



EPA CLEAN POWER PLAN RELIABILITY OVERVIEW

Advanced Energy Economy

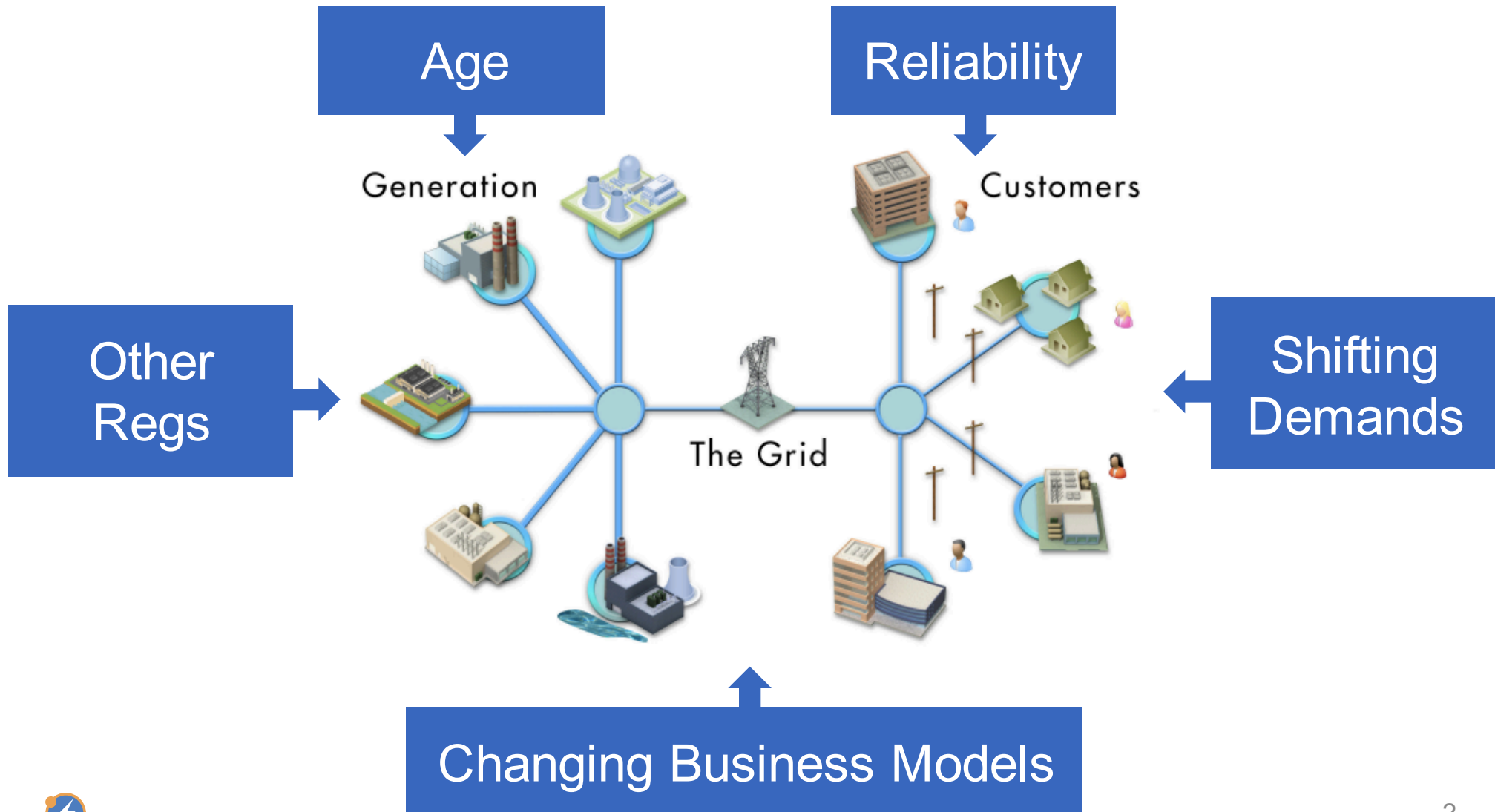
September 2015, Western Clean Energy Advocates

About Advanced Energy Economy

AEE is a national association of business leaders who are making the global energy system more secure, clean, and affordable.



We View the CPP as an Opportunity To Modernize a Challenged Energy System



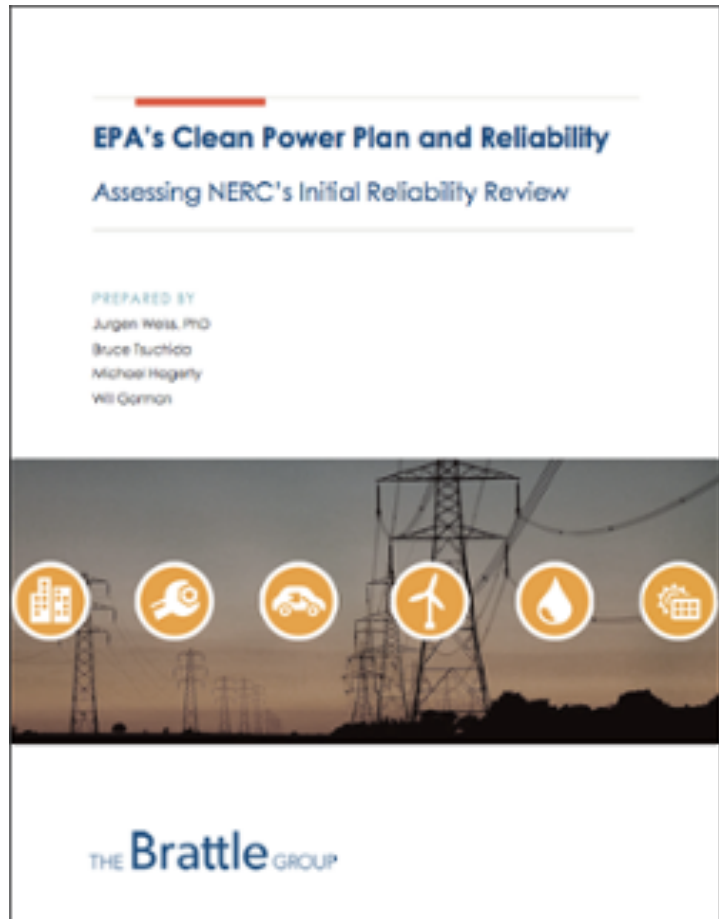
AEE has released a series of reports on 111(d), focusing heavily on reliability.

- You can find all of these reports and more at info.aee.net/reports

AEE Report	Cited	Location
<i>Markets Drive Innovation – Why History Shows that the Clean Power Plan Will Stimulate a Robust Industry Response</i>	✓	<ul style="list-style-type: none">➤ p. 375, footnote 376➤ CPP Legal Memo reprints report's entire executive summary on page 130
<i>The Brattle Group's EPA's Clean Power Plan and Reliability: Assessing NERC's Initial Reliability Review</i>	✓	<ul style="list-style-type: none">➤ p. 1134
<i>The Brattle Group's Integrating Renewable Energy into the Electricity Grid: Case studies showing how system operators are maintaining reliability</i>	✓	<ul style="list-style-type: none">➤ p. 1137



Assessing NERC's Initial Reliability Review



In November 2014, the North American Electric Reliability Corporation (NERC) issued an “initial reliability review” in which it identified elements of the CPP that could lead to reliability concerns. Echoed by some grid operators and cited in comments to EPA submitted by states, utilities, and industry groups, the NERC study has made reliability a critical issue in finalizing, and then implementing, the Clean Power Plan.

“Following a review of the reliability concerns raised and the options for mitigating them, we find that compliance with the CPP is unlikely to materially affect reliability.”



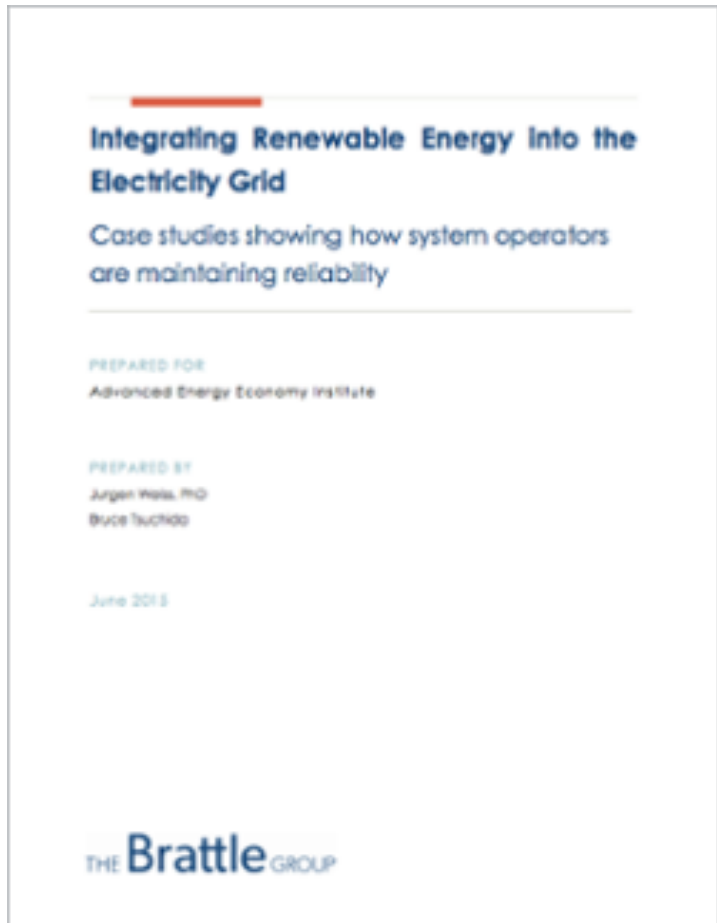
NERC's Clean Power Plan 'Phase I' Reliability Assessment: A Critique



On April 21, the North American Electric Reliability Corp. (NERC) released its “Phase I” assessment of the reliability impacts of EPA’s Clean Power Plan (CPP). The Phase I report is a follow-up to NERC’s Initial Reliability Review, and NERC indicates there will be more to come. This is in keeping with NERC’s vital role in informing policymakers and grid operators about issues in maintaining reliable electric service across the country. This white paper provides a critique of the Phase I reliability assessment and suggests ways future assessments can be improved.



Integrating Renewable Energy into the Electricity Grid: Case Studies Showing How Technologies and Operations are Maintaining Reliability



AEEI commissioned The Brattle Group, a leading consulting firm to utilities and grid operators, to provide an overview of how utilities and grid operators were integrating variable renewable resources while maintaining reliable electric service. In this report, The Brattle Group provides two case studies representing the two types of electricity market structures in the United States - the Electric Reliability Council of Texas (ERCOT), a regional transmission organization (RTO), and Xcel Energy Colorado, a vertically integrated utility - each of which is successfully managing a high and increasing share of electric power from variable renewable resources.



Impacts of the CPP on U.S. Natural Gas Markets and Pipeline Infrastructure



The AEE Institute contracted with ICF International to perform an assessment of the potential impacts of the EPA Clean Power Plan (CPP) on required gas pipeline capacity. This report responds to concerns raised by some stakeholders, including the North American Electric Reliability Corp. (NERC), that states might rely heavily on natural gas generation for compliance with the CPP, creating stress on gas pipeline capacity and ultimately impacting electric system reliability.



For More Information on the Role of Advanced Energy in Meeting CPP Goals

- **Advanced Energy Technologies for Greenhouse Gas Reduction**
<http://info.aee.net/epa-advanced-energy-tech-report>
- **Design Principles for a Rate-Based Federal Plan Under EPA's Clean Power Plan**
<http://info.aee.net/rate-based-federal-plan-under-clean-power-plan>
- **Competitiveness of Renewable Energy and Energy Efficiency in U.S. Markets**
<http://info.aee.net/competitiveness-of-renewable-energy-and-energy-efficiency-in-us>
- **Impacts of the Clean Power Plan on U.S. Natural Gas Markets and Pipeline Infrastructure** <http://info.aee.net/impacts-of-clean-power-plan-on-us-natural-gas>
- **Markets Drive Innovation: Why History Shows that the Clean Power Plan Will Stimulate a Robust Industry Response** <http://info.aee.net/market-response-to-epa-clean-power-plan>
- **Integrating Renewable Energy into the Electricity Grid: Large RE Integration Case Studies** <http://info.aee.net/integrating-renewable-energy-into-the-electricity-grid>
- **EPA's Clean Power Plan and Reliability: Assessing NERC's Initial Reliability Review,**
<http://info.aee.net/brattle-reliability-report>
- **Advanced Energy Technologies for Greenhouse Gas Reduction**
<http://info.aee.net/epa-advanced-energy-tech-report>
- **Assessing Virginia's Energy Future: Employment Impacts of Clean Power Plan Compliance Scenarios** <http://info.aee.net/virginia-energy-future>
-  **State Tool for Electricity Emissions Reduction Model:** <http://info.aee.net/steer>

AEE's STEER Model

Input Data

- Generator
 - Net Capacity, fuel, heat rate and VOM
- Net Load
 - 24 representative days
 - Weekday/weekend

Represent the Grid

- Create merit order of generators from dispatch costs
- Use merit order to match net load with generation to create hourly LMPs curves
- Calculate annual generation and emissions from LMP data

Incorporate Building Blocks for Mitigation

- STEER calculates the mitigation cost of each mitigation measure

Meet the Carbon Rules

- Optimization accounts for the interactive effects of the building blocks rather than a sequential selection of projects by block
- STEER minimizes the cost to mitigate from all blocks to create a unique mitigation strategy



There are a number of technologies eligible as compliance measures

Eligible for Compliance

- PV Solar and CSP
 - Onshore and Offshore Wind
 - Incremental and New Nuclear
 - Renewable DG
 - Incremental and New Hydropower (including Canadian Hydro)
 - Geothermal
 - Wave and Tidal Power
 - CHP
 - CCS and CCU
 - “Qualified” Biomass, including biogenic portion of MSW in WTE
 - WHP with no incremental emissions
 - T&D Efficiency, including VVO, CVR, and Smart Grid
 - Demand-Side EE, including ESCOs, industrial EE, utility EE, behavioral EE
 - Demand Response (if demand reduced)
 - Other zero-emitting generation, such as RE powered fuel cells
 - Upgrades at existing fossil-fired facilities
- States may apply for technologies to be considered eligible for ERCs.



Others are ineligible, but many can support the plan while being implemented outside

Ineligible for Compliance

- Relicensed Existing Nuclear
- Relicensed Existing Hydropower
- Non-“qualified” Biomass
- Direct Energy Storage
- New Gas (unless under New Source Complement)
- Electric Vehicles
- Measures that reduce CO₂ emissions outside the electric power sector (including offsets)



New NGCC plays a very different role in the final rule as compared to the proposed

- **p. 1253-1255:** This section addresses measures that may not be used to adjust a CO₂ emission rate. New, modified, and reconstructed EGUs covered under the CAA section 111(b) final Standards of Performance for Greenhouse Gas Emissions from New Stationary Sources: Electric Utility Generating Units rule **are not approvable sources** of electric generation for adjusting the CO₂ emission rate of an affected EGU under a rate-based state plan.



New NGCC plays a very different role in the final rule as compared to the proposed

- **p. 1253-1255:** “Allowing affected EGUs to adjust their emission rates as a result of lower-emitting new NGCC units not covered under this section 111(d) rule would not mitigate leakage concerns, and could even exacerbate the situation. Consequently, new EGUs covered under the CAA section 111(b) rule are not allowable measures in state plans because the EPA believes it would result in increased emission leakage.”
- "In addition, other new and existing non-affected fossil fuel-fired EGUs that are not subject to CAA section 111(b) or 111(d), such as simple cycle combustion turbines, may not be used to adjust the CO₂ emission rate of an affected EGU."



What does that mean for new NGCC units?

- If a new NGCC or CHP unit that is an affected unit subject to 111(b) is built in a **rate-based state**, its rate is not incorporated into the state's overall emission rate goals. That new plant helps to reduce emissions by taking other fossil fuel fired units off-line but otherwise doesn't enter into the equation – it just does its thing, providing power at the specified emissions rate under 111(b).



What does that mean for new NGCC units?

- If a new NGCC or CHP unit that is an affected unit subject to 111(b) is built in a **mass-based state**, its tons could be incorporated into a state's overall CO₂ reduction goal under the “new source complement” concept, but that it is not required. (A state could also choose an allowance allocation methodology that allocated allowances to existing sources in a way to avoid leakage or otherwise demonstrate that leakage will not occur based on the state's unique generation mix).



The final rule addressed reliability directly in three primary ways

- 1 States must consider reliability when drafting plan
- 2 States can revise final plans due to long-term reliability issues (e.g., unexpected plant closure)
- 3 Reliability Safety Valve (RSV) developed for short-term reliability issues

EPA also considered reliability when extending the compliance period start date to 2022, in gradually phasing in building block 2, and in establishing continued coordination across EPA, FERC, and DOE.

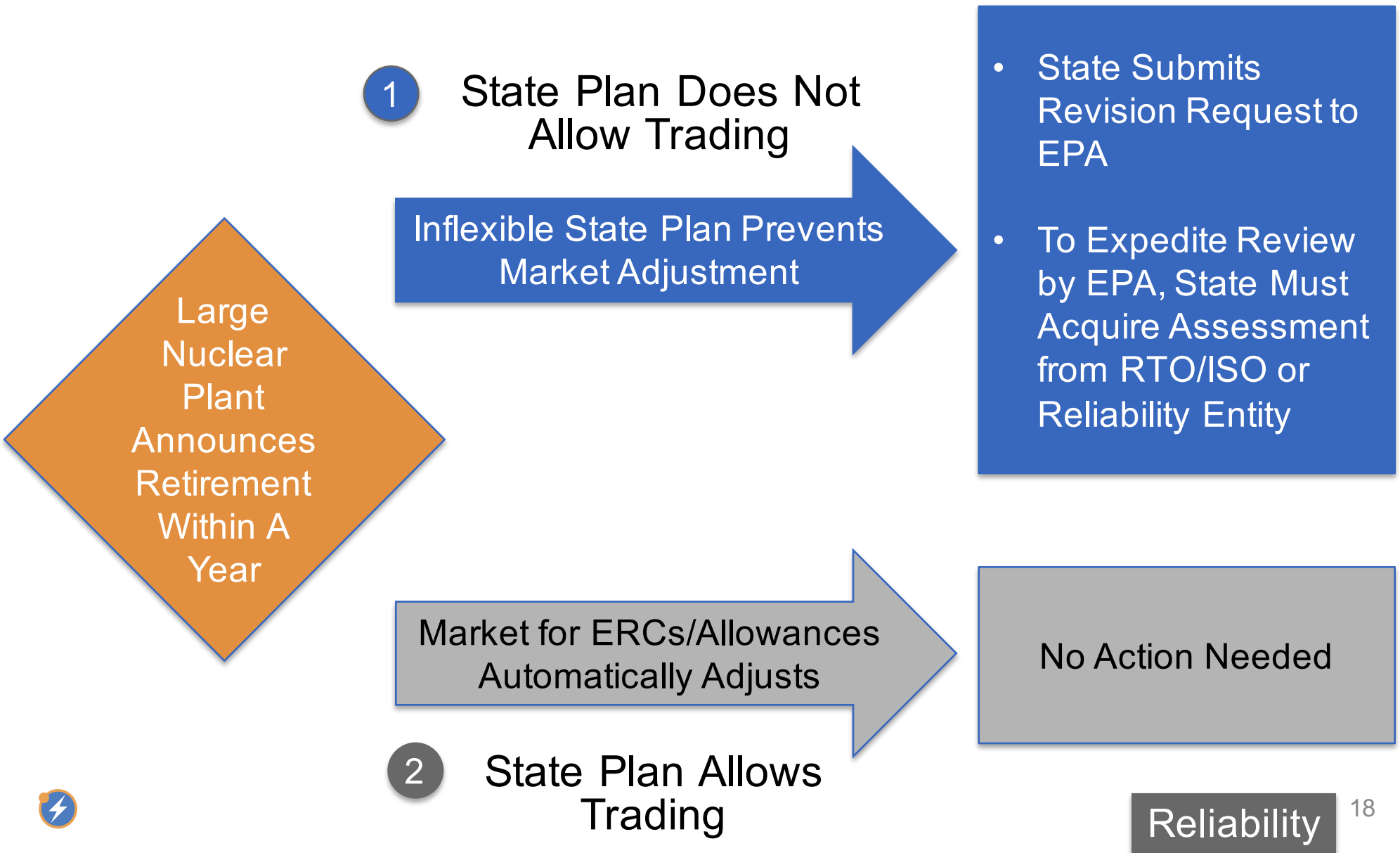


States must consider reliability when drafting plans

- EPA recommends but does not require that state has RTO/ISO or reliability entity review state plan before submittal.
- EPA requires that state submit documentation that reliability was considered in planning. Eligible documentation includes:
 - Proof of consultation with RTO/ISO or designated reliability entity
 - Proof of consultation with PUC or state energy office
 - Other comparable demonstration that state has considered reliability
- Consultations and reviews by other entities are not binding on states.



States with unplanned changes may need to revise final plans if trading is not available



The RSV is triggered in the case of emergency events

RSV Requirements

1. Unanticipated emergency event
2. EGU that will exceed emission target must be essential to prevent grid failure
3. State plan doesn't provide flexibility for EGU to run (e.g. no trading)

Storm floods
baseload
NGCC plant

Temporary need
to exceed
emission targets

Triggers RSV

- State must notify regional EPA within 48 hours.
- RSV can be triggered up to 90 days.

Continued need
to exceed
emission targets
after 90 days

State must
begin work
on a revised
state plan



EPA has to evaluate the plans for approval, partial approval, or rejection

EPA evaluates plans within one year of submission

- EPA will hold a notice-&-comment period for each submitted plan
- EPA will either finalize a state's plan, partially approve the plan, or reject it
- If a state's plan is rejected or if a state chooses not to submit a plan, EPA will finalize the Federal Plan for the state
- Approved plans become federally enforceable



EPA provides states with multiple rate and mass options for compliance plan

Mass- or rate-based plan?



Mass

Rate

1

State Measures Plan

A

Tech-Specific Emission Performance Rates*

2

EPA Mass Goal for Existing Units Only*

B

State-wide Emission Rate

3

EPA Mass Goal for Existing Units + New Unit Complement

C

Individual EGU Performance Rates

#

Choose Your Own Adventure

*Model Rule Options



When a state chooses a plan, certain characteristics are defined by that choice.

Credit Types	Interstate Trading	Emission Projections	Backstop Standards	EM&V
Measures can receive either ERCs or allocations.	Plans can allow for interstate trading with other states of your type (mass or rate).	The state may need to show how it will achieve an equivalent goal to the one set by EPA.	Some plans require the inclusion of federally enforceable backstops that are triggered if a state fails to meet its interim goals.	EM&V plans may be required in state submissions to EPA.



Each state plan option has different results

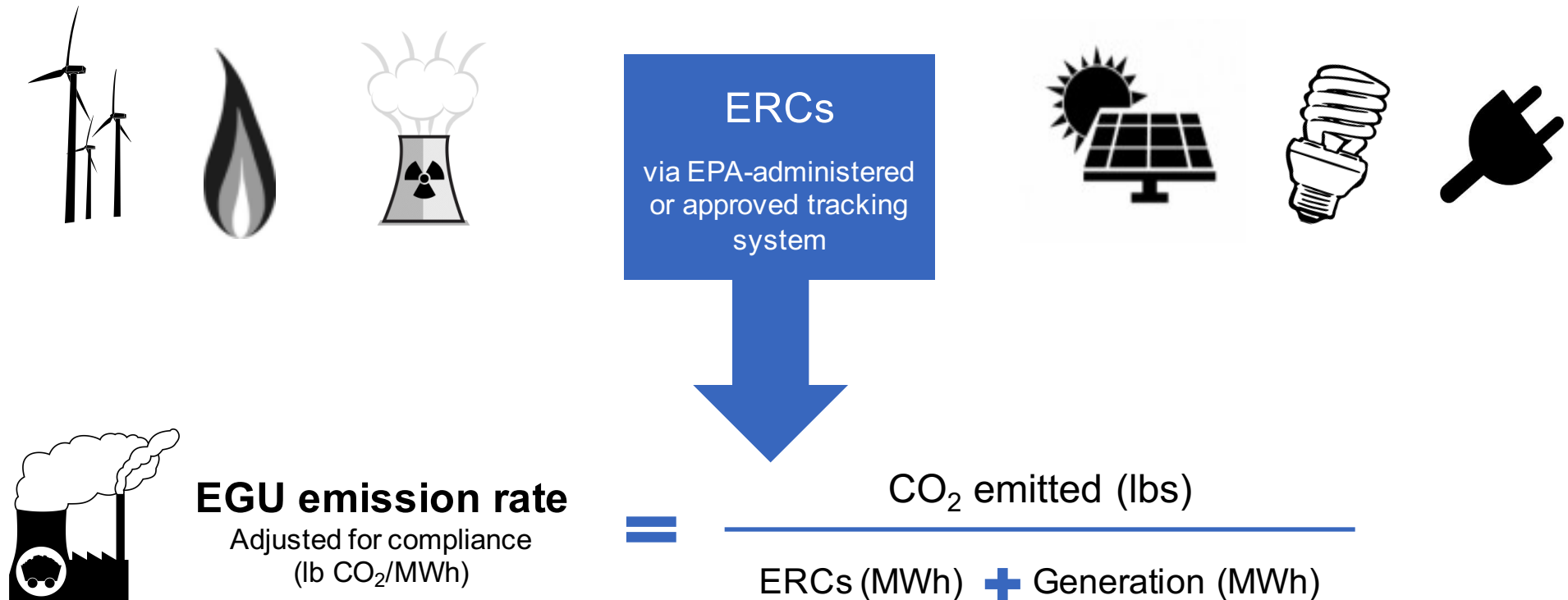
	Credit Types	Interstate Trading	Emission Projections	Backstop Standards	EM&V
1 State Measures Plan	Allocations	Possible	Required	Required	Not Needed
2 EPA Mass Goal for Existing Units Only	Allocations	Possible	Not Needed	Not Needed	Not Needed
3 EPA Mass Goal for Existing Units + New Unit Complement	Allocations	Possible	Not Needed	Not Needed	Not Needed
A Tech-Specific Emission Performance Rates	ERCs	Possible	Not Needed	Not Needed	Required
B State-wide Emission Rate	ERCs	Possible	Not Needed	Not Needed	Required
C Individual EGU Performance Rates	ERCs	Only Intrastate	Required	Not Needed	Required



Emission Rate Credits give states a common currency for trading rate-based credits

1 ERC = 1 MWh of zero-CO₂ electricity generated

1 ERC = 1 MWh of electricity saved



Any eligible emission reduction measure can generate ERCs. ERCs can be banked and never expire. ERCs can be traded within states or between states with common rate-based standards. Common standards can be national subcategory-specific performance standards (as in a trading-ready plan) or a weighted average of state rates (available in a multi-state plan).



Mass Allowances Enable Trading Within and Between States with Mass-based Plans

State converts state CO₂ goal into mass budget of allowances.

States have the option to include new covered sources and/or other non-covered sources.

State issues allowances to EGUs and/or certain qualified market participants

Allowances are tracked in an EPA-approved or EPA-administered tracking system.

Allowances can be bought, sold, and banked within or between states.

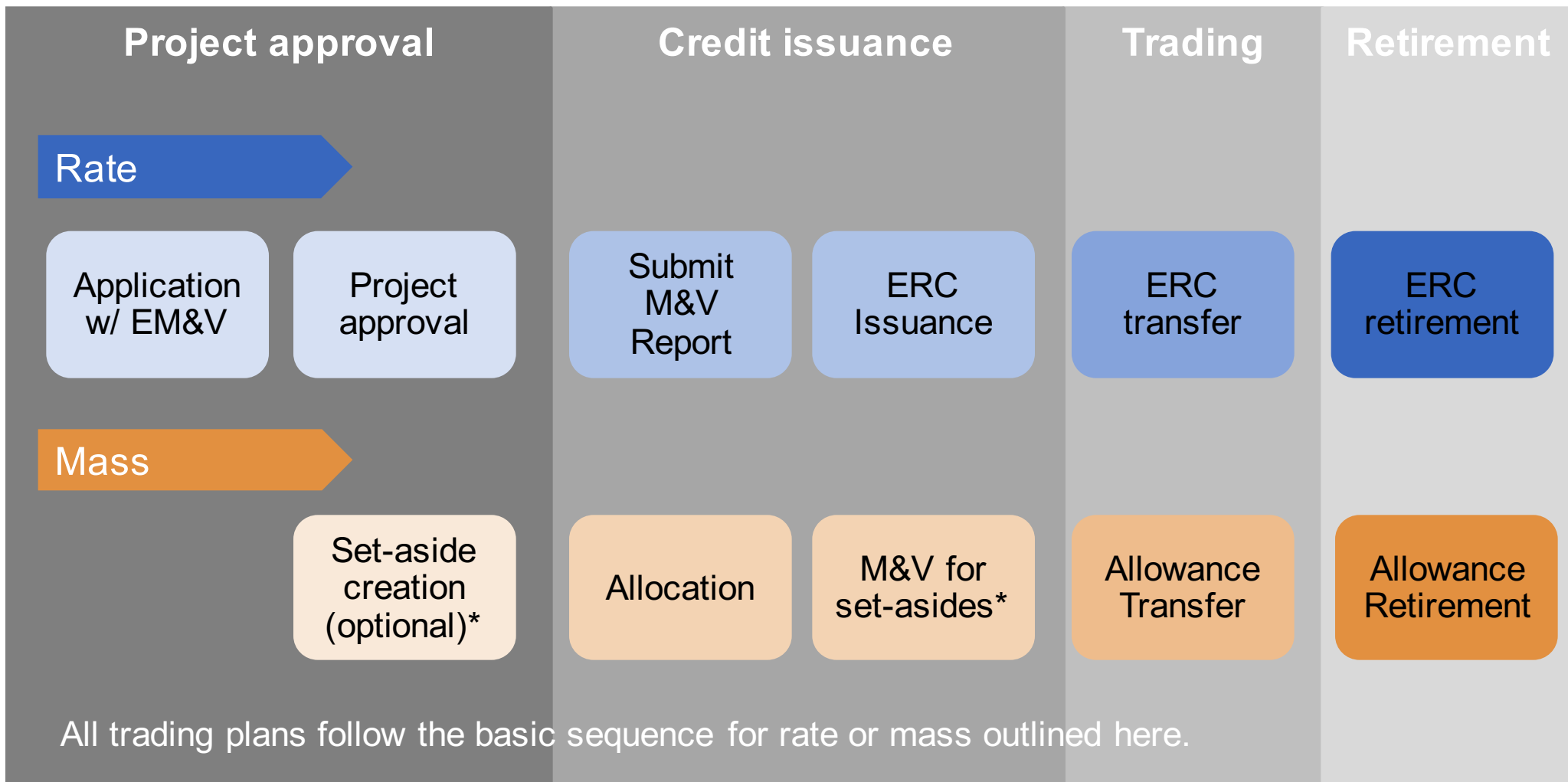
To be trading-ready, states must accept allowances from other states and use a specified EPA-approved tracking system.

EGUs surrender to state sufficient allowances to cover compliance period emissions.

A state with a measures plan must calculate net transfers of allowances over the compliance period to determine compliance.



To understand tracking, first understand how crediting differs under rate and mass



*This step is optional. States choose how to allocate allowances, and this can include set-asides for RE and/or EE. There is some ambiguity in the rule around EM&V requirements for mass allocations. In the proposed mass-based Federal Plan (FP), EPA proposes a set-aside of allowances for RE with upfront generation projections and ex-post M&V reports.



Both mass-based and rate-based trading plans require a tracking system

Rate-based Tracking

- Needed to track ERCs
- ERCs issued to relevant accounts after generation/savings have been verified
- Must include EM&V

Mass-based Tracking

- Needed to track allowances
- Allowances deposited into relevant accounts prior to compliance period
- EM&V required for EE and RE

All tracking systems

- Must track from issuance through transfer and surrender
- Used for compliance “true-up”
 - EGUs surrender ERCs/allowances to demonstrate compliance
- Must provide unique serial numbers and traceability
- For interstate trading, tracking systems must be joint, interoperable, or EPA-administered



If states want to trade with other states, their tracking systems have to work together

All interstate trading

- State must use a joint, interoperable, or EPA-administered tracking system (p.1291)

Ready for trading

- Must use a tracking system that is EPA-approved or EPA-administered (p.1197)

States linking with Fed. Plan

- As proposed, states that link to Federal Plan must use an EPA-administered tracking system
- EPA is requesting comment on accepting an EPA-designated tracking system interoperable with the EPA-administered system (p.59)



What is a joint, interoperable, or EPA-approved tracking system?

- In the Final Rule, EPA provides broad guidelines for tracking system requirements
 - EPA indicates that it will designate approved tracking systems but has not yet done so
 - “The EPA is exploring options for providing [tracking system development and/or administrative] support and is conducting an initial scoping assessment of tracking system support needs and functionality.”
- In the federal plan, EPA proposes using its own Allowance Tracking & Compliance System (ATCS) to track allowances and ERCs once they have been issued, and proposes developing a complementary tracking system to track ERC application and issuance



EPA has created a new incentive program to encourage states to submit plans early

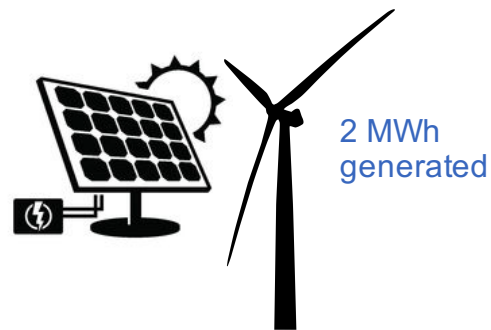
Eligible projects:

- Are located in or benefit a state participating in CEIP
- Commenced construction (RE) or operation (EE) after final plan submission or Sept. 6, 2018
- Generated MWh or saved MWh in 2020 and/or 2021

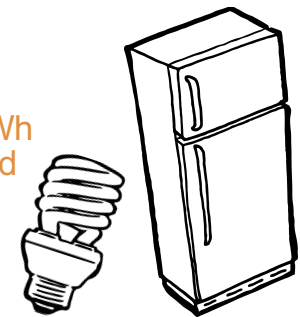
State voluntarily participating in CEIP sets aside early allowances or generates early ERCs

1 ERC or equivalent allowance

2 ERCs or equivalent allowance



2 MWh saved



1 ERC or equivalent allowance

2 ERCs or equivalent allowance

EPA matches from fund equivalent to ERCs and allowances totaling 300 M short tons CO₂



States can provide early credit to certain RE and EE projects

- States may set aside allowances from the state emission budget (mass) or may “borrow” early action ERCs (rate) to credit early projects.
 - Credits come out of state’s entire budget.
 - Only metered wind and solar projects and low-income community EE projects that result in savings qualify.
 - These credits do not expire and they are tradable.
 - States must demonstrate that early credits will not impact the emission performance of the affected EGUs during the compliance periods.
 - States could choose to limit the size of the pool to be equivalent to the size of the federal matching pool or could consider another pathway.



EPA provides matching credits to the state up to a limit

- When a state submits its final plan or on September 6, 2018, EPA allots a state matching credits proportional to the reductions required from the state's affected EGUs (using 2012 baseline) to achieve targets **RELATIVE** to affected EGUs in other states.
- EPA intends to set aside a portion of the federal matching pool for RE and a portion for low-income community EE.
- M&V is required for projects to receive matching credits from EPA.
- After Sept 6, 2018, undistributed credits are distributed pro rata to states with approved plans participating in CEIP.
- Unused matching credits from EPA in state accounts will be retired on January 1, 2023.

Pool of 300 M short tons credits



19 GW installed/year; 2017-2020

200 TWh generated/year; 2020-2021



Source: CPP p. 867-871

When can you start earning credits, and for what?

Applies to all eligible measures:

Must be installed after 2012.
No early action credits.

Start generating credit in 2022.

Applies to Clean Energy Incentive Program measures:

Must commence construction (wind/solar) or operation (low-income community EE) after state submits plan or Sept. 2018, whichever comes first.

Start generating credit in 2020 when CEIP begins.



For more information

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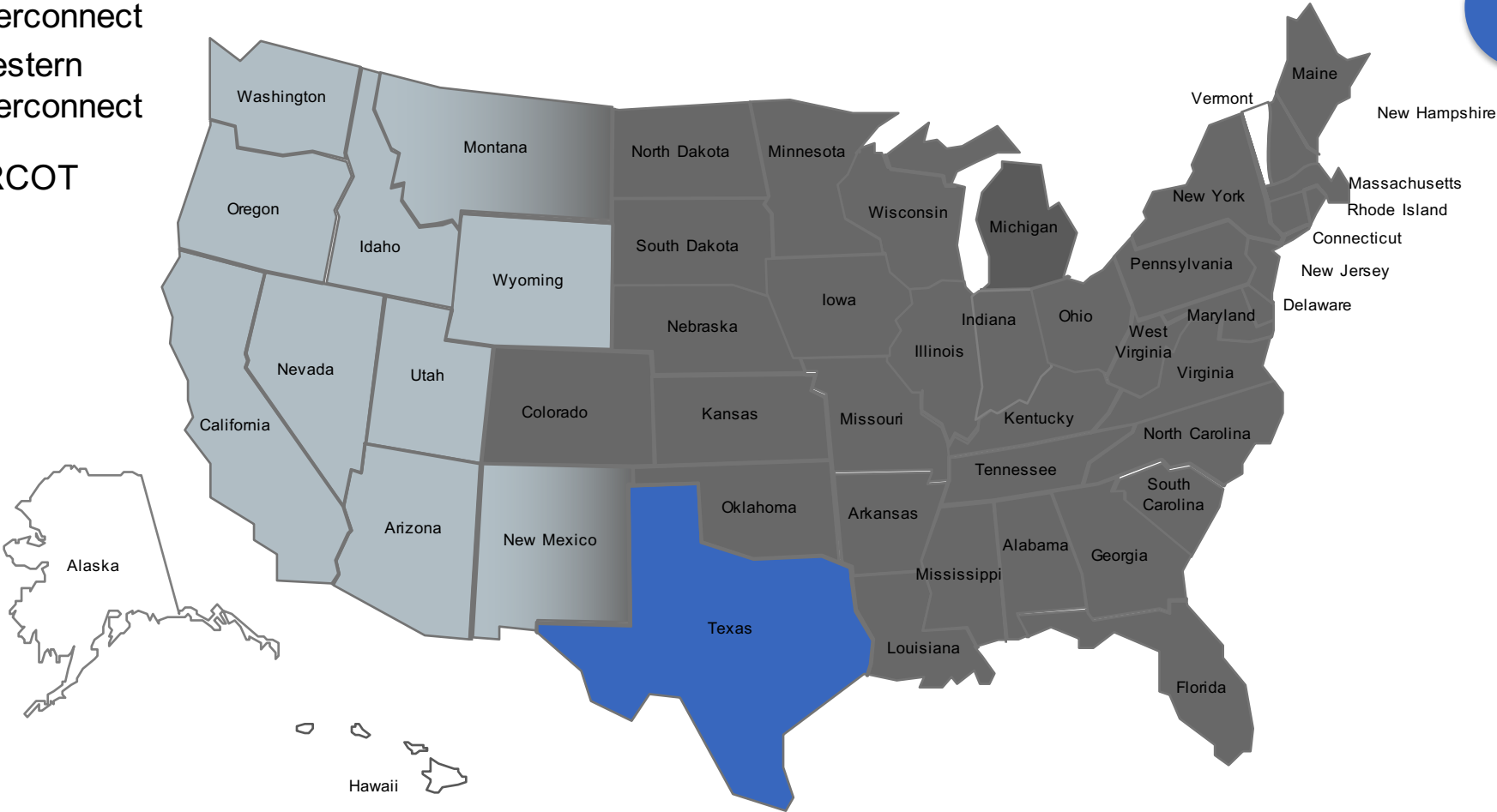
Appendix



First, EPA broke up the country into the three interconnections

- Eastern Interconnect
- Western Interconnect
- ERCOT

1



Notes: Alaska and Hawaii were not assigned rates in the August 2015 CPP Final Rule. Small parts of TX fall into the Eastern and Western Interconnects. Montana and New Mexico are in both Eastern and Western Interconnects. Vermont and Washington D.C. do not have EGUs subject to the CPP.

Then EPA calculated adjusted* emission rates by technology type by region for 2012

2

The Fossil Steam generation adjusted* starting emission rate and NGCC generation adjusted starting emission rate are calculated for 2012. This is the starting baseline rate used for each year's rate calculation from 2022-2030.



Interconnection	lbs CO ₂ /MWh	lbs CO ₂ /MWh
Eastern	2,160	894
Western	2,198	899
ERCOT	2,192	951

*EPA adjusted the 2012 starting rates for high snow pack hydro power in 2012 (lowered hydro, increased fossil) for ID, ME, MT, OR, SD, and WA; extended outages and maintenance for Sherburne County Unit 3 in MN; units that came online part way through the year were annualized; and NGCC and ST units that were under construction before January 8, 2014



EPA then applied the Building Blocks 1, 3, and 2 (in that order)

Building Block 1: Regional Heat Rate Improvement

3a

Example Year 2030	Initial Rate	HRI (%)	Rate after BB1
	lbs CO ₂ /MWh		lbs CO ₂ /MWh
Eastern	2,160	4.3	2,071
Western	2,198	2.1	2,154
ERCOT	2,192	2.3	2,144

- BB1 only applies to the fossil steam rate.
- BB1 is applied in 2022 for the calculation.








BB3 assumes fossil steam and gas generation is replaced with renewables

Building Block 3: Renewable Energy

3b

Using NREL capacity factors for RE and historical growth rates to predict future market growth, EPA calculated regional estimates for RE MWh for each year of 2022-2030 via IPM modeling. The Agency subjected the generation projections to an artificial cap.* EPA assumed RE generation replaced fossil steam and NGCC generation proportional to the region's fossil fuel generation mix.

Example Year 2030	Rates after BB1		Rates after BB3	
				
Eastern	2,071	894	1,625	702
Western	2,154	899	1,320	551
ERCOT	2,144	951	1,267	562


 NGCC rates unchanged from initial step



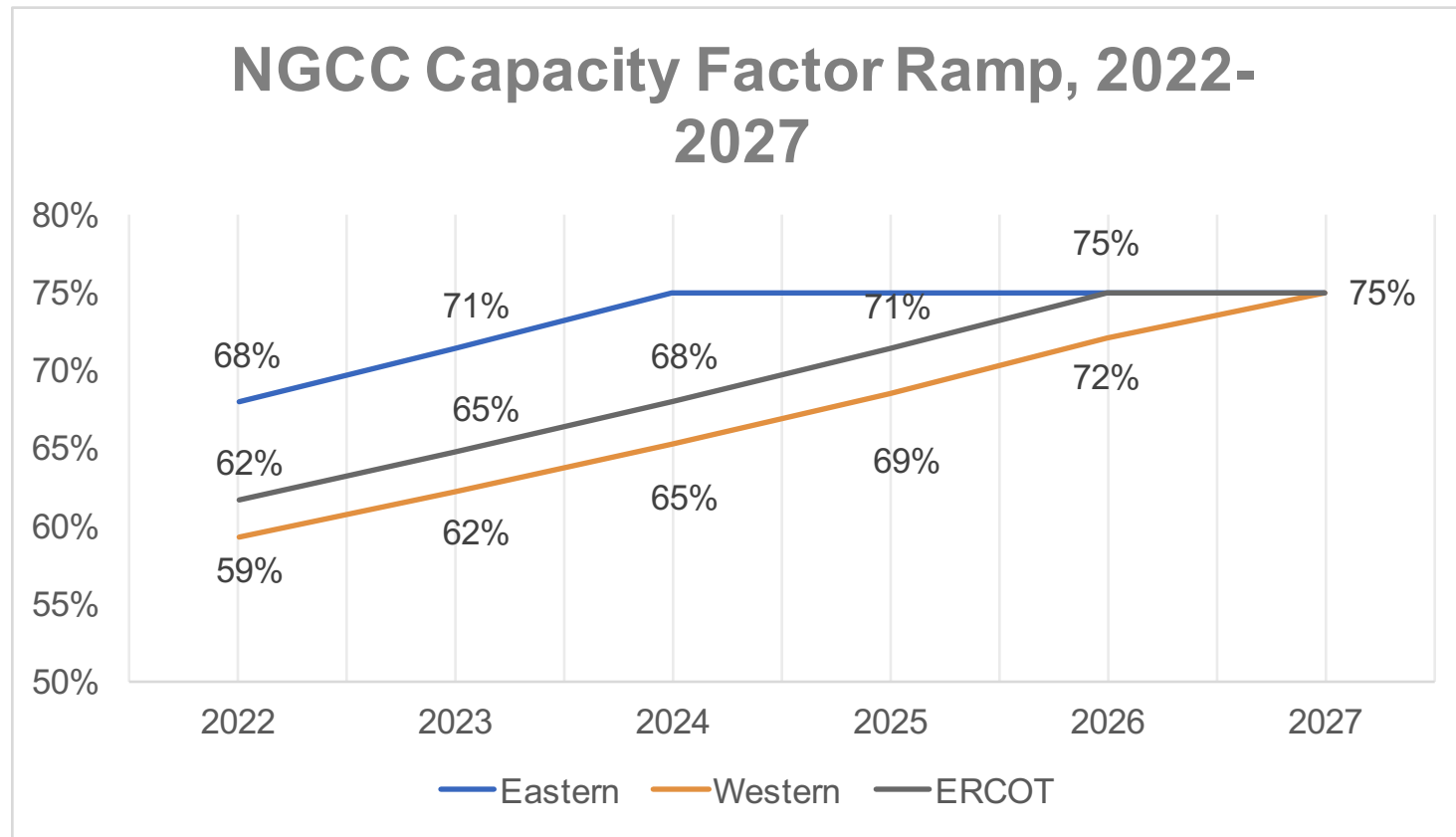
* EPA caps the estimates of variable, non-dispatchable RE resources at 20% per technology type and 30% net energy load total in each of IPM's 64 sub-regions. EPA acknowledges this approach is conservative on p.760 of the rule.

BB2 phases in a ramp up of existing NGCCs to back down fossil steam from 2022-2027

Building Block 2: Existing NGCC

3c





Existing NGCC is ramped from current capacity factors to 75% net summer capacity or until all fossil steam generation is displaced.



After applying BB2, EPA selected a national uniform standard for each fuel type

Building Block 2: NGCC

3c

Example Year 2030	Rates after BB3		Rates after BB2	
	 lbs CO ₂ /MWh	 lbs CO ₂ /MWh	 lbs CO ₂ /MWh	 lbs CO ₂ /MWh
Eastern	1,625	702	1,304	770
Western	1,320	551	360	690
ERCOT	1,267	562	237	697

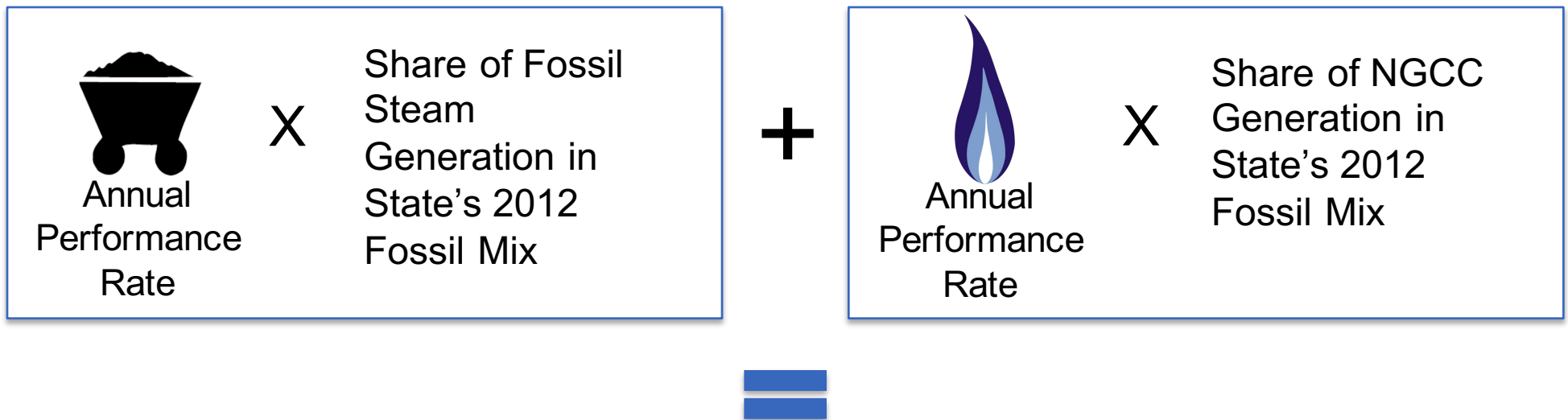
EPA selected the least stringent rate to develop final subcategorized national standards.

Note: The existing NGCC performance rate is lower in all regions after applying BB3 than after applying BB2 since some NGCC generation is displaced by RE. As NGCC generation is ramped up to replace fossil steam generation in the next Building Block, the emissions are "pulled" back up for NGCC. Because the incremental existing NGCC is displacing fossil steam generation, the average emission rate is lower. ST was not considered for redispatch in the BSER due to concerns about maintaining grid reliability.



For states that want a single state rate, EPA used state generation mix to translate

4



The state's total target rate for the chosen year

Let's look at an example...



Here we calculate Arizona's final 2030 rate

Example Year
2030

Example State
AZ



X 49%

1,304
lbs CO₂/MWh

+



X 51%

770
lbs CO₂/MWh

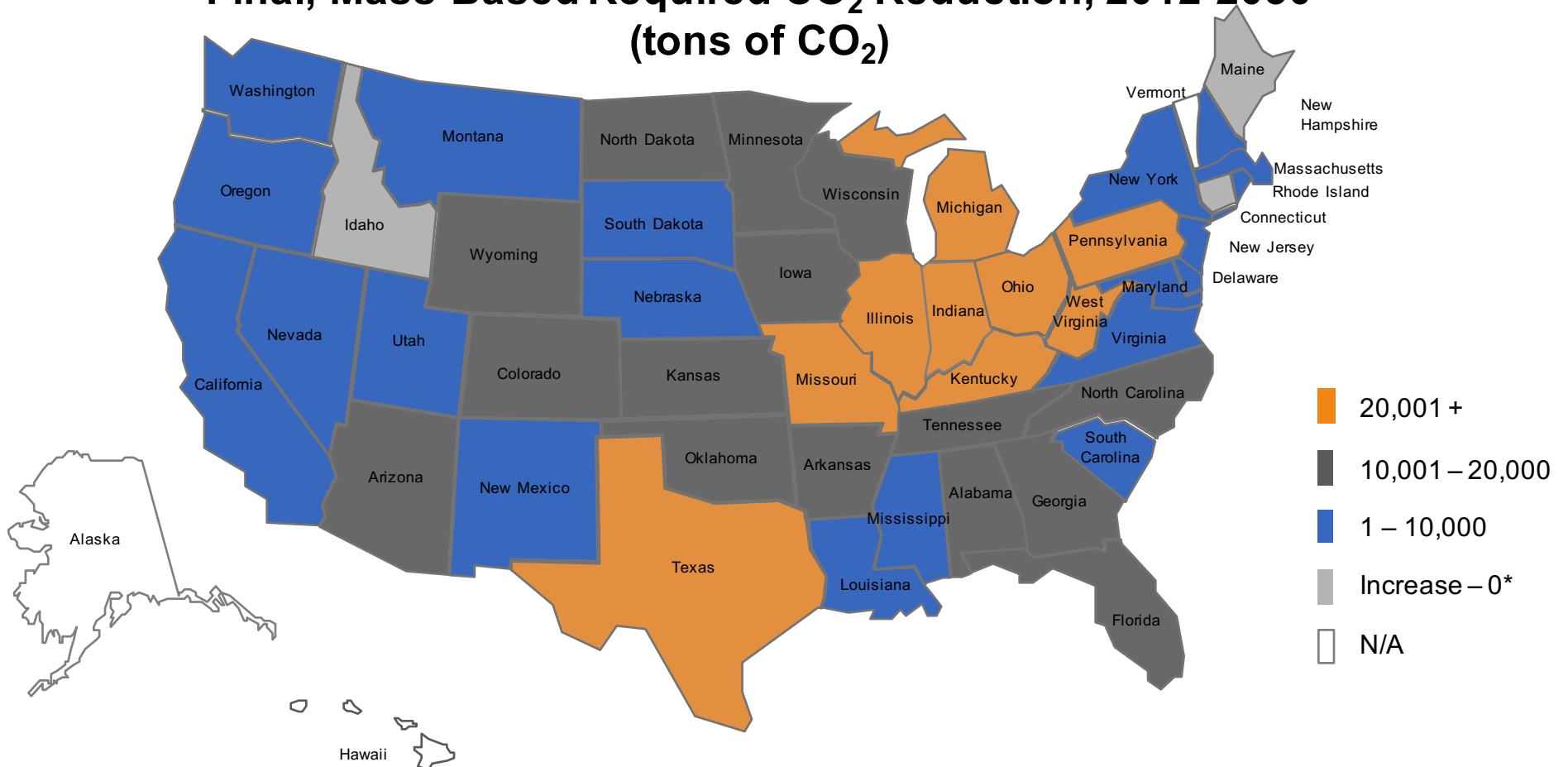
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1,031 lbs CO₂/MWh



From a mass perspective, TX and eastern Midwest are hit hardest

Final, Mass-Based Required CO₂ Reduction, 2012-2030 (tons of CO₂)



*Because the emission targets were set as rate-based lbs CO₂/MWh, three states are allowed a net increase in total tons CO₂ emissions under the Final CPP.



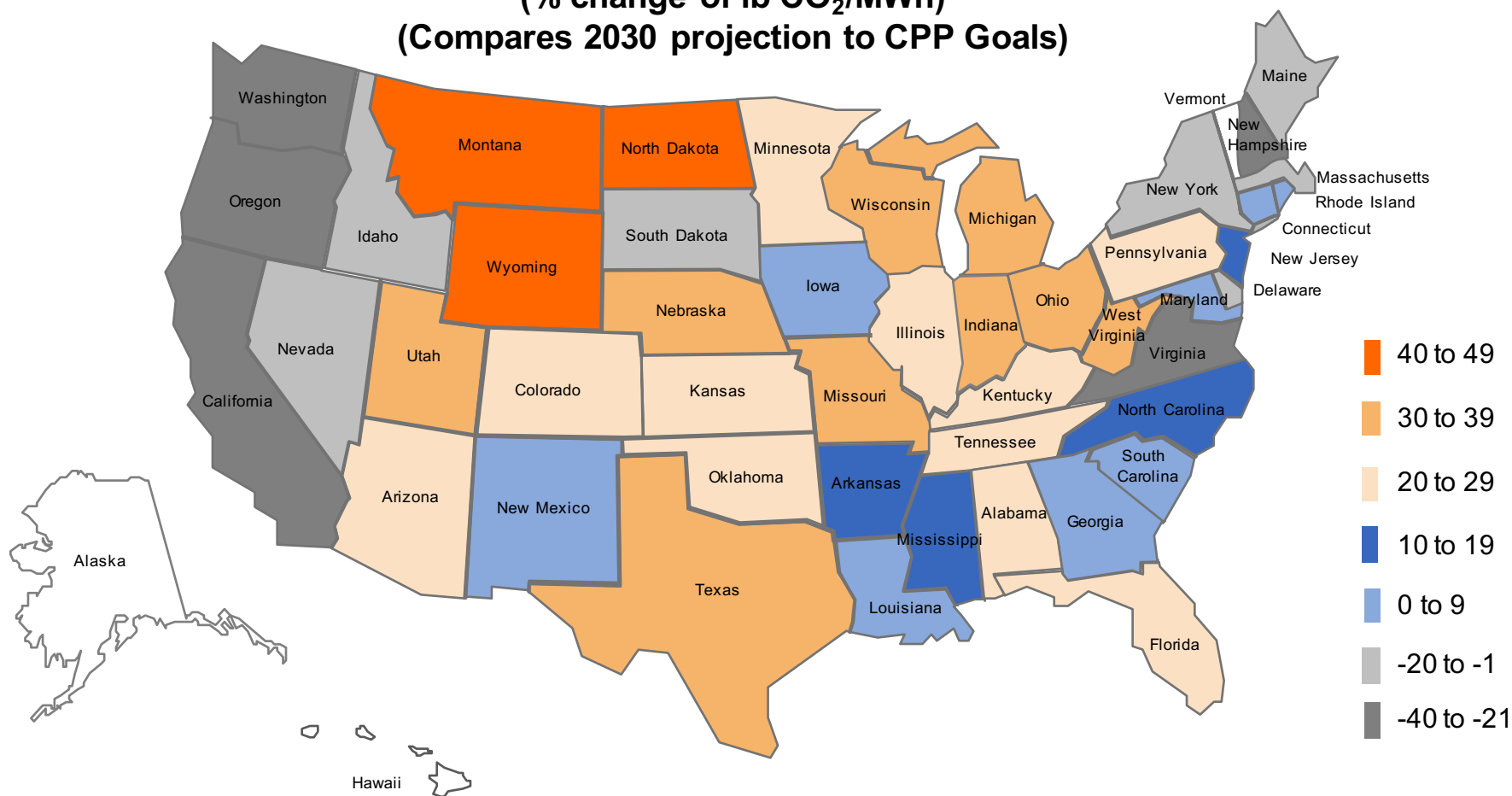
Source: <http://www.epa.gov/airquality/cpp/tsd-cpp-emission-performance-rate-goal-computation-appendix-1-5.xlsx>
Analysis by Advanced Energy Economy

State's required progress from BAU varies significantly state-to-state

CPP Rate Targets Compared to BAU Rates, 2030

(% change of lb CO₂/MWh)

(Compares 2030 projection to CPP Goals)



Source: <https://blog.epa.gov/blog/wp-content/uploads/2015/08/State-tables-tab-2.pdf>
 Analysis by Advanced Energy Economy

The Final Rule has changed significantly from the proposed rule

BSER/Targets

- Removed EE and nuclear from BSER calculations
- Consideration of market-based data for RE BSER
- Coal-to-gas shifting is phased in between 2022-2027
- EPA set national technology-specific emission rate targets for EGUs
- Individual state targets have changed by varying amounts
- Hawaii, Alaska, Puerto Rico, and Guam targets deferred

Compliance

- States can get extensions until 2018 to complete plans
- EPA only counts projects after 2012 towards compliance
- States begin compliance in 2022
- 90-day RSV put in place for unexpected events
- Optional CEIP developed for early action crediting in states
- Several technologies were added to the non exclusive list of options
- EPA laid out trading approaches in the proposed model federal plan



All compliance measures must follow certain rules to qualify for appropriate credit.

- Any compliance measures must be **grid-connected**.
- All EE measures must result in **electricity savings** at a building, facility, or other end-use location that is connected to the electricity grid
- Compliance measures must **directly substitute** for electrical energy on the grid or **avoid energy use** from the grid.

