

The Battelle logo is displayed in a large, white, sans-serif font. It is positioned over a faint, light-colored globe that serves as a background for the upper left portion of the slide.

The Business of Innovation



The Value of Advanced CO₂ Capture Technologies for the MRCSP Regional Economy

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Motivation

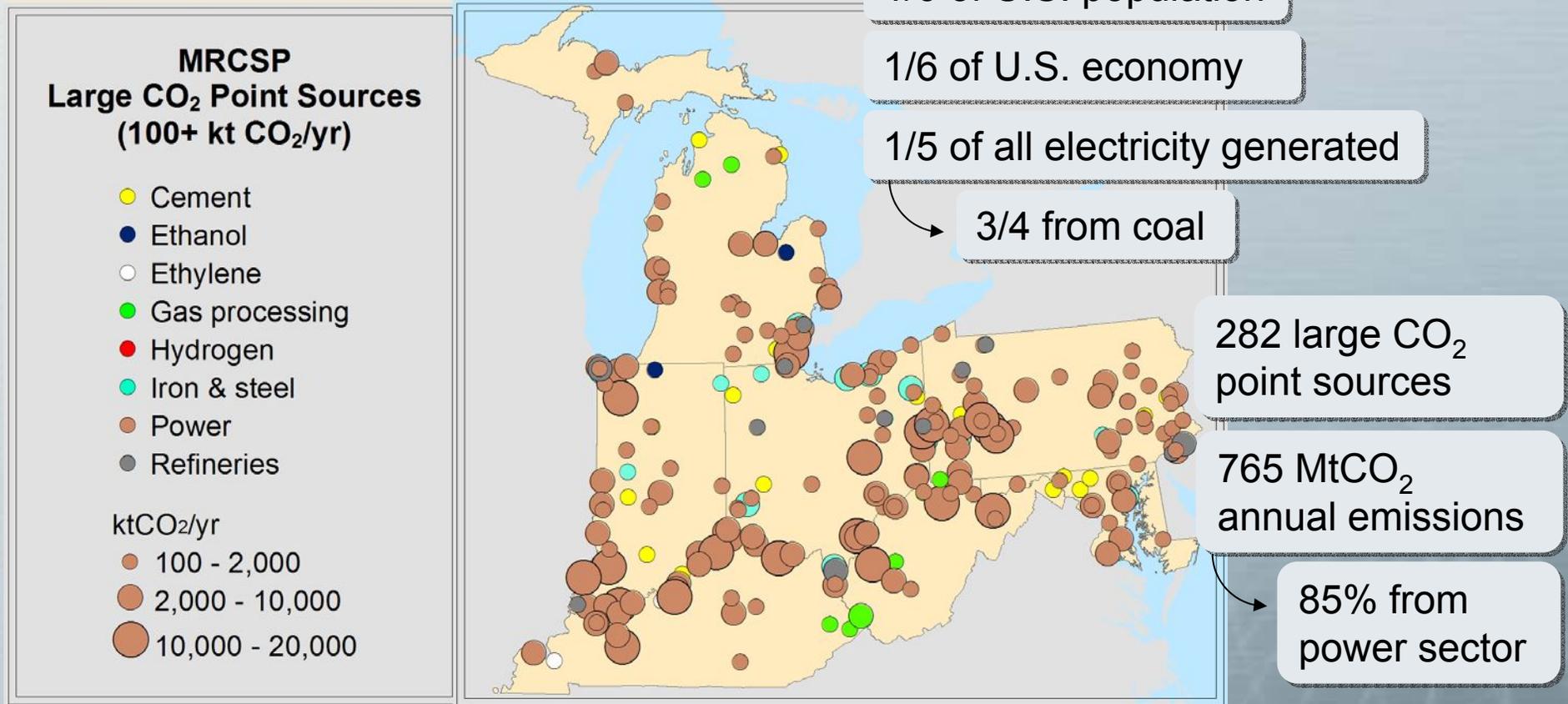
- Given the composition of the Midwest Regional Carbon Sequestration Partnership's regional economy, its size and its significant reliance on fossil fuels and the region's large geologic CO₂ storage potential, our previous work has suggested that the MRCSP region could be one of the most intensive areas of CCS adoption in the world.
- This presentation represents a first-order, bottom-up assessment of the potential economic value of advanced CO₂ capture systems in controlling the cost of CCS deployment in the MRCSP Region.

The Midwest Regional Carbon Sequestration Partnership

Mission: be the premier resource in the Region for identifying the technical, economic, and social considerations associated with CO₂ sequestration and creating viable pathways for its deployment.



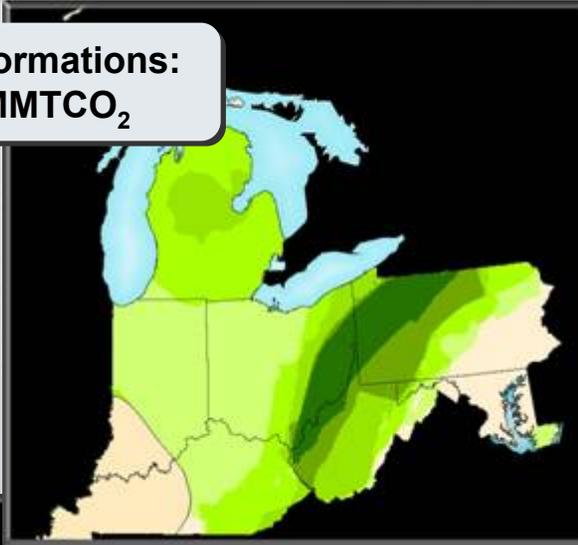
The MRCSP Region: The Nation's "Engine Room"



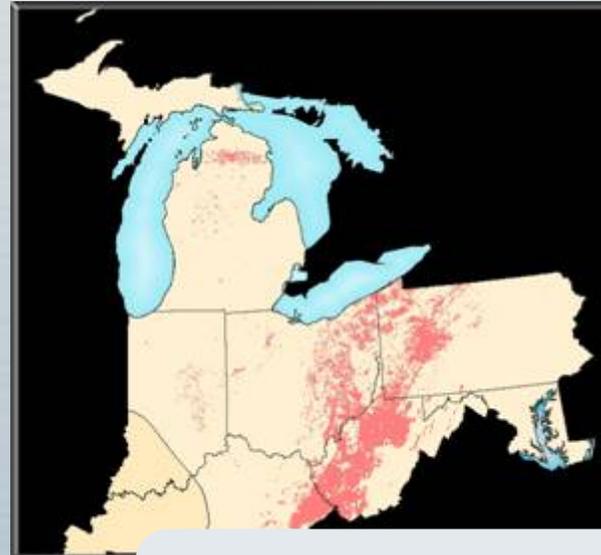
Sequestration technologies are needed to protect core economic assets in the region in a greenhouse gas constrained world

Geologic Sequestration Potential

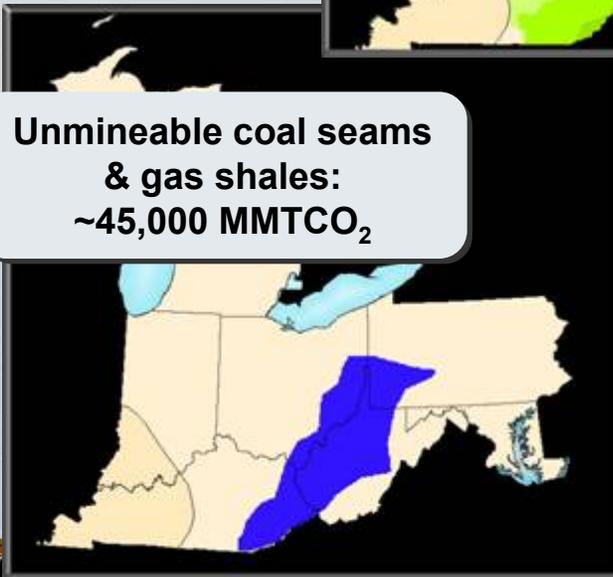
Deep saline formations:
~470,000 MMTCO₂



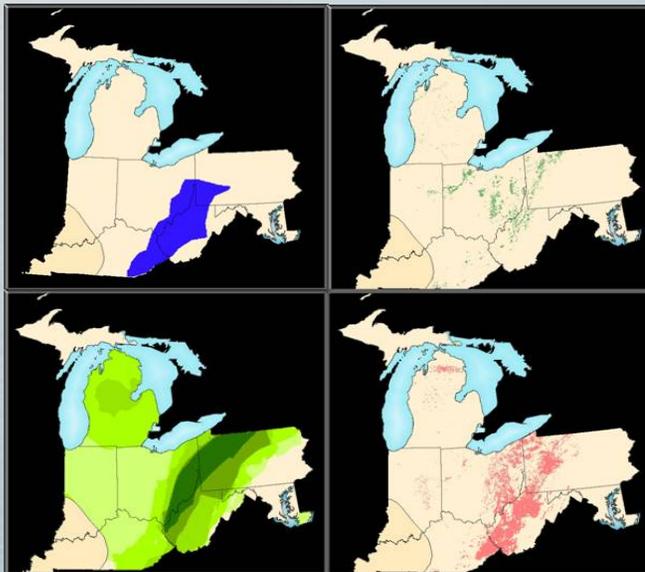
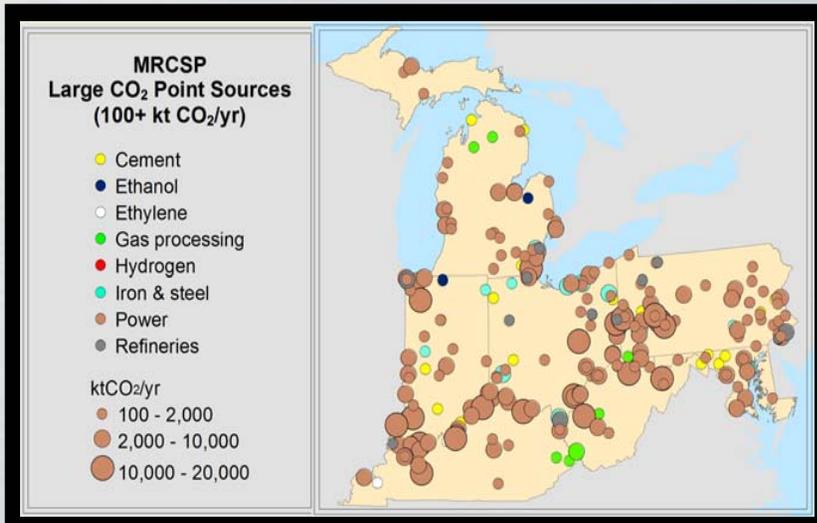
Oil & Gas reservoirs:
~2,500 MMTCO₂



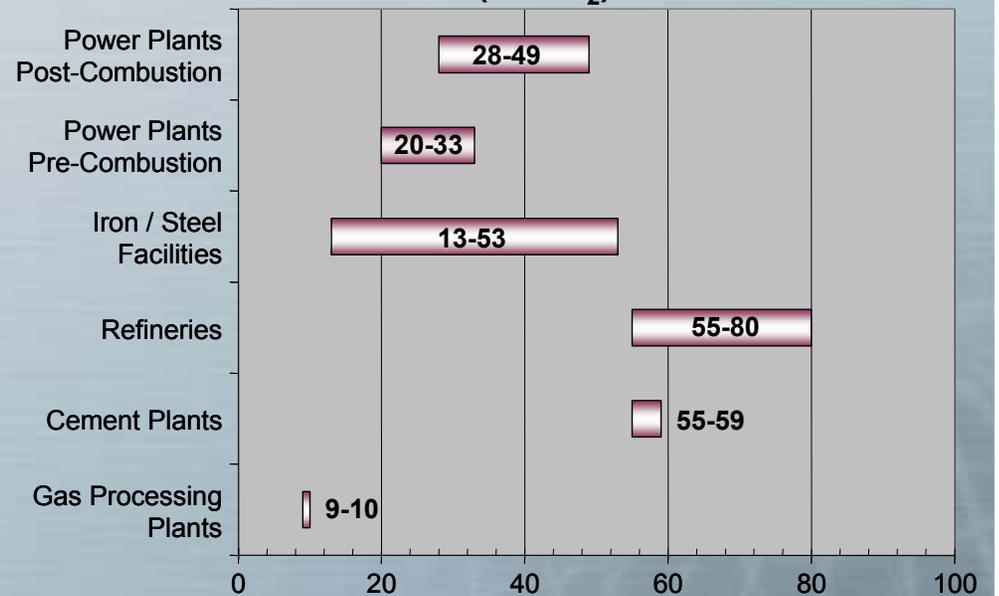
Unmineable coal seams
& gas shales:
~45,000 MMTCO₂



"CCS" Not One Homogeneous Technology and Not a Homogenous Market



Typical Current Technology Capture Costs (\$/tCO₂)

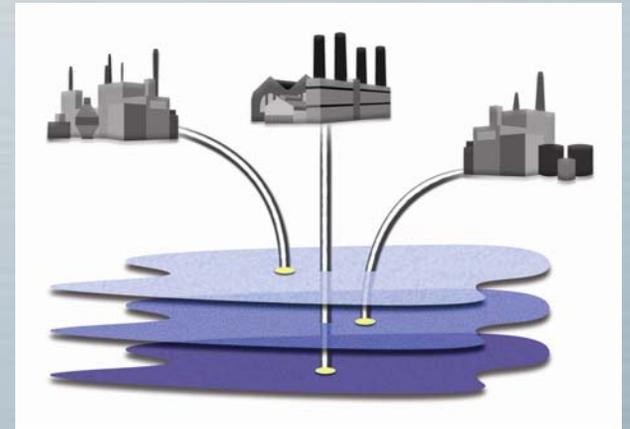


Cost Curve Methodology, Part 1: Estimating Net CCS Costs for Region's Sources

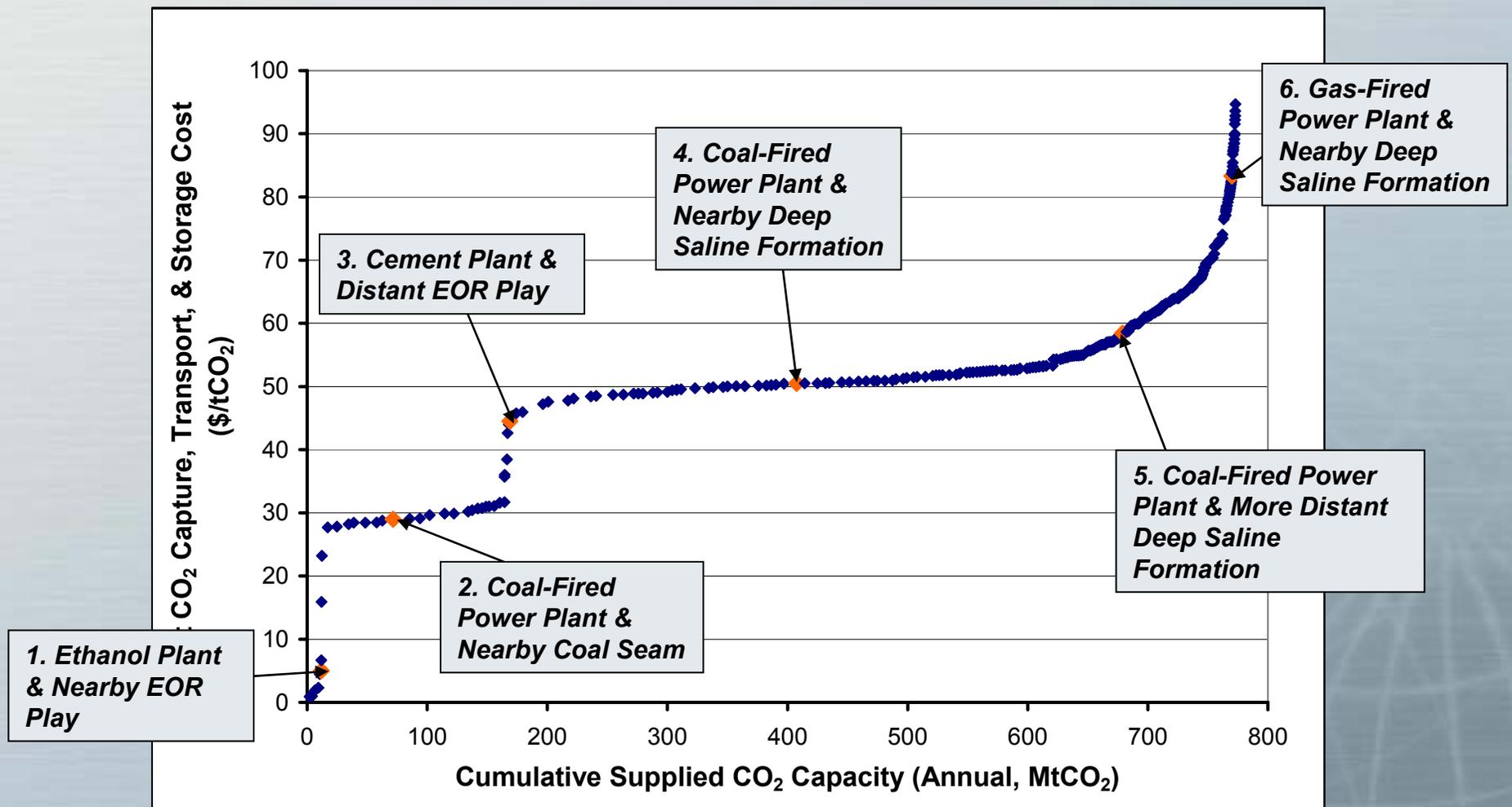
- GIS-based methodology develops levelized costs of capture, transport, and storage for each possible source-reservoir pair
- Net Storage Cost = Cost of CO₂ Capture and Compression
 - + Cost of Transport (via pipeline)
 - + Cost of Injection (capital, operating, and MMV)
 - Revenue from Value-Added Hydrocarbon Recovery
- Large CO₂ sources within 50 miles of the MRCSP region were included to account for the additional demand that might be placed on the region's storage capacity.

Cost Curve Methodology, Part 2: Identifying Least-Cost Pairings, Considering Reservoir Capacity Constraints

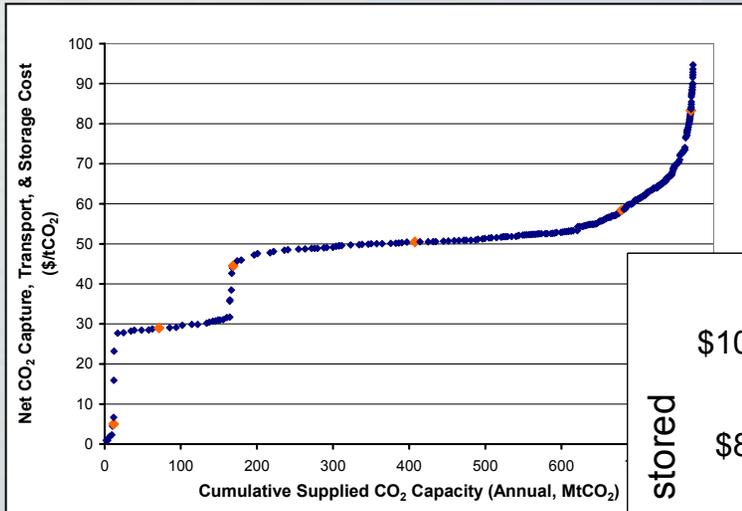
- Cost-minimizing decision process based on:
 - Source characteristics
 - Distance to reservoir
 - Reservoir characteristics
 - Oil and natural gas price
 - Remaining capacity of reservoir and minimum capacity commitment required by source
 - Requirement that reservoir must be able to store at least 20 years' worth of the point source's CO₂
- Pairing requests are filled in order of net levelized cost
- Results in a cost curve of cumulative CO₂ capacity supplied on an annual basis vs. cost (\$/tCO₂)



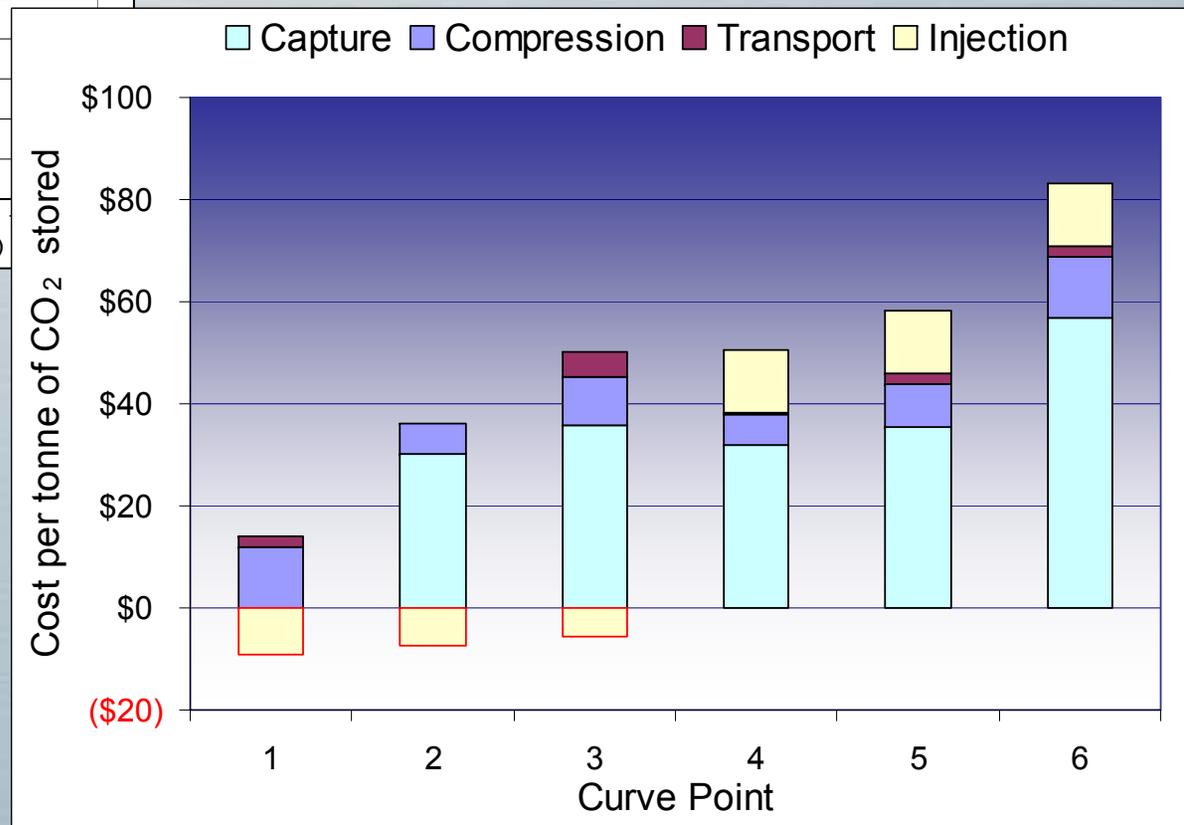
MRCSP CCS Cost Curve: Currently Available CO₂ Capture Technologies



The Cost of CO₂ Capture Dominates the Cost of Deploying CCS within the MRCSP



- The cost of capture is the largest CCS cost component for the vast majority of the region's sources.

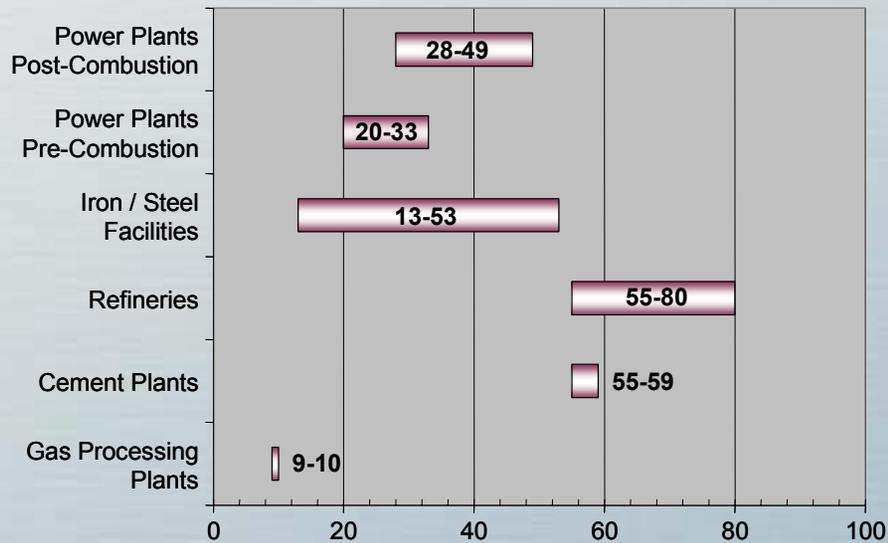


What's the value of advanced capture technologies for the MRCSP?

Current Capture Technologies Case

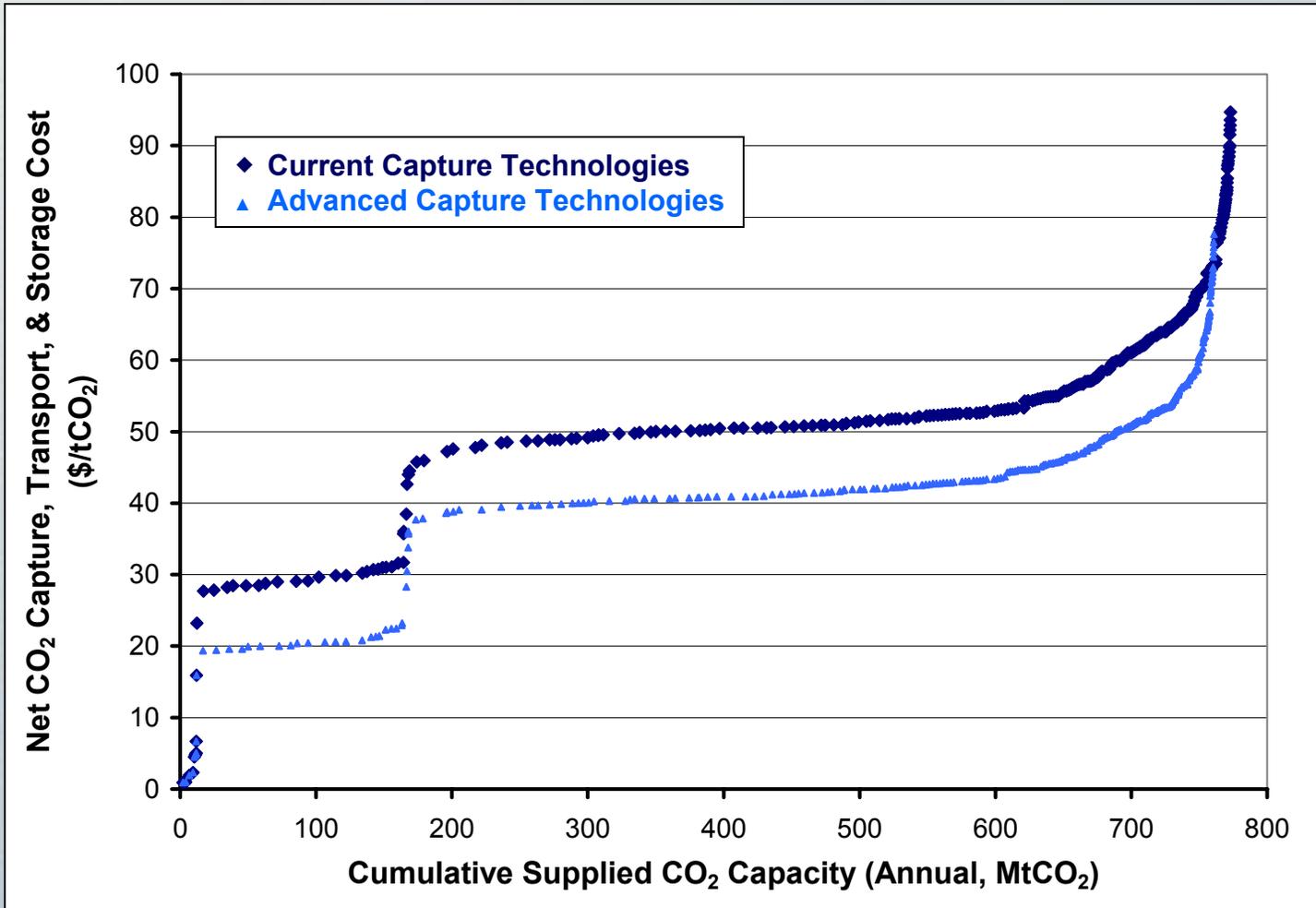
Advanced Capture Technologies Case

Typical Current Technology Capture Costs
(\$/tCO₂)



- Assumes a 30% reduction in the cost of capture (exclusive of compression).
- All other costs (compression, transport, storage, potential revenues from hydrocarbon recovery) were held constant.

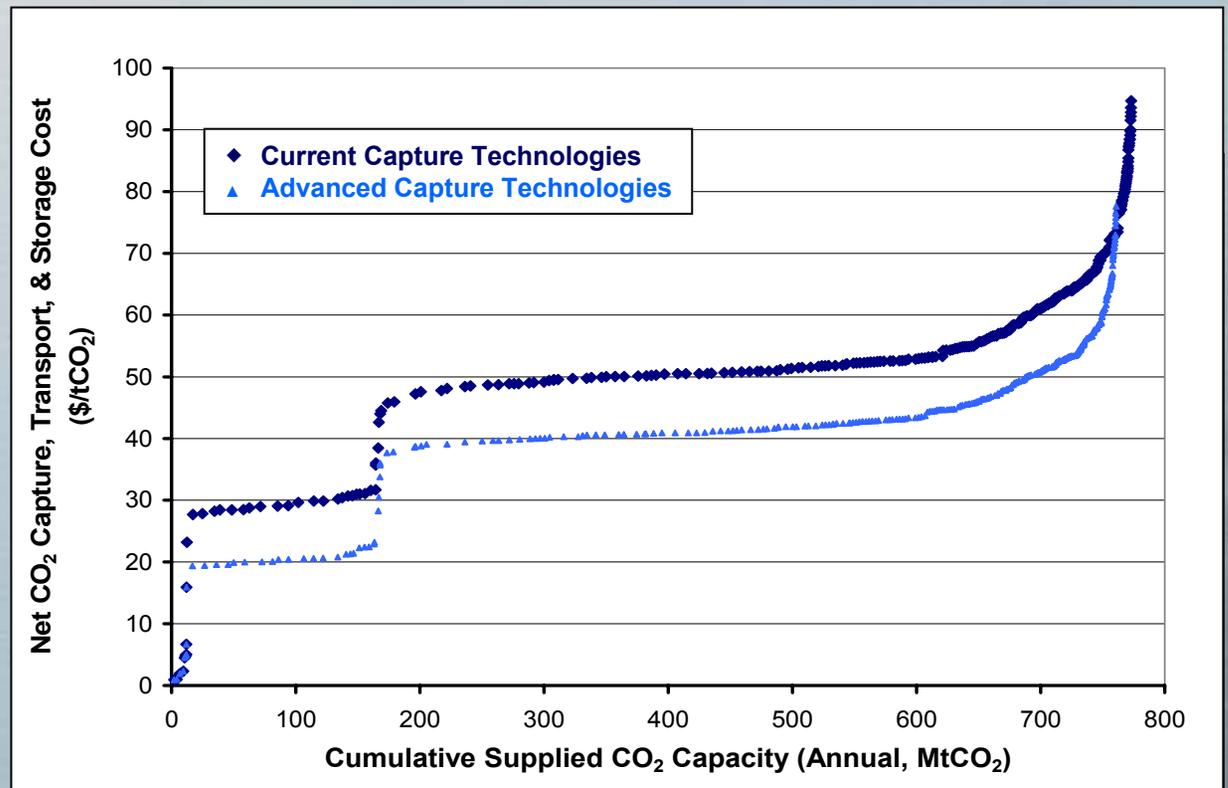
CCS Cost Curve with Advanced Capture Technologies



- Advanced CO₂ capture technologies make CCS technologies less expensive to implement within the MRCSP (i.e., the MRCSP CCS cost curve shifts down and to the left).

CCS Cost Curve with Advanced Capture Technologies

- The average cost of deploying CCS for the first 200 MtCO₂ of CCS deployment opportunities within the MRCSP drops from \$27/tCO₂ to \$20/tCO₂.
- The average cost of deploying CCS for the next 500 MtCO₂ of CCS deployment opportunities within the MRCSP drops from \$53/tCO₂ to \$44/tCO₂.
- The greatest unit cost savings are experienced by refineries, cement and gas-fired power plants.
- Coal-fired power plants experience the highest total cumulative savings.



The Value of Advanced Capture Technologies

Regional Savings (\$Million/yr):

Power	5,270
<i>Coal-Fired</i>	5,130
<i>Gas/Oil-Fired</i>	140
Iron & Steel	520
Refineries	220
Cement	140
Ethylene	10
Total	6,160

Power sector benefits the most

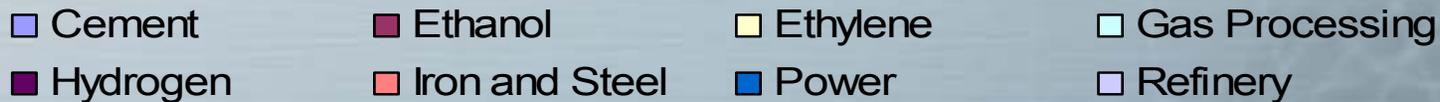
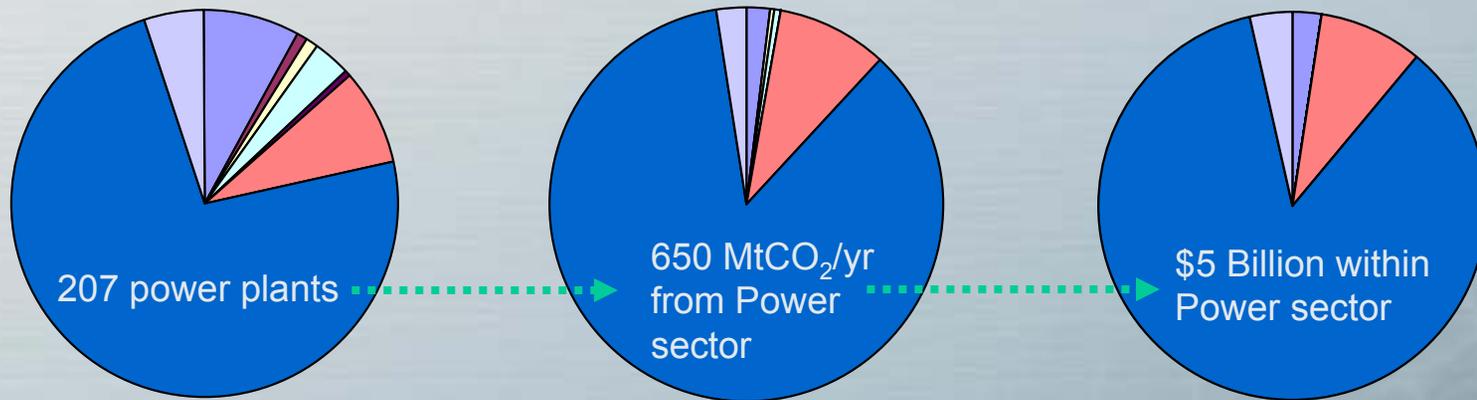
As much as \$6 Billion in annual savings for the entire region's economy

Coal-fired power plants experience the highest cumulative savings via the adoption of advanced capture technologies.

Overall Impact on the MRCSP Region

Focusing on large point sources (>100,000 tCO₂/yr)

282 Point Sources → 765 MtCO₂/yr → \$6 Billion/yr Potential Savings



Conclusions

- Given the scale and composition of its economy, the MRCSP region could be one of the most intensive regions for CCS deployment in a greenhouse gas constrained world.
- The development and deployment of advanced CO₂ capture technologies could result in substantial cost savings for the regional economy.
- The majority of these cost savings will be associated with the adoption of advanced CO₂ capture technologies by the region's large coal-fired power plants.
- The development and adoption of even more advanced CO₂ capture technologies than assumed here would result in even larger cost savings for the regional economy.
- Continued research directed at the development of advanced CO₂ capture technologies could be of significant economic benefit for the MRCSP region.