State Planning and Emissions Trading under the CPP
Modeling and Insights

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Key Takeaways

No Clean Power Plan (CPP) pathway is right for every state
- Some states have a clear-cut choice and/or may be in compliance due to existing trends, but other states’ choices depend on factors like planned coal retirements, renewable deployment, and other state goals
- Natural gas price path is key factor determining outcomes

Markets for allowances and ERCs could reduce compliance costs, but potential variability in prices creates risks for compliance investments
- Cost of compliance is highly sensitive to a state’s planned investments and retirements absent the CPP
- CPP trading mixes cause more variation in coal generation outcomes; renewable and NGCC deployment impacted more by gas price uncertainty

Multi-market interactions (e.g., cross-border trade in power markets and multi-state CPP permit markets) impact CPP outcomes
US-REGEN 48-State Version: EPRI’s In-House Electric Sector Model

Capacity Expansion Economic Model, Long Horizon to 2050

State-Level Resolution for Policy and Regulation Analysis

Innovative Algorithm to Capture Wind, Solar, and Load Correlations in a Long-Horizon Model
**Focus on State-Level Decisions of CPP Compliance Pathways**

- **Rate**
  - **Subcategory Rate**
    - Steam units target of 1,305 lb/MWh, NGCC units target of 771 lb/MWh (2030)
  - **State Rate**
    - Steam and NGCC units target equal to the state rate

- **Path**
  - **Cap on Existing & New Units**
    - Existing/New Steam and NGCC units emit less than the state mass target + the new source complement target
  - **Cap on Existing Units Only**
    - Existing Steam and NGCC units emit less than the state mass target

* US-REGEN modeling of existing mass target is based on the **proposed** Federal Plan
What if States Were to Comply with the Clean Power Plan as “Islands?”

In other words, each state complies relying solely on resources within its own boundary
Natural Gas Price Uncertainty Represented by EIA’s Annual Energy Outlook Paths

Note: AEO data extends through 2040. Prices held constant through 2050.

High Price Path
(based on AEO 2015 Ref)

Low Price Path
(based on AEO 2016 Ref)

Note: AEO data extends through 2040. Prices held constant through 2050.
2030 Allowance and ERC Prices with “Island” Compliance

*Low Natural Gas Prices*

State rate/mass path based on minimum costs of island compliance (based on present value through 2050)

For *rate* states (blue), prices for emissions rate credits (ERCs) are expressed in $/MWh

For *mass* states (brown), prices are for *allowances* in $/short ton

Rate Subcategory

Mass Existing
2030 Allowance and ERC Prices with “Island” Compliance

*High Natural Gas Prices*

For **rate** states (blue), prices for emissions rate credits (ERCs) are expressed in $/MWh.

For **mass** states (brown), prices are for allowances in $/short ton.
Observations

- Zero prices imply states are in compliance in 2030 (though extra effort potentially required in other periods)
- Low prices driven by ease of compliance, which are driven by:
  - Low natural gas prices
  - Low incremental cost of wind (especially in high-wind states)
  - Energy efficiency credits from existing programs
  - Announced/expected post-2012 coal retirements
- States do not necessarily know which path is best right now
CPP trading mixes cause more variation in coal generation outcomes; renewable and NGCC deployment impacted more by gas price uncertainty.
Observations

- Simple economics of rate vs. mass pathways
  - Rate compliance achieved with investment in renewables (largely wind), energy efficiency, and coal-to-NGCC re-dispatch
  - Mass compliance achieved with investment in more NGCC generation

- **State pathway selections** and **allowance/ERC trading** impact CPP compliance costs and generation mix
  - CPP trading mixes cause more variation in coal generation outcomes
  - Renewable and NGCC deployment impacted more by **gas price uncertainty** (i.e., substitutes)
Example Analysis for State X

How do Clean Power Plan pathway choices impact power sector outcomes?
Reference Case without the CPP: State X Generation

Reference Generation (State X)

- EE + Price Response
- Ex Wind
- Hydro
- New NGCC
- Ex NGCC
- Ex Coal
- Other
- Ex Nuclear
- Scenario Load

TWh

2015 2020 2025 2030 2035 2040 2045 2050
CPP Compliance as an Island Requires Overhaul of the Generation Mix for Either Rate or Mass Pathways

<table>
<thead>
<tr>
<th>Reference</th>
<th>Rate (Island)</th>
<th>Mass (Island)</th>
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<tbody>
<tr>
<td>More Use of Coal</td>
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- **Reference**: More Use of Coal
- **Rate (Island)**: New Wind
- **Mass (Island)**: New NGCC
Island Compliance Depends on New Investment in Wind (for Rate Path) or New NGCC (for Mass Path)

Cumulative Capacity Additions through 2030 (State X)
Compliance with Trading

- Opportunity to reduce cost
- Trade-off is reliance on a market
  - Slow to develop?
  - Liquidity?
  - Exposure to additional external forces?
  - Lower volatility?
- Different mixes of rate/mass compliance from other states will impact market prices and the value of trading for State X
With Low Investment (e.g., Mix 5) Comes High ERC/Allowance Import Dependence

Cumulative Capacity Additions through 2030 (State X)

State X Pathway
Rest-of-Country Mix

Island
Mix 1
Mix 2
Mix 5

GW

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Strategic Insights

- Key decisions for states are rate vs. mass selection, but also the degree of market participation in inter-state allowance/ERC trade
- Some states appear to have lower costs with rate, some for mass, but no single lowest-cost choice
- The future matters
  - Big uncertainties and big influence: Natural gas prices, renewable costs
  - Pre-CPP planned retirement/investment decisions
  - Market scope and depth: Supply/demand for ERCs and allowances depend on individual state choices
  - Other state and federal policies, both pre- and post-2030
Together...Shaping the Future of Electricity

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Definitions of State Mixes

- Assume all mass states trade together (tons CO$_2$); all rate states trade together (ERCs)
- California and RGGI states do not trade outside of their borders
Reference Case Assumptions

- Reference load growth and fuel prices per AEO 2016
  - Includes existing energy efficiency (EE) programs
  - Fuel price paths per AEO 2016 Reference case → Gas prices $4–5/MMBtu
- No forced retirements for existing coal units; retirement for economic reasons possible for any unit
  - Follows AEO assumptions
  - 60–80 year lifetimes for nuclear units
- Limitations on new transmission and nuclear builds
- Technology costs per EPRI Generation Options report
  - Solar and wind costs updated more regularly
- Includes state RPS, RGGI, California AB 32
  - Fleet database as of December 2015, plus announced retirements
  - No additional environmental regulatory costs are included
  - Include CAA § 111(b) CO₂ performance standards for fossil units
  - December 2015 updates of PTC and ITC
With Low Investment (e.g., Mix 5) Comes High ERC/Allowance Import Dependence