Calculating Alabama's 111(d) Target

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AUTHORS

Spencer Fields
Elizabeth A. Stanton, PhD
Pat Knight
Bruce Biewald
Joe Daniel
Sarah Jackson
Ezgi Karaca
John Rosenkranz
Kenji Takahashi

Synapse
Energy Economics, Inc.

485 Massachusetts Avenue, Suite 2
Cambridge, Massachusetts 02139

617.661.3248 | www.synapse-energy.com

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1. 111(d) OVERVIEW

In order to comply with section 111(d) of the Clean Air Act, the U.S. Environmental Protection Agency (EPA) has proposed guidelines for reducing carbon dioxide (CO_2) emissions from existing fossil fuel-fired power plants—the largest single source of greenhouse gas emissions in the country—by 30 percent below 2005 levels by 2030. EPA's proposal is called the Clean Power Plan.

For the purpose of setting 111(d) CO_2 emission reduction targets, EPA has identified a set of options (called "building blocks") that allow states to achieve meaningful CO_2 emission reductions at a reasonable cost. These building blocks include:

- Reducing coal-fired emission rates (Building Block 1);
- Re-dispatching to existing (BB2a) and under-construction (BB2b) natural gas combined cycle units;
- Crediting a portion of nuclear generation (BB3a) and expanding renewable generation (BB3b); and
- Expanding end-use energy efficiency (BB4).

In developing specific targets for each state, EPA conducted what could be considered a high-level feasibility assessment of each building block in each state. However, EPA did not perform a cost-benefit analysis for each building block.[1] Furthermore, none of the building blocks are required for compliance; they are used only to establish the emission targets each state must meet.

Both target-setting and compliance emission rates under 111(d) are calculated according to the formula provided in Figure 1, called the "111(d) emission rate."

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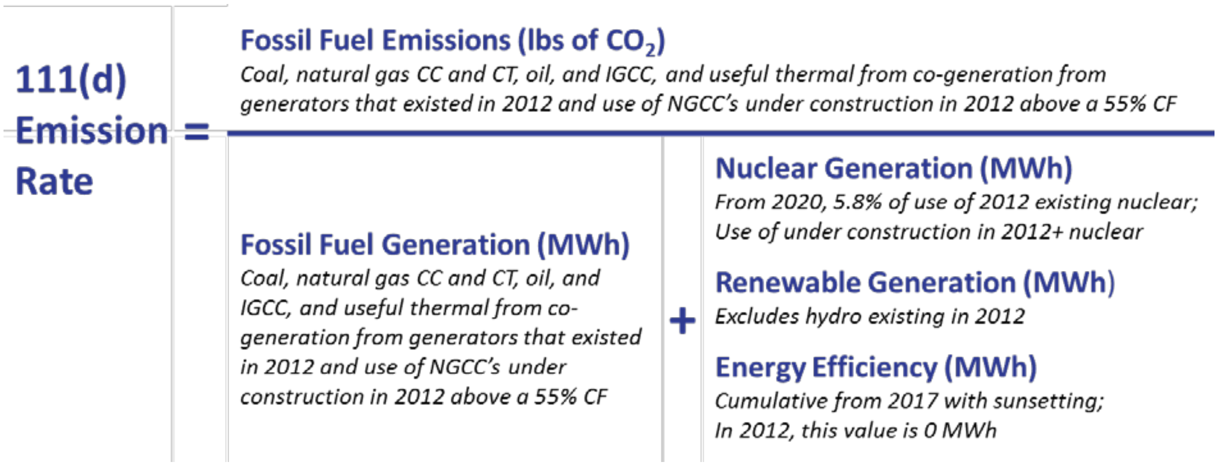
[1] EPA applied a cost-benefit analysis to the rule as a whole, after the creation of each state's building blocks. Cost-benefit analysis was not applied separately and independently to each state's building block.

Figure 1. EPA’s 111(d) emission rate formula for the “proposed/option 1” rule[2]



111(d) Emission Rate =

Fossil Fuel Emissions (lbs of CO_2)
Coal, natural gas CC and CT, oil, and IGCC, and useful thermal from co-generation from generators that existed in 2012 and use of NGCC’s under construction in 2012 above a 55% CF

Fossil Fuel Generation (MWh)
Coal, natural gas CC and CT, oil, and IGCC, and useful thermal from co-generation from generators that existed in 2012 and use of NGCC’s under construction in 2012 above a 55% CF

+

Nuclear Generation (MWh)
From 2020, 5.8% of use of 2012 existing nuclear; Use of under construction in 2012+ nuclear

Renewable Generation (MWh)
Excludes hydro existing in 2012

Energy Efficiency (MWh)
Cumulative from 2017 with sunsetting; In 2012, this value is 0 MWh

In this memo, we walk through this calculation in detail for Alabama, including the implications of any known errors or anomalies in the input data. We also offer additional information on how a variety of resource considerations in Alabama could affect the state’s 111(d) compliance.

2. HOW DID EPA ARRIVE AT ALABAMA’S 111(d) EMISSION RATE TARGET?

Each state’s target calculation begins with its initial 2012 CO_2 emission rate for fossil-fueled electric resources. In 2012, Alabama’s coal-fired power plants produced 46 million megawatt-hours (MWh), and its natural gas combined cycle (NGCC) units 53.5 million MWh. The state had no generation from oil and gas (O/G) steam or other fossil units. In total, Alabama’s fossil-fuel-fired energy fleet emitted 151 billion pounds of CO_2 in 2012. Alabama’s initial fossil-fuel emission rate in 2012 was 1,518 lbs per MWh, as illustrated in Figure 2.[3]

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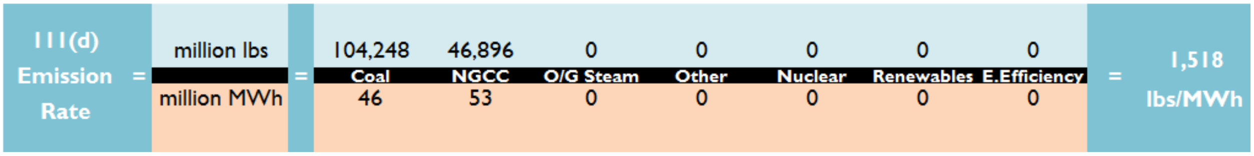
[2] EPA analyzed two options for its target setting. Option 1, the “Proposed” option, features different assumptions for NGCC dispatch, energy efficiency penetration, and renewable generation than Option 2, the “Alternate” option. All discussion of the EPA’s building blocks in this report addresses the compliance target set under Option 1.

[3] The figures in Section 3 provide a visual representation of the steps taken to calculate Alabama’s target 111(d) emission rate. The figures displayed in color replicate the formula provided by the EPA: the numerator in these figures displays emissions while the denominator presents generation. By dividing the sum of all of the emissions by the sum of all of the generation, we produce the EPA’s 2012 and targeted emission rates. The figures displayed in gray represent changes resulting from the application of each building block.

Figure 2. 2012 Initial Alabama 111(d) emission rate



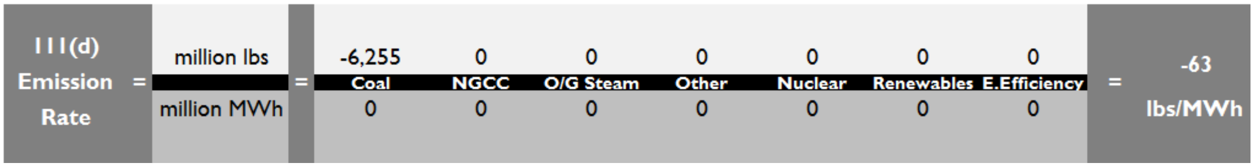
				Coal	NGCC	O/G Steam	Other	Nuclear	Renewables	E.Efficiency		
111(d) Emission Rate	=	million lbs	=	104,248	46,896	0	0	0	0	0	=	1,518
		million MWh		46	53	0	0	0	0	0		lbs/MWh

2.1. Building Block 1: Reduce coal-fired emission rate

EPA's first building block measure involves reducing the carbon intensity of generation at individual coal plants through measures that improve the efficiency with which these units convert coal to electricity (i.e., heat rate improvements). EPA found that best practices to reduce hourly heat rate variability at coal plants could improve heat rates, on average, by 4 percent, while equipment upgrades could achieve an average 2 percent improvement. Overall, EPA determined that a 6 percent heat-rate improvement at each of a state's coal-fired power plants was reasonable.

A 6 percent improvement in the heat rate of Alabama's coal fleet would lead to a decrease of 6,255 million pounds of CO_2 from the 2012 initial total of 104,248 million pounds. This building block lowers Alabama's 111(d) emission rate by an increment of 63 lbs per MWh (see Figure 3).

Figure 3. Change in Alabama 111(d) emission rate formula elements: from 2012 initial to BB1 (lower average coal emission rate)



				Coal	NGCC	O/G Steam	Other	Nuclear	Renewables	E.Efficiency		
111(d) Emission Rate	=	million lbs	=	-6,255	0	0	0	0	0	0	=	-63
		million MWh		0	0	0	0	0	0	0		lbs/MWh

It is important to note that EPA's Building Block 1 does not account for what EPA calls the "rebound effect," whereby increased unit efficiency (and any resultant decrease in variable operating costs) might lead the unit to run more because it is more competitive. This means that the reduction in the unit's CO_2 emissions caused by the improvement in its heat rate could be partially offset by the increase in the unit's CO_2 emissions associated with increased dispatch. The extent of the offset would depend on the unit's generation after the heat rate improvements, as well as the CO_2 emission rates of the units whose generation would be displaced. EPA believes that the combination of building block approaches will counteract the rebound effect by encouraging overall reductions in electricity demand and increases in generation from lower- or zero-emitting resources.

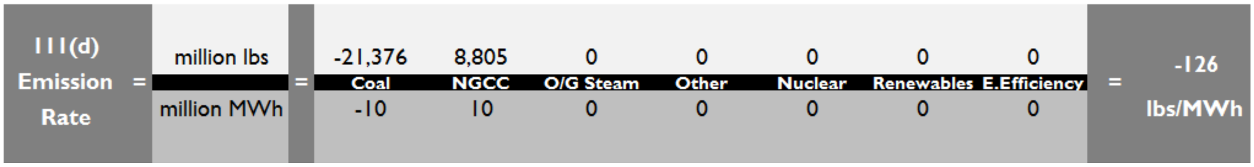
2.2. Building Block 2a: Re-dispatch to underutilized NGCCs

Building Block 2 involves reducing emissions by shifting electricity generation from the most carbon-intensive units (coal, and oil and gas steam generators) to less carbon-intensive NGCC units. A typical NGCC produces less than half the CO_2 per MWh of a typical coal-fired unit. EPA identifies approximately 245 GW of NGCC capacity in operation in the United States in 2012, a substantial majority of which (196 GW) was built in the last 14 years.

According to EPA, these resources are only being utilized at a nationwide average capacity factor of 46 percent—well below what the units are capable of achieving. Alabama's average NGCC capacity factor was 59 percent in 2012. In the Clean Power Plan, EPA's Building Block 2 increases the average NGCC utilization rate up to a maximum of 70 percent by re-dispatching existing fossil generation to these NGCCs. To determine a state's total potential NGCC generation at a 70 percent capacity factor, EPA multiplied the 2012 existing NGCC nameplate capacity by 8,784 hours (the number of hours in 2012) and then multiplied the product by 70 percent. Because Alabama is historically a coal-dependent state, it has ample historical fossil generation to displace with NGCC generation. Alabama would need to increase NGCC generation by 10 million MWh to achieve a 70 percent capacity factor (up from the 2012 average of 59 percent). Since Alabama's 2012 coal and steam generation was 46 million MWh, there is sufficient generation to allow for re-dispatch of the state's NGCCs up to the 70 percent maximum. In contrast, states that are historically less dependent on coal do not have this opportunity – even if California re-dispatched all of its historical coal and steam generation to NGCCs, it would still only achieve a 49 percent NGCC capacity factor—an increase of just 4 percentage points.[4]

Figure 4 illustrates Building Block 2a for Alabama, converting a 59 percent average NGCC capacity factor to a 70 percent capacity factor. Coal emissions and generation decrease, while lower-carbon-intensity NGCC emissions and generation increase. This building block lowers Alabama's 111(d) emission rate by an increment of 126 lbs per MWh.[5]

Figure 4. Change in Alabama 111(d) emission rate formula elements: from BB1 to BB2a (re-dispatch to existing NG)



111(d) Emission Rate =		=	Coal	NGCC	O/G Steam	Other	Nuclear	Renewables	E.Efficiency	=
	million lbs		-21,376	8,805	0	0	0	0	0	-126
	million MWh		-10	10	0	0	0	0	0	lbs/MWh

In 2012, nine states had under-construction NGCCs. For those states, Building Block 2b covers the effect of re-dispatch to new NGCC capacity. Alabama did not have under-construction NGCCs in 2012; thus, there is no additional reduction resulting from the application of Building Block 2b.

The remaining building blocks add no-emission generation to the denominator of the emission rate, but are assumed not to displace remaining coal, natural gas, or oil/gas steam generation in the calculation of the emission rate target.

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[4] In the proposed rule, in states such as Alabama where the 70 percent capacity factor ceiling is reached through re-dispatch, the mix of coal and steam generation is reduced in proportion to the state's historical generation mix. For instance, if coal only accounted for 85 percent of a state's historical coal and steam generation, then only 85 percent of the displacement associated with increased NGCC generation would be applied to coal generation, while the remaining 15 percent would displace oil/gas steam generation.

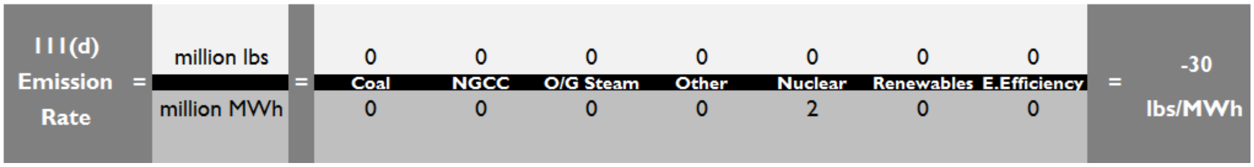
[5] We follow EPA's practice of reporting 111(d) emission rate impacts by building block as the changes in emissions and generation resulting from the addition of a building block onto the previous building blocks; that is, our reported building block 111(d) emission rate changes are sequential.

2.3. Building Block 3a: At-risk and under-construction nuclear

In Building Block 3a, EPA estimates the amount of existing nuclear capacity that is considered “at risk” of being retired, and the total under-construction nuclear capacity in each state in 2012. The “at risk” nuclear generation in each state is not directly tied to the amount of nuclear generation actually at risk of retirement. Instead, EPA has identified 5.8 percent as the approximate nationwide amount of nuclear generation that was at risk of retirement in 2012, based on recent U.S. Energy Information Administration projections. EPA believes this represents a reasonable proxy for the amount of nuclear capacity that is at risk of retirement in the future and, therefore, assigns credit for a flat 5.8 percent of each state’s nuclear capacity in each state’s 111(d) targets.[6]

The 5.8 percent credit applied to Alabama’s 40.8 million MWh of 2012 nuclear generation results in a credit of 2 million MWh (see Figure 5). This building block lowers Alabama’s 111(d) emission rate by an increment of 30 lbs per MWh.

Figure 5. Change in Alabama 111(d) emission rate formula elements: from BB2a to BB3a (at-risk nuclear)



				Coal	NGCC	O/G Steam	Other	Nuclear	Renewables	E.Efficiency		
111(d) Emission Rate	=	million lbs	=	0	0	0	0	0	0	0	=	-30
		million MWh		0	0	0	0	2	0	0		lbs/MWh

Only three states had nuclear plants under construction in 2012: Georgia, South Carolina, and Tennessee. The entire amount of expected generation from these plants is included in the 111(d) emission rate formulae for these states as a part of Building Block 3a. Because Alabama has no under-construction nuclear, the emission reductions under Building Block 3a are limited to the credit for at-risk nuclear generation.

It is important to note that at-risk and under-construction nuclear generation is used both to set 111(d) emission rate targets and is available to states to count toward compliance with their targets, to the extent that they preserve or complete these nuclear resources. If states with existing or under-construction nuclear plants retire these resources before the compliance period, they will not be able to include this generation for compliance.

2.4. Building Block 3b: Renewables

In Building Block 3b, EPA determines its “best practices” scenario for renewables based on average existing renewable portfolio standard (RPS) requirements in each region. EPA first quantified the 2012 level of renewable generation in each region prior to implementation of the best practices scenario.[7]

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[6] EPA assumes a 90 percent capacity factor for each state’s 2012 nuclear capacity.

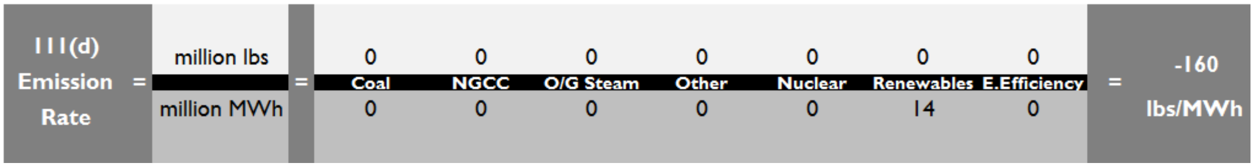
[7] According to EPA, hydropower is excluded from this 2012 starting level determination so as not to distort the regional targets in states that do not have hydropower capacity. However, new or incremental hydropower may be used for compliance.

Next, EPA estimated for each region the average of the state RPS percentage requirements for 2020 and multiplied it by total 2012 generation for the region. The average of the state RPS goals in each region is also used as a maximum renewable energy target for each state; this maximum acts as a ceiling for each state's Building Block 3b target.

EPA then computed a regional growth factor that would be necessary to bring the region from the 2012 starting level up to the average regional RPS requirement in 2020. For this computation, EPA assumes that new renewable energy capacity investments begin in 2017, the year following the initial state plan submission deadline, and continue through 2029. This regional growth factor is then applied to each state's 2012 starting level, beginning in 2017 and stopping if the state gets to the point where additional renewable energy generation would surpass the state's maximum.

Here, the relevant region is the Southeast, comprised of the states of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee. Alabama's target is calculated assuming the state will meet the Southeast region's renewable energy goal of 10 percent. In 2012, Alabama's existing renewable generation made up 3 percent of generation, equivalent to 2.8 million MWh. This existing generation, together with the expected growth in renewables under Building Block 3b, accounts for 14 million MWh of zero-emission generation, which lowers Alabama's 111(d) emission rate by an increment of 160 lbs per MWh (see Figure 6).

Figure 6. Change in Alabama 111(d) emission rate formula elements: from BB3a to BB3b (incremental renewables)



111(d) Emission Rate	=		=	Coal	NGCC	O/G Steam	Other	Nuclear	Renewables	E.Efficiency	=	
		million lbs		0	0	0	0	0	0	0		-160
		million MWh		0	0	0	0	0	14	0		lbs/MWh

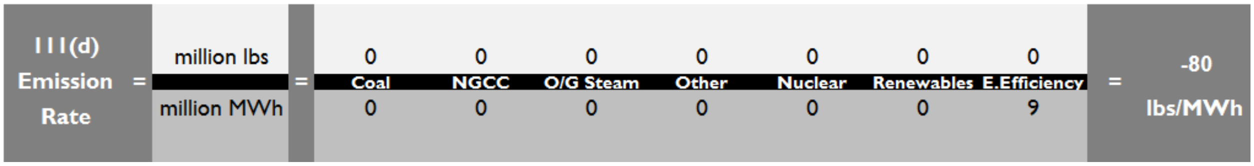
It is important to note that in its calculation of Building Block 3b for target setting, EPA bases its target percentages on regional average RPS objectives, which may include both in-state renewable generation and out-of-state renewable energy certificate (REC) purchases. EPA has requested comments on how to measure a state's renewables for compliance purposes: include in-state generation only, or any generation for which entities within the state have purchased RECs. Of course, under this latter definition, if RECs associated with part of a state's renewable generation are purchased *out-of-state*, then the emission reduction resulting from those renewables displacing fossil generation will not be counted in the generating state's 111(d) emission formula, but rather would displace generation in the purchasing state's formula.

2.5. Building Block 4: Demand-side energy efficiency

The final building block consists of measures to decrease demand for generation through the use of demand-side energy efficiency. EPA provides an analysis of states' energy efficiency potential and finds that the 12 leading states have achieved—or will achieve under existing requirements—annual incremental savings rates of at least 1.5 percent of the electricity demand that would have otherwise occurred. Therefore, EPA determines that for Building Block 4, each state's annual incremental savings rate should increase from its 2012 annual savings rate to a rate of 1.5 percent over a period of years starting in 2017.[8] The increase to 1.5 percent will take place at a rate of 0.2 percent incremental savings per year, so that states already near 1.5 percent will reach their target rate sooner than states that have not yet implemented much demand-side energy efficiency. Any states that have already achieved 1.5 percent in 2012 are assumed to maintain that rate from 2017 through 2029. All states are expected to reach the 1.5 percent target rate by 2025 at the latest.

In the calculation of the final 111(d) emission rate, states that are net importers of electricity receive credit for only a portion of their energy efficiency investments (the product of their cumulative energy efficiency savings and their share of in-state generation); however, as a net electricity exporting state, Alabama receives full credit for its energy efficiency investments. Alabama is expected to achieve annual increments to energy efficiency savings of 1.5 percent by 2025, and cumulative savings of 9 percent, or 9 million MWh, by 2030 (see Figure 7). This building block lowers Alabama's 111(d) emission rate by an increment of 80 lbs per MWh.

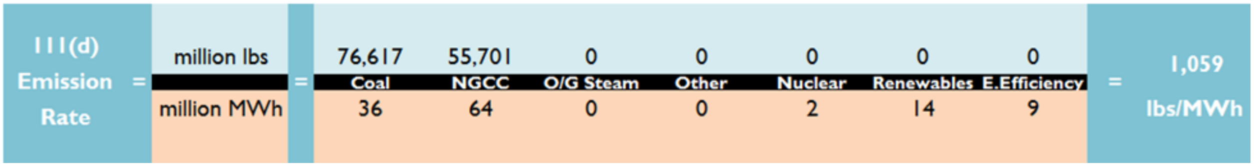
Figure 7. Change in Alabama 111(d) emission rate formula elements: from BB3b to BB4 (incremental energy efficiency)



111(d) Emission Rate =		=	Coal	NGCC	O/G Steam	Other	Nuclear	Renewables	E.Efficiency	=	
	million lbs		0	0	0	0	0	0	0		-80
	million MWh		0	0	0	0	0	0	9		lbs/MWh

After applying all building blocks to each state's initial 2012 emission rate, EPA reports the final target for each state. These targets are customized to each state's specific resources and potential. Alabama's target includes significant reductions from re-dispatch to NGCCs as well as renewable generation. Figure 8 presents Alabama's final state target in 2030, 1,059 lbs per MWh, calculated from all the steps described above.

Figure 8. 2030 target Alabama 111(d) emission rate



111(d) Emission Rate =		=	Coal	NGCC	O/G Steam	Other	Nuclear	Renewables	E.Efficiency	=	
	million lbs		76,617	55,701	0	0	0	0	0		1,059
	million MWh		36	64	0	0	2	14	9		lbs/MWh

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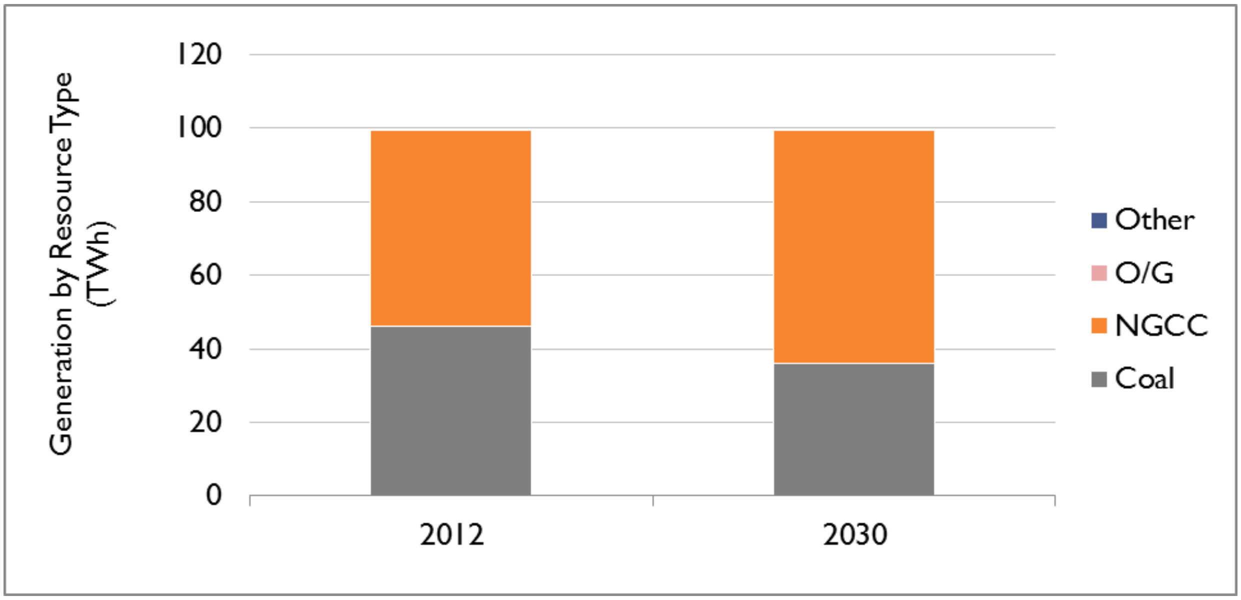
[8] Each state's 2012 reported annual savings rate is assumed to be the starting point for 2017 calculation of the state target.

3. CONSIDERATIONS FOR 111(d) COMPLIANCE STRATEGIES

3.1. Will Alabama have sufficient natural gas supply to meet EPA's targeted re-dispatch?

Figure 9 illustrates the effect of EPA's Building Block 2 (re-dispatch to NGCCs) on Alabama's fossil-fuel generation. EPA assumes NGCCs are fully unconstrained in terms of pipeline capacity. States requiring pipeline expansion to allow NGCCs to achieve 70 percent capacity factors will end up having higher costs of compliance associated with this block. As a result, in these states, increasing the emission reductions by increasing reliance on other strategies may be more cost-effective for compliance.

Figure 9. Effect of re-dispatch to gas units on overall generation in Alabama



Source: EPA Clean Power Plan Technical Support Document: Appendix 1 "Goal Computation"

Peak to annual natural gas usage comparison

Natural gas use for power generation in 2012 averaged 1,096 MMcf per day, and accounted for 64 percent of the total gas delivered to consumers.[9] About 30 percent of the total gas used for power generation in Alabama was consumed during the three summer months of June, July, and August.

Operating existing combined-cycle generating capacity at 70-percent capacity factor throughout the year would increase the amount of natural gas used for power generation by about 20 percent, or approximately 200 MMcf per day. The increase in gas use would be lower during the peak summer

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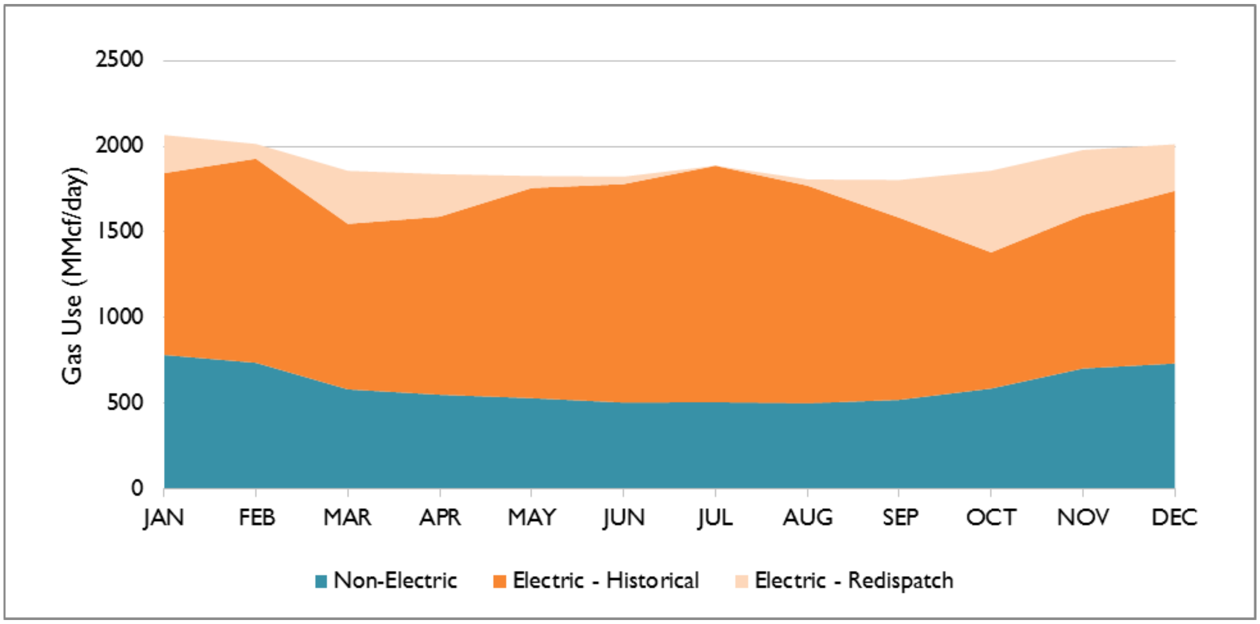
[9] Energy Information Administration (EIA), "Natural Gas Consumption by End Use", Available at: http://www.eia.gov/dnav/ng/ng_cons_sum_dcu_nus_a.htm

months of June through August, when existing gas-fired plants already operate at a relatively high load factor. With re-dispatching, total gas delivered to consumers during the peak month is estimated to increase by about 140 MMcf per day, from 1,928 MMcf per day to just over 2,066 MMcf per day.

Alabama is within the Gulf Coast gas producing area. According to the EIA, Alabama produced 589 MMcf per day in 2012,[10] and the total capacity of the pipelines entering the state is 22,181 MMcf per day.[11]

The estimated increase in peak month gas use of 140 MMcf per day would be a 7-percent increase in consumption, but represents less than 1 percent of the available supply. It does not appear that additional gas infrastructure would be needed as a result of re-dispatching existing combined cycle generating plants in Alabama.

Figure 10. Gas usage in Alabama, historical and after re-dispatch



Hourly analysis of natural gas and coal

In 2013, Synapse performed retrospective analysis on the 2012 U.S. electric dispatch system and evaluated the available, unused natural gas generation that could feasibly be used to displace coal

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[10] Energy Information Administration (EIA), "Natural Gas Wellhead Value and Marketed Production", http://www.eia.gov/naturalgas/data.cfm

[11] Energy Information Administration (EIA), "U.S. State-to-State Capacity", available at: http://www.eia.gov/naturalgas/data.cfm (spreadsheet)

generation on a region-by-region basis.[12] This analysis was conducted on a unit-by-unit basis and results were compiled at the scale of eGRID subregionsand ISOs/RTOs, approximating regional power markets.[13] In general terms, the analysis shows that natural gas was available to displace coal during lower demand hours.

In the proposed 111(d) rule, EPA asserts that NGCC units can be operated at an annual capacity factor of 70 percent to displace coal and steam oil and gas units. However, there are many reasons why an individual gas plant might not be able to produce electricity at a high capacity factor. Generating units must produce electricity exactly when it is needed and at peak times there may not be enough natural gas capacity to meet regional demand. Synapse analyzed hourly EPA Air Markets data to investigate the potential for natural gas power plants to displace coal generation in all hours of the year.[14]

Alabama is divided into two different subregions of eGRID: SRTV and SRSO. In 2012, natural gas in the SRTV subregion generated 34,337 GWh, and NGCCs had an aggregated capacity factor of 45 percent (see Table 1). The Synapse analysis indicated that this region could exceed the EPA's natural gas re-dispatch target of 70 percent and could, under the assumptions modeled, reach an 80-percent capacity factor.

Table 1. SRTV coal and natural gas dispatch in 2012, historical and under Synapse assumptions

SRTV: SERC Tennessee Valley	Peak Load (MW)	Generation (GWh)	% of Total Generation	Capacity Factor	% of Total Days
Total Fossil (2012)	38,398	185,889			
Coal (2012)	25,595	147,051	79%	59%	100%
Natural Gas CC (2012)	7,672	34,337	18%	45%	100%
Coal Displaced by NGCC		26,871	14%		
Remaining Coal		120,180	65%	48%	100%
Total Natural Gas CC Potential		61,208	33%	80%	100%

Source: Knight, P., B. Biewald, J. Daniel. 2013. Displacing Coal: An Analysis of Natural Gas Potential in the 2012 Electric System Dispatch. *Synapse Energy Economics*.

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[12] Knight, P., B. Biewald, J. Daniel. 2013. *Displacing Coal: An Analysis of Natural Gas Potential in the 2012 Electric System Dispatch.* Synapse Energy Economics. Available at http://www.synapse-energy.com/Downloads/SynapseReport.2013-09.EF.Displacing-Coal.13-020.pdf.

[13] The US EPA's Emissions & Generation Resource Integrated Database (eGRID) breaks the country down into subregions based on electric companies throughout the US. For more information on eGRID, see also: http://www.epa.gov/cleanenergy/energy-resources/egrid/

[14] This analysis assumed that all coal generation is able to be displaced in any given hour, regardless of constraints. In reality, fossil generation units, particularly coal, have significant operational constraints, including ramp rates and minimum up-times, minimum down-times, and minimum load levels.

In 2012, natural gas in the SRSO subregion generated 85,262 GWh, and NGCCs had an aggregated capacity factor of 46 percent (see Table 2). The Synapse analysis indicated that this region could, under the assumptions modeled, reach an 80 percent capacity factor.

Table 2. SRSO coal and natural gas dispatch in 2012, historical and under Synapse assumptions

SRSO: SERC South	Peak Load (MW)	Generation (GWh)	% of Total Generation	Capacity Factor	% of Total Days
Total Fossil (2012)	41,656	185,846			
Coal (2012)	21,189	94,995	51%	42%	100%
Natural Gas CC (2012)	14,985	85,262	46%	56%	100%
Coal Displaced by NGCC		35,646	19%		
Remaining Coal		59,349	32%	26%	100%
Total Natural Gas CC Potential		120,908	65%	80%	100%

Source: Knight, P., B. Biewald, J. Daniel. 2013. Displacing Coal: An Analysis of Natural Gas Potential in the 2012 Electric System Dispatch. *Synapse Energy Economics*.

3.2. How will expected nuclear retirements impact Alabama's 111(d) compliance?

Alabama's significant nuclear capacity is an important element in constructing its 111(d) emission rate target (see Table 3). The state's nuclear units range in age from 33 to 40 years, as compared to the national average nuclear unit age of 33 years. If Alabama's nuclear units were to retire before the end of the 111(d) compliance period in 2030, the state would need to rely more heavily on other measures to achieve compliance; however, the relative youth of the state's nuclear fleet indicates this will likely not be an issue for Alabama.

Table 3. Alabama nuclear fleet statistics

Plant/Reactor Name	Capacity (MW)	Grid Connection	Age	2012 Capacity Factor	2011 Capacity Factor
Browns Ferry Nuclear Plant, Unit 1	1,141	8/1/1974	40	88%	91%
Browns Ferry Nuclear Plant, Unit 2	1,141	3/1/1975	39	99%	80%
Browns Ferry Nuclear Plant, Unit 3	1,141	3/1/1977	37	83%	87%
Joseph M. Farley Nuclear Plant, Unit 1	916	12/1/1977	37	91%	101%
Joseph M. Farley Nuclear Plant, Unit 2	916	7/30/1981	33	104%	89%

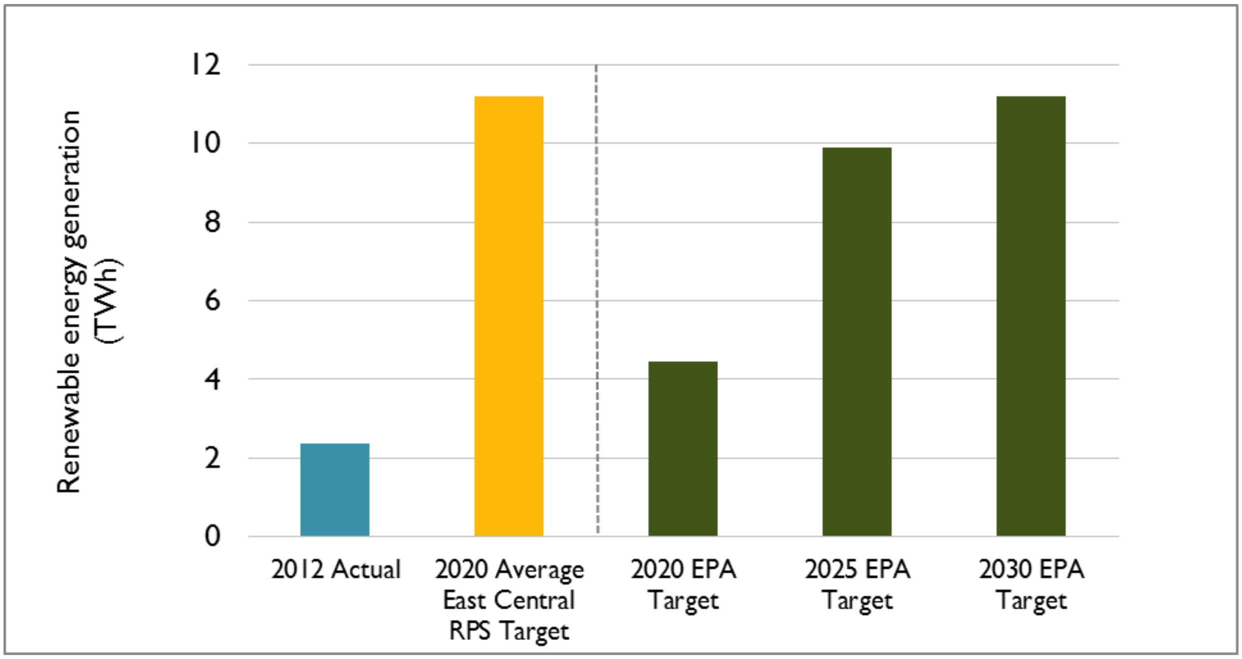
Note: The NRC database does not elaborate on how a unit could achieve above a 100-percent capacity factor. It may be that the unit may have received an uprate recently, so that current generation is being compared to an outdated capacity level. Source: Available at: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1350/

3.3. How do EPA's renewable targets for Alabama compare to planned and potential renewables?

Figure 11 reports Alabama's actual 2012 renewable generation along with its EPA 111(d) target renewable generation for 2020, 2025, and 2030. As discussed in Section 3.4, EPA estimates state renewable targets based on average existing, non-zero RPS requirements in each region. The incremental renewable energy targets that EPA set for Alabama are based on the state achieving a regional Southeast target of 10-percent renewable generation by 2030. The regional target is based solely on the 2020 goal of North Carolina, as it is the only state in the Southeast with a mandatory RPS.

The low level of existing renewable generation in the Southeast region results in the second highest annual growth factor of any region. Southeast states are expected to increase renewable generation at an annual rate of 13 percent. Alabama's 2012 renewable generation was about 3 percent of total generation—well below the national average of 6.5 percent. Given the combination of Alabama's current level of renewable generation and the regional growth factor of 13 percent, Alabama's renewable target grows from 3 percent in 2020 to 9.3 percent in 2030. Alabama does not reach the regional RPS cap by 2030.

Figure 11. Renewable generation, current and targeted, in Alabama compared to EPA target



Source: EPA AMPD Dataset, 2009-2013; EPA TSD and Data File: Alternative Renewable Energy Approach; Lopez, A. et al. 2012. "U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis." NREL/TP-6A20-51946. Golden, CO: National Renewable Energy Laboratory.

As mentioned above, Alabama does not have a mandatory RPS. The second bar in Figure 11 illustrates what Alabama's renewables target for 2020 would be if it had an RPS equivalent to North Carolina's, which is 10 percent in 2019. Since EPA uses this goal to set the regional 2030 target, the amount of generation produced by this hypothetical RPS in 2020 greatly exceeds EPA's 2020 target and is equivalent to the 2030 target set by the EPA for Alabama.

Alabama's technical potential for renewable generation greatly exceeds the state's 2012 total generation: indeed, Alabama's utility-scale solar potential alone is over 25 times greater than current state generation (not shown in Figure 11 due to scale).[15]

States' ability to use renewables for 111(d) compliance will depend, in part, on EPA's decision in the final 111(d) rule on whether qualifying renewable generation must be sited within the geographic boundary of the state, or whether a state's purchase of RECs from other states may count towards compliance.[16] Because Alabama does not currently have an RPS, utilities have no obligation—at present—to buy RECs from anywhere, as shown in Table 4. Table 4 also indicates which states may purchase RECs from entities in Alabama.

Table 4. List of states with which Alabama can trade RECs

States that Alabama can buy RECs from:	Alabama does not currently have an RPS
States that Alabama can sell RECs to:	Kansas, North Carolina

Source: Holt, E. 2014. "Potential RPS Markets for Renewable Energy Generators." Prepared for the State-Federal RPS Collaborative by the Clean Energy States Alliance. Available at http://www.cesa.org/assets/2014-Files/Potential-RPS-Markets-Report-Holt-January-2014.pdf.

It is likely that the most cost-effective strategy to pursue building block 3b in Alabama will come through bundled out-of-state REC purchases. Bundled purchases would include both delivered energy and RECs, meaning that Alabama will be able to claim both generation and emission benefits associated with these RECs.

3.4. How could Alabama comply using a mass-based target?

When the Clean Power Plan was announced in June 2014, EPA issued proposed carbon reduction goals using a rate approach (i.e., in lbs/MWh), but gave states the option to convert these rate-based targets to mass-based targets (pounds of CO2). On November 6, 2014 EPA released further guidance on how states might translate the rate-based goals to mass-based equivalents. Two agency proposed two

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[15] Lopez, A., et al. 2012. *U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis*. National Renewable Energy Laboratory. Available at: http://www.nrel.gov/docs/fy12osti/51946.pdf.

[16] Note that the target is set based on renewable generation that is physically located in the state.

approaches: one focused on existing units alone, and another that accounts for load growth and includes emissions from new or incremental fossil fuel generation.

The "Existing Affected Sources" approach calculates a generation level for each state based on existing 2012 fossil, renewable, and at-risk nuclear generation, and multiplies this value by the previously determined rate-based target to develop a goal in metric tons of CO_2. The "Existing Affected and New Sources" approach is more complicated, accounting for load growth and including new fossil-fuel fired sources. This approach projects sales based on region-specific load growth rates from the EIA's 2013 Annual Energy Outlook, adjusted for transmission losses, and adds these adjusted sales to the generation assumed for the "Existing Affected Sources" approach. This approach assumes that all new or incremental generation to meet load growth comes from new fossil generation within the state in question. Both approaches calculate a "mass equivalent generation level" in MWh, and multiply this by the EPA's rate-based target to calculate a mass-based target in metric tons of CO_2. By 2030, the "Existing Affected Sources" approach requires a reduction in 2012 emissions by 608 million metric tons nationwide (31 percent of 2012 emissions). In contrast, by 2030, the "Existing Affected and New Sources" approach requires a reduction in 2012 emissions by 391 million metric tons nationwide (20 percent of 2012 emissions). Required emission reductions in the "Existing Affected and New Sources" approach are smaller because it accounts for new generation required to meet growing load.

This simplified approach does not account for changes in import/export patterns among states, and assumes renewable energy and energy efficiency displace generation exclusively within the state in question. A more accurate approach would use a detailed hourly production cost model to assess such changes on a going-forward basis, but this type of analysis is time and resource intensive.

Table 5 presents the resulting targets under these two approaches for Alabama:

Table 5. Rough estimate of emissions cap for Alabama for mass-based target compliance

Alabama	Emissions in 2012 (million metric tons CO_2)	Target for 2030 (million metric tons CO_2)	Reduction as % of 2012
Existing Affected Sources	68.5	50.3	27%
Existing Affected and New Sources	68.5	59.2	14%

Source: EPA Clean Power Plan Technical Support Document: Rate to Mass Translation Data File.

States will need to compare the 111(d) rate- and mass-based compliance approaches. Fossil-fuel unit retirements, expected construction of new fossil-fuel units, and expected changes in load over time are all critical to understanding the advantages and disadvantages of each approach.