Limits to the Future of U.S. Coal-Fired Electricity Generation: EPA's Clean Power Plan or Available Reserves?

33nd USAEE/IAEE North American Conference
October 2015
Pittsburgh, Pennsylvania

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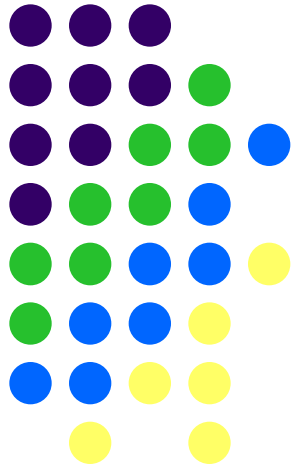

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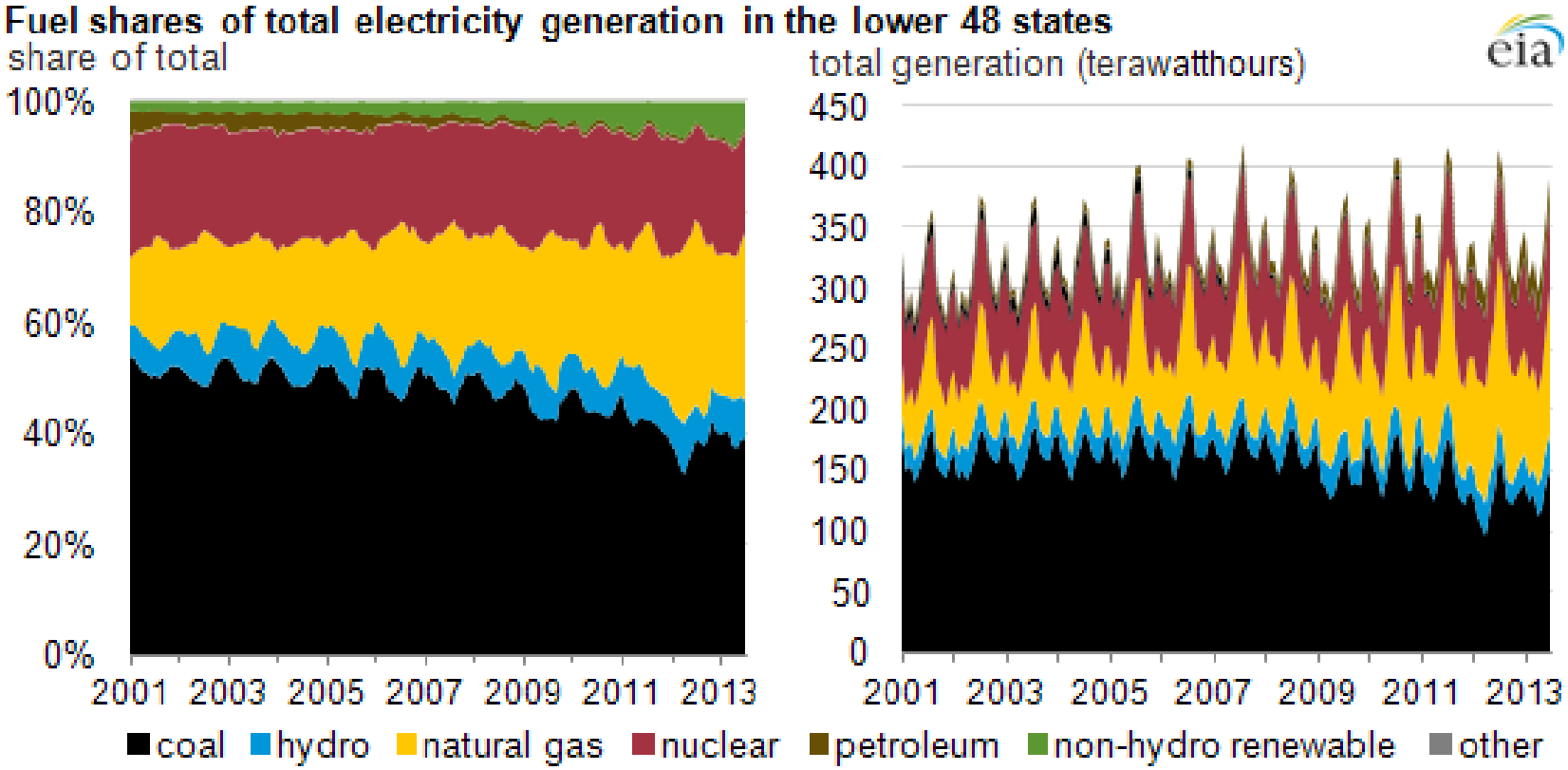
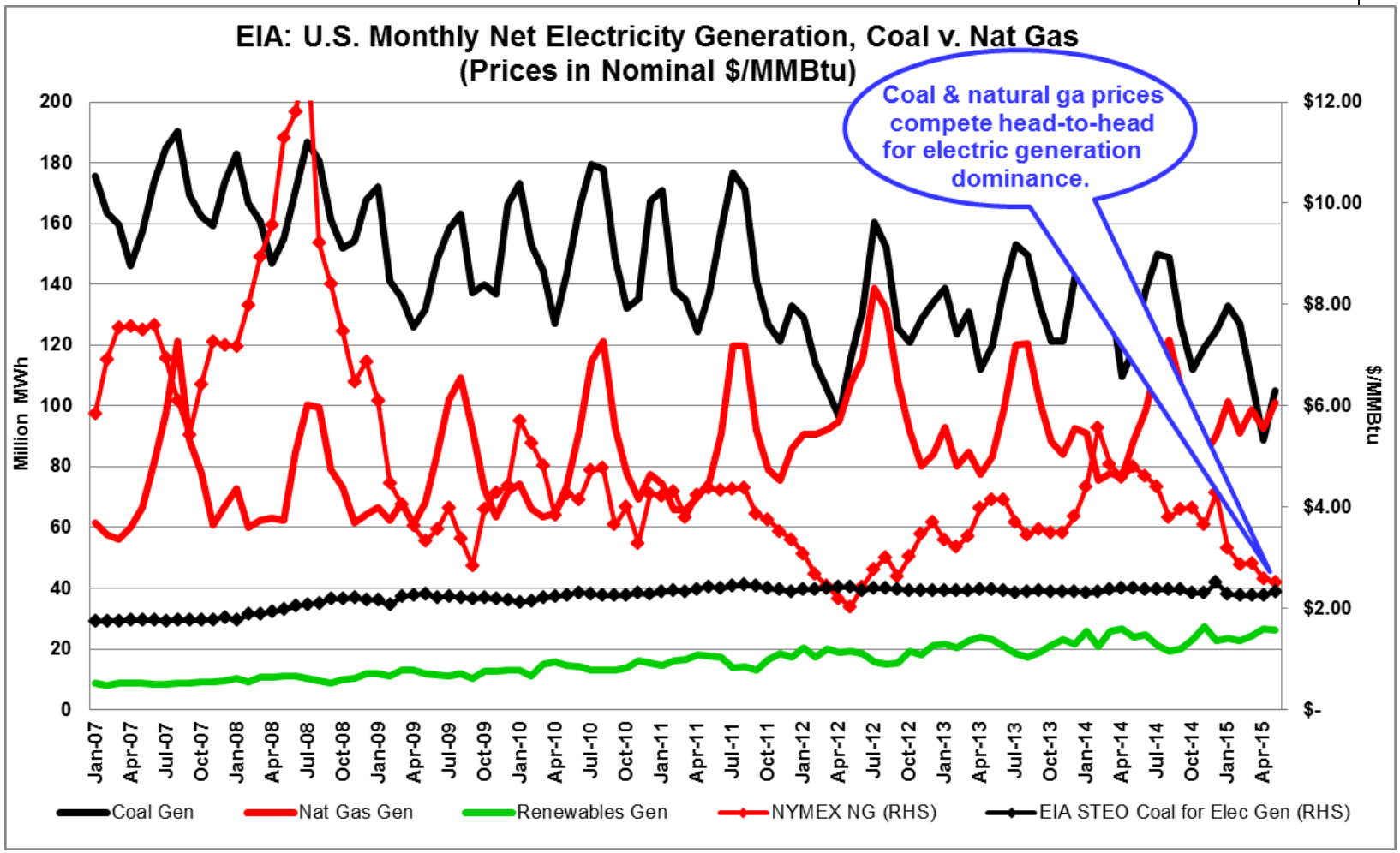
U.S. Electricity Generation Has Been Dominated by Coal…



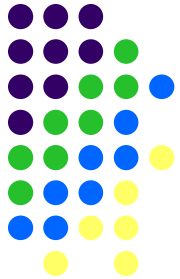
Source: U.S. Energy Information Administration ("EIA"), Analysis of the Clean Power Plan
Note: Other refers to electricity generated from the non-biogenic portion of municipal solid waste, other non-renewable waste fuels, hydroelectric pumped storage, other energy storage, and other sources.

But Low Natural Gas Prices Have Become a Game Changer



Source of Data: U.S. Energy Information Administration and New York Mercantile Exchange (NYMEX).

Parameters of the Coal Reserves as Reported by EIA

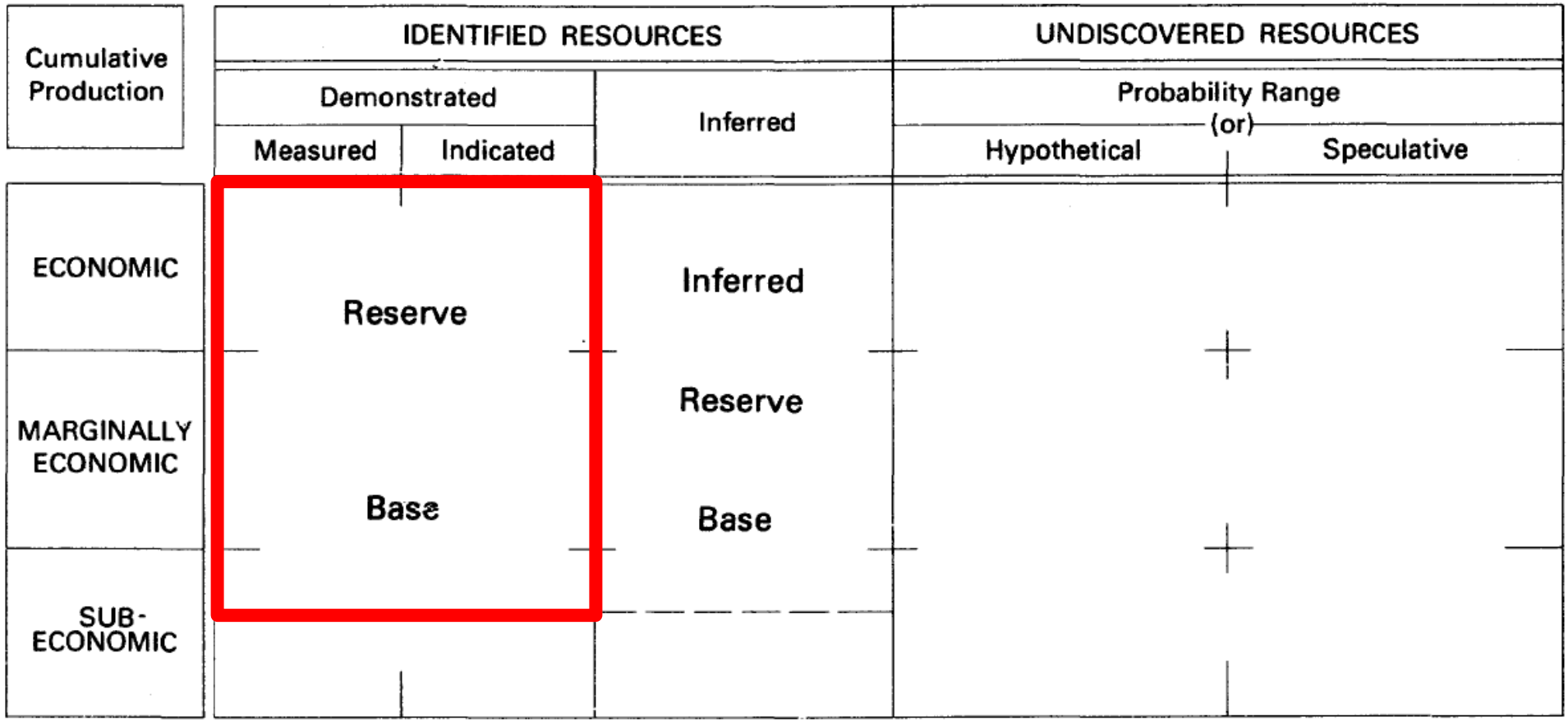


- Based on corporate self-reporting in *Annual Survey of Coal Production and Preparation* *
- Indicate "…the amount of coal identified in the reserve that is technologically and economically feasible to extract."
- Do "not include any specific economic feasibility criteria" performed by EIA.

Notes: Recoverable coal reserves at producing mines represent the quantity of coal that can be recovered (i.e. mined) from existing coal reserves at reporting mines. EIA's estimated recoverable reserves include the coal in the demonstrated reserve base considered recoverable after excluding coal estimated to be unavailable due to land use restrictions, and after applying assumed mining recovery rates. This estimate does not include any specific economic feasibility criteria. The effective date for the demonstrated reserve base, as customarily worded, is 'Remaining as of January 1, 2014.' These data are contemporaneous with the Recoverable Reserves at Producing Mines, customarily presented as of the end of the reporting year's mining, that is in this case, December 31, 2013. The demonstrated reserve base includes publicly available data on coal mapped to measured and indicated degrees of accuracy and found at depths and in coalbed thicknesses considered technologically minable at the time of determinations; see Glossary for criteria.

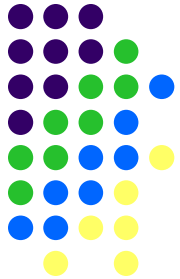
***Source*: U.S. Energy Information Administration, Annual Coal Report 2013, Table 15, p. 23. (Emphasis added.)**

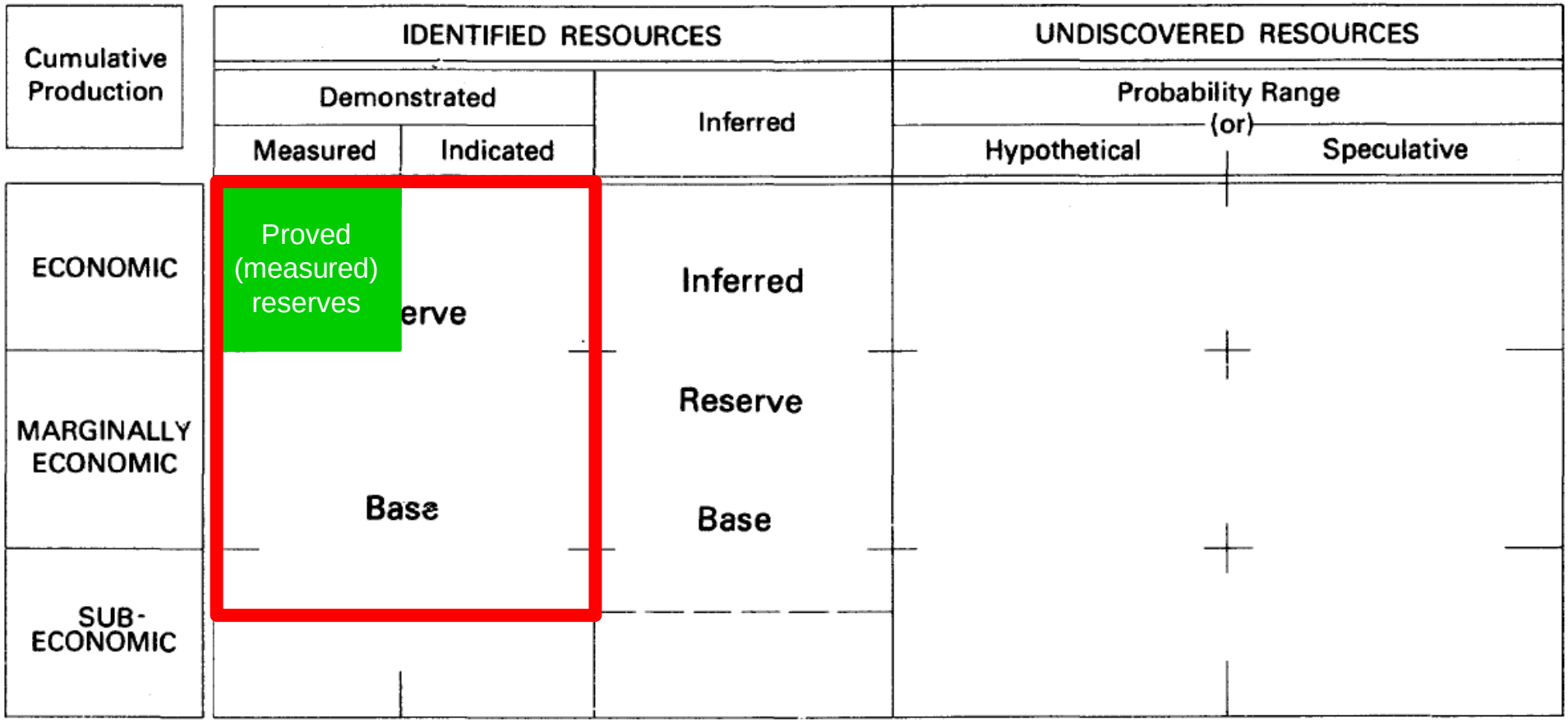
EIA Uses 1980 USGS Resource/ Reserve Classification System



Source: U.S. Department of the Interior, 1980, Geological Survey Circular 831, Figure 2, p. 5. http://pubs.usgs.gov/circ/1980/0831/report.pdf

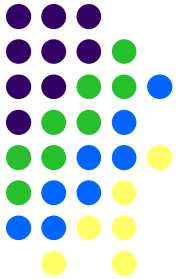
Proved (Measured) Reserves Economically Recoverable Now

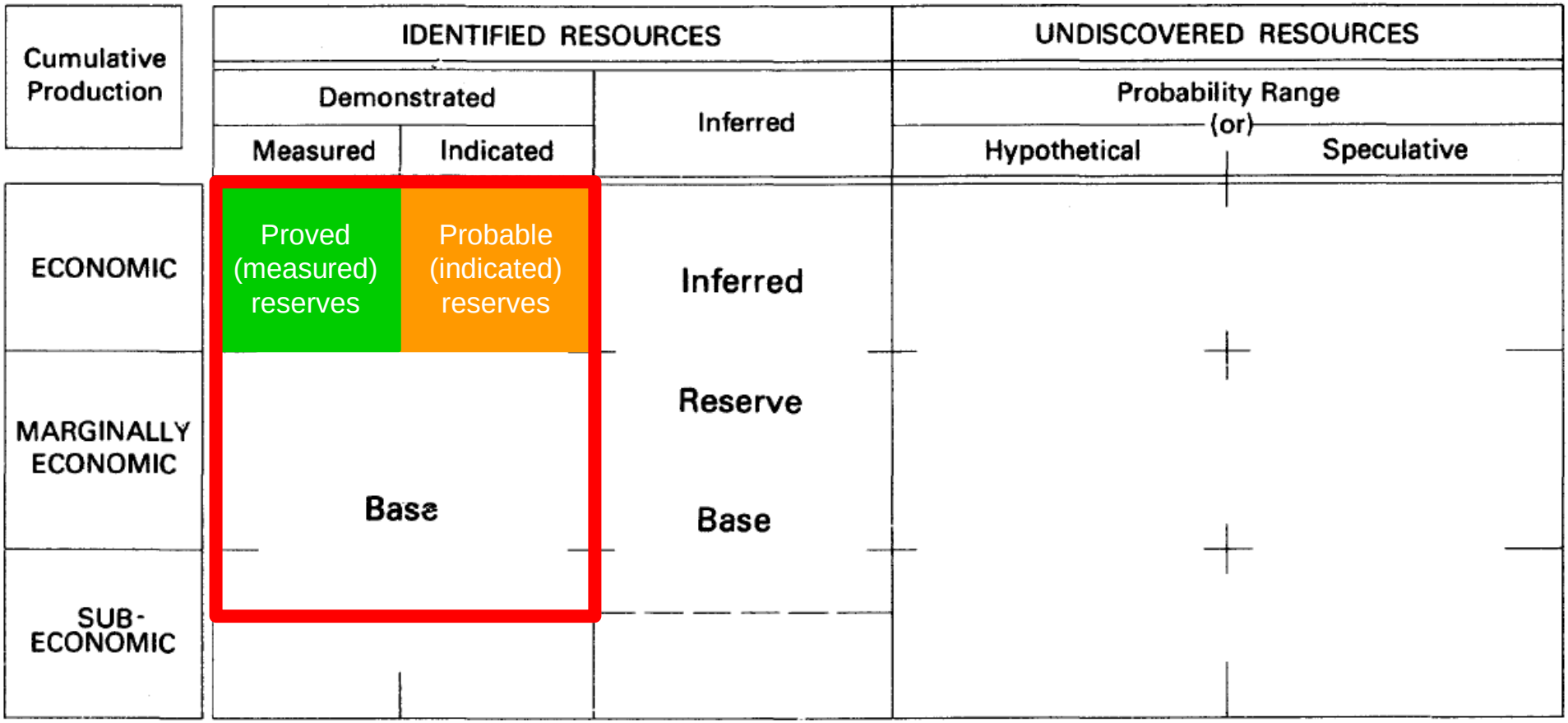




Source: U.S. Department of the Interior, 1980, Geological Survey Circular 831, Figure 2, p. 5. http://pubs.usgs.gov/circ/1980/0831/report.pdf

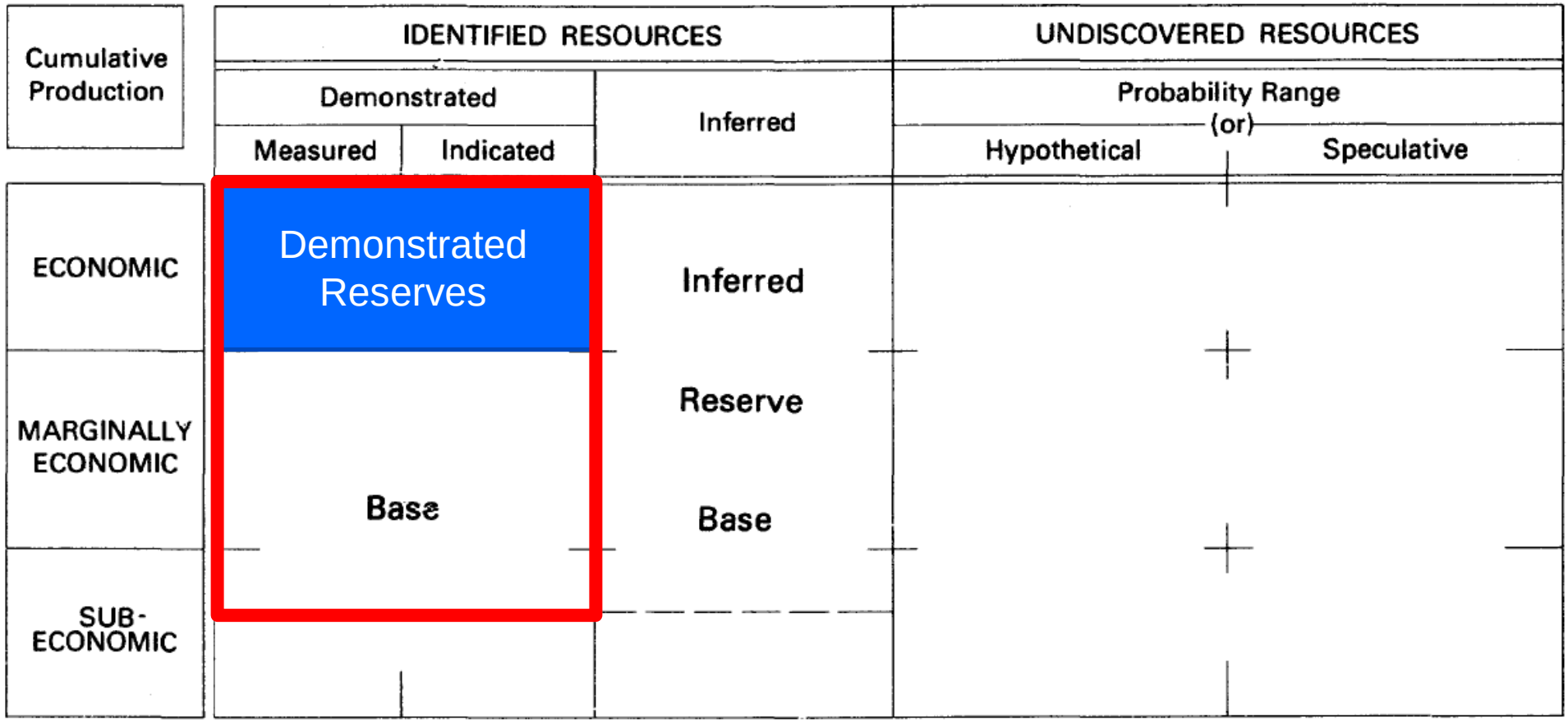
Probable (Indicated) Reserves Are a Step-Out from Proved





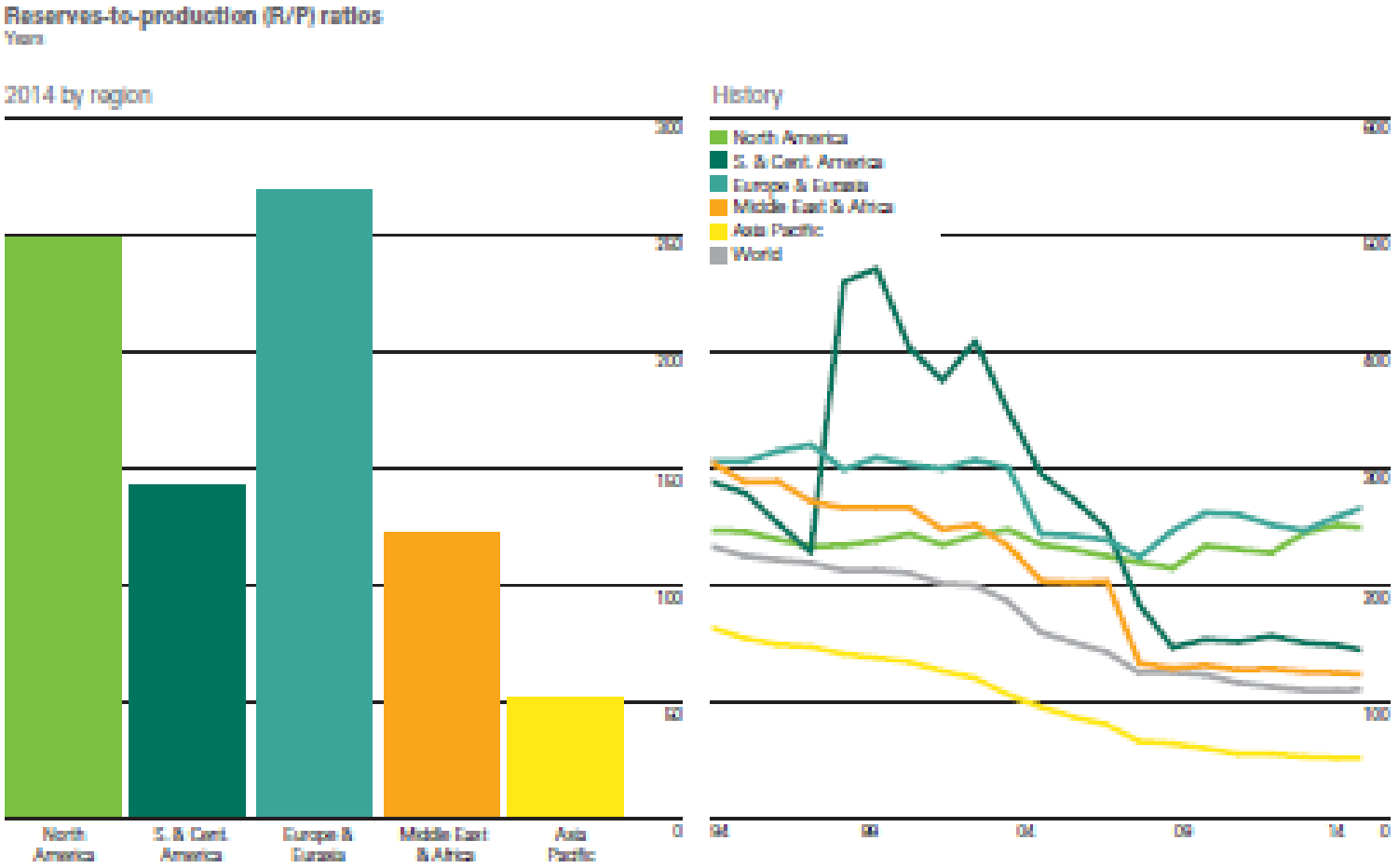
Source: U.S. Department of the Interior, 1980, Geological Survey Circular 831, Figure 2, p. 5. http://pubs.usgs.gov/circ/1980/0831/report.pdf

Together, Proved and Probable = Demonstrated Reserves



Source: U.S. Department of the Interior, 1980, Geological Survey Circular 831, Figure 2, p. 5. http://pubs.usgs.gov/circ/1980/0831/report.pdf

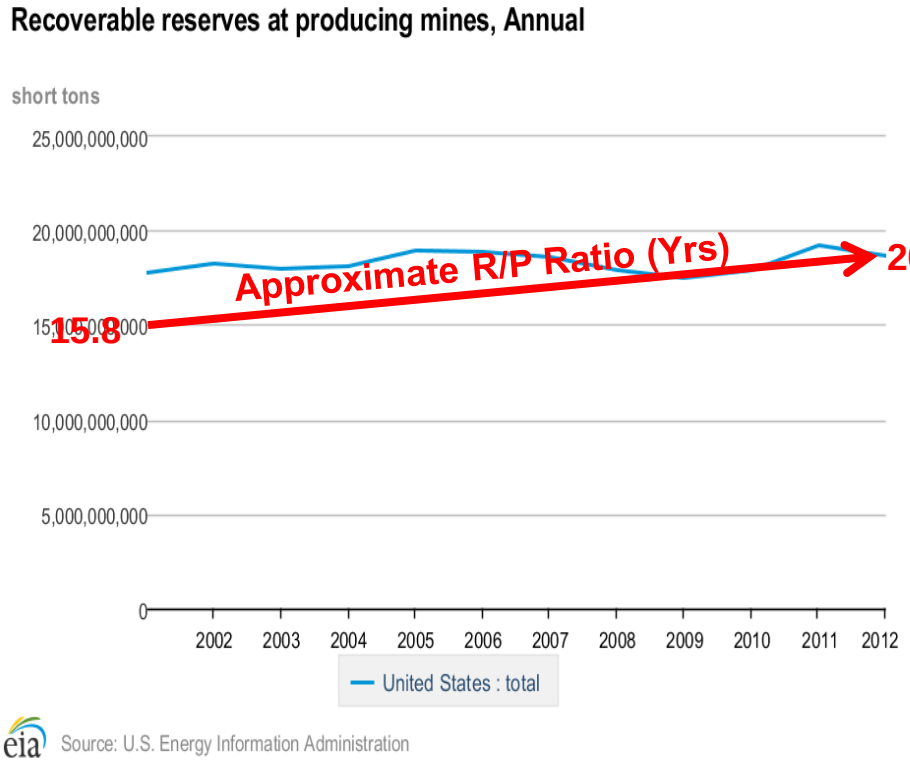
BP's "Reserved" Support for 200 Years of U.S. "Reserves"

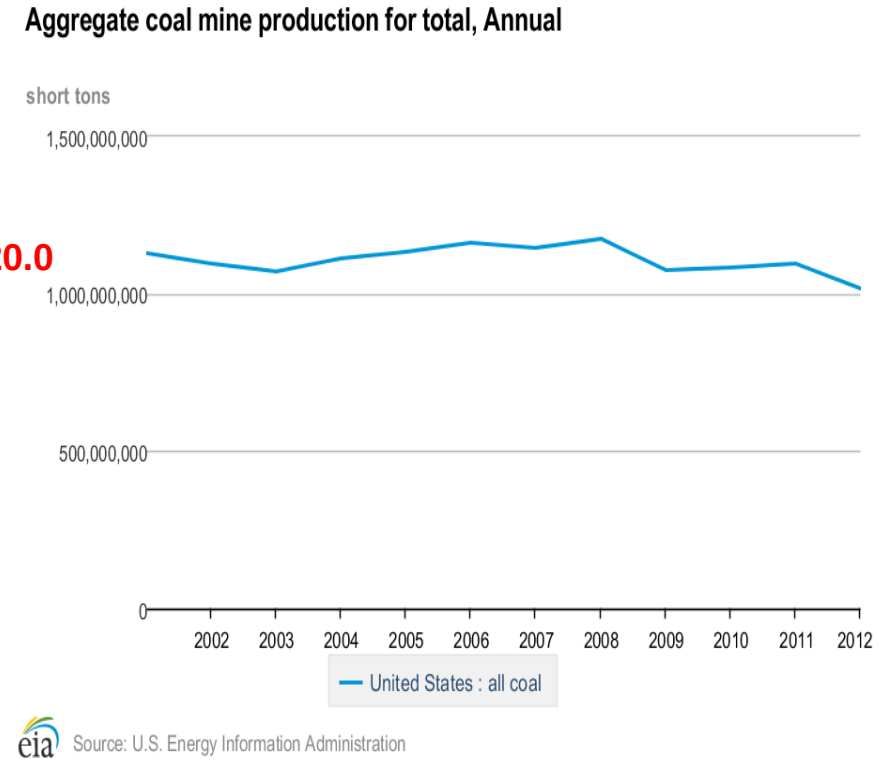


World proved coal reserves in 2014 were sufficient to meet 110 years of global production, by far the largest R/P ratio for any fossil fuel. By region, Europe & Eurasia holds the largest proved reserves and has the highest R/P ratio – 268 years, compared with 258 years for North America. The lowest R/P ratio is in the Asia Pacific region (51 years).

Source: BP, June 2015, BP Statistical Review of World Energy, p. 32.

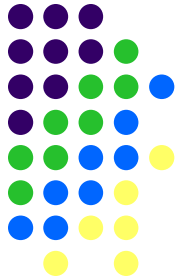
But EIA Statistics Suggest 20-Year Inventory Management





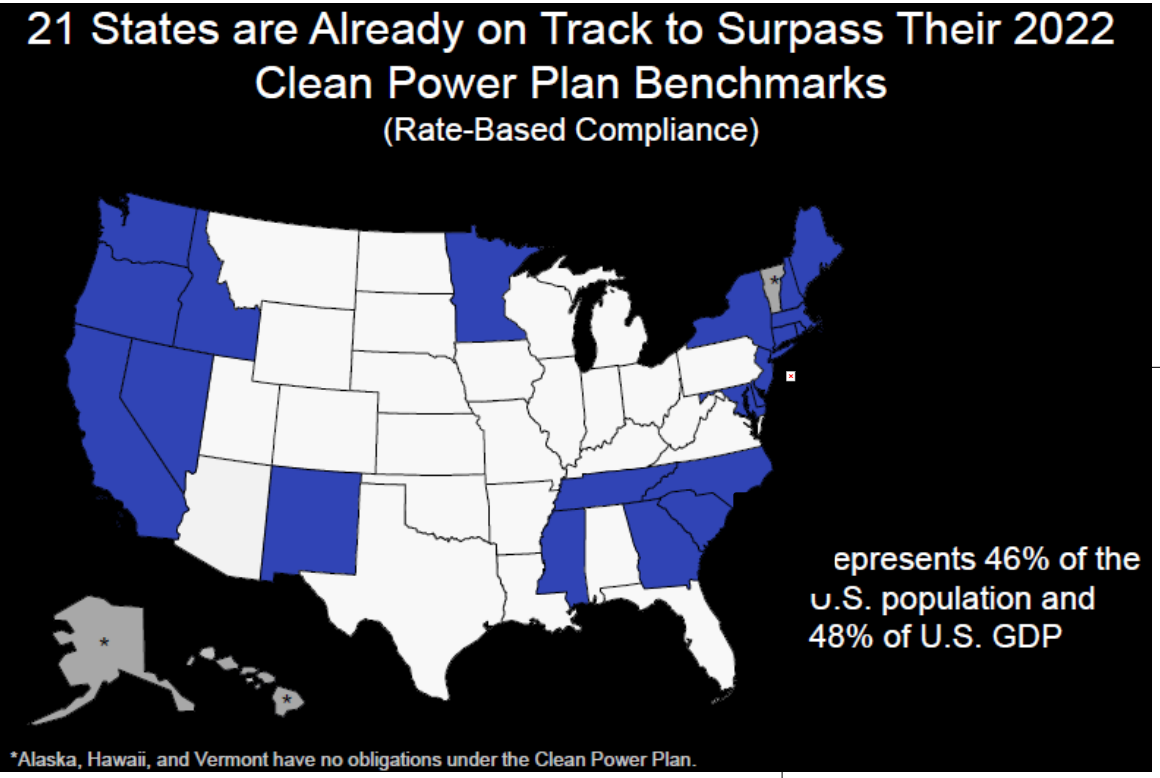
- Difference based on differing definition?
  - Reserve Base vs. Demonstrated Reserves

EPA Issued Final Clean Power Plan ("CPP") August 3, 2015



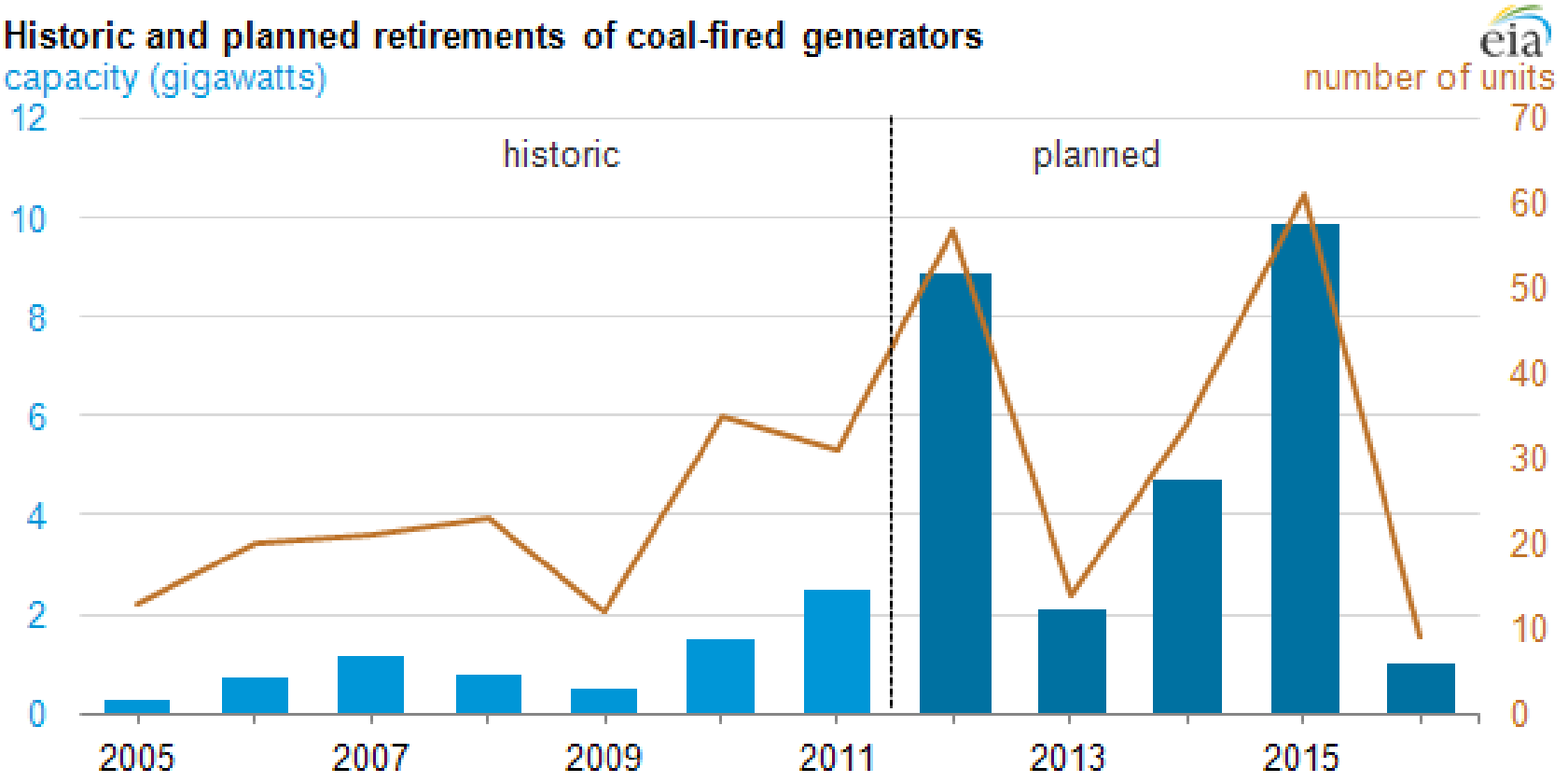
- End: Cut power sector CO_2 emissions 32% by 2030 (2012 base) via state-specific targets
  - Rate-based: Reduce CO_2/MWh generated
  - Mass-based: Reduce absolute quantity emitted
- Means: "Building blocks" of (i) increased coal plant efficiency, (i) swapping gas for coal, and (iii) swapping renewables for fossil fuel
- Final Rule: Increased reduction requirements for states with coal-fired generation vs. draft.

UCS' Assessment of States' Readiness for CPP Compliance



Source: Union of Concerned Scientists, August 13, 2015, *States of Progress Update: Existing Clean Energy Commitments Put Most States in Strong Position to Meet the EPA's Final Clean Power Plan*, pp. 12-13, http://www.ucsusa.org/sites/default/files/attach/2015/08/States-of-Progress-Update-Slidedeck.pdf

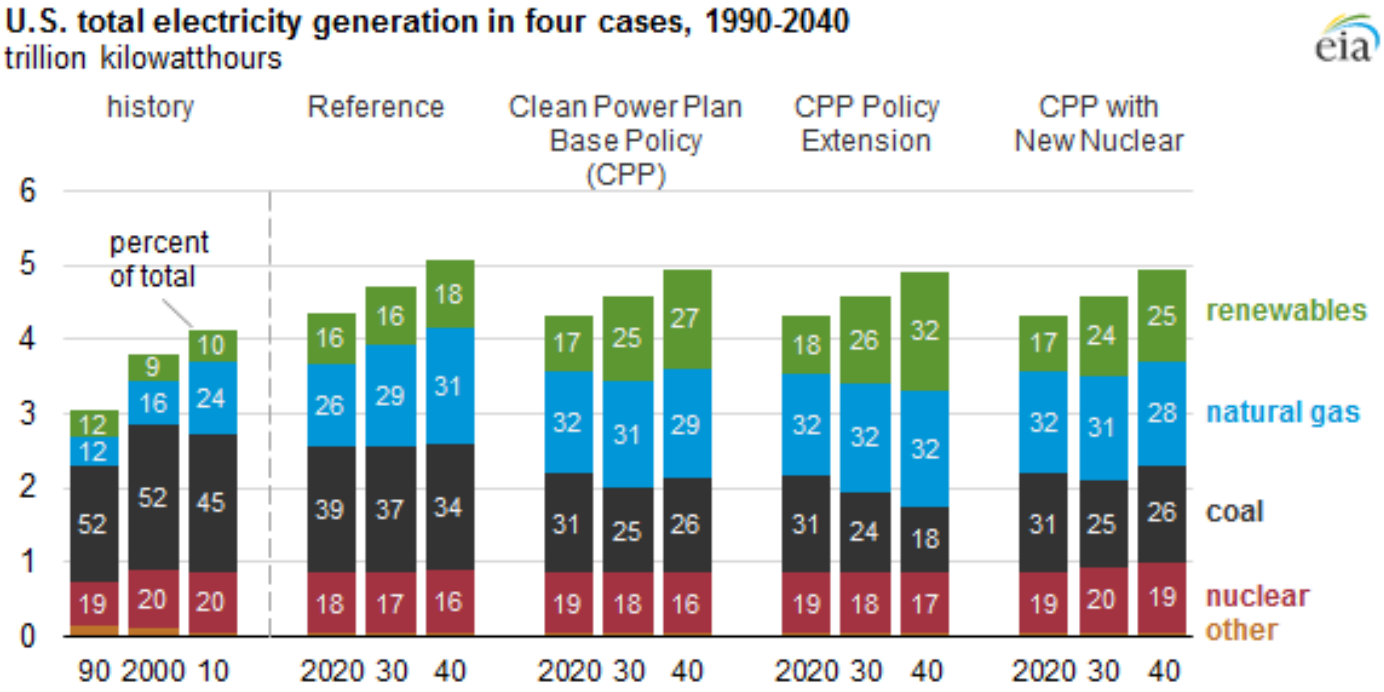
Many Coal-Fired Generators Closed *Before* the Final CPP



Source: U.S. Energy Information Administration, Form EIA-860, "Annual Electric Generator Report."
Note: Data for 2005 through 2011 represent actual retirements. Data for 2012 through 2016 represent planned retirements, as reported to EIA. Data for 2011 through 2016 are early-release data and not fully vetted. Capacity values represent net summer capacity.

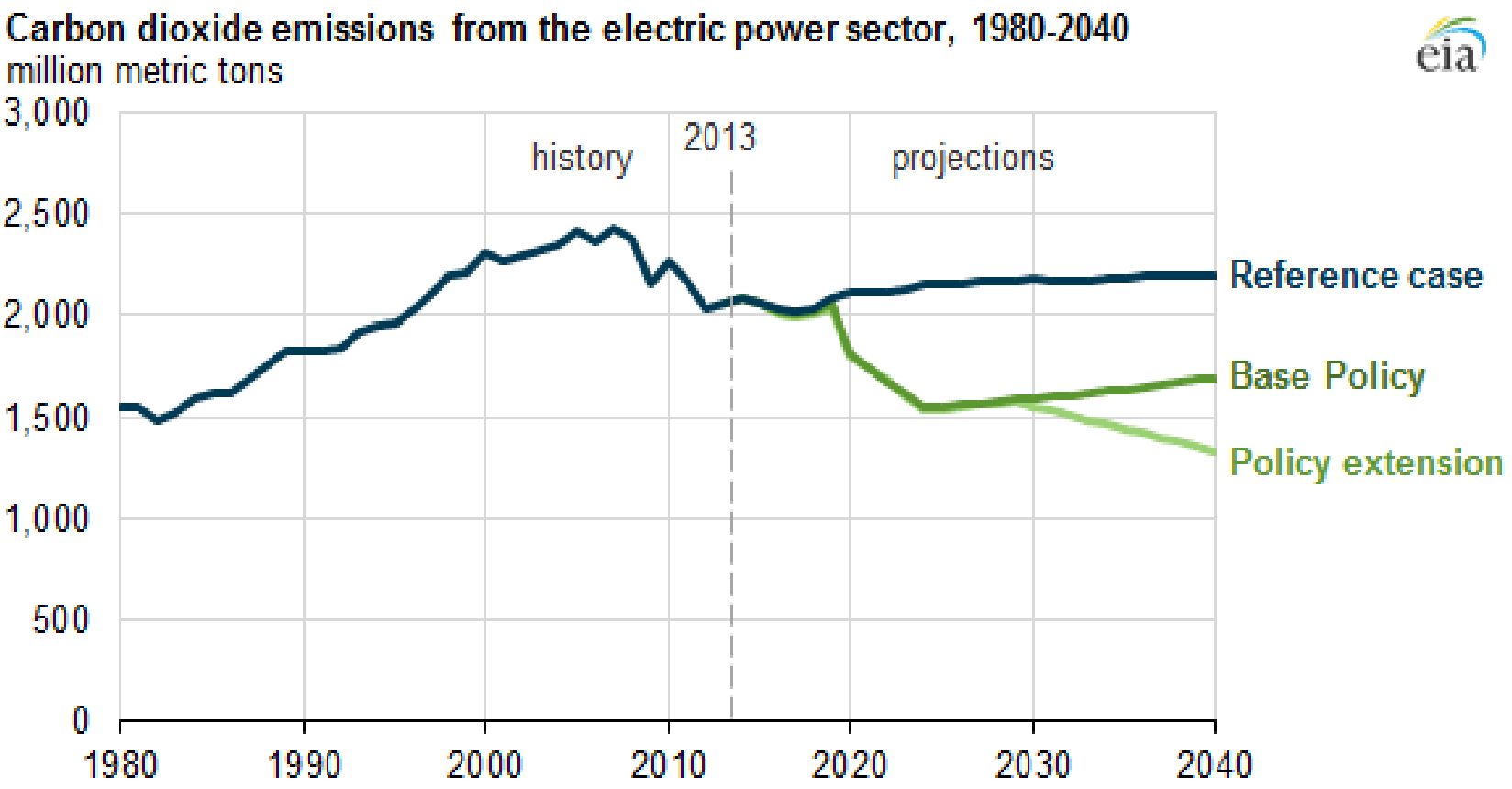
EIA Estimated Significant Plant Closures Under Draft CPP…

- Final CPP increased impact on states dominated by coal-fired generation vs. draft
  - Generator shutdowns likely also will increase



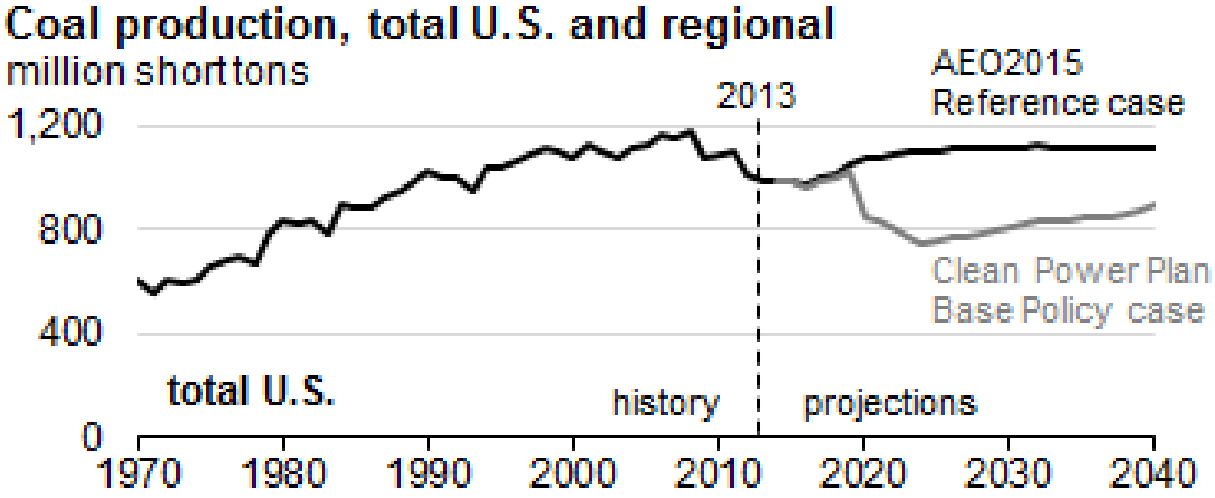
***Source*: U.S. Energy Information Administration, Analysis of the Impacts of the Clean Power Plan**

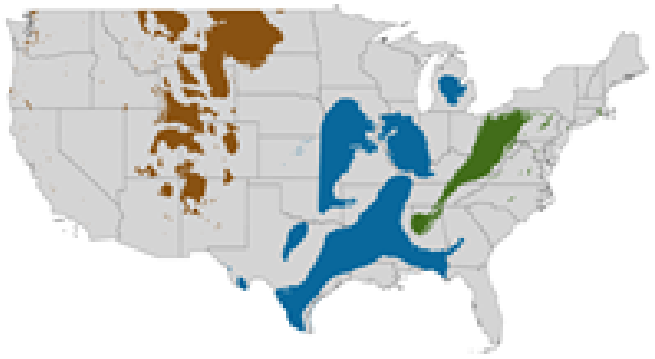
Returning Power Sector CO_2 Emissions Back to 1980 Levels

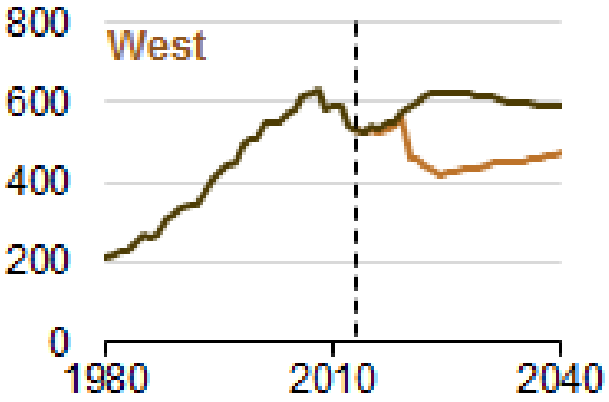


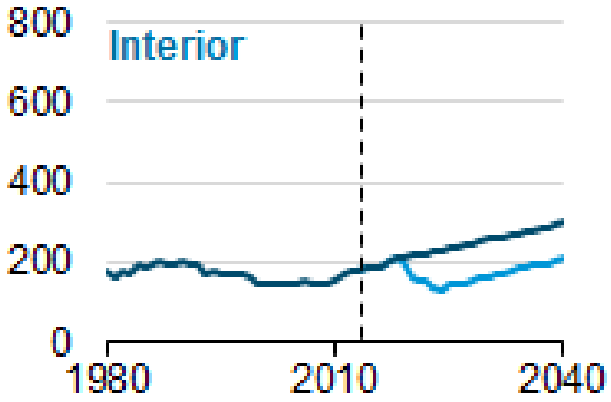
***Source*: U.S. Energy information Administration, Analysis of the Impacts of the Clean Power Plan**

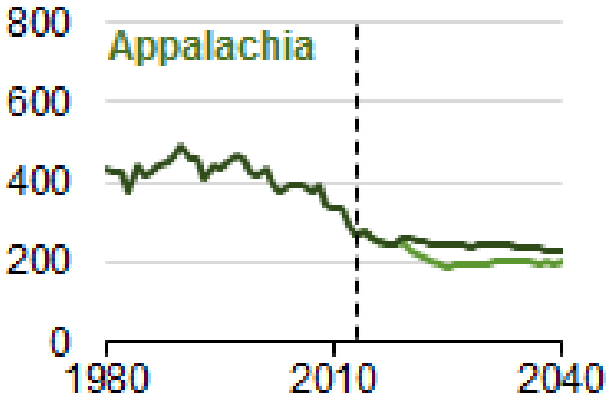
EIA: Coal Production Declined In All Regions Under Draft CPP







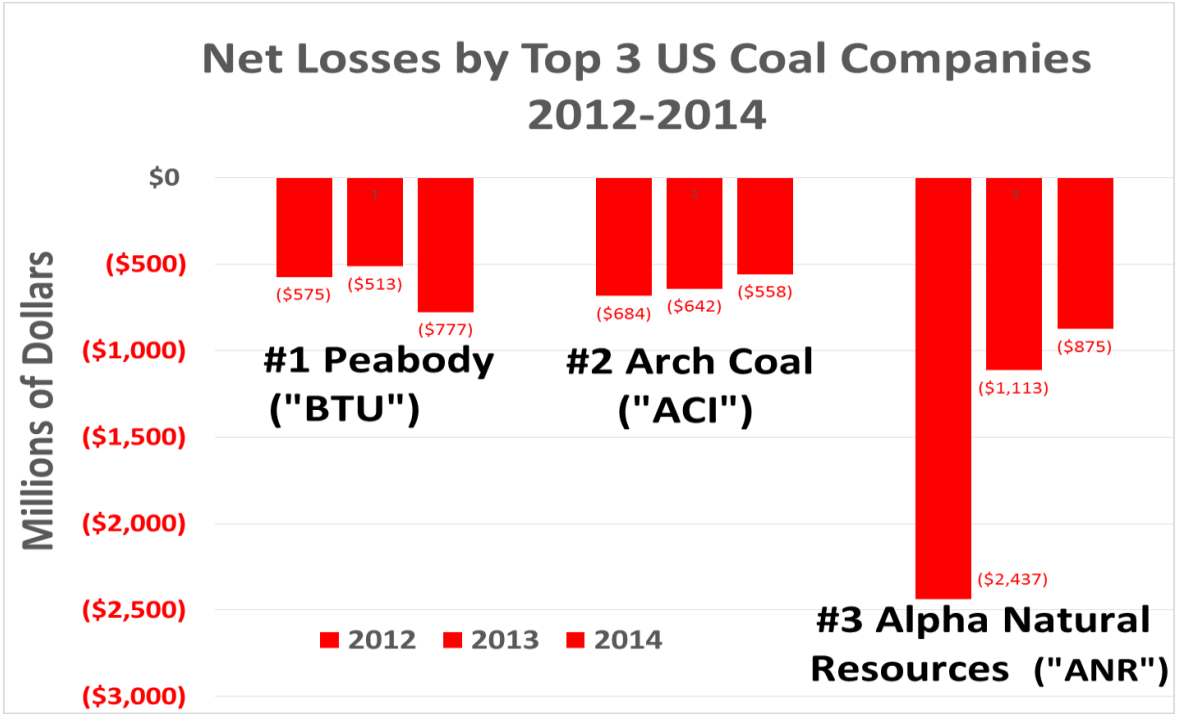




Source: U.S. Energy Information Administration, Analysis of the Impacts of the Clean Power Plan

Lack of Profitably Casts Doubt On Future of U.S. Coal Mining

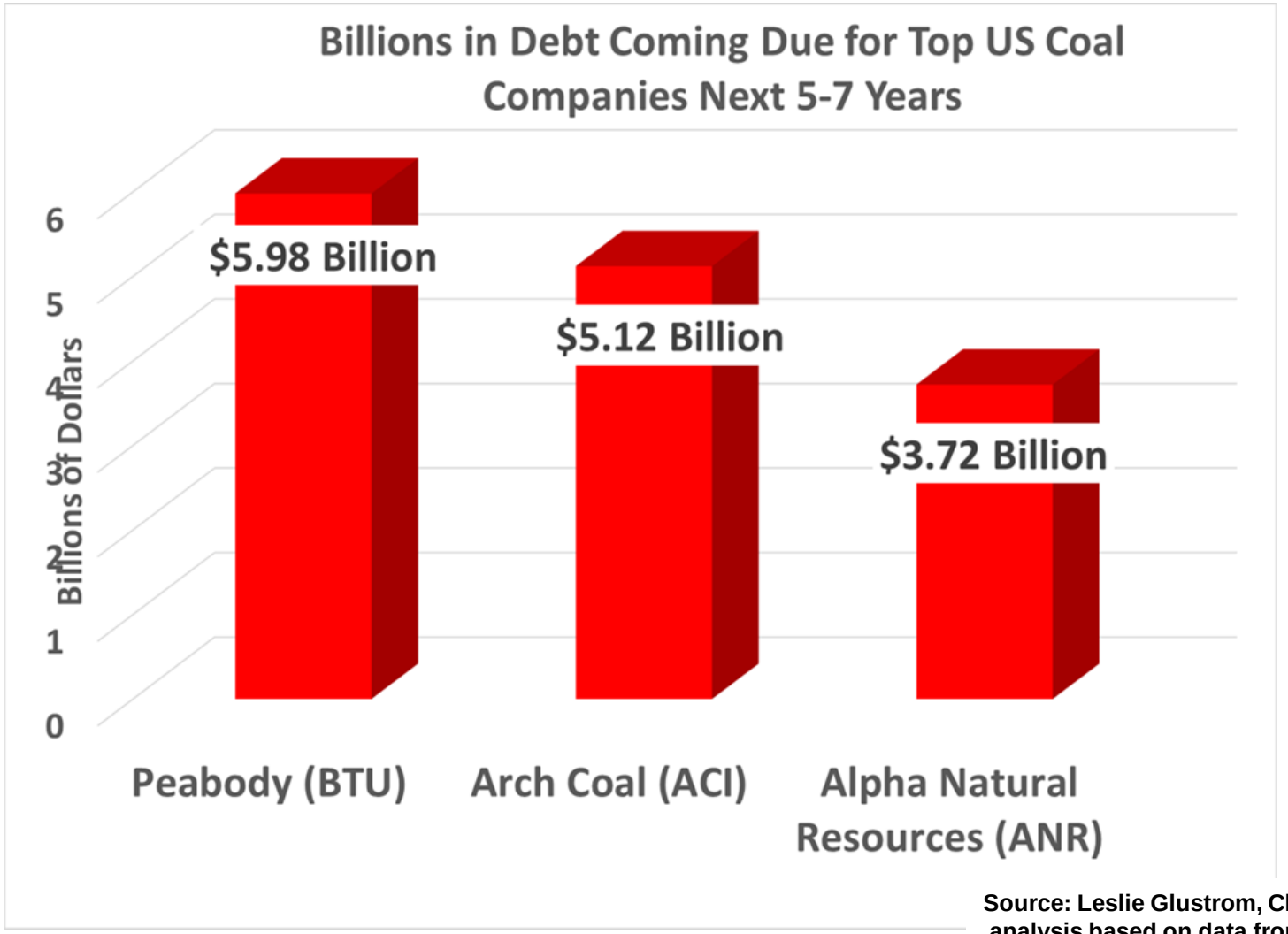
- Top 3 U.S. coal mining companies in the red



Source: Leslie Glustrom, Clean Energy Action, analysis based on data from corporate 10-K filings.

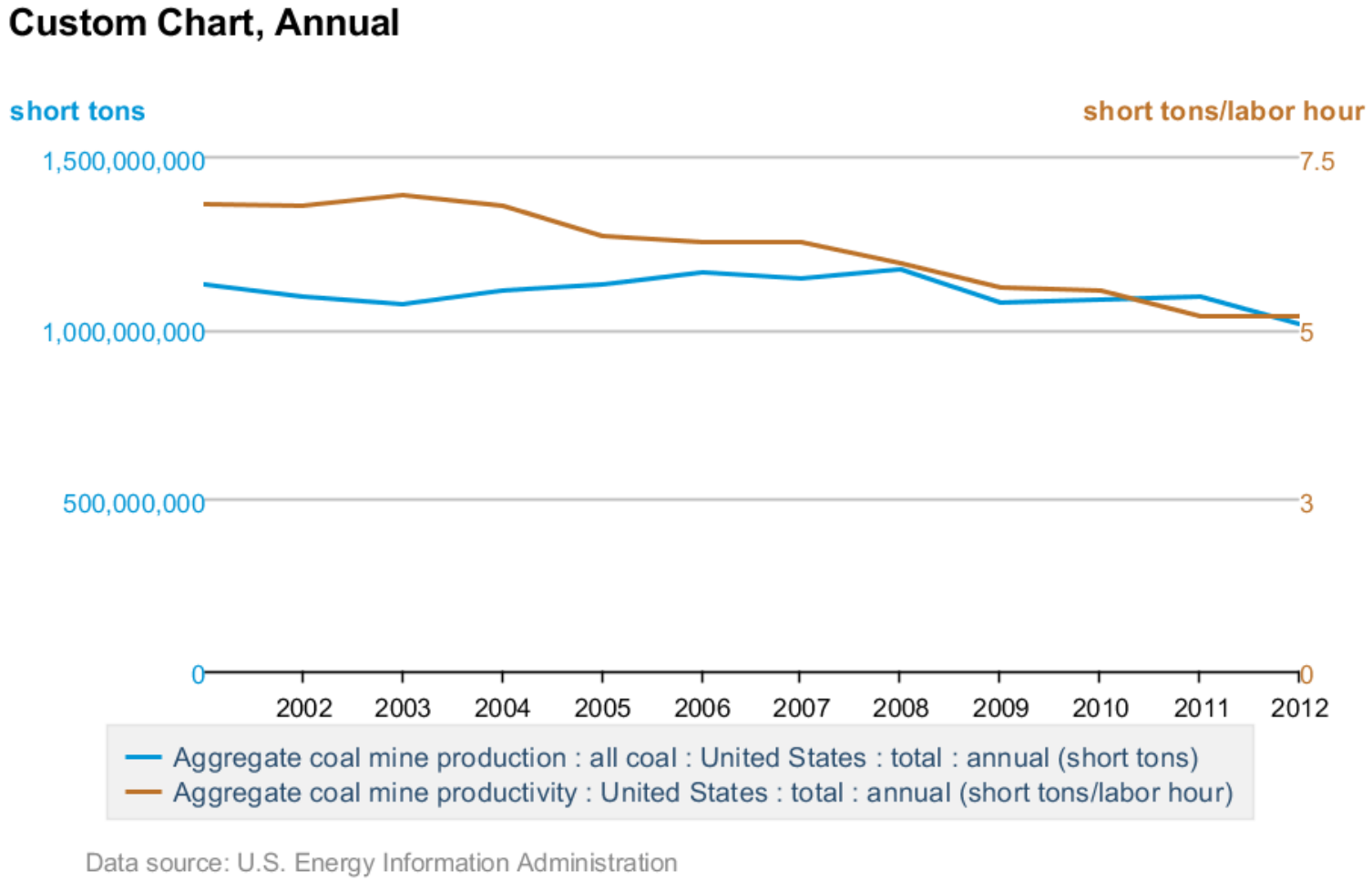
- (Formerly) #3 ANR and over 20 small coal companies have filed for bankruptcy…

Exacerbated by Heavy Debt Load and Need to Restructure



Source: Leslie Glustrom, Clean Energy Action; analysis based on data from 2014 10-K filings (Peabody, p. R-38; Arch, p. R-27; ANR, p.75.

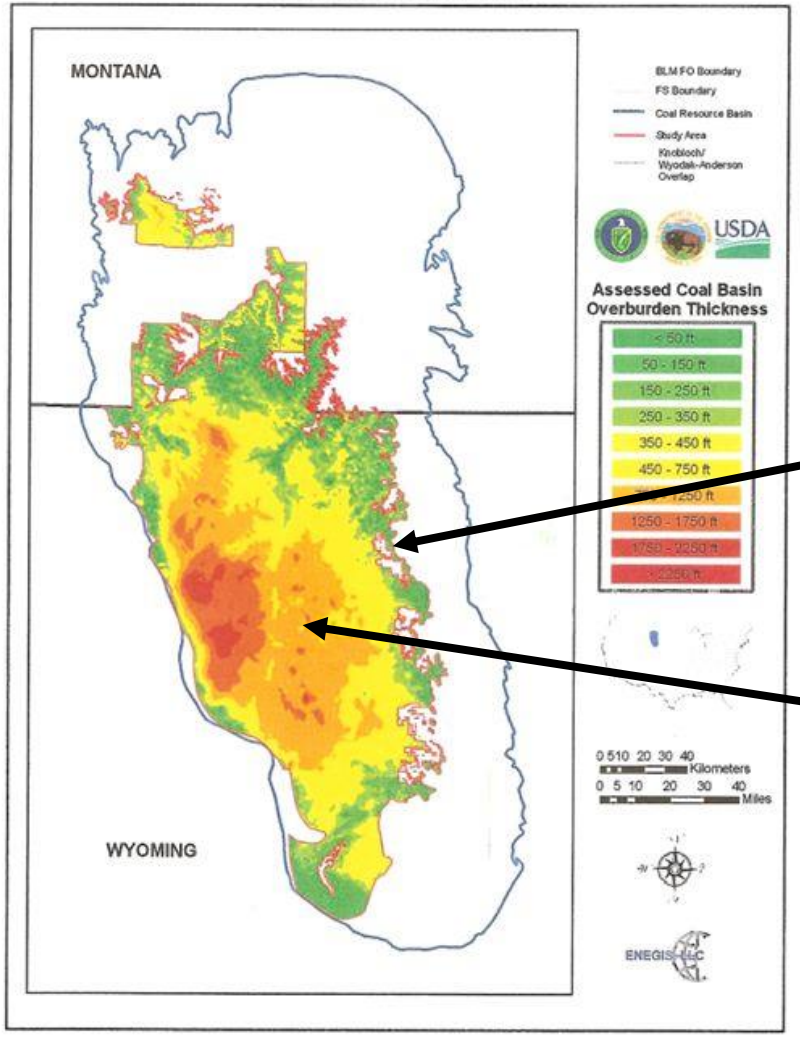
Productivity Declining; No Major Improvements Expected



Data source: U.S. Energy Information Administration

USGS Reports Much Coal Too Deep to Be Mined Profitably

Figure 2-3. Overburden Thickness above Assessed Coal Zones in the Powder River Basin

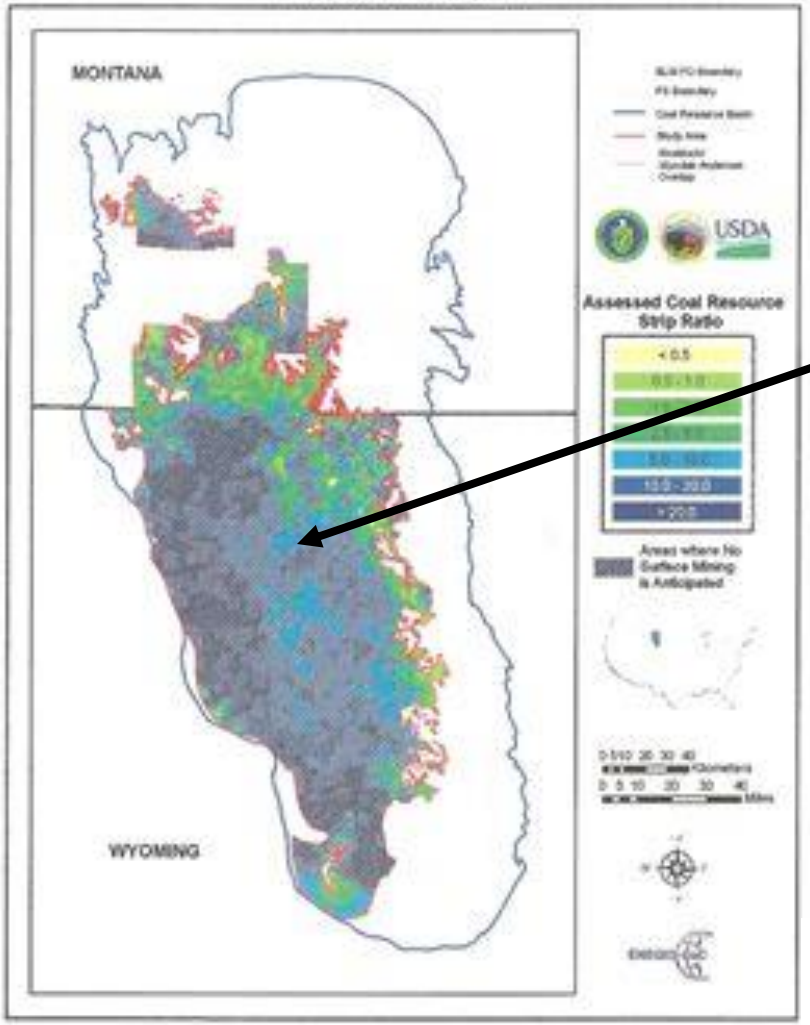


- Powder River Basin ("PRB") in Wyoming and Montana a major producing area
- PRB coal at 50-200' deep is typically surface mined, but…
- Much of PRB coal lies beneath more than 750' of overburden.

Source: U.S. Departments of Energy, Interior, and Agriculture, August 2007, Inventory of Federal Coal Resources and Restrictions to Their Development, p. 25, http://www.law.indiana.edu/publicland/files/epact437_final_rpt.pdf.

70% of PRB Coal Is Not Today Accessible by Surface Mining

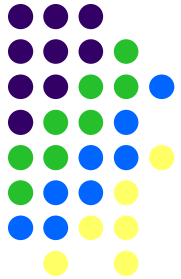
Figure 2-6. Resources beyond Conventional Surface Mining Technology in the Powder River Basin



- Blue-shaded areas = Areas where PRB surface mining is not anticipated
- Underground mining costs likely would make much PRB not currently economical to produce.

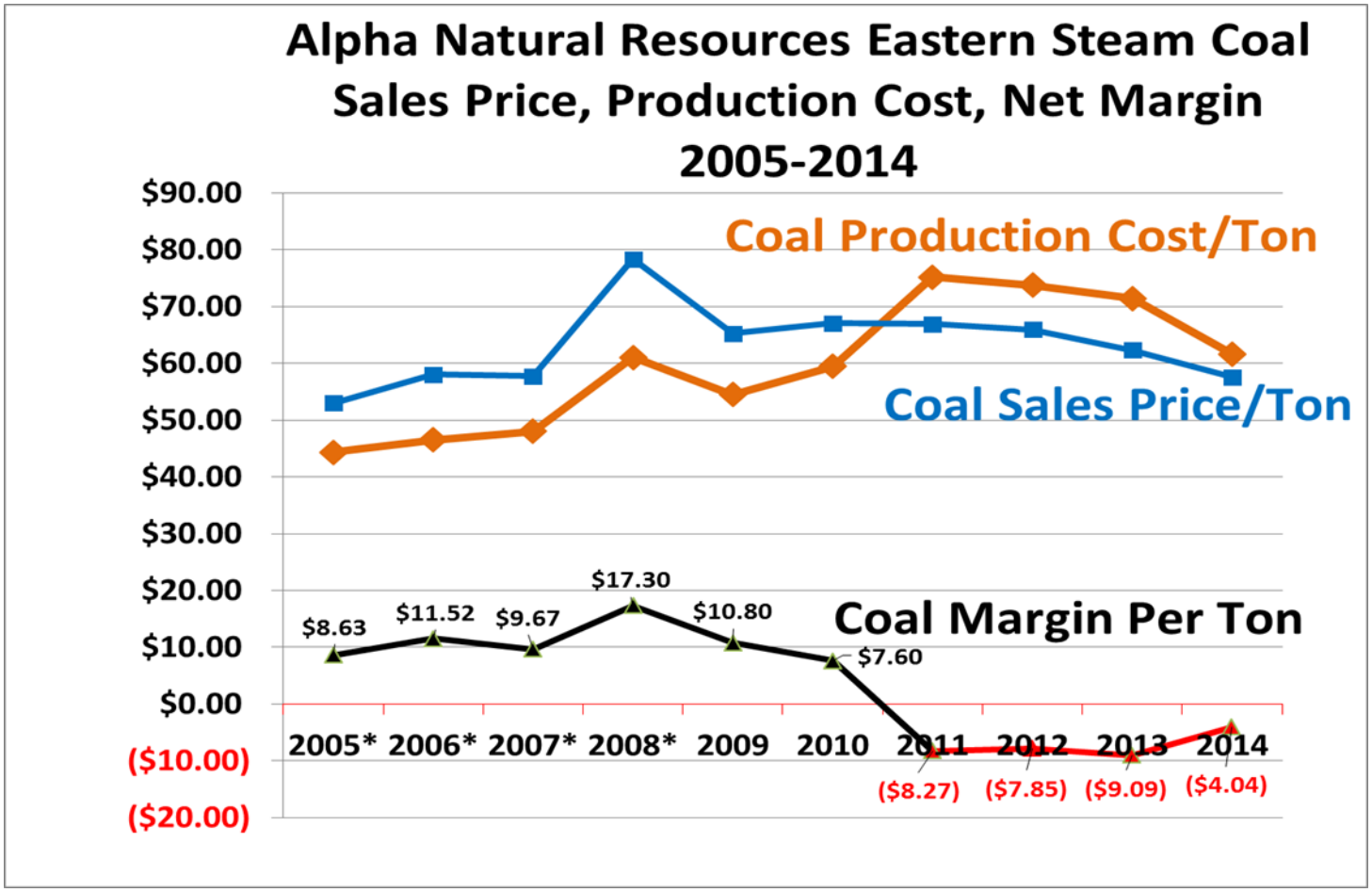
Source: U.S. Departments of Energy, Interior, and Agriculture, August 2007, Inventory of Federal Coal Resources and Restrictions to Their Development, p. 33, http://www.law.indiana.edu/publicland/files/epact437_final_rpt.pdf. Full details available in USGS 2008-1202 available at http://pubs.usgs.gov/of/2008/1202/

#1 Peabody Former CEO Greg Boyce 3Q2013 Earnings Call:



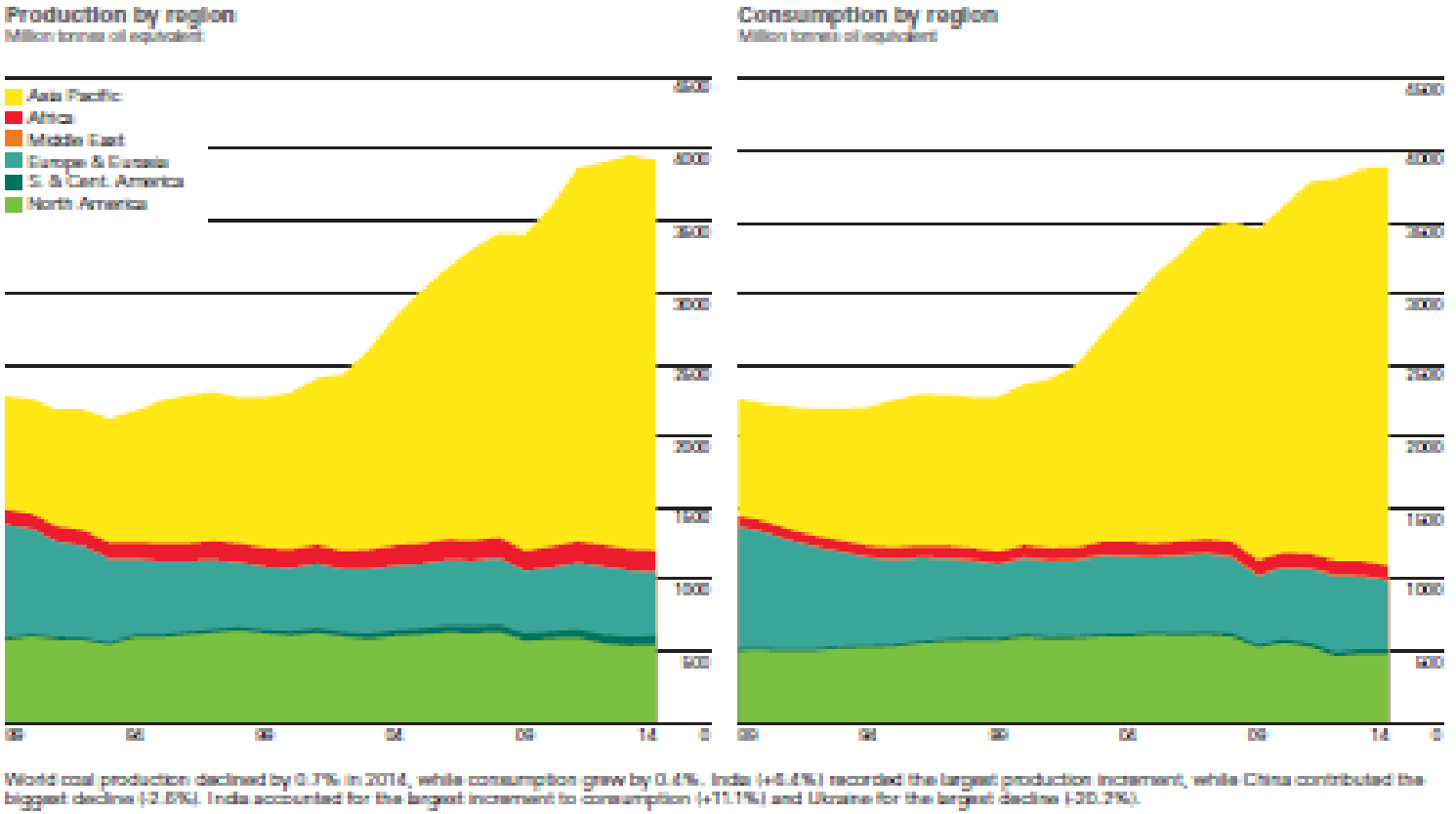
- …our view is [the capacity out in the Powder River Basin that can come back in as prices continue to increase] it's fairly limited.
- "…people are going to have to start spending real cash to repair equipment that's been parked……people have not spent capital to replace equipment that ultimately reached the end of its useful life or…to overcome the annual increase in stripping ratio that naturally occurs in the Powder River Basin."

#3 ANR Operating at Negative Margins in Eastern Coal Fields



Source: Leslie Glustrom, Clean Energy Action, analysis based on data from ANR Q4 financial reports.

Imports/Exports: Balancing Tool

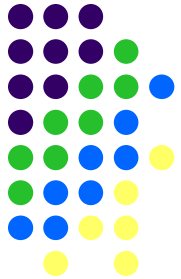


World coal production declined by 0.7% in 2014, while consumption grew by 0.4%. India (+6.4%) recorded the largest production increment, while China contributed the biggest decline (-2.6%). India accounted for the largest increment to consumption (+11.1%) and Ukraine for the largest decline (-20.2%).

Source: BP, June 2015, BP Statistical Review of World Energy, p. 34.

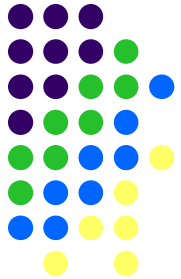
- Chinese and Indian coal imports are slowing
- U.S. coal exports unlikely to turn red ink into black ink.

Conclusion: Multiple Factors Conspiring Against U.S. Coal



- EIA coal “reserves” may be overstated given lack of independent economic analysis
- More onerous final CPP likely to lead to more coal plant shutdowns than previously thought
- Low natural gas prices challenge coal use
- Financial distress of major U.S. coal producers likely to be exacerbated; some may not survive; operating at a loss not viable long term
- Geology of coal won’t be changed by politics.

Null Hypothesis Tests with Major Implications in Results…

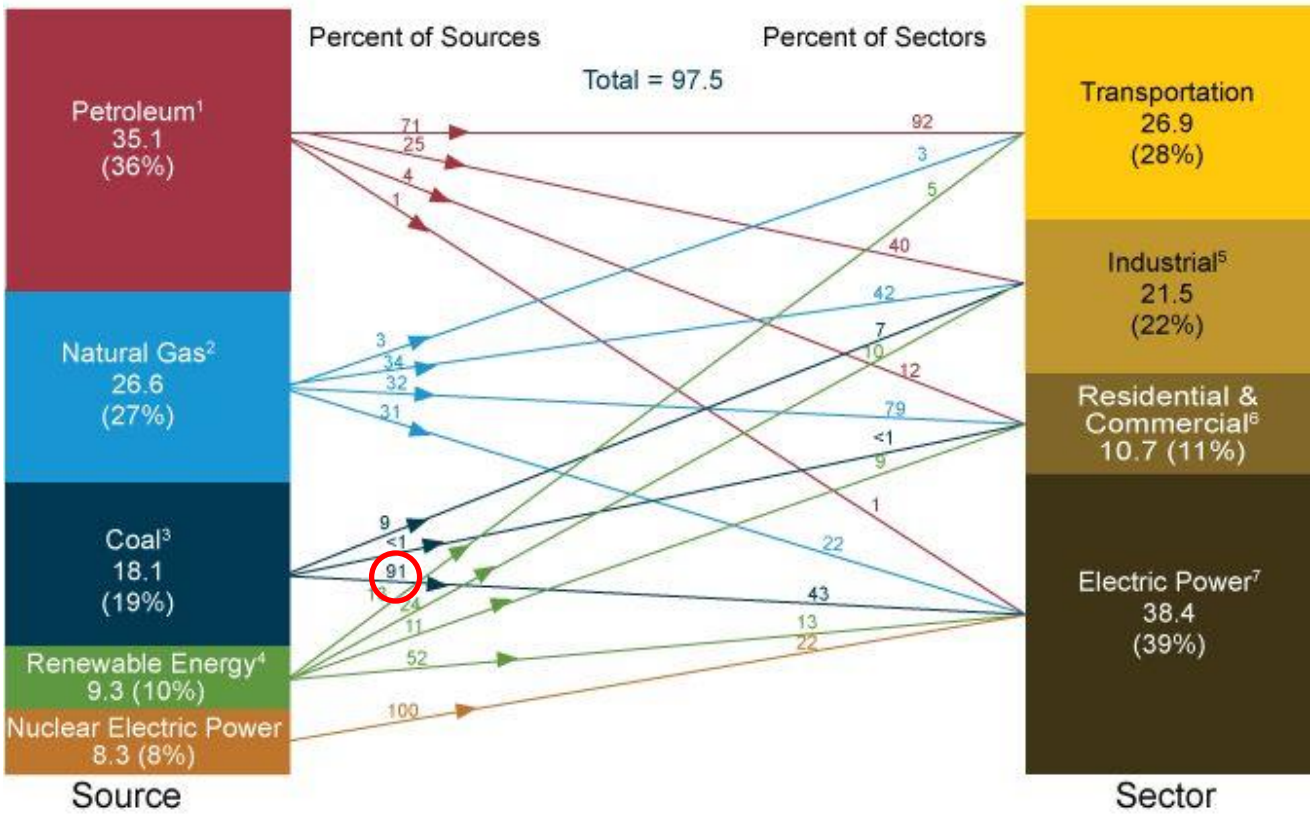


- The U.S. coal industry is in structural decline and facing geological constraints that are not likely to be overcome anytime soon; OR
- The U.S. coal industry will recover when natural gas prices increase; OR
- U.S. coal industry problems stem from Obama (Dem.) Administration policies. Under a Republican President, the U.S. coal industry will rebound quickly and remain stable.

Primary energy consumption by source and sector, 2013

quadrillion Btu

Source: U.S. Energy Information Administration, http://www.eia.gov/totalenergy/data/monthly/pdf/flow/css_2013_energy.pdf.



Thank you! Questions?

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