A Perspective on the Clean Power Plan: Stringency, Scope and Form

Sophie Pan, Dallas Burtraw, Anthony Paul, Karen Palmer

Presented at TAI Conference 10/06/2014
Presented by Sophie Pan

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RESOURCES FOR THE FUTURE

Outline

- 1. Introduction
- 2. *Stringency* of Regulation: Within BSER
- 3. *Scope* of Regulation : Beyond BSER
- 4. *Form* of Regulation: Rate v.s. Mass
- 5. Conclusion

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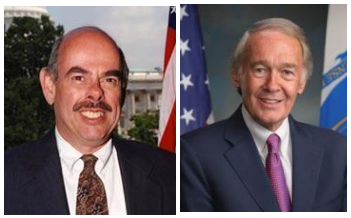
The Roadmap of GHG Regulation



Waxman-Markey passed in the US House of Representatives

Obama's Climate Action Plan foreshadows EPA's Clean Power Plan for existing power plants.

2007 — Jun 2009 — Jul 2010 — Jun 2013 — Jun 2014

Supreme Court ruled in *Massachusetts v. EPA* that greenhouse gases are covered by the CAA's definition of air pollutant

Senate failed to take up climate bill effort

Cap and trade was declared dead.

EPA Proposed Clean Power Plan under the Clean Air Act 111(d)

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Background: Clean Power Plan's Federal-State Framework

<table>
<tr><th></th><th>FEDERAL</th><th>STATE</th></tr>
<tr><td>111(b): new sources</td><td colspan="2">Federal standards</td></tr>
<tr><td rowspan="2">111(d): existing sources</td><td>EPA issues Guidelines:
- State-specific "rate-based" emissions targets
- Determined based on <u>best system of emissions reductions</u> (BSER)</td><td>State develops Implementation Plan—
- Broad flexibility
- single-state or multi-state.</td></tr>
<tr><td colspan="2">If state fails to submit plan, or the plan is inadequate, EPA imposes federal plan</td></tr>
</table>

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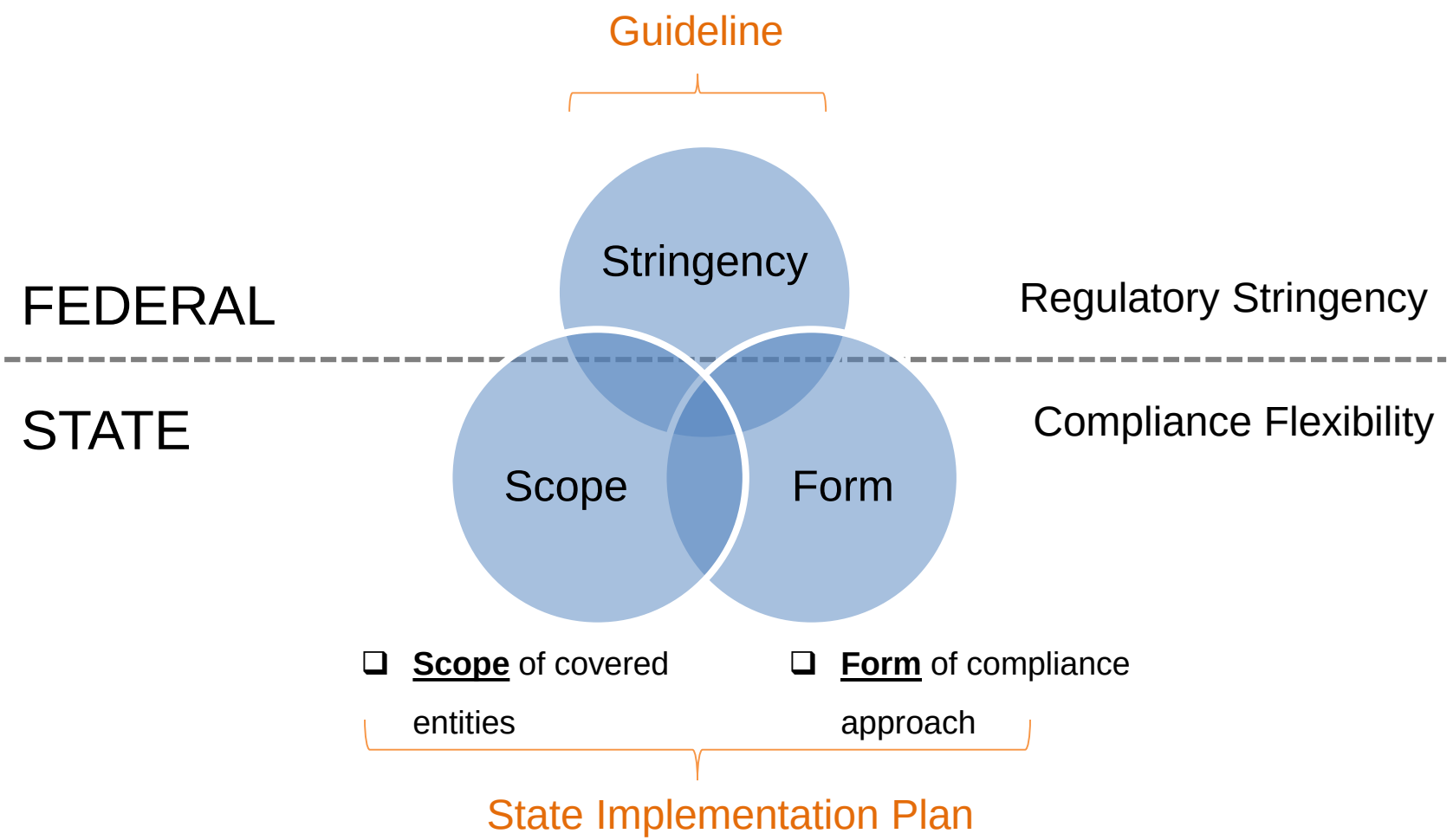
Background: Clean Power Plan's Federal-State Framework



BSER: Building Blocks Translate to State Goals

Building Block	Proposed Option 1	Alternative Option 2
1. Heat rate improvement (Avg. Reduction for Coal)	6%	4%
2. Dispatch to existing and under-construction NGCC	Utilization of NGCC up to 70% capacity factor	Utilization of NGCC up to 65% capacity factor
3. Dispatch to new clean electric generation	Includes new nuclear generation under construction, moderate deployment of new renewable generation, and continued use of existing nuclear generation	
4. Demand-side Energy Efficiency (% reduction in demand from BAU MWh sales)	3.0% / 10.7% (2020 / 2030)	2.4% / 5.2% (2020 / 2025)
Goal	**Proposed Option 1**	**Proposed Option 2**
Average nationwide goal for covered sources (lbs/MWh)	25% to 30% below 2005 levels	20% to 25% below 2005 levels

- BSER is applied to observed state-level data (e.g., *best practice*) to set state-specific emission rate goals.

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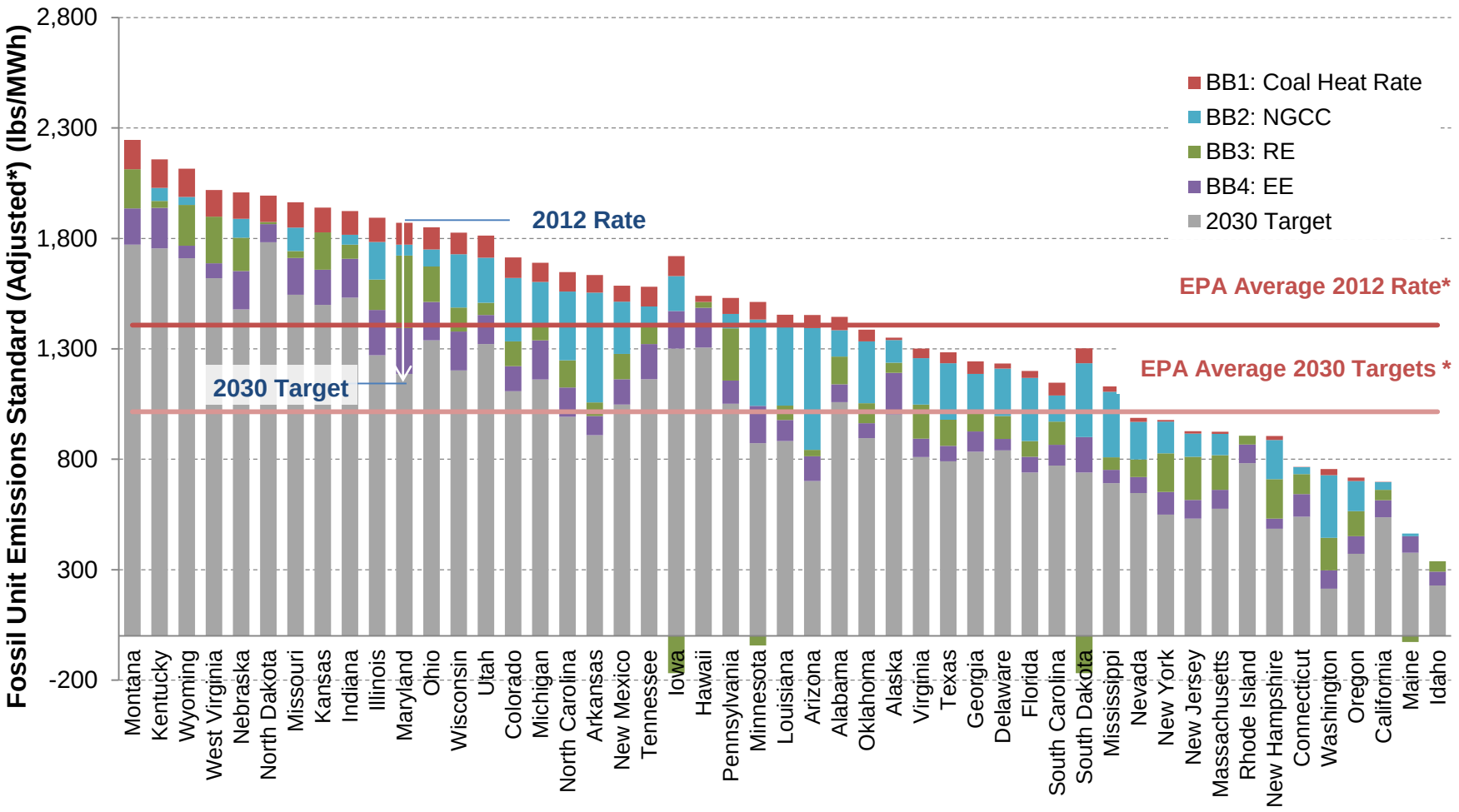
BSER: State Targets in 2030 Under Option 1



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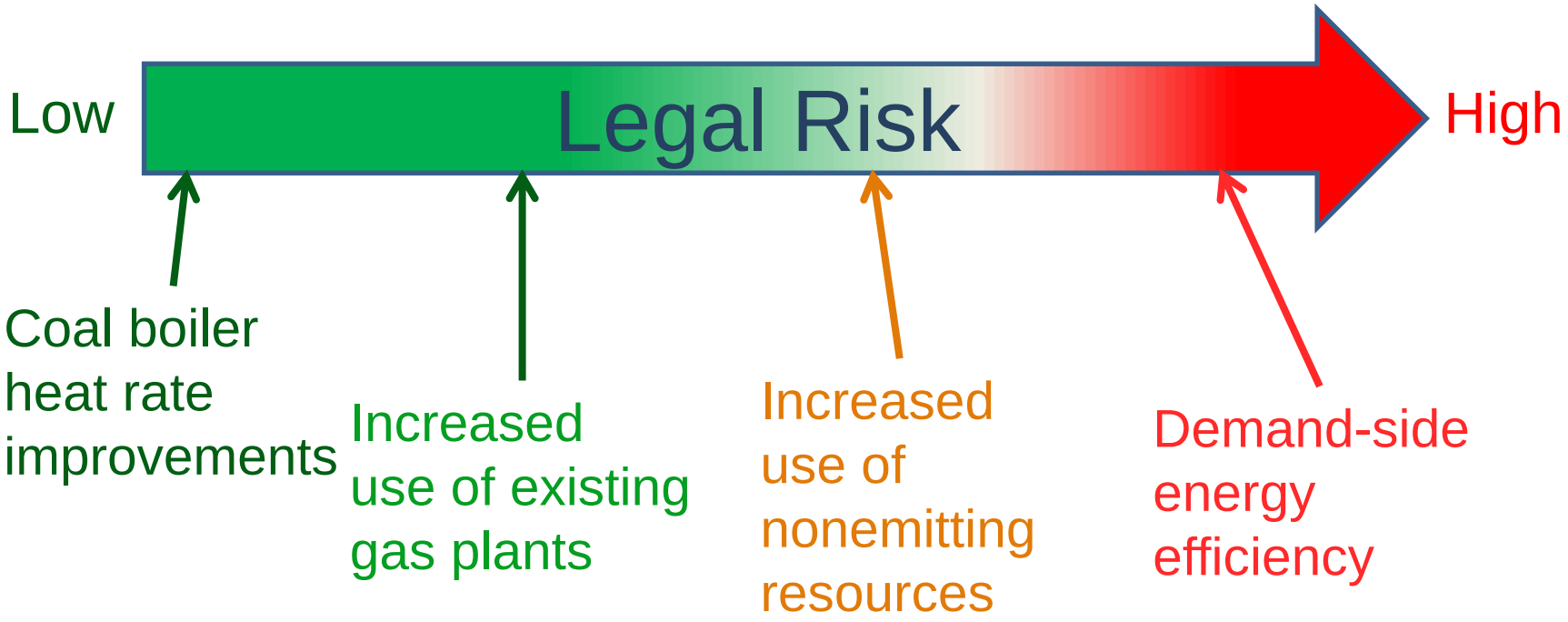
Sources and Notes:
Reflects Option 1 final rate for year 2030 from EPA Technical Support Document: Goal Computation, Appendix 1.
*Adjusted emissions rate applies to Fossil, 2012 RE, Nuclear (At Risk + Under Construction)
*BB3: RE includes Existing+New Renewable, Nuclear At+UC+New

Stringency and Legal Risk are Intertwined

- More BB, More Legal Risk



- What about stringency assuming severable BB?

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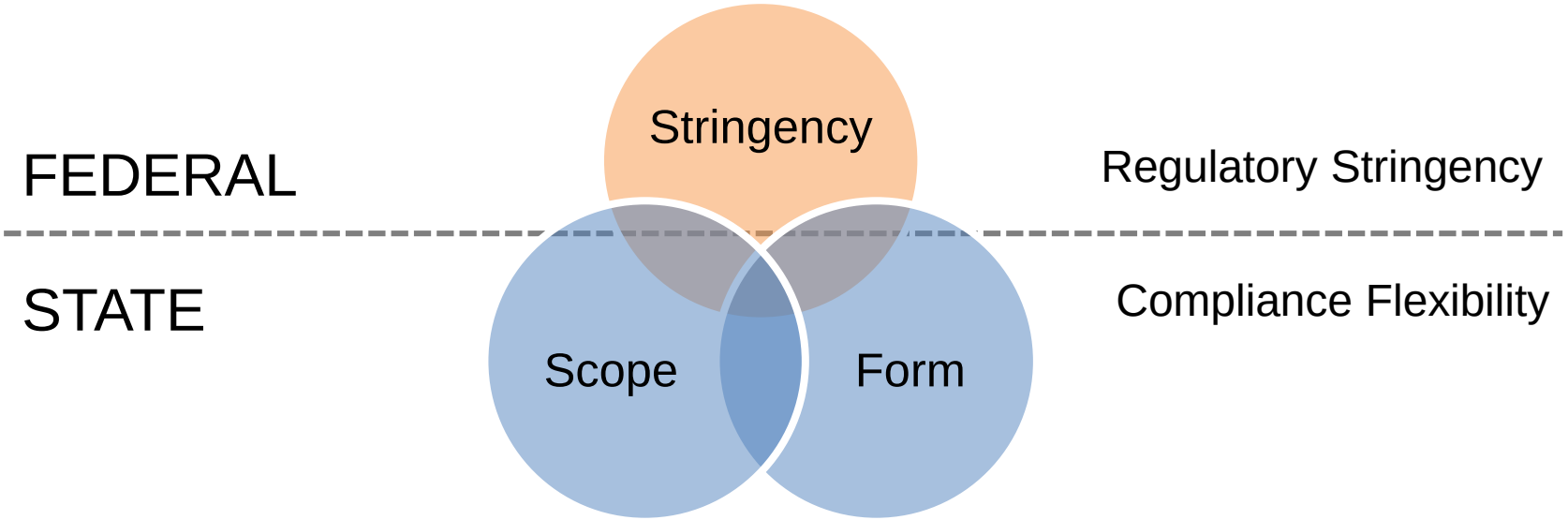
Background: Clean Power Plan's Federal-State Framework

- Multiple **stringency** criteria are relevant



- **Scope** of covered entities
- **Form** of compliance approach

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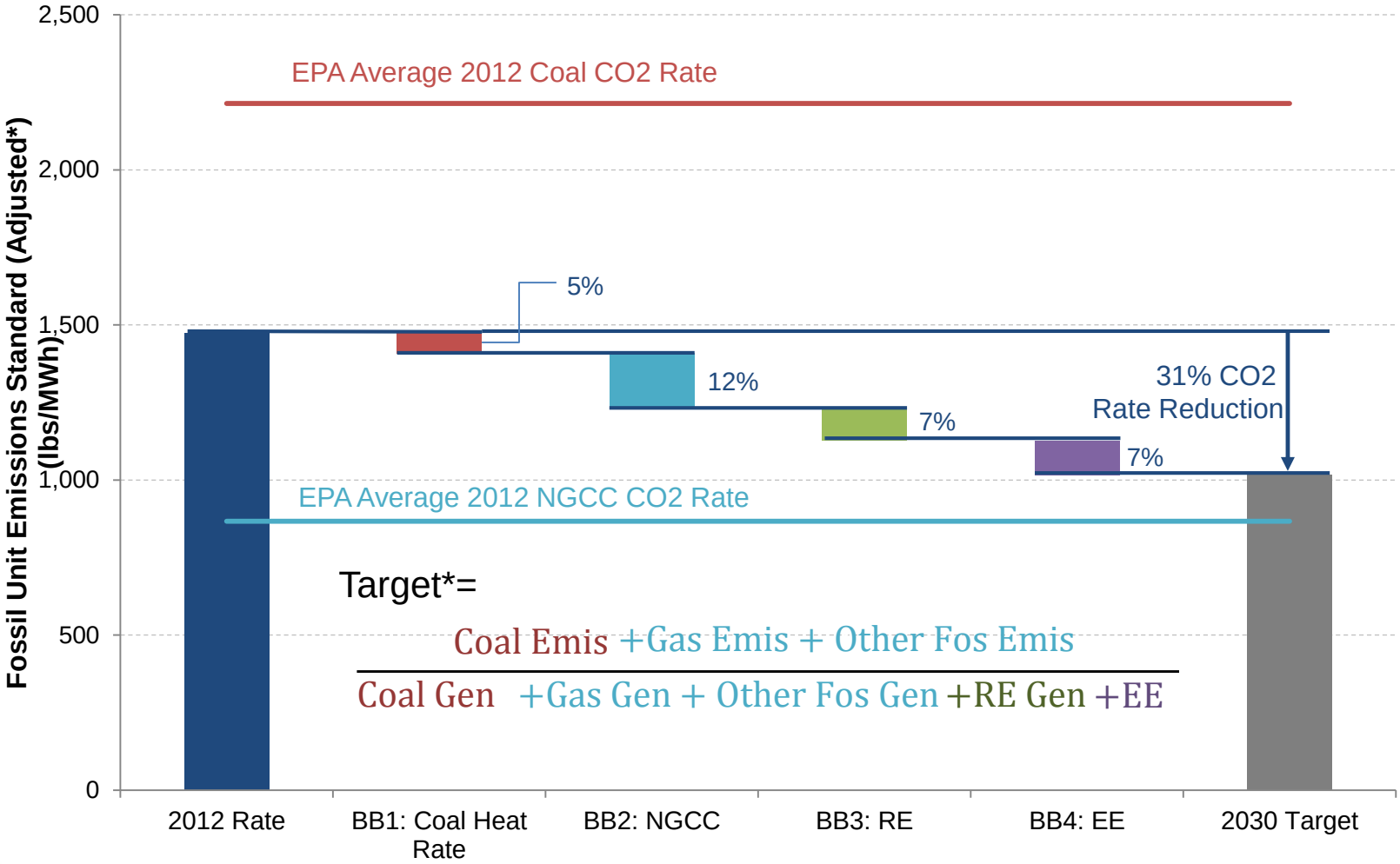
Stringency Under 1) Emissions Rate Criteria

- More BB, More Stringency



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Stringency of Regulation: Within BSER

- Stringency of target depends on the <u>survival of each building block</u> after facing legal challenge

$$\text{Target*} = \frac{\text{Coal Emis} + \text{Gas Emis} + \text{Other Fos Emis}}{\text{Coal Gen} + \text{Gas Gen} + \text{Other Fos Gen} + \text{RE Gen} + \text{EE}}$$

= Emissions Rate Achieved Through:

BB1: More efficient coal boilers

\+ BB2: More use of existing natural gas combined cycle

\+ BB3: More clean energy

\+ BB4: More efficient use of electricity

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* The target is unadjusted here. EPA's published rate target is "adjusted" emissions rate" where existing renewables and nuclear at risk (5.8%) are included in the denominator for BB1, BB1&2 goal computation.

* BB3 Denoted as RE includes Existing+New Renewable, Nuclear At+UC+New

Stringency of Regulation: Within BSER (cont'd)

- Stringency of each target also depends on the **"covered"** technologies: technological flexibility could dilute stringency

$$\text{Target}^* = \frac{\text{Coal Emis} + \text{Gas Emis} + \text{Other Fos Emis}}{\text{Coal Gen} + \text{Gas Gen} + \text{Other Fos Gen} + \text{RE Gen} + \text{EE}}$$

Covered Techs

Stringency →

Building Blocks	1	1&2	1,2&3	1,2,3&4
Rate Target for Covered Techs	2086	927	652	549
Covered Techs	Existing Coal	Existing Fossil	Existing Fossil, RE	Existing Fossil, RE, EE

← Stringency

(Example: New York 2030 Targets in the Clean Power Plan)

* The target is unadjusted here. EPA's published rate target is "adjusted" emissions rate" where existing renewables and nuclear at risk (5.8%) are included in the denominator for BB1, BB1&2 goal computation.

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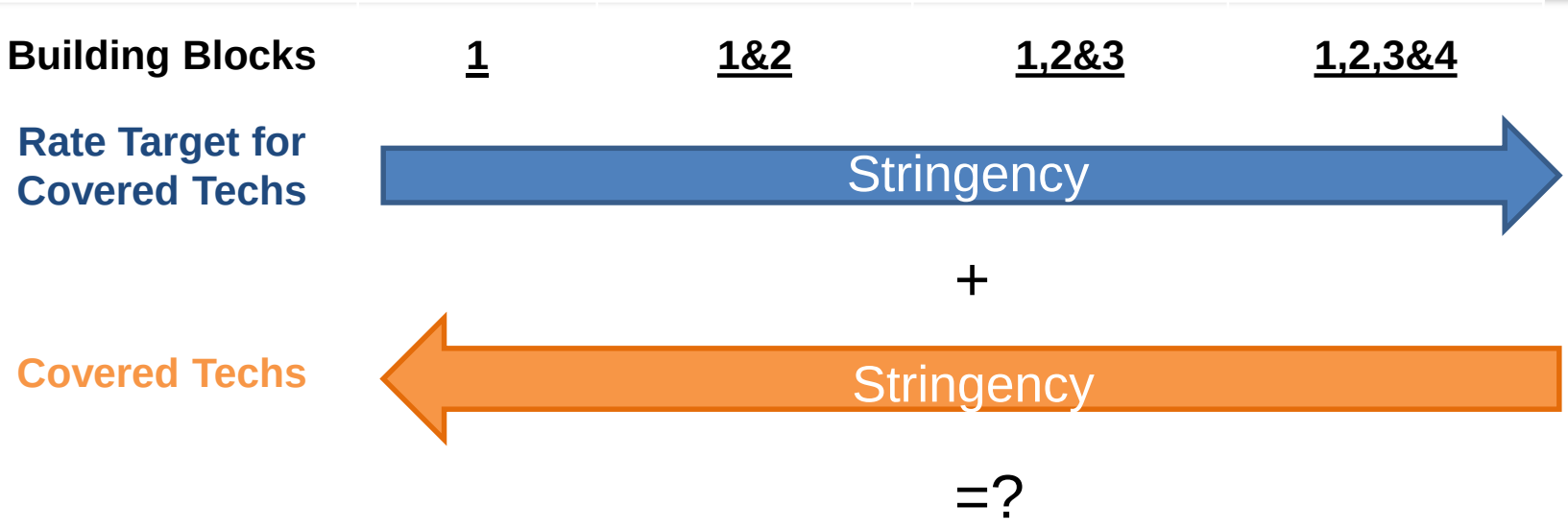
Stringency of Regulation: Within BSER (cont'd)



Simulate rate-based performance standard

❑ 4 scenarios applying 4 targets on 4 covered techs

Target	BB1 Rate	BB1&2 Rate	BB1,2&3 Rate	BB1,2,3&4 Rate
Covered Techs	Existing Coal	Existing Fossil	Existing Fossil, RE	Existing Fossil, RE, EE

(Example: New York 2030 Targets in the Clean Power Plan)

* The target is unadjusted here. EPA's published rate target is "adjusted" emissions rate" where existing renewables and nuclear at risk (5.8%) are included in the denominator for BB1, BB1&2 goal computation.

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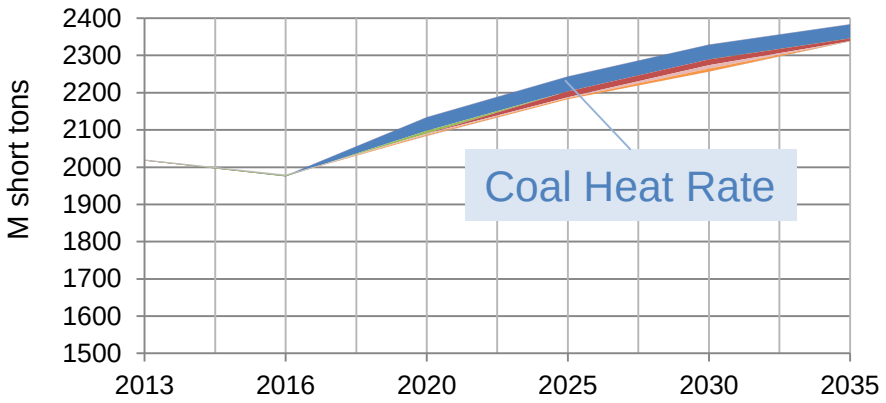
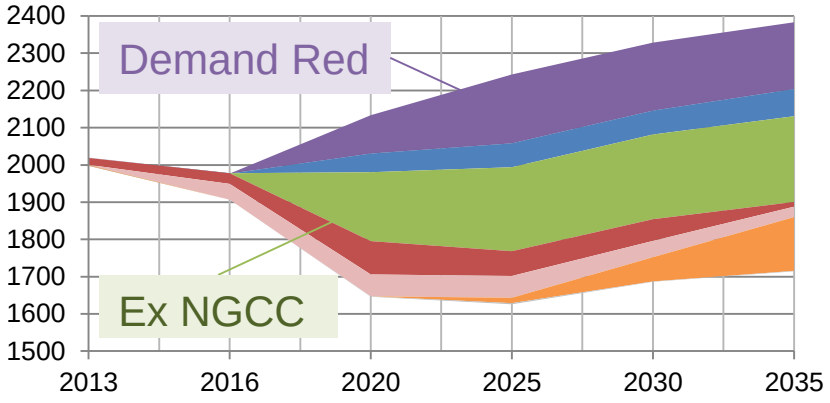
Emissions: Sources of Emissions Reductions (M short tons)

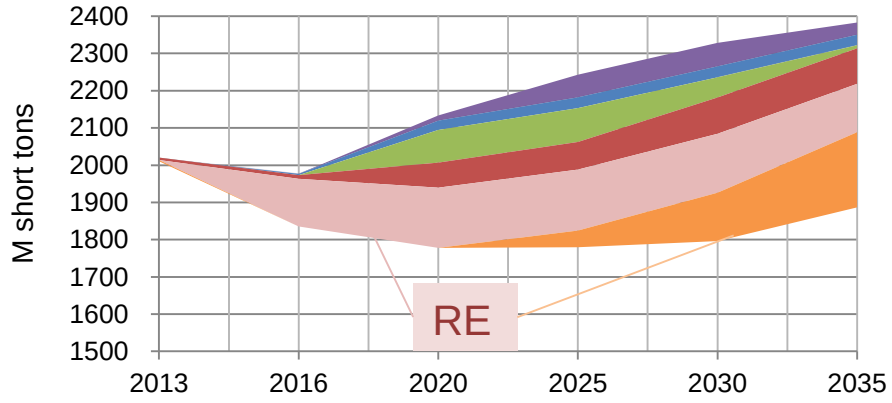
BB1 Rate As Existing Coal Policy



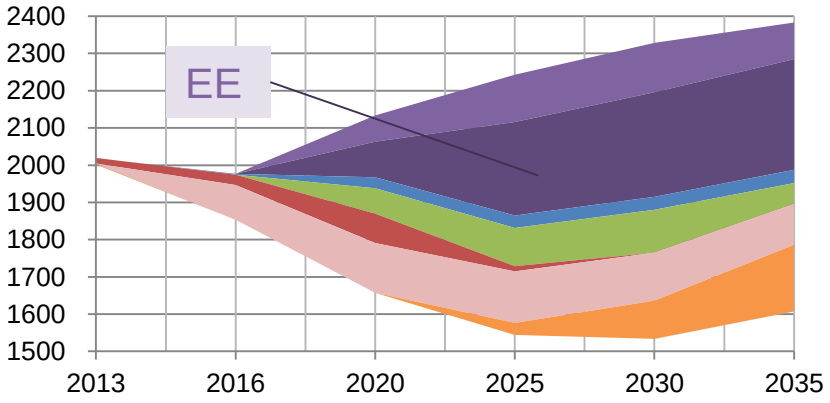
BB2 Rate As Existing Fossil Policy



BB3 Rate As Existing Fossil+Renewables Policy



BB4 Rate As Existing Fossil+Renewables Policy w/ EE



Demand Reduction
EE Savings
Coal Heat Rate Improvement
Existing CC Nat Gas
New CC Nat Gas
Wind
Nuclear
Other

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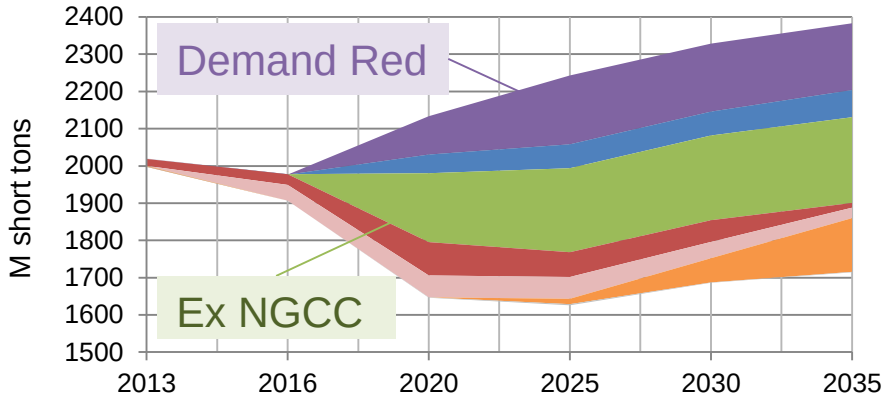
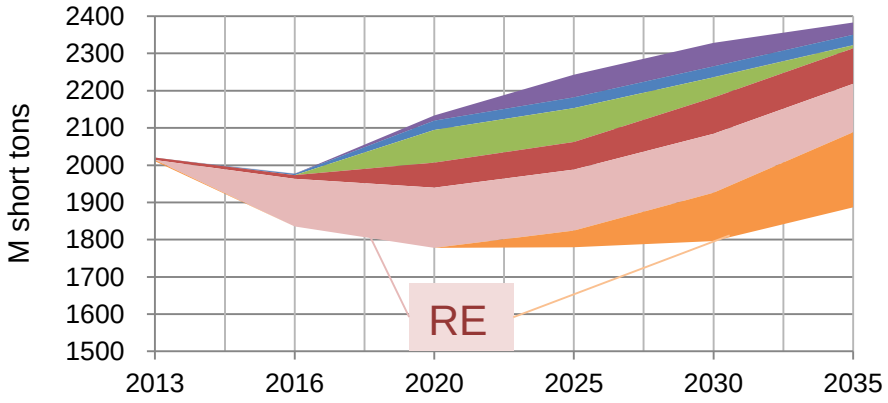
Emissions: Sources of Emissions Reductions (M short tons)

BB2 Rate As Existing Fossil Policy



BB3 Rate As Existing Fossil+Renewables Policy



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- Demand Reduction
- EE Savings
- Coal Heat Rate Improvement
- Existing CC Nat Gas
- New CC Nat Gas
- Wind
- Nuclear
- Other

Emissions: Abatement Margin

Abatement Margins					Target	Covered Techs
Coal heat rate improvement margin	Coal/gas switching margin	Emitting/non-emitting margin	Demand reduction margin			
			Price driven	Program driven		
√					BB1 Rate	Existing Coal
√√	√√	√	√		BB2 Rate	Existing Fossil
√	√	√√√			BB3 Rate	Existing Fossil, RE
√	√	√√	√	√	BB4 Rate	Existing Fossil, RE, EE

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(All results are for 2020 if not specified)

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Scope of Regulation: Beyond BSER

Beyond the building blocks

1. Heat rate improvement
2. Dispatch to existing and under-construction NGCC
3. Dispatch to new clean electric generation
4. Demand-side Energy Efficiency

Co-firing Low Carbon Fuels

Carbon Capture & Storage

New Natural Gas Plants ⟵

Distributed Generation

Combined Heat and Power

Retirements

Gains from Trade/Regional Compliance

……

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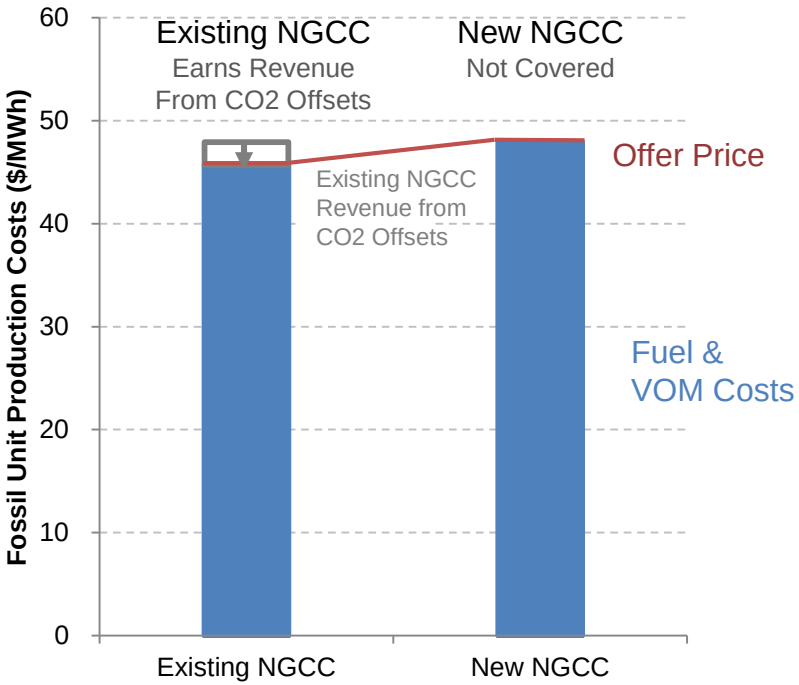
Scope of Regulation: Beyond BSER

- Rate-based approach creates different incentive for existing/new NGCC

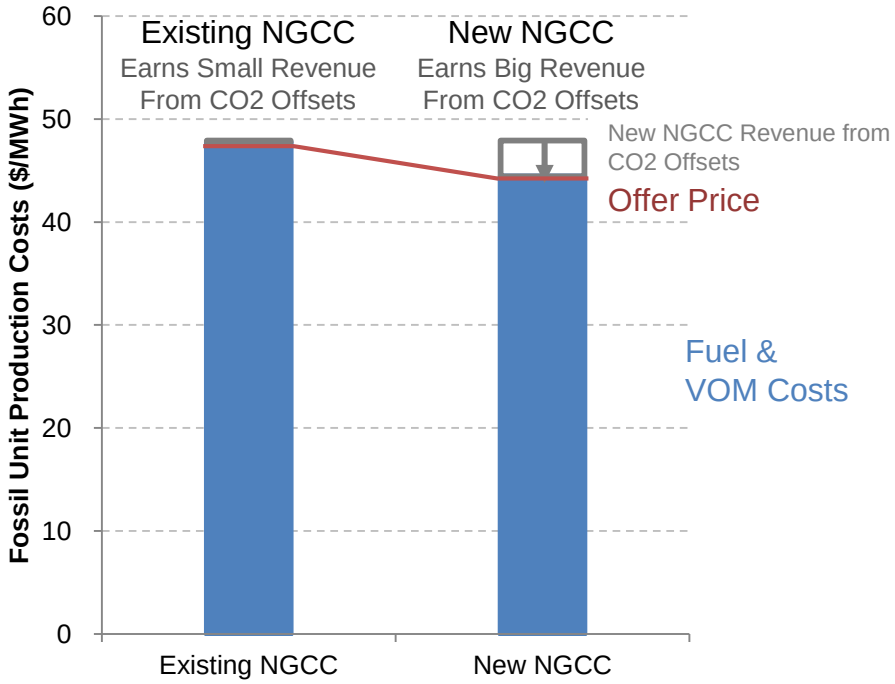
Excluding New NG
(Covers Existing Fossil + RE+EE)

Existing NGCC at advantage compared to New



Including New NG
(Covers All Fossil RE+EE)

New NGCC at advantage compared to Existing



Note: Based on 2020 simulation results. Existing and new NGCC are assumed to have identical Fuel and VOM Costs for this illustration

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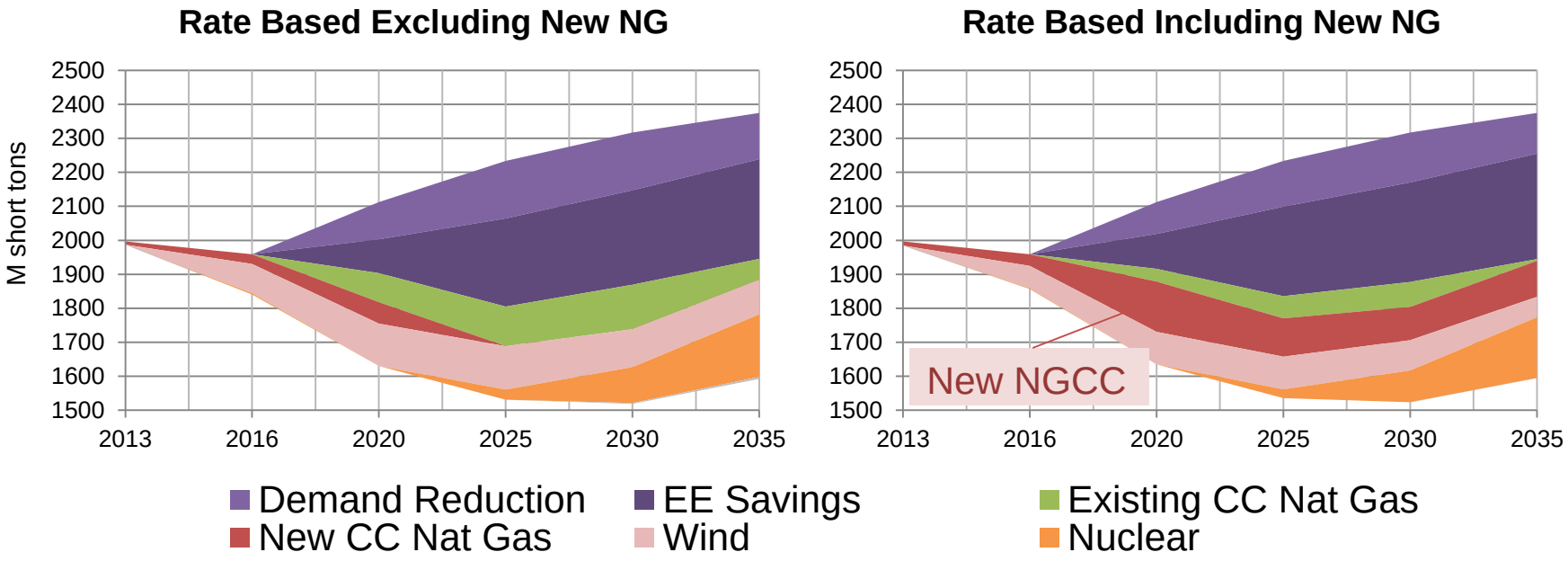
Scope of Regulation: Beyond BSER

- Including new NGCC replaces some existing NGCC and wind generation

Sources of Emissions Reductions (M short tons)



* Each scenario models rate-based performance standard with 6 trading regions. Two scenarios are calibrated to achieve equivalent emissions reductions

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Form of Regulation: Many options

Comprehensive Approach

- Rate-based Credit Trading
- Mass-based Credit Trading
- Clean Energy Standard

Portfolio Approach

- Coal Boiler Mandate
- Non-tradable Performance Standard
- Incentives for Renewable
  - RPS, ITC, PTC
- Energy Efficiency Policies

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Form of Regulation: Rate v.s. Mass

- **Rate- and Mass-Based Trading are Very Different**

	Allowance Allocation		Target
	Generators	Consumers	
Rate-based	- Earn credits at standard - Surrender credits at actual emissions rate		Emissions Rate
Mass-based	- Surrender allowance for each ton CO2	- Receive subsidy	Emissions Cap

	Covered Techs	
	Excluding New NG	Including New NG
Rate-based	**Form and scope of regulation interact in important ways**	
Mass-based		

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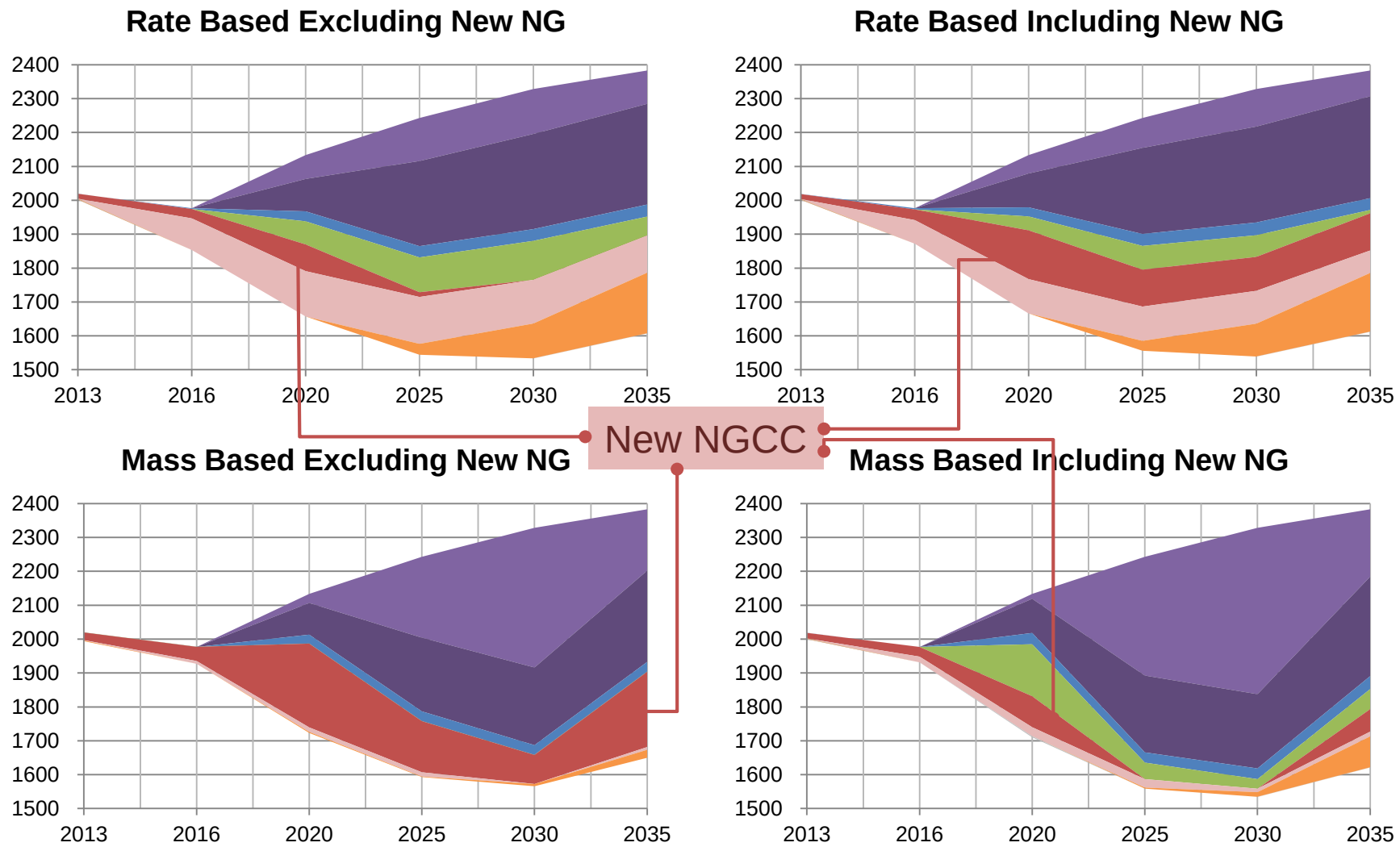
Emissions: Sources of Emissions Reductions (M short tons)



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Scope of Regulation: Beyond BSER

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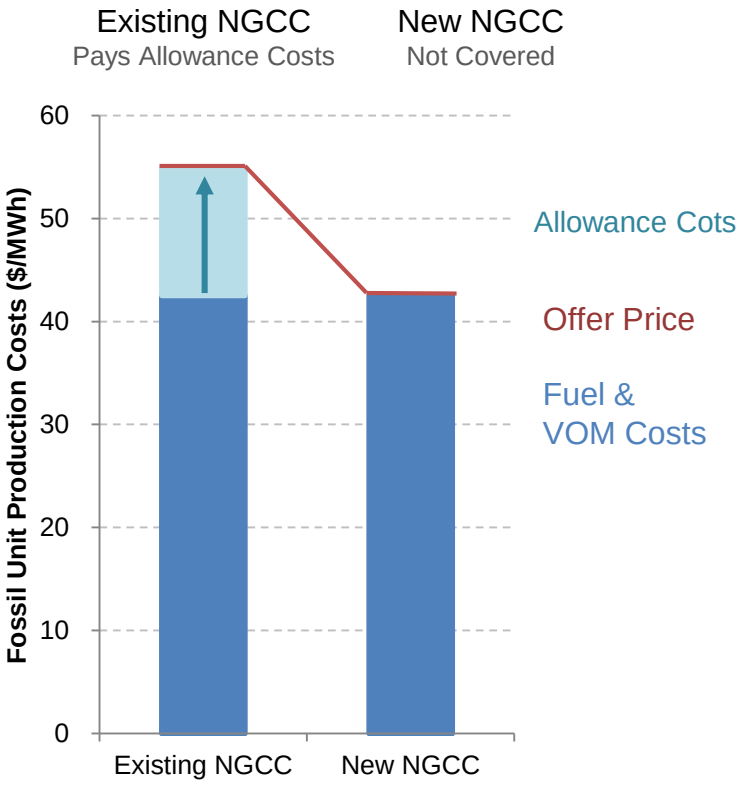
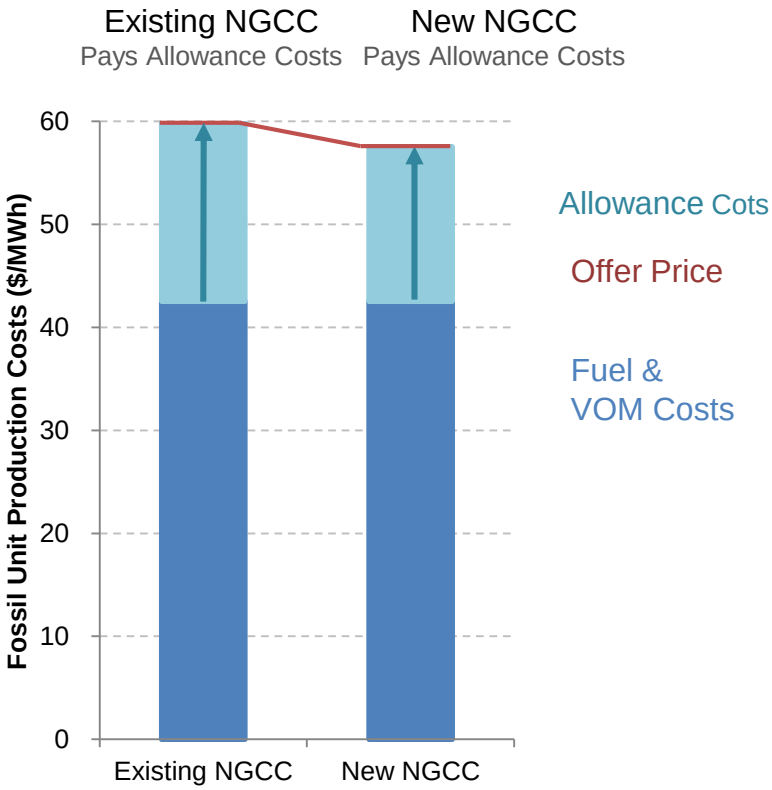
Excluding New NG
(Covers Existing Fossil + RE+EE)

New NGCC at advantage compared to Existing



Including New NG
(Covers All Fossil RE+EE)

Existing NGCC at advantage compared to New



Note: Based on 2020 simulation results. Existing and new NGCC are assumed to have identical Fuel and VOM Costs for this illustration

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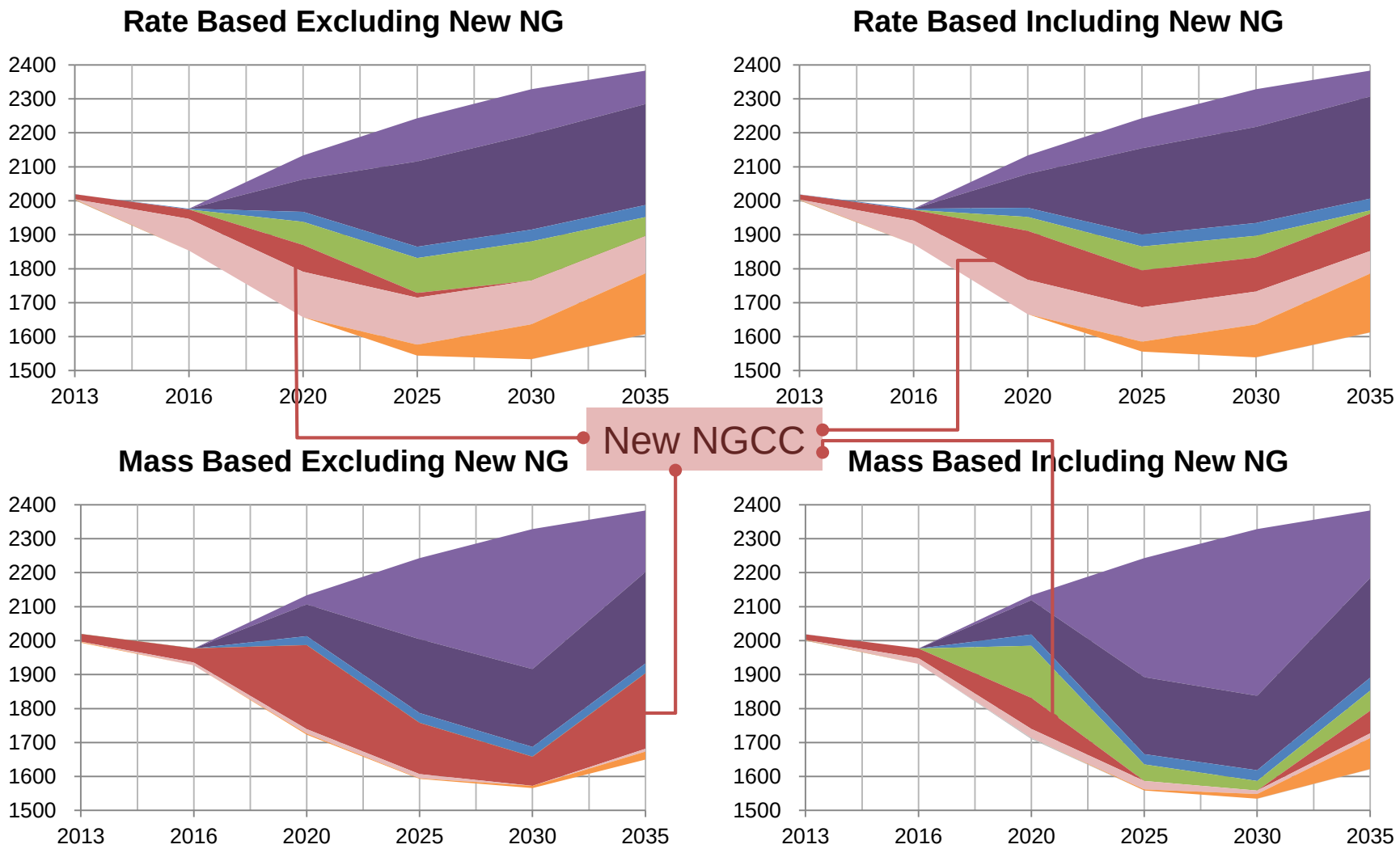
Emissions: Sources of Emissions Reductions (M short tons)



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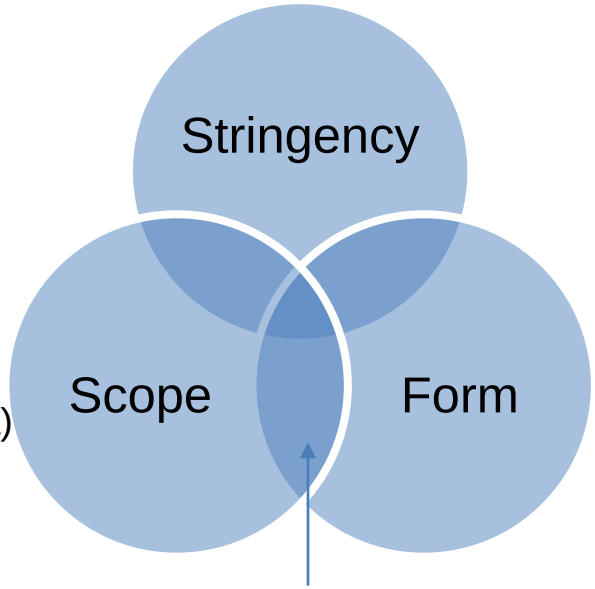
- Multiple stringency criteria are relevant
- BB 2 produce largest incremental emissions reductions.
- Adding BB 3 could produce negative emissions reductions in market equilibrium



- New Natural Gas Combined Cycle plays important role if a) covered under rate, b) not covered under mass

- Rate encourages clean costly technologies
- Mass achieve more emissions reduction through demand reduction

- Form and scope of regulation interact in important ways

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Suggested Future Directions

- More insights on different treatments of new natural gas
- Analysis of policy designs to address inter-regional leakage
- Gains from regional cooperation in compliance
- Comprehensive versus portfolio approaches
- Treatment of energy efficiency in equilibrium
- Consequences of particular policy design choices in different states

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Timeline for results dissemination

- We expect results to come out on a rolling basis over the next 6 – 24 months.
- To learn more go to www.rff.org and check out RFF's Expert Forum on the Clean Power Plan at http://www.rff.org/centers/climate_and_electricity_policy/Pages/RFFs-Expert-Forum-on-EPAs-Clean-Power-Plan.aspx
- Google "RFF Expert Forum on EPA's Clean Power Plan."
- E-mail Pan@rff.org

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Appendix A

Haiku Electricity Market Model Summary:

- Iterative forward looking algorithm to solve for market equilibria
- Covers electricity sector in the contiguous 48 states by 22 regions
- Simulation to 2035 for 3 seasons per year, 4 time block per season
- Dynamic, price-responsive demand side with 3 customer classes
- Each region is cost-of-service regulated or competitive
- Supply-side investment, retirement, system operation endog.
- Endogenous investment in air pollution abatement technologies
- Natural gas and coal prices are outputs
- Includes heat rate improvements and co-firing at coal plants

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Appendix B

Baseline Scenario

- Demand and fuel prices calibrated to Annual Energy Outlook 2013 forecasts
- Environmental policies: Title IV/CAIR, RGGI, California AB32, Mercury and Air Toxics Standards
- Federal renewable energy production and investment tax credits
- State renewable portfolio standards, tax credits, mercury constraints

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Appendix C

Illustrative Regional Policy Scenarios Specifications

- 6 trading regions from RIA
- State rate-based targets
- rate-based approach (including “adjusted” denominator)
- banking and borrowing through 2029
- Firm rate target in 2030 and beyond
- EE funded by SBC of $3 per MWh (counts toward compliance)

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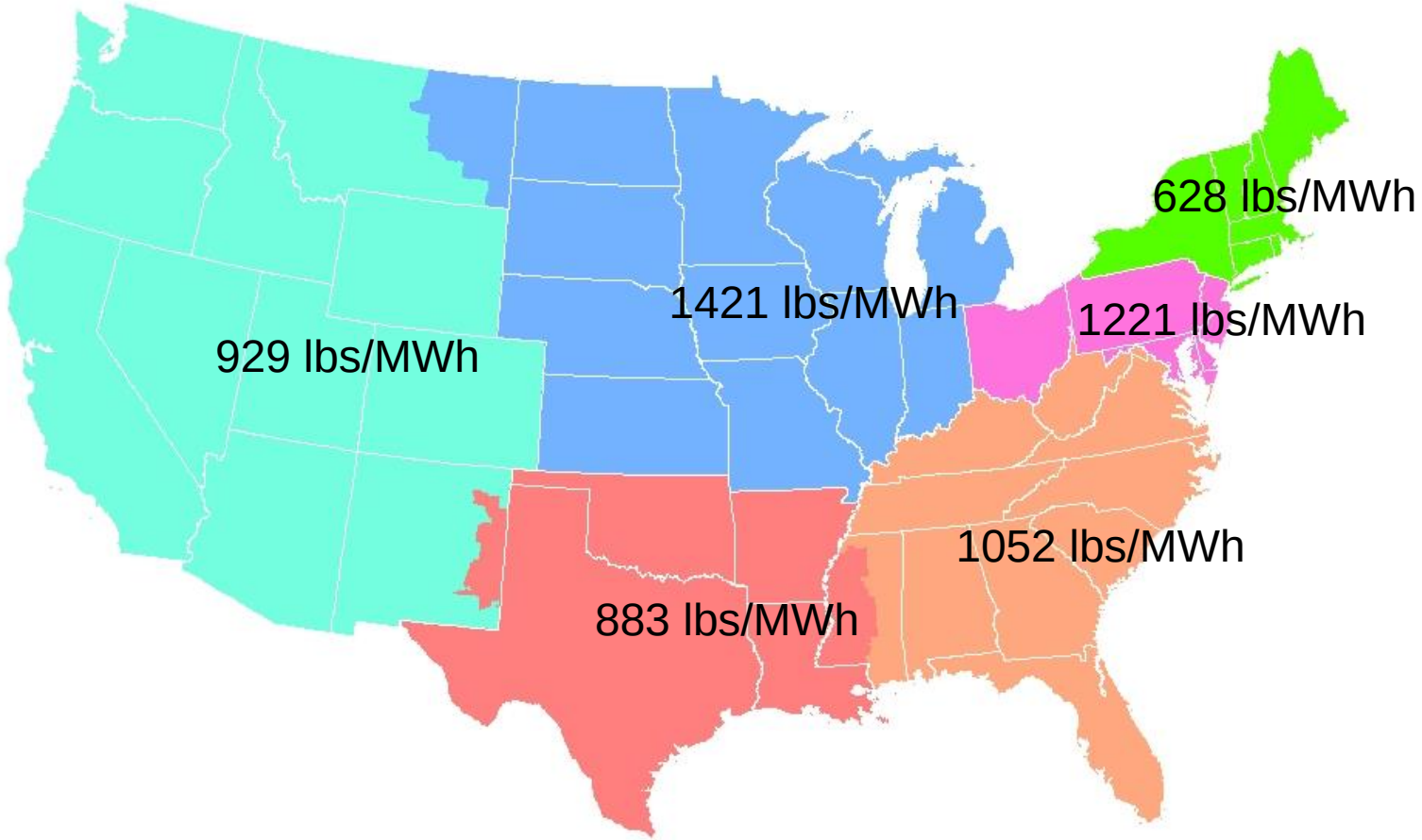
6 Trading Regions

Regional Interim (2020-2029) Emission Rate Goal



- Regional target is translated from state targets by weighting each state's contribution to regional generation based on 2012 generation

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Modeling Approach: Rate-based performance standard

- Two instruments in one!:

Net Production Incentive = ($/MWh)

(- Emissions Rate (lbs/MWh) + Performance Standard (lbs/MWh)) * Credit Price ($/lb)