

# Introduction

## About NACAA

The National Association of Clean Air Agencies (NACAA) is a national, nonpartisan, nonprofit association of air pollution control agencies in 41 states, the District of Columbia, four territories, and 116 metropolitan areas. NACAA seeks to encourage the exchange of information, to enhance communication and cooperation among federal, state, and local regulatory agencies, and to promote good management of our air resources. NACAA has prepared this *Menu of Options* to assist state and local air pollution control officials in developing strategies for reducing greenhouse gas (GHG) emissions, particularly carbon dioxide (CO<sub>2</sub>) emissions, from the power sector in order to comply with the US Environmental Protection Agency's (EPA) Clean Power Plan (CPP).

## The Clean Power Plan

On June 25, 2013, President Obama announced his Climate Action Plan, a multipronged approach to address global warming by reducing US GHG emissions, adapting to the effects of global warming, and participating in international efforts to address global warming.<sup>1</sup> The Climate Action Plan reflects a commitment to reduce GHG emissions to 30 percent below 2005 levels by 2030. Central to achieving that target is an Administration proposal to reduce CO<sub>2</sub> emissions from new and existing power plants, the President directed the EPA to undertake in a Presidential

Memorandum released alongside the Action Plan.<sup>2</sup>

On June 2, 2014, the EPA proposed CO<sub>2</sub> emissions limits for existing power plants using its authority under Section 111(d) of the Clean Air Act (CAA). The agency expects to issue a final rule during the summer of 2015. States will be expected to develop implementation plans consistent with the federal rule as early as June 2016. On the same date, the EPA also proposed standards of performance for CO<sub>2</sub> emissions from affected *modified and reconstructed* electric utility steam generating units and natural gas-fired stationary combustion turbines. Consistent with the requirements of CAA Section 111, the proposed standards are intended to reflect the degree of emissions limitation achievable through the application of the best system of emissions reduction (BSER) that the EPA has determined has been adequately demonstrated for each type of unit, taking into account the cost of achieving such reduction and any non-air-quality health and environmental impacts and energy requirements.<sup>3</sup>

The EPA maintains that the CPP as proposed would continue progress already underway to reduce CO<sub>2</sub> emissions from the electric power sector in the United States, including promoting greater reliance on renewable energy sources, modernizing the US electric grid, increasing investments in technologies that reduce the GHG impacts of fossil fuels, and conducting a periodic strategic energy policy planning process.<sup>4</sup>

1 The President's Climate Action Plan is available at: <https://www.whitehouse.gov/sites/default/files/image/president27climateactionplan.pdf>. Additional information about President Obama's climate change actions is available at: <https://www.whitehouse.gov/climate-change>.

2 The President's Memorandum to the EPA, *Presidential Memorandum – Power Sector Carbon Pollution Standards*, is available at: <https://www.whitehouse.gov/the-press-office/2013/06/25/presidential-memorandum-power-sector-carbon-pollution-standards>.

3 US Environmental Protection Agency. (2014, June 18). 40

*CFR Part 60. Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Proposed Rule*. Federal Register Vol. 79, No. 117, p 34834. Available at: <http://www.gpo.gov/fdsys/pkg/FR-2014-06-18/pdf/2014-13726.pdf>

4 The Obama Administration has also proposed a \$1 billion climate resilience fund to mitigate the effects of climate change through research and community adaptation projects. In addition, the EPA has already adopted several regulations to reduce GHG emissions, including regulations to limit GHG emissions from motor vehicles, mandatory GHG reporting requirements, and GHG permitting regulations.

## The Challenge

In 2009, the EPA Administrator issued an Endangerment Finding under CAA Section 202(a)(1).<sup>5</sup> In the Endangerment Finding, which focused on public health and public welfare impacts within the United States, the Administrator found that elevated concentrations of GHGs in the atmosphere could reasonably be anticipated to endanger public health and welfare.

The EPA determined that climate change caused by human emissions of GHGs threatens public health in multiple ways. It can be expected to raise average temperatures, increasing the likelihood of heat waves, which are associated with increased deaths and illnesses. The EPA also found that climate change can be expected to increase ozone pollution over broad areas of the United States, including in the largest metropolitan areas with the worst ozone problems, and thereby increase the risk for morbidity and mortality. In addition, the EPA concluded that, because of projected increases in the intensity or frequency of extreme weather associated with climate change, public health will be threatened from the effects of increased hurricane intensity, increased frequency of intense storms, and heavy precipitation.

## The Power Sector

Fossil fuel-fired electric generating units (EGUs) are the nation's largest emitters of GHGs, primarily in the form of CO<sub>2</sub>, from stationary sources in the United States. Among fossil fuel-fired units, coal-fired units are by far the largest emitters. The EPA prepares the official *US Inventory of Greenhouse Gas Emissions and Sinks* to comply with commitments under the United Nations Framework Convention on Climate Change.<sup>6</sup> The inventory is organized by industrial sectors and contains information on total US anthropogenic GHG emissions, including CO<sub>2</sub> emissions, for the years 1990, 2005, and 2012. Total fossil

energy-related CO<sub>2</sub> emissions (including both stationary and mobile sources) are the largest contributor to total US GHG emissions, representing 77.7 percent of total 2012 GHG emissions. In 2012, fossil fuel combustion by the electric power sector (entities that burn fossil fuel and whose primary business is the generation of electricity) accounted for 38.7 percent of all energy-related CO<sub>2</sub> emissions.

Electricity in the United States is produced by an assortment of generation types – from power plants that use fossil fuels like coal, oil, and natural gas, to non-fossil sources, such as nuclear, solar, wind, and hydroelectric power. In 2013, more than 67 percent of electric power in the United States was generated from the combustion of coal (40 percent), natural gas (26 percent), and other fossil fuels (1 percent).<sup>7</sup> More recently, the amount of renewable generation being used has increased significantly. For example, approximately 38 percent of new generating capacity built in 2013 (more than 5 GW out of 13.5 GW) relied on renewable generation technologies.<sup>8</sup>

## Reducing Power Sector CO<sub>2</sub> Emissions

To determine the BSER for reducing CO<sub>2</sub> emissions at affected EGUs, the EPA considered numerous measures that are either already being implemented or could be implemented more broadly to improve emissions rates and to reduce overall CO<sub>2</sub> emissions from fossil fuel-fired EGUs. The EPA defined BSER based on a range of measures that fall into four main categories, or “building blocks”:<sup>9</sup>

1. Reducing the carbon intensity of generation at individual affected EGUs through heat rate improvements;
2. Reducing emissions from the most carbon-intensive affected EGUs in the amount that results from substituting generation at those EGUs with generation from less carbon-intensive affected EGUs (including

5 Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act. 74 FR 66496. (2009, December 15). (Endangerment Finding).

6 US Environmental Protection Agency. (2014, April 15). *Inventory of US Greenhouse Gas Emissions and Sinks: 1990 – 2012*. Report EPA 430-R-14-003. Available at: <http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Main-Text.pdf>

7 US Energy Information Administration. (2014, April 25). *Table 7.2b Electricity Net Generation: Electric Power Sector*. Data from April 2014 Monthly Energy Review. Available

at: <http://www.eia.gov/totalenergy/data/browser/xls.cfm?tbl=T07.02B&freq=m>

8 Based on Table 6.3 (New Utility Scale Generating Units by Operating Company, Plant, Month, and Year) of the US Energy Information Administration's Electric Power Monthly, data for December 2013, for the following renewable energy sources: solar, wind, hydro, geothermal, landfill gas, and biomass. Available at: [http://www.eia.gov/electricity/monthly/epm\\_table\\_grapher.cfm?t=epmt\\_6\\_03](http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_6_03)

9 Supra footnote 3 at p. 34835.

natural gas-fired combined-cycle units under construction);

3. Reducing emissions from affected EGUs in the amount that results from substituting generation at those EGUs with expanded low- or zero-carbon generation.
4. Reducing emissions from affected EGUs in the amount that results from the use of demand-side energy efficiency that reduces the amount of generation required.

The EPA developed proposed Section 111(d) emissions rate standards for each state by applying the BSER to the specific circumstances in the power sector of each state. However, the proposed Section 111(d) rule reinforces the important fact that states would not be required to use the BSER building blocks to reduce emissions, but could instead use any combination of those building blocks and other options that reduce CO<sub>2</sub> emissions to achieve compliance with the emissions rate standards.

### **The Menu of Options**

This report contains 26 detailed chapters, 25 of which explore various approaches to reducing GHG emissions in the electric sector. The *Menu of Options* looks first at proven *technologies* for reducing emissions, and then at various *policies* that have been demonstrated to promote or facilitate emissions reductions.

Each of these chapters starts with a profile (i.e., a description of the pros and cons of the approach). The chapters also contain a description of the regulatory backdrop, the policy underpinnings, implementation experience, and GHG reduction potential. Each chapter also examines the co-benefits of each approach, including benefits to society and the utility system, and explores the costs and cost-effectiveness of the various options. Finally, in the twenty-sixth chapter, the *Menu of Options* addresses a variety of emerging technologies and other important policies that regulators may wish to consider as they

formulate plans to reduce power sector GHG emissions. Table Intro-1 lists the technologies and policies addressed in the *Menu of Options*.

Although the focus of this *Menu of Options* primarily concerns federal efforts to reduce GHG emissions from the power sector, specifically the EPA's proposed CPP, many states and localities have already adopted plans or requirements for such reductions. Some may also choose to require greater reductions in GHG emissions than required by the CPP. These jurisdictions may also find the technology and policy options described in this Menu to be valuable in their consideration or implementation of state and local GHG reduction programs or goals.

In addition, while the *Menu of Options* principally targets technologies and policies to reduce GHG emissions, many of the options described – particularly those that enhance the efficiency of generation, transmission, distribution, or use of electricity – can be expected to reduce other, non-GHG pollutants as well, including key criteria pollutants regulated under Section 110 of the CAA. The CAA mandates that the EPA periodically review National Ambient Air Quality Standards and revise them, if warranted. It may therefore be in the best interest of regulators to consider GHG and other air quality goals in a more integrated fashion than has historically been the case, in order to identify and implement options that can provide broad emissions reduction benefits and reduce overall costs.<sup>10</sup>

---

10 For one example of how such integrated planning might be conducted, see: James, C., & Colburn, K. (2013, March). *Integrated, Multi-Pollutant Planning for Energy and Air Quality (IMPEAQ)*. Montpelier, VT: The Regulatory Assistance Project. Available at: [www.raponline.org/document/download/id/6440](http://www.raponline.org/document/download/id/6440)

Table Intro-1

<b>The Menu of Options</b>		
<b>Chapter Number</b>	<b>Title</b>	<b>Description</b>
<b>1</b>	<b>Optimize Power Plant Operations</b>	Explores techniques to permit a plant to improve thermal efficiencies by up to four to seven percent, reducing coal combustion and GHG emissions by an equivalent quantity
<b>2</b>	<b>Implement Combined Heat and Power in the Electric Sector</b>	Focuses on combined heat and power at central electric generating units as a means of reducing the carbon emissions of the power sector
<b>3</b>	<b>Implement Combined Heat and Power in Other Sectors</b>	Discusses how combined heat and power technologies in the commercial, institutional, and manufacturing sectors can reduce CO <sub>2</sub> emissions across the economy through system-wide gains in energy efficiency that improve economic competitiveness
<b>4</b>	<b>Improve Coal Quality</b>	Discusses different coal types and beneficiation options, examples of different types of beneficiation in practice, and the resulting GHG and environmental impacts of such actions
<b>5</b>	<b>Optimize Grid Operations</b>	Discusses activities to improve the performance and efficiency of electricity transmission and distribution systems by grid operators
<b>6</b>	<b>Increase Generation From Low-Emission Resources</b>	Analyzes the state of low-emissions resources in the United States and the policies that affect their deployment, and provides an overview of state implementation of these resources
<b>7</b>	<b>Pursue Carbon Capture and Utilization or Sequestration</b>	Describes the process of carbon capture and storage/utilization, updates the state of projects throughout the United States, and details the regulatory backdrop for this technology
<b>8</b>	<b>Retire Aging Power Plants</b>	Explores the various decision metrics that affect whether a unit is retired and provides examples of how retirement decisions have been carried out in select jurisdictions.
<b>9</b>	<b>Switch Fuels at Existing Power Plants</b>	Explores fuel switching as an emissions reduction option, and outlines three strategies to accomplish fuel switching
<b>10</b>	<b>Reduce Losses in the Transmission and Distribution System</b>	Discusses how each component of the distribution system can be optimized, and how equipment choices can affect efficiency, and by extension, GHG emissions
<b>11</b>	<b>Establish Energy Savings Targets for Utilities</b>	Focuses on policies that establish mandatory energy savings targets for electric utilities
<b>12</b>	<b>Foster New Markets for Energy Efficiency</b>	Focuses on policies that create or expand the opportunities for voluntary, market-based transactions that promote energy efficiency
<b>13</b>	<b>Pursue Behavioral Efficiency Programs</b>	Discusses the types, benefits, and limitations of behavioral energy efficiency programs, as well as states' experiences in addressing barriers to implementing them

## Introduction

Chapter Number	Title	Description
14	<b>Boost Appliance Efficiency Standards</b>	Discusses the benefits from appliance standards, as well as states' experiences in addressing political and other barriers to implementation
15	<b>Boost Building Energy Codes</b>	Analyzes different types of building codes and other mandatory building efficiency policies, and provides examples of programs and codes that cities and states have enacted
16	<b>Increase Clean Energy Procurement Requirements</b>	Explores a variety of policies that can be adopted to increase clean energy procurement
17	<b>Encourage Clean Distributed Generation</b>	Discusses how improvements in interconnection policies, effective tax and incentive policies, state policies preferring clean energy sources such as Renewable Portfolio Standards policies, and the terms and conditions of tariffs and contracts can each contribute to increasing the deployment of clean distributed generation
18	<b>Revise Transmission Planning and Cost Allocation</b>	Discusses the issues and challenges affecting transmission planning and pricing, regulatory rules affecting these issues, and how states have addressed these issues
19	<b>Revise Capacity Market Practices and Policies</b>	Identifies capacity market rules that support emissions reductions and should be emulated, as well as market rules that can inhibit emissions reductions and should be changed
20	<b>Improve Integration of Renewables Into the Grid</b>	Focuses on a suite of policies and mechanisms that can help to ensure continued electric system reliability as the electric system changes to include a higher penetration of variable energy resources, particularly wind and solar electric generating units
21	<b>Change the Dispatch Order of Power Plants</b>	Discusses various policies to influence dispatch order, implementation experiences, and associated GHG reductions
22	<b>Improve Utility Resource Planning Practices</b>	Explores utility planning policies and the process to implement them, as well as implementation scenarios from around the United States
23	<b>Improve Demand Response Policies and Programs</b>	Reviews the many forms of demand response and the scale of energy savings and emissions reductions it can produce
24	<b>Adopt Market-Based Emissions Reduction Programs</b>	Explains market-based emissions reduction programs, describes programs that have been implemented worldwide, and provides examples of successful programs in the United States
25	<b>Tax Carbon Dioxide Emissions</b>	Explores different types of carbon taxes and gives examples of how they have been implemented worldwide
26	<b>Consider Emerging Technologies and Other Important Policies</b>	Provides a brief introduction to several emerging technology and policy considerations