CHINA'S CARBON NEUTRALITY PATHWAYS AND THE ECONOMIC AND TECHNOLOGICAL IMPLICATIONS

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Introduction

Ahead of COP26 in Glasgow, China updated its NDC targets and pledged to peak its carbon dioxide (CO_2) emissions before 2030 and achieve carbon neutrality before 2060. It is crucial to understand the implications of achieving these two targets in such a short time frame on China's emission pathways, socioeconomic development, energy transition, decarbonization, and climate governance.

Given China's broad landscape with regional differences in current development status and resource abundance, it is also necessary to understand how each region would be impacted by China's low-carbon transition. In addition,as the energy transition from fossil fuels to low and zero-emission fuels would likely lead to the rapid development of variable renewable energy (VRE), which might threaten the energy system's reliability and resilience, it is critical to investigate the role of other non-fossil fuel energy sources that could ensure a safe and sustainable transition.

Methods & Models

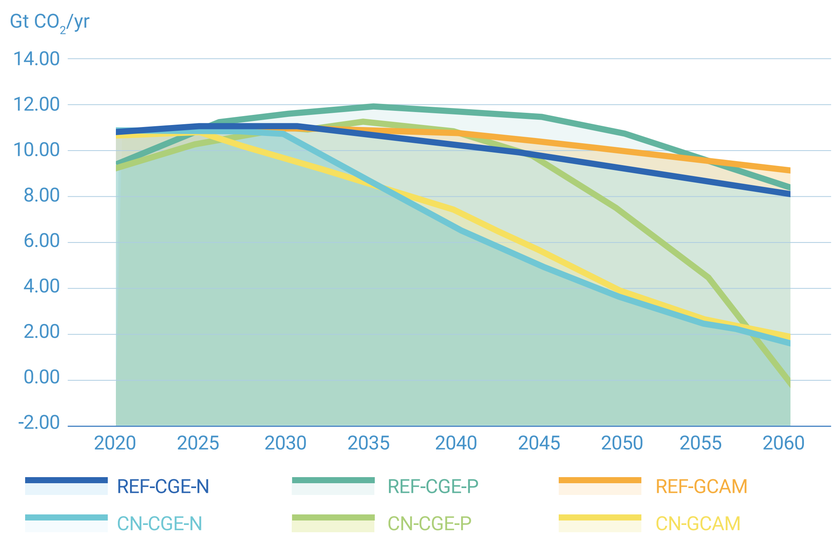
China Energy Modeling Forum (CEMF) conducted model-based research on China's carbon peaking and neutrality pathways under different policy and technical scenarios using two versions of the Computable General Equilibrium (CGE) model and the Global Change Analysis Model (GCAM), an integrated assessment model.

Model	Note
CGE-N	Modeling China as a whole
CGE-P	Modeling China at the provincial level
GCAM	Modeling China as a whole

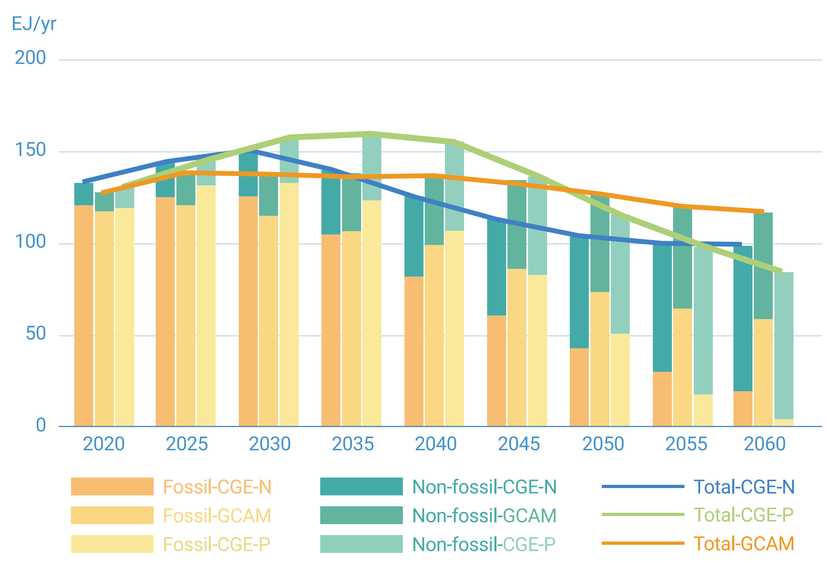
Scenario	Abbv.	Note
REF	REF	Baseline scenarios
Carbon Neutrality	CN	Carbon neutrality by 2060
Carbon Neutrality-hiNU	CN-NU	Carbon neutrality + high nuclear penetration

Results

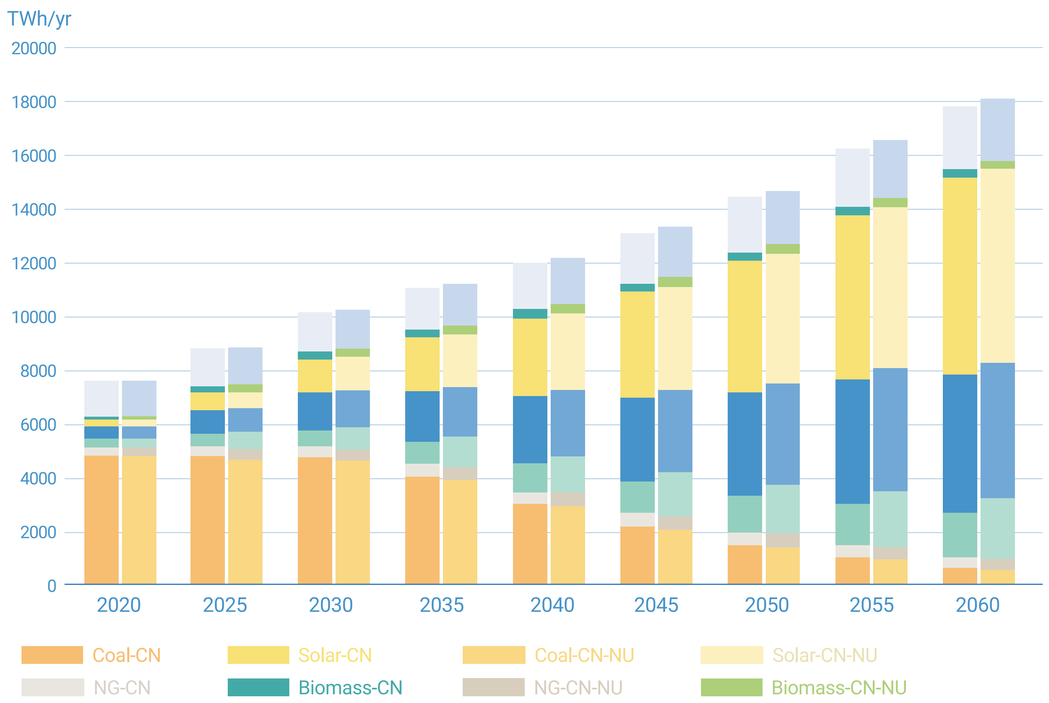
CO_2 Emission Pathways Across Models



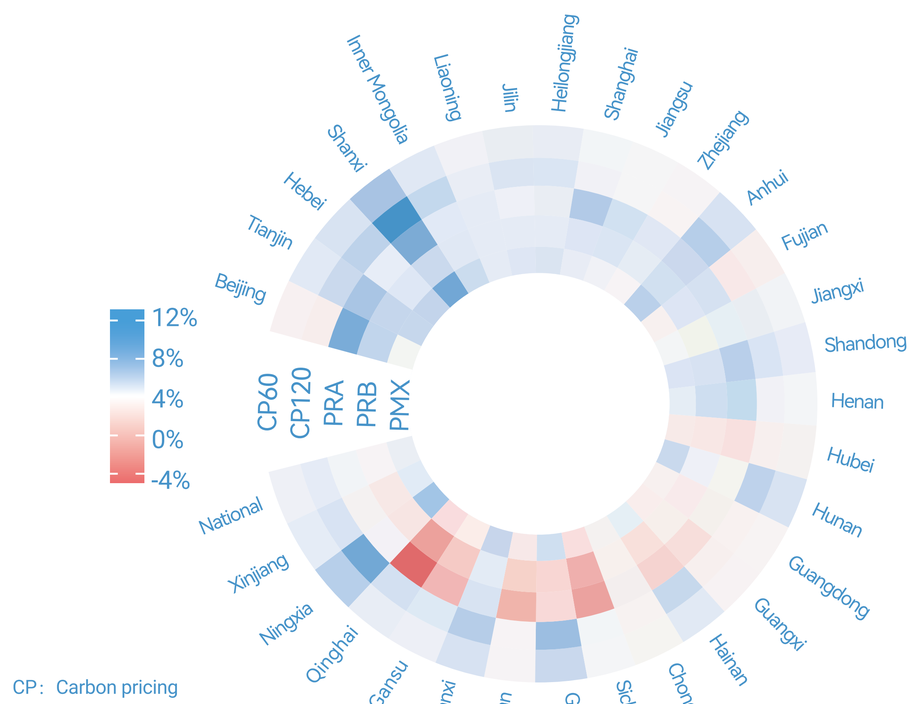
Primary Energy Mix Across Models



Electricity Generation by Fuel Type



Economic Impacts of Achieving Carbon Neutrality Across-regions



CP: Carbon pricing
PR: Power investment adjustment
PMX: Mixed policy

Discussion

- Models have different assumptions regarding cost and deployment projections for CCUS, yielding unalike results in the share of fossil fuels in primary energy consumption.
- The CN scenario assumes nuclear projection based on historical and recent trends and political signals, with considerations for extreme weather events. CN-NU assumes a slightly more ambitious deployment for nuclear, but inland nuclear deployment is not considered here.
- While the use of CCUS is not presented here, we expect a higher nuclear generation to reduce the need for CCUS technologies by providing a reliable, zero-emission electricity supply. Given the cost projections for CCUS technologies remain relatively high compared to that of nuclear, lessening the need for CCS can lead to a reduction in total mitigation cost.

Conclusion

- In baseline scenarios, China's energy-related CO_2 emissions are expected to platue around 2030. Under carbon neutrality scenarios, however, China can peak its emissions before 2030, even by 2025, with a peaking level below 11Gt.
- Relatively well-developed regions are less likely to experience GDP losses, whereas less-developed regions, especially those that rely heavily on the fossil fuel industry and lack renewable resources for development, will experience the worst impacts.
- More ambitious deployment of nuclear energy will mildly reduce the use of fossil fuels in the short-term, prior to carbon peaking, and reduce demand for renewables after peaking.