

Optimizing multi-regional production with economic-energy-environmental constraints in China

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Sustainable development has become a hot topic to integrating economic, energy, and environmental (E3) considerations. However, environmental emission due to the excessive use of fossil fuel is the biggest obstacle to achieve sustainable development. The Chinese government has promulgated series of policies on economic development, energy transition, and environmental protection and set corresponding targets, whereas a distinguishing feature of these decisions is the conflicts (trade-offs) between various objectives or priorities. Specifically, economic development leads to an increase of energy consumption and emissions, while energy conservation and emission reduction policies, in turn, may hinder economic growth. Therefore, in order to balance the conflicting objectives given the spatial heterogeneity in China, how to reallocate production among multi-regions and multi-sectors has become an important issue. Thus, compromise solutions are required to reconcile the competing goals. In this research, a multi-regional input-output (MRIO) based multi-objective programming model is proposed based on the MRIO dataset, taking into account the amount of utilized labor, energy, water resource, and emissions (4 air pollutions and 13 water pollutions). The model contains four competing goals, maximizing economic growth, and minimizing energy consumption, water use, and emissions, respectively. The model is applied to find a compromise composition of sectoral outputs of different provinces in Chinese economy. Results show that all the conflicting goals can be achieved through a compromise solution and thereby providing a provincial cooperation strategy related to reorganization of sectoral production structure to achieve common national goals. The marginal contribution of this research is that the national-level competing goals are reconciled through reallocation of provincial-level sectoral production. Additionally, multiple emissions are involved in this research. The framework proposed can be easily extended to search for E3 compromise solutions in other countries as long as the data is available.