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# Understanding CCS in China's Mitigation Strategy using GCAM-China

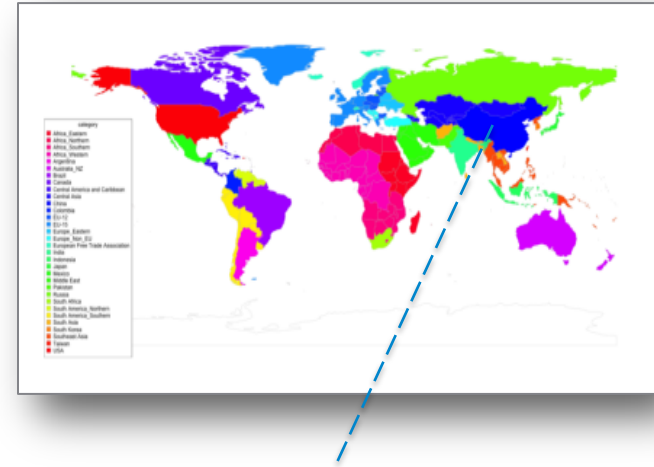
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HAEWON MCJEON

JOINT GLOBAL CHANGE RESEARCH INSTITUTE

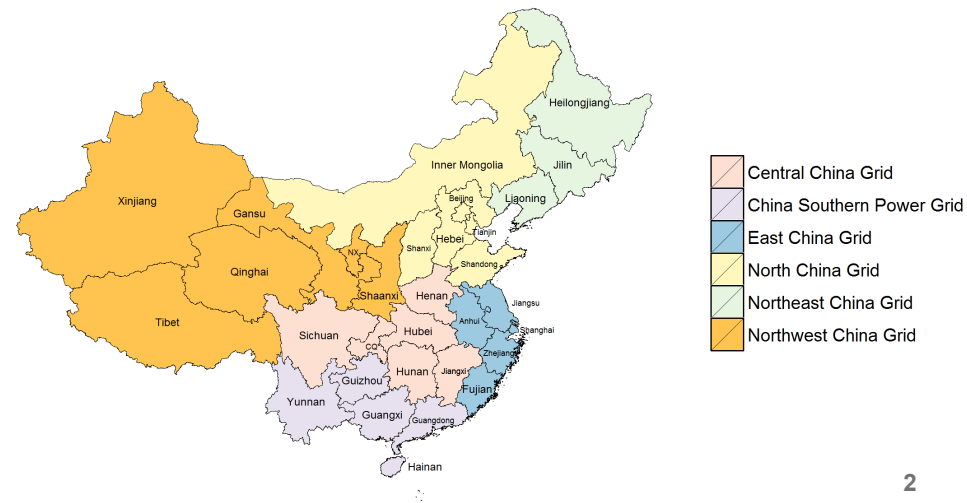
# GCAM-China – Regional Modeling in a Global Context

- ▶ 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 AEZ
  - Water supply and demand at major watershed scale
- ▶ The rest of the model operates normally, thus providing global constraints and context.

Standard GCAM: 32 geopolitical regions



GCAM-China: Modeled Provinces





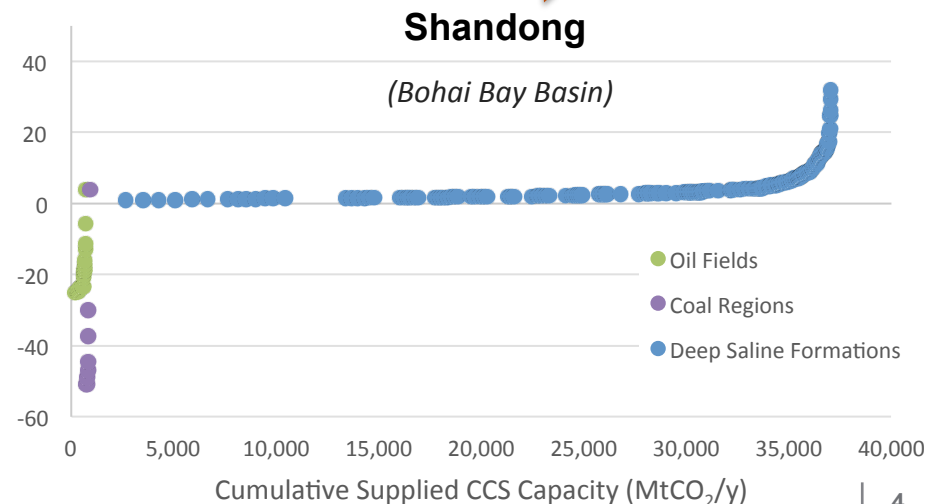
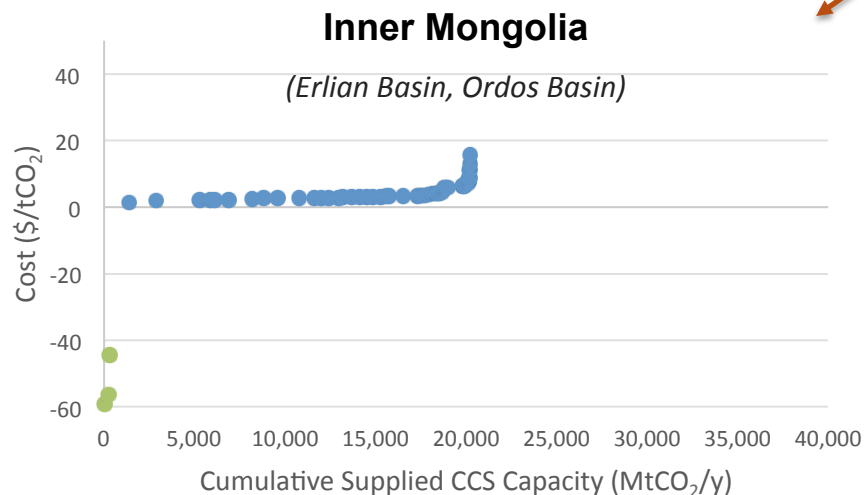
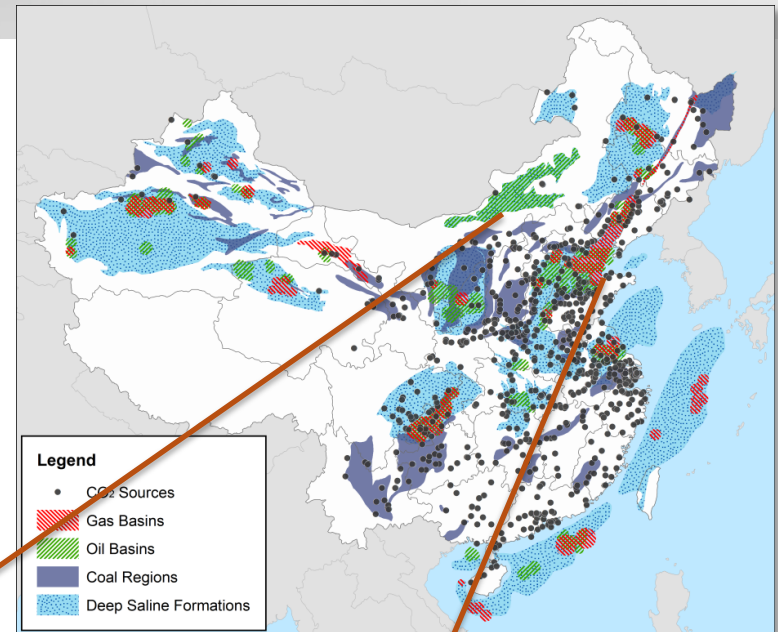
# Current GCAM-China Detail

- ▶ Socioeconomics at the provincial level
  - Population
  - GDP
- ▶ Energy transformation at the provincial level
  - Electricity generation and refining by province
  - Electricity trade within 6 grid regions
- ▶ Renewable and carbon storage resources at the provincial level
  - Wind and solar
  - Carbon storage
- ▶ Final energy demand at the provincial level
  - Buildings: commercial, urban residential, and rural residential
  - Transportation: passenger & freight with detailed technologies
  - Industry: aggregate energy demand
- ▶ Not modeled at the provincial level
  - Fossil resources
  - Agricultural demand and supply
  - Water demand and supply
  - Air pollutant emissions



# 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
  - ▶ Deep saline sedimentary, EOR, coal basins
- ▶ Significant opportunity for both low-cost and moderately priced storage



# How do development pathways and provincial variations affect future energy use in China?

## Scenario development

### Energy Future

High

Low

Without

#### **Consumption Boom**

- ❖ Deepening social reform focusing on equality
- ❖ Economic booms
- ❖ Shift towards western lifestyle

#### **Sustainable Development**

- ❖ Rapid economic development
- ❖ Growing middle class
- ❖ Emphasis on sustainable growth & social equity

### Provincial Variation

With

#### **Dispersed Growth**

- ❖ Widening regional disparity
- ❖ More living space and energy services
- ❖ Conflicts between economic development & environmental protection

#### **Hub and Spoke**

- ❖ Substantial growth in high-income and coastal provinces
- ❖ Strong technology innovation and efficiency improvement
- ❖ Environmental consciousness



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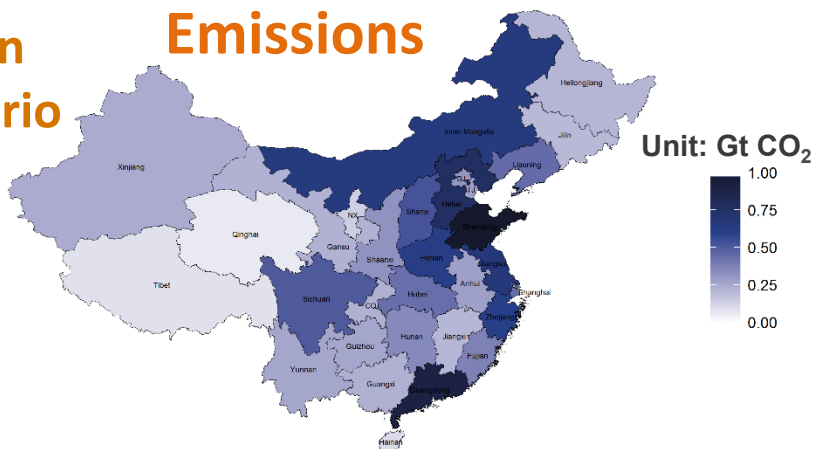
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# What are the primary applications for CCS through 2050?

# Consumption Boom Scenario

2030

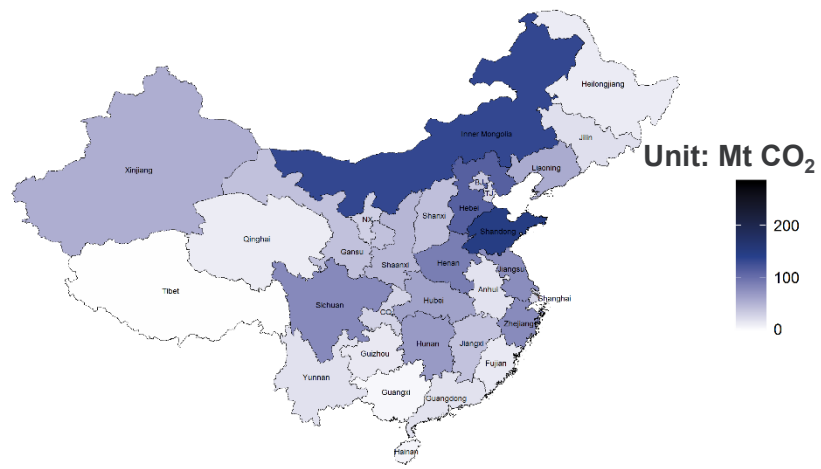
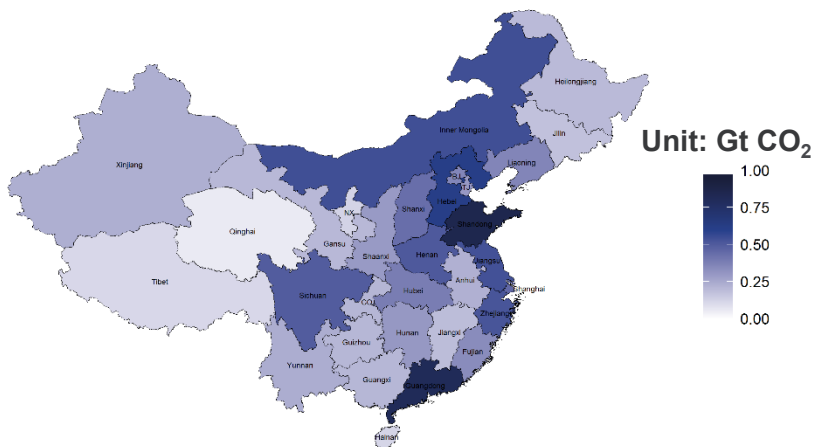
## Emissions



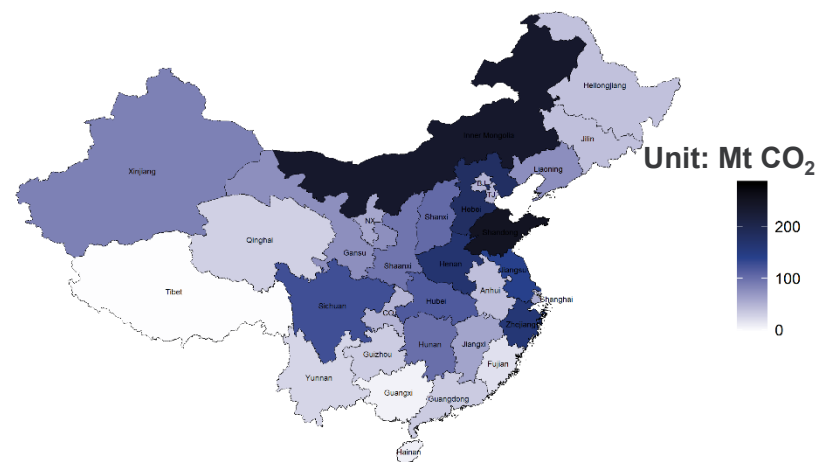
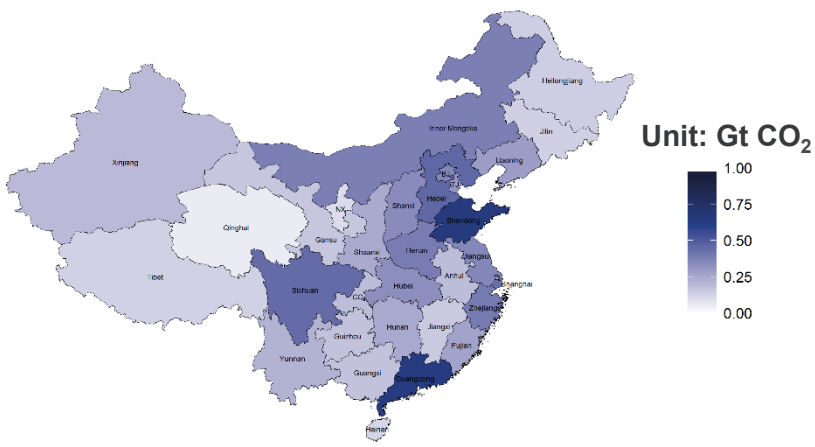
## Sequestration



2040



2050

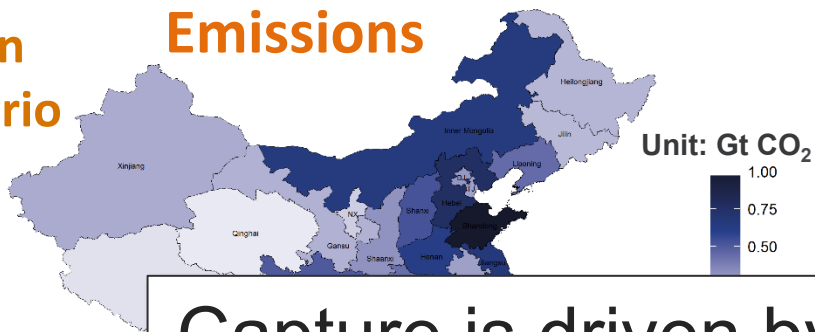




# Consumption Boom Scenario

2030

## Emissions

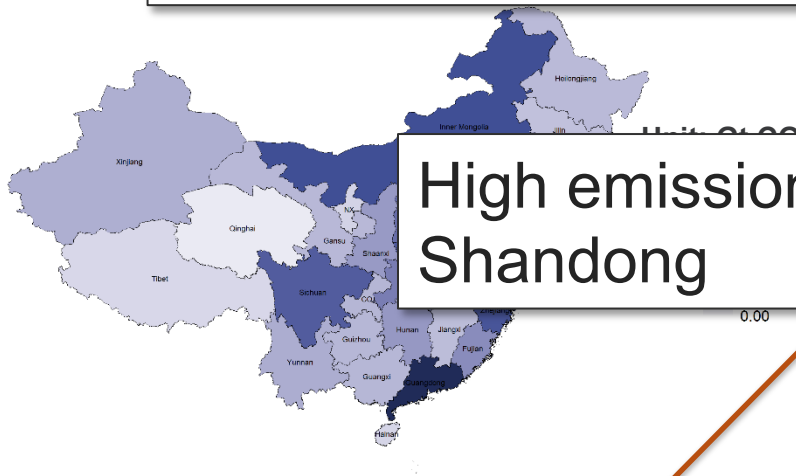


## Sequestration



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

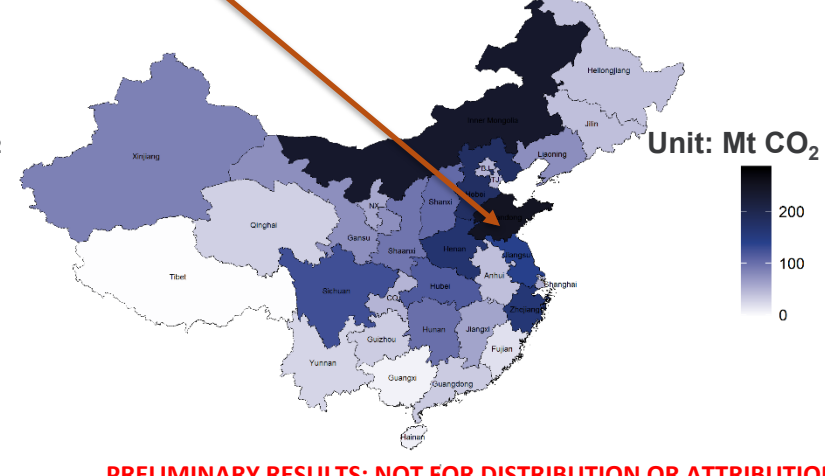
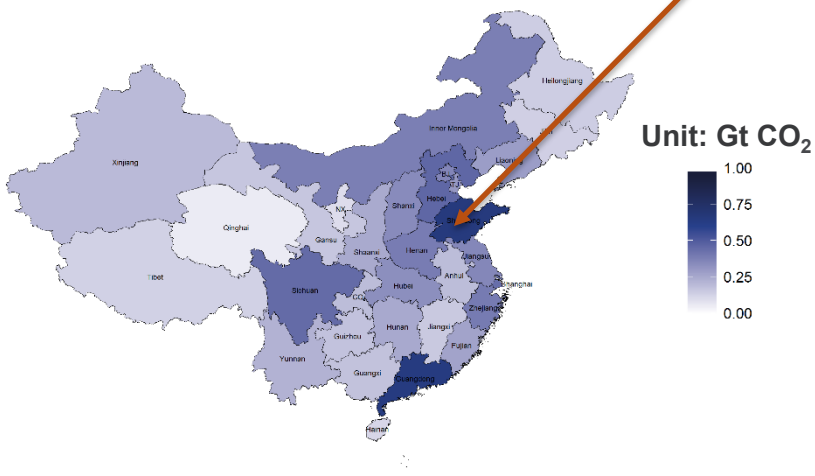
2040



High emissions, high capture:  
Shandong



2050

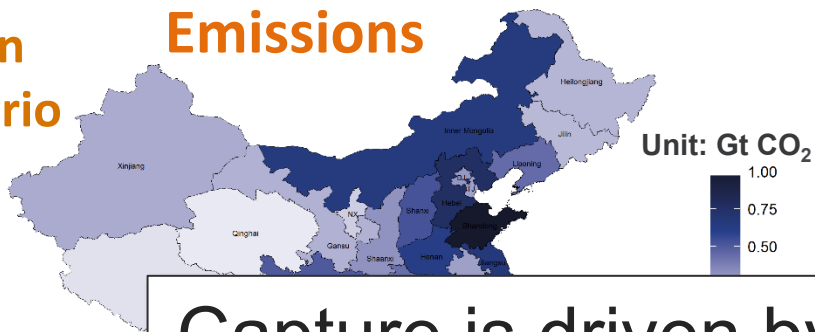




# Consumption Boom Scenario

2030

## Emissions

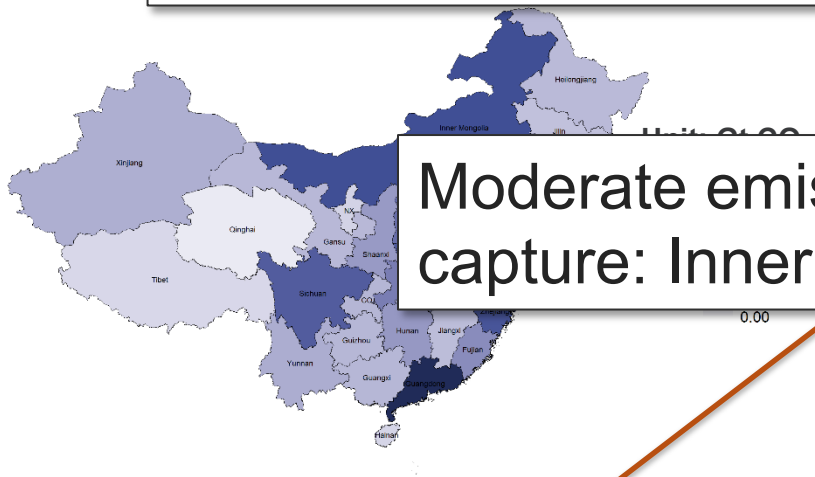


## Sequestration

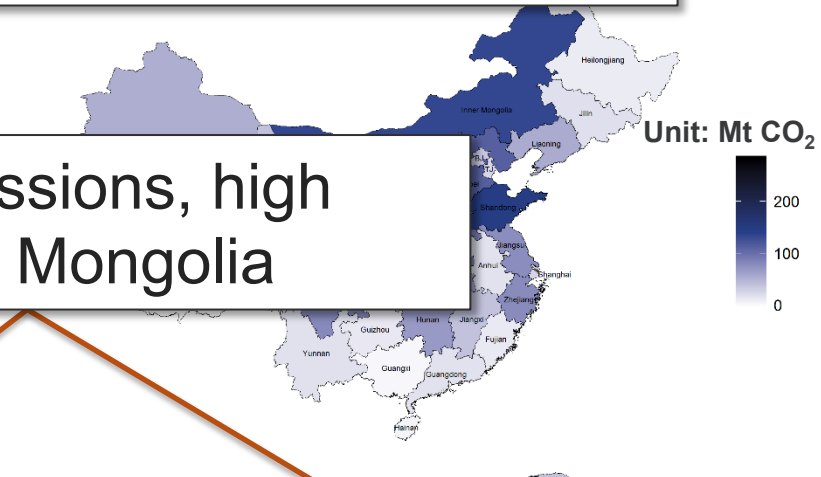


Capture is driven by emissions, energy structure, and available storage

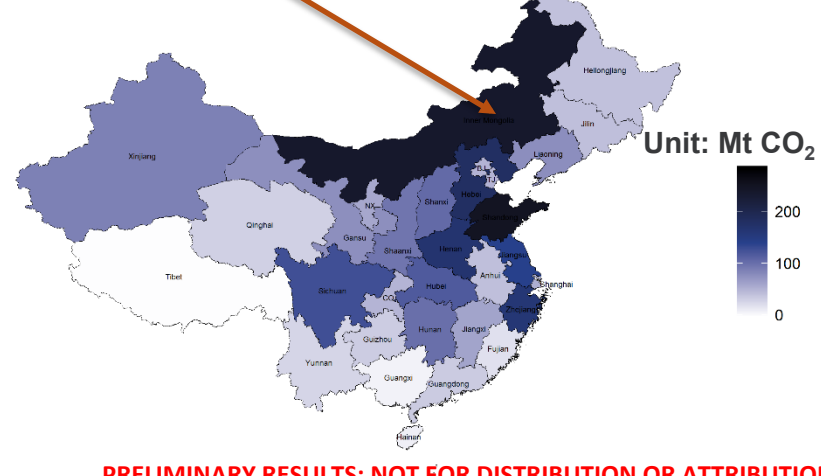
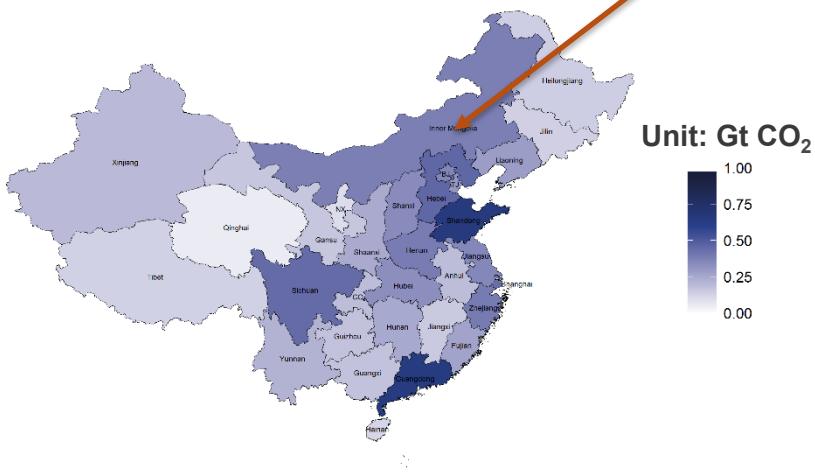
2040



Moderate emissions, high capture: Inner Mongolia



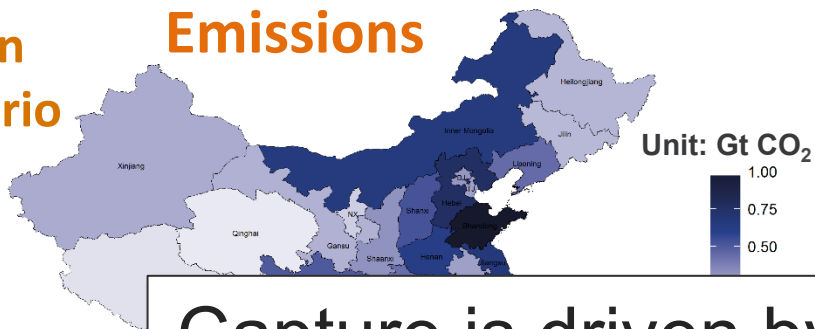
2050



# Consumption Boom Scenario

2030

## Emissions

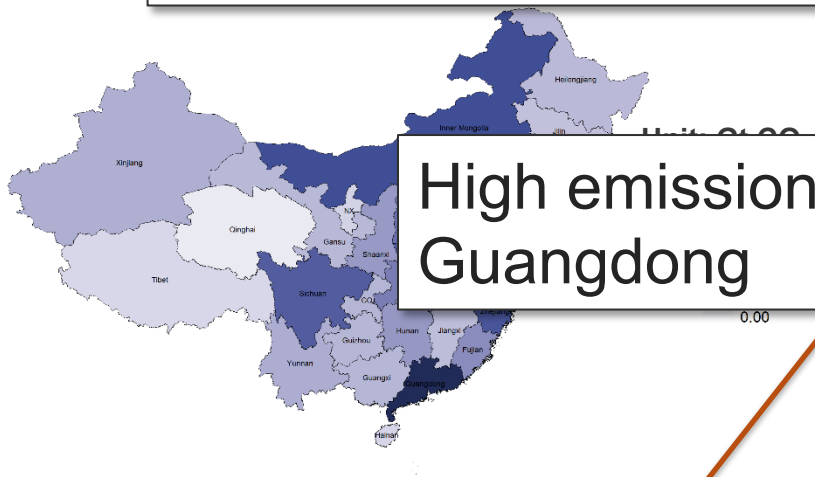


## Sequestration

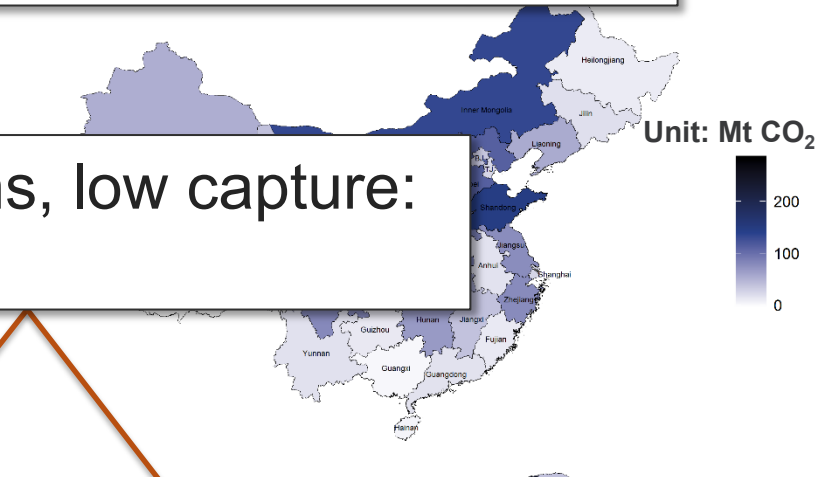


Capture is driven by emissions, energy structure, and available storage

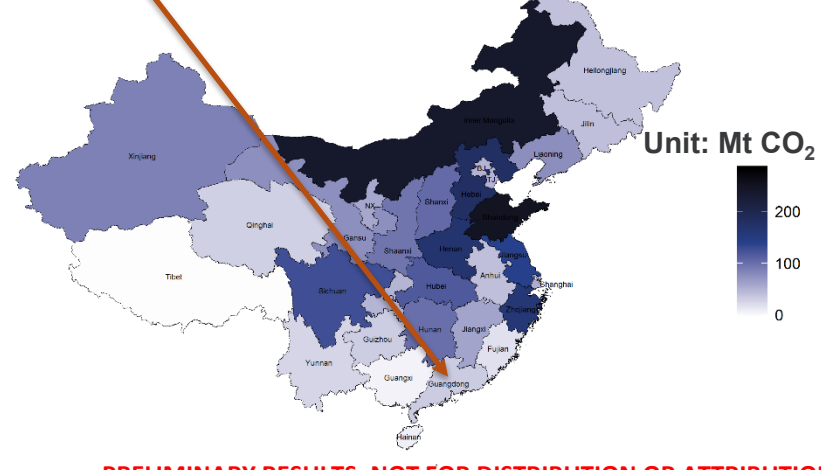
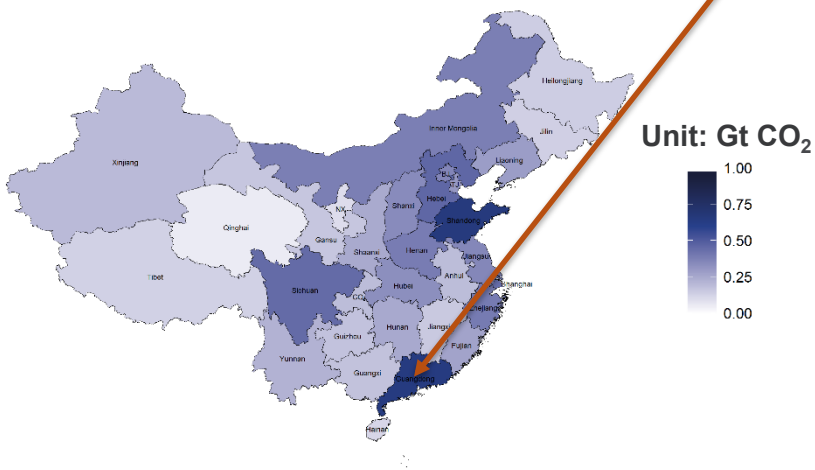
2040



High emissions, low capture:  
Guangdong

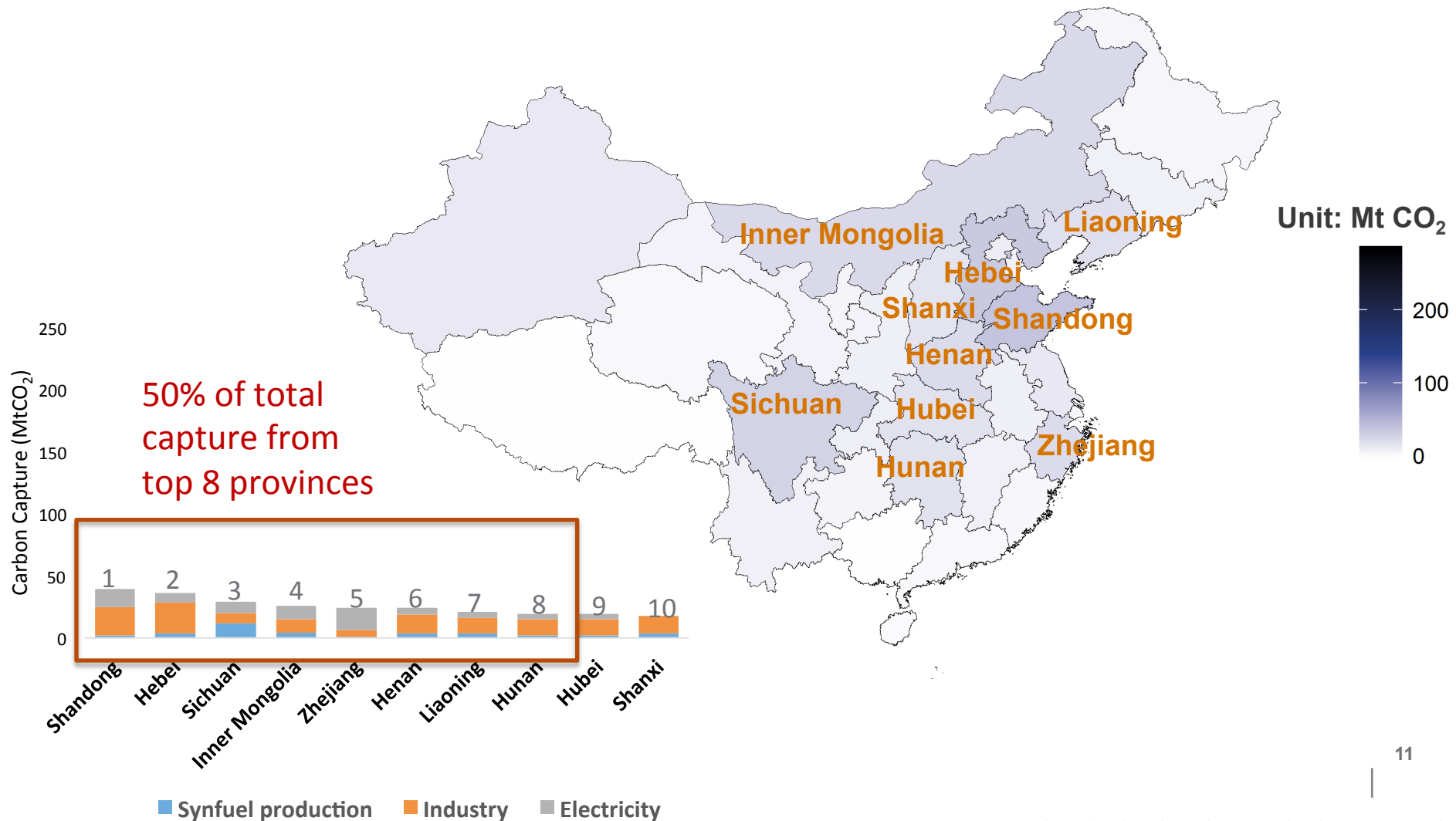


2050



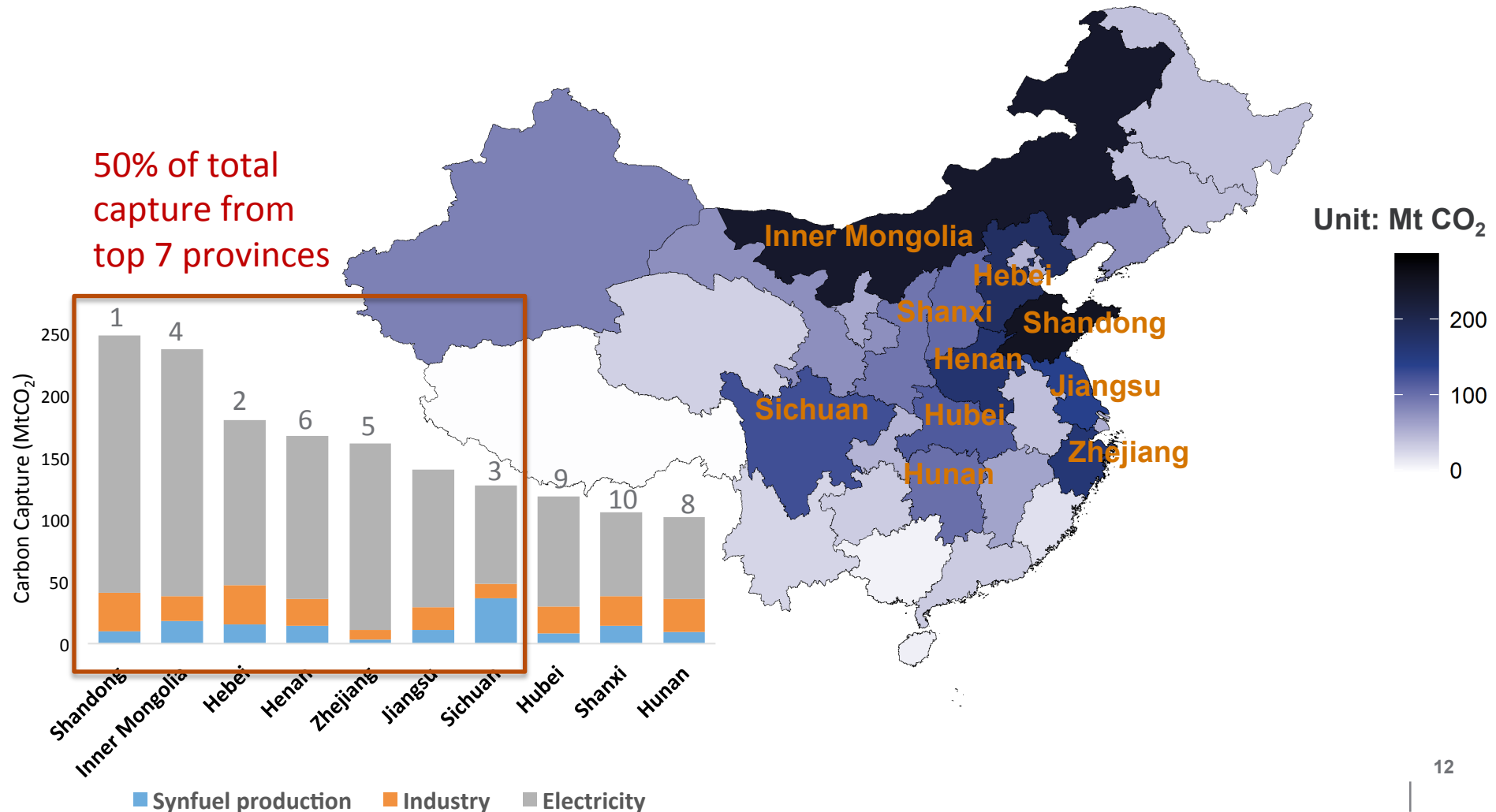
# Top 10 provinces in CO<sub>2</sub> capture in 2030 show diverse profile; most captures are from the industrial sector

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



# Electricity sector responsible for most capture in top provinces by 2050

2050 CO<sub>2</sub> Sequestration by Province (MtCO<sub>2</sub>)



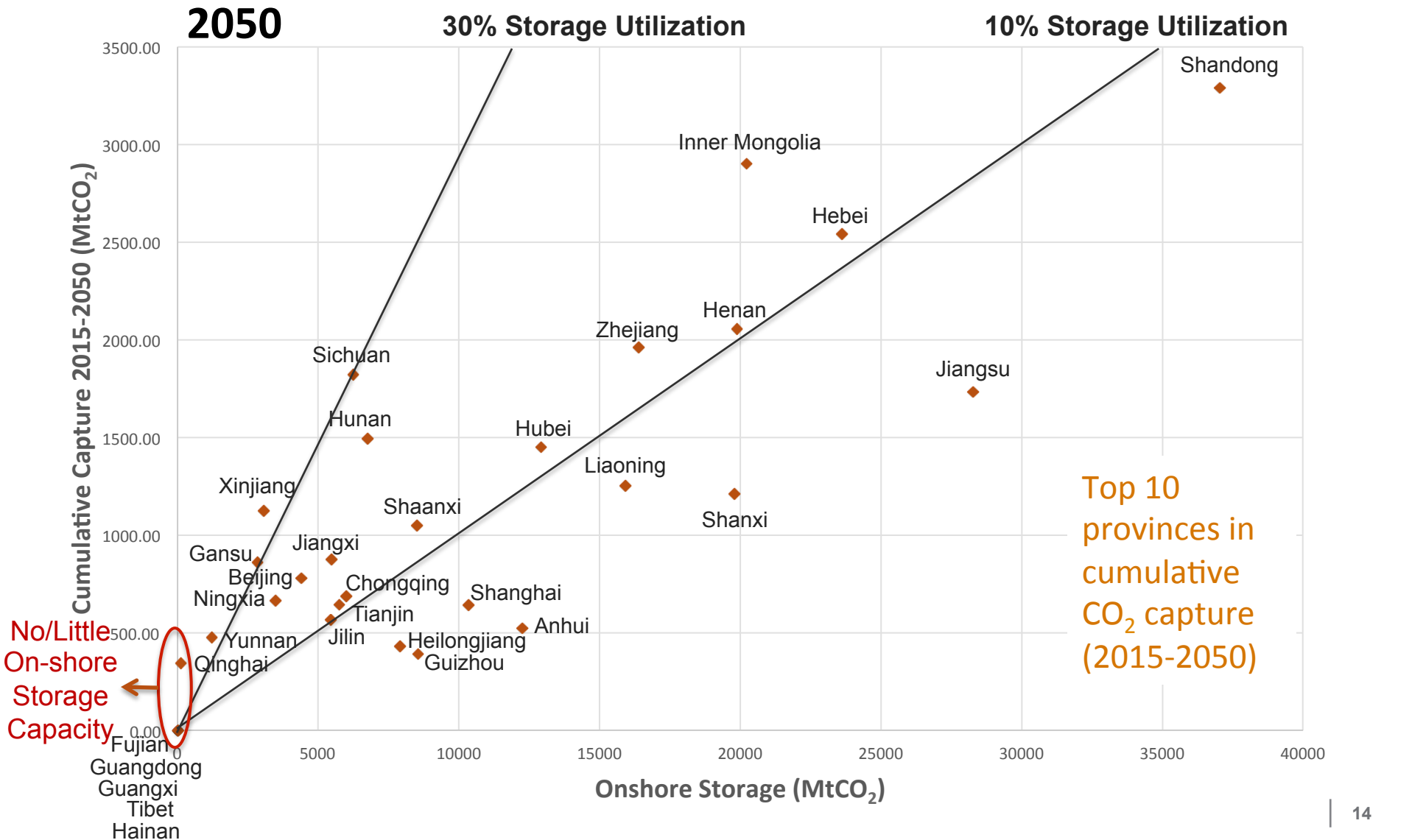


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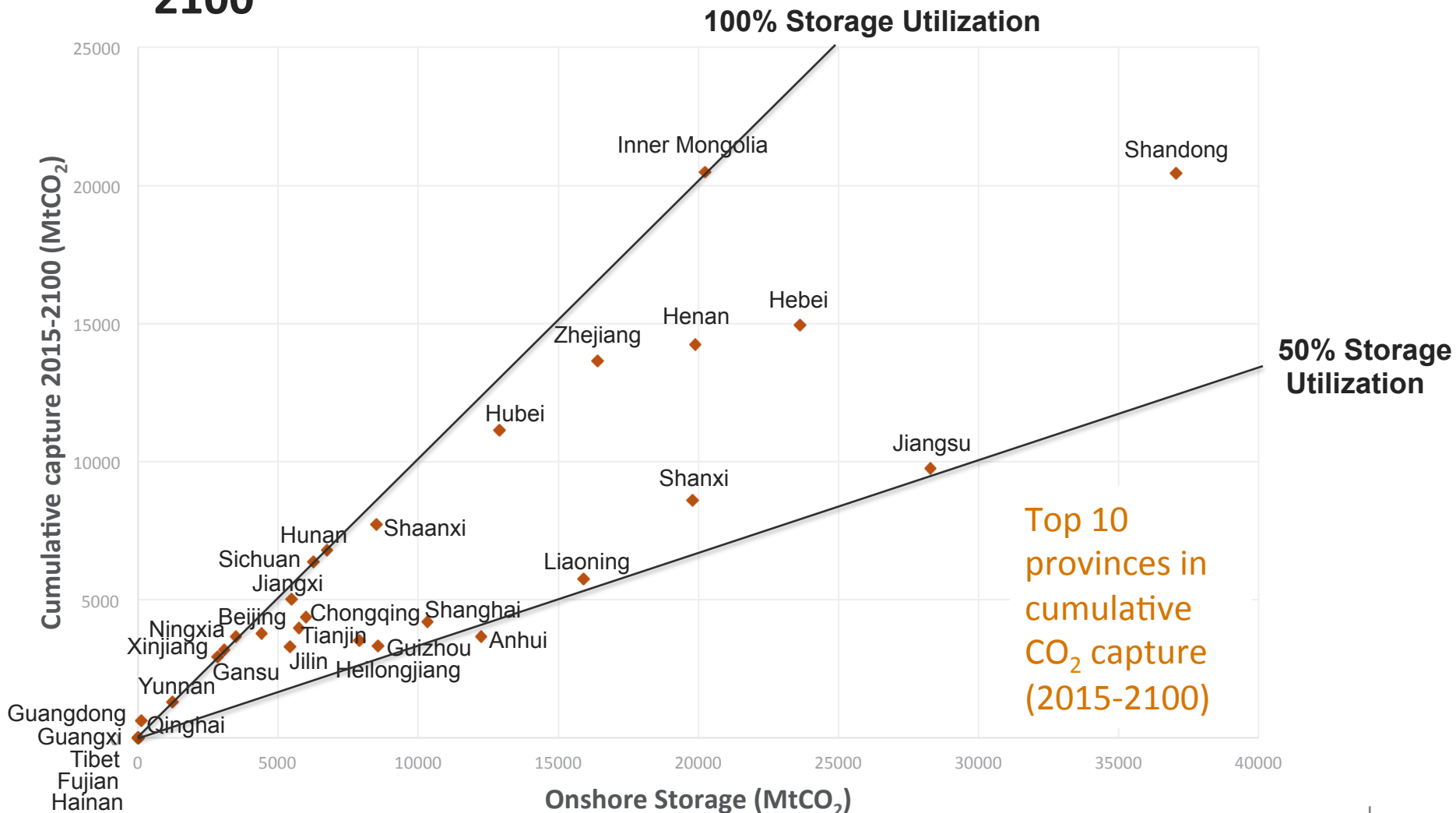
# Will storage capacity be a constraint for future CCS deployment?

# Provincial storage utilization by 2050 shows that CCS can be sustained



# Storage would become a more important constraint towards the end of the century

2100







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# Questions?

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