Analysis of flexibility options in the German electricity system via coupled simulation and optimization models

ERAFlex*
Marc Deissenroth1, Laura Torralba Díaz2, Benjamin Fleischer2, Felix Guthoff2, Matthias Reeg1, Christoph Schimeczek1
1 German Aerospace Center, Institute of Engineering Thermodynamics
2 University of Stuttgart, Institute of Energy Economics and Rational Energy Use

Challenge

Real world

Model world

Can we close the gap?

The ERAFlex project tries to narrow the gap between real world and models by coupling two different model types, i.e. an optimization (E2M2, University of Stuttgart) and an agent-based simulation model (AMIRIS, German Aerospace Center, Stuttgart). An iteratively adjustment of both models’ results leads to a cost optimized energy system that should be economically feasible for all actors.

Approach

The basis of the model coupling is realized by the harmonization of the models. This implies the matching of input parameters as well as a best possible alignment of model configurations. It allows to understand the inherent model specific differences.

Harmonization results

The figure shows the difference of marginal costs (optimization) and exchange prices (agent-based simulation). After alignment of input parameters, enabling perfect foresight for agents and neglecting the regulatory framework, the results are the same.

The exchange prices peak without storage in the simulation (dashed). Applying storage, the system optimization flattens the prices as good as possible (blue). Though the models are harmonized, the agent simulation preserves peaks as to maximize the agent’s profit (orange).

The curtailed power differs when the regulatory framework is considered. For renewables, bids at the market change due to remuneration. Thus, the market driven curtailed power is less compared to a system driven curtailment.

*The ERAFlex project is supported by the German Federal Ministry for Economic Affairs and Energy, reference 03ET4025B