

Technical Support Document (TSD) for  
Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units  
Docket ID No. EPA-HQ-OAR-2013-0602

# **Translation of the Clean Power Plan Emission Rate- Based CO<sub>2</sub> Goals to Mass-Based Equivalents**

U.S. Environmental Protection Agency

Office of Air and Radiation

November 2014

## Translation of the Clean Power Plan Emission Rate-Based CO<sub>2</sub> Goals to Mass-Based Equivalents

### I. Overview

This technical support document (TSD) describes two illustrative calculation-based approaches for translating the Clean Power Plan (CPP) emission rate-based goals to a mass-based equivalent.<sup>1</sup> These approaches should be viewed as two potential ways in which implementing authorities may wish to translate the form of the goal to a mass-based equivalent.<sup>2</sup> The first approach produces mass-based equivalents that apply to existing affected fossil fuel-fired sources only. In light of the fact that the CPP takes comment on the inclusion of new, fossil fuel-fired sources as a component of state plans,<sup>3</sup> the second approach produces mass equivalents that are inclusive of emissions from existing affected and new fossil fuel-fired sources.

This TSD describes each approach to converting emission rate-based goals to mass-based equivalents conceptually and then applies the calculation to an example state. The data, historical emissions, calculations, and results for every affected jurisdiction are available in the appendix to this TSD or the 'Rate to Mass Translation' data file posted on the CPP website.<sup>4</sup>

In its simplest form, a mass-based outcome is the product of an emissions rate and generation level:

$$\text{Mass} = \text{CO}_2 \text{ Emissions Rate} * \text{Generation}$$

In calculating a mass-based equivalent, the illustrative methodologies presented in this TSD use each affected jurisdiction's proposed rate-based goal as the emissions rate. The basic concepts and considerations that both methodologies adopt for specifying a mass equivalent generation level are detailed in the next section.

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<sup>1</sup> The Clean Power Plan (CPP) is a reference to the proposed rule, "Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units," published on June 18, 2014 and the proposed supplemental rule "Carbon Pollution Emission Guidelines for Existing Stationary Sources: EGUs in Indian Country and U.S. Territories; Multi-jurisdictional Partnerships," issued on October 28, 2014. The methodologies for translating rate-based CO<sub>2</sub> goals to mass-based equivalents described in this TSD apply to both the June 2014 proposal and October 2014 supplemental proposal.

<sup>2</sup> Note that the metric for compliance is independent from the approaches states (as well as areas of Indian country and U.S. territories with affected EGUs) may adopt to achieve them. For example, a state could potentially adopt a mass-based program that achieves a rate-based goal, or adopt rate-based standards and/or other measures and demonstrate that they have met the goal using a mass-based metric.

<sup>3</sup> The term 'state plans' is intended to encompass all implementing authorities.

<sup>4</sup> Historical emissions for affected EGUs are provided for 2012 in the 'Rate to Mass Translation' data file, which is available at <http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents>

## II. Establishing a Level of Generation for Use in the Translation from an Emission Rate-Based Goal to a Mass-Based Equivalent

This TSD defines several concepts and considerations that we use here to quantify a generation level that – combined with the rate-based goal – is capable of translating the emission rate-based goal to a mass-based equivalent.<sup>5</sup> The first concept is to recognize that the deployment of BSER measures will reduce generation from affected fossil fuel-fired sources. BSER measures are grouped into four building blocks, which describe the emission reductions achievable through:

1. Heat rate improvements to affected coal steam electric generating units (EGUs);
2. Dispatch changes among affected fossil fuel-fired EGUs;<sup>6</sup>
3. Deployment of less carbon-intensive generating capacity; and
4. Deployment of demand-side energy efficiency

The four BSER building blocks interact with the total generation level from affected fossil fuel-fired sources in different ways. For example, the application of BSER building blocks one and two is not assumed to alter the overall generation level from affected units.<sup>7</sup> In contrast, incremental renewable energy (RE), under construction nuclear facilities<sup>8</sup>, and energy efficiency (EE) under building blocks three and four are part of BSER due to their assumed replacement of generation from affected sources.<sup>9</sup>

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<sup>5</sup> The concepts and considerations presented in this section should not be viewed as prescriptive; rather, these concepts represent one particular way of constructing an approach that is capable of translating the form of the rate-based goal to a mass-based equivalent.

<sup>6</sup> EPA recognizes that the word “dispatch” can be used to describe how balancing authorities conduct real-time selection of specific generation (supply) to meet load (demand), on an hourly or even 15-minute basis. In the context of the proposed CPP and in this TSD, the word “dispatch” is intended to refer to broader patterns of generation across different generating technologies over longer periods of time, in keeping with the compliance flexibilities afforded under this rule (e.g., where emission performance can be averaged over multiple years).

<sup>7</sup> Building block one assumes no change in generation due to heat rate improvements. Likewise, the re-dispatch assumed under building block two maintains the overall level of utilization. Although BSER building blocks one and two do not affect the mass equivalent generation level, the emissions impact of applying heat rate improvements and dispatch changes among affected fossil fuel-fired EGUs is captured in the rate-based goal that is multiplied by generation to produce the mass equivalent.

<sup>8</sup> EPA has received significant comment on the inclusion of under construction nuclear facilities in BSER, including how generation from these facilities interact with affected sources and future demand. Consistent with the methodology for both approaches, the application of under construction nuclear facilities as part of BSER building block three is simply intended to reflect the June 18, 2014 proposal.

<sup>9</sup> The methodology for calculating rate-based goals in the June 2014 proposal and October 2014 supplemental proposal did not assume any reduction of historical generation or emissions from the affected fossil fuel-fired fleet due to the deployment of BSER building blocks three and four. As a result, in the context of developing mass equivalents, we demonstrate potential adjustments to the generation in the denominator of the formula in the June 2014 proposal and October 2014 supplemental proposal that was used to determine the rate-based goal. Some stakeholders have suggested that the methodology for calculating rate-based goals could itself be changed to reflect this type of assumed reduction. If the rate-based goal setting methodology was revised to incorporate the replacement of affected fossil fuel-fired generation by incremental resources under building blocks

The second concept that both approaches share is that the mass equivalent generation level should include generation from whatever set of CO<sub>2</sub> emitting sources are covered under the mass equivalent. This TSD presents two approaches to calculating mass equivalents – one that is applied only to existing affected sources and one that is inclusive of generation from new fossil fuel-fired sources. The incorporation of new sources under the second approach necessitates quantifying a mass equivalent generation level that includes expected future generation from those new fossil fuel-fired sources.

The third concept common to both approaches is that BSER is applied to generation from the historical affected fossil fuel-fired fleet, rather than to a projection of the affected fleet's future performance. Consistent with the rate-based goal setting methodology presented in the proposed CPP, the methodologies presented in this TSD apply the BSER building blocks to 2012 generation levels.

The next subsection, (a), describes the mass equivalent generation level that was developed for existing affected sources only. The following subsection, (b), specifies a generation level used for developing a mass-based equivalent that includes both affected and new fossil fuel-fired sources.

*a. Quantifying a Generation Level for Use in the Translation to a Mass-Based Equivalent for Existing Affected Sources*

This section outlines an approach to calculating a mass equivalent generation level by using the data from the June 2014 and October 2014 proposal's goal calculation appendices.<sup>10</sup> As an example, the steps described in this section will be applied to data from Ohio (the same state for which EPA included example calculations of the rate-based goals in the Goal Computation TSD, available in the docket to the proposed CPP rule). Final mass equivalent generation levels under this approach can be found for all jurisdictions in Table 1 of the appendix to this TSD; interim values can be found in the 'Rate to Mass Translation' data file posted on the CPP website.<sup>11</sup>

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three and four, the generation total embedded in the rate-based goal may not require any adjustment to produce a viable mass equivalent based on historical data.

<sup>10</sup> Appendix 1 of the Goal Computation TSD in the June 2014 proposed rule provides the derivation of the proposed (i.e., Option 1) rate-based goals. Appendix 2 of the supplemental proposal provides the derivation of the three proposed Option 1 rate-based goals. All generation and mass equivalent values presented in this TSD are calculated based on the Option 1 goals from the June 2014 proposal and Option 1A goals from the October 2014 supplemental proposal. Values for the alternative (e.g., Option 2) rate-based goals are provided in the 'Rate to Mass Translation' data file.

<sup>11</sup> Final generation levels and mass equivalents refer to 2029 values under the proposed goals; interim values are average values from 2020-2029.

The starting point under this methodology is to quantify the historical generation from the affected fossil fuel-fired fleet:<sup>12</sup>

- **Historical Affected Fossil Generation** = 2012 Coal Generation + 2012 NGCC Generation + Expected Generation from Under Construction NGCC + 2012 Oil/Gas Steam Generation + 2012 'Other' Fossil Generation<sup>13</sup>
- **Ohio Historical Affected Fossil Generation**<sup>14</sup> = 86,473,075 MWh (Coal) + 20,907,183 MWh (NGCC) + 2,604,017 MWh (Under Construction NGCC) + 321,602 MWh (Oil/Gas Steam) + 214,178 MWh (Other) = 110,520,055 MWh

The application of BSER is expected to reduce generation from the affected fossil fuel-fired fleet as the deployment of incremental resources under building blocks three and four replace generation from affected fossil fuel-fired sources. The continuing operation of existing resources under building block three (RE and at-risk nuclear) is not assumed to affect historical generation levels.<sup>15</sup> This new, adjusted level of affected fossil generation that reflects the deployment of incremental building block three and four resources is defined as:

- **Adjusted Affected Fossil Generation**<sub>Year X</sub><sup>16</sup> = Historical Affected Fossil Generation – Incremental RE<sub>Year X</sub> – Under Construction Nuclear – Incremental EE<sub>Year X</sub>
- **Ohio Final Adjusted Affected Fossil Generation**<sup>17</sup> = 110,520,055 MWh (Historical Affected Fossil Generation) – 12,036,972 MWh (2029 Incremental RE) – 0 MWh (Under Construction Nuclear) – 16,284,584 MWh (2029 Incremental EE) = 82,198,499 MWh

Generation from affected fossil fuel-fired sources is only one component of the total generation associated with affected entities. Inclusion of existing and incremental non-fossil generation connected to building blocks three and four is necessary to fully define the mass equivalent generation level:

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<sup>12</sup> All of the generation totals described in this TSD are consistent with the totals presented in Appendix 1 of the Goal Computation TSD; <http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents>.

<sup>13</sup> 'Other' fossil generation includes sources that are likely subject to 111(d) rulemaking, but not subject to BSER building block abatement measures (e.g., IGCC, high utilization CTs, and useful thermal output at cogeneration units); generation and emissions from 'other' fossil fuel-fired sources are also included in the calculation of the proposed rate-based goals.

<sup>14</sup> Example equations presented in this TSD may not sum due to rounding; please refer to the 'Rate to Mass Translation' data file for complete calculations.

<sup>15</sup> The components for determining the adjusted affected fossil generation level can be found in Table 1 of the appendix.

<sup>16</sup> In two states (Washington and Idaho), the proposal identified incremental generation under building blocks three and four that exceed the amount of affected fossil fuel-fired generation in 2012. A strict application of this equation for those states would yield a negative number for adjusted affected fossil generation; instead, the approach is modified to limit the minimum amount of adjusted affected fossil generation to zero. It should be noted that a zero value for adjusted affected fossil generation does not imply a zero mass equivalent because the emissions intensity associated with the mass equivalent generation level is defined by the (non-zero) rate-based goal.

<sup>17</sup> 'Final' generation totals and mass equivalents refer to values for 2029.

- **Mass Equivalent Generation Level** $_{\text{Year X}} = \text{Adjusted Affected Fossil Generation}_{\text{Year X}} + \text{BSER Building Block Three Generation}_{\text{Year X}}$ <sup>18</sup> + BSER Building Block Four Avoided Generation $_{\text{Year X}}$ <sup>19</sup>
- **Ohio Final Mass Equivalent Generation Level** = 82,198,499 MWh (2029 Adjusted Affected Fossil Generation) + 14,768,671 MWh (2029 Building Block Three Generation) + 16,284,584 MWh (2029 Building Block Four Avoided Generation) = 113,251,754 MWh

b. Quantifying a Generation Level for Use in the Translation to a Mass-Based Equivalent for Existing Affected and New Fossil Fuel-Fired Sources

EPA's illustrative approach to developing mass equivalent generation levels inclusive of new fossil fuel-fired sources assumes those new sources contribute an amount of incremental generation that is equal to projected demand growth.<sup>20</sup> To calculate projections of future demand, EPA assigns an annual average growth rate based on regional demand projections from the Energy Information Administration's (EIA's) 2013 Annual Energy Outlook (AEO2013).<sup>21</sup> Using regional demand projections from EIA's AEO2013 is consistent with the methodology used to develop incremental EE deployment levels under building block four, as well as the demand projections underlying the illustrative compliance scenarios presented in the CPP's regulatory impact analysis (RIA). To quantify a sales level for all future years, the annual average growth rate is applied to each jurisdiction's historical 2012 power sector sales. Under this approach, projected sales for any future year are:

- **Projected Sales** $_{\text{Year X}} = \text{Historical 2012 Sales} * (1 + \text{Regional Growth Rate})^{(\text{Year X} - 2012)}$
- **Ohio Final Projected Sales** = 153,780 GWh \* 1.0044898<sup>(2029-2012)</sup> = 165,949 GWh

To convert projected sales to a generation increment, transmission losses and the generation from under construction NGCC facilities must be accounted for. The incremental demand for new generation is:

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<sup>18</sup> Building block three generation equals generation from existing RE, incremental RE, at-risk nuclear, and under construction nuclear.

<sup>19</sup> Building block four avoided generation equals avoided generation from incremental EE.

<sup>20</sup> Both methodologies for quantifying a mass equivalent generation level described in this TSD assume that incremental resources under building blocks three and four replace historical generation from affected fossil fuel-fired sources and those incremental resources are therefore unavailable to meet new demand for electricity.

<sup>21</sup> Growth rates are the annual average growth rate at the Electricity Market Module (EMM) region level for 2012-2029. Alaska, Hawaii, Guam and Puerto Rico are not included in EMM projections. Assigned growth rates for Alaska and Hawaii reflect the average growth rate of the lower 48 states from 2012-2029; Puerto Rico and Guam are assigned a zero percent growth rate. A map displaying the 22 EMM regions can be found at [http://www.eia.gov/forecasts/aeo/pdf/nerc\\_map.pdf](http://www.eia.gov/forecasts/aeo/pdf/nerc_map.pdf); a listing of the EMM region assigned is provided in the 'Rate to Mass Translation' data file. Jurisdictions that are in multiple EMM regions are assigned the growth rate of the region that encompasses the largest portion of that jurisdiction's territory.

- **Incremental Demand for New Generation** $_{Year X} = (Projected Sales_{Year X} - Historical 2012 Sales) * (1 + Percent Transmission Losses^{22}) - Assumed Generation from Under Construction NGCC EGUs^{23}$
- **Ohio Final Incremental Demand for New Generation** = (165,949 GWh – 153,780 GWh)\* 1.0751 – 2,597 GWh<sup>24</sup> = 10,486 GWh

Final incremental demand levels for new generation are provided in Table 2 of the appendix; interim demand levels are available in the ‘Rate to Mass Translation’ data file posted on the CPP website.

The final step in producing a mass equivalent generation level inclusive of new fossil fuel-fired sources is to add the incremental demand for new generation to generation from existing affected sources, building block three generation, and building block four avoided generation. The final mass equivalent generation incorporating new fossil fuel-fired sources is:

- **Mass Equivalent Generation Incorporating New Sources** $_{Year X} = Adjusted Affected Fossil Generation_{Year X} + BSER Building Block Three Generation_{Year X} + BSER Building Block Four Generation_{Year X} + Incremental Demand for New Generation_{Year X}$
- **Ohio Final Mass Equivalent Generation Incorporating New Sources** = 82,198,499 MWh (2029 Adjusted Affected Fossil Generation) + 14,768,671 MWh (2029 Building Block Three Generation) + 16,284,584 MWh (2029 Building Block Four Avoided Generation) + 10,485,798 MWh = 123,737,553 MWh

Final mass equivalent generation levels incorporating new sources are provided in Table 3 of the appendix; interim mass equivalent generation levels incorporating new sources are available in the ‘Rate to Mass Translation’ data file posted on the CPP website.

### III. Establishing Mass-Based Equivalents

With a fully defined emissions rate (proposed rate-based goal) and generation level (mass equivalent generation), the mass-based equivalent calculation is:

$$Mass\ Equivalent = Proposed\ Emission\ Rate\ Goal * Mass\ Equivalent\ Generation\ Level$$

- **Final CPP Mass-Based Equivalent for Ohio Affected Sources** = 1,338.341 lbs/MWh (Proposed 2029 Emission Rate-Based Goal) \* 113,251,754 MWh (Final Mass Equivalent Generation) = 68,751 Thousand Metric Tons

<sup>22</sup> Consistent with the methodology used to establish each the rate-based CO<sub>2</sub> goal, transmission losses are assumed to be 7.51%.

<sup>23</sup> Under construction NGCC EGUs are assumed to operate at a 55% capacity factor to satisfy future demand requirements.

<sup>24</sup> The generation value for under construction NGCC in this equation does not match the generation value for NGCC in the historical affected fossil generation because 2012 was a leap year and 2029 is not.

- **Final CPP Mass-Based Equivalent for Ohio Affected and New Sources** = 1,338.341 lbs/MWh (Proposed 2029 Emission Rate-Based Goal)<sup>25</sup> \* 123,737,553 MWh (Final Mass Equivalent Generation Incorporating New Sources) = 75,116 Thousand Metric Tons

Final and interim mass-based equivalents are provided in Tables 4 and 5 of the appendix.

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<sup>25</sup> The inclusion of new fossil fuel-fired sources does not impact the proposed emission rate-based goal.



IV. Appendix

**Table 1: Final Mass Equivalent Generation Level for Existing Affected Sources (MWh)<sup>26</sup>**

|               | Historical Affected Fossil Generation | BSER Building Block Three Generation (Incremental) | BSER Building Block Three Generation (Existing) | BSER Building Block Four Avoided Generation | Final Mass Equivalent Generation Level |
|---------------|---------------------------------------|--|---|---|--|
| Alabama       | 99,537,272                            | 11,516,247   | 5,106,082                                       | 8,785,234                                   | 104,643,354                            |
| Alaska        | 3,162,202                             | 123,131  | 39,958  | 622,817                                     | 3,202,160                              |
| Arizona       | 52,171,488                            | 1,965,673  | 3,516,139                                       | 9,215,884                                   | 55,687,627                             |
| Arkansas      | 46,201,403                            | 3,048,452  | 2,502,407                                       | 4,890,534                                   | 48,703,810                             |
| California    | 116,004,809                           | 11,183,859   | 31,001,494                                      | 22,924,771                                  | 147,006,302                            |
| Colorado      | 44,226,308                            | 4,647,738  | 6,192,082                                       | 5,658,360                                   | 50,418,389                             |
| Connecticut   | 15,764,474                            | 2,447,850  | 1,637,662                                       | 3,767,583                                   | 17,402,136                             |
| Delaware      | 7,663,274                             | 907,301  | 131,051   | 529,068                                     | 7,794,325                              |
| Florida       | 197,040,669                           | 17,585,816   | 6,146,902                                       | 21,348,682                                  | 203,187,571                            |
| Fort Mojave   | 1,360,093                             | 0  | 0   | 4,724                                       | 1,360,093                              |
| Georgia       | 78,647,028                            | 26,344,420   | 5,106,777                                       | 12,149,397                                  | 83,753,806                             |
| Guam          | 713,075                               | 0  | 0   | 162,866                                     | 713,075                                |
| Hawaii        | 5,846,229                             | 122,112  | 924,815   | 949,330                                     | 6,771,044                              |
| Idaho         | 1,639,922                             | 682,185  | 2,514,502                                       | 1,324,481                                   | 4,521,168                              |
| Illinois      | 87,763,971                            | 9,445,344  | 13,678,002                                      | 17,952,530                                  | 101,441,973                            |
| Indiana       | 101,683,754                           | 4,000,719  | 3,546,367                                       | 12,564,129                                  | 105,230,121                            |
| Iowa          | 34,797,763                            | 0  | 8,843,705                                       | 5,730,306                                   | 43,641,468                             |
| Kansas        | 29,612,590                            | 3,632,285  | 5,795,382                                       | 4,123,417                                   | 35,407,972                             |
| Kentucky      | 87,450,251                            | 1,380,676  | 332,879   | 9,317,877                                   | 87,783,130                             |
| Louisiana     | 63,550,051                            | 4,461,577  | 3,415,267                                       | 7,654,779                                   | 66,965,319                             |
| Maine         | 4,112,445                             | 0  | 3,611,728                                       | 1,507,396                                   | 7,724,173                              |
| Maryland      | 19,887,662                            | 5,083,916  | 1,685,686                                       | 4,653,837                                   | 21,573,348                             |
| Massachusetts | 26,236,160                            | 6,770,058  | 2,159,679                                       | 5,234,817                                   | 28,395,839                             |
| Michigan      | 76,784,775                            | 4,270,420  | 5,613,348                                       | 13,262,541                                  | 82,398,123                             |
| Minnesota     | 27,832,261                            | 0  | 8,728,734                                       | 7,095,830                                   | 36,560,995                             |
| Mississippi   | 50,281,217                            | 3,949,240  | 2,141,064                                       | 4,920,527                                   | 52,422,281                             |
| Missouri      | 77,794,081                            | 1,464,950  | 1,848,236                                       | 8,741,141                                   | 79,642,317                             |
| Montana       | 14,704,923                            | 1,460,954  | 1,261,752                                       | 1,624,321                                   | 15,966,675                             |
| Navajo        | 29,629,453                            | 0  | 0   | 66,525                                      | 29,629,453                             |

<sup>26</sup> The state generation totals presented in this TSD are consistent with the data in Appendix 1 of the Goal Computation TSD (<http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents>), which demonstrate the derivation of the proposed (i.e., Option 1) rate-based goals. Generation totals for U.S. territories and areas of Indian country with affected EGUs are consistent with the Option 1A rate-based goals presented in the October 2014 supplemental proposal. Generation totals associated with alternative rate-based goals for all affected jurisdictions are provided in the ‘Rate to Mass Translation’ data file posted on the CPP website.

|                |             |            |            |            |             |
|----------------|-------------|------------|------------|------------|-------------|
| Nebraska       | 25,122,145  | 2,472,665  | 1,921,592  | 3,448,297  | 27,043,737  |
| Nevada         | 28,394,937  | 3,437,309  | 2,968,630  | 3,908,761  | 31,363,568  |
| New Hampshire  | 8,300,824   | 3,440,938  | 1,956,900  | 1,286,054  | 10,257,724  |
| New Jersey     | 25,087,907  | 8,866,751  | 2,896,752  | 5,889,351  | 27,984,658  |
| New Mexico     | 19,292,945  | 2,148,144  | 2,573,851  | 2,641,866  | 21,866,796  |
| New York       | 63,251,690  | 19,069,478 | 7,603,065  | 16,847,624 | 70,854,754  |
| North Carolina | 77,031,073  | 8,964,257  | 4,999,544  | 12,169,414 | 82,030,617  |
| North Dakota   | 28,186,691  | 179,905    | 5,280,052  | 1,536,491  | 33,466,743  |
| Ohio           | 110,520,055 | 12,036,972 | 2,731,699  | 16,284,584 | 113,251,754 |
| Oklahoma       | 67,548,140  | 7,058,594  | 8,520,724  | 6,362,323  | 76,068,865  |
| Oregon         | 14,188,366  | 5,360,143  | 7,207,229  | 5,727,910  | 21,395,596  |
| Pennsylvania   | 142,523,873 | 30,871,737 | 8,939,513  | 18,188,845 | 151,463,386 |
| Puerto Rico    | 19,983,504  | 0          | 0          | 1,890,703  | 19,983,504  |
| Rhode Island   | 8,140,017   | 374,215    | 101,895    | 935,118    | 8,241,912   |
| South Carolina | 40,089,998  | 24,924,416 | 5,091,813  | 8,553,402  | 45,181,812  |
| South Dakota   | 2,950,257   | 0          | 1,818,850  | 1,028,768  | 4,769,107   |
| Tennessee      | 40,922,593  | 12,339,440 | 2,382,994  | 7,634,031  | 43,305,587  |
| Texas          | 342,653,237 | 51,945,805 | 36,307,703 | 38,157,030 | 378,960,939 |
| Utah           | 32,899,850  | 1,273,345  | 1,099,724  | 3,524,028  | 33,999,574  |
| Ute            | 3,090,433   | 0          | 0          | 43,635     | 3,090,433   |
| Virginia       | 47,510,651  | 8,833,564  | 4,003,719  | 6,269,112  | 51,514,370  |
| Washington     | 10,582,589  | 9,511,207  | 8,721,051  | 11,178,874 | 29,411,132  |
| West Virginia  | 70,344,849  | 8,976,473  | 1,296,563  | 3,349,795  | 71,641,412  |
| Wisconsin      | 42,564,851  | 3,636,123  | 3,770,063  | 7,322,473  | 46,334,914  |
| Wyoming        | 43,970,291  | 5,058,889  | 4,369,107  | 1,775,751  | 48,339,398  |

**Table 2: Incremental Demand for New Generation in 2029 (GWh)<sup>27</sup>**

|            | <b>Historical<br/>2012<br/>Sales</b> | <b>Regional<br/>Growth Rate<br/>(2012-2029)</b> | <b>Projected<br/>2029<br/>Sales</b> | <b>Expected<br/>Generation<br/>From Under<br/>Construction<br/>NGCC Facilities<br/>(2029)</b> | <b>Incremental<br/>Demand for<br/>New<br/>Generation<br/>(2029)</b> |
|------------|--------------------------------------|---|-------------------------------------|---|---|
| Alabama    | 86,239                               | 1.08%   | 103,563                             | -   | 18,625  |
| Alaska     | 6,418                                | 0.80%   | 7,348                               | -   | 1,000   |
| Arizona    | 76,275                               | 1.31%   | 95,141                              | -   | 20,283  |
| Arkansas   | 46,912                               | 0.90%   | 54,646                              | -   | 8,315   |
| California | 262,824                              | 0.92%   | 306,906                             | 8,938   | 38,455  |
| Colorado   | 54,145                               | 1.28%   | 67,257                              | 964   | 13,134  |

<sup>27</sup> Exact, non-rounded values for sales, generation, and growth rates are available in the 'Rate to Mass Translation' data file.

|                |         |       |         |        |        |
|----------------|---------|-------|---------|--------|--------|
| Connecticut    | 29,844  | 0.29% | 31,348  | -      | 1,617  |
| Delaware       | 11,530  | 0.55% | 12,659  | -      | 1,214  |
| Florida        | 221,261 | 1.14% | 268,106 | 5,574  | 44,789 |
| Fort Mojave    | 48      | 1.31% | 60      | -      | 13     |
| Georgia        | 131,220 | 1.08% | 157,581 | -      | 28,340 |
| Guam           | 1,563   | 0.00% | 1,563   | -      | -      |
| Hawaii         | 9,643   | 0.80% | 11,041  | -      | 1,503  |
| Idaho          | 23,920  | 1.06% | 28,606  | -      | 5,039  |
| Illinois       | 144,869 | 0.45% | 156,332 | -      | 12,325 |
| Indiana        | 105,788 | 0.45% | 114,160 | -      | 9,000  |
| Iowa           | 46,190  | 0.53% | 50,522  | -      | 4,657  |
| Kansas         | 40,302  | 0.50% | 43,878  | -      | 3,845  |
| Kentucky       | 89,249  | 1.00% | 105,782 | 3,084  | 14,691 |
| Louisiana      | 84,731  | 0.90% | 98,699  | -      | 15,018 |
| Maine          | 11,788  | 0.29% | 12,381  | -      | 639    |
| Maryland       | 62,384  | 0.55% | 68,493  | -      | 6,567  |
| Massachusetts  | 55,834  | 0.29% | 58,647  | -      | 3,025  |
| Michigan       | 105,880 | 0.32% | 111,747 | -      | 6,308  |
| Minnesota      | 68,748  | 0.53% | 75,195  | -      | 6,932  |
| Mississippi    | 48,424  | 0.90% | 56,408  | 723    | 7,860  |
| Missouri       | 82,536  | 0.40% | 88,352  | -      | 6,253  |
| Montana        | 13,955  | 1.06% | 16,689  | -      | 2,939  |
| Navajo         | 676     | 1.31% | 843     | -      | 180    |
| Nebraska       | 30,921  | 0.53% | 33,821  | -      | 3,118  |
| Nevada         | 35,369  | 1.06% | 42,298  | -      | 7,450  |
| New Hampshire  | 10,922  | 0.29% | 11,472  | -      | 592    |
| New Jersey     | 75,208  | 0.55% | 82,573  | -      | 7,917  |
| New Mexico     | 23,317  | 1.31% | 29,084  | -      | 6,200  |
| New York       | 144,501 | 0.25% | 150,702 | -      | 6,667  |
| North Carolina | 128,555 | 1.13% | 155,678 | 10,836 | 18,324 |
| North Dakota   | 14,727  | 0.53% | 16,109  | -      | 1,485  |
| Ohio           | 153,780 | 0.45% | 165,949 | 2,597  | 10,486 |
| Oklahoma       | 59,465  | 0.89% | 69,165  | -      | 10,429 |
| Oregon         | 47,200  | 1.06% | 56,448  | -      | 9,942  |
| Pennsylvania   | 146,244 | 0.55% | 160,564 | -      | 15,395 |
| Puerto Rico    | 18,150  | 0.00% | 18,150  | -      | -      |
| Rhode Island   | 7,768   | 0.29% | 8,160   | -      | 421    |
| South Carolina | 78,055  | 1.13% | 94,523  | -      | 17,705 |
| South Dakota   | 11,749  | 0.53% | 12,851  | -      | 1,185  |
| Tennessee      | 96,684  | 1.00% | 114,595 | -      | 19,256 |
| Texas          | 366,154 | 0.89% | 425,373 | -      | 63,667 |
| Utah           | 29,943  | 1.06% | 35,810  | -      | 6,307  |
| Ute            | 470     | 1.06% | 562     | -      | 99     |
| Virginia       | 107,825 | 1.13% | 130,574 | 9,289  | 15,168 |
| Washington     | 93,230  | 1.06% | 111,496 | -      | 19,638 |
| West Virginia  | 30,872  | 0.45% | 33,315  | -      | 2,626  |

|           |        |       |        |       |       |
|-----------|--------|-------|--------|-------|-------|
| Wisconsin | 69,542 | 0.40% | 74,363 | -     | 5,183 |
| Wyoming   | 16,995 | 1.06% | 20,325 | 1,060 | 2,520 |

**Table 3: Final Mass Equivalent Generation Level for Existing Affected and New Sources (MWh)**

|                | <b>Mass Equivalent Generation Level for Affected Sources</b> | <b>Incremental Demand for New Generation</b> | <b>Mass Equivalent Generation Level for Affected and New Sources</b> |
|----------------|--|--|--|
| Alabama        | 104,643,354  | 18,625,370                                   | 123,268,725  |
| Alaska         | 3,202,160  | 999,956                                      | 4,202,116  |
| Arizona        | 55,687,627   | 20,283,128                                   | 75,970,755   |
| Arkansas       | 48,703,810   | 8,314,743                                    | 57,018,553   |
| California     | 147,006,302  | 38,454,957                                   | 185,461,259  |
| Colorado       | 50,418,389   | 13,133,634                                   | 63,552,023   |
| Connecticut    | 17,402,136   | 1,616,721                                    | 19,018,856   |
| Delaware       | 7,794,325  | 1,213,786                                    | 9,008,111  |
| Florida        | 203,187,571  | 44,788,698                                   | 247,976,269  |
| Fort Mojave    | 1,360,093  | 12,764                                       | 1,372,857  |
| Georgia        | 83,753,806   | 28,340,253                                   | 112,094,059  |
| Guam           | 713,075  | -  | 713,075  |
| Hawaii         | 6,771,044  | 1,502,513                                    | 8,273,557  |
| Idaho          | 4,521,168  | 5,038,527                                    | 9,559,695  |
| Illinois       | 101,441,973  | 12,324,551                                   | 113,766,524  |
| Indiana        | 105,230,121  | 8,999,839                                    | 114,229,960  |
| Iowa           | 43,641,468   | 4,657,387                                    | 48,298,855   |
| Kansas         | 35,407,972   | 3,844,550                                    | 39,252,521   |
| Kentucky       | 87,783,130   | 14,691,398                                   | 102,474,529  |
| Louisiana      | 66,965,319   | 15,017,752                                   | 81,983,071   |
| Maine          | 7,724,173  | 638,561                                      | 8,362,734  |
| Maryland       | 21,573,348   | 6,567,269                                    | 28,140,617   |
| Massachusetts  | 28,395,839   | 3,024,661                                    | 31,420,500   |
| Michigan       | 82,398,123   | 6,307,587                                    | 88,705,710   |
| Minnesota      | 36,560,995   | 6,931,860                                    | 43,492,855   |
| Mississippi    | 52,422,281   | 7,860,099                                    | 60,282,380   |
| Missouri       | 79,642,317   | 6,252,748                                    | 85,895,064   |
| Montana        | 15,966,675   | 2,939,474                                    | 18,906,149   |
| Navajo         | 29,629,453   | 179,767                                      | 29,809,220   |
| Nebraska       | 27,043,737   | 3,117,742                                    | 30,161,479   |
| Nevada         | 31,363,568   | 7,450,116                                    | 38,813,683   |
| New Hampshire  | 10,257,724   | 591,669                                      | 10,849,394   |
| New Jersey     | 27,984,658   | 7,917,277                                    | 35,901,936   |
| New Mexico     | 21,866,796   | 6,200,450                                    | 28,067,246   |
| New York       | 70,854,754   | 6,667,260                                    | 77,522,014   |
| North Carolina | 82,030,617   | 18,323,738                                   | 100,354,356  |
| North Dakota   | 33,466,743   | 1,484,956                                    | 34,951,699   |

|                |             |            |             |
|----------------|-------------|------------|-------------|
| Ohio           | 113,251,754 | 10,485,798 | 123,737,553 |
| Oklahoma       | 76,068,865  | 10,428,942 | 86,497,807  |
| Oregon         | 21,395,596  | 9,942,253  | 31,337,849  |
| Pennsylvania   | 151,463,386 | 15,395,241 | 166,858,627 |
| Puerto Rico    | 19,983,504  | -          | 19,983,504  |
| Rhode Island   | 8,241,912   | 420,830    | 8,662,742   |
| South Carolina | 45,181,812  | 17,704,703 | 62,886,514  |
| South Dakota   | 4,769,107   | 1,184,701  | 5,953,808   |
| Tennessee      | 43,305,587  | 19,255,678 | 62,561,264  |
| Texas          | 378,960,939 | 63,666,577 | 442,627,517 |
| Utah           | 33,999,574  | 6,307,238  | 40,306,812  |
| Ute            | 3,090,433   | 99,002     | 3,189,435   |
| Virginia       | 51,514,370  | 15,168,202 | 66,682,572  |
| Washington     | 29,411,132  | 19,638,144 | 49,049,276  |
| West Virginia  | 71,641,412  | 2,626,384  | 74,267,796  |
| Wisconsin      | 46,334,914  | 5,183,311  | 51,518,225  |
| Wyoming        | 48,339,398  | 2,519,886  | 50,859,284  |

**Table 4: Interim and Final Mass Equivalents – Existing Affected Sources<sup>28</sup>**

|             | <b>Interim Mass Equivalent<br/>(Thousand Metric Tons)</b> | <b>Final Mass Equivalent<br/>(Thousand Metric Tons)</b> |
|-------------|---|---|
| Alabama     | 54,441  | 50,267  |
| Alaska      | 1,593   | 1,457   |
| Arizona     | 18,559  | 17,734  |
| Arkansas    | 21,384  | 20,096  |
| California  | 37,052  | 35,805  |
| Colorado    | 26,495  | 25,335  |
| Connecticut | 4,712   | 4,265   |
| Delaware    | 3,226   | 2,972   |
| Florida     | 73,209  | 68,221  |
| Fort Mojave | 528   | 528   |
| Georgia     | 33,850  | 31,676  |
| Guam        | 561   | 513   |
| Hawaii      | 4,232   | 4,010   |
| Idaho       | 472   | 468   |

<sup>28</sup> The state mass equivalents presented in this TSD are consistent with the data in Appendix 1 of the Goal Computation TSD (<http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents>), which demonstrate the derivation of the proposed (i.e., Option 1) rate-based goals. Mass equivalents for U.S. territories and areas of Indian country with affected EGUs are consistent with the Option 1A rate-based goals presented in the October 2014 supplemental proposal. Mass equivalents associated with alternative rate-based goals for all affected jurisdictions are provided in the ‘Rate to Mass Translation’ data file posted on the CPP website.

|                |         |         |
|----------------|---------|---------|
| Illinois       | 62,868  | 58,471  |
| Indiana        | 76,689  | 73,090  |
| Iowa           | 26,554  | 25,749  |
| Kansas         | 25,346  | 24,081  |
| Kentucky       | 73,409  | 70,203  |
| Louisiana      | 28,808  | 26,823  |
| Maine          | 1,377   | 1,323   |
| Maryland       | 13,186  | 11,613  |
| Massachusetts  | 8,435   | 7,414   |
| Michigan       | 45,868  | 43,403  |
| Minnesota      | 15,106  | 14,474  |
| Mississippi    | 17,397  | 16,449  |
| Missouri       | 58,558  | 55,792  |
| Montana        | 13,630  | 12,828  |
| Navajo         | 26,757  | 26,731  |
| Nebraska       | 19,577  | 18,142  |
| Nevada         | 9,915   | 9,209   |
| New Hampshire  | 2,541   | 2,262   |
| New Jersey     | 8,213   | 6,741   |
| New Mexico     | 10,977  | 10,391  |
| New York       | 20,415  | 17,649  |
| North Carolina | 40,068  | 36,918  |
| North Dakota   | 27,577  | 27,069  |
| Ohio           | 74,614  | 68,751  |
| Oklahoma       | 32,133  | 30,892  |
| Oregon         | 3,952   | 3,614   |
| Pennsylvania   | 81,022  | 72,272  |
| Puerto Rico    | 13,321  | 12,805  |
| Rhode Island   | 3,072   | 2,924   |
| South Carolina | 17,218  | 15,816  |
| South Dakota   | 1,731   | 1,602   |
| Tennessee      | 24,624  | 22,837  |
| Texas          | 146,705 | 135,937 |
| Utah           | 21,244  | 20,384  |
| Ute            | 2,804   | 2,787   |
| Virginia       | 20,650  | 18,923  |
| Washington     | 2,728   | 2,862   |
| West Virginia  | 56,814  | 52,636  |
| Wisconsin      | 26,916  | 25,275  |
| Wyoming        | 39,649  | 37,590  |

**Table 5: Interim and Final Mass Equivalents – Existing Affected and New Sources<sup>29</sup>**

|               | <b>Interim Mass Equivalent<br/>(Thousand Metric Tons)</b> | <b>Final Mass Equivalent<br/>(Thousand Metric Tons)</b> |
|---------------|---|---|
| Alabama       | 61,335  | 59,214  |
| Alaska        | 1,948   | 1,912   |
| Arizona       | 23,365  | 24,193  |
| Arkansas      | 23,996  | 23,527  |
| California    | 43,370  | 45,171  |
| Colorado      | 31,250  | 31,935  |
| Connecticut   | 5,027   | 4,661   |
| Delaware      | 3,588   | 3,435   |
| Florida       | 84,104  | 83,259  |
| Fort Mojave   | 532   | 532   |
| Georgia       | 41,995  | 42,394  |
| Guam          | 561   | 513   |
| Hawaii        | 4,906   | 4,899   |
| Idaho         | 868   | 990   |
| Illinois      | 68,371  | 65,574  |
| Indiana       | 81,433  | 79,341  |
| Iowa          | 28,605  | 28,496  |
| Kansas        | 27,331  | 26,696  |
| Kentucky      | 81,470  | 81,953  |
| Louisiana     | 33,425  | 32,839  |
| Maine         | 1,460   | 1,432   |
| Maryland      | 16,045  | 15,148  |
| Massachusetts | 9,080   | 8,204   |
| Michigan      | 48,411  | 46,725  |
| Minnesota     | 17,175  | 17,218  |
| Mississippi   | 19,194  | 18,916  |
| Missouri      | 61,887  | 60,173  |
| Montana       | 15,420  | 15,190  |
| Navajo        | 26,873  | 26,893  |
| Nebraska      | 21,201  | 20,233  |
| Nevada        | 11,591  | 11,396  |
| New Hampshire | 2,646   | 2,392   |
| New Jersey    | 9,857   | 8,649   |
| New Mexico    | 13,184  | 13,337  |

<sup>29</sup> The state mass equivalents presented in this TSD are consistent with the data in Appendix 1 of the Goal Computation TSD (<http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents>), which demonstrate the derivation of the proposed (i.e., Option 1) rate-based goals. 2012 historical emissions from affected EGUs and mass equivalents for U.S. territories and areas of Indian country with affected EGUs are consistent with the Option 1A rate-based goals presented in the October 2014 supplemental proposal. 2012 historical emissions from affected EGUs and mass equivalents associated with alternative rate-based goals for all affected jurisdictions are provided in the 'Rate to Mass Translation' data file posted on the CPP website.

|                |         |         |
|----------------|---------|---------|
| New York       | 21,791  | 19,310  |
| North Carolina | 44,871  | 45,165  |
| North Dakota   | 28,465  | 28,270  |
| Ohio           | 79,112  | 75,116  |
| Oklahoma       | 35,290  | 35,127  |
| Oregon         | 5,250   | 5,293   |
| Pennsylvania   | 86,920  | 79,618  |
| Puerto Rico    | 13,321  | 12,805  |
| Rhode Island   | 3,186   | 3,074   |
| South Carolina | 22,001  | 22,014  |
| South Dakota   | 2,040   | 2,000   |
| Tennessee      | 32,425  | 32,992  |
| Texas          | 164,279 | 158,775 |
| Utah           | 24,063  | 24,165  |
| Ute            | 2,868   | 2,876   |
| Virginia       | 23,856  | 24,494  |
| Washington     | 4,367   | 4,772   |
| West Virginia  | 58,317  | 54,566  |
| Wisconsin      | 29,091  | 28,102  |
| Wyoming        | 40,878  | 39,550  |