

The effect of different modeling approaches and model scopes on the results of large-scale power system planning models with sector coupling

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IEA Task 35 “Flexible sector coupling”

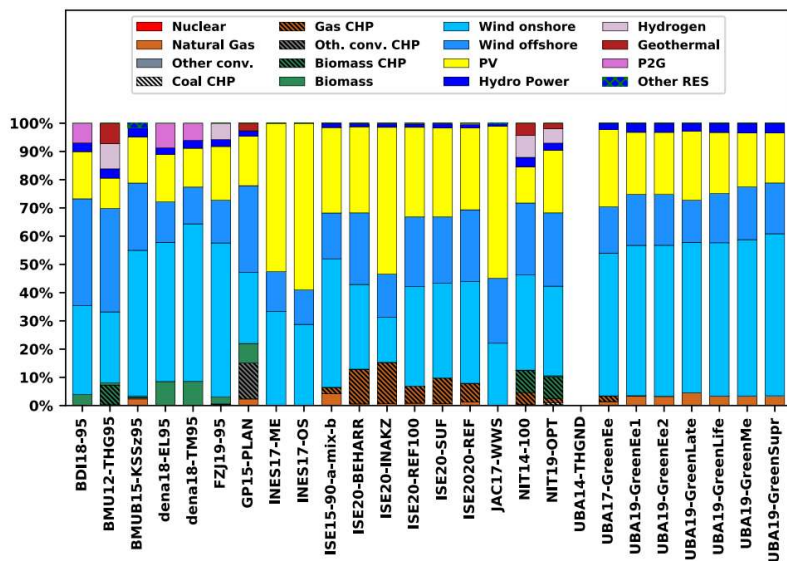
Copenhagen

25-27 April 2022

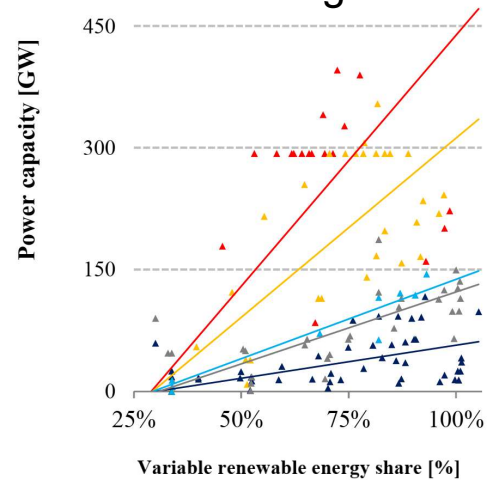


Why FlexMex?

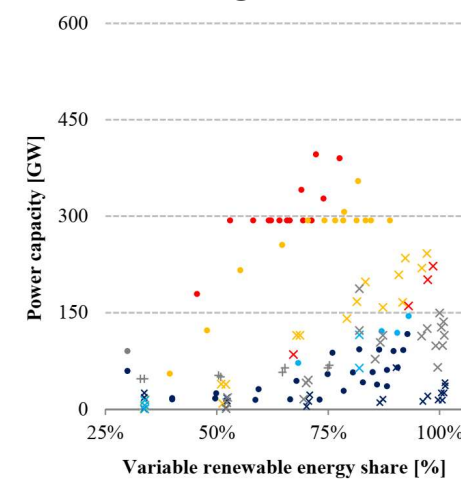
[Naegler et al. \(2021\)](#)



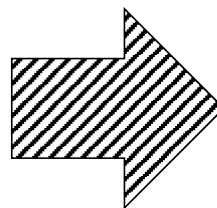
Storage



Grid



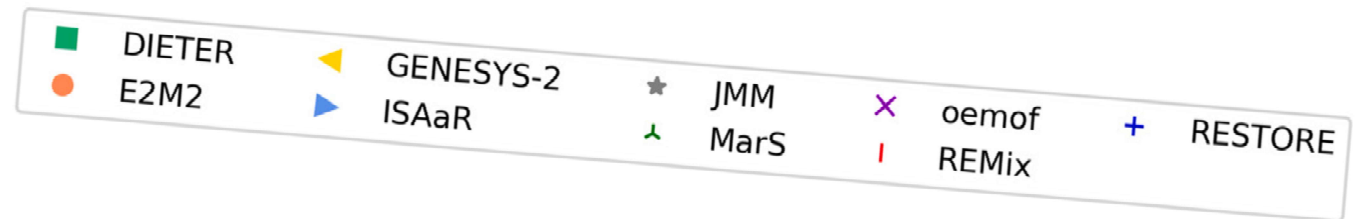
[Cebulla et al. 2018](#)



Is it the data, or is it the model?



Project design



Focus

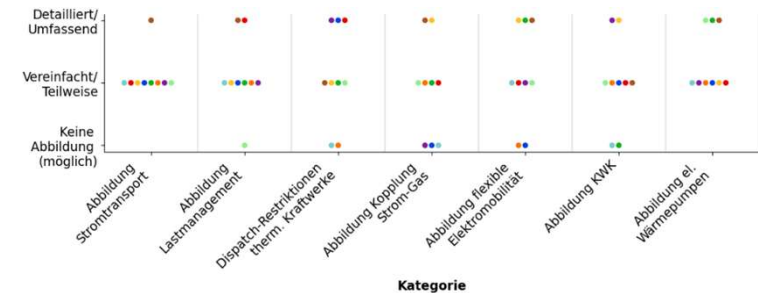
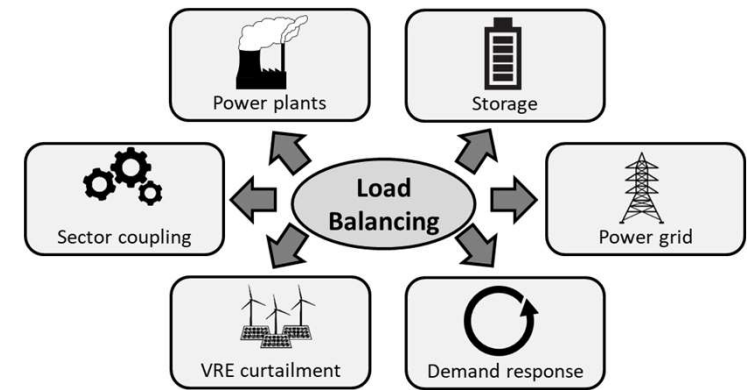
- Load balancing options (investment and dispatch)
- Optimizing, hourly-resolved power system models with sector coupling

Method

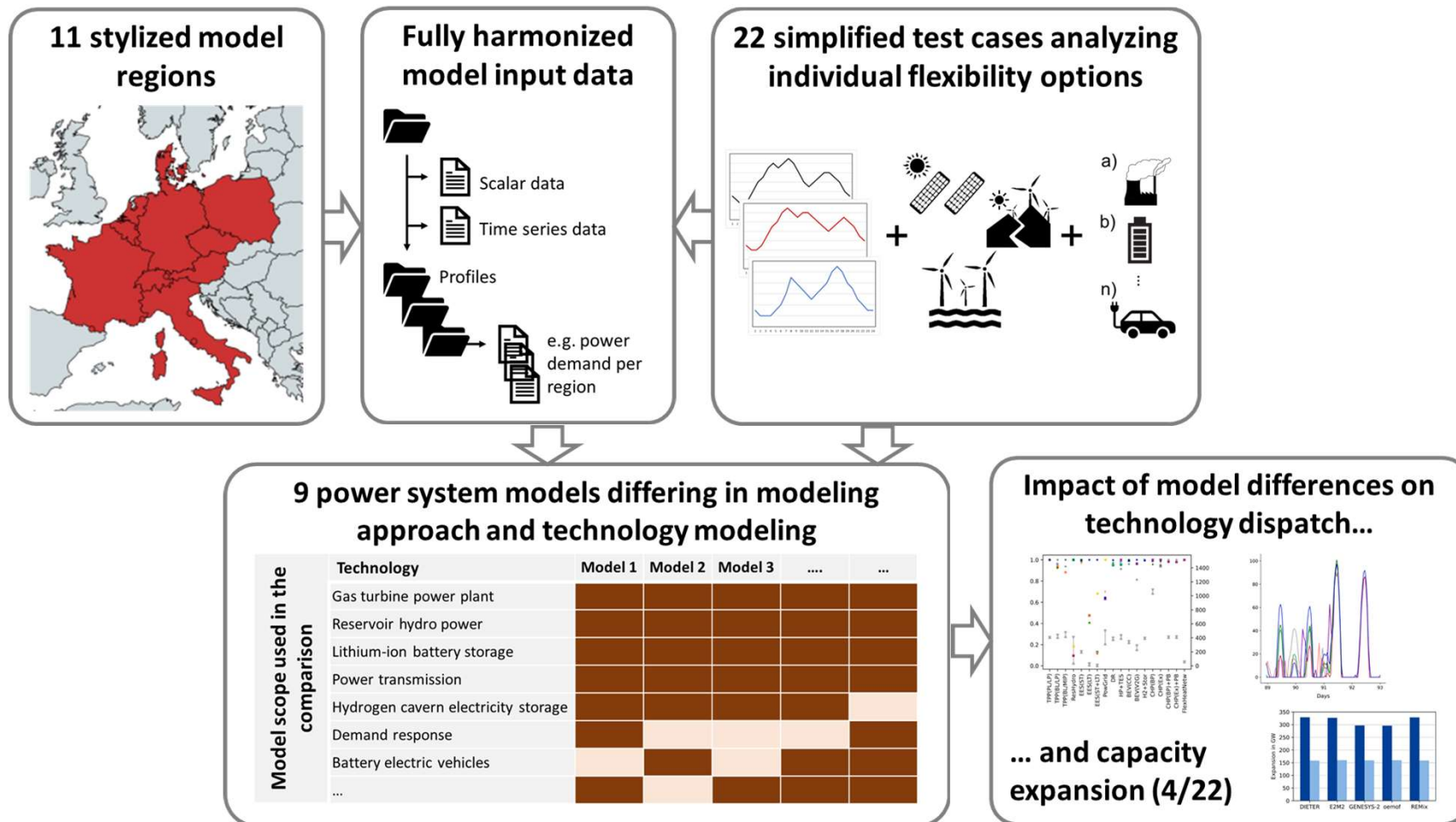
- Stylized test cases with maximum model and data harmonization
- Part 1: Effect of differences in modeling approaches (FlexMex-1)
- Part 2: Interaction of model differences (FlexMex-2)

Model differences

- Approach: LP/MIP vs. QP vs. heuristics, perfect vs. rolling foresight.
- Technologies: Approach and detail of modeling
- Scope: different technology portfolios (esp. sector coupling)



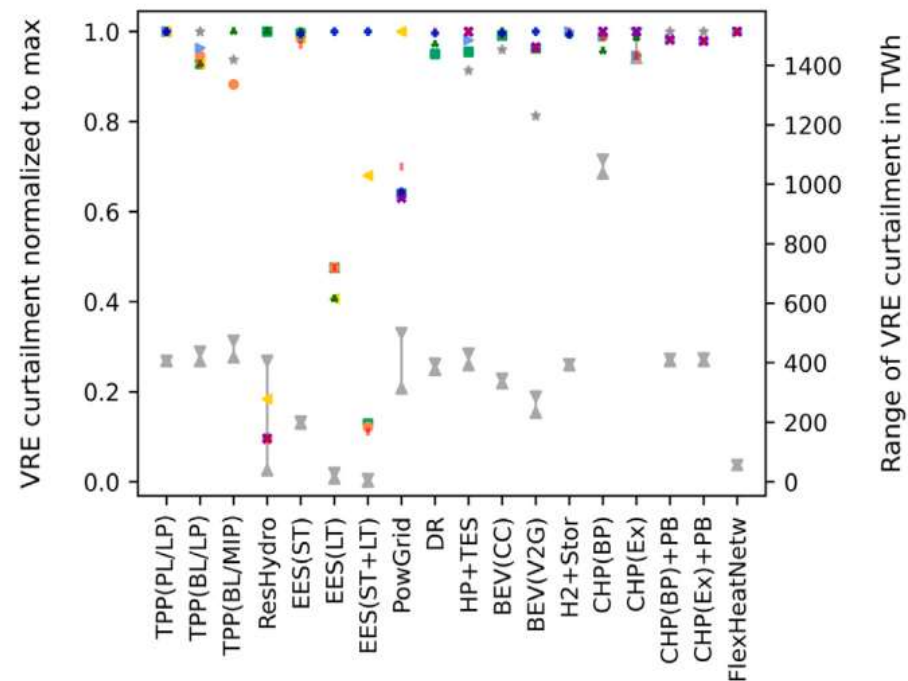
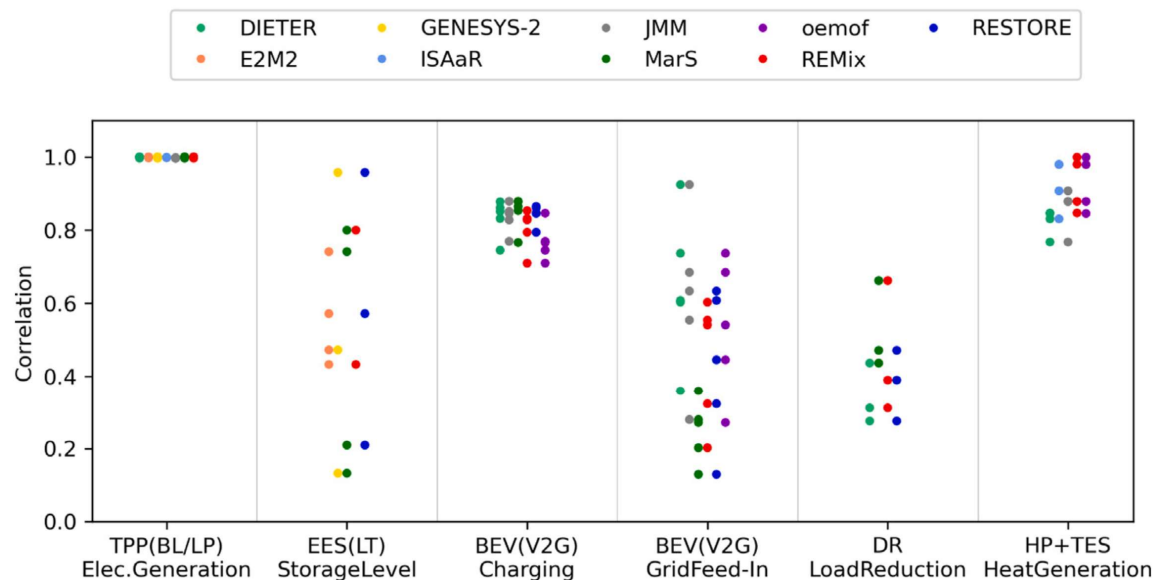
Approach FlexMex-1



Key results and findings FlexMex-1

Methodological

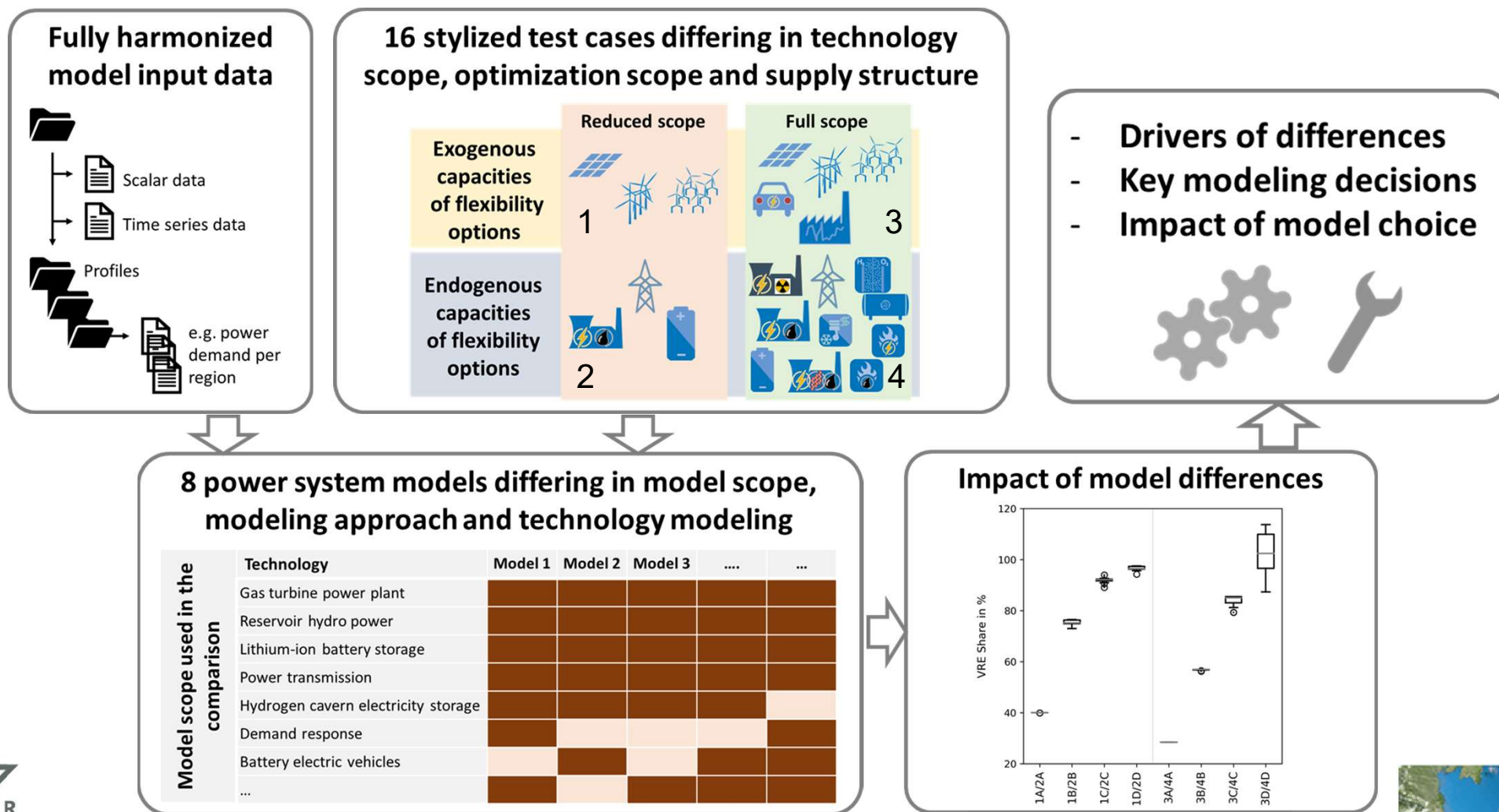
- Model differences can be tracked well
- Overlapping effects in individual test cases
- Method not suitable for evaluating modeling approaches



Content

- Minor differences in technology modelling
- Most relevant differences for storage hydro power, battery vehicles and demand response
- Many detailed differences with small effect

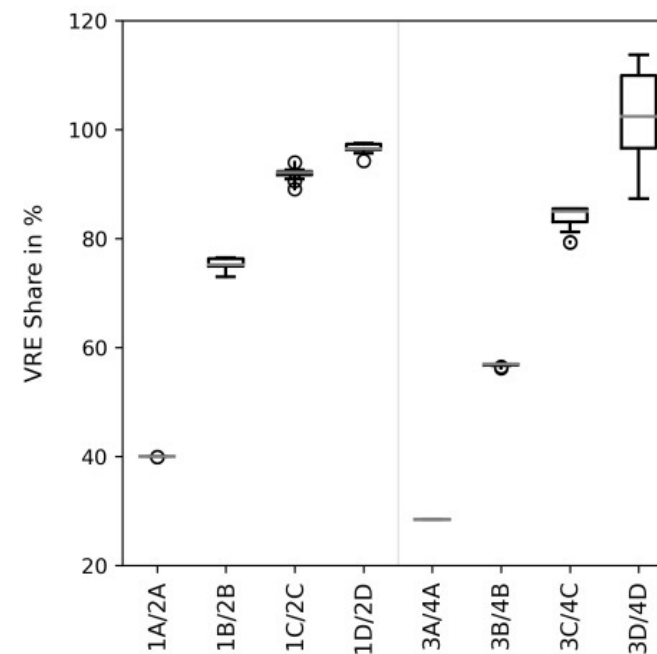
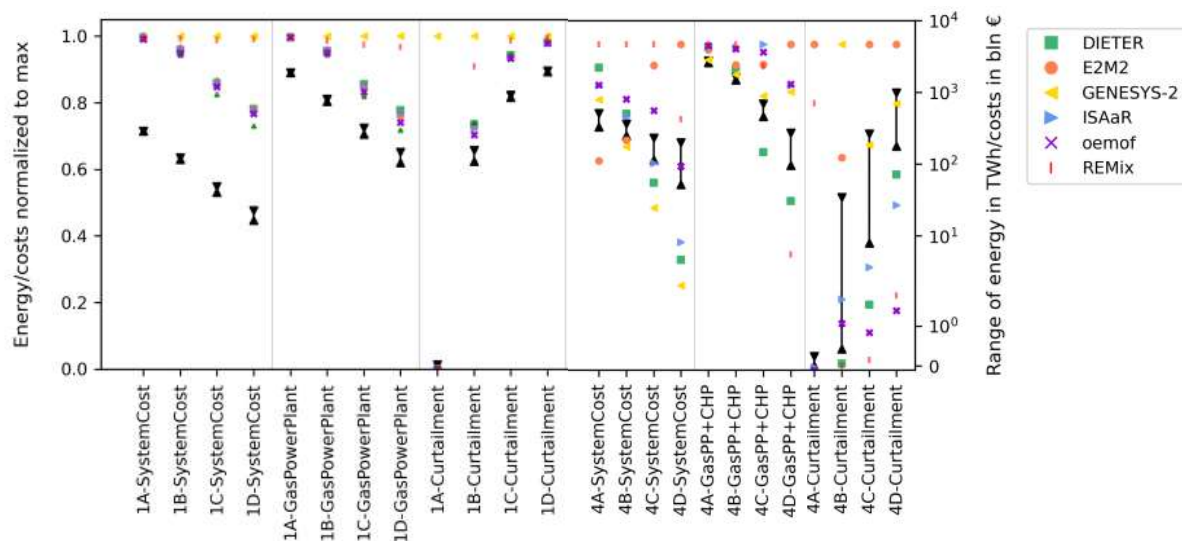
Approach FlexMex-2



Key results and findings FlexMex-2

Methodological

- High similarity with harmonized model scope
- Heterogeneous scope leads to large deviations
- Differences can be still be tracked
- Model scopes and modeling approaches have greater impact than technology modeling



Content

- All models use flexibility of sector coupling
- Model scope: neglect of flexible heat grids and battery vehicles have largest impact
- Technology modeling: largest differences for storage hydropower plants and the power grid



Learnings on modelling frameworks

Model comparisons can help validation...

...and bring knowledge gain for own and other models as well as data management

Many similarities, but also key differences in approach and technology modelling

Thus, model choice can have large influence on results → consider model specializations

Use of individual flexibility options is overestimated with reduced technology scope

Make your model comprehensive and scalable also in the technology detail



Publications of FlexMex and other MODEX projects



Papers in the Special Issue [MODEX: energy system model comparisons through harmonized applications](#)

- FlexMex-1, dispatch cases: <https://doi.org/10.1016/j.rser.2021.111995>.
- FlexMex-1, capacity expansion cases: <https://doi.org/10.1016/j.rser.2021.112004>.
- FlexMex-2: <https://doi.org/10.1016/j.rser.2022.112177>.

Data and tool publications:

- Input and output data, data templates: <https://doi.org/10.5281/zenodo.5802178>.
- Analysis and plotting tool: <https://doi.org/10.5281/zenodo.6010392>.
- Plotting tool data: <https://doi.org/10.5281/zenodo.6010427>.



Methodological recommendations on model comparisons

Start with a detailed theoretical comparison

Use standardized data formats

Be aware of high data harmonization effort

Automatic data processing and plotting wins

Make plausibility checks with one model

Include key input variables in the analysis

Use simplified test cases for quantification of the effect of model differences

Consider that quantitative insights can hardly be transferred to more complex scenarios

