The Clean Power Plan:
Retirements and Reliability

PRESENTED TO

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THE Brattle GROUP

Introduction to the Clean Power Plan

Developed under section 111(d) of the Clean Air Act, addressing existing electric generation unit (EGU) sources of CO_2

- Objective: reduce sector CO_2 emissions 30% below 2005 levels (25% below expected BAU 2030 levels)
- Construction: state-level emission rate standards based on Best System of Emission Reduction (BSER)
  - Primary Option – 2030 "final" standard, with 2020-2029 average "interim" standard
  - States must either develop a State Implementation Plan (SIP) or default to EPA's Federal Implementation Plan (FIP - forthcoming)
- Implementation: states have flexibility to achieve reductions
  - Any combination of measures that achieve standard, regardless of how BSER is calculated
  - Rate-based vs. mass-based standard
  - State-level vs. multi-state coordination

Best System of Emission Reductions (BSER)

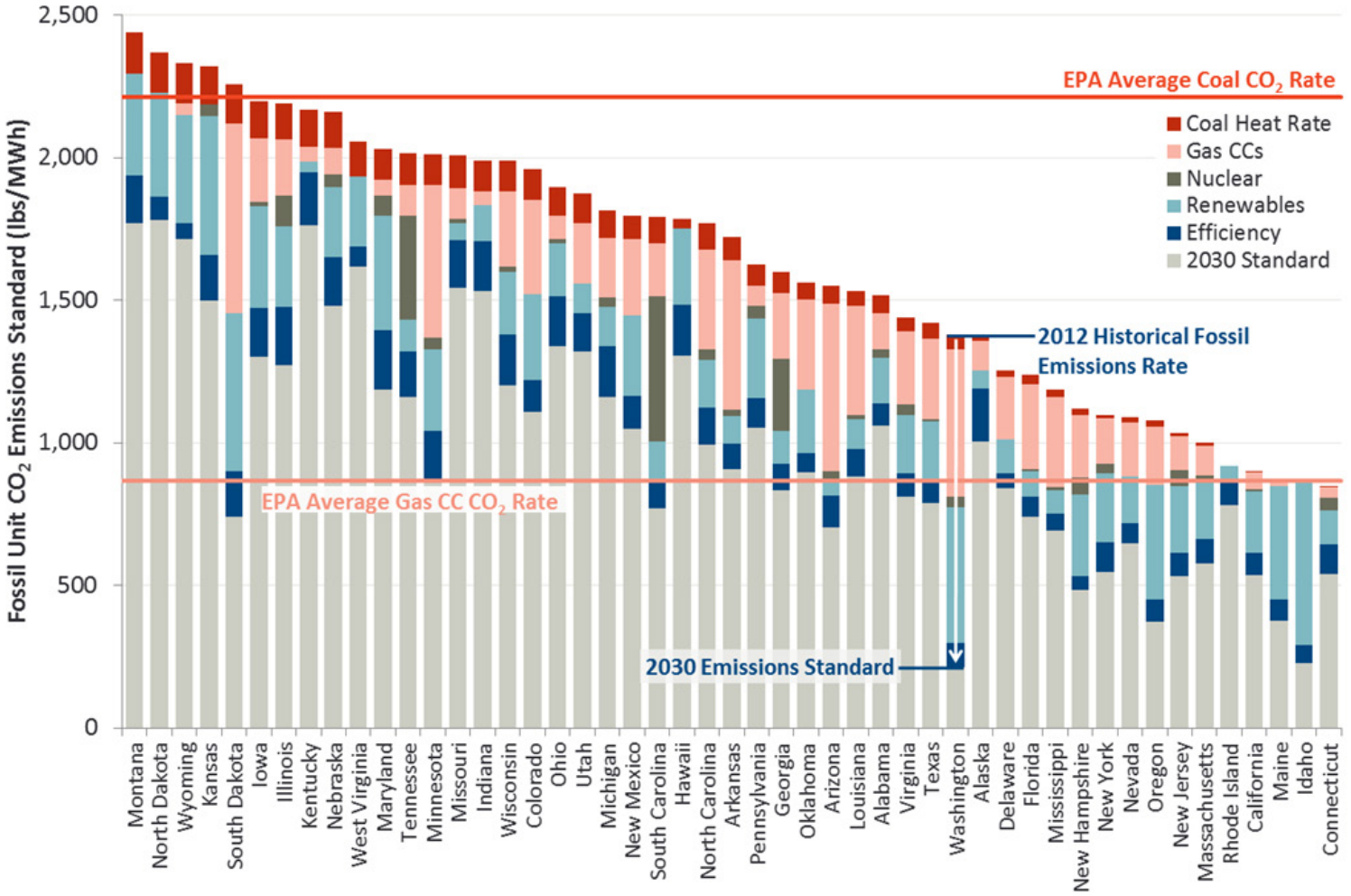
BSER Building Block	EPA Basis for BSER Determination	EPA Estimated Average Cost	% of BSER CO_2 Reductions
1. Increase efficiency of fossil fuel power plants	EPA reviewed the opportunity for coal-fired plants to improve their heat rates through best practices and equipment upgrades, identified a possible 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%

Sources and Notes:

EPA, Carbon Pollution Emissions Guidelines for Existing Stationary Sources: Electric Generating Units, 40 CFR Part 60, EPA-HQ-OAR-2013-0602, RIN 2060-AR33, June 2, 2014 (“Proposed Rule”). Details of Block 1 on pp. 155–171, Block 2 on pp. 171–194, Block 3 on pp. 195–218, and Block 4 on pp. 219–236.

EPA estimated average cost is calculated per metric ton of CO_2 emissions reduction.

2030 Fossil EGU CO_2 Emissions Standards by State

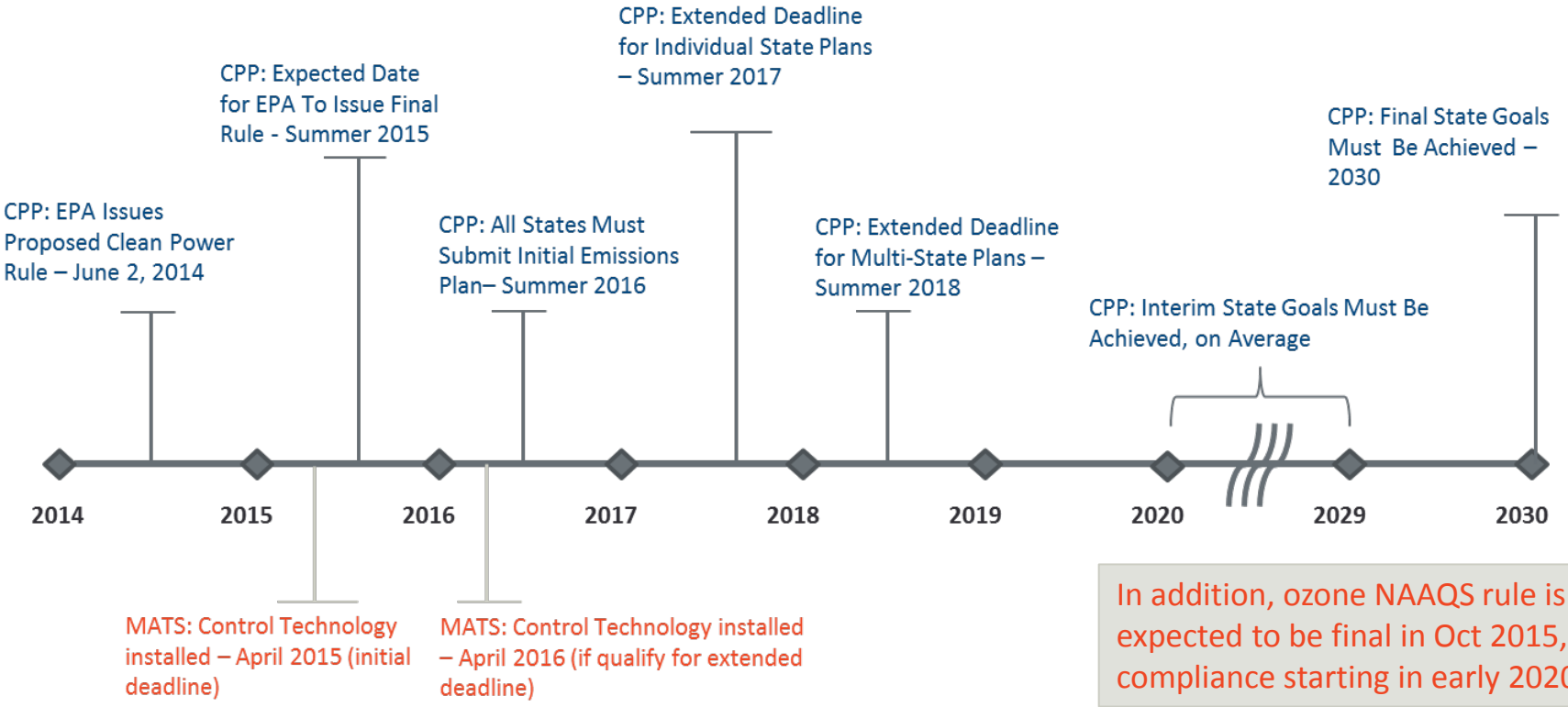


Sources and Notes:

Reflects Option 1 final rate for years 2030 and on, from EPA Technical Support Document: Goal Computation, Appendix 1.

CPP Implementation Timeline is Aggressive and Coincides with MATS Compliance

Impacts on coal plants are different in MATS vs. CPP: MATS requires each unit to either retrofit/refuel or retire, while CPP has no such unit-specific federal mandate (but affects the economics of operating the coal unit).



In addition, ozone NAAQS rule is expected to be final in Oct 2015, with compliance starting in early 2020s

Source: EPA Proposed MATS Timeline taken online from the EPA website: http://www.epa.gov/mats/actions.html and EPA proposed Clean Power Plan Timeline taken online from the EPA website: http://www2.epa.gov/sites/production/files/2015-01/documents/20150107fs-key-dates.pdf.

Other EPA Regulations Affecting Coal

Compliance with other EPA regulations adds to the cost pressure for coal units in retire/retrofit decisions.

Regulation	Status	Pollutant Targeted	Compliance Options	Expected Date of Compliance	EPA Source
Mercury and Air Toxics Standards (MATS)	Final	HAPs (mercury, acid gases, PM)	Activated Carbon injection (ACI), Baghouse, Flue Gas Desulphurization (FGD)/Dry Sorbent Injection (DSI)	2015/2016	http://www.epa.gov/mats/
Cross-State Air Pollution Rule (CSAPR)	Reinstated by Court on Apr 29th, 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	Impingement: Mesh screens; Entrainment: Case-by-case, may include cooling towers	the permitting authority to establish a 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

Announced Coal Plant Retirements

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

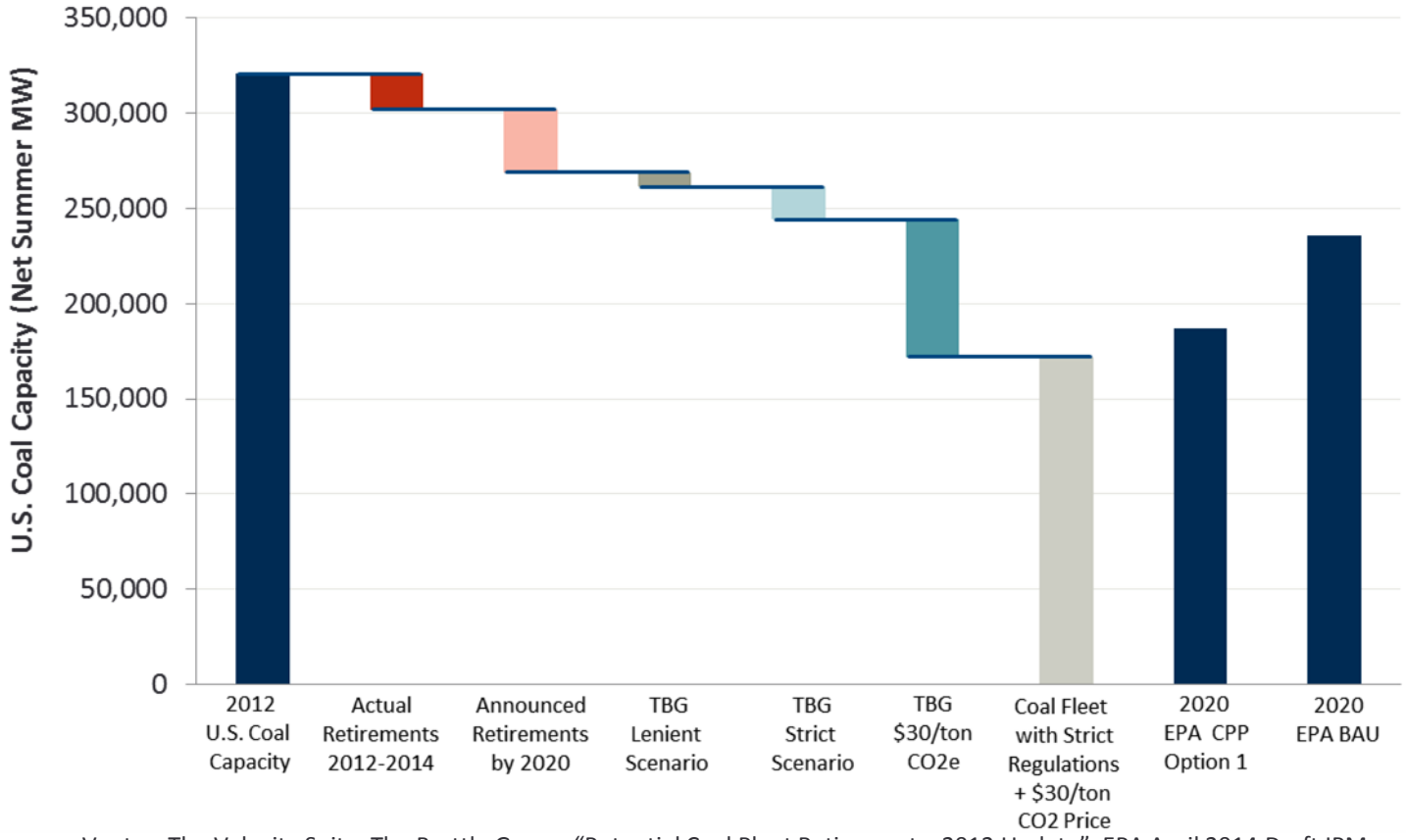
- 19 GW already retired since 2012
- 22 GW announced to retire by the end of 2016
- Another 11 GW announced to retire after 2016

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**

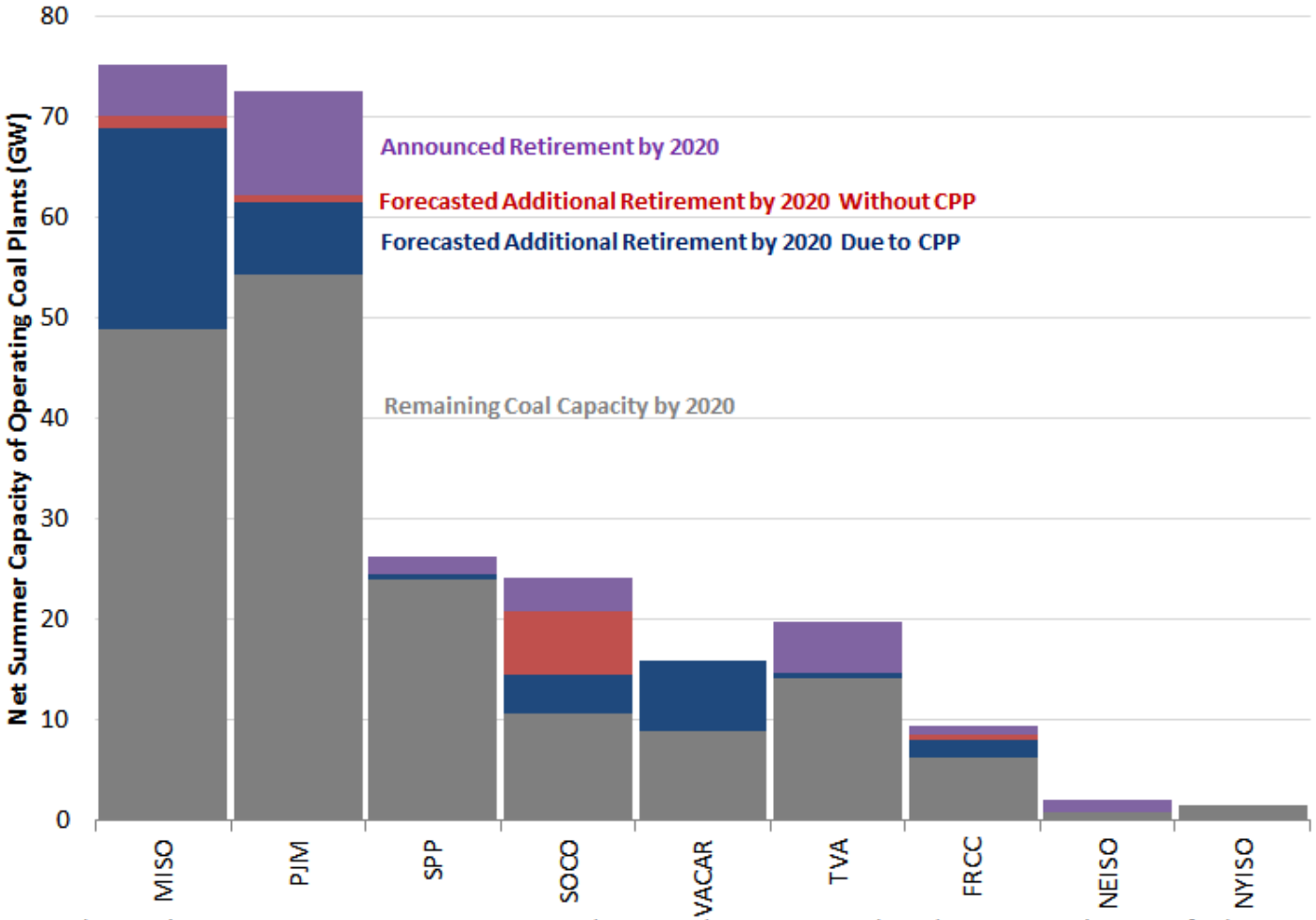
Coal Plant Retirements (US Totals)

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).

Recent Outlook in Eastern Interconnect



Source: The Brattle Group; Current operating capacity and annouced retirement are based on Energy Velocity as of Feb 19, 2015

Relative to the current Eastern Interconnect coal fleet as of Feb 2015:

- 35 GW is likely to retire by 2020 w/o CPP, and
- Additional 40 GW likely to retire w/CPP (mass-based regional)

Most retirements in MISO, PJM and SOCO areas.

Potential Reliability Issues

Two conditions give rise to reliability concerns stemming from a significant policy change:

- A shift in market conditions or outcomes of significant ***magnitude***
- A change that occurs more ***rapidly*** than ordinary market or institutional adjustment processes can accommodate

For example, commenters have raised several concerns:

- Application of BSER formulas creates some arbitrary burdens
- Compliance choices may be practically constrained to reliability-threatening actions or outcomes
- Deadlines (particularly interim standards) are too aggressive relative to SIP development timetables (SIPs finalized by 2018 for multi-state plans; implementation period begins 2020)

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

Will the Clean Power Plan challenge reliability?

Concern	Description	Challenging Factors	Mitigating Factors
Resource Adequacy	Additional coal retirements could cause shortages absent new investment	- Replacement capacity may be costly - More capacity needed if EE offers little peak reduction	- Plants can stay online for capacity purposes (at additional cost) - Additional EE, DR and DG can be procured
Transmission Security	Some coal plants are relied upon for voltage support or other aspects of transmission security	- Solutions come at a cost - Timing challenging if EPA maintains stringent targets for 2020	- Compliance flexibility may use other reductions to keep critical plants online - Tx upgrades or new resources can replace critical plants
Gas / Electric Coordination	Increased reliance on gas generation may lead to pipeline constraints during cold snaps	- Limited gas-electric planning and coordination today	- Can use coal/oil units on small number of critical days - LNG and gas storage
Integrating Renewable Energy	High levels of variable energy resources may pose operational challenges and provide limited firm capacity	- Costlier if much higher penetrations occur than expected - Will need new Tx	- Flexible generation - Improved forecasting, scheduling, and A/S products - Emerging energy storage

Resource Adequacy & Reserve Margins

Combination of high coal retirements and limited EE/DR might squeeze reserve margins in 2020 timeframe for some states

Brattle study(1) for Salt River Project identified shortcomings and flaws in EPA's analysis of cost and reliability implications in Arizona:

- EE targets aggressive, not clear how DR fits into peak reductions
- IPM analyses assume that:
  - out-of-state-owned capacity in Arizona can meet load in Arizona,
  - Arizona can switch at little cost and over a short timeframe from being a major net exporter to being a major net importer of energy and capacity from as far as Pacific Northwest to meet its planning reserve margin requirements (instead of incurring additional costs to add new gas CCs/CTs by 2020).

(1): "Comments On EPA's Modeling Of the Impacts Of the Proposed Clean Power Plan In Arizona", by Ira Shavel, Metin Celebi, and Marc Chupka, November 21, 2014 (filed as an attachment to SRP's November 24, 2014 Comments in Response to EPA's Proposed Rule).

Presenter Information

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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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