

Techno-Economic Analysis of Intercontinental Electricity Grids in a Fully Renewable Energy System

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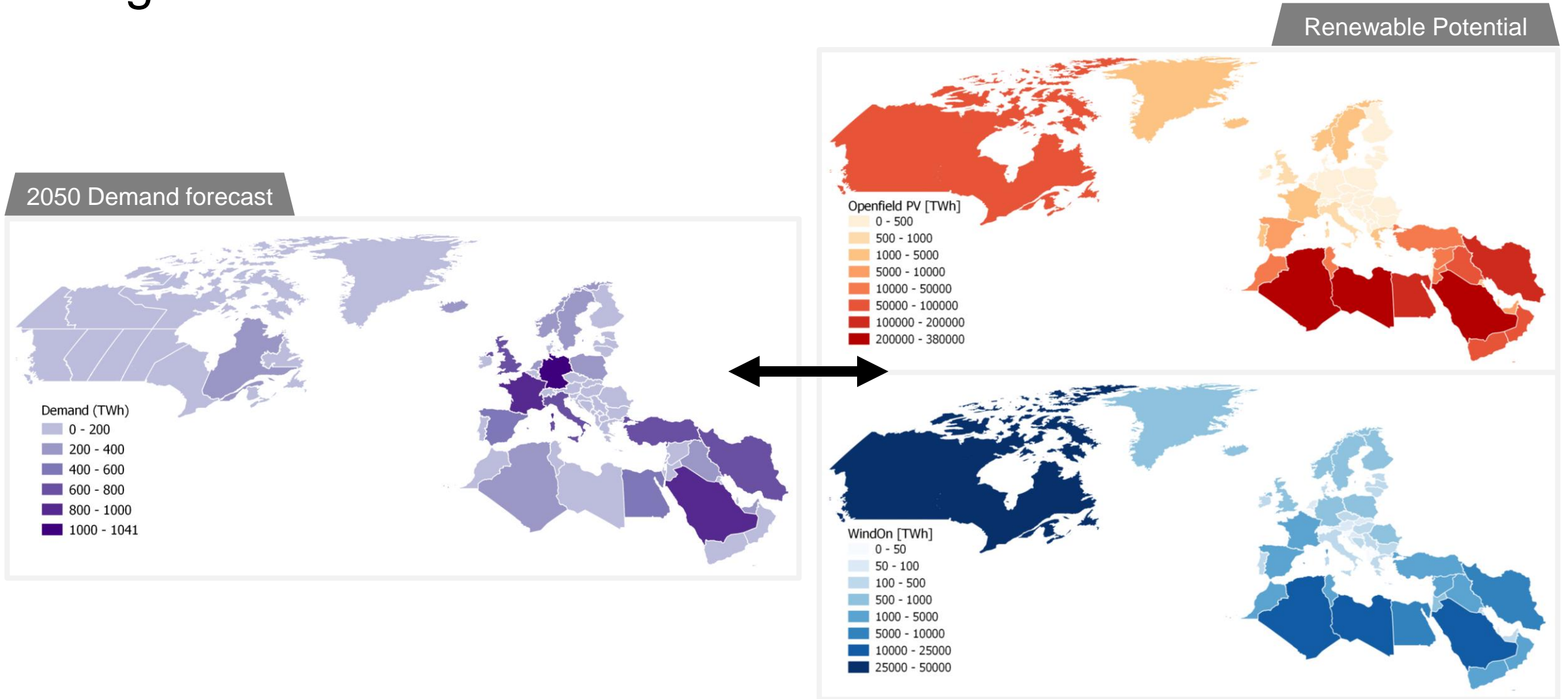
Technical University of Munich

Chair of Renewable and Sustainable Energy Systems

Garching, 28 July 2022



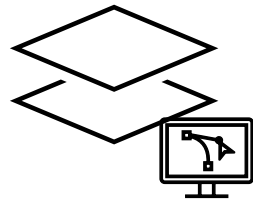
Background



Agenda



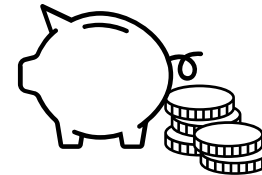
Motivation



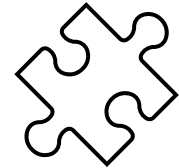
Model Definition



Super-grids



Economic Benefit

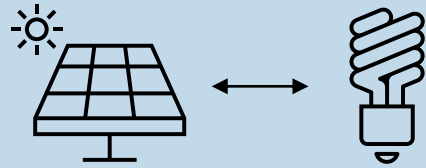


Challenges and
Retrospection

Role of Super Grids

Ideal renewable energy system

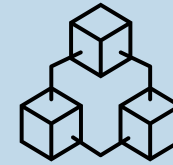
✓ Super-grids



Use of optimal sites for renewable generation



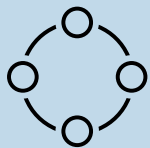
Regions that are few thousand km away can be connected



Diverse solutions to avoid over dependence



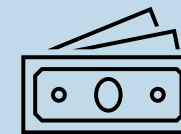
Various regions play a role simultaneously



Consisting well Integrated elements



Highly efficient with no further chemical conversions

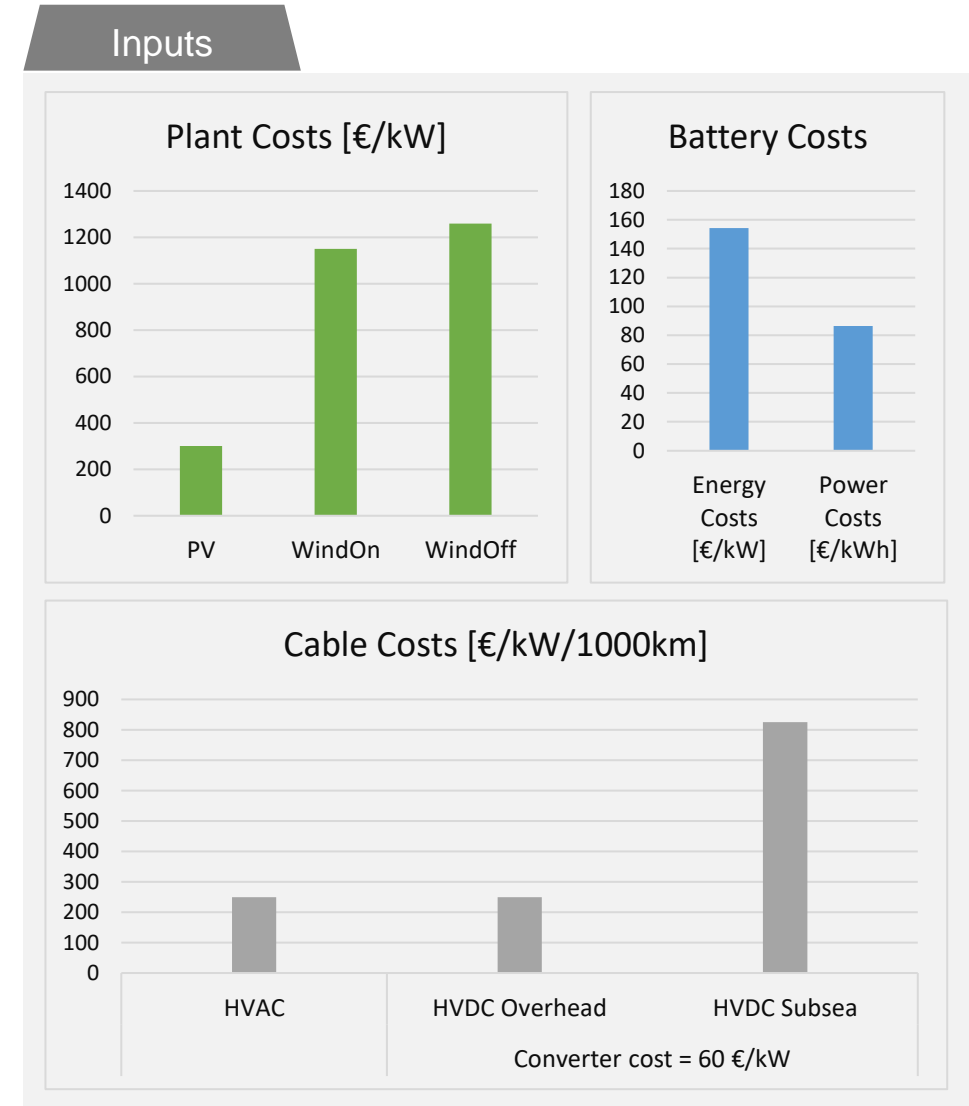
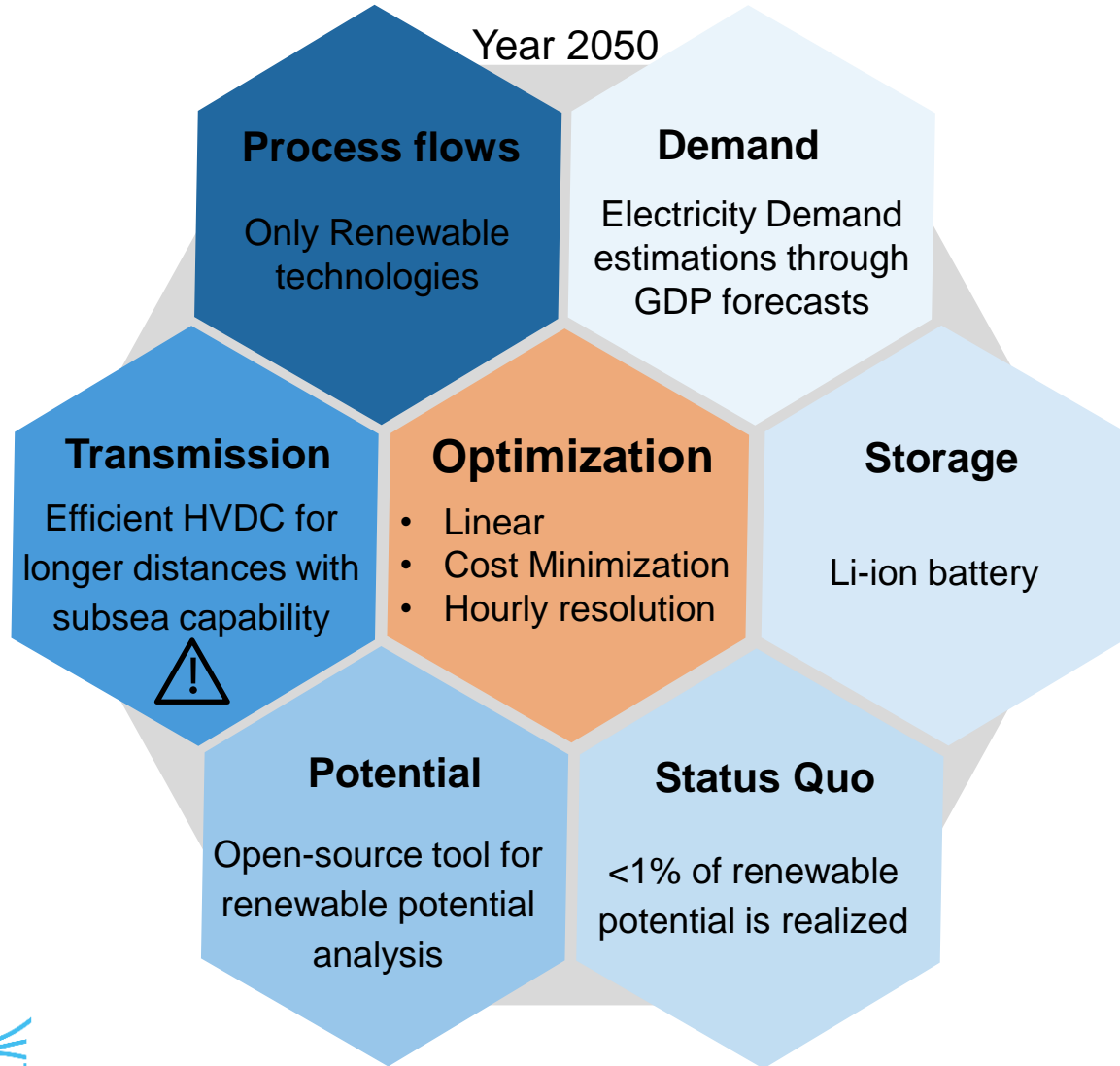


Economically beneficial



Goal of the study: How big is the cost reduction can be?

Electricity Exchange Model

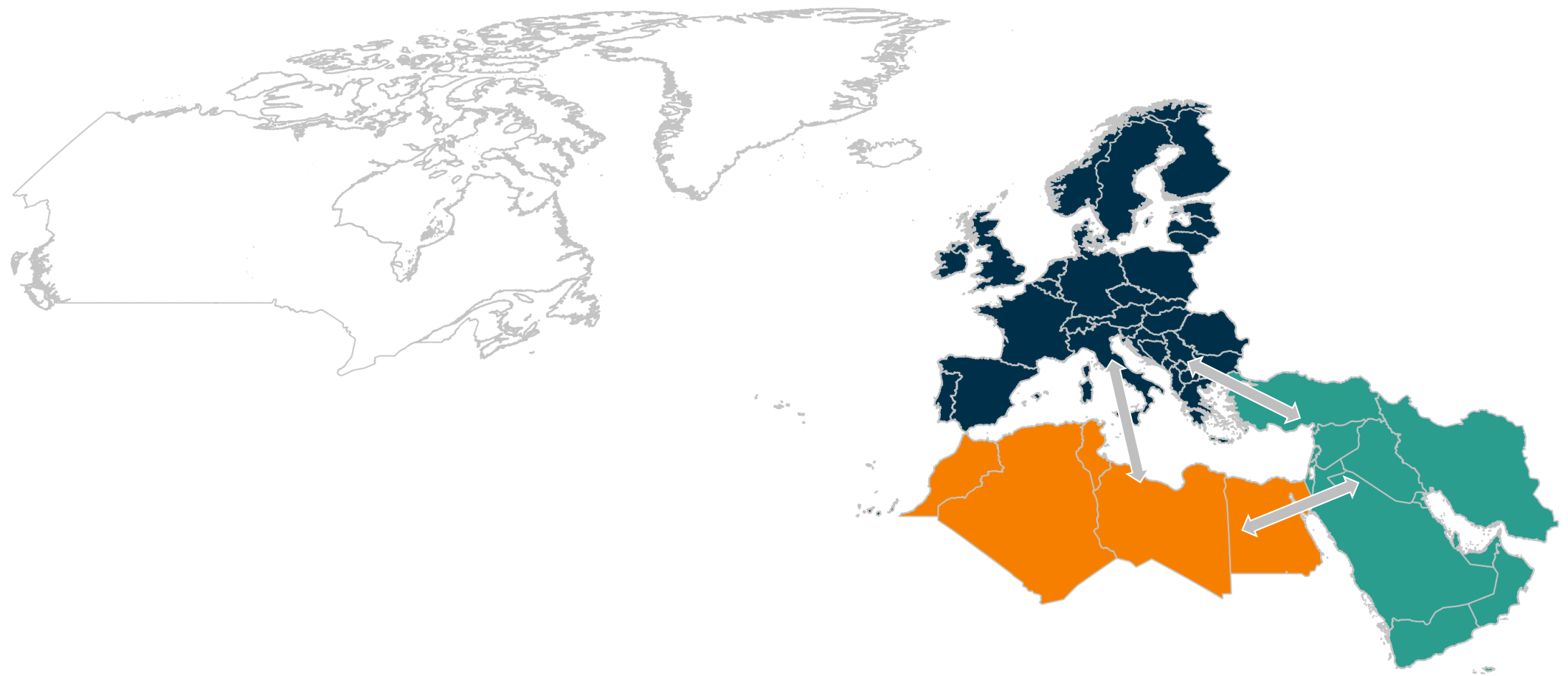


Sources: World Energy Outlook 2021 - IEA, Annual Technology Baseline 2021 - NREL

Scenarios

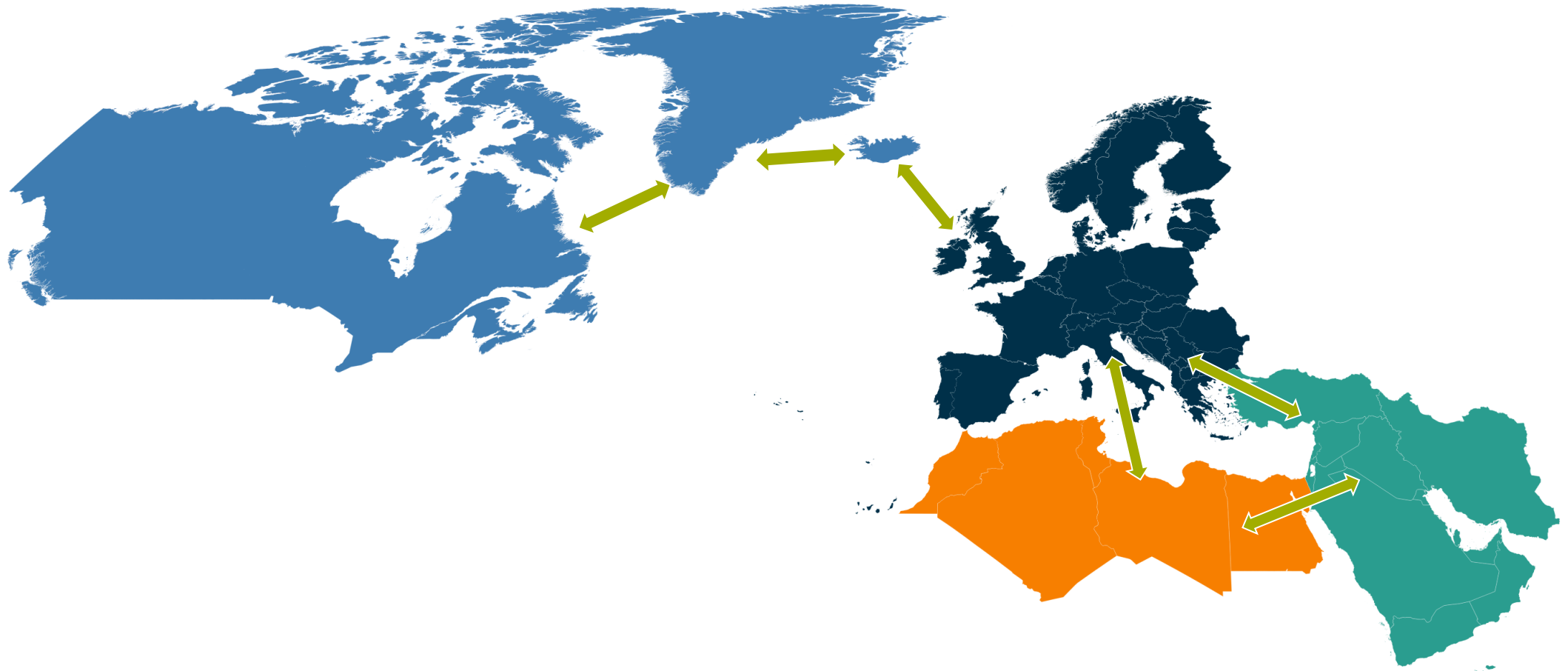
Base Scenarios – No capacity limit for lines

Translim Scenarios – Max capacity for each line is 24 GW

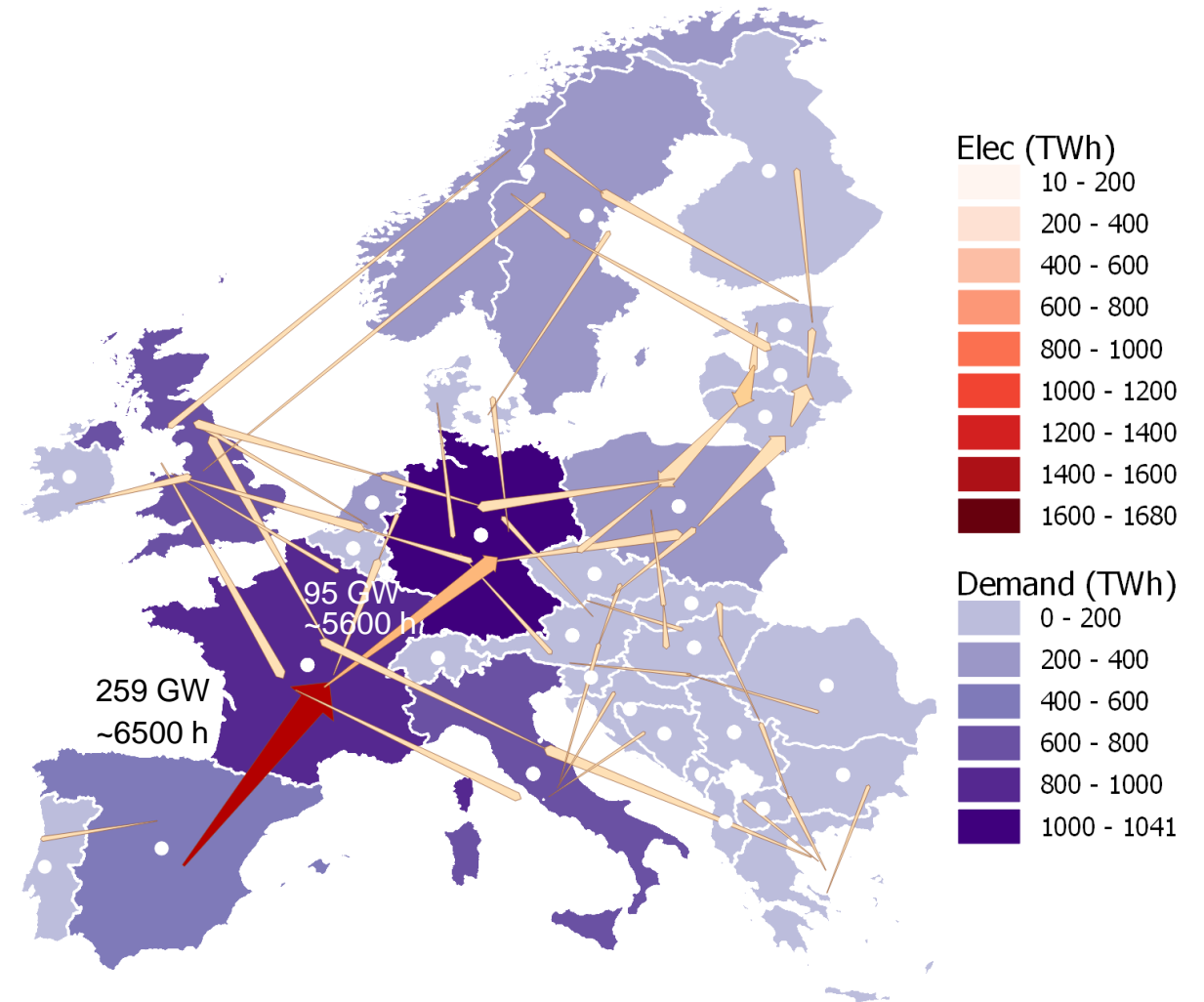
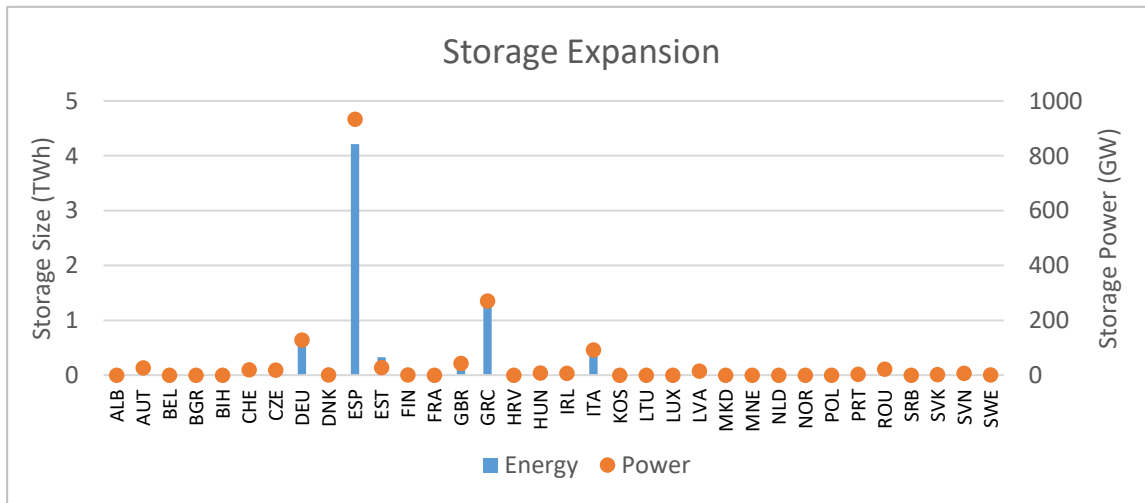
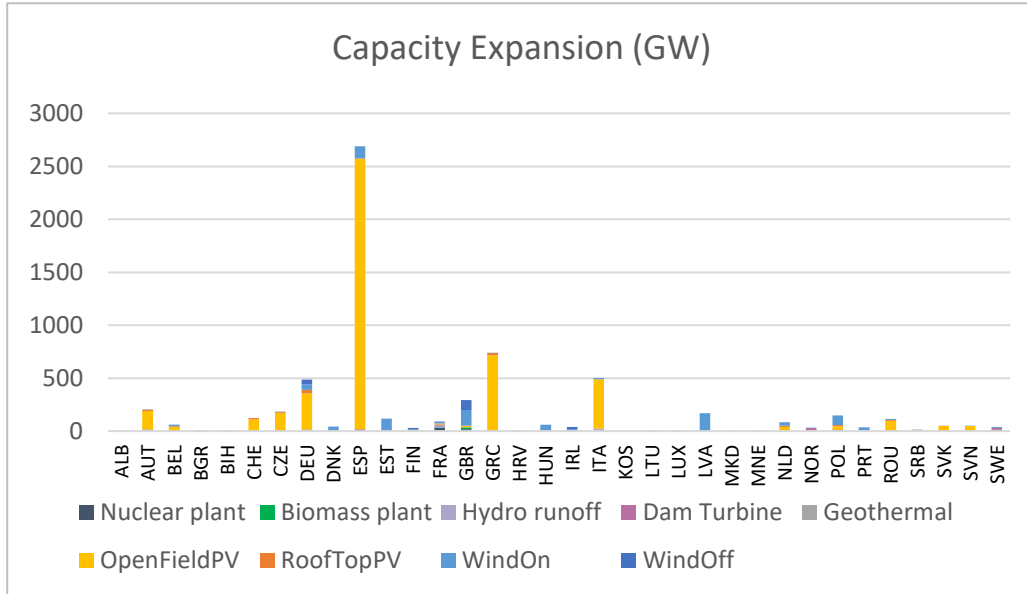


Base Scenarios

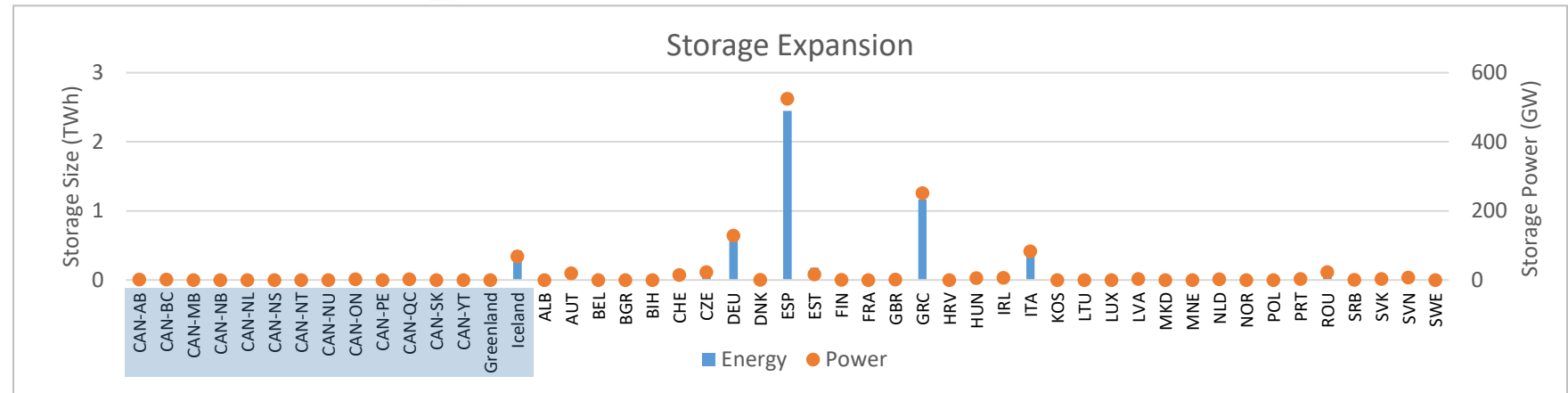
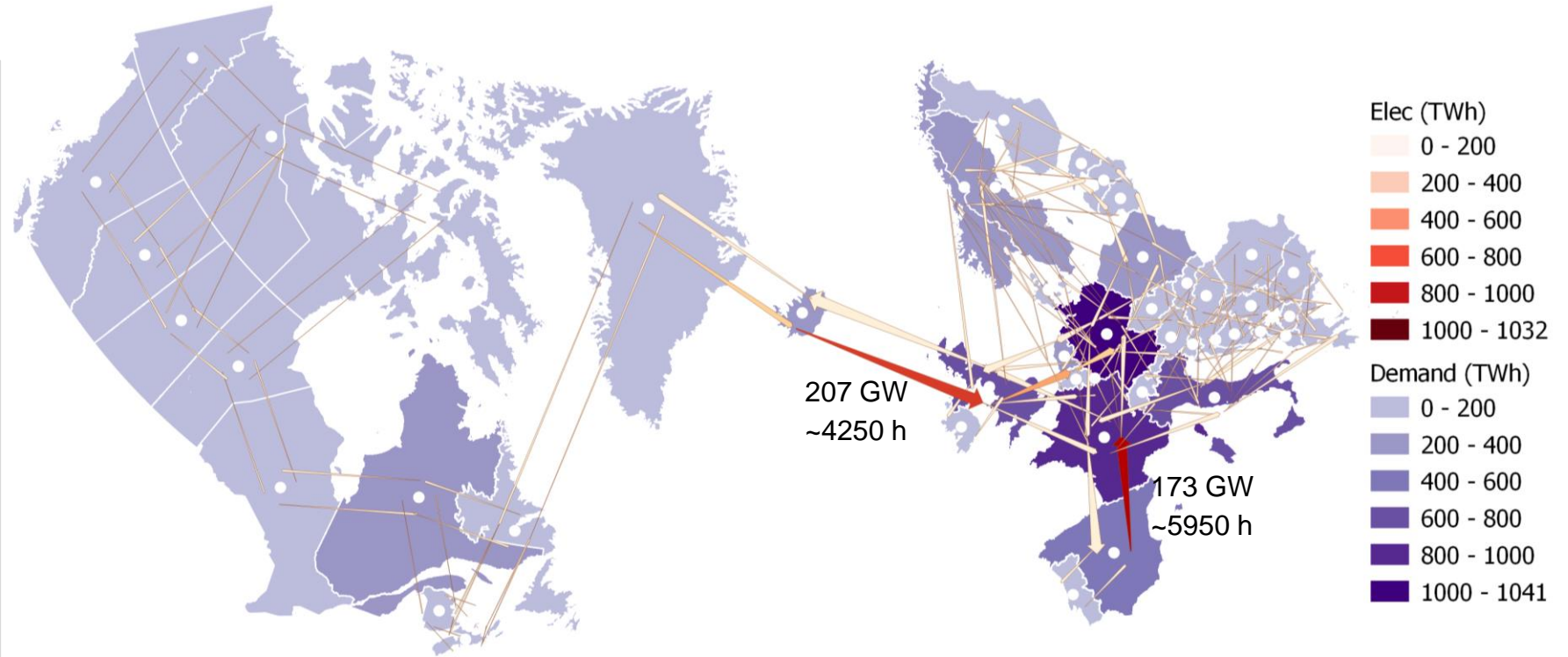
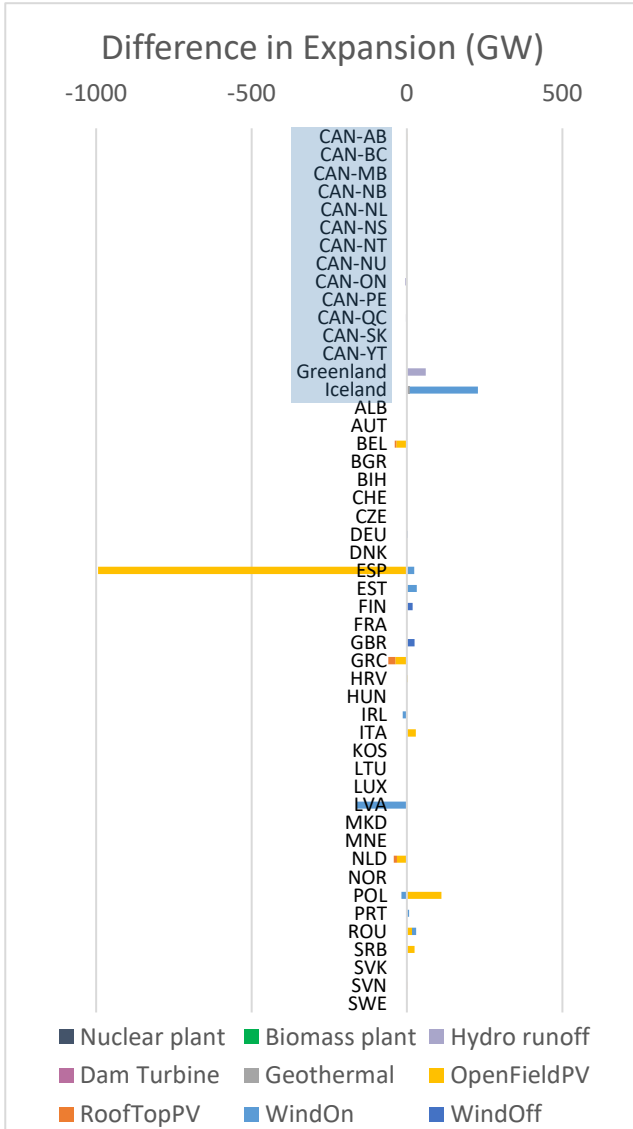
No capacity limit for lines



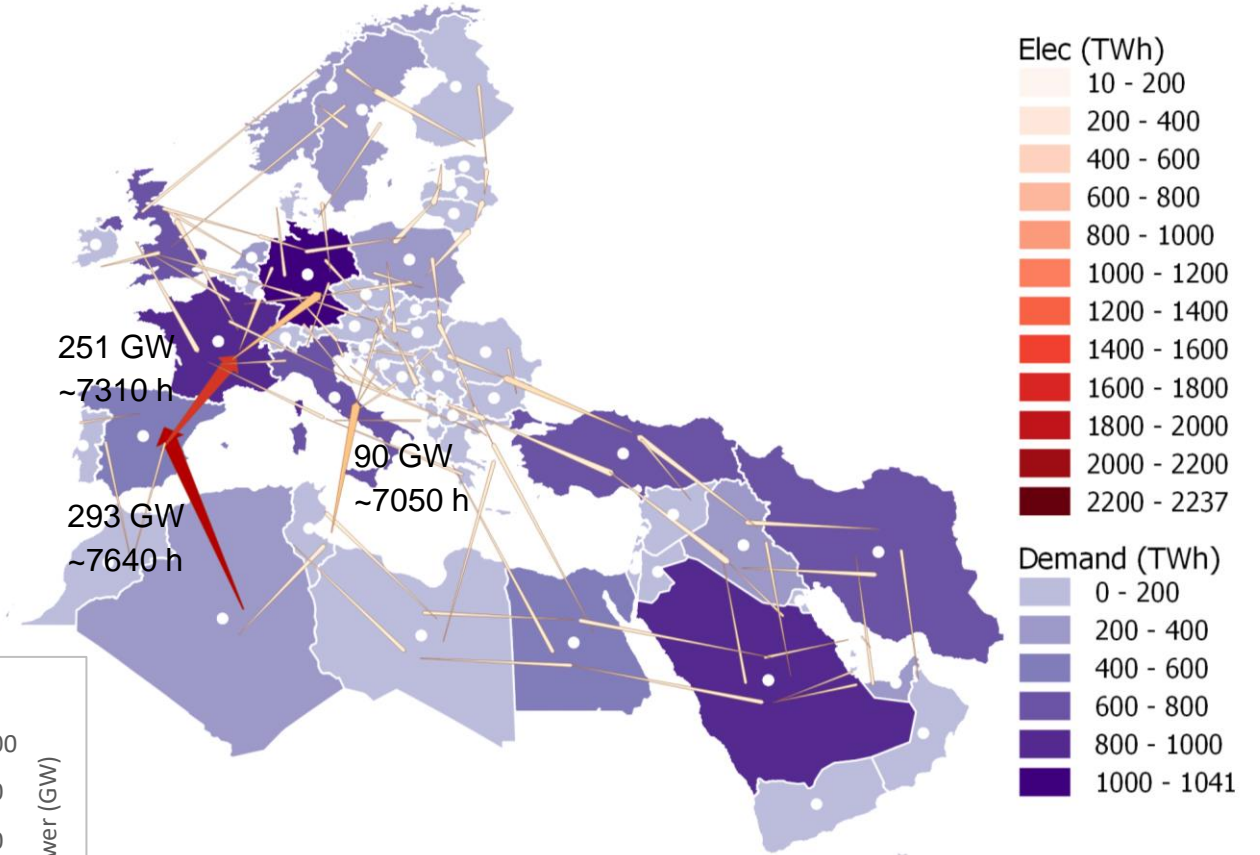
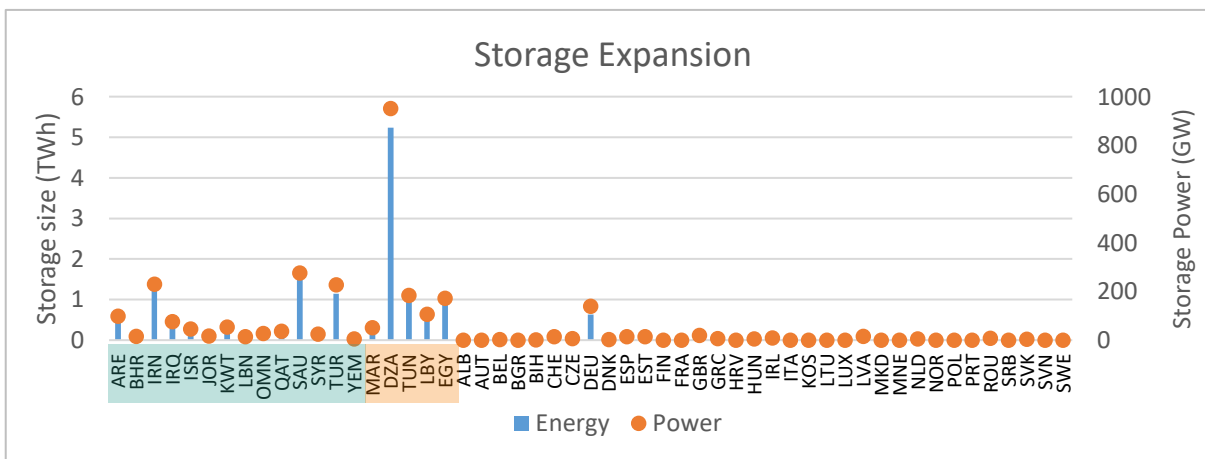
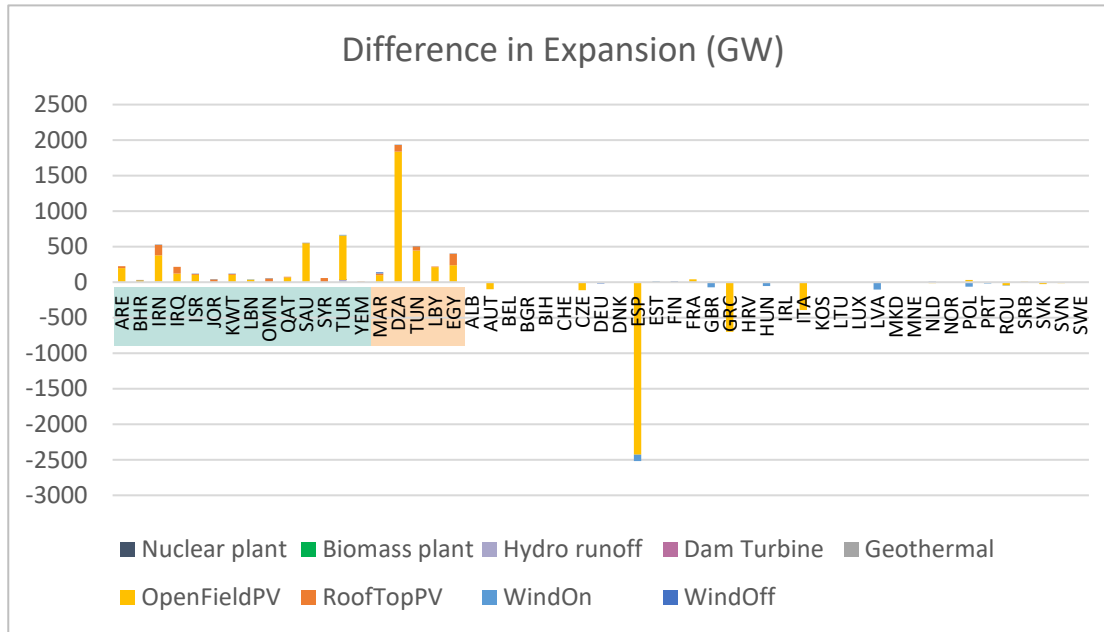
EU



Canada-EU

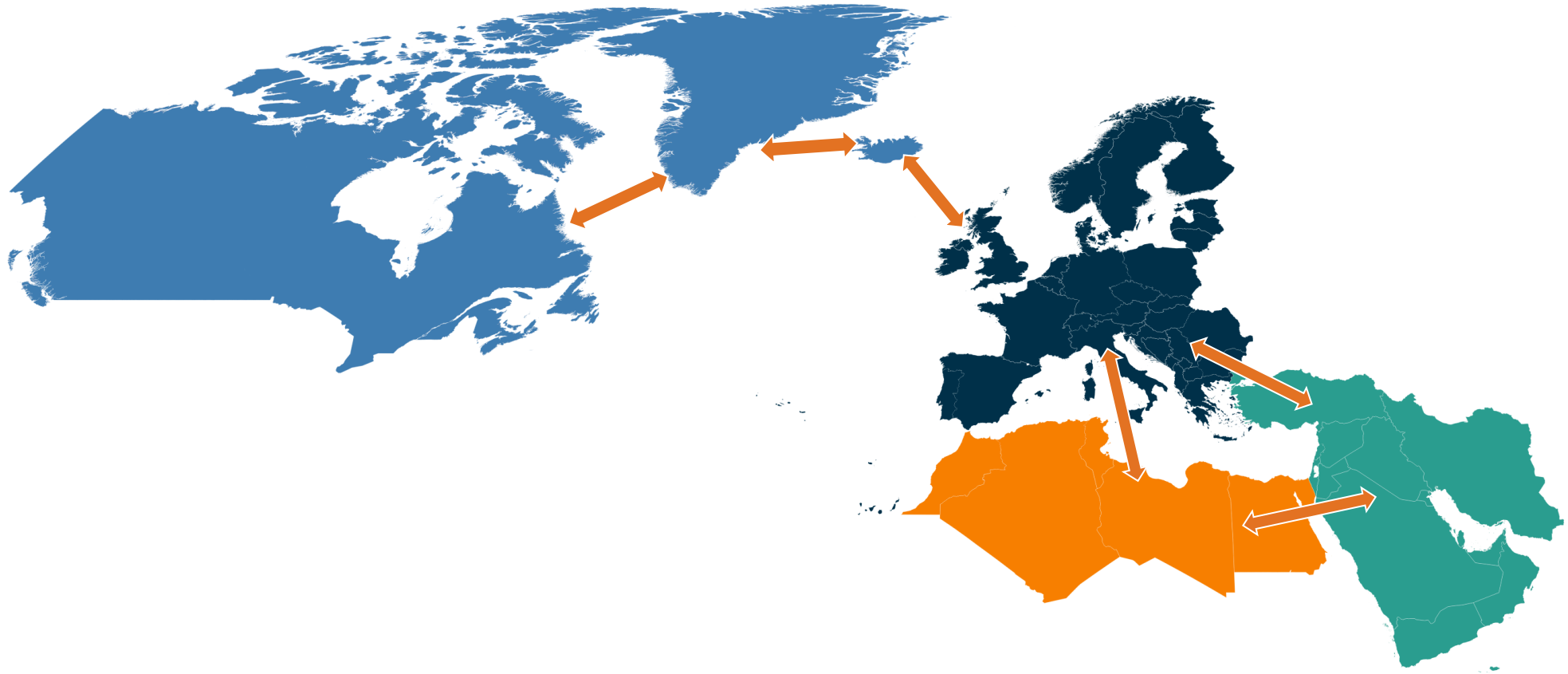


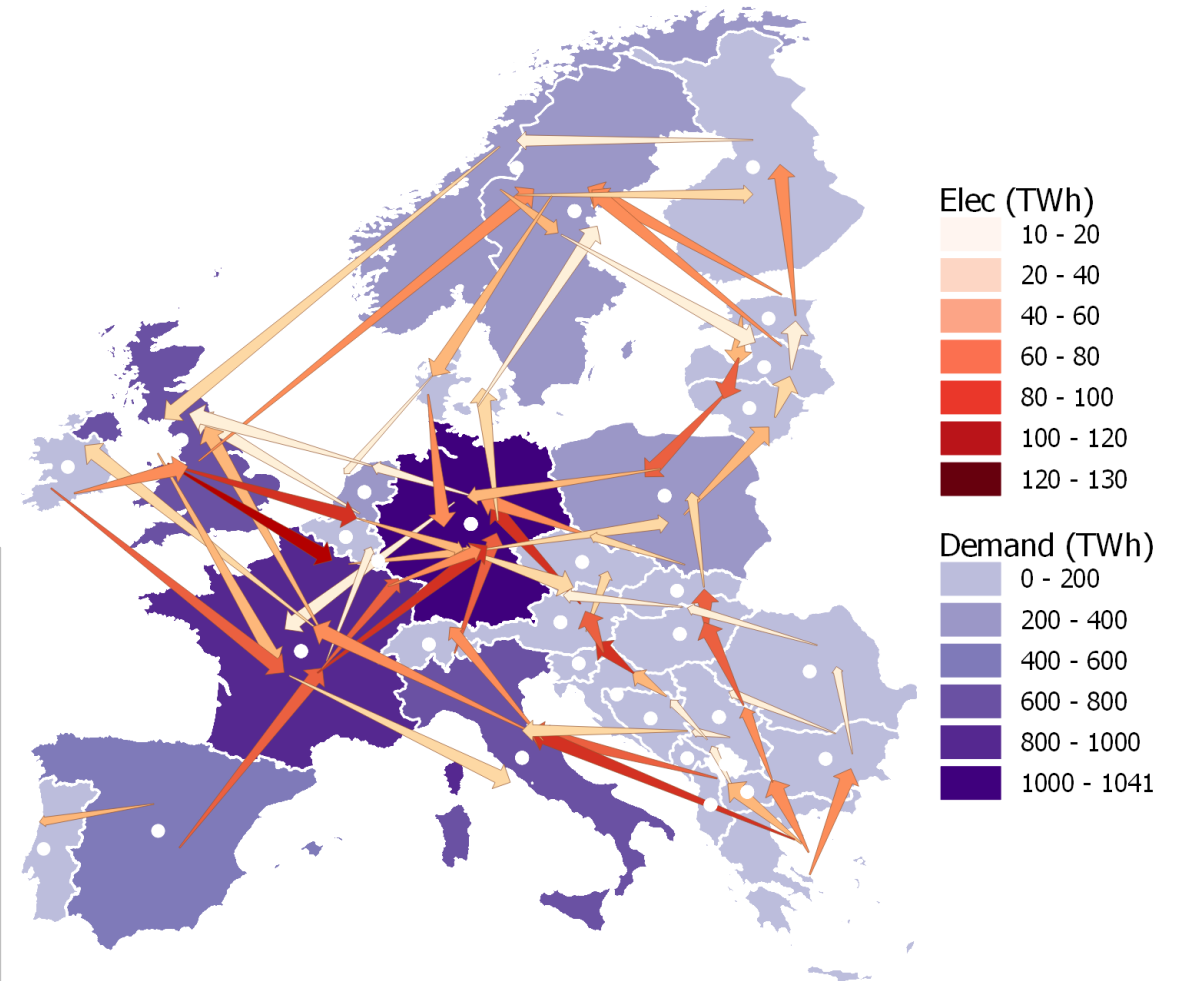
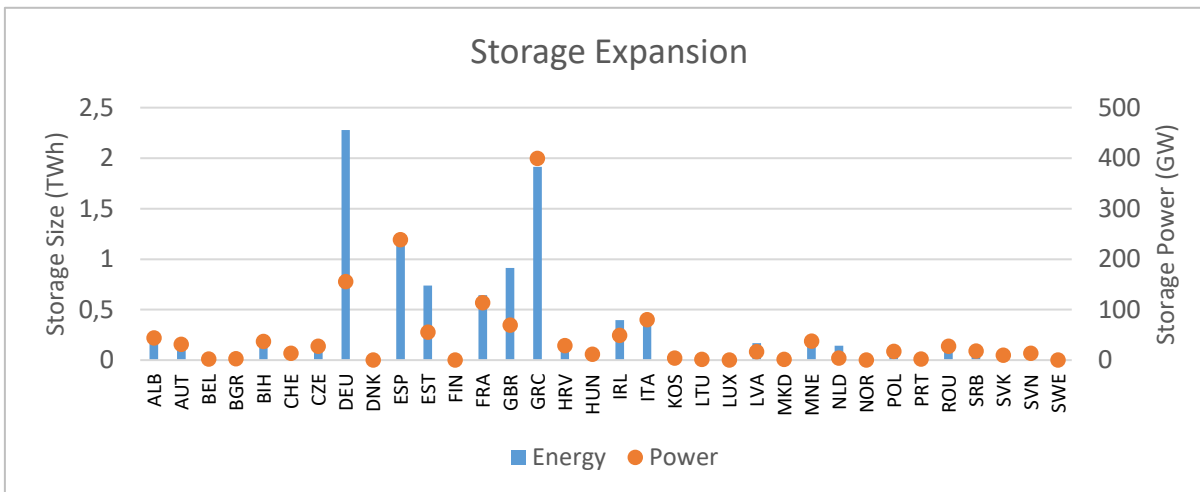
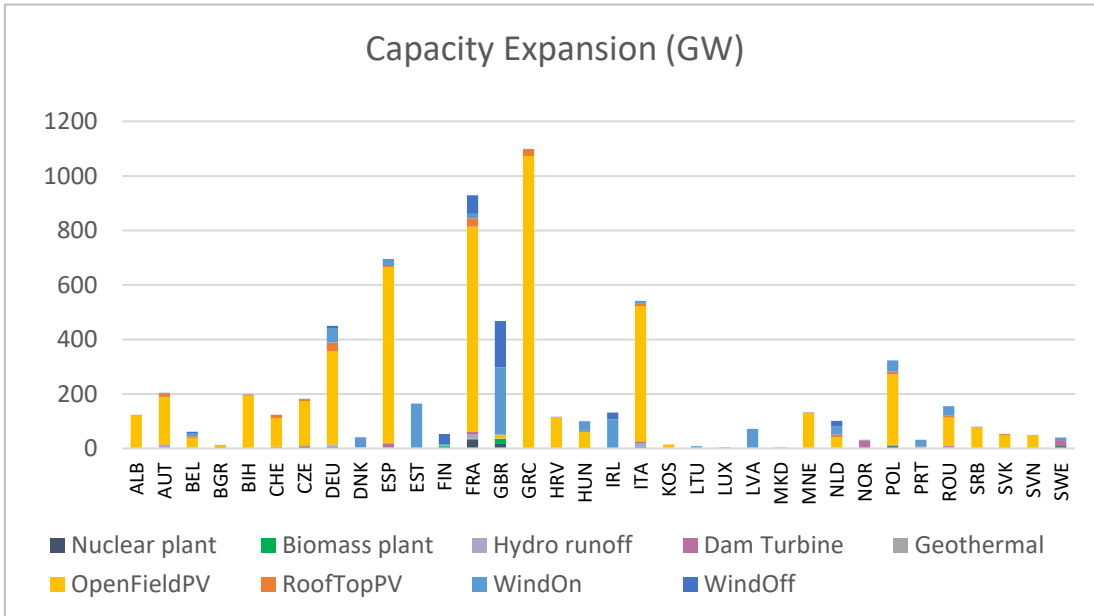
MENA-EU



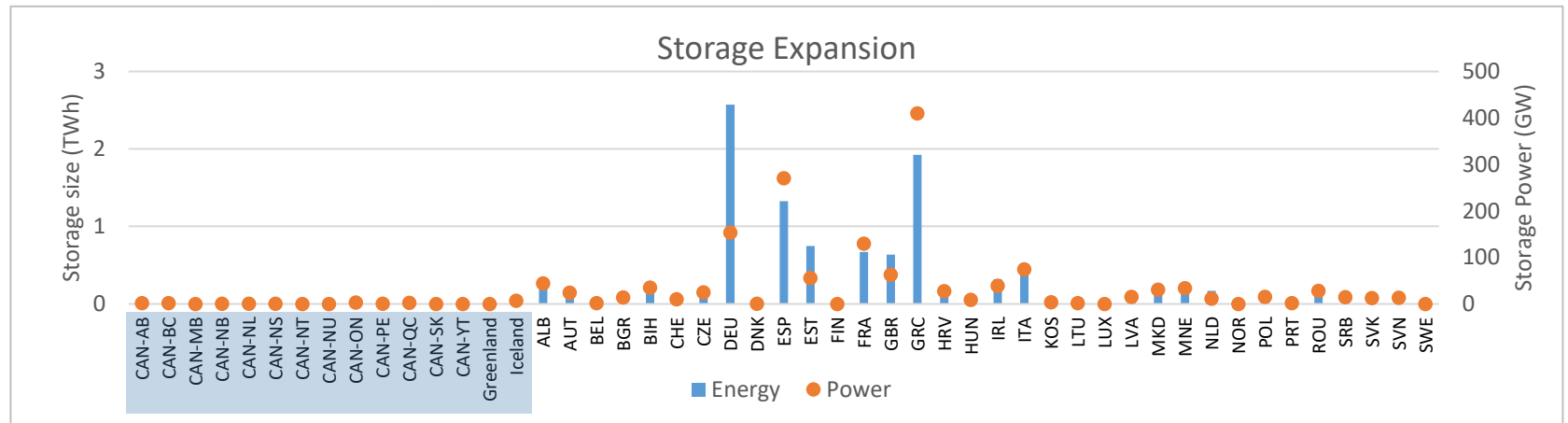
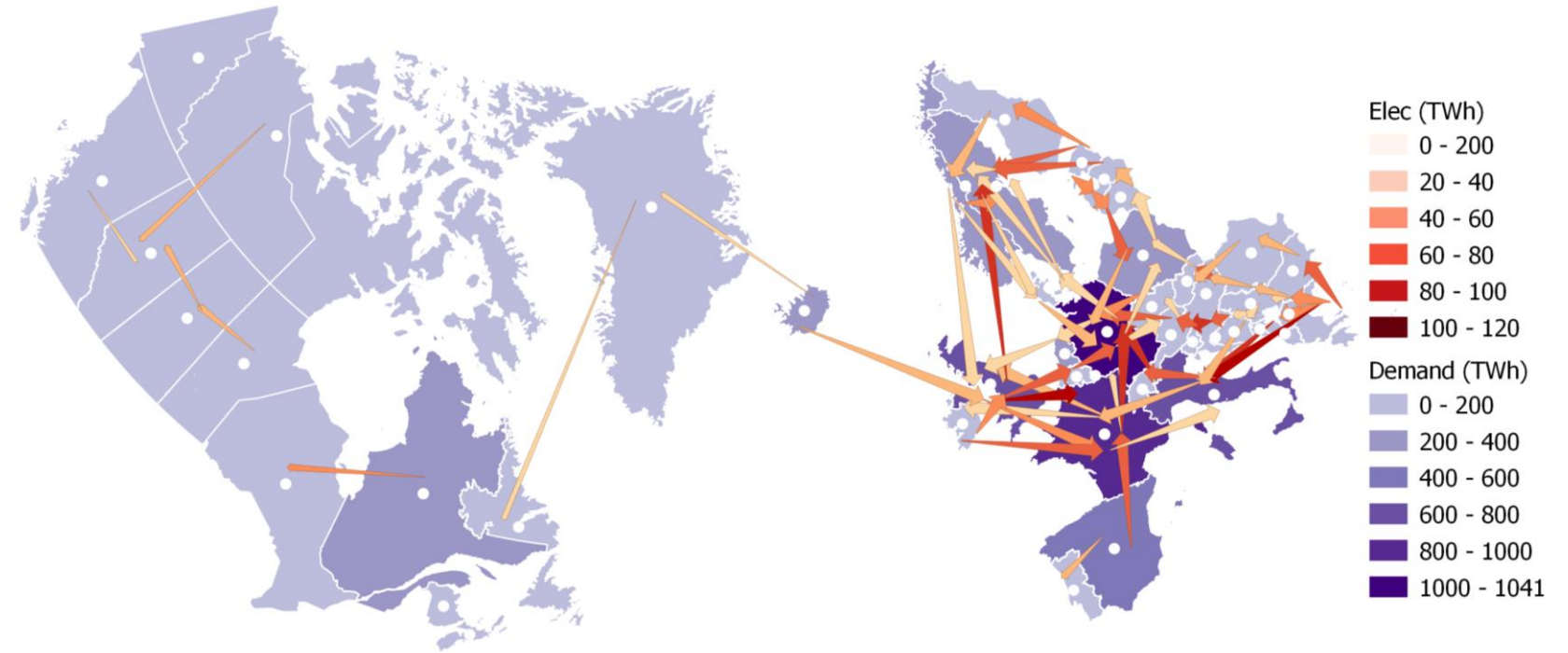
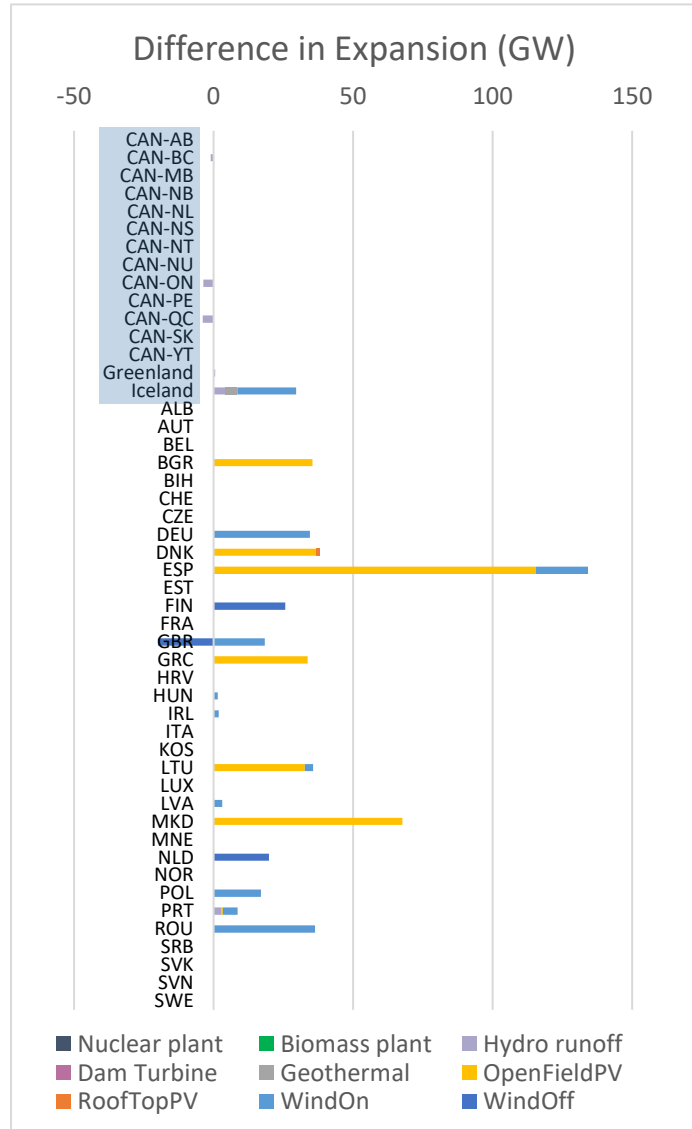
Translim Scenarios

Each line capacity is limited to 24GW

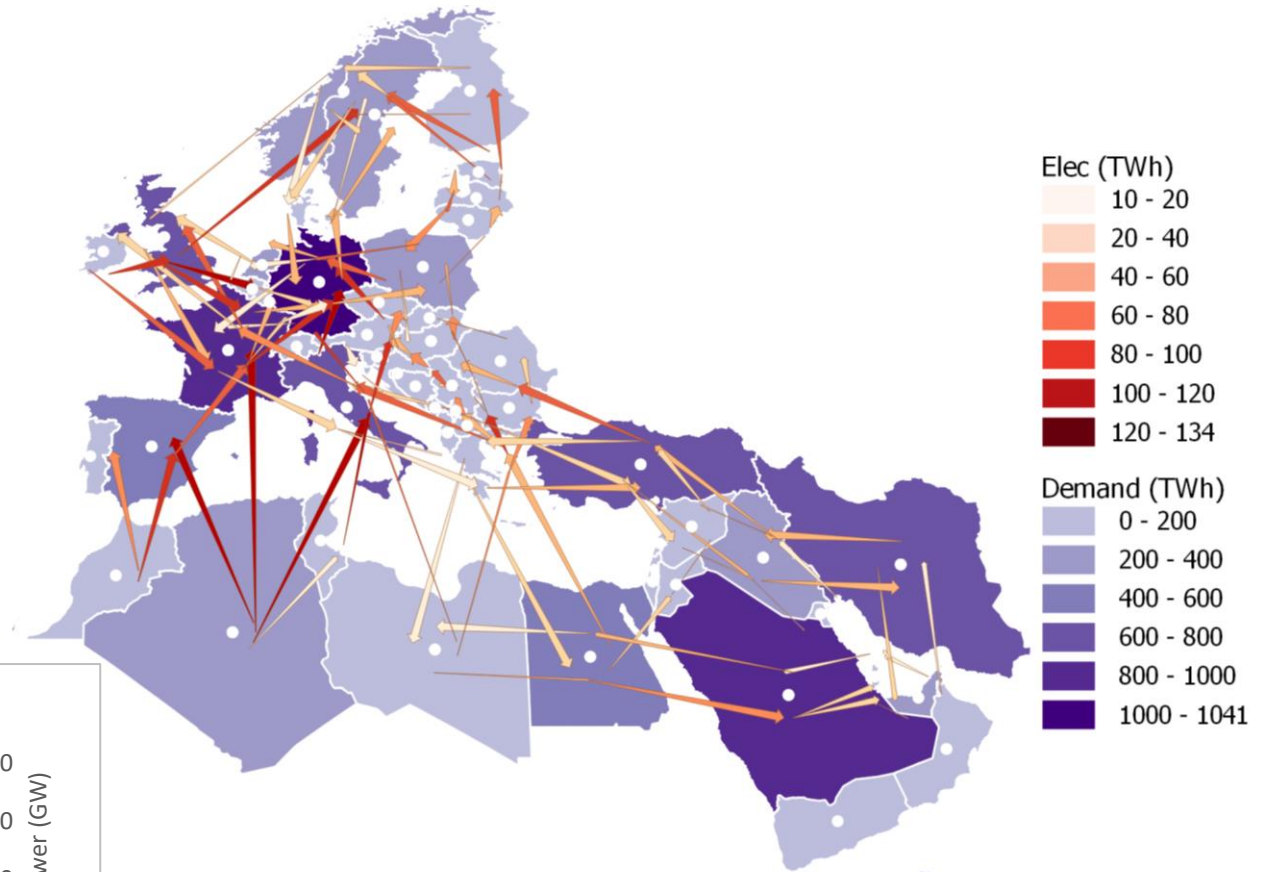
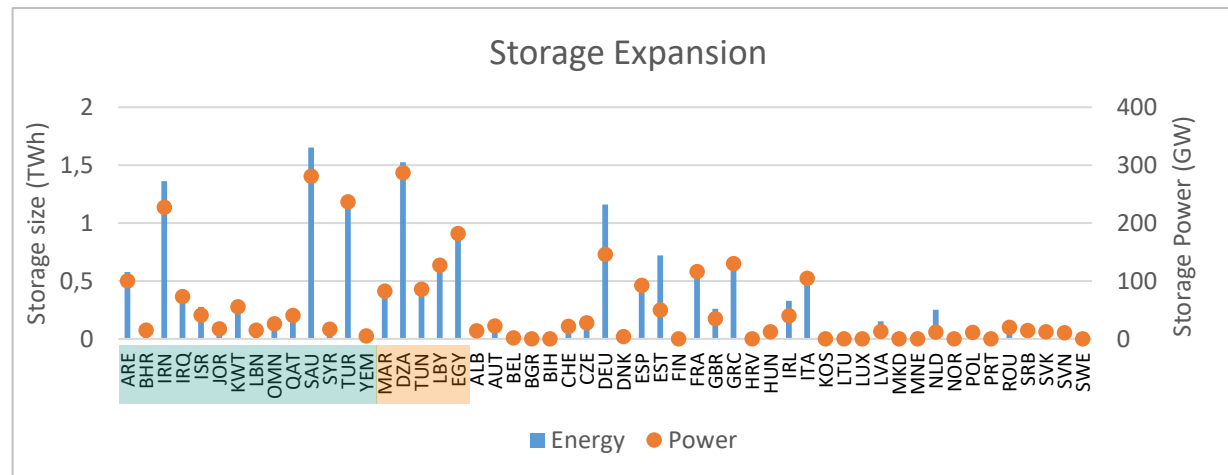
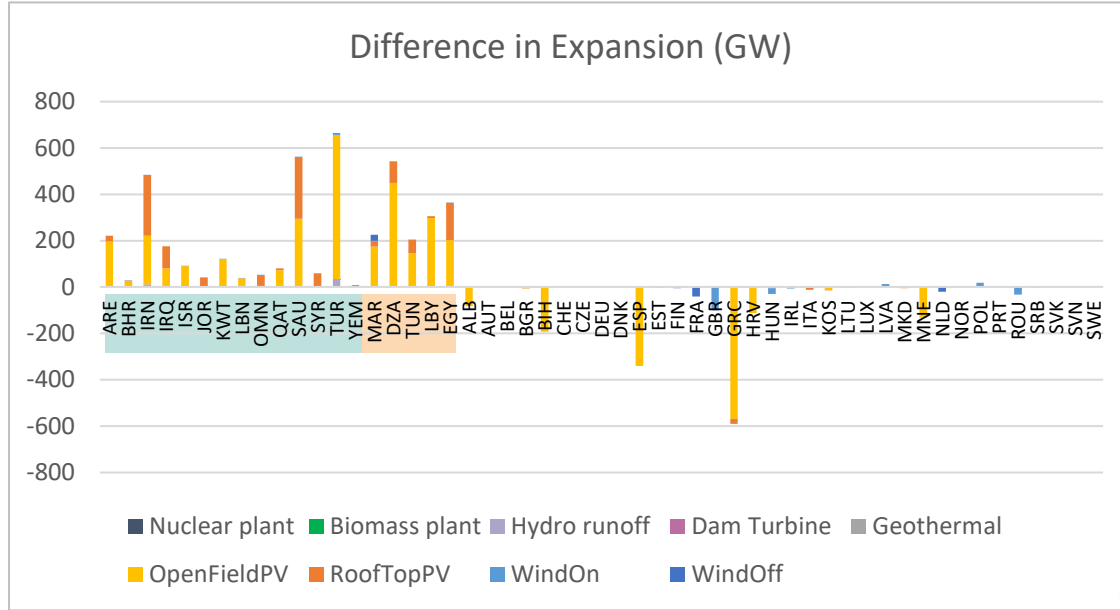




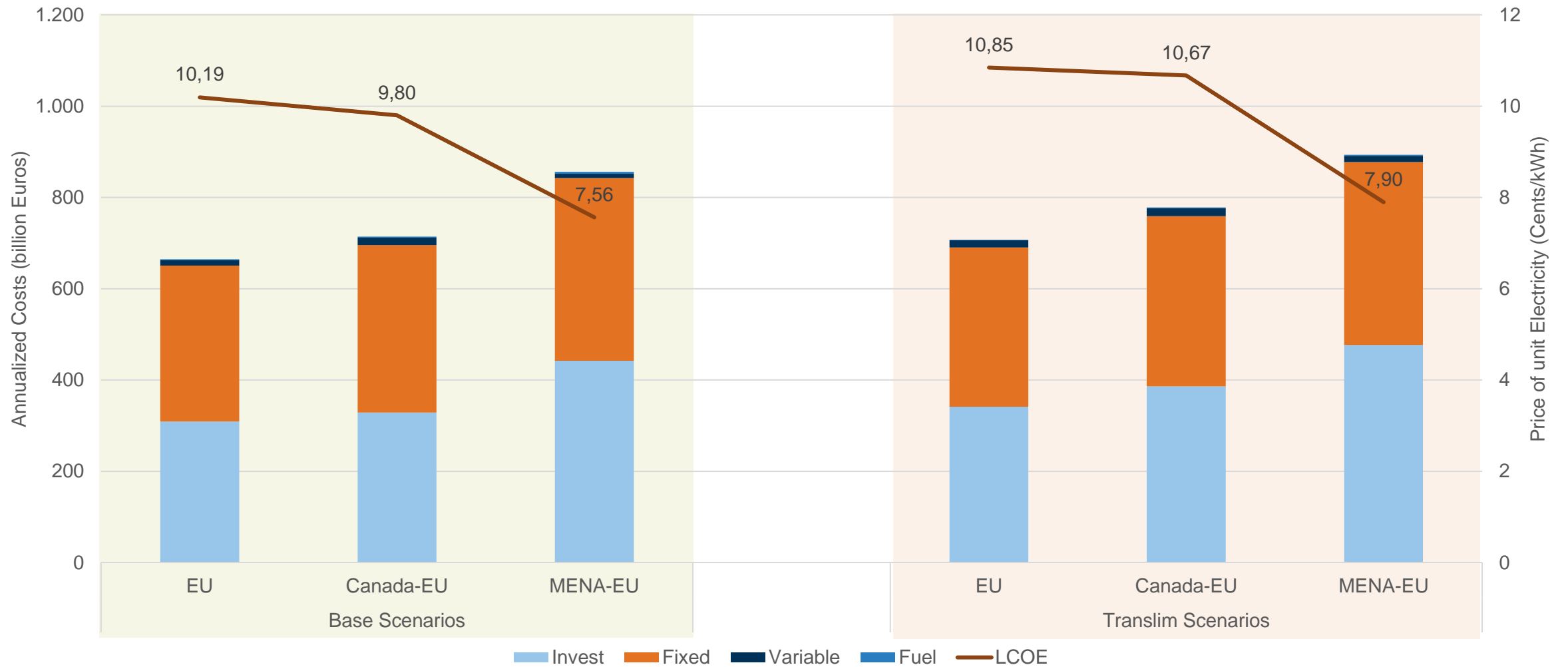
Canada-EU



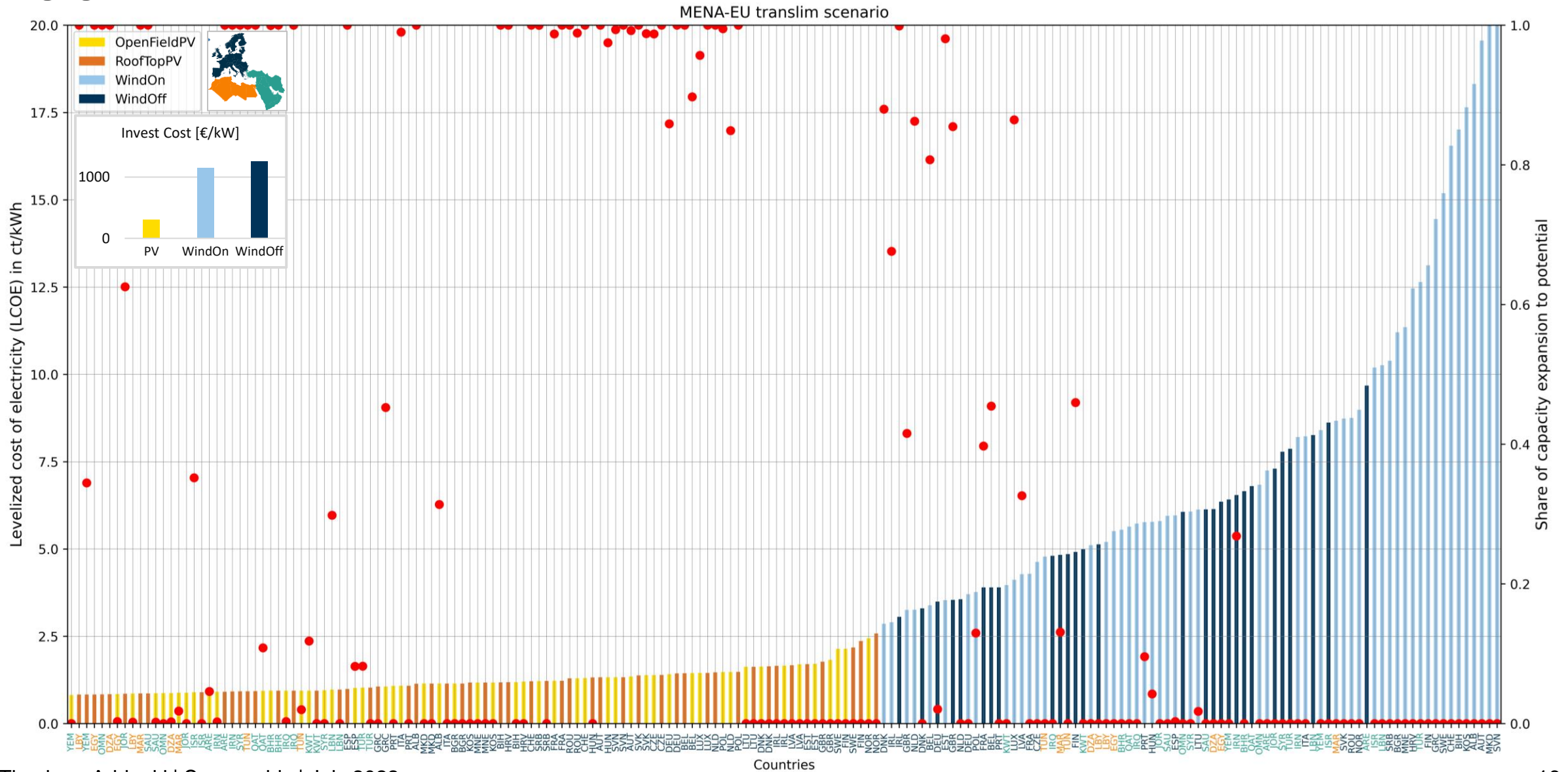
MENA-EU



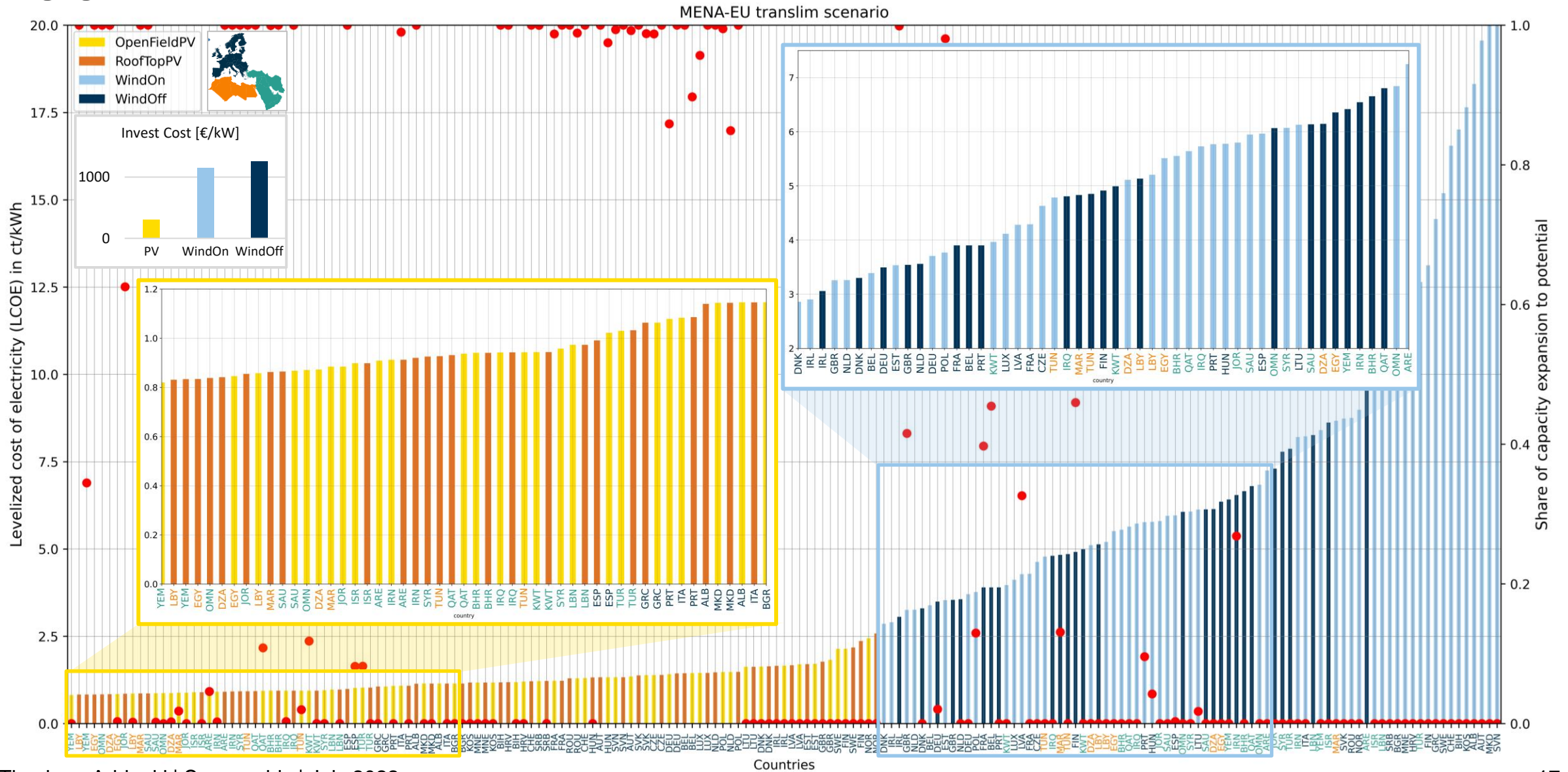
Economic Benefit from Super-grids



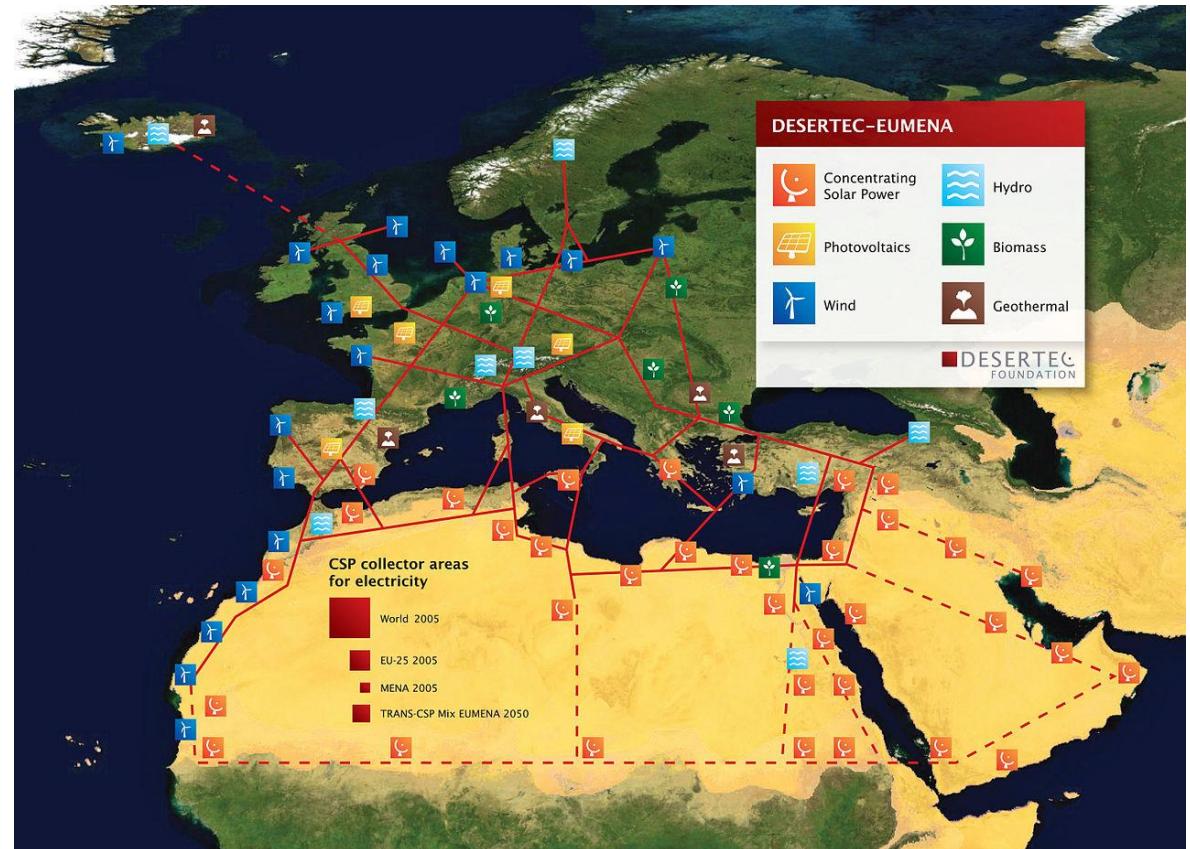
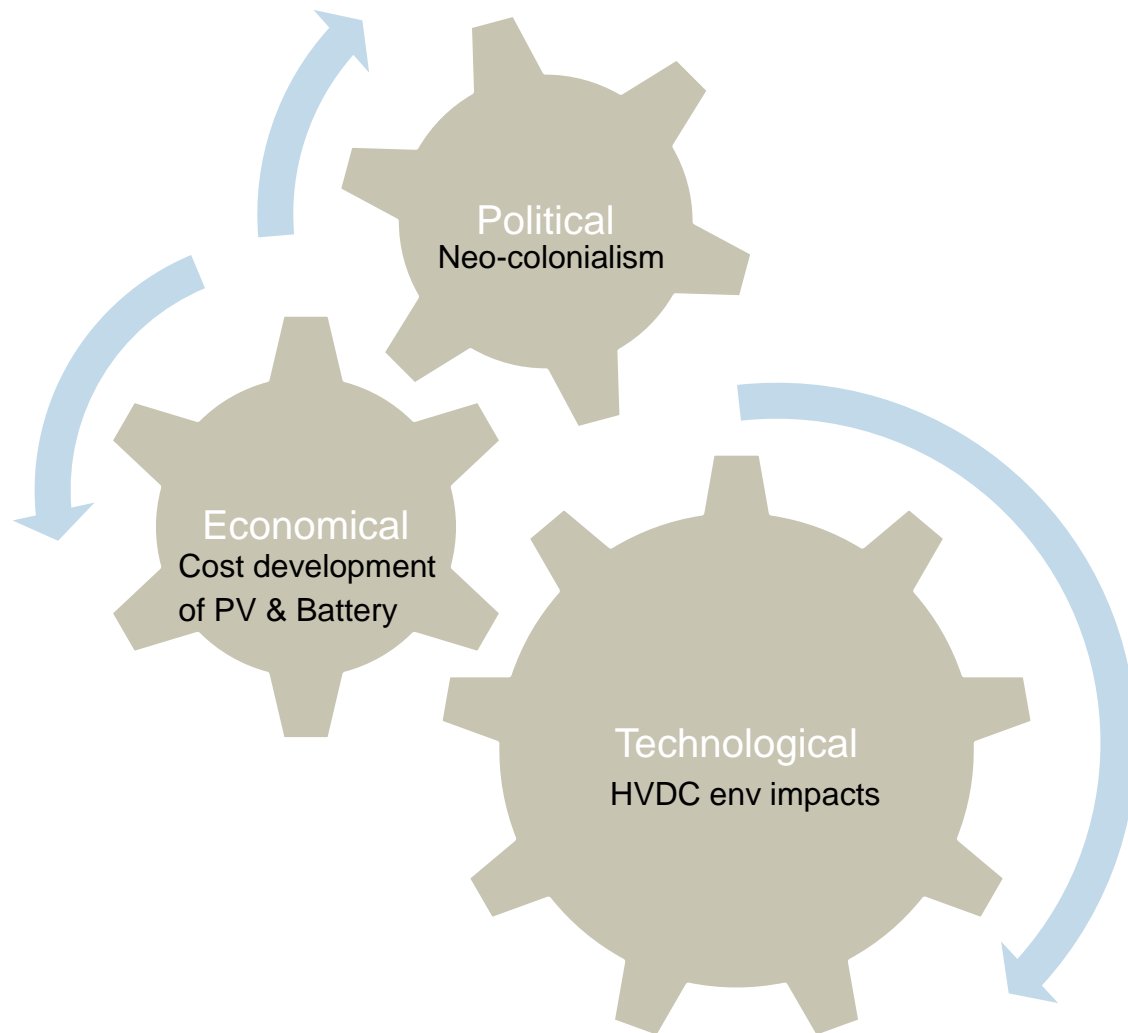
LCOE



LCOE



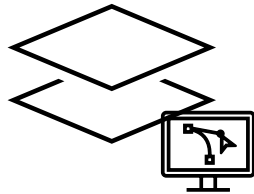
Learnings from the past



Summary & Outlook



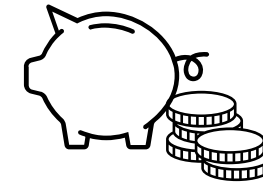
- Trans-continental electricity transmission is a valuable solution for integration.



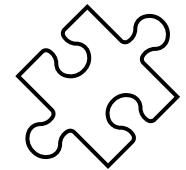
- Very high PV potential exist in Middle East and North Africa.



- PV and Battery work together due to their low costs.



- Overall savings can be as high as 2.95 cents/kWh with super-grids.



- Understanding model limitations is the key.

Back-up slides

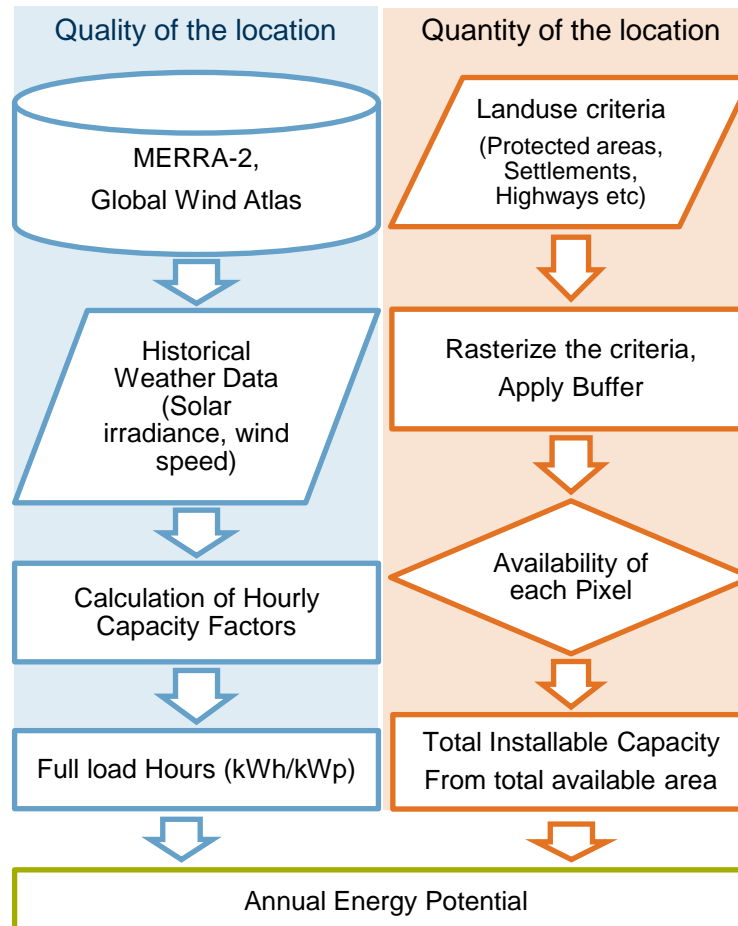
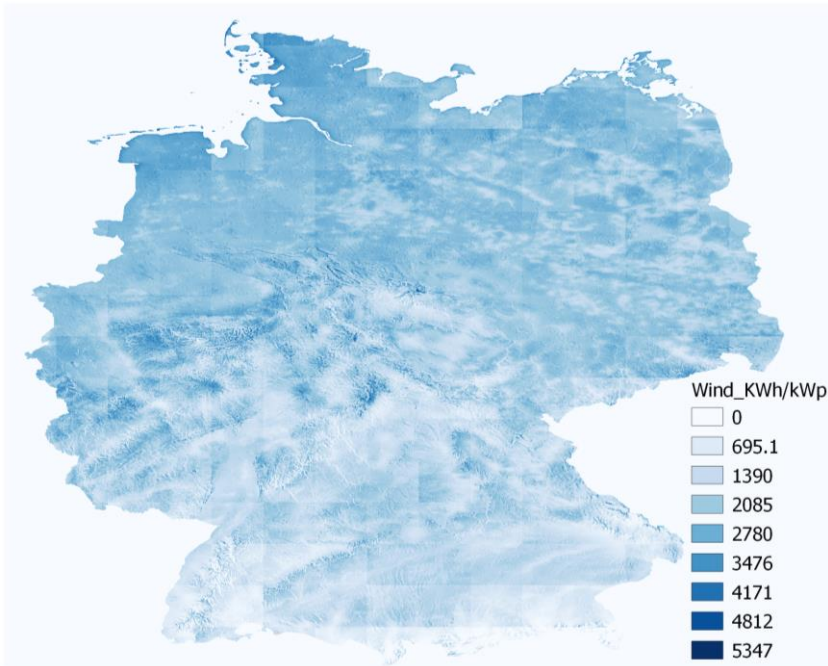
pyGRETA

Generation of Renewable Timeseries and Potential Maps

Scope: Worldwide

Temporal Resolution: 8760 hours /a

Spatial Resolution: 250 x 250m



Modelled Technologies:

- Onshore-Wind
- Offshore-Wind
- Open-field PV
- Roof-top PV
- Biomass

