Faculté des Sciences Appliquées
Laboratoire de Thermodynamique et d'Energétique
Integrated & Sustainable Energy Systems (ISES)

Université de Liège

Master Thesis Proposal: Improving the simulation of variable renewable energy in integrated assessment models

Advisor: Prof. Sylvain Quoilin

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Context

Integrated assessment models (IAMs) attempt to link main features of society and economy with the biosphere and atmosphere into one modelling framework. The goal of integrated assessment modelling is to accommodate informed policy-making, usually in the context of climate change. These models are used, for example, to establish the IPCC scenarios and evaluate the possible pathways to achieve our objectives of 1.5°C or 2°C global warming.

However, because of the very general scope and their long-term horizons, these models have a poor representation of the electricity system, and in particular of the variability of wind and solar. Modeling these aspects in an integrated manner is a challenge: the high temporal and technical granularities required by the power system models can become uncompatible with the requirements of long-term energy planning involving and multi-sectoral approach of IAMs.

Objectives

The goal of this thesis is to overcome the limitations IAMs by a new approach coupling a power system model (the EU-wide Dispa-SET power system model) and a system dynamics IAM model (the MEDEAS model). The method relies on the creation of surrogate models that approximate the results of the power system optimizations. A multi-dimensional inputs space will be created by varying key system characteristics: flexible capacity, no flexible capacity, short-term storage, long-term storage, grid infrastructure, renewable penetration. A latin hypercube sampling will then be defined to run the model over this inputs space and Artificial Neural Networks will be used to predict key system performance indicators (in this case curtailment and loss of load) to be integrated into the IAM model.

Requirements

The candidate should have a Bachelor in engineering and a background in Electrical/Electromechanical/Energy engineering. Knowledge or experience in Machine Learning, Python or linear programming is a plus.

Location

This final thesis will be performed within the University of Liege (Belgium), in close collaboration with the University of Valladolid (Spain). The selection of the candidate will be done based on a CV and a short interview.

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Further informations

Further information can be obtained by directly contacting S. Quoilin by e-mail.

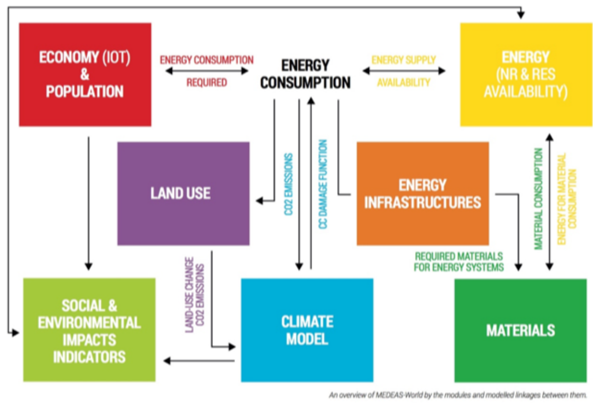

Figure 1: Schematic representation of the MEDEAS IAM model

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