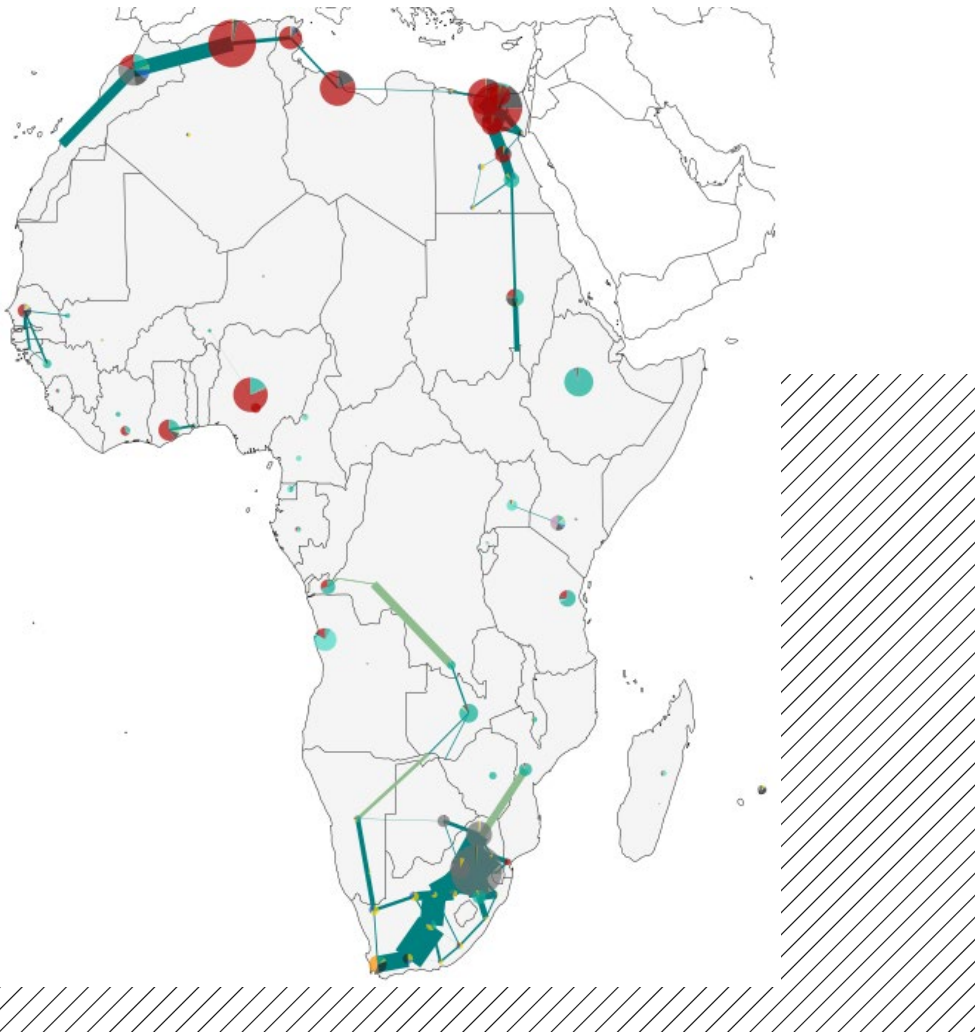


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Key facts

- Period: 01.01.2023 – 31.12.2025
- Budget: 4.2 Millionen €
- Funded by the Federal Ministry of Education and Research

Project partners

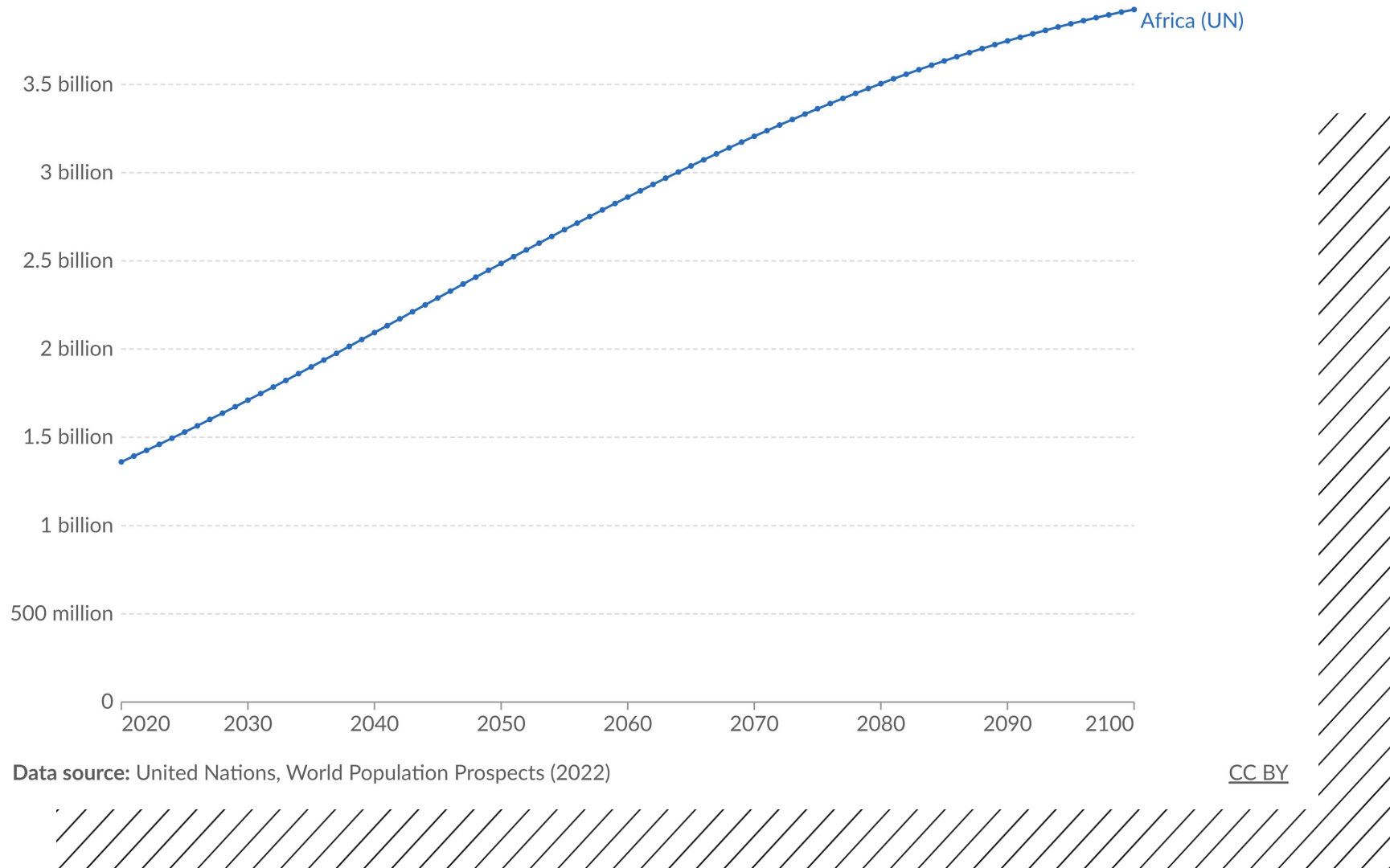


Associated partners



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Motivation



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Motivation

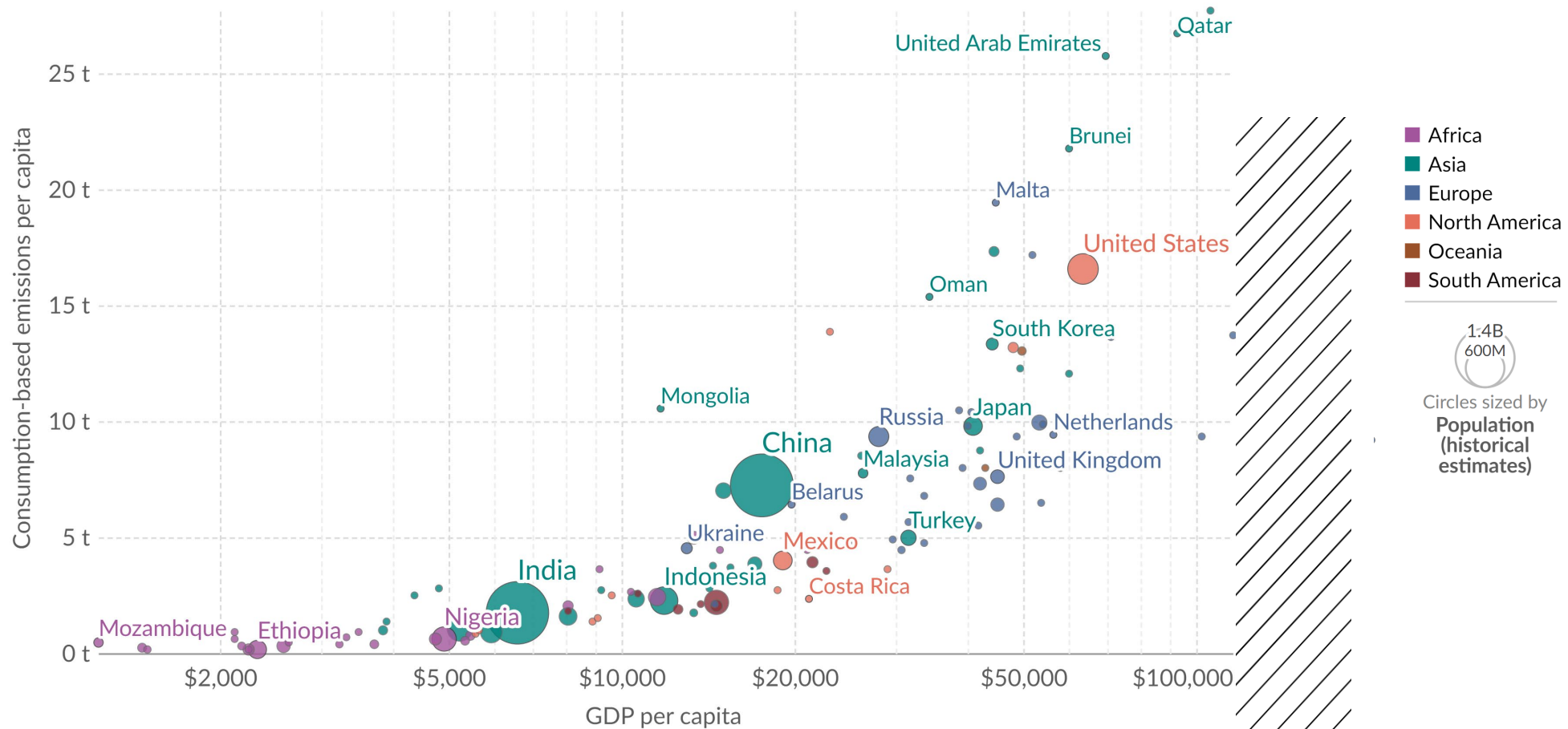
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Data source: Global Carbon Budget (2023); Population based on various sources (2023); World Bank (2023)

[OurWorldInData.org/co2-and-greenhouse-gas-emissions](https://ourworldindata.org/co2-and-greenhouse-gas-emissions) | CC BY

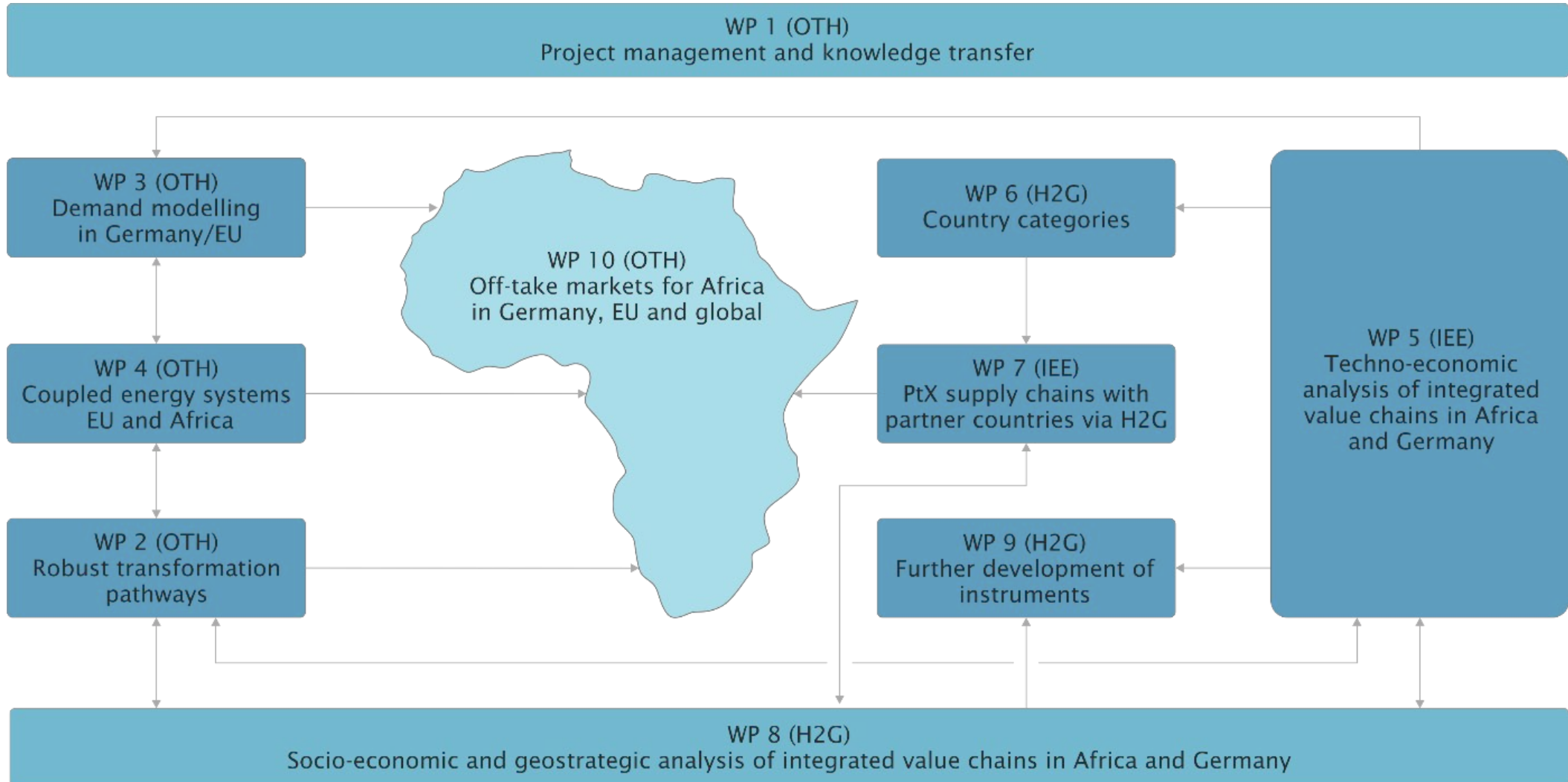
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Methodology

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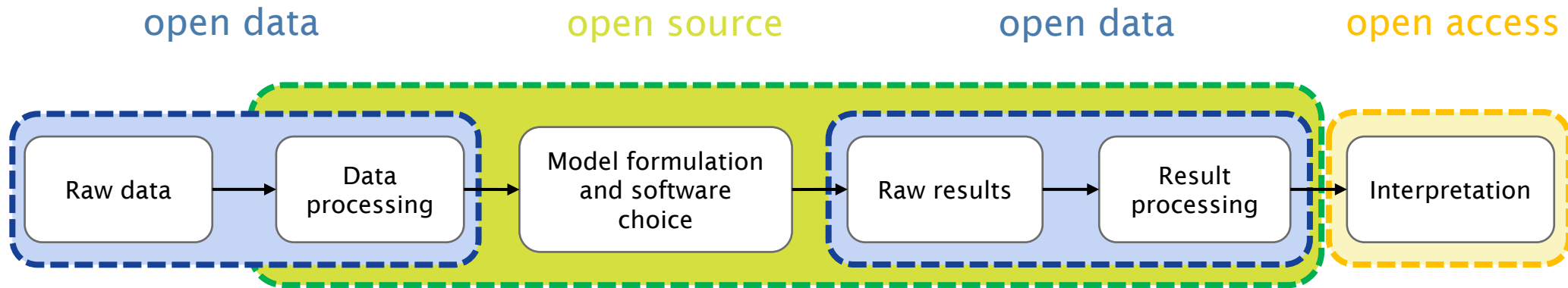
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Following the Idea of Open Energy Modelling

The whole chain from raw data to modelling results should be open:



open data + free software → transparency + reproducibility

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Energy Transformation Pathways

Main Models:

- PyPSA-Earth
- PyPSA-Earth-Sec
- PyPSA-Eur



PyPSA-Earth. A new global open energy system optimization model demonstrated in Africa

Maximilian Parzen^{a,*}, Hazem Abdel-Khalek^b, Ekaterina Fedotova^c, Matin Mahmood^d, Martha Maria Frysztacki^e, Johannes Hampf^d, Lukas Franken^a, Leon Schumm^{b,e}, Fabian Neumann^g, Davide Poli^f, Aristides Kiprakis^h, Davide Fioriti^{i,*}

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GRAPHICAL ABSTRACT



ARTICLE INFO

Dataset link: <https://github.com/pypsa-meets-earth-paer>

Keywords:
Macro-energy systems
Optimization
OpenStreetMap
Copernicus
openmod

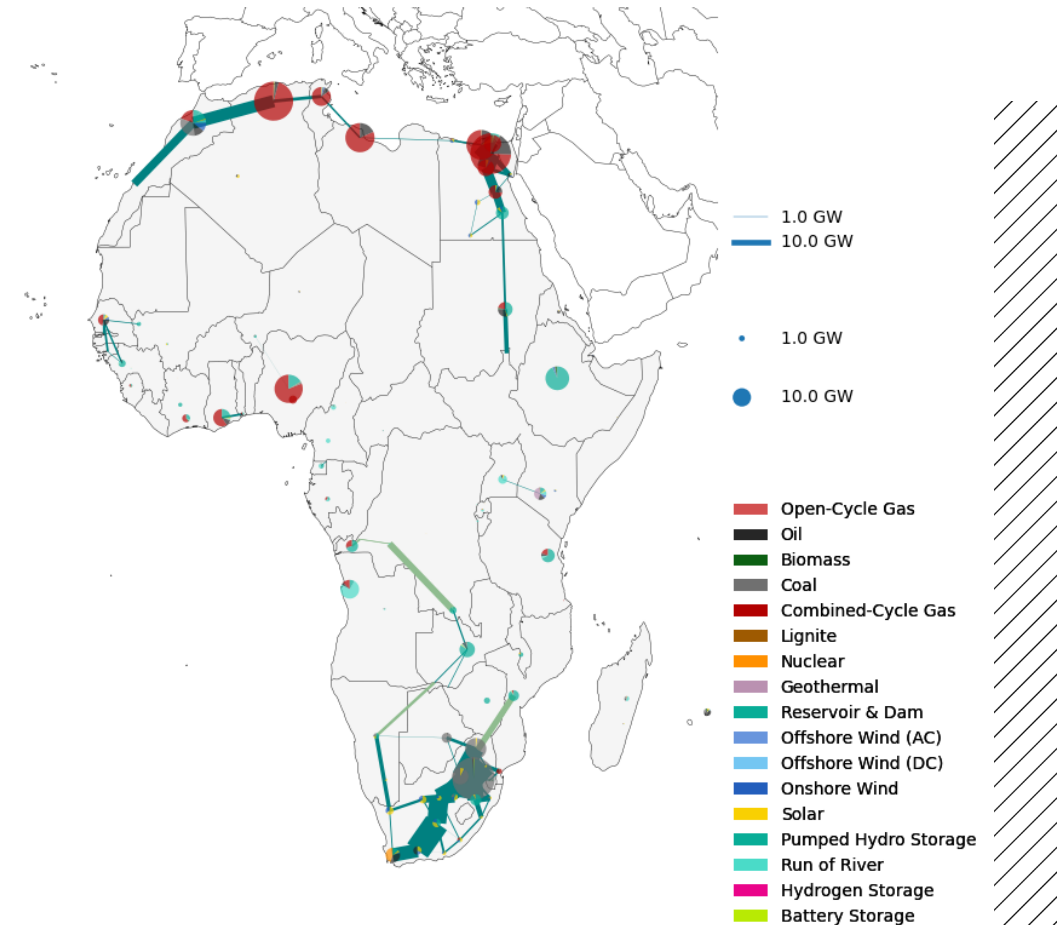
ABSTRACT

Macro-energy system modelling is used by decision-makers to steer the global energy transition towards an affordable, sustainable and reliable future. Closed-source models are the current standard for most policy and industry decisions. However, open models have proven to be competitive alternatives that promote science, robust technical analysis, collaboration and transparent policy decision-making. Yet, two issues slow the adoption: open models are often designed with particular geographic scope in mind, thus hindering synergies from collaborating, or are based on low spatially resolved data, limiting their use. Here we introduce PyPSA-Earth, an open-source global energy system model with data in high spatial and temporal resolution. It enables large-scale collaboration by providing a tool that can model the world's energy system or any subset of it. The model is suitable for operational as well as combined generation, storage and transmission expansion studies. In this study, the novel power system capabilities of PyPSA-Earth are highlighted and demonstrated. The model provides two main features: (1) customizable data extraction and preparation with global coverage and (2) a PyPSA energy modelling framework integration. The data includes electricity demand, generation

Check out
PyPSA-Earth here:



Check out
PyPSA-Earth-Sec here:



Quelle: Erstellt mit PyPSA-Earth und https://github.com/pypsa-meets-earth/documentation/blob/main/notebooks/viz/regional_transm_system_viz.ipynb

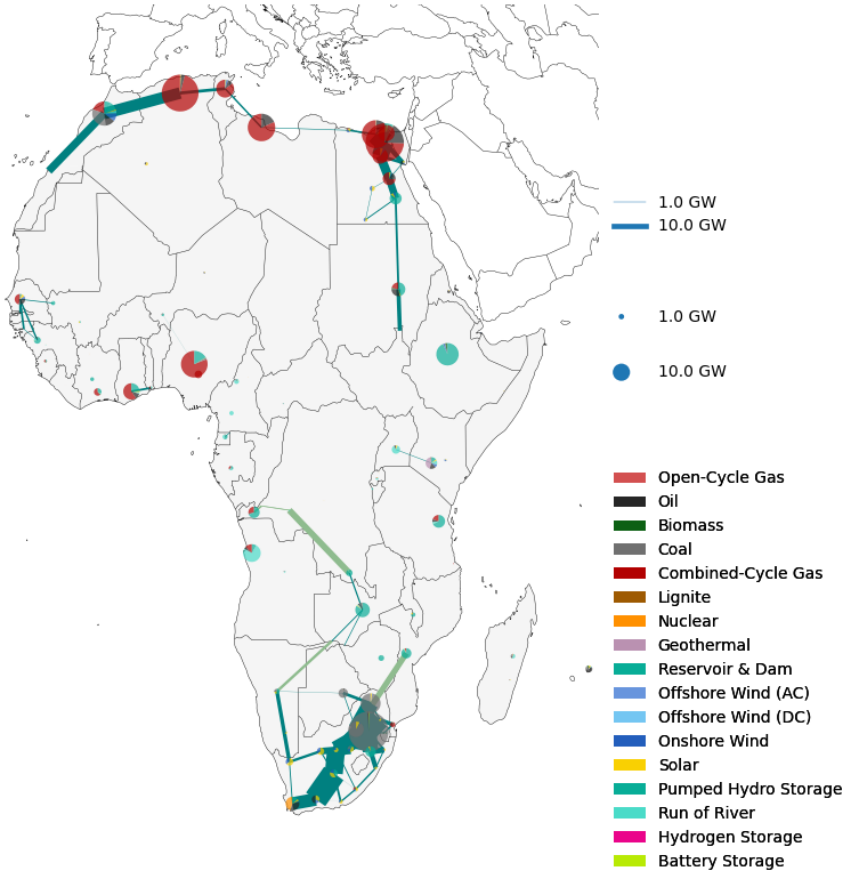
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Model coupling Africa/Europe

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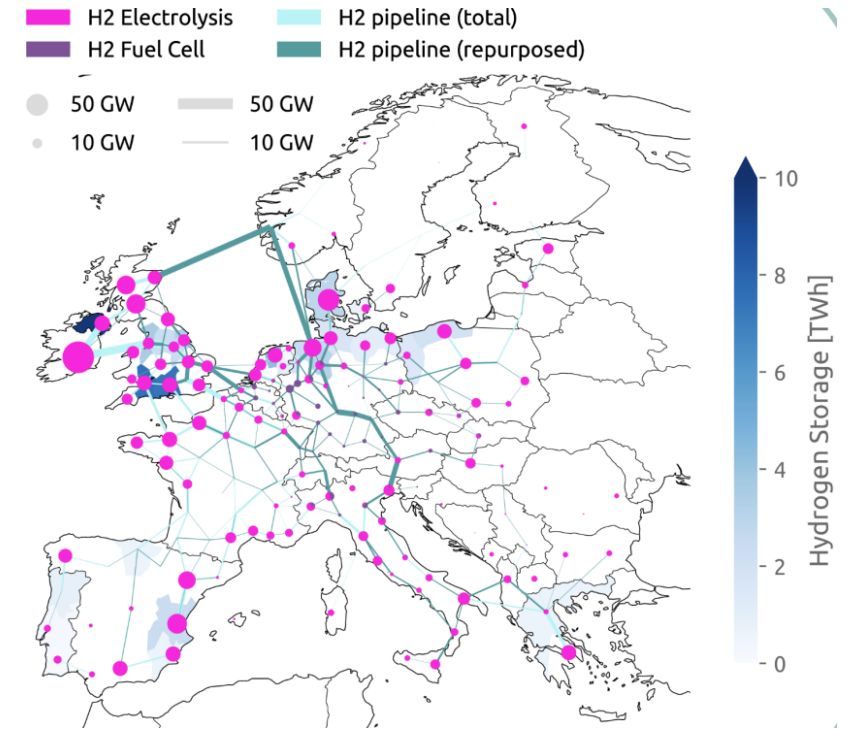
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Direct model coupling



Common optimization of
selected countries



Quelle: Neumann, Fabian; Zeyen, Elisabeth; Victoria, Marta; Brown, Tom (2022): Benefits of a Hydrogen Network in Europe

Quelle: Erstellt mit PyPSA-Earth und https://github.com/pypsa-meets-earth/documentation/blob/main/notebooks/viz/regional_transm_system_viz.ipynb

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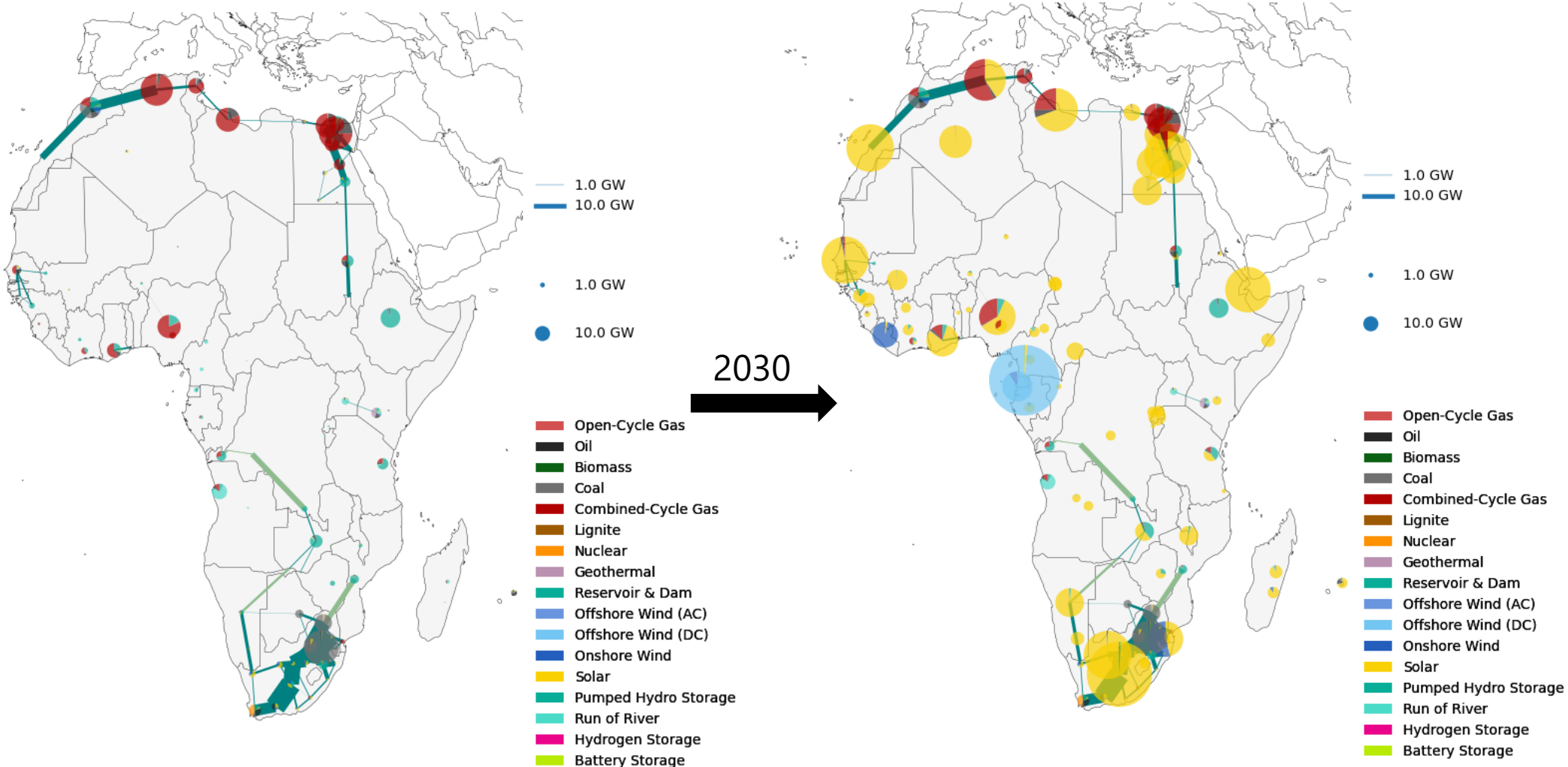
Results

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Check out
PyPSA-Earth here:



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Backup - Results

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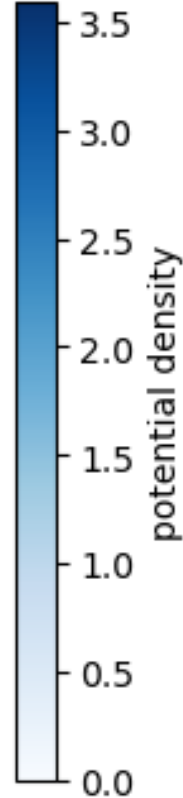
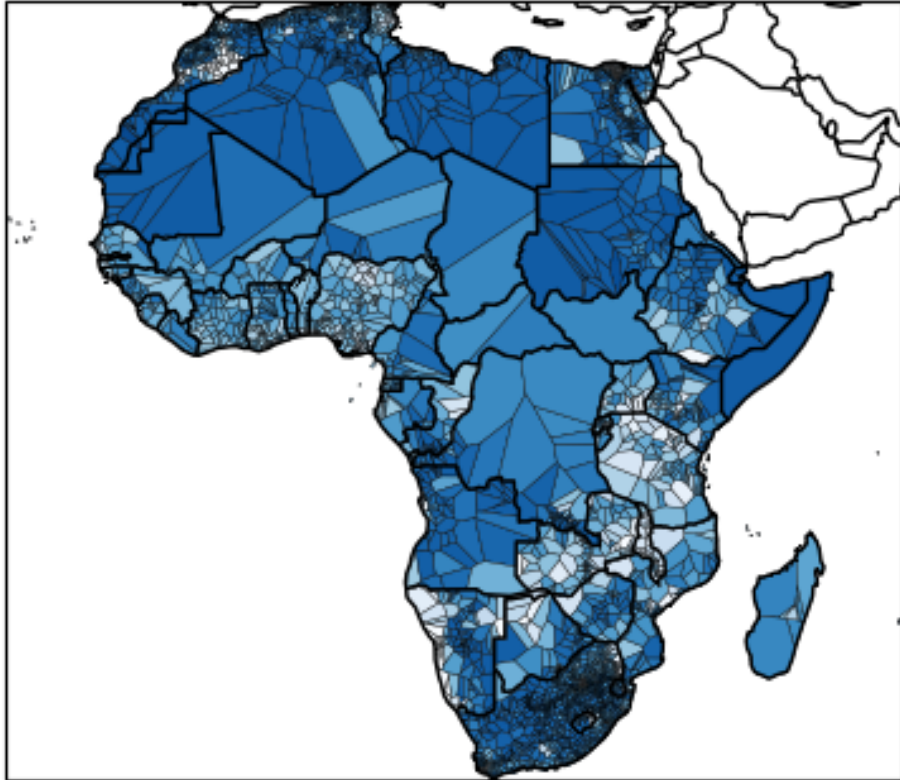


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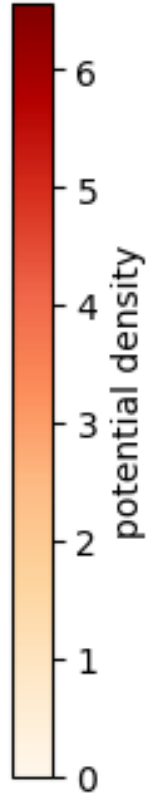
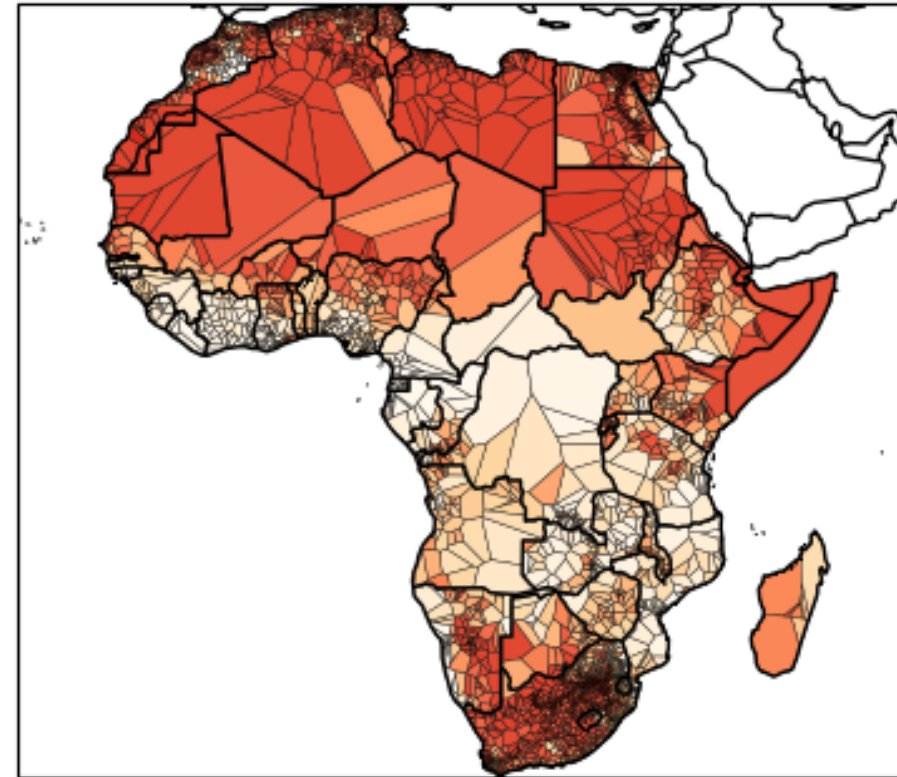


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Onshore Wind Potential Density [MW/km²]

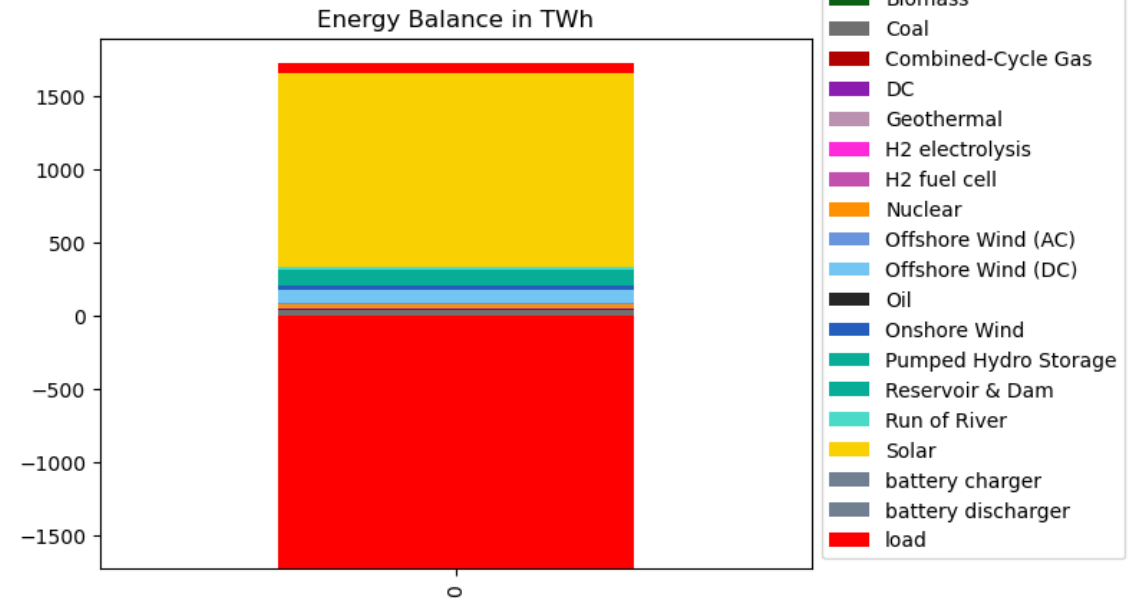
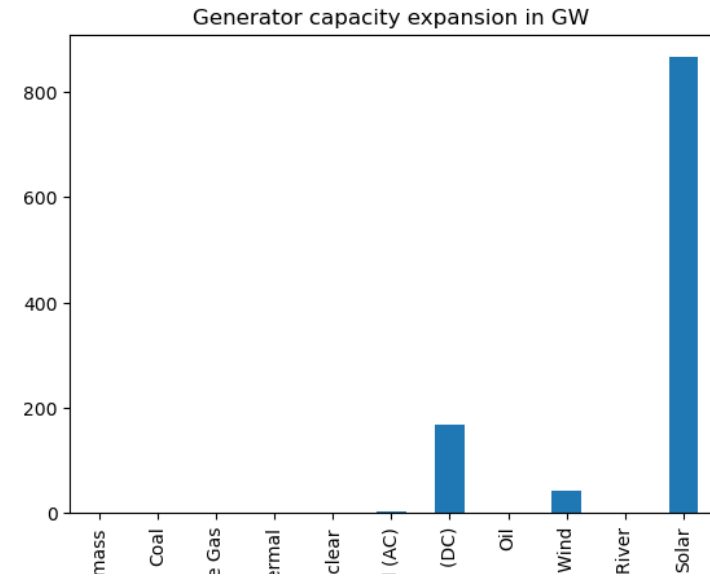
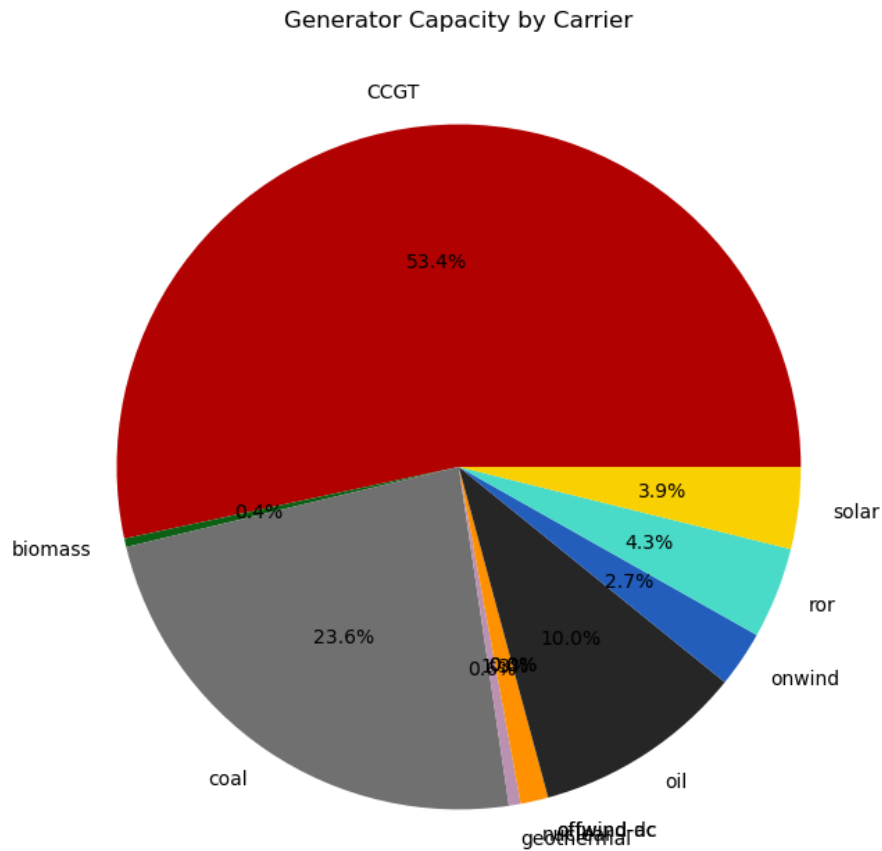


Solar Photovoltaic Potential Density [MW/km²]



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Backup - Results



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Backup – Salt deposits

