

CO₂ Regulations and Coal

PRESENTED TO

Energy Bar Association - Ongoing Climate Imperative

PRESENTED BY

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November 10, 2016



THE **Brattle** GROUP

Agenda

CO₂ Regulations in U.S.

Market Developments

Coal Generation Trends

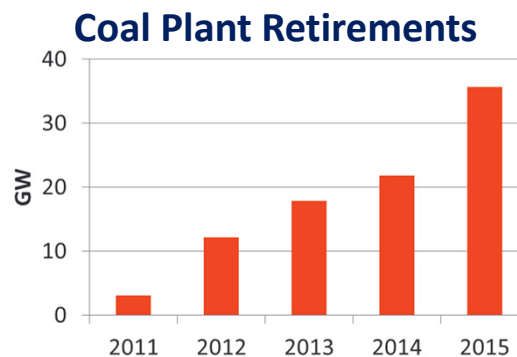
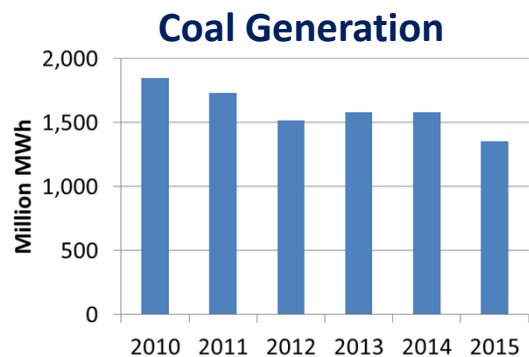
Coal Plant Retirements

Coal Industry Bankruptcies

What's Happening to Coal?

U.S. coal generation and the mining industry have been under distress over the last few years, as evidenced by reduction in output, plant closures, and bankruptcies.

- So far, the main drivers have been low natural gas prices, increasing penetration of renewable generation, lack of load growth and environmental regulations (mostly MATS).
- Going forward, further increase in renewable generation and additional environmental regulations (mainly CO₂ standards, but also Regional Haze and tightening emission standards for criteria pollutants such as NO_x and SO₂) will continue to challenge coal generation and mining industry, with possible upside from increasing gas prices.



Largest Coal Bankruptcies (Market Share in 2015)

Peabody (2016): 23%
Arch Coal (2016): 15%

US Carbon Overview

EPA's Clean Power Plan

- Finalized in August 2015
- Target: electric CO₂ emissions 32% below 2005 levels by 2030
- State targets:
 - Lower coal heat rates
 - Gas substitution for coal
 - More zero-emission generation
- Flexible approaches (i.e., trading) encouraged and enabled
- State plans due: 2016 – 2018
- Compliance: 2022 – 2030
- Mutually reinforcing with Paris Climate Agreement

- ➡ **Supreme Court Stay: 2/9/16**
- ➡ **Oral Argument at Court of Appeals September 27, 2016**
Possible decision by early 2017.

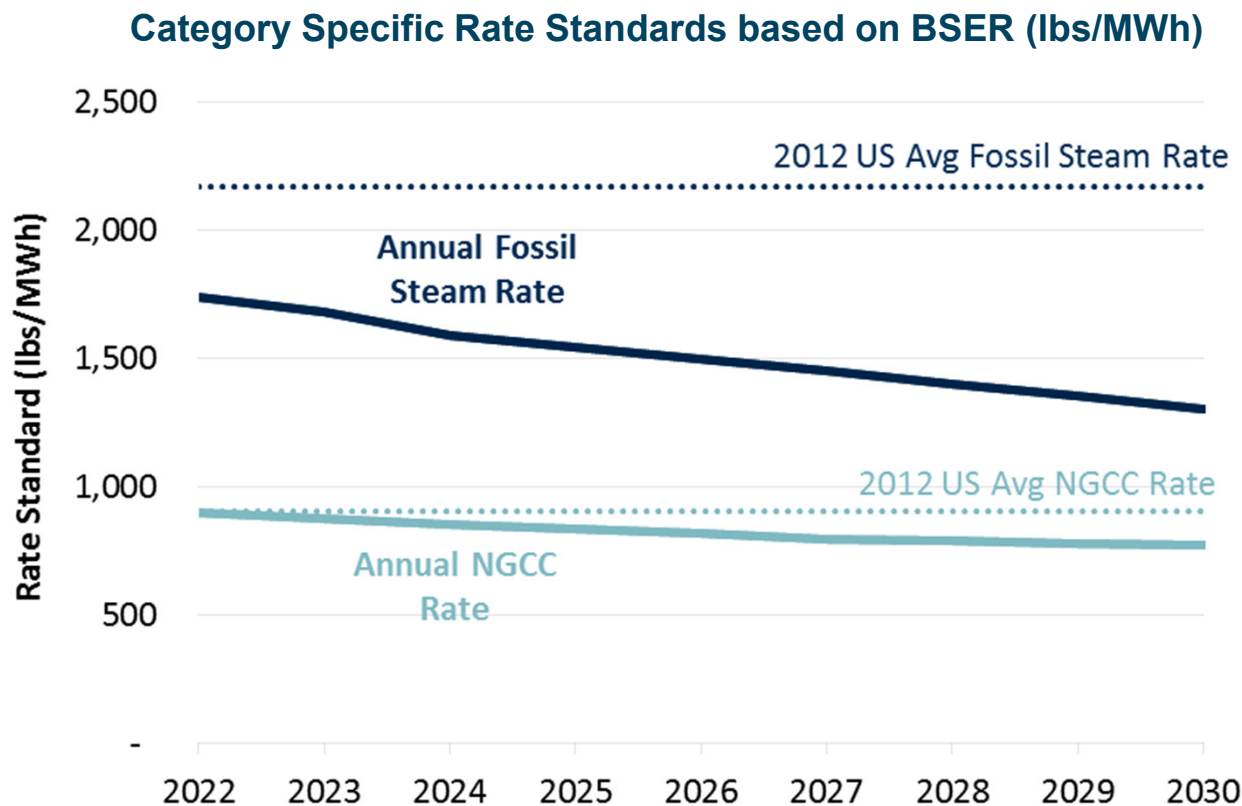
Regional CO₂ Programs

- **AB32 Cap and Trade Program (CA)**
 - In 4th year of operation
 - Auction prices at \$12-13/tonne
 - Small emissions reductions to date
 - Expected to become more stringent post 2020
 - Complementary policies: RPS, EE
- **Regional Greenhouse Gas Initiative (RGGI)**
 - In 7th year of operation
 - 6/16 auction clearing price of \$4.53/ton lower than 2015 high of \$7.50/ ton

- ➡ **Regional CO₂ markets form alternatives to CPP as well as potential implementation templates**

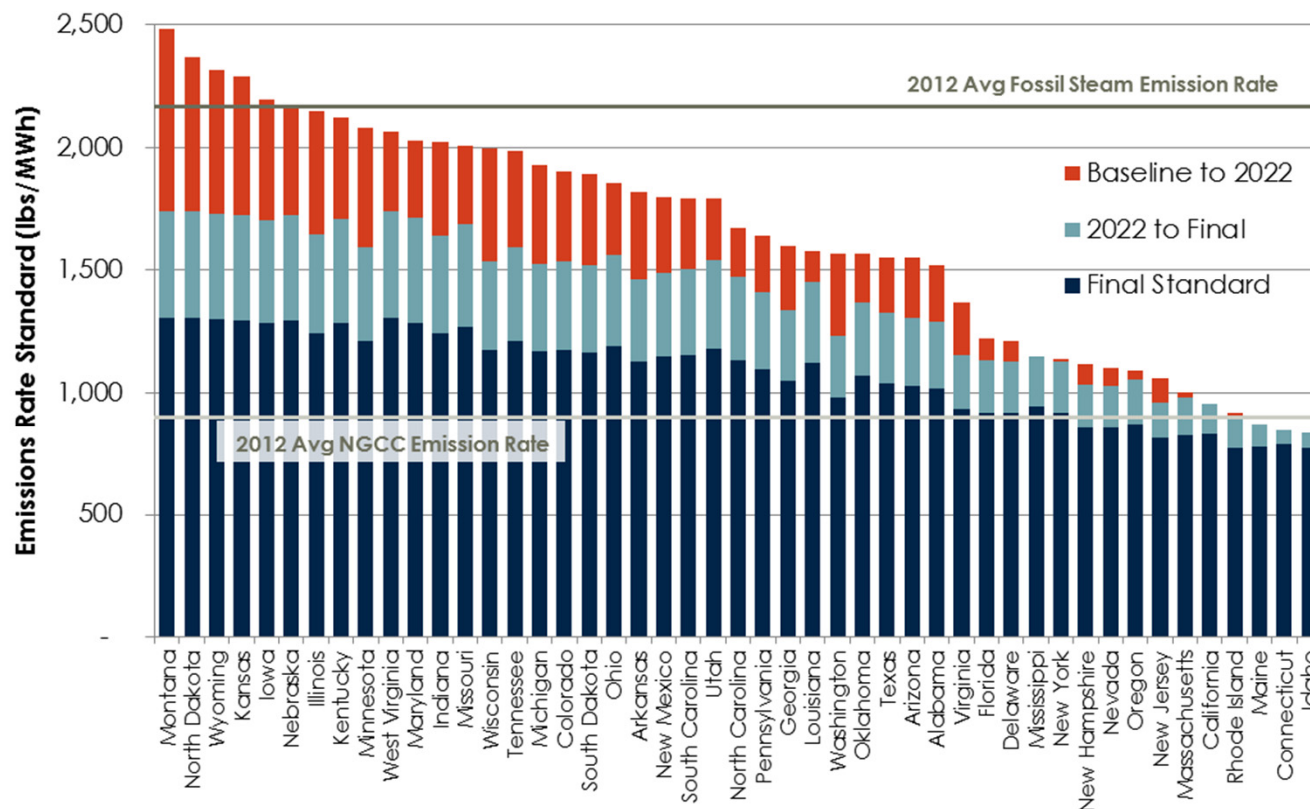
CPP National Rate Targets, by Year

- The Final (8/15) CPP goals have a larger effect on coal from the start
- Compliance assumes “beyond the plant fence” measures and credit trading



CPP State Rate Standards from 2012 Baseline to 2030 Final

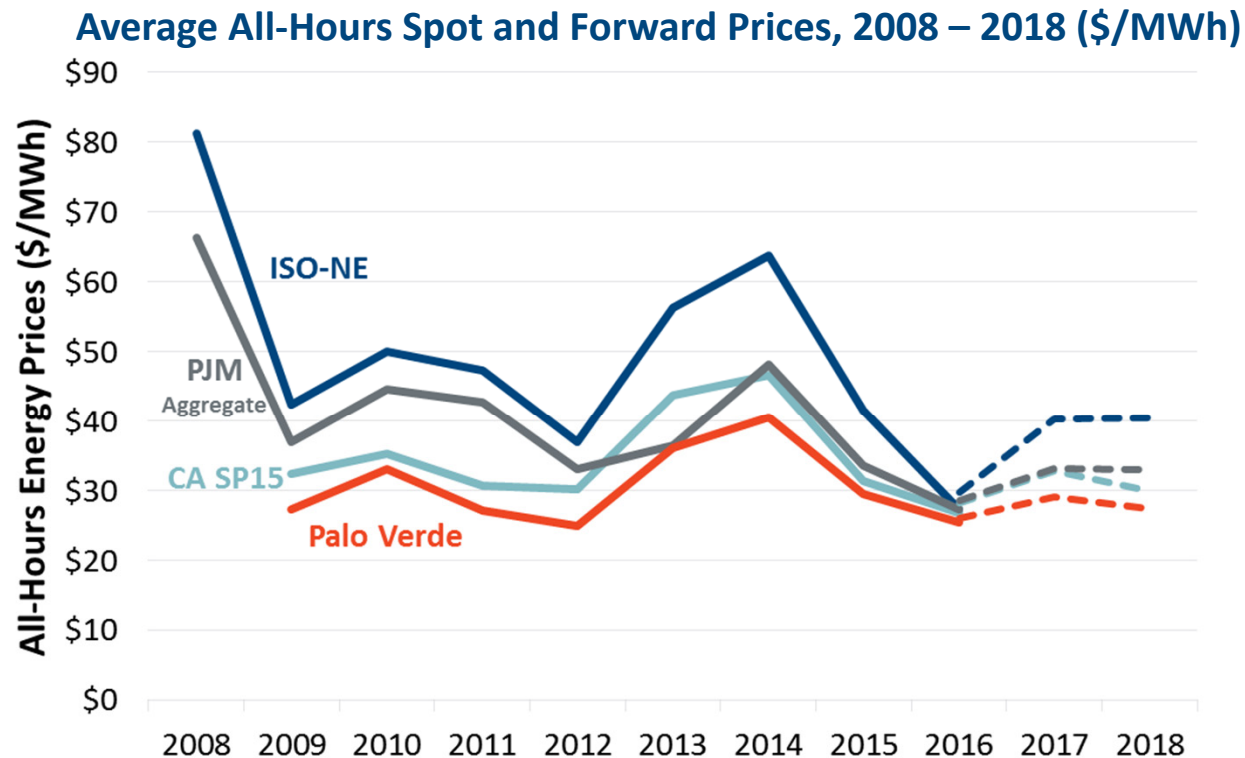
Rate reductions are phased-in from 2012 Baseline to 2030 goals. The largest reductions are in MT, ND and WY, while some others such as ME, CT, ID, CA and MS are already in compliance with 2022 goals.



Power Markets Outlook

Low wholesale energy prices persist due to economic pressures and policy goals

- Low electricity demand following recession and low natural gas prices (often setting the market clearing price for power as the marginal fuel)
- Forward power markets indicate continuing future low prices

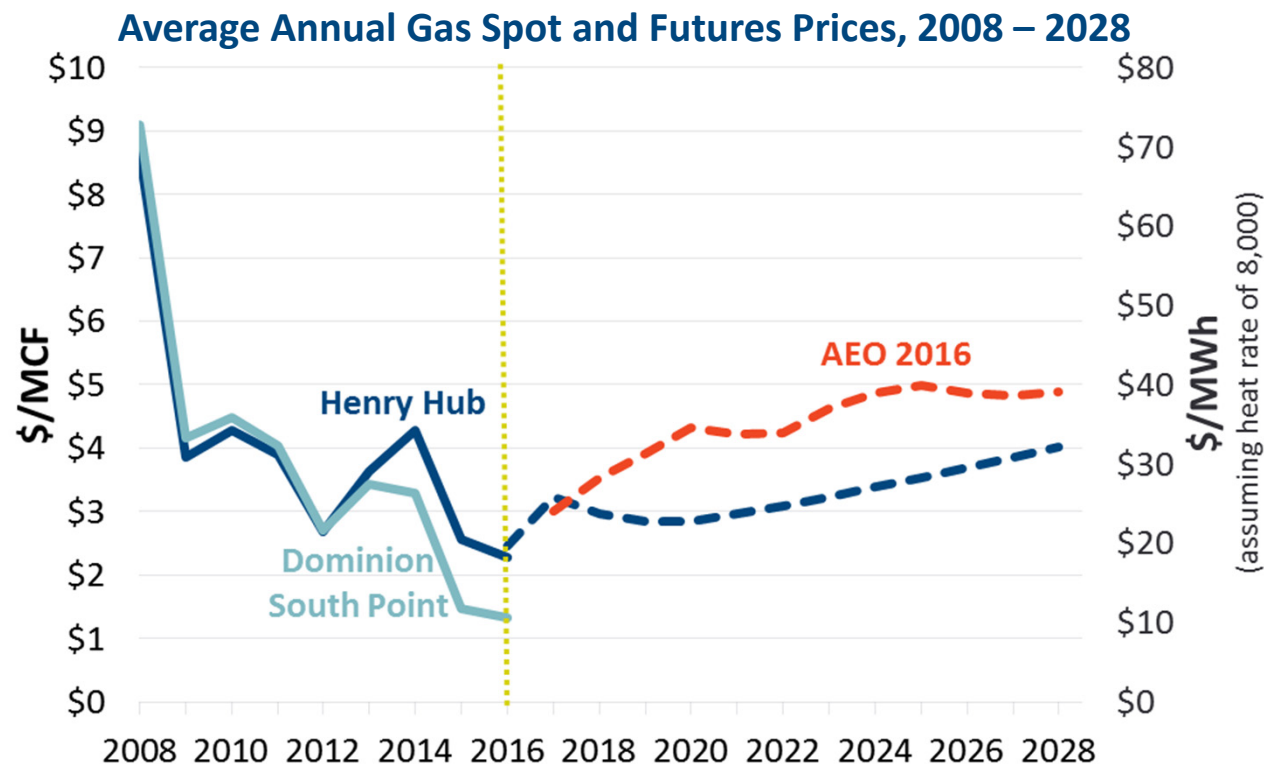


Source: Historical spot prices and forward prices from SNL Energy.

Underlying Causes: Gas, Growth, Renewables (I)

Low natural gas prices are a primary driver of low energy market prices

- Steady decrease in near-term prices over the past few years
 - Deep shale reserves and low offtake capacity
 - Mothballed wells available for reopening will keep prices low
- Forward price curve has dipped, now almost flat over coming decade

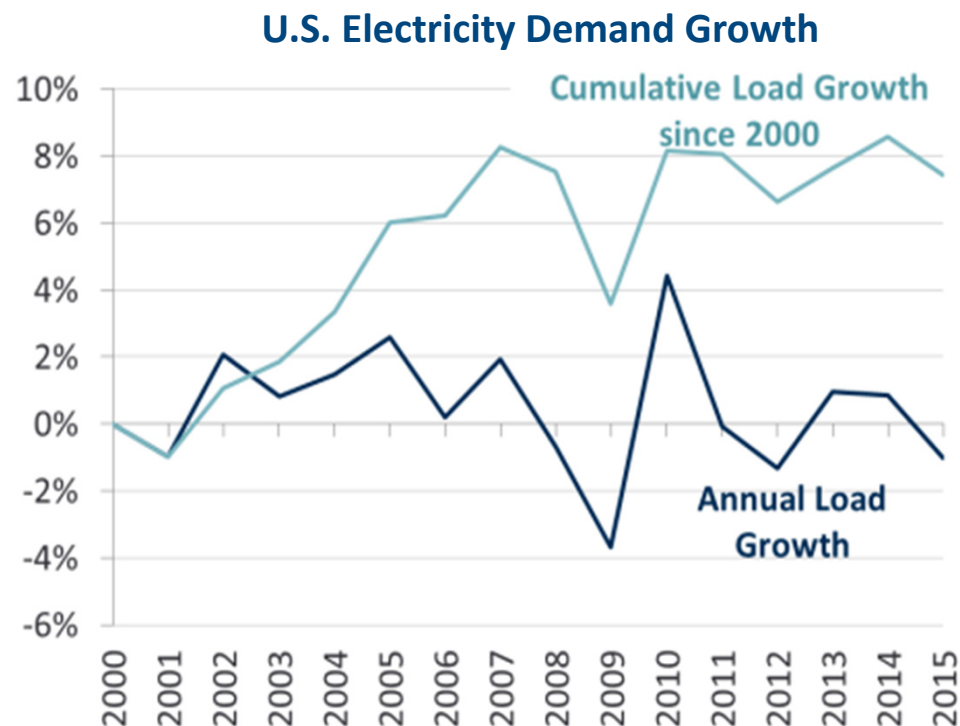


Source: Historical natural gas spot prices from SNL Energy; futures as of October 2016 from SNL Energy (sourced from NYMEX) and AEO 2016 reference case.

Underlying Causes: Gas, Growth, Renewables (II)

Recent history with low demand growth and expected continuation of that trend reflect increased focus on energy efficiency and distributed generation

- Trend will be exacerbated by declining costs of end-use energy management technologies—though those will eventually require expensive system reconfiguration, controls, and data systems for integration.

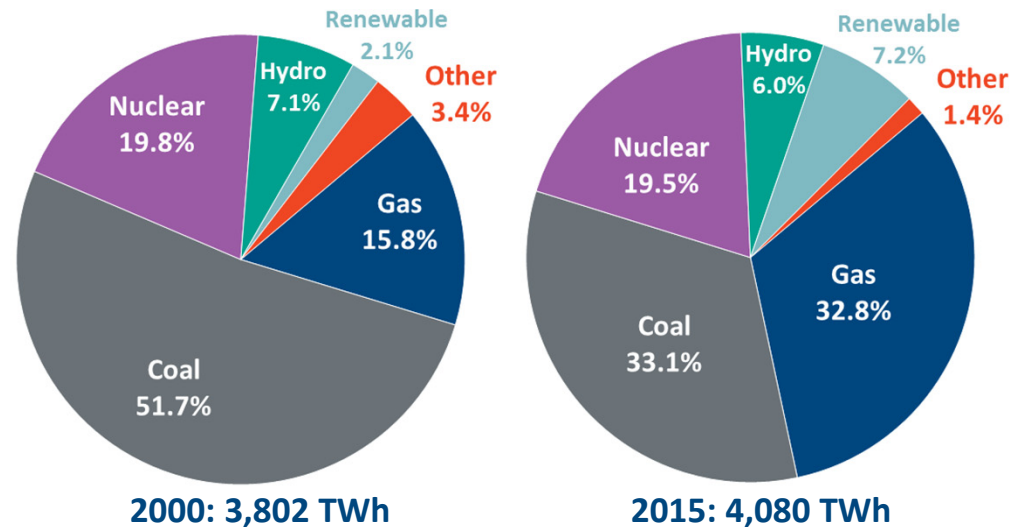


Underlying Causes: Gas, Growth, Renewables (III)

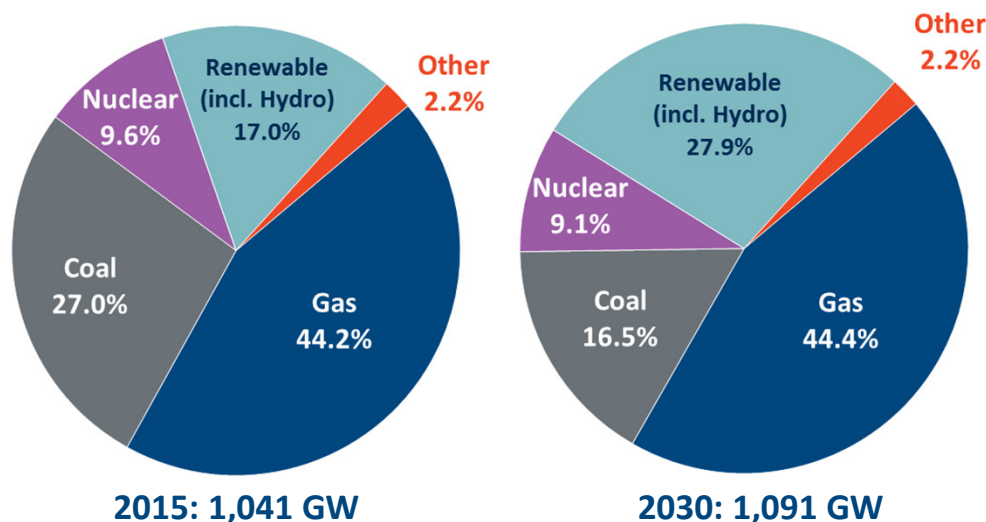
Natural gas and renewables' share of generation is growing, while coal is falling behind

- From 2000 – 2015, gas generation nearly doubled while coal cut by more than one-third
- Although total generation is increasing, efficiency is improving (in terms of GWh/\$GDP)

% of U.S. Net Generation by Technology



% of U.S. Net Summer Capacity by Technology



U.S. Electric Generation/\$GDP

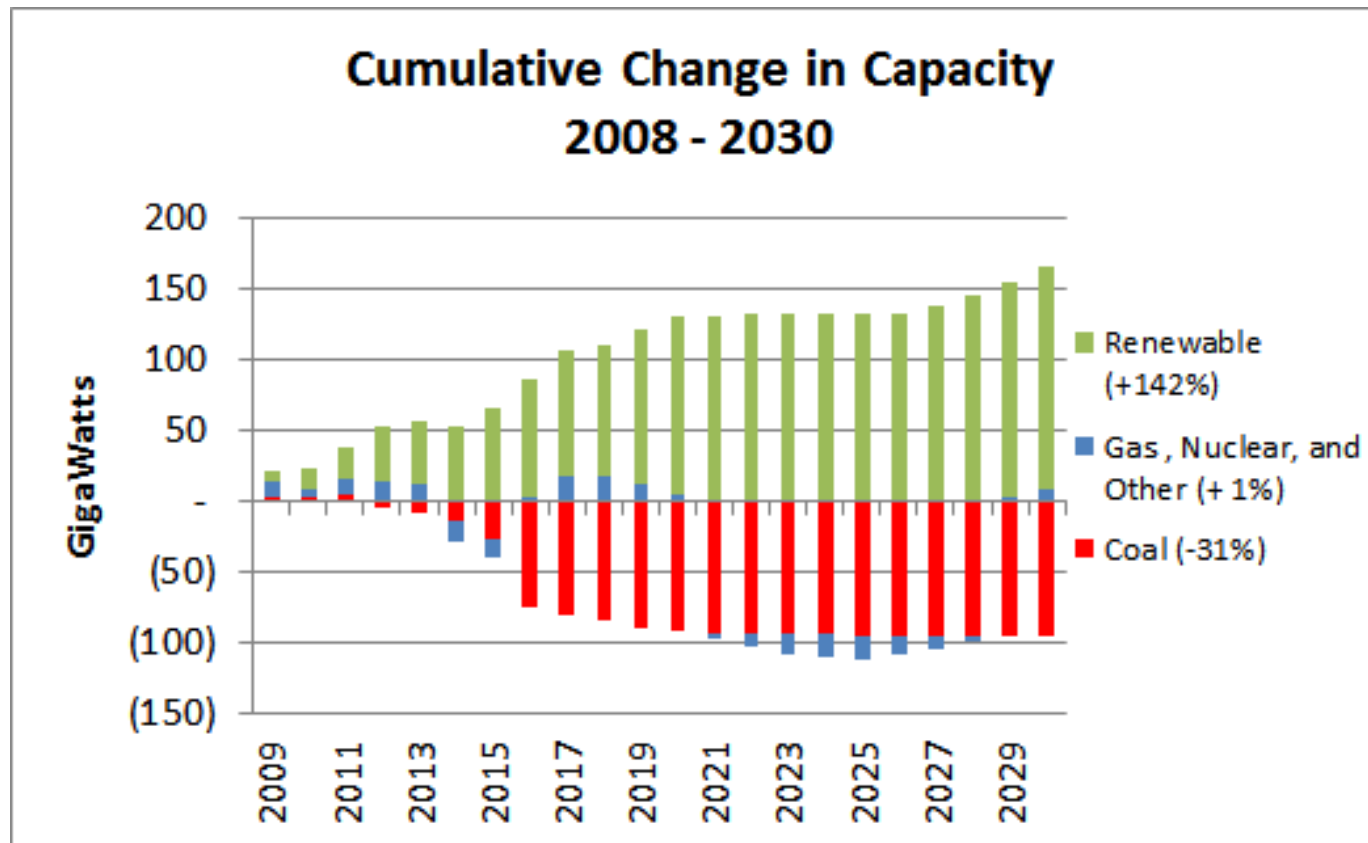
1995: 330 GWh/ \$billion
 2005: 285 GWh/ \$billion
 2015: 249 GWh/ \$billion

(in billions of chained 2009 dollars)

Sources: 1990-2015 Net Generation by State by Type of Producer by Energy Source (EIA-906, EIA-920, and EIA-923), <https://www.eia.gov/electricity/data/state/>; 2016 AEO Reference Case, Table 9; U.S. GDP from Bureau of Economic Analysis, US Dept. of Commerce, <http://www.bea.gov/national/Index.htm>. 9 | brattle.com

Market Developments: Renewables

EIA's AEO2016 projections (w/o CPP) already show considerable displacement of coal capacity and lots of renewables:



With CPP, EIA projects 30 GW less coal and 40 GW more renewables by 2030.

Coal Plant Retirements

As of August 2016, 54 GW of coal fleet has either retired or announced to retire by 2020

- 39 GW already retired since 2012
- 8 GW announced to retire by the end of 2017
- Another 7 GW announced to retire by 2020

EPA's IPM analysis:

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

EIA's AEO2016 analysis:

- 87 GW coal retirements by 2020 and another 5 GW by 2030 with no CPP
- About 130 GW by 2030 with CPP

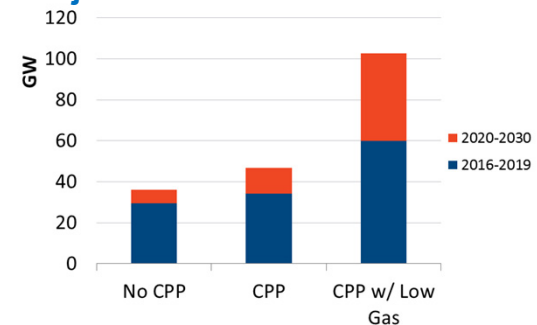
Brattle's recent analyses:

- 65 GW coal likely to retire by 2020 and another 6 GW by 2030 with no CPP relative to fleet in 2012
- CPP adds another 10 GW by 2030, and low gas prices another 55 GW for a total of 135 GW.

U.S. Actual and Announced Coal Plant Retirements

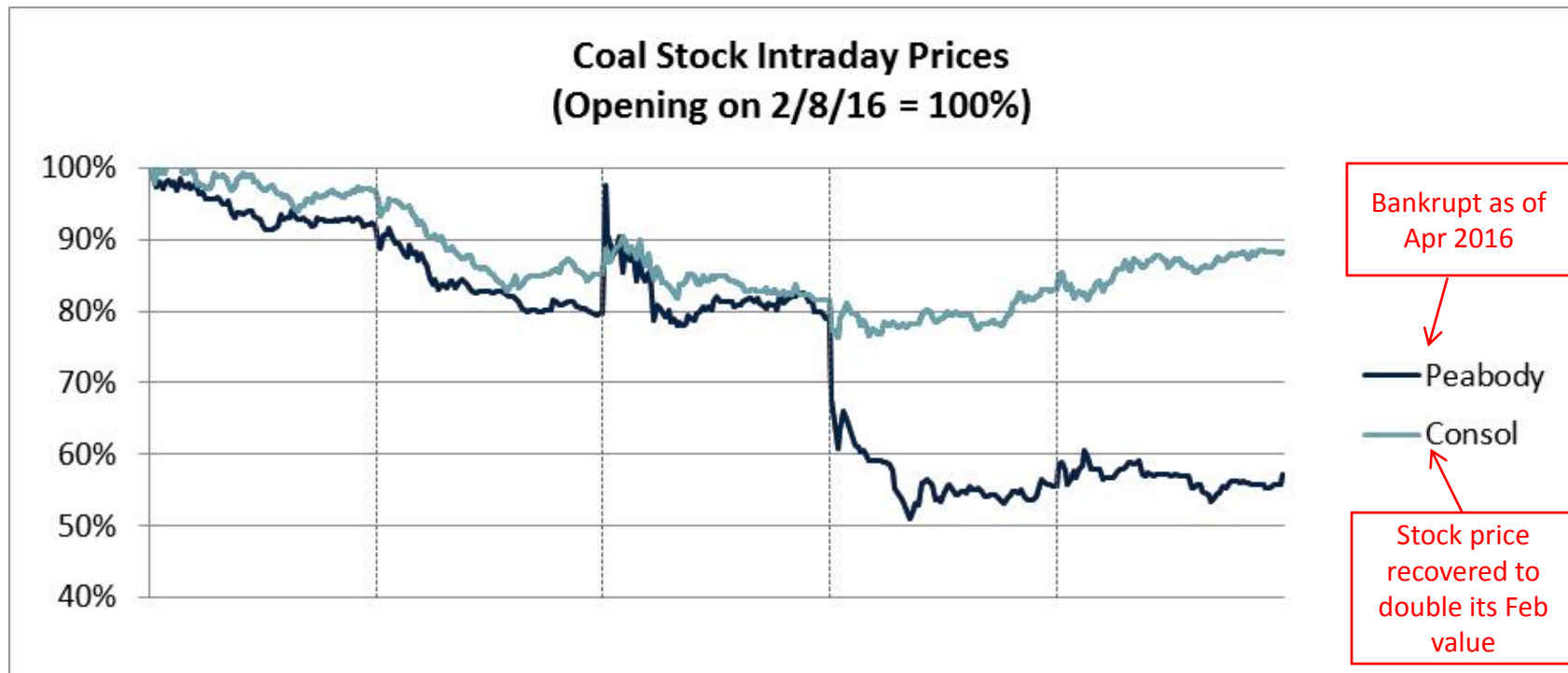
| Year of Retirement | Number of Units | Capacity (MW) |
|------------------------|-----------------|---------------|
| Actual | | |
| 2012 | 88 | 9,085 |
| 2013 | 46 | 5,696 |
| 2014 | 39 | 3,906 |
| 2015 | 101 | 13,899 |
| 2016 | 45 | 6,455 |
| 2012-2016 | 319 | 39,041 |
| Announced | | |
| 2016 | 10 | 1,729 |
| 2017 | 31 | 6,654 |
| 2016-2017 | 41 | 8,382 |
| 2018 | 18 | 3,477 |
| 2019 | 14 | 2,143 |
| 2020 | 10 | 1,200 |
| Total 2012-2020 | 402 | 54,243 |

Projected Coal Plant Retirements



Impact of SCOTUS CPP Stay on Coal

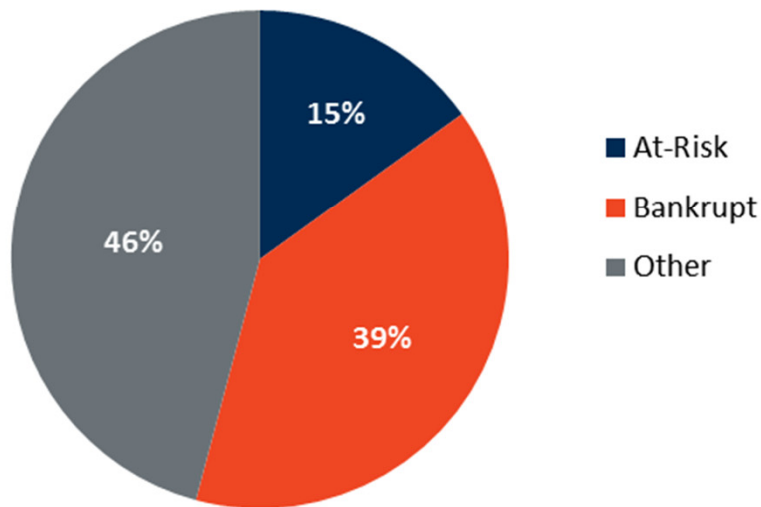
- Coal stocks jumped briefly after Supreme Court stay on 2/9/16...
- But market hope for coal stocks did not last long:



Coal Industry

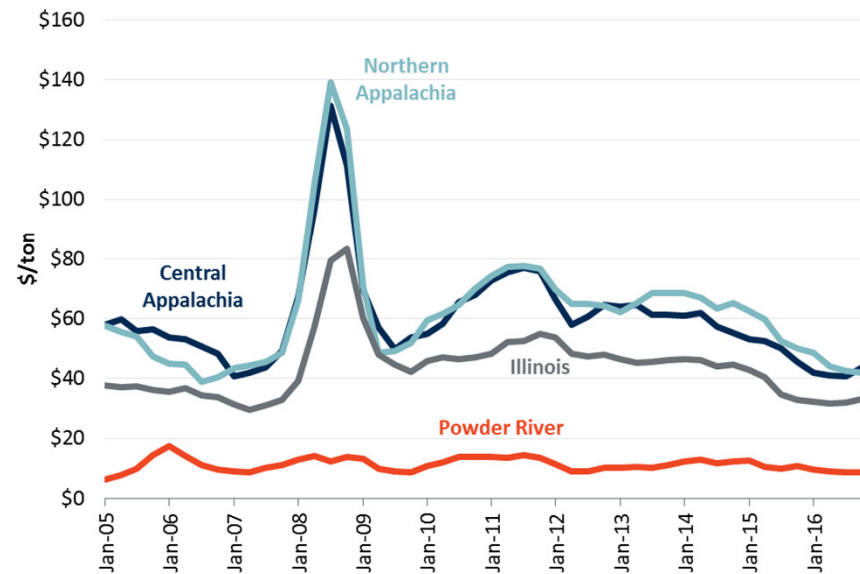
- About 40% of coal sold in 2015 from bankrupt companies, and 15% from companies at risk for bankruptcy
- Spot coal prices fell to very low levels in 2015/2016
- Future coal prices: some recovery expected near-term, but beyond 2020 looks dim due to lack of load growth, renewables penetration, environmental regulations and CO₂ reduction goals

Coal Sales in 2015
(Total 747 Million tons)



Source: SNL.

Spot Minemouth Coal Prices



Source: SNL Physical Markets Survey.

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.

The views expressed in this presentation are strictly those of the presenter(s) and do not necessarily state or reflect the views of The Brattle Group, Inc.

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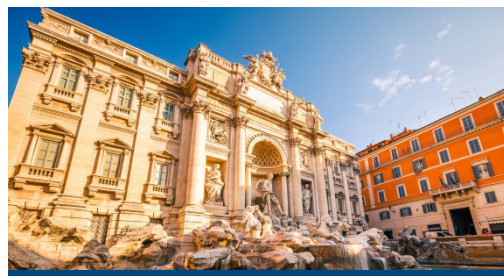
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