	49	65	51	44	45	56	48	36	36	54	27	19	27	36	25	31	43		
Intermountain Power Agency	power district	66	49	28	53	17	44	67	44	1	6	48	1	20	66	8	71	70		
International Paper	investor-owned corp.	94	91	72	-	68	91	-	-	51	86	-	3	79	-	1	73	-		

\* Breakdown of ownership categories provided in endnote 2 ■ privately/investor owned ■ public power ■ cooperative

A ranking of 1 indicates the highest absolute number or rate in any column: the highest generation (MWh), highest emissions (tons), or highest emission rate (lb/MWh). A ranking of 100 indicates the lowest absolute number or rate in any column.

Owner	Ownership Type*	By Generation			By Tons of Emissions				By Emission Rates									
		Total	Fossil	Coal	SO <sub>2</sub>	NO <sub>x</sub>	CO <sub>2</sub>	Hg	All Generating Sources			Fossil Fuel Plants			Coal Plants			
									SO <sub>2</sub>	NO <sub>x</sub>	CO <sub>2</sub>	SO <sub>2</sub>	NO <sub>x</sub>	CO <sub>2</sub>	SO <sub>2</sub>	NO <sub>x</sub>	CO <sub>2</sub>	Hg
Inverney	privately held corp.	62	86	-	86	81	88	-	86	82	85	82	75	93	-	-	-	-
JEA	municipality	53	41	48	41	30	45	47	33	8	18	40	15	38	38	10	42	46
J-Power	foreign-owned corp.	82	62	68	73	74	73	71	71	69	59	72	74	75	59	69	39	71
Los Angeles City	municipality	50	52	62	63	62	59	62	60	56	53	65	63	61	67	31	56	60
Lower CO River Authority	state power authority	55	43	46	64	56	48	33	59	49	27	66	60	46	71	65	23	15
LS Power	privately held corp.	27	21	54	55	57	30	50	58	68	52	62	71	66	56	71	50	42
Municipal Elec. Auth. of GA	municipality	52	76	58	65	67	65	54	63	62	73	59	51	42	69	51	17	40
NC Public Power	municipality	95	93	-	-	-	93	-	-	-	93	-	-	1	-	-	-	-
NE Public Power District	power district	45	57	32	20	36	46	15	9	23	42	3	14	8	9	36	46	5
New York Power Authority	state power authority	30	84	-	85	84	87	-	88	89	89	78	81	77	-	-	-	-
NextEra Energy	investor-owned corp.	2	4	53	51	21	10	49	68	72	79	69	68	76	64	24	32	36
NISource	investor-owned corp.	59	45	37	32	42	42	31	19	16	8	21	33	22	25	42	6	23
NRG	investor-owned corp.	8	7	3	1	6	4	4	8	35	32	10	41	31	5	48	30	21
Oaktree Capital	investor-owned corp.	100	75	-	81	83	82	-	77	78	71	79	83	90	-	-	-	-
Occidental	investor-owned corp.	73	59	-	90	80	67	-	90	80	58	91	82	74	-	-	-	-
OGE	investor-owned corp.	40	27	29	21	29	28	24	14	19	26	15	28	41	12	40	13	16
Oglethorpe	cooperative	33	40	44	58	52	43	46	61	61	64	61	55	50	70	52	18	41
Omaha Public Power District	power district	48	46	24	18	31	38	19	2	13	20	4	12	7	10	34	45	11
Panda Power Funds	privately held corp.	75	60	-	78	85	71	-	79	83	62	81	90	81	-	-	-	-
PG&E	investor-owned corp.	25	68	-	79	88	77	-	87	91	87	87	91	86	-	-	-	-
Pinnacle West	investor-owned corp.	29	33	26	40	16	31	30	46	12	50	44	4	40	53	7	53	27
PNM Resources	investor-owned corp.	68	71	50	56	34	58	63	49	6	39	46	2	21	60	9	29	66
Portland General Electric	investor-owned corp.	58	61	55	46	51	61	58	39	41	49	36	42	52	32	29	36	58
PowerSouth Energy Coop	cooperative	99	72	63	57	60	68	53	43	28	36	45	44	59	39	15	15	29
PPL	investor-owned corp.	24	17	13	17	14	17	18	21	14	7	24	24	18	37	47	48	31
PSEG	investor-owned corp.	18	23	49	39	39	32	55	56	65	81	50	56	64	28	13	65	63
PUD No 1 of Chelan County	power district	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PUD No 2 of Grant County	power district	74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Puget Holdings	privately held corp.	51	51	52	54	47	52	52	48	38	43	49	43	51	51	28	19	52
Sacramento Municipal Util Dist	municipality	96	80	-	83	91	84	-	81	85	75	90	92	89	-	-	-	-
Salt River Project	power district	28	25	22	50	23	25	35	53	22	38	57	23	39	65	23	40	37
Santee Cooper	state power authority	39	30	23	47	46	27	39	50	55	31	54	62	36	62	70	62	53
SCANA	investor-owned corp.	35	34	33	49	43	36	61	52	54	46	51	54	53	57	57	72	68
Seminole Electric Coop	cooperative	72	56	39	34	65	50	38	20	58	15	22	65	37	31	72	69	32
Sempra	investor-owned corp.	85	82	-	84	89	86	-	82	86	78	86	89	88	-	-	-	-
South Mississippi Electric	cooperative	93	79	70	71	71	79	60	67	64	70	70	66	72	44	5	9	1
Southern	investor-owned corp.	3	1	4	5	4	3	3	29	46	45	31	50	57	20	41	47	17
Talen Energy	investor-owned corp.	15	14	15	16	10	13	28	31	25	48	28	21	48	23	16	51	50
TECO	investor-owned corp.	42	32	36	38	44	35	57	40	45	34	43	58	54	45	56	60	65
Tenaska	privately held corp.	54	42	-	77	75	62	-	78	75	67	80	78	82	-	-	-	-
Tennessee Valley Authority	federal power authority	5	9	7	3	7	7	7	23	50	60	11	32	30	14	43	44	33
The Blackstone Group	privately held corp.	91	70	-	80	73	78	-	80	66	68	85	70	87	-	-	-	-
The Carlyle Group	privately held corp.	69	53	73	72	79	69	-	70	79	66	71	84	84	2	3	2	-
TransCanada	foreign-owned corp.	86	74	-	74	70	75	-	72	60	65	73	64	65	-	-	-	-
Tri-State	cooperative	64	48	30	45	25	41	40	32	2	2	38	5	10	55	17	38	49
US Bureau of Reclamation	federal power authority	21	88	56	62	61	76	59	69	73	88	53	11	12	68	32	57	61
US Corps of Engineers	federal power authority	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WEC Energy Group	investor-owned corp.	22	16	14	26	24	18	29	42	42	13	41	49	23	54	67	26	54
Westar	investor-owned corp.	36	31	20	42	33	23	13	45	32	11	47	34	4	63	60	10	13
Xcel	investor-owned corp.	14	10	9	14	9	9	14	26	26	33	26	27	25	35	44	33	35

\* Breakdown of ownership categories provided in endnote 2 ■ privately/investor owned ■ public power ■ cooperative



## NO<sub>x</sub> and SO<sub>2</sub> Emissions Levels and Rates

Figures 6 and 7 display NO<sub>x</sub> and SO<sub>2</sub> emission levels and emission rates for fossil fuel-fired generating sources owned by each company.

“Fossil only” emission rates are calculated by dividing each company’s total NO<sub>x</sub> and SO<sub>2</sub> emissions from fossil-fired power plants by its total generation from fossil-fired power plants. Companies with significant coal-fired generating capacity have the highest total emissions of SO<sub>2</sub> and NO<sub>x</sub> because coal contains higher concentrations of sulfur than natural gas and oil and coal-fired plants generally have higher NO<sub>x</sub> emission rates.

Figures 6 and 7 illustrate wide disparities in the “fossil only” emission levels and emission rates of the 100 largest power producers. The largest amount of fossil generation from a single company totaled 149 million MWh, 7 of the 100 largest producers had no fossil generation, and:

- NO<sub>x</sub> emission rates range from 0.02 to 3.8 lb/MWh (0.008-3.8 lb/MWh, if generation from all fuel types is considered), and NO<sub>x</sub> emissions range from 37 to 80,786 tons;
- SO<sub>2</sub> emission rates range from 0.0004 to 12.5 lb/MWh (0.0002-12.2 lb/MWh, if generation from all fuel types is considered), and SO<sub>2</sub> emissions range from 0.8 to 196,168 tons.

FIGURE 6

**Fossil Fuel - NOx Total Emissions and Emission Rates (2015)**

Total emissions (thousand ton) and emission rates (lb/MWh) from fossil fuel generating facilities

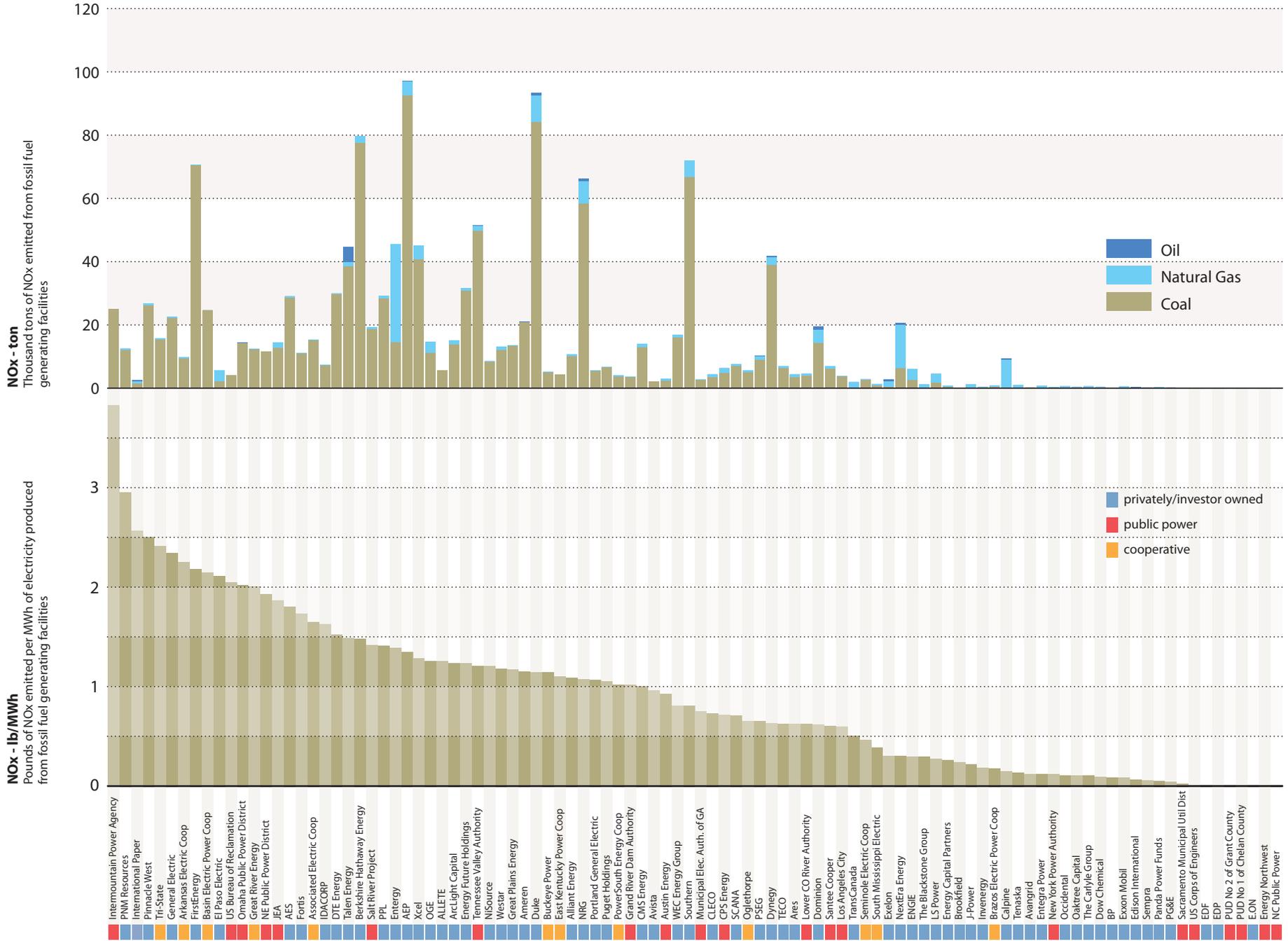
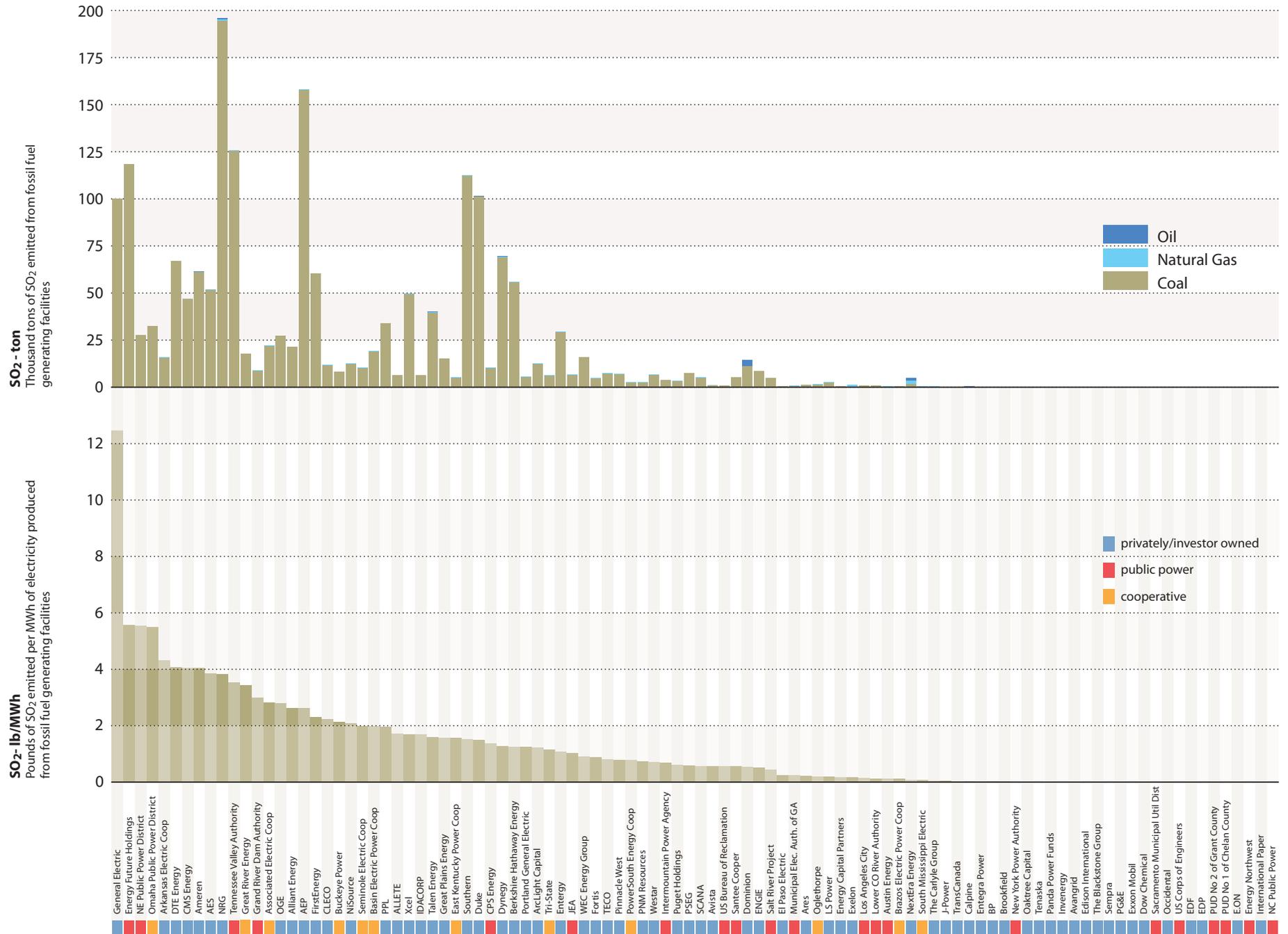


FIGURE 7

**Fossil Fuel - SO<sub>2</sub> Total Emissions and Emission Rates (2015)**

Total emissions (thousand ton) and emission rates (lb/MWh) from fossil fuel generating facilities



## CO<sub>2</sub> Emission Levels and Rates

Figure 8 displays total CO<sub>2</sub> emission levels from coal, oil, and natural gas combustion and emission rates based on all generating sources owned by each company.

“All-source” emission rates are calculated by dividing each company’s total CO<sub>2</sub> emissions by its total generation. In most cases, producers with significant non-emitting fuel sources, such as nuclear, hydroelectric, solar, and wind power, have lower all-source emission rates than producers owning primarily fossil fuel power plants. Among the 100 largest power producers:

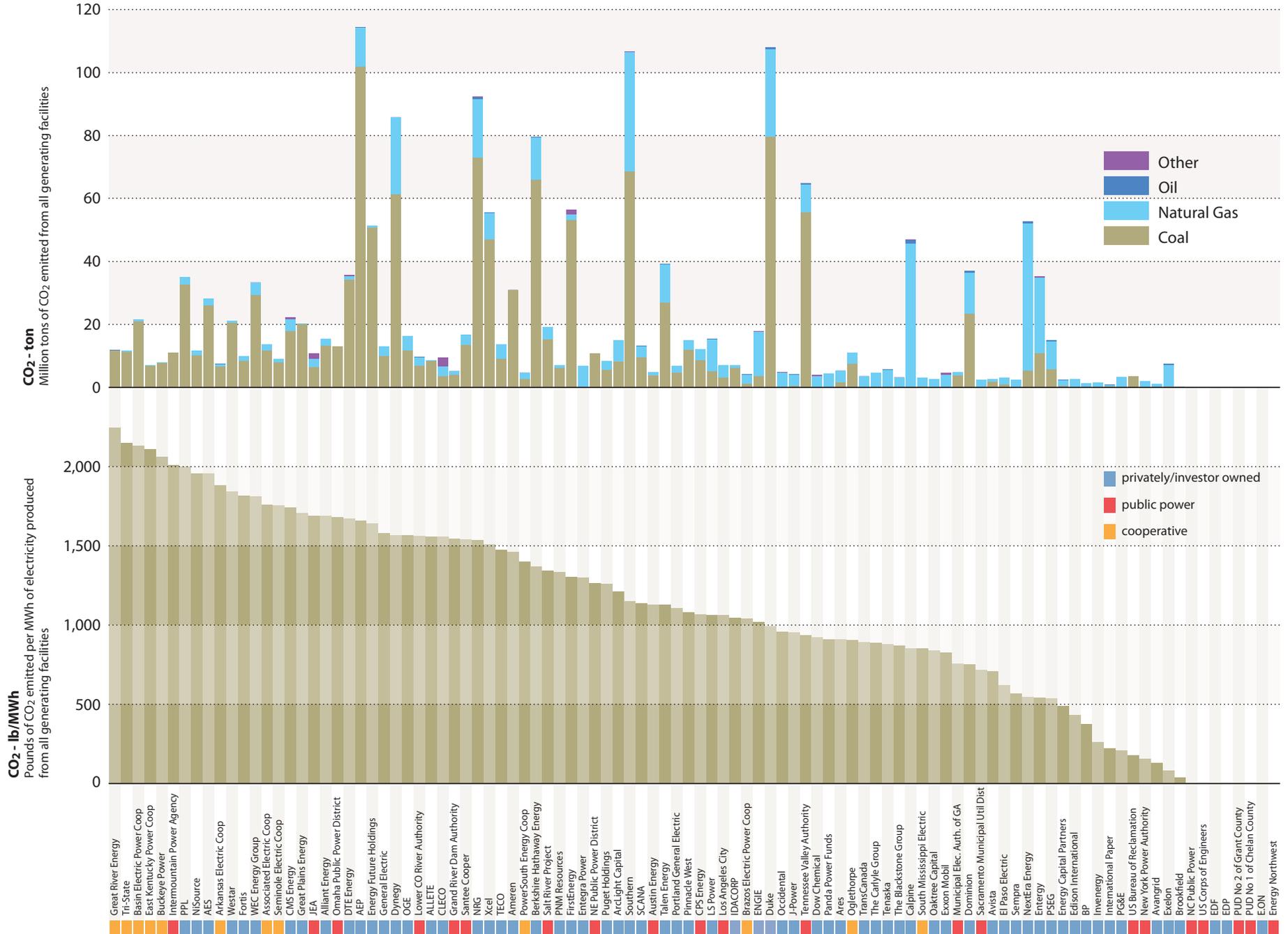
- Coal-fired power plants are responsible for 71 percent of CO<sub>2</sub> emissions
- Natural gas-fired power plants are responsible for 28 percent of CO<sub>2</sub> emissions
- Oil-fired power plants are responsible for 0.4 percent of CO<sub>2</sub> emissions

Figure 8 illustrates wide disparities in the “all-source” emission levels and emission rates of the 100 largest power producers. Their total electric generation varies from 6.2 million to 218 million MWh, their CO<sub>2</sub> emissions range from 0 to 114 million tons, and their CO<sub>2</sub> emission rates range from 0 to 2,245 lb/MWh.

FIGURE 8

**All Source - CO<sub>2</sub> Total Emissions and Emission Rates (2015)**

Total emissions (million ton) and emission rates (lb/MWh) from all generating facilities



## Mercury Emission Levels and Rates

Figure 9 displays total mercury emission levels and emission rates from coal-fired power plants.

In 2012, EPA finalized the Mercury and Air Toxics Standards (MATS), regulating emissions of mercury and other hazardous air pollutants from coal- and oil-fired electric generating units. The standards went into effect April 16, 2015, although many coal units obtained a one-year extension to the initial compliance date. Reported emissions have declined 31 percent between 2014 and 2015.

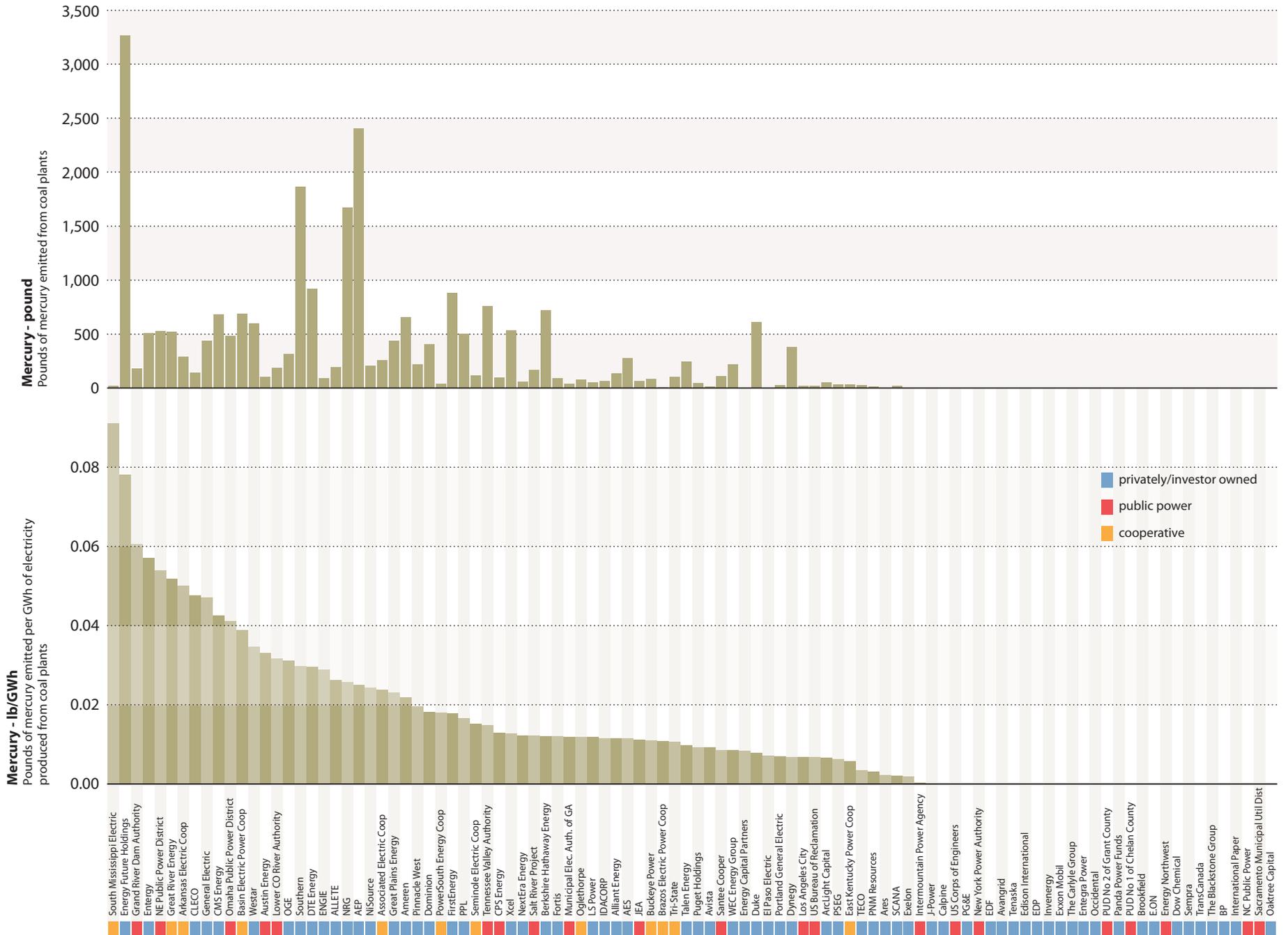
Coal mercury emissions from the top 100 power producers range from less than 1 to 3,264 pounds, and coal mercury emission rates range from 0.0002 to 0.091 pound per gigawatt hour (a gigawatt hour is 1,000 megawatt hours).

FIGURE 9

**Coal - Mercury Emission Rates and Total Emissions (2015)**

Emission rates (lb/GWh) and total emissions (pound) from coal plants

1 gigawatt hour (GWh) = 1,000 MWh

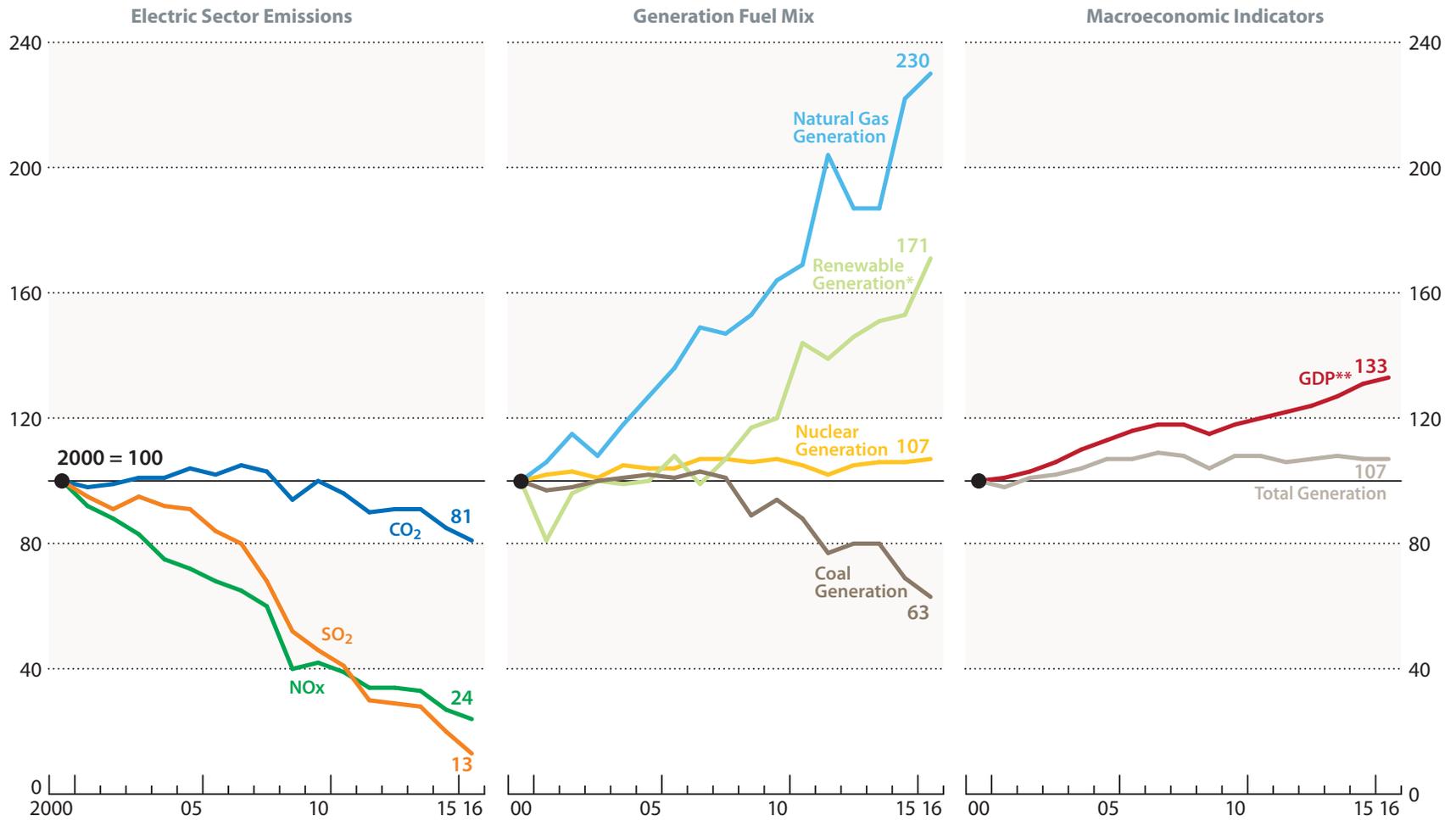


# Emissions Trends Analysis

Figure 10 plots the trends in power plant NO<sub>x</sub>, SO<sub>2</sub>, and CO<sub>2</sub> emissions from 2000 to 2016 (indexed annual totals).<sup>4</sup> Figure 10 also plots the total electricity generation by fuel type, as well as gross domestic product (GDP). The electric industry has cut its NO<sub>x</sub>, SO<sub>2</sub>, and CO<sub>2</sub> emissions even as overall electricity generation and GDP have increased. In 2016, power plant NO<sub>x</sub> and SO<sub>2</sub> emissions were 76 and 87 percent lower, respectively, compared to 2000. Less progress has been made in terms of reducing CO<sub>2</sub> emissions which, until recently, had not been a focus of federal regulation. In 2016, CO<sub>2</sub> emissions were 19 percent lower than 2000 levels. Over the same period, total U.S. electricity generation increased by 7 percent, while GDP grew 33 percent. Increased natural gas generation and a decrease in coal generation, driven in large part by low natural gas prices, have contributed to the reduction in emissions. Over the last decade and a half, natural gas generation has more than doubled, while coal generation decreased by nearly 40 percent. Renewable generation, primary from wind and solar resources, has also grown significantly, with 2016 generation 71 percent higher than 2000 levels. Pollution control retrofits have also contributed to reductions of NO<sub>x</sub> and SO<sub>2</sub> emissions.

FIGURE 10

**Annual Electric Sector Trends and Macroeconomic Indicators**  
(Indexed: 2000 = 100)



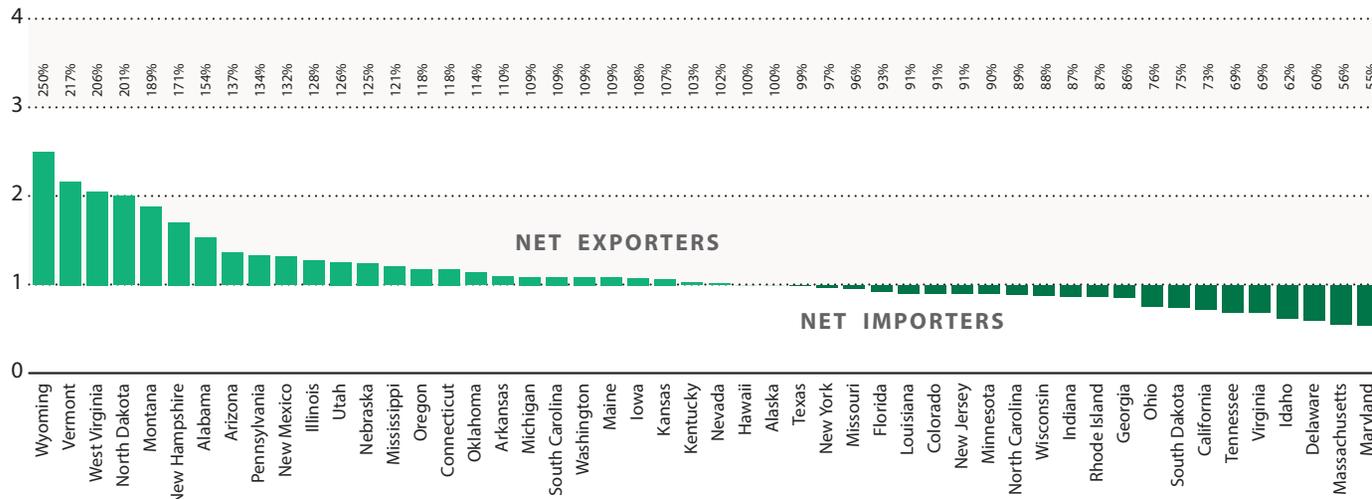
\*INCLUDES HYDROELECTRIC, WIND, SOLAR, BIOMASS, GEOTHERMAL AND OTHER RENEWABLE SOURCES.

\*\*GDP IN CHAINED 2009 DOLLARS.

# State-by-State Emissions Summary

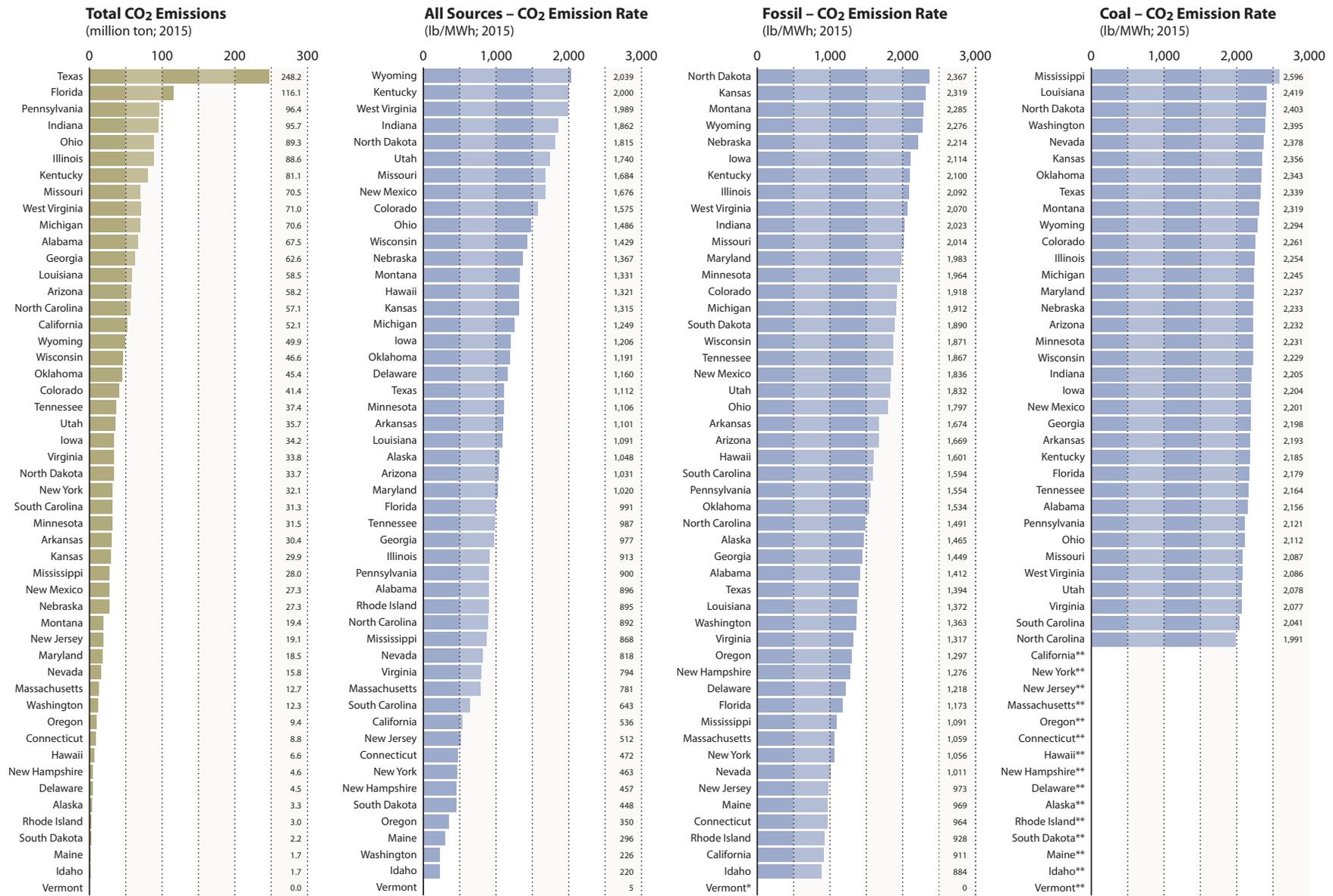
Figure 12 summarizes CO<sub>2</sub> emissions from power plants on a state-by-state basis. Texas, Florida, and Pennsylvania had the highest total CO<sub>2</sub> emissions in the U.S. in 2015. Vermont, Idaho, and Maine had the lowest total CO<sub>2</sub> emissions. Figure 12 also presents the average CO<sub>2</sub> emission rates for each state, including all source CO<sub>2</sub> emission rates, fossil CO<sub>2</sub> emission rates, and coal-only CO<sub>2</sub> emission rates. While Texas ranks first in terms of total emissions, it ranks 20th in terms of its all-source CO<sub>2</sub> emission rate. Wyoming, Kentucky, and West Virginia had the highest all-source CO<sub>2</sub> emission rates because of their heavy reliance on coal for electricity generation. States also vary in terms of their import and export of electricity. Florida, for example, produces virtually all of the electricity that it generates with limited imports. West Virginia and North Dakota, in contrast, are large exporters of electricity. Figure 11 summarizes the net imports or exports of electricity by state.

**FIGURE 11**  
**Electricity Exporters/Importers**  
 (Net Trade Index; 2015)



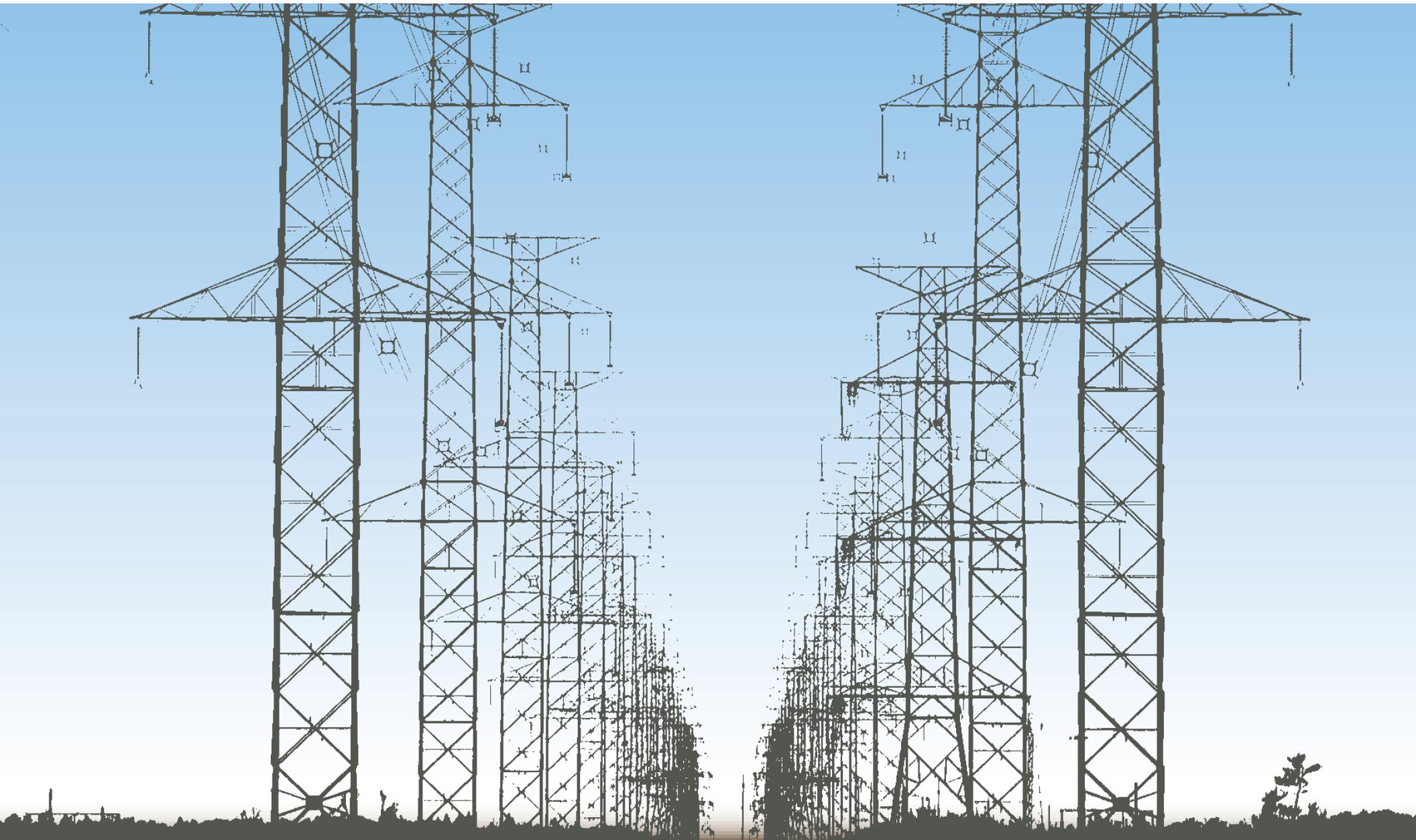
% : TOTAL IN-STATE SUPPLY OF ELECTRICITY AS % SHARE OF TOTAL IN-STATE CONSUMPTION NEEDS; IN-STATE SUPPLY INCLUDES INTERNATIONAL IMPORTS.

FIGURE 12



\* FOSSIL-FIRED GENERATION OUTPUT IN THE STATE OF VERMONT IS TOO LOW TO CALCULATE A MEANINGFUL EMISSION RATE.

\*\* COAL-FIRED GENERATION OUTPUT IN THESE STATES IS TOO LOW TO CALCULATE A MEANINGFUL EMISSION RATE.



# Appendix A

## Data Sources, Methodology and Quality Assurance

This report examines the air pollutant emissions of the 100 largest electricity generating companies in the United States based on 2015 electricity generation, emissions, and ownership data. The report relies on publicly-available information reported by the U.S. Energy Information Administration (EIA), U.S. Environmental Protection Agency (EPA), Securities and Exchange Commission (SEC), state environmental agencies, company websites, and media articles. Emission data may include revisions to 2015 data that companies were in the process of submitting or have already submitted to EPA at the time of publication of this report.

This report relies almost entirely on publicly available information. Data sets published by EIA and EPA are the primary source of the generation and emissions data used in this report. The organizations that fund this report believe maintaining public access to this information is essential to tracking the industry's performance and making accurate and informed analyses and policy decisions.

### Data Sources

The following public data sources were used to develop this report:

EPA AIR MARKETS PROGRAM DATA (AMP): EPA's Air Markets Program Data account for almost all of the SO<sub>2</sub> and NO<sub>x</sub> emissions, and about 20 percent of the CO<sub>2</sub> emissions analyzed in this report. These emissions were compiled using EPA's on-line emissions database available at <http://ampd.epa.gov/ampd/>.

EPA TOXIC RELEASE INVENTORY (TRI): Power plants and other facilities are required to submit reports on the use and release of certain toxic chemicals to the TRI. The 2015 mercury emissions used in this report are based on TRI reports submitted by facility managers and are available at [http://iaspub.epa.gov/triexplorer/tri\\_release.chemical](http://iaspub.epa.gov/triexplorer/tri_release.chemical).

EIA FORMS 923 POWER PLANT DATABASES (2015): EIA Form 923 provided almost all of the generation data analyzed in this report. EIA Form 923 provides data on the electric generation and heat input by fuel type for utility and non-utility power plants. The heat input data was used to calculate approximately 80 percent of the CO<sub>2</sub> emissions analyzed in this report. The form is available at [http://www.eia.doe.gov/cneaf/electricity/page/eia906\\_920.html](http://www.eia.doe.gov/cneaf/electricity/page/eia906_920.html).

EIA FORM 860 ANNUAL ELECTRIC GENERATOR REPORT (2015): EIA Form 860 is a generating unit level data source that includes information about generators at electric power plants, including information about generator ownership. EIA Form 860 was used as the primary source of power plant ownership for this report. The form is available at <http://www.eia.doe.gov/cneaf/electricity/page/eia860.html>.

EPA U.S. INVENTORY OF GREENHOUSE GAS EMISSIONS AND SINKS (2017): EPA's U.S. Inventory of Greenhouse Gas Emissions and Sinks report provides in Annex 2 heat contents and carbon content coefficients of various fuel types. This data was used in conjunction with EIA Form 923 to calculate approximately 20 percent of the CO<sub>2</sub> emissions analyzed in this report. Annex 2 is available at <http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2017-Annex-2-Emissions-Fossil-Fuel-Combustion.pdf>.

## Plant Ownership

This report aims to reflect power plant ownership as of December 31, 2015. Plant ownership data used in this report are primarily based on the EIA-860 database from the year 2015. EIA-860 includes ownership information on generators at electric power plants owned or operated by electric utilities and non-utilities, which include independent power producers, combined heat and power producers, and other industrial organizations. It is published annually by EIA.

For the largest 100 power producers, plant ownership is further checked against self-reported data from the producer's 10-K form filed with the SEC, listings on their website, and other media sources. Ownership of

plants is updated based on the most recent data available. Consequently, in a number of instances, ultimate assignment of plant ownership in this report differs from EIA-860's reported ownership. This primarily happens when the plant in question falls in one or more of the categories listed below:

1. It is owned by a limited liability partnership, the shareholders of which are among the 100 largest power producers.
2. The owner of the plant as listed in EIA-860 is a subsidiary of a company that is among the 100 largest power producers.
3. It was sold or bought during the year 2015. Because form 10-K for a particular year is usually filed by the producer in the first quarter of the following year, this report assumes that ownership as reported in form 10-K is more accurate.

Publicly available data do not provide a straightforward means to accurately track lease arrangements and power purchase agreements. Therefore, in order to apply a standardized methodology to all companies, this report allocates generation and any associated emissions according to reported asset ownership as of December 31, 2015.

Identifying "who owns what" in the dynamic electricity generation industry is probably the single most difficult and complex part of this report. In addition to the categories listed above, shares of power plants are regularly traded and producers merge, reorganize, or cease operations altogether. While considerable effort was expended in ensuring the accuracy of ownership information reflected in this report, there may be inadvertent errors in the assignment of ownership for some plants where public information was either not current or could not be verified.

## Generation Data and Cogeneration Facilities

Plant generation data used in this report come from EIA Form 923.

Cogeneration facilities produce both electricity and steam or some other form of useful energy. Because electricity is only a partial output of these plants, their reported emissions data generally overstate the emissions associated with electricity generation. Generation and emissions data included in this report for cogeneration facilities have been adjusted to reflect only their electricity generation. For all such cogeneration

facilities emissions data were calculated on the basis of heat input of fuel associated with electricity generation only. Consequently, for all such facilities EIA Form 923, which report a plant's total heat input as well as that which is associated with electricity production only, was used to calculate their emissions.

## NO<sub>x</sub> and SO<sub>2</sub> Emissions

The EPA AMP database collects and reports SO<sub>2</sub> and NO<sub>x</sub> emissions data for nearly all major power plants in the U.S. Emissions information reported in the AMP database is collected from continuous emission monitoring (CEM) systems. SO<sub>2</sub> and NO<sub>x</sub> emissions data reported to the AMP account for all of the SO<sub>2</sub> and NO<sub>x</sub> emissions assigned to the 100 largest power producers in this report.

The AMP database collects and reports SO<sub>2</sub> and NO<sub>x</sub> emissions data by fuel type at the boiler level. This report consolidates this data at the generating unit and plant levels. In the case of jointly owned plants, because joint ownership is determined by producer's share of installed capacity, assignment of SO<sub>2</sub> and NO<sub>x</sub> emissions to the producers on this basis implicitly assumes that emission rates are uniform across the different units. This may cause producers to be assigned emission figures that are slightly higher or lower than their actual shares.

The apportionment of NO<sub>x</sub> emissions between coal and natural gas at boilers that can burn both fuels may in certain instances slightly overstate coal's share of the emissions. This situation is likely to arise when a dual-fuel boiler that is classified as "coal-fired" within AMP burns natural gas to produce electricity in substantial amounts. In most years there would be very little economic reason to make this switch in a boiler that is not part of a combined cycle setup. Continued low natural gas prices in 2015 led to a small number of boilers switching to natural gas for most or a large part of their electricity output. Because AMP datasets do not make this distinction, apportioning emissions based on the fuel-type of the boiler would increase coal's share of emissions.

SO<sub>2</sub> and CO<sub>2</sub> emissions are mostly not affected by this issue. Natural gas emits virtually no SO<sub>2</sub>. CO<sub>2</sub> emissions can be calculated from the heat input data reported in EIA Form 923, which allows for the correct apportionment of emissions between coal and natural gas.

## CO<sub>2</sub> Emissions

A majority of CO<sub>2</sub> emissions used in this report were calculated using heat input data from EIA form 923 and carbon content coefficients of various fuel types provided by EPA. Table A.1 shows the carbon coefficients used in this procedure. Non-emitting fuel types, whose carbon coefficients are zero, are not shown in the table. CO<sub>2</sub> emissions reported through the EPA AMP account for a small share of the CO<sub>2</sub> emissions used in this report.

The datasets report heat input and emissions data by fuel type at either the prime mover or boiler level. This report consolidates that data at the generating unit and plant levels. In the case of jointly owned plants, because joint ownership is determined by producer's share of installed capacity, assignment of CO<sub>2</sub> emissions to the producers on this basis implicitly assumes that emission rates are uniform across the different units. This may cause producers to be assigned emission figures that are slightly higher or lower than their actual shares.

## Mercury Emissions

Mercury emissions data for coal power plants presented in this report were obtained from EPA's Toxic Release Inventory (TRI). Mercury emissions reported to the TRI are based on emission factors, mass balance calculations, or data monitoring. The TRI contains facility-level information on the use and environmental release of chemicals classified as toxic under the Clean Air Act. The TRI contains information on all toxic releases from a facility; mercury emissions in this report are based on air releases only. Because coal plants are the primary source of mercury emissions within the electric industry, the mercury emissions and emission rates presented in this report reflect the emissions associated with each producer's fleet of coal plants only.

TABLE A.1

### Carbon Content Co-efficients by Fuel Type

From Table A-42, A-43 (in Annex 2 of GHG Inventory 2017)

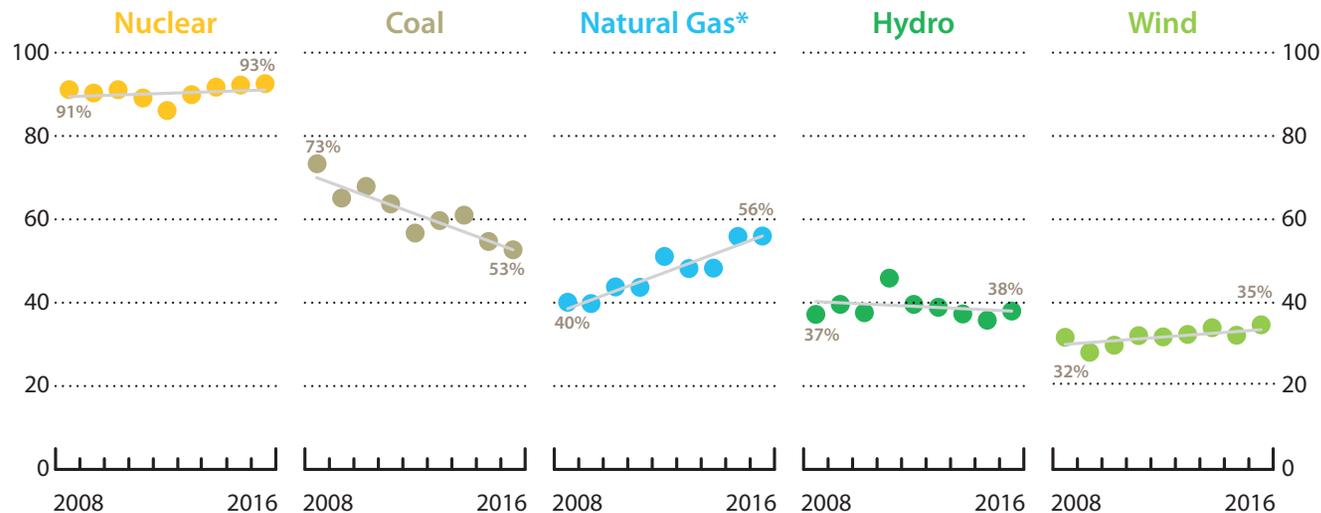
FUEL TYPE	CARBON CONTENT COEFFICIENTS (Tg Carbon/Qbtu)
<b>COAL</b>	
Anthracite Coal	28.28
Bituminous Coal	25.44
Sub-bituminous Coal	26.50
Lignite Coal	26.65
Waste/Other Coal (includes anthracite culm, bituminous gob, fine coal, lignite waste, waste coal)	26.05
Coal-based Synfuel (including briquettes, pellets, or extrusions, which are formed by binding materials or processes that recycle materials)	25.34
Coal-based Synfuel Gas	18.55
<b>OIL</b>	
Distillate Fuel Oil (Diesel, No. 1, No. 2, and No. 4 Fuel Oils)	20.17
Jet Fuel	19.70
Kerosene	19.96
Residual Fuel Oil (No. 5, No. 6 Fuel Oils, and Bunker C Fuel Oil)	20.48
Waste/Other Oil (including Crude Oil, Liquid Butane, Liquid Propane, Oil Waste, Re-Refined Motor Oil, Sludge Oil, Tar Oil, or other petroleum-based liquid wastes)	20.55
Petroleum Coke	27.85
<b>GAS</b>	
Natural Gas	14.46
Blast Furnace Gas	18.55
Other Gas	18.55
Gaseous Propane	14.46

# Appendix B

## Average Capacity Factors by Fuel Type

Figure B.1 shows the capacity factors of different types of power plants from 2008 to 2016. Capacity factors measure the extent to which a power plant is utilized over the course of time. The technical definition is the ratio of the electrical energy produced by a generating unit to the electrical energy that could have been produced assuming continuous full power operation. Coal plant utilization has declined in recent years; the average annual capacity factor of coal plants in the U.S. dropped from 73 percent in 2008 to 53 percent in 2016, while over the same time period, natural gas combined-cycle capacity factors rose, from 40 to 56 percent. Nuclear plants have high utilization rates, consistently running at a 90 percent average capacity factor. Hydropower and wind capacity factors are lower, but have also remained relatively constant over the past nine years.

**FIGURE B.1**  
**Annual Capacity Factors for Select Fuels and Technologies**  
 (percent)



\* COMBINED CYCLE  
 SOURCE: U.S. ENERGY INFORMATION ADMINISTRATION. ELECTRIC POWER MONTHLY, TABLES 6.7A AND 6.7B. FEBRUARY 2017

# Endnotes

1. Private entities include investor-owned and privately held utilities and non-utility power producers (e.g., independent power producers). Cooperative electric utilities are owned by their members (i.e., the consumers they serve). Publicly-owned electric utilities are nonprofit government entities that are organized at either the local or State level. There are also several Federal electric utilities in the United States, such as the Tennessee Valley Authority.
2. Power plant ownership in this report is divided into three categories: privately/investor owned (investor-owned corporations, privately held corporations, foreign-owned corporations), public power (federal power authorities, state power authorities, municipalities, power districts), and cooperative.
3. SO<sub>2</sub> and NO<sub>x</sub> emissions data from U.S. Environmental Protection Agency (EPA), “Average Annual Emissions for Criteria Pollutants National Tier 1 for 1970-2016 in MS Excel.” National Emissions Inventory (NEI) Air Pollutant Emissions Trends Data, December 19, 2016. <https://www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data> (accessed March 21, 2017).

CO<sub>2</sub> emissions data for 2015 from EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015, p. ES-5, April 14, 2017. [https://www.epa.gov/sites/production/files/2017-02/documents/2017\\_complete\\_report.pdf](https://www.epa.gov/sites/production/files/2017-02/documents/2017_complete_report.pdf) (accessed May 10, 2017).

CO<sub>2</sub> emissions data for 2010 from EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014, p. ES-5, April 15, 2016. <https://www.epa.gov/sites/production/files/2016-04/documents/us-ghg-inventory-2016-main-text.pdf> (accessed March 21, 2017).

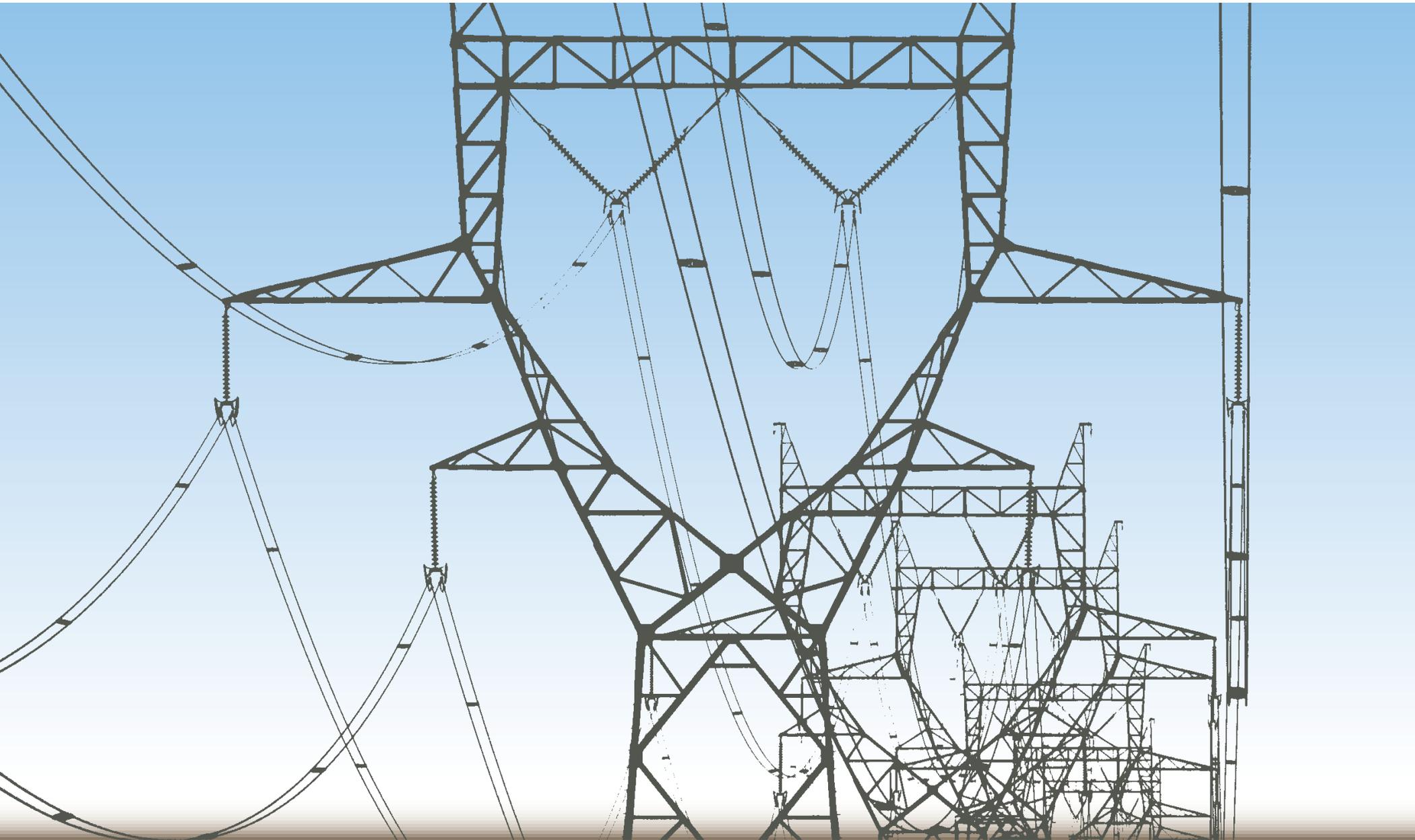
Mercury emissions data for 2014 from EPA, “Sector Summaries - Criteria and Hazardous Air Pollutants by 60 EIS emission sectors.” 2014 National Emissions Inventory (NEI) Data, December 2016. <https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-data> (accessed April 5, 2017).

4. Electric Sector Emissions data from EPA AMP database available at <http://ampd.epa.gov/ampd/> (accessed April 7, 2017).

Generation data from EIA Monthly Energy Review Table 7.2a Electricity Generation Total for All Sectors available at <https://www.eia.gov/totalenergy/data/monthly/#electricity> (accessed April 7, 2017).

Gross Domestic Product (GDP) data from the U.S. Bureau of Economic Analysis available at <https://www.bea.gov/national/index.htm#gdp> (accessed April 7, 2017).

The sources used in Figure 10 have already made national-level 2016 data available, allowing the trends section to extend through 2016. Detailed 2016 data used for the company-specific analysis of the top 100 electricity producers was not yet available at the time of report publication.





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