Technical Support Document (TSD) for the CAA Section 111(d) Emission Guidelines for Existing Power Plants

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Goal Computation Technical Support Document

U.S Environmental Protection Agency

Office of Air and Radiation

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State Emission Rate Goal Setting under 111(d)

This Technical Support Document (TSD) provides information that supports the EPA's determination of state emission rate goals under the Proposed Rule. Section VII of the preamble discusses state emission rate goals more broadly, and the Green House Gas (GHG) Abatement Measures TSD explains the technical basis for the development of the Best System of Emission Reductions (BSER) that inform the state goals. This TSD provides detailed explanation of the data, the data underlying the state goal calculation, the BSER-based calculations used to determine the state goals, and the state goals. The TSD is organized as follows:

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Note – This TSD also contains an excel attachment that contains the aggregate state-level data, calculations, and proposed state emission rate goals. The underlying plant-level data and unit-level data is also available in the Docket for this rulemaking.

In EPA's technical evaluation, reasonable assumptions regarding application of each GHG reducing technology were identified (see GHG Abatement Measures TSD). The EPA used these assumptions to develop the two regulatory options provided in this proposal: (1) Proposed state goals based on reasonable assumptions related to BSER, and (2) Alternative state goals with less ambitious assumptions relative to those used for the Proposed state goals.

1. BSER Factors Informing State Emission Rate Goals

The GHG Abatement Measures TSD describes the four categories of emission reduction measures (building blocks) used in determining the state emission rate goals. That document describes EPA's historic data review and analysis underlying each technology and informing EPA's assessment of its feasibility and cost-effectiveness as part of a BSER. The technology estimates determined through EPA's analysis and documented in the GHG Abatement Measures TSD are summarized below. These estimates are used in EPA's calculation of state emission rate goals, as described in this TSD.

a. Heat Rate Improvement
Proposed – A 6% heat rate improvement in the state's coal fleet
Alternative – A 4% heat rate improvement in the state's coal fleet

b. Redispatch to Existing Natural Gas Combined Cycle Plants (NGCC)
Proposed – a 70% capacity factor (CF) ceiling for the state's NGCC fleet
Alternative – a 65% capacity factor ceiling for the state's NGCC fleet

Note – These capacity factor values represent ceilings for NGCC utilization. The EPA used these ceilings while calculating state goal adjustments related to redispatching coal and/or oil and gas (O/G) steam generation to the state's NGCC capacity.

c. Renewable and Nuclear
Both Proposed and Alternative state goals include under construction (5.5 GW) and at risk nuclear capacity (~5.8% of nuclear capacity)
Proposed –RE at 13% by start of 2030 and thereafter*
Alternative –RE at 9.4% by start of 2025 and thereafter*

d. End-use Energy Efficiency (EE)*

Proposed – 10.7% cumulative savings by start of 2030 and each year thereafter
Alternative – 5.2% cumulative savings by start of 2025 and thereafter

*Note – The above RE values and EE saving rates are nationwide averages. Each state's CO_2 emission rate goal is informed by state-specific RE and EE values that relate to its pre-existing RE generation and EE savings rates respectively as described in the GHG Abatement Measures TSD. Also, the RE estimates do not count existing hydro generation.

The technology assumptions described above are used to determine an emission rate (lb/MWh) for each state that constitutes the state goal. As these building blocks reflect both fossil and non-fossil measures, the corresponding state goal reflects a composite emission rate including fossil and zero emitting non-fossil technologies. The EPA proposed to use an emission-rate metric for state goals, rather than a mass-based metric to promote state flexibility. See preamble section VII for more description on the rate based standard.

2. Data Used

A. Rationale for Historic Data Basis for State Goal Setting

The EPA used 2012 state-level data to determine each state's emission rate goal. The EPA carefully considered using a historic year data set, a projected year data set, or a hybrid of the two as a starting point for applying the above technology assumptions and calculating the state's emission rate goals.[1] Ultimately the 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. The 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. The state goal is an emission rate representing the deployment of BSER measures, and that deployment level is largely a function of technology-specific emission rate reduction capability and total NGCC capacity installed to date. Because these two critical variables do not vary significantly when looking at a larger baseline period, the benefits of an expanded baseline period are dampened, and overshadowed by the complexities introduced through creating a "hypothetical" year. Consequently, the EPA decided that using data from an actual year (for which facility representatives had reported the values as complete and accurate to the best of their knowledge) was preferable to using calculated values that did not reflect any real year supply/demand balance.

For this work, the EPA used 2012 data compiled using the same methodology as in EPA's Emissions and Generation Resource Integrated Database (eGRID) to determine the following 2012 values at the state level, which become the basis from which state emission rate goals are calculated.

- State level coal generation
- State level coal emission rate
- State level oil/gas steam generation
- State level oil/gas steam emission rate
- State level NGCC generation
- State level NGCC emission rate
- State level NGCC capacity
- "Other" generation

[1] Data sources for future year or hybrid approach would be EPA Base Case Power Sector modeling.

- "Other" emissions[2]

All generation values are expressed as net generation. Emission rate values are net emission rates and expressed as lbs/MWh. The capacity expressed is nameplate capacity in Megawatts.

B. Source of Data

i. Emissions & Generation Integrated Resource Database (eGRID)

eGRID is a comprehensive inventory of environmental attributes of the U.S. electric power system. It is the preeminent source of air emissions data for the electric power sector, based on available plant-specific data for all U.S. electricity generating plants that provide power to the electric grid and report data to the U.S. government. 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). Emissions data from the EPA are carefully integrated with generation data from EIA to produce useful values like pounds per megawatt-hour (lb/MWh) of emissions, which allows direct comparison of the environmental attributes of electricity generation. Although 2012 eGRID data had not yet been released, the EPA applied its eGRID methodology for matching the publically available and reported 2012 emissions and generation data. The EPA relies on this most recent data to calculate state goals.

The state level totals for each technology category described in the above bullets are intended to reflect the electric generating units (EGUs) meeting the following criteria:[3]

In general, a covered EGU is a stationary combustion turbine, steam generating unit or IGCC that is: (1) capable of combusting more than 250 MMBtu/h heat input of fossil fuel and (2) constructed for the purpose of supplying one-third or more of its potential net- electric output capacity and more than 219,000 MWh to any utility power distribution system for sale (that is, to the grid). In addition, for a stationary combustion turbine to be considered an EGU the heat input must consist of over 90% natural gas.[4]

Integrated gasification combined cycles (IGCCs) and combustion turbines (CTs) operating at a capacity factor greater than 33% are not part of the inventory of units subjected to building blocks one and two. Although they are covered units under the rule, they are excluded from the

[2] "Other" includes fossil sources that are likely subject to 111(d) rulemaking, but not subject to building block abatement measures (e.g., IGCC, high utilization CTs, useful thermal output at cogeneration units).
[3] The set of sources used to compile state-level totals and eventual state goal rates does not constitute an applicability determination for any particular EGU. The ultimate universe of EGUs subject to this rulemaking may vary from that used in this goal setting exercise and will be determined by the rule's applicability language and actual operating conditions at that plant.
[4] See Preamble and Regulatory text for full description of 111(d) applicability criteria

generating technologies that are considered eligible for blocks one and two, and instead designated as the "other" category. IGCCs and high utilization CTs present unique circumstances and are not subjected to building block application. 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 CTs 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.[5] Therefore, IGCCs and CTs were not considered for cost-effective deployment of BSER building blocks one and two (i.e., there are no redispatch or heat rate improvements assumed to occur at these units). The historical generation and emissions from IGCCs and high capacity factor CTs are still averaged into the state goal to account for these units as affected sources. Therefore, their generation and emissions would be averaged into the state emission rate for compliance purposes. This category of affected units that are covered under the 111(d) applicability language, but not subjected to BSER technologies, is accounted for in an "other" category. The IGCC and high utilization CTs represent a small portion (i.e., less than 1%) of total generation and emissions relative to the other affected source categories, and has a small impact on the state goal rates.

Appendix 1 shows the 2012 state-level aggregate data and corresponding calculations applied to achieve the state goal rate.

ii. Data sources for under construction units

Although the 2012 eGRID data described above forms the starting point for the goal calculation, the EPA's BSER methodology also included under construction nuclear and NGCC capacity that was not operating in 2012. For this small subset of "existing" units, EPA relied on its National Electric Energy Data System (NEEDS). NEEDS includes basic geographic, operating, capacity, and other data on existing or under construction generating units. NEEDS was completely updated for EPA's new power sector modeling platform v.5.13. For a description of the sources used in preparing NEEDS v.5.13, see Documentation, Chapter 4: Generating Resources.[6] In addition to those under construction NGCC units in NEEDS, the EPA identified three other NGCC plants and one IGCC plant that were under construction and would likely fit the rulemaking's definition of "existing" unit. These were the Dominion Brunswick plant in Virginia (1,358 MW), the Cheyenne Generating Station in Wyoming (220 MW), the Cane Run plant in Kentucky (640 MW), and the Kemper IGCC plant in Mississippi (582 MW).

C. State-Level Data Rationale and Significance

[5] "High utilization" CTs are categorized as those with a capacity factor greater than 33% in 2012.
[6] http://www.epa.gov/powersectormodeling/BaseCasev513.html#needs, also available in the Docket File titled "NEEDSv.5.13 Database"

The EPA aggregated plant-level data to the state level for purposes of state-specific emission rate goal calculation. Then, for each state, the EPA made BSER-related adjustments to the historical state-level data to derive a new emission rate that constitutes the state goal. In making adjustments to aggregate state-level data, the EPA is simply suggesting that BSER assumptions (e.g., 6% heat rate improvement for the coal fleet) can be achieved on average at the state level. The EPA is not making any assertions about specific units or plants. The EPA recognizes the uniqueness and complexity of individual power plants, and is aware that there are site-specific factors that may prevent some EGUs from achieving performance equal to state-level assumptions. Likewise, the EPA also recognizes that some EGUs are capable of, and regularly do, achieve performance levels that surpass the BSER values assumed. In any case, the EPA is not making those unit-level evaluations in this exercise. The EPA is instead attempting to quantify what is feasible at the state level based on application of the BSER values to historic state-level data. Therefore, the ability or inability of a specific EGU to under/overachieve the assumed technology value cannot be taken, on its own, as an indication of the appropriateness of the state goals estimated using this approach.

3. **Example of State Goal Calculation and Discussion**

EPA's methodology for calculating state goals is described in the steps below. The implementation of each step is illustrated in the table below its description, using the state of Ohio as an example. The mathematical calculations are fundamental to translating the building blocks into a quantifiable state goal.

Step 1: Calculation of unadjusted 2012 state fossil emission rate for covered sources

As noted above, the EPA begins the state goal emission rate calculation by starting with actual historic data at the state level. Plant-level data are summed to state-level values describing: coal generation, coal emission rate, NGCC generation, NGCC emission rate, OG steam generation, OG steam emission rate, "other" emissions, "other" generation, and NGCC capacity. These categories are identified as they represent the historical generation that is subject to building block application and/or would likely be subject to the state goal. For combined heat and power (CHP) units that are covered under the rule, the emissions and energy output associated with the useful thermal output not used for electricity production are included in the state goal and would be reported under the 111(d) reporting guidelines if the unit meets the 111(d) applicability criteria. The emissions and energy output associated with the useful thermal output are captured in the "other" category. The emission rates shown reflect total emissions divided by total net energy output (e.g. net electricity generation + useful thermal output).[7] However, only the electricity generation portion of CHP is available for redispatch purposes, and therefore only this portion of the cogeneration operation is reflected in the technology generation totals.[8] There are four coal facilities that co-fired biomass in 2012 that did not report emissions under Part 75 in these cases an emission rate factor is used to estimate stack CO_2 emissions attributable to the type of biomass reported.[9,10] These technology specific values become the basis for calculating the state's emission rate. All emission rates provided in the state goal determination are on a net basis.

[7] A separate state goal rate is calculated for the EPA Integrated Planning Model (IPM) power sector analysis that reflects total emissions from CHP units, but just their net electricity generation in the denominator. This was necessary as IPM is a dispatch model that optimizes around net electricity demand, so it reflects total emissions associated with cogeneration operation, but only the generation associated with meeting net electricity demand. These corresponding goals expressed in lb/net MWh of electricity generation can be found in the docket file titled "State Goals (excluding useful thermal output)".

[8] The useful thermal output is converted to a net MWh value and captured in the other generation

[9] 40 CFR, Part 98, Subpart C, Table C-1A has CO2 emission factors for stationary combustion of various fuels, including biomass. See here: http://www.ecfr.gov/cgi-bin/text-idx?SID=834bf8d737d2100f8affa21bc7b13bbc&node=40:22.0.1.1.3.3.1.10.18&rgn=div9

[10] Please see section VIII of the preamble for more information on biomass in the context of this rulemaking.

	2012 Rate (lbs/MWh)			2012 mass (lbs)	2012 Generation (MWh)				2012 Capacity	**Starting Covered Fossil Rate (lbs/MWh)**
	A	B	C	D	E	F	G	H	I	**J**
	Coal Rate	OG Steam Rate	NGCC Rate	Other Emissions	Coal Gen	OG Steam Gen	NGCC Gen	Other Gen	NGCC MW	
Ohio	2,126	1,332	963	284,732,506	86,473,075	321,602	20,907,183	214,178	4,343	**1,897**

Note, when the values in the above cells shaded green and blue are applied to the equation below, the state's 2012 "unadjusted fossil" emission rate (or historical fossil rate) for likely covered sources equals 1,897 lb/MWh.

Historical fossil emission rate = $\frac{\text{(coal gen. x coal emission rate)+ (OG gen. x OG emission rate) + (NGCC gen. x NGCC emission rate) + "Other" emissions}}{\text{Coal gen. + OG gen. + NGCC gen. + "Other" gen.}}$

Step 2: BSER Block One - Calculation of state fossil emission rate goal for covered sources resulting *from heat rate improvement (HRI)*

After this historical data is collected for each state, the EPA begins to adjust particular variables to the data to reflect each building block element of BSER. The EPA assumes that a 6% heat rate improvement at the facility will directly translate to a 6% reduction in the net CO_2 emission rate. Therefore, in conjunction with determining state goals under the Proposed state goal assumptions in this proposal, the EPA adjusts the state-level coal emission rate (column A) downwards by 6% to reflect the 6% heat rate improvement. In the case of Ohio, this results in a drop from 2,126 lb/MWh to 1,999 lb/MWh. This completes the building block 1 treatment for the Proposed state goals.[11]

[11] EPA makes a similar adjustment for the Alternative state goals, but uses a 4% HRI improvement assumption when reducing the coal rate

	Emission Rate (lbs/MWh)			Emissions (lbs)	Generation (MWh)				2012 Capacity	**State Goal Post Block 1 (lbs/MWh)**
	A	B	C	D	E	F	G	H	I	**J**
	Coal Rate	OG Steam Rate	NGCC Rate	Other Emissions	Coal Gen	OG Steam Gen	NGCC Gen	Other Gen	NGCC MW	
Ohio	1,999	1,332	963	284,732,506	86,473,075	321,602	20,907,183	214,178	4,343	**1,795**

Note that when the total emission rate is recalculated with heat rate improvement reflected in the adjustment to the state's coal emission rate, the state emission rate drops from 1,897 lb/MWh to 1,795 lbs/MWh. This is not the final state emission rate goal rate, rather an emission rate reflecting building block 1 application before moving onto the remaining blocks. The bold areas in the equation below reflect the values that are adjusted from their historical level at this step.

State Emission Rate Post Block 1 = (coal gen. **x coal emission rate**) + (OG gen. x OG emission rate) + (NGCC gen. x NGCC emission rate) + "Other" Emissions

Coal gen. + OG gen. + NGCC gen. + "Other" gen.

Step 3a: BSER Block Two - Calculation of state fossil emission rate goal resulting from heat rate improvement and redispatch to *existing NGCC capacity*

In the GHG Abatement Measures TSD, the EPA described how historical 2012 data illustrated that a significant number of NGCC plants had a net generation that was greater than or equal to its nameplate capacity x 8784 * 0.7 – in other words a 70% or greater capacity factor. It also provided analysis supporting a 70% capacity factor as cost-effective and historical data that illustrated the ability to increase utilization at NGCCs under favorable market conditions. That portion of the TSD also describes the engineering analysis that suggests the average availability of a NGCC is significantly greater than 70%. Building block 2 was intended to reflect the potential redispatch to the state's existing NGCC fleet up to a 70% capacity factor level.

To operationalize the 70% CF ceiling in the state goal setting, the state's 2012 existing NGCC nameplate capacity is multiplied by 8,784 hours (the number of hours in the 2012 year) and then by 70% to get total potential net NGCC generation at a 70% capacity factor. However, this 70% capacity factor represents a redispatch ceiling, and the state's NGCC generation is only adjusted up to this ceiling if its historic fossil sources

support such a level.[12] Therefore, if this ceiling value (MWh) is *less than* the sum of the state's 2012 coal, OG steam, and NGCC net generation, the historic NGCC generation is increased to this calculated MWh ceiling value representing the NGCC fleet at a 70% capacity factor, and historic coal and OG steam generation are ramped down by an equivalent amount of generation. If the generation of existing NGCC at a 70% capacity factor is *greater than* the sum of the state's 2012 coal, OG steam, and NGCC net generation, the historical NGCC generation is only adjusted to equal the total of the 2012 net fossil generation from these sources. In summary, adjusted NGCC net generation is equal to the lesser of existing NGCC fleet at 70% capacity factor or 2012 total fossil generation from BSER subjected sources. This preserves the historical total covered fossil generation in the state for BSER subjected sources, but reapportions it assuming a 70% state-average capacity factor ceiling for the NGCC fleet. The increase in NGCC generation is subtracted from the coal and OG steam generation in proportion to the state's historic generation. For example, if coal historically accounted for 90% of the total coal and OG steam generation in the state, then its historic generation would be reduced by 90% of the amount that NGCC generation increases. Likewise, the OG steam generation would be reduced by 10% of the amount by which NGCC generation is increased.

	Emission Rate (lbs/MWh)			Emissions (lbs)	Generation (MWh)				2012 Capacity	**State Goal Post Block 2.1 (lbs/MWh)**
	A	B	C	D	E	F	G	H	I	**J**
	Coal Rate	OG Steam Rate	NGCC Rate	Other Emissions	Coal Gen	OG Steam Gen	NGCC Gen	Other Gen	NGCC MW	
Ohio	1,999	1,332	963	284,732,506	80,700,563	300,133	26,701,164	214,178	4,342.5	**1,739**

4,342.5 MW x 8784 hours x 70% CF = 26,701,164

Note – in the above example, the total covered fossil generation has not increased in the state from the historic totals shown in step 1. It has only been reapportioned assuming a 70% capacity factor for NGCC. NGCC generation is adjusted upwards by approximately 6,000,000 MWh, and coal and O/G are adjusted downward by the same amount. This increase in NGCC generation reflects the existing fleet increasing from a

[12] Fossil sources here refers to those units subject to BSER redispatch building block treatment (i.e., coal, o/g steam, and NGCC)

historical level of approximately 55% CF up to the ceiling of 70% CF. When these updated generation values are folded into the state goal calculation, the emission rate drops from 1,795 lb/MWh in Step 2 to 1,739 lb/MWh. The values in bold below reflect the historic data points that have been adjusted to reflect building block implementation at this point in the process.[13][14]

$$\textit{State Emission Rate Post Block 2.1} = \frac{(\textbf{coal gen}.\ \text{x coal emission rate}) + (\textbf{OG gen}.\ \text{x OG emission rate}) + (\textbf{NGCC gen}.\ \text{x NGCC emission rate}) + \text{“Other” emissions}}{\textbf{Coal gen.} + \textbf{OG gen.} + \textbf{NGCC gen.} + \text{“Other” gen.}}$$

Step 3b: BSER Block Two, cont. - Calculation of state fossil emission rate goal resulting from heat rate improvement and redispatch to existing and *under construction NGCC capacity*

Step 3a is repeated for under construction NGCC capacity that would also be considered an existing covered fossil source. For this step, “under construction” is defined as anything that came online in 2013 or that was under construction, site prep, or testing by January 8, 2014. The EPA looked at reported data for 2012 and calculated the average performance of NGCCs that came online in the past 5 years and observed that 55% was the average capacity factor for these units.[15] Therefore, the EPA assumed that a 55% capacity factor would be a reasonable representation for the expected generation of “under construction” NGCCs capacity under a business as usual scenario. The EPA conservatively designated the generation associated with this 55% capacity factor as unavailable for redispatch to reduce CO_2 (i.e., not qualifying for building block 2), instead, reserving that amount of generation potential to meet other system needs presumed to have motivated the construction of the “under construction” NGCCs. Because these sources are nevertheless covered under the state emission rate goal, the emissions and generation from this 55% generation are added to the “other” category and averaged into the state goal calculation. The EPA assumes that while these units would operate at 55% CF under a business as usual scenario, the average availability for these units is greater than 55%, and they too could ramp up to 70% CF ceiling, on average, under a BSER framework and displace relatively higher CO_2-emitting generation. Thus, 15% of their ultimate CF (70% - 55%) is assumed to be available for redispatch purposes. The MWh associated with this 15% additional CF displaces coal and OG steam generation in the same manner as in step 3a.

[13] While a 70% capacity factor ceiling is assumed in the state goal setting exercise, the majority of states are not expected to operate their existing fleet at this level in EPA’s projected compliance scenarios.
[14] In the Alternative state goal calculations, the EPA makes similar adjustments to the historic data but utilizes a 65% capacity factor ceiling in place of the 70% CF shown above.
[15] http://ampd.epa.gov/ampd/ and available in docket file titled “NGCC capacity factor for units online in last 5 years”.

The portion of the "under construction" NGCC unit's generation that is not considered available for redispatch (i.e., the first 55%) is captured in the "other" category. The generation and emissions from these sources are still included in the emission rate quantified as the state goal by averaging in their unadjusted emissions and generation. For "under construction" NGCC units that have no 2012 historical data, the generation associated with the 55% baseline capacity factor is obtained by using the capacity and historical average emission rate for NGCCs in the state.[16] The emissions total for these units is calculated by multiplying the generation at a 55% CF by the average emission rate for existing NGCCs in the state.

	Emission Rate (lbs/MWh)			Emissions (lbs)	Generation (MWh)				2012 Capacity	"Under Construction" NGCC	**State Goal Post Block 2.2 (lbs/MWh)**
	A	B	C	D	E	F	G	H	I	J	**K**
	Coal Rate	OG Steam Rate	NGCC Rate	Other Emissions	Coal Gen	OG Steam Gen	NGCC Gen	Other Gen	NGCC MW	NGCC MW	
Ohio	1,999	1,332	963	2,791,474,084	79,993,008	297,502	27,411,350	2,818,195	4,343	539	**1,715**

4,343 MW x 8784 hours x 70% CF = 26,701,164
539 x 8784 x 15% CF = 710,186
Total NGCC = 27,411,350
539 x 8784 x 55% CF =2,604,017
Total "other"= 2,604,017 + 214,178 = 2,818,195

Note that when the total emission rate is recalculated to reflect the "under construction" NGCC capacity, the state's emission rate at this step drops from 1,739lb/MWh to 1,715 lbs/MWh. This is not the final state emission rate goal rate, rather an interim rate reflecting building blocks one and

[16] Note, both Wyoming and Kentucky had "under construction" NGCC capacity, but did not have existing covered NGCC in the state from which a proxy emission rate could be derived for the "under construction" capacity. Therefore, the nationwide average NGCC emissions rate of 907 lb/MWh (net basis). became the assumed emission rate for the "under construction" NGCC in these two states. EPA assumed 800 lb/MWh and 70% capacity factor for the Kemper unit as it was not yet operating in 2012. This is reflected in Mississippi's "Other" Generation and Emissions in step 2. http://www.netl.doe.gov/publications/proceedings/11/co2capture/presentations/4-Thursday/25Aug11-%20Nelson-Kemper-Capture%20at%20Kemper%20IGCC.pdf and available in the docket file titled "CO2 capture at Kemper".

two application before moving onto the remaining blocks. The bold areas in the equation below reflect the values that are adjusted from their historical level at this stage. Note the "Other" category is bolded here as it reflects the addition of the 55% utilization of under construction NGCC.

$$\textit{State Emission Rate post block 2.2} = \frac{\textbf{(coal gen. x} \text{ coal emission rate)} + (\textbf{OG gen}. \text{ x OG emission rate)} + (\textbf{NGCC gen}. \text{ x NGCC emission rate)} + \textbf{"Other" emissions}}{\textbf{Coal gen. + OG gen. + NGCC gen. + "Other" gen.}}$$

Step 4a: BSER Block Three - Calculation of state fossil emission rate goal resulting from heat rate improvement, redispatch to existing and under construction NGCC capacity, and *under construction and "at risk" nuclear capacity*

In Step 4a, the total under construction nuclear capacity is determined.[17] Additionally, an amount of the nuclear capacity that is "at risk" of being retired is identified as approximately 5.8% of the historical nuclear fleet (see GHG Abatement Measures TSD for further discussion on how the percent assumption was derived). This under construction and "at risk" nuclear capacity was incorporated into the state goals as zero emitting generation. This was achieved by applying a 90% capacity factor to the nuclear capacity identified as under construction or "at risk" and then applying the resulting MWh figure into the denominator of the state goal calculation. Nuclear is not considered a "dispatchable" resource as is NGCC capacity. That is, its utilization will remain fairly constant in both a business-as-usual and policy scenario due to both its low variable operating cost relative to fossil sources and technical limitations regarding start-up and shut-down times. The differing dispatch economics between NGCC and nuclear plants leads to a different treatment in the goal setting. Existing nuclear is not assumed to increase generation in the same manner as the NGCC fleet is assumed capable of in the above steps. Instead of redispatching from coal to nuclear in the same fashion as the previous steps, the expected generation for new and "at risk" nuclear is simply added to the state goal denominator – resulting in a lower state goal emission rate. However, it is important to note that this "under construction and at risk" nuclear capacity is also part of the inventory that the state can count towards compliance with its state goal (i.e., zero emitting generation that can be averaged with that of the covered fossil sources in order to obtain a rate that is equal to or less than the state emission rate goal).

[17] Watts Bar in TN, Vogtle in GA, and Summer in SC

	Emission Rate (lbs/MWh)			Emissions (lbs)	Generation (MWh)				2012 Capacity	"Under Construction" NGCC	Under Construction and "at risk" Nuclear	**State Goal Post Block 3.1 (lbs/MWh)**
	A	B	C	D	E	F	G	H	I	J	K	**L**
	Coal Rate	OG Steam Rate	NGCC Rate	Other Emissions	Coal Gen	OG Steam Gen	NGCC Gen	Other Gen	NGCC MW	NGCC MW	MWh	
Ohio	1,999	1,332	963	2,791,474,084	79,993,008	297,502	27,411,350	2,818,195	4,343	539	993,077	**1,699**

Ohio has 0 MW of under construction nuclear and 125.617 MW of "at risk" nuclear capacity share as described in the "GHG Abatement Measures TSD"(referred to as Nuclear gen $_{uc + ar}$. This results in an expected nuclear generation amount of 933,077 MWh that is incorporated into the state goal calculation (based on 90% capacity factor). When this value is added into the state goal calculation, the state's emission rate drops from 1,715 lb/MWh to 1,699 lb/MWh

State Emission Rate Post Block 3.1 = $\frac{\text{(coal gen. x coal emission rate) + (OG gen. x OG emission rate) + (NGCC gen. x NGCC emission rate) + "Other" emissions}}{\text{Coal gen. + OG gen. + NGCC gen. + "Other" gen. + } \mathbf{Nuclear\ gen}_{uc + ar}}$

Step 4b: BSER Block Three, cont. - Calculation of state fossil emission rate goal resulting from heat rate improvement, redispatch to existing and under construction NGCC capacity, new and "at risk" nuclear, *and Renewable (RE)*

The GHG Abatement Measures TSD describes how the RE generation total for each state was derived from a combination of existing renewable generation in the state and target RE levels informed by existing Renewable Portfolio Standards (RPS) in the region. Although the amount of assumed RE generation varies by state to reflect the different existing portfolios of renewable resources and the amount of renewable fuels available in different regions of the country, the nationwide average assumed under the Proposed state goals is approximately 13% RE by the end

of 2029.[18] A potential RE generation value is calculated for each state annually for all years between 2020-2029 to reflect the annual growth as states move toward a particular regional RE benchmark. The state-specific RE generation values that relate to this goal nationwide average are available in the Excel attachment to this TSD and the GHG Abatement Measures TSD. These RE MWh totals include both existing renewable resources in the state and new renewable generation.

	Emission Rate (lbs/MWh)			Emissions (lbs)	Generation (MWh)				2012 Capacity	"Under Construction " NGCC	Under Construction and "at risk" Nuclear	Existing and New RE	**State Goal Post Block 3.2 (lbs/MWh)**
	A	B	C	D	E	F	G	H	I	J	K	L	**M**
	Coal Rate	OG Steam Rate	NGC C Rate	Other Emissions	Coal Gen	OG Steam Gen	NGCC Gen	Other Gen	NGCC MW	NGCC MW	MWh	MWh	
Ohio	1,999	1,332	963	2,791,474,084	79,993,008	297,502	27,411,350	2,818,195	4,343	539	993,077	13,775,594	**1,512**

Ohio had 1,738,622 MWh of RE in 2012[19] (approximately 1% of total net generation) and would grow to 13,775,594 MWh by 2029 (approximately 10.6% of current net generation) under the building block three assumptions. This 13,775,594 MWh of RE generation would be added into the state goal by adding it in the denominator. The RE value and resulting state goal shown above reflect the 2029 year. When this is added into the state goal calculation, the state's emission rate drops from 1,699 lb/MWh to 1,512 lb/MWh.

$$\textit{State Emission Rate Post Block 3.2} = \frac{\text{(coal gen. x coal emission rate) + (OG gen. x OG emission rate) + (NGCC gen. x NGCC emission rate) + "Other" emissions}}{\text{Coal gen. + OG gen. + NGCC gen. + "Other" gen. + Nuclear gen.}_{uc+ar} \textbf{ + RE gen.}}$$

Step 5: BSER Block 4 - Calculation of state fossil emission rate goal resulting from heat rate improvement, redispatch to existing NGCC, "under construction" NGCC, under construction and at risk nuclear, RE, and *demand-side EE*

[18] See "GHG Abatement Measures" TSD available in the docket and on website. Value does not reflect existing hydro generation.
[19] http://www.eia.gov/electricity/data/state/ and available in the docket file titled "2012 sales (EIA data)".

A state-specific percent value is determined for each state reflecting the amount of total MWh sales that could potentially be avoided through demand-side energy efficiency measures (see GHG Abatement Measures TSD). Annual percentage savings rates for MWh sales are derived for each state for all years between 2020 and 2029 in the Proposed state goals. A different set of annual percent savings are derived for 2020-2024 for the Alternative state goals. Because of the temporal nature of demand-side energy efficiency, this building block, along with RE portion of building block three, are the only BSER components that increase each year. The GHG Abatement Measures TSD explains the rationale and derivation of these annual savings rates. Once these state-specific percent savings rates are derived, they are multiplied by the state's 2012 historical retail sales and scaled by a factor of 1.0751 to obtain an avoided generation value in MWhs.[20] The 7.51% scaling factor effectively converts the retail sales figure into a corresponding total net generation value that accounts for transmission and distribution losses.[21] The lesser of 1) this avoided net generation value, or 2) the avoided net generation value multiplied by the state's generation share of its sales is then applied to the denominator. This last step helps assure that building block four reductions for net importer states are linked to their own in-state generation.[22]

This step further reduces the state goal. However, the state may also count EE measures towards compliance with its state goal. Therefore, if a state achieves the assumed avoided generation based on EE, it does not have to further lower its emission rate from covered fossil-fuel fired generators determined in the previous steps. Instead, adding the avoided generation to the denominator (i.e., averaging in the avoided generation at a 0 lbs/MWh emission rate) will lower the state's emission rate used for compliance with the state goal.

[20] http://www.eia.gov/electricity/data/state/ "Retail Sales of Electricity by State and Sector" and available in the docket file titled "2012 sales (EIA data)".

[21] The 7.51% scaler represents the historical difference between total net generation of electricity (4,036 TWh) and retail sales of electricity (3,754 TWh). http://www.eia.gov/electricity/state/pdf/sep2010.pdf and also available in the file titled "State-level Generation – Net Importer and Exporter Derivation for Goal Calculation" in the docket.

[22] Demand-side energy efficiency measures may result in out-of-state emission reductions for states that consume more electricity than they produce (i.e., net importer states). For these net importer states, the proposal's approach assumes that each MWh of displaced generation from end-use EE would have occurred in part inside the state and in in part outside the state. The proportion of generation displaced inside the state is assumed to be equivalent to the ratio of generation in the state to consumption in that state. For example, in a state that produces 75% of the level of electricity that the state consumes, this approach assumes that each MWh of avoided generation from end-use EE only yields .75 MWh of avoided generation within that state. Only the portion of avoided generation assumed to occur within that state is incorporated into the relevant state goal, on the premise that the proposed BSER is intended to quantify emission reduction potential at the generators located in the state in question. For more explanation on how these percent values were derived and the underlying data, See "State-level Generation – Net Importer and Exporter Derivation for Goal Calculation" in the docket.

	Emission Rate (lbs/MWh)			Emissions (lbs)	Generation (MWh)				2012 Capacity	"Under construction" NGCC	Under Construction and At risk Nuclear	Existing and New RE	Avoided Sales via demand-side EE	**Post Block 4 (lbs/MWh)**
	A	B	C	D	E	F	G	H	I	J	K	L	M	**N**
	Coal Rate	OG Steam Rate	NGCC Rate	Other Emissions	Coal Gen	OG Steam Gen	NGCC Gen	Other Gen	NGCC MW	NGCC MW	MWh	MWh	MWh	
Ohio	1,999	1,332	963	2,791,474,084	79,993,008	297,502	27,411,350	2,818,195	4,343	539	993,077	13,775,594	16,284,584	**1,338**

As described in the demand-side energy efficiency section of the *GHG Abatement Measures TSD*, the 2029 percent of generation savings due to energy efficiency is calculated to be 11.557% in Ohio[23]. This value is then multiplied by the retail electricity sales in the state (152,456,864 MWh)[24] and multiplied by 1.0751 to reflect the net generation commensurate with these sales (i.e., inclusive of transmission and distribution losses). This results in 18,942,382 MWh of avoided generation. This value is then multiplied by 85.97% (Ohio's share of sales coming from in state power generation) to reflect the amount of avoided in-state generation that results from the energy efficiency investments. This final adjustment results in 16,284,584 MWh of avoided generation for Ohio that is assumed for 2029. This avoided generation value is added into the denominator and results in the state goal being decreased from 1,512 lbs/MWh to 1,338 lbs/MWh. This concludes the application of all four building blocks for the year 2029, and the 1,338 lb/MWh rate reflects Ohio's *adjusted* emission rate for the year 2029.

$$\textit{State Emission Rate Post Block 4} = \frac{\text{(coal gen. x coal emission rate) + (OG gen. x OG emission rate) + (NGCC gen. x NGCC emission rate) + "Other" emissions}}{\text{Coal gen. + OG gen. + NGCC gen. + "Other" gen. + Nuclear gen.}_{uc+ar} + \text{RE gen. } \mathbf{+ EE\ gen.}}$$

Steps 6 & 7: Interim and Final State Goals

The completion of the previous five steps results in a 2029 emission rate for the state. However, as noted above, the RE and EE assumptions change for each year from 2020 through 2029. Thus this procedure is repeated for each of those years using the corresponding RE and EE

[23] 11.557% reflects rounded value. See Appendix 1 for actual calculated value of 11.55683…% used to arrive at MWh shown above. Most values shown throughout this example are rounded for visual purposes. See Appendix for unrounded number.
[24] http://www.eia.gov/electricity/data/state/ and available in the docket file titled "2012 sales (EIA data)".

assumption for that year. This results in a set of annual adjusted emission rates for the years 2020-2029. However, this rulemaking only issues two state goals – an interim and final state goal. Thus, goals are derived by averaging, or taken directly from and the annual adjusted emission rate values.

For The Proposed state goals:
Interim State Goal – Average of the adjusted yearly emission rates for the period 2020-2029
Final State Goal – The 2029 emission rate (as calculated above) becomes the state goal for 2030 and each year thereafter

For The Alternative state goals:
Interim State Goal – Average of the adjusted yearly rates for the period 2020-2024
Final State Goal – The 2024 emission rate becomes the state goal for 2025 and each year thereafter

The EPA recognizes that the emission rate goals calculated here include measures that may yield reductions in mass emissions but may not yield emission rate reductions in practice when observing monitored and reported emission and generation data from affected units. As such, it is not fully informative to compare the state goals calculated here to observable emission rates across affected units either historically or in future years. For more discussion about how states can demonstrate compliance with these emission rate goals, please see the "State Plans Considerations TSD". For more discussion on emission reductions, please see the Regulatory Impact Analysis.

Finally, the assumptions used to arrive at each state's goal are not prescriptive of necessary actions that a state must take. As described in the preamble, these values are used only for calculating a state goal. A state may choose to comply with that state goal through any combination of abatement measures that differ in class and magnitude from those assumed in the state goal calculation.

Example of Final State Goal Calculation for Ohio:

Final Proposed State Goal Rate for Ohio

$$-\frac{(1{,}999 \times 79{,}993{,}008) + (1{,}332 \times 297{,}502) + (963 \times 27{,}411{,}350) + 2{,}791{,}474{,}084}{(79{,}993{,}008 + 297{,}502 + 27{,}411{,}350 + 2{,}818{,}195 + 993{,}077 + 13{,}775{,}594 + 16{,}284{,}585)} = \mathbf{1{,}338\ lb/MWh}$$

See the accompanying Excel Workbook for all state level data, calculations, and final state level emission rate goals used to calculate the Interim and Final State Goals for Options 1 and 2. This workbook shows all the calculations used to transform the historical covered fossil emission rate to the Interim and Final State Goal (columns BA and BB) for the Proposed state goals, and (columns AL and AM) for the Alternative state goals.

APPENDIX

Appendix 1 - State level goals, underlying state level data, and calculations for The Proposed state goals

See "Appendix 1" worksheet in the Excel attachment titled "Appendix 1 & 2 - State Goal Data and Computation"

Appendix 2 - State level goals, underlying state level data, and calculations for The Alternative state goals

See "Appendix 2" worksheet in the Excel attachment titled "Appendix 1 & 2 - State Goal Data and Computation"

*The above referenced workbook has the data and formulas embedded for state goal calculations. Therefore, a commenter suggesting an adjustment to a building block assumption or any historic state-level data can replace the current assumed values with the suggested amount and see the resulting state-level goal under such assumptions.

Appendix 3 – Summary of state goals under the proposed Existing Source Performance Standard

Proposed State Goals

State	Interim Goal (2020-2029)	Final Goal (2030 and after)		State	Interim Goal (2020-2029)	Final Goal (2030 and after)
Alabama	1,147	1,059		Montana	1,882	1,771
Alaska	1,097	1,003		Nebraska	1,596	1,479
Arizona	735	702		Nevada	697	647
Arkansas	968	910		New Hampshire	546	486
California	556	537		New Jersey	647	531
Colorado	1,159	1,108		New Mexico	1,107	1,048
Connecticut	597	540		New York	635	549
Delaware	913	841		North Carolina	1,077	992
Florida	794	740		North Dakota	1,817	1,783
Georgia	891	834		Ohio	1,452	1,338
Hawaii	1,378	1,306		Oklahoma	931	895
Idaho	244	228		Oregon	407	372
Illinois	1,366	1,271		Pennsylvania	1,179	1,052
Indiana	1,607	1,531		Rhode Island	822	782
Iowa	1,341	1,301		South Carolina	840	772
Kansas	1,578	1,499		South Dakota	800	741
Kentucky	1,844	1,763		Tennessee	1,254	1,163
Louisiana	948	883		Texas	853	791
Maine	393	378		Utah	1,378	1,322
Maryland	1,347	1,187		Virginia	884	810
Massachusetts	655	576		Washington	264	215
Michigan	1,227	1,161		West Virginia	1,748	1,620
Minnesota	911	873		Wisconsin	1,281	1,203
Mississippi	732	692		Wyoming	1,808	1,714
Missouri	1,621	1,544				

The Alternative State Goals

State	Interim Goal (2020-2024)	Final Goal (2025 and after)		State	Interim Goal (2020-2024)	Final Goal (2025 and after)
Alabama	1,270	1,237		Montana	2,007	1,960
Alaska	1,170	1,131		Nebraska	1,721	1,671
Arizona	779	763		Nevada	734	713
Arkansas	1,083	1,058		New Hampshire	598	557
California	582	571		New Jersey	722	676
Colorado	1,265	1,227		New Mexico	1,214	1,176
Connecticut	651	627		New York	736	697
Delaware	1,007	983		North Carolina	1,199	1,156
Florida	907	884		North Dakota	1,882	1,870
Georgia	997	964		Ohio	1,588	1,545
Hawaii	1,446	1,417		Oklahoma	1,019	986
Idaho	261	254		Oregon	450	420
Illinois	1,501	1,457		Pennsylvania	1,316	1,270
Indiana	1,715	1,683		Rhode Island	855	840
Iowa	1,436	1,417		South Carolina	930	897
Kansas	1,678	1,625		South Dakota	888	861
Kentucky	1,951	1,918		Tennessee	1,363	1,326
Louisiana	1,052	1,025		Texas	957	924
Maine	418	410		Utah	1,478	1,453
Maryland	1,518	1,440		Virginia	1,016	962
Massachusetts	715	683		Washington	312	284
Michigan	1,349	1,319		West Virginia	1,858	1,817
Minnesota	1,018	999		Wisconsin	1,417	1,380
Mississippi	765	743		Wyoming	1,907	1,869
Missouri	1,726	1,694				

Appendix 4 – Blocks 1 & 2 only State Goals

The table below provides the interim and final goals from just blocks 1 and 2, before the introduction of nuclear, renewable, and EE into the denominator. Note – there is no difference between the Interim and Final rates through the first two building blocks as the increasing annual potential only applies to block 3 and block 4.

	Proposed State Goals (lbs/MWh)		Alternative State Goals (lbs/MWh)	
State	**Interim Goal (2020 - 2029 average)**	**Final Goal (2030 and thereafter)**	**Interim Goal (2020 - 2024 average)**	**Final Goal (2025 and thereafter)**
Alabama	**1,329**	**1,329**	**1,405**	**1,405**
Alaska	**1,252**	**1,252**	**1,252**	**1,252**
Arizona	**900**	**900**	**900**	**900**
Arkansas	**1,115**	**1,115**	**1,196**	**1,196**
California	**838**	**838**	**838**	**838**
Colorado	**1,521**	**1,521**	**1,586**	**1,586**
Connecticut	**809**	**809**	**812**	**812**
Delaware	**1,013**	**1,013**	**1,068**	**1,068**
Florida	**910**	**910**	**991**	**991**
Georgia	**1,296**	**1,296**	**1,375**	**1,375**
Hawaii	**1,751**	**1,751**	**1,762**	**1,762**
Idaho	**858**	**858**	**858**	**858**
Illinois	**1,865**	**1,865**	**1,924**	**1,924**
Indiana	**1,834**	**1,834**	**1,883**	**1,883**
Iowa	**1,846**	**1,846**	**1,900**	**1,900**
Kansas	**2,186**	**2,186**	**2,230**	**2,230**
Kentucky	**1,986**	**1,986**	**2,031**	**2,031**
Louisiana	**1,099**	**1,099**	**1,162**	**1,162**
Maine	**848**	**848**	**848**	**848**
Maryland	**1,868**	**1,868**	**1,908**	**1,908**
Massachusetts	**886**	**886**	**886**	**886**
Michigan	**1,511**	**1,511**	**1,574**	**1,574**
Minnesota	**1,369**	**1,369**	**1,446**	**1,446**
Mississippi	**843**	**843**	**843**	**843**
Missouri	**1,784**	**1,784**	**1,832**	**1,832**
Montana	**2,295**	**2,295**	**2,343**	**2,343**
Nebraska	**1,941**	**1,941**	**1,987**	**1,987**
Nevada	**882**	**882**	**882**	**882**
New Hampshire	**878**	**878**	**878**	**878**

New Jersey	**905**	**905**	**905**	**905**
New Mexico	**1,447**	**1,447**	**1,511**	**1,511**
New York	**927**	**927**	**970**	**970**
North Carolina	**1,329**	**1,329**	**1,391**	**1,391**
North Dakota	**2,226**	**2,226**	**2,273**	**2,273**
Ohio	**1,714**	**1,714**	**1,766**	**1,766**
Oklahoma	**1,186**	**1,186**	**1,255**	**1,255**
Oregon	**852**	**852**	**852**	**852**
Pennsylvania	**1,480**	**1,480**	**1,537**	**1,537**
Rhode Island	**918**	**918**	**918**	**918**
South Carolina	**1,514**	**1,514**	**1,576**	**1,576**
South Dakota	**1,456**	**1,456**	**1,521**	**1,521**
Tennessee	**1,798**	**1,798**	**1,855**	**1,855**
Texas	**1,083**	**1,083**	**1,150**	**1,150**
Utah	**1,559**	**1,559**	**1,614**	**1,614**
Virginia	**1,135**	**1,135**	**1,216**	**1,216**
Washington	**811**	**811**	**811**	**811**
West Virginia	**1,933**	**1,933**	**1,974**	**1,974**
Wisconsin	**1,619**	**1,619**	**1,689**	**1,689**
Wyoming	**2,151**	**2,151**	**2,199**	**2,199**

Appendix 5 – 2012 Emission Rate and Building Block Application

The table below provides a block-by-block summary for each state and attempts to compare those rates to both the state's 2012 fossil and fossil/RE/Nuclear$_{ar}$ emission rate from relevant sources. It summarizes the 2012 state emission rates (highlighted in yellow) and the resulting emission rate following the application of each successive BSER building block. Column C shows the 2012 emission rate from existing sources that could count towards the state goal, including the state goal's capture of useful thermal output at cogeneration units. Column C provides an emission rate that may be helpful to compare to the state goal as it covers the same generating source types as those subject to the state goal (with the exception of avoided generation via demand-side energy efficiency).

These block-by-block values are purely illustrative and meant to assist in the understanding of the state goals. For example, the table illustrates that block 1 & 2 application has no impact on Idaho's state goal relative to its current emission rate as the state does not have any covered coal sources to which a heat rate improvement or redispatch assumption is applied. On the other hand, a state like Ohio does see its emission rate decrease based on blocks 1 and 2 assumptions.

The state goal development blocks are not prescriptive in terms of abatement measures or magnitude of that measure. States have the flexibility to select their own portfolio of abatement measures to comply with the state goal. It is also useful to recognize that many states have already moved, or have plans in place to move below their 2012 rates provided in columns B and C due to scheduled retirement of certain fossil units, new renewable and low emissions generation coming online, State RPS programs, and State Energy Efficiency Resource Standards (EERS).

2012 Emission Rate and Building Block Application for Proposed Final State Goal (2030)

A	B	C	D	E	F	G
State	**2012 Fossil Rate (lbs/MWh)**	**2012[1] Fossil, RE, Nuclear$_{AR}$**	**Block 1**	**Blocks 1 & 2**	**Blocks 1, 2, & 3**	**Blocks 1,2,3 & 4 (i.e.,Final State Goal)**
Alabama	**1,518**	**1,444**	1,385	1,264	1,139	1,059
Alaska	**1,368**	**1,351**	1,340	1,237	1,191	1,003
Arizona	**1,551**	**1,453**	1,394	843	814	702
Arkansas	**1,722**	**1,634**	1,554	1,058	996	910
California	**900**	**698**	697	662	615	537
Colorado	**1,959**	**1,714**	1,621	1,334	1,222	1,108
Connecticut	**844**	**765**	764	733	643	540
Delaware	**1,255**	**1,234**	1,211	996	892	841
Florida	**1,238**	**1,199**	1,169	882	812	740
Georgia[2]	**1,598**	**1,500**	1,433	1,216	926	834
Hawaii	**1,783**	**1,540**	1,512	1,512	1,485	1,306
Idaho	**858**	**339**	339	339	291	228

Illinois	**2,189**	**1,894**	1,784	1,614	1,476	1,271
Indiana	**1,991**	**1,924**	1,817	1,772	1,707	1,531
Iowa	**2,197**	**1,552**	1,461	1,304	1,472	1,301
Kansas	**2,320**	**1,940**	1,828	1,828	1,658	1,499
Kentucky	**2,166**	**2,158**	2,028	1,978	1,947	1,763
Louisiana	**1,533**	**1,455**	1,404	1,043	978	883
Maine	**873**	**437**	437	425	451	378
Maryland	**2,029**	**1,870**	1,772	1,722	1,394	1,187
Massachusetts	**1,001**	**925**	915	819	661	576
Michigan	**1,814**	**1,690**	1,603	1,408	1,339	1,161
Minnesota	**2,013**	**1,470**	1,389	999	1,042	873
Mississippi	**1,140**	**1,093**	1,071	809	752	692
Missouri	**2,010**	**1,963**	1,849	1,742	1,711	1,544
Montana	**2,439**	**2,246**	2,114	2,114	1,936	1,771
Nebraska	**2,162**	**2,009**	1,889	1,803	1,652	1,479
Nevada	**1,091**	**988**	970	799	720	647
New Hampshire	**1,119**	**905**	887	710	532	486
New Jersey	**1,035**	**928**	916	811	616	531
New Mexico	**1,798**	**1,586**	1,513	1,277	1,163	1,048
New York	**1,096**	**978**	970	828	652	549
North Carolina	**1,772**	**1,647**	1,560	1,248	1,125	992
North Dakota	**2,368**	**1,994**	1,875	1,875	1,865	1,783
Ohio	**1,897**	**1,850**	1,751	1,673	1,512	1,338
Oklahoma	**1,562**	**1,387**	1,334	1,053	964	895
Oregon	**1,081**	**717**	701	565	452	372
Pennsylvania	**1,627**	**1,531**	1,458	1,393	1,157	1,052
Rhode Island	**918**	**907**	907	907	867	782
South Carolina[3]	**1,791**	**1,587**	1,506	1,342	866	772
South Dakota	**2,256**	**1,135**	1,067	732	900	741
Tennessee[4]	**2,015**	**1,903**	1,797	1,698	1,322	1,163
Texas	**1,420**	**1,284**	1,235	979	861	791
Utah	**1,874**	**1,813**	1,713	1,508	1,454	1,322
Virginia	**1,438**	**1,302**	1,258	1,047	894	810
Washington	**1,379**	**756**	728	444	298	215
West Virginia	**2,056**	**2,019**	1,898	1,898	1,687	1,620
Wisconsin	**1,988**	**1,827**	1,728	1,487	1,379	1,203
Wyoming	**2,331**	**2,115**	1,988	1,957	1,771	1,714

1. "2012 Fossil, RE, $Nuclear_{AR}$" includes all generation subject to the state goals for which data was reported in 2012. That data includes generation from covered fossil fuel-fired units (e.g., >25 MW), all RE generation except hydropower, and

approximately 5.8% of nuclear generation (the "at-risk" component of nuclear generation). The 2012 CO2 rates shown here have not been adjusted for any incremental end-use energy efficiency improvements that states may make as part of their plans to reach these state goals.

2. As described above, Georgia's state goal includes expected generation from nuclear capacity currently under construction at the Vogtle facility. Adding that expected nuclear generation in the "2012 Fossil, RE, $Nuclear_{AR}$" emission rate for Georgia would yield a CO2 emission rate of 1,243 lbs/MWh.
3. As described above, South Carolina's state goal includes expected generation from nuclear capacity currently under construction at the Summer facility. Adding that expected nuclear generation in the "2012 Fossil, RE, $Nuclear_{AR}$" emission rate for South Carolina would yield a CO2 emission rate of 1,147 lbs/MWh.
4. As described above, Tennessee's state goal includes expected generation from nuclear capacity currently under construction at the Watts Bar facility. Adding that expected nuclear generation in the "2012 Fossil, RE, $Nuclear_{AR}$" emission rate for Tennessee would yield a CO2 emission rate of 1,581 lbs/MWh.

Appendix 6- Description of State-level Data Development

The unit-level emissions and generation data derived using the eGRID methodology was relied upon for determining state-level totals ultimately used in the goal calculation. One notable difference is that published editions of eGRID match emissions and generation at the plant level, while the development of the state-level data matches emissions and generation at the unit level in order to filter out units that are not likely subject to the Rule's applicability criteria. Also, the state-level data for goal setting were limited to the following elements at the unit level: CO_2 emissions, nameplate capacity, net generation, state location, and information used to place the unit in each category. The data sources are from reports from units that submit data to the EPA under 40 CFR Part 75, and Energy Information Administration data from forms EIA-860 and EIA-923. The data were assembled at the unit level and were aggregated to the state-level generation totals, capacity totals, and emission rates for the following categories: coal steam, Oil Gas Steam (O/G steam), Natural Gas Combined Cycle (NGCC) and Simply Cycle Combustion Turbines (CTs), and Integrated Gasification Combined Cycle (IGCC). The year 2012 historical values for these categories were then modified for each state to derive the state goal emission rates as described in the main body of the TSD.

Industrial units that are not grid connected are excluded. Units for which fossil fuel was less than 10% of the heat input in year 2012 were also excluded.

For units that report to the EPA under 40 CFR Part 75, reported CO_2 emissions were used. These emissions are either determined from continuous emissions monitors that measure CO_2 concentration and stack gas volumetric flow or, for units that combust certain gaseous and liquid fuels, fuel flow meters and fuel testing as required under appendix D and E of 40 CFR Part 75.

For units that do not report to the EPA under 40 CFR Part 75, CO_2 emissions are calculated from fuel use reported in the EIA-923 and emission factors under EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks or The Climate Registry Default Emission Factors. If no unit level fuel use exists in the EIA-923 dataset and prime mover fuel data exists, and there is more than one unit at a plant that has the same prime mover (e.g. steam turbine, combustion turbine, etc.), then prime mover fuel level emissions are distributed to each generator in the prime mover by proportionately by nameplate capacity. For most cases (where all units in the prime mover would likely be covered by the rule), this apportionment does not matter because emissions are summed to the state level. However, if there is a smaller unit in the prime mover that would not likely be covered by the rule, then this apportionment may not exactly match the amount of fuel actually burned and the associated emissions for each unit. Fuels categorized as "other" that could not be defined and assigned an emissions factor were excluded from this task.

Net generation is taken from EIA-923 data. If no unit-level net generation exists in the EIA-923 dataset and prime mover fuel data exists, and there are more than one unit at a plant that have the same prime mover (e.g. steam turbine, combustion turbine, etc.), then prime mover fuel level net generation is distributed to each generator in the prime mover proportionally by nameplate capacity.

Logic for determination of source CATEGORY:

CATEGORY	Category Name	Includes
COALST	Coal Steam	Coal is designated as primary fuel. Nameplate capacity 25 MW or greater or if heat input capacity is 250MMBtu/hr or greater
OGST	Oil Gas Steam	All steam units not in "Coal Steam" category that have oil or gas primary fuel. Nameplate capacity 25 MW or greater.
NGCC	Natural Gas Combined Cycle Units -Duct burners and heat recovery steam generators are included with combustion turbines that are 25 MW.	NG is primary fuel or if actual fuel use is >90% NG. Combustion turbine parts having nameplate capacity 25 MW or greater. Any associated duct burners and heat recovery steam generators are included.
SST	Simple Cycle Combustion Turbines – 25 MW	Nameplate capacity 25 MW or greater & 33% capacity factor & 219,000MWh
IGCC	IGCC	IGCCs at: Wabash, Polk, Edwardsport

Appendix 7 – 2012 Plant-level Data and Unit-level Inventory

See Appendix 7 Excel attachment titled "Appendix 7 – Plant-level data and unit-level inventory". The unit-level data is available in the Docket and titled "2012 Unit-level Data Using the eGRID Methodology".