IO-Multiobjective model to assess economy-energy-environment interactions in the Brazilian economic system

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The social welfare and infrastructure levels have been raised by the current economic growth in Brazil, which has also influenced the energy consumption in the country. Even though the energy supply and the renewable energy mix have been improved in Brazil, the fossil fuel consumption rate is still high, leading to impacts in terms of GHG emissions. An economy-energy-environment (E3) model has been developed to study the interactions between different economic activities based on Input Output Analysis (IOA) coupled with Multi-Objective Linear Programming (MOLP). Since E3 axes of evaluation are generally conflicting in a real world setting, MOLP models are a valuable tool for assessing the trade-offs, rather than "amalgamating" those distinct aspects into a single objective function such an aggregate economic indicator. In this study, the MOLP models proposed by Oliveira and Antunes (2004; 2011) are adapted to the Brazilian economic system. In the model, the Brazilian 2005 IO table is rearranged to allocate endogenously the Brazilian energy balance generating a hybrid framework, in which the level of activity in each sector is associated with its energy demand (by fuel source). The IO system is extended externally to assess GHG emissions from fossil energy combustion. Specific IPCC (2006) GHG emission factors are applied to the total energy consumed in each sector to obtain the total emissions of each activity sector and the whole economy. The MOLP uses the hybrid IO framework to construct coherence and defining constraints. Four different objective functions are explicitly considered: the maximization of GDP and employment level, and the minimization of fossil energy consumption and GHG emissions. The aim is to evaluate the trade-offs between these different and conflicting objective functions for plausible future scenarios.