Coupling input-output analysis with multi-objective liner programming models to optimize economic-energy-water and carbon emission in North China

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The multi-objective linear programming (MOLP) model based on the mixed input-output (IO) framework is designed to assess the trade-off between economy, energy, water, and carbon emissions in the North China's economic system. This methodological framework aims at assessing the trade-offs between the economic, energy and water systems, which also plays a significant role for studying the corresponding impacts on the carbon emissions. Then, this model offers a consistent framework for optimizing the effects of distinct policies on these systems. The national energy balance table is integrated with the National Accounts System to create a hybrid IO framework which is extended to assess the carbon emissions, energy and water consumption. The objective functions considered here are the maximization of GDP (gross domestic product) and the minimization of energy, water consumption and carbon emissions. This study aims to search for non-dominated solutions with different characteristics and potential trade-offs. The results show that the maximization of GDP leads to an increase in energy, water consumption and carbon emissions, while the minimization of carbon emissions or energy and water consumption has a negative impact on GDP.