Input-Output Scenario Analysis – Using constraint optimisation to integrate dynamic model outputs

Topic: Environmental IO models 5
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Australia faces significant sustainability challenges in the context of climate change, economic growth, population pressures, and increasing resource scarcity. In order to understand these interacting challenges and assess the consequences of different policy choices, a flexible and integrated assessment modelling (IAM) approach is needed, drawing on a coupled suite of models that evaluate scenarios across a range of climate, economic, population and development projections. CSIRO intends to build up new analytical capacity with the aim to provide a systematic and integrated analysis of Australia's physical economy and development pathways. Work on the sustainability assessment of urban systems and infrastructure has started as a sub-component of the IAM capacity. Environmentally extended input-output analysis is one of the techniques to be used for assessing scenarios of future urban development and to be integrated with a climate/economic systems model, a stocks-and-flows model, a land-use model and an energy sector model.

In this paper we describe the process of generating historic and future time series of environmentally extended multi-state input-output tables of the Australia economy (AUS-MRIO). We use the software tool AISHA which was created for the purpose of building series of contingency tables (for example input-output matrices with environmental extensions). The software operates a matrix balancing algorithm based on KRAS and uses externally defined constraints to solve a constrained optimisation problem. Creating a time series of tables involves preparing initial estimates, defining and scripting constraints, and setting appropriate boundary conditions. AISHA has not only been used to update an existing AUS-MRIO from 1999 to 2008, but also to implement scenario variables derived from other IAM models as exogenous constraints. Effectively, this creates a 'dynamic' version of AUS-MRIO linked to defined scenario pathways.

The novelty of our work lies in the cross-model integration of scenario variables by implementing a mechanism to use these variables as data constraints in future time series of IO tables. Application of the dynamic IO tool in (urban) sustainability analyses adds the perspective of consumption-based environmental accounting to integrated assessment modelling.