

# Recent development and applications of GCAM-China: CCS in China's Mitigation Strategy

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JOINT GLOBAL CHANGE RESEARCH INSTITUTE

GCAM Community Modeling Meeting 2017

# How could CCS help China achieve its NDC and long-term mitigation target?

- ▶ **What are expectations for the scale of CCS deployment in China through 2050?**
- ▶ **What is the pathway by which China might evolve from near-term, pilot project to large-scale deployment?**
- ▶ **What might be the most appropriate provinces for deployment of CCS?**
- ▶ **Will available CO<sub>2</sub> storage capacity act as a constraint for future CCS deployment?**



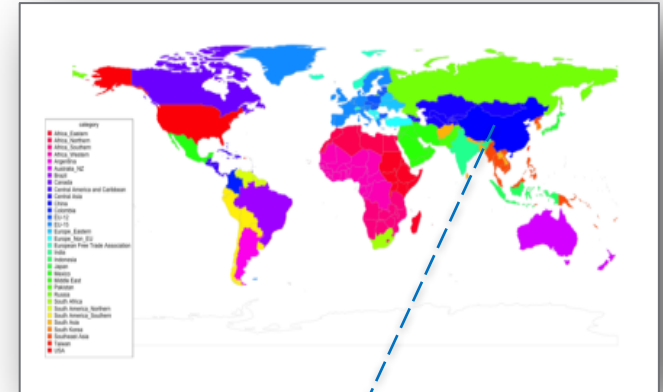
# Motivation – importance of CCS in China

- ▶ Many countries are pursuing policies to reduce their fossil fuel CO<sub>2</sub> emissions
- ▶ There is a need to understand potential future energy system transformations
- ▶ CCS technologies carry important implications for fossil fuel markets
- ▶ China is the world's largest CO<sub>2</sub> emitter and relies heavily on domestic fossil fuel resources
  - Understanding CCS deployment in China would be critical to informing research and development directions
  - Changes in China's policy influence coal use and thus global coal market.

# GCAM-China – Regional Modeling in a Global Context

- ▶ To explore regional activities in China, we have added subnational detail to GCAM (version name: GCAM-China):
  - 31-province energy and economic system
  - Agriculture and land use by agro-ecological zones
  - Water supply and demand at major watershed scale
- ▶ The regional detail is imbedded in the broader GCAM model, thus providing global constraints and context.
- ▶ The model is currently used by institutions in China for policy analyses:
  - Access to data
  - Understanding China's policy decisions
  - Identifying potential markets for US technologies

Standard GCAM: 32 geopolitical regions



GCAM-China: Modeled Provinces





# Recent Model Developments

- ▶ Shared socioeconomic pathways assumptions at the provincial level
- ▶ Carbon storage cost curves
- ▶ Better calibration and improvements in assumptions
  - CCS technology readiness
  - Renewable energy competitiveness

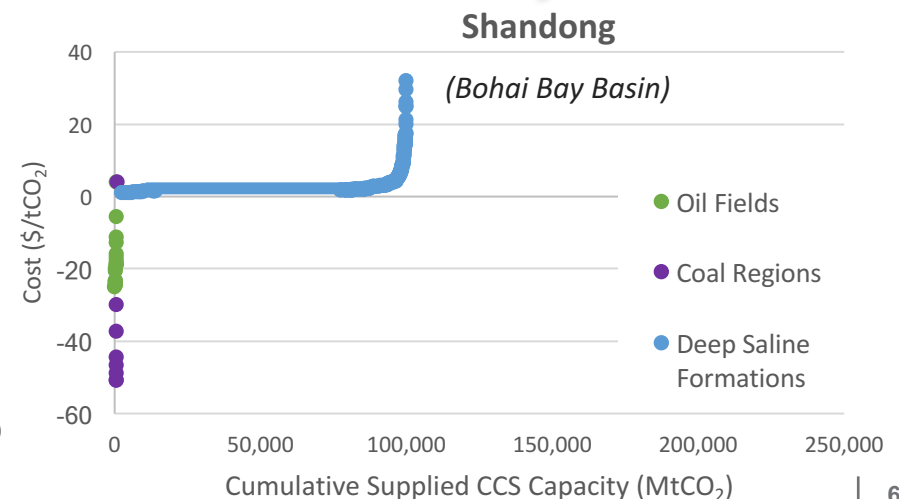
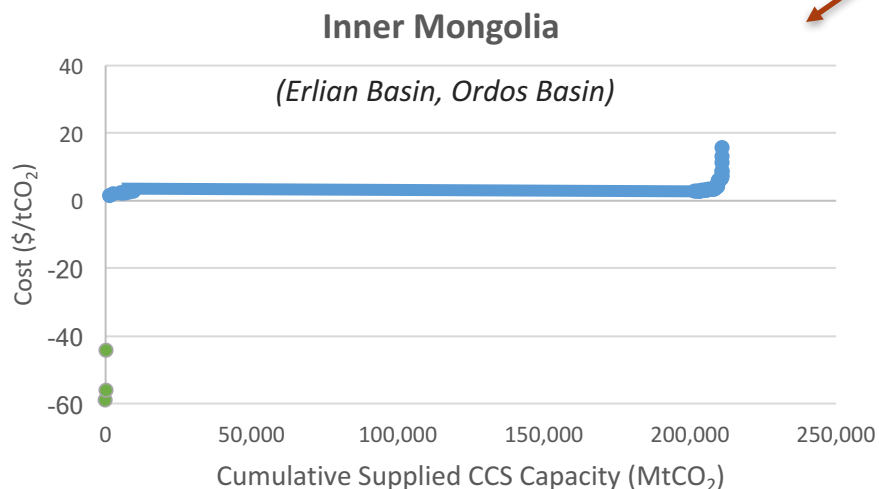
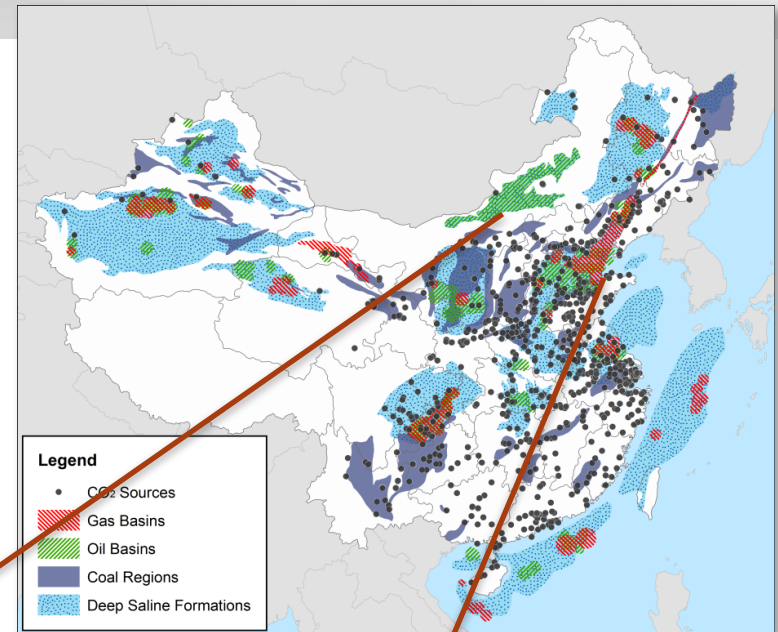
## On-going developments

- ▶ Addition of nonCO<sub>2</sub>s at the provincial level
- ▶ Industrial sector breakout

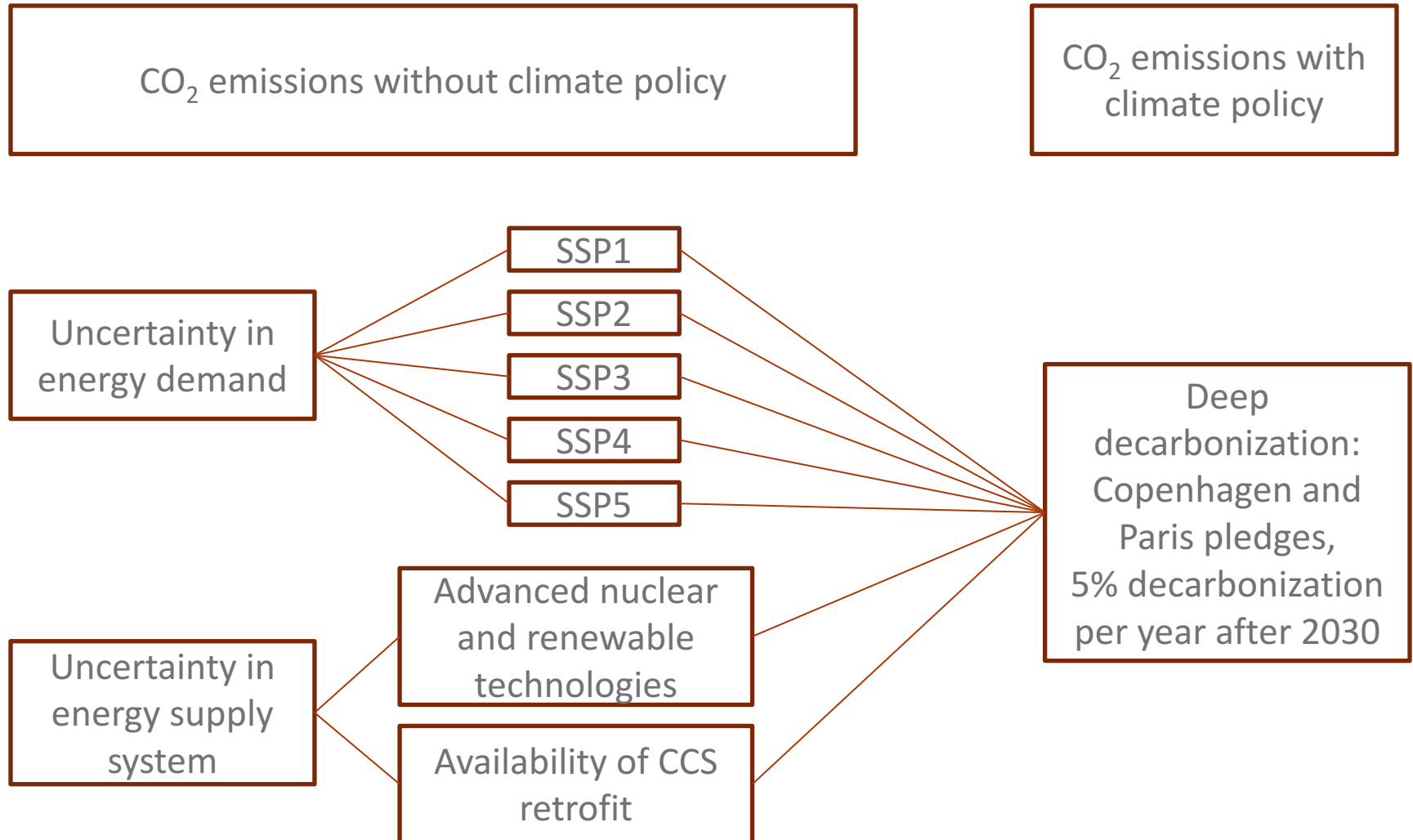


# Provincial CCS Cost Curves

- ▶ 1,600 large CO<sub>2</sub> point sources (power plants and industrial sources)
- ▶ 2,300,000 MtCO<sub>2</sub> storage capacity
  - ▶ EOR, coal basins, deep saline formations
- ▶ Significant opportunity for both low-cost and moderately priced storage

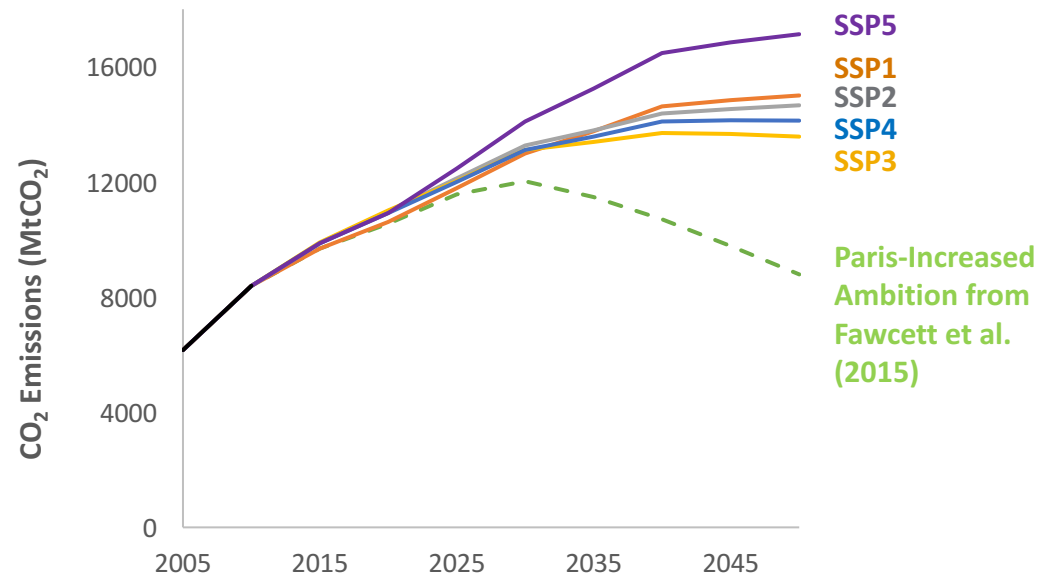


# Scenarios to Understand Energy Demand and Technology Options



# Scenario Development – Shared socioeconomic pathways and Paris-Increased Ambition

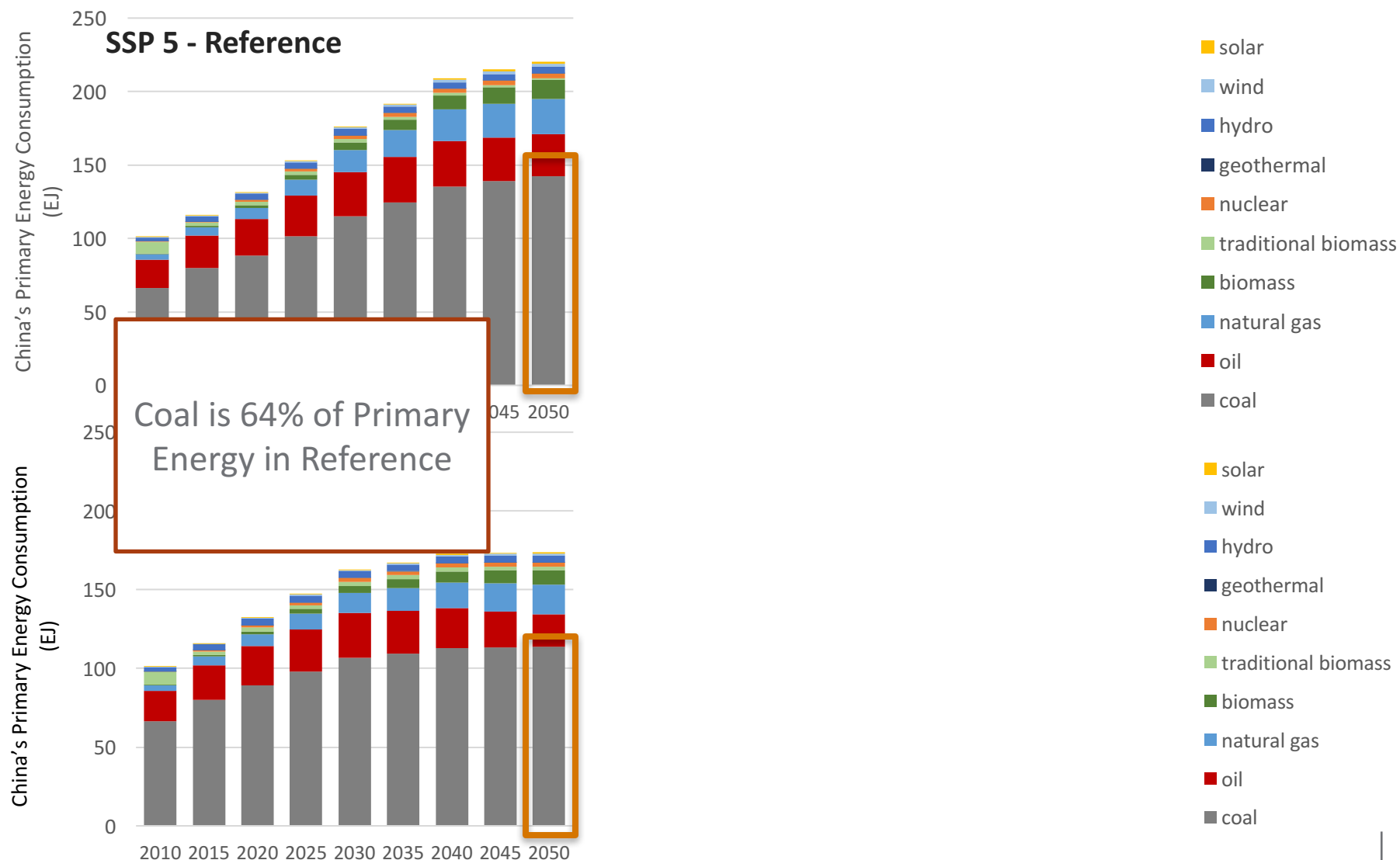
- ▶ SSP1 – SSP5 include varying assumptions of population and GDP growth, income elasticity
- ▶ Provincial level population and GDP growth rates converge to country level in the long term
- ▶ Only demand-side SSP assumptions were used
- ▶ Policy scenario across all SSPs is the Paris-Increased Ambition
  - ▶ Copenhagen and Paris pledges are met, continued decarbonization of 5% per year



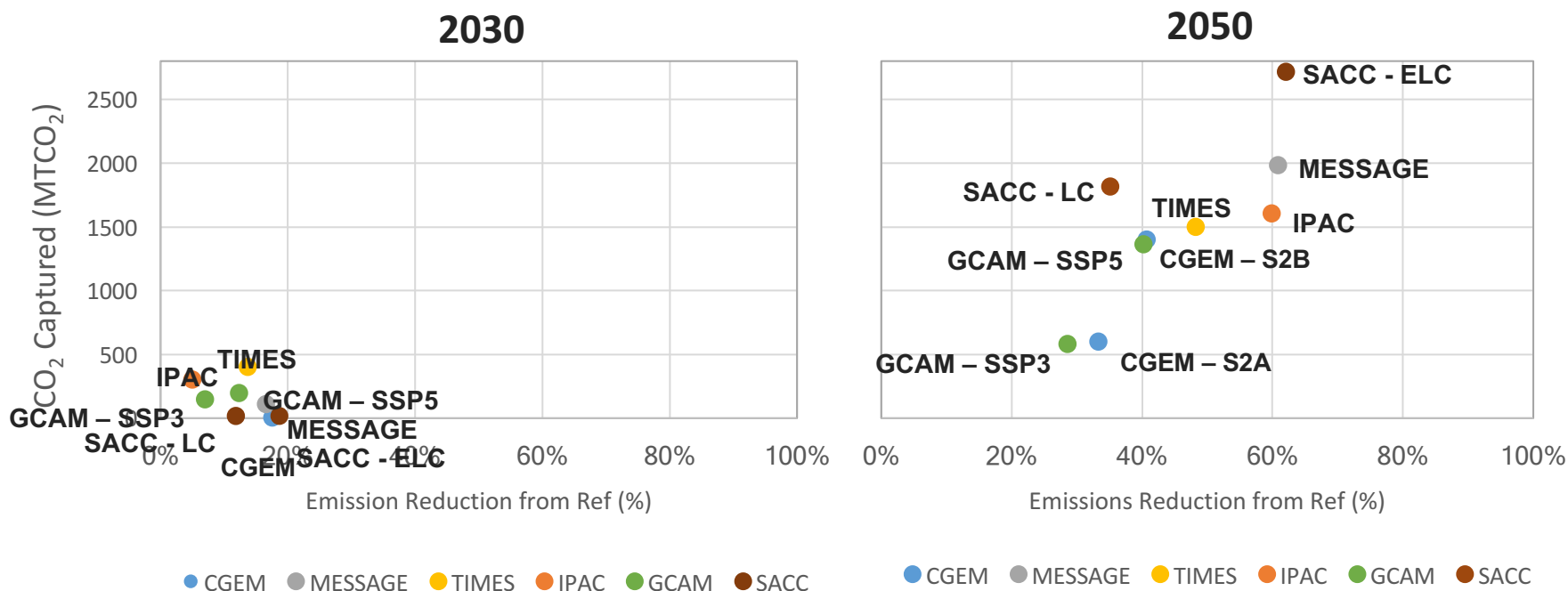




# Transition of China's energy system

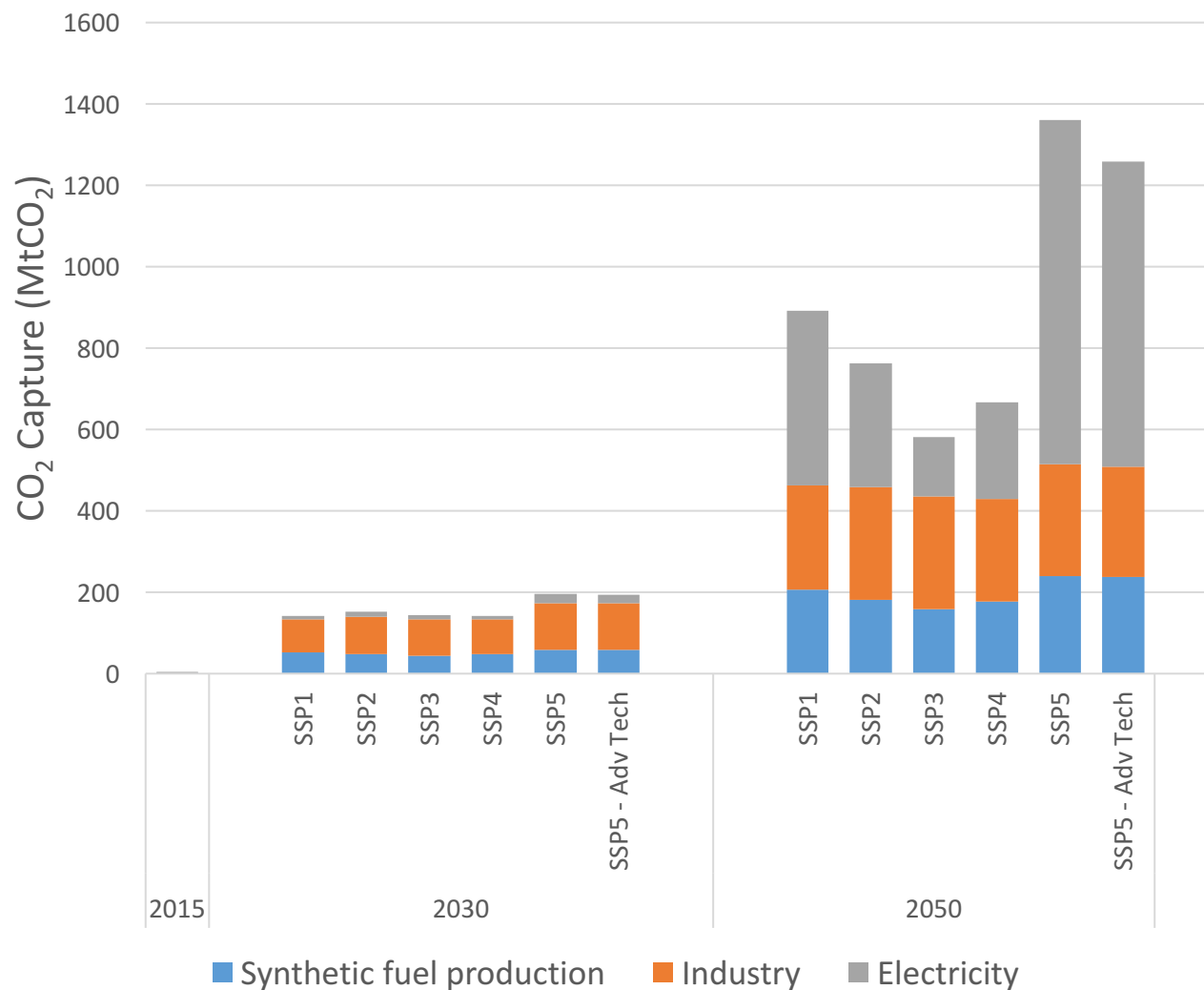


# What are expectations for the scale of CCS deployment in China through 2050?



- ▶ Near term uncertainty in CCS deployment level
- ▶ Mid-century trend across models – as mitigation level increases, role of CCS increases

# What is the pathway by which China might evolve from near-term, pilot project to large-scale deployment?

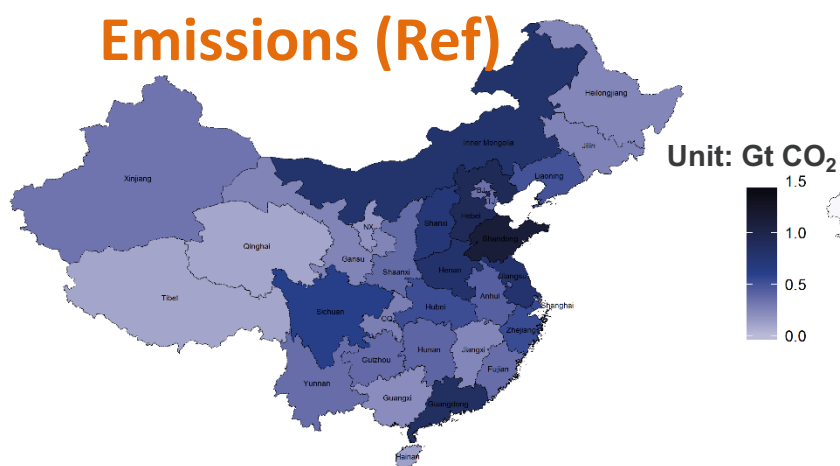


SSP5

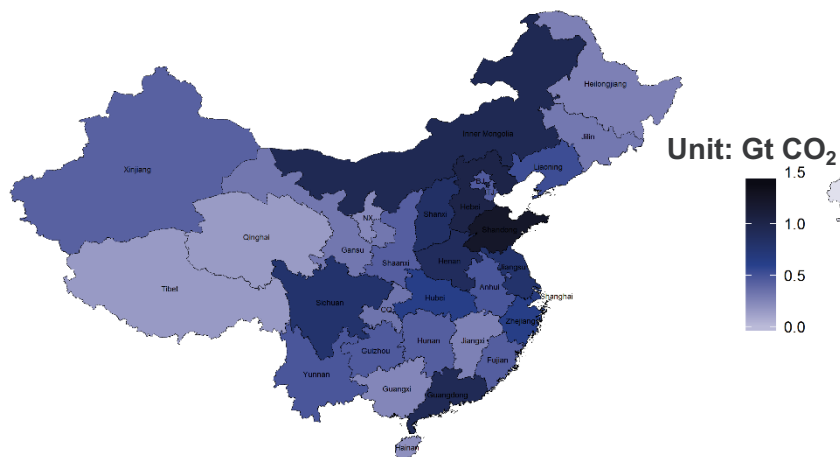
Emissions (Ref)

Sequestration (policy)

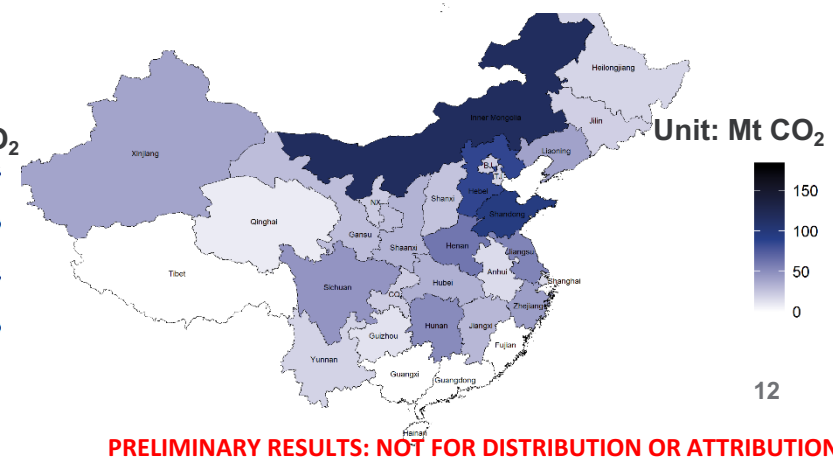
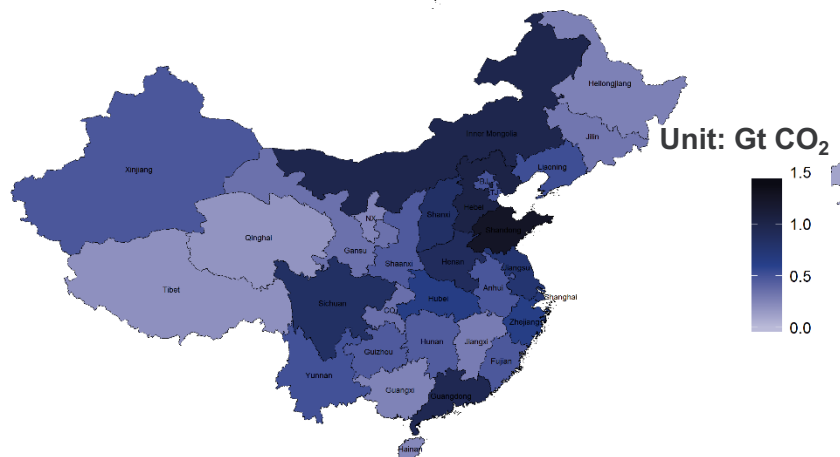
2030



2040



2050

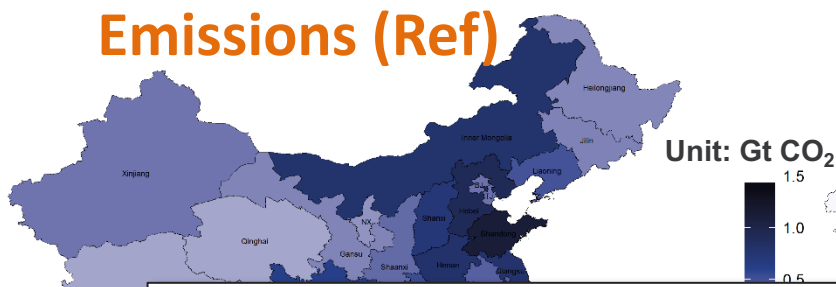


SSP5

Emissions (Ref)

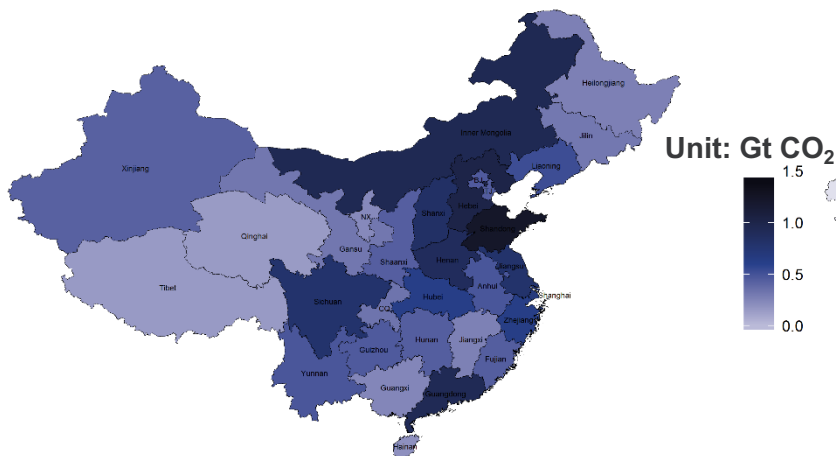
Sequestration (policy)

2030

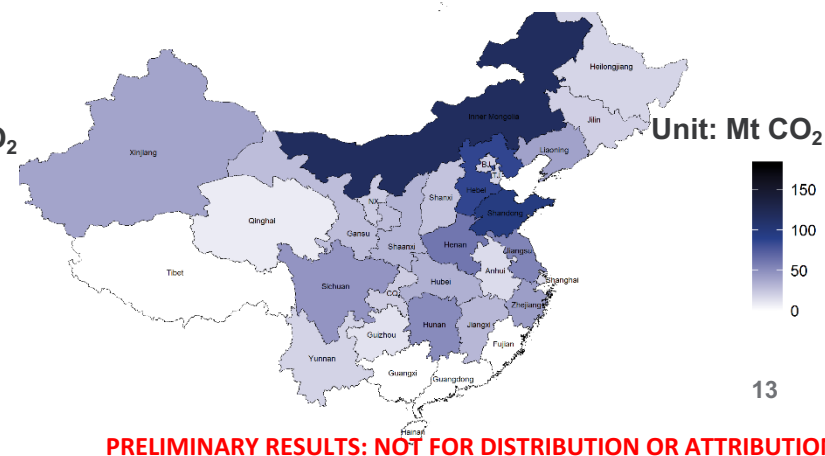
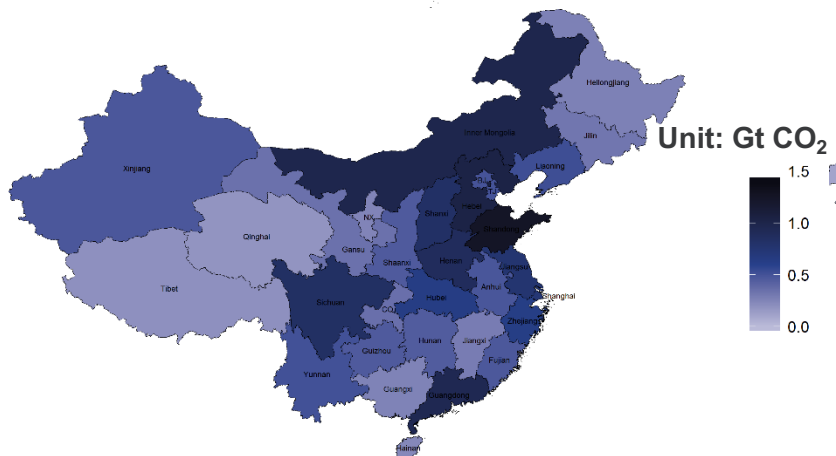


Capture is driven by emissions, energy structure, and available storage

2040



2050

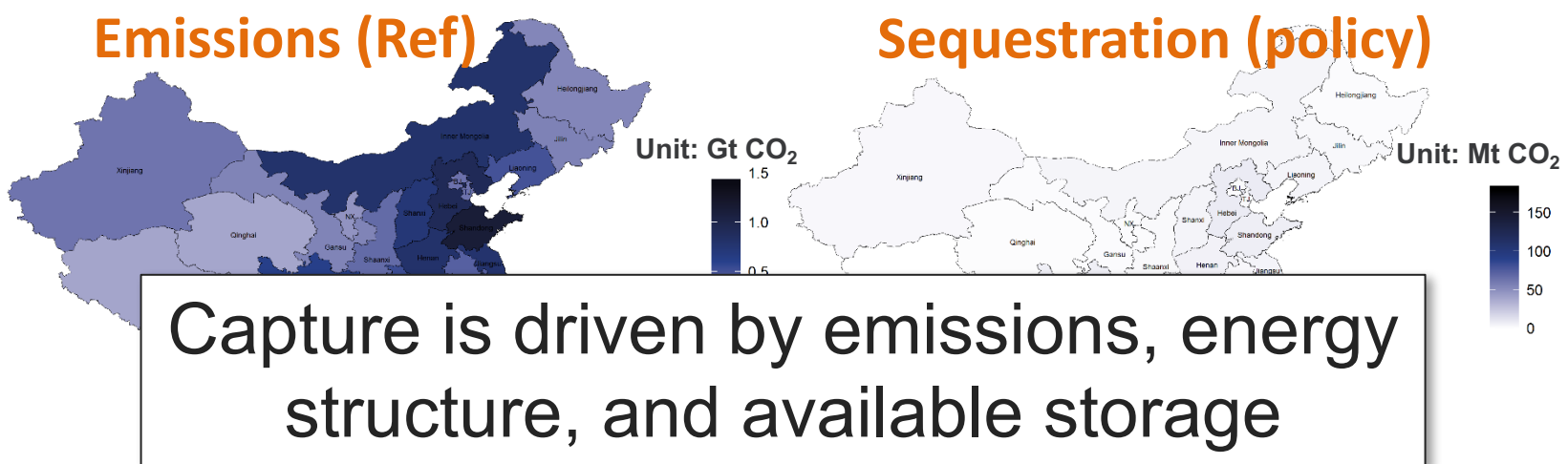


SSP5

Emissions (Ref)

Sequestration (policy)

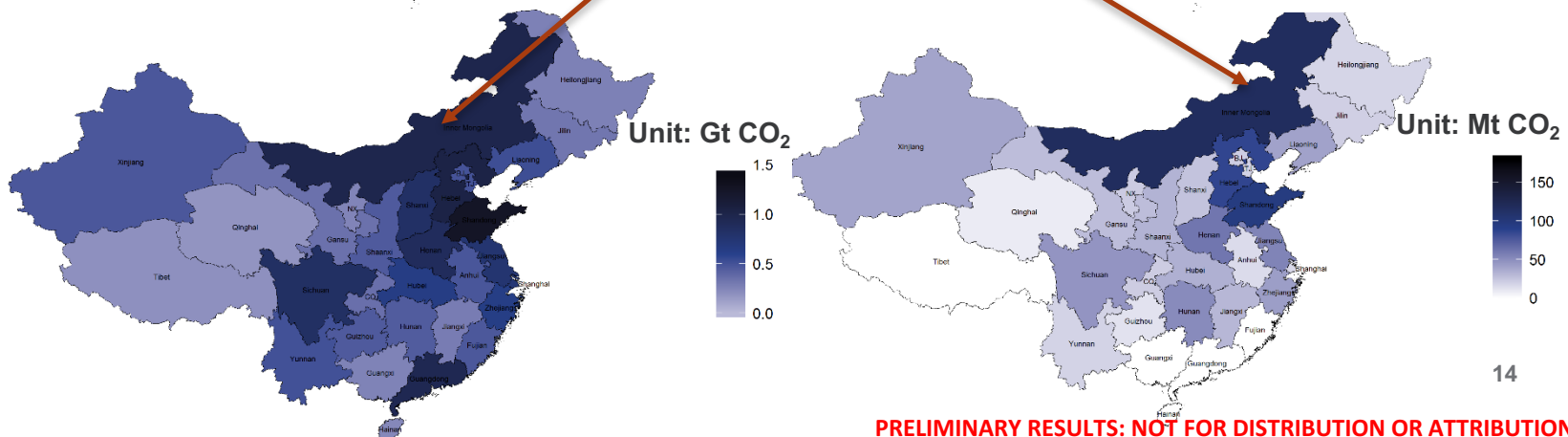
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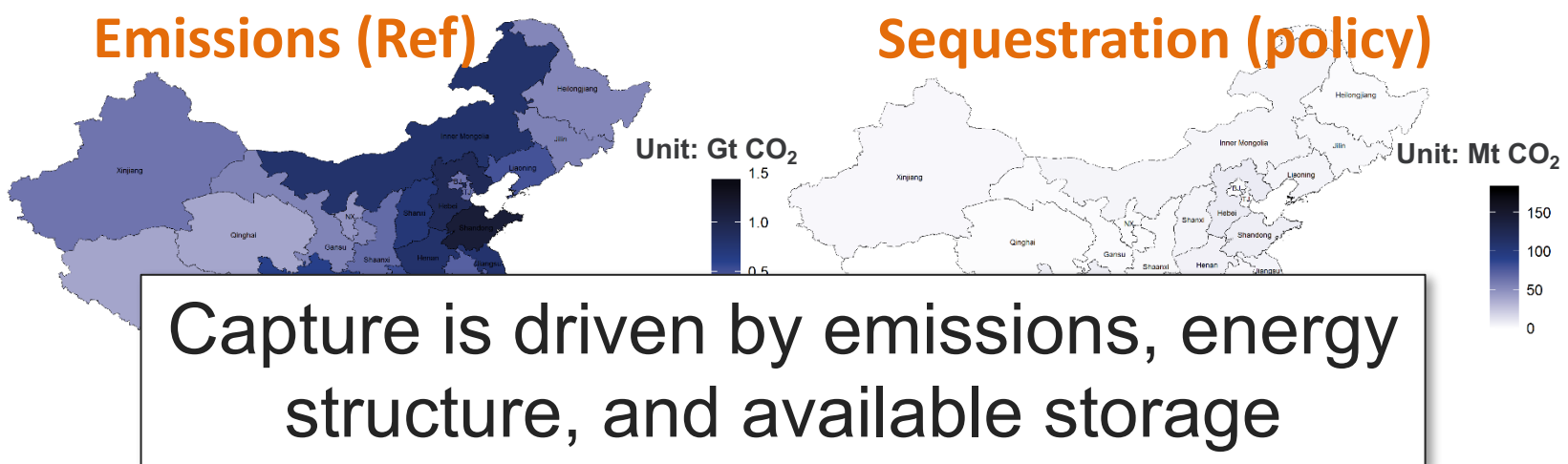


SSP5

Emissions (Ref)

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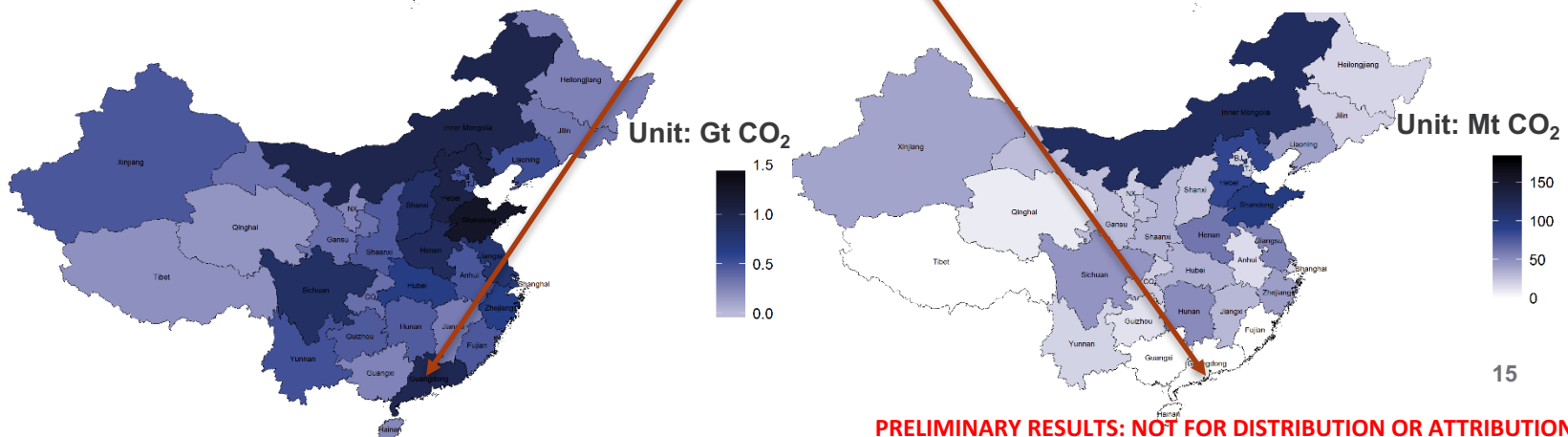
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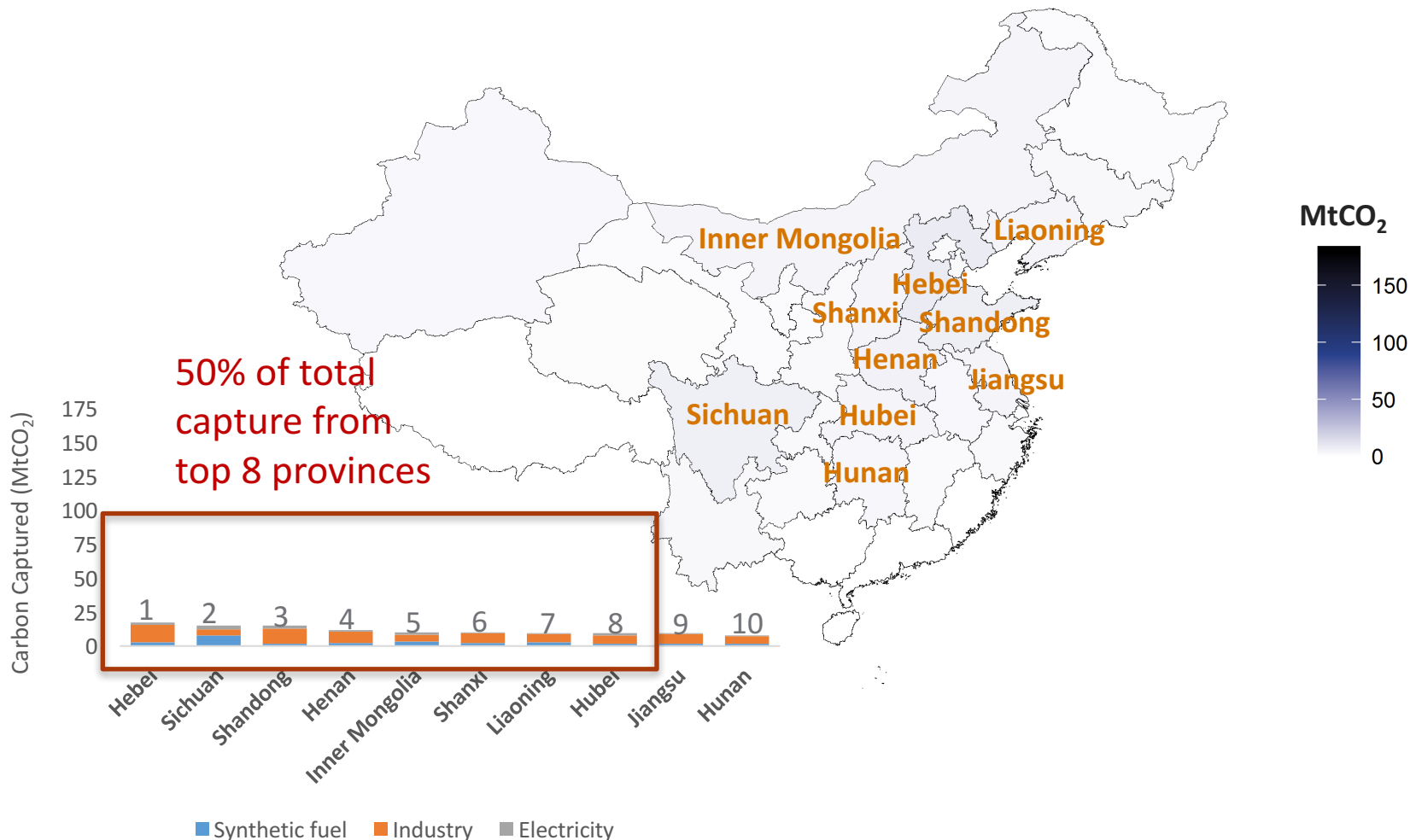


2050



# What might be the most appropriate provinces for deployment of CCS?

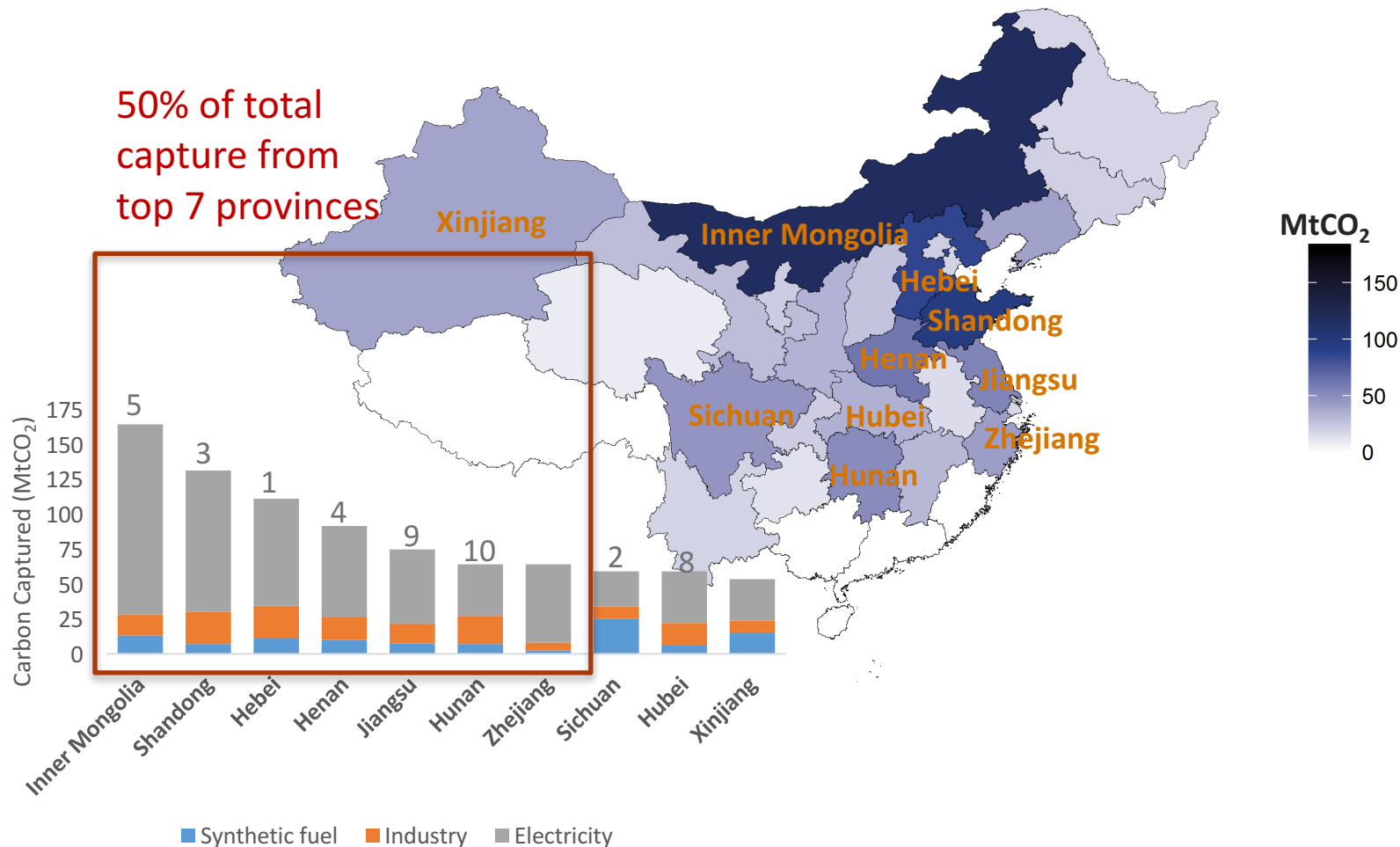
2030 CO<sub>2</sub> Sequestration by Province (MtCO<sub>2</sub>)



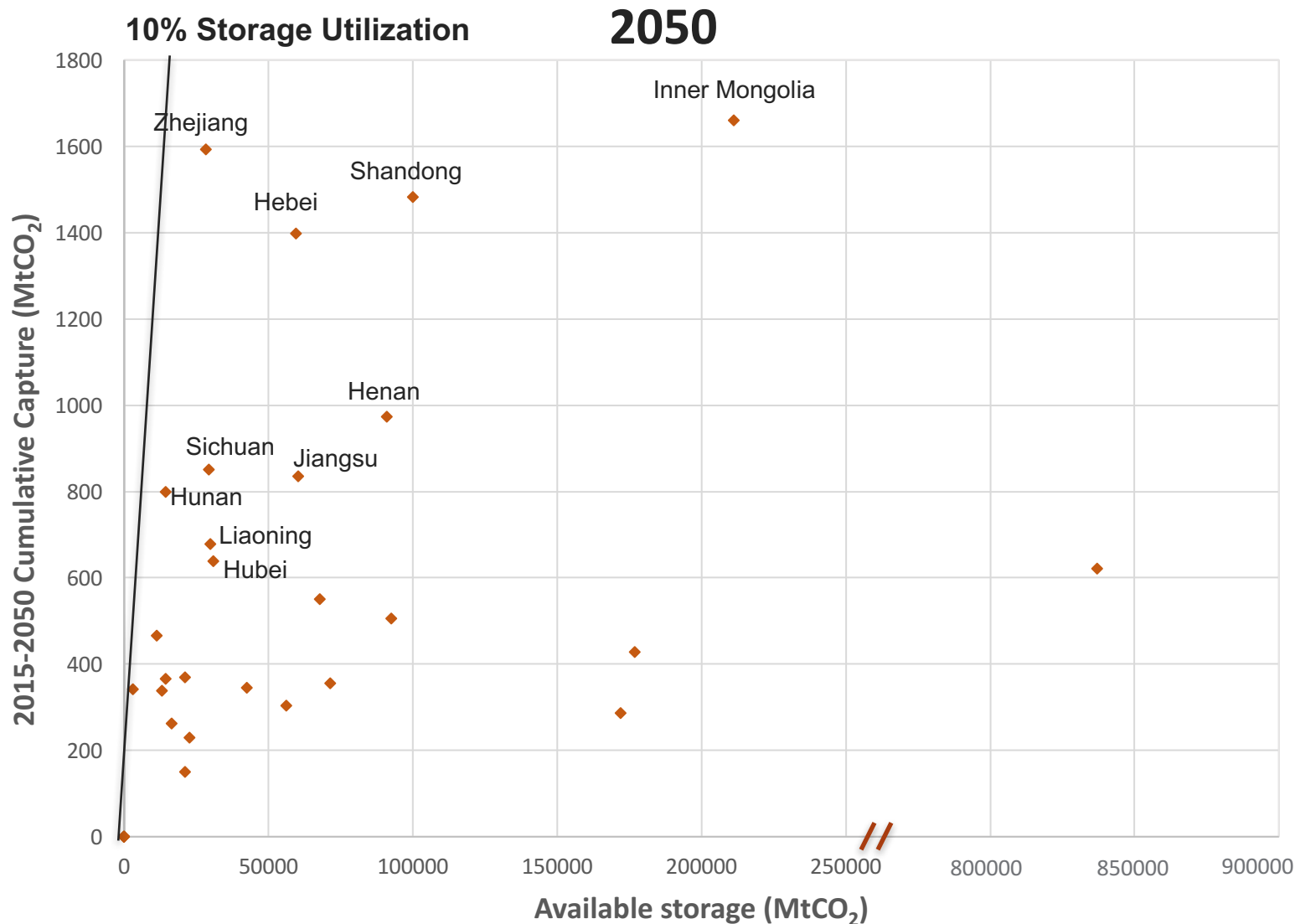


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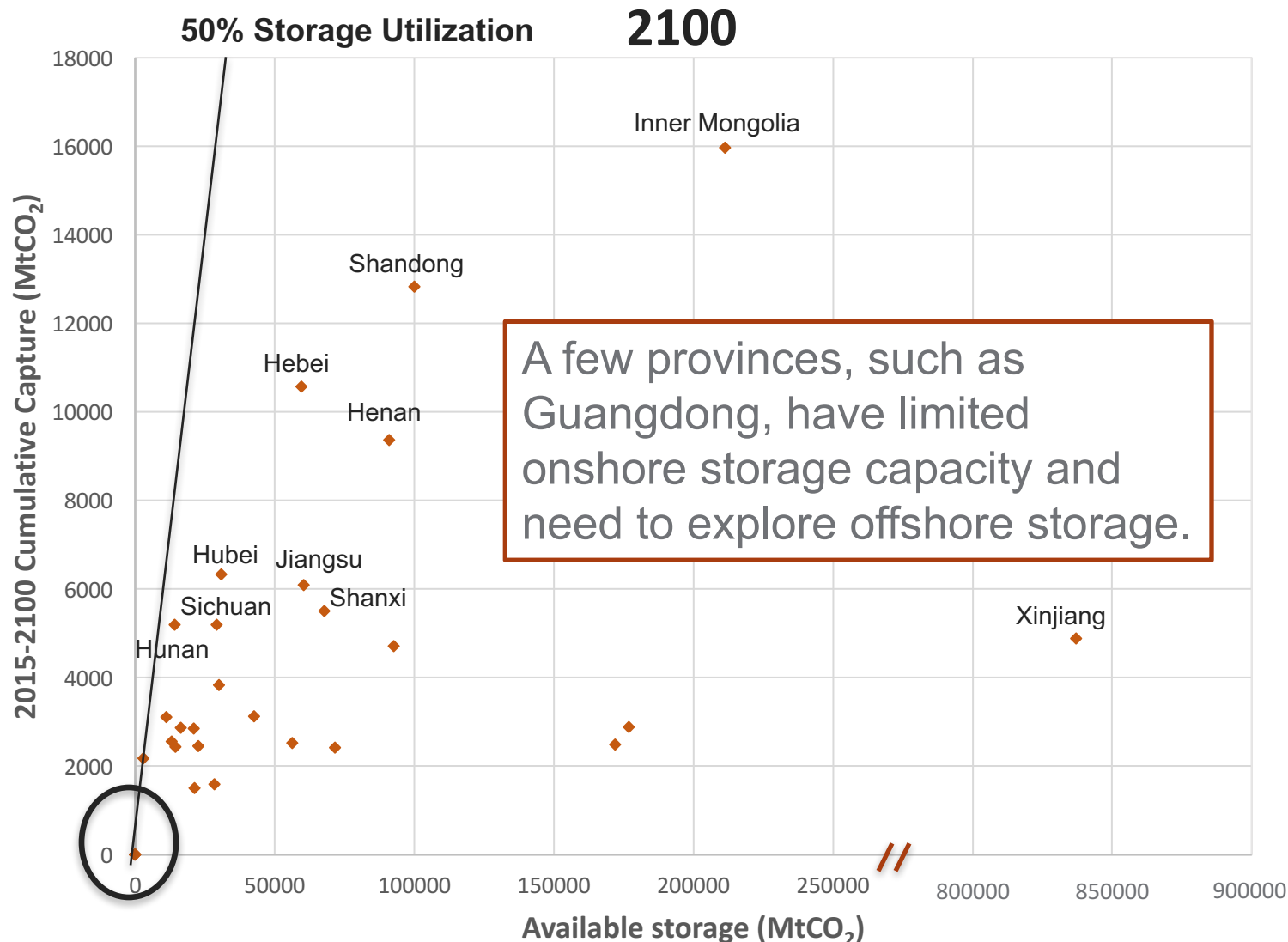
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# Will available CO<sub>2</sub> storage capacity act as a constraint for future CCS deployment?



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# How could CCS help China achieve its NDC and long-term mitigation target?

- ▶ **What are expectations for the scale of CCS deployment in China through 2050?**
  - China is an ideal candidate for CCS deployment with large-scale storage capacity and an emphasis on coal in the energy system. Use of CCS will depend on policy approaches and total mitigation needs.
- ▶ **What is the pathway by which China might evolve from near-term, pilot project to large-scale deployment?**
  - Near-term CO<sub>2</sub> capture will likely focus on industrial and synfuel sectors, while capture in the power sector would become more prominent in the long term.
- ▶ **What might be the most appropriate provinces for deployment of CCS?**
  - Several provinces, such as Inner Mongolia, Shandong and Hebei, emerge as key players in both the near and long term.
- ▶ **Will available CO<sub>2</sub> storage capacity act as a constraint for future CCS deployment?**
  - For most provinces, storage will not be a constraint through the end of the century. Several important provinces are without meaningful on-land storage and would therefore require offshore storage.



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