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

ERAFlex*

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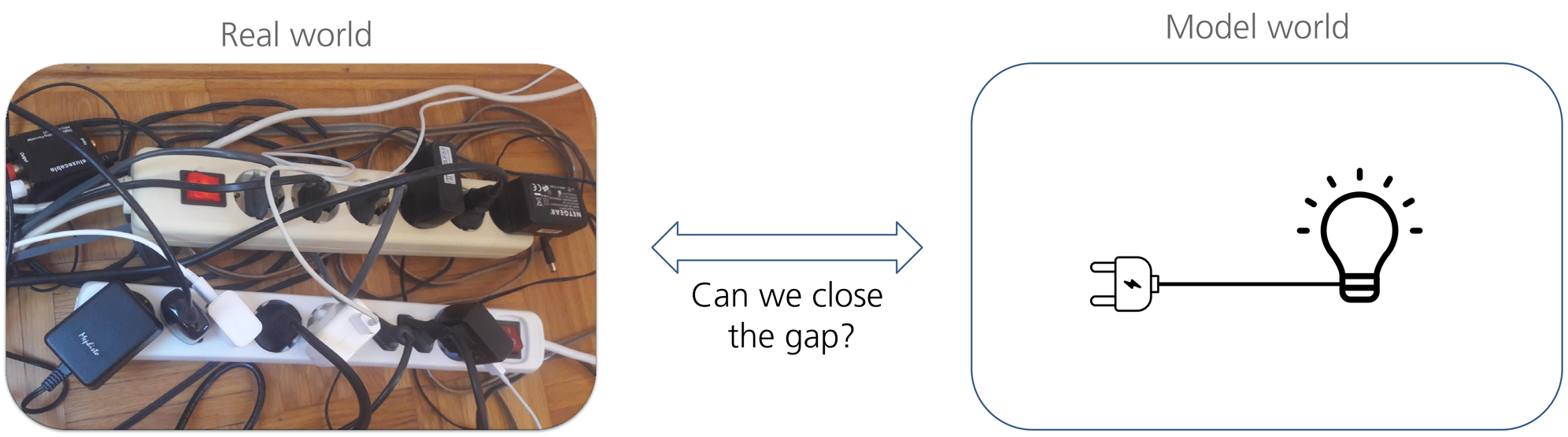
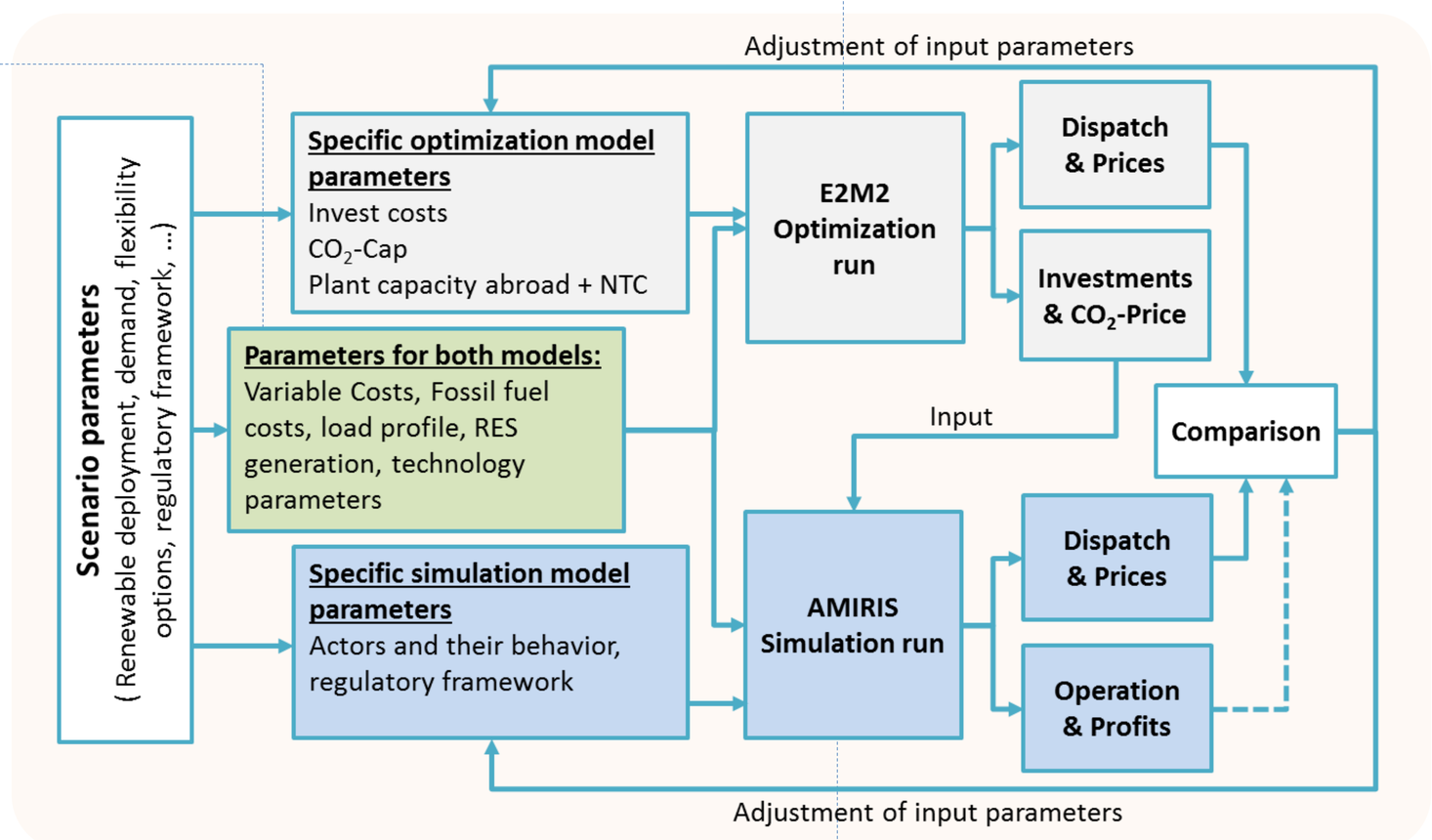
Challenge



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

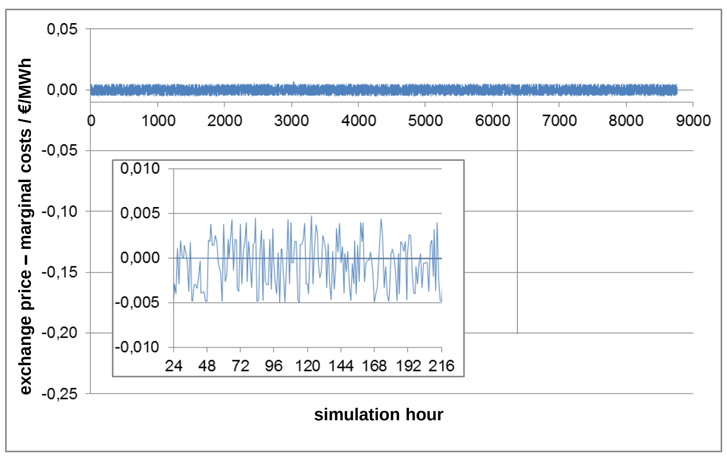
The basis of the model coupling is realized by the **harmonization** of the models. This implies the matching of input parameters as well as a best possible alignment of model configurations. It allows to understand the inherent, model specific differences.



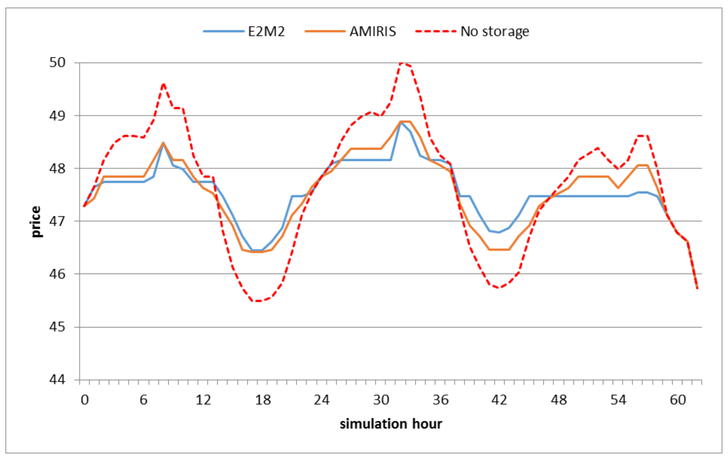
The **optimization model** result yields a cost optimal system assuming certainty of the whole system demand and supply at all times.

The **agent-based model** considers the behaviour of actors within a regulatory regime as well as underlying uncertainties of price and weather forecast.

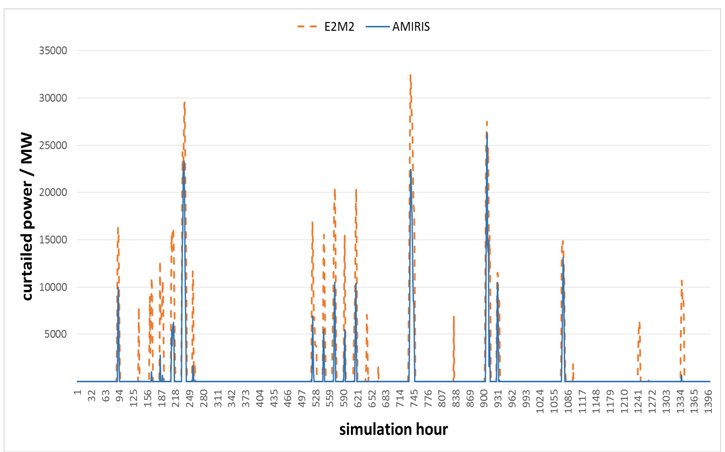
Harmonization results



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.

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