Soft-Linking Power Generation Optimization Models to Top-down Macroeconomic analysis tools: the case of Egypt

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Traditional bottom-up energy optimization models have been widely applied so far to assess the future electricity technology mix over a specific planning horizon in different regions, assuming various future energy demand scenarios, and quantifying their direct economic and environmental implications. However, such approaches ignore the interactions that the energy sector has with other sectors in the economy, hence failing in quantifying the global â€“ direct and indirect â€“ impact related to future energy technology mix: this may constitute an unfortunate bias in the definition of future energy and environmental policies.
The purpose of this study is to assess and to compare the direct and the total economic and environmental impact due to optimal future energy scenarios in the Egyptian economy, by soft-linking a bottom-up, technology-rich model with a top-down macroeconomic model.

More specifically, the OSeMOSYS energy model is applied to prospective institutional scenarios for Egypt, thus identifying the evolution of the Egyptian electricity production mix towards 2040. These results are then provided as exogenous inputs to a Single-Region Input-Output model (IOA) based on the EORA dataset. Due to the high level of aggregation of the adopted dataset, a robust disaggregation methodology was firstly applied in order to split the energy sector, distinguishing the detailed power generation technologies. Then, the future energy scenario has been applied to the disaggregated IOA model in terms of change in energy technology mix, change in final demand of electricity and change in national GDP production. Beside the results of the energy model, this approach enables to assess the expected primary energy requirements, GHG emissions and water use induced by the evolution of the energy mix in a broader national perspective.

It is found that Combined Cycles, Wind and Photovoltaic rooftop systems are competent to be included in the future Egyptâ€™s future power generation mix. However, the direct primary energy consumption and GHG emissions by the electricity production sector remain approximately constant according to the results obtained by OSeMOSYS, a significant reduction, driven by production sectors other than electricity generation, in the total energy requirements and GHG emission is realized. In addition, there is an opportunity for the decoupling of the GDP growth and the embodied emission within the Egyptian economy, as the prospective production mix will include a high efficient and less polluting power generation technologies.