America's Dirtiest Power Plants

Polluters on a Global Scale

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Executive Summary

America's power plants are among the leading global sources of the dangerous carbon pollution that is fueling global warming. Devastating droughts such as the one in California, massive wildfires, increased threats to coastal areas due to sea level rise, and an increase in extreme rainfall are among the impacts that science tells us will become more frequent and severe unless the United States and the world take action now to reduce carbon pollution.

To address this threat, in June 2014 the U.S. Environmental Protection Agency took a bold step to reduce carbon pollution from power plants by proposing the Clean Power Plan, which would cut pollution from power plants by 30 percent below 2005 levels by 2030.

Cleaning up power plants is one of the most important steps the U.S. can take to reduce the threat of global warming. **In 2012, U.S. power plants produced more carbon pollution than the entire**

Table ES-1. The Dirtiest U.S. Power Plants Produce Globally Significant Amounts of Carbon Dioxide (CO_2) Pollution

	Total 2012 Emissions (Million Metric Tons of CO_2)	Percent of Total U.S. CO_2 Emissions	Percent of Global CO_2 Emissions from Energy Use	Emissions Equivalent by Country and Global Ranking for Energy-related CO_2 Pollution
Top Polluting Plant (Scherer Power Plant, GA)	20	0.4%	0.1%	Sri Lanka (86th)
Top 10 Polluting Power Plants	176	3.3%	0.5%	Vietnam (32nd)
Top 50 Polluting Power Plants	637	12%	1.8%	South Korea (7th)
Top 100 Polluting Power Plants	1,023	19%	3.0%	Germany (6th)
Top 500 Polluting Power Plants	1,918	36%	5.6%	Russia (4th)
All Power Plants	2,154	40%	6.3%	India (3rd)

economies of Russia, India, Japan or any other nation besides China. In fact, the 50 dirtiest U.S. power plants alone – representing less than 1 percent of U.S. power plants – produced as much pollution in 2012 as the nation of South Korea (the world's seventh leading emitter of greenhouse gases).

To reduce the threat of global warming, the United States must strengthen and implement the Clean Power Plan, while encouraging other nations to agree to take similar bold action at the international climate conference in Paris in 2015.

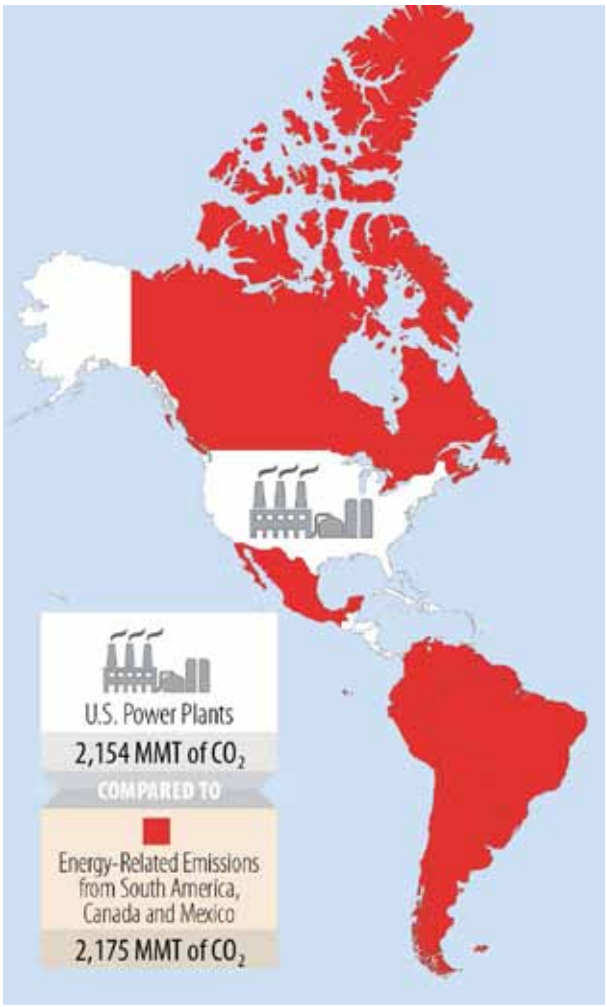
U.S. power plants are among the most significant sources of global warming pollution in the world.

- In 2012, U.S. power plants produced more than 6 percent of global warming emissions worldwide – more than any other industrialized nation except China. The 50 dirtiest power plants produced nearly 2 percent of the world's carbon dioxide emissions. (See Table ES-1.)
- U.S. power plants produced nearly as much carbon dioxide pollution in 2012 as was produced cumulatively that year in all of South America, Canada and Mexico. (See Figure ES-1.)

A small handful of the dirtiest coal plants produce a massive and disproportionate share of the nation's global warming pollution.

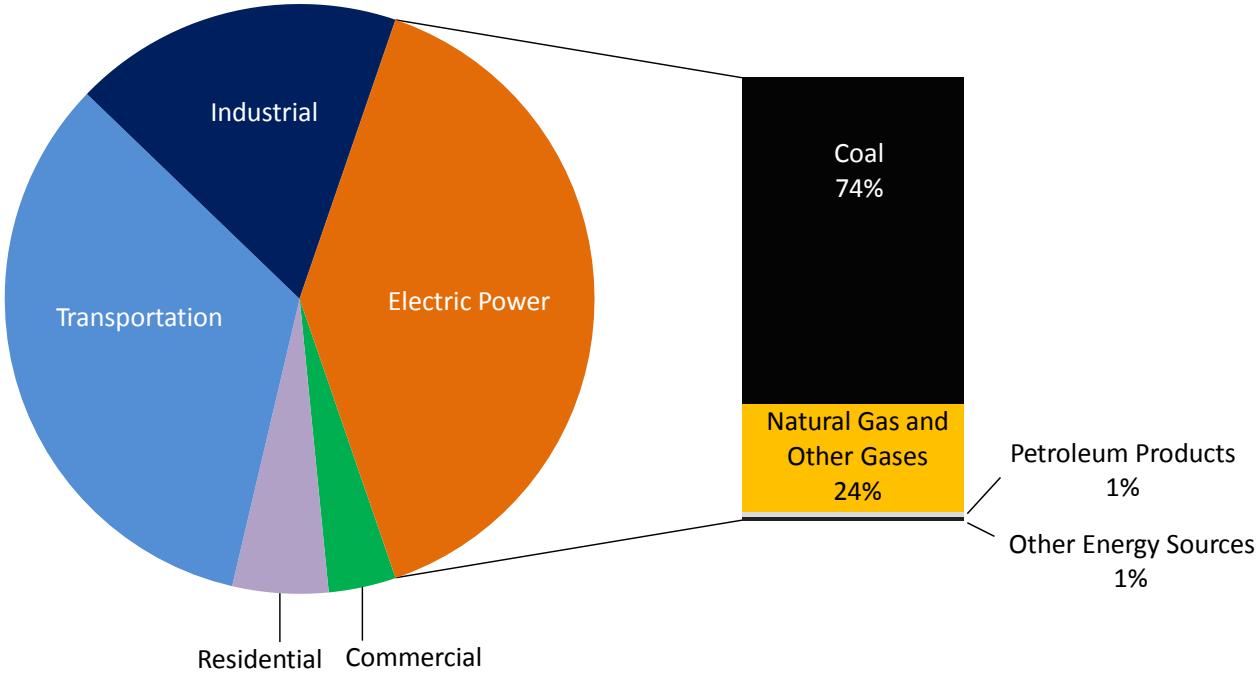
- In 2012, power plants produced about 40 percent of all U.S. emissions of carbon dioxide, the leading pollutant driving global warming. (See Table ES-1.)
- The 50 dirtiest U.S. power plants produced 30 percent of all power-sector carbon dioxide emissions in 2012 while producing only 15 percent of the nation's electricity.

Figure ES-1. In 2012, U.S. Power Plants Produced Nearly as Much CO_2 Pollution as Canada, Mexico and All Countries in South America Combined



- The dirtiest power plants tend to be older plants fueled by coal. Coal-fired power plants produced about 74 percent of all power plant pollution in 2012, despite producing only 37 percent of the nation's electricity. (See Figure ES-2.)

Figure ES-2. Share of Total U.S. CO_2 Emissions Produced by Power Plants and U.S Power-Sector Emissions by Fuel Type, 2012



New pollution standards for U.S. power plants announced by the Environmental Protection Agency in June 2014 will result in important reductions in carbon emissions on the global scale.

- By 2030, the U.S. EPA's proposed Clean Power Plan will cut 550 million metric tons of carbon pollution from power plants each year –roughly equivalent to the amount emitted in 2012 by the entire nation of Canada, the world's eighth-largest emitter of carbon dioxide.
- When finalized, the Clean Power Plan would be the largest step the United States has ever taken to cut global warming pollution.

However, the United States must do more to prevent the worst impacts of global warming. The United States should cut overall emissions of global warming pollution by at least 80 percent below 2005 levels by 2050. This will require action at all levels of government.

- **The U.S. EPA should strengthen, finalize and implement the Clean Power Plan**. The EPA should strengthen the Clean Power Plan by tapping the potential for renewable energy and energy efficiency to cut carbon pollution deeper and faster – *achieving a 35 to 40 percent cut in power-sector emissions below 2005 levels by 2020* and fully meeting President Obama's climate commitment to the international community. The EPA should finalize the plan by June 2015 and begin enforcing it by July 2016.

- Congress should also take action to drive down emissions and promote renewable energy, including by adopting a comprehensive national climate policy and passing a national renewable electricity standard.
- President Obama should propose a strong international target for reducing carbon emissions at the Paris climate conference in 2015.

- **States should implement the Clean Power Plan in ways that maximize the potential for clean, renewable energy and energy efficiency, rather than increasing reliance on natural gas or nuclear power. States should:**
  - Begin working now on a compliance plan that will meet the EPA's currently proposed standards. After the standards are finalized in 2015, states should plan to submit final compliance plans to the EPA on time in 2016 or by 2018 for states creating regional programs.
  - Consider adopting or strengthening renewable electricity standards (RESs) by moving compliance years forward or by increasing the share of electricity utilities must obtain from renewable sources.
  - Consider incorporating specific targets for solar or wind energy capacity into RESs. Include carve-outs for distributed generation to maximize potential economic benefits.
  - Adopt or strengthen state energy efficiency resource standards that require utilities to deliver energy efficiency improvements in homes, businesses and industries.
  - Consider statewide adoption of the newest International Energy Conservation Code to improve building energy efficiency and lower emissions.

Figure ES-3. Dirty Power Plants Make an Outsized Contribution to U.S. Carbon Dioxide Pollution (Million Metric Tons - MMT, 2012)

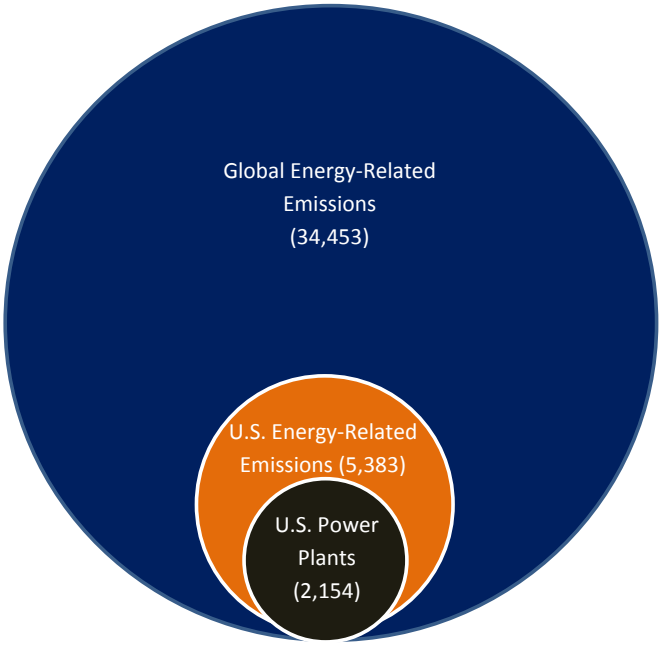


Figure is drawn to scale.

  - Explore joining or creating regional emissions trading programs such as the Northeast's Regional Greenhouse Gas Initiative. Regional programs can help maximize the potential for cost-effective emissions reductions, since electricity systems often span several states.

Introduction

Global warming is not a distant problem. It is changing our climate today, with devastating consequences for human health and economies worldwide. Higher average global surface temperatures have increased the frequency and severity of droughts, heat waves and heavy downpours in many places in the world, threatening human health and safety with floods, wildfires and crop failure.[1] At the same time, extreme coastal storms – exacerbated by rising seas – have killed thousands of people and destroyed billions of dollars in coastal infrastructure.[2] Scientists expect these impacts to grow worse without an immediate and dramatic reduction in global emissions of heat-trapping pollutants like carbon dioxide and methane.

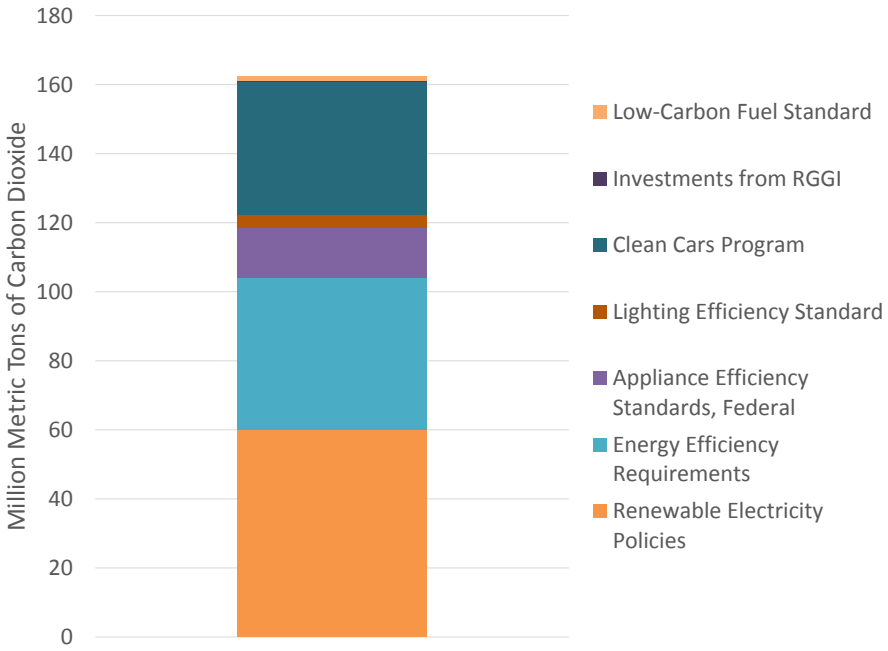
Achieving the emissions reductions necessary for the world to avoid the worst impacts of global warming will require a strong international commitment from both developed nations and emerging economies to make steep reductions in climate-altering pollution. To that end, the international community will meet in Paris to discuss a new global climate accord at the United Nations Conference of Parties in 2015.

As the world's largest economy, the nation responsible for more of the carbon pollution in the atmosphere than any other, and a center for clean energy technology and research, the United States has the responsibility and opportunity to lead the world in tackling the problem of global warming. The United States is the second-largest current emitter of global warming pollution, by which this report means carbon dixide emissions, the leading but by no means only contributor to global warming. Our nation emits more than 5 billion metric tons of carbon dioxide each year – about one-fifth of the world total – meaning that there is no solution to global warming that does not require United States involvement and leadership.[3]

In order to lead, the United States needs to reduce its own emissions of climate-altering pollution, and then inspire the world to transition from dirty energy sources to the efficient use of clean energy. Fortunately, thanks to clean energy policies adopted and implemented over the last decade, the United States is already beginning to rise to that challenge. States across the nation have adopted a variety

By cleaning up U.S. power plants, the EPA is addressing one of the most significant sources of carbon dioxide pollution in the world.

Figure 1. Estimated Carbon Dioxide Emission Reductions in 2012 from Policies Adopted or Implemented from 2007 to 2012[7]



of policies to reduce emissions, such as renewable electricity standards, fuel economy standards for passenger vehicles, and emissions caps. These state policies have helped pave the way for strong federal action. For example, in 2009, President Obama established a goal of reducing global warming pollution in the United States by 17 percent below 2005 levels by 2020 and has pursued policies to cut emissions – including from power plants, the nation's biggest source of pollution.[4]

These actions are having an impact. For example, a set of state and federal clean energy policies adopted and in effect from 2007 to 2012 reduced U.S. carbon dioxide pollution by 162 million metric tons in 2012.[5] (See Figure 1.) That's equal to annual emissions from 42 typical coal-fired power plants, according to the U.S. Environmental Protection Agency.[6]

In June 2014, the U.S. EPA proposed the Clean Power Plan, which would reduce power plant carbon pollution by 30 percent (below 2005 levels) by 2030. When finalized and implemented, this will be the most significant single action the United States has ever taken to limit global warming pollution.[8]

By cleaning up U.S. power plants, the EPA is addressing one of the most significant sources of carbon dioxide pollution in the world. A sizable share of *worldwide* global warming emissions comes from just a handful of exceptionally dirty coal, oil, and natural gas-fired power plants in the United States. This report is a follow-up study to our 2013 report, *America's Dirtiest Power Plants,* which identified the nation's dirtiest power plants in terms of total annual carbon dioxide emissions.[9] This report updates that analysis with new data. It also places that data in the context of global carbon emissions and examines the impact of the proposed Clean Power Plan.

U.S. Power Plants Are a Major Source of Global Warming Pollution

Carbon dioxide is the leading, though by no means only, greenhouse gas driving global warming, and power plants are the largest source of carbon dioxide pollution in the United States.[10] Burning fossil fuels for electricity generation produced 40 percent of total U.S. carbon dioxide emissions in 2012.[11] A disproportionate share of these power-sector carbon dioxide emissions come from a small subset of the nation's dirtiest power plants, particularly coal-fired power plants. These power plants are also among the largest sources of carbon dioxide pollution in the world, which makes cleaning them up critically important to combating global warming pollution on a worldwide scale.

A Handful of Dirty U.S. Power Plants Contribute a Massive and Disproportionate Share of Carbon Dioxide Emissions

There are about 6,400 electric generating facilities in the United States, but most of the global warming pollution emitted by the U.S. power sector comes from a handful of exceptionally dirty coal-fired power plants.[12] These dirty power plants also produce a disproportionate amount of the nation's total global warming pollution relative to the amount of electricity they generate. For example, just 50 of the dirtiest U.S. power plants – all coal-fired and representing less than 1 percent of all U.S. power plants – produced about 30 percent of U.S. power-sector emissions in 2012, despite only producing about 15 percent of the nation's electricity. Similarly, all U.S. coal-fired power plants accounted for about 74 percent of power-sector emissions, but only 37 percent of electricity generation.[13] (See Figures 2 and 3, page 11.)

The Dirtiest Power Plants Are Old and Inefficient Coal Plants

U.S. power plants make such an outsized contribution to global warming emissions because so many of them are old and inefficient, and because so many of them run on coal, one of the dirtiest fuels on the planet. In fact, 98 of the nation's 100 most-polluting power plants in terms of total carbon dioxide emissions are coal plants; among the top 500, 317 (63 percent) are coal plants. The remainder is comprised of older oil- and gas-fired power plants. (See Table A-2 in Appendix.)

Coal plants are not designed to last much longer than 30 years, but power plant operators routinely renovate these plants to extend their lifetimes.[15] About 74 percent of U.S. coal-fired generating capacity was at least 30 years old at the end of 2012, according to the Energy Information Administration (EIA).[16] Because old coal plants are inefficient to operate, power providers often run them at only a fraction of their full capacity or for shorter periods of time, which results in a lower "capacity factor" (the ratio of a power plant's actual output compared to its full capacity). At the end of 2013, the average capacity factor for the whole U.S. coal fleet was about 60 percent.[17]

Although many coal plants today are underutilized because of their age and inefficiency, they remain among the worst contributors to global warming pollution. That's because coal is an extremely dirty fuel,

Figure 2. Share of Total U.S. CO_2 Emissions Produced by Power Plants and U.S Power-Sector Emissions by Fuel Type, 2012[14]

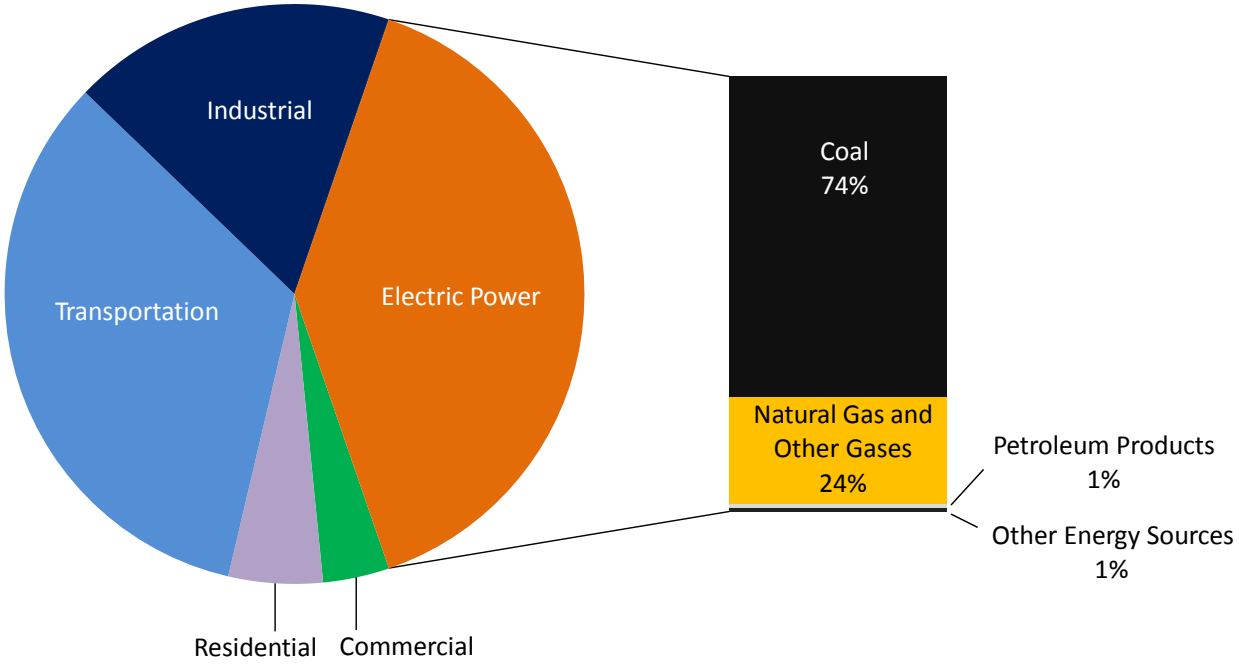


Figure 3. U.S. Power Plants Contribute Significantly to Global Carbon Dioxide Pollution (Million Metric Tons – MMT), 2012

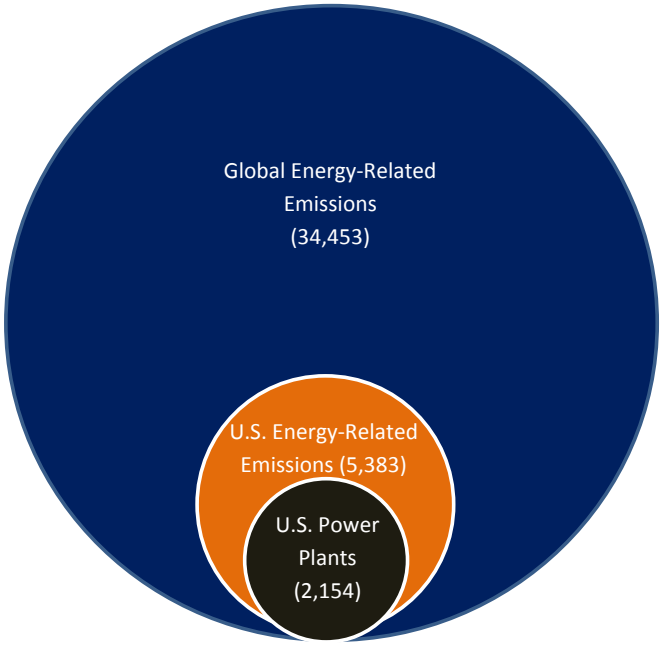


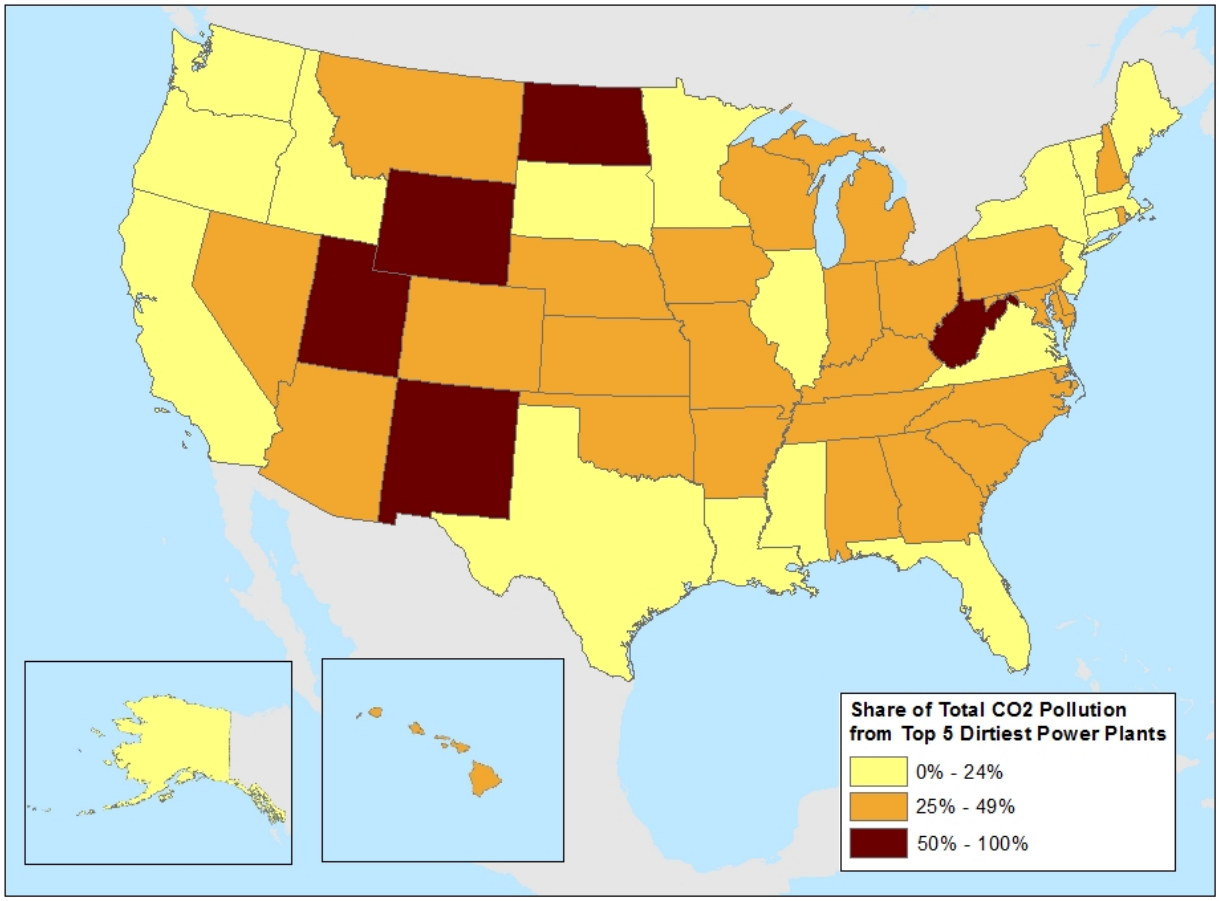
Figure is drawn to scale.

and many of the dirtiest power plants – in terms of total emissions – are quite large. Five out of the Top 10 most-polluting power plants, for example, have nameplate capacities exceeding 800 MW.[18]

In many states, power plants are responsible for more global warming pollution than any other sector of the economy, including industry and transportation.

For example, in five states – New Mexico, Wyoming, Utah, North Dakota and West Virginia – just five of the dirtiest power plants produce at least half of all energy-related carbon dioxide emissions. In 26 other states, these top polluters are responsible for at least one-quarter of statewide energy-related emissions. (See Figure 4 and Table A-3 in the Appendix.)

Figure 4. In Five States, the Five Dirtiest Power Plants Produce at Least Half of Economy-Wide CO_2 Emissions



Pollution from U.S. Power Plants Is Significant on a Global Scale

In 2012, U.S. power plants produced more than 6 percent of all energy-related carbon dioxide emissions worldwide – more than the entire economy of any other nation except China and the U.S. as a whole.[19] (See Figure 5.) These emissions were roughly equivalent to the combined energy-related emissions of all of South America, Canada and Mexico (2,175 MMT).[20] (See Figure 6.)

America's dirtiest U.S. coal and gas-fired power plants make an outsized contribution to carbon emissions on the global scale, just as they do in the United States. For example:

Figure 5. Carbon Dioxide Pollution Emitted by U.S. Power Plants Compared to Other Countries, 2012

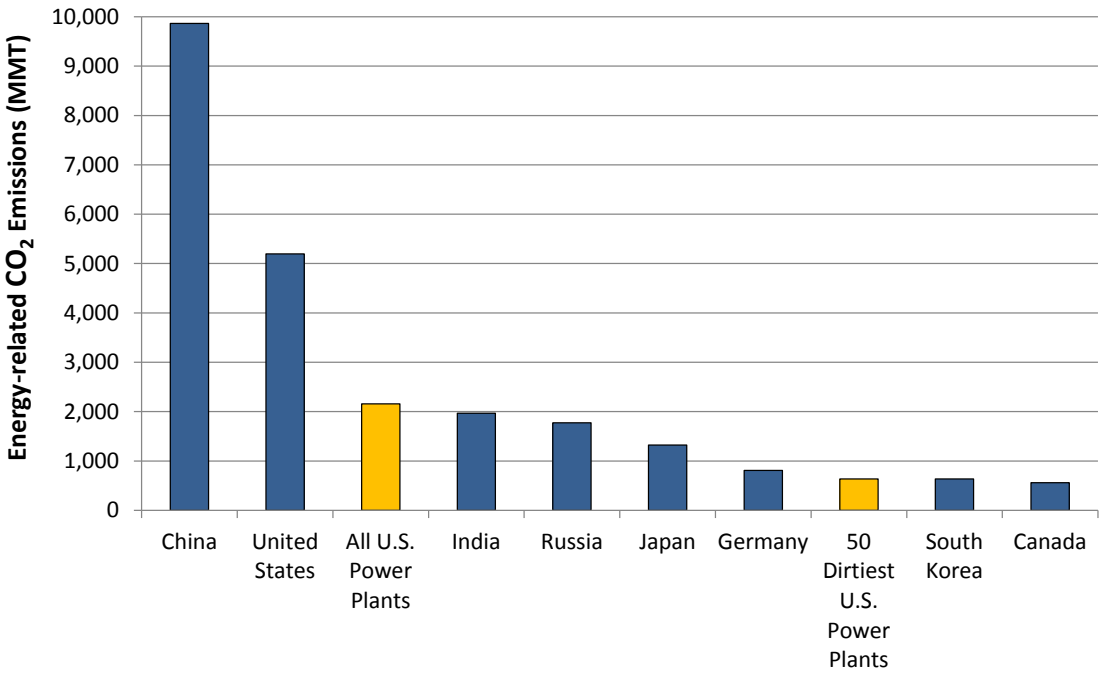
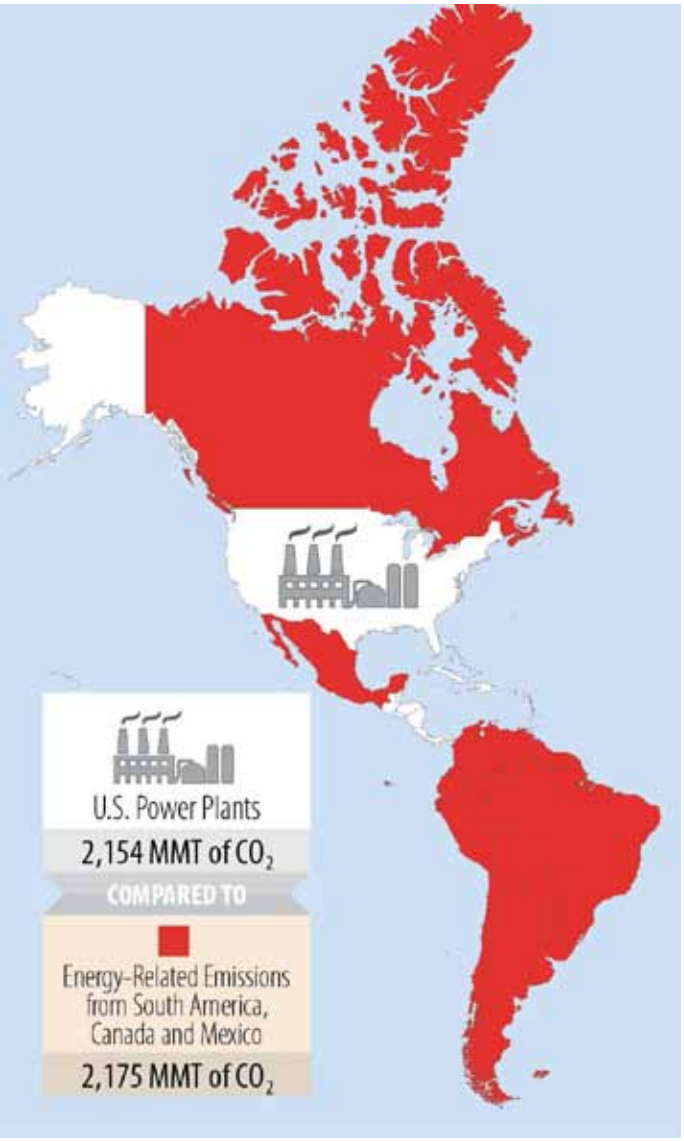


Figure 6. In 2012, U.S. Power Plants Produced Nearly As Much CO_2 Pollution As Canada, Mexico and All Countries in South America Combined



- The nation's 500 dirtiest power plants – about 8 percent of all U.S. power plants – produce more global warming emissions each year than all of the "Asian Tiger" nations of Indonesia, Singapore, Malaysia, Thailand, South Korea and Taiwan, combined.[21]
- The top 100 dirtiest power plants – about 1.5 percent of all facilities – produce more pollution than the combined economy-wide emissions of Canada and Mexico (ranked 8th and 10th world-wide for CO_2 emissions, respectively).[22]
- Just *one* of these power plants – Georgia Power's Plant Scherer in Juliette, Georgia – produces more global warming pollution annually than all the energy-related CO_2 emissions of Sri Lanka, a country of nearly 22 million people.[23] (For more comparisons, see Table 1.)

Table 1. The Dirtiest U.S. Power Plants Produce Globally Significant Amounts of Carbon Dioxide (CO_2) Pollution

	Total 2012 Emissions (Million Metric Tons of CO_2)	Percent of Total U.S. CO_2 Emissions	Percent of Global CO_2 Emissions from Energy Use	Emissions Equivalent by Country and Global Ranking for Energy-related CO_2 Pollution
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Top 100 Polluting Power Plants	1,023	19%	3.0%	Germany (6th)
Top 500 Polluting Power Plants	1,918	36%	5.6%	Russia (4th)
All Power Plants	2,154	40%	6.3%	India (3rd)

Table 2. CO_2 Emissions of the Top 10 Most-Polluting Power Plants (MMT), 2012

2014 Rank	Operator Name	Plant Name	City	State	2012 Emissions (MMT CO_2)	Emissions Equivalent in Passenger Vehicles (Millions)
1	Georgia Power Co.	Scherer	Juliette	GA	20.1	4.3
2	Duke Energy Indiana Inc.	Gibson	Owensville	IN	19.9	4.3
3	FirstEnergy Generation Corp.	FirstEnergy Bruce Mansfield	Shippingport	PA	18.3	3.9
4	Indiana Michigan Power Co.	Rockport	Rockport	IN	18.0	3.8
5	Alabama Power Co.	James H. Miller Jr.	Quinton	AL	17.7	3.8
6	Ohio Power Co.	General James M. Gavin	Cheshire	OH	17.5	3.8
7	Salt River Project	Navajo	Page	AZ	16.5	3.5
8	Luminant Generation Company, LLC	Martin Lake	Tatum	TX	16.3	3.5
9	The DTE Electric Company	Monroe	Monroe	MI	15.8	3.4
10	Tennessee Valley Authority	Paradise	Drakesboro	KY	15.6	3.3

Cutting U.S. Power Plant Pollution Is Essential to Prevent the Worst Impacts of Global Warming

Global warming threatens our health, our safety and our environment. Rising global average temperatures and other climate impacts have already resulted in extreme precipitation events and heat waves in the United States, and climate science tells us that global warming will likely lead to further changes in weather extremes.[24] Extreme weather events such as Hurricane Sandy, extended droughts, heat waves and floods caused by heavy precipitation are likely to become more common in a warming world.[25] At the same time, global warming-induced sea-level rise, changes in summer and winter precipitation patterns, and ecosystem changes could reduce the ability of natural and man-made systems to withstand even normal weather events.

To limit the most severe global warming impacts, the international community has set a target of limiting the increase in global temperature to 3.6° F (2° C) above the pre-industrial era.[26] In order to have a "likely" chance of meeting this target, according to the Intergovernmental Panel on Climate Change (IPCC), global emissions must drop 40 to 70 percent below 2010 levels by 2050, and to near zero by 2100.[27] The United States is not only the largest country in the world with a developed economy, but it is also the largest cumulative contributor to global warming pollution, giving America a clear mandate to lead the world on emissions reductions.[28] Through the Clean Cars Program, the Obama Administration has already put the United States on track to make major reductions in global warming pollution from our transportation sector, the second-largest source of U.S. global warming emissions.[29] The best near-term opportunity to make further progress is cleaning up our dirty power plants, the biggest contributors to U.S. global warming pollution.

The U.S. Must Act Now to Prevent the Worst Impacts of Global Warming

In 2013, the IPCC – the world's foremost scientific authority on global warming – concluded that it is "extremely likely" (at least a 95 percent probability) that human-caused releases of greenhouse gases into the atmosphere have been the leading cause of global warming.[30] The report also found that if greenhouse gas emissions continue unabated, seas could rise by as much as three feet by the end of the century, among other catastrophic and irreversible impacts.[31]

Clear signs of global warming have already begun to emerge:

- The global average surface temperature increased by more than 1.5° F (0.8° C) between 1880 and 2012.[32] The last three decades have been warmer than any period since at least 1850.[33] In the continental United States, 2012 was the hottest year on record.[34]

- Warmer temperatures have increased the amount of water vapor in the atmosphere.[35] In many places in the world, including the United States, this phenomenon has led to increases in heavy downpours, flooding and extreme snowstorms.[36]
- Oceans have absorbed 80 percent of the extra heat in the climate system, causing ocean water to expand.[37] Coupled with melting glaciers, this has caused sea levels to rise by about eight inches – with the rate of increase accelerating.[38]
- Heat waves and droughts in many parts of the world have become longer and more severe, especially in the tropics and subtropics.[39] For example, in 2012, a catastrophic drought, exacerbated by near-record heat, withered crops across the United States; economists estimated losses at $77 billion.[40]

The more global warming pollution we produce by burning fossil fuels, the more serious the consequences. And the changes will be largely irreversible for a thousand years after emissions stop.[41] On the world's current emissions path, humanity risks increasing the average global temperature by 4° C (7.2° F) or more (above the pre-industrial era) by the end of this century.[42] If significant steps are not taken to reduce global warming pollution, sea level rise will flood more land, and the frequency and intensity of extreme weather events will only get worse. For example:

- Sea levels could rise between two and six feet, submerging thousands of miles of coastline and wreaking havoc on coastal communities around the world.[43] According to a study led by World Bank Senior Economist Stephane Hallegatte, five of the world's 10 cities most endangered by continued sea level rise are in the United States. Miami, New York, New Orleans, Tampa and Boston stand to be hit the hardest of U.S. cities, and global flood losses are expected to rise tenfold, to over $60 billion annually, by 2050.[44] Continued global warming could make extreme storm surges like that from Hurricane Katrina up to seven times more likely – meaning that by the end of the century, such a storm could occur every other year.[45] By 2300, global mean sea levels could rise as high as 13 feet above present-day levels.[46]
- Regardless of how quickly temperatures rise, increases in carbon dioxide emissions could cause ocean acidity to rise by 150 percent above pre-industrial levels, resulting in wide-ranging, negative impacts on marine species and ecosystems, with particularly severe damage to coral reefs and fisheries.[47]
- The amount of precipitation falling during heavy rainstorms could increase by 20-30 percent, increasing the risk of major flooding events in many parts of the world.[48]
- Increasing aridity, drought and extreme temperatures could occur in Africa, southern Europe, the Middle East and most of the Americas, Australia, and Southeast Asia.[49] Without change to current climate policies, University of Illinois climate experts predict that the annual acreage lost to wildfires in the United States may double by 2043. "You might get to the point where in some parts of the West, there are no more forests," warns Professor Don Wuebbles, coordinating lead author of the Intergovernmental Panel on Climate Change's Fifth Assessment Report.[50]
- Threats to national and international security are likely to increase as sea levels rise, prolonged drought and flooding lead to food shortages, desertification, population dislocation and mass migrations.[51] As President Obama's former Chairman of the Joint Chiefs of Staff, Admiral Mike Mullen, put it: "The scarcity of and potential competition for resources like water, food, and space, compounded by the influx of refugees if coastal lands are lost, does not only create a humanitarian crisis, but it creates conditions of

hopelessness that could lead to failed states and make populations vulnerable to radicalization."[52]

- Extreme weather, hotter temperatures and sea-level rise are likely to have adverse impacts on human health, including respiratory illnesses from increased levels of ground-level ozone, or "smog;"[53] premature deaths caused by heat stress;[54] an increase in outbreaks of waterborne illnesses;[55] and the displacement of coastal communities by disasters such as strong storms and floods, fueled by rising seas.[56]
- The ecological consequences of unchecked global warming could include the extinction of as much as 70 percent of all species on earth and the loss of unique ecosystems like the Amazon.[57]

Some of these climate impacts, given the tremendous amount of global warming pollution already emitted and the accumulation of carbon dioxide in the atmosphere, are inevitable. However, if policymakers take action now to reduce climate-altering pollution, there is still time to prevent the worst impacts of global warming.

Solutions Exist to Reduce Global Warming Pollution

The tools to address global warming pollution are available to us today. We are surrounded by clean energy options – the power of the sun, the movement of wind and waves, the heat of the earth, even the energy leaking from drafty windows in our homes and businesses. By using energy more efficiently and tapping our vast renewable energy resources, the world can move toward 100 percent clean energy that never runs out and doesn't contribute to global warming.

The rapid expansion of clean energy over the last decade has already resulted in enormous environmental benefits. In the United States, electricity generation from wind and solar energy increased four-fold from 2007 to 2012, slashing carbon dioxide emissions by 62 million metric tons in 2012 – equivalent to that emitted annually by more than 2.5 million passenger vehicles.[58] U.S. wind power produced 4.5 percent of the nation's electricity in 2013 – enough to power the equivalent of more than 16 million homes, according to the U.S. Department of Energy.[59] As of mid-2013, the United States is adding one solar PV system every four minutes.[60] Globally, solar energy capacity has reached nearly 139 GW.[61] On a sunny day in June 2014, Germany (the world's sixth-largest emitter of carbon dioxide pollution) generated over half of its electricity with solar power.[62]

America's capacity for renewable energy is virtually endless. For example, a recent analysis by researchers with the National Renewable Energy Laboratory estimated that rooftop photovoltaic systems could generate more than 20 percent of the electricity used in the United States each year.[63] The potential for utility-scale photovoltaics in rural areas is even greater – representing *70 times* more electricity than is used in the United States each year. By meeting more of our electricity needs with renewable energy sources and energy efficiency, the United States can quickly achieve significant reductions in global warming emissions.

However, in order to avoid emission levels that trigger dangerous, irreversible climate change impacts, the United States must address its largest existing sources of global warming pollution – namely, the transportation and electric power sectors. The United States has already begun to tackle transportation-sector emissions with the federal adoption of the Clean Cars Program, which raises fuel economy standards for cars and light trucks. Now, America has taken another historic step to limit carbon pollution from the U.S. electricity sector by announcing the first-ever federal pollution limits on existing power plants, including major polluters whose emissions of carbon pollution are significant on a global scale.

The Clean Power Plan Will Cut Carbon Pollution on a Global Scale

In June 2014, the U.S. EPA announced the Clean Power Plan, which places the first-ever federal limits on carbon dioxide pollution from existing power plants. The plan, mandated by President Obama in his 2013 climate policy speech, establishes a target emission rate (pounds of CO_2 per megawatt-hour) for each state based on its unique electricity generation mix and patterns of consumption. As currently proposed, the plan is projected to achieve a 30 percent reduction from 2005 emissions by 2030.[64]

Meeting the emissions reduction targets laid out in the Clean Power Plan would have an important impact on carbon dioxide emissions worldwide. **By 2030, the Clean Power Plan would cut U.S. power-sector emissions by about 550 million metric tons annually – roughly equivalent to that emitted in 2012 by the entire economy of Canada, the world's eighth-largest emitter of carbon dioxide.**[65] It would have the same impact on annual emissions of carbon dioxide pollution as removing half of all existing U.S. cars and light trucks from the road.[66]

As the single largest step the United States has ever taken to limit climate change pollution, the Clean Power Plan demonstrates the kind of American leadership that is necessary to influence other industrialized nations to reduce their own emissions.

However, it is only a single step. Even a reduction of 550 million metric tons – the anticipated impact of the plan in 2030 – is equivalent to the pollution emitted by only our 41 dirtiest power plants today. To lead the world, America needs to cut global warming pollution at least 80 percent below 2005 levels by 2050 – which means, at a minimum, meeting President Obama's commitment to a 17 percent reduction below 2005 levels by 2020. Making steeper cuts in power plant pollution is one of America's best opportunities to achieve this economy-wide emissions reduction target, because so much power plant pollution comes from relatively few sources. The EPA can achieve these steeper cuts by strengthening the Clean Power Plan to more fully capture the potential for renewable energy and energy efficiency. Already, some states – Iowa, Minnesota and South Dakota – get more of their energy from renewable energy than the proposed Clean Power Plan assumes they will get by 2030.[67] By maximizing the power of clean energy, we can get bigger reductions more quickly than has been proposed.

Policy Recommendations

To prevent the worst impacts of global warming, the United States should cut overall emissions of global warming pollution by 50 percent below 2005 levels by 2030, and by at least 80 percent below 2005 levels by 2050. This will require action at all levels of government.

- **The U.S. EPA should strengthen, finalize and implement the Clean Power Plan**. The EPA should strengthen the Clean Power Plan by tapping the potential for renewable energy and energy efficiency to cut carbon pollution deeper and faster – *achieving a 35 to 40 percent cut below 2005 emissions by 2020* and fully meeting President Obama's climate commitment to the international community. The EPA should finalize the plan by June 2015 and begin enforcing it by July 2016.
    - Congress should also take action to drive down emissions and promote growth in renewable energy, including adopting a comprehensive national carbon policy and passing a national renewable electricity standard.
    - President Obama should propose a strong international target for reducing carbon emissions at the Paris climate conference in 2015.
- **States should implement the Clean Power Plan in ways that maximize the potential for clean, renewable energy and energy efficiency, rather than increasing reliance on natural gas or nuclear power (see text box on page 21). States should:**
    - Begin working now on a compliance plan that will meet EPA's currently proposed standards. After the standards are finalized in 2015, states should plan to submit final compliance plans to EPA on time in 2016 or by 2018 for states creating regional programs.
    - Consider adopting or strengthening renewable electricity standards (RESs) by moving compliance years forward or by increasing the share of electricity utilities must obtain from renewable sources.
    - Consider incorporating specific MW targets for solar or wind energy deployment into RESs. Include carve-outs for distributed generation to maximize potential economic benefits.
    - Adopt or strengthen state energy efficiency resource standards that require utilities to deliver energy efficiency improvements in homes, businesses and industries.
    - Consider statewide adoption of the newest International Energy Conservation Code to improve building energy efficiency and lower emissions.
    - Explore joining or creating regional emissions trading programs such as the Northeast's Regional Greenhouse Gas Initiative. Regional programs can help maximize the potential for cost-effective emissions reductions, since electricity systems often span several states.

Getting the Most Out of the Clean Power Plan by Maximizing Renewable Energy and Energy Efficiency

Any long-term solution to global warming requires the virtual elimination of carbon pollution from our electricity system. Any new investments that states make in energy infrastructure, therefore, should not prolong our dependence on fossil fuel-fired electricity generation and should focus on the development of truly clean sources of energy that can safely and affordably power the economy for the long term. As states develop their strategies for complying with the Clean Power Plan, that means minimizing the role of natural gas and nuclear power and maximizing support for renewable energy and energy efficiency.

Natural gas emits less carbon dioxide than coal, but far more than will keep our climate safe over the long term. Additionally, releases of methane from natural gas production, storage and transportation reduce – or even eliminate, according to some studies – any climate benefits of switching from coal to gas. Methane, the main component of natural gas, is a global warming pollutant far more powerful than carbon dioxide. Even relatively small methane leaks – on the order of 3.2 percent to 3.4 percent of natural gas produced – make it a dirtier fuel than coal in terms of its impact on global warming.[68] A recent study by researchers at Carnegie Mellon and the National Atmospheric and Oceanic Administration suggests that fugitive emissions from natural gas production since 2000 have ranged from 2 to 4 percent, though they may have been as high as 5 percent from 2006 to 2011.[69] Electricity generated from natural gas is therefore either a bit better for the climate than electricity from coal, or a bit worse. The combination of carbon pollution emitted during the combustion of natural gas and methane leakage during production, storage and transportation mean that investing in more natural gas-fired power plants, natural gas-powered vehicles, and new transmission and distribution infrastructure will ensure our long-term dependence on yet another dirty fossil fuel.

Nuclear power emits no carbon pollution, but the costs of nuclear power plants and the long timeline for their construction mean that investing in nuclear power would actually set America back in the race to reduce carbon pollution in the short run. One nuclear reactor is scheduled to come online by December 2015, but no others are likely to come online before 2018 or later – with billions of dollars in investment needed to achieve that goal.[70] During the last wave of nuclear construction in the United States, the average reactor took nine years to build.[71] New reactors are likely to experience similar delays. For example, in June 2014, the Georgia Public Service Commission announced that two new nuclear reactors under construction at Plant Vogtle are now nearly two and three years behind schedule, respectively, and that the cost overrun for the project has now reached $650 million.[72] Unlike renewable energy technologies, which continue to get cheaper as they are brought to scale, nuclear power remains an expensive way to reduce carbon pollution in the short run: the up-front capital investment required to build 100 new nuclear reactors, for example, could prevent twice as much pollution over the next 20 years if invested in energy efficiency and clean, renewable energy instead.[73]

If states are to make meaningful progress in cutting global warming pollution, they must stop relying on fossil fuels and nuclear power, and put their full efforts into developing the truly clean energy sources that will power a 21st century economy: energy efficiency and renewable energy.

Methodology

In this report we examine emissions of carbon dioxide from all utility and non-utility fossil fuel-fired power plants in the United States in 2012. We derive emissions data from fuel consumption figures reported to the U.S. Department of Energy and estimates of the carbon content of each fuel source developed by the U.S. Environmental Protection Agency. Details follow.

- We obtained fuel consumption and electricity generation data for power plants operating in the United States from the U.S. Department of Energy's Energy Information Administration (EIA), *EIA-923 Monthly Generation and Fuel Consumption Time Series File, 2012 Final Release*.[74] We focused on fuel consumption for electricity generation, excluding any fuel consumption for the purposes of generating heat.
- We obtained estimates of the carbon dioxide emissions created per unit of energy output of the various fuels used in electricity generation from the U.S. Environmental Protection Agency, Center for Climate Leadership, *Emission Factors for Greenhouse Gas Inventories*, updated April 2014; and U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2012*, April 2014.
- We multiplied fuel consumption in terms of energy content by the appropriate carbon dioxide emissions factors, yielding an estimate of 2012 carbon dioxide emissions by plant.[75] Our methodology resulted in a value for 2012 carbon dioxide pollution from the power sector (2,154 MMT) very similar to that listed in the EIA's *Electric Power Annual* for 2012 (2,156 MMT). U.S. EPA's *Greenhouse Gas Emissions Inventory* gives a value of 2,064 MMT of carbon dioxide pollution from the U.S. power sector in 2012.
- We chose to estimate 2012 carbon dioxide pollution based on plant-level energy consumption data because EIA's *Form 923* database (which contains such data) includes information on a broader range of power plants than in EPA's *Air Markets Program Data* or *Greenhouse Gas Emissions from Large Facilities,* both of which provide estimates of carbon dioxide emissions for a subset of large electric power plants.

Table 3. Carbon Dioxide Emission Coefficients

Category	Fuel	Emission Coefficient (Kg CO2 / MMBtu)*
Coal	Bituminous	103.69
Coal	Lignite	97.72
Coal	Sub-Bituminous	97.17
Coal	Waste Coal[76]	95.52
Coal	Coal-Derived Synthesis Gas[77]	95.52
Coal	Anthracite	103.69
Coal	Coal-Based Synfuel[78]	92.91
Petroleum Products	Distillate Fuel Oil[79]	94.38
Petroleum Products	Jet Fuel	72.22
Petroleum Products	Kerosene	75.20
Petroleum Products	Petroleum Coke	102.41
Petroleum Products	Petroleum Coke-Derived Synthesis Gas[80]	102.41
Petroleum Products	Residual Fuel Oil[81]	78.80
Petroleum Products	Propane	62.87
Petroleum Products	Waste Oil[82]	66.5
Natural Gas and other gases	Natural Gas	53.06
Natural Gas and other gases	Blast Furnace Gas	274.32
Natural Gas and other gases	Waste Oil[83]	59.00
Other	Other Fossil-Fuel Gas[84]	66.33
Other	Purchased Steam[85]	85.97
Other	Municipal Solid Waste - Non-Biogenic Fraction	90.70

*Coefficients are from sources as described in the methodology's bullet points, except where otherwise noted in the "Fuel" column.

Appendices

Table A-1. Power Plant Carbon Dioxide Emissions as a Share of Total State-Level Emissions (MMT), 2012[86]

State	Electric Power Sector Emissions	Total Statewide Energy-Related Emissions	Percentage of Statewide Emissions Attributable to Power Plants	Total Power Sector Emissions Equivalent in Number of Passenger Vehicles[87]	Emissions Equivalent by Country and Global Ranking for Economy-Wide Energy-Related CO_2 Pollution	Population of Equivalent Country[88]
Alabama	65.3	123.1	53%	13,964,682	Morocco (52)	32,987,206
Alaska	3.1	37.8	8%	666,981	Zambia (134)	14,638,505
Arizona	50.9	91.2	56%	10,873,539	Hungary (59)	9,919,128
Arkansas	34.3	66.2	52%	7,326,091	Tunisia (75)	10,937,521
California	47.9	364.2	13%	10,249,602	Switzerland (62)	8,061,516
Colorado	38.6	90.6	43%	8,243,404	New Zealand (72)	4,401,916
Connecticut	7.2	34.7	21%	1,537,669	El Salvador (108)	6,125,512
Delaware	4.5	14.1	32%	968,798	The Bahamas (126)	321,834
District of Columbia	0.0	2.7	0%	2,354		
Florida	105.8	224.2	47%	22,623,335	Chile (39)	17,363,894
Georgia	54.8	136.9	40%	11,704,470	Finland (56)	5,268,799
Hawaii	6.9	18.8	36%	1,464,500	Uruguay (115)	3,332,972
Idaho	0.7	15.9	5%	155,921	Afghanistan (170)	31,822,848
Illinois	83.6	218.1	38%	17,863,191	Israel (45)	7,821,850
Indiana	96.2	194.1	50%	20,565,581	Philippines (40)	107,668,231
Iowa	34.0	82.0	41%	7,261,446	Tunisia (75)	10,937,521
Kansas	30.1	67.3	45%	6,436,309	Tunisia (75)	10,937,521
Kentucky	84.4	138.1	61%	18,046,141	Colombia (47)	46,245,297
Louisiana	43.0	205.5	21%	9,183,500	Cuba (67)	11,047,251
Maine	1.7	16.0	11%	370,129	Uganda (145)	35,918,915
Maryland	18.7	61.4	30%	4,001,191	Bolivia (87)	10,631,486
Massachusetts	12.0	62.8	19%	2,574,188	Luxembourg (96)	520,672
Michigan	61.8	154.0	40%	13,214,599	Morocco (52)	32,987,206
Minnesota	25.2	87.6	29%	5,388,179	Dominican Republic (79)	10,349,741
Mississippi	23.0	61.9	37%	4,905,950	Bolivia (87)	10,631,486
Missouri	71.8	128.6	56%	15,353,649	Austria (50)	8,223,062

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State	Electric Power Sector Emissions	Total Statewide Energy-Related Emissions	Percentage of Statewide Emissions Attributable to Power Plants	Total Power Sector Emissions Equivalent in Number of Passenger Vehicles[87]	Emissions Equivalent by Country and Global Ranking for Economy-Wide Energy-Related CO_2 Pollution	Population of Equivalent Country[88]
Montana	15.4	30.7	50%	3,301,143	Mongolia (90)	2,953,190
Nebraska	24.1	50.6	48%	5,159,539	Dominican Republic (79)	10,349,741
Nevada	14.6	34.6	42%	3,117,527	Kenya (92)	45,010,056
New Hampshire	4.1	14.8	28%	874,284	Namibia (130)	2,198,406
New Jersey	14.8	106.1	14%	3,158,944	Guatemala (91)	14,647,083
New Mexico	28.6	54.6	52%	6,118,397	Tunisia (75)	10,937,521
New York	32.1	163.5	20%	6,865,836	Tunisia (75)	10,937,521
North Carolina	55.7	120.6	46%	11,900,268	Finland (56)	5,268,799
North Dakota	30.6	52.7	58%	6,536,649	Tunisia (75)	10,937,521
Ohio	92.1	217.2	42%	19,679,028	Greece (42)	10,775,557
Oklahoma	46.7	105.4	44%	9,992,996	Switzerland (62)	8,061,516
Oregon	6.8	37.0	18%	1,463,306	Uruguay (115)	3,332,972
Pennsylvania	104.8	237.5	44%	22,396,602	Chile (39)	17,363,894
Rhode Island	3.3	10.6	31%	710,342	Zambia (134)	14,638,505
South Carolina	32.6	74.3	44%	6,970,400	Tunisia (75)	10,937,521
South Dakota	3.2	15.1	21%	673,441	Zambia (134)	14,638,505
Tennessee	36.3	99.9	36%	7,767,760	New Zealand (72)	4,401,916
Texas	222.1	676.9	33%	47,480,928	Egypt (26)	86,895,099
Utah	30.9	61.2	50%	6,607,978	Tunisia (75)	10,937,521
Vermont	0.0	5.6	0%	700		
Virginia	24.8	98.5	25%	5,309,327	Croatia (80)	4,470,534
Washington	6.1	71.1	9%	1,314,459	Uruguay (115)	3,332,972
West Virginia	65.9	90.7	73%	14,079,496	Morocco (52)	32,987,206
Wisconsin	36.6	90.9	40%	7,829,058	New Zealand (72)	4,401,916
Wyoming	42.9	66.2	65%	9,169,858	Cuba (67)	11,047,251

Table A-2. The Nation's 100 Most-Polluting Power Plants, Carbon Dioxide Emissions Equivalent in Passenger Vehicles and Primary Fuel Category, 2012

Rank	State	Operator Name	Plant Name	City	Emissions (MMT)	Primary Fuel Category	Emissions Equivalent in Passenger Vehicles (Millions)
1	GA	Georgia Power Co.	Scherer	Juliette	20.1	Coal	4.3
2	IN	Duke Energy Indiana Inc.	Gibson	Owensville	19.9	Coal	4.3
3	PA	FirstEnergy Generation Corp.	FirstEnergy Bruce Mansfield	Shippingport	18.3	Coal	3.9
4	IN	Indiana Michigan Power Co.	Rockport	Rockport	18.0	Coal	3.8
5	AL	Alabama Power Co.	James H. Miller Jr.	Quinton	17.7	Coal	3.8
6	OH	Ohio Power Co.	General James M. Gavin	Cheshire	17.5	Coal	3.8
7	AZ	Salt River Project	Navajo	Page	16.5	Coal	3.5
8	TX	Luminant Generation Company, LLC	Martin Lake	Tatum	16.3	Coal	3.5
9	MI	The DTE Electric Company	Monroe	Monroe	15.8	Coal	3.4
10	KY	Tennessee Valley Authority	Paradise*	Drakesboro	15.6	Coal	3.3
11	MO	Union Electric Co - (MO)	Labadie	Labadie	15.3	Coal	3.3
12	NC	Progress Energy Carolinas Inc.	Roxboro	Semora	15.1	Coal	3.2
13	TN	Tennessee Valley Authority	Cumberland	Cumberland City	15.1	Coal	3.2
14	TX	NRG Texas Power, LLC	W. A. Parish	Thompsons	14.3	Coal	3.1
15	NM	Arizona Public Service Co.	Four Corners*	Fruitland	13.8	Coal	2.9
16	KY	Kentucky Utilities Co.	Ghent	Ghent	13.7	Coal	2.9
17	WY	PacifiCorp	Jim Bridger	Point of Rocks	13.6	Coal	2.9
18	NC	Duke Energy Carolinas, LLC	Belews Creek	Belews Creek	13.3	Coal	2.8
19	SC	South Carolina Public Service Authority	Cross	Cross	13.2	Coal	2.8
20	WV	Appalachian Power Co.	John E. Amos	St Albans	13.2	Coal	2.8
21	MT	PPL Montana, LLC	Colstrip	Colstrip	12.9	Coal	2.7
22	KS	Westar Energy Inc.	Jeffrey Energy Center	St. Mary's	12.4	Coal	2.7
23	IL	Dynegy Midwest Generation Inc.	Baldwin Energy Complex	Baldwin	12.2	Coal	2.6
24	OH	Dayton Power & Light Co.	J. M. Stuart	Aberdeen	11.8	Coal	2.5
25	TX	NRG Texas Power, LLC	Limestone	Jewett	11.5	Coal	2.5
26	TX	Oak Grove Management Co., LLC	Oak Grove	Franklin	11.4	Coal	2.4
27	NM	Public Service Co. of NM	San Juan*	Waterflow	11.4	Coal	2.4
28	IA	MidAmerican Energy Co.	Walter Scott Jr Energy Center*	Council Bluffs	11.1	Coal	2.4
29	FL	Duke Energy Florida, Inc.	Crystal River*	Crystal River	11.1	Coal	2.4
30	WY	Basin Electric Power Coop	Laramie River Station	Wheatland	10.9	Coal	2.3
31	MO	Kansas City Power & Light Co.	Iatan	Weston	10.8	Coal	2.3
32	TX	Southwestern Electric Power Co.	Welsh*	Pittsburg	10.8	Coal	2.3
33	IN	Indianapolis Power & Light Co.	AES Petersburg	Petersburg	10.8	Coal	2.3
34	PA	GenOn Northeast Management Company	Conemaugh	New Florence	10.7	Coal	2.3

*Indicates that this power plant is scheduled for retirement.[89]

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Rank	State	Operator Name	Plant Name	City	Emissions (MMT)	Primary Fuel Category	Emissions Equivalent in Passenger Vehicles (Millions)
35	LA	Louisiana Generating, LLC	Big Cajun 2	New Roads	10.7	Coal	2.3
36	PA	Midwest Generations EME, LLC	Homer City Station	Homer City	10.6	Coal	2.3
37	AR	Entergy Arkansas Inc.	Independence	Newark	10.5	Coal	2.2
38	WV	Allegheny Energy Supply Co., LLC	FirstEnergy Harrison Power Station	Haywood	10.4	Coal	2.2
39	FL	Tampa Electric Co.	Big Bend	Apollo Beach	10.4	Coal	2.2
40	PA	Allegheny Energy Supply Co., LLC	Hatfields Ferry Power Station*	Masontown	10.4	Coal	2.2
41	OH	FirstEnergy Generation Corp.	FirstEnergy W. H. Sammis	Stratton	10.3	Coal	2.2
42	AZ	Tucson Electric Power Co.	Springerville	Springerville	10.0	Coal	2.1
43	UT	Los Angeles Department of Water & Power	Intermountain Power Project*	Delta	10.0	Coal	2.1
44	GA	Georgia Power Co.	Bowen	Cartersville	9.9	Coal	2.1
45	AR	Entergy Arkansas, Inc	White Bluff	Redfield	9.7	Coal	2.1
46	UT	PacifiCorp	Hunter	Castle Dale	9.6	Coal	2.1
47	NC	Duke Energy Carolinas, LLC	Marshall	Terrell	9.6	Coal	2.0
48	PA	GenOn Northeast Management Company	Keystone	Shelocta	9.5	Coal	2.0
49	ND	Great River Energy	Coal Creek	Underwood	9.5	Coal	2.0
50	KY	Louisville Gas & Electric Co.	Mill Creek	Louisville	9.2	Coal	2.0
51	NE	Omaha Public Power District	Nebraska City	Nebraska City	9.1	Coal	1.9
52	CO	Tri-State G & T Assn, Inc.	Craig	Craig	9.0	Coal	1.9
53	WV	Virginia Electric & Power Co.	Mt. Storm	Mount Storm	9.0	Coal	1.9
54	CO	Public Service Co. of Colorado	Comanche	Pueblo	9.0	Coal	1.9
55	FL	Florida Power & Light Co.	West County Energy Center	Loxahatchee	9.0	Coal	1.9
56	IL	Midwest Generations EME, LLC	Powerton	Pekin	8.9	Coal	1.9
57	TX	City of San Antonio - (TX)	J. K. Spruce	San Antonio	8.9	Coal	1.9
58	OH	Duke Energy Ohio Inc.	Miami Fort*	North Bend	8.8	Coal	1.9
59	NE	Nebraska Public Power District	Gerald Gentleman	Sutherland	8.8	Coal	1.9
60	KS	Kansas City Power & Light Co.	La Cygne	LaCygne	8.8	Coal	1.9
61	KY	East Kentucky Power Coop, Inc.	H L Spurlock	Maysville	8.7	Coal	1.9
62	TX	Lower Colorado River Authority	Fayette Power Project	La Grange	8.6	Coal	1.8
63	WV	Appalachian Power Co.	Mountaineer	New Haven	8.6	Coal	1.8
64	AL	Alabama Power Co.	Barry*	Bucks	8.6	Coal	1.8
65	MN	Northern States Power Co - Minnesota	Sherburne County	Becker	8.6	Coal	1.8

*Indicates that this power plant is scheduled for retirement.[89]

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Rank	State	Operator Name	Plant Name	City	Emissions (MMT)	Primary Fuel Category	Emissions Equivalent in Passenger Vehicles (Millions)
66	WV	Allegheny Energy Supply Co., LLC	FirstEnergy Pleasants Power Station	Willow Island	8.5	Coal	1.8
67	OK	Oklahoma Gas & Electric Co.	Muskogee	Fort Gibson	8.5	Coal	1.8
68	AL	Alabama Power, Co.	E C Gaston*	Wilsonville	8.4	Coal	1.8
69	TX	Luminant Generation Company, LLC	Monticello	Mount Pleasant	8.4	Coal	1.8
70	PA	PPL Montour, LLC	PPL Montour	Washingtonville	8.3	Coal	1.8
71	KY	Louisville Gas & Electric Co	Trimble County	Bedford	8.1	Coal	1.7
72	TX	Big Brown Power Company, LLC	Big Brown	Fairfield	8.1	Coal	1.7
73	FL	Seminole Electric Cooperative Inc.	Seminole	Palatka	8.0	Coal	1.7
74	MO	Union Electric Co - (MO)	Rush Island	Festus	7.9	Coal	1.7
75	WV	Ohio Power Co.	Mitchell	Captina	7.8	Natural Gas and other gases	1.7
76	KY	Tennessee Valley Authority	Shawnee	West Paducah	7.8	Coal	1.7
77	MI	Consumers Energy Co.	J. H. Campbell	West Olive	7.6	Coal	1.6
78	OH	Cardinal Operating Co.	Cardinal	Brillant	7.6	Coal	1.6
79	WI	Wisconsin Power & Light Co.	Columbia	Pardeville	7.6	Coal	1.6
80	MO	Associated Electric Coop, Inc.	New Madrid	New Madrid	7.5	Coal	1.6
81	MI	The DTE Electric Company	Belle River	China Twp	7.4	Coal	1.6
82	MN	Minnesota Power Inc.	Clay Boswell	Cohasset	7.4	Coal	1.6
83	TX	Southwestern Public Service Co.	Tolk	Muleshoe	7.4	Coal	1.6
84	OK	Public Service Co. of Oklahoma	Northeastern*	Oologah	7.3	Coal	1.6
85	AZ	Arizona Public Service Co.	Cholla	Joseph City	7.2	Coal	1.5
86	UT	PacifiCorp	Huntington	Huntington	7.0	Natural Gas and other gases	1.5
87	MO	Associated Electric Coop, Inc.	Thomas Hill	Clifton Hill	7.0	Coal	1.5
88	ND	Basin Electric Power Coop	Antelope Valley	Beulah	7.0	Coal	1.5
89	IN	Northern Indiana Public Service Co.	R. M. Schahfer	Wheatfield	6.8	Coal	1.5
90	IL	Electric Energy Inc.	Joppa Steam	Joppa	6.7	Coal	1.4
91	FL	JEA	St. Johns River Power Park	Jacksonville	6.6	Coal	1.4
92	TN	Tennessee Valley Authority	Gallatin	Gallatin	6.5	Coal	1.4
93	OH	Ohio Power Co.	Conesville*	Conesville	6.5	Coal	1.4
94	LA	Entergy Gulf States – LA, LLC	R. S. Nelson	Westlake	6.5	Coal	1.4
95	IN	Indiana-Kentucky Electric Corp.	Clifty Creek	Madison	6.4	Coal	1.4
96	TX	Southwestern Public Service Co.	Harrington	Amarillo	6.3	Coal	1.3
97	PA	PPL Brunner Island, LLC	PPL Brunner Island	York Haven	6.3	Coal	1.3
98	FL	Florida Power & Light Co.	Martin	Indiantown	6.2	Coal	1.3
99	OK	Oklahoma Gas & Electric Co.	Sooner	Red Rock	6.1	Coal	1.3
100	MI	The DTE Electric Company	St. Clair	East China Twp	6.0	Coal	1.3

*Indicates that this power plant is scheduled for retirement.[89]

Table A-3. Share of Each State's Electricity-Sector Carbon Dioxide Pollution Contributed by the Top 5 Most-Polluting Power Plants

State	RANK	Operator Name	Plant Name	Total Emissions of Top 5 Plants (MMT of CO_2)	Emissions for Top 5 as a Share of Power-Sector Total (2012)	Emissions for Power-Sector as a Share of Statewide Total (2012)	Share of Statewide Emissions Contributed by Top 5 (2012)	Top 5 Share of Total Electricity Generation (2012)
AK	1	Chugach Electric Assn Inc.	Beluga	2.7	72%	8%	7%	58%
	2	Anchorage Municipal Light and Power	George M Sullivan Generation Plant 2					
	3	Golden Valley Elec Assn Inc.	North Pole					
	4	Aurora Energy, LLC	Aurora Energy, LLC Chena					
	5	Golden Valley Elec Assn Inc.	Healy					
AL	1	Alabama Power Co.	James H. Miller Jr.	43.9	61%	53%	36%	36%
	2	Alabama Power Co.	Barry*					
	3	Alabama Power Co.	E C Gaston*					
	4	Tennessee Valley Authority	Widows Creek*					
	5	Southern Power Co.	H. Allen Franklin Combined Cycle					
AR	1	Entergy Arkansas Inc.	Independence	32.0	91%	52%	48%	58%
	2	Entergy Arkansas Inc.	White Bluff					
	3	Plum Point Energy Associates, LLC	Plum Point Energy Station					
	4	Southwestern Electric Power Co.	Flint Creek					
	5	Union Power Partners, LP	Union Power Partners, LP					
AZ	1	Salt River Project	Navajo	41.9	78%	56%	46%	40%
	2	Tucson Electric Power Co.	Springerville					
	3	Arizona Public Service Co.	Cholla					
	4	Salt River Project	Coronado					
	5	Mesquite Power, LLC	Mesquite Generating Station Block 2					
CA	1	Southern California Edison Co.	Mountainview Generating Station	10.8	21%	13%	3%	14%
	2	Delta Energy Center, LLC	Delta Energy Center					
	3	La Paloma Generating Co., LLC	La Paloma Generating, LLC					
	4	Dynegy -Moss Landing, LLC	Dynegy Moss Landing Power Plant					
	5	High Desert Power Project, LLC	High Desert Power Plant					
CO	1	Tri-State G & T Assn, Inc.	Craig	27.4	68%	43%	30%	51%
	2	Public Service Co. of Colorado	Comanche					
	3	Public Service Co. of Colorado	Cherokee*					
	4	Public Service Co. of Colorado	Pawnee					
	5	Public Service Co. of Colorado	Hayden					

*Indicates that this power plant is scheduled for retirement.[90]

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State	RANK	Operator Name	Plant Name	Total Emissions of Top 5 Plants (MMT of CO_2)	Emissions for Top 5 as a Share of Power-Sector Total (2012)	Emissions for Power-Sector as a Share of Statewide Total (2012)	Share of Statewide Emissions Contributed by Top 5 (2012)	Top 5 Share of Total Electricity Generation (2012)
CT	1	Lake Road Generating Co., LP	Lake Road Generating Plant	5.9	68%	21%	17%	42%
	2	Kleen Energy Systems, LLC	Kleen Energy Systems Project					
	3	Milford Power Co., LLC	Milford Power Project					
	4	Bridgeport Energy, LLC	Bridgeport Energy Project					
	5	Wheelabrator Environmental Systems	Wheelabrator Bridgeport					
DC	1	US GSA Heating and Transmission	US GSA Heating and Transmission	0.1	100%	0%	3%	100%
	2	Potomac Power Resources	Buzzard Point					
	3	Potomac Power Resources	Benning					
DE	1	Calpine Mid-Atlantic Generation, LLC	Hay Road	5.1	99%	32%	37%	98%
	2	Indian River Operations Inc.	Indian River Generating Station*					
	3	Calpine Mid-Atlantic Generation, LLC	Edge Moor*					
	4	Delaware City Refining Company, LLC	Delaware City Plant					
	5	NRG Energy Center Dover, LLC	NRG Energy Center Dover					
FL	1	Duke Energy Florida, Inc.	Crystal River*	45.0	40%	47%	20%	26%
	2	Tampa Electric Co.	Big Bend					
	3	Florida Power & Light Co.	West County Energy Center					
	4	Seminole Electric Cooperative Inc.	Seminole					
	5	JEA	St. Johns River Power Park					
GA	1	Georgia Power Co.	Scherer	42.3	72%	40%	31%	44%
	2	Georgia Power Co.	Bowen					
	3	Georgia Power Co.	Wansley					
	4	Georgia Power Co.	Jack McDonough*					
	5	Georgia Power Co.	McIntosh Combined Cycle Facility					
HI	1	Hawaiian Electric Co. Inc.	Kahe	6.0	81%	36%	32%	73%
	2	AES Hawaii Inc.	AES Hawaii					
	3	Hawaiian Electric Co. Inc.	Waiau					
	4	Maui Electric Co. Ltd	Maalaea					
	5	Kalaeloa Partners LP	Kalaeloa Cogen Plant					
IA	1	MidAmerican Energy Co.	Walter Scott Jr Energy Center*	28.1	76%	41%	34%	50%
	2	MidAmerican Energy Co.	Louisa					
	3	MidAmerican Energy Co.	George Neal South					
	4	MidAmerican Energy Co.	George Neal North*					
	5	Interstate Power and Light Co.	Ottumwa					

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*Indicates that this power plant is scheduled for retirement.[90]

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State	RANK	Operator Name	Plant Name	Total Emissions of Top 5 Plants (MMT of CO_2)	Emissions for Top 5 as a Share of Power-Sector Total (2012)	Emissions for Power-Sector as a Share of Statewide Total (2012)	Share of Statewide Emissions Contributed by Top 5 (2012)	Top 5 Share of Total Electricity Generation (2012)
ID	1	Rathdrum Operating Services Co., Inc.	Rathdrum Power LLC	0.7	91%	5%	4%	12%
	2	Idaho Power Co.	Langley Gulch Power Plant					
	3	Idaho Power Co.	Evander Andrews Power Complex					
	4	Idaho Power Co.	Bennett Mountain					
	5	Energy Operations Group	Rupert Cogen Project					
IL	1	Dynegy Midwest Generation Inc.	Baldwin Energy Complex	39.0	43%	38%	18%	19%
	2	Midwest Generations EME, LLC	Powerton					
	3	Electric Energy Inc.	Joppa Steam					
	4	Ameren Energy Generating Co.	Newton					
	5	Ameren Energy Generating Co.	Coffeen					
IN	1	Duke Energy Indiana Inc.	Gibson	61.8	56%	50%	32%	51%
	2	Indiana Michigan Power Co.	Rockport					
	3	Indianapolis Power & Light Co.	AES Petersburg					
	4	Northern Indiana Pub Service Co.	R. M. Schahfer					
	5	Indiana-Kentucky Electric Corp.	Clifty Creek					
KS	1	Westar Energy Inc.	Jeffrey Energy Center	27.6	87%	45%	41%	59%
	2	Kansas City Power & Light Co.	La Cygne					
	3	Westar Energy Inc.	Lawrence Energy Center					
	4	Sunflower Electric Power Corp.	Holcomb					
	5	Westar Energy Inc.	Tecumseh Energy Center					
KY	1	Tennessee Valley Authority	Paradise*	55.2	58%	61%	40%	57%
	2	Kentucky Utilities Co.	Ghent					
	3	Louisville Gas & Electric Co.	Mill Creek					
	4	East Kentucky Power Coop, Inc.	H L Spurlock					
	5	Louisville Gas & Electric Co.	Trimble County					
LA	1	Louisiana Generating, LLC	Big Cajun 2	30.2	56%	21%	15%	30%
	2	Entergy Gulf States – LA, LLC	R. S. Nelson					
	3	Cleco Power, LLC	Brame Energy Center					
	4	Cleco Power, LLC	Dolet Hills					
	5	Entergy Louisiana Inc.	Nine Mile Point					
MA	1	Constellation Mystic Power, LLC	Mystic Generating Station	8.6	62%	19%	14%	52%
	2	Brayton Point Energy, LLC	Brayton Point*					
	3	Constellation Mystic Power, LLC	Fore River Generating Station					
	4	ANP Blackstone Energy Company, LLC	ANP Blackstone Energy Project					
	5	Millennium Power Partners LP	Millennium Power					

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*Indicates that this power plant is scheduled for retirement.[90]

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State	RANK	Operator Name	Plant Name	Total Emissions of Top 5 Plants (MMT of CO_2)	Emissions for Top 5 as a Share of Power-Sector Total (2012)	Emissions for Power-Sector as a Share of Statewide Total (2012)	Share of Statewide Emissions Contributed by Top 5 (2012)	Top 5 Share of Total Electricity Generation (2012)
MD	1	Raven Power Holdings, LLC	Brandon Shores	17.4	80%	30%	28%	46%
	2	GenOn Mid-Atlantic, LLC	Morgantown Generating Plant					
	3	NRG Chalk Point, LLC	Chalk Point, LLC*					
	4	AES WR Ltd Partnership	AES Warrior Run Cogeneration Facility					
	5	Raven Power Holdings, LLC	Herbert A Wagner					
ME	1	Westbrook Energy Center	Westbrook Energy Center Power Plant	2.4	80%	11%	15%	45%
	2	Verso Bucksport, LLC	Verso Paper					
	3	Casco Bay Energy Co., LLC	Maine Independence Station					
	4	Rumford Power	Rumford Power, Inc.					
	5	Verso Paper Androscoggin, LLC	Androscoggin Energy Center					
MI	1	The DTE Electric Company	Monroe	40.4	62%	40%	26%	37%
	2	Consumers Energy Co.	J. H. Campbell					
	3	The DTE Electric Company	Belle River					
	4	The DTE Electric Company	St. Clair					
	5	The DTE Electric Company	Trenton Channel*					
MN	1	Northern States Power Co. - Minnesota	Sherburne County	21.4	79%	29%	24%	40%
	2	Minnesota Power Inc.	Clay Boswell					
	3	Northern States Power Co - Minnesota	Allen S. King					
	4	Northern States Power Co - Minnesota	Black Dog*					
	5	Minnesota Power Inc.	Taconite Harbor Energy Center*					
MO	1	Union Electric Co - (MO)	Labadie	48.5	64%	56%	38%	55%
	2	Kansas City Power & Light Co.	Iatan					
	3	Union Electric Co - (MO)	Rush Island					
	4	Associated Electric Coop, Inc.	New Madrid					
	5	Associated Electric Coop, Inc.	Thomas Hill					
MS	1	Mississippi Power Co.	Victor J. Daniel Jr.	13.5	55%	37%	22%	40%
	2	Choctaw Generating LP	Red Hills Generating Facility					
	3	Mississippi Power Co.	Jack Watson*					
	4	Tennessee Valley Authority	Magnolia Power Plant					
	5	Entergy Mississippi Inc.	Baxter Wilson					
MT	1	PPL Montana, LLC	Colstrip	15.1	96%	50%	49%	51%
	2	PPL Montana, LLC	J. E. Corette Plant					
	3	Rocky Mountain Power Inc.	Hardin Generator Project					
	4	Yellowstone Energy LP	Yellowstone Energy LP					
	5	Colstrip Energy LP	Colstrip Energy LP					

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State	RANK	Operator Name	Plant Name	Total Emissions of Top 5 Plants (MMT of CO_2)	Emissions for Top 5 as a Share of Power-Sector Total (2012)	Emissions for Power-Sector as a Share of Statewide Total (2012)	Share of Statewide Emissions Contributed by Top 5 (2012)	Top 5 Share of Total Electricity Generation (2012)
NC	1	Progress Energy Carolinas Inc.	Roxboro	45.9	75%	46%	38%	43%
	2	Duke Energy Carolinas, LLC	Belews Creek					
	3	Duke Energy Carolinas, LLC	Marshall					
	4	Progress Energy Carolinas Inc.	Mayo					
	5	Progress Energy Carolinas Inc.	Sherwood H Smith Jr Energy Complex					
ND	1	Great River Energy	Coal Creek	28.5	93%	58%	54%	73%
	2	Basin Electric Power Coop	Antelope Valley					
	3	Minnkota Power Coop, Inc.	Milton R Young					
	4	Basin Electric Power Coop	Leland Olds					
	5	Otter Tail Power Co.	Coyote					
NE	1	Omaha Public Power District	Nebraska City	23.7	92%	48%	47%	70%
	2	Nebraska Public Power District	Gerald Gentleman					
	3	Omaha Public Power District	North Omaha*					
	4	City of Hastings - (NE)	Whelan Energy Center					
	5	Nebraska Public Power District	Sheldon					
NH	1	Granite Ridge Energy, LLC	Granite Ridge	4.3	97%	28%	29%	45%
	2	Public Service Co of NH	Merrimack					
	3	EP Newington Energy, LLC	EP Newington Energy, LLC					
	4	Public Service Co of NH	Schiller					
	5	Wheelabrator Environmental Systems	Wheelabrator Concord Facility					
NJ	1	PSEG Fossil, LLC	Bergen Generating Station*	8.8	58%	14%	8%	34%
	2	PSEG Fossil, LLC	PSEG Linden Generating Station					
	3	Red Oak Power, LLC	Red Oak Power, LLC					
	4	Cogen Technologies Linden Vent	Linden Cogen Plant					
	5	North Jersey Energy Assoc LP	Sayreville Cogeneration Facility					
NM	1	Arizona Public Service Co.	Four Corners*	28.3	93%	52%	52%	82%
	2	Public Service Co. of NM	San Juan*					
	3	Tri-State G & T Assn, Inc	Escalante					
	4	CAMS NM LLC	Hobbs Generating Station					
	5	Public Service Co. of NM	Luna Energy Facility					
NV	1	Nevada Power Co.	Chuck Lenzie Generating Station	8.7	59%	42%	25%	47%
	2	Sierra Pacific Power Co.	North Valmy*					
	3	Nevada Power Co.	Reid Gardner*					
	4	Sierra Pacific Power Co.	Tracy*					
	5	Nevada Power Co.	Harry Allen					

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State	RANK	Operator Name	Plant Name	Total Emissions of Top 5 Plants (MMT of CO_2)	Emissions for Top 5 as a Share of Power-Sector Total (2012)	Emissions for Power-Sector as a Share of Statewide Total (2012)	Share of Statewide Emissions Contributed by Top 5 (2012)	Top 5 Share of Total Electricity Generation (2012)
NY	1	TC Ravenswood, LLC	Ravenswood	10.6	32%	20%	6%	15%
	2	Somerset Operating Co., LLC	Somerset Operating Co., LLC					
	3	New Athens Generating Company, LLC	Athens Generating Plant					
	4	Sithe/Independence, LLC	Sithe Independence Station					
	5	National Grid Generation, LLC	Northport					
OH	1	Ohio Power Co.	General James M. Gavin	56.1	54%	42%	26%	41%
	2	Dayton Power & Light Co.	J. M. Stuart					
	3	FirstEnergy Generation Corp	FirstEnergy W. H. Sammis					
	4	Duke Energy Ohio Inc.	Miami Fort*					
	5	Cardinal Operating Co.	Cardinal					
OK	1	Oklahoma Gas & Electric Co.	Muskogee	30.1	62%	44%	29%	39%
	2	Public Service Co. of Oklahoma	Northeastern*					
	3	Oklahoma Gas & Electric Co.	Sooner					
	4	Grand River Dam Authority	GRDA					
	5	Western Farmers Elec Coop, Inc.	Hugo					
OR	1	Portland General Electric Co.	Boardman*	6.1	85%	18%	16%	19%
	2	Hermiston Power Partnership	Hermiston Power Partnership					
	3	Hermiston Generating Co., LP	Hermiston Generating Plant					
	4	Pacific Klamath Energy Inc.	Klamath Cogeneration Plant					
	5	Portland General Electric Co.	Port Westward					
PA	1	FirstEnergy Generation Corp	FirstEnergy Bruce Mansfield	59.5	51%	44%	25%	26%
	2	GenOn Northeast Management Company	Conemaugh					
	3	Midwest Generations EME, LLC	Homer City Station					
	4	Allegheny Energy Supply Co., LLC	Hatfields Ferry Power Station*					
	5	GenOn Northeast Management Company	Keystone					
RI	1	Dominion Energy New England, LLC	Manchester Street	3.3	99%	31%	31%	98%
	2	Entergy RISE	Entergy Rhode Island State Energy LP					
	3	Tiverton Power, LLC	Tiverton Power Plant					
	4	Ocean State Power Co.	Ocean State Power					
	5	Ocean State Power II	Ocean State Power II					

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State	RANK	Operator Name	Plant Name	Total Emissions of Top 5 Plants (MMT of CO_2)	Emissions for Top 5 as a Share of Power-Sector Total (2012)	Emissions for Power-Sector as a Share of Statewide Total (2012)	Share of Statewide Emissions Contributed by Top 5 (2012)	Top 5 Share of Total Electricity Generation (2012)
SC	1	South Carolina Public Service Authority	Cross	26.0	71%	44%	35%	29%
	2	South Carolina Electric & Gas Co.	Wateree					
	3	South Carolina Genertg Co., Inc.	Williams					
	4	South Carolina Public Service Authority	Winyah					
	5	South Carolina Public Service Authority	John S Rainey					
SD	1	Otter Tail Power Co.	Big Stone	3.3	100%	21%	22%	26%
	2	Black Hills Power Inc.	Ben French*					
	3	Northern States Power Co - Minnesota	Angus Anson					
	4	Basin Electric Power Coop	Groton Generating Station					
	5	Basin Electric Power Coop	Deer Creek Station					
TN	1	Tennessee Valley Authority	Cumberland	34.0	84%	36%	34%	41%
	2	Tennessee Valley Authority	Gallatin					
	3	Tennessee Valley Authority	Kingston					
	4	Tennessee Valley Authority	Allen Steam Plant					
	5	Tennessee Valley Authority	Johnsonville*					
TX	1	Luminant Generation Company, LLC	Martin Lake	64.3	27%	33%	10%	14%
	2	NRG Texas Power, LLC	W. A. Parish					
	3	NRG Texas Power, LLC	Limestone					
	4	Oak Grove Management Co., LLC	Oak Grove					
	5	Southwestern Electric Power Co.,	Welsh*					
UT	1	Los Angeles Department of Water & Power	Intermountain Power Project*	31.4	89%	50%	51%	76%
	2	PacifiCorp	Hunter					
	3	PacifiCorp	Huntington					
	4	Deseret Generation & Tran Coop	Bonanza					
	5	PacifiCorp	Carbon*					
VA	1	Virginia Electric & Power Co.	Chesterfield	14.7	55%	25%	15%	31%
	2	Virginia Electric & Power Co.	Clover					
	3	Tenaska Virginia Partners LP	Tenaska Virginia Generating Station					
	4	Virginia Electric & Power Co.	Possum Point					
	5	Virginia Electric & Power Co.	Chesapeake*					

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*Indicates that this power plant is scheduled for retirement.[90]

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State	RANK	Operator Name	Plant Name	Total Emissions of Top 5 Plants (MMT of CO_2)	Emissions for Top 5 as a Share of Power-Sector Total (2012)	Emissions for Power-Sector as a Share of Statewide Total (2012)	Share of Statewide Emissions Contributed by Top 5 (2012)	Top 5 Share of Total Electricity Generation (2012)
VT	1	Middlebury College Biomass[91]	Middlebury College	0.0	96%	0.1%	0%	3.5%
	2	City of Burlington Electric - (VT)	J. C. McNeil					
	3	Green Mountain Power Corp.	Berlin 5					
	4	Green Mountain Power Corp.	Ascutney					
	5	Green Mountain Power Corp.	Rutland					
WA	1	TransAlta Centralia Gen, LLC	Transalta Centralia Generation*	5.4	84%	9%	8%	7%
	2	Puget Sound Energy Inc.	Mint Farm Generating Station					
	3	March Point Cogeneration Co.	March Point Cogeneration					
	4	PacifiCorp	Chehalis Generating Facility					
	5	Puget Sound Energy, Inc.	Goldendale Generating Station					
WI	1	Wisconsin Power & Light Co.	Columbia	25.7	66%	40%	28%	40%
	2	Wisconsin Electric Power Co.	Pleasant Prairie					
	3	Wisconsin Public Service Corp.	Weston*					
	4	Wisconsin Electric Power Co.	South Oak Creek					
	5	Wisconsin Power & Light Co.	Edgewater*					
WV	1	Appalachian Power Co.	John E. Amos	49.6	68%	73%	55%	65%
	2	Allegheny Energy Supply Co LLC	FirstEnergy Harrison Power Station					
	3	Virginia Electric & Power Co.	Mt. Storm					
	4	Appalachian Power Co.	Mountaineer					
	5	Allegheny Energy Supply Co., LLC	FirstEnergy Pleasants Power Station					
WY	1	PacifiCorp	Jim Bridger	38.4	85%	65%	58%	76%
	2	Basin Electric Power Coop	Laramie River Station					
	3	PacifiCorp	Dave Johnston					
	4	PacifiCorp	Naughton					
	5	Basin Electric Power Coop	Dry Fork Station					

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12. U.S. Energy Information Administration reports that there are about 6,403 power plants with unique plant identification numbers that report fuel consumption data monthly or annually on EIA Form 923. This figure includes some wind and solar power plants, as well as combined heat-and-power facilities. See U.S. Energy Information Administration, *Form EIA-923 detailed data*, final data for 2012 released 12 November 2013, available at www.eia.gov/electricity/data.

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30. See note 24.

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34. See note 2.

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63. Anthony Lopez et al., National Renewable Energy Laboratory, *U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis*, July 2012. Note: "Technical potential" for rooftop solar PV systems does not consider economic factors or policies to drive solar market development; it is merely an accounting of how much rooftop space can support solar PV systems, accounting for factors such as shading, building orientation, roof structural soundness and obstructions such as chimneys and fan systems.

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65. According to U.S. Environmental Protection Agency's emissions scenario for 2030, achieving Clean Power Plan targets will result in emission reductions of 555 MMT of CO_2 annually. See note 64. For Canada's emissions in 2012, see note 19.

66. In 2012, U.S. passenger vehicles emitted about 1,112 MMT CO_2. For the calculation, we used emissions from motor gasoline consumed in the transportation sector – adjusted for the percentage of motor gasoline used by light-duty passenger vehicles – as a proxy for emissions from passenger vehicles in the United States. Calculated by multiplying consumption of motor gasoline in 2012 (per U.S. Energy Information Administration, *State Energy Data System (SEDS), Table F3: Motor Gasoline Consumption, Price, and Expenditure Estimates, 2012*, accessed at www.eia.gov/state/seds on 8 August 2014) by an emissions factor of 8.887×10^{-3} metric tons CO_2/gallon of gasoline (per U.S. Environmental Protection Agency, *Calculations and References,* accessed at www.epa.gov/cleanenergy/energy-resources on 5 August 2014). We then multiplied this figure by 95 percent, which is the percentage of transportation-sector motor gasoline consumed by light-duty passenger vehicles (per U.S. Energy Information Administration, *Annual Energy Outlook 2013, Light-Duty Vehicle Energy Consumption by Technology Type and Fuel Type, Reference case,* April 2013).

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71. Travis Madsen and Tony Dutzik, Frontier Group; and Bernadette Del Chiaro and Rob Sargent, Environment America Research & Policy Center, *Generating Failure: How Building Nuclear Power Plants Would Set America Back in the Race Against Global Warming*, November 2009.

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73. See note 71.

74. See note 12.

75. Note: This methodology also captures fossil fuels burned at biomass plants. As a result, some biomass power plants are listed in the data in addition to coal, natural gas and oil-fired power plants.

76. This fuel category includes anthracite culm, bituminous gob, fine coal, lignite waste and waste coal. We used the value for Coal, Mixed Electrical Power Sector from U.S. Environmental Protection Agency, Center for Climate Leadership, Emission Factor*s for Greenhouse Gas Inventories*, April 2014.

77. Ibid.

78. Natural Resources Defense Council, Benchmarking *Air Emissions of the 100 Largest Electric Power Producers in the United States*, May 2014.

79. Includes diesel as well as No. 1, No. 2, and No. 4 fuel oils.

80. The value for petroleum coke was used.

81. U.S. Energy Information administration, Carbon Dioxid*e Emissions Coefficients by Fuel,* accessed at www.eia.gov/environment/emissions on 11 August 2014.

82. The value for waste oil blended with residual fuel oil was used, per U.S. Environmental Protection Agency, Office of Air and Radiation, Office of Air Quality Planning and Standards, Compilation of Air Pollutant Emiss*ions Factors, Volume 1: Stationary Point and Area Sources*, January 1995, 1.11-1 – 1.11-9.

83. The value for fuel gas was used, per U.S. Environmental Protection Agency, Center for Climate Leadership, Emission Factor*s for Greenhouse Gas Inventories*, April 2014.

84. We used the value for purchased steam and hot water, per U.S. Environmental Protection Agency, Center for Climate Leadership, Emission Factor*s for Greenhouse Gas Inventories*, April 2014.

85. We used the value for tires, per U.S. Environmental Protection Agency, Center for Climate Leadership, Emission Factor*s for Greenhouse Gas Inventories*, April 2014.

86. See note 14, "CO_2 emissions by economic sector."

87. Calculated using U.S. Environmental Protection Agency, Greenhouse Gas Equivalencies Calculator, accessed at www.epa.gov/cleanenergy/energy-resources on 8 August 2014.

88. See note 23.

89. Coal plant retirement list (spreadsheet) obtained from Jeff Deyette, Senior Energy Analyst at Union of Concerned Scientists, personal communication, 25 August 2014. See also U.S. Energy Information Administration, *Electric Power Monthly, Table 6.6 Planned U.S. Electric Generating Unit Retirements,* data for May 2014, released 23 July 2014.

90. Ibid.

91. This biomass plant is listed because it burns some residual fuel oil. See note 12.