

Open Energy Transition Introduction

Discussion Document, October 2023

Open Energy Transition is an open energy modelling solution provider aiming to accelerate the World's transition to sustainable energy



from the creators of PyPSA meets Earth



Maximilian Parzen
CEO of OET

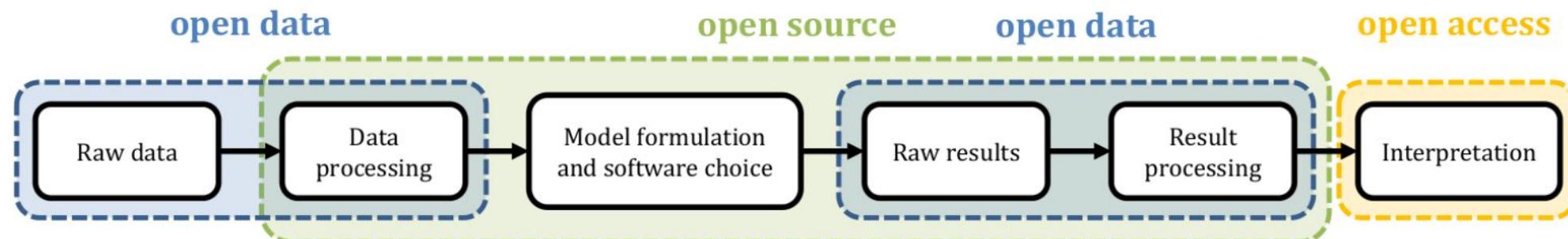
What is open modelling?

Open energy modelling means modelling with open software, open data and open publishing.

Open means that anybody is free to download the software/data/publications, inspect it, machine process it, share it with others, modify it, and redistribute the changes.

This is typically done by uploading the model to an online platform with an **open licence** telling users what their reuse rights are.

The **whole pipeline** should be open:



Open Energy Transition is an open energy modelling solution provider aiming to accelerate the World's transition to sustainable energy

Open Consultancy

- We perform energy planning studies with best open tools and data,
- enable secure data integration in open source software

Aim: Enable people to build on studies and tools even after the consultation

Software Development

- We develop and maintain open source software,
- create visualization platforms,
- computing infrastructure,
- data infrastructure
- customized solutions

Aim: Make open tools user-friendly and decision-ready using cutting-edge technology. Close requirement gaps to other tools.

Support and Training

- We offer reliable on demand support for open source software and train people to adopt cutting-edge open tools

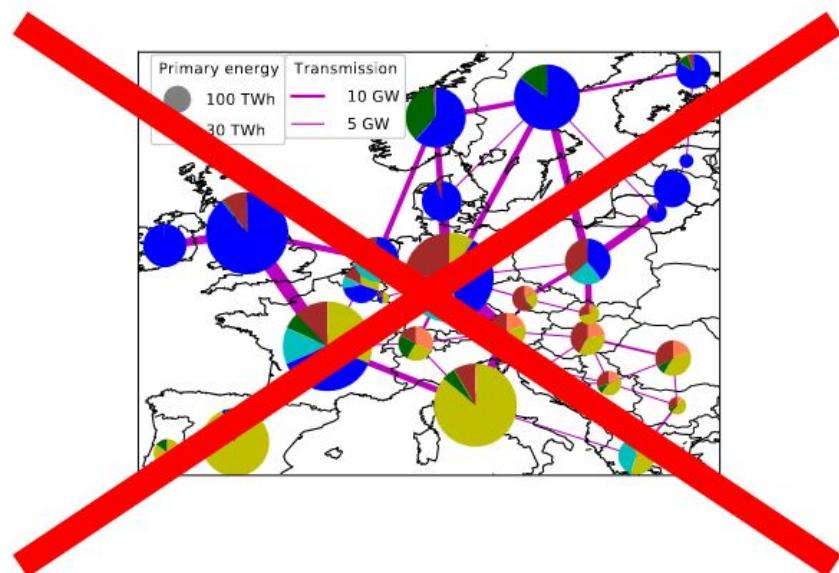
Aim: Help you to maximise impact with open-source software and open data

AGENDA

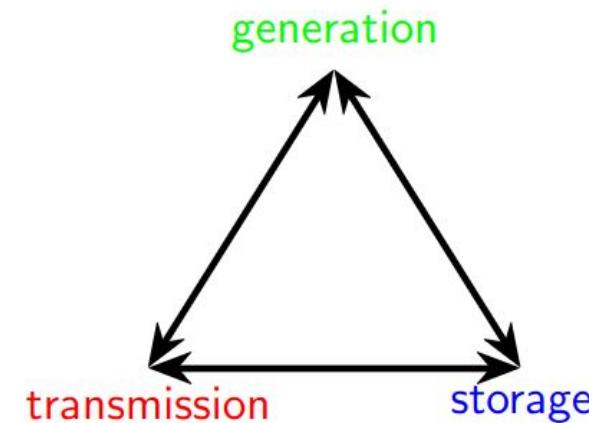
- PyPSA - Energy System Planning Tool
- Case Studies

Modelling challenges: high space-time resolution and sectoral co-optimization

Challenge 1: Need spatial resolution to see grid bottlenecks & infrastructure trade-offs.
⇒ One node per country won't work.



Challenge 2: Need to co-optimize balancing solutions with generation.
⇒ Optimising separately is inefficient.



⇒ Need **very large** models, big data and methods for complexity management

Modelling challenges: high space-time resolution and sectoral co-optimization

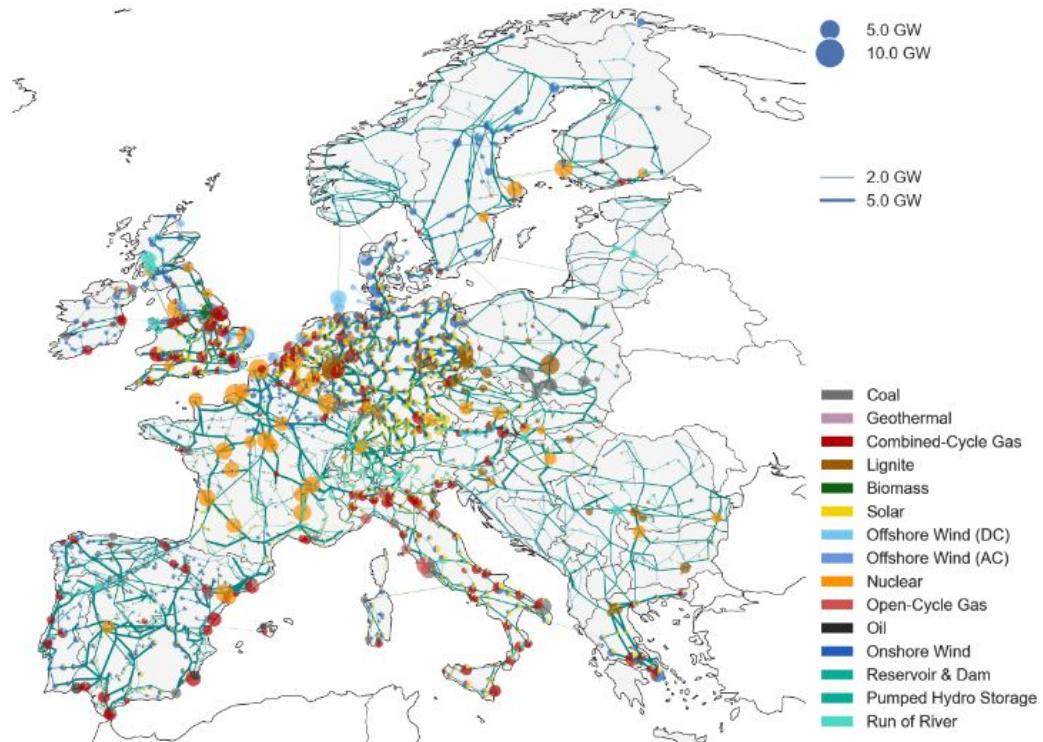
Challenge 3. Need temporal resolution to see benefits of energy storage e.g. trade-offs to curtailments and peak generation saving

- Using only typical days or weeks won't work



Python for Power System Analysis (PyPSA)

- Open source tool for modelling energy systems at **high resolution**.
- Fills missing gap between **power flow software** (e.g. PowerFactory, MATPOWER) and **energy system simulation software** (e.g. PLEXOS, TIMES, OSeMOSYS).
- Good grid modelling is increasingly important, for integration of **renewables** and **electrification** of transport, heating and industry.



PyPSA is available on [GitHub](#). It is used worldwide by researchers, consultants, TSOs and NGOs.

Python for Power System Analysis (PyPSA)

Capabilities

- **capacity expansion planning** (linear)
- **market modelling** (linear)
- non-linear **power flow**

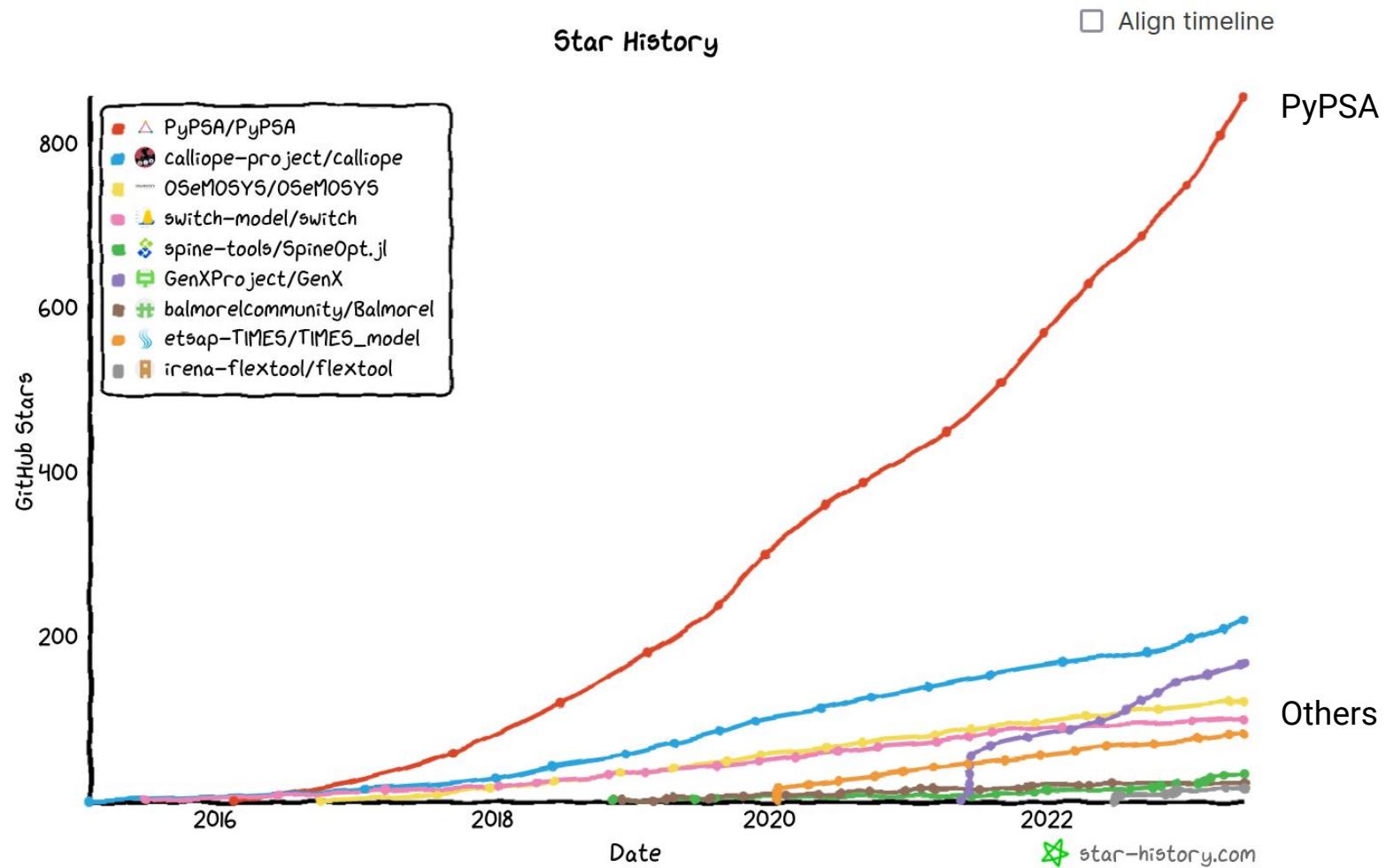
with components for:

- AC and DC **power networks**
- generators with **unit commitment**
- **variable generation** with time series
- **storage** and **conversion**
- **power-to-mobility/heat/gas**

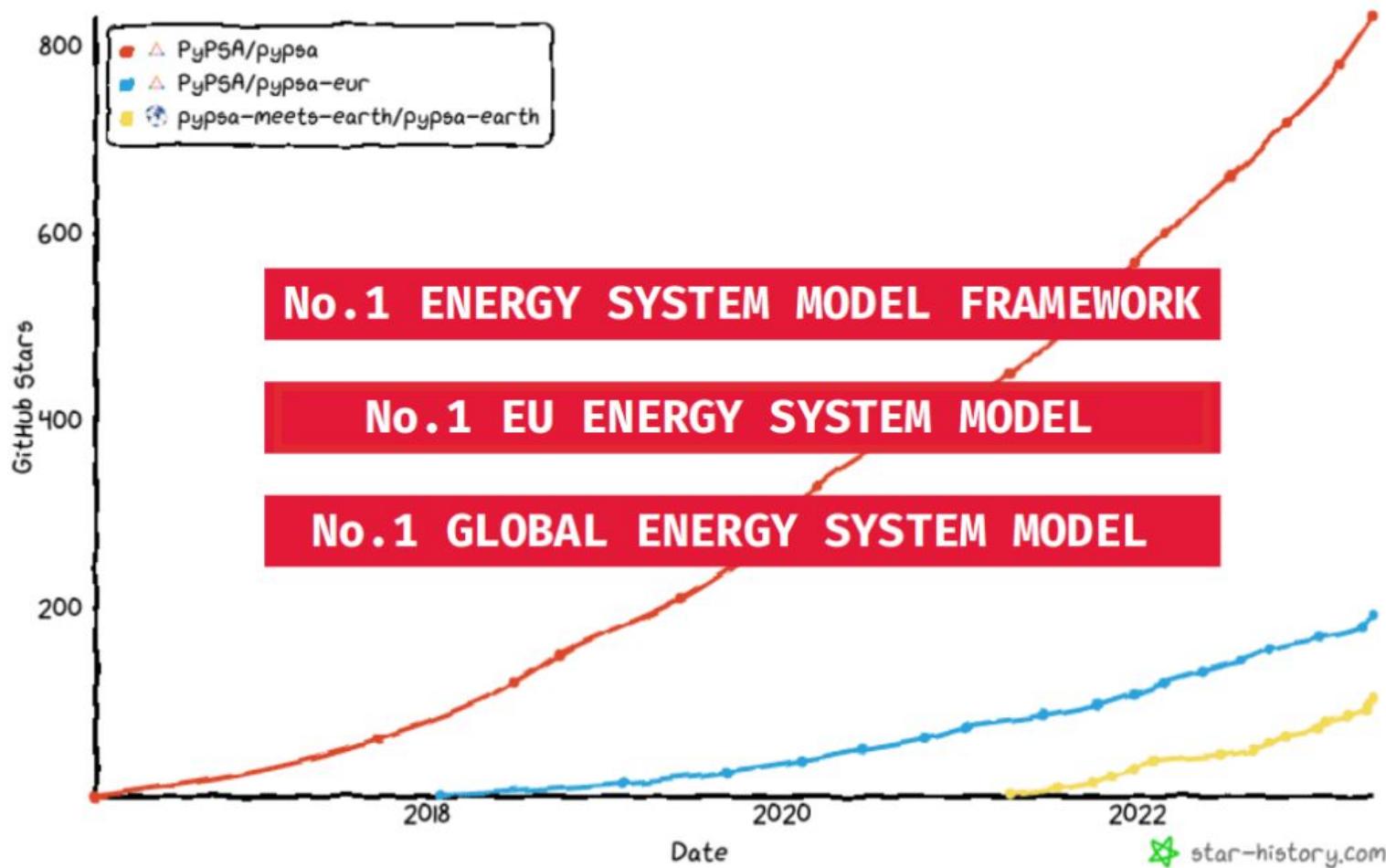
Backend

- all data for components stored in **pandas** DataFrames for easy manipulation
- **optimisation framework** built for large networks and long time series
- interfaces to **major solvers** (Gurobi, CPLEX, Express, cbc, glpk, etc.)
- suitable for **greenfield**, **brownfield** and **pathway** planning
- highly **customisable**

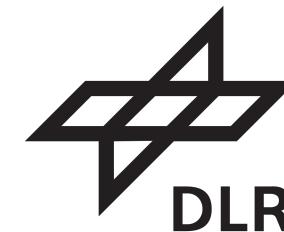
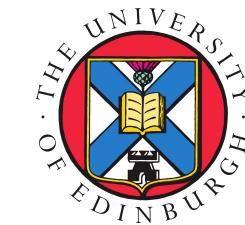
PyPSA is a popular open source toolbox for simulating and optimising modern power and energy systems



Models build on PyPSA experience similar popularity



Maybe you know these institutions? They (& others) use PyPSA



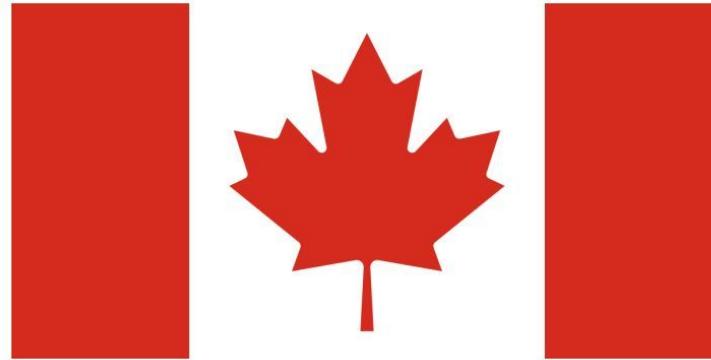
NEWS



“While ENTSOG is free to select any modelling tool for the assessment of the benefits of candidate hydrogen projects, it is recommended, when possible and relevant, the use of an open source tool (for instance, PyPSA [5]) to foster transparency.”

– JRC EU Commission, Harmonised system-wide cost-benefit analysis for candidate hydrogen projects, May 2023

NEWS



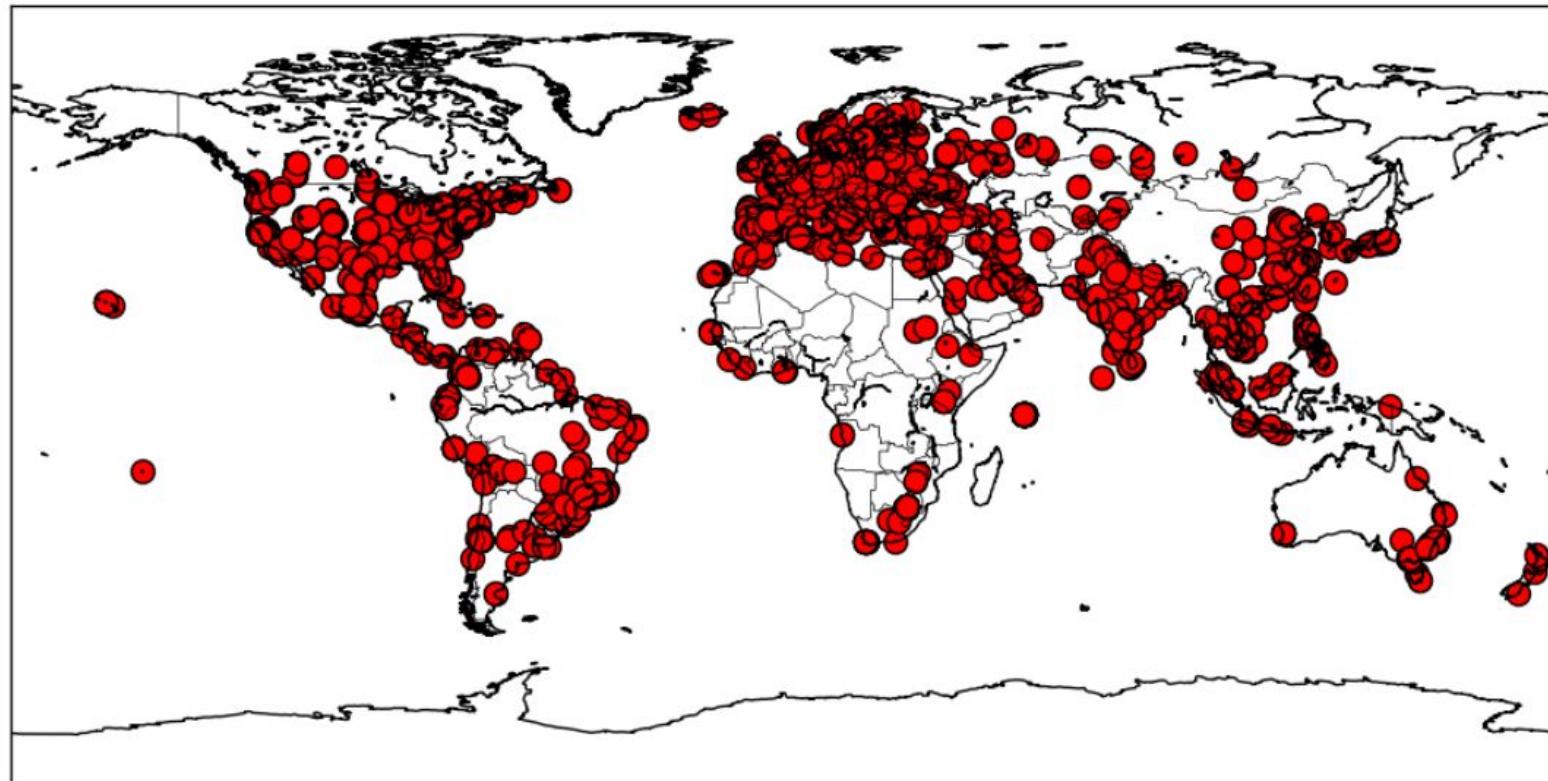
“Canada’s Energy Regulator uses open-source tool PyPSA for their first long-term outlook modelling for net-zero by 2050”

– Maximilian Parzen, [LinkedIn post](#) on Canada’s Energy Future 2023 which was published on June 2023

Case Studies

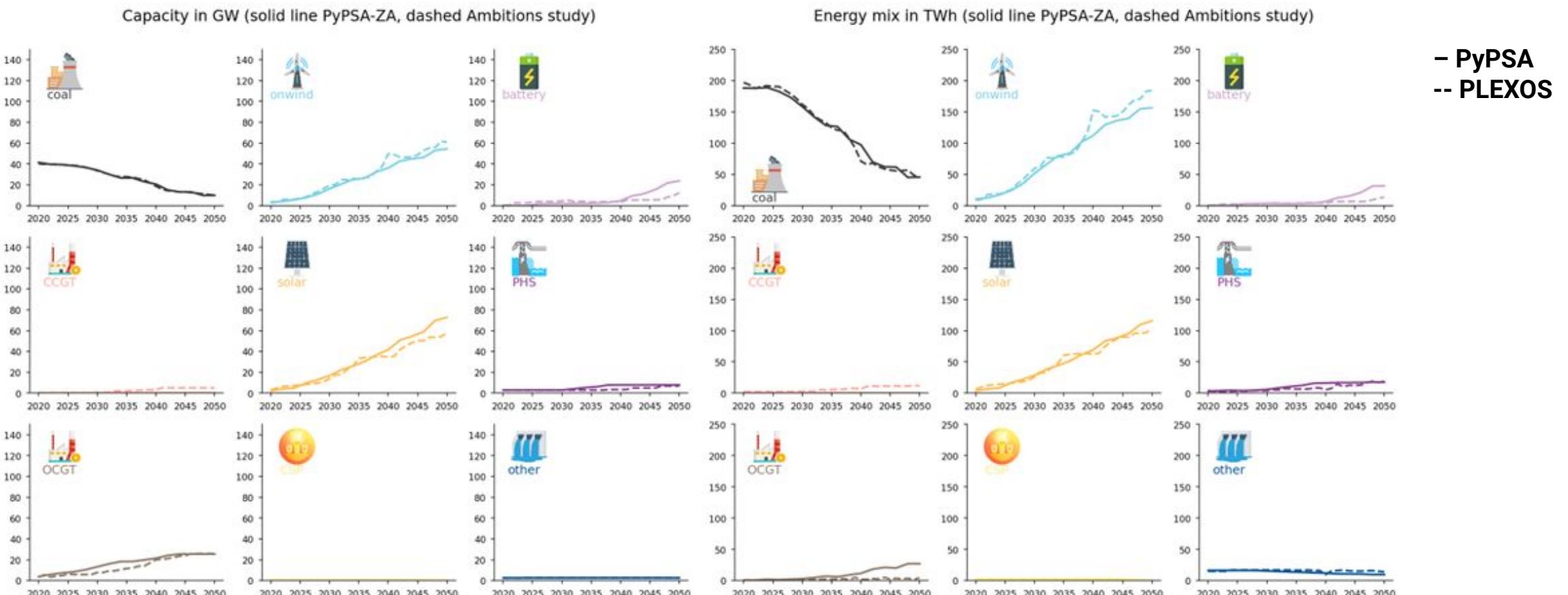
Python for Power System Analysis: Worldwide Usage

PyPSA is used worldwide by **dozens of research institutes and companies** (TU Delft, KIT, Shell, TSO TransnetBW, TERI, Agora Energiewende, RMI, Ember, Instrat, Fraunhofer ISE, Climate Analytics, DLR, FZJ, RLI, Saudi Aramco, Edison Energy, spire and many others). See [list of users](#).



Example - Reproducing PLEXOS results

South-African consultancy used a tailored PyPSA-ZA model to demonstrate that PyPSA can replicate commercial state-of-the-art PLEXOS scenarios. Why? They believe in open-source benefits like **customization/ vendor independency** and wanted to **build trust** in open-source with this activity. **OET** can deliver that for any regions.

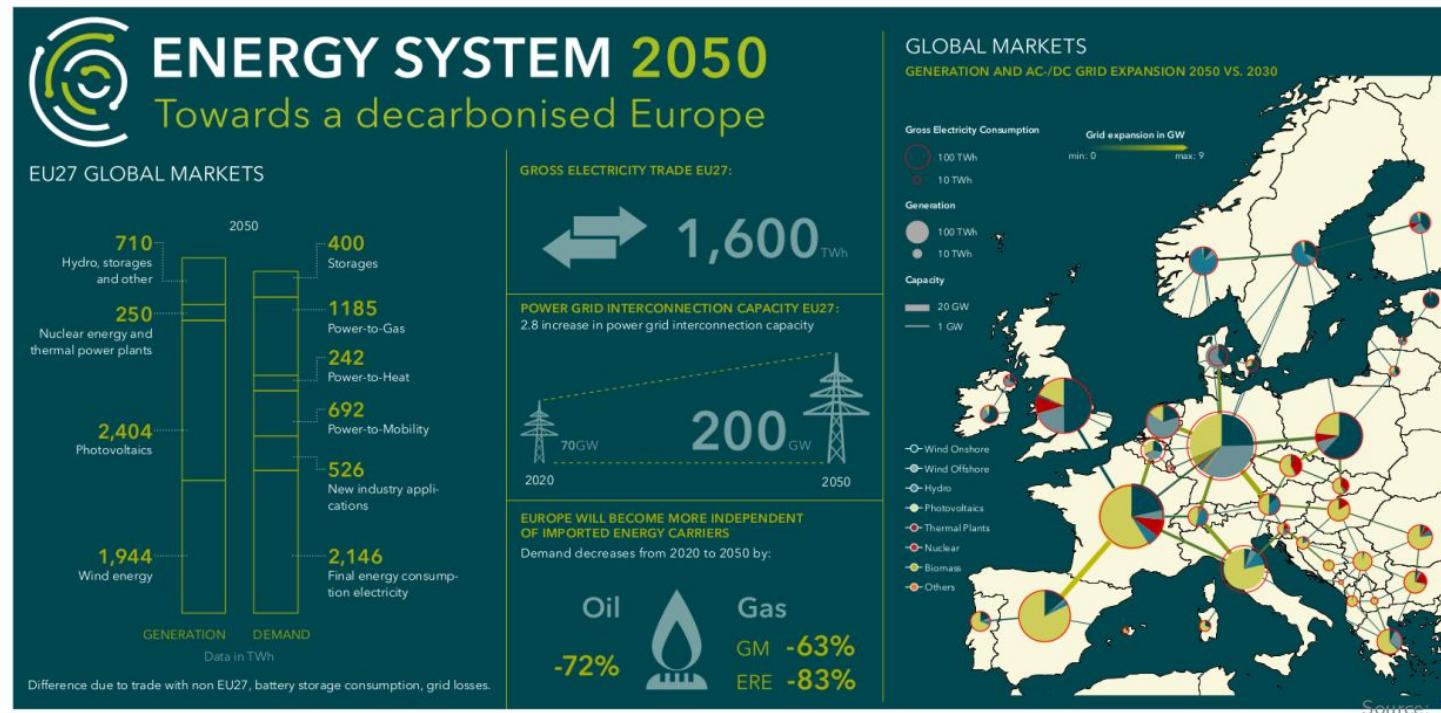


Example - Exploring future continental infrastructure requirements

PyPSA example: TransnetBW used PyPSA-Eur-Sec

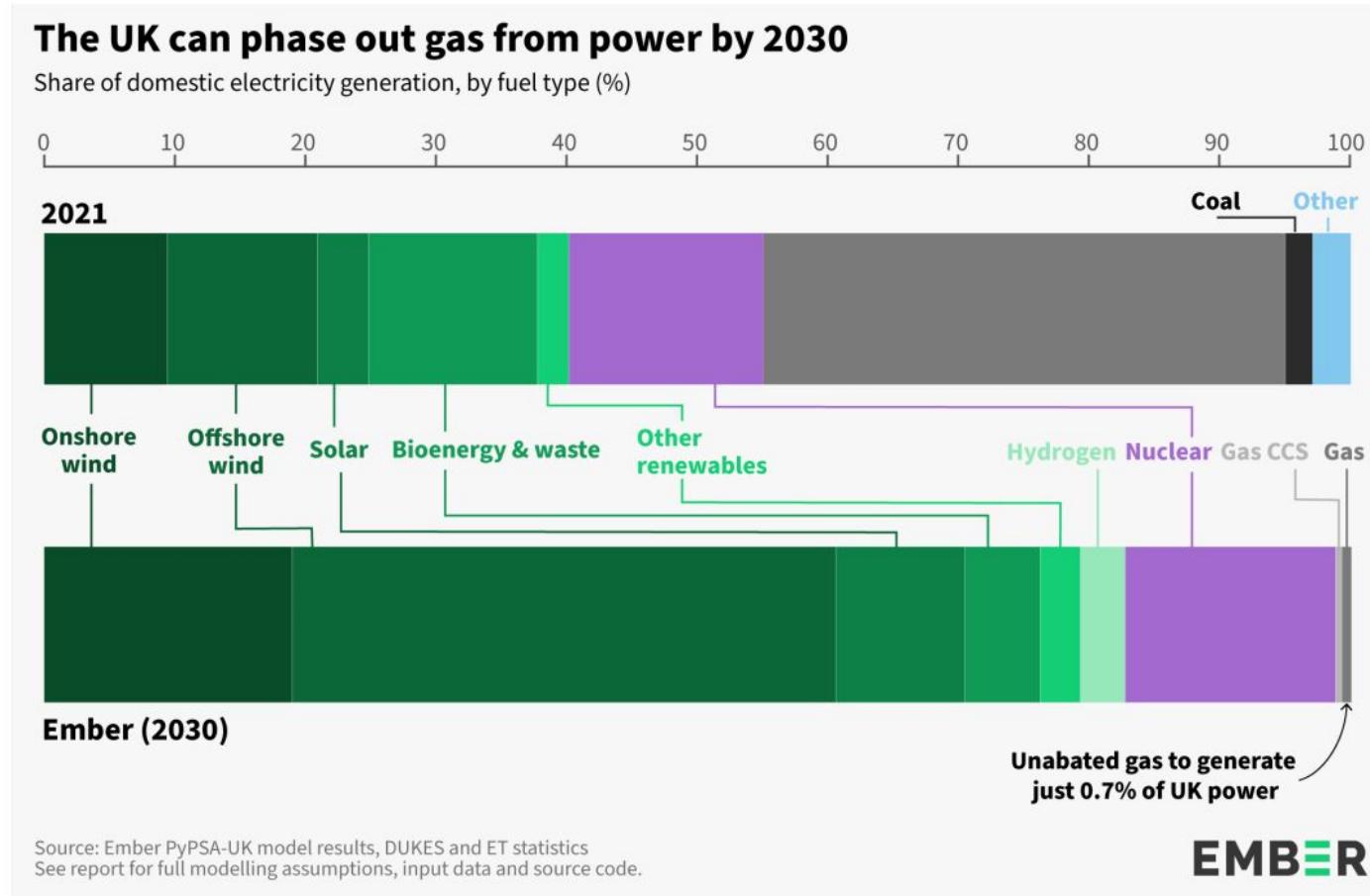


German **Transmission System Operator (TSO)** **TransnetBW** used an open model (PyPSA-Eur-Sec) to model the European energy system in 2050. Why? Easier to build on an existing model than reinvent the wheel.



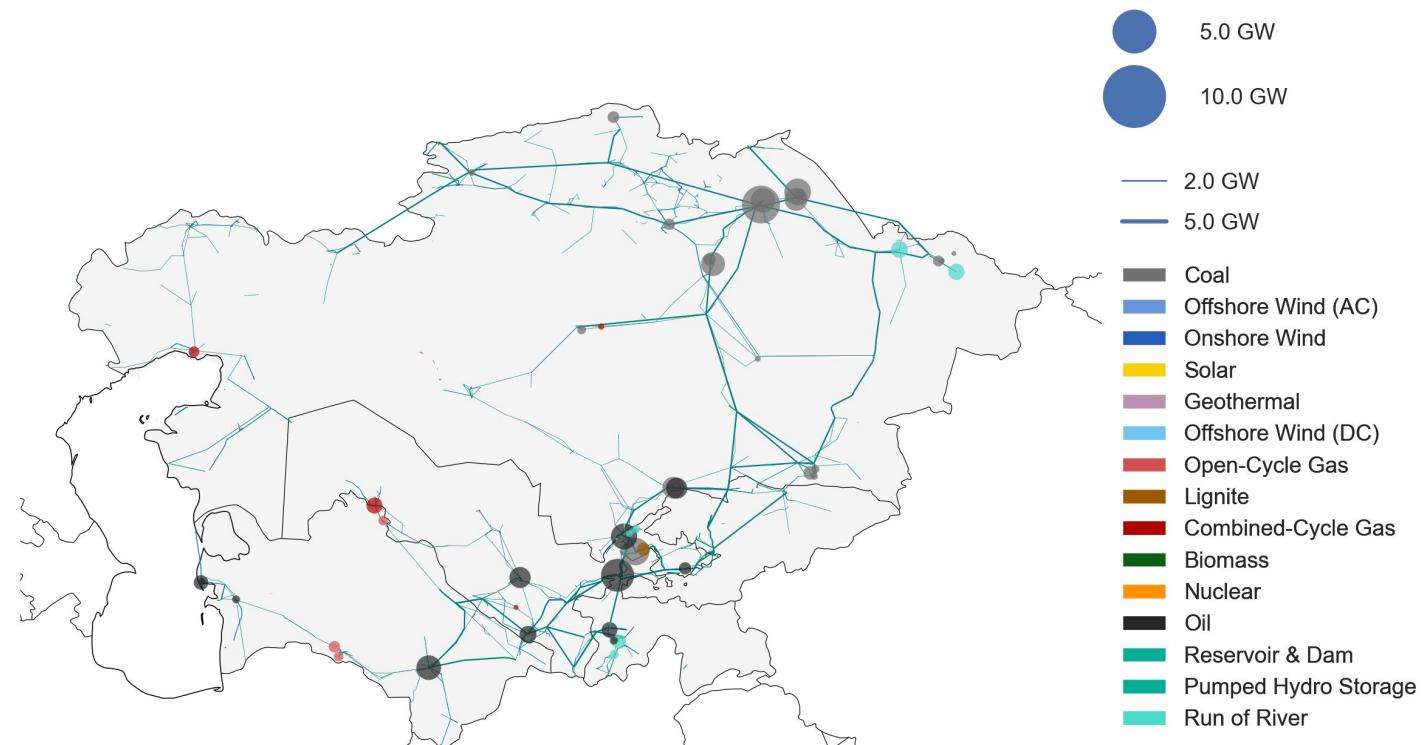
Example - Gas-phase out modelling

NGO Ember used PyPSA to model a gas phase out in the UK by 2030, releasing all code on [github](#).

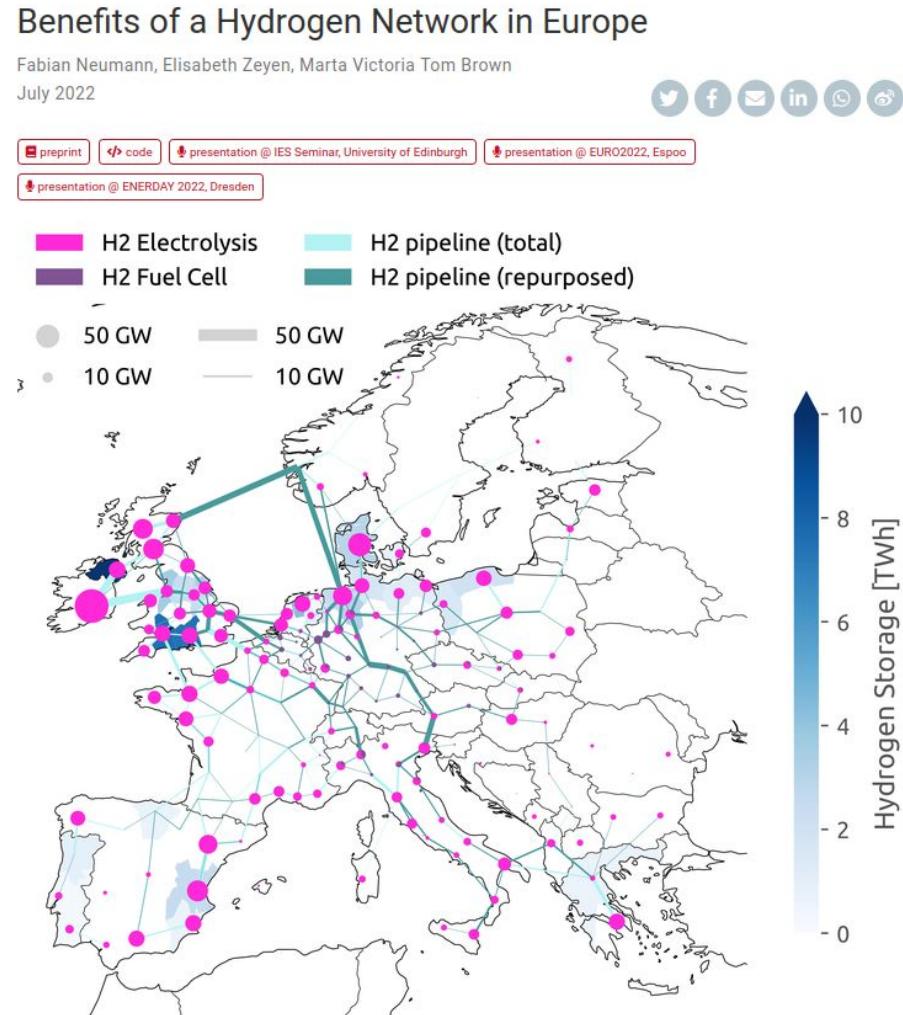


Example - Exploring more ambitious renewable targets

OET supports German NGO with PyPSA-Earth for exploring viable renewable energy systems in Kazakhstan.
Why? It's cheaper, benefits of transparency, **support is available**, and long-term sustainable since **people can reuse** and **build up on existing work**.

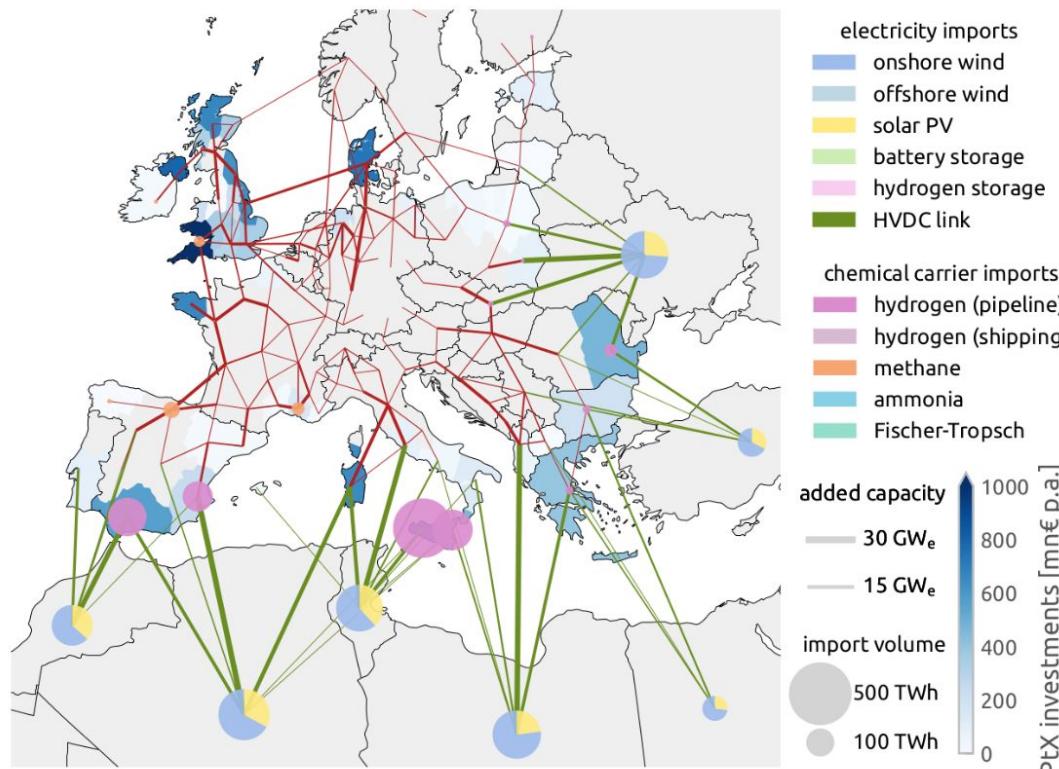


Example - Exploring green hydrogen infrastructure requirements



Example - Exploring import and export potentials and their energy system impact

With e-fuel imports instead of autarky



- Allowing imports of electricity, green hydrogen, e-fuels, **changes infrastructure needs completely**
- PtX out-sourced from Europe
- Electricity imported too, providing seasonal balancing

Example - Technology assessments under competition e.g. 20 energy storage technologies

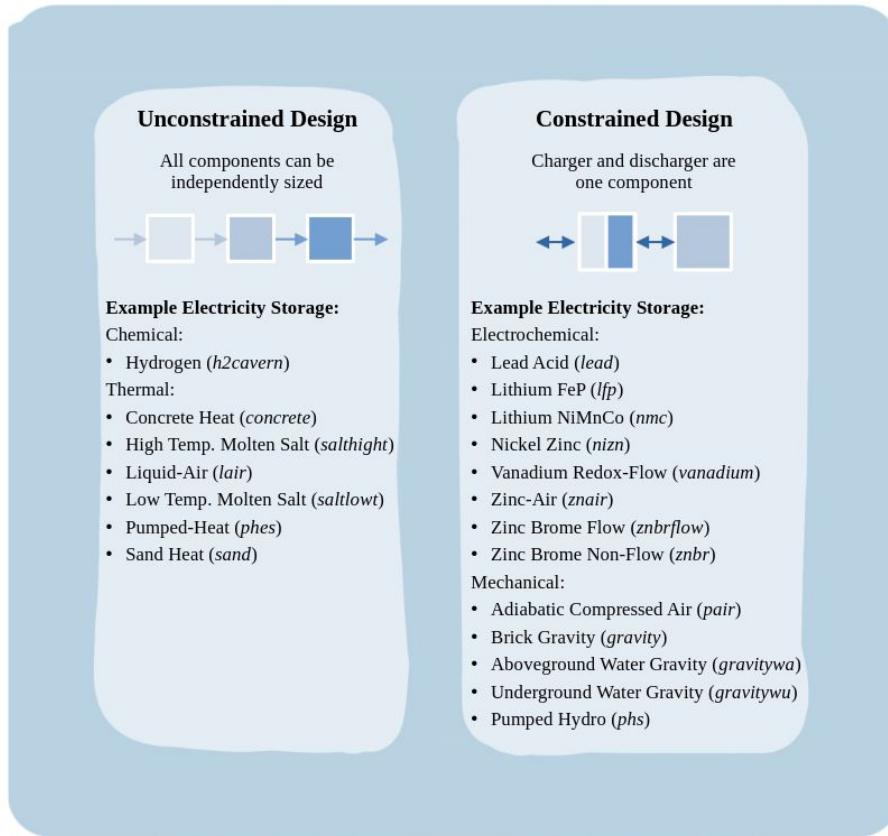
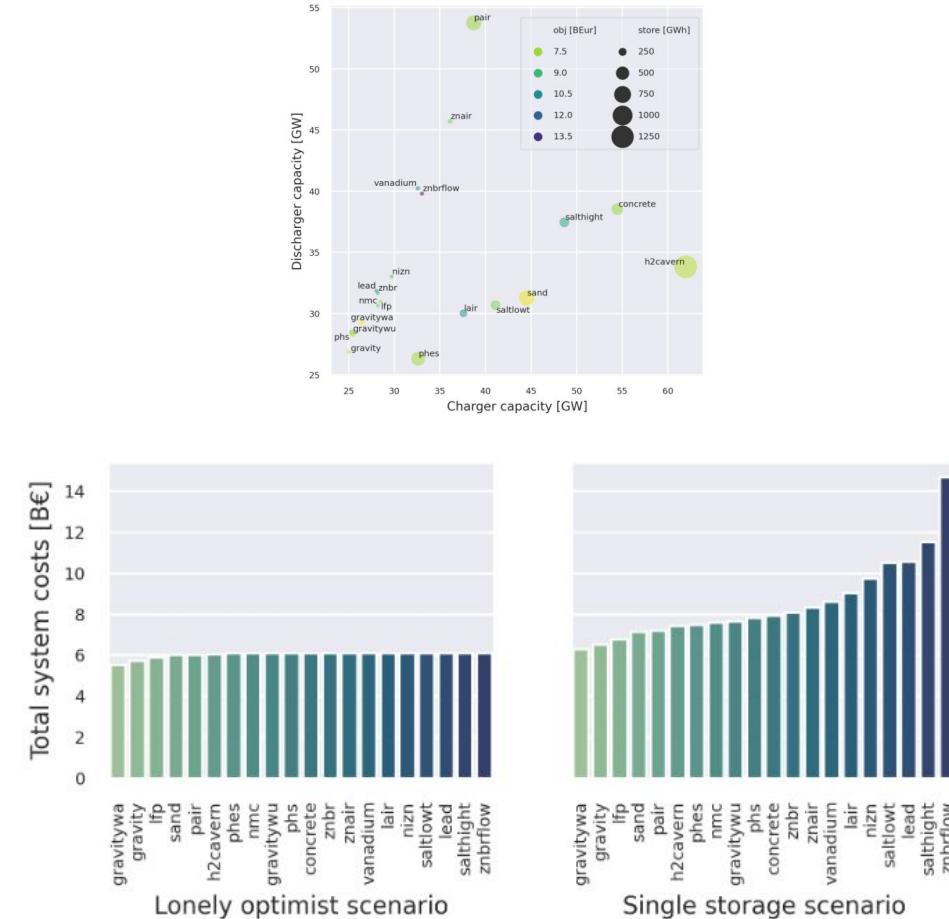


Figure 2: Illustration of energy storage technologies with abbreviations used in this study.



Conclusion

- Open data and software is **great** for decision-makers
- Open solutions are **trusted** by industry & research
- PyPSA is **flexible+** and **offers novel insights** for decision-makers
- OET can help you making the best out of open energy modelling