

LTI



Pacific Northwest
NATIONAL LABORATORY



Battelle
The Business of Innovation

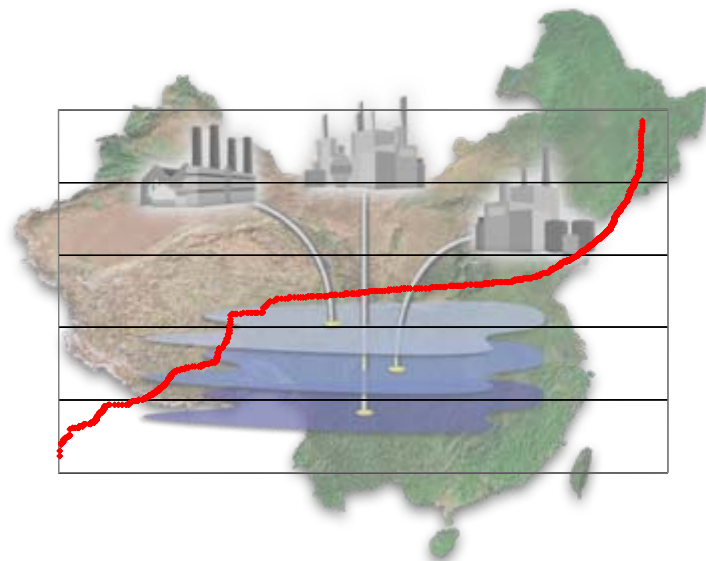
Early Assessment of Carbon Dioxide Capture and Storage Potential in China

8th Annual Conference on Carbon Capture & Sequestration
5 May 2009 – Pittsburgh, Pennsylvania

RT Dahowski, X Li, CL Davidson, N Wei, JJ Dooley, RH Gentile

Topics

- CO₂ Point Source Inventory
- Geologic CO₂ Storage Potential
- Cost Curves for Transport and Storage
- Sensitivity Analyses
- Summary & Next Steps

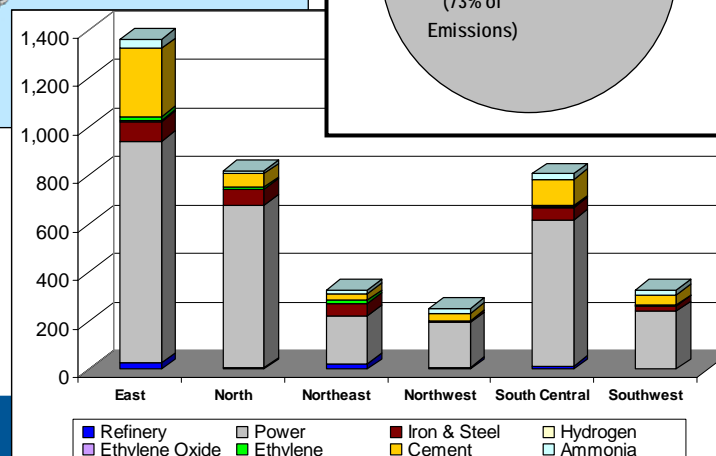
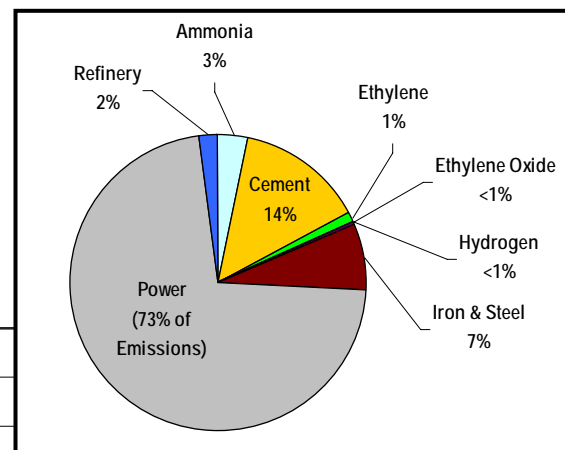
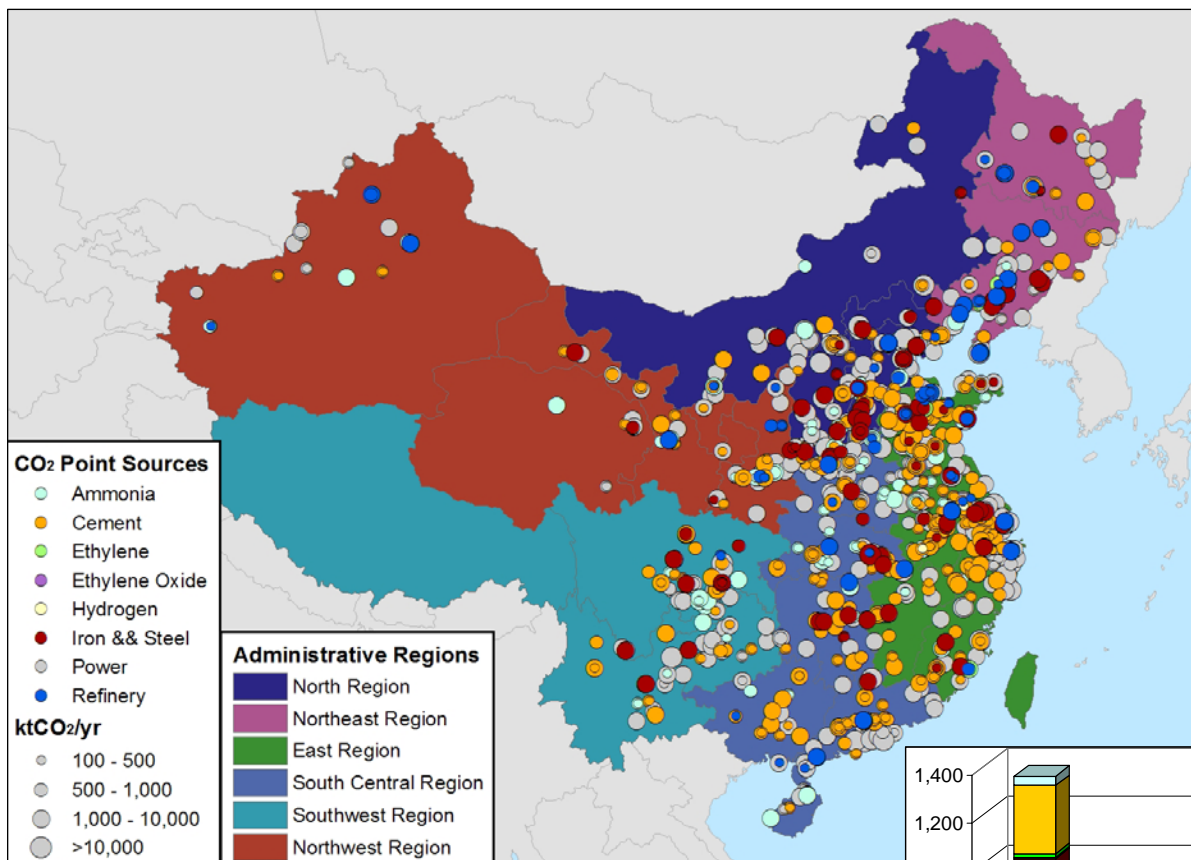


China Overview

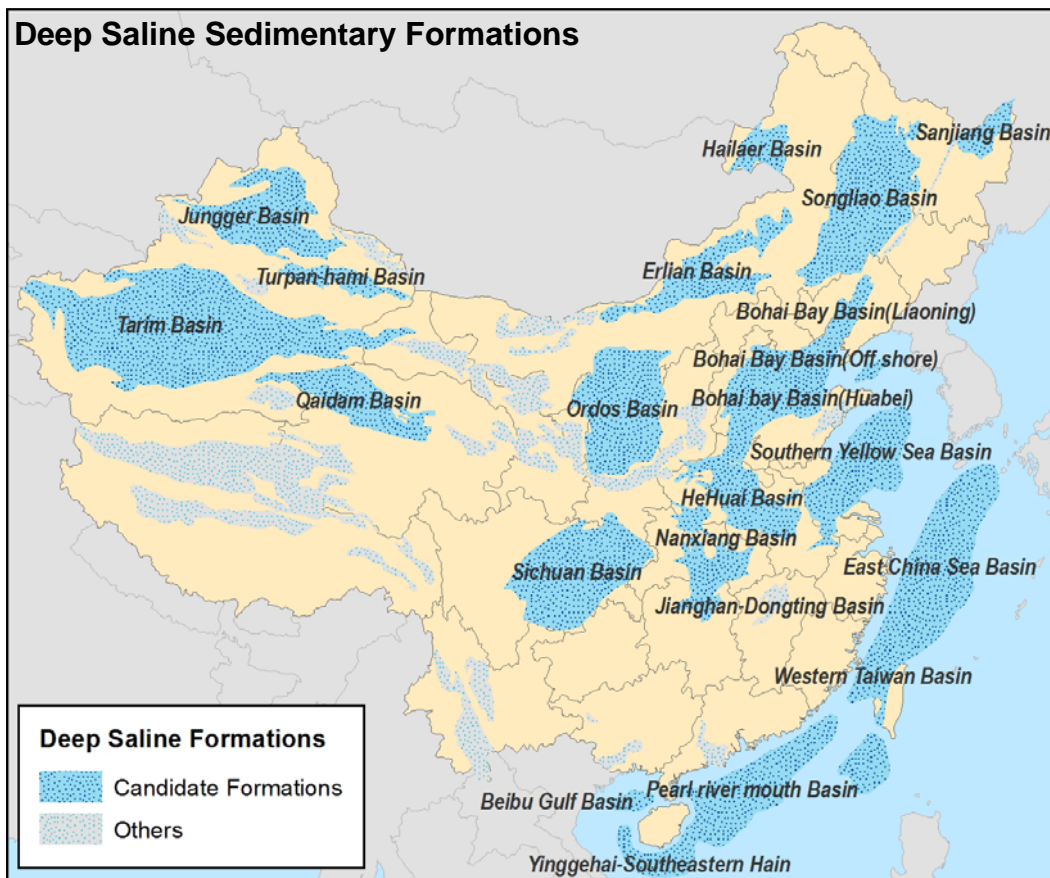
- Rapidly expanding economy
- Driven largely by coal
- Emissions increasing
- Increasing pressure and determination for GHG mitigation
- Growing focus on environmental protection and sustainable development of China
- Primary goals:
 - Assess the potential for CCS technologies to deploy in China
 - Provide preliminary insight for decision-makers on the potential role of CCS technologies in China

Large CO₂ Point Sources in China

- Over 1,600 CO₂ sources (100+ ktCO₂/yr each)
- Total estimated CO₂ emissions from these large stationary sources: 3,890 MtCO₂/yr



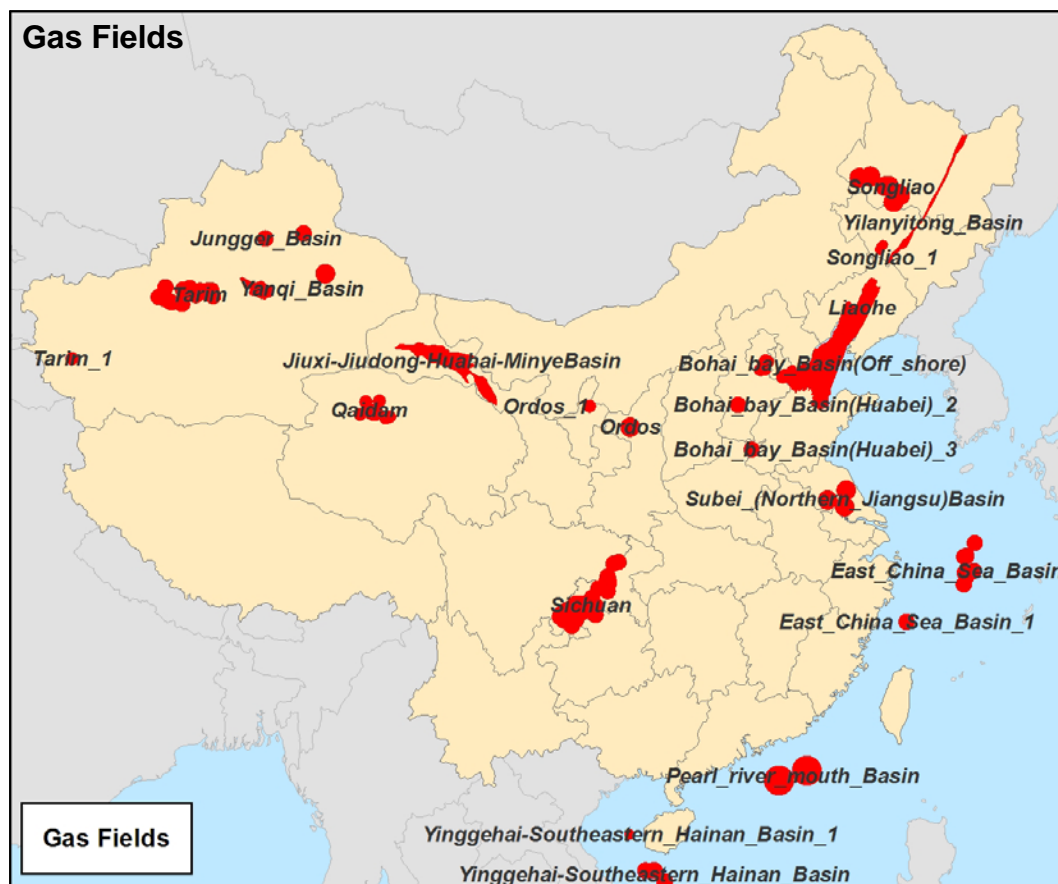
Geologic CO₂ Storage Capacity



- Estimated Onshore Storage Capacity, MtCO₂:

DSF:	2,288,000
Gas:	4,280
Oil:	4,610
Coal:	11,970
TOTAL:	2,309,000
- Potential Offshore Storage Capacity: 780,000 MtCO₂

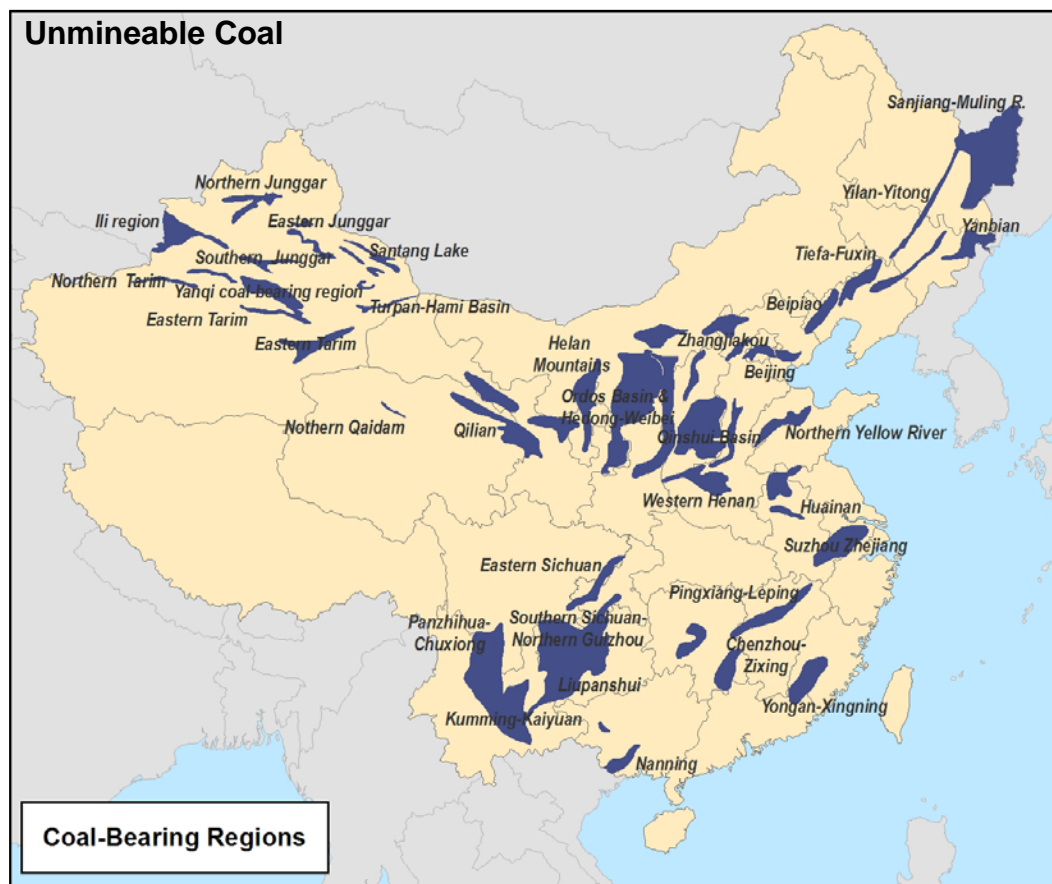
Geologic CO₂ Storage Capacity



- Estimated Onshore Storage Capacity, MtCO₂:

DSF:	2,288,000
Gas:	4,280
Oil:	4,610
Coal:	11,970
TOTAL:	2,309,000
- Potential Offshore Storage Capacity: 780,000 MtCO₂

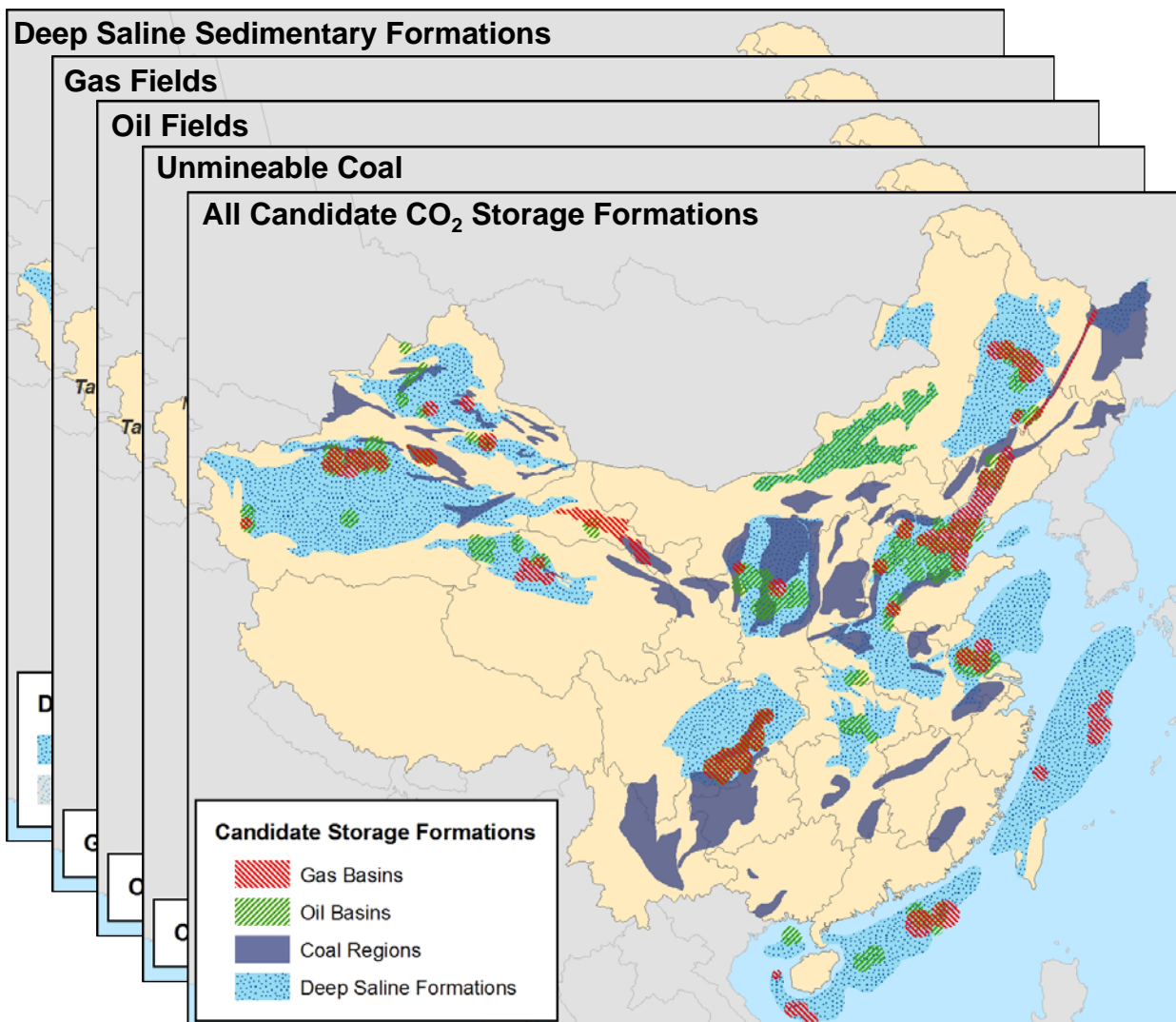
Geologic CO₂ Storage Capacity



- Estimated Onshore Storage Capacity, MtCO₂:

DSF:	2,288,000
Gas:	4,280
Oil:	4,610
Coal:	11,970
TOTAL:	2,309,000
- Potential Offshore Storage Capacity: 780,000 MtCO₂

Geologic CO₂ Storage Capacity

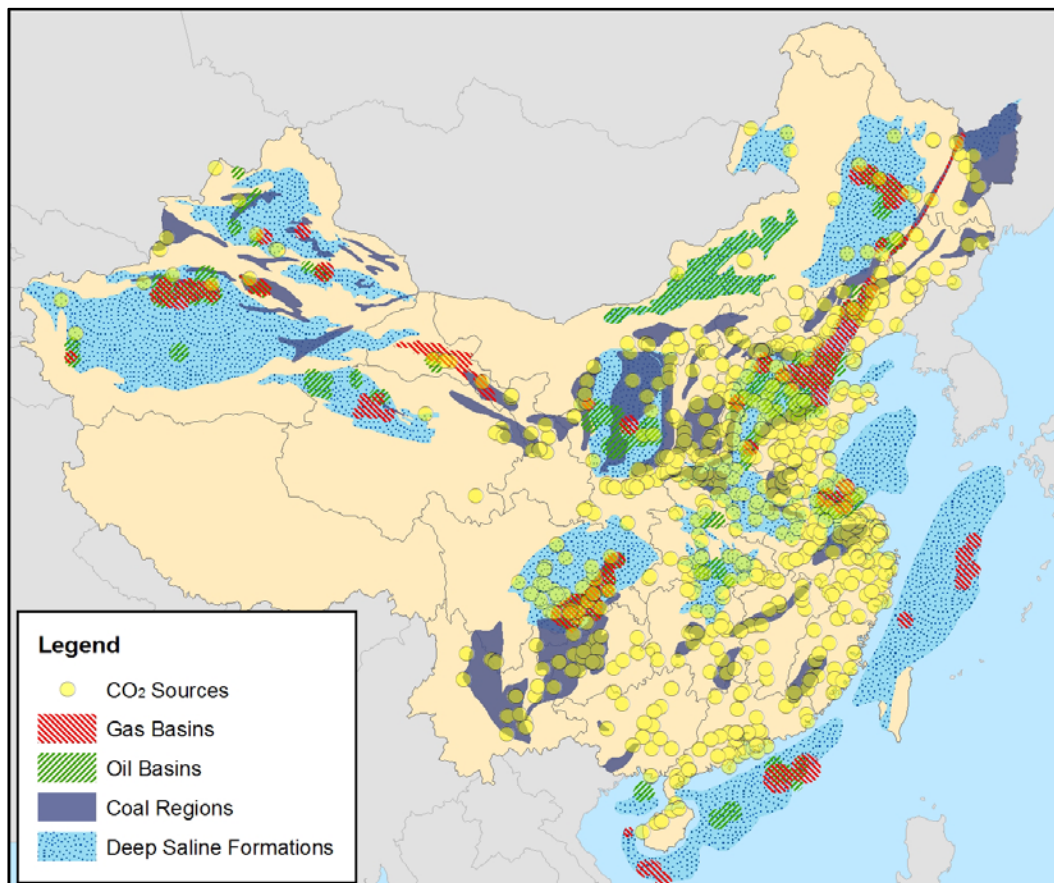


- Estimated Onshore Storage Capacity, MtCO₂:

DSF:	2,288,000
Gas:	4,280
Oil:	4,610
Coal:	11,970
TOTAL:	2,309,000
- Potential Offshore Storage Capacity:
780,000 MtCO₂

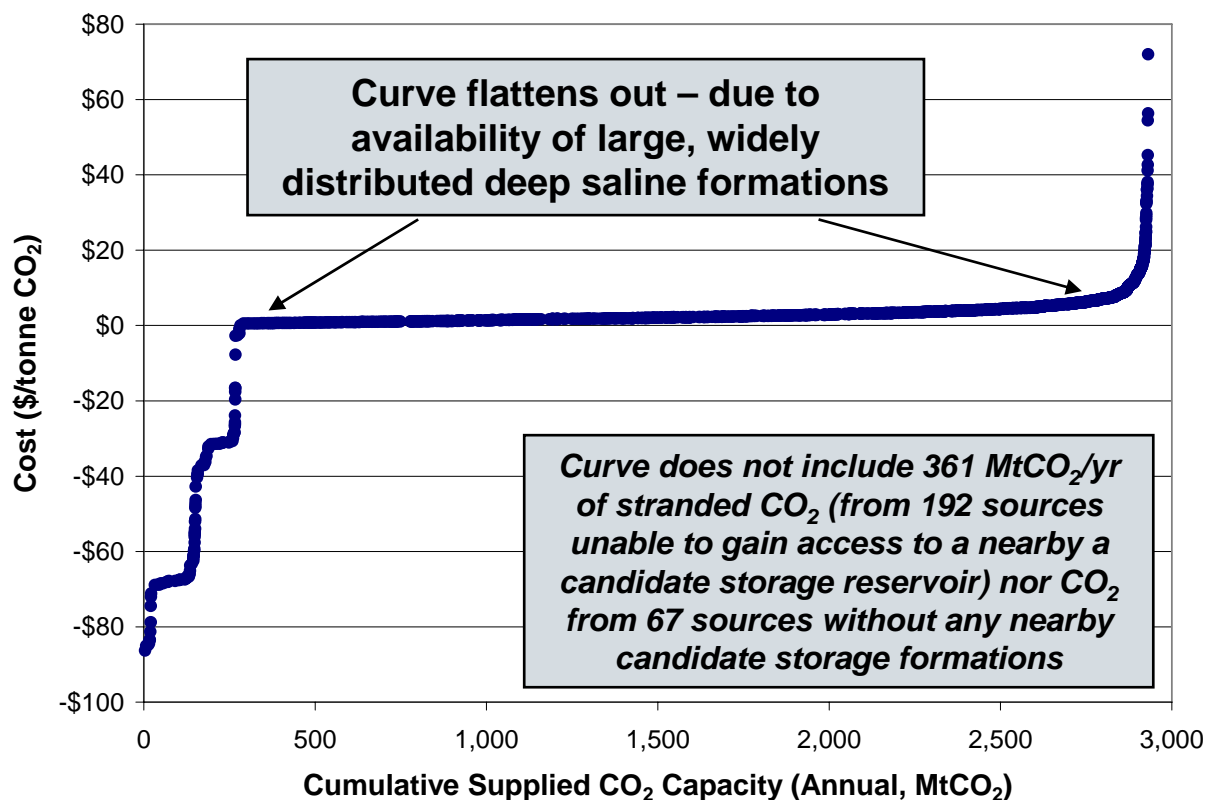
CO₂ Sources & Storage Reservoirs

- 2300 GtCO₂ total potential onshore storage capacity
- 99% in deep saline formations
- 91% of large CO₂ point sources have a candidate storage formation within 100 miles (161 km)
 - 83% within 50 miles (80 km)
- Some sources in coastal regions do not appear to have many onshore storage options



Preliminary Cost Curve for CO₂ Transport & Storage in China

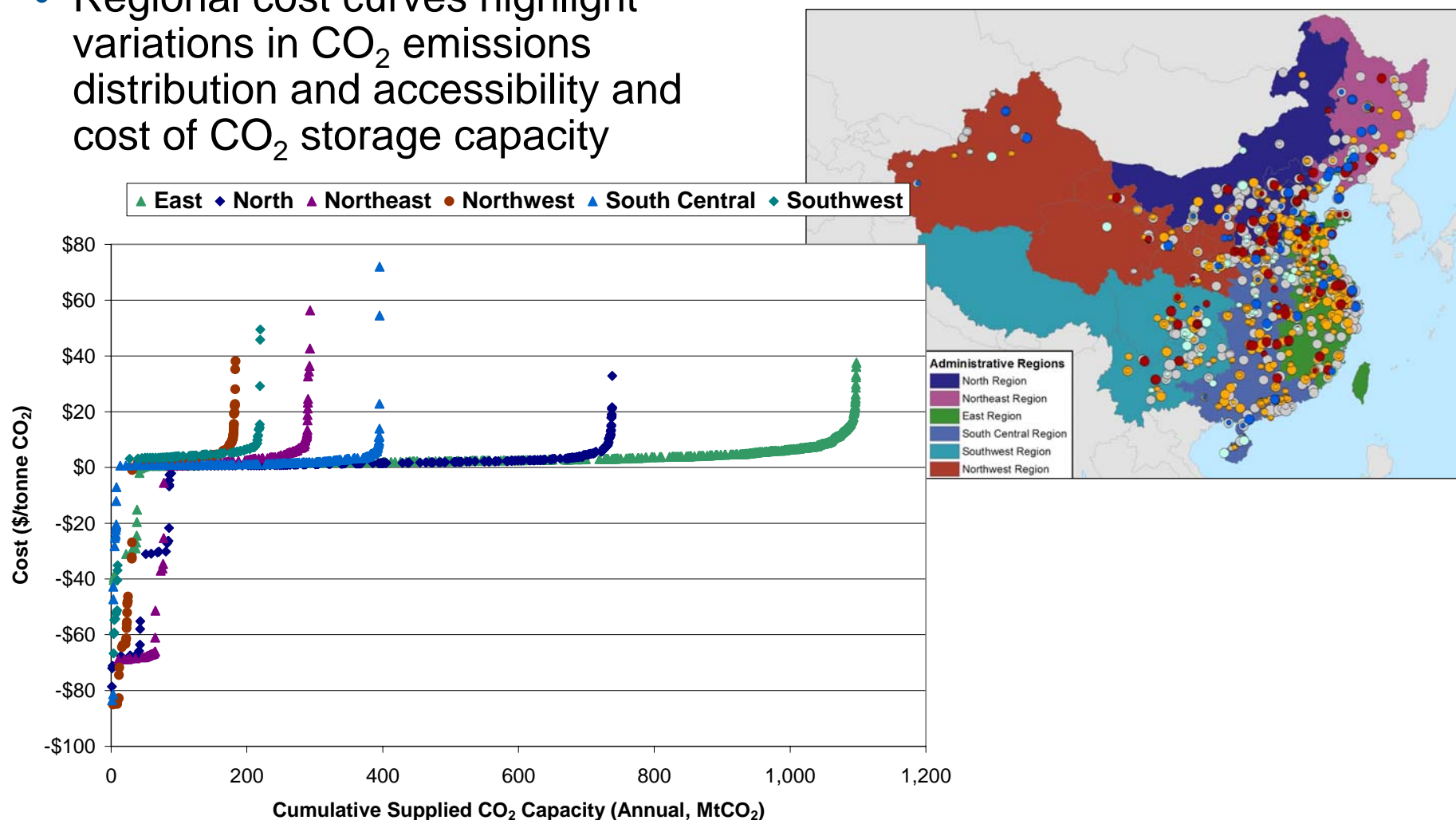
- CO₂ capture, dehydration, and compression cost intentionally excluded
- Each point on the curve represents a unique CO₂ source and its selected CO₂ storage reservoir.
- This curve represents the potential for annual storage at the specified costs assuming that all sources seek to begin storing their CO₂ at the same time and all capacity is available on day one, based on a 20-year commitment.



- Deep saline formations provide storage for over 90% of the individual source-reservoir pairs on this curve.
- Low-cost storage opportunities appear to be available in China but are likely exaggerated here due to a number of factors (e.g., timing of availability, smaller overall and individual capacities, lack of demonstrated performance)

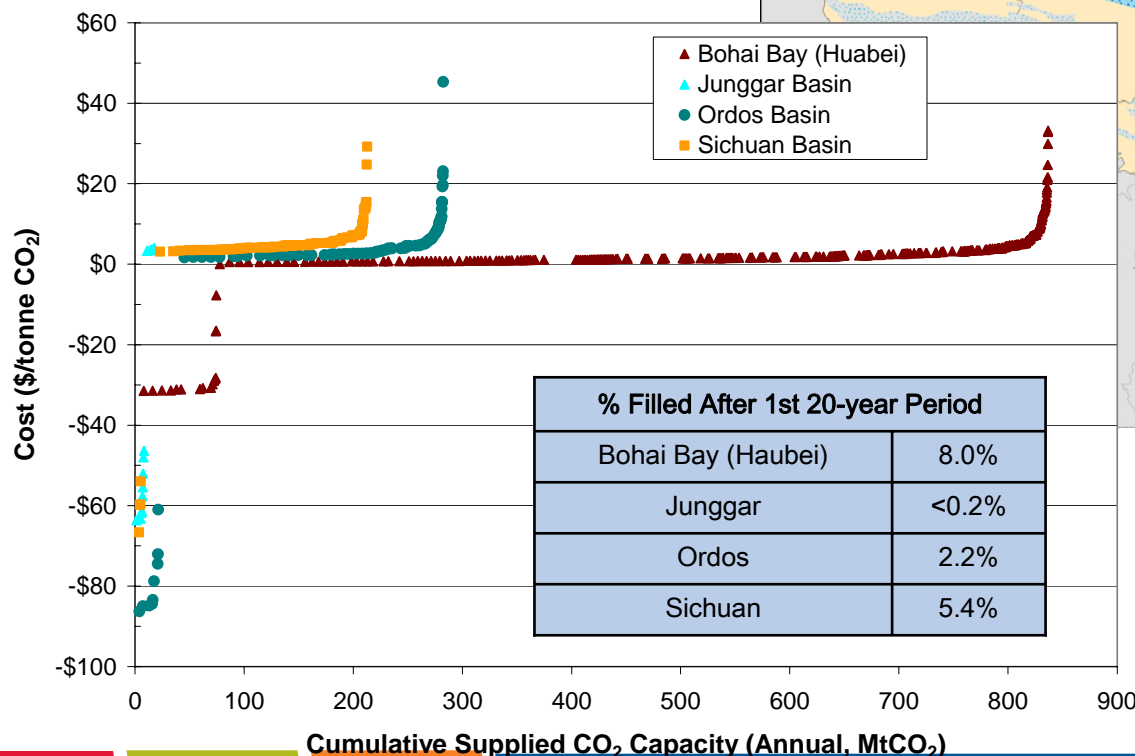
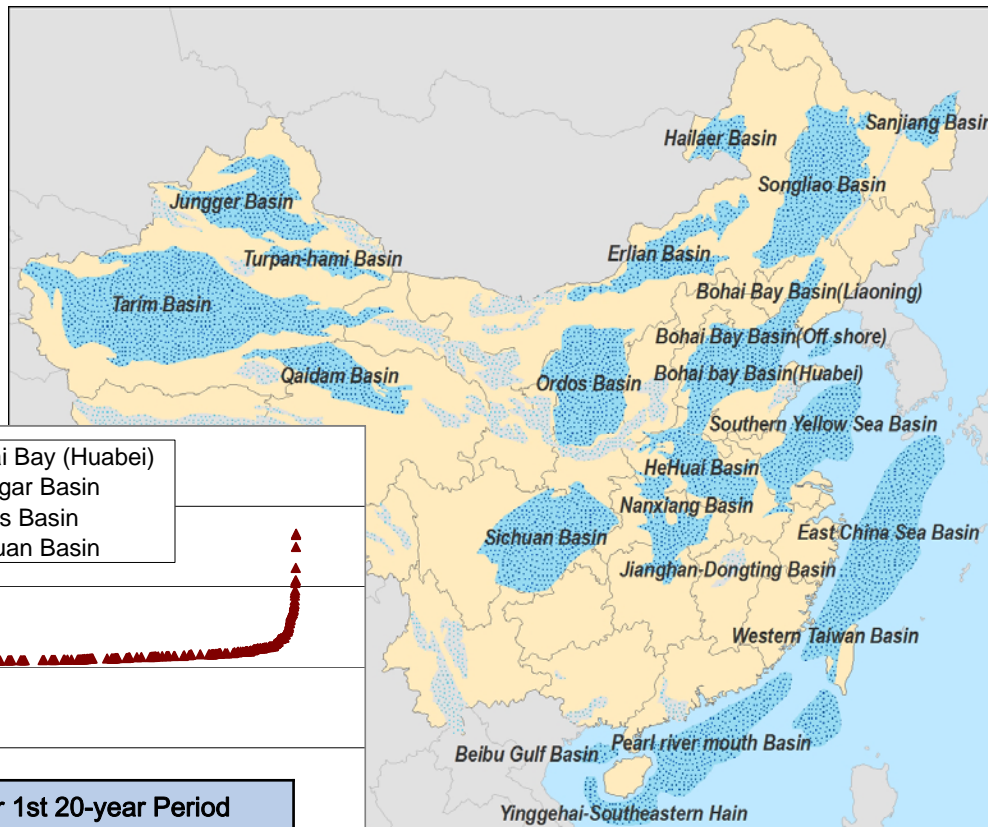
Regional Cost Curves for CO₂ Transport & Storage in China

- Regional cost curves highlight variations in CO₂ emissions distribution and accessibility and cost of CO₂ storage capacity

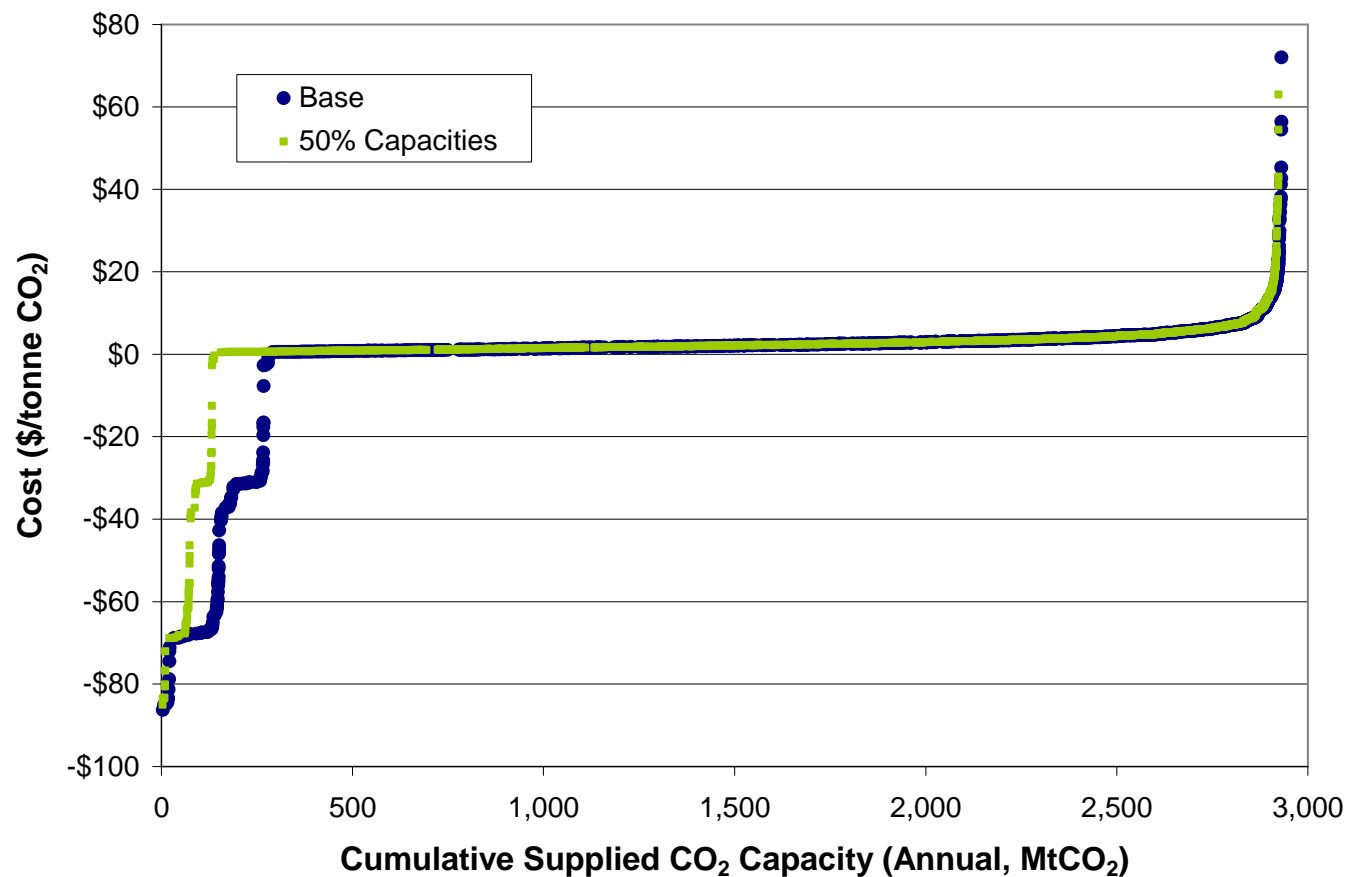


Basin-Specific Cost Curves

- Basin-specific cost curves help to identify highly demanded storage targets; as well as those where future growth could best be accommodated.

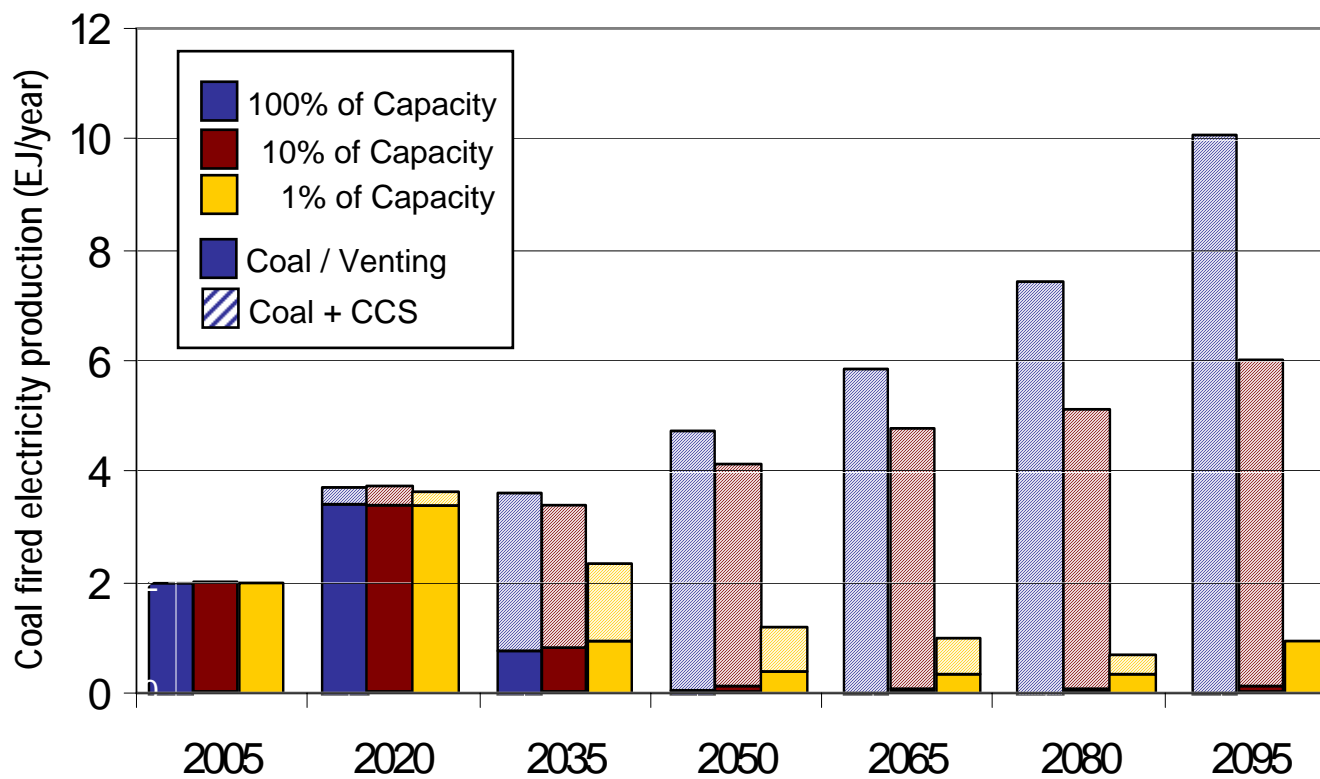


Sensitivity: Reduced Storage Capacity (50%)

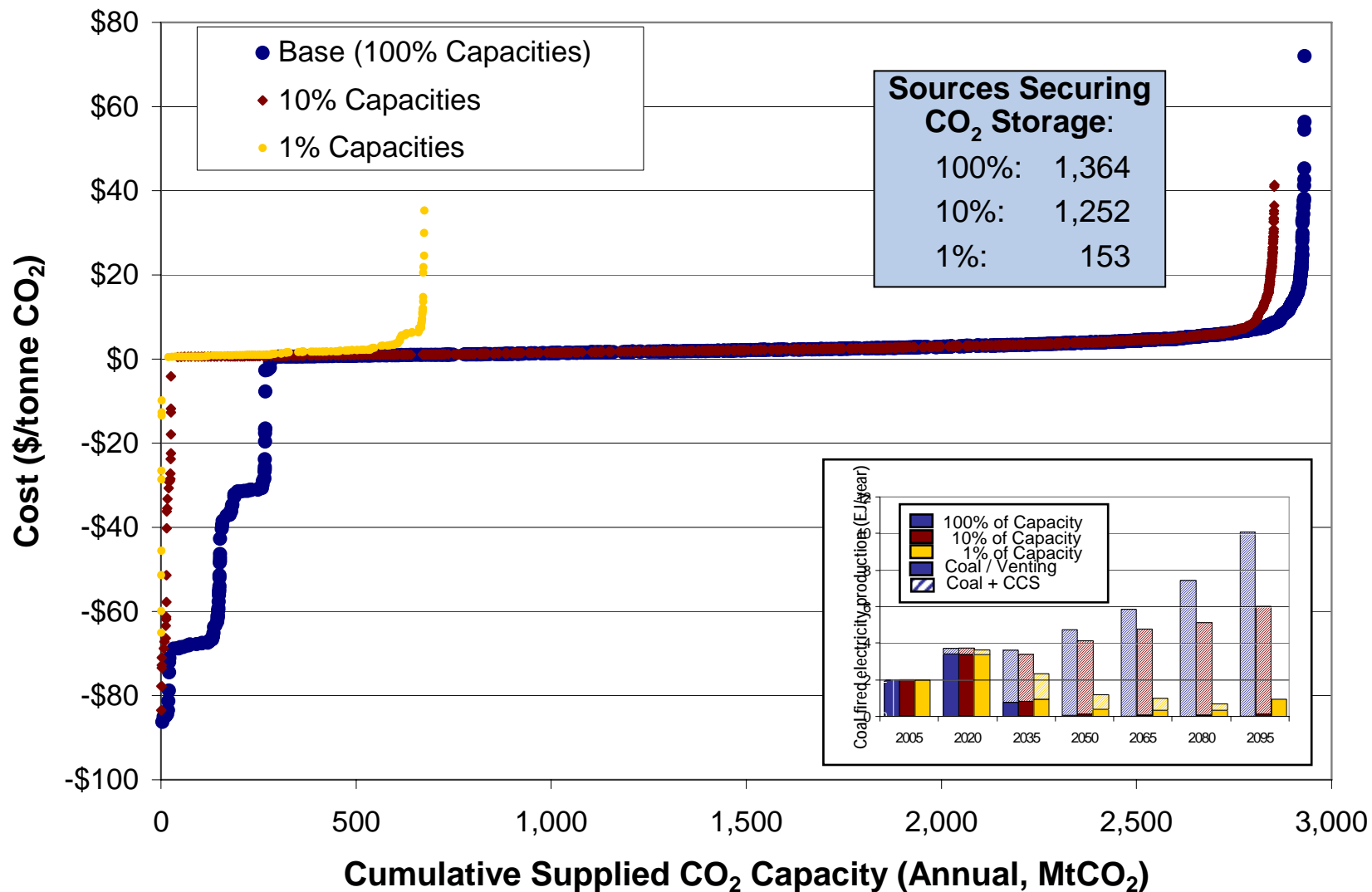


Value of CCS in China

- China's Electricity Sector Use of Coal under WRE450 Constraint and Varying Storage Capacity Availability

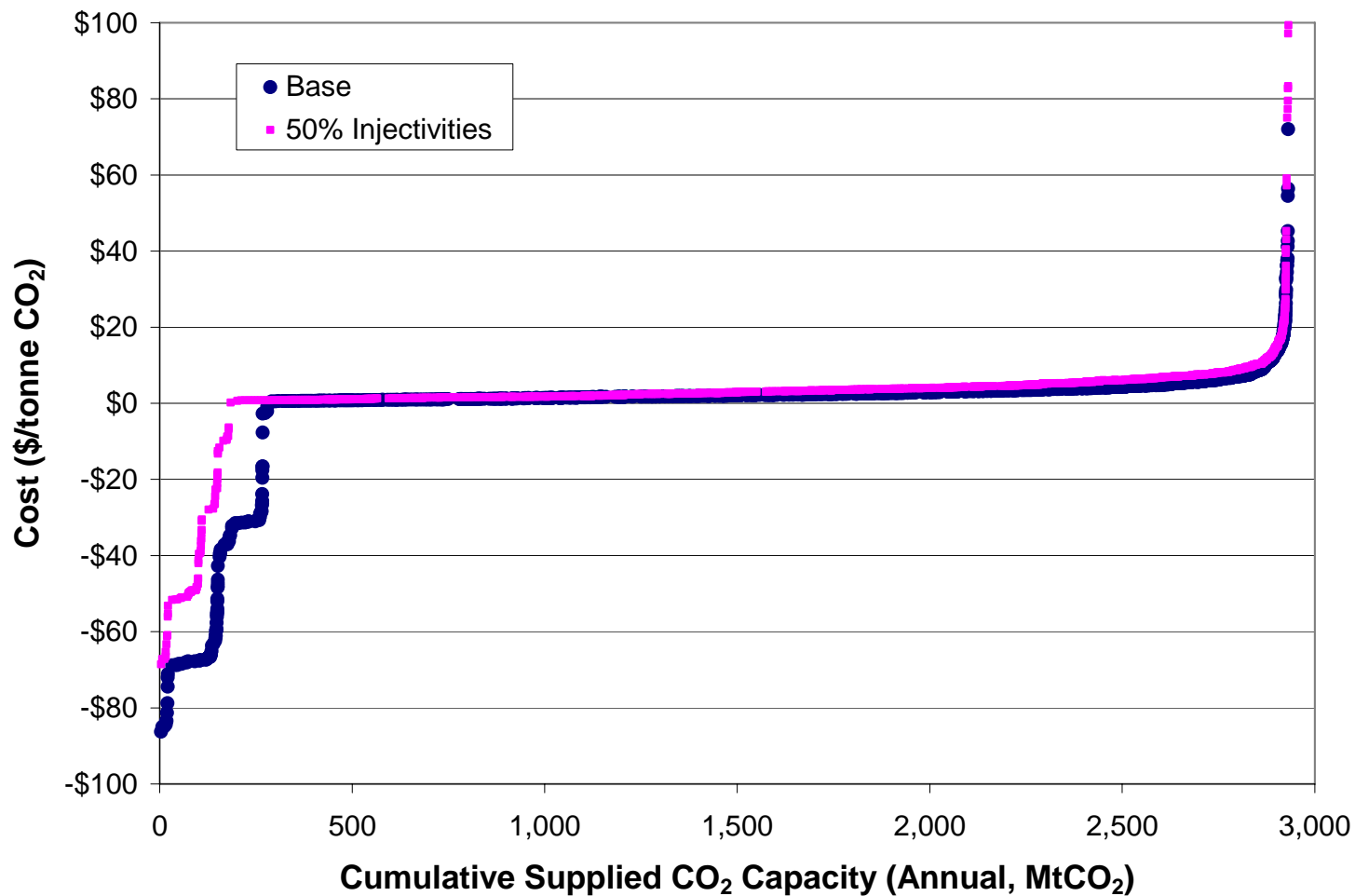


Value of CCS in China - Cost Curve Results for 100%, 10%, 1% Storage

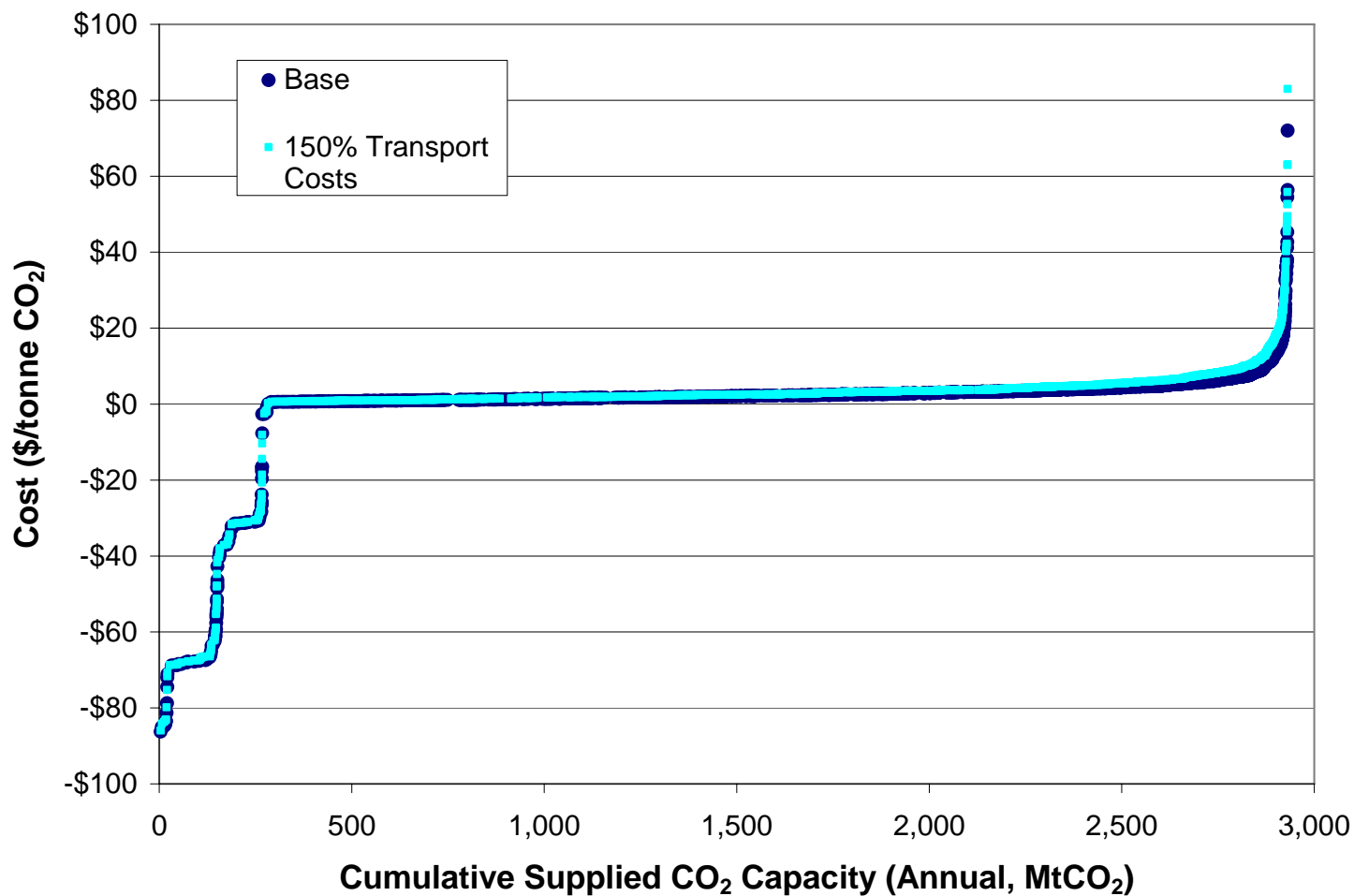


Sensitivity: Reduced Injection Rates (50%)

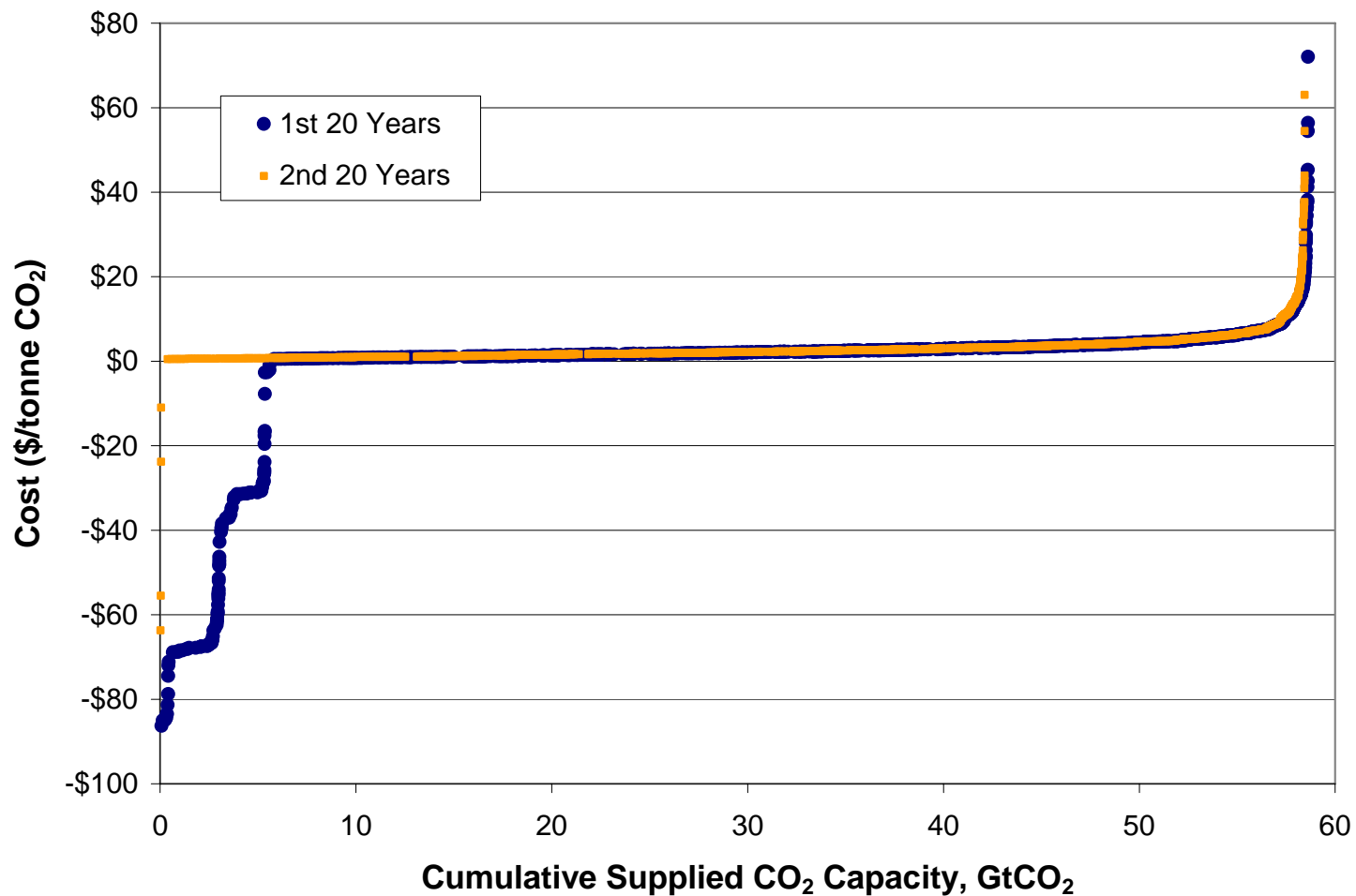
Base Values (tonnes/yr/well): Oil 21,000; coal 14,000; gas/DSF 100,000 - 1,000,000



Sensitivity: Increased Transport Costs (150%)



Reservoir Filling Impacts - Over Two 20 Year Periods



Summary

- Over 1600 large CO₂ point sources → 3890 MtCO₂/yr
- 2300 GtCO₂ theoretical storage capacity in onshore reservoirs
- There is strong potential for CCS technologies to offer significant emissions reductions in China, at transport and storage costs of up to about \$10/tCO₂
- Sensitivity analyses suggest that the storage capacity in China is robust and able to withstand significant reductions in ultimately accessible capacity and possible increases in component costs
- However, certain key regions may not have ready access to sufficient storage capacity in onshore basins – and may need to consider basins near offshore
- This work represents an initial step; follow-on research is critical to further understand the technical and economic potential and challenges for CCS to help reduce the carbon emissions from the growing Chinese economy