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Future health co-benefits in the Shared Socio-economic Pathways: A case study of China's power sector

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Overview

In China, the negative environmental externalities (such as climate change and air pollution) from energy use are primary challenges to the sustainability of human society. To solve this problem, China has enacted many short-term policies (such as 12th Five Year Plan for Energy Saving and Emission Reduction) to guide the energy transition. A long-term sustainable energy transition plan for China, tackling both climate change and air pollutant problems in a unified framework, is still in urgent need.

To meet the need, recent years, there are studies focus on the synergies/trade-offs between CC (Climate Change) and AH (Air quality and Health) resulted from China's long-term energy transition. However, most of these studies are at national level, provincial disparities of the synergies/trade-offs are poorly understood. Moreover, previous studies only recognized the AH impacts under CC policies or the CC impacts under AH policies, an optimal solution to maximize the synergies between AH and CC are still lacking.

To fill these gaps, our study chooses China's power sector, the largest emission sector in China, as research objective. We identify the possible synergies/trade-offs between AH and CC at provincial level, and we offer provincial level optimal technologies solution considering both AH and CC targets.

Methods

For this modeling study, we link a Multi-regional model for Energy Supply system and their Environmental ImpaCts (MESEIC), a Multi-resolution Emission Inventory for China (MEIC) model, an offline-coupled Weather Research and Forecasting (WRF) model, a Community Multiscale Air Quality (CMAQ) model, and an Integrated Health Impact Assessment (IHIA) model. Additionally, we also develop cross system feedback, so that we could minimize monetized health impact and power sector cost at the same time. For the scenario setting part, we calculate and compare the health impacts between two scenarios – the REF (no climate policy) scenario and the DDP (deep decarbonization policy) scenario and we also consider the uncertainty from different social-economic pathways.

Our research builds a dataset for China's power plants, which including 7093 units, covering capacity, status, fuel type, cooling technology, types of water sources, and latitude and longitude information. We validate and calibrate the MESEIC model using this database.

Conclusion

National level:

1) Added costs of AH are comparatively low when CC is taken as an entry point.

2) Lowering electricity demand growth is key to managing these trade-offs and creating synergies between AH and CC.

Provincial level:

1) Phasing out coal is the optimal solution to minimize the trade-offs in the electricity output centres (such as Inner Mongolia, Ningxia and Qinghai etc.).

2) Including monetized health impacts in the technology selection process could substantially change the technol-

ogy preference in the high-population density and high air pollution provinces, which could solve the trade-offs problem at a certain extent.

3) It is critical to have good policies preparation to compensate the provinces like Inner Mongolia, Ningxia and Qinghai etc. Because trade-offs might happen in these province and they will cost a lot for the energy transition process as electricity output centres.