Synapse
Energy Economics, Inc.

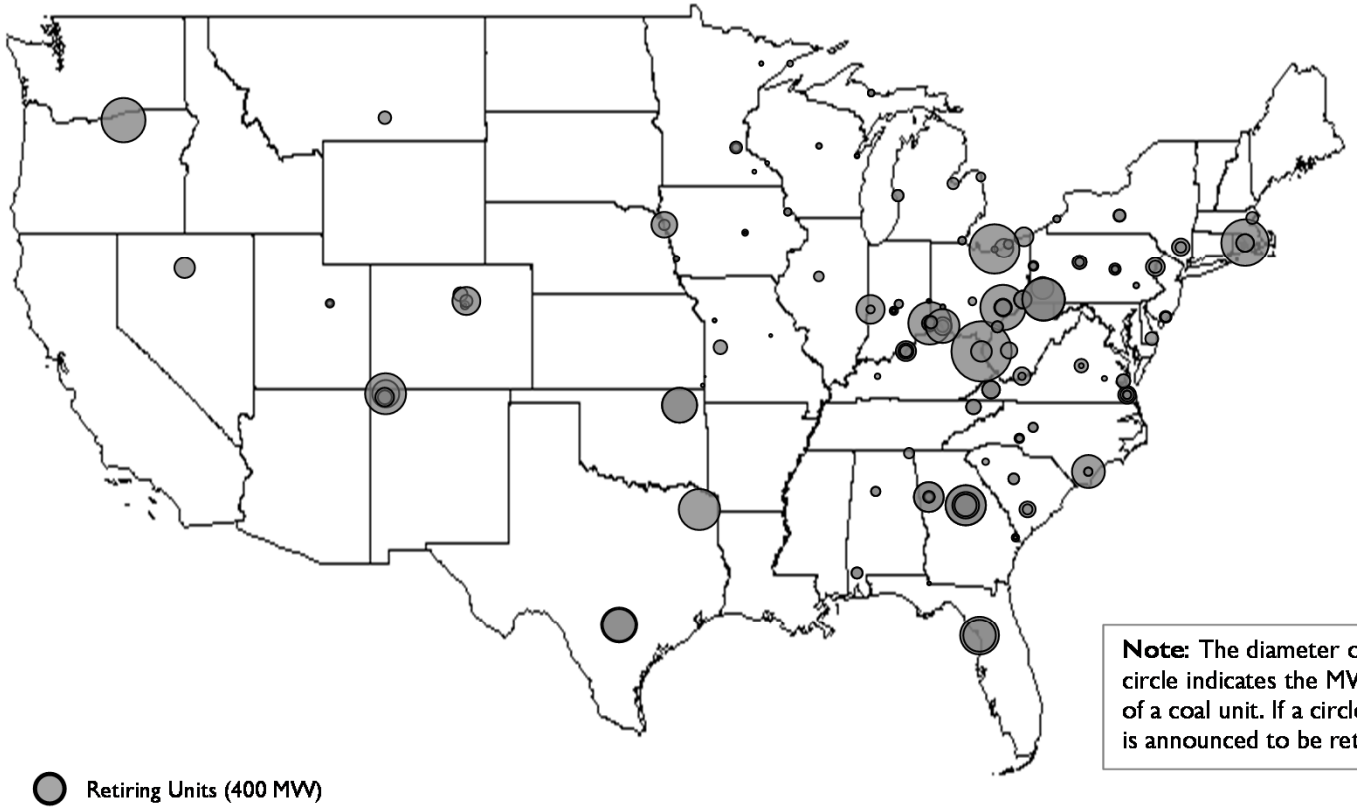
Coal Asset Valuation Tool (CAVT)

Coal Finance Training

19 March 2014, New York City

Bruce Biewald

Coal units all over the country are retiring



Coal unit retrofit vs. retirement decisions

Coal units are typically retired due to:

- Economic drivers:
  - Future costs of including environmental retrofits
  - Increased competitiveness of market purchases
- Other drivers:
  - Advocacy
  - Politics
  - Various other strategic considerations

What is CAVT?

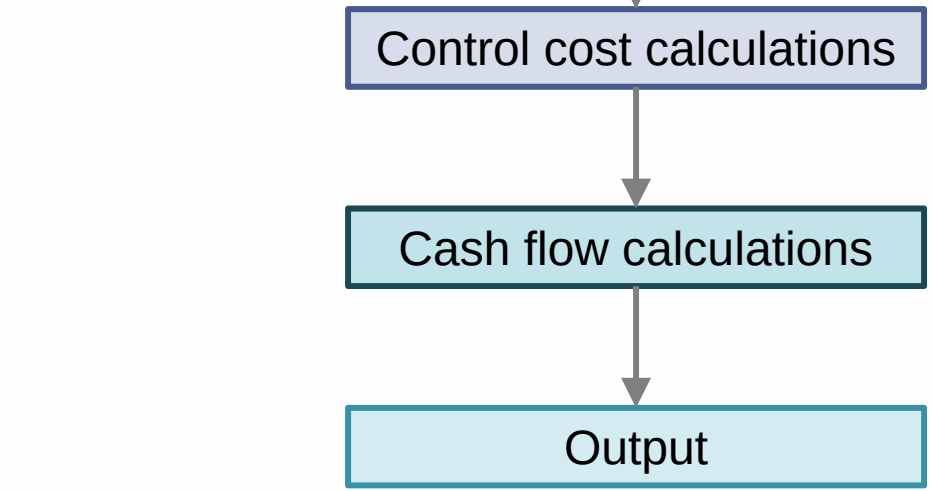
- CAVT is a spreadsheet-based database and model.
- It aggregates publicly available data (such as capacity, generated power, and heat rate) on ~1,000 non-cogenerating coal units
- CAVT combines this with publicly available cost methodologies to calculate the cost of complying with environmental regulations
- It adds in environmental retrofit capital and O&M costs for the year the control is expected to come into effect. The net present value of each unit's lifetime cost is then calculated for 2013 through 2042.
- CAVT then compares these economics with proxy values for energy market prices.

Model Framework

Publicly-available data
- EIA 860
- EIA 923
- EPA AMP dataset
- AEO assumptions for market price

Environmental control cost estimates
- Sargent & Lundy
- EPA 316(b) technical development document
- EPRI cost assessment
- EPA effluent guidelines
- Synapse CO2 forecast

User-defined toggles
- Gas price sensitivities, environmental retrofit cases
- Dates of control requirement



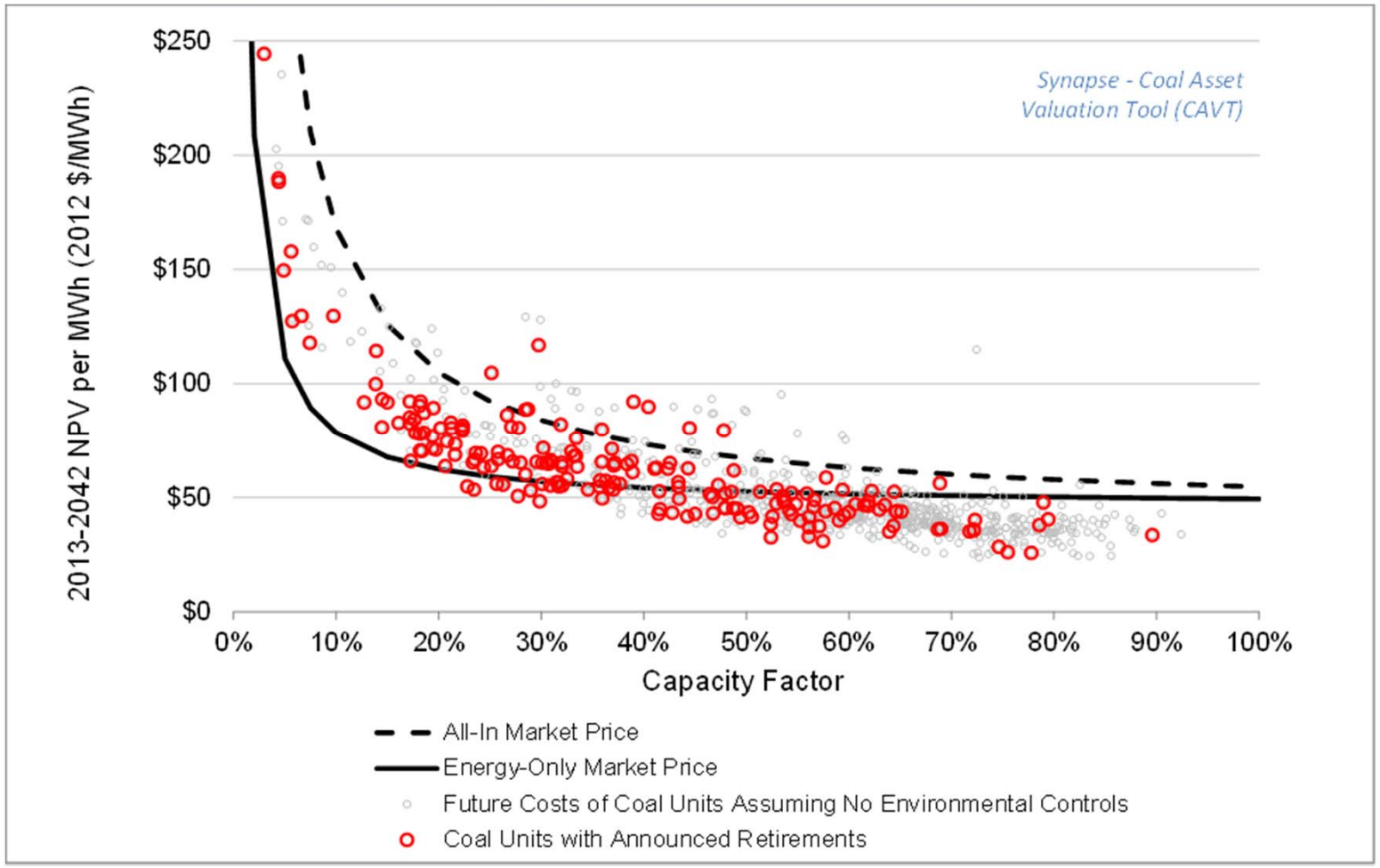
What is CAVT for?

- **Preliminary assessment of coal asset value**. Providing publicly available estimates, triggering public and commission scrutiny where otherwise obscured, compelling utility planning where otherwise absent
- **Starting point for detailed, unit-specific cash flow analysis**. Generic publicly available data can be replaced with unit-specific (and possibly confidential) data incrementally, as such data are obtained
- **Prioritization and screening**. Identifying candidates for retirement and focusing advocacy efforts
- **National and regional analyses**. Developing and costing out broadly defined coal fleet retrofit/retirement scenarios

Limitations and caveats:

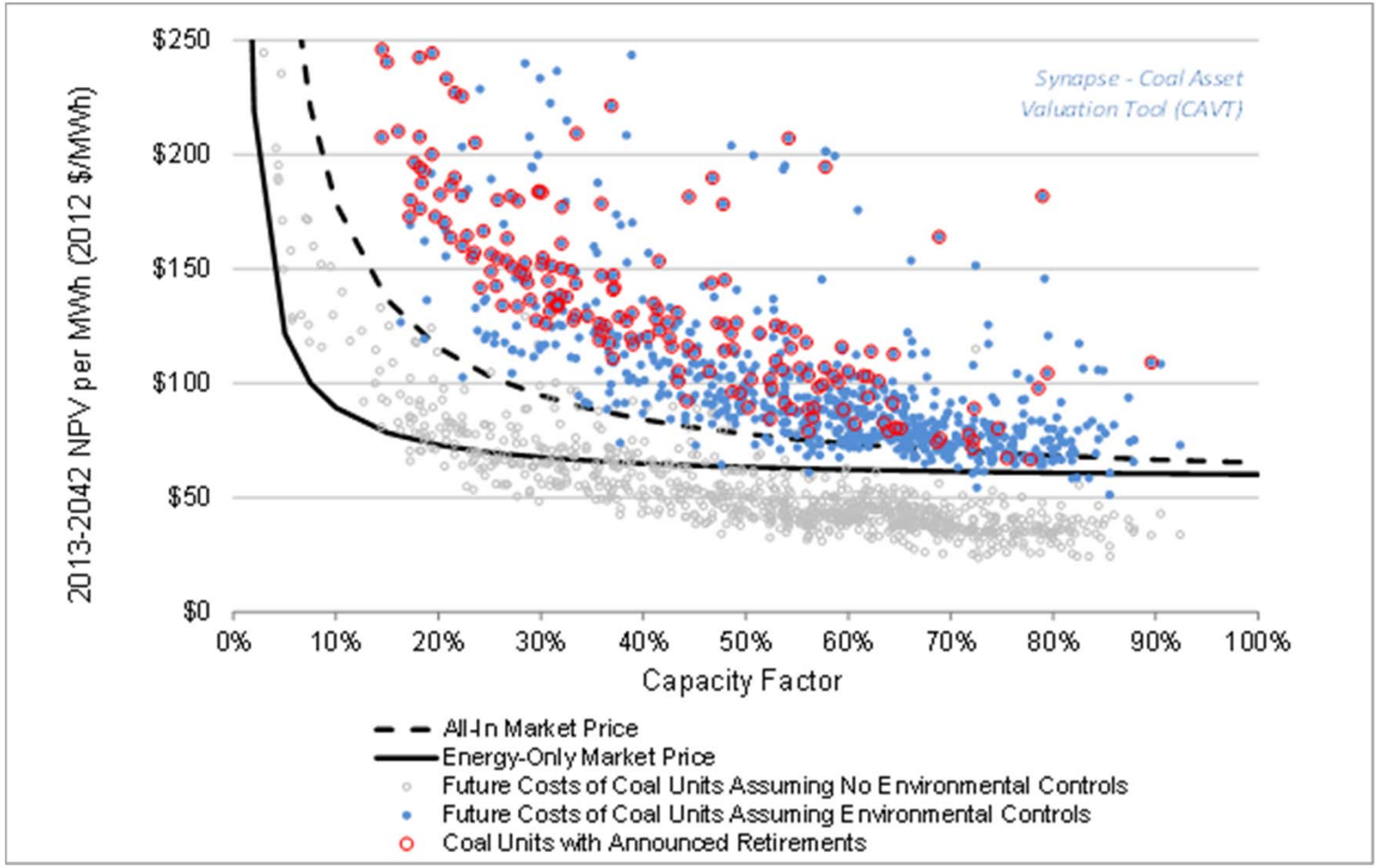
- *Where possible, users should review CAVT assumptions for specific cases, particularly with regard to individual units*
- *CAVT uses numerous simplifying assumptions (e.g., capacity factors are fixed over time)*

Coal unit competitiveness without retrofit costs



Many units currently announced for retirement are more economic than market price, if we assume no change in environmental controls.

Coal unit competitiveness with retrofit costs



Adding in the costs of environmental retrofits drives most units to be uneconomic– including all but three units currently announced for retirement.

Sensitivity Analysis

Natural Gas Price	**High**	Natural gas prices grow at the AEO 2012 Low Estimated Ultimate Recovery Case rate of change
	Mid	Natural gas prices grow at the AEO 2012 Reference Case rate of change
	Low	Natural gas prices grow at the AEO 2012 High Estimated Ultimate Recovery Case rate of change

Environmental Control Requirements	**Strict**	FGD, SCR, Baghouse, ACI, Impingement Controls and Recirculating Cooling on units with intakes > 125 MGD, Coal Combustion Residual (Subtitle C), Effluent Regulatory Option "4a," "Synapse Mid" CO_2 Price
	Mid	FGD, SCR, Baghouse, ACI, Impingement Controls and Recirculating Cooling on units with intakes > 125 MGD, Coal Combustion Residual (Subtitle D), Effluent Regulatory Option "3," "Synapse Mid" CO_2 Price
	Lenient	Baghouse, ACI, Impingement Controls, Effluent Regulatory Option "3a," "Synapse Low" CO_2 Price

Note that environmental retrofits are required in different years based on the sensitivity.

Results: Mid-cases and sensitivities

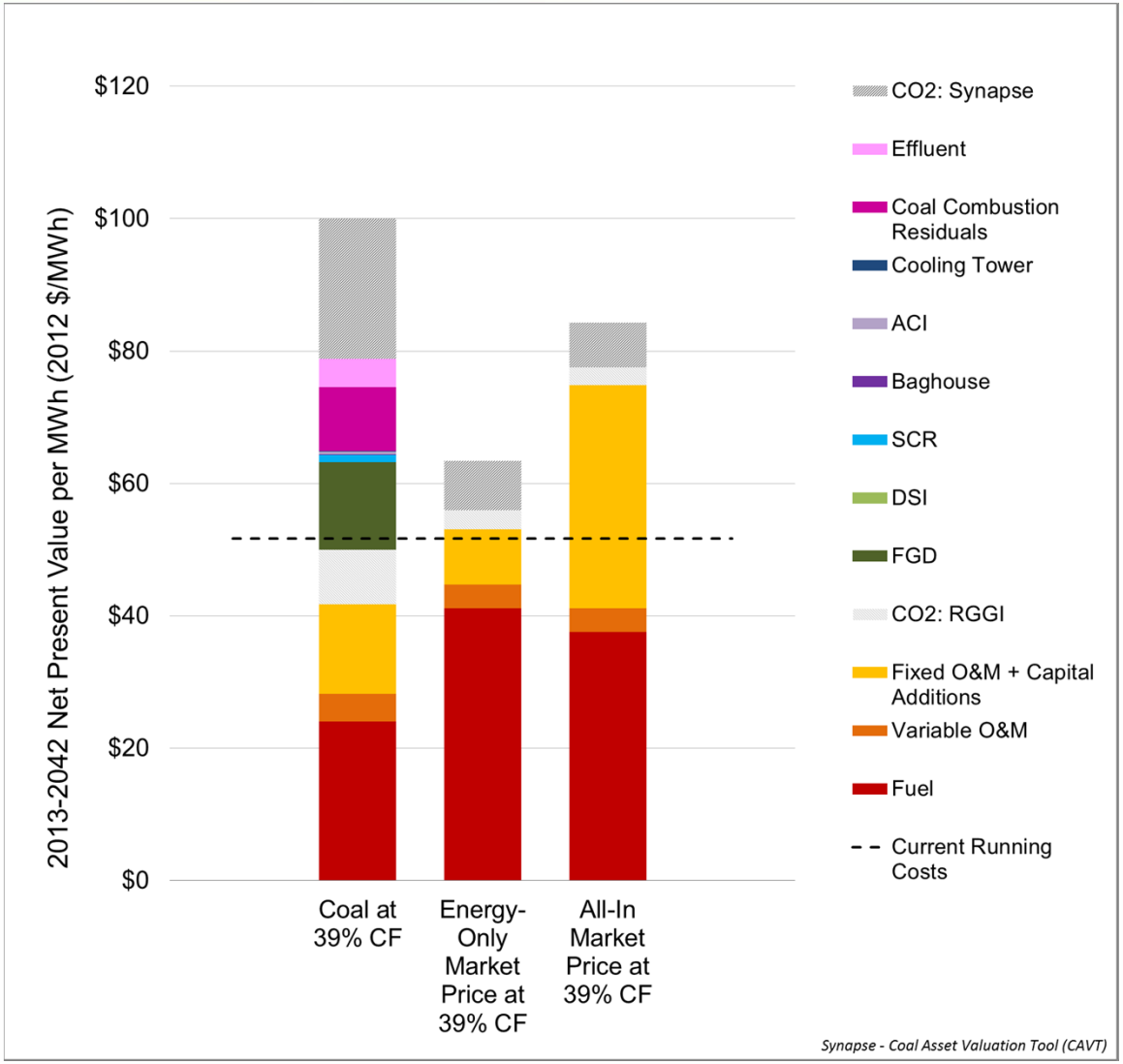
Uneconomic Coal Capacity Compared to Energy-Only Purchases (GW)

Natural Gas Price	Environmental Retrofit			
		Lenient	Mid	Strict
	High	192 (62%)		292 (94%)
	Mid		295 (95%)	
	Low	254 (82%)		306 (98%)

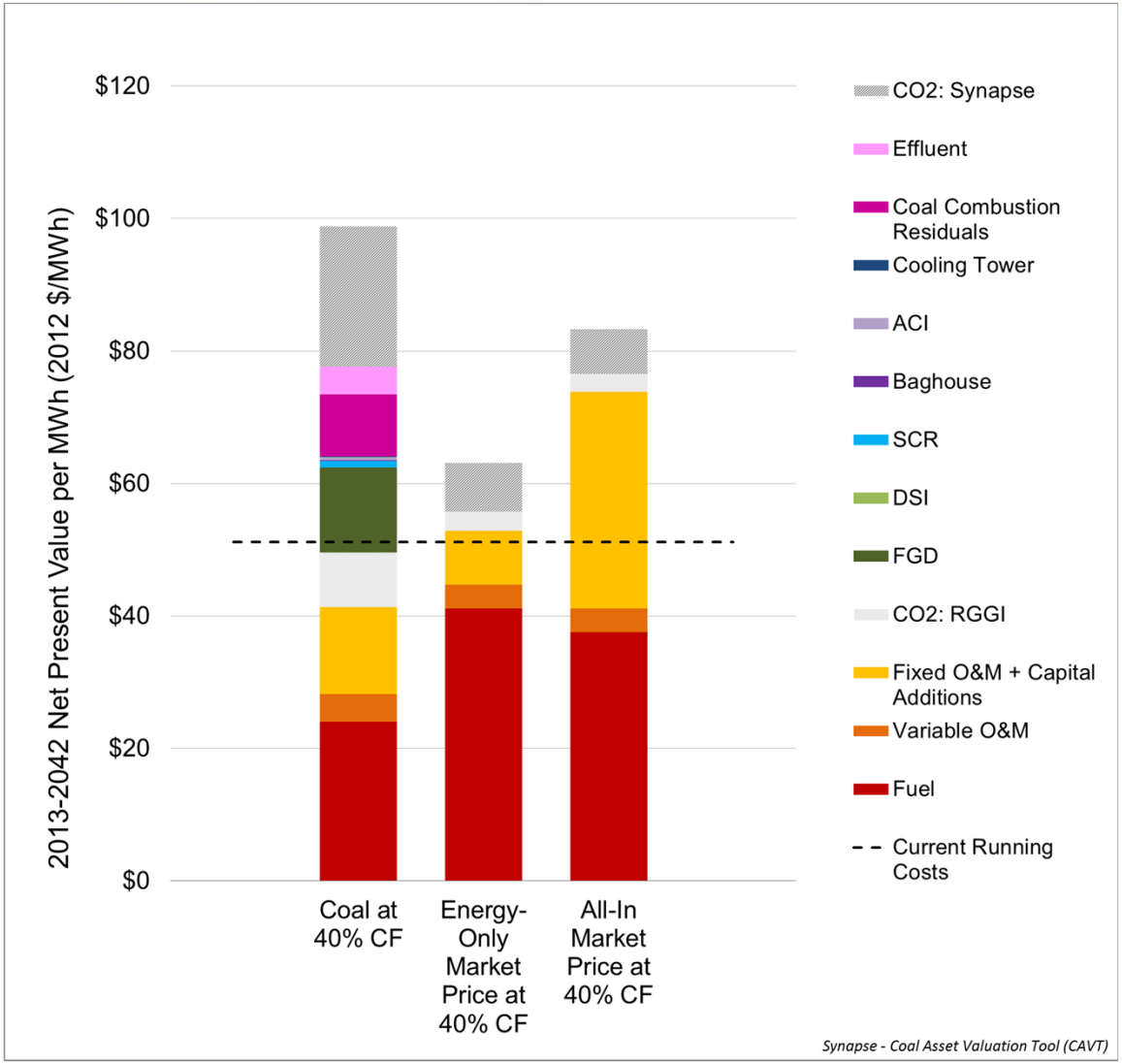
Uneconomic Coal Capacity Compared to All-In Purchases (GW)

Natural Gas Price	Environmental Retrofit			
		Lenient	Mid	Strict
	High	63 (20%)		230 (74%)
	Mid		228 (73%)	
	Low	101 (33%)		274 (88%)

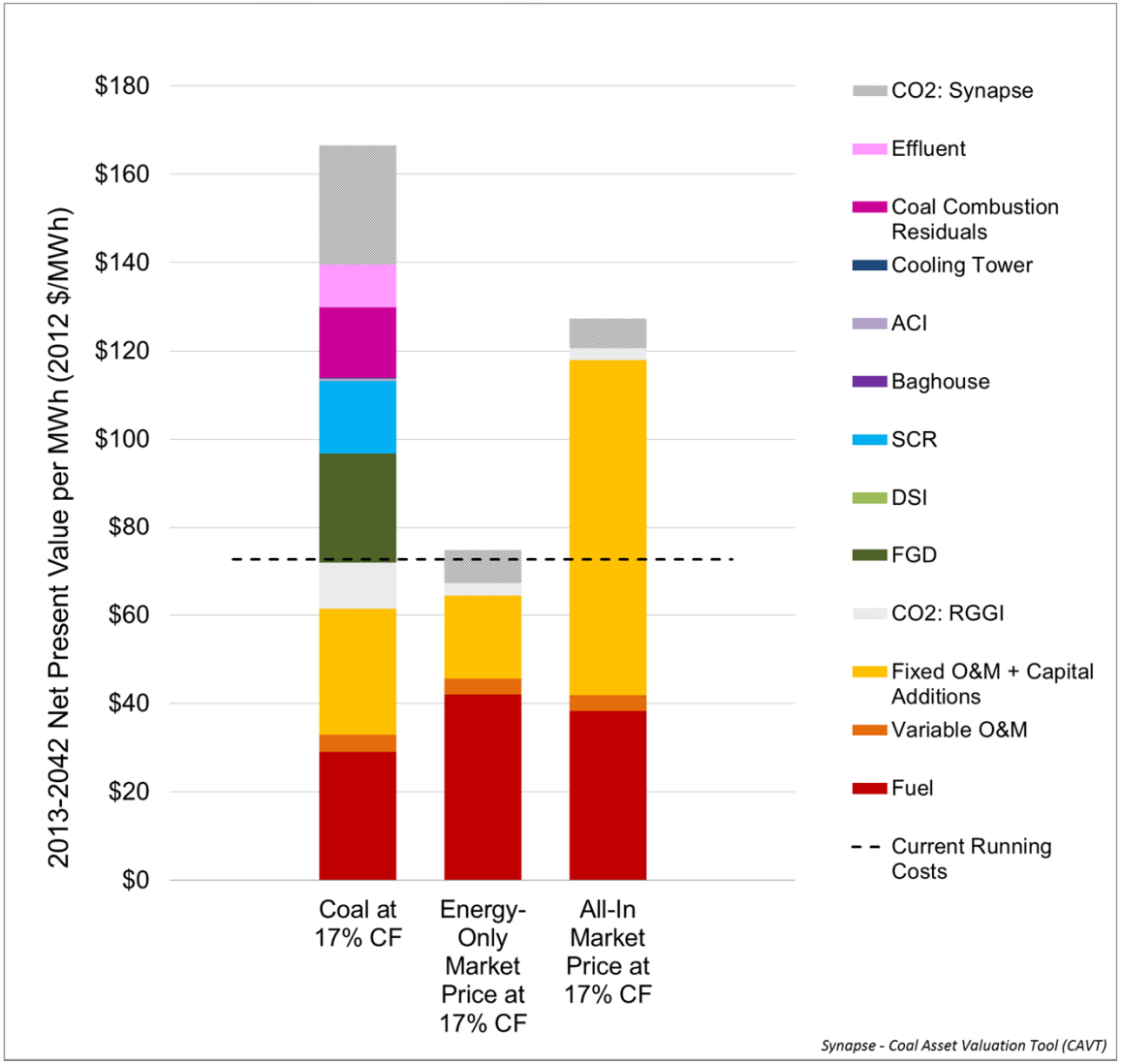
C R Huntley Generating Station 67: A Case Study in Uneconomic Coal



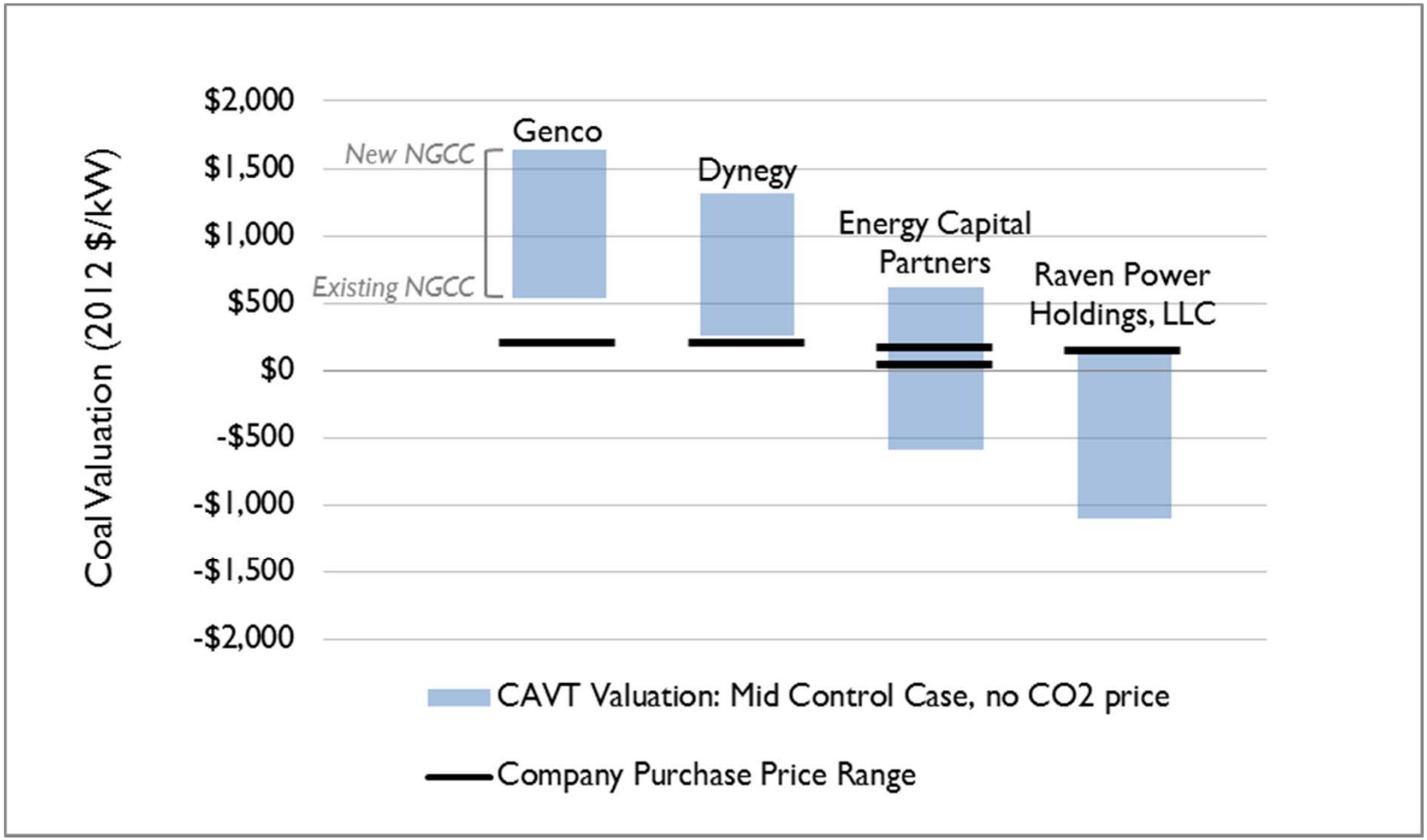
C R Huntley Generating Station S68: A Case Study in Uneconomic Coal



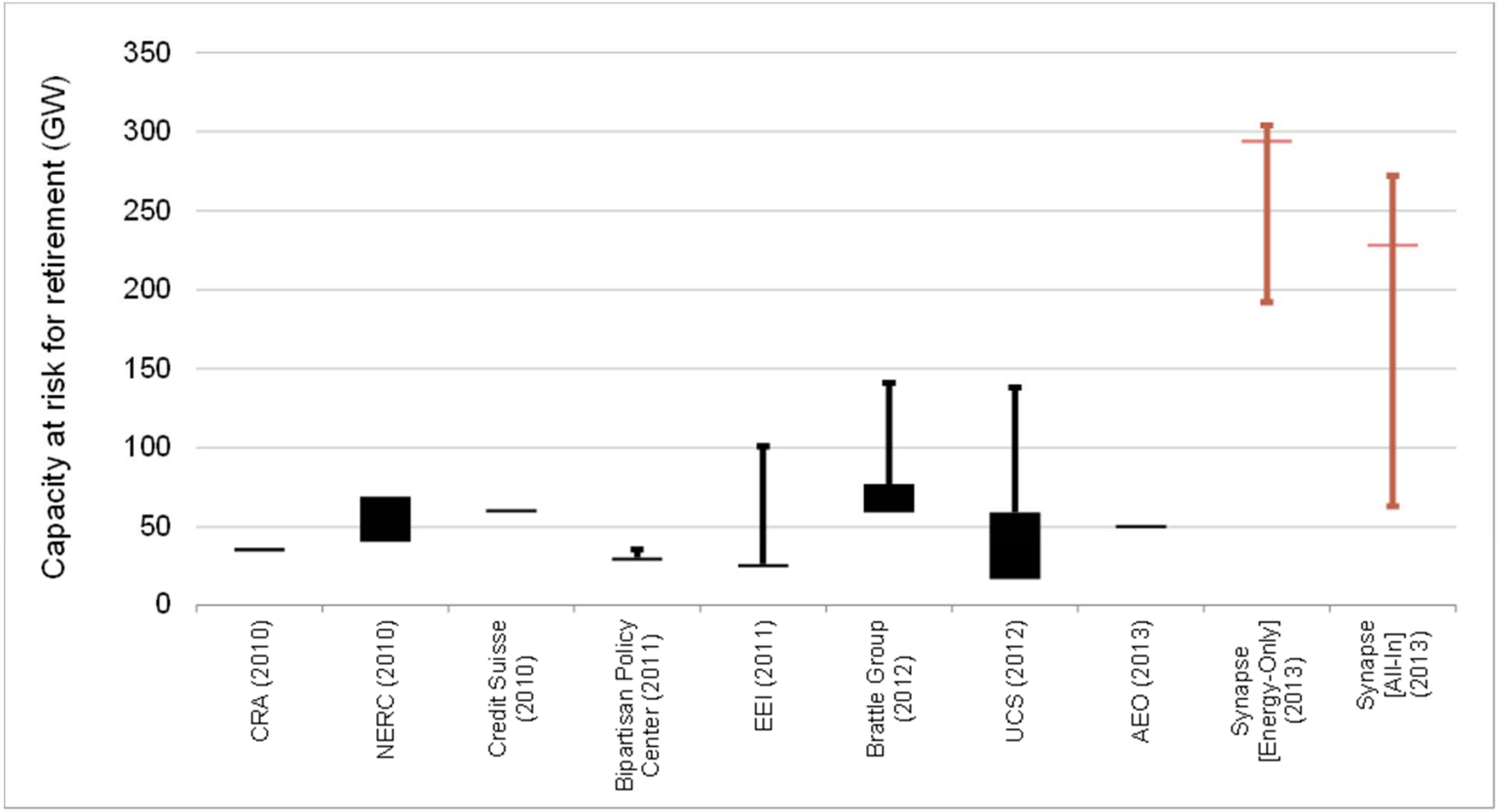
Bridgeport Station 3: A Case Study in Uneconomic Coal



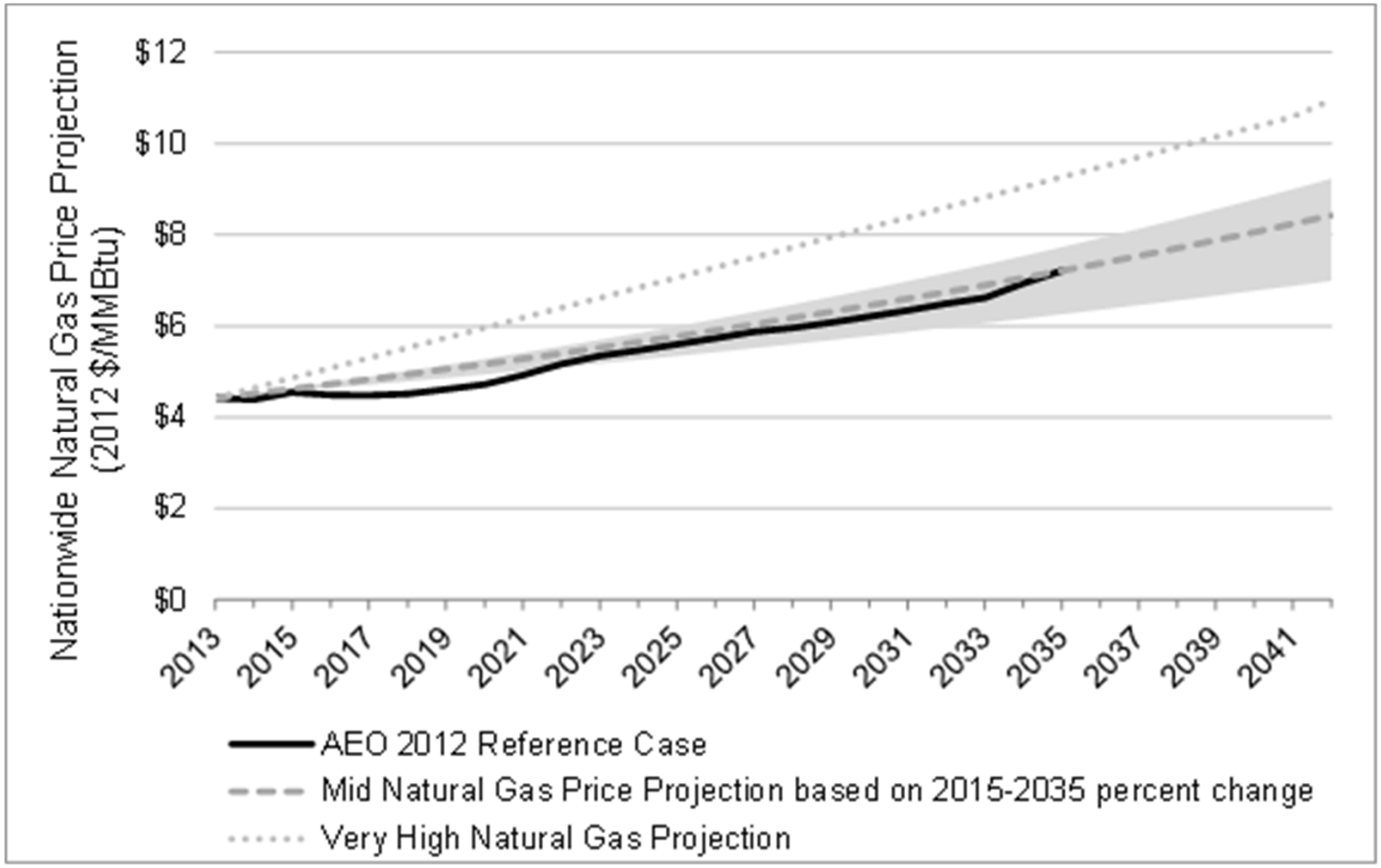
CAVT vs. Actual Market Valuations



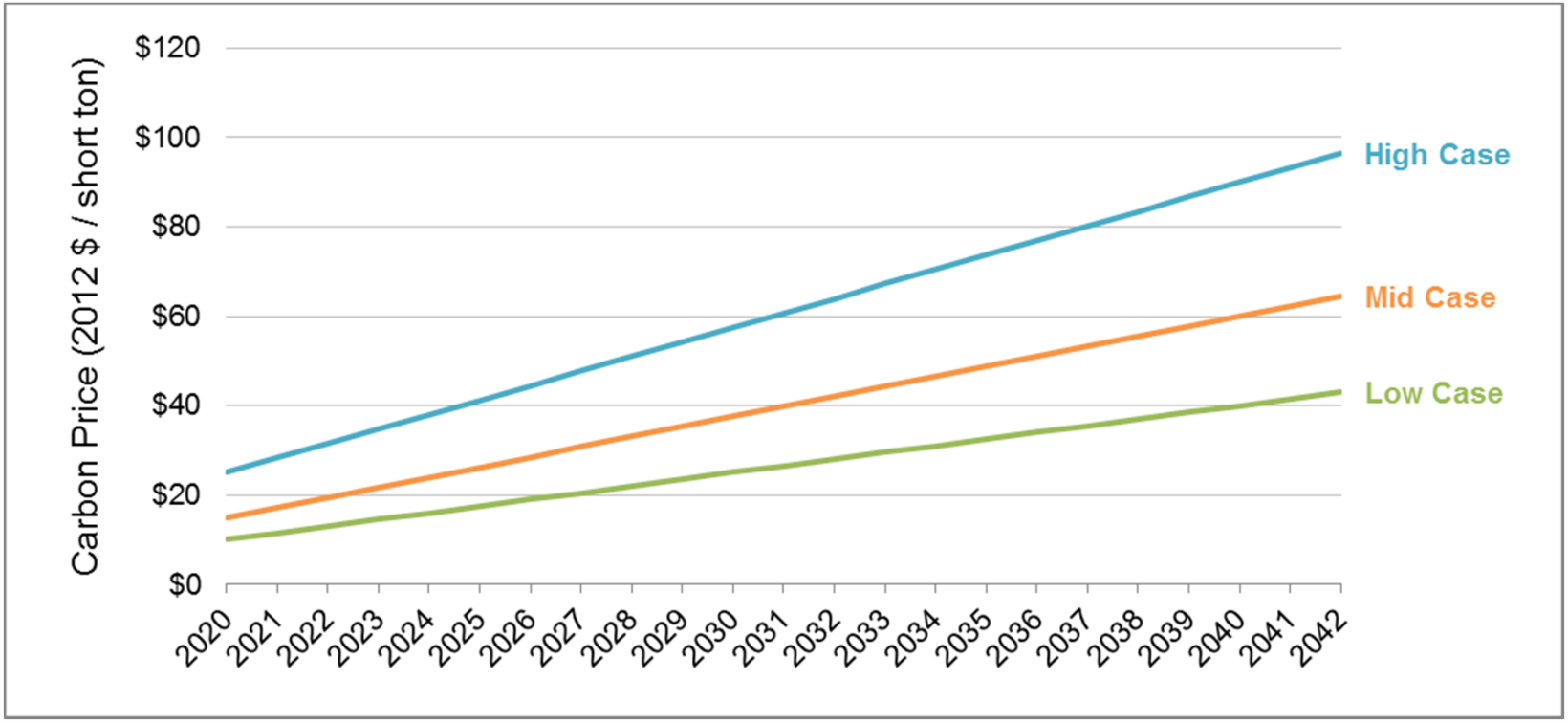
Appendix: How does CAVT compare?



Appendix: Natural Gas Price Projections



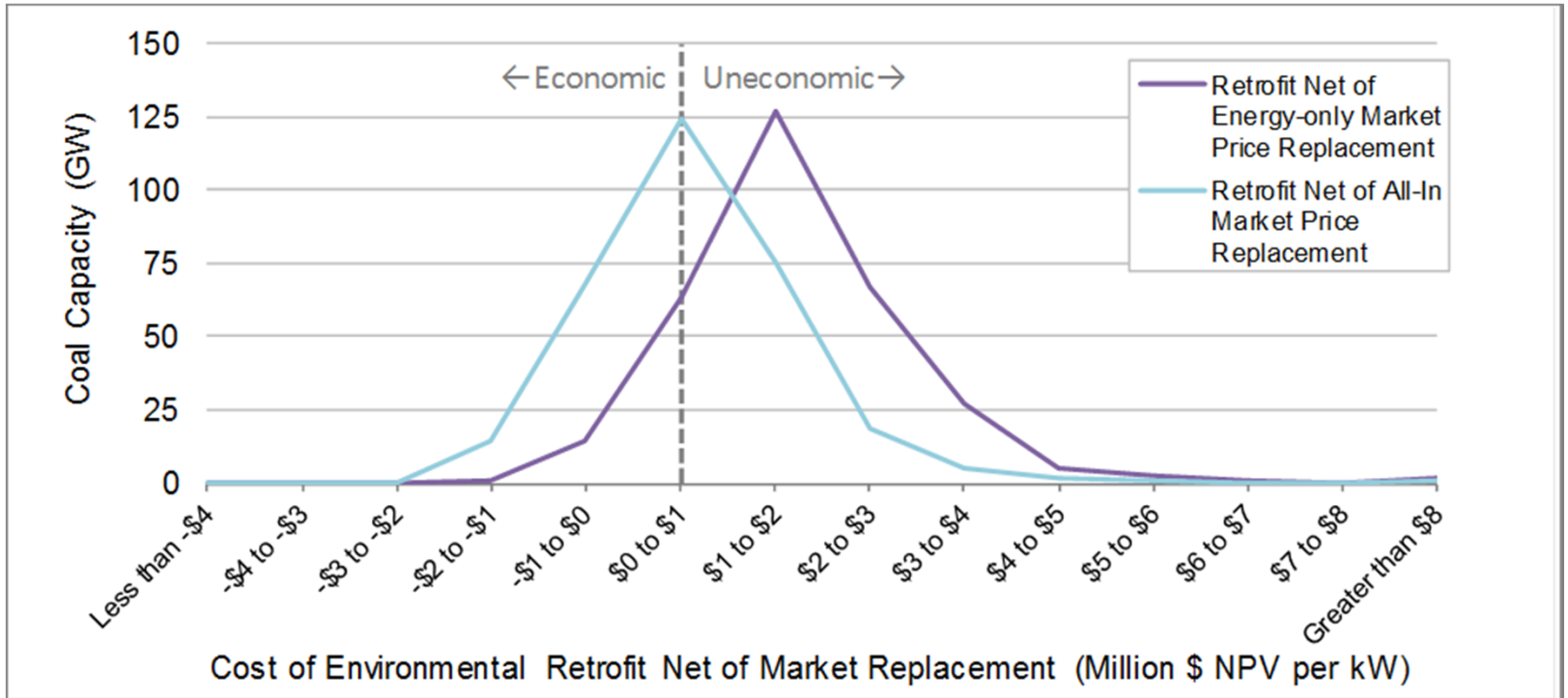
Appendix: Carbon Price Projections



Levelized Costs (2012 $/short ton)
High: $51.79/short ton
Mid: $33.54/short ton
Low: $22.36/short ton

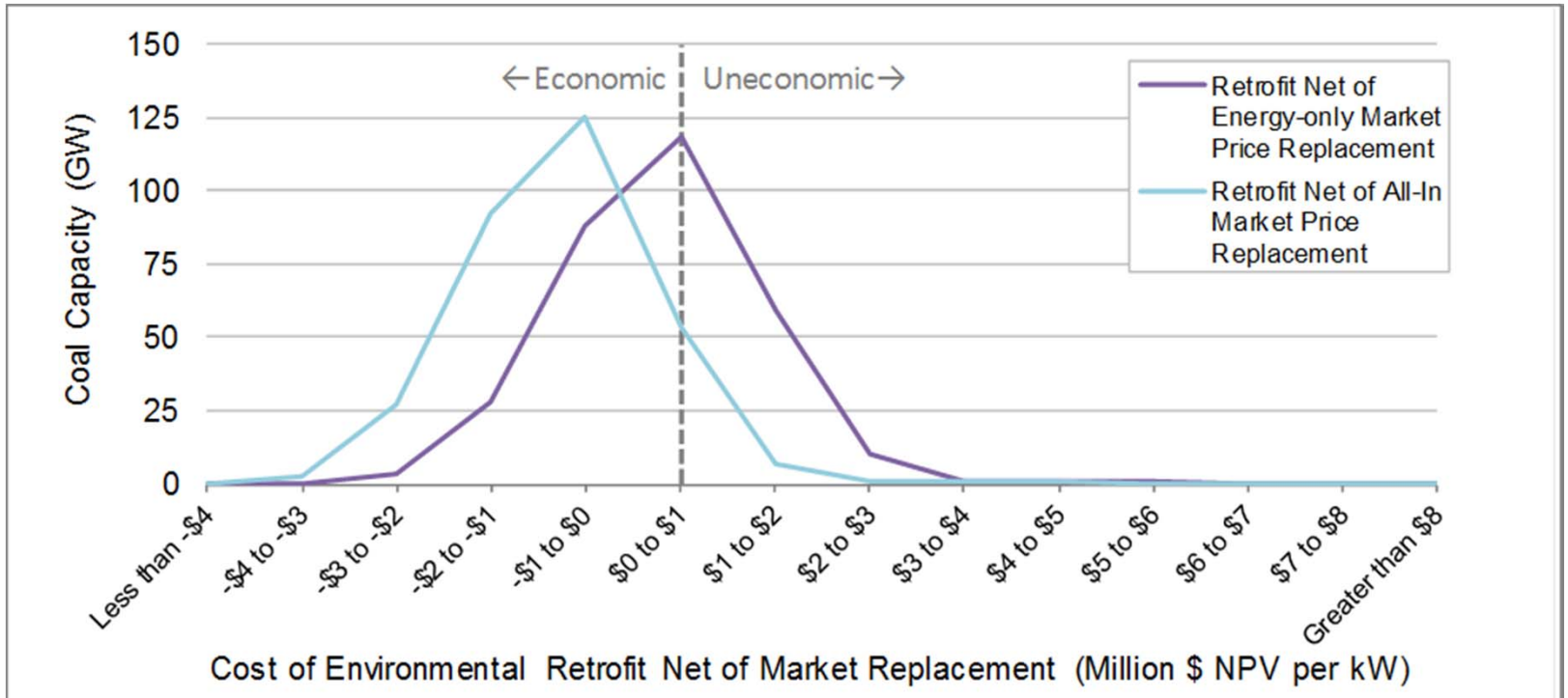
Synapse “Mid” assumed for medium and Strict CAVT cases.
Synapse “Low” assumed for Lenient CAVT case.

Results: Mid Environmental Retrofits, Mid Gas Price



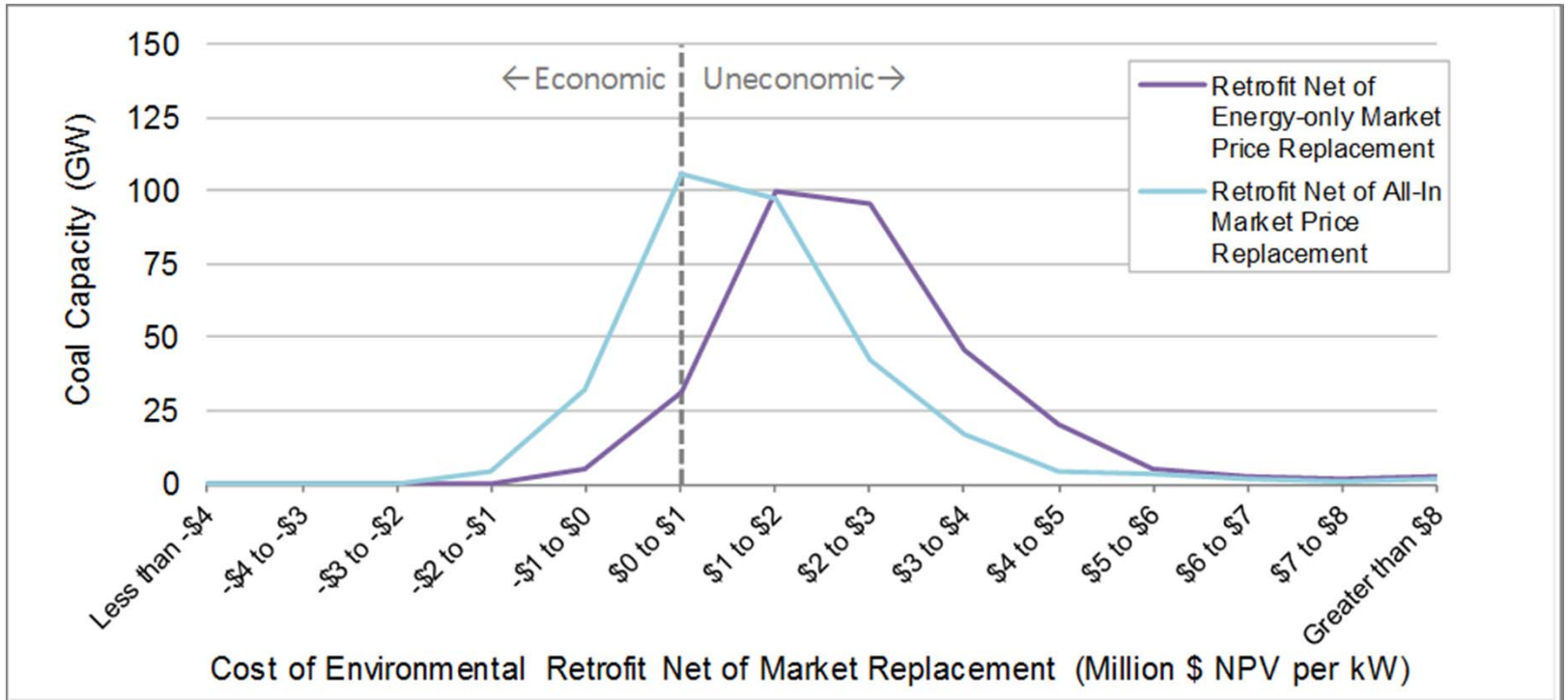
Percent of Coal Fleet Rendered Uneconomic	Cost of Environmental Retrofit Net of Energy-only Market Price Replacement	Cost of Environmental Retrofit Net of All-In Market Price Replacement
Number of Units	860 (97%)	751 (85%)
Capacity (GW)	295 (95%)	228 (73%)
Generation (TWh)	1,501 (94%)	1,122 (70%)

Results: Lenient Environmental Retrofits, High Gas Price



Percent of Coal Fleet Rendered Uneconomic	Cost of Environmental Retrofit Net of Energy-only Market Price Replacement	Cost of Environmental Retrofit Net of All-In Market Price Replacement
Number of Units	676 (76%)	364 (41%)
Capacity (GW)	192 (62%)	63 (20%)
Generation (TWh)	883 (55%)	244 (15%)

Results: Strict Environmental Retrofits, Low Gas Price



Percent of Coal Fleet Rendered Uneconomic	Cost of Environmental Retrofit Net of Energy-only Market Price Replacement	Cost of Environmental Retrofit Net of All-In Market Price Replacement
Number of Units	881 (99%)	829 (93%)
Capacity (GW)	306 (98%)	274 (88%)
Generation (TWh)	1,573 (98%)	1,388 (87%)

CAVT Development & Availability

Who made CAVT?

- Pat Knight, with others at Synapse including Liz Stanton, Jeremy Fisher, and Bruce Biewald
- Inspiration and funding from Synapse (internal), Energy Foundation, and Sierra Club ("Triage," a predecessor model)
- Feedback from applications in many IRP, CPCN, and rate cases

Where can I get CAVT?

- CAVT will eventually be on our new and improved website (scheduled for release August 2014)
- Questions, requests for updates and features, version control: Contact Pat Knight at pknight@synapse-energy.com or 617-453-7051

Reference List

- Stanton, E. A., F. Ackerman, and J. Daniel. 2014. *Comments on the 2013 Technical Update of the Social Cost of Carbon*. Synapse Energy Economics for the Environment, Economics and Society Institute.
- Knight, P., E. A. Stanton, J. Fisher, B. Biewald. 2013. *Forecasting Coal Unit Competitiveness: Coal Retirement Assessment Using Synapse's Coal Asset Valuation Tool (CAVT).* Synapse Energy Economics for The Energy Foundation.
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- Comings, T. 2013. *Midwest Generation's Illinois Coal Plants: Too Expensive to Compete? Report Update*. Synapse Energy Economics for the Sierra Club.