

Coal Plant Retirements and Power Markets

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THE **Brattle** GROUP

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Outline

Drivers of coal plant retirements

Projected retirements

Impacts on wholesale markets

Coal plants are retiring

As of mid-March 2015, 52 GW of coal fleet has either retired or announced to retire

- *19 GW have retired since 2012*
- *22 GW announced to retire by the end of 2016*
- *Another 11 GW announced to retire after 2016*

Actual and Announced Coal Plant Retirements

Year of Retirement	Number of Units	Capacity (MW)
Actual		
2012	88	9,085
2013	46	5,696
2014	40	3,980
2012-2014	174	18,761
Announced		
2015	97	15,380
2016	48	6,133
2015-2016	145	21,513
2017	33	6,108
2018	10	2,880
2019	13	1,931
2020	4	585
Total 2012-2020	379	51,779

Sources: Ventyx, The Velocity Suite and Brattle analysis.

Coal plants are retiring because of environmental requirements and natural gas prices

The *combination* of low gas prices (resulting in weak wholesale power prices) and the costs of environmental compliance (including investment and operating costs) has and will continue to result in retirements.

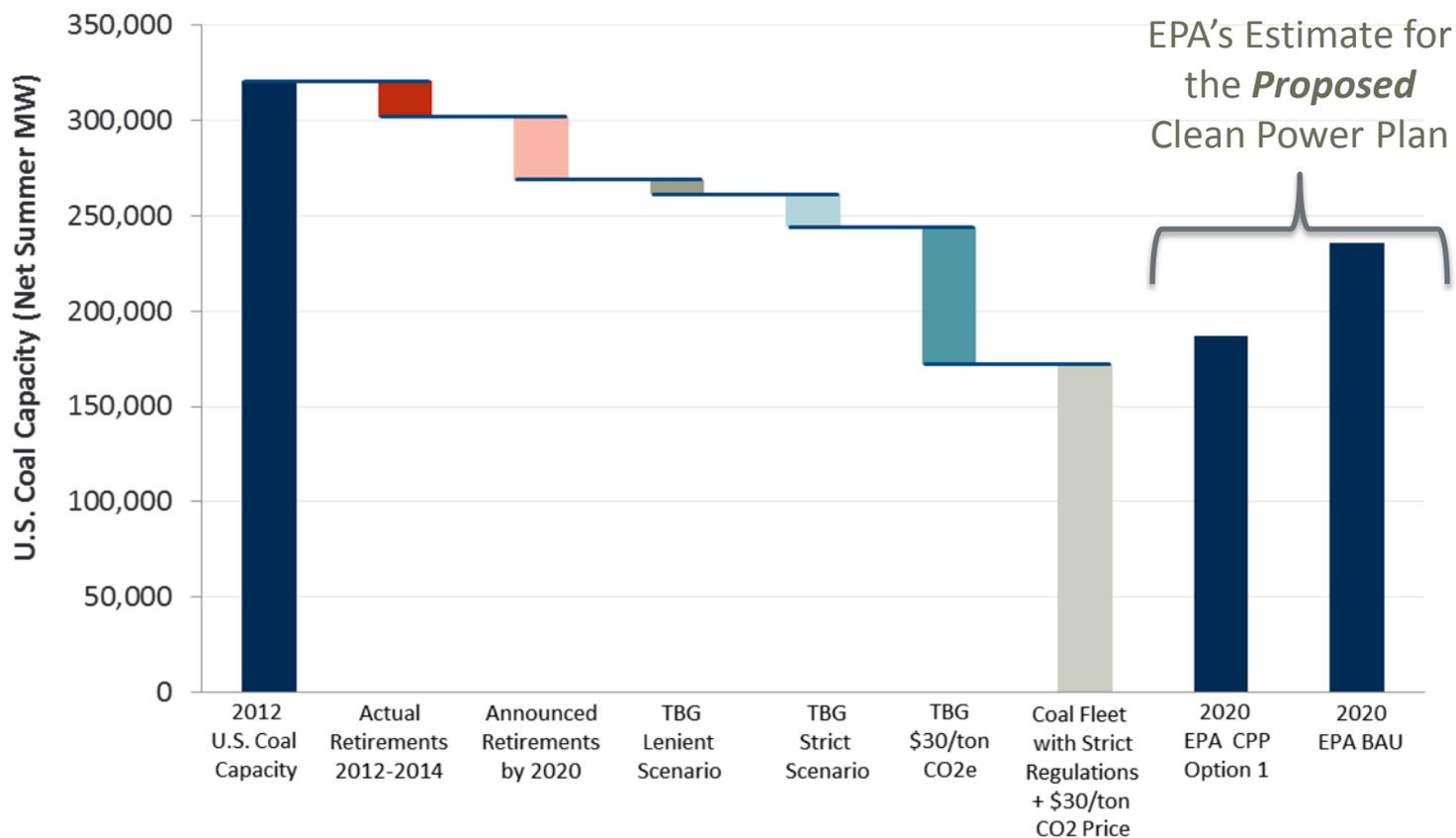
The Clean Power Plan is the latest EPA program to affect coal units. However, the Clean Power Plan benefits natural gas combined cycle units.

There are many EPA regulations affecting coal plants

Regulation	Status	Pollutant Targeted	Compliance Options	Expected Date of Compliance	EPA Source
Mercury and Air Toxics Standards (MATS)	Final – but then remanded in June 2015 by the Supreme Court	HAPs (mercury, acid gases, PM)	Activated Carbon injection (ACI), Baghouse, Flue Gas Desulphurization (FGD)/Dry Sorbent Injection (DSI)	Unknown	http://www.epa.gov/mats/
Cross-State Air Pollution Rule (CSAPR)	Reinstated by Court in April 2014	NO _x , SO ₂	Selective Catalytic Reduction (SCR)/Selective Non-Catalytic Reduction (SNR), FGD/DSI, fuel switch, allowance purchases	2015 and 2017 (with likely revisions to emissions caps later to comply with stricter ozone standards)	http://www.epa.gov/airtransport/CSAPR/
Cooling Water Intakes 316(b)	Final	Cooling water intake structures	<u>Impingement</u> : Mesh screens; <u>Entrainment</u> : Case-by-case, may include cooling towers	Permitting authorities to establish compliance schedule	http://water.epa.gov/lawsregs/lawsguidance/cwa/316b/
Combustion by-products (Ash)	Final	Ash, control equipment waste	Bottom ash dewatering, dry fly ash silos, etc.	2018	http://www2.epa.gov/coalash/coal-ash-rule
Regional Haze	Final	NO _x , SO ₂ , PM	SCR/SNCR, FGD/DSI, Baghouse/Electrostatic Precipitator (ESP), combustion controls	Typically 5 years after ruling	http://www.epa.gov/airquality/visibility/actions.html

Estimates of Coal Plant Retirements

In addition to actual and announced coal retirements of 52 GW, an additional 25 GW is at risk with no carbon policy, and 50-90 GW with carbon policy.



Sources: Ventyx, The Velocity Suite. The Brattle Group, "Potential Coal Plant Retirements: 2012 Update." EPA April 2014 Draft IPM Results (Base Case and Option 1 – State).

The Final Clean Power Plan will put further pressure on coal units

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:

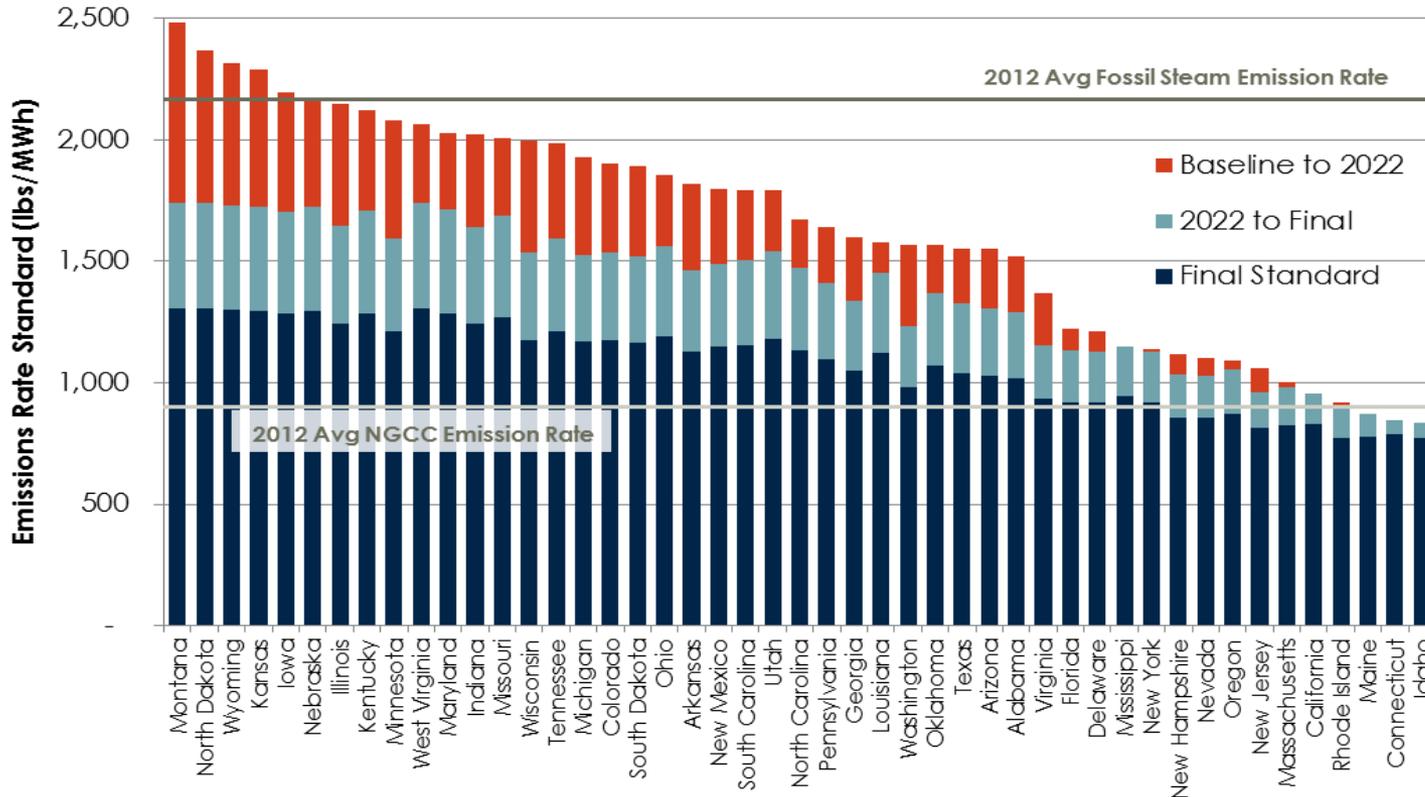
- *Nov 2015:* End of comment period on FIP and Clean Energy Incentive Program
- *Sept 6, 2016:* Initial submission of SIP (must request extension to 2018)
- *Sept 6, 2018:* Final submission of SIP
- *2022 – 2029:* Annual EGU standards, with three interim compliance periods
- *2030 and beyond:* Final EGU standard

State CPP compliance choices are complicated

	Rate Based	Mass Based
Subcategory	ERC trading between states with subcategory rate plans "Gas Shift" ERC trading between states with subcategory rate plans	N/A
Performance Rates	It appears that ERC trading is not allowed between states with other types of rate plans New EE, RE, and nuclear are compliance options	
Statewide Limit for Existing EGUs	It appears that interstate ERC trading requires states to form compliance group with uniform rate "Gas Shift" ERCs are not Fossil Steam compliance option New EE, RE, and nuclear are compliance options	Interstate allowance trading allowed between states with mass caps (including new and existing) Must demonstrate there is no emission "leakage" to new units
Statewide Limit for New & Existing EGUs	N/A	Interstate allowance trading allowed between states with mass caps (including existing only)
State-Specific Measures	Interstate ERC trading is not allowed States have option to set rates that vary by EGU New EE, RE, and nuclear are compliance options	Interstate allowance trading allowed between other states with mass caps Must demonstrate the plan is equivalent to EPA targets

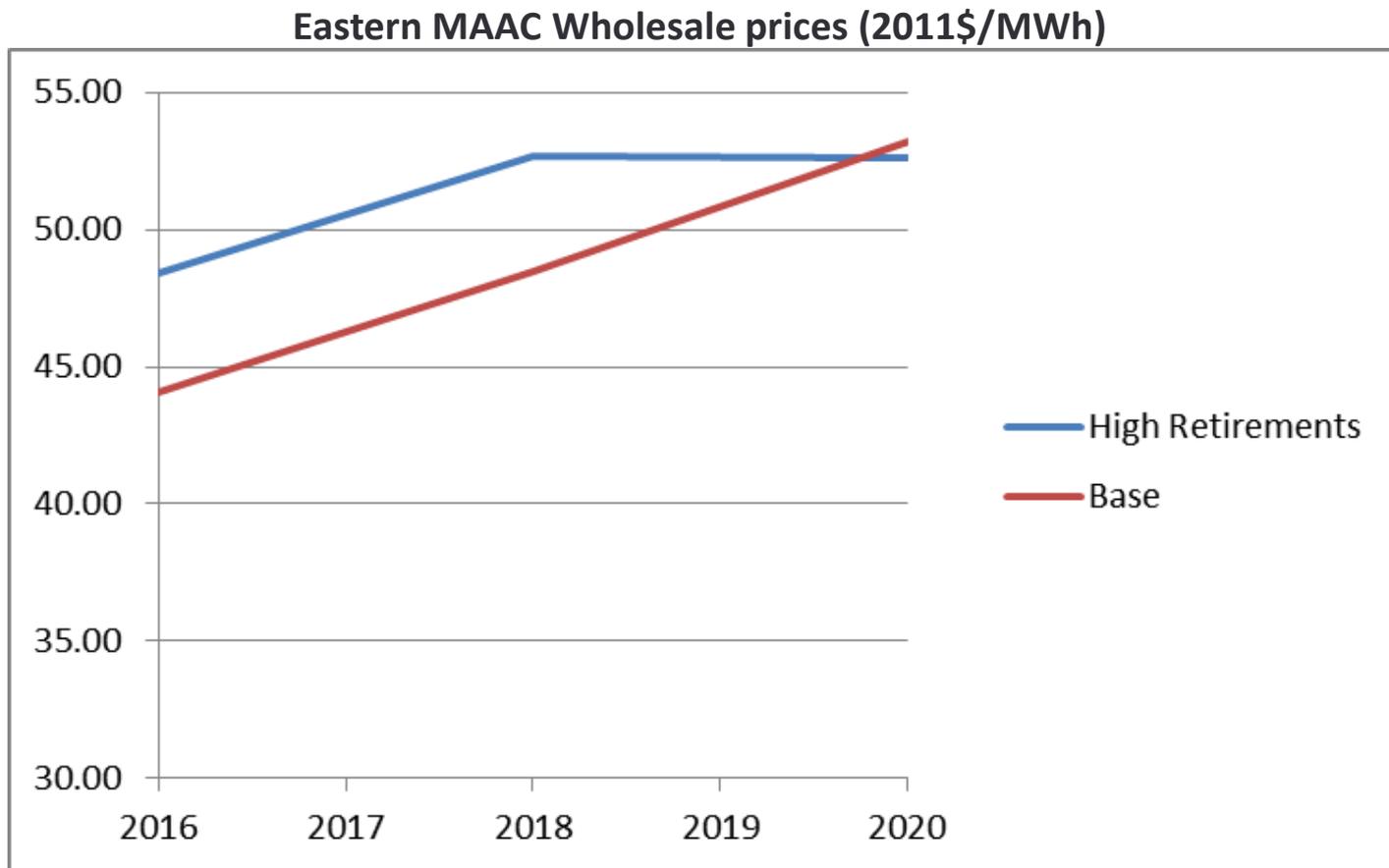
State EGU emission rates fall sharply under the CPP

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



Coal retirements result in higher wholesale prices

EPA analyzed a “side case” for its analysis of the *Proposed* CPP that allows us to compare wholesale prices for two cases with different levels of capacity. In the high retirements case, 13 GW more capacity retires nationwide than in the Base Case



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