Synapse
Energy Economics, Inc.

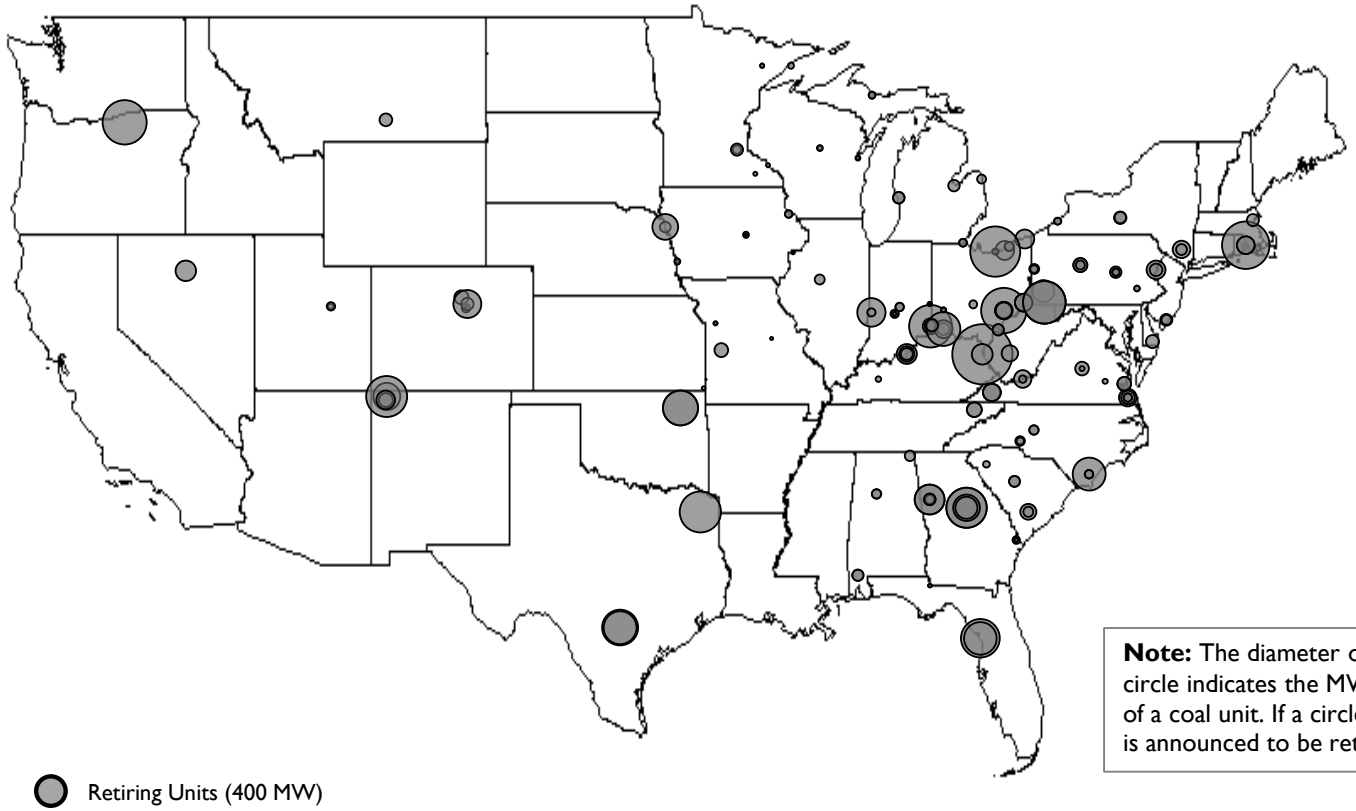
Coal Asset Valuation Tool (CAVT)

Stemming the Tide of Imprudent Investment

17 October 2013

Liz Stanton and Pat Knight

Coal units all over the country are retiring



Note: The diameter of each circle indicates the MW capacity of a coal unit. If a circle is filled, it is announced to be retired.

Retiring Units (400 MW)

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What coal units will be economic in the future?

Coal units are typically retired due to:

- Future costs of additional environmental retrofits
- Increased competiveness of market purchases

How can we anticipate the potential costs of environmental retrofits?

How can we compare these costs to market purchases?

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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 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.

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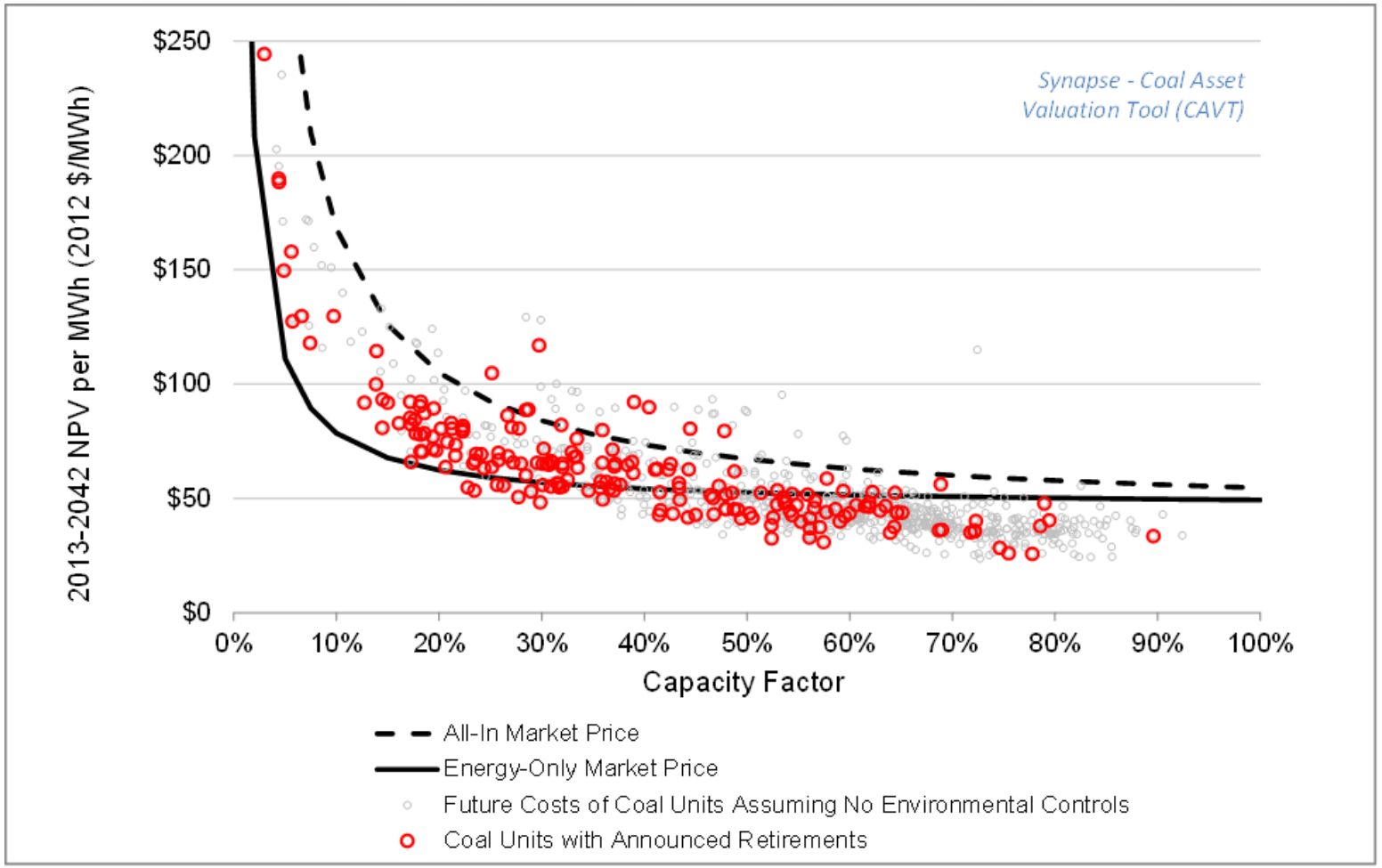
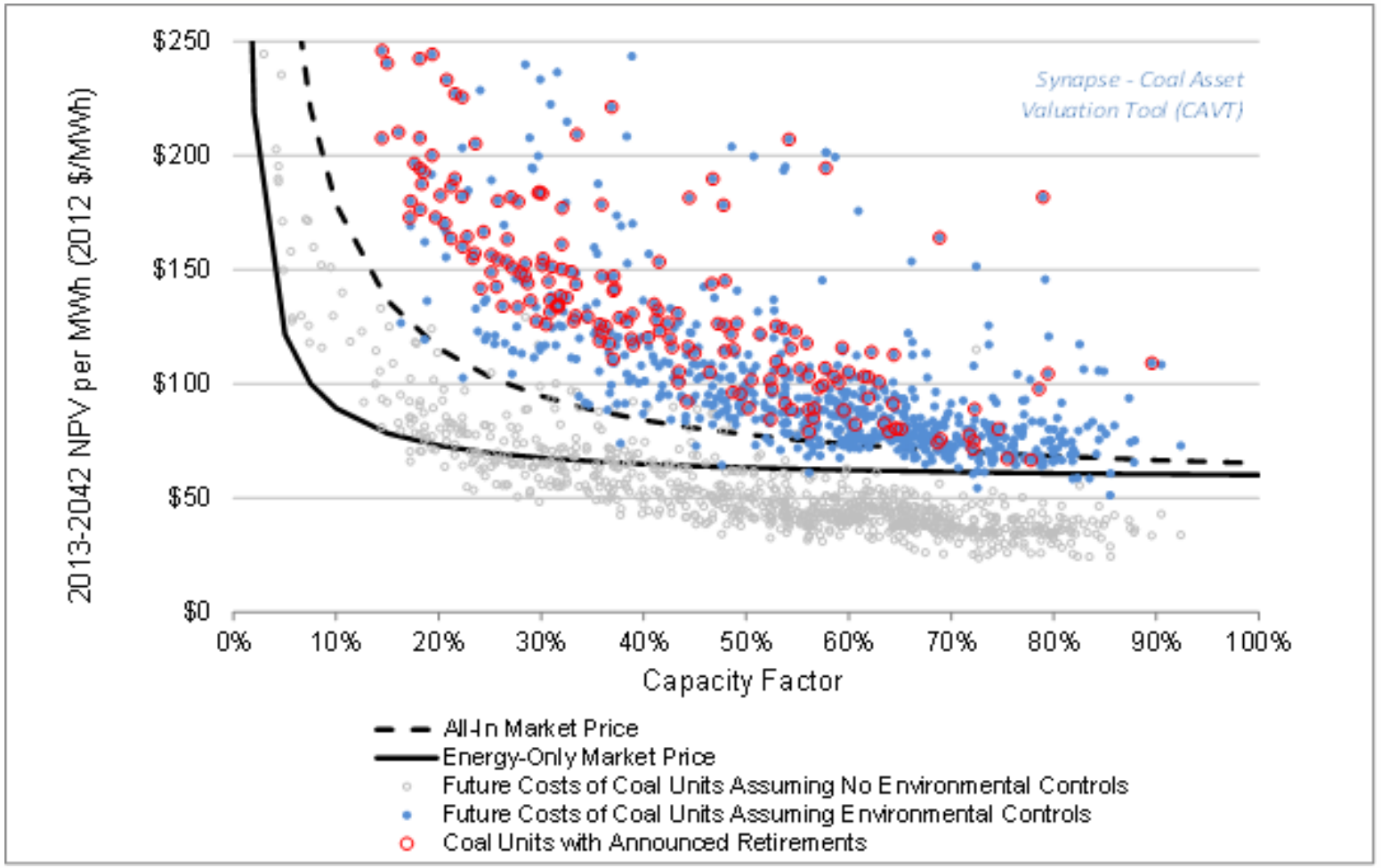
Coal unit competitiveness without retrofit costs



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%)

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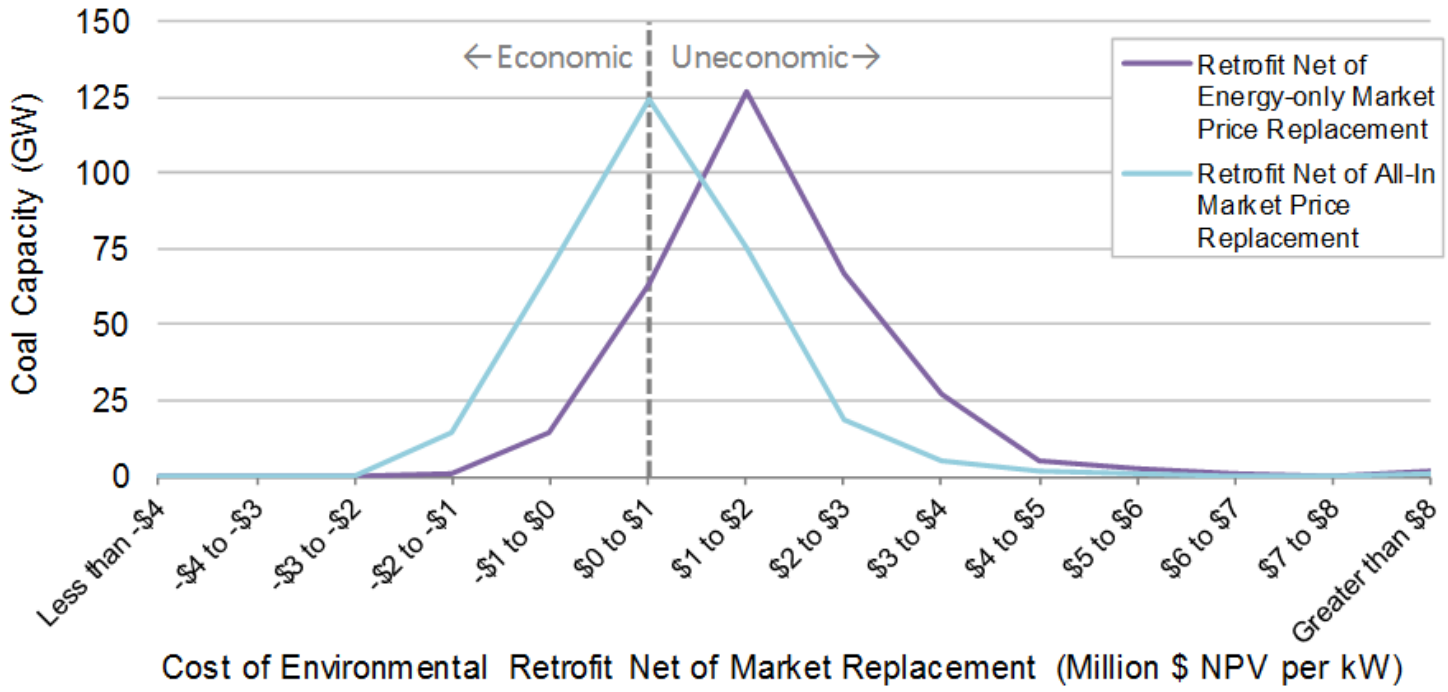
Results: Mid Environmental Retrofits, Mid Gas Price



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%)

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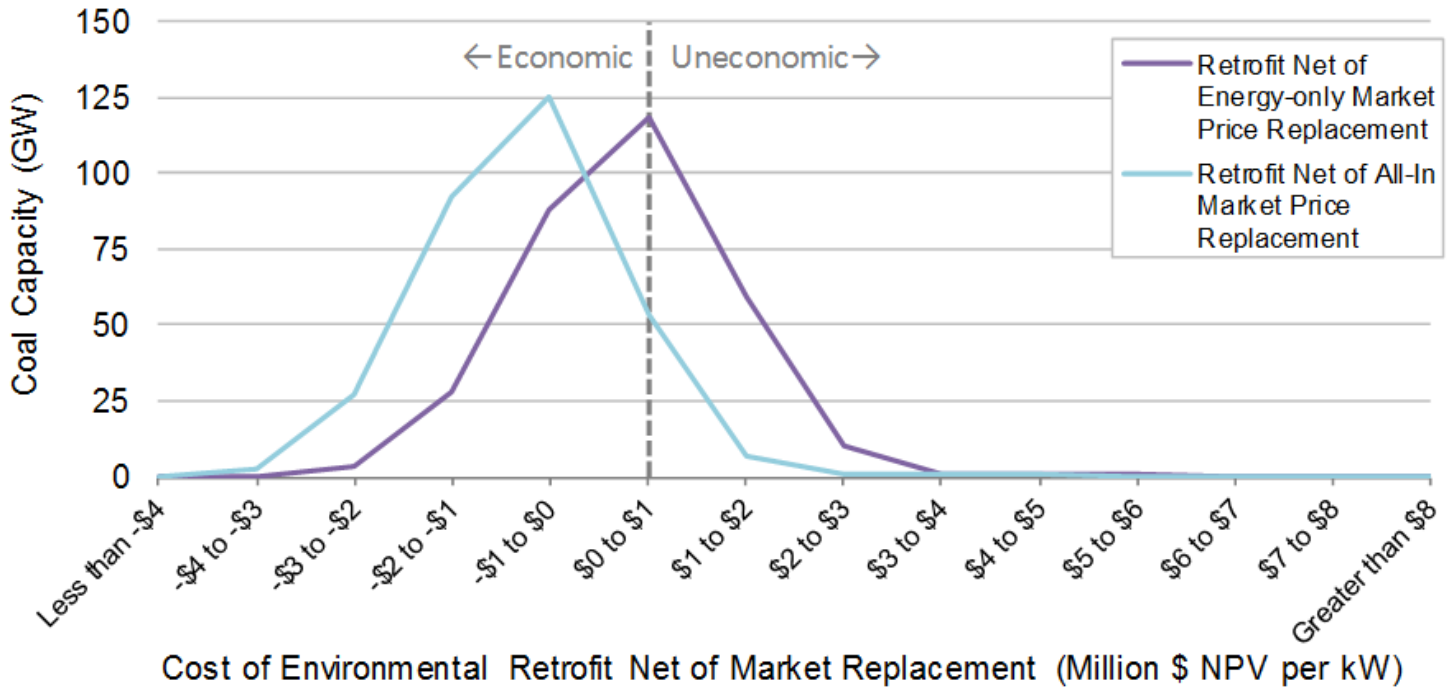
Results: Lenient Environmental Retrofits, High Gas Price



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%)

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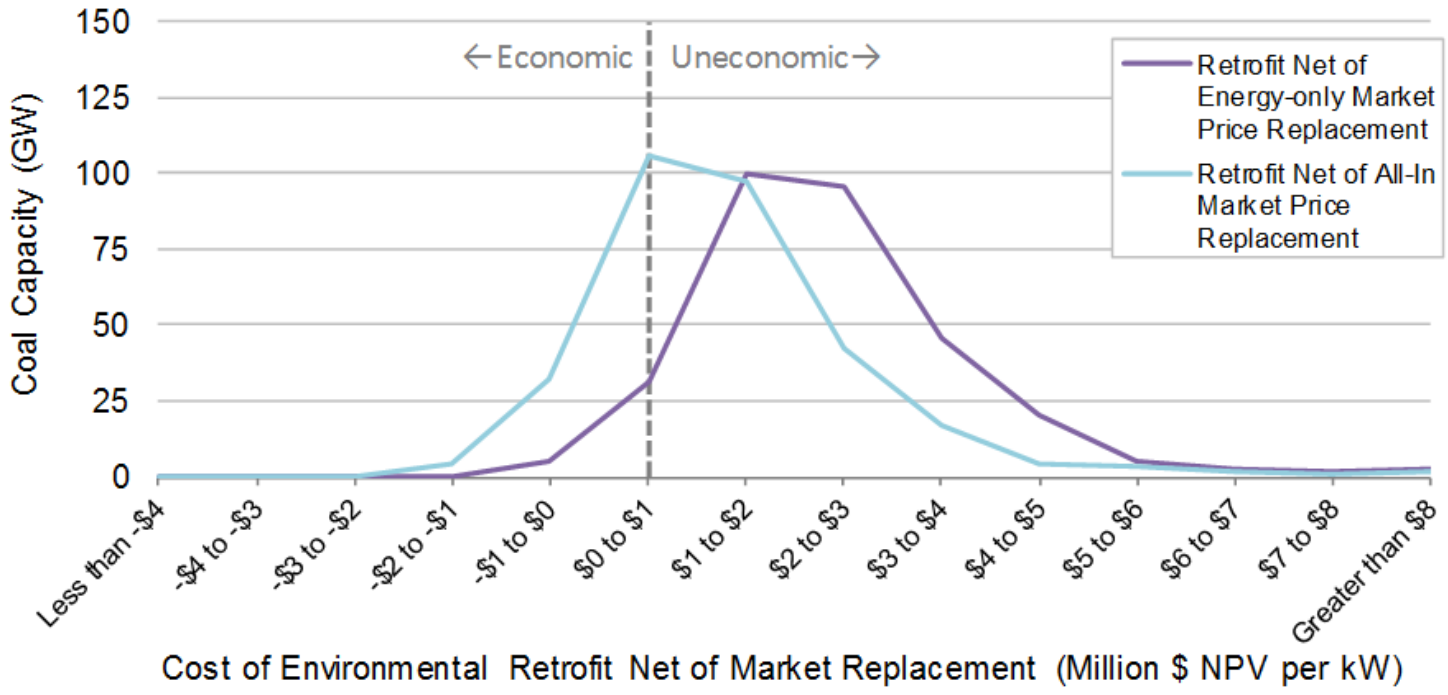
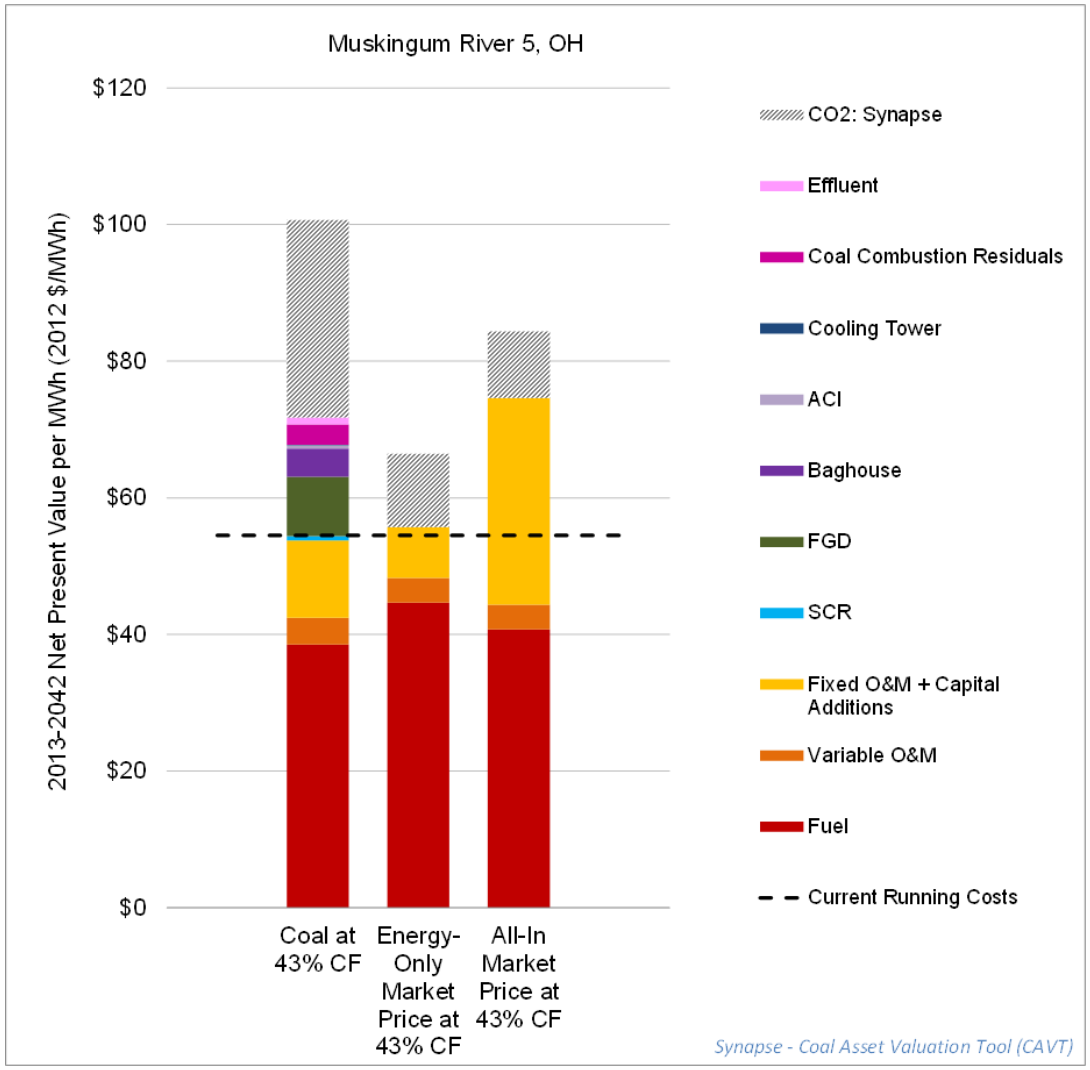
Results: Strict Environmental Retrofits, Low Gas Price

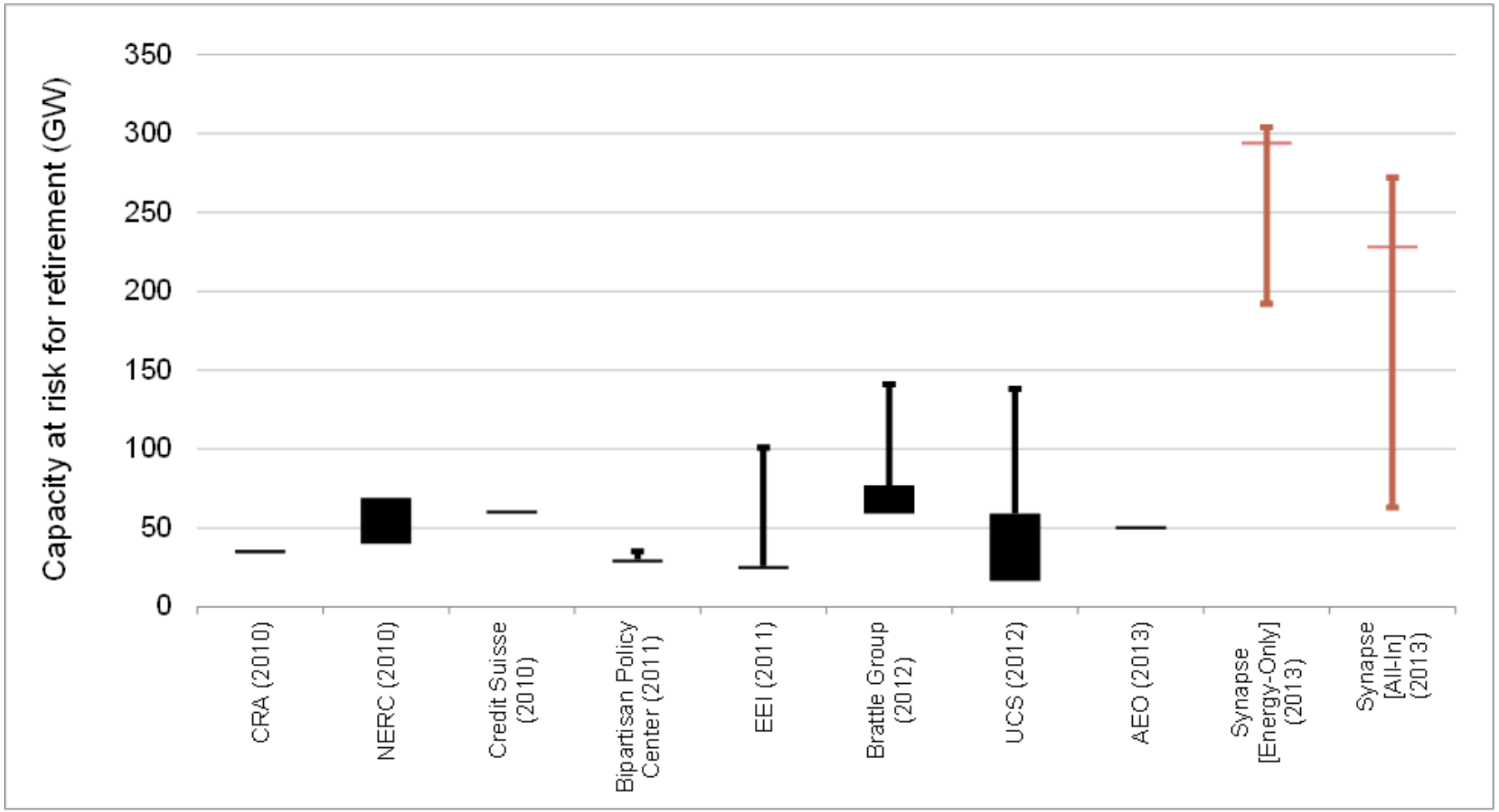


Percent of Coal Fleet Rendered Uneconomic	Cost of Environmental Retrofit Net of Energy-only Market Price Replacement	Cost of Environmental Retrofit Net of All-In Market Price Replacement
Number of Units	881 (99%)	829 (93%)
Capacity (GW)	306 (98%)	274 (88%)
Generation (TWh)	1,573 (98%)	1,388 (87%)

Muskingum River 5: A Case Study in Uneconomic Coal



How does CAVT compare?



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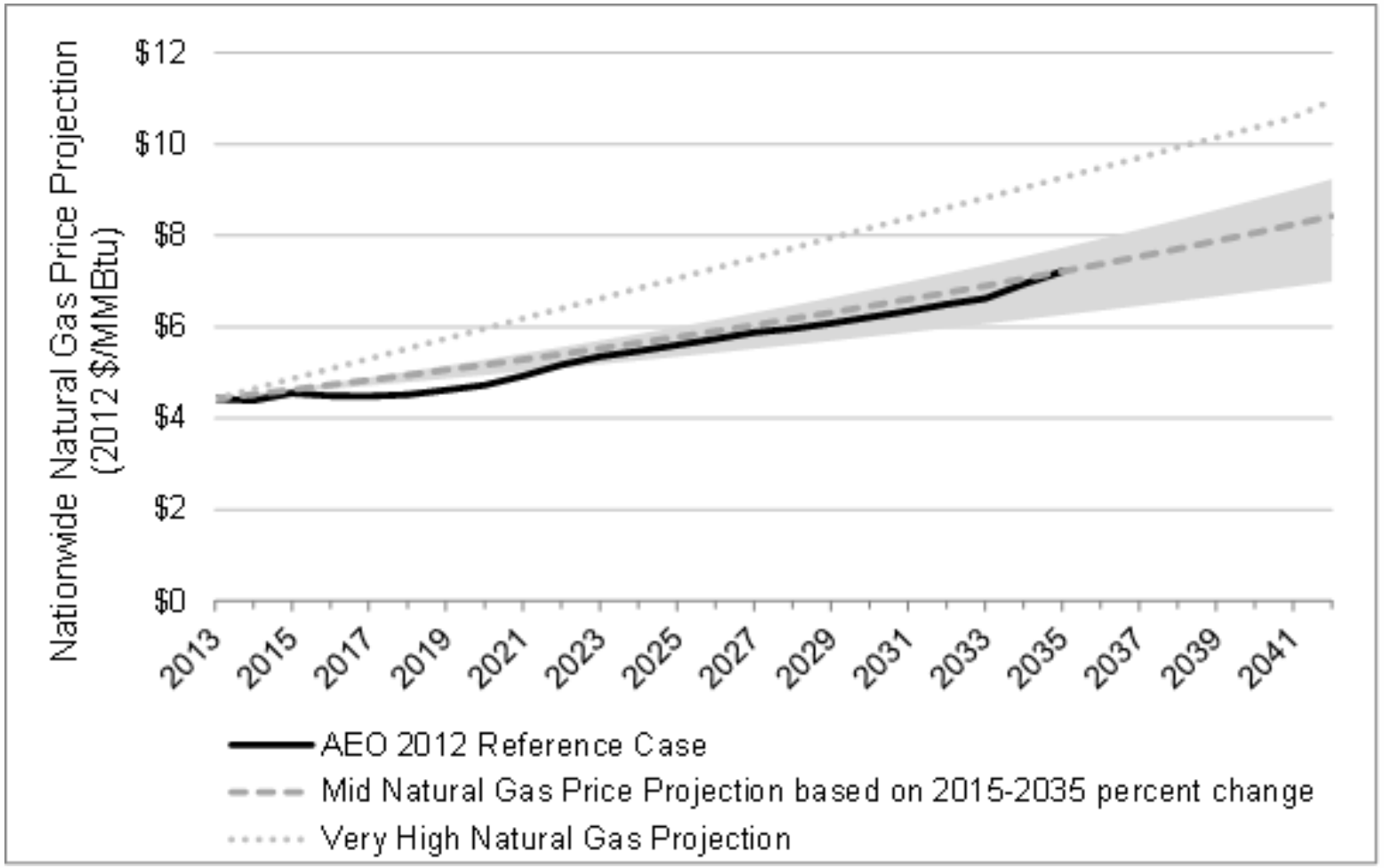
Appendix: Natural Gas Price Projections



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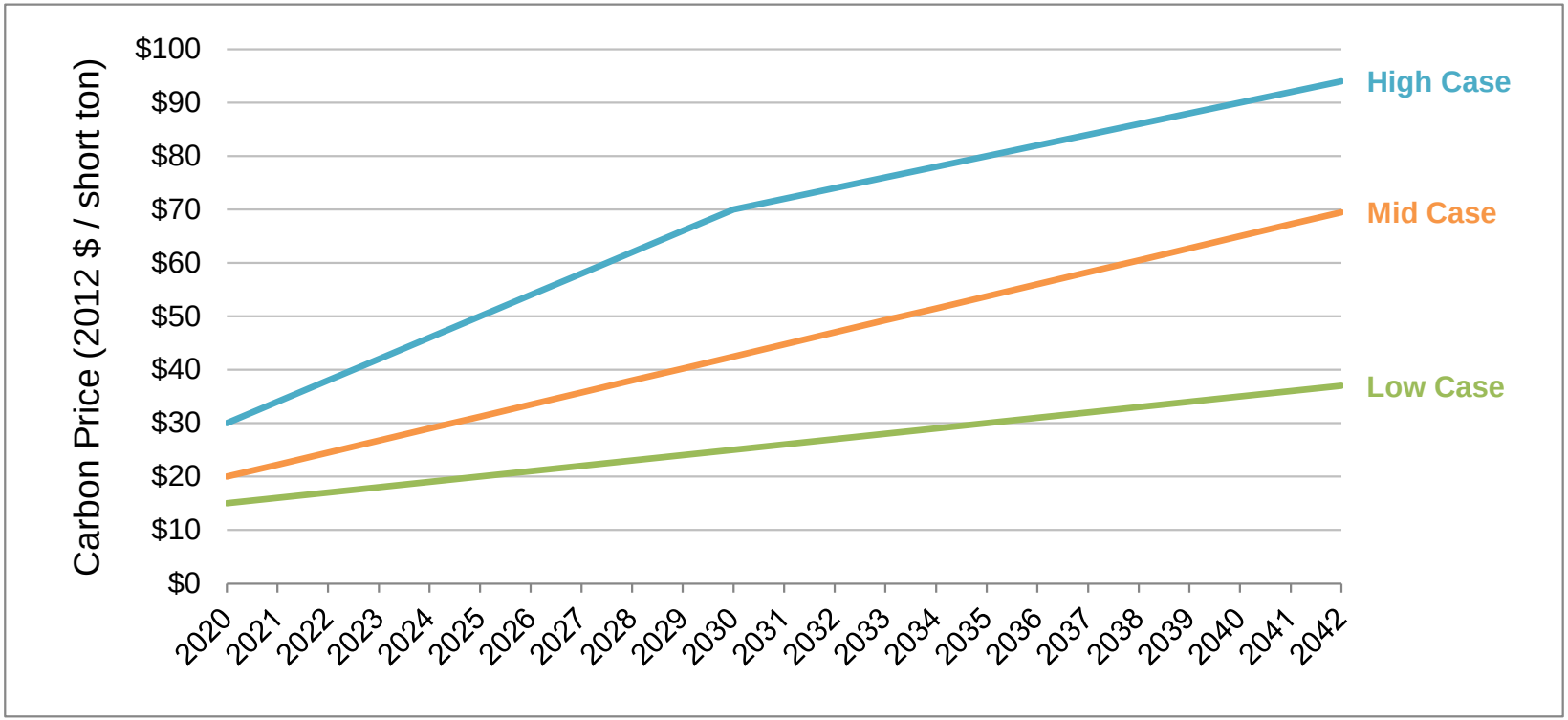
Appendix: Carbon Price Projections



Levelized Costs (2012 $/short ton)
High: $59.38/short ton
Mid: $38.54/short ton
Low: $23.24/short ton

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