State CO_2 Emission Rate Goals in EPA's Proposed Rule for Existing Power Plants

Jonathan L. Ramseur
Specialist in Environmental Policy

July 21, 2014

Congressional Research Service
7-5700
www.crs.gov
R43652

Summary

On June 18, 2014, the Environmental Protection Agency (EPA) published a proposed rulemaking that would establish guidelines for states to use when developing plans that address carbon dioxide (CO_2) emissions from existing fossil fuel-fired electric generating units. The proposal creates CO_2 emission rate goals—measured in pounds of CO_2 emissions per megawatts-hours (MWh) of electricity generation—for each state to achieve by 2030 and an interim goal to be achieved "on average" between 2020 and 2029. EPA estimates that if the states achieve their individual emission rate goals in 2030, the CO_2 emissions from the electric power sector in the United States would be reduced by 30% compared to 2005 levels.

This report discusses the methodology EPA used to establish state-specific CO_2 emission rate goals that apply to states' overall electricity generation portfolio.

The emission rate goals do not apply directly to individual emission sources. EPA established the emission rate goals by first determining each state's 2012 emission rate baseline, which is generally a function of each state's portfolio of electricity generation in 2012. The resulting baselines in each state vary considerably, reflecting, among other things, the different energy sources used to generate electricity in each state.

To establish the emission rate goals, EPA applied four "building blocks" to the state baselines. The four building blocks involve estimates of various opportunities for states to decrease their emission rates:

- Building block 1: coal-fired power plant efficiency improvements;
- Building block 2: natural gas combined cycle displacement (NGCC) of more carbon-intensive sources, particularly coal;
- Building block 3: increased use of renewable energy and preservation of existing and under construction nuclear power; and
- Building block 4: energy efficiency improvements.

Building blocks 1 and 2 directly affect the CO_2 emission rate at affected EGUs by factoring in EGU efficiency improvements and opportunities to switch from high- to low-carbon power generation. In contrast, building blocks 3 and 4 involve so-called "outside the fence" opportunities that do not directly apply to electricity generation at affected EGUs.

The building blocks affect each state's emission rate in different ways, depending on each state's specific circumstances. On average, block 1 has the smallest average impact, decreasing state emission rate goals (compared to 2012 baselines) by a range of 0% to 6%.

Building block 2, on average, lowers rates by 13%, with a range of impacts from 0% to 38% (compared to baseline). The largest rate changes are seen in states that have both coal-fired EGUs and under-utilized NGCC plants. The smallest rate impacts are in states without any NGCC units and states that already have relatively high NGCC utilization rates.

The under construction nuclear component of building block 3 only affects rates in three states, but its rate impacts are considerable. An amount of at-risk nuclear generation was included in the 2012 baseline rates, lowering some state baselines by as much as 7%.

The renewable energy component of block 3, on average, reduces emission rate baselines by 9%, with a range from 2% to 33%. This block has a greater impact in states that use renewable energy (not counting hydroelectric power) to generate a substantial percentage of their total electricity.

Building block 4 reduces rates, on average, by 13%, with a range of impacts between 4% and 37%. This range is a result of several factors, including (1) the contribution of in-state electricity generation that comes from hydroelectric power or nuclear power; and (2) whether the state is a net importer or net exporter of electricity.

The results of applying the four building blocks do not require or predict a particular outcome in a state's electricity generation profile. The emission rates are a function of EPA's specific emission rate methodology. States may choose to meet emission rate goals by focusing on one or more of the building block strategies or through alternative approaches.

Contents

Introduction ... 1
2012 Emission Rate Baseline ... 2
EPA Data Sources ... 2
Affected EGUs ... 2
2012 Emission Rate Equation ... 3
CO_2 Emission Rate Goals ... 5
Building Block 1—Coal-Fired Generation Efficiency Improvements ... 6
Building Block 2—Increased Utilization of Natural Gas Combined Cycle Units ... 7
Building Block 3—Renewable Energy and Nuclear Power ... 8
Renewable Energy ... 9
Nuclear Energy ... 13
Building Block 4—Energy Efficiency Improvements ... 14
Concluding Observations ... 18

Figures

Figure 1. EPA's 2012 State-Specific Emission Rate Baselines ... 5
Figure 2. EPA's Proposed Regions in its Renewable Energy Methodology ... 9
Figure 3. Incremental Energy Efficiency Savings in 2012 by State ... 16

Tables

Table 1. EPA's "Adjusted" 2012 Baseline Emission Rate Equation ... 4
Table 2. Illustration of Building Block 2 for Arizona's Emission Rate Goal ... 8
Table 3. Renewable Energy Regions, Targets, and Growth Rates ... 10
Table 4. Renewable Energy Generation ... 12
Table 5. Equation for CO_2 Emission Rate Goals ... 20
Table 6. 2012 State Emission Rate Baselines and Building Block Applications ... 21
Table 7. Application of EPA's Building Blocks *in Isolation* ... 23

Contacts

Author Contact Information ... 26

Introduction

On June 18, 2014, the Environmental Protection Agency (EPA) published in the *Federal Register* a proposed rulemaking[1] under Section 111(d) of the Clean Air Act.[2] The proposal would establish carbon dioxide (CO_2) emission guidelines for states to use when developing plans that address CO_2 emissions from existing fossil fuel-fired electric generating units. For more background on the statutory authority, history, and legal and administrative processes involving this rulemaking, see CRS Report R43572, *EPA's Proposed Greenhouse Gas Regulations for Existing Power Plants: Frequently Asked Questions*, by James E. McCarthy et al.

The proposed rule establishes state-specific CO_2 emission rate goals, measured in pounds of CO_2 emissions per megawatt-hours (MWh) of electricity generation. This metric is generally described as carbon intensity, which is a ratio of CO_2 emissions per a unit of output, which is electric power (MWh) in this context. EPA based its intensity goals on each state's current portfolio of electricity generation and various assumptions involving opportunities for states to decrease their carbon intensity, including:

- coal-fired power plant efficiency improvements;
- natural gas combined cycle displacement of more carbon-intensive sources, particularly coal;
- increased use of low-carbon sources, namely renewable energies like wind and solar, and continued use of existing nuclear power generation; and
- energy efficiency improvements.

The proposal sets a final goal for each state[3] for 2030 and an interim goal to be achieved "on average" between 2020 and 2029.[4] EPA estimates that if the states achieve their individual emission rate goals in 2030, the CO_2 emissions from the electric power sector in the United States would be reduced by 30% compared to 2005 levels. However, the state emission rate goals are based on a baseline year of 2012, not 2005.

This report discusses the methodology EPA used to establish the state-specific CO_2 emission rate goals. The first section explains the process by which EPA created state-specific 2012 emission rate baselines. The emission rate equation EPA used to calculate the state baselines is provided at the end of this section.

The second section discusses the four categories of emission reduction opportunities, described as "building blocks" by EPA, that the agency used to determine the interim and 2030 emission rate goals for each state. The emission rate equation that incorporates each building block is provided

[1] 79 *Federal Register* 34830, "Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units," June 18, 2014 (hereinafter EPA Proposed Rule).

[2] 42 U.S.C. §7411(d).

[3] Vermont and the District of Columbia do not have emission rate goals, because they do not have electric generating units affected by the proposal in their jurisdictions.

[4] To satisfy the interim goal requirement, each state must demonstrate that the components of its plan would yield an emission rate that is less than or equal to the interim goal. In addition, EPA proposes that states provide annual performance updates to EPA during the interim period.

at the end of this section. In addition, **Table 6** at the end of this section lists the state-specific 2012 emission rate baselines, the final emission rate goals, and the incremental effects of applying each of EPA's building blocks to the 2012 baselines.

2012 Emission Rate Baseline

EPA's first step in establishing the state-specific CO_2 emission rate goals involved setting state-specific baselines. The baseline is the starting point, from which future goals are measured. The baseline year selection is an important issue for some states, because some states already have regulations or policies that would directly (e.g., emissions cap) or indirectly (e.g., renewable portfolio standards) reduce CO_2 emissions. Some of these state requirements were in place well before 2012.

EPA chose to use state-specific data from 2012 to establish the rate-based baselines, stating:

> EPA chose the historic data approach as it reflected actual historic performance at the state level. EPA chose the year 2012 as it represented the most recent year for which complete data were available at the time of the analysis .... EPA also considered the possibility of using average fossil generation and emission rate values over a baseline period (e.g., 2009 – 2012), but determined that there would be little variation in results compared to a 2012 base year data set due to the rate-based nature of the goal.[5]

EPA Data Sources[6]

EPA used its Emissions & Generation Integrated Resource Database (eGRID) to provide the underlying data for the vast majority of the inputs the agency used to generate state emission rates. According to EPA, "eGRID integrates many different data sources on power plants and power companies, including, but not limited to: the EPA, the Energy Information Administration (EIA), the North American Electric Reliability Corporation (NERC), and the Federal Energy Regulatory Commission (FERC)."[7] In addition, EPA used its National Electric Energy Data System (NEEDS) to identify nuclear and NGCC plants that were not operating in 2012 but are under construction.

Affected EGUs

The 2012 state baselines are based on CO_2 emissions from electric generating units (EGUs) that are addressed in the proposal. These units are called "affected EGUs." The terminology in this proposal differs from other air pollutant regulations that apply directly to "covered sources" or "regulated entities." The emission rate goals described below do not apply directly to individual power plants, but to the state's overall electricity generation portfolio.

---

[5] See EPA, Goal Computation Technical Support Document, June 2012, at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents.

[6] For more details, see EPA, "Goal Computation Technical Support Document," June 2014, at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents.

[7] EPA, Technical Support Document, *GHG Abatement Measures*, at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents.

In general, an affected EGU is a fossil fuel-fired unit that was in operation or had commenced construction as of January 8, 2014, has a generating capacity above a certain threshold, and sells a certain amount of its electricity generation to the grid. The specific criteria include the following:

1. has a base load rating greater than 73 MW;
2. combusts fossil fuel for more than 10% of its total annual heat input; and
3. sells the greater of 219,000 MWh per year[8] or one-third of its potential electrical output to a utility distribution system.[9]

Based on 2012 data provided by EPA, the "affected EGU" definition applies to over 3,100 EGUs at 1,508 facilities throughout the United States.[10] The number of "affected" power plant facilities range by state, from 2 EGUs in Idaho to 115 EGUs in Texas, with a median number of 19.

Net Energy Output Versus Gross Output

In its proposed rule, EPA measures energy generation from affected EGUs in terms of net output rather than gross output. Gross output is the total amount of electricity (and/or useful thermal output)[11] that is produced at the generator terminal. Some of this gross output is used on-site to operate equipment at the EGU (e.g., pumps, fans, or pollution control devices). Net output equals gross output minus the amount of energy used on-site, thus capturing only the electricity that is delivered to the transmission grid.

EPA explains that a net output measure would account for reduction opportunities in on-site energy use, which would not be captured using a gross output measure.[12] This would provide an incentive for on-site energy efficiency improvements. However, EPA notes that its proposed rule for new EGUs measures gross generation. The agency is requesting comment on the use of net generation for existing EGUs.

2012 Emission Rate Equation

EPA constructed the 2012 state baselines using CO_2 emissions and electricity generation data from the affected EGUs and several additional electricity generation categories described below.

First, EPA grouped the affected EGUs into different categories: coal-fired steam generation; oil and gas (OG) steam generation; natural gas combined cycle (NGCC) generation; and "other" affected EGUs. This last grouping includes fossil sources, such as integrated gasification combined cycle (IGCC) units, high utilization combustion turbine units, and applicable thermal output at cogeneration units. EPA separated the data from these units because they are not part of the building block applications described below.[13] On a national basis, the "other" category

[8] This generally equates to a 25 MW unit (25 MW * 8,760 hours = 219,000 MWh).

[9] This is measured on an annual basis for steam units and IGCC units and on a three-year rolling average basis for stationary combustion turbine units. For more information, the proposed rule references a discussion in the proposed rule for *new sources* at 79 *Federal Register* 1430 (January 8, 2014).

[10] CRS calculations using EPA's "Technical Support Document: Goal Computation-Appendix 7" Excel spreadsheet, at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents-spreadsheets.

[11] For the most part, energy generation refers to electricity, but some EGUs, namely combined heat and power facilities, also produce heat (referred to as "useful thermal output") that can be used on-site for other industrial processes.

[12] See EPA Proposed Rule, p. 34894.

[13] According to EPA, "IGCCs represent a very small sample size of three operating plants and have a different utilization pattern and different capital cost profile than NGCCs that result in a different set of redispatch economics. Likewise, high utilization [combustion turbines] that may be covered by the rule are generally less efficient and have higher emission rates than NGCCs, and are therefore generally less cost effective for redispatch purposes [i.e., building (continued...)

accounts for approximately 1% of total U.S. electricity generation and CO_2 emissions.[14] And for the vast majority of states, these sources have minimal impacts on emission rates.

To establish each state's 2012 baseline, EPA calculated the pounds of CO_2 generated from affected EGUs in each state (the numerator in the **Table 1** equation)[15] and then divided that sum by the electricity generated (the denominator in the **Table 1** equation) from affected EGUs in each state. This yields an emission rate measured in pounds (lbs.) of CO_2 per megawatt-hours (MWh) of electricity generation. EPA described this result as the "unadjusted" emission rate.

To establish the final, "adjusted" 2012 baseline for each state, EPA added two elements to the denominator of the emission rate equation (in **Table 1**): "at-risk" nuclear power (discussed below) and renewable energy generation. The addition of these elements produced the "adjusted" emission rate equation, which is used to generate the 2012 baseline emission rate for each state. The adjusted emission rate equation is provided below:

Table 1. EPA's "Adjusted" 2012 Baseline Emission Rate Equation

$$\text{2012 Emission Rate} = \frac{\text{coal generation} \times \text{coal emission rate} + \text{OG generation} \times \text{OG emission rate} + \text{NGCC generation} \times \text{NGCC emission rate} + \text{"Other" } CO_2 \text{ emissions}}{\text{coal generation} + \text{OG generation} + \text{NGCC generation} + \text{"Other" generation} + \text{"At-Risk" Nuclear} + \text{Renewable energy generation}}$$

Notes: OG = oil and gas; NGCC = natural gas combined cycle; "other" generation includes fossil fuel EGUs, such as integrated gasification combined cycle (IGCC) units, high utilization combustion turbine units, and applicable thermal output at cogeneration units; "at-risk" nuclear includes 5.8% of a state's nuclear power capacity; renewable energy includes solar, wind, geothermal, wood and wood-derived fuels, other biomass, but not hydroelectric power.

For the "at-risk" nuclear power element, EPA assumes that under a business-as-usual scenario some amount of existing nuclear power will be unavailable for use in the near future. Using projections from EIA, EPA determined that 5.8% of total U.S. nuclear power capacity was at risk of being retired in the near future.[16] EPA used this percentage value to estimate at-risk nuclear power (in MWh) for each state with operating nuclear units in 2012.[17] According to EPA, this projected outcome is due to a "host of factors –increasing fixed operation and maintenance costs,

(...continued)

block 2]." See EPA, "Goal Computation Technical Support Document," June 2014, at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents.

[14] CRS calculation based on 2012 data provided in EPA's technical document spreadsheets.

[15] At first glance, the numerator appears to have extraneous information. For example, it could simply contain pounds of CO_2 from the various categories, instead of generation and emission rate data (which ultimately yields pounds).

[16] See EPA's Technical Support Document, *GHG Abatement Measures*.

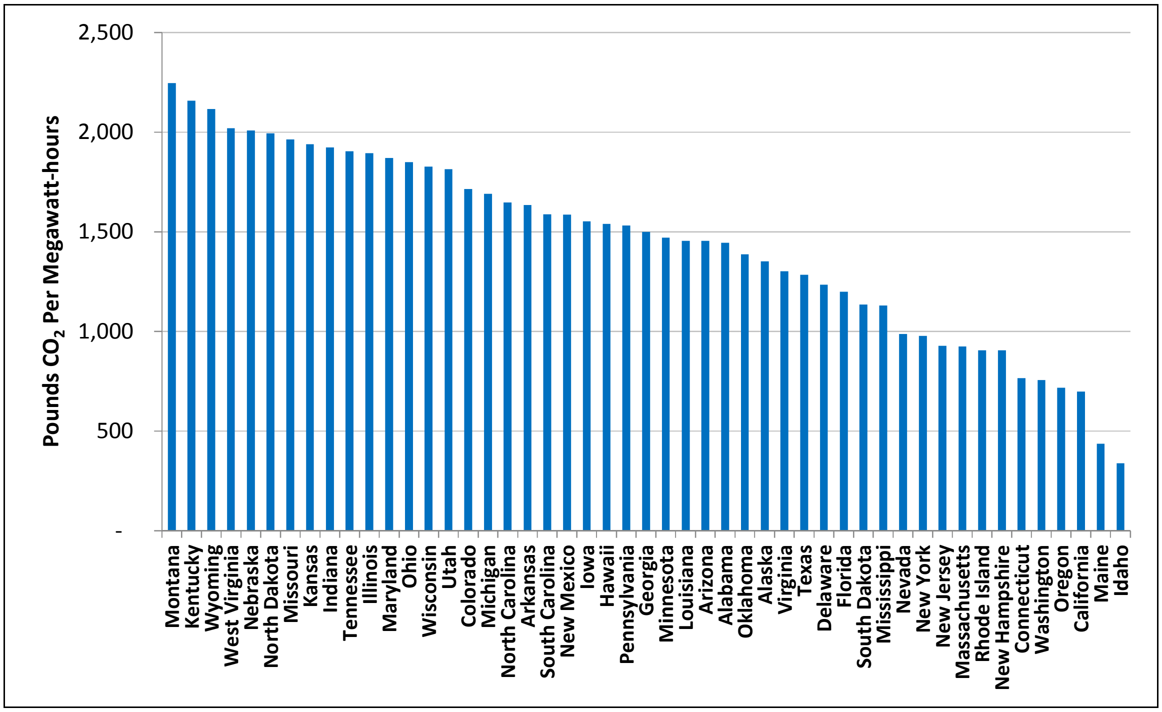
[17] For states that use a greater portion of nuclear power as part of their electricity generation portfolio, adding this element to the denominator has a more pronounced effect. For example, South Carolina generated the highest percentage (53%) of its electricity generation from nuclear power in 2012. South Carolina's unadjusted emission rate decreased by 7% with the addition of at-risk nuclear power to the emission rate equation (CRS calculations, using EIA electricity generation, by source and state, at http://www.eia.gov/electricity/data.cfm#generation).

relatively low wholesale electricity prices, and additional capital investment associated with ensuring plant security and emergency preparedness."

In addition, EPA added each state's renewable energy electricity generation (in MWh) from 2012 into the state baseline calculation.[18] As discussed below, renewable energy potential plays an important role in determining EPA's emission rate interim and final goals. Including renewable energy in the state baseline rates allows for a more appropriate comparison between the 2012 baseline and interim and final rate goals.

Applying the above equation to each state's specific circumstances yields a range of emission rate baselines, as illustrated in **Figure 1**.

Figure 1. EPA's 2012 State-Specific Emission Rate Baselines



Source: Prepared by CRS.

CO_2 Emission Rate Goals

In its proposed rule, EPA identified four categories of CO_2 emission reduction strategies that states could employ to reduce the states' overall CO_2 emission rates. EPA proposed that the combination of these four strategies—described as "building blocks"—represents the "best system of emission reduction...adequately demonstrated," a key determination pursuant to CAA Section 111(d).[19] Using the state-specific 2012 baseline data as its starting point, EPA applied the four building blocks to establish CO_2 emission rate goals for each state.

[18] For reasons discussed below, hydropower is not included in the 2012 renewable energy baseline.

[19] See CRS Report R43572, *EPA's Proposed Greenhouse Gas Regulations for Existing Power Plants: Frequently* (continued...)

Building blocks 1 and 2 directly affect the CO_2 emission rate at affected EGUs by factoring in efficiency improvements at EGUs and opportunities to switch from high- to low-carbon power generation. In contrast, blocks 3 and 4 involve so-called "outside the fence" opportunities that do not directly apply to electricity generation at affected EGUs. These blocks decrease the states' overall CO_2 emission rates by (1) increasing the use of low- or zero-carbon electricity generation and (2) reducing consumer demand for electricity through energy efficiency improvements.

The equation for the 2030 emission rate goals, which includes the application of all four building blocks, is provided at the end of this section. Compared to the 2012 baseline emission rate equation, building blocks 3 and 4 add more elements to the equation's denominator. In its proposal, EPA explained:

> A goal expressed as an unadjusted output-weighted-average emission rate would fail to account for mass emission reductions from reductions in the total quantity of fossil fuel-fired generation associated with state plan measures that increase low- or zero-carbon generating capacity [e.g., renewable portfolio standards] or demand-side energy efficiency. Accordingly, under the proposed goals, the emission rate computation includes an adjustment designed to reflect those mass emission reductions .... Mathematically, this adjustment has the effect of spreading the measured CO_2 emissions from the state's affected EGUs over a larger quantity of energy output, thus resulting in an adjusted mission rate lower than the unadjusted emission rate.

The following discussion describes each of these building blocks and their relative contributions to the state-specific emission rate goals.

Building Block 1—Coal-Fired Generation Efficiency Improvements

Building block 1 applies heat rate[20] (i.e., efficiency) improvements to coal-fired, steam EGUs. EPA maintains that these EGUs are "less efficient at converting fuel into electricity than is technically and economically possible."[21] Almost all of the existing coal-fired EGUs are considered steam EGUs. A small percentage of coal-fired EGUs are integrated gasification combined cycle (IGCC) units, but the proposed heat rate improvements in building block 1 do not apply to these units. EPA is seeking comment on whether the agency should include heat rate improvements at other fossil-fuel EGUs as part of its emission rate calculations.

Potential heat rate improvements include the adoption of operation and maintenance best practices and equipment upgrades. EPA determined that a combination of these potential options could improve coal-fired EGU heat rates by 6%. A reduction in the heat rate leads to a proportional reduction in CO_2 emissions, because CO_2 emissions are directly related to the amount of fuel consumed. Therefore, building block 1 reduces each state's CO_2 emissions rate (pounds of CO_2 per MWh) for coal-fired affected EGUs by as much as 6%.[22]

(...continued)

Asked Questions, by James E. McCarthy et al.

[20] Heat rate is the efficiency of conversion from fuel energy input to electrical energy output often expressed in terms of BTU per kiloWatt-hour.

[21] EPA's Technical Support Document, *GHG Abatement Measures*, at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents.

[22] For a further discussion, see CRS Report R43621, *EPA's Proposed Greenhouse Gas Regulations: Implications for*

(continued...)

For example, if a state's coal-fired affected EGUs averaged 2,000 pounds of CO_2 emissions per MWh in 2012, building block 1 could decrease this rate to 1,880 pounds CO_2 per MWh. This lowers one of the elements ("coal emission rate") in the numerator of the emission rate equation (**Table 5**), but has no effect on the denominator.

As indicated in **Table 6**, building block 1 decreases state emission rate goals (compared to 2012 baselines) by a range of 0% to 6%. The greater rate impacts are seen in states that have a relatively high percentage of coal-fired electricity in their electricity generation portfolio.

Building Block 2—Increased Utilization of Natural Gas Combined Cycle Units

Building block 2 lowers a state's CO_2 emission rate (pounds of CO_2 per MWh) from the baseline by shifting a state's electricity generation from higher-carbon units, such as coal-fired EGUs, to lower-carbon NGCC units.[23] The carbon intensity of different types of EGUs can vary considerably. According to EPA,[24] the 2012 *average* CO_2 emission rates by unit type category were the following:

- Coal steam units = 2,220 lbs. CO_2/MWh
- Oil and natural gas steam units = 1,463 lbs. CO_2/MWh
- NGCC units = 907 lbs. CO_2/MWh

As electricity demand increases during the day, system operators or regional transmission organizations call into service ("dispatch") additional power plants to meet the electricity needs. When electricity demand decreases, these additional units are taken off-line. In general, coal-fired EGUs are dispatched before NGCC units, because coal-fired plants take hours or days to ramp up to their design capacity and they have traditionally been cheaper to operate than most other sources.

EPA concluded that there is "significant potential for re-dispatch" from steam EGUs to NGCC units.[25] The agency estimated that, in aggregate, NGCC units provided about 46% of their total generating capacity in 2012. This measure is called the capacity factor. Based on its analysis, EPA determined that a state's capacity factor for its NGCC units could be increased to 70%. Building block 2 uses the 70% capacity factor to increase the utilization of NGCC units and correspondingly decrease generation from more carbon intensive EGUs.

As an example, **Table 2** illustrates the application of building block 2 for Arizona. In 2012, NGCC units in Arizona generated 26.8 million MWh of electricity, which represented approximately 27% of the total NGCC nameplate capacity (11,202 MW) in the state.[26] Under

(...continued)

the Electric Power Sector, by Richard J. Campbell.

[23] For a further discussion, see CRS Report IN10089, *The Role of Natural Gas in EPA's Proposed Clean Power Plan*, by Richard K. Lattanzio.

[24] EPA's Technical Support Document, *GHG Abatement Measures*.

[25] EPA's Technical Support Document, *GHG Abatement Measures*.

[26] If the state had NGCC under construction, this generating capacity would also be included.

building block 2 methodology, the increase in NGCC generation is capped at the lower of two ceilings: 70% of the nameplate capacity or the total generation from coal and OG steam EGUs and NGCC units in 2012. Applying the 70% NGCC capacity factor would increase NGCC generation from 26.8 million MWh to 68.9 million MWh,[27] well above the total generation from all units in 2012 of 52.1 million MWh. Therefore, NGCC generation increases to 52.1 million MWh, the total generation from fossil fuel units in 2012. Applying block 2 methodology, the increased NGCC generation replaces generation from coal and OG steam EGUs, decreasing their generation to zero.

As **Table 2** indicates, building block 2 has a substantial effect on Arizona's emission rate, reducing it by 42%. Note that the results of applying building block 2 do not require or predict a particular outcome in a state's electricity generation profile. The results are a function of the emission rate methodology. States may choose to meet their emission rate goals through alternative approaches.

Table 6 shows the effect that building blocks 1-2 have on all of the 2012 state emission rate baselines.

Table 2. Illustration of Building Block 2 for Arizona's Emission Rate Goal

	2012 Baseline	After Building Block 2
Coal steam generation	24.3 million MWh	0
OG steam generation	1.0 million MWh	0
NGCC generation	26.8 million MWh	52.1 million MWh
Total generation	**52.1 million MWh**	**52.1 million MWh**
NGCC capacity factor	27%	53%
Emissions Rate	1,453 lbs. CO_2/MWh	843 lbs. CO_2/MWh
NGCC nameplate capacity = 11,202 MW		

Source: Prepared by CRS; data from EPA Proposed Rule, technical support documents and spreadsheets, at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents.

Building Block 3—Renewable Energy and Nuclear Power

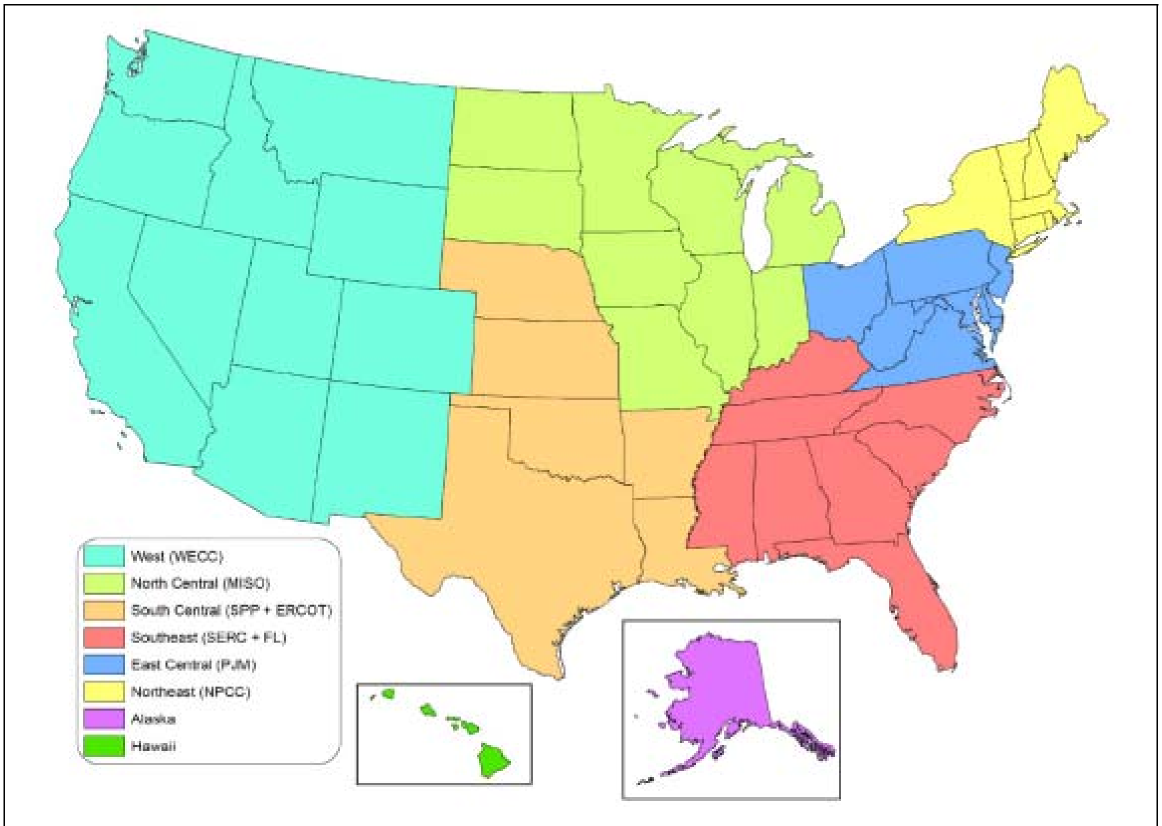
Building block 3 factors in additional electricity generation from low- or zero-carbon emitting sources, including renewable energy and nuclear power. Both types of generation are added to the denominator for the emission rate equation (see **Table 5** at the end of this section), but the numerator is unchanged. The methodologies for incorporating these categories of electricity generation are very different, thus they are discussed separately below.

[27] 11,202 MW * 8,784 hours (in 2012, a leap-year) * 0.7 = 68.9 million MWh.

Renewable Energy

Building block 3 projects annual renewable energy (RE) increases for each state. Current RE use varies by states and the potential to utilize different types of renewable energy sources—wind, solar, geothermal—varies by geographic location. To "account for similar power system characteristics as well as geographic similarities in [renewable energy] potential,"[28] As illustrated in **Figure 2**, EPA placed each state into one of six regions (Alaska and Hawaii have individual targets). EPA determined a RE 2030 target for each region based on an average of existing RE targets that are required by states in the relevant region.[29] Then, EPA calculated an annual growth rate for each region that would allow each region to reach its specific target by 2030.

Figure 2. EPA's Proposed Regions in its Renewable Energy Methodology



Source: Figure 4-3 from EPA, Technical Support Document, *GHG Abatement Measures*.

Table 3 lists the six regions and their states, the regional targets, and the average annual growth rates for each region. The regional targets range from 10% to 25%, and the growth rates range from 6% to 17%. As the table indicates, a region can have a relatively high regional target (e.g., the West region's target of 21%) but have a relatively low growth rate (6% in the West region).

[28] Unofficial proposed rule, p. 195.

[29] As of March 2013, 29 states (and the District of Columbia) have established renewable portfolio standards (RPS), requiring retail electricity suppliers to supply a minimum percentage or amount of their retail electricity load with electricity generated from eligible sources of renewable energy, as defined by the state. An additional nine states have voluntary goals. See the Database of State Incentives for Renewables and Efficiency, at http://www.dsireusa.org/.

Conversely, a state can have a relatively low target (10% in the Southeast region) and a relatively high growth rate (13% in the Southeast region). These outcomes are a function of EPA's methodology. For instance, the West region's growth rate is relatively low, because some of the states—namely California, which accounts for 28% of the region's total electricity generation—are more than halfway toward the regional goal. In contrast, the states in the Southeast are starting with relatively low percentages (0% to 3%) of RE generation in 2012, which accounts for the relatively high growth rate needed to achieve their regional target.

Table 3. Renewable Energy Regions, Targets, and Growth Rates

Region	States	Regional Target	Average Annual Growth Rate
East Central	Delaware, District of Columbia, Maryland, New Jersey, Ohio, Pennsylvania, Virginia, and West Virginia	16%	17%
North Central	Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, North Dakota, South Dakota, and Wisconsin	15%	6%
Northeast	Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont	25%	13%
South Central	Arkansas, Kansas, Louisiana, Nebraska, Oklahoma, and Texas	20%	8%
Southeast	Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee	10%	13%
West	Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming	21%	6%
	Alaska	10%	11%
	Hawaii	10%	8%

Source: Prepared by EPA; data from EPA, Technical Support Document, Greenhouse Gas Abatement Measures.

Notes: Although Vermont does not have an emission rate goal, EPA included Vermont's RE generation when the agency determined the annual growth rate for the Northeast region. If Vermont's RE generation is excluded, the annual growth rate increases slightly, but remains at 13%.

EPA applies the region-specific, annual growth rate to each state's RE generation in 2012 to estimate annual RE generation for each state from 2017 through 2030.[30] If a state's RE use equals or exceeds its 2030 regional target, the state's RE use is held constant at the level that matches its regional target.

The 2012 RE baseline does not include hydroelectric generation.[31] According to EPA:

> Inclusion of this generation in current and projected levels of performance would distort the proposed approach by presuming future development potential of large hydroelectric capacity in other states. Because RPS [renewable portfolio standard] policies were implemented to stimulate the development of new RE generation, existing hydroelectric

[30] Further details about this methodology are in a technical support document for the proposed rule, *GHG Abatement Measures*, Chapter 4, at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents.

[31] According to EPA, "

> facilities are often excluded from RPS accounting. No states are expected to develop any new large facilities.[32]

Although EPA's determination of regional RE targets does not explicitly account for opportunities to build new hydroelectric facilities,[33] states could use increased hydroelectric power generation in the future to lower their emission rate.

Table 4 applies EPA's methodology and depicts the states' RE levels in 2012, total electricity generation in 2012, and the percentage of electricity generation from renewable sources in 2012 and 2030. The last column measures the projected RE generation in 2030 against the total electricity generation in 2012.

EPA's RE building block 3 methodology yields the following results:

- About half of the states would not reach their region-specific goals by 2030; the other half would reach the region-specific goals. Some of these states reached their goals in the early years. In general, the percentage of electricity generated from renewable sources in these states was relatively high in the baseline year (2012);
- Five states—Iowa, Maine, Minnesota, North Dakota, and South Dakota—matched or exceeded their regional RE targets in 2012, so the estimated future RE generation (for the purposes of the emission rate calculations) in these states actually *decreases* to match their regional targets. Arguably, this outcome artificially lowers the emission rate targets for these states and EPA specifically asks for comment on whether the calculations should include a RE floor based on 2012 generation; and
- The impact of building block 3 varies considerably by states. Not counting the states that meet or exceed their targets in 2012, some states increase their percentages of RE generation by 2%; others increase their percentages by over 18%. These different impacts are reflected in **Table 6**, which shows the emission rate change after applying blocks 1-3.

[32] EPA, Technical Support Document, Greenhouse Gas Abatement Measures, pp. 4-5.

[33] EPA, Technical Support Document, Greenhouse Gas Abatement Measures, pp. 4-5.

Table 4. Renewable Energy Generation

States Grouped in Their Renewable Energy Regions

State	2012 RE Generation (MWh)	2012 Total Electricity Generation (MWh)	Percent of RE Generation in 2012	Percent of RE Generation in 2030
Region: East Central – Target 16% – Annual Growth Rate 17%				
Delaware	131,051	8,633,694	2%	12%
Maryland	898,152	37,809,744	2%	16%
New Jersey	1,280,715	65,263,408	2%	16%
Ohio	1,738,622	29,745,731	1%	11%
Pennsylvania	4,459,118	23,419,715	2%	16%
Virginia	2,358,444	70,739,235	3%	16%
West Virginia	1,296,563	73,413,405	2%	14%
Region: North Central –Target 15% – Annual Growth Rate 6%				
Illinois	8,372,660	197,565,363	4%	9%
Indiana	3,546,367	114,695,729	3%	7%
Iowa	14,183,424	56,675,404	25%	15%
Michigan	3,785,439	108,166,078	3%	7%
Minnesota	9,453,871	52,193,624	18%	15%
Missouri	1,298,579	91,804,321	1%	3%
North Dakota	5,280,052	36,125,159	15%	15%
South Dakota	2,914,666	12,034,206	24%	15%
Wisconsin	3,223,178	63,742,910	5%	11%
Region: Northeast – Target 25% – Annual Growth Rate 13%				
Connecticut	666,525	36,117,544	2%	9%
Maine	4,098,795	14,428,596	28%	25%
Massachusetts	1,843,419	36,198,121	5%	24%
New Hampshire	1,381,285	19,264,435	7%	25%
New York	5,192,427	135,768,251	4%	18%
Rhode Island	101,895	8,309,036	1%	6%
Vermont	465,169	6,569,670	7%	25%
Region: South Central – Target 20% – Annual Growth Rate 8%				
Arkansas	1,660,370	65,005,678	3%	7%
Kansas	5,252,653	44,424,691	12%	20%
Louisiana	2,430,042	103,407,706	2%	7%
Nebraska	1,346,762	34,217,293	4%	11%
Oklahoma	8,520,724	77,896,588	11%	20%
Texas	34,016,697	429,812,510	8%	20%
Region: Southeast – Target 10% – Annual Growth Rate 13%				

State	2012 RE Generation (MWh)	2012 Total Electricity Generation (MWh)	Percent of RE Generation in 2012	Percent of RE Generation in 2030
Alabama	2,776,554	152,878,688	2%	9%
Florida	4,523,798	221,096,136	2%	10%
Georgia	3,278,536	122,306,364	3%	10%
Kentucky	332,879	89,949,689	0.4%	2%
Mississippi	1,509,190	54,584,295	3%	10%
North Carolina	2,703,919	116,681,763	2%	10%
South Carolina	2,143,473	96,755,682	2%	10%
Tennessee	836,458	77,724,264	1%	6%
Region: West – Target 21% – Annual Growth Rate 6%				
Arizona	1,697,652	95,016,925	2%	4%
California	29,966,846	199,518,567	15%	21%
Colorado	6,192,082	52,556,701	12%	21%
Idaho	2,514,502	15,499,089	16%	21%
Montana	1,261,752	27,804,784	5%	10%
Nevada	2,968,630	35,173,263	8%	18%
New Mexico	2,573,851	22,894,524	11%	21%
Oregon	7,207,229	60,932,715	12%	21%
Utah	1,099,724	36,312,527	3%	7%
Washington	8,214,350	116,835,474	7%	15%
Wyoming	4,369,107	49,588,606	9%	19%
Alaska	39,958	6,946,419	1%	2%
Hawaii	924,815	10,469,269	9%	10%

Source: Prepared by CRS; data from EPA, Technical Support Document, Greenhouse Gas Abatement Measures, which uses data from EIA, "Net Generation by State by Type of Producer by Energy," at http://www.eia.gov/electricity/data/state/.

Notes: RE generation includes solar, wind, geothermal, wood and wood-derived fuels, other biomass, but not hydroelectric power. The "total electricity generation" data include generation from multiple sources, including both affected and non-affected fossil-fired EGUs, the above renewable energy sources and hydroelectric power. The column labeled "Percent of RE Generation in 2030" measures the projected RE generation (MWh) in 2030 compared to the total MWh of electricity generated in 2012.

Although Vermont does not have an emission rate goal, EPA included Vermont's RE generation when the agency determined the annual growth rate for the Northeast region. If Vermont's RE generation is excluded, the annual growth rate increases slightly, but remains at 13%.

Nuclear Energy

The second part of building block 3 involves nuclear power generation. EPA includes both "at-risk" and "under construction" nuclear power in the denominator of the emission rate equation (see **Table 5** at the end of this section). As discussed above, the "at-risk" nuclear power, which exists in 30 states, was factored into the state 2012 baseline emission rates. Thus, its inclusion in the emission rate goal equation has no effect on the emission rate compared to the 2012 baseline.[34] However, its inclusion in the 2012 baseline equation was unique: it was the only part of the baseline equation that projected future activity (i.e., loss of nuclear power capacity). Thus, if states do not maintain their existing nuclear generation, their emission rates will increase (all else being equal). Including at-risk nuclear generation in the baseline equation denominator was one of EPA's "adjustments." The at-risk nuclear generations lowered the (unadjusted) baselines in some states by as much as 7%, thus having a stronger impact that building block 1.

In addition to the "at-risk" nuclear power, EPA added projected electricity generation from nuclear power units that are currently under construction. EPA identified five under-construction nuclear units at three facilities in Georgia, South Carolina, and Tennessee. The estimated electric generation from these units and their percentage contribution to the state's total electricity generation in 2012 are listed below:

- Georgia: approximately 17 million MWh (14% of total electric generation in 2012)
- South Carolina: approximately 17 million MWh (18% of total electric generation in 2012);
- Tennessee: approximately 9 million MWh (11% of total electric generation in 2012).

Including the estimated generation from these anticipated units in the emission rate equation substantially lowers the emission rates of these three states (**Table 6**). If these anticipated units do not complete construction and enter service, these states would likely have more difficulty achieving their emission rate goals.

Building Block 4—Energy Efficiency Improvements

The fourth building block reduces state emission rates by including avoided electricity generation that results from projected energy efficiency (EE) improvements. These EE improvements are described as "demand-side," because they would seek to reduce the demand for electricity from end-users, such as factories, office buildings, and homes. EPA estimated the amount of decreased electricity generation in each state that would result from EE activities and added the avoided MWh to the denominator of the emission rate equation (**Table 5**).

Demand-side EE activities can involve a range of practices in the residential, commercial, and industrial sectors. According to EPA, "every state has established demand-side energy efficiency policies."[35] However, these policies cover a wide range of activities, and, as discussed below, their effectiveness varies. EPA states that the "most prominent and impactful" EE policies in most states are those that the drive development and funding of EE programs and building codes.[36]

To estimate the avoided electricity generation, EPA first determined the "best practices" performance target for all states. Using data from EIA,[37] EPA calculated each state's incremental

---

[34] The same MWh value is added to the denominator in both equations, having no impact on the emission rate goals.

[35] EPA Proposed Rule, p. 34871.

[36] EPA, Technical Support Document, Greenhouse Gas Abatement Measures.

[37] EPA used data from EIA Form 861, which includes retail electricity sales and incremental electricity savings from (continued...)

EE savings as a percentage of retail electricity sales. According to EPA, "incremental savings (also known as first-year savings) represent the reduction in electricity use in a given year associated with new EE activities in that same year." As **Figure 3** illustrates, the states' 2012 incremental EE savings ranged from 0% to 2.19%.

In addition to the three states—Vermont, Maine, and Arizona—that achieved EE savings greater than 1.5% (**Figure 3**), EPA concluded that nine other states are expected to reach this annual level of performance by 2020.[38] Based on these observed and expected achievements, EPA determined that the "best practices" performance target for all states should be 1.5%. **Figure 3** depicts this performance target as a red line. EPA explained:

> [The best practices scenario] does not represent an EPA forecast of business-as-usual impacts of state energy efficiency policies or an EPA estimate of the full potential of end-use energy efficiency available to the power system, but rather represents a feasible policy scenario showing the reductions in fossil fuel-fired electricity generation resulting from accelerated use of energy efficiency policies in all states consistent with a level of performance that has already been achieved or required by policies (e.g., energy efficiency resource standards) of the leading states.[39]

Similar to the RE methodology described above, EPA's calculations assume that the EE component of the rate equation begins in 2017, and states would start that year at the EE incremental saving levels achieved in 2012 (**Figure 3**). EPA points out that EE improvements made between 2012 and 2017 would count toward achieving a state's emission rate target. However, if a state were to decrease its actual EE performance prior to 2017, the state would face a more difficult effort (all else being equal) in achieving its emission rate goal, as its 2017 EE starting point would be based on its (higher) 2012 EE performance level.

(...continued)

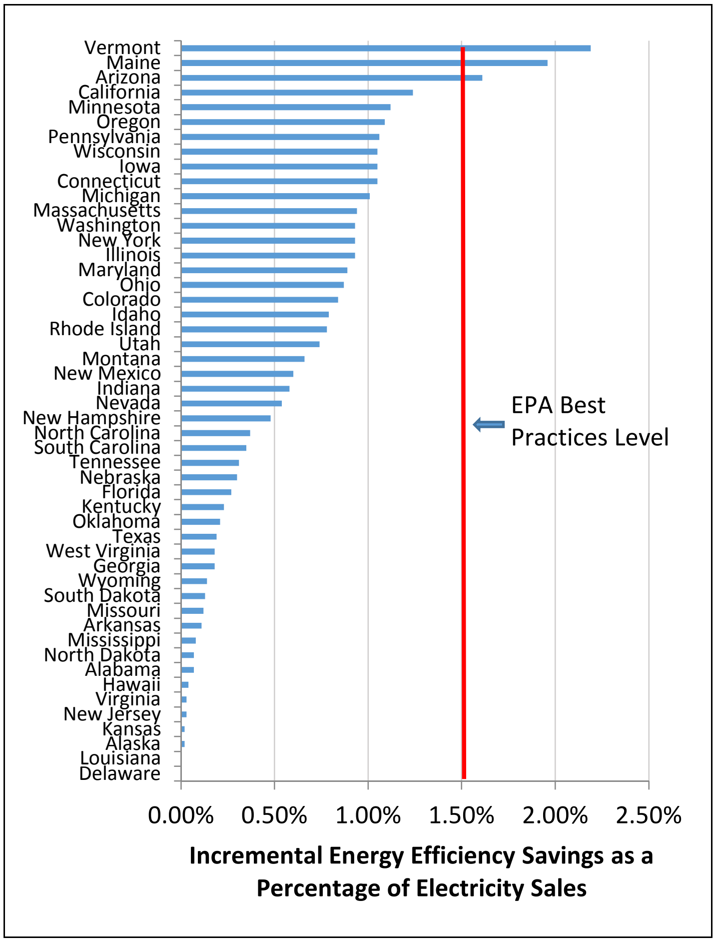
energy efficiency, available at http://www.eia.gov/electricity/data/eia861/index.html.

[38] EPA, Technical Support Document, Greenhouse Gas Abatement Measures.

[39] EPA Proposed Rule, p. 34872.

Figure 3. Incremental Energy Efficiency Savings in 2012 by State

Compared to EPA's Best Practices Level



Source: Prepared by CRS; data from EPA, Technical Support Document, Greenhouse Gas Abatement Measures. EPA used data from EIA Form 861, which includes retail electricity sales and incremental electricity savings from energy efficiency, available at http://www.eia.gov/electricity/data/eia861/index.html.

Notes: Although Vermont does not have an emission rate goal, EPA included its EE performance in its best practice analysis.

The next determination made by EPA was the pace at which states, starting in 2017, would annually increase their EE incremental performance. Based on its analysis of historical EE performance increases and future requirements for some states, EPA chose an annual increase of 0.2%, which it deemed as a "conservative" value.

EPA assumed that each state would increase its incremental EE performance by 0.2% each year, starting in 2018, until it reached the best practices, incremental target of 1.5%. EPA projects that a small number of states would achieve this level in 2017, with the rest of the states reaching this level by 2025. Once this level is achieved, EPA assumed the states could sustain that incremental performance level through 2030.

Next, EPA estimated the cumulative savings that each state would achieve through its annual, incremental EE efforts. In contrast to incremental savings, which measure EE improvements made in one specific year, cumulative savings include the aggregate impacts of EE improvements made in prior years. This raises the question: how many years are counted in the cumulative savings tally? For instance, the installation of a high-efficiency appliance may yield EE savings for the life of the appliance (e.g., 10-15 years), referred to as its "measure life." Other improvements (e.g., home insulation, building codes) may provide savings for twenty years or more. Based on its analysis of various studies, EPA determined the average measure life for an EE portfolio would be 10 years. However, in its EE methodology, EPA distributed the decline in EE savings over 20 years, instead of having 10 years of savings and then dropping to zero at year 11. Both approaches lead to the same overall EE savings, but EPA's approach spreads the savings over a longer period of time.

EPA used the above inputs to estimate cumulative EE savings, as a percentage of retail sales, for each state for each year between 2020 and 2030. This calculation combined the above state-specific inputs with business-as-usual regional estimates of electricity retail sales.[40] Based on EPA's estimates, the EE improvements would yield cumulative reductions in electricity generation in the range of 9% to 12% by 2030, depending on the state's EE starting point.

EPA applied each state's annual (2020-2029) cumulative reductions (as a percentage of sales) to the amount of total electricity (including hydropower) sold to in-state consumers in 2012. EPA adjusted this value to account for states that are net importers or exporters of electricity. Some states (e.g., Idaho and Delaware) import close to 50% of the electricity sold in their state. Other states (e.g., North Dakota, Wyoming, and West Virginia) generate more than twice the amount of electricity they use in-state, exporting the additional electricity to neighboring states.

For net importers, EPA adjusted the cumulative reductions by applying the cumulative reduction percentage to in-state sales, multiplied by the in-state generation as a percentage of sales. For example, Delaware's in-state generation as a percentage of sales equaled 45%, meaning it imported 55% of its total electricity in 2012. To calculate Delaware's cumulative EE reductions, EPA multiplied Delaware's electricity sales (12 million MWh) by its generation as a percentage of sales (0.45) by its cumulative EE reduction percentage (9.5% in 2029).

For net exporters, the EE cumulative reduction percentages only apply to in-state electricity sales, not the total amount of electricity generated. The resulting avoided electricity generation values for each state are added to the denominator in the emission rate equation (**Table 5**).

The impacts of applying building block 4 to the emission rate equation vary by state. In general, the effects appear to be more pronounced in states that generate a large percentage of their electricity from sources that are not already included in the emission rate equation. This primarily involves hydroelectric power, and to some extent, nuclear power generation. For example, building block 4 appears to have a greater effect in Washington (77% of total power generation from hydropower), Idaho (71% from hydropower), and Oregon (65% from hydropower). Building block 4 includes hydroelectric power generation as part of the total generation subject to EE reductions, but this is the only instance in which MWh from hydroelectric power generation are part of the emission rate equation.

In addition, the EE methodology appears to have a greater effect in states with relatively high percentages of nuclear power generation, such as South Carolina (53% nuclear power) and New

[40] EPA generated these projections by using the 2012 retail sales data and average annual growth rates for different regions provided in EIA's 2013 Annual Energy Outlook.

Jersey (51% nuclear power). Although existing nuclear power is captured in the emission rate equation, it only accounts for the at-risk (5.8%) component.

By comparison, the effects of building block 4 are less pronounced in states that export a substantial amount of the electricity they generate, such as Wyoming, North Dakota, and West Virginia. These states generate more than twice as much electricity as they consume. The total generation from affected EGUs is captured in the equation's numerator, but only the avoided generation from in-state sales is captured in the denominator, resulting in a lesser impact from building block 4.

What do the different effects of the EE building block mean for states? The states that generate a considerable percentage of electricity from either hydroelectric power or nuclear power may have more limited options to find emission rate reductions than other states. The inclusion of avoided generation from all electricity generating sources may compel these states to focus on EE improvements to reach their emission rate targets. This potential outcome assumes these states cannot find rate reductions from their existing hydroelectric or nuclear power sources.

Concluding Observations

As **Table 6** indicates, the building blocks affect each state's emission rate baseline in different ways, depending on each state's specific electricity generation circumstances. **Table 6** presents an incremental analysis of the impacts of applying the building blocks in a stepwise fashion (or all at once), ultimately reaching the 2030 emission rate goal.

As another measure of a state-by-state comparison, CRS used EPA's emission rate methodology to calculate the impacts of each building block *in isolation*. The results are listed in **Table 7**. These calculations illustrate the relative impacts of the four building blocks for each state. For example in Idaho, building blocks 1, 2, and 3 (nuclear) have no impact on the 2012 emission rate, because Idaho has no coal-fired EGUs, no room to improve its NGCC utilization, and no nuclear generation. Therefore, the only impacts to its 2012 baseline rate are due to the renewable component of building block 3 and EE improvements from building block 4.

As **Table 7** indicates, on average, building block 1 has the smallest impact (4%), decreasing state emission rate goals (compared to 2012 baselines) by a range of 0% to 6%. The emission rates in states (e.g., Rhode Island, Maine, and Idaho) without coal-fired, steam EGUs are unaffected by this block; states that employ coal-fired units to generate a significant percentage of their electricity (e.g., Kentucky, West Virginia, and Wyoming) see a greater impact to their emission rates.

Building block 2, on average, generates the largest (tied with block 4 below) incremental impact (13%), ranging from a 0% to 38% change (compared to baseline). The largest changes are seen in states that have both coal-fired EGUs and under-utilized NGCC plants. The smallest impacts are in states without any NGCC and states that already have relatively high NGCC utilization rates.

Although the nuclear component of building block 3 only affects three states, its impacts are considerable in those states.

The RE component of building block 3, on average, reduces emission rate baselines by 9% (10% if the negative values are omitted). The impacts from the RE block application range from 2% to

33%. Multiple factors explain this range of impacts. For example, this block has a considerable effect in Washington (33%), because it increases the state's RE generation by 116% and RE accounts for a substantial percentage of the state's total generation (not counting hydroelectric power): 30% in 2012 and 65% in 2030. Although Kentucky's RE generation increases by 415% between 2012 and 2030 (from 0.4% to 2%), the RE block has a relatively small impact, because RE continues to account for a small percentage of the state's total generation.

Building block 4 has the largest impact (tied with block 2) on emission rate baselines, reducing them, on average, by 13%, but the range of impacts is between 4% and 37%. This range is a result of several factors, including (1) the contribution of in-state electricity generation that comes from hydroelectric power or nuclear power; and (2) whether the state is a net importer or net exporter of electricity.

Although the isolated building block application (in **Table 7**) provides a comparison of the relative magnitude of potential effects in each state, states have the flexibility to combine the building blocks (and/or other potential activities) to meet their emission rate targets. EPA's building blocks were meant to establish the emission rate goals, not predict a particular outcome in a state's electricity generation profile.

Table 5. Equation for CO_2 Emission Rate Goals

Building Block (BB) Adjustments

$$\text{2030 Emission Rate Goal} = \frac{\text{coal generation } \textbf{(BB2)} \times \text{coal emission rate (}\textbf{BB1}\text{)} + \text{OG generation } \textbf{(BB2)} \times \text{OG emission rate} + \text{NGCC generation } \textbf{(BB2)} \times \text{NGCC emission rate} + \text{“Other” } CO_2 \text{ emissions}}{\text{coal generation } \textbf{(BB2)} + \text{OG generation } \textbf{(BB2)} + \text{NGCC generation } \textbf{(BB2)} + \text{“Other” generation} + \text{“At-risk” and under construction nuclear generation } \textbf{(BB3)} + \text{Renewable energy generation } \textbf{(BB3)} + \text{Avoided generation from energy efficiency } \textbf{(BB4)}}$$

Source: Prepared by CRS; additional information in EPA, *Goal Computation Technical Support Document*, at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents.

Notes: OG = oil and gas; NGCC = natural gas combined cycle; “other” generation includes fossil fuel EGUs, such as integrated gasification combined cycle (IGCC) units, high utilization combustion turbine units, and applicable thermal output at cogeneration units; “at-risk” nuclear includes 5.8% of a state’s nuclear power capacity; renewable energy includes solar, wind, geothermal, wood and wood-derived fuels, other biomass, but not hydroelectric power.

Table 6. 2012 State Emission Rate Baselines and Building Block Applications

Emission rate baselines in pounds of CO_2 emissions per MWh

State	2012 Emission Rate Baseline	Block 1	Blocks 1-2	Blocks 1-3	Blocks 1-4 (2030 Emissions Rate Goal)	Percent Reduction from 2012 Baseline
Alabama	1,444	1,385	1,264	1,139	1,059	27%
Alaska	1,351	1,340	1,237	1,191	1,003	26%
Arizona	1,453	1,394	843	814	702	52%
Arkansas	1,634	1,554	1,058	996	910	44%
California	698	697	662	615	537	23%
Colorado	1,714	1,621	1,334	1,222	1,108	35%
Connecticut	765	764	733	643	540	29%
Delaware	1,234	1,211	996	892	841	32%
Florida	1,199	1,169	882	812	740	38%
Georgia	1,500	1,433	1,216	926	834	44%
Hawaii	1,540	1,512	1,512	1,485	1,306	15%
Idaho	339	339	339	291	228	33%
Illinois	1,894	1,784	1,614	1,476	1,271	33%
Indiana	1,924	1,817	1,772	1,707	1,531	20%
Iowa	1,552	1,461	1,304	1,472	1,301	16%
Kansas	1,940	1,828	1,828	1,658	1,499	23%
Kentucky	2,158	2,028	1,978	1,947	1,763	18%
Louisiana	1,455	1,404	1,043	978	883	39%
Maine	437	437	425	451	378	14%
Maryland	1,870	1,772	1,722	1,394	1,187	37%
Massachusetts	925	915	819	661	576	38%
Michigan	1,690	1,603	1,408	1,339	1,161	31%
Minnesota	1,470	1,389	999	1,042	873	41%
Mississippi	1,093	1,071	809	752	692	37%
Missouri	1,963	1,849	1,742	1,711	1,544	21%
Montana	2,246	2,114	2,114	1,936	1,771	21%
Nebraska	2,009	1,889	1,803	1,652	1,479	26%
Nevada	988	970	799	720	647	35%
New Hampshire	905	887	710	532	486	46%
New Jersey	928	916	811	616	531	43%
New Mexico	1,586	1,513	1,277	1,163	1,048	34%
New York	978	970	828	652	549	44%
North Carolina	1,647	1,560	1,248	1,125	992	40%

State	2012 Emission Rate Baseline	Block 1	Blocks 1-2	Blocks 1-3	Blocks 1-4 (2030 Emissions Rate Goal)	Percent Reduction from 2012 Baseline
North Dakota	1,994	1,875	1,875	1,865	1,783	11%
Ohio	1,850	1,751	1,673	1,512	1,338	28%
Oklahoma	1,387	1,334	1,053	964	895	35%
Oregon	717	701	565	452	372	48%
Pennsylvania	1,531	1,458	1,393	1,157	1,052	31%
Rhode Island	907	907	907	867	782	14%
South Carolina	1,587	1,506	1,342	866	772	51%
South Dakota	1,135	1,067	732	900	741	35%
Tennessee	1,903	1,797	1,698	1,322	1,163	39%
Texas	1,284	1,235	979	861	791	38%
Utah	1,813	1,713	1,508	1,454	1,322	27%
Virginia	1,302	1,258	1,047	894	810	38%
Washington	756	728	444	298	215	72%
West Virginia	2,019	1,898	1,898	1,687	1,620	20%
Wisconsin	1,827	1,728	1,487	1,379	1,203	34%
Wyoming	2,115	1,988	1,957	1,771	1,714	19%

Source: Prepared by CRS; data from EPA, Goal Computation Technical Support Document, at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents.

Notes: EPA did not establish emission rate goals for Vermont and the District of Columbia because they do not currently have affected EGUs.

Table 7. Application of EPA's Building Blocks *in Isolation*

State	2012 Emission Rate Baseline	Block 1	Percent Reduction from Baseline	Block 2	Percent Reduction from Baseline	Block 3 (Nuclear)	Percent Reduction from Baseline	Block 3 (Renewables)	Percent Reduction from Baseline	Block 4	Percent Reduction from Baseline
Alabama	1,444	1,385	4%	1,311	9%	1,444	0%	1,301	10%	1,332	8%
Alaska	1,351	1,340	1%	1,237	8%	1,351	0%	1,301	4%	1,131	16%
Arizona	1,453	1,394	4%	843	42%	1,453	0%	1,404	3%	1,247	14%
Arkansas	1,634	1,554	5%	1,087	34%	1,634	0%	1,538	6%	1,485	9%
California	698	697	0%	662	5%	698	0%	645	7%	598	14%
Colorado	1,714	1,621	5%	1,394	19%	1,714	0%	1,567	9%	1,538	10%
Connecticut	765	764	0%	733	4%	765	0%	671	12%	629	18%
Delaware	1,234	1,211	2%	999	19%	1,234	0%	1,105	10%	1,156	6%
Florida	1,199	1,169	3%	885	26%	1,199	0%	1,101	8%	1,083	10%
Georgia	1,500	1,433	5%	1,261	16%	1,243	17%	1,355	10%	1,310	13%
Hawaii	1,540	1,512	2%	1,540	0%	1,540	0%	1,512	2%	1,350	12%
Idaho	339	339	0%	339	0%	339	0%	291	14%	257	24%
Illinois	1,894	1,784	6%	1,705	10%	1,894	0%	1,732	9%	1,609	15%
Indiana	1,924	1,817	6%	1,874	3%	1,924	0%	1,853	4%	1,719	11%
Iowa	1,552	1,461	6%	1,377	11%	1,552	0%	1,752	-13%	1,390	10%
Kansas	1,940	1,828	6%	1,940	0%	1,940	0%	1,759	9%	1,738	10%
Kentucky	2,158	2,028	6%	2,093	3%	2,158	0%	2,123	2%	1,944	10%
Louisiana	1,455	1,404	3%	1,067	27%	1,455	0%	1,364	6%	1,305	10%
Maine	437	437	0%	424	3%	437	0%	465	-6%	370	16%
Maryland	1,870	1,772	5%	1,815	3%	1,870	0%	1,513	19%	1,538	18%
Massachusetts	925	915	1%	819	11%	925	0%	747	19%	781	16%

State	2012 Emission Rate Baseline	Block 1	Percent Reduction from Baseline	Block 2	Percent Reduction from Baseline	Block 3 (Nuclear)	Percent Reduction from Baseline	Block 3 (Renewables)	Percent Reduction from Baseline	Block 4	Percent Reduction from Baseline
Michigan	1,690	1,603	5%	1,476	13%	1,690	0%	1,607	5%	1,456	14%
Minnesota	1,470	1,389	5%	1,038	29%	1,470	0%	1,533	-4%	1,239	16%
Mississippi	1,093	1,071	2%	809	28%	1,130	0%	1,040	8%	1,020	10%
Missouri	1,963	1,849	6%	1,844	6%	1,963	0%	1,928	2%	1,769	10%
Montana	2,246	2,114	6%	2,246	0%	2,246	0%	2,058	8%	2,038	9%
Nebraska	2,009	1,889	6%	1,910	5%	2,009	0%	1,840	8%	1,781	11%
Nevada	988	970	2%	799	19%	988	0%	890	10%	878	11%
New Hampshire	905	887	2%	710	22%	905	0%	678	25%	804	11%
New Jersey	928	916	1%	811	13%	928	0%	704	24%	766	17%
New Mexico	1,586	1,513	5%	1,326	16%	1,586	0%	1,444	9%	1,415	11%
New York	978	970	1%	828	15%	978	0%	771	21%	790	19%
North Carolina	1,647	1,560	5%	1,298	21%	1,647	0%	1,463	11%	1,407	15%
North Dakota	1,994	1,875	6%	1,994	0%	1,994	0%	1,984	1%	1,907	4%
Ohio	1,850	1,751	5%	1,763	5%	1,850	0%	1,669	10%	1,613	13%
Oklahoma	1,387	1,334	4%	1,079	22%	1,387	0%	1,269	8%	1,280	8%
Oregon	717	701	2%	565	21%	717	0%	573	20%	565	21%
Pennsylvania	1,531	1,458	5%	1,458	5%	1,531	0%	1,272	17%	1,367	11%
Rhode Island	907	907	0%	907	0%	907	0%	867	4%	814	10%
South Carolina	1,587	1,506	5%	1,406	11%	1,147	28%	1,361	14%	1,335	16%
South Dakota	1,135	1,067	6%	754	34%	1,135	0%	1,395	-23%	965	15%
Tennessee	1,903	1,797	6%	1,794	6%	1,581	17%	1,762	7%	1,618	15%

State	2012 Emission Rate Baseline	Block 1	Percent Reduction from Baseline	Block 2	Percent Reduction from Baseline	Block 3 (Nuclear)	Percent Reduction from Baseline	Block 3 (Renewables)	Percent Reduction from Baseline	Block 4	Percent Reduction from Baseline
Texas	1,284	1,235	4%	1,002	22%	1,284	0%	1,129	12%	1,167	9%
Utah	1,813	1,713	6%	1,584	13%	1,813	0%	1,748	4%	1,643	9%
Virginia	1,302	1,258	3%	1,067	18%	1,302	0%	1,076	17%	1,133	13%
Washington	756	728	4%	444	41%	756	0%	506	33%	479	37%
West Virginia	2,019	1,898	6%	2,019	0%	2,019	0%	1,794	11%	1,929	4%
Wisconsin	1,827	1,728	5%	1,561	15%	1,827	0%	1,694	7%	1,577	14%
Wyoming	2,115	1,988	6%	2,075	2%	2,115	0%	1,911	10%	2,039	4%
Average			4%		13%		1%		9%		13%

Source: Prepared by CRS; data from EPA, technical support document spreadsheets, at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents.

Notes: Using EPA's emission rate formula and underlying data (provided in EPA spreadsheets), CRS calculated the impacts that each building block would have on the emission rate baselines. The building block applications examine their impacts in isolation. For example, the data in the block 2 column do not include the impacts of applying block one methodology, only the effects of applying block 2.

EPA did not establish emission rate goals for Vermont and the District of Columbia because they do not currently have affected EGUs.

Author Contact Information

Jonathan L. Ramseur
Specialist in Environmental Policy
jramseur@crs.loc.gov, 7-7919