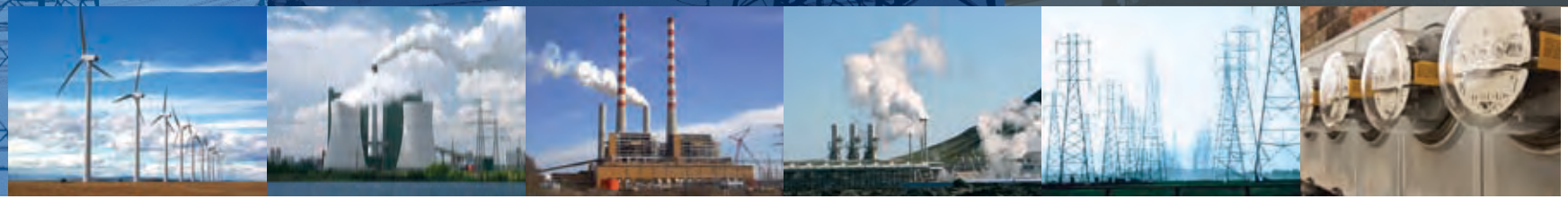
Benchmarking Air Emissions

OF THE 100 LARGEST ELECTRIC POWER PRODUCERS IN THE UNITED STATES



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Acknowledgments

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M. J. Bradley & Associates. (2010). *Benchmarking Air Emissions of the 100 Largest Electric Power Producers in the United States.*

Preface

The 2010 Benchmarking report is the seventh 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 2008 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 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_2), oxides of nitrogen (NOx), carbon dioxide (CO_2) and mercury 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.

The report is available in PDF format on the Internet at http://www.ceres.org and http://www.nrdc.org. Plant and company level data used in this report are available on the Internet at http://www.nrdc.org.

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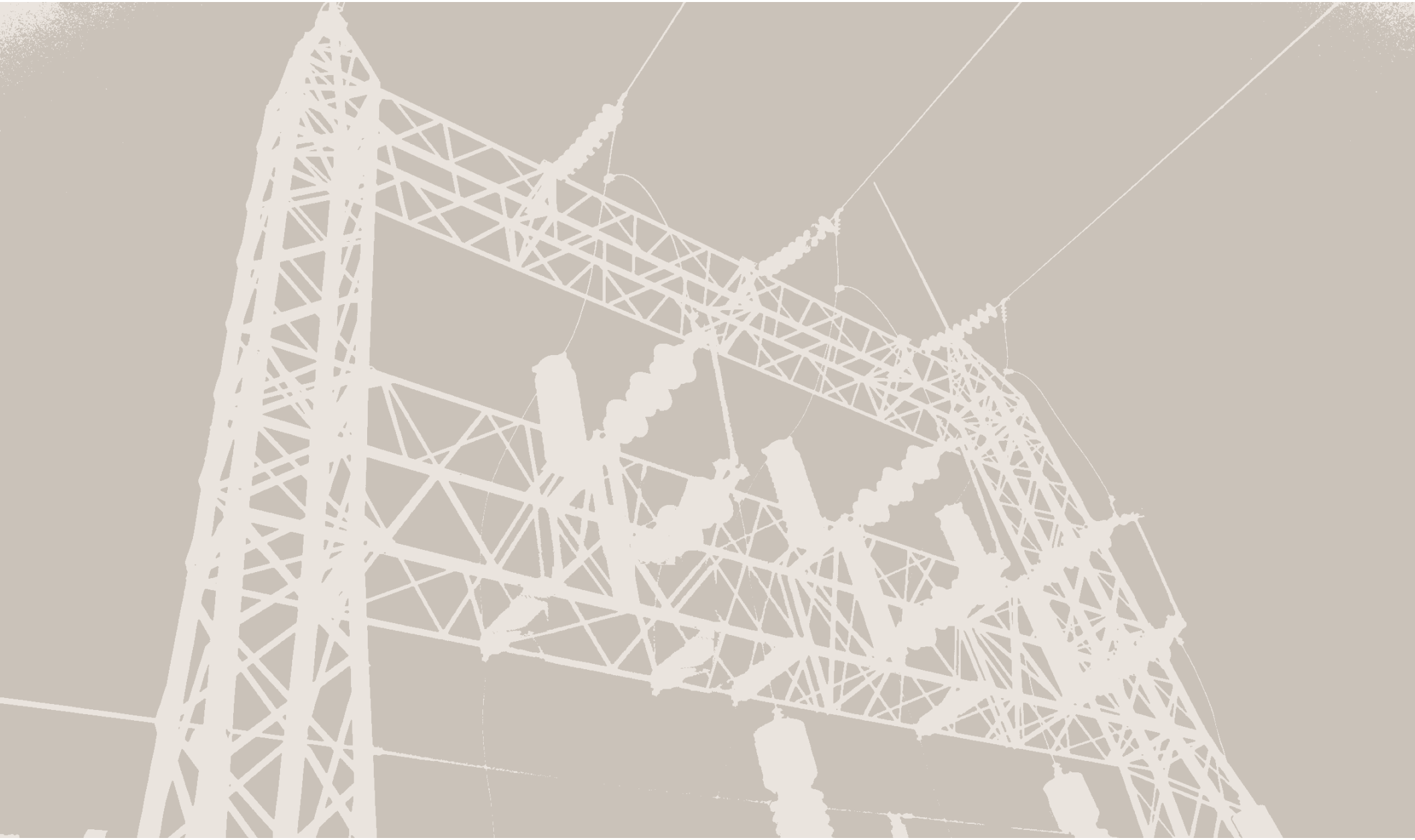


Executive Summary

This report examines and compares the air pollutant emissions of the 100 largest power producers in the United States based on 2008 plant ownership and emissions data. Table ES.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 (collectively referred to as "companies" or "producers" in this report) that own roughly 2,200 power plants and account for 85 percent of reported electric generation and 89 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_2), oxides of nitrogen (NOx), mercury (Hg), and carbon dioxide (CO_2). These pollutants are associated with significant environmental and public health problems, including acid deposition, global warming, fine

TABLE ES.1

100 Largest Electric Power Producers in the U.S., 2008

RANK	PRODUCER NAME	2008 MWh (millions)	RANK	PRODUCER NAME	2008 MWh (millions)	RANK	PRODUCER NAME	2008 MWh (millions)	RANK	PRODUCER NAME	2008 MWh (millions)
1	Southern	200.1	26	AES	43.5	51	Basin Electric Power Coop	16.2	76	Great River Energy	10.1
2	AEP	192.1	27	E.ON	40.1	52	DPL	16.1	77	Entegra Power	10.1
3	Tennessee Valley Authority	158.9	28	RRI	33.3	53	Los Angeles City	15.1	78	Buckeye Power	9.8
4	NextEra Energy (formerly FPL)	153.4	29	Westar	28.4	54	NiSource	15.0	79	Big Rivers Electric	9.7
5	Exelon	150.6	30	Pinnacle West	27.9	55	IDACORP	14.5	80	Integrys	9.6
6	Duke	149.0	31	New York Power Authority	27.8	56	Intermountain Power Agency	14.4	81	SUEZ Energy	9.6
7	Entergy	123.9	32	OGE	26.7	57	JEA	14.2	82	PUD No 2 of Grant County	9.4
8	Dominion	107.3	33	Salt River Project	26.6	58	US Power Generating Company	14.0	83	Energy Northwest	9.4
9	MidAmerican	93.3	34	Santee Cooper	26.4	59	Tri-State	13.8	84	Lower CO River Authority	9.2
10	Progress Energy	93.3	35	PG&E	25.7	60	General Electric	13.2	85	PUD No 1 of Chelan County	8.6
11	Calpine	87.6	36	SCANA	25.0	61	PNM Resources	13.1	86	Hoosier Energy	8.3
12	Edison International	85.1	37	Great Plains Energy	24.6	62	Austin Energy	13.0	87	El Paso Electric	8.0
13	FirstEnergy	83.0	38	Oglethorpe	21.9	63	Municipal Elec. Auth. of GA	12.6	88	Grand River Dam Authority	8.0
14	Ameren	78.9	39	San Antonio City	21.6	64	NC Public Power	12.3	89	Avista	7.4
15	Xcel	76.8	40	Wisconsin Energy	21.2	65	Omaha Public Power District	12.3	90	International Paper	7.4
16	NRG	70.8	41	International Power	20.7	66	Portland General Electric	12.1	91	CLECO	7.2
17	Energy Future Holdings	68.3	42	NV Energy	20.1	67	UniSource	11.9	92	National Grid	7.1
18	US Corps of Engineers	67.2	43	Sempra	20.1	68	TransAlta	11.6	93	Vectren	6.8
19	PSEG	64.7	44	CMS Energy	19.7	69	Dow Chemical	11.2	94	Occidental	6.8
20	PPL	52.6	45	Mirant	18.7	70	ALLETE	11.2	95	Sacramento Municipal Util Dist	6.8
21	DTE Energy	52.1	46	Tenaska	18.6	71	Exxon Mobil	10.9	96	Dairyland Power Coop	6.7
22	Constellation	49.9	47	Alliant Energy	18.5	72	Arkansas Electric Coop	10.7	97	Chevron	6.6
23	US Bureau of Reclamation	45.9	48	NE Public Power District	17.8	73	Seminole Electric Coop	10.6	98	TransCanada	6.5
24	Allegheny Energy	45.4	49	TECO	17.8	74	East Kentucky Power Coop	10.4	99	Brazos Electric Power Coop	6.4
25	Dynegy	43.9	50	Associated Electric Coop	17.5	75	Puget Energy	10.3	100	Orlando Utilities Comm	6.4

particle air pollution, mercury deposition, nitrogen deposition, ozone smog, and regional haze. The report benchmarks, or ranks, each company's absolute emissions and its emission rate (determined by dividing emissions by electricity produced) for each pollutant against the emissions of the other companies. In addition, this report calls attention to the opportunities and risks companies may face from potential changes in environmental regulations. Becoming aware of a company's exposure to these business opportunities and risks is the first step in developing effective corporate environmental strategies.

Several issues and trends are influencing investment decisions in the U.S. electric power sector, including trends in fuel prices, technology developments, and environmental regulations. This report discusses trends in natural gas supply and prices, as well as trends in coal- and oil-fired power plant retirements. The report also examines renewable energy developments in the U.S., including wind and solar, and trends in energy efficiency investments and programs.

The report also highlights numerous regulations related to air quality and climate change that are facing the electric generating sector. As these regulatory programs evolve, they will have a significant impact on electric generation in the U.S. by driving investment in lower-carbon technologies and forcing inefficient plants into retirement. In addition, the report discusses the basic structure of the U.S. electric power sector and emissions associated with delivered electricity. This analysis is intended to help inform policy and educate investors and companies on the key issues associated with the electric power industry.

Major Findings

Electric Industry Emission Trends

Since 1990, power plant emissions of SO_2 and NOx have decreased and CO_2 emissions have increased.

- SO_2 and NOx emissions from power plants have decreased since 1990 due in large part to programs implemented under the 1990 Clean Air Act Amendments. In 2008, power plant SO_2 emissions were 52 percent lower and NOx emissions were 54 percent lower than they were in 1990.
- CO_2 emissions from power plants are not currently regulated at the federal level. In 2008, power plant CO_2 emissions were 30 percent higher than they were in 1990. However, in 2008, CO_2 emissions from electric power generation declined by 2.1 percent from 2007 levels due in part to

reduced electricity sales resulting from a weakened economy and increased renewable generation.[1] Congress is currently considering legislation that would regulate CO_2 emissions from power plants and other sources of greenhouse gas emissions, and in December 2009, the U.S. Environmental Protection Agency (EPA) signed the greenhouse gas endangerment finding that prepares EPA to establish federal emissions standards for greenhouse gases under existing Clean Air Act authority. The finding was in response to the U.S. Supreme Court's April 2007 ruling that concluded that EPA has clear statutory authority to regulate greenhouse gases *(Massachusetts v. EPA).*

Power plants only began to report their mercury emissions in 1998; therefore, longer-term emissions trends are not available.

Overall Emissions from Electricity

The electric industry in the U.S. is a major source of air pollution.

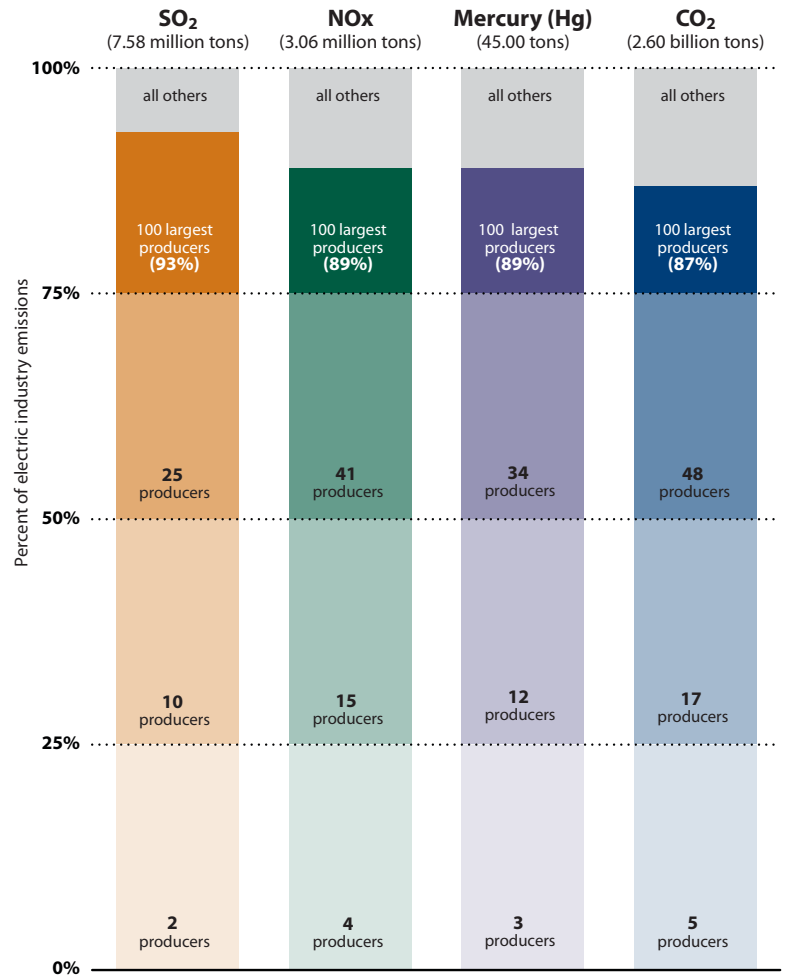
- In 2008, power plants were responsible for 66 percent of SO_2 emissions, 19 percent of NOx emissions, and 72 percent of mercury air emissions in the U.S.
- The electric industry accounts for more CO_2 emissions than any other sector, including the transportation and industrial sectors. The electric industry is responsible for about 39 percent of CO_2 emissions in the U.S.

Air Pollution Rankings and Comparisons

The 100 largest power producers generated 85 percent of electric power in the U.S. in 2008. The 100 largest producers generated 97 percent of all nuclear power, 91 percent of all coal-fired power, 83 percent of all hydroelectric power, 73 percent of all natural gas-fired power, and 52 percent of all non-hydroelectric renewable power.

FIGURE ES.1

Concentration of Air Emissions among All Electric Power Producers



Air pollution emissions from power plants are highly concentrated among a small number of producers. For example, almost a quarter of the electric power industry's SO_2 and CO_2 emissions are emitted by just two and five top 100 producers, respectively. Figure ES.1 summarizes the distribution of emissions among electric power producers.

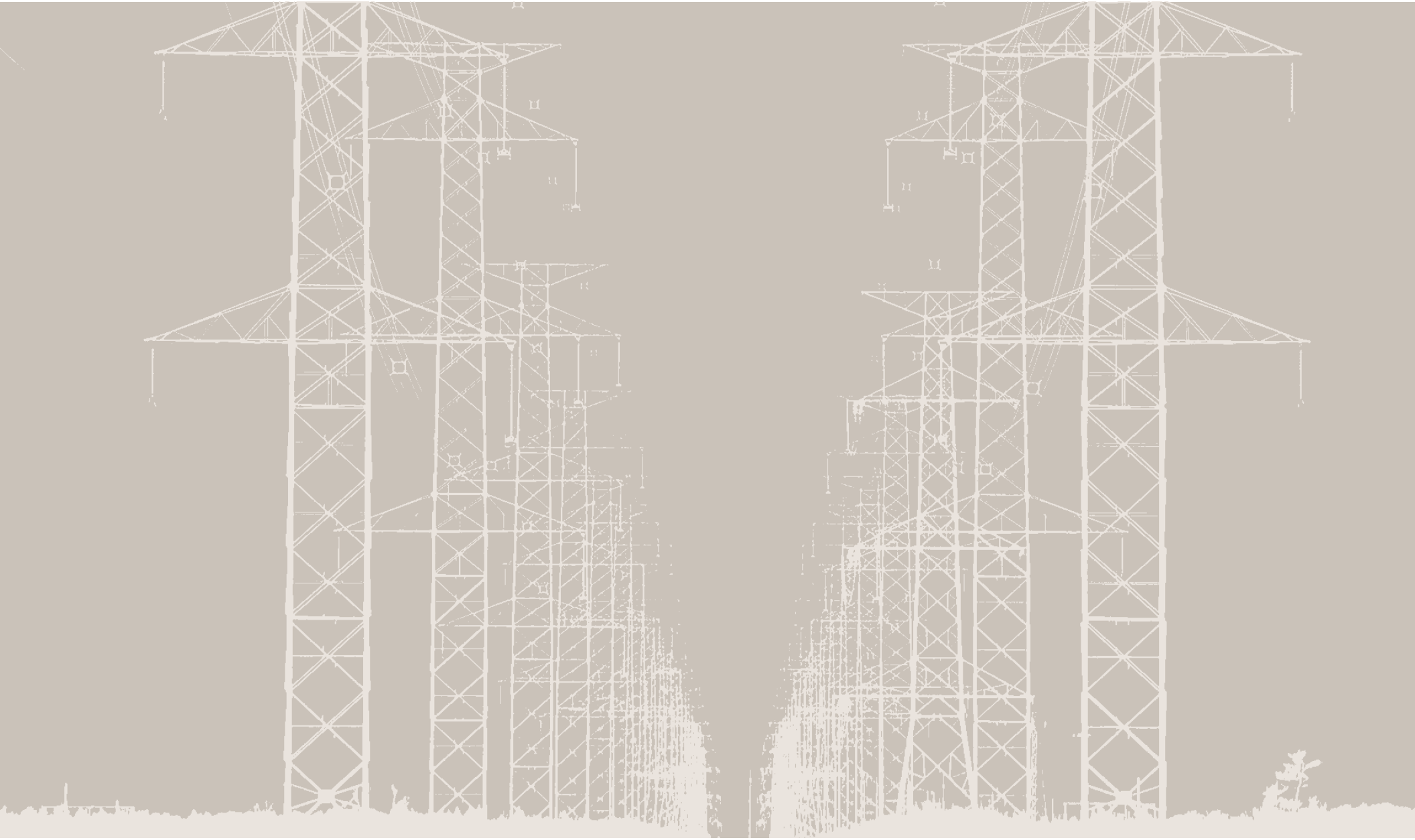
Electric power producers' emission levels and emission rates vary significantly due to the amount of power produced, the efficiency of the technology used in producing the power, the fuel used to generate the power, and installed pollution controls. In 2008, total generation among the 100 largest power producers varied from 6.4 million megawatt hours to 200 million megawatt hours and:

- SO_2 emissions ranged from zero to 827,413 tons, and SO_2 emission rates ranged from zero to 16.1 pounds per megawatt hour;
- NOx emissions ranged from zero to 261,973 tons, and NOx emission rates ranged from zero to 4.3 pounds per megawatt hour;
- CO_2 emissions ranged from zero to 171 million tons, and CO_2 emission rates ranged from zero to 2,408.4 pounds per megawatt hour;
- Mercury emissions from producers with coal plants ranged from 7 to 8,110 pounds, and mercury emission rates ranged from 0.001 to 0.19 pounds per gigawatt hour.

Using this Report

The information in this report supports informed decision-making in several areas:

- It can be used by policymakers who are addressing the public health and environmental risks of SO_2, NOx, mercury, and CO_2 emissions.
- It can be used by the investment community to assess the costs and business risks associated with compliance with future additional emission reduction requirements.
- It can be used by electric power companies and the public to assess corporate performance relative to key competitors, prior years, and industry benchmarks.



Electric Industry Overview

Electric power production is essential to the growth and operation of the U.S. economy. The availability, reliability, and price of electricity have significant impacts on national economic output, energy security and quality of life. At the same time, the production of electricity from fossil fuels results in air pollution emissions that affect both public health and the environment.

This report focuses on four power plant pollutants for which public emissions data are available: sulfur dioxide (SO_2), nitrogen oxides (NOx), mercury, and carbon dioxide (CO_2). Collectively, power plants are responsible for about 66 percent of SO_2 emissions, 19 percent of NOx emissions, 72 percent of mercury air emissions, and 39 percent of CO_2 emissions in the U.S.[2] The electric power industry accounts for more CO_2 emissions than any other sector, including the transportation and industrial sectors.

SO_2 and NOx emissions from power plants contribute to acid rain, regional haze, and fine particle air pollution. Acid rain damages trees and crops, acidifying soils, lakes, and streams. Fine particle air pollution can affect the heart and lungs through inhalation. Exposure to fine particle air pollution is linked to respiratory illness and other ailments, particularly in children and the elderly. Regional haze impairs visibility, most notably at national parks. NOx emissions are also associated with nitrogen deposition and ground-level ozone. Nitrogen deposition can impair water quality by overloading a water body with nutrients. Ground-level ozone can trigger serious respiratory problems.

Mercury air emissions deposited to lakes and ponds are converted by certain microorganisms to a highly toxic form of the chemical known as methylmercury. Methylmercury then accumulates in fish, shellfish, as well as birds and mammals that feed on fish. Humans are exposed to mercury when they eat contaminated fish. High levels of methlymercury can be detrimental to the development of fetuses and young children.

CO_2 is the most prevalent of anthropogenic (or human caused) greenhouse gas emissions. Greenhouse gases (or global warming pollutants) trap heat in the atmosphere and at elevated concentrations lead to global climate change.

FIGURE 1

U.S. Electric Industry Contribution to Total Emissions

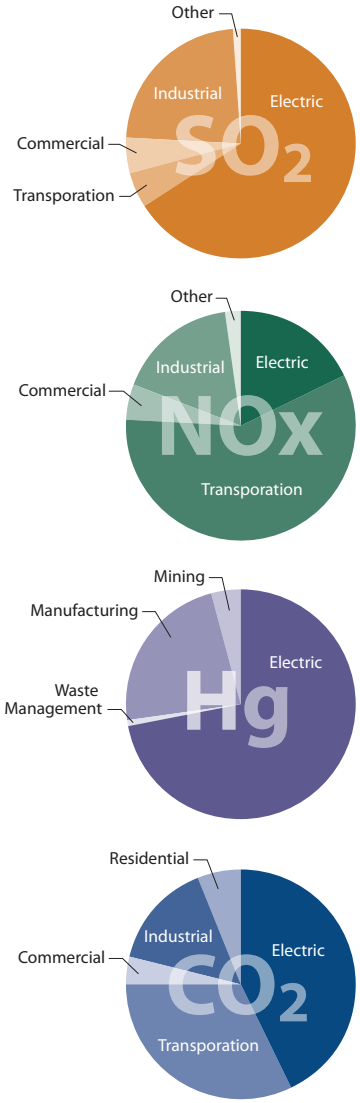
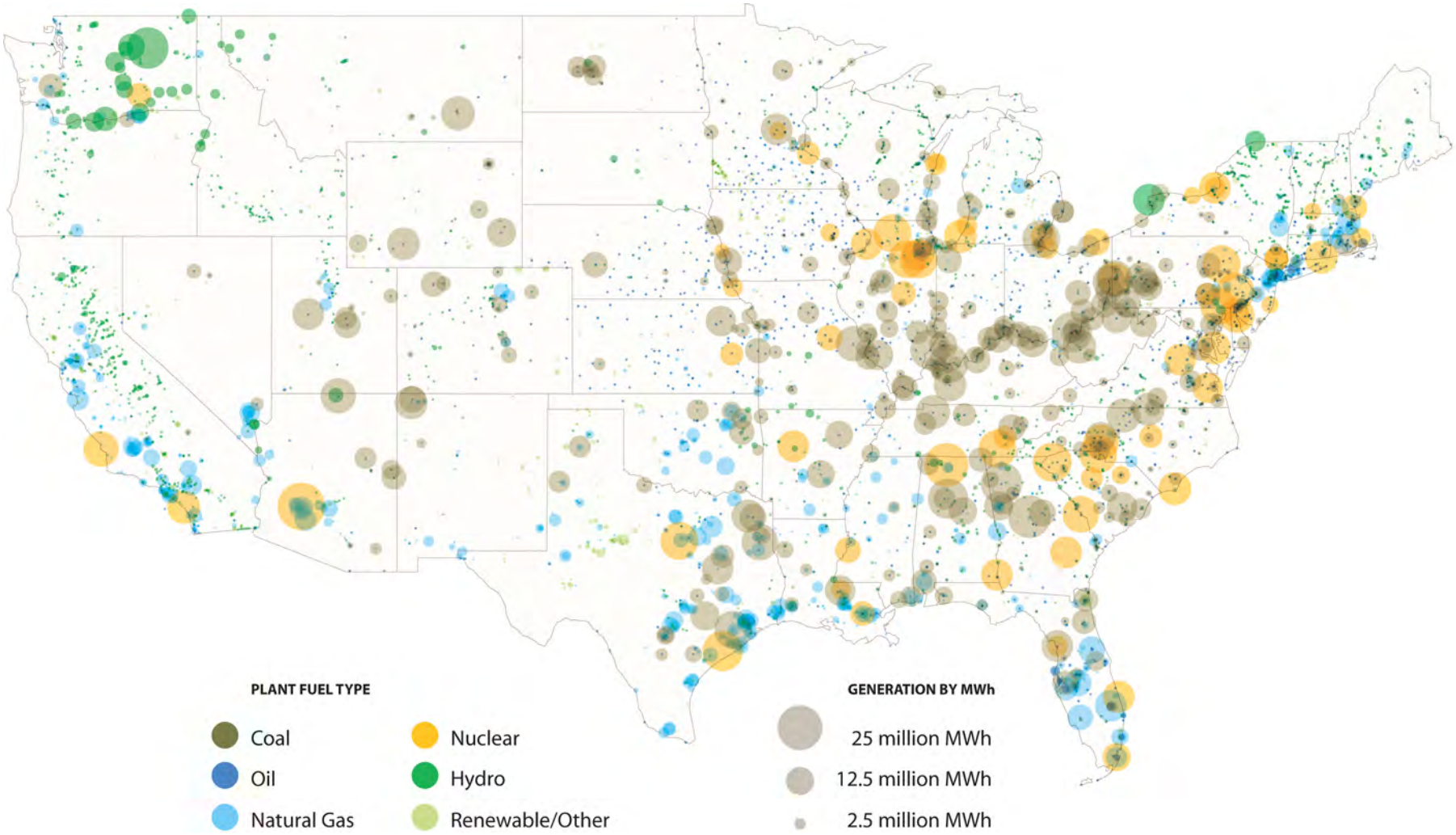


FIGURE 2

Location and Relative Size of U.S. Power Plants by Fuel Type



U.S. Environmental Protection Agency (EPA) regulates emissions of NOx and SO_2 emissions from power plants through a number of regulatory programs, including the Acid Rain Program, the Clean Air Interstate Rule, New Source Performance Standards, and others. EPA is currently developing regulations to limit emissions of mercury and other hazardous air pollutants from power plants, as discussed later in this chapter.

In April 2007, the U.S. Supreme Court found that EPA has clear statutory authority to regulate greenhouse gases under the Clean Air Act *(Massachusetts v. EPA)*. In response, EPA issued an official notice ("endangerment finding") in December 2009 that "greenhouse gases threaten the health and welfare of the American people," clearing the way for the Agency to regulate greenhouse gas emissions from cars and trucks, as well as other sources of emissions. At the same time, members of Congress are seeking to build consensus for a federal climate change bill and many state and local governments have developed or are developing strategies to address global warming pollutants. Many of these strategies have developed into state commitments to reduce emissions of CO_2 and other heat-trapping gases from power plants and other sources. While it is unclear at this time how these various efforts might be coordinated, it is widely expected that the power sector will face controls on CO_2 emissions in the near term.

The many environmental regulatory issues facing the electric power sector are discussed in more detail below.

Sources of Power

Over 5,500 power plants generate electricity in the U.S. In 2008, these plants generated approximately 4.1 billion megawatt hours of electricity. Seventy percent of this power was produced by burning

FIGURE 3.1

Location and Relative Size of U.S. Power Plants by NOx Emissions

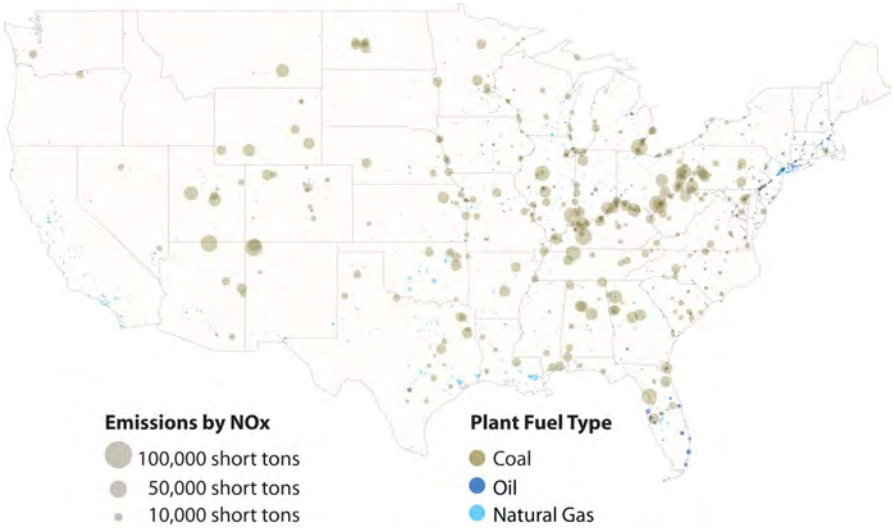


FIGURE 3.2

Location and Relative Size of U.S. Power Plants by SO_2 Emissions

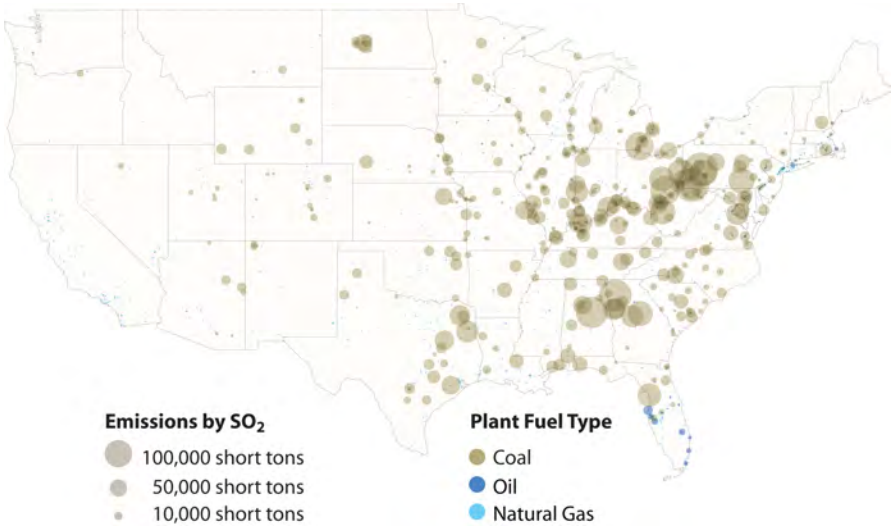


FIGURE 3.3

Location and Relative Size of U.S. Power Plants by CO_2 Emissions

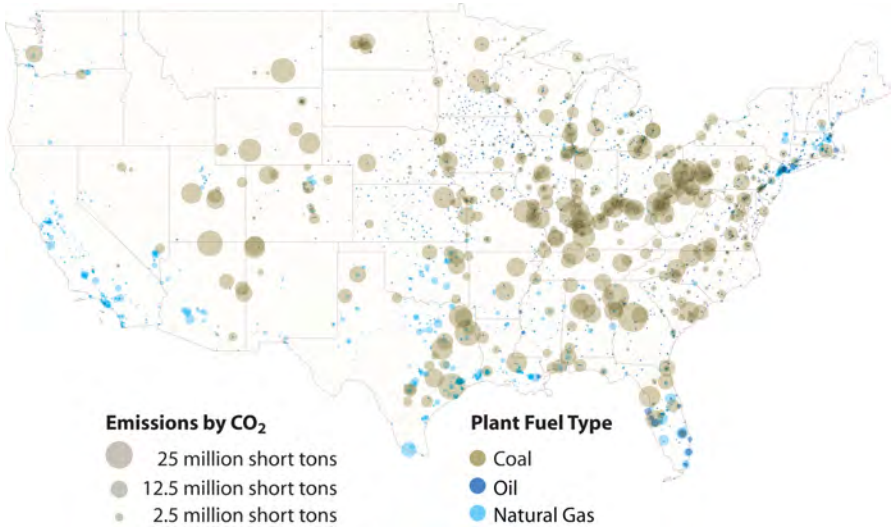
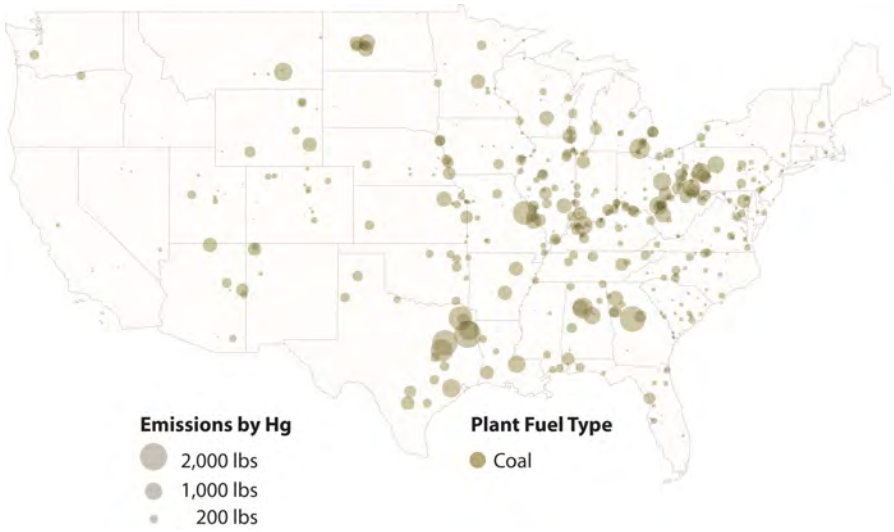


FIGURE 3.4

Location and Relative Size of U.S. Power Plants by Mercury Emissions



fossil fuels (coal, natural gas and oil) resulting in the release of SO_2, NOx, mercury, and CO_2 into the air. Coal accounted for 48 percent of total power production, and the remaining fossil fuels – natural gas and oil – accounted for 21 percent and 1 percent, respectively. Nuclear power, the largest non-fossil fuel energy source, generated 20 percent of U.S. electric power. Hydroelectricity accounted for about 6 percent of total power production and non-hydroelectric renewables (such as wind turbines and solar photovoltaic cells) accounted for almost 2 percent. A variety of other fuel sources comprised the remaining 2 percent of generation.[3]

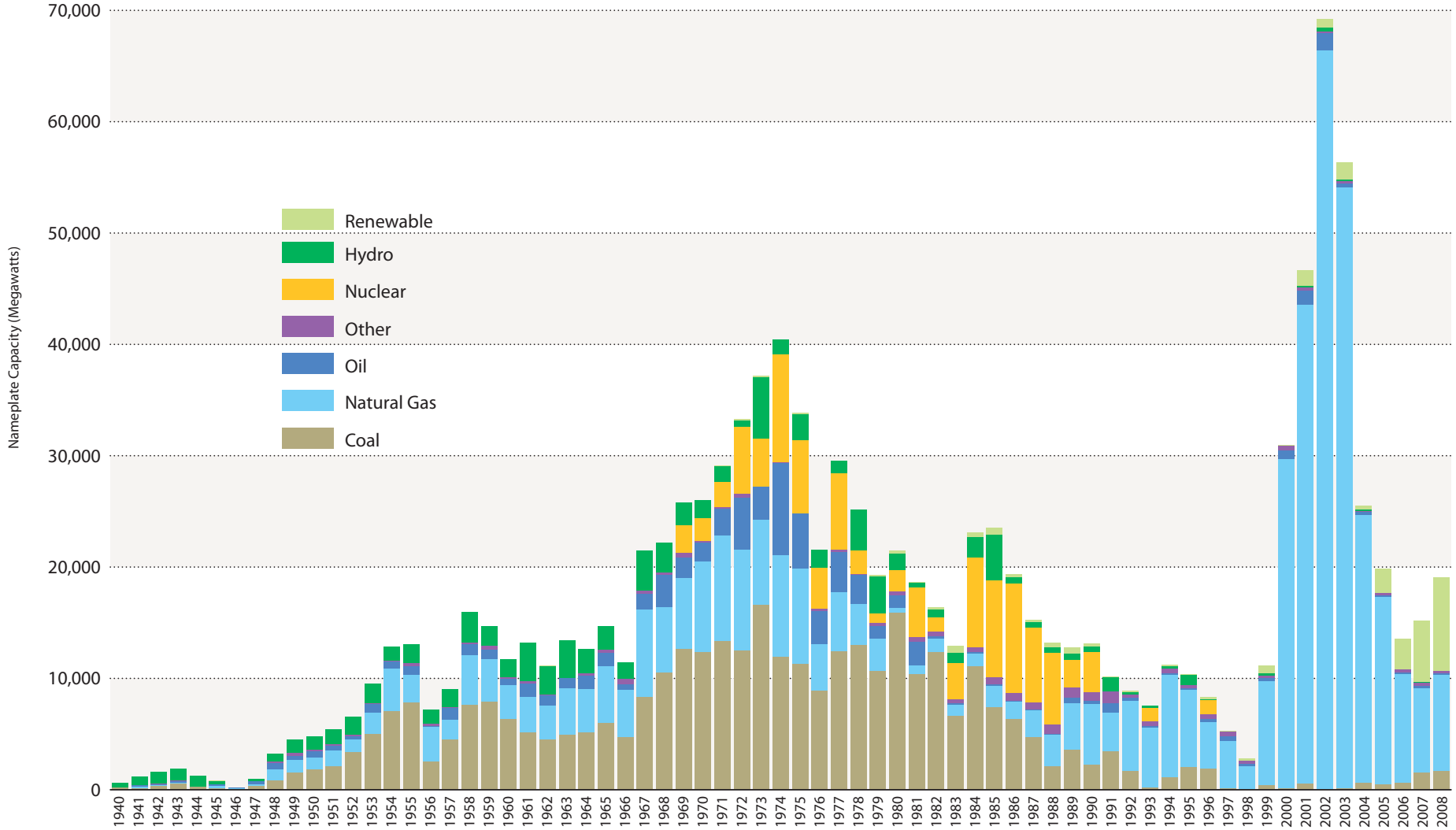
Coal-fired power plants are located across the nation, most predominantly in the midwestern and eastern parts of the country, with the heaviest concentrations of coal plants located along the Ohio and Mississippi Rivers. Natural gas plants are generally smaller than coal plants and are also spread across the country. The heaviest concentrations of natural gas-fired power plants are in Texas and Louisiana, near the Gulf of Mexico, and in California. Most large nuclear plants are located in eastern and upper-midwestern states, and most hydroelectric facilities are in western states.

Figure 2 plots the locations of the nation's major power plants, sized according to their electricity production in 2008 and colored based on their primary fuel type. Figure 3 plots the same power plants, sized according to their 2008 air emissions (NOx, SO_2, CO_2, and mercury).

Power plant development in the U.S. has occurred in cycles with a dramatic spike in natural gas-fired power plant construction in the period from 2000-2005. The electric power sector continues to favor natural gas-fired generation with a growing emphasis on renewable energy technologies. Figure 4 presents the in service year and fuel type of the existing electric generating fleet in the U.S.

FIGURE 4

U.S. Electric Generating Capacity by In Service Year



SOURCE: ENERGY INFORMATION ADMINISTRATION. ANNUAL ELECTRIC GENERATOR REPORT: FORM EIA-860 (2008).
http://www.eia.doe.gov/cneaf/electricity/page/eia860.html

Electricity prices vary across the U.S. depending in part on the mix of power plants available in the region. Coal-fired power plants have historically enjoyed a significant fuel cost advantage over natural gas fired power plants, but this gap has closed in recent years as natural gas prices have fallen significantly (Figure 5). The average utilization of coal-fired power plants was 56 percent in 2008. In contrast, natural gas combined cycle facilities were only utilized an average of 33 percent. Renewable technologies, such as wind and solar photovoltaic cells, have no fuel costs and produce no emissions, but the up-front capital costs can be significant. Because of the high carbon content of coal, the operating costs of a coal-fired power plant would increase more than other fossil fuel fired technologies if CO_2 were regulated, as is widely expected, and companies had to pay for their carbon emissions.

Market Trends

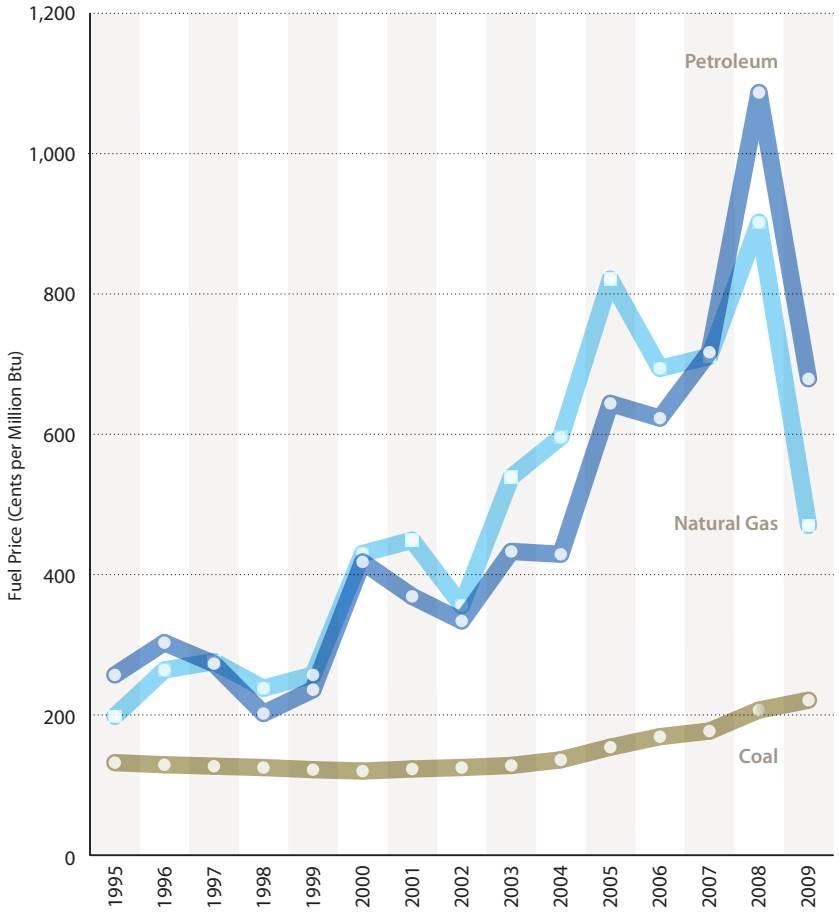
Several issues and trends are influencing investment decisions in the electric power sector, including trends in fuel prices, technology developments, and environmental regulations. These issues will influence capital spending on pollution control equipment, power plant retirement decisions, and future technology choices. The following discussion highlights some of the key issues facing the electric power sector, including implications for future emissions trends.

Natural Gas Outlook

Wholesale electricity prices tend to reflect trends in fuel prices—particularly natural gas prices, because natural gas-fired power plants often set the market price of electricity, and the U.S. relies on natural gas for a significant share of its electricity production. Natural gas prices have fallen dramatically since reaching record highs in mid-2008.

FIGURE 5

Costs of Fuels for Electricity Generation: 1993-2006



SOURCE: U.S. ENERGY INFORMATION ADMINISTRATION, FORM EIA-423, "MONTHLY COST AND QUALITY OF FUELS FOR ELECTRIC PLANTS REPORT," FEDERAL ENERGY REGULATORY COMMISSION, FERC FORM 423, "MONTHLY REPORT OF COST AND QUALITY OF FUELS FOR ELECTRIC PLANTS," FORM EIA-923, "POWER PLANT OPERATIONS REPORT" AND EIA MARCH 2010 MONTHLY ENERGY REVIEW, "COST OF FOSSIL-FUEL RECEIPTS AT ELECTRIC GENERATING PLANTS".

The U.S. Energy Information Administration (EIA) reported an average wellhead price of $10.82 per thousand cubic feet (mcf) in June 2008.[4] Twelve months later prices had declined to less than $4.00 per mcf—a two-thirds decline.[5] There are two primary factors that have contributed to the fall in prices: lower demand and increased domestic supplies. On the demand side, natural gas consumption in the U.S. industrial sector—a major consumer of natural gas—fell nearly nine percent in the twelve months since October 2008 in response to the global economic downturn.[6] (By contrast, natural gas use in the electric sector saw a modest increase, despite a decline in electricity consumption, because low natural gas prices prompted electricity producers to use natural gas in place of coal in many parts of the country.[7]) On the supply side, new advancements in the techniques of hydraulic fracturing and horizontal drilling technologies have enabled expanded domestic production. For example, output from the Barnett shale play, a geological formation in Texas, has expanded from 94 million cubic feet (mmcf) per day in 1998 to 3,014 mmcf per day in 2007 as a result of these technologies.[8] Looking ahead, energy analysts are predicting that natural gas prices will remain depressed until the global economy recovers and demand starts to pick up again.[9]

Coal Outlook

While most natural gas-fired power plants in the U.S. were built in the last 10 years, the majority of the nation's coal- and oil-fired power plants are at least 30 years old with many approaching retirement age (see Figure 4). In fact, several major power companies have announced plans to retire older, less efficient generating facilities. There are several factors that are contributing to these retirement decisions, including, most notably, the current market conditions. Electricity prices have declined due to lower natural gas prices, reducing the earnings and profitability of unregulated coal plants. Electricity demand has also declined in response to the economic downturn, reducing the utilization and earnings of less efficient generating facilities. Companies are also faced with the prospect of incurring additional capital expenses to continue operating aging facilities. Power plant components will deteriorate over time, reducing power plant efficiency and requiring capital investments to maintain safe and efficient operations. New environmental standards and requirements (discussed below) may also require that companies make additional capital investments. Companies will weigh the economics of these decisions and, in the end, may decide that their capital is better spent on the development of new generating assets. As older generating facilities are retired, they are likely to be replaced with lower emitting generating facilities, reducing the sector's overall emissions.

Recent Coal Plant Retirement Announcements and Reports

April 20, 2010	Xcel Energy, the largest utility in Colorado, announced plans to retire, retrofit, or repower about 900 megawatts of coal-fired generation in an effort to reduce the company's air emissions. [10]
March 9, 2010	Bernstein Research projects that 24 percent of coal fired generation in the U.S. will be retired by 2020. [11]
January 14, 2010	Portland General Electric Company submitted a proposal to the Oregon Public Utility Commission to retire the utility's thirty-year old Boardman Power Plant by 2020. Boardman is a 550 megawatt coal-fired power plant and the only coal-fired power plant in Oregon. [12]
December 29, 2009	Consumers Energy announced that the state issued an air permit for its proposed 830-megawatt coal-fired power plant in Michigan. Consumers (a unit of CMS Energy) said it would retire up to seven older coal-fired units if the plant is constructed. [13]
December 2, 2009	Exelon announced plans to retire four generating units (900 megawatts) in suburban Philadelphia by May 2011. These units are all about 50 years old. The company cited "decreased power demand, over supply of natural gas, and increasing operating costs" as the driving factors in their decision. [14]
December 1, 2009	Progress Energy announced tentative plans to retire 1,500 megawatts of coal capacity (11 coal-fired units) in North Carolina by 2017. [15] These units date from the 1940s to 1970s.
October 30, 2009	On an earnings call, Jim Rogers, president and CEO of Duke Energy, predicted that "over the next five to 10 years you're going to see virtually every [coal] plant that hasn't been retrofitted for SO_2 or NOx retired". [16]
August 18, 2009	Progress Energy decided against a $330 million investment in SO_2 controls at one of its North Carolina coal plants, whose units date from the early 1950s and 1960s, instead opting to repower another coal plant to natural gas—a $900 million investment. The decision was driven by the fall in natural gas prices. [17]
April 23, 2008	According to investment analyst Bernstein Research, coal plant retirements over the next decade could reduce U.S. generation capacity by five percent. Particularly at risk are the owners of older, unregulated coal fired power plants that lack SO_2 control equipment. [18]

Renewable Energy Outlook

Renewable energy (excluding large hydroelectric projects) accounted for 2 percent of U.S. electricity generation in 2008.[19] Renewable production capacity has been rapidly expanding in response to technology improvements, tax incentives, and state renewable mandates.[20]

Wind energy, in particular, has been rapidly expanding over the past several years. In 2009, the U.S. wind energy industry developed over 10,000 megawatts of new wind power capacity, bringing the nation's

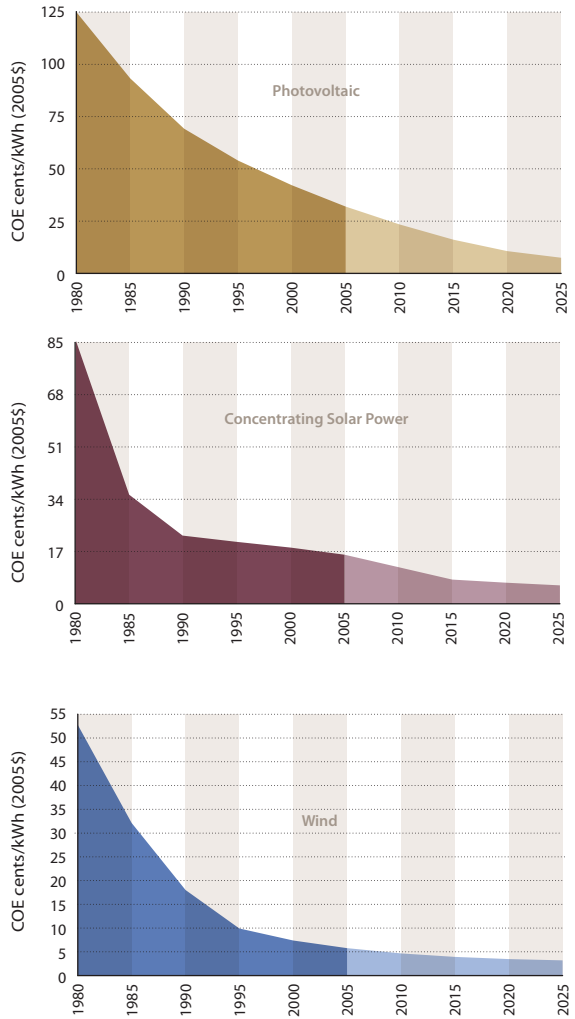
cumulative total to over 35,000 megawatts.[21] NextEra Energy (formerly FPL Group) dominates the wind energy market in the U.S. with more than 6,000 megawatts of installed capacity. Only five other companies own more than 1,000 megawatts of wind capacity in the U.S.: Iberdrola Renewables (2,063 megawatts), MidAmerican Energy (1,939 megawatts), Horizon EDP Renewables (1,872 megawatts), Invenergy (1,276 megawatts), and Babcock and Brown (1,118 megawatts).[22]

According to the Energy Information Administration, carbon dioxide emissions from electric power generation declined by 2.1 percent in 2008.[23] The decline was attributable to lower electricity sales and a decline in the carbon intensity of power generation, due in part to a 50 percent increase in generation from wind resources.[24] Electricity generation from all fossil fuels dropped by 2.2 percent from 2007 to 2008.

Solar energy has also been rapidly expanding with a growing number of utility scale projects under development or in the proposal phase. Electric utilities have over 4,800 megawatts of photovoltaic projects in the pipeline.[25] Additionally, over a dozen concentrating solar thermal power plants are being planned in the U.S., with some 3,100 megawatts expected to come online by 2012.[26] In October 2009, NextEra Energy completed construction of North America's largest solar photovoltaic facility, the 25 megawatt DeSoto Next Generation Solar Energy Center (pictured). The facility produces enough energy to power about 3,000 homes.[27] NextEra has two other large-scale solar projects underway in Florida. Many large solar energy projects have also been proposed for development in California's southwest desert region, using a variety of solar technologies. The largest solar photovoltaic project in California started commercial operation in December 2009.[28] The 21 megawatt Blythe Solar Project utilizes thin-film photovoltaic technology, and is owned by NRG Energy. Several concentrating solar power projects—

FIGURE 6

Renewable Energy Cost Trends
Levelized cost of energy in constant 2005$



SOURCE: NATIONAL RENEWABLE ENERGY LABORATORY (NREL) ENERGY ANALYSIS OFFICE. "RENEWABLE ENERGY COST TRENDS." NOVEMBER 2005. NOTE: THESE COSTS ARE REFLECTIONS OF HISTORICAL TRENDS NOT PRECISE ANNUAL HISTORICAL DATA.

a technology that uses mirrors to concentrate sunlight for electricity production—have also been proposed in California. BrightSource Energy is currently developing a 440 megawatt solar energy complex in the Mojave Desert that will use mirrors to focus the sun's rays on solar receivers atop "power" towers (pictured).[29] Construction is slated to start in 2010.

Energy Efficiency Outlook

Energy efficiency is widely recognized to be a low cost energy resource that reduces emissions by avoiding the need for additional energy production. According to the American Council for an Energy-Efficient Economy's latest review of utility energy efficiency programs, the average cost to utilities of a kilowatt hour saved by energy efficiency was 2.5 cents per kilowatt hour. Factoring in customer costs, the average total cost of energy efficiency was 4.6 cents per kilowatt hour.[30] The average retail price of electricity in the U.S. is about 10 cents per kilowatt hour.

As a result, many states and utilities are seeking to expand investment in energy efficiency through a variety of programs and policies, and the data show that investment has dramatically increased in the past several years. According to information compiled by the Consortium for Energy Efficiency, the budgets of ratepayer funded energy efficiency programs increased 37 percent in 2009 over 2008 levels.[31] National Grid, for example, increased spending on its Rhode Island energy efficiency programs by 57 percent in 2009, and the Massachusetts Energy Efficiency Advisory Council has approved the company's proposal to more than double its energy efficiency spending in Massachusetts from $85 million in 2009, to approximately $570 million between 2010 and 2012.[32] Similarly, the California Public Utilities Commission

DeSoto Next Generation Solar Energy Center
PHOTO COURTESY OF NEXTERA ENERGY (FORMERLY FPL)

Simulation of Ivanpah Solar Energy Generating System in the Mojave Desert
PHOTO COURTESY OF BRIGHTSOURCE ENERGY

approved $3.1 billion in energy efficiency spending over the next three years for Pacific Gas & Electric, San Diego Gas & Electric and Southern California Gas Company and Southern California Edison Company. This represents an increase of over 42 percent from the previous three year cycle. Other parts of the country are also taking steps to expand investment in energy efficiency programs. Ohio and Indiana, for example, adopted identical energy savings targets in 2009 ramping up to two percent of annual electricity sales by 2019. This ranks them among the most aggressive targets in the nation.

Leading utilities typically offer a wide variety of energy efficiency programs and incentives to their customers. The offerings include: home energy audits, rebates to encourage replacement of inefficient refrigerators, lighting retrofits, and technical assistance to large commercial and industrial customers building new facilities.

Environmental Regulatory Trends

The electric generating sector currently faces numerous regulations related to air quality and climate change. As detailed in this report, fossil fuel-fired power plants, particularly coal-fired power plants, are a significant source of SO_2, NOx, CO_2, mercury, and other hazardous air pollutants. These power plant emissions are controlled through several statutory and regulatory programs. As these regulatory programs continue to evolve, they will have important implications for public health, for the mix of U.S. generating resources, and for economic growth by driving investment in new and cleaner technologies and forcing some of the more inefficient and higher polluting plants into retirement. The discussion below provides a snapshot of the major environmental regulatory programs facing the electric generating sector.

Mandatory Reporting of Greenhouse Gases

Pursuant to existing EPA authority under Clean Air Act Sections 114 and 208, as well as direction included in the Fiscal Year 2008 Consolidated Appropriations Act, all major stationary sources of greenhouse gas emissions, including power plants, must report their greenhouse gas emissions beginning January 1, 2010. The first annual reports for the largest emitting facilities, covering calendar year 2010, will be submitted to EPA by March 31, 2011. The program is expected to cover approximately 85 percent of the nation's greenhouse gas emissions and apply to approximately 10,000 facilities.

Regulation of Greenhouse Gases under the Clean Air Act

On December 7, 2009, EPA signed the greenhouse gas endangerment finding in response to the U.S. Supreme Court's 2007 decision in *Massachusetts v. EPA*. In the finding, EPA made an official determination that greenhouse gas emissions endanger public health and welfare within the meaning of Section 202(a) of the Clean Air Act. This decision sets the stage for EPA to establish the first-ever federal vehicle emissions standards for greenhouse gases, following the Agency's simultaneous finding that vehicle greenhouse gas emissions cause or contribute to global warming. In April 2010, EPA finalized emissions standards for new motor vehicles (in coordination with Department of Transportation fuel economy standards) and is currently considering options for setting air permitting requirements for stationary sources of greenhouse gas emissions under the Prevention of Significant Deterioration (PSD) and Title V permitting requirements of the Clean Air Act. PSD is a preconstruction permitting program under the Clean Air Act that requires companies to install pollution control systems when constructing a new facility or when undertaking a major upgrade at an existing facility that significantly increases emissions. EPA is currently considering the emissions standards that would apply to power plants and other sources of greenhouse gas emissions. Stakeholders participating in a recent advisory panel have suggested a wide variety of alternatives, ranging from efficiency standards to alternative fuel requirements.[33]

Clean Air Interstate Rule

In 2005, EPA issued the Clean Air Interstate Rule (CAIR), building on progress made under the NOx SIP Call to reduce the transport of ozone and fine particulates (PM-2.5) in the eastern U.S. CAIR requires that 28 eastern states and the District of Columbia that contribute to ozone and PM-2.5 nonattainment problems in downwind states achieve further reductions in SO_2 and NOx emissions from power plants. CAIR establishes an annual and a seasonal cap-and-trade program for NOx, and uses the Clean Air Act's existing Acid Rain program as a framework for further SO_2 reductions.

After vacating CAIR, the D.C. Circuit sent the rule back to the Agency for reconsideration on December 23, 2008, while leaving the program in place until EPA issues a new rule to replace CAIR in accordance with the parameters established in its July 11, 2008 decision. EPA expects to release a proposed replacement CAIR program in mid-2010, with a final rule in 2011. Some observers have questioned EPA's ability to implement a regional trading program similar to the original CAIR program in light of the court decision.

Mercury and Other Hazardous Air Pollutants

Section 112 of the Clean Air Act requires EPA to regulate emissions of hazardous air pollutants, including mercury, nickel, arsenic, acid gases, and other toxic pollutants, through the establishment of maximum achievable control technology (MACT) standards. On February 8, 2008, the D.C. Circuit held that EPA violated the Clean Air Act when it sought to regulate mercury-emitting power plants through the Clean Air Mercury Rule (CAMR), a cap-and-trade program developed under Section 111, rather than under a traditional MACT standard under Section 112. The court concluded that EPA violated the Clean Air Act by failing to make or even attempt specific health-based findings to remove electric generating units from regulation under Section 112.

EPA is now developing a MACT standard for coal- and oil-fired electric generating units to regulate emissions of mercury and scores of other hazardous air pollutants. EPA issued an Information Collection Request (ICR) under Clean Air Act Section 114 to compel coal- and oil-fired power plants throughout the U.S. to submit emissions data for mercury, nickel, and other hazardous air pollutants. The Agency will then set the MACT standards based in part on the data collected. A recent consent decree with environmental groups requires EPA to propose the MACT standards by March 2011 and finalize the standards by November 2011. The MACT standards are likely to require the addition of SO_2 "scrubbers" and particulate control devices on coal-fired power plants throughout the U.S. Several states have already adopted mercury emissions standards under independent state law.

National Ambient Air Quality Standards

A core element of U.S. air quality regulation is EPA's National Ambient Air Quality Standards (NAAQS) program, established under the Clean Air Act in 1990. NAAQS are based on scientifically determined levels of air pollution, and are established for six specific criteria pollutants (ozone, particulate matter, sulfur dioxides, nitrogen oxides, lead, and carbon monoxide). NAAQS have two components: primary standards to protect public health and secondary standards to protect public welfare and the environment. NAAQS are implemented through enforceable source-specific emission limitations and other air quality regulations established by states via State Implementation Plans (SIPs). The SIPs detail each state's strategy to "attain" or "maintain" the NAAQS.

The CAA requires EPA to review and, if appropriate, revise each NAAQS every five years. These revisions often result in lower standards for each criteria pollutant, leading to further restrictions of power plant emissions and directly affecting the electric generating sector.

On January 25, 2010, EPA released the final primary NO_2 NAAQS, and on June 2, 2010, EPA revised the final primary SO_2 NAAQS. EPA anticipates finalizing a revised NAAQS for ozone in August 2010 and will be proposing a revised PM-2.5 NAAQS this year for finalization in 2011.

The transport of criteria pollutants often contributes to "nonattainment" designations for downwind areas. One approach EPA has used to address transport is establishing national or regional requirements to ensure they reach attainment. For example, EPA's Clean Air Interstate Rule (CAIR) was designed to address downwind transport of NOx and SO_2.

The Structure of the U.S. Electric Power Industry

The basic model of the U.S. electric power sector is one that is replicated around the world. Large central station power plants, often in remote locations, spin generators to feed a network of high-voltage transmission lines. These generators are typically powered by coal, natural gas, water or nuclear fission. To a lesser extent, the system is powered by smaller, distributed generating sources, like solar. The electricity pulsing through the transmission grid in turn feeds a system of low-voltage distribution lines, which connect to homes and businesses. Turning on a reading lamp or computer connects the appliance to this network of wires, drawing electricity from the grid. Power plant operators are continually responding to these changes in the system, increasing or decreasing supply to match demand in a carefully orchestrated exercise managed by a central dispatcher.

This report focuses on the companies that own and operate the power plants that supply the electric power system (and the air pollution emissions associated with their operations); however, this represents only one segment of the industry. The other major segment of the industry is comprised of the companies that deliver electricity to retail customers.

Local Distribution Companies

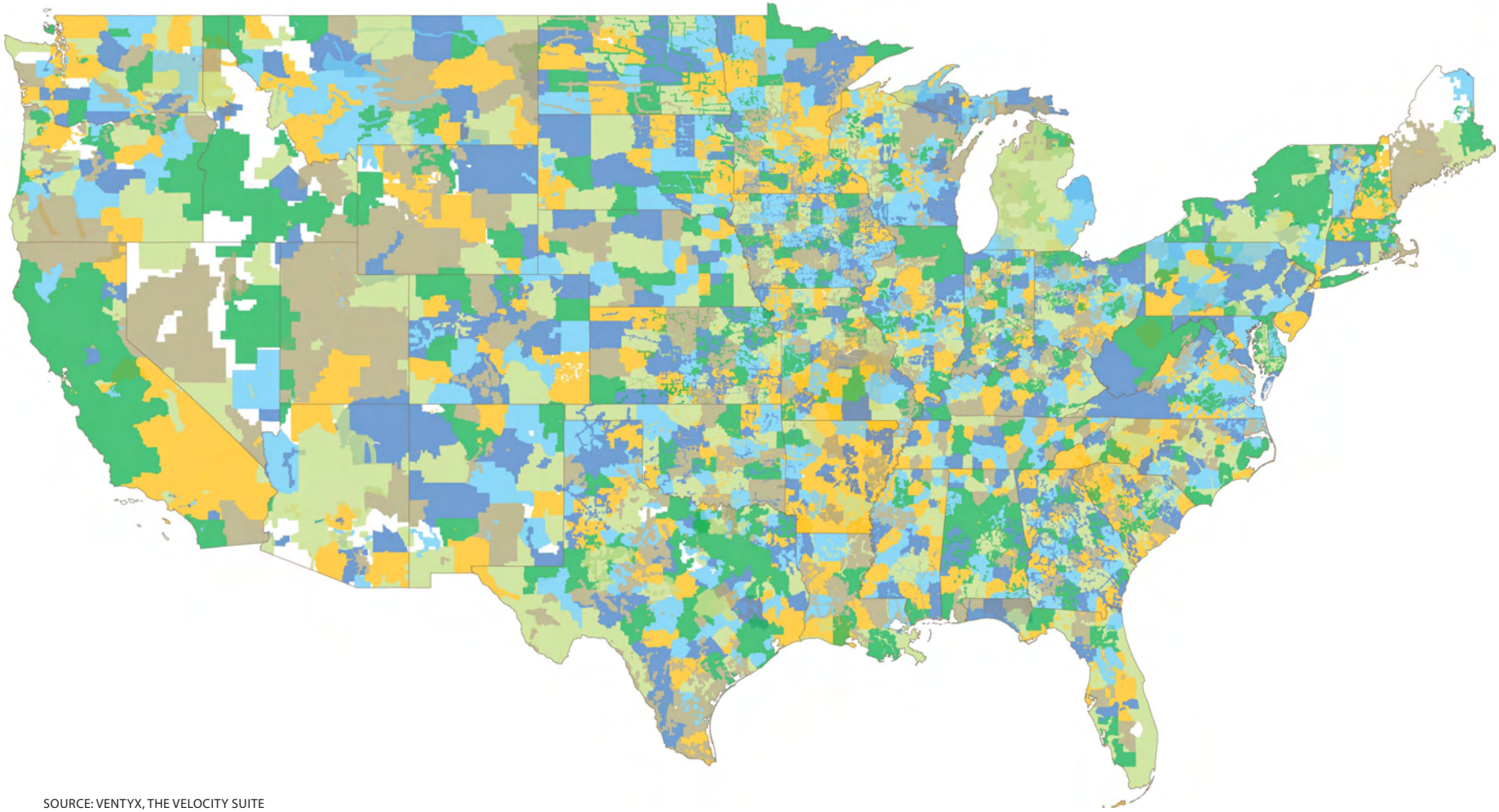
There are more than 3,000 electric utility companies—or local distribution companies—in the U.S. that are responsible for delivering electricity to retail customers within their service territories. In some cases, these are the same companies that also own and operate the power plants inventoried in this report, but not always. Southern Company, for example, owns a large fleet of regulated power plants and operates four local distribution companies in the Southeast: Alabama Power, Georgia Power, Gulf Power, and Mississippi Power. In contrast, NSTAR, one of the largest utility companies in Massachusetts, owns no power plants. The company relies on market purchases to supply its customers. Figure 7 presents the service territories of all the electric utilities in the U.S., including investor-owned utilities, municipal utilities, and rural electric cooperatives.

A local distribution company has three basic options for acquiring the electricity that it supplies to its customers: (1) self-generation with its own power plants; (2) spot-market purchases; and (3) long-term supply contracts. Many utility companies are exclusively distribution utilities that rely on power purchases to supply their customers, rather than generating the electricity themselves. A traditional, vertically-integrated utility both produces and delivers electricity to retail customers.

Several states have ended the monopoly status of local utilities, allowing other power marketers to offer retail electric service to customers. For those states that have adopted retail competition, many investor-owned utilities have divested their generation assets and placed their transmission assets under the operational control of independent system operators (ISOs). The primary function of these investor-owned utilities is providing distribution service and serving as the supplier of last resort for retail customers that have not chosen an alternative retail energy service provider. Many investor-owned utilities that operate in regulated retail markets continue to operate on a vertically integrated basis, providing generation, transmission and delivery service at a bundled price to retail customers. In all states, whether regulated or deregulated, state public utility commissions (PUCs) retain jurisdiction over retail electricity prices (or rates) for investor-owned utilities.

FIGURE 7

U.S. Electric Utility Service Territory Map



SOURCE: VENTYX, THE VELOCITY SUITE

Emissions Associated with Delivered Electricity

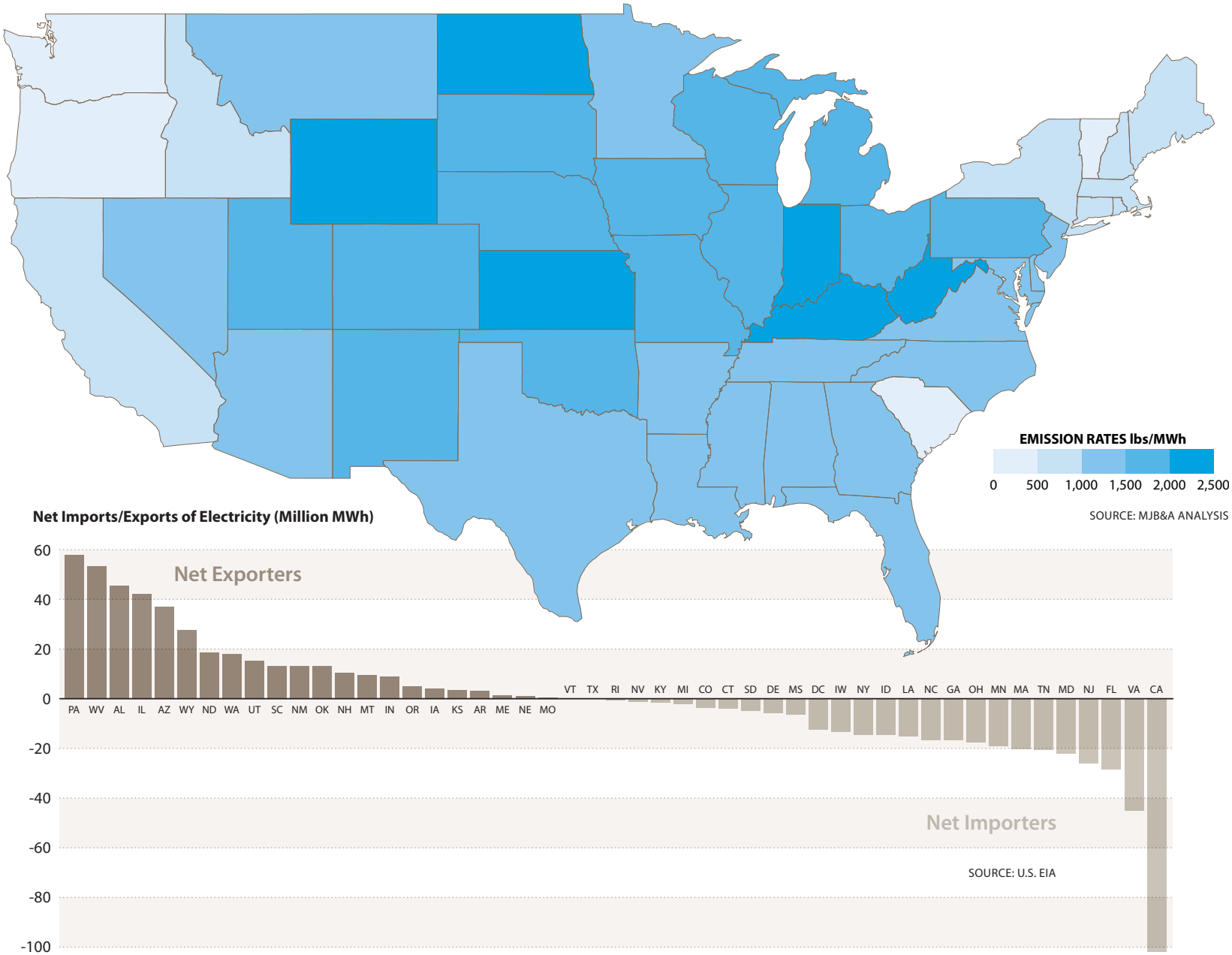
Because of the complexity of the electric power system, it is generally impossible to determine with absolute precision the air pollution emissions associated with a given megawatt hour of delivered electricity. There are several reasons for this. First, as detailed in this report, electricity is produced by a wide variety of generating facilities with very different emissions performance. Second, the mix of power plants supplying the grid, and therefore the emissions produced by the system, varies throughout the day and at different times of the year. For example, hydroelectric facilities, which produce no air emissions, will increase their output during the wetter months of the year. Third, electricity is transported over long distances by an interconnected network of transmission and distribution lines, making it difficult, if not impossible, to trace the electrical energy back to its source. Fourth, in many cases, local distribution utilities are purchasing electricity from the wholesale power market, not individual generating facilities. The original source of the electricity is unknown to the buyer.

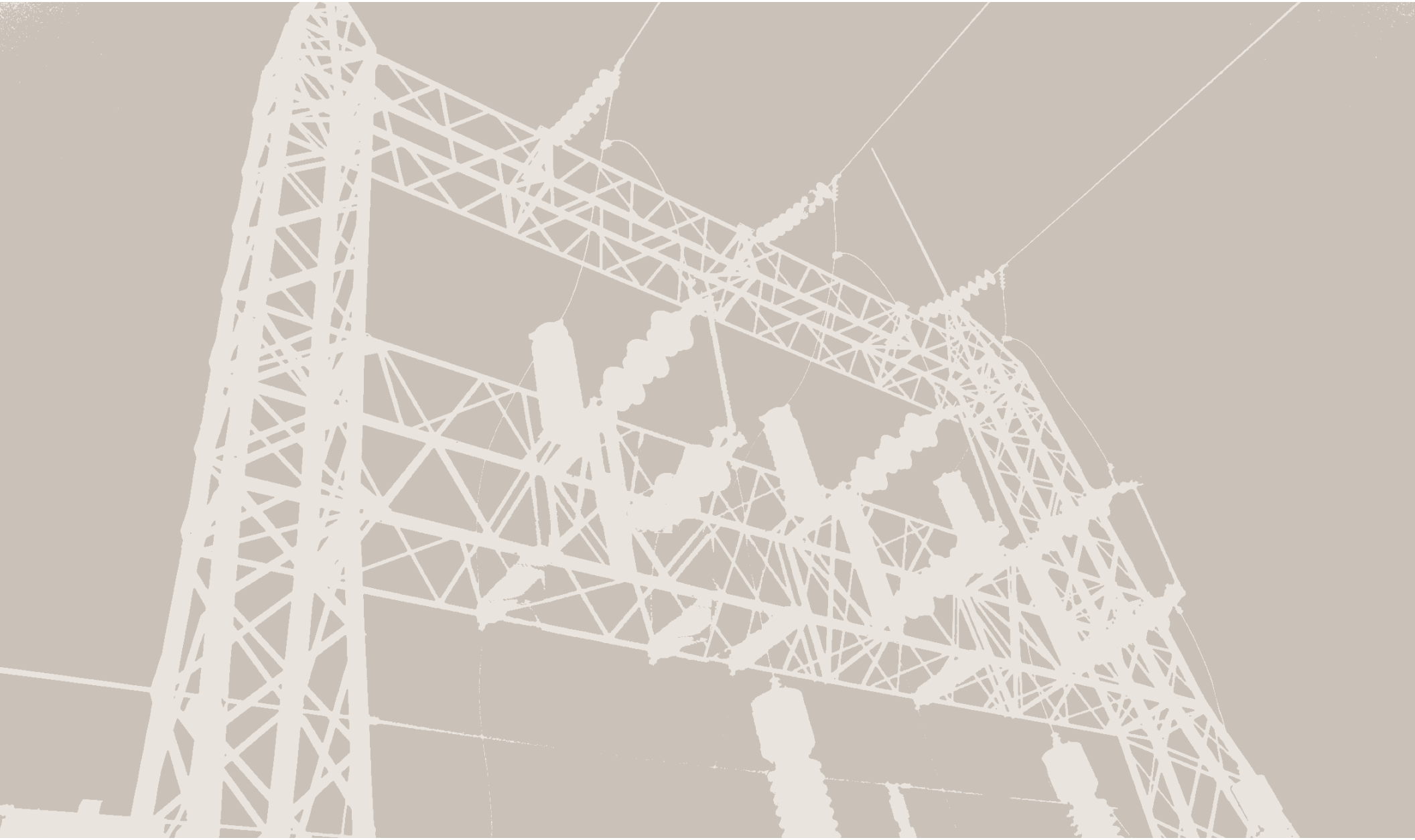
Despite the complexities, there are methods available for estimating the emissions associated with delivered electricity. Figure 8 presents an estimate of the CO_2 emission rates associated with the electricity delivered to retail customers in the U.S.

The emission rates in Figure 8 are based on the average CO_2 emissions of power plants in the different regions of the country, while accounting for the interstate trade in electricity. In deregulated states, where electricity suppliers rely primarily on market purchases to supply their customers, the analysis relied on the average emission rates of the electricity sold in the competitive market of which the state is a part. In regulated states, where electricity is supplied primarily by vertically-integrated utilities, the analysis relied on a different approach depending on whether the state is a net importer or exporter of electricity. For states that are net exporters of electricity, the analysis relied on the average emission rate of in-state electricity generators. For states that are net importers of electricity, the analysis relied on a weighted average of in-state electricity generators and regional average emission rates.

FIGURE 8

Estimated CO_2 Emission Rates Associated With Delivered Electricity





Emissions of the 100 Largest Electric Power Producers

In 2008, the 100 largest power producers in the U.S. generated 85 percent of the nation's electricity supply and 89 percent of the industry's air pollution emissions. Table 1 lists the 100 largest electric power producers in order of their total 2008 electric generation in megawatt hours. The three largest producers were responsible for 16 percent of the 3.5 billion megawatt hours of electricity generated by the 100 largest producers. The 100 largest power producers emitted approximately 7 million tons of SO_2, 2.7 million tons of NOx, 40 tons of mercury, and 2.3 billion tons of CO_2. The top three producers were responsible for 27 percent of the SO_2, 23 percent of the NOx, 20 percent of the mercury, and 19 percent of the CO_2 emissions of the 100 largest producers.

The average and median emission levels (tons) and emission rates (lbs/MWh) shown in Table 1 provide benchmark measures of overall industry emissions that can be used as reference points to evaluate the emissions performance of individual power producers.

TABLE 1

Emissions Data for 100 Largest Power Producers

in order of 2008 generation

			2008 Generation (MWh)			2008 Emissions (tons)				Emission Rates (lbs/MWh)									
										All Generating Sources			Fossil Fuel Plants †			Coal Plants ††			
Rank	Owner	Ownership Type	Total	Fossil Fuel	Coal	SO_2	NOx	CO_2	Hg*	SO_2	NOx	CO_2	SO_2	NOx	CO_2	SO_2	NOx	CO_2	Hg†††
1	Southern	investor-owned corp.	200,145,045	167,701,125	134,153,248	827,413	197,801	155,107,239	3.45	8.3	2.0	1,549.9	9.9	2.4	1,849.8	12.3	2.9	2,105.3	0.05
2	AEP	investor-owned corp.	192,128,241	175,021,763	164,179,849	715,691	261,973	171,253,191	4.05	7.5	2.7	1,782.7	8.2	3.0	1,956.9	8.7	3.1	2,010.3	0.05
3	Tennessee Valley Authority	federal power authority	158,866,850	98,318,649	97,597,845	335,758	168,112	104,775,170	1.49	4.2	2.1	1,319.0	6.8	3.4	2,131.3	6.9	3.4	2,139.2	0.03
4	NextEra Energy (formerly FPL)	investor-owned corp.	153,399,071	92,659,283	6,666,142	48,974	34,845	49,545,564	0.20	0.6	0.5	646.0	1.1	0.8	1,069.4	4.9	2.2	2,190.6	0.06
5	Exelon	investor-owned corp.	150,557,232	9,007,627	7,787,398	50,072	13,212	9,239,010	0.23	0.7	0.2	122.7	11.1	2.9	2,051.4	12.8	3.3	2,136.7	0.06
6	Duke	investor-owned corp.	149,023,541	107,798,695	102,755,813	403,504	125,180	105,512,223	1.32	5.4	1.7	1,416.1	7.5	2.3	1,957.4	7.9	2.4	2,010.9	0.03
7	Entergy	investor-owned corp.	123,913,830	43,888,167	16,069,899	51,928	40,232	35,642,520	0.56	0.8	0.6	575.3	2.4	1.8	1,623.2	6.2	2.7	2,246.3	0.07
8	Dominion	investor-owned corp.	107,343,219	60,849,788	48,972,868	155,401	64,965	58,468,229	0.82	2.9	1.2	1,089.4	5.1	2.1	1,921.7	6.2	2.5	2,154.3	0.03
9	MidAmerican	privately held corp.	93,345,114	81,027,818	68,371,058	134,678	108,027	81,784,623	1.11	2.9	2.3	1,752.3	3.3	2.7	2,018.7	3.9	3.1	2,231.0	0.03
10	Progress Energy	investor-owned corp.	93,272,526	62,281,137	42,486,560	210,496	67,455	55,513,274	0.66	4.5	1.4	1,190.3	6.8	2.2	1,782.7	8.7	2.8	2,097.9	0.03
11	Calpine	investor-owned corp.	87,644,660	81,019,547	-	196	5,892	33,986,372	-	0.0	0.1	775.5	0.0	0.1	832.8	-	-	-	-
12	Edison International	investor-owned corp.	85,104,385	63,478,490	47,651,514	184,583	83,120	59,256,143	1.06	4.3	2.0	1,392.6	5.8	2.6	1,862.1	7.7	3.5	2,227.0	0.04
13	FirstEnergy	investor-owned corp.	82,985,292	49,759,501	49,603,607	215,627	71,013	52,546,488	0.66	5.2	1.7	1,266.4	8.6	2.8	2,063.7	8.6	2.8	2,067.3	0.03
14	Ameren	investor-owned corp.	78,866,652	67,736,436	67,092,836	245,006	56,167	73,230,925	2.30	6.2	1.4	1,857.1	7.2	1.7	2,162.2	7.3	1.7	2,172.2	0.07
15	Xcel	investor-owned corp.	76,812,787	62,226,237	50,815,643	113,245	88,358	64,722,153	0.98	2.9	2.3	1,685.2	3.6	2.8	2,074.6	4.4	3.3	2,291.4	0.04
16	NRG	investor-owned corp.	70,827,676	61,339,903	54,484,003	152,584	44,242	64,909,805	1.70	4.3	1.2	1,832.9	5.0	1.4	2,105.4	5.6	1.5	2,208.1	0.06
17	Energy Future Holdings	investor-owned corp.	68,308,612	49,073,991	44,750,234	229,952	43,036	55,218,995	2.39	6.7	1.3	1,616.8	9.4	1.8	2,250.4	10.3	1.7	2,333.7	0.11
18	US Corps of Engineers	federal power authority	67,200,768	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	PSEG	investor-owned corp.	64,667,426	34,797,975	12,740,994	63,224	17,264	24,078,221	0.21	2.0	0.5	744.7	3.6	1.0	1,348.1	9.9	2.2	2,177.0	0.03
20	PPL	investor-owned corp.	52,597,915	30,806,999	27,785,250	173,942	42,423	30,012,412	0.52	6.6	1.6	1,141.2	11.3	2.8	1,948.4	12.4	3.0	2,043.0	0.04
21	DTE Energy	investor-owned corp.	52,147,834	42,186,973	41,598,028	220,226	65,014	44,524,717	1.13	8.4	2.5	1,707.6	10.4	3.1	2,110.8	10.6	3.1	2,118.3	0.05
22	Constellation	investor-owned corp.	49,854,497	16,871,815	16,085,472	120,129	25,556	16,981,297	0.46	4.8	1.0	681.2	14.2	3.0	2,001.4	14.9	3.1	2,033.3	0.06
23	US Bureau of Reclamation	federal power authority	45,907,183	4,258,084	4,254,111	927	8,457	4,964,828	0.07	0.0	0.4	216.3	0.4	4.0	2,332.0	0.4	4.0	2,334.1	0.03
24	Allegheny Energy	investor-owned corp.	45,366,816	45,191,485	44,812,634	306,776	72,168	45,283,914	1.32	13.5	3.2	1,996.3	13.6	3.2	2,004.1	13.7	3.2	2,013.5	0.06
25	Dynegy	investor-owned corp.	43,922,554	43,653,347	24,194,412	59,633	15,240	35,306,467	0.43	2.7	0.7	1,607.7	2.7	0.7	1,617.3	4.8	1.1	2,163.7	0.04
26	AES	investor-owned corp.	43,516,994	40,881,586	32,510,800	72,165	36,012	40,740,912	0.50	3.3	1.7	1,872.4	3.4	1.7	1,935.5	4.2	2.1	2,143.9	0.03
27	E.ON	foreign-owned corp.	40,121,662	38,169,474	37,634,835	164,277	53,064	40,030,595	0.61	8.2	2.6	1,995.5	8.6	2.8	2,097.5	8.7	2.8	2,109.9	0.03
28	RRI	investor-owned corp.	33,259,684	33,259,684	23,324,016	216,812	42,086	29,170,888	0.95	13.0	2.5	1,754.1	13.0	2.5	1,754.1	18.6	3.5	2,129.6	0.08
29	Westar	investor-owned corp.	28,363,276	24,369,610	22,369,076	62,978	32,409	26,852,155	0.56	4.4	2.3	1,893.4	5.2	2.7	2,203.7	5.6	2.7	2,294.3	0.05
30	Pinnacle West	investor-owned corp.	27,878,279	19,358,805	12,807,942	14,974	28,108	17,019,048	0.23	1.1	2.0	1,221.0	1.5	2.9	1,758.3	2.3	4.3	2,195.6	0.04
31	New York Power Authority	state power authority	27,792,801	6,674,176	-	147	1,915	3,607,170	-	0.0	0.1	259.6	0.0	0.6	1,080.9	-	-	-	-
32	OGE	investor-owned corp.	26,665,824	26,236,289	17,461,574	47,219	37,053	24,036,301	0.26	3.5	2.8	1,802.8	3.6	2.8	1,832.3	5.4	3.4	2,179.4	0.03
33	Salt River Project	power district	26,625,838	21,307,360	14,074,122	19,003	31,386	19,343,460	0.35	1.4	2.4	1,453.0	1.8	2.9	1,815.7	2.7	4.4	2,301.9	0.05
34	Santee Cooper	state power authority	26,395,396	23,676,231	22,435,029	40,356	15,559	24,282,976	0.14	3.1	1.2	1,839.9	3.4	1.3	2,046.5	3.6	1.4	2,105.2	0.01
35	PG&E	investor-owned corp.	25,706,459	524,967	-	27	1,104	411,305	-	0.0	0.1	32.0	0.1	4.2	1,567.0	-	-	-	-
36	SCANA	investor-owned corp.	24,988,638	19,788,517	16,464,366	97,056	23,774	17,262,661	0.20	7.8	1.9	1,381.6	9.8	2.4	1,744.7	11.8	2.9	1,912.5	0.02
37	Great Plains Energy	investor-owned corp.	24,622,660	20,198,376	19,555,907	54,727	31,454	22,231,748	0.35	4.4	2.6	1,805.8	5.4	3.1	2,201.3	5.6	3.2	2,231.9	0.04
38	Oglethorpe	investor-owned corp.	21,903,347	12,396,019	10,924,172	45,607	9,631	12,234,810	0.29	4.2	0.9	1,117.2	7.4	1.6	1,974.0	8.3	1.7	2,119.4	0.05
39	San Antonio City	municipality	21,592,758	12,995,658	9,579,167	25,871	9,448	13,994,665	0.21	2.4	0.9	1,296.2	4.0	1.5	2,153.7	5.4	1.5	2,424.9	0.04
40	Wisconsin Energy	investor-owned corp.	21,247,743	20,589,101	18,664,481	37,366	19,236	23,426,323	0.47	3.5	1.8	2,205.1	3.6	1.9	2,275.6	4.0	2.0	2,412.8	0.05
41	International Power	foreign-owned corp.	20,721,612	20,679,637	4,926,783	17,450	4,579	12,156,762	0.12	1.7	0.4	1,173.3	1.7	0.4	1,173.1	7.1	1.6	2,067.6	0.05
42	NV Energy	investor-owned corp.	20,147,812	20,130,537	6,046,028	5,174	14,460	12,591,702	0.06	0.5	1.4	1,249.9	0.5	1.4	1,251.0	1.7	3.7	2,237.5	0.02
43	Sempra	investor-owned corp.	20,090,804	17,011,614	-	36	532	7,119,054	-	0.0	0.1	708.7	0.0	0.1	837.0	-	-	-	-
44	CMS Energy	investor-owned corp.	19,662,026	18,611,008	17,580,395	73,029	22,818	19,672,875	0.40	7.4	2.3	2,001.1	7.8	2.4	2,087.7	8.3	2.5	2,142.5	0.05
45	Mirant	investor-owned corp.	18,650,653	18,650,653	14,210,592	149,773	16,883	17,921,706	0.32	16.1	1.8	1,921.8	16.1	1.8	1,921.8	20.4	2.1	2,051.5	0.04
46	Tenaska	investor-owned corp.	18,596,914	18,596,914	-	45	1,694	8,275,922	-	0.0	0.2	890.0	0.0	0.2	890.0	-	-	-	-
47	Alliant Energy	investor-owned corp.	18,500,821	17,895,860	16,818,410	75,686	24,766	21,237,784	0.65	8.2	2.7	2,295.9	8.5	2.8	2,329.8	9.0	2.9	2,414.1	0.08
48	NE Public Power District	power district	17,840,913	11,659,843	11,269,259	35,918	23,199	13,083,994	0.15	4.0	2.6	1,466.7	6.2	4.0	2,244.3	6.4	4.1	2,286.7	0.03
49	TECO	investor-owned corp.	17,780,238	17,780,238	10,132,941	9,632	17,698	15,173,074	0.07	1.1	2.0	1,706.7	1.1	2.0	1,527.2	1.9	3.4	2,013.3	0.01
50	Associated Electric Coop	cooperative	17,530,580	17,530,580	14,614,083	30,095	24,168	16,435,065	0.23	3.4	2.8	1,875.0	3.4	2.8	1,875.0	4.1	3.3	2,070.6	0.03
51	Basin Electric Power Coop	cooperative	16,235,187	16,222,853	16,080,520	66,775	32,634	19,344,917	0.56	8.2	4.0	2,383.1	8.2	4.0	2,384.9	8.3	4.0	2,397.7	0.07
52	DPL	investor-owned corp.	16,079,755	16,079,755	15,934,751	46,815	28,747	16,743,130	0.23	5.8	3.6	2,082.5	5.8	3.6	2,082.5	5.9	3.6	2,091.4	0.03

* Mercury emissions are based on preliminary 2008 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

			2008 Generation (MWh)			2008 Emissions (tons)				Emission Rates (lbs/MWh)									
										All Generating Sources			Fossil Fuel Plants †			Coal Plants ††			
Rank	Owner	Ownership Type	Total	Fossil Fuel	Coal	SO_2	NOx	CO_2	Hg*	SO_2	NOx	CO_2	SO_2	NOx	CO_2	SO_2	NOx	CO_2	Hg†††
53	Los Angeles City	municipality	15,133,171	12,511,918	3,711,190	844	7,610	9,015,319	0.06	0.1	1.0	1,191.5	0.1	1.2	1,441.1	0.4	4.0	2,334.3	0.03
54	NiSource	investor-owned corp.	14,998,320	14,947,625	14,713,029	58,573	30,999	18,056,904	0.37	7.8	4.1	2,407.9	7.8	4.1	2,416.0	8.0	4.2	2,443.9	0.05
55	IDACORP	investor-owned corp.	14,472,881	7,493,121	7,264,020	11,760	11,526	7,899,691	0.09	1.6	1.6	1,091.7	3.1	3.1	2,108.5	3.2	3.2	2,135.8	0.02
56	Intermountain Power Agency	power district	14,449,788	14,449,788	14,444,378	5,692	27,199	14,587,603	0.12	0.8	3.8	2,019.1	0.8	3.8	2,019.1	0.8	3.8	2,019.8	0.02
57	JEA	municipality	14,166,142	10,962,607	8,766,595	14,709	19,076	14,264,461	0.12	2.1	2.7	2,013.9	2.7	3.5	1,936.1	3.2	4.2	2,156.0	0.03
58	US Power Generating Company	privately held corp.	14,020,213	14,020,213	-	1,264	2,185	6,959,769	-	0.2	0.3	992.8	0.2	0.3	992.8	-	-	-	-
59	Tri-State	cooperative	13,800,014	13,800,014	13,649,367	9,529	20,657	15,630,180	0.18	1.4	3.0	2,265.2	1.4	3.0	2,265.2	1.4	3.0	2,276.7	0.03
60	General Electric	investor-owned corp.	13,183,265	12,310,004	-	19	902	5,478,125	-	0.0	0.1	831.1	0.0	0.1	861.8	-	-	-	-
61	PNM Resources	investor-owned corp.	13,053,140	10,069,589	7,521,898	8,152	15,439	9,874,223	0.14	1.2	2.4	1,512.9	1.6	3.1	1,961.2	2.2	4.0	2,220.0	0.04
62	Austin Energy	municipality	13,030,226	9,591,387	5,963,342	15,023	4,833	8,259,097	0.07	2.3	0.7	1,267.7	3.1	1.0	1,722.2	5.0	1.1	2,124.3	0.02
63	Municipal Elec. Auth. of GA	municipality	12,555,765	6,057,564	5,498,500	22,955	4,841	6,066,745	0.14	3.7	0.8	966.4	7.6	1.6	2,003.0	8.3	1.7	2,119.4	0.05
64	NC Public Power	municipality	12,344,546	1,235,258	1,232,397	4,166	643	1,229,942	0.02	0.7	0.1	199.3	6.7	1.0	1,991.4	6.8	1.0	1,994.4	0.04
65	Omaha Public Power District	power district	12,267,194	8,707,676	8,474,919	32,512	16,801	9,515,903	0.40	5.3	2.7	1,551.4	7.5	3.9	2,185.6	7.7	3.9	2,213.0	0.01
66	Portland General Electric	investor-owned corp.	12,090,629	9,911,559	5,437,180	11,160	10,728	7,922,414	0.17	1.8	1.8	1,310.5	2.3	2.2	1,598.6	4.1	3.9	2,213.4	0.06
67	UniSource	investor-owned corp.	11,904,851	11,898,102	10,734,544	10,105	15,538	12,447,462	0.12	1.7	2.6	2,091.2	1.7	2.6	2,092.3	1.9	2.8	2,214.5	0.02
68	TransAlta	foreign-owned corp.	11,552,846	10,215,401	8,727,176	2,318	11,043	11,146,820	0.16	0.4	1.9	1,929.7	0.5	2.2	2,182.4	0.5	2.5	2,402.1	0.04
69	Dow Chemical	investor-owned corp.	11,241,068	10,916,810	-	9	363	4,540,547	-	0.0	0.1	807.8	0.0	0.1	802.1	-	-	-	-
70	ALLETE	investor-owned corp.	11,218,259	10,510,826	10,473,521	36,258	23,928	12,423,820	0.27	6.5	4.3	2,214.9	6.8	4.4	2,364.0	6.8	4.4	2,369.6	0.05
71	Exxon Mobil	investor-owned corp.	10,878,028	9,922,506	-	9	418	4,279,544	-	0.0	0.1	786.8	0.0	0.1	786.3	-	-	-	-
72	Arkansas Electric Coop	cooperative	10,746,279	10,150,533	9,637,627	27,168	13,880	10,843,524	0.24	5.1	2.6	2,018.1	5.4	2.7	2,136.5	5.6	2.8	2,186.9	0.05
73	Seminole Electric Coop	cooperative	10,631,747	10,422,116	8,831,843	19,303	17,543	9,934,151	0.04	3.6	3.3	1,868.8	3.7	3.4	1,886.9	4.4	3.9	2,057.0	0.00
74	East Kentucky Power Coop	cooperative	10,367,811	10,262,717	10,094,768	59,278	9,933	10,645,985	0.25	11.4	1.9	2,053.7	11.6	1.9	2,074.7	11.7	2.0	2,083.9	0.05
75	Puget Energy	investor-owned corp.	10,314,350	8,232,646	5,284,988	4,975	8,469	7,502,827	0.15	1.0	1.6	1,454.8	1.2	2.1	1,822.7	1.9	3.2	2,390.6	0.06
76	Great River Energy	cooperative	10,129,465	9,975,367	9,713,589	26,017	11,636	11,496,820	0.43	5.1	2.3	2,270.0	5.2	2.3	2,305.0	5.4	2.4	2,328.4	0.09
77	Entegra Power	privately held corp.	10,053,909	10,053,909	-	23	549	4,624,001	-	0.0	0.1	919.8	0.0	0.1	919.8	-	-	-	-
78	Buckeye Power	cooperative	9,755,462	9,755,462	9,698,096	44,287	17,788	9,666,956	0.20	9.1	3.6	1,981.9	9.1	3.6	1,981.9	9.1	3.7	1,990.9	0.04
79	Big Rivers Electric	cooperative	9,696,279	6,987,460	6,956,675	20,041	16,957	11,676,080	0.12	4.1	3.5	2,408.4	5.7	4.9	2,366.4	5.8	4.9	2,371.4	0.03
80	Integrys	investor-owned corp.	9,606,374	9,220,494	8,959,708	28,135	13,957	10,491,221	0.30	5.9	2.9	2,184.2	6.1	3.0	2,275.6	6.3	3.1	2,305.8	0.07
81	SUEZ Energy	foreign-owned corp.	9,603,021	8,344,246	1,690,807	4,395	3,832	4,875,997	0.02	0.9	0.8	1,015.5	1.1	0.9	1,168.7	5.2	3.3	2,245.1	0.03
82	PUD No 2 of Grant County	power district	9,406,902	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
83	Energy Northwest	municipality	9,367,636	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
84	Lower CO River Authority	state power authority	9,193,884	8,967,765	5,963,342	15,017	5,320	8,266,016	0.07	3.3	1.2	1,798.2	3.3	1.2	1,843.5	5.0	1.1	2,124.3	0.02
85	PUD No 1 of Chelan County	power district	8,590,131	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
86	Hoosier Energy	cooperative	8,265,236	8,248,346	8,191,571	39,881	10,657	8,869,910	0.13	9.7	2.6	2,146.3	9.7	2.6	2,150.7	9.7	2.6	2,159.3	0.03
87	El Paso Electric	investor-owned corp.	8,043,841	3,420,984	739,153	534	4,715	2,487,314	0.01	0.1	1.2	618.4	0.3	2.8	1,454.2	1.4	5.5	2,050.4	0.04
88	Grand River Dam Authority	state power authority	7,994,480	6,854,451	5,651,708	14,865	11,388	7,425,458	0.11	3.7	2.8	1,857.6	4.3	3.3	2,166.6	5.3	4.0	2,437.8	0.04
89	Avista	investor-owned corp.	7,439,156	3,387,393	1,651,294	1,552	2,620	1,995,988	0.05	0.4	0.7	536.6	0.9	1.5	1,178.5	1.9	3.2	2,390.6	0.06
90	International Paper	investor-owned corp.	7,375,253	2,276,976	737,715	-	1,238	982,006	0.02	-	0.3	266.3	-	1.1	862.6	-	3.0	1,382.5	0.06
91	CLECO	investor-owned corp.	7,160,172	7,160,172	3,251,894	9,477	6,008	5,780,120	0.08	2.6	1.7	1,614.5	2.6	1.7	1,614.5	5.8	2.5	2,237.2	0.05
92	National Grid	foreign-owned corp.	7,134,819	7,134,819	-	6,740	5,328	5,039,561	-	1.9	1.5	1,412.7	1.9	1.5	1,412.7	-	-	-	-
93	Vectren	investor-owned corp.	6,849,210	6,849,210	6,739,170	28,219	10,349	7,927,460	0.17	8.2	3.0	2,314.9	8.2	3.0	2,314.9	8.4	3.1	2,345.0	0.05
94	Occidental	investor-owned corp.	6,781,563	6,773,681	-	5	554	2,818,855	-	0.0	0.2	831.3	0.0	0.2	831.1	-	-	-	-
95	Sacramento Municipal Util Dist	municipality	6,770,217	5,619,855	-	12	151	2,389,845	-	0.0	0.0	706.0	0.0	0.1	850.5	-	-	-	-
96	Dairyland Power Coop	cooperative	6,701,869	6,643,804	6,628,990	32,366	11,120	7,314,830	0.05	9.7	3.3	2,182.9	9.7	3.3	2,202.0	9.8	3.4	2,205.6	0.01
97	Chevron	investor-owned corp.	6,615,108	6,307,838	-	2	29	2,000,402	-	0.0	0.0	604.8	0.0	0.0	613.0	-	-	-	-
98	TransCanada	foreign-owned corp.	6,517,057	4,683,849	-	107	407	2,692,095	-	0.0	0.1	826.2	0.1	0.2	1,149.5	-	-	-	-
99	Brazos Electric Power Coop	cooperative	6,445,735	6,445,735	1,351,775	5,370	2,421	4,358,985	0.13	1.7	0.8	1,352.5	1.7	0.8	1,352.5	7.9	2.4	2,859.9	0.19
100	Orlando Utilities Comm	municipality	6,382,443	5,792,967	5,077,573	7,256	7,653	5,618,572	0.00	2.3	2.4	1,760.6	2.5	2.6	1,939.7	2.9	3.0	2,086.8	0.00
		Total (in thousands)	3,527,028	2,471,735	1,803,793	7,069	2,723	2,273,588	0.04										
		Average (mean)	35,270,282	24,717,349	18,037,930	70,691	27,234	22,735,883	0.40	3.7	1.7	1,438.6	4.6	2.2	1,778.4	6.5	3.0	2,189.1	0.04
		Median	16,882,883	12,453,968	9,269,437	25,944	15,340	12,195,786	0.17	2.9	1.7	1,489.8	3.6	2.3	1,944.0	5.8	3.1	2,177.0	0.04

Generation by Fuel Type

The 100 largest power producers in the U.S. accounted for 85 percent of the electricity produced in 2008 (see Figure 11). Coal accounted for 51 percent of the power produced by the 100 largest companies, followed by nuclear power (22 percent), natural gas (18 percent), hydroelectric power (6 percent), oil (1 percent), and non-hydroelectric renewables and other fuel sources (1 percent each). Natural gas was the source of 39 percent of the power produced by smaller companies (outside the top 100), followed by coal (30 percent), non-hydroelectric renewables/other (18 percent), hydroelectric power (7 percent), nuclear power (4 percent), and oil (2 percent).

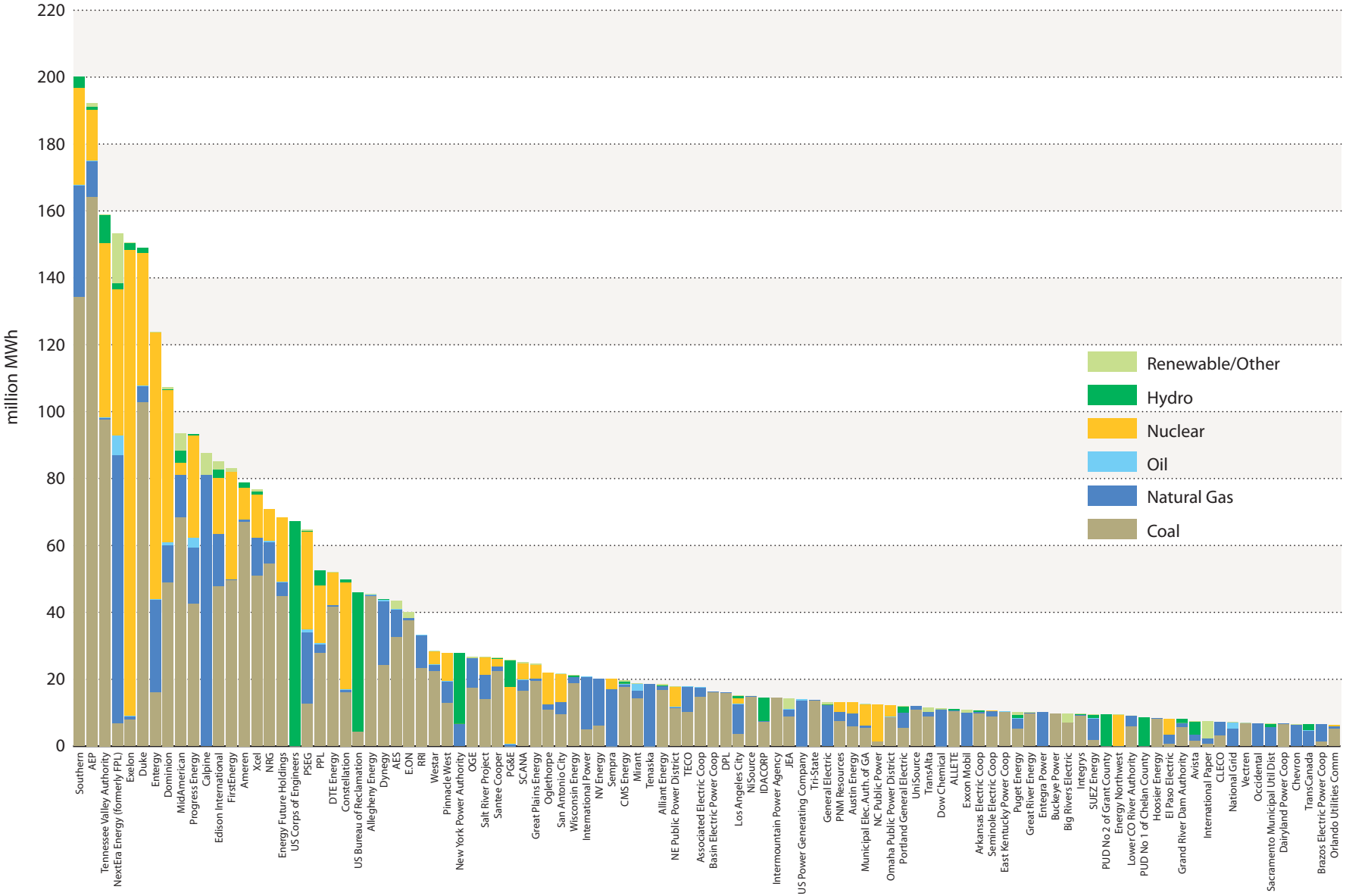
As a portion of total electric power production, the 100 largest companies accounted for 91 percent of all coal-fired power, 73 percent of natural gas-fired power, 64 percent of oil-fired power, 97 percent of nuclear power, 83 percent of hydroelectric power and 52 percent of non-hydroelectric renewable power.

Figure 9 illustrates 2008 electric generation by fuel for each of the 100 largest power producers. The generation levels, expressed in million megawatt hours, show production from facilities wholly and partially owned by each producer and reported to the EIA. Coal or nuclear accounted for over half of the output of the largest generators. The exceptions are a handful of generating companies whose assets are dominated by hydroelectric or natural gas-fired plants. Figure 9 illustrates the modest contribution non-hydroelectric renewable sources made to the total generation of the largest power producers.

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. Please see chapter entitled "The Structure of the U.S. Electric Power Industry" for more details.

FIGURE 9

Generation of 100 Largest Power Producers by Fuel Type



Emissions Rankings

Table 2 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 10 through 17 illustrate SO_2, NOx, CO_2, and mercury emissions levels (expressed in tons for SO_2, NOx and CO_2, 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_2 and NOx, the report presents comparisons of total emissions levels and rates for fossil fuel-fired facilities. For CO_2, 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. 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.

The emissions data for each pollutant are displayed in several formats to assist with a thorough evaluation of emissions performance. The charts present both the total emissions by company as well as their average emission rates. The charts are sorted by either total emissions or average emission rates. The charts of total emissions provide a breakdown of emissions by fuel type.

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_2 emissions range from zero to over 171 million tons per year. The NOx emission rates range from zero to 4.3 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. Although the amount of generation owned is an important factor, some producers that generated similar amounts of electricity had significantly disparate total emission levels. For example in the top quartile, eight producers each generated between 100 and 200 million megawatt hours of electricity in 2008. Among these producers, emissions ranged from 48,974 to 827,413 tons of SO_2, 13,212 to 261,973 tons of NOx, and 9.2 to 171 million tons of CO_2.

TABLE 2

Company Rankings for 100 Largest Power Producers
in alphabetical order

		By Generation			By Tons of Emissions				By Emission Rates									
									All Generating Sources			Fossil Fuel Plants			Coal Plants			
Owner	**Ownership Type**	**Total**	**Fossil**	**Coal**	**SO_2**	**NOx**	**CO_2**	**Hg ***	**SO_2**	**NOx**	**CO_2**	**SO_2**	**NOx**	**CO_2**	**SO_2**	**NOx**	**CO_2**	**Hg**
AEP	investor-owned corp.	2	1	1	2	1	1	1	16	18	36	20	26	47	19	41	77	31
AES	investor-owned corp.	26	20	17	24	21	17	23	45	51	27	52	62	51	58	67	47	60
Allegheny Energy	investor-owned corp.	24	16	12	5	8	15	8	2	10	20	3	17	39	4	31	74	16
ALLETE	investor-owned corp.	70	57	44	42	34	49	36	20	1	8	29	2	4	34	3	12	21
Alliant Energy	investor-owned corp.	47	38	27	22	32	30	17	13	20	5	17	34	6	16	47	5	6
Ameren	investor-owned corp.	14	8	6	6	13	6	4	21	58	30	27	64	20	31	73	42	9
Arkansas Electric Coop	cooperative	72	61	49	49	54	55	39	28	24	17	38	38	23	46	52	39	32
Associated Electric Coop	cooperative	50	40	34	46	33	40	43	44	16	26	50	35	55	59	29	65	58
Austin Energy	municipality	62	68	65	57	76	67	68	54	72	60	56	77	66	52	79	53	70
Avista	investor-owned corp.	89	93	77	78	80	93	75	77	73	90	75	67	79	72	34	10	18
Basin Electric Power Coop	cooperative	51	43	30	25	23	32	21	11	3	3	19	5	2	24	9	8	8
Big Rivers Electric	cooperative	79	79	60	53	45	52	64	37	7	1	36	1	3	42	2	11	52
Brazos Electric Power Coop	cooperative	99	85	78	72	81	85	59	62	71	56	67	81	76	27	62	1	1
Buckeye Power	cooperative	78	67	48	38	41	60	47	7	5	22	14	10	43	15	19	79	39
Calpine	investor-owned corp.	11	7	-	83	72	21	-	87	87	81	86	90	92	-	-	-	-
Chevron	investor-owned corp.	97	86	-	95	96	92	-	95	96	88	95	96	96	-	-	-	-
CLECO	investor-owned corp.	91	77	75	67	71	77	67	52	50	44	59	63	69	41	58	27	34
CMS Energy	investor-owned corp.	44	36	25	23	37	31	29	17	32	19	21	47	30	25	59	48	35
Constellation	investor-owned corp.	22	42	29	19	31	38	25	29	65	85	2	22	41	3	36	72	17
Dairyland Power Coop	cooperative	96	84	63	45	59	73	74	5	8	11	11	15	15	13	26	36	77
Dominion	investor-owned corp.	8	13	10	15	12	10	14	49	61	70	41	54	53	39	57	46	53
Dow Chemical	investor-owned corp.	69	56	-	93	94	84	-	93	93	79	93	93	94	-	-	-	-
DPL	investor-owned corp.	52	44	32	36	28	39	41	23	6	14	34	11	31	40	20	62	63
DTE Energy	investor-owned corp.	21	19	15	8	11	16	9	8	28	40	8	19	25	10	38	57	20
Duke	investor-owned corp.	6	3	3	3	4	3	7	24	49	52	24	50	46	28	61	76	69
Dynegy	investor-owned corp.	25	18	19	28	51	20	27	51	74	45	57	82	68	55	78	43	49
E.ON	foreign-owned corp.	27	21	16	14	14	18	18	12	21	21	15	33	28	18	51	58	56
East Kentucky Power Coop	cooperative	74	59	46	29	64	56	38	4	42	15	5	57	32	9	69	64	30
Edison International	investor-owned corp.	12	9	11	12	7	9	11	33	41	54	35	42	56	29	22	30	37
El Paso Electric	investor-owned corp.	87	92	80	82	77	90	80	80	63	87	80	36	73	75	1	70	46
Energy Future Holdings	investor-owned corp.	17	15	13	7	16	12	3	18	59	43	13	61	12	11	70	16	2
Energy Northwest	municipality	83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Entegra Power	privately held corp.	77	63	-	89	90	83	-	86	89	74	88	91	86	-	-	-	-
Entergy	investor-owned corp.	7	17	31	32	19	19	20	71	75	89	61	59	67	38	55	24	7
Exelon	investor-owned corp.	5	70	57	33	55	62	42	74	83	95	7	28	35	5	28	50	15
Exxon Mobil	investor-owned corp.	71	65	-	92	92	86	-	92	92	80	92	92	95	-	-	-	-
FirstEnergy	investor-owned corp.	13	14	9	10	9	13	15	26	48	61	16	32	34	20	50	67	65
NextEra Energy (formerly FPL)	investor-owned corp.	4	5	62	34	22	14	48	75	77	86	73	80	84	54	64	38	14
General Electric	investor-owned corp.	60	52	-	90	87	79	-	90	86	77	91	89	89	-	-	-	-
Grand River Dam Authority	state power authority	88	80	67	60	58	72	65	39	14	29	43	16	19	50	11	3	43
Great Plains Energy	investor-owned corp.	37	31	23	31	25	29	32	31	26	33	37	18	16	44	32	28	47
Great River Energy	cooperative	76	64	47	50	56	53	26	27	35	6	39	49	8	49	63	17	4
Hoosier Energy	cooperative	86	74	56	40	62	64	58	6	25	12	12	44	22	14	56	44	57
IDACORP	investor-owned corp.	55	76	59	62	57	70	66	63	54	69	55	20	26	64	35	51	73
Integrys	investor-owned corp.	80	69	51	48	53	57	34	22	13	10	33	23	9	37	39	18	10
Intermountain Power Agency	power district	56	46	35	71	30	43	63	72	4	16	76	9	37	77	17	73	76
International Paper	investor-owned corp.	90	94	81	-	85	95	78	-	80	91	-	75	88	-	45	81	11
International Power	foreign-owned corp.	41	29	72	56	78	51	60	61	78	66	66	84	80	32	74	66	33
JEA	municipality	57	55	53	61	40	44	61	56	19	18	58	12	50	65	7	45	64
Los Angeles City	municipality	53	50	74	81	70	63	73	81	66	64	82	73	74	79	12	14	50

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 (lbs/MWh). A ranking of 100 indicates the lowest absolute number or rate in any column.

* Mercury emissions are in pounds and rankings are based on preliminary 2008 TRI data for coal plants only.

		By Generation			By Tons of Emissions				By Emission Rates									
									All Generating Sources			Fossil Fuel Plants			Coal Plants			
Owner	Ownership Type	Total	Fossil	Coal	SO_2	NOx	CO_2	Hg *	SO_2	NOx	CO_2	SO_2	NOx	CO_2	SO_2	NOx	CO_2	Hg
Lower CO River Authority	state power authority	84	71	65	58	74	66	69	46	64	35	53	74	58	52	79	53	71
MidAmerican	privately held corp.	9	6	5	18	5	5	10	50	33	39	54	39	38	62	37	29	55
Mirant	investor-owned corp.	45	35	36	17	46	35	33	1	46	24	1	60	52	1	66	69	36
Municipal Elec. Auth. of GA	municipality	63	87	68	52	75	76	56	40	70	73	23	65	40	23	72	56	23
National Grid	foreign-owned corp.	92	78	-	70	73	80	-	58	55	53	63	68	75	-	-	-	-
NC Public Power	municipality	64	95	79	76	88	94	77	73	90	94	31	76	42	35	81	78	40
NE Public Power District	power district	48	54	41	43	36	46	53	38	23	49	32	6	13	36	8	22	66
New York Power Authority	state power authority	31	83	-	84	83	87	-	84	85	92	85	83	83	-	-	-	-
NiSource	investor-owned corp.	54	45	33	30	27	34	30	14	2	2	22	4	1	26	6	2	25
NRG	investor-owned corp.	16	12	7	16	15	7	5	34	60	32	42	70	27	45	75	35	12
NV Energy	investor-owned corp.	42	32	64	73	52	47	72	76	57	62	77	71	78	74	18	26	75
Occidental	investor-owned corp.	94	82	-	94	89	88	-	94	84	76	94	88	93	-	-	-	-
OGE	investor-owned corp.	32	25	26	35	20	27	37	42	15	34	49	30	59	47	25	40	62
Oglethorpe	investor-owned corp.	38	51	42	37	65	50	35	36	67	68	26	66	44	22	71	55	22
Omaha Public Power District	power district	65	72	55	44	47	61	28	25	17	46	25	8	17	30	14	34	3
Orlando Utilities Comm	municipality	100	88	71	69	69	78	81	55	29	37	60	41	49	66	43	63	81
PG&E	investor-owned corp.	35	96	-	88	86	96	-	91	91	96	83	3	71	-	-	-	-
Pinnacle West	investor-owned corp.	30	34	39	59	29	37	40	68	38	63	69	29	63	68	5	37	45
PNM Resources	investor-owned corp.	61	62	58	68	50	59	55	66	30	48	68	21	45	69	10	31	42
Portland General Electric	investor-owned corp.	66	66	69	63	61	69	51	59	47	58	62	52	70	60	16	33	13
PPL	investor-owned corp.	20	24	18	13	17	22	22	19	53	67	6	37	48	6	44	71	44
Progress Energy	investor-owned corp.	10	10	14	11	10	11	16	30	56	65	30	51	62	17	53	61	59
PSEG	investor-owned corp.	19	22	40	26	44	26	45	57	76	82	46	78	77	12	65	41	54
PUD No 1 of Chelan County	power district	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PUD No 2 of Grant County	power district	82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Puget Energy	investor-owned corp.	75	75	70	74	67	71	54	69	52	50	71	55	60	72	33	9	19
RRI	investor-owned corp.	28	23	20	9	18	23	13	3	27	38	4	45	64	2	21	52	5
Sacramento Municipal Util Dist	municipality	95	89	-	91	95	91	-	88	95	84	89	95	90	-	-	-	-
Salt River Project	power district	33	28	37	55	26	33	31	64	31	51	64	27	61	67	4	19	26
San Antonio City	municipality	39	49	50	51	66	45	44	53	68	59	44	69	21	48	76	4	38
Santee Cooper	state power authority	34	27	21	39	48	25	57	47	62	31	51	72	36	63	77	60	79
SCANA	investor-owned corp.	36	33	28	21	35	36	46	15	44	55	10	46	65	8	48	80	72
Seminole Electric Coop	cooperative	73	58	52	54	43	58	76	41	9	28	45	14	54	57	15	68	80
Sempra	investor-owned corp.	43	41	-	87	91	74	-	89	94	83	90	94	91	-	-	-	-
Southern	investor-owned corp.	1	2	2	1	2	2	2	9	40	47	9	48	57	7	46	59	24
SUEZ Energy	foreign-owned corp.	81	73	76	75	79	82	79	70	69	71	74	79	81	51	27	25	68
TECO	investor-owned corp.	49	39	45	65	42	42	70	67	39	41	72	56	72	70	24	75	78
Tenaska	investor-owned corp.	46	37	-	86	84	65	-	85	82	75	87	86	87	-	-	-	-
Tennessee Valley Authority	federal power authority	3	4	4	4	3	4	6	35	37	57	28	13	24	33	23	49	61
TransAlta	foreign-owned corp.	68	60	54	77	60	54	52	78	43	23	78	53	18	78	60	7	48
TransCanada	foreign-owned corp.	98	90	-	85	93	89	-	83	88	78	84	87	82	-	-	-	-
Tri-State	cooperative	59	48	38	66	38	41	49	65	12	7	70	25	11	76	42	23	67
UniSource	investor-owned corp.	67	53	43	64	49	48	62	60	22	13	65	43	29	71	49	32	74
US Bureau of Reclamation	federal power authority	23	91	73	80	68	81	71	82	79	93	79	7	5	80	13	15	51
US Corps of Engineers	federal power authority	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
US Power Generating Company	privately held corp.	58	47	-	79	82	75	-	79	81	72	81	85	85	-	-	-	-
Vectren	investor-owned corp.	93	81	61	47	63	68	50	10	11	4	18	24	7	21	40	13	28
Westar	investor-owned corp.	29	26	22	27	24	24	19	32	36	25	40	40	14	43	54	20	29
Wisconsin Energy	investor-owned corp.	40	30	24	41	39	28	24	43	45	9	48	58	10	61	68	6	27
Xcel	investor-owned corp.	15	11	8	20	6	8	12	48	34	42	47	31	33	56	30	21	41

NOx and SO_2 Emissions Levels and Rates

Figures 10 through 13 display SO_2 and NOx 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 NOx and SO_2 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_2 and NOx because coal contains higher concentrations of sulfur than natural gas and oil and coal plants generally have higher NOx emission rates.

Figures 10 through 13 illustrate wide disparities in the "fossil only" emission levels and emission rates of the 100 largest power producers. Their total fossil generation varies from zero to 175 million megawatt hours and:

- SO_2 emissions range from zero to 827,413 tons, and SO_2 emission rates range from zero to 16.1 pounds per megawatt hour;
- NOx emissions range from zero to 261,973 tons, and NOx emission rates range from zero to 4.3 pounds per megawatt hour.

FIGURE 10

Fossil Fuel - NOx Total Emissions and Emission Rates
Total emissions (thousand tons) and emission rates (lbs/MWh) from fossil fuel generating facilities

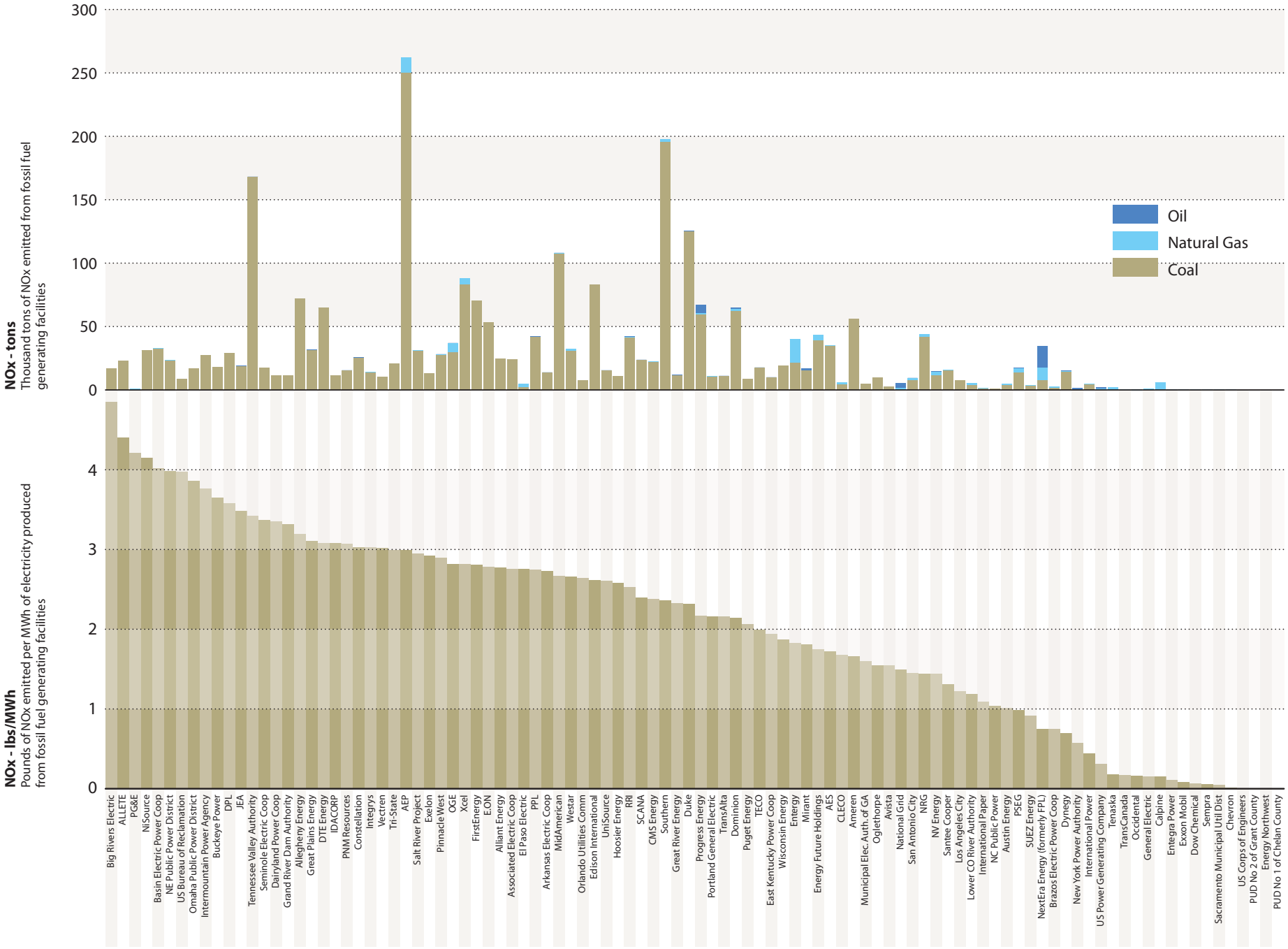


FIGURE 11

Fossil Fuel - NOx Total Emissions and Emission Rates

Total emissions (thousand tons) and emission rates (lbs/MWh) from fossil fuel generating facilities

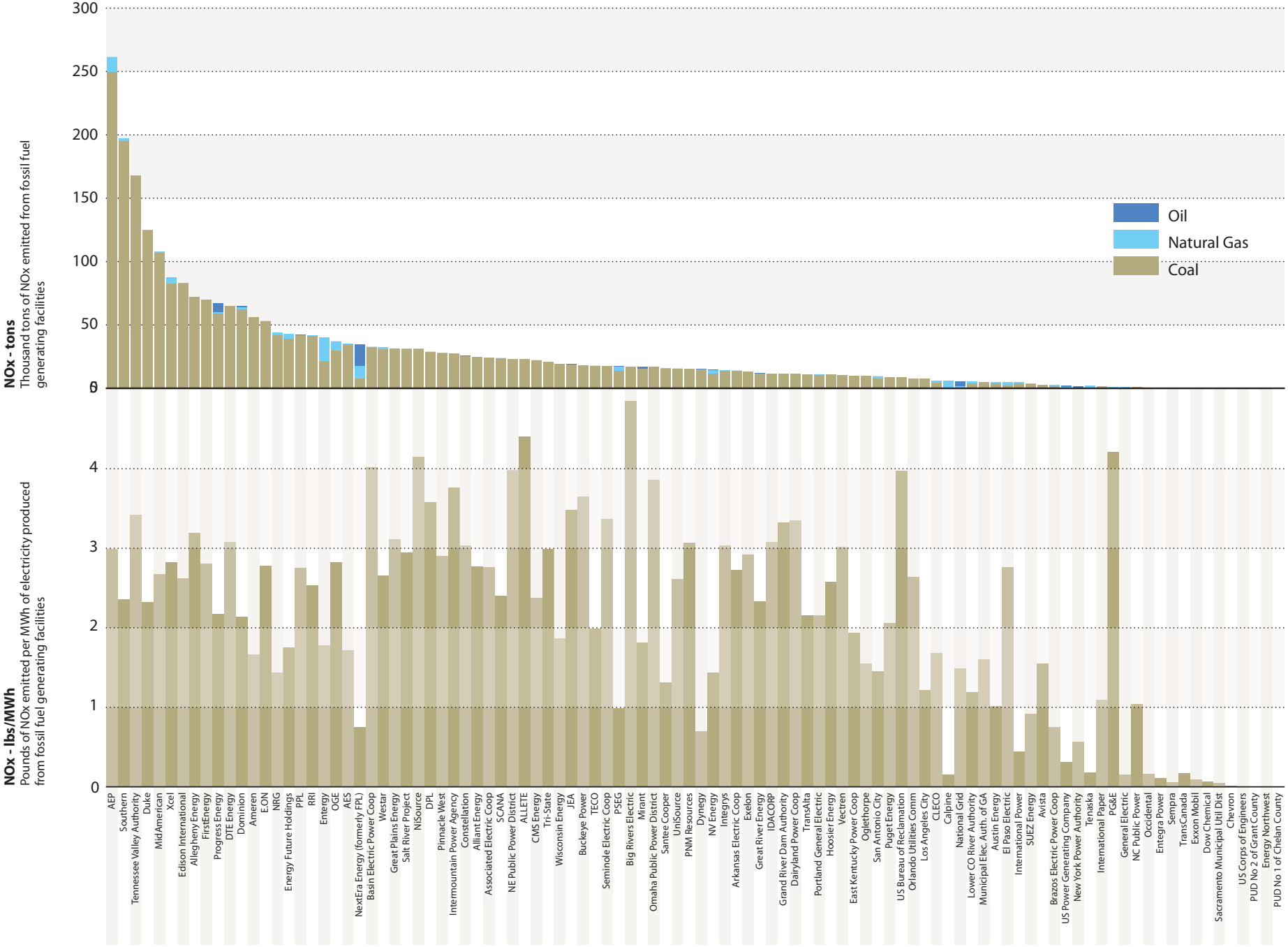


FIGURE 12

Fossil Fuel - SO_2 Total Emissions and Emission Rates

Total emissions (thousand tons) and emission rates (lbs/MWh) from fossil fuel generating facilities

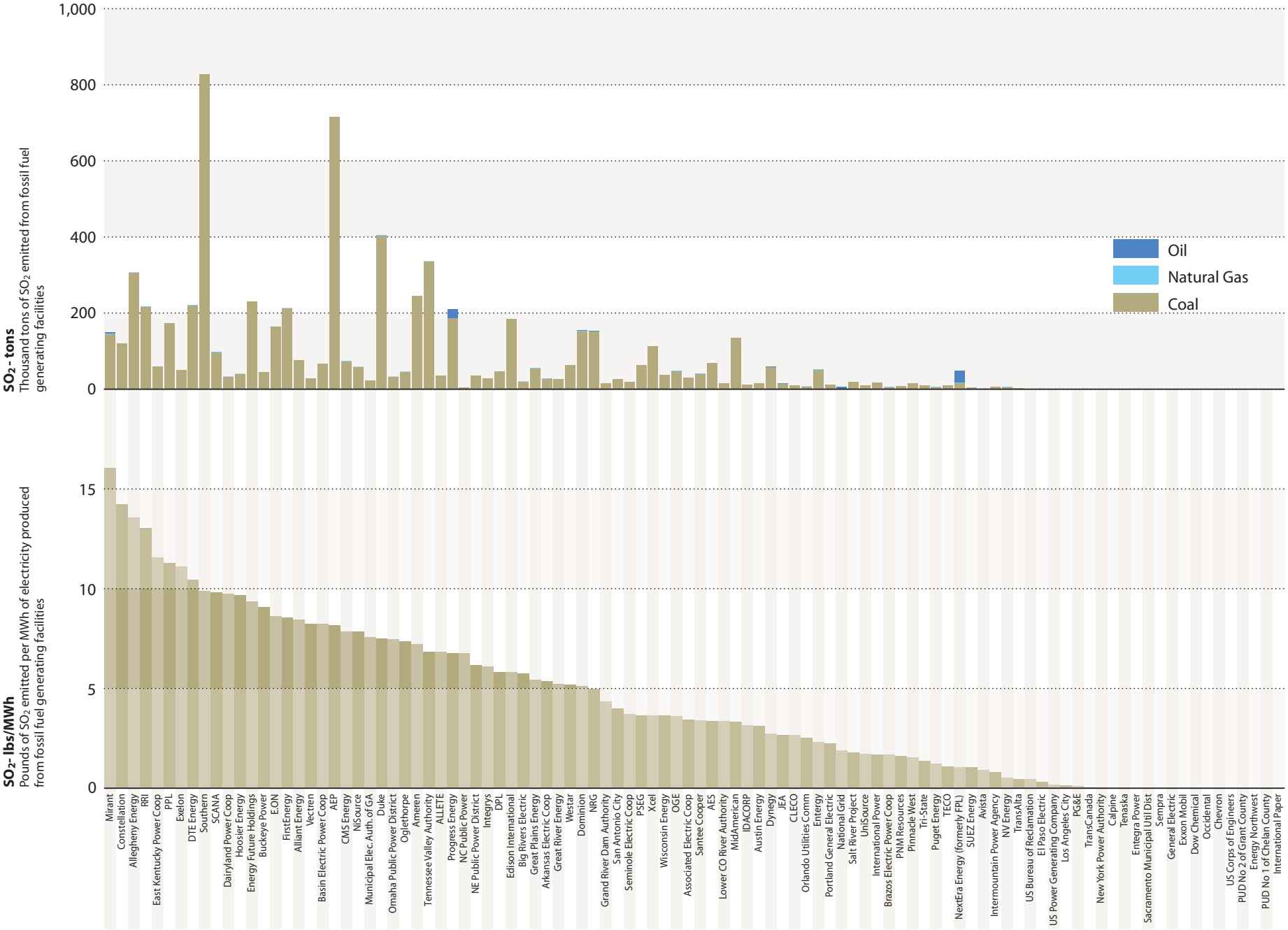
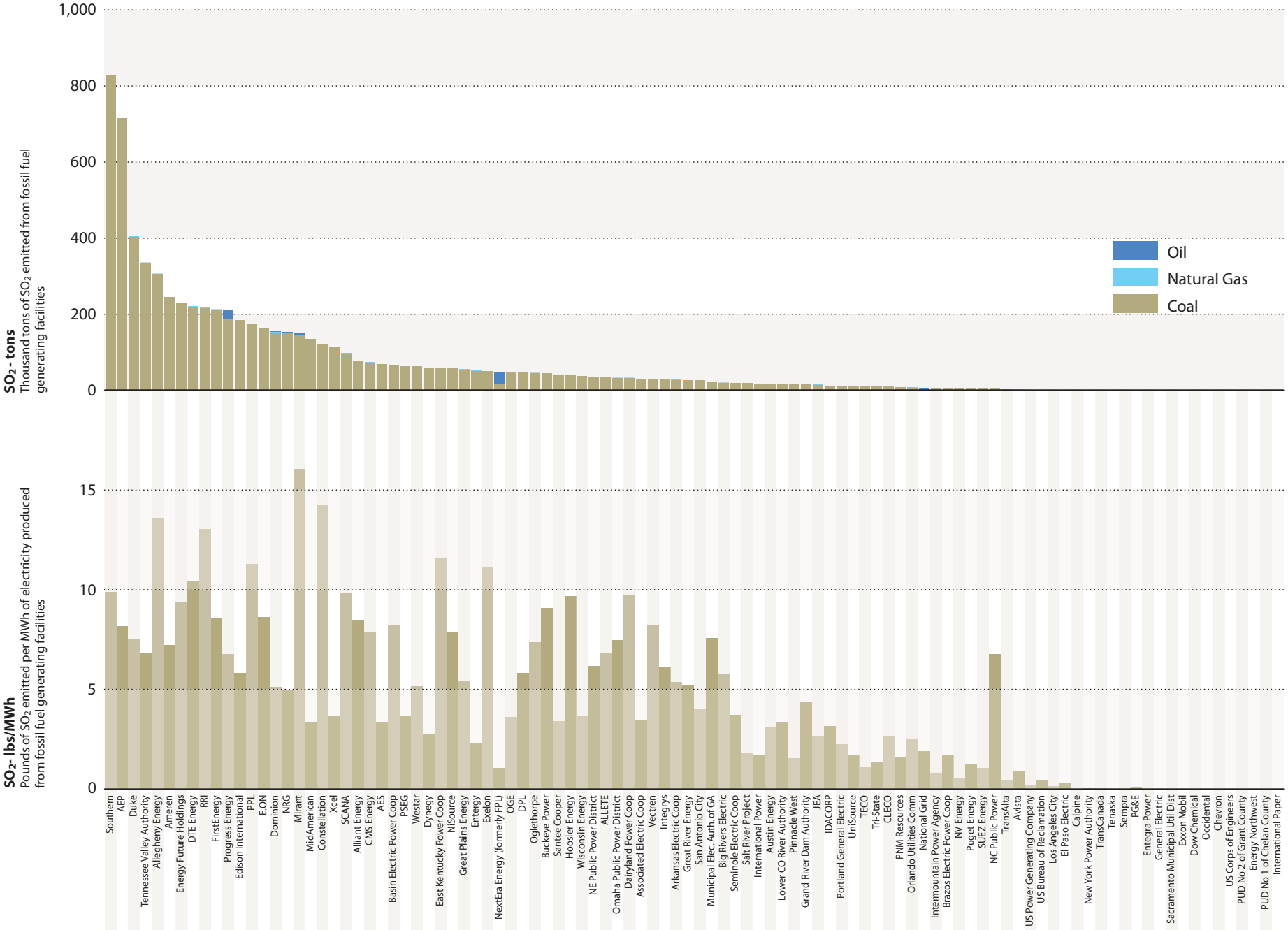
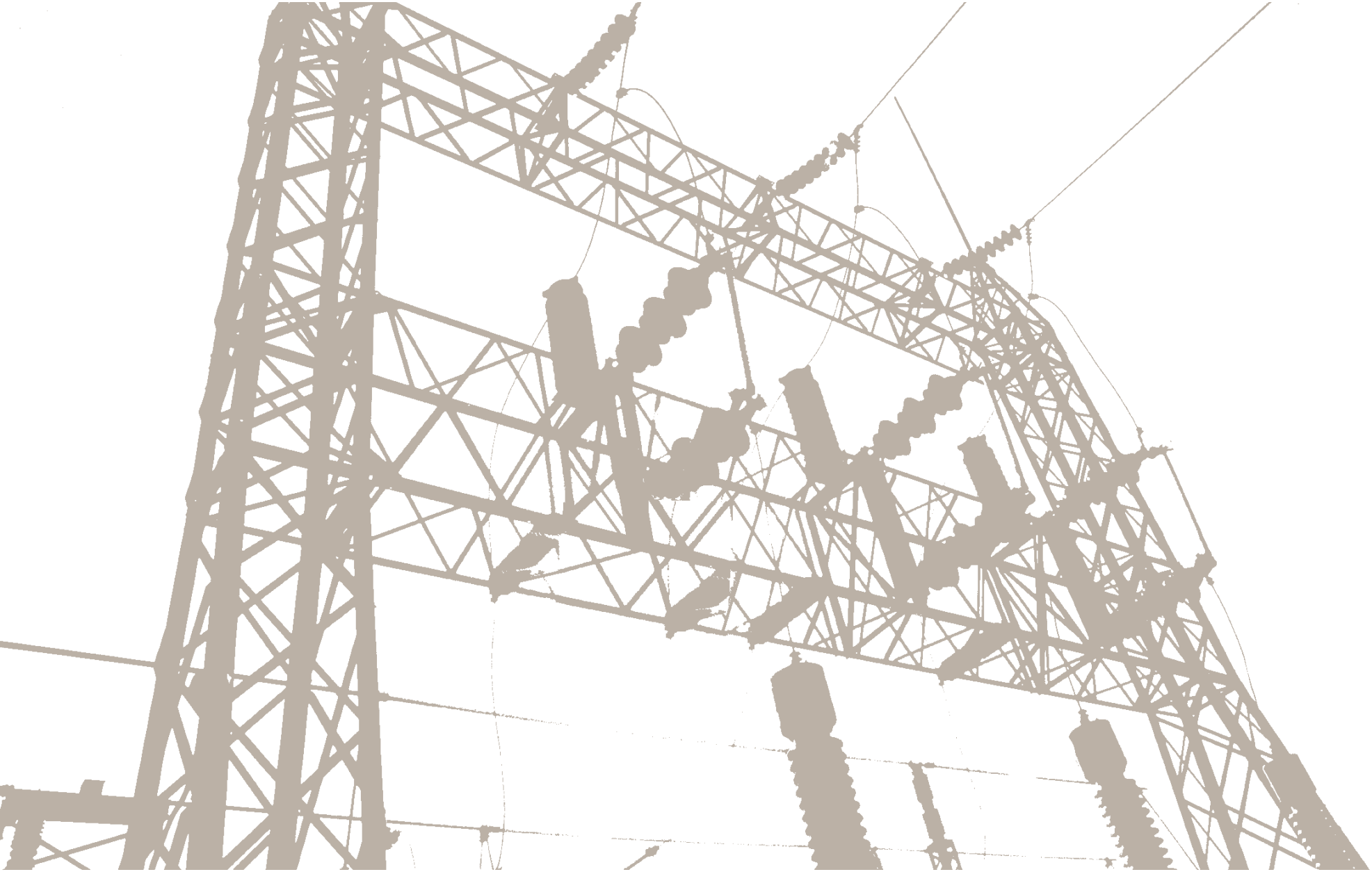


FIGURE 13

Fossil Fuel - SO_2 Total Emissions and Emission Rates

Total emissions (thousand tons) and emission rates (lbs/MWh) from fossil fuel generating facilities





CO_2 Emission Levels and Rates

Figures 14 and 15 display total CO_2 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_2 emissions by its total generation. In most cases, producers with significant non-emitting fuel sources, such as nuclear, hydroelectric 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 85.3 percent of CO_2 emissions.
- Natural gas-fired power plants are responsible for 12.8 percent of CO_2 emissions.
- Oil-fired power plants are responsible 1.3 percent of CO_2 emissions.

Figures 14 and 15 illustrate wide disparities in the "all-source" emission levels and emission rates of the 100 largest power producers. Their total electric generation varies from 6.4 to 200 million megawatt hours and their CO_2 emissions range from zero to 171 million tons, and CO_2 emission rates range from zero to 2,408.4 pounds per megawatt hour.

FIGURE 14

All Source - CO_2 Total Emissions and Emission Rates

Total emissions (million tons) and emission rates (lbs/MWh) from all generating facilities

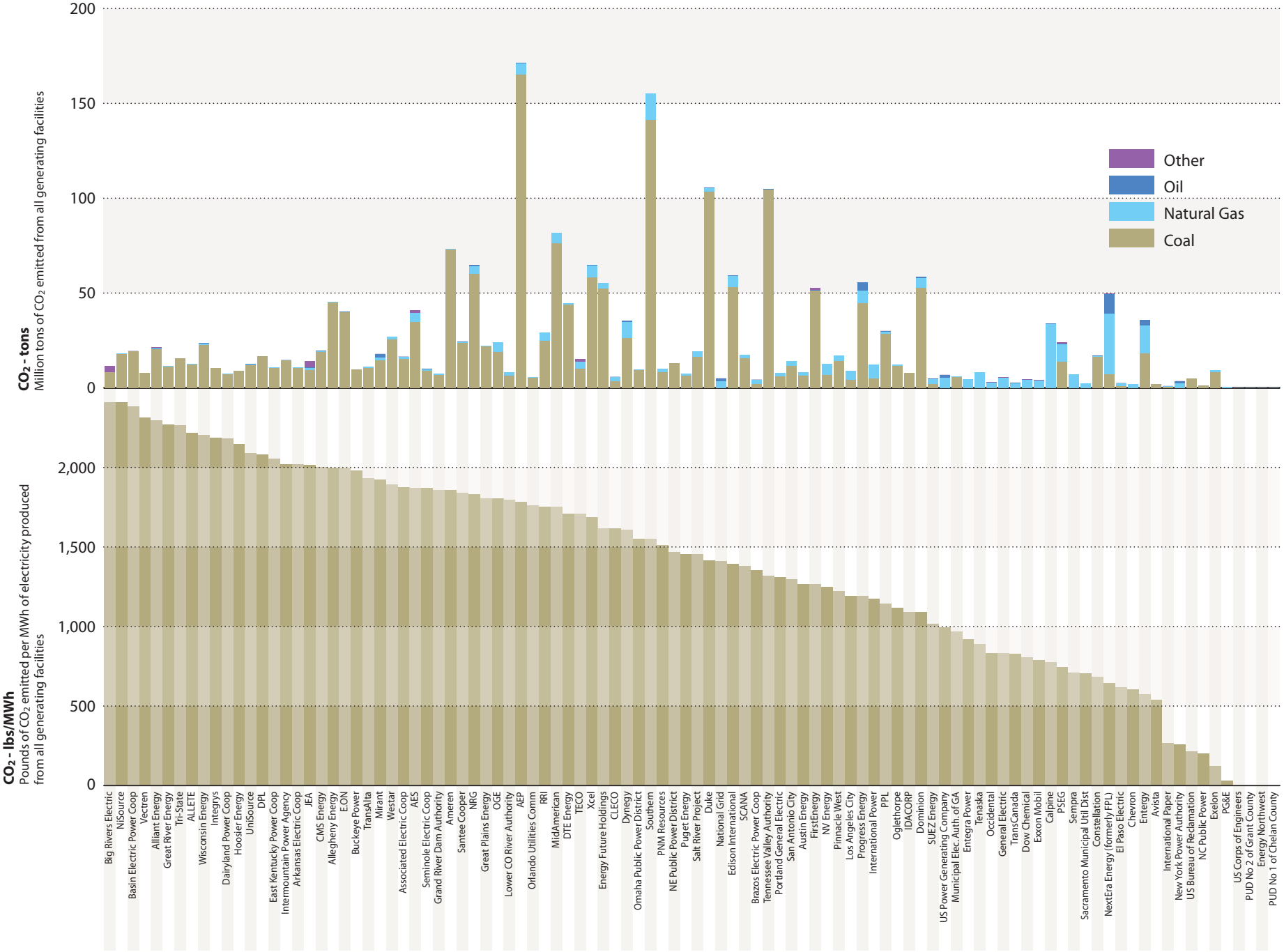
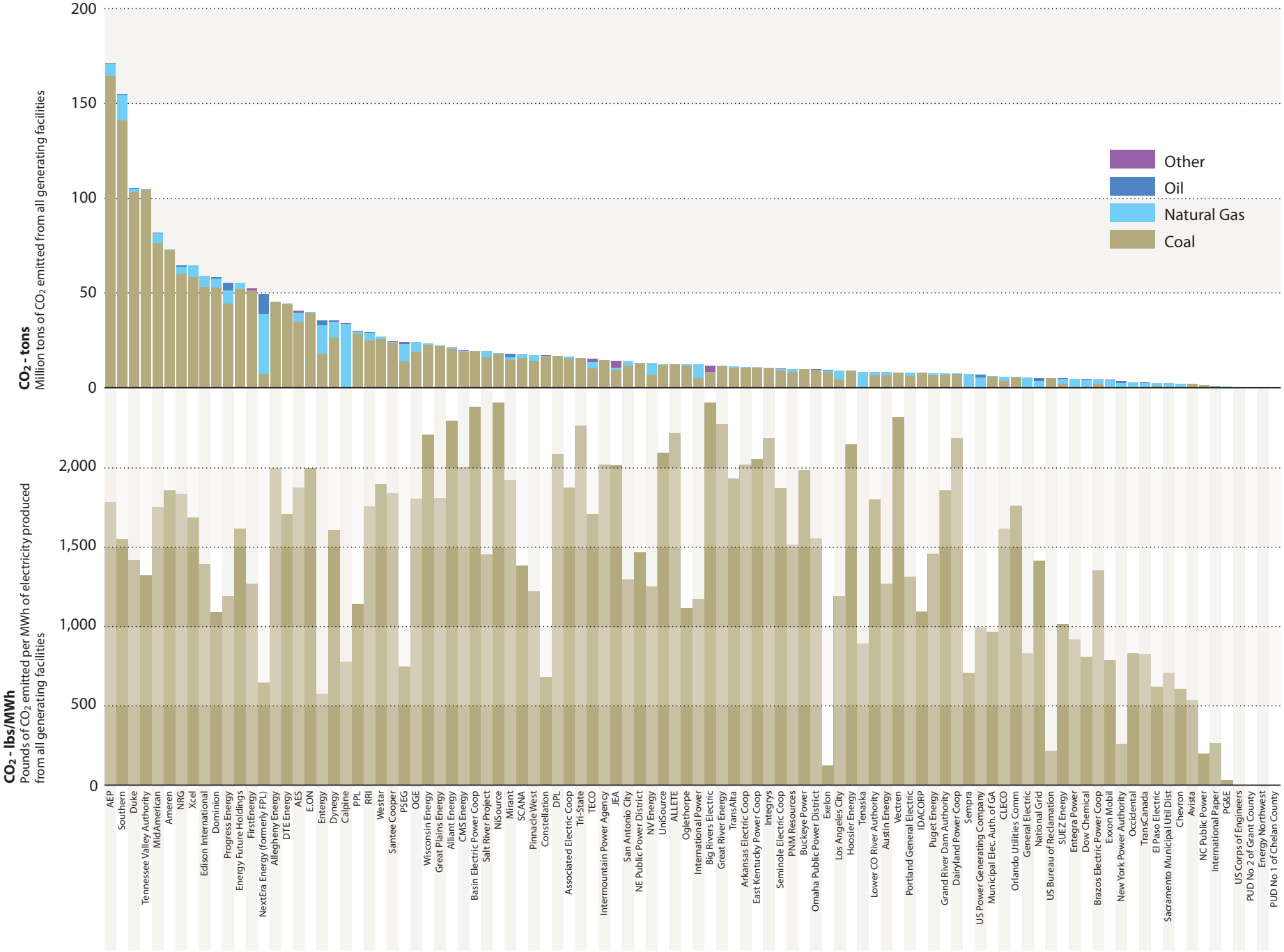


FIGURE 15

All Source - CO_2 Total Emissions and Emission Rates

Total emissions (million tons) and emission rates (lbs/MWh) from all generating facilities



Mercury Emission Levels and Rates

Figures 16 and 17 display total mercury emission levels and emission rates from coal-fired power plants.

In 2005, EPA issued rules regulating mercury emissions from coal-fired power plants. However, in February 2008, the D.C. Circuit found the rules invalid and they never took effect. Therefore, coal plants generally are not required to have pollution controls specifically designed to remove mercury. EPA is currently developing a MACT standard for coal- and oil-fired electric generating units to regulate emissions of mercury and other hazardous air pollutants, and is required by a recent consent decree to propose MACT standards by March 2011. The differences in mercury emission rates seen in the following figures are largely due to the mercury content and type of coal used, and the effect of control technologies designed to lower SO_2, NOx, and particulate emissions.

Coal mercury emissions from the top 100 power producers range from 7 to 8,110 pounds, and coal mercury emission rates range from 0.0014 to 0.192 pounds per gigawatt-hour (a gigawatt-hour is 1,000 megawatt-hours).

FIGURE 16

Coal - Mercury Emission Rates and Total Emissions

Emission rates (lbs/GWh) and total emissions (pounds) from coal plants

1 gigawatt-hour (GWh) = 1,000 MWh

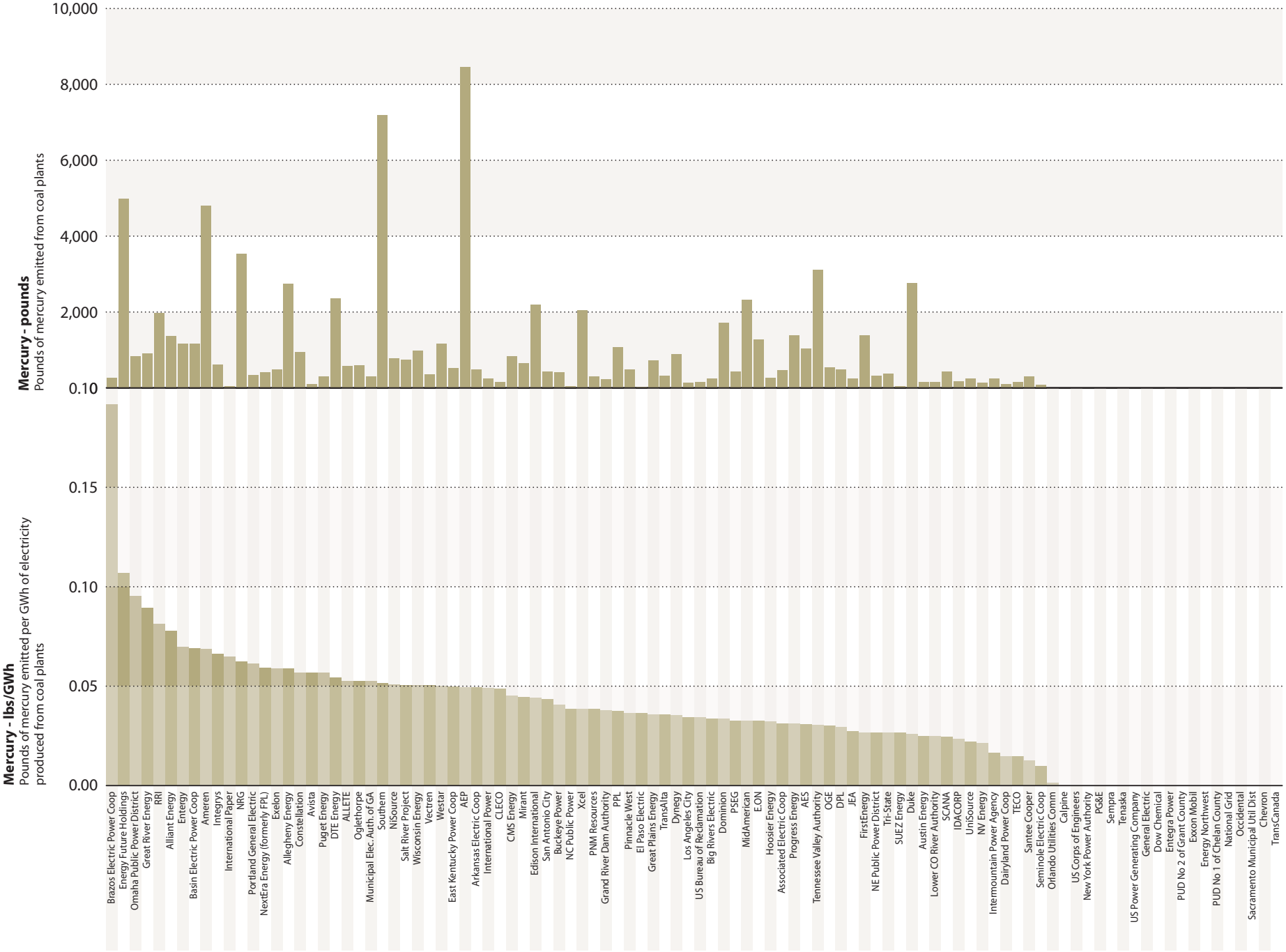
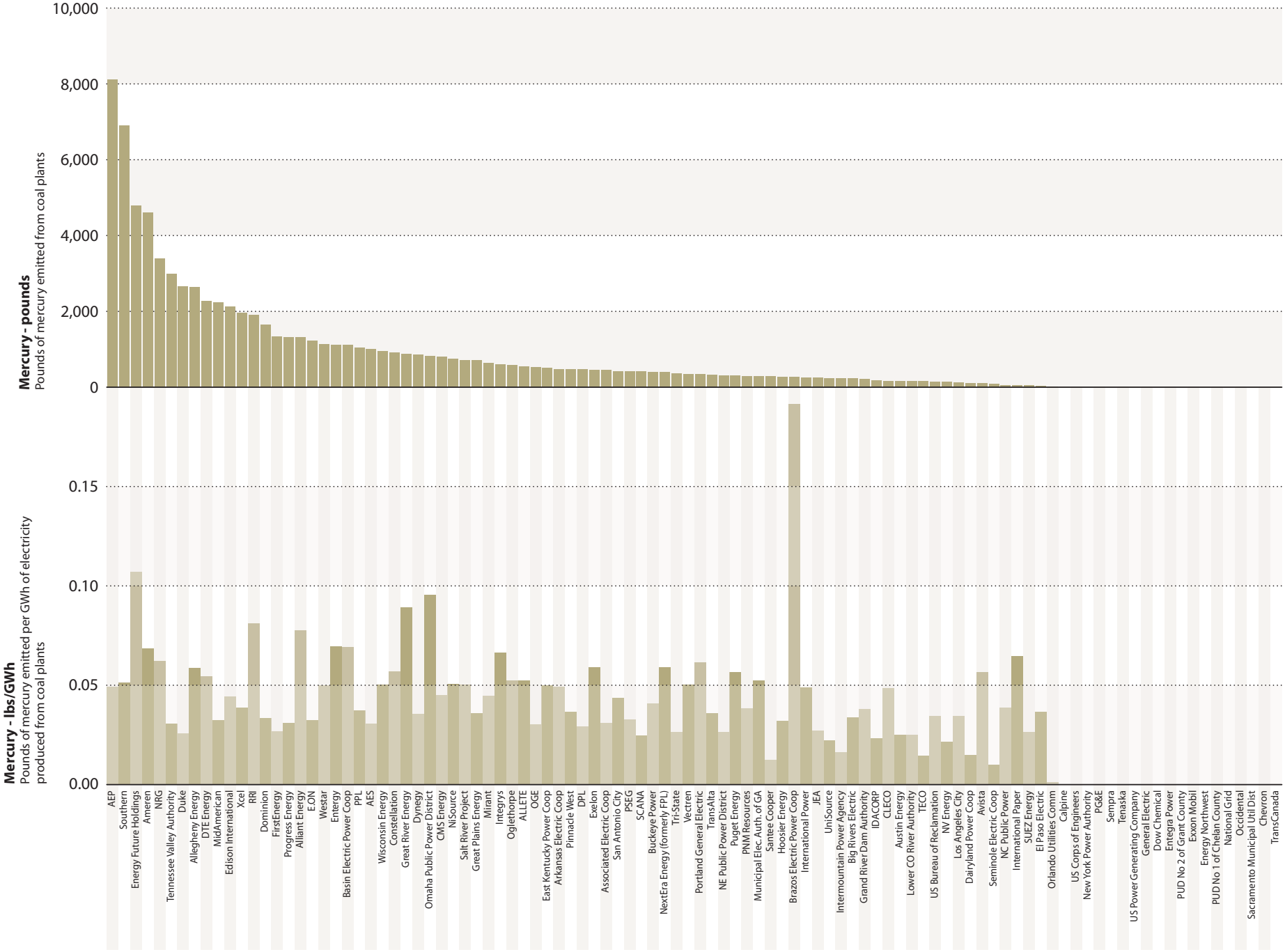


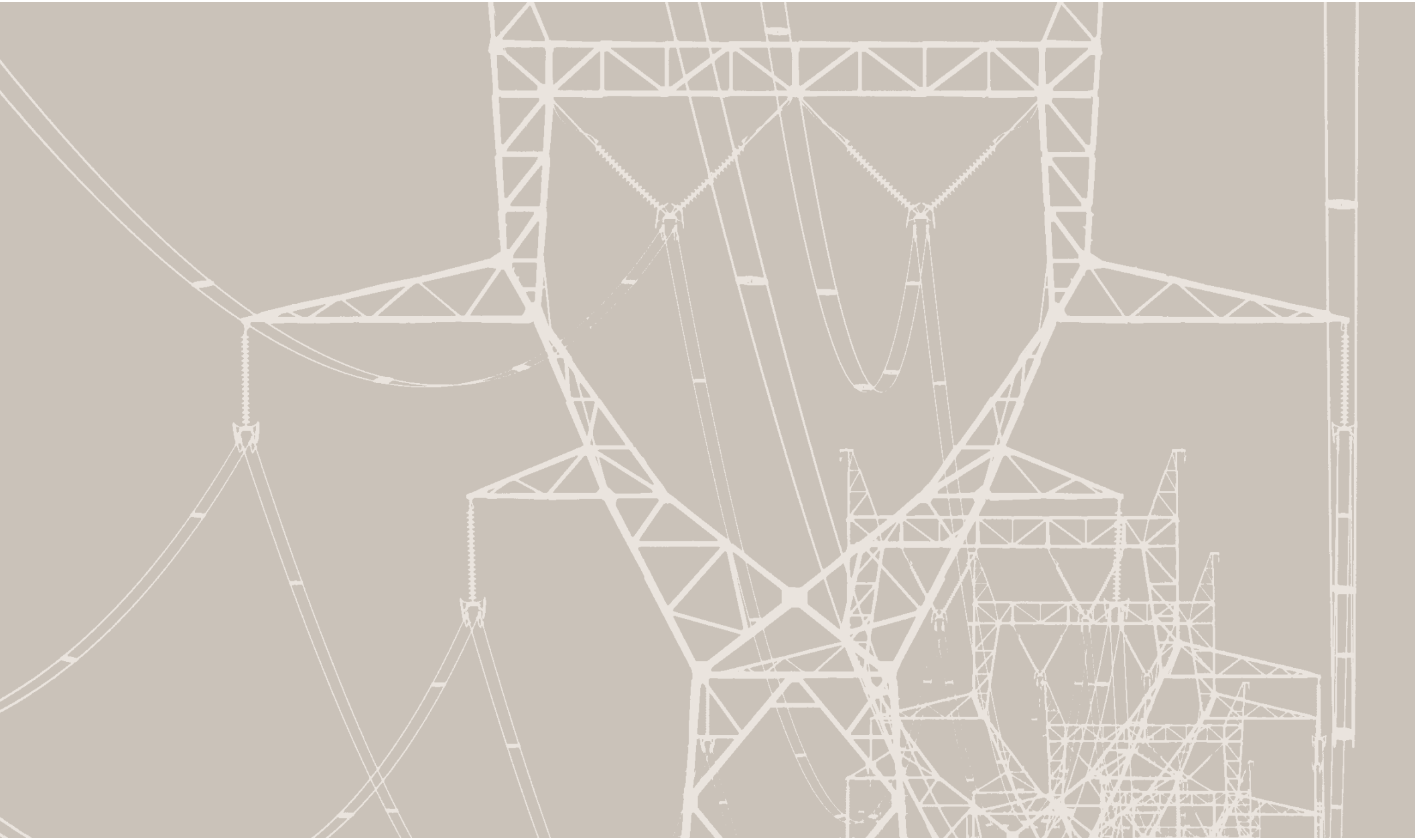
FIGURE 17

Coal - Mercury Total Emissions and Emission Rates

Total emissions (pounds) and emission rates (lbs/GWh) from coal plants

1 gigawatt-hour (GWh) = 1,000 MWh





Use of the Benchmarking Data

This report provides public information that can be used to evaluate electric power producers' emissions performance and risk exposure. Transparent information on emissions performance is useful to a wide range of decision-makers, including electric companies, financial analysts, investors, policymakers, and consumers.

Electric Companies

This provision of transparent information supports corporate self-evaluation and business planning by providing a useful "reality check" that companies can use to assess their performance relative to key competitors, prior years and industry benchmarks. By understanding and tracking their performance, companies can evaluate how different business decisions may affect emissions performance over time, and how they may more appropriately consider environmental issues in their corporate policies and business planning.

This report is also useful for highlighting the opportunities and risks companies may face from environmental concerns and potential changes in environmental regulations. Business opportunities may include increasing the competitive advantage of existing assets, the chance to generate or enhance revenues from emission trading mechanisms, and opportunities to increase market share by pursuing diversification into clean energy. Corporate risks that could have severe financial implications include a loss of competitive advantage or decrease in asset value due to policy changes, risks to corporate reputation, and the risk of exposure to litigation arising from potential violations of future environmental laws and regulations. Becoming aware of a company's exposure to these opportunities and risks is the first step in developing effective corporate environmental strategies.

Investors

The financial community and investors in the electric industry need accurate information concerning environmental performance in order to evaluate the financial risks associated with their investments and

to assess their overall value. Air emissions information is material to investors and can be an important indicator of a company's management.

Evaluation of financial risks associated with SO_2, NOx and mercury has become a relatively routine corporate practice. By comparison, corporate attention and disclosure of business impacts related to CO_2 has been more limited. This is likely to change substantially with the U.S. Securities and Exchange Commission's (SEC) issuance, in January 2010, of interpretive guidance concerning corporate climate risk disclosure. All publicly-traded companies in the U.S. are required to disclose climate-related "material" effects on business operations – whether from new emissions management policies, the physical impacts of changing weather or business opportunities associated with the growing clean energy economy – in their annual SEC filings. Numerous studies have pointed to the growing financial risks of climate change issues for all firms, especially those within the electric industry. Changing environmental requirements can have important implications for long-term share value, depending on how the changes affect a company's assets relative to its competitors. Especially in the context of climate change, which poses considerable uncertainty and different economic impacts for different types of power plants, a company's current environmental performance can shed light on its prospects for sustained value.

As the risks associated with climate change have become clearer and the prospect of regulation more imminent, the financial implications of climate change for the electric industry have drawn the attention of Wall Street. Ratings agencies such as Moody's Investors Service and Standard and Poor's have issued reports analyzing the credit impacts of climate change for the power sector. In its *Annual Industry Outlook* published in January 2010, Moody's identified "regulatory risks… from increasingly stringent environmental mandates, especially potential carbon dioxide emission restrictions" as a key longer-term challenge for the industry.[34] In 2009, Standard & Poor's published research stating that an economy-wide cap-and-trade program to reduce CO_2 emissions "will disproportionately affect the power sector," and furthermore that "the EBITDA[35] of coal-heavy fleets in the mid-2020s could be 20 percent lower on even nominal dollar terms, compared with current levels."[36] Mainstream financial firms such as Citigroup and Sanford C. Bernstein have issued reports evaluating the company-specific financial impacts of different regulatory scenarios on electric power companies and their shareholders.[37]

Shareholder concern about the financial impacts of climate change has increased significantly over the past decade. Much of this concern is directed toward encouraging electric companies to disclose the financial

risks associated with climate change, particularly the risks associated with the future regulation of CO_2. The Carbon Disclosure Project (CDP) was launched in 2000 and annually requests climate change information from companies. CDP now represents institutional investors with combined assets of over $57 trillion under management, and, as of 2009, requests climate strategy and greenhouse gas emissions data from over 3,000 of the world's largest companies. In 2003, the Investor Network on Climate Risk (INCR) was launched to promote better understanding of the risks of climate change among institutional investors. INCR, which now numbers 80 institutional investors representing assets of $8 trillion, encourages companies in which its members invest to address and disclose material risks and opportunities to their businesses associated with climate change and a shift to a lower carbon economy.

Shareholders have demonstrated increasing support for proxy resolutions requesting improved analysis and disclosure of the financial risks companies face from CO_2 emissions and their strategies for addressing these risks. In response to shareholder activity, more than a dozen of the largest U.S. electric power companies have issued reports for investors detailing their climate-related business risks and strategies. Shareholders continue to file resolutions with electric power companies that have not yet disclosed this information.

Policymakers

The information on emissions contained in this report is useful to policymakers who are working to develop long-term solutions to the public health and environmental effects of air pollutant emissions. The outcomes of federal policy debates concerning various regulatory and legislative proposals to improve power plant emissions performance will impact the electric industry, either in regard to the types of technologies or fuels that will be used at new power plant facilities or the types of environmental controls that will be installed at existing facilities.

Information about emissions performance helps policymakers by indicating which pollution control policies have been effective (e.g. SO_2 reductions under the Clean Air Act's Acid Rain Program), where opportunities may exist for performance and environmental improvements (e.g. SO_2 and NOx emissions performance standards for large, older facilities under the Regional Haze Rule), and where policy action is required to achieve further environmental gains (e.g. the environmental and financial risks associated with climate change).

Electricity Consumers

Finally, the information in this report is valuable to electricity consumers. Accurate and understandable information on emissions promotes public awareness of the difference in environmental performance and risk exposure. In jurisdictions that allow consumers to choose their electricity supplier, this information enables consumers to consider environmental performance in power purchasing decisions. This knowledge also enables consumers to hold companies accountable for decisions and activities that affect the environment and/or public health and welfare.

The information in this report can also help the public verify that companies are meeting their environmental commitments and claims. For example, some electric companies are establishing voluntary emissions reduction goals for CO_2 and other pollutants, and many companies are reporting significant CO_2 emission reductions from voluntary actions. Public information is necessary to verify the legitimacy of these claims. Public awareness of companies' environmental performance supports informed public policymaking by promoting the understanding of the economic and environmental tradeoffs of different generating technologies and policy approaches.

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 2008 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, and company websites.

Data Sources

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

EPA ACID RAIN PROGRAM DATABASE: EPA's Acid Rain Emissions Reporting Program accounts for almost all of the SO_2 and NOx emissions, and approximately three quarters of the CO_2 emissions analyzed in this report. These emissions were compiled using EPA's on-line emissions database available at http://camddataandmaps.epa.gov/gdm/.

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 2008 mercury emissions used in this report are based on TRI reports submitted by facility managers and which are available at http://www.epa.gov/tri/tridata/tri08/national_analysis/index.htm.

EIA FORM 923 POWER PLANT DATABASE (2008): 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 estimate approximately one

quarter of the CO_2 emissions analyzed in this report. The form is available at http://www.eia.doe.gov/cneaf/electricity/page/eia906_920.html.

EIA FORM 860 ANNUAL ELECTRIC GENERATOR REPORT (2008): 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 .

EIA FORM 861 ANNUAL ELECTRIC POWER INDUSTRY DATABASE (2008): EIA Form 861 provided all of the electricity sales and delivery data analyzed in this report. The form contains aggregate information about electricity sales, revenue, and customer counts of all electric utilities in the United States. It is available at http://www.eia.doe.gov/cneaf/electricity/page/eia861.html.

EPA U.S. INVENTORY OF GREENHOUSE GAS EMISSIONS AND SINKS (2008): 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 estimate approximately 25 percent of the CO_2 emissions analyzed in this report. Annex 2 is available at http://www.epa.gov/climatechange/emissions/downloads10/US-GHG-Inventory-2010_Annex2.pdf.

Plant Ownership

This report aims to reflect power plant ownership as of December 31, 2008. Plant ownership data used in this report are primarily based on the EIA-860 database from the year 2008. 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 Form 10-K filed with the SEC. If a discrepancy is found, ownership of the plant is updated using data from its 10-K filed with the SEC for the year 2008. Consequently, in a number of instances, ultimate assignment of plant ownership in this report differs from EIA-860's reported ownership. This may happen when the plant in question falls in one or more of the categories listed below:

1. It is owned by a limited liability partnership 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 2008. Because the 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 the Form 10-K is more accurate.

In all cases listed above, information reported in the Form 10-K takes precedence over the EIA-860 database. If the partnership or the subsidiary has multiple shareholders, percentage ownership is adjusted accordingly.

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, were used to calculate their emissions.

Note that beginning in 2008 the EIA implemented a new method of allocating fuel consumption between electric power generation and useful thermal output for cogeneration facilities. The new method distributes a plant's losses equally between electricity and thermal outputs. Prior to 2008, useful thermal output was generally assumed to be up to 80 percent efficient assigning all other losses to electric output of a plant. The new method, therefore, results in an increase of electric power production efficiency at cogeneration facilities.

NOx and SO_2 Emissions

The EPA Acid Rain Program collects and reports SO_2 and NOx emissions data for nearly all major power plants in the U.S. Emissions information reported in the Acid Rain database is collected from continuous emission monitoring (CEM) systems. SO_2 and NOx emissions data reported to the Acid Rain Program account for almost all of the SO2 and NOx emissions assigned to the 100 largest power producers in this report.

The Acid Rain database collects and reports SO_2 and NOx emissions data by fuel type at the 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 SO_2 and NOx 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.

CO_2 Emissions

CO_2 emissions reported through the EPA Acid Rain Program account for approximately three quarters of the CO_2 emissions used in this report. The remaining 25 percent was 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.

FUEL TYPE	CARBON CONTENT COEFFICIENTS (Tg Carbon/Qbtu)
COAL	
Anthracite Coal and Bituminous Coal	25.49
Lignite Coal	26.30
Sub-bituminous Coal	26.48
Waste/Other Coal (includes anthracite culm, bituminous gob, fine coal, lignite waste, waste coal)	25.49
Coal-based Synfuel (including briquettes, pellets, or extrusions, which are formed by binding materials or processes that recycle materials)	25.34
OIL	
Distillate Fuel Oil (Diesel, No. 1, No. 2, and No. 4 Fuel Oils)	19.95
Jet Fuel	19.33
Kerosene	19.72
Residual Fuel Oil (No. 5, No. 6 Fuel Oils, and Bunker C Fuel Oil)	21.49
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)	19.95
Petroleum Coke	27.85
GAS	
Natural Gas	14.47
Blast Furnace Gas	16.99
Other Gas	16.99
Gaseous Propane	14.47

EIA Form 923 reports heat input data by fuel type at the prime mover 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_2 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. 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.

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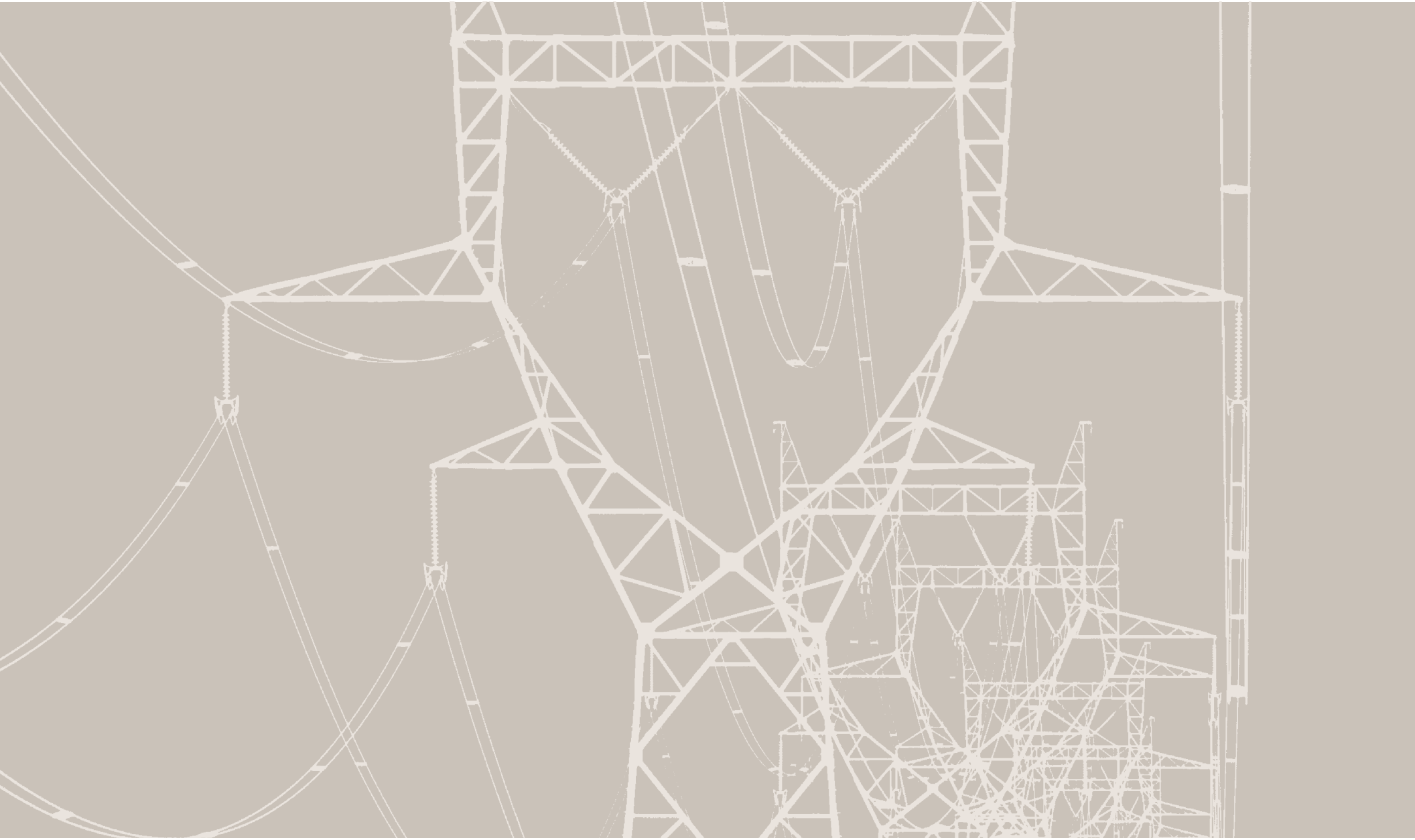

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