

Yongping Li speech title/abstract at IC3E2022

Title: An integrated bi-level model for China's multi-regional energy system planning under uncertainty

Abstract:

As the damage brought by climate change becomes a reality, more and more countries have realized that it is imperative to take actions to mitigate greenhouse gas emissions and develop renewable energy resources. In this study, an integrated bi-level model is developed for China's multi-regional energy system planning by synergistically minimizing carbon dioxide (CO₂) emission and system cost from a long-term perspective. The developed model can handle leader-follower issues in decision-making process as well as examine the risk of violating joint-probabilistic constraints. A series of scenarios associated with different carbon capture and storage (CCS) levels and violation risks of energy-demand constraints are analyzed. Results indicate that the share of non-fossil energy in China's energy supply would keep increasing in 2021-2050, where Sichuan, Inner Mongolia, and Gansu would be the top three suppliers of renewable electricity. Results also reveal that the national CO₂ emission would reach a peak during the period of 2026-2030, and Shandong, Inner Mongolia, and Shanxi would be main contributors of CO₂ emission in the future. Among developed regions, the individual probability level of Jiangsu-Zhejiang-Shanghai is the most significant parameter for both CO₂ emission and system cost. Compared with the single-level model under all scenarios, the CO₂ emission from the integrated bi-level model could reduce by [2.7, 5.7]%. The study provides more solid method for planning multi-regional energy system with a low-carbon and cost-effective manner.