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EPA's Greenhouse Gas Rules

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Overview

- Greater stringency overall: 32 percent vs. 30 percent reductions by 2030; setting the stage post-2030
- Compliance begins in 2022 with Clean Energy Incentive Program starting sooner; three "step down" periods
- Regulatory focus expanding from coal to fossil fuels; NGCC negatively impacted compared to proposal (4% reduction from business as usual)
- Significant focus on driving new renewable and energy efficiency; Clean Energy Incentive Program
- Specific emission performance rate of 1,305 lb CO_2/MWh for fossil fuel steam (coal) and 771 lb CO_2/MWh for NGCC.

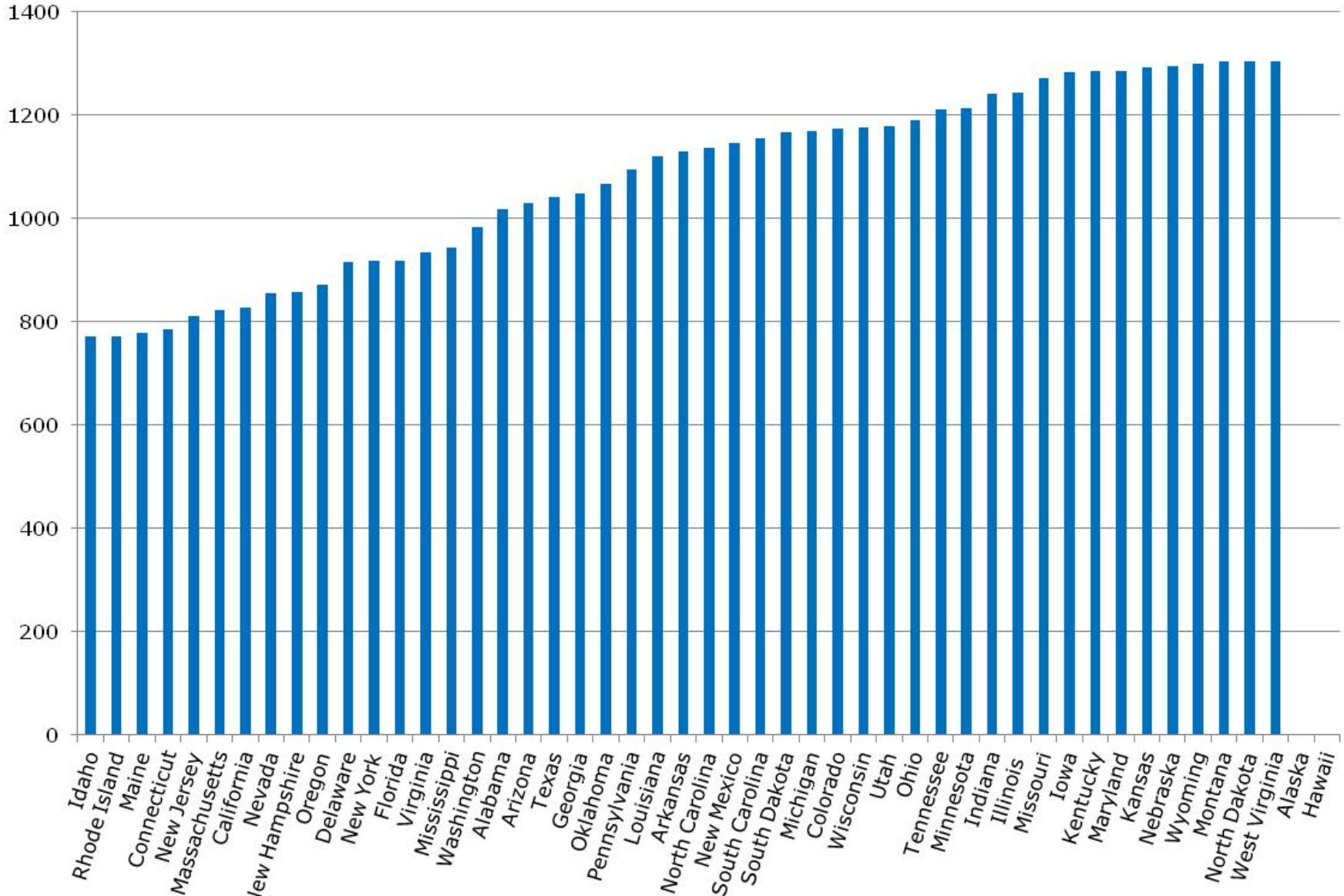
Overview (cont.)

- The final rule substitutes a “state measures” approach for the “portfolio” approach
- New building block methodology
- New state targets
- Revised legal rationales
- Encourages emissions trading
- “Reliability safety valve”

Themes

- "Drive a more aggressive transition to zero-carbon renewable energy sources than the proposed rule."
- "[T]he rule will drive deeper decarbonization after 2030 than in the proposed rule."
- "In the final rule, that early rush to gas is eliminated. Indeed, the share of natural gas is essentially flat compared to business as usual."
- "The final rule will also drive a more aggressive transition to zero-carbon renewable energy sources than the proposed rule. The share of renewable energy generation capacity in 2030 is projected to be over 25 percent higher than in the proposed rule, at 28 percent, compared to 22 percent."
- "The rule drives early reductions from renewable energy and energy efficiency, which will drive a more aggressive transformation in the domestic energy industry."
- "An important driver of these outcomes is the Clean Energy Incentive Program, which that [sic] will incentivize early deployment of renewable energy and energy efficiency." The Rule will "drive a more aggressive transformation in the domestic energy industry."

Final 2030 Rate-Based Emission Goal



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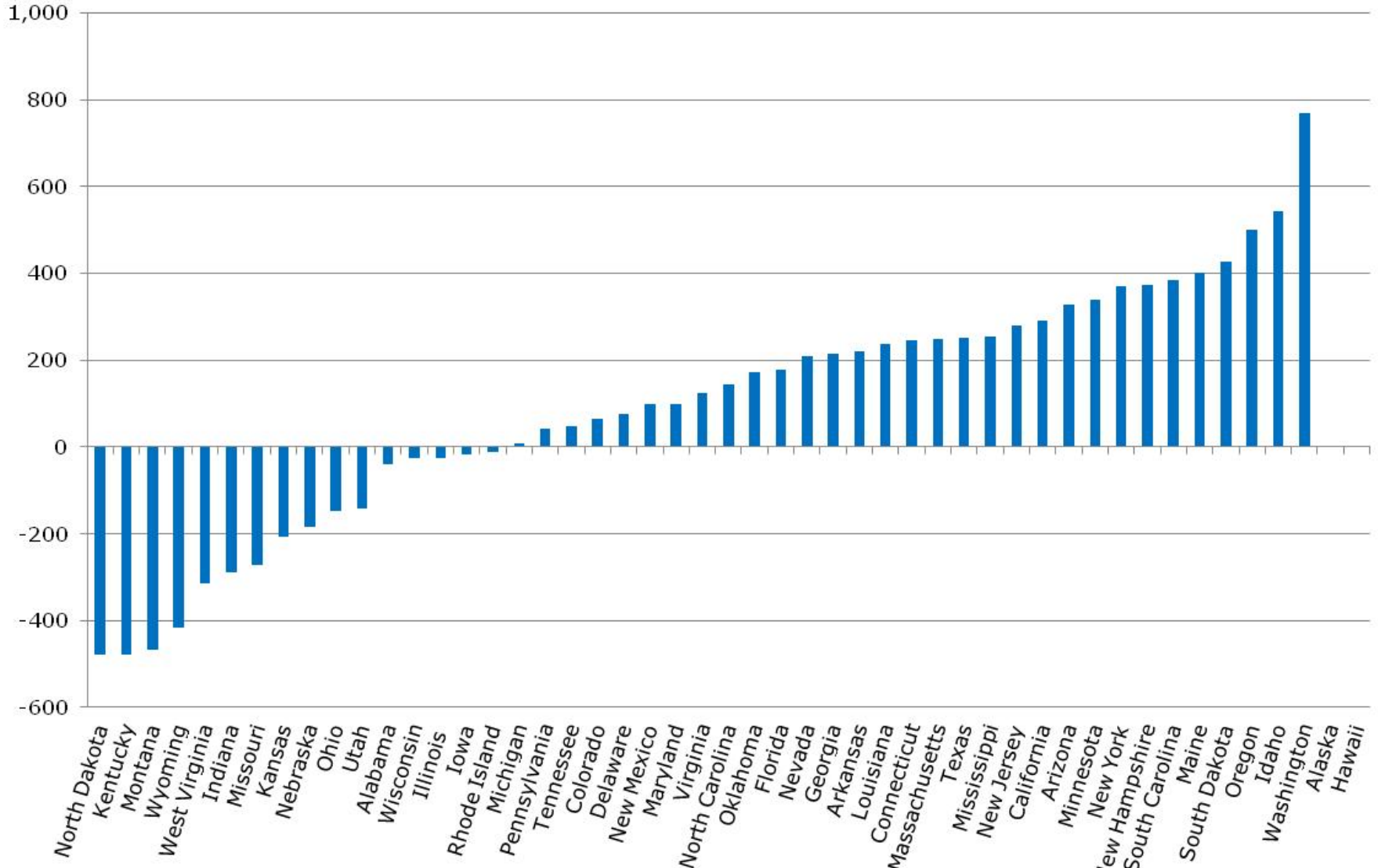
Difference Between Proposed and Final Rate-based Goal



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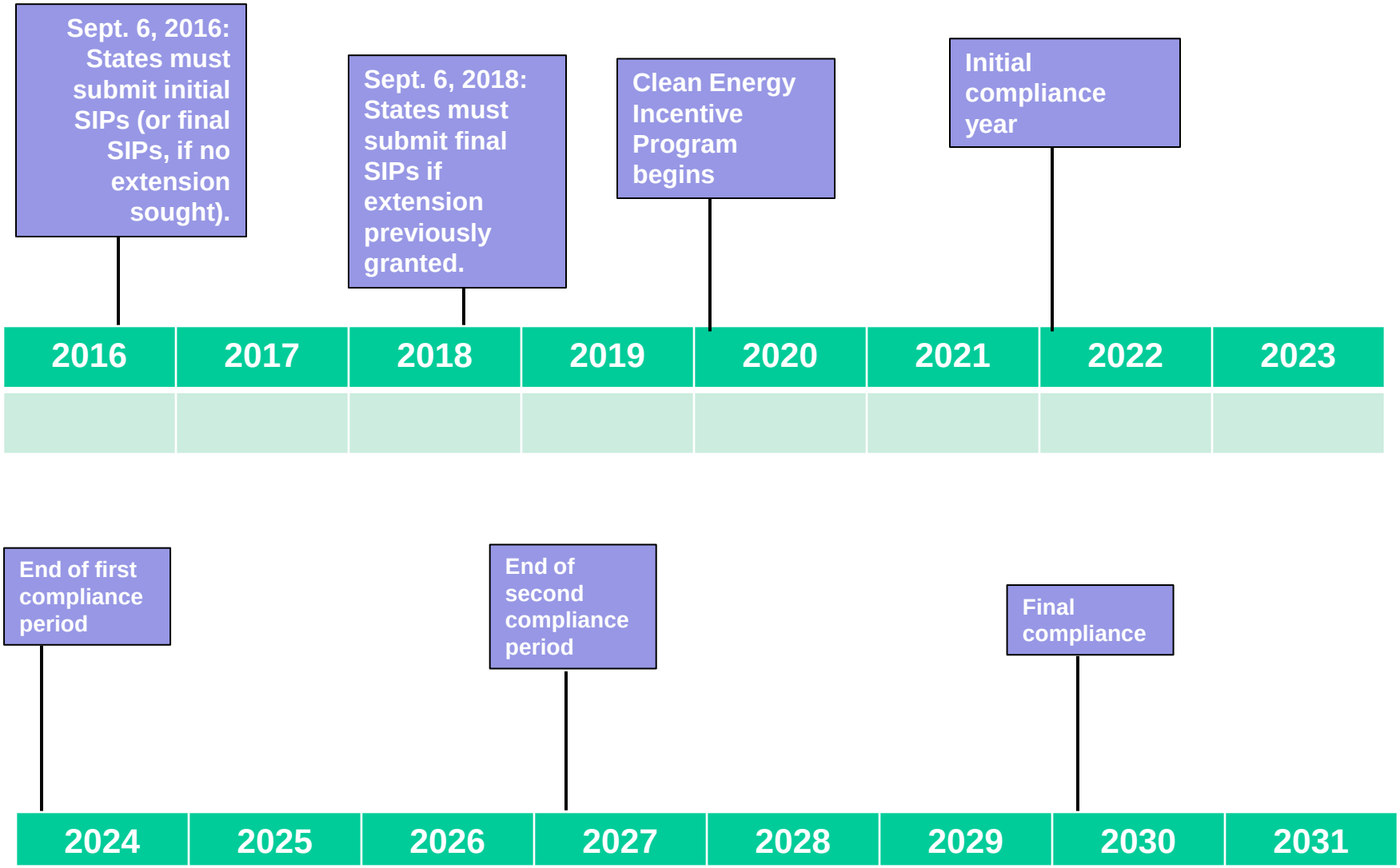

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Building Block 1

- Proposed Rule: 6% heat rate improvement (HRI)
  - Work practice improvements
  - Equipment upgrades

- Final Rule:
  - Eastern Interconnection: 4.3% HRI
  - Texas Interconnection: 2.3% HRI
  - Western Interconnection: 2.1% HRI

- Primary Differences
  - Regional HRI values
  - Elimination of equipment upgrades for BSER

Building Block 2

- Proposed Rule:
  - 70% capacity factor for existing and under construction NGCC
  - Achieved by 2020

- Final Rule:
  - 75% capacity factor for existing and under construction NGCC
  - Based on summer capacity
  - Achieved in 2030, with glide path from 2020
  - Applied after Building Block 3 when setting goals

Building Block 3

- Proposed Rule:
  - Nuclear
    - No retirement of “at risk” capacity
    - Inclusion of under construction nuclear
  - Renewable
    - Regional RE generation targets derived from existing RPS goals and applied to each state
    - Glide path to 2030
- Final Rule:
  - Elimination of nuclear energy for BSER (new nuclear still available as compliance option)
  - Incremental renewables only
  - 25% increase in renewable energy potential
  - RE potential based on economic modeling
  - Applied at regional “interconnection” level

Building Block 4

- Proposed Rule: Annual improvement of 1.5%

- Final Rule:
  - No longer part of the BSER analysis in setting targets
  - Remains front and center as a compliance option for states

Building Block Potential

Table 1. 2030 Building Block Potential Identified for Each Region			
	BB1 – Heat Rate Improvement (HRI) for Coal Fleet	**BB2** - TWh of Total NGCC Generation at 75 % Utilization, (Amount of NGCC Generation Potential Incremental to Baseline)	**BB3** - Incremental RE Potential (TWh)
Eastern Interconnection	4.3%	988, (253)	438
Western Interconnection	2.1%	306, (108)	161
Texas Interconnection	2.3%	204, (66)	107

Note - Totals are building block potential only (rounded). As evidenced in Section 4-step 8, not all of the building block potential is utilized in establishing BSER category-specific rates and state goals.

Source: EPA, CO_2 Emission Performance Rate and Goal Computation Technical Support Document for CPP Final Rule 3 (Aug. 2015)

Application of BSER to Calculation Emission Reduction Targets

- Step 1 – Compile and aggregate state-level baseline emission performance rates for coal, oil & gas steam, and NGCC facilities.
- Step 2 – Aggregate adjusted state baseline data to regional “interconnection” level.
- Step 3 – Identify category-specific baseline emission rates for fossil steam and NGCC units.
- Step 4 – Adjust fossil steam baseline emission rates to account for BB 1 heat rate improvements.
- Step 5 – Adjust fossil steam and NGCC baseline generation to account for BB 3 incremental renewable energy generation

Application of BSER to Calculation Emission Reduction Targets

- Step 6 – Adjust fossil steam generation to account for BB 2 increase in NGCC capacity factor to 75%.
- Step 7 – Calculate adjusted category-specific emission rates for each region based on BBs 1-3.
- Step 8 – Identify least stringent regional emission rates for fossil steam and NGCC.
    - Fossil steam = 1,305 lb/MWh
      NGCC = 771 lb/MWh
- Calculation of rate-based state goals – application of category specific emission rates to all baseline fossil steam and NGCC generation on weighted average.
- Calculation of mass-based goals – mass-based conversion of rate-based goals with additional emissions based on excess RE potential.

Methods for state compliance

- **Emissions standard approach**: Apply the national emission rates—1,305/771—directly to steam and NGCC facilities.
- **Rate-based emissions approach**: Ensure that the state achieves compliance with the state-specific rate-based goals (may permit individual EGUs to exceed 1,305/771).
- **Mass-based emissions approach**: Ensure that the state achieves compliance with the state-specific mass-based goals (may permit individual EGUs to exceed 1,305/771).
    - *Can apply "state measures" approach to impose requirements directly on non-EGUs under state law.*

Scope of State Measures Approach

- State measures must be "quantifiable, verifiable, enforceable, non-duplicative, and permanent."

- EPA specifically references renewable energy and energy efficiency as permissible under state measures approach.

- Requires federally-enforceable backstop emission standards for affected EGUs

"Beyond BSER"

Final ESPS offers a number of "beyond BSER" options states can use to achieve emissions reduction targets

- Demand-side energy efficiency
- New or uprated nuclear generation
- Renewables not included in BSER (distributed solar generation, offshore wind)
- Sustainable biomass
- Combined heat and power and waste heat power
- Transmission and distribution improvements
- Inclusion of new NGCC generation option for mass-based standard

Clean Energy Incentive Program

- Gives additional credits for renewable and energy-efficiency programs started in 2020 and 2021.
- For renewable energy:
  - Must generate metered MWh from wind or solar sources.
  - For every two MWh generated, project receives 1 credit.
- For energy efficiency
  - Must result in quantified and verified electricity savings through implementation in low-income communities.
  - For every two MWh of savings, project receives two credits.
- Credits may be banked and traded.

Severability

- EPA maintains that blocks 2 and 3 are severable from each other.
- Unlike in the proposed rule, EPA concedes that block 1 is *not* severable from blocks 2 and 3.
  - EPA asserts that if block 2 or 3 stands, block 1 stands as well
  - EPA does not contest that, if both blocks 2 and 3 fall, block 1 would fall with it.

Impacts to NGCC

The final ESPS rule impacts gas vs. the proposal in at least two ways:

- Instead of mandating a complete ramp-up of existing NGCC units at the outset of the compliance period (2020), the rule requires full ramp-up by 2030.

- The rule also does not count new NGCC capacity to calculate the BSER, on the basis that "emission reductions achieved through the use of new NGCC capacity require the construction of additional CO2-emitting generating capacity, a consequence that is inconsistent with the long-term need to continue reducing CO2 emissions beyond the reductions that will be achieved through this rule."

EPA estimates 2030 demand for natural gas will be reduced by 4% under mass-based standard and 1% under rate-based standard compared to base case

Reliability Safety Valve

The final rule includes a safety valve that EPA asserts will avoid threats to grid reliability during implementation.

- Safety valve is triggered on source-specific basis when there is conflict between requirements of SIP and maintenance of electric system reliability due to unforeseen or catastrophic events.
- When the safety valve is triggered, a source's emissions will be excluded from the applicable emissions standards for 90 days.
- During the 90-day period, the source must meet an alternative emission standard that will not jeopardize grid reliability.
- If the risk to grid reliability cannot be resolved, the State must submit a SIP revision that will address the reliability concern.

Summary of the NSPS Standards

- Newly-constructed fossil fuel-fired steam EGUs: 1,400 lbs CO2/MWh (gross).

- Newly-constructed and reconstructed fossil fuel-fired stationary combustion turbines:
  - 1,000 lb CO2/MWh (gross) or 1,030 lb CO2/MWh (net) for base load natural gas-fired units.
  - 120 lb CO2/MMBtu for non-base load natural gas-fired units.
  - 120 to 160 lb CO2/MMBtu for multi-fuel-fired units.

- Modified fossil fuel-fired steam EGUs: particularized standard based on unit's historical performance.

- Reconstructed fossil fuel-fired steam EGUs:
  - Sources with heat input > 2,000 Mmtu/h: 1,800 lb CO2/MWh (gross).
  - Sources with heat input < 2,000 Mmtu/h: 2,000 lb CO2/MWh (gross).

Changes from the Proposed NSPS

- The final rule reduces the stringency of required CCS: CCS must capture 16% of CO_2 produced by an EGU burning bituminous coal (or 23% if burning subbituminous or dried lignite).
- This change results in an increase of 300 lbs CO_2/MWh (gross) over the proposed emission standard for these sources.
- EPA collapsed the distinction between small and large base load stationary combustion turbines. They now have the same standard of 1,000 lbs CO_2/MWh (gross) (or alternatively 1,030 lb CO_2/MWh (net)).

Comparing NSPS to ESPS

	Newly-constructed	Existing
Coal	1,400 lbs CO_2/MWh (gross)	1,305 lbs CO_2/MWh (gross)
NGCC	1,000 lbs CO_2/MWh (gross) (base load sources)	771 lbs CO_2/MWh (gross)

The Proposed FIP

- EPA proposes to adopt a federal implementation plan for states that do not adopt their own SIPs.
- The federal plan would "achieve the same levels of emissions performance as required of state plans" under the final existing source rule.
- The federal plan would adopt one of the following approaches:
  - A mass-based approach (favored by EPA).
  - A rate-based approach.

Mass-Based Approach

- EPA creates state emissions budget equal to total tons of CO_2 allowed to be emitted by EGUs in that state under the final ESPS rule.
- EPA distributes allowances within the state budget to EGUs based on their historic generation.
- Allowances may be traded and banked, and additional allowances may be earned by supporting renewable energy projects.
- EGUs must have a sufficient number of allowances to cover their actual emissions during a given compliance period.

Rate-Based Approach

- Sources must meet emission standard set by final ESPS rule.
- If sources emit above the assigned rate, they must acquire a sufficient number of emission rate credits to bring themselves into compliance.
- Each emission rate credit represents a zero-emitting megawatt hour.
- Emission rate credits may be generated by "affected EGUs or by other entities that supply zero- or low-emitting electricity … through an approval and recognition process that the EPA will administer."
- Emission rate credits may be traded or banked for use in later years.

Thank You.

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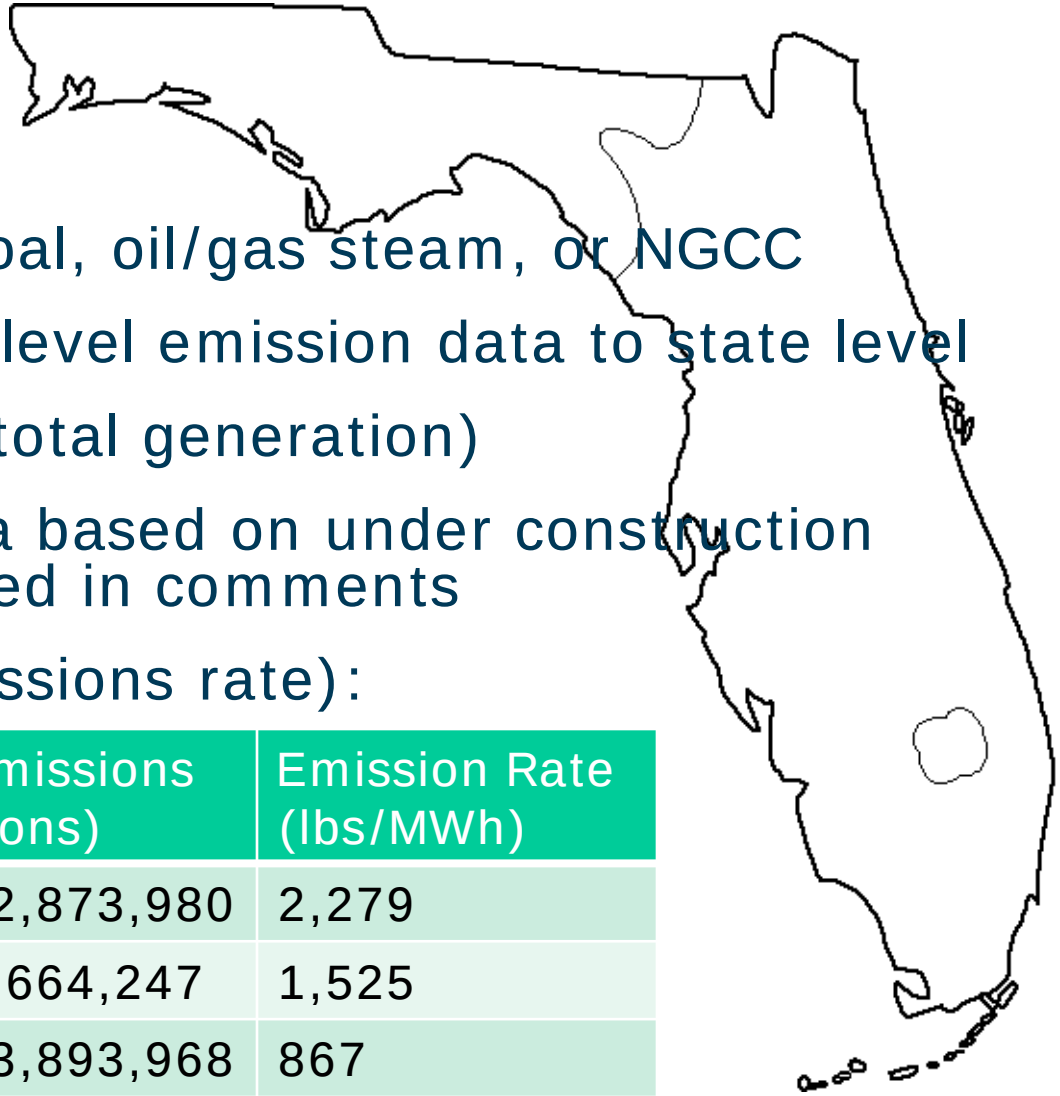
Appendix A

Calculation of Emission Reduction Targets

Florida as an Example

Step 1 – State-Level Emissions Rates - Florida



- Categorize units as coal, oil/gas steam, or NGCC
- Aggregate 2012 unit-level emission data to state level (total emissions / total generation)
- Adjust emissions data based on under construction units and factors raised in comments
- Florida (adjusted emissions rate):

Unit	Generation (MWh)	Emissions (tons)	Emission Rate (lbs/MWh)
Coal	46,401,833	52,873,980	2,279
O/G	10,050,187	7,664,247	1,525
NGCC	147,327,444	63,893,968	867

Step 2 – Aggregate State Data to Regional Level

- Sum state generation and emission data for each regional interconnection

Table 3. Regional Baseline						
A	B	C	D	E	F	G
	Coal		NGCC		OG Steam	
Interconnection	Emissions (1000 short tons)	Net Generation (GWh)	Emissions (1000 short tons)	Net Generation (GWh)	Emissions (1000 short tons)	Net Generation (GWh)
Eastern	1,356,066	1,230,448	328,220	734,535	52,979	74,241

Source: EPA, CO2 Emission Performance Rate and Goal Computation Technical Support Document for CPP Final Rule 10 (Aug. 2015)

Step 3 – Calculate Regional Baseline Rates (Eastern Interconnection)

- Fossil steam rate based on coal and oil and gas steam:

$$\frac{\text{coal emissions + OG emissions}}{\text{coal gen + OG gen}}$$

$$\frac{\text{1,356,066,366 tons + 52,979,259 tons}}{\text{(1,230,447,795 MWh + 74,240,802 MWh)}} = 2{,}160 \text{ lbs/MWh}$$

- NGCC rate:

$$\frac{\text{NGCC emissions}}{\text{NGCC gen}} \quad \frac{\text{328,219,519 tons}}{\text{734,535,157 MWh}} = 894 \text{ lbs/MWh}$$

Step 4 – Application of Building Block 1 (Eastern Interconnection)

Reduce baseline based on regional HRI value

$$\frac{(\text{coal emissions} \times (1 - \text{HRI})) + (\text{OG emissions})}{\text{Coal generation} + \text{OG generation}}$$

$$\frac{(1{,}356{,}066{,}366 \times (1-.043) + 52{,}979{,}259}{1{,}230{,}447 + 74{,}240{,}802} = 2{,}071$$

BB1: 2,160 lbs/MWh → 2,071 lbs/MWh

Step 5 – Application of Building Block 3 (Eastern Interconnection)

Replace fossil fuel generation with incremental RE on pro rata basis

- Eastern interconnection RE potential: 438,445 GWh

- Fossil fuel steam (64%)

  1,304,689 – (438,445 x 0.64) = 1,024,173 GWh

- NGCC (36%)

  734,353 – (438,445 x 0.36) = 573,606 GWh

Step 6 – Application of Building Block 2 (Eastern Interconnection)

Replace fossil fuel generation with NGCC generation

- Increase NGCC to 75% of summer capacity (2030 goal) – 987,857 GWh

Potential NGCC (at 75%) – Remaining NGCC

= Redispatched NGCC

987,857 – 576,606 = 411,250 GWh

Remaining FF steam – Redispatched NGCC

= Redispatched FF Steam

1,024,173 – 411,250 = 612,922 GWh

Step 7 – Calculate Regional Category-Specific Performance Rates (Eastern Interconnection)

- FF Steam:

$$\frac{\text{(FF steam gen x FF rate) + (redispatched NGCC x NGCC rate)}}{\text{FF steam gen + pro rata RE gen + redispatched NGCC gen}}$$

$$\frac{612{,}922{,}289 \times 2{,}071 + 253{,}332{,}608 \times 894}{612{,}992289 + 280{,}515{,}465 + 253{,}332{,}608} = 1{,}305 \text{ lbs/MWh}$$

- NGCC:

$$\frac{\text{(post BB3 NGCC x NGCC em)}}{\text{Post BB3 NGCC + pro rata RE gen}}$$

$$\frac{987{,}857{,}765 \times 894}{987{,}857{,}765 + 157{,}929{,}234} = 771 \text{ lbs/MWh}$$

Step 8 – Identify Source-Based Performance Rates

- Compare rates from the three interconnections
- Select least stringent rates as standard

Region	FF Steam Rate	NGCC Rate
Eastern	1,305 lbs/MWh	771 lbs/MWh
~~Western~~	~~360 lbs/MWh~~	~~690 lbs/MWh~~
~~Texas~~	~~237 lbs/MWh~~	~~697 lbs/MWh~~

State Emission Rate Goals - Florida

- State-specific goal based on source-specific performance rates and state's fossil fuel generating fleet

$$\frac{(\text{FF gen} \times \text{FF rate}) + (\text{NGCC gen} \times \text{NGCC rate})}{(\text{FF gen} + \text{NGCC gen})}$$

$$\frac{(56{,}452{,}021 \times 1{,}305 + (147{,}327{,}444 \times 771)}{(56{,}452{,}021 + 147{,}327{,}444)} = 919 \text{ lb/MWh}$$

- Comparison to proposal:

  740 lb/MWh (proposed rule) < 919 lb/MWh (final rule)

State Mass-Based Goals - Florida

- Calculate excess RE potential from Western and Texas interconnections using optimizing algorithm
    - Excess RE potential is RE potential that was not needed to meet the less stringent category-specific targets in eastern interconnection.
- Apportion excess RE potential based on 2012 share of affected EGU generation.
    - Excess RE potential distributed among all states, regardless of where excess RE might be generated (i.e. Florida allocated portion of excess RE potential from California).
    - As a practical matter, electricity cannot be moved between interconnections;
- Approximation of demand growth?

State Mass-Based Goals - Florida

Calculation of Mass-Based Goals

- State rate x 2012 gen + 2 x state rate x excess RE

(rate-based emissions) + (pro rata excess RE emissions RE)

  - Multiplier of 2 necessary for pro rate excess emissions to balance zero-emission RE generation:
  - 1 MW at 2x emissions rate + 1 MW zero emission = 2 MW at emissions rate

- Florida:

  919 x 203,779,465 + 2 x 919 x 12,476,481

  = 105,094,703 tons (in 2030)