China's provincial energy consumption, emissions and mitigation costs towards 2030

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Introduction

- Most existing integrated assessment models consider China as a homogenous region; however, in reality, China has huge regional diversity in terms of per capita GDP and emissions, industry and energy structure , energy and carbon intensity etc.
- This study develops a multi-region CGE model which is used to assess low-carbon policies at more detailed provincial level.

Scenarios

- BaU scenario has no carbon constraint and assumes future GDP growth rate, energy efficiency improvement (EEI), total factor productivity (TFP).
- CM scenario assumes carbon intensity target for each province.

Table 1 Scenario settings

BaU	CM
GDP grows at 6-8% per year from 2002-2030; no carbon cap; EEI: 3% for solid, liquid and electricity, -2% for gas fuel; TFP: 3-5% .	Carbon intensity reduces by 40% in 2020 and 60% in 2030 against 2005 level.

Methods

Features of a new multi-region CGE model for China

- General equilibrium model representing 22 economic sectors, 30 regions of China and several world regions.
- Provides the trajectory of economic development, energy demand and supply structure, carbon emissions, carbon prices.
- Assessing the economic impacts of climate policy.

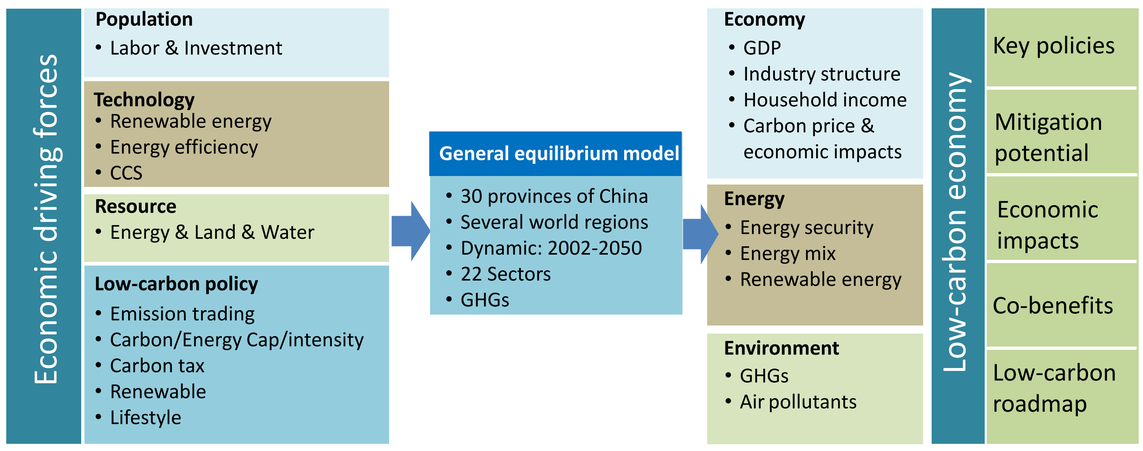

Figure 1 A multi-region CGE model for China.

Results

China's share to world:

2010->2030

- GDP: 7%->14%;
- Fossil energy: 24%->37%;
- CO_2 emissions: 20%->32%.

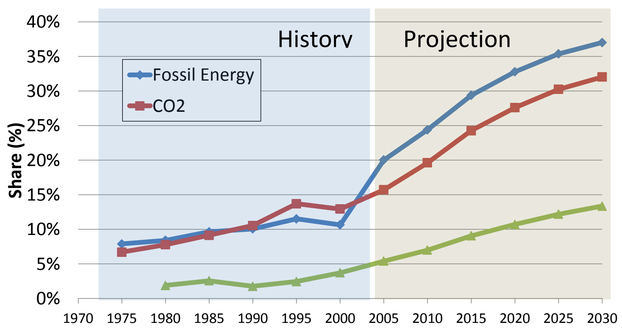

Figure 2 China's share to the world: 1978-2030.

Carbon intensity reduction in 2030 (Figure 3a)

- Intensity reduction is related to economic structure and energy structure.
- Some regions reduce less: Xinjiang, Shanxi, Heilongjiang, as they provides coal and oil to feed China's demand.
- Some regions reduce more: Beijing, Jilin, Chongqing, Hunan, Gansu.

Mitigation costs among provinces (Figure 3b&c)

- Different carbon prices. Provinces whose carbon intensity reduces less in BaU scenario will face higher mitigation costs.
- Different impacts on GDP. Most provinces suffer GDP loss due to carbon reduction, but some provinces gain due to less import of energy intensive products.

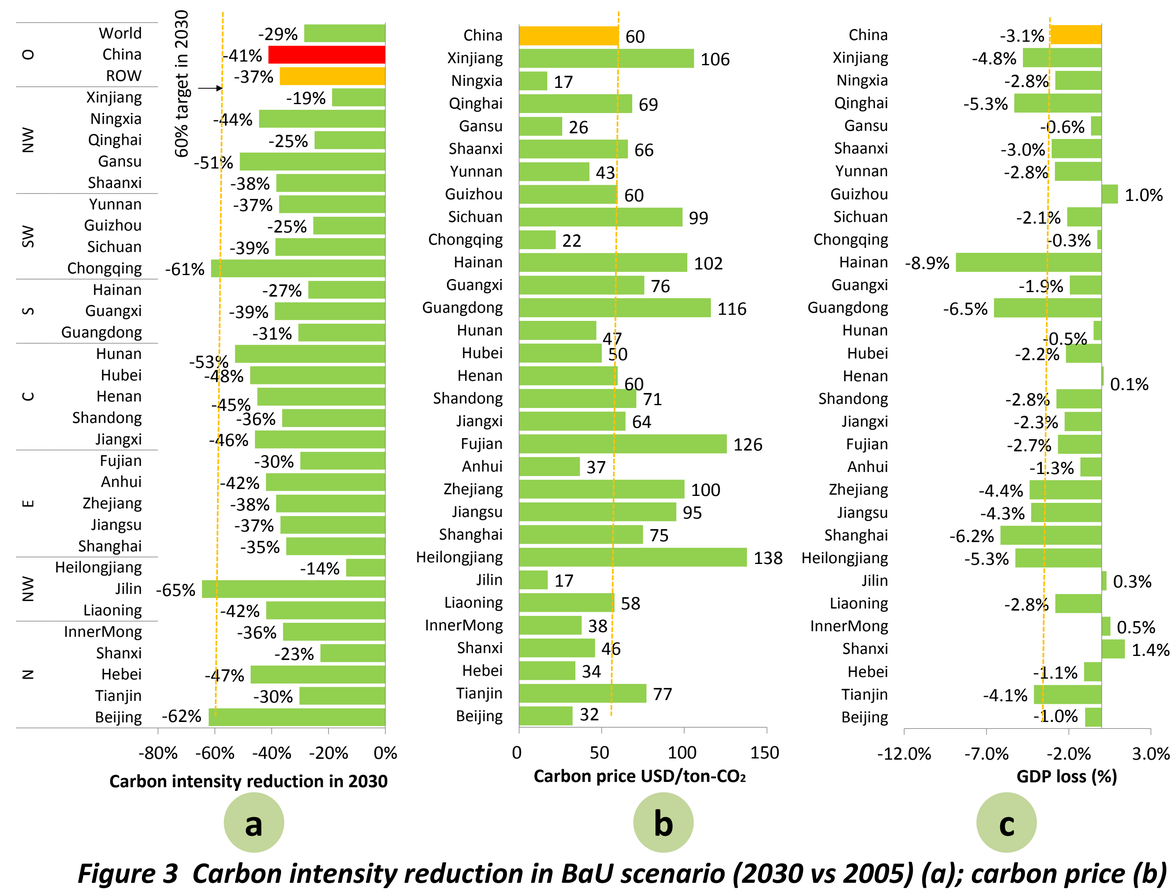

Figure 3 Carbon intensity reduction in BaU scenario (2030 vs 2005) (a); carbon price (b) and GDP loss (c) in CM scenario. [N: North; NW: Northwest; E: East; C: Central; S: South; SW: Southwest; NW: Northwest; O: Other]

Summary & Conclusion

- This study assessed future trajectory of China's provincial energy consumption, carbon emissions, carbon intensity and mitigation costs by using a newly developed multi-region CGE model.
- Outcomes indicate that as China's economy increases, its energy consumption and carbon emissions will continue to take a larger share in the world, implying that China is increasingly important in determining whether global 2 degree target could be achieved or not.
- Diverse trends of carbon intensity and carbon mitigation costs are observed across China's provinces. This study offers insights for regional climate policy making. Such regional diversity needs to be taken into account, when the central government sets carbon intensity targets provinces, other market based policy instruments such as inter-provincial emission trade should be introduced.

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