Consistently representing long-term dynamics of energy-economy interrelations in context of the WILIAM Integrated Assessment Model

Themenbereich: Energiesystem- und Klimamodellierung

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Motivation und zentrale Fragestellung

WILIAM (**WI**thin **L**imits **I**ntegrated **A**ssessment **M**odel) is a long-term integrated assessment model developed by the H2020 Project LOCOMOTION [1]. In conventional energy models, the development of the economy (and therefore a large part of resulting energy demand) is often treated as exogenous parameter via scenarios. Integrated Assessment Model on the other side aim to integrate multiple dimensions – economy, energy, environment, social aspects – into one consistent modelling framework. In WILIAM special attention is given to the interrelation between the energy sector and the economic system as a whole, aiming to better understand the impact of the energy transition on the whole economy.

Methodische Vorgangsweise

At the heart of the economic module stands a multi-regional input output model (MRIO) with 35 Regions and 62 Sectors, representing final and intermediary economic demand between sectors on a global scale.

The energy module represents the complete conversion chain from final energy demand via energy transformation (in 39 transformation technologies) to the resulting primary energy demand.

The sectoral disaggregation of the economic Input-Output table and the structure of the energy transformation technologies were carefully matched to allow a consistent representation of the energy sector in both energetic and monetary terms. The target of this exercise was to achieve consistency of physical and monetary energy flows in all WILIAM modules. It further enabled us to dynamize the evolvement of the different energy sectors in the future. Unlike in many other MRIO-Models the relations between the economic sectors and countries in WILIAM are not static, but linked to physical flows that are modelled bottom-up in the energy module.

Further important links between energy and economy module include energy prices (prices for fossil fuels being endogenously calculated in the materials module and influence the utilization of the existing power plant capacity stock), and investments in new transformation capacities (which influences the long-term dynamic of the energy system).

Ergebnisse und Schlussfolgerungen

While the scenario work is still ongoing in the project, it is clear that the energy transition towards a carbon neutral world will turn our current energy system upside down.

Expected results include that the implemented methodology is capable of capturing the implications of this transition in terms of the major economic benchmarks (economic output, employment, taxes, imports/exports etc.).

E.g. in a scenario where electricity production from coal decreases and is replaced by PV, we can observe that the economic output (in $) of the economic sector ”Electricity from Coal” decreases, while the economic output “Electricity from PV” grows in correspondence with the change of physical output (in kWh) of the respective transformation technologies. This causes secondary effects in the whole global supply chain via the MRIO model, e.g. less economic demand from the coal mining sector in Australia, more economic demand from the national construction sector and the electronic manufacturing sector in China, GDP, employment, taxes etc. in the respective regions.

However, the high complexity and interconnectedness of the model also poses challenges for scenario process: results must be interpreted carefully, and the causal chain of the most relevant variables needs to be traced in order to assure the plausibility of the resulting scenarios.

Literatur

[1] <https://www.locomotion-h2020.eu/>

[2] <https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm>

[3] <https://www.exiobase.eu/>



1. Adresse, Telefon, Email, Web, (gegebenenfalls vor Kontaktdaten „Jungautor:innen“ angeben) [↑](#footnote-ref-1)