Clean Power Plan
Choices and Implications

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PRESENTED BY
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Final Clean Power Plan

Who: Existing Generation Units (EGUs) considered affected units under the 111(d) applicability criteria are grouped into two categories:

- Steam Units: Coal and oil/gas-fired steam turbine units
- NGCCs: Natural gas-fired combined cycle units
- Not Included: Simple cycle combustion turbine units

When:

- January 2016 (estimate): End of comment period on FIP and Clean Energy Incentive Program
- Sept 6, 2016: Initial submission of SIP (must request extension to 2018)
- Sept 6, 2018: Final submission of SIP
- 2022 – 2029: Annual EGU standards, with three interim compliance periods
- 2030 and beyond: Final EGU standard
State Rate Standards from 2012 Baseline to 2030 Final

Rate reductions are phased-in from 2012 Baseline to 2030 goals. The largest reductions are in MT, ND and WY, while some others such as ME, CT, ID, CA and MS are already in compliance with 2022 goals.
# Compliance Plan Types

<table>
<thead>
<tr>
<th>Plan Type</th>
<th>Emission Standards</th>
<th>State Measures (e.g., AB32, RGGI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enforceability</td>
<td>Federally-enforceable, EGU-specific requirements</td>
<td>Same, but also submit portfolio of non-federally enforceable emissions reduction measures, with a federally enforceable backstop</td>
</tr>
<tr>
<td>Emission Standard Type</td>
<td>Mass-Based</td>
<td>Rate-Based</td>
</tr>
<tr>
<td>Covered Generators</td>
<td>Existing EGUs (excluding CTs), with option to include New EGUs, but not other sectors</td>
<td>Only Existing EGUs (excluding CTs)</td>
</tr>
<tr>
<td>Tradable Compliance Instrument</td>
<td>Allowance, equivalent to 1 short ton CO₂</td>
<td>Emission Rate Credit (ERC), equivalent to 1 MWh of zero CO₂ Generation</td>
</tr>
<tr>
<td>Compliance Formula</td>
<td>$CO_2$ Allowances = $CO_2$ Emitted</td>
<td>Submit $ERCs = \frac{\text{EGU Emission Rate}}{\text{Reference Emission Rate}} - 1$</td>
</tr>
</tbody>
</table>
Based on EPA’s 2012 data, most of the existing NGCC capacity (131 GW) have emission rates between the 2022 and 2030 rates, i.e., creating ERCs in 2022 but needing ERCs in 2030. Most of the remaining capacity will need ERCs for compliance in all years.

Source: EPA, “tsd-cpp-emission-performance-rate-goal-computation-appendix-1-5.xlsx”. Note that some of the NGCCs were reported by EPA as having emission rates substantially below 800 lbs/MWh, likely an error.
Based on EPA’s 2012 data, most Fossil Steam capacity (321 GW) will need ERCs for compliance in all years, though 61 GW (mostly oil/gas steam) will be in compliance in 2022 and 15 GW will be in compliance in 2030. Therefore, 76 GW of Fossil Steam would likely create ERCs in 2022.
**Coal Plant Retirements**

As of September 2015, 51 GW of coal fleet has either retired or announced to retire by 2020

- 30 GW already retired since 2012 (1.5 GW in MISO)
- 10 GW announced to retire by the end of 2016 (3.5 GW in MISO)
- Another 11 GW announced to retire after 2016 (1 GW in MISO)

EPA’s IPM analysis:

- about 100 GW coal retirements by 2020 with no CPP (most of it by 2016, and 15 GW in MISO)
- With CPP, an additional 15 GW by 2020 and 24-33 GW by 2030.

**U.S. Actual and Announced Coal Plant Retirements**

<table>
<thead>
<tr>
<th>Year of Retirement</th>
<th>Number of Units</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Actual</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>88</td>
<td>9,085</td>
</tr>
<tr>
<td>2013</td>
<td>46</td>
<td>5,696</td>
</tr>
<tr>
<td>2014</td>
<td>39</td>
<td>3,806</td>
</tr>
<tr>
<td>2015</td>
<td>74</td>
<td>11,382</td>
</tr>
<tr>
<td><strong>2012-2014</strong></td>
<td><strong>247</strong></td>
<td><strong>29,970</strong></td>
</tr>
<tr>
<td><strong>Announced</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>17</td>
<td>2,484</td>
</tr>
<tr>
<td>2016</td>
<td>52</td>
<td>7,176</td>
</tr>
<tr>
<td><strong>2015-2016</strong></td>
<td><strong>69</strong></td>
<td><strong>9,660</strong></td>
</tr>
<tr>
<td>2017</td>
<td>29</td>
<td>5,592</td>
</tr>
<tr>
<td>2018</td>
<td>16</td>
<td>3,165</td>
</tr>
<tr>
<td>2019</td>
<td>15</td>
<td>2,307</td>
</tr>
<tr>
<td>2020</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total 2012-2020</strong></td>
<td><strong>302</strong></td>
<td><strong>50,694</strong></td>
</tr>
</tbody>
</table>
Potential Reliability Issues

Many concerns combine potentially high costs with reliability threats – these can be related but are not synonymous.

Final CPP rule by itself is less likely to threaten reliability compared to the proposed rule:
- Compliance requirements are phased in,
- Compliance starts in six years, and
- Compliance options include buying ERCs and emission allowances from market (without having to cut multi-state deals).

However, retirements could be accelerated and compliance cost could go up if a state chooses to adopt a plan that blocks interstate trading of credits/allowances (e.g., state-average rate plan or customized rate standards for each type of unit under a state-measure plan).

Also, market price of ERCs and emission allowances could be volatile depending on the depth/participation in the market.
## Will the Clean Power Plan challenge reliability?

<table>
<thead>
<tr>
<th>Concern</th>
<th>Description</th>
<th>Challenging Factors</th>
<th>Mitigating Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource Adequacy</td>
<td>Additional coal retirements could cause shortages absent new investment</td>
<td>- Replacement capacity may be costly</td>
<td>- Plants can stay online for capacity purposes (at additional cost)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- More capacity needed if EE offers little peak reduction</td>
<td>- Purchasing in-state and out-of-state ERCs/allowances is possible</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Plants can stay online for capacity purposes (at additional cost)</td>
<td>- EE, DR and DG can be installed (cost/feasibility vary by region)</td>
</tr>
<tr>
<td>Transmission Security</td>
<td>Some coal plants are relied upon for voltage support or other aspects of transmission security</td>
<td>- Solutions come at a cost</td>
<td>- Compliance flexibility may use other reductions or ERC/allowance trading to keep critical plants online</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Tx upgrades or new resources can replace critical plants</td>
<td>- Can use coal/oil units on small number of critical days</td>
</tr>
<tr>
<td>Gas / Electric Coordination</td>
<td>Increased reliance on gas generation may lead to pipeline constraints during cold snaps</td>
<td>- Limited gas-electric planning and coordination today</td>
<td>- LNG and gas storage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Can use coal/oil units on small number of critical days</td>
<td>- Purchasing in-state and out-of-state ERCs/allowances is possible</td>
</tr>
<tr>
<td>Integrating Renewable Energy</td>
<td>High levels of variable energy resources may pose operational challenges and provide limited firm capacity</td>
<td>- Costlier if much higher penetrations occur than expected</td>
<td>- Flexible generation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Will need new Tx</td>
<td>- Improved forecasting, scheduling, and A/S products</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Emerging energy storage</td>
</tr>
</tbody>
</table>
Will Power Prices Increase due to CPP?

Depends on states' choice of compliance plans, participation of states in ERC/allowance trading, relative fuel prices, and deployment of EE/RE solutions

- Rate-based tend to result in lower price increase (and in some cases decrease) versus mass-based
- High participation in trading would lower ERC/allowance prices
- Continued low gas prices would reduce cost of coal-to-gas dispatch switching, though would also delay economic entry of RE/EE
- New EE/RE would decrease energy prices, but may increase capacity prices and retail rates
EPA’s Estimates for Impact on Wholesale Energy Prices

EPA estimated energy prices generally higher under mass-based compliance relative to rate-based by 2030, but impacts differ by state and by year

- **Mass-based:** +$5/MWh by 2030 in TX/IA; +$2-3/MWh in CA/PA, -$2/MWh in MA
- **Rate-based:** price decreases in CA and MA by 2030; +$1-3/MWh in TX, IA and PA

**Energy Price Impact of CPP under EPA’s IPM Analysis***

*The Brattle Group has not confirmed that the EPA IPM results are a valid reflection of the economic impacts of the Clean Power Plan Final Rule. These values are presented for illustrative purposes only.

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**Note:** Energy prices are the energy-weighted prices from the following IPM regions: CA - WECC_Southern California Edison; IA - MISO_Iowa-MidAmerican; PA – PJM_Western MAAC; MA– ISONE_MA, VT, NH, RI (Rest of ISO New England).
## CPP Impacts on Dispatch Costs – Distortions?

<table>
<thead>
<tr>
<th></th>
<th>Rate-Based (Category-Specific)</th>
<th>Rate-Based (State-Specific)</th>
<th>Mass-Based</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Existing Coal</strong></td>
<td>Buy ERCs or GS-ERCs (only two coal plants have lower emission rates than the 2022 standard of 1,741 lbs/MMBtu)</td>
<td>Buy ERCs</td>
<td>Buy allowances for all emissions</td>
</tr>
<tr>
<td><strong>Existing Gas CC</strong></td>
<td>Create ERCs in early years, create GS-ERCs in all years (NGCC standard decreases from 898 to 770, NGCC at 7000 heat rate emits at 819 lbs/MWh)</td>
<td>Buy/create ERCs depending on the plant emission rate</td>
<td>Buy allowances for all emissions</td>
</tr>
<tr>
<td><strong>Existing Gas CT</strong></td>
<td>No ERC creation or purchase</td>
<td>No ERC creation or purchase</td>
<td>Not covered, no allowance costs (unless state measure includes CTs)</td>
</tr>
<tr>
<td><strong>New Gas CC</strong></td>
<td>No ERC creation or purchase</td>
<td>No ERC creation or purchase</td>
<td>Buy allowances only if state cap includes new NGCCs</td>
</tr>
</tbody>
</table>
Some Takeaways for CPP Compliance

Ability to choose is a good thing, but only if you understand the cost of each option

- UNDERSTANDING THE RELATIVE COSTS OF EACH OPTION IS KEY

Cost of many of the options under CPP compliance depends in part on what options the other states choose (i.e., trading partners)

- NEED TO DEVELOP EXPECTATIONS OF WHAT OTHER STATES WOULD LIKELY DO
- THEN ENGAGE WITH THEM TO ASSESS BENEFITS FROM COORDINATION
Dr. Celebi provides expertise in electricity markets and analysis of environmental and climate policy. He has consulted primarily in the areas of electricity spot pricing and market design, and has experience in developing and analyzing climate policies, resource planning, power plant valuation, cost/benefit analyses for joining RTOs, LMP modeling, and merger analysis.

Dr. Celebi received his Ph.D. degree in Economics at Boston College, M.A. degree in Economics at Bilkent University, Turkey, and B.Sc. Degree in Industrial Engineering at METU, Turkey.

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