EPA's Clean Power Plan

Basics and Implications of the Proposed CO_2 Emissions Standard on Existing Fossil Units under CAA Section 111(d)

PRESENTED TO

Goldman Sachs *Power, Utilities, MLP and Pipeline* Conference

PRESENTED BY

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THE Brattle GROUP

Agenda

Key Aspects of the Proposed Rule

EPA's Projected Changes in Emissions and Fuel Use

Wholesale Electricity Price Impacts

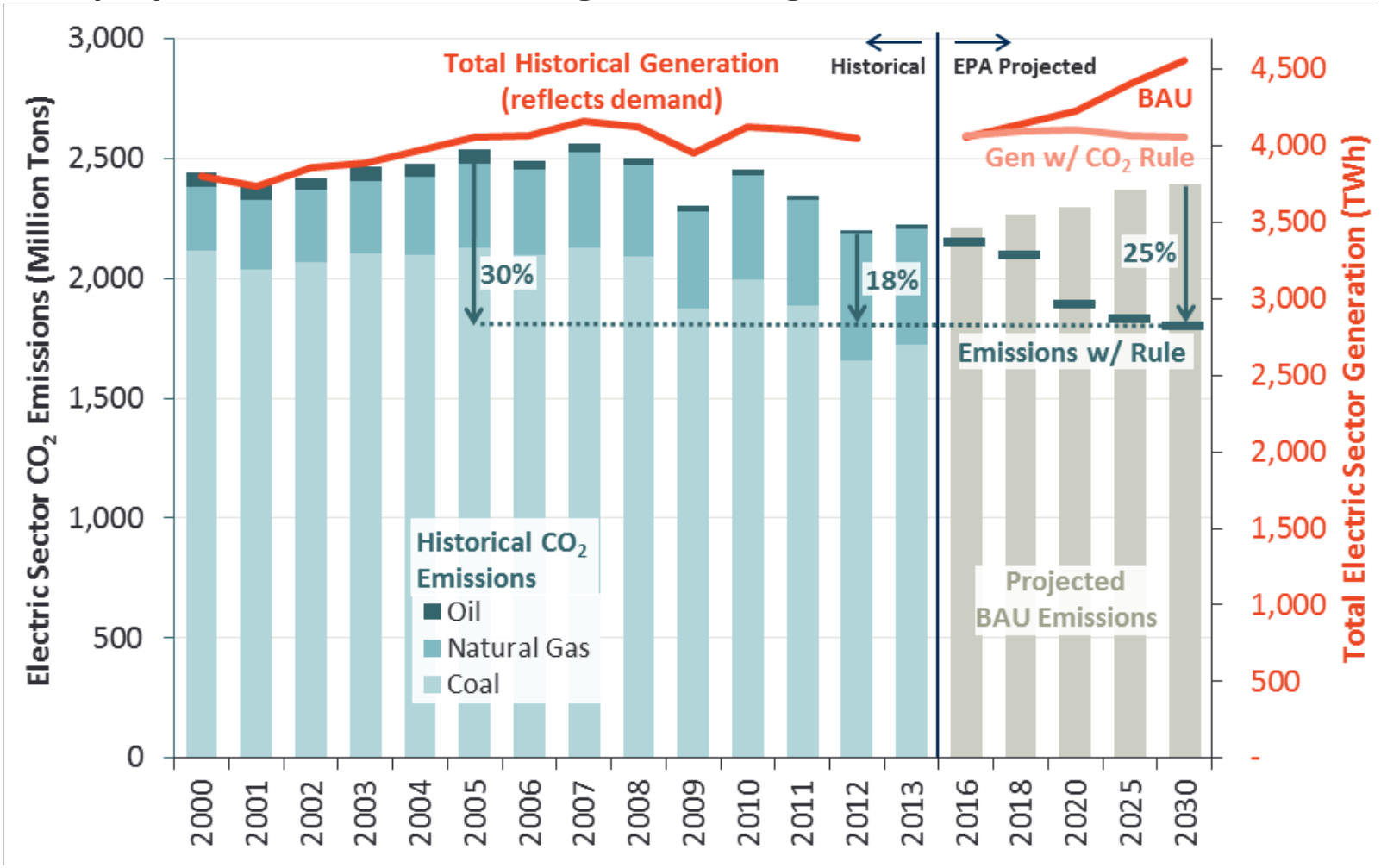
Implications for Asset Values

Clean Power Plan Overview and Timeline

- **On June 2, the EPA under Section 111(d) set CO_2 emissions standards on existing fossil generation units (EGUs)**
  - EPA reviewed existing emissions reductions methods to establish the Best System of Emissions Reduction (BSER)
  - BSER is applied to each state's current fossil EGU emissions rate to set state-specific fossil emissions rate standards for 2020-30
  - Option 1: interim goal for 2020-29 (to meet on average); final goal for 2030 and beyond
  - Option 2: less stringent but earlier goals for 2020-24; final goal for 2025 and beyond
  - States given flexibility in how to meet the standards
- **Timeline for compliance**
  - 2014: Proposed Rule; 120 day comment period concludes October 16, 2014
  - 2015: Final Rule
  - 2016: Initial report on State Implementation Plans (SIPs)
  - 2017: Final SIPs (for single-state plans)
  - 2018: Final SIPs (for multi-state plans)
  - 2020-30: Compliance period

Projected Effect of Standards on Emissions

The proposed standards are designed to bring emissions to 30% below 2005 levels



Sources and Notes:
Historical emissions from EPA's CEMS database; historical generation from EIA; Projected generation and CO_2 from EPA's IPM model results, comparing its "Business as Usual" Base Case to its Policy (Option 1 w/o cooperation) scenario.

EPA's Best System of Emissions Reductions (BSER)

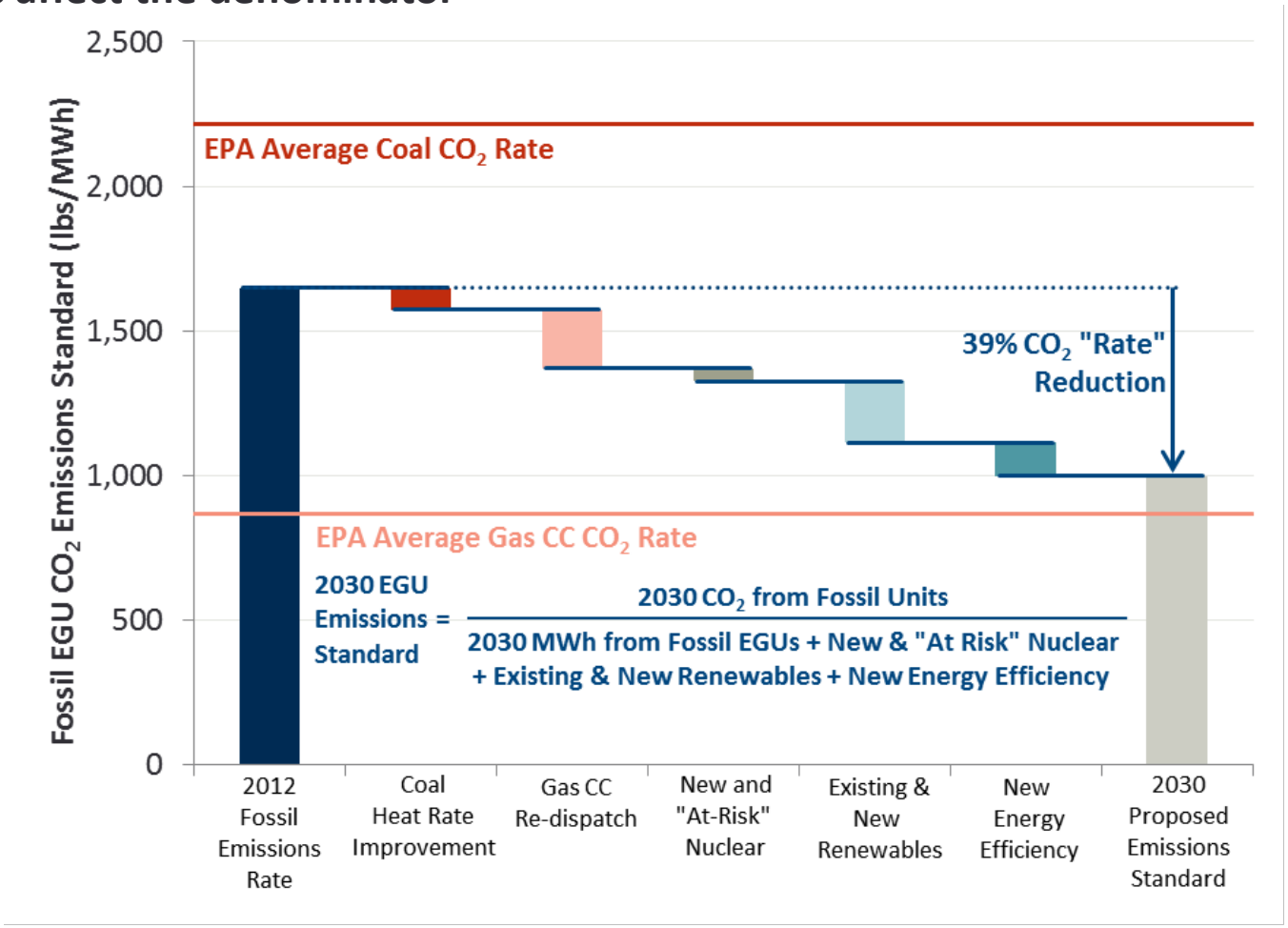
BSER includes four existing methods of emissions reduction, assessed for feasibility in each state

BSER Building Block	EPA Basis for BSER Determination	EPA Estimated Average Cost	% of BSER CO_2 Reductions
1. Increase efficiency of fossil fuel power plants	EPA reviewed the opportunity for coal-fired plants to improve their heat rates through best practices and equipment upgrades, identified a possible range of 4–12%, and chose 6% as a reasonable estimate. BSER assumes all coal plants increase their efficiency by 6%.	$6–12/ton	12%
2. Switch to lower-emitting power plants	EPA determined for re-dispatching gas for coal that the average availability of gas CCs exceeds 85% and that a substantial number of CC units have operated above 70% for extended periods of time, modeled re-dispatch of gas CCs at 65–75%, and determined 70% to be technically feasible. BSER assumes all gas CCs operate up to 70% capacity factor and displace higher-emitting generation (*e.g.* , coal and gas steam units).	$30/ton	31%
3. Build more low/zero carbon generation	EPA identified 5 nuclear units currently under construction and estimated that 5.8% of all existing nuclear capacity is "at-risk" based on EIA analysis. BSER assumes the new units and retaining 5.8% of at-risk nuclear capacity will reduce CO_2 emissions by operating at 90% capacity factor.	Under Construction: $0/ton "At-Risk": $12–17/ton	7%
	EPA developed targets for existing and new renewable penetration in 6 regions based on its review of current RPS mandates, and calculated regional growth factors to achieve the target in 2030. BSER assumes that 2012 renewable generation grows in each state by its regional factor through 2030 (up to a maximum renewable target) to estimate future renewable generation.	$10–40/ton	33%
4. Use electricity more efficiently	EPA estimated EE deployment in the 12 leading states achieves annual incremental electricity savings of at least 1.5% each year. BSER assumes that all states increase their current annual savings rate by 0.2% starting in 2017 until reaching a maximum rate of 1.5%, which continues through 2030.	$16–24/ton	18%

Source: EPA's Proposed Rule.

National Average Fossil EGU Emissions Standard from BSER

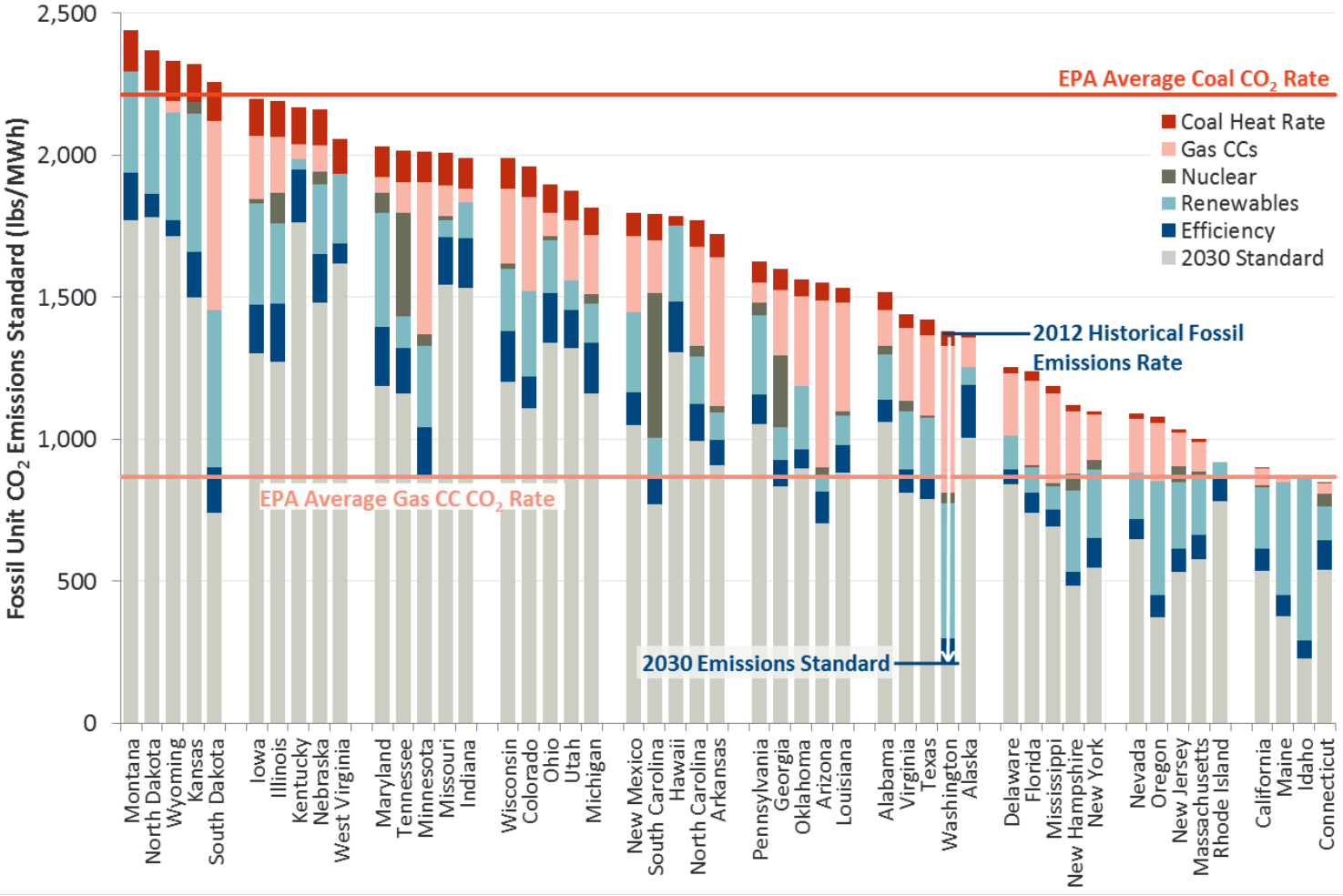
The EPA standards are not true emission rates for fossil plants, because some BSER elements affect the numerator (emissions) and other, non-fossil CO_2 abatement elements affect the denominator



Sources and Notes:
Reflects Option 1 final rate for year 2030 from EPA Technical Support Document: Goal Computation, Appendix 1.

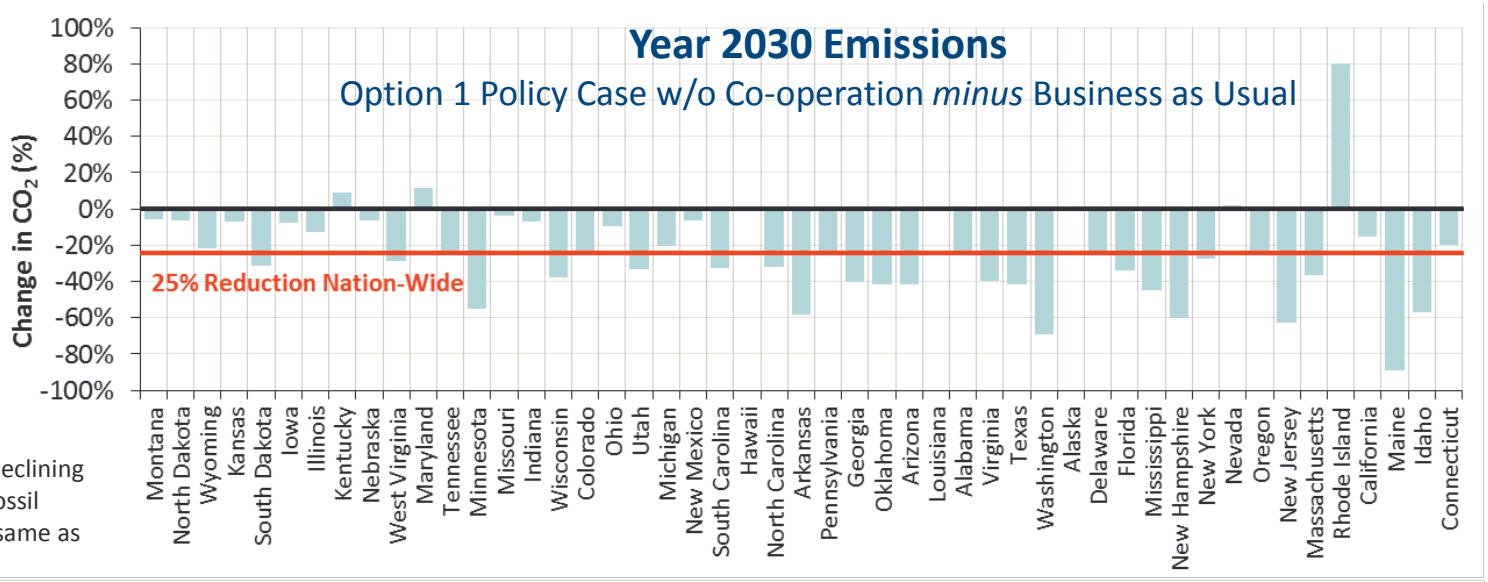
Fossil EGU Emissions Standard by State

State standards vary considerable relative to current fossil emission levels, due to differences in perceived BSER opportunities within each state

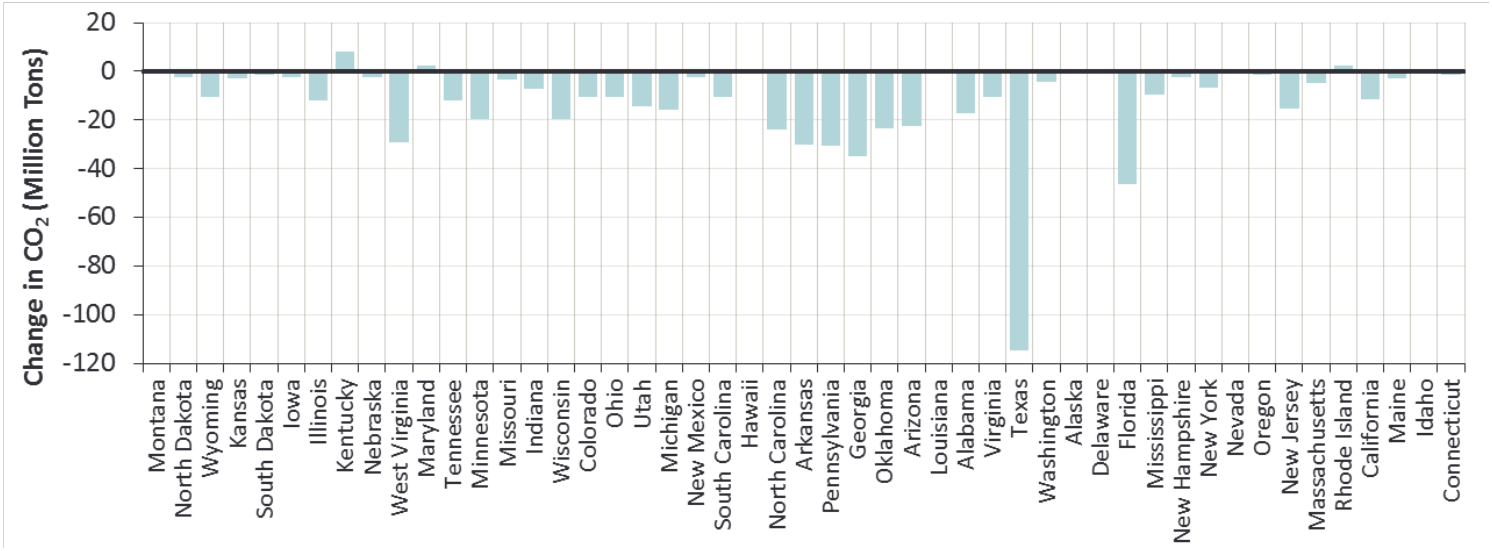


Sources and Notes:
Reflects Option 1 final rate for year 2030 (and beyond) from EPA Technical Support Document: Goal Computation, Appendix 1.

EPA's Projected 2030 Emissions Reductions

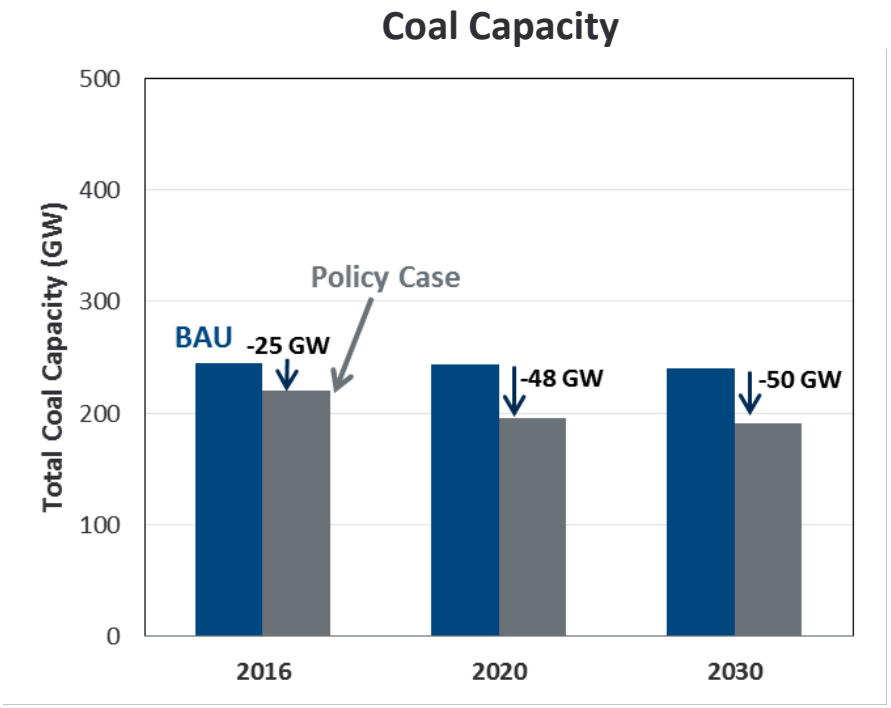


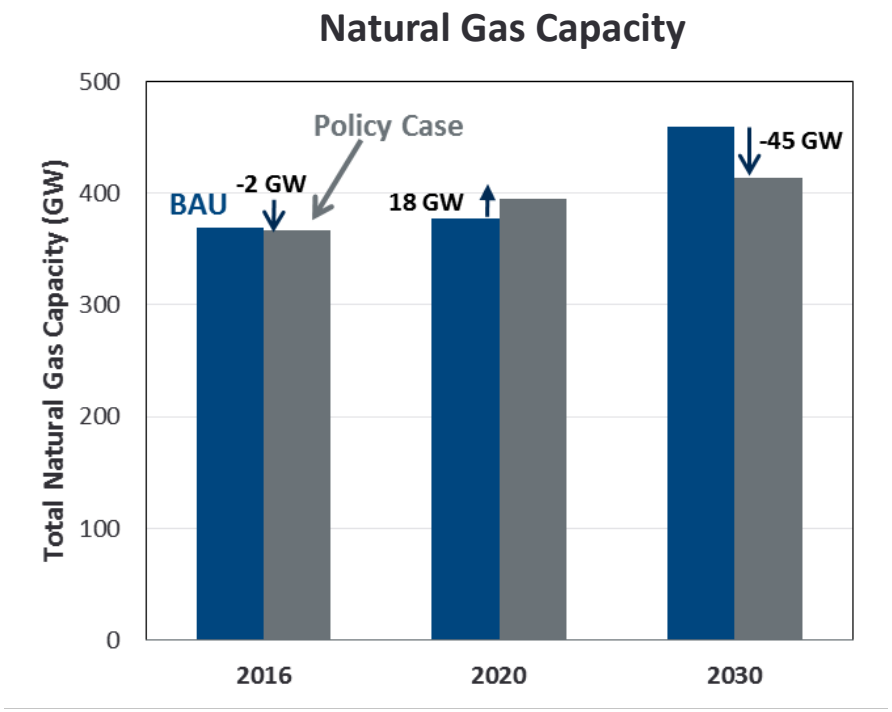
States listed in declining order of 2012 fossil emission rates (same as prior slide)



Sources and Notes:
Reflects differences in state emissions from EPA IPM model results, comparing its Policy (Option 1 w/o cooperation) scenario to its "Business as Usual" Base Case .

Projected Retirements and New Builds





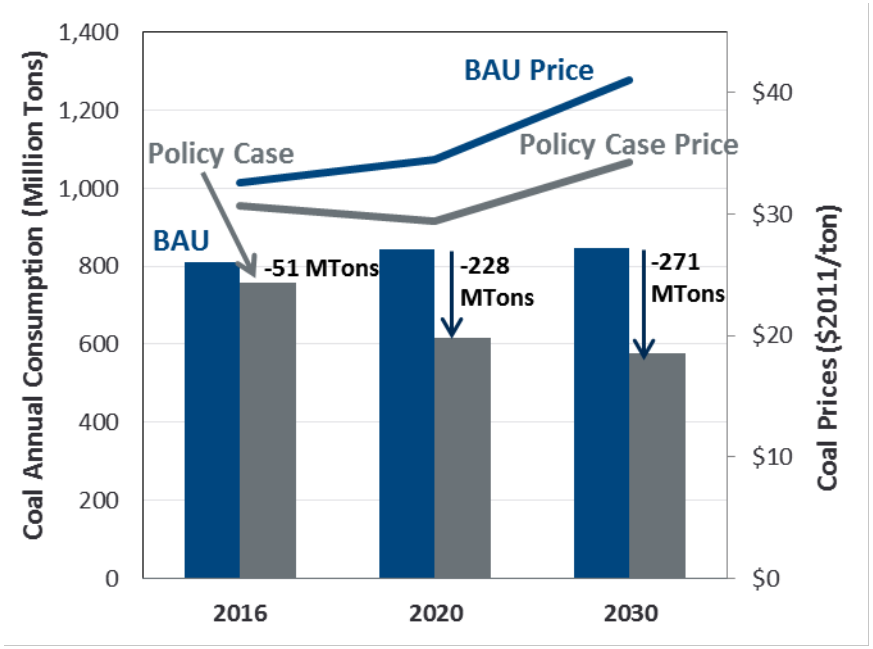
EPA projects that the rule would:

- Induce about 1/5 of the coal fleet to retire by 2020
- Increase investment in gas-fired generation capacity by 2020
- Long-term, entry would be less than in BAU due to energy efficiency

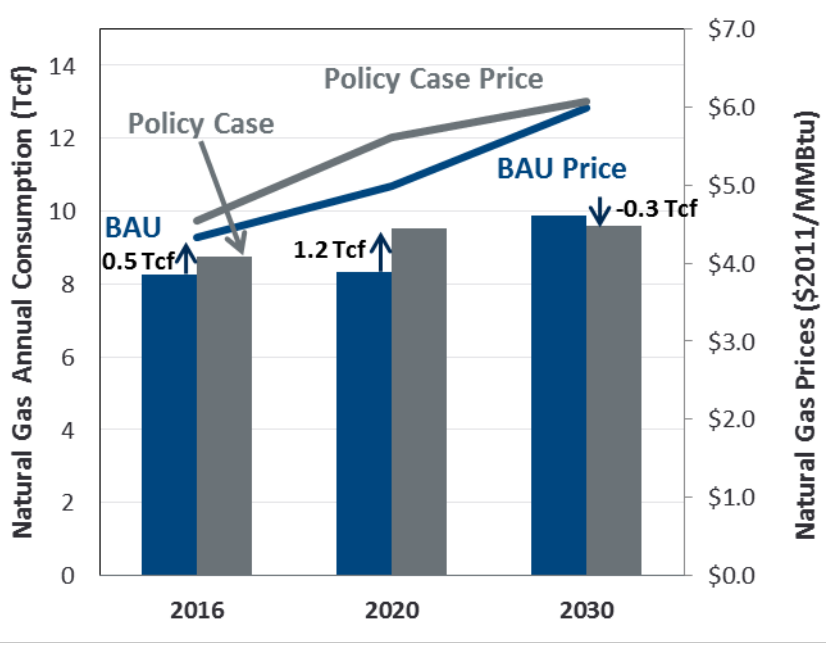
Sources and Notes:
Coal and gas capacity numbers from EPA's IPM model results, comparing its BAU Base Case to its Policy (Option 1 w/o cooperation) scenario.

Projected Fossil Use and Prices

Coal Consumption and Prices



Natural Gas Consumption and Prices

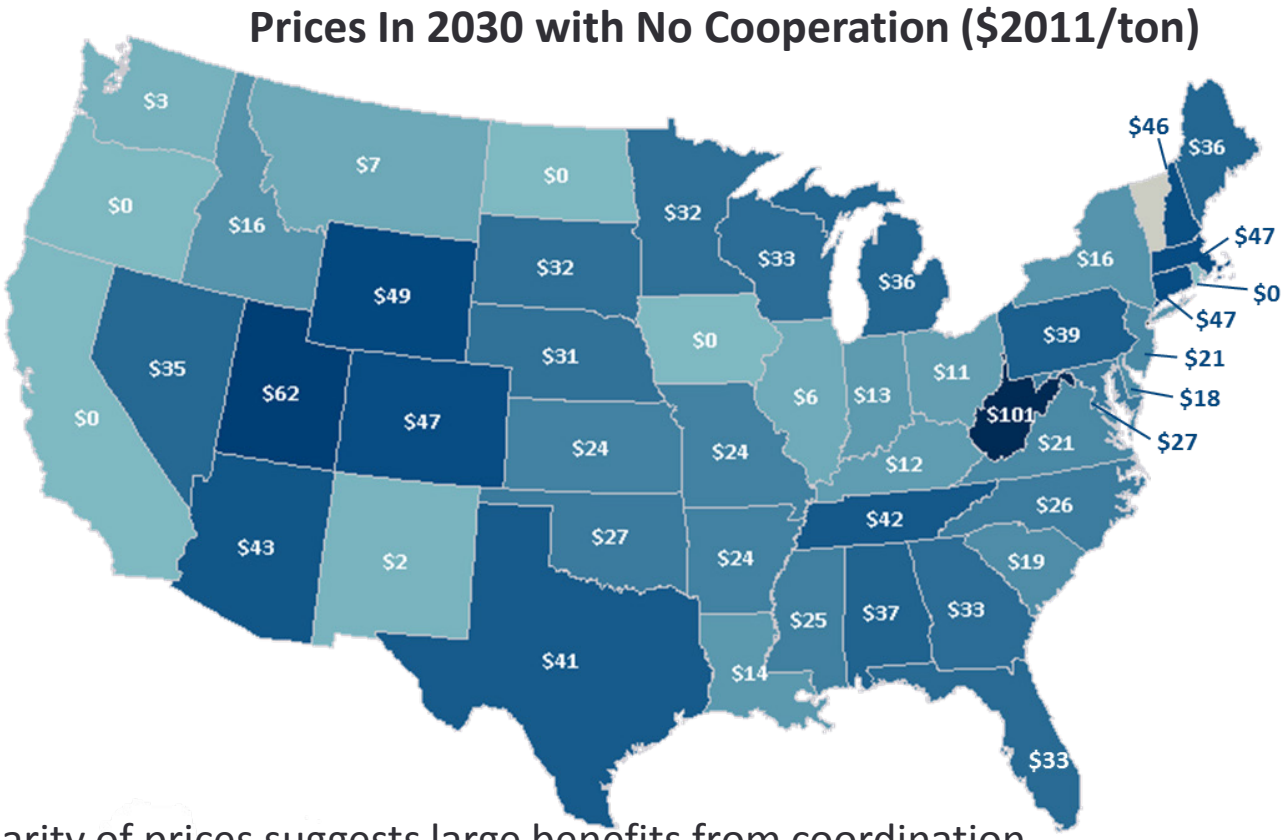


EPA projects that the rule would:

- Cut 1/3 of coal use and reduce prices by $6.8/ton
- Expand natural gas use by 1.2 Tcf/yr and raise prices by $0.60/MMBtu in 2020
- Have little net impact on gas use/prices by 2030 due to expanded energy efficiency

Sources and Notes:
Coal and gas consumption is for power sector only. Coal price represents minemouth price, and natural gas price refers to the Henry Hub price.
Coal and gas consumption and prices from EPA's IPM model results, comparing its BAU Base Case to its Policy (Option 1 w/o cooperation) scenario.

EPA Indicative Marginal CO_2 Prices



- Disparity of prices suggests large benefits from coordination
- National average cost of compliance is $15 per ton without interstate cooperation
- EPA's modeled rate-based cooperation reduces the average compliance cost to $13/ton
- Mass-based allowance trading would likely reduce the compliance cost even further

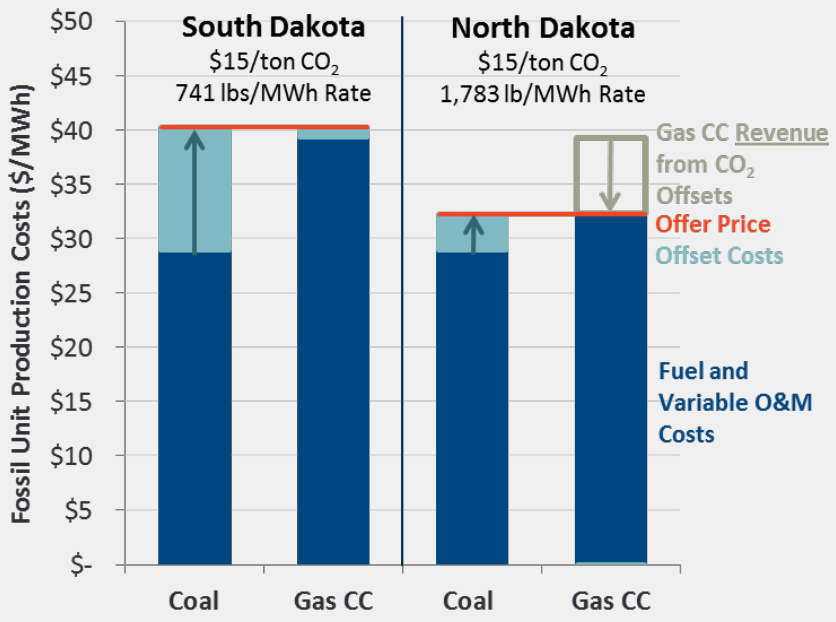
Sources and Notes:
Values reflect shadow prices on emissions rate constraint, expressed in $2011/ton of CO_2.
Values from EPA's IPM model results for its Policy (Option 1 w/o cooperation) scenario.

Inefficiencies Under Rate-Based Trading

Rate-based approaches will create substantial dispatch inefficiencies between states and some resource types. Two examples:

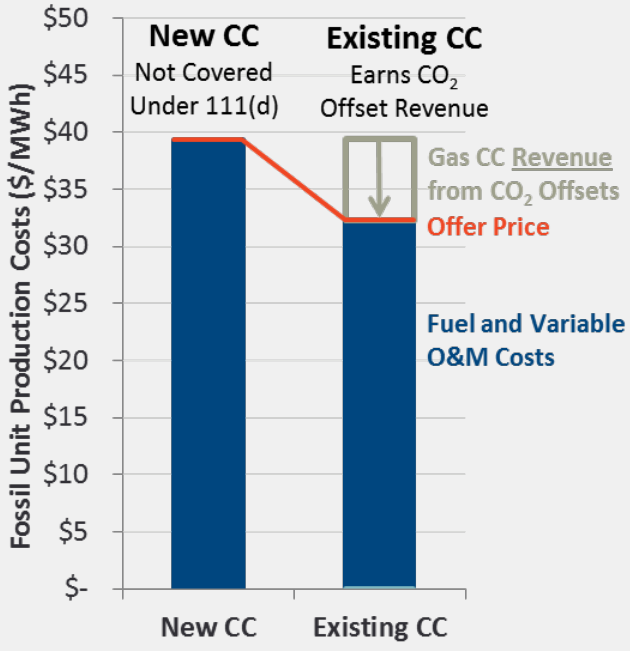
Different Dispatch Prices for Identical Plants in Neighboring States

Production shifts into the state with a more lax standard



Identical "New" and "Existing" Gas CCs

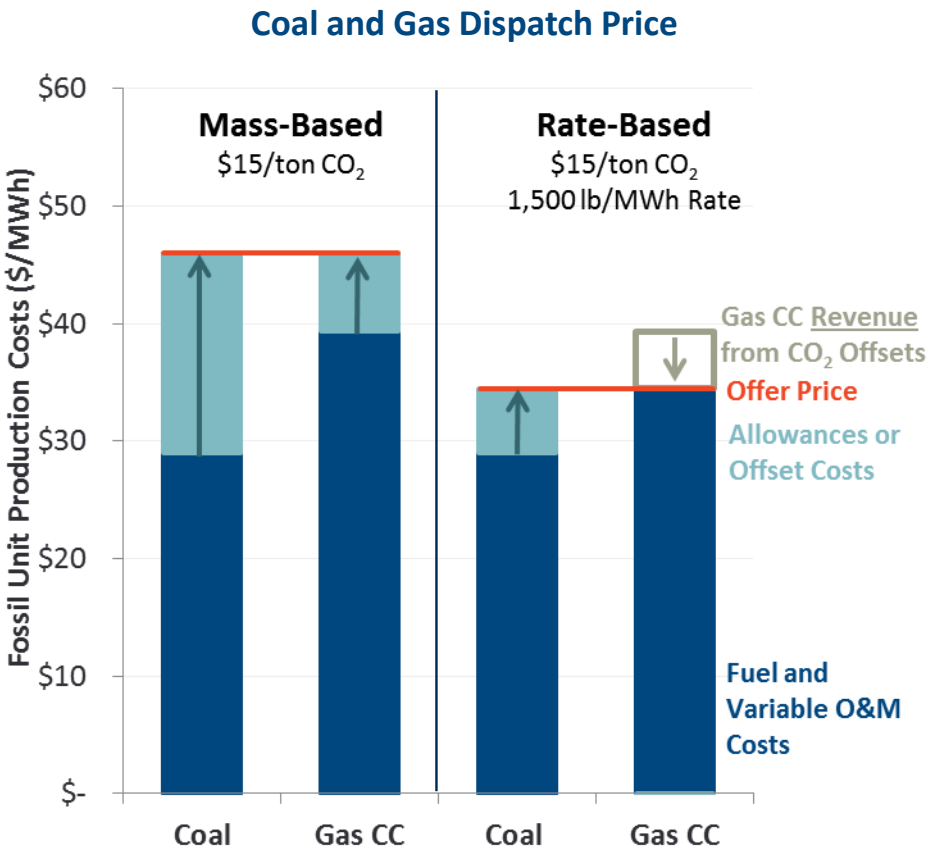
Existing CCs at advantage compared to new.



Mass- and Rate-Based Trading are Very Different

Wholesale prices would be higher under mass-based CO_2 trading:

- **Mass-based**:
  - Fossil generators must pay for every ton of carbon produced, increasing dispatch costs and wholesale prices
  - They or consumers could be compensated through allowance auction revenues
- **Rate-based**:
  - Fossil units only have to pay for enough CO_2 to reduce their emissions rate to the standard
  - In many states, the rate exceeds that of gas CCs, so they will earn revenue from creating offsets when they run (reducing energy their offer price!)

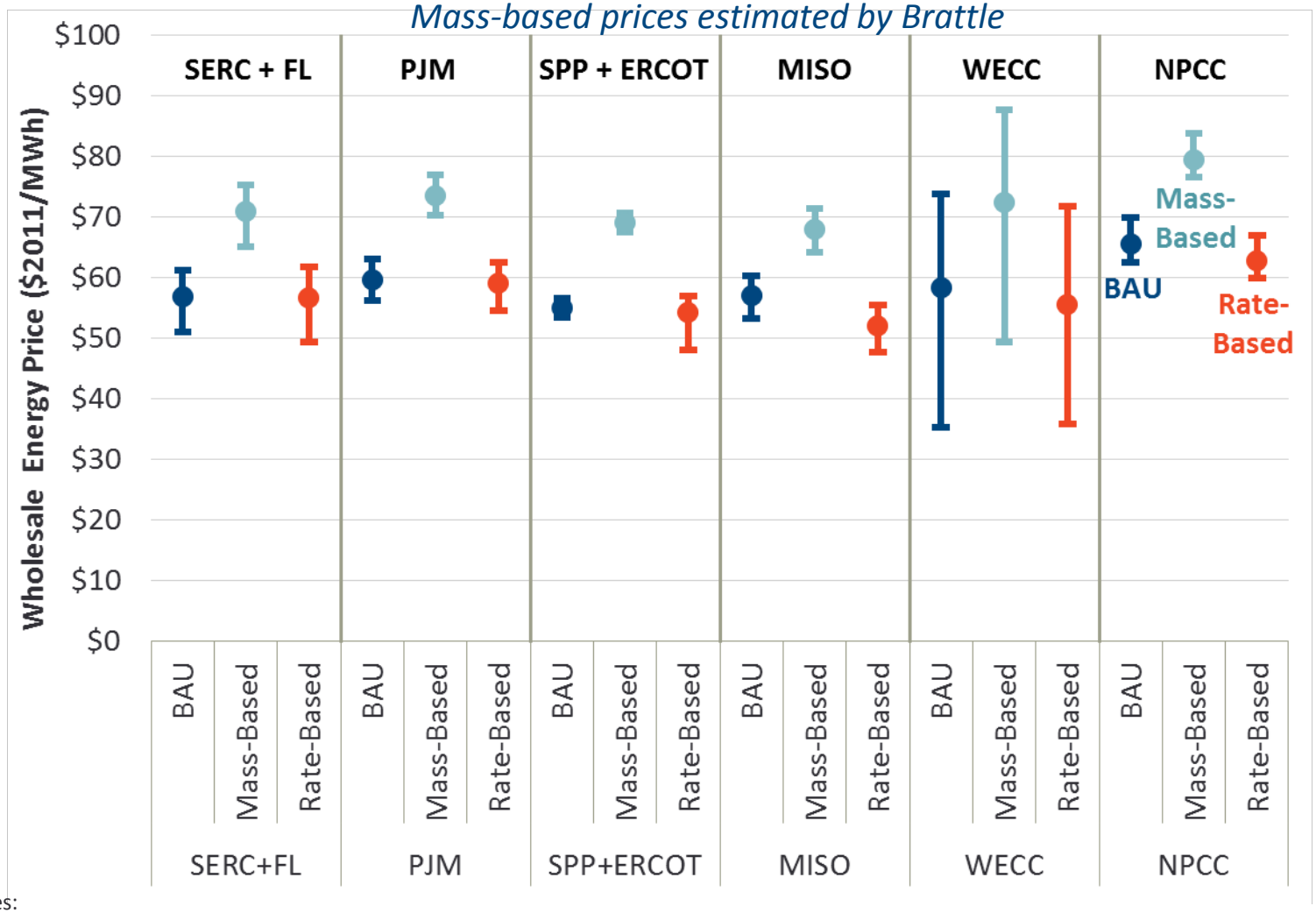


Sources and Notes:
Illustrative calculation assumes that coal-to gas switching is the marginal CO_2 abatement opportunity, resulting in equal coal and gas dispatch prices.

EPA Projects Prices will Decrease with Rate-Based

2030 Average and Range of Prices by Region

Mass-based prices estimated by Brattle



Sources and Notes:

BAU and Rate-based prices are from EPA's IPM model results for its BAU Base Case and its Policy (Option 1: with regional al cooperation) scenario.

BAU and Rate-based prices show simple averages and range of prices across the different sub-regions modeled by EPA's IPM model.

Mass-based prices estimated by Brattle by adding EPA's BAU energy prices and EPA's marginal CO_2 price (Policy case w/cooperation) applied to a CC.

Implications for Asset Values

	Nuclear	Coal	Gas
Mass-Based Trading	⊕ ⊕ ⊕ ⊕ ⊕	⊖ ⊖ ⊖	⊕
	▪ Might save some of the fleet at risk	▪ Less impact on value if plants are allocated allowances	▪ Assume new gas is included in program, else existing is disadvantaged
	⊖	⊖ ⊖	⊕ ⊕
Rate-Based Trading	▪ Rate-based would exclude most existing nuclear and all hydro in spite of being carbon-free ▪ Could try to change the rule….	▪ Less impact than with mass-based because plants have a right to emit at target level	▪ Exclusion of new gas could raise capacity prices and benefit existing

Takeaways

- **EPA's Proposed Rule**
  - Will achieve substantial emissions reductions within the confines of EPA's authority, but with some interesting features
  - Standards vary widely across states based on numerous assumptions about sources of potential target reductions, which some states are questioning
  - Individual state standards don't directly indicate relative compliance burdens
  - The rule treats resources with similar emissions asymmetrically
- **Key Compliance Questions for States** (other than disputing their standards)
  - Whether and how to cooperate with other states to reduce compliance costs
  - Whether to convert to mass-based compliance or at least *mass-based trading*, which efficiently puts all carbon abatement options on a level playing field. Higher wholesale prices are not worse for consumers if they own allowance auction revenues.
  - If not converting to mass-based, find other ways to remedy inefficiencies caused by the rate's exclusion of new CCs, most nuclear, and hydro
- **Implications for Asset Values**
  - Nuclear: value highly depends on the rate-based vs. mass-based trading
  - Coal: loses substantial value
  - Gas: a slight winner, esp. with rate-based trading that inefficiently excludes new

Presenter Information

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Dr. Samuel Newell, a Principal of The Brattle Group, is an economist and engineer with experience in electricity wholesale markets, the transmission system, and RTO/ISO rules. He supports clients throughout the U.S. in regulatory, litigation, and business strategy matters involving wholesale market design, generation asset valuation, transmission development, integrated resource planning, demand response programs, and contract disputes. He has provided testimony before the FERC, state regulatory commissions, and the American Arbitration Association.

Dr. Newell earned a Ph.D. in Technology Management and Policy from MIT, and a M.S. in Materials Science and Engineering from Stanford University. Prior to joining Brattle, Dr. Newell was Director of the Transmission Service at Cambridge Energy Research Associates.

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