Understanding CCS in China’s Mitigation Strategy using GCAM-China

SHA YU, JILL HORING, LEON CLARKE, PRALIT PATEL, JEFF MCLEOD, BO LIU, AND HAEWON MCJEON

JOINT GLOBAL CHANGE RESEARCH INSTITUTE
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.
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$_2$ point sources (power plants and industrial sources)
- 2,300,000 MtCO$_2$ storage capacity
  - Deep saline sedimentary, EOR, coal basins
- Significant opportunity for both low-cost and moderately priced storage

**Inner Mongolia**
*(Erlian Basin, Ordos Basin)*

**Shandong**
*(Bohai Bay Basin)*

**Sources:** Dahowski et al., 2013.
How do development pathways and provincial variations affect future energy use in China?

Scenario development

<table>
<thead>
<tr>
<th>Energy Future</th>
<th>High</th>
<th>Low</th>
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<tr>
<td><strong>Consumption Boom</strong></td>
<td>❖ Deepening social reform focusing on equality</td>
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<td>❖ Economic booms</td>
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<td>❖ Shift towards western lifestyle</td>
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<td><strong>Sustainable Development</strong></td>
<td>❖ Rapid economic development</td>
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<td>❖ Growing middle class</td>
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<td>❖ Emphasis on sustainable growth &amp; social equity</td>
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| **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 costal provinces |
| | ❖ Strong technology innovation and efficiency improvement |
| | ❖ Environmental consciousness |

**Provincial Variation**

- Without
  - Deepening social reform focusing on equality
  - Economic booms
  - Shift towards western lifestyle

- With
  - Widening regional disparity
  - More living space and energy services
  - Conflicts between economic development & environmental protection
What are the primary applications for CCS through 2050?
Capture is driven by emissions, energy structure, and available storage.

High emissions, high capture: Shandong
Capture is driven by emissions, energy structure, and available storage.

 Moderate emissions, high capture: Inner Mongolia.
Capture is driven by emissions, energy structure, and available storage.

High emissions, low capture: Guangdong
Top 10 provinces in CO₂ capture in 2030 show diverse profile; most captures are from the industrial sector.

50% of total capture from top 8 provinces.
Electricity sector responsible for most capture in top provinces by 2050

50% of total capture from top 7 provinces
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.
Questions?
sha.yu@pnnl.gov