



# America's Dirtiest Power Plants

**Polluters on a Global Scale**

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Written by:

Jordan Schneider, Frontier Group

Julian Boggs, Environment America Research & Policy Center

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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<sub>2</sub>) Pollution**

|   | Total 2012 Emissions (Million Metric Tons of CO <sub>2</sub> ) | Percent of Total U.S. CO <sub>2</sub> Emissions | Percent of Global CO <sub>2</sub> Emissions from Energy Use | Emissions Equivalent by Country and Global Ranking for Energy-related CO <sub>2</sub> 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 (32 <sup>nd</sup> )   |
| Top 50 Polluting Power Plants                 | 637  | 12%   | 1.8%  | South Korea (7 <sup>th</sup> )  |
| Top 100 Polluting Power Plants                | 1,023  | 19%   | 3.0%  | Germany (6 <sup>th</sup> )  |
| Top 500 Polluting Power Plants                | 1,918  | 36%   | 5.6%  | Russia (4 <sup>th</sup> )   |
| All Power Plants                              | 2,154  | 40%   | 6.3%  | India (3 <sup>rd</sup> )  |

**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.

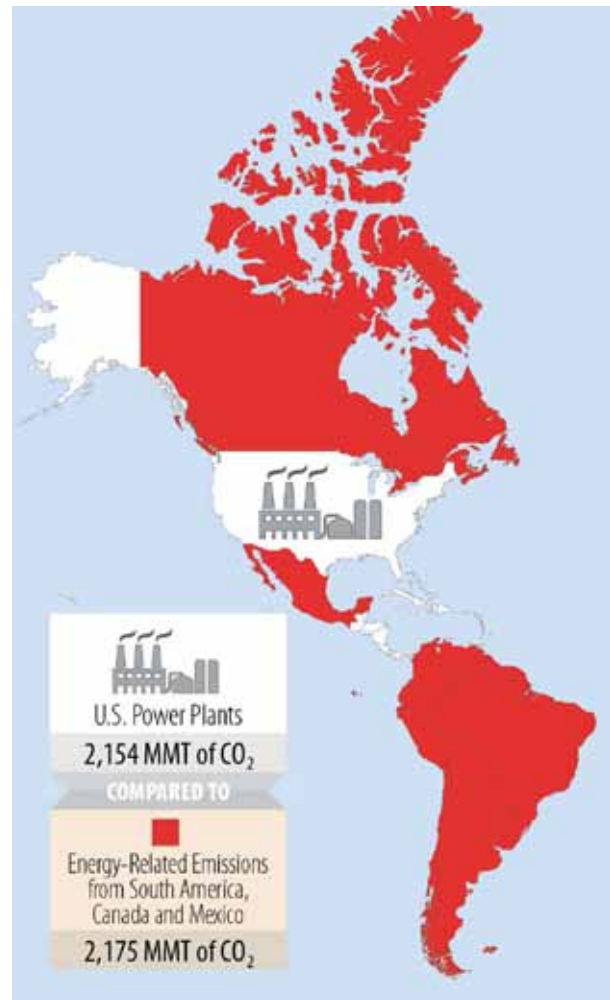
**U.S. power plants are among the most significant sources of global warming pollution in the world.**

- 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.**

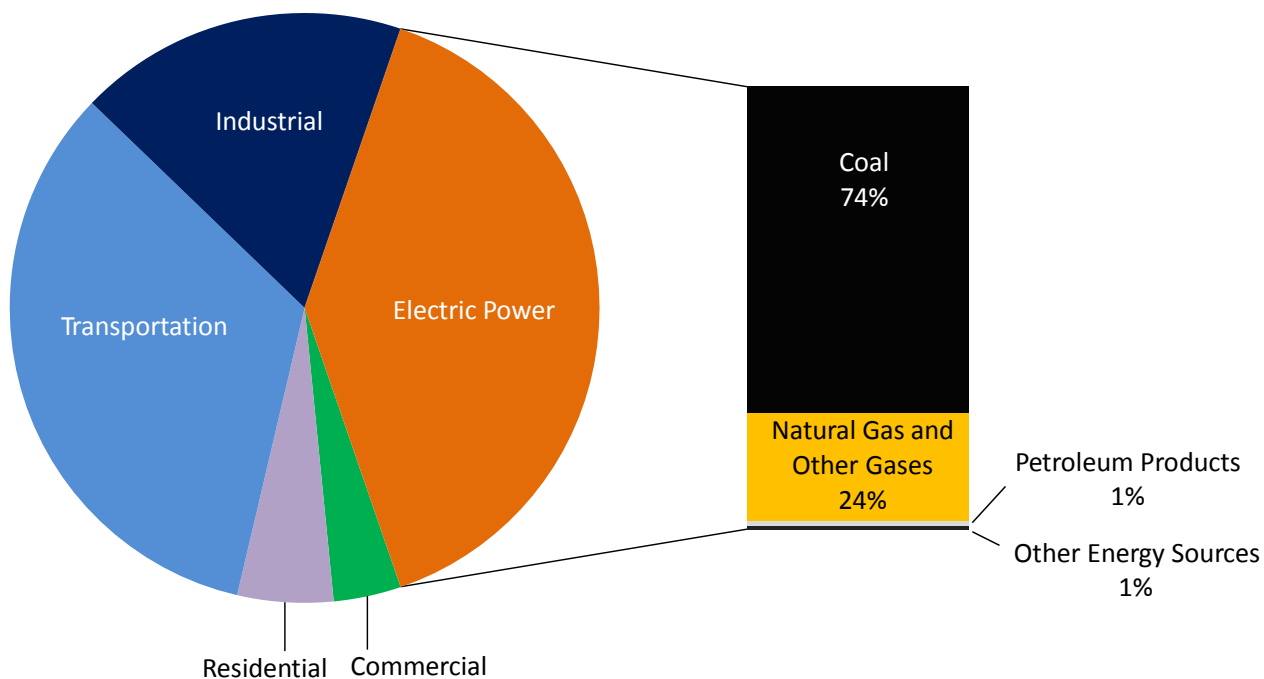
- In 2012, power plants produced about 40 percent of all U.S. emissions of carbon dioxide, the leading pollutant driving global warming. (See Table ES-1.)
- The 50 dirtiest U.S. power plants produced 30 percent of all power-sector carbon dioxide emissions in 2012 while producing only 15 percent of the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

**Figure ES-1. In 2012, U.S. Power Plants Produced Nearly as Much CO<sub>2</sub> 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<sub>2</sub> 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)**

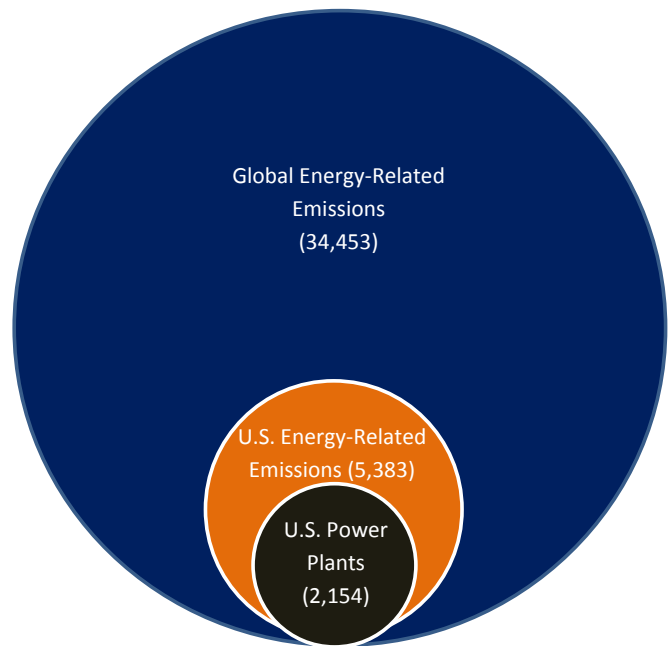


Figure is drawn to scale.

- 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

**G**lobal 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.<sup>1</sup> At the same time, extreme coastal storms – exacerbated by rising seas – have killed thousands of people and destroyed billions of dollars in coastal infrastructure.<sup>2</sup> 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.

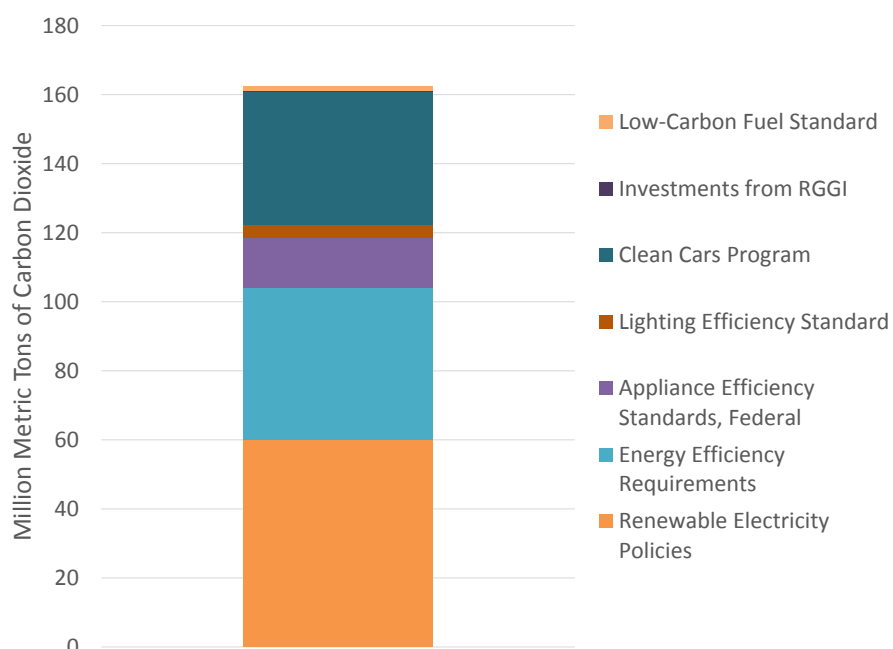
Achieving the emissions reductions necessary for the world to avoid the worst impacts of global warming will require a strong international commitment from both developed nations and emerging economies to make steep reductions in climate-altering pollution. To that end, the international community will 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 dioxide 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.<sup>3</sup>

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<sup>7</sup>**



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.<sup>4</sup>

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.<sup>5</sup> (See Figure 1.) That’s equal to annual emissions from 42 typical coal-fired power plants, according to the U.S. Environmental Protection Agency.<sup>6</sup>

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.<sup>8</sup>

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.<sup>9</sup> 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.<sup>10</sup> Burning fossil fuels for electricity generation produced 40 percent of total U.S. carbon dioxide emissions in 2012.<sup>11</sup> 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.<sup>12</sup> 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 per-

cent of power-sector emissions, but only 37 percent of electricity generation.<sup>13</sup> (See Figures 2 and 3, page 11.)

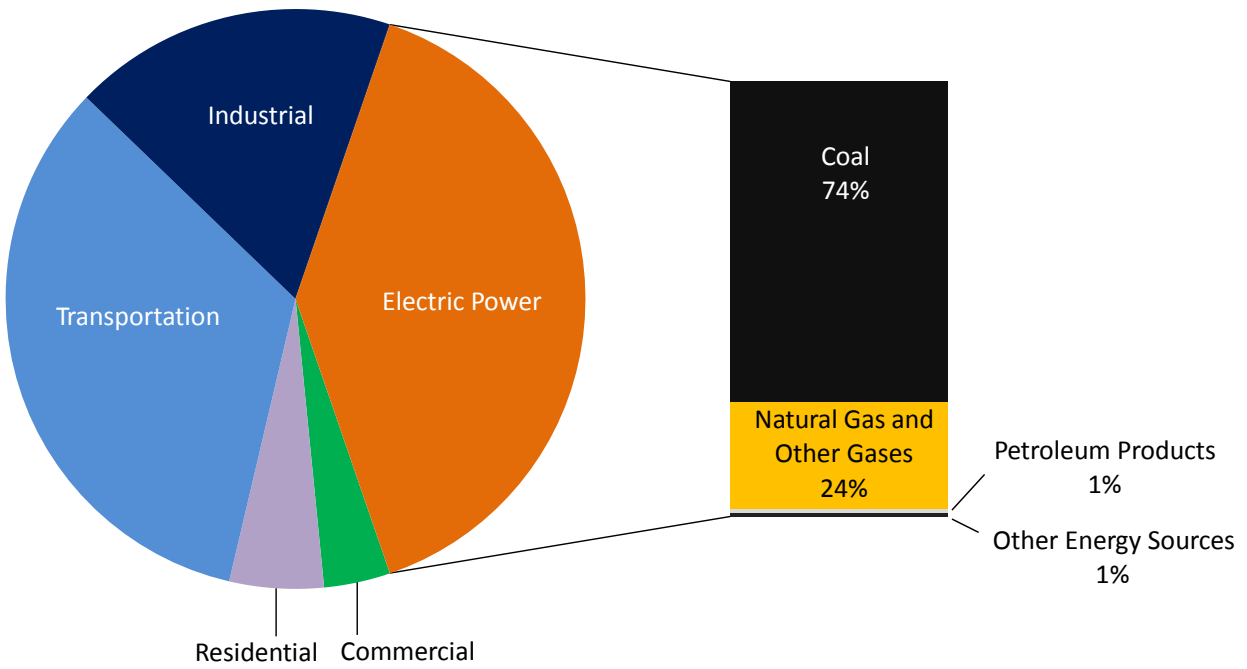
## The Dirtiest Power Plants Are Old and Inefficient Coal Plants

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.<sup>15</sup> 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).<sup>16</sup> 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.<sup>17</sup>

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<sub>2</sub> Emissions Produced by Power Plants and U.S Power-Sector Emissions by Fuel Type, 2012<sup>14</sup>**



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

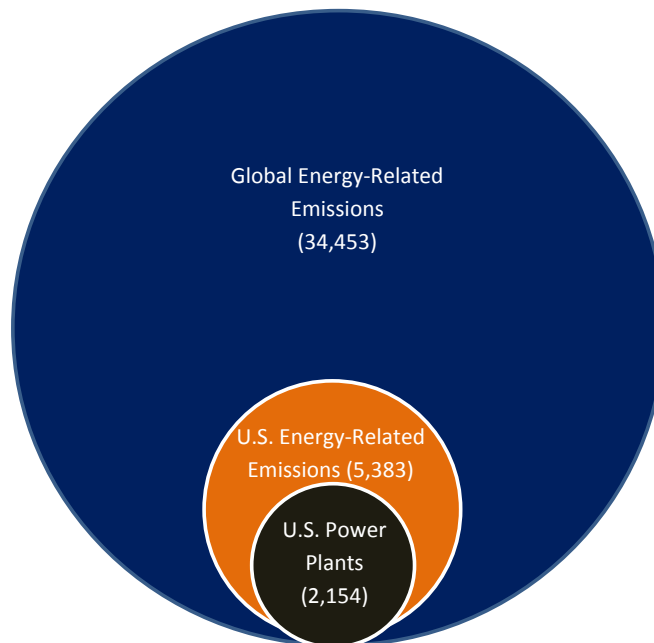


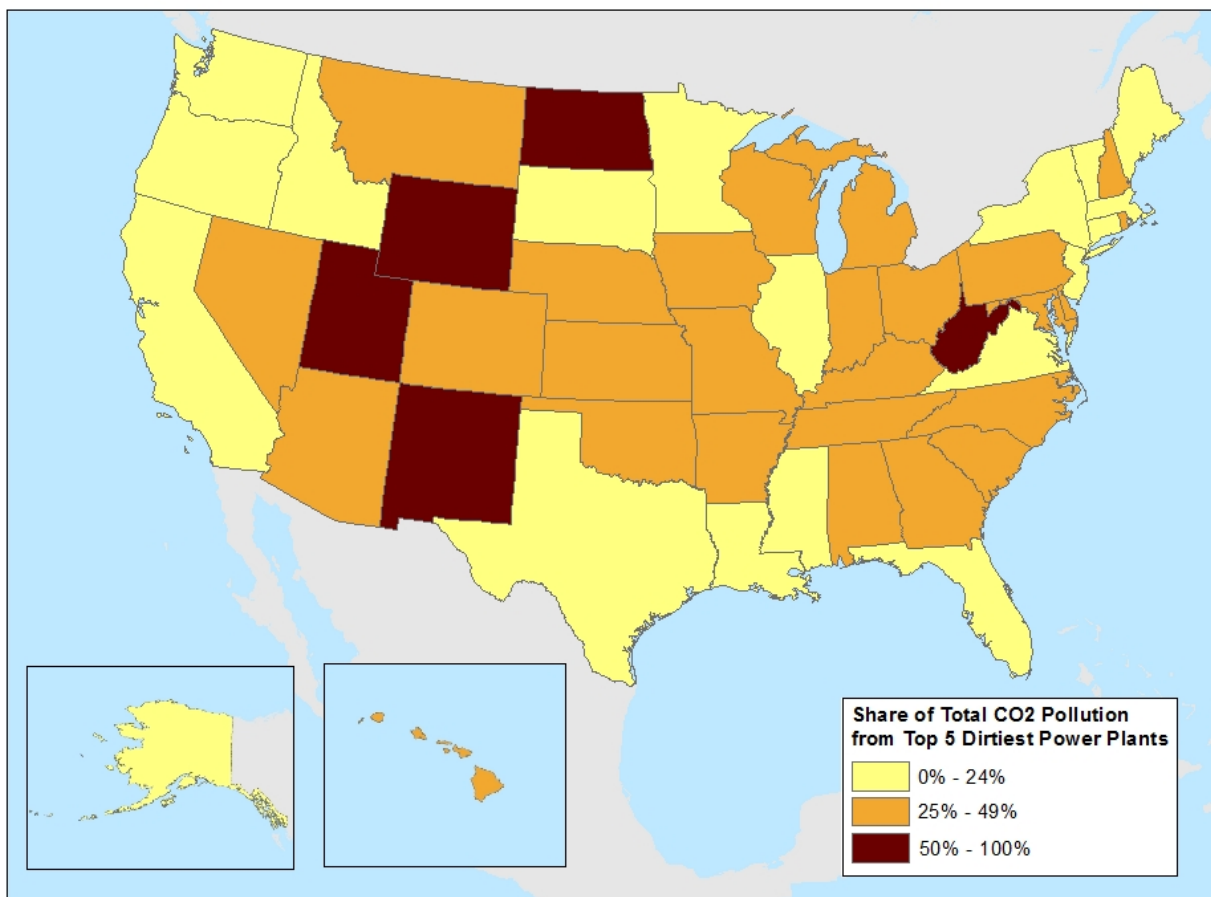
Figure is drawn to scale.

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.<sup>18</sup>

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<sub>2</sub> Emissions**



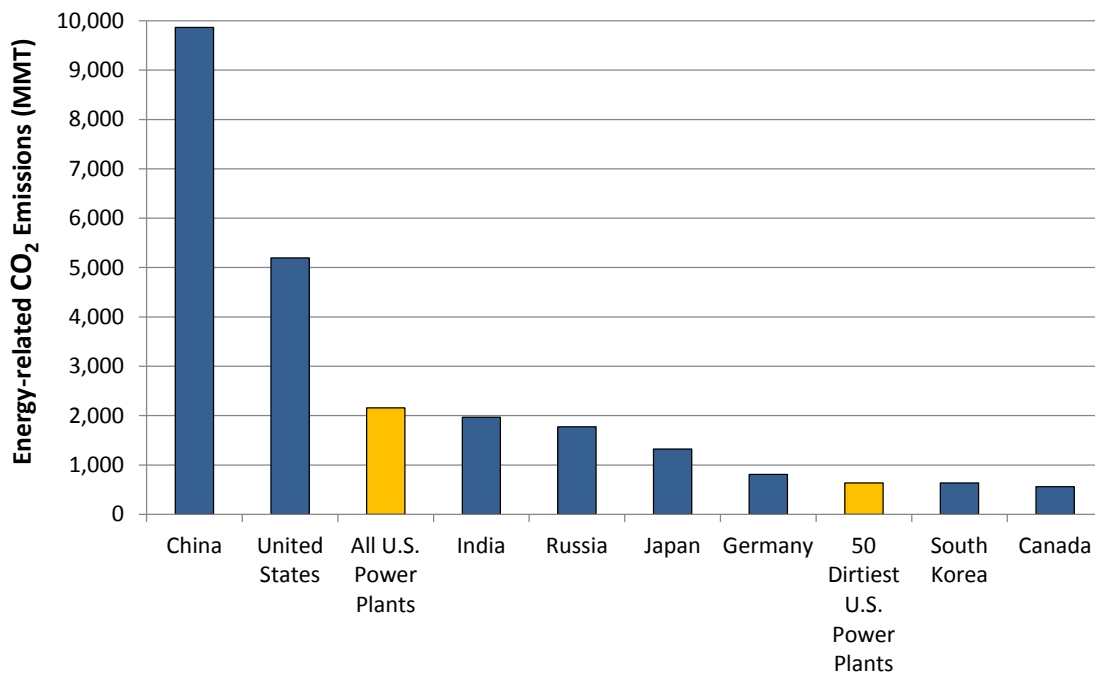
## Pollution from U.S. Power Plants Is Significant on a Global Scale

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.<sup>19</sup> (See Figure 5.) These emissions were roughly equiva-

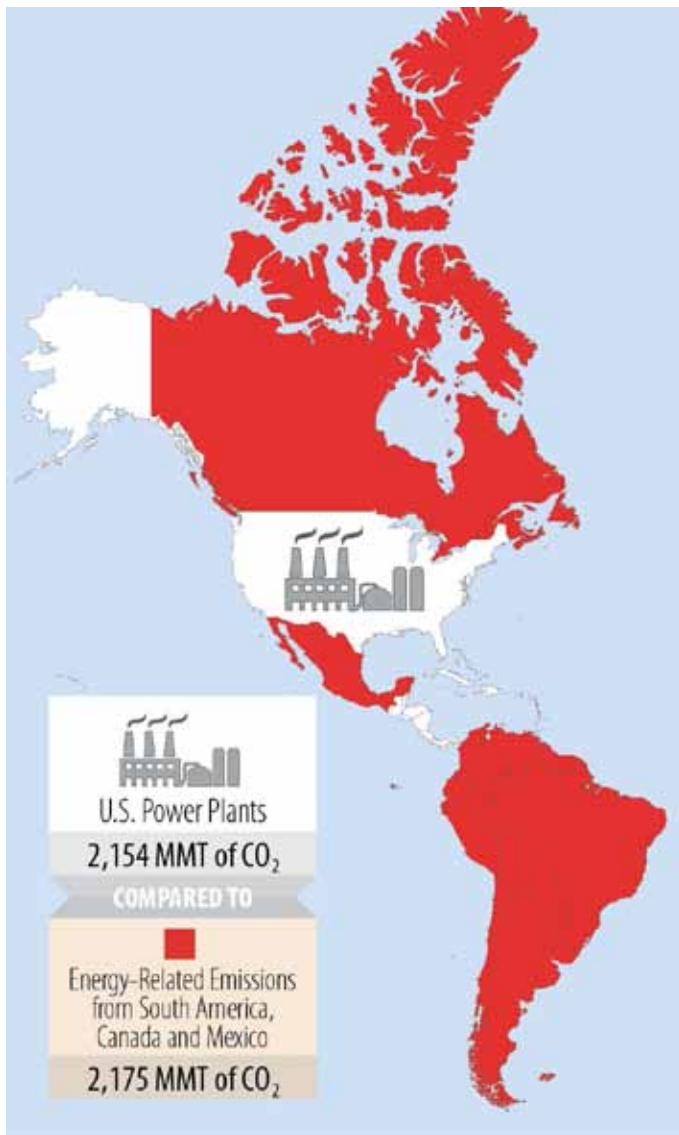
lent to the combined energy-related emissions of all of South America, Canada and Mexico (2,175 MMT).<sup>20</sup> (See Figure 6.)

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<sub>2</sub> 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.<sup>21</sup>
- 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 8<sup>th</sup> and 10<sup>th</sup> world-wide for CO<sub>2</sub> emissions, respectively).<sup>22</sup>
- 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<sub>2</sub> emissions of Sri Lanka, a country of nearly 22 million people.<sup>23</sup> (For more comparisons, see Table 1.)

**Table 1. The Dirtiest U.S. Power Plants Produce Globally Significant Amounts of Carbon Dioxide (CO<sub>2</sub>) Pollution**

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

**Table 2. CO<sub>2</sub> Emissions of the Top 10 Most-Polluting Power Plants (MMT), 2012**

| 2014<br>Rank | Operator Name                       | Plant Name                       | City         | State | 2012 Emissions<br>(MMT CO <sub>2</sub> ) | Emissions<br>Equivalent in<br>Passenger Vehicles<br>(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<br>Corp.     | FirstEnergy Bruce Mans-<br>field | Shippingport | PA    | 18.3                                     | 3.9  |
| 4            | Indiana Michigan Power<br>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<br>Company, LLC | Martin Lake                      | Tatum        | TX    | 16.3                                     | 3.5  |
| 9            | The DTE Electric<br>Company         | Monroe                           | Monroe       | MI    | 15.8                                     | 3.4  |
| 10           | Tennessee Valley<br>Authority       | Paradise                         | Drakesboro   | KY    | 15.6                                     | 3.3  |



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

**G**lobal 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.<sup>24</sup> 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.<sup>25</sup> 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.<sup>26</sup> 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.<sup>27</sup> 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.<sup>28</sup> 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.<sup>29</sup> 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.<sup>30</sup> 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.<sup>31</sup>

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.<sup>32</sup> The last three decades have been warmer than any period since at least 1850.<sup>33</sup> In the continental United States, 2012 was the hottest year on record.<sup>34</sup>

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

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.<sup>41</sup> 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.<sup>42</sup> 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.<sup>43</sup> 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.<sup>44</sup> 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.<sup>45</sup> By 2300, global mean sea levels could rise as high as 13 feet above present-day levels.<sup>46</sup>

- 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.<sup>47</sup>
- 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.<sup>48</sup>
- Increasing aridity, drought and extreme temperatures could occur in Africa, southern Europe, the Middle East and most of the Americas, Australia, and Southeast Asia.<sup>49</sup> 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.<sup>50</sup>
- 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.<sup>51</sup> 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.”<sup>52</sup>

- 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;”<sup>53</sup> premature deaths caused by heat stress;<sup>54</sup> an increase in outbreaks of waterborne illnesses;<sup>55</sup> and the displacement of coastal communities by disasters such as strong storms and floods, fueled by rising seas.<sup>56</sup>
- 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.<sup>57</sup>

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 policy-makers 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.<sup>58</sup> 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.<sup>59</sup> As of mid-2013, the United States is adding one solar PV system every four minutes.<sup>60</sup> Globally, solar energy capacity has reached nearly 139 GW.<sup>61</sup> 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.<sup>62</sup>

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.<sup>63</sup> 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<sub>2</sub> 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.<sup>64</sup>

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.**<sup>65</sup> 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.<sup>66</sup>

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 lead-

ership 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.<sup>67</sup> 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.<sup>68</sup> 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.<sup>69</sup> 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.<sup>70</sup> During the last wave of nuclear construction in the United States, the average reactor took nine years to build.<sup>71</sup> 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.<sup>72</sup> 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.<sup>73</sup>

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 21<sup>st</sup> 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*.<sup>74</sup> 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.<sup>75</sup> 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<br>(Kg CO <sub>2</sub> / MMBtu)* |
|-----------------------------|--|---|
| Coal                        | Bituminous   | 103.69  |
| Coal                        | Lignite  | 97.72   |
| Coal                        | Sub-Bituminous                                     | 97.17   |
| Coal                        | Waste Coal <sup>76</sup>                           | 95.52   |
| Coal                        | Coal-Derived Synthesis Gas <sup>77</sup>           | 95.52   |
| Coal                        | Anthracite   | 103.69  |
| Coal                        | Coal-Based Synfuel <sup>78</sup>                   | 92.91   |
| Petroleum Products          | Distillate Fuel Oil <sup>79</sup>                  | 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 <sup>80</sup> | 102.41  |
| Petroleum Products          | Residual Fuel Oil <sup>81</sup>                    | 78.80   |
| Petroleum Products          | Propane  | 62.87   |
| Petroleum Products          | Waste Oil <sup>82</sup>                            | 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 <sup>83</sup>                            | 59.00   |
| Other                       | Other Fossil-Fuel Gas <sup>84</sup>                | 66.33   |
| Other                       | Purchased Steam <sup>85</sup>                      | 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<sup>86</sup>**

| 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 <sup>87</sup> | Emissions Equivalent by Country and Global Ranking for Economy-Wide Energy-Related CO <sub>2</sub> Pollution | Population of Equivalent Country <sup>88</sup> |
|----------------------|---------------------------------|--|--|---|--|--|
| 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 <sup>87</sup> | Emissions Equivalent by Country and Global Ranking for Economy-Wide Energy-Related CO <sub>2</sub> Pollution | Population of Equivalent Country <sup>88</sup> |
|----------------|---------------------------------|--|--|---|--|--|
| 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.<sup>89</sup>

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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.<sup>89</sup>

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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                            | Brilliant       | 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.<sup>89</sup>

**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 <sub>2</sub> ) | 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.<sup>90</sup>

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| State | RANK | Operator Name                        | Plant Name                       | Total Emissions of Top 5 Plants (MMT of CO <sub>2</sub> ) | 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.<sup>90</sup>

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| State | RANK | Operator Name                         | Plant Name                    | Total Emissions of Top 5 Plants (MMT of CO <sub>2</sub> ) | 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.<sup>90</sup>



| State | RANK | Operator Name                         | Plant Name                            | Total Emissions of Top 5 Plants (MMT of CO <sub>2</sub> ) | 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                    |   |   |   |  |  |

\*Indicates that this power plant is scheduled for retirement.<sup>90</sup>

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| State | RANK | Operator Name                      | Plant Name                         | Total Emissions of Top 5 Plants (MMT of CO <sub>2</sub> ) | 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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\*Indicates that this power plant is scheduled for retirement.<sup>90</sup>

| State | RANK | Operator Name                      | Plant Name                           | Total Emissions of Top 5 Plants (MMT of CO <sub>2</sub> ) | 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                 |   |   |   |  |  |

\*Indicates that this power plant is scheduled for retirement.<sup>90</sup>

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| State | RANK | Operator Name                           | Plant Name                          | Total Emissions of Top 5 Plants (MMT of CO <sub>2</sub> ) | 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.<sup>90</sup>

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| State | RANK | Operator Name                            | Plant Name                          | Total Emissions of Top 5 Plants (MMT of CO <sub>2</sub> ) | 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 <sup>91</sup> | 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                    |   |   |   |  |  |

\*Indicates that this power plant is scheduled for retirement.<sup>90</sup>

# Notes

1. Intergovernmental Panel on Climate Change, *Climate Change 2013: The Physical Science Basis, Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, 2013.

2. Jerry M. Melillo, Terese (T.C.) Richmond, and Gary W. Yohe, Eds., *Climate Change Impacts in the United States: The Third National Climate Assessment*, U.S. Global Change Research Program, 2014.

3. Kevin Baumert et al., World Resources Institute, *Navigating the Numbers: Greenhouse Gas Data and International Climate Policy*, 2005, and U.S. Environmental Protection Agency, *Global Greenhouse Gas Emissions Data*, accessed at [www.epa.gov/climatechange/ghgemissions/global.html](http://www.epa.gov/climatechange/ghgemissions/global.html), 14 October 2013. Note: throughout this report, we refer to “carbon pollution” as the leading contributor to global warming. While carbon is the chief pollutant that fuels global warming, other gases, including most notably methane, are also important contributors.

4. Executive Office of the President, The White House, *The President’s Climate Action Plan*, June 2013.

5. Miles Unterreiner and Elizabeth Ridlington, Frontier Group, and Rob Sargent, Travis Madsen and Julian Boggs, Environment America Research and Policy Center, *Moving America Forward: State and Federal Leadership Is Producing Results in the Fight against Global Warming*, 2014.

6. Calculated using U.S. Environmental Protection Agency’s *Greenhouse Gas Equivalencies Calculator*, accessed at [www.epa.gov/cleanenergy](http://www.epa.gov/cleanenergy) on 27 August 2014.

7. See note 5.

8. According to the Natural Resources Defense Council, “The Clean Car Standards set in 2010 and 2012 are projected to reduce CO<sub>2</sub> emissions by 4,140 million metric tons from

2020 to 2030. This proposal [the Clean Power Plan] would deliver 5,344 million metric tons over the same period – almost 30 percent more.” See *NRDC Summary of EPA’s Clean Power Plan, Carbon Pollution Standards for Existing Power Plants*, 2 June 2014, accessed at [www.nrdc.org/air/pollution-standards](http://www.nrdc.org/air/pollution-standards) on 3 September 2014. See also Starlah Yeh, Natural Resources Defense Council, *EPA’s Clean Power Plan Delivers Greater Emission Reductions than Vehicle Standards*, 9 June 2014, accessed at [www.switchboard.nrdc.org/blogs](http://www.switchboard.nrdc.org/blogs) on 3 September 2014.

9. Jordan Schneider and Travis Madsen, Frontier Group, and Julian Boggs, Environment America Research & Policy Center, *America’s Dirtiest Power Plants: Their Oversized Contribution to Global Warming and What We Can Do About It*, September 2013.

10. Leading pollutant: Intergovernmental Panel on Climate Change, *Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007*; National Research Council, *Advancing the Science of Climate Change*, 2010. Power plants are the largest source of carbon dioxide in the U.S.: See U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011*, 12 April 2013. Note: throughout this report, we refer to “carbon pollution” as the leading contributor to global warming. While carbon is the chief pollutant that fuels global warming, other gases, including most notably methane, are also important contributors.

11. 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/eia923/](http://www.eia.gov/electricity/data/eia923/) and *Electric Power Annual, Table 9.5. Emissions from energy consumption at conventional power plants and combined-heat-and-power plants, by state*, released 12 December 2013. See methodology.

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](http://www.eia.gov/electricity/data).

13. Ibid.; U.S. Energy Information Administration, *Electric Power Annual*, 12 December 2013. See methodology. Note: To the extent that natural gas has replaced coal as a preferred fuel for power providers since 2011, the contribution of coal plants to U.S. carbon dioxide pollution may be reduced.

14. CO<sub>2</sub> emissions by economic sector: U.S. Environmental Protection Agency, State and Local Climate and Energy Program, *State CO<sub>2</sub> Emissions from Fossil Fuel Combustion, 1990-2012* (PDF), accessed at [www.epa.gov/statelocalclimate/resources](http://www.epa.gov/statelocalclimate/resources) on 27 August 2014; power-sector CO<sub>2</sub> emissions by fuel type: see note 12. Note that the share of total emissions from the electric power sector according to the Environmental Protection Agency and shown in this chart (37 percent) is slightly lower than the share according to calculations made using data from the U.S. Energy Information Administration (40 percent). We used EIA data for most of the calculations and figures in this report.

15. Union of Concerned Scientists, *Ripe for Retirement: The Case for Closing America's Costliest Coal Plants*, November 2012.

16. U.S. Energy Information Administration, *How Old Are U.S. Power Plants?*, updated 5 March 2013, available at [www.eia.gov/energy\\_in\\_brief](http://www.eia.gov/energy_in_brief).

17. U.S. Energy Information Administration, *Electric Power Monthly, Table 6.7.A. Capacity Factors for Utility Scale Generators Primarily Using Fossil Fuels, January 2008-June 2014*, released 25 August 2014, available at [www.eia.gov/electricity/monthly](http://www.eia.gov/electricity/monthly).

18. U.S. Energy Information Administration, *Form 860 detailed data, Generator Report*, final 2012 data, released 10 October 2013.

19. European Commission, Joint Research Centre, *Emission Database for Global Atmospheric Research (EDGAR)*, release version 4.2, accessed at [www.edgar.jrc.ec.europa.eu](http://www.edgar.jrc.ec.europa.eu) on 11 August 2014.

20. Ibid.

21. Ibid.

22. Ibid.

23. U.S. Central Intelligence Agency, *The World Factbook, Country Comparisons: Population*, accessed at [www.cia.gov/library/publications](http://www.cia.gov/library/publications) on 3 September 2014.

24. See note 2, and Intergovernmental Panel on Climate Change, *Climate Change 2013: The Physical Science Basis, Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, 2013.

25. Ibid.

26. Nathaniel Gronenwold, "IPCC Chief Raps G-8, Calls for Global Greenhouse Gas Emissions Cuts After 2015," *New York Times*, 21 July 2009.

27. Intergovernmental Panel on Climate Change, *Climate Change 2014: Mitigation of Climate Change, Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, 2014.

28. H. Damon Matthews et al., "National Contributions to Observed Global Warming," *Environmental Research Letters* 9: 1-9, 15 January 2014.

29. See note 14, "CO<sub>2</sub> emissions by economic sector."

30. See note 24.

31. See note 24.

32. See note 2.

33. See note 1.

34. See note 2.
35. See note 1.
36. See note 2.
37. See note 1.
38. National Oceanic and Atmospheric Administration, National Climatic Data Center, *Global Climate Change Indicators, Warming Climate*, accessed at [www.ncdc.noaa.gov/indicators](http://www.ncdc.noaa.gov/indicators) on 8 August 2014.
39. See note 1.
40. Judy Keen, "Midwest Drought Belt: A Changed World Emerges," *USA Today*, 20 September 2012.
41. Susan Solomon et al., U.S. National Oceanic and Atmospheric Administration, "Irreversible Climate Change Due to Carbon Emissions," *Proceedings of the National Academy of Sciences* 106: 1704-1709, 10 February 2009.
42. See note 27.
43. Martin Vermeer and Stefan Rahmstorf, "Global Sea Level Linked to Global Temperature," *Proceedings of the National Academy of Sciences*, 106(51): 21527-21532, doi: 10.1073/pnas.0907765106, 2009.
44. Stephane Hallegatte et al., "Future Flood Losses in Major Coastal Cities," *Nature Climate Change* 3:802-806, 2013; The World Bank, "Which Coastal Cities Are at Highest Risk of Damaging Floods? New Study Crunches the Numbers," *News*, 19 August 2013.
45. Aslak Grinsted, John C. Moore and Svetlana Jevrejeva, "Projected Atlantic Hurricane Surge Threat from Rising Temperatures," *Proceedings of the National Academy of Sciences*, 110(14):1, doi: 10.1073/pnas.1305960110, 2 April 2013.
46. The World Bank, *Turn Down the Heat: Why a 4° C Warmer World Must Be Avoided*, A Report for the World Bank by the Potsdam Institute for Climate Impact Research and Climate Analytics, November 2012.
47. Ibid.
48. Ibid.
49. Ibid.
50. Melody Kramer, "Why Big, Intense Wildfires Are the New Normal," *National Geographic*, 28 August 2013.
51. Center for Naval Analysis Military Advisory Board, *National Security and the Accelerating Risks of Climate Change*, May 2014.
52. As cited in "Climate Change and National Security," as delivered on the Senate Floor by Sheldon Whitehouse, U.S. Senator for Rhode Island on 8 April 2014, accessed at [www.whitehouse.senate.gov/news/speeches](http://www.whitehouse.senate.gov/news/speeches) on 3 September 2014.
53. See note 2.
54. Thomas R. Karl, Jerry M. Melillo and Thomas C. Peterson (eds.), U.S. Global Change Research Program, *Global Climate Change Impacts in the United States*, 2009.
55. Natural Resources Defense Council, *Rising Tide of Illness: How Global Warming Could Increase the Threat of Waterborne Diseases*, July 2010.
56. Natural Resources Defense Council, *Climate and Your Health: Addressing the Most Serious Health Effects of Climate Change*, downloaded from [www.nrdc.org/health](http://www.nrdc.org/health) on 26 August 2013.
57. Extinction: Intergovernmental Panel on Climate Change, *Fourth Assessment Report, Climate Change 2007: Synthesis Report*, 2007; Brian Walsh, "The New Age of Extinction," *Time*, 1 April 2009. Drought: E.J. Burke, S.J. Brown and N. Christidis, "Modeling the Recent Evolution of Global Drought and Projections for the Twenty-First Century with the Hadley Centre Climate Model," *Journal of Hydrometeorology* 7: 1113-1125, 2006; Susan Solomon et al., U.S. National Oceanic and Atmospheric Administration, "Irreversible Climate Change Due to Carbon Emissions," *Proceedings of the National Academy of Sciences* 106: 1704-1709, 10 February 2009. Wildfires: Donald McKenzie et al., "Climatic Change, Wildfire, and Conservation," *Conservation Biology* 18(4):890-902, August 2004. Hurricanes: Researchers at Florida State University calculate that for every 1° C increase in sea-surface temperatures,



the frequency of severe hurricanes (category 4 and 5) increases by nearly one-third. James Elsner et al., "The Increasing Intensity of the Strongest Tropical Cyclones," *Nature* 455: 92-95, 4 September 2008. Heat waves: Andreas Sterl et al., "When Can We Expect Extremely High Surface Temperatures?" *Geophysical Research Letters* 35, L14703, doi: 10.1029/2008GL034071, 19 July 2008. Amazon: Rachel Warren, "Impacts of Global Climate Change at Different Annual Mean Global Temperature Increases," in Hans Joachim Schnellhuber, ed., *Avoiding Dangerous Climate Change*, Cambridge University Press, 2006; HM Treasury, *Stern Review: The Economics of Climate Change*, 2006, 57.

58. Four-fold: U.S. Energy Information Administration, *Electricity Data Browser: Net Generation for Electric Power*, accessed at [www.eia.gov/electricity/data](http://www.eia.gov/electricity/data), 28 February 2014; 62 million metric tons: Miles Unterreiner and Elizabeth Ridlington, Frontier Group, and Rob Sargent, Travis Madsen and Julian Boggs, Environment America Research & Policy Center, *Moving America Forward: State and Federal Leadership Is Producing Results in the Fight against Global Warming*, 2014.

59. Ryan Wisser, Lawrence Berkeley National Laboratory, *2013 Wind Technologies Market Report*, produced for the U.S. Department of Energy, August 2014. See also: U.S. Department of Energy, *Wind Farm Growth through the Years*, [www.energy.gov/maps/wind-farms-through-years](http://www.energy.gov/maps/wind-farms-through-years) on 24 August 2013.

60. Stephen Lacey, "A Solar System Is Installed in the US Every 4 Minutes," *GreenTech Media*, 19 August 2013, accessed at [www.greentechmedia.com](http://www.greentechmedia.com) on 3 September 2014.

61. European Photovoltaic Industry Association, *Global Market Outlook for Photovoltaics, 2014-2018*, 2014.

62. John Vidal, "UK and Germany Break Solar Power Records," *The Guardian*, 23 June 2014.

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.

64. U.S. Federal Register, *Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units A Proposed Rule by the Environmental Protection Agency*, 18 June 2014.

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<sub>2</sub> 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<sub>2</sub>. 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](http://www.eia.gov/state/seds) on 8 August 2014) by an emissions factor of  $8.887 \times 10^{-3}$  metric tons CO<sub>2</sub>/gallon of gasoline (per U.S. Environmental Protection Agency, *Calculations and References*, accessed at [www.epa.gov/cleanenergy/energy-resources](http://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).

67. See note 64; U.S. Energy Information Administration, *Net Generation by State by Type of Producer by Energy Source (EIA-906, EIA-920, and EIA-923), 1990-2012*, 12 November 2013.

68. Stefan Schwietzke et al., "Natural Gas Fugitive Emissions Rates Constrained by Global Atmospheric Methane and Ethane" *Environmental Science and Technology*, 48(14), 2014.

69. Ramon A. Alvarez et al., "Greater Focus Needed on Methane Leakage from Natural Gas Infrastructure," *Proceedings of the National Academy of Sciences*, 109 (12), 24 April 2012; Ibid.

70. Tennessee Valley Authority, *Watts Bar Unity 2*, accessed at [www.tva.com/power](http://www.tva.com/power) on 28 August 2014; World Nuclear Association, *Nuclear Power in the USA*, updated August 2014, accessed at [www.world-nuclear.org/info](http://www.world-nuclear.org/info) on 3 September 2014.

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.

72. Sonal Patel, "Delays and More Costs for Plant Vogtle Nuclear Expansion," *Power*, 24 June 2014.

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 Factors 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 Dioxide Emissions Coefficients by Fuel*, accessed at [www.eia.gov/environment/emissions](http://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 Emissions 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 Factors 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 Factors for Greenhouse Gas Inventories*, April 2014.

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

86. See note 14, "CO<sub>2</sub> emissions by economic sector."

87. Calculated using U.S. Environmental Protection Agency, Greenhouse Gas Equivalencies Calculator, accessed at [www.epa.gov/cleanenergy/energy-resources](http://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.