12th openmod workshop 26.-28.03.2024, Grenoble, France

Breakout Session

Model Linking







Einstein Stiftung Berlin Einstein Foundation Berlin

- 1.5-2 hour break-out session
- Mostly open discussion, with some input up front
- Goal: to find and discuss common challenges and issues when linking models
- Output (hopefully): a written conclusion about discussed findings and best practices regarding the linking of models

Welcome Round

Introduction

Very Little / Very Bad



A Lot / Very Good



Have you soft- or hard-linked models?





What expectations do you have for this break out session? 57 responses



feedbacks see the state of the art know best practice bottlenecks in data hear other experiences sharing experiences new solutions best practice accuracy share experiences experiences speed it up know how good practices workflow tools fix consistency issues ideas compatibility ease my pain issues main difficulties share define concepts feedback on linking oppor shared frustration recommended practice



What, in your opinion, are the benefits of linking multiple models? 52 responses

not too comp
different dimensions study complex systems solving complexity complementations comprehensive
more tractability faster solving share knowlegde more re- more details sp increase resolution cap increase resolution cap robustness broader coverage expand boundaries break enlarge the scope interaction impacts coverage

ic models combined results effects actions more complex more fun lex in single problem decomposition development effort actors cooperation more complex ights holistic approach validate hypothesis e analysis link two different fiels no code duplication synergies alistic eed up studies not exponential scaling pturing the real world integrated results systems of systems interaction combining fields isting tools reusability out of silos distribute the work need for data omplementarity more complete analysis address nexus problems cific problems adding complexity decision assessments keep functions separate



What barriers have you faced when performing model coupling? 44 responses

changing interfaces complexity compromise programming language semantic agreement modelling incompatibility methodology inconsistent formulations data structure mismatch pain au chocolat different assumptions data format aligning data model compatibility assumption alignment compatibility issues process flow updating data consistency data interoperability different actors computation time programming languages black box models data interface lot of assumptions different structures consistency data formats data availability data incompatibilities integration issue model consistency understanding different data formats missing documentation different aggregations input ouput consistency software compatibility closed models harmonization of data different basic assumptio data matching work required by others



Background Information: Our Project

- Title: Open-source modeling of the future role of renewable hydrogen in Germany and Europe
- Acronym: ¯_(ツ)_/¯
- Funded by the Einstein Foundation Berlin
- Duration: 11/2021 11/2024
- TU Berlin & DIW Berlin
- Idea: extend and link three open-source models from TUB and DIW Berlin to answer questions about future demands and use cases of renewable hydrogen in the energy system

Open-Source Modeling of the Role of Renewable Hydrogen



• Current status:

- Instead of extending the existing Global Gas Model (GGM), a new model called HYDROGEN-Mod has been developed
- GENeSYS-MOD and DIETER were extended to better represent hydrogen and different aspects, such as gas infrastructure, in the models
- The HYDROGEN-Mod prices are used for the other models (\checkmark)
- GENeSYS-MOD and DIETER is actively underway, with multiple iterations already conducted

Model backgrounds

	GENeSYS-MOD	DIETER
Sectors covered Years covered Hours per year	4 (Electricity, Buildings, Industry, Transport) 7 (2018, 2025, 2030, 2035, 2040, 2045, 2050) ~120	1 (Electricity) 1 (2030 or 2050) 8760
Regional scope Focus	Europe, 30 regions Long-term pathways	Europe, 30 regions Power sector analysis, flexibility

The Good

• The model coupling revealed really interesting shortcomings in the large-scale energy system model regarding power system instability, which is now used to improve the model:

Generation infeasibility



- Since GENeSYS-MOD and DIETER have a fundamentally different operating range (long-term pathway vs. single year), it is sometimes difficult to directly compare results
- Model complexity quickly shoots up
- Fixing DIETER to GENeSYS-MOD results usually leads to infeasibility, so a boundary range needed to be defined
- Convergence criteria still a bit unclear (e.g. when do we stop iterating)

- "Timeseries uncrunching":
 - Since GENeSYS-MOD uses a reduced hourly timeseries (usually down to ~120 time steps per year), but DIETER uses a full hourly calculation, load and generation profiles cannot easily be passed on
 - GENeSYS-MOD does endogenously calculate EV power consumption per time step, but how do we disaggregate / "uncrunch" the time series again?
 - For now, we are just exchanging annual values

• Etherpad for joint note-taking and discussion:

https://etherpad.opendev.org/p/r.6bcf29e06ef9a5d4ce3d99ea6e4c8f96 (replaced with read-only link to preserve comments)

- What experiences have you had doing model coupling?
- What were successes, where did you struggle?

Wrap-Up and Conclusion

• We will structure our findings and discussions collected in the Etherpad and create a written summary and post it on the openmod forum