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Energy-Economic Recovery Resilience with Input-Output Linear Programming Models

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Abstract

In this work we develop a novel Input-Output linear programming model to study the energy-economic recovery resilience of an economy by analyzing the relationships between energy production disruption, impacts on sectoral production and demands, and post-disruption recovery efforts. The proposed model evaluates the minimum level of recovery investments required to restore production levels so that total economic impacts are acceptable over a stipulated post-disruption duration. It is assumed that disruptions are uncertain and can occur at different sectors and possibly simultaneously. The optimization model is then solved using a cutting plane method which involves computing a small sequence of mixed integer programming problems of moderate dimensions. A case study using China 2012 Input-Output data is performed, and we demonstrate the model's ability to uncover critical inter-sectoral dependencies at different disruption levels. This provides decision-makers with important information in evaluating and improving the energy-economic resilience in a systematic and rigorous manner.

Keywords: Energy-economic resilience, Input-Output modeling, Linear programming, Post-disruption recovery

1. Introduction

Energy supply and production disruptions can have severe consequences in the entire economy. For example, the natural gas supply disruptions experienced by Argentina in 2004 led to power generation shortages for the industrial and residential demands, leading to significant impacts the national economy (Honoré, 2004). The Northeast power outage of 2003 in the U.S. affected more than 55 million people and resulted in estimated $ 10 billion economic losses (Liscouski and Elliot, 2004). The topic of *energy resilience*

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