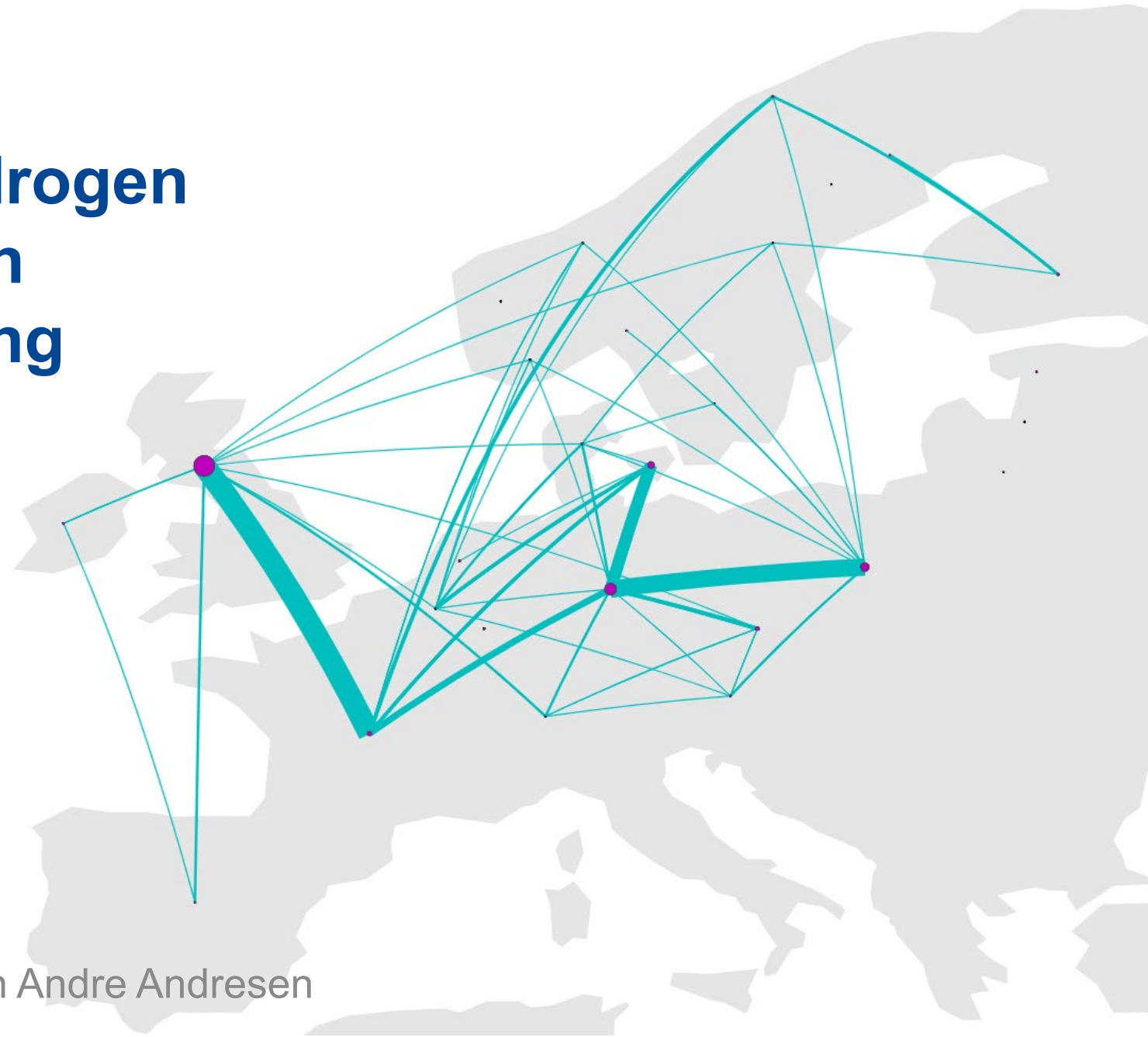


Offshore wind and hydrogen capacity expansion: An energy system modeling challenge



18.01.2024

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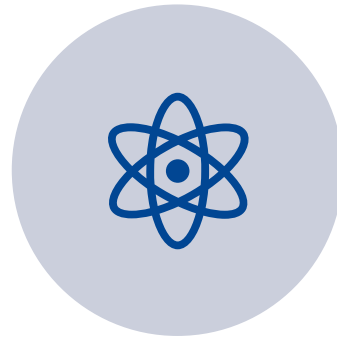
Agenda

- 1) Background
- 2) Research Goals
- 3) Methodological Challenges
- 4) Results
- 5) Conclusion

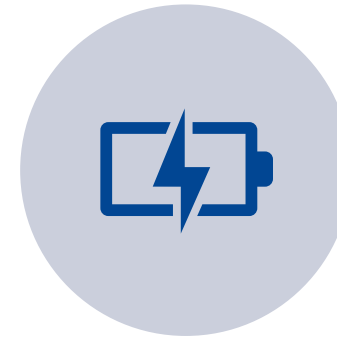
Why do we need hydrogen?



GRAVIMETRIC
ENERGY DENSITY



VERSATILE



STORABLE

Research Goals

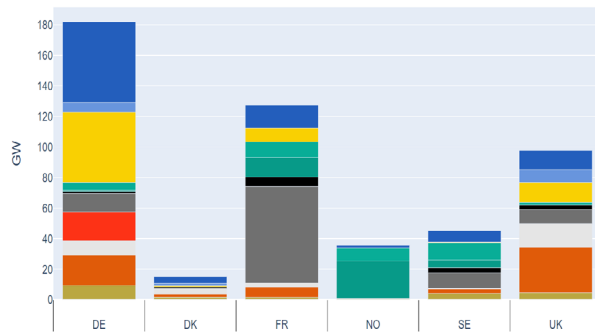


Understand the role of hydrogen in an energy system with high shares of VRES

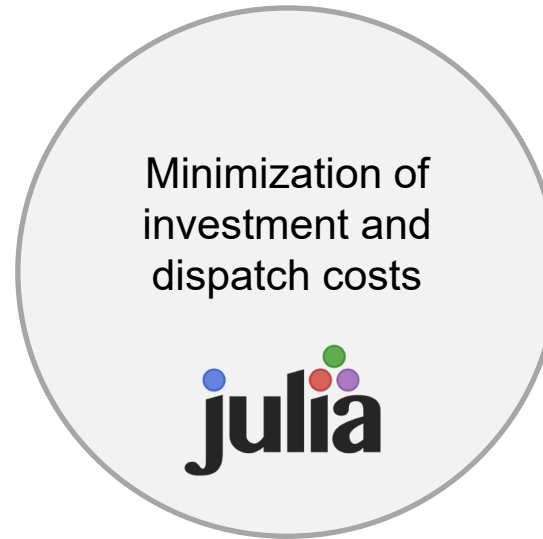
- Curtailment vs. electrolyser capacity
- Battery vs. hydrogen storage
- Power lines vs. hydrogen pipelines

Energy System Optimization

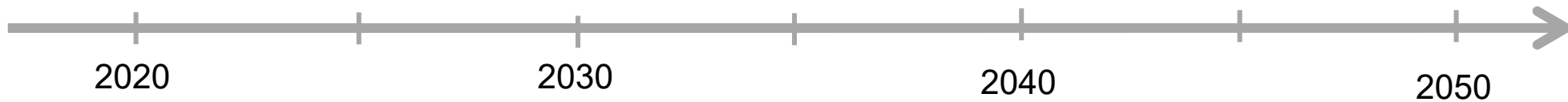
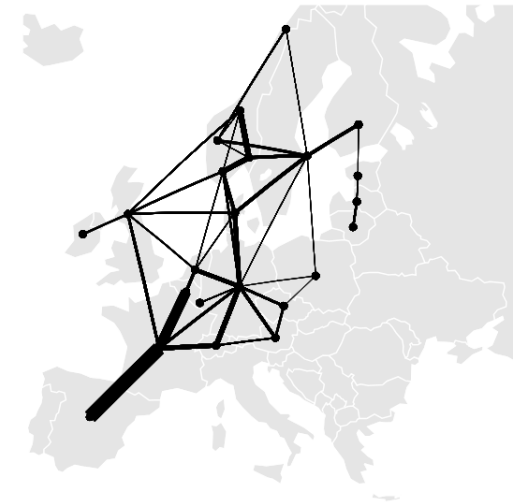
Input



Model



Output



Model Characteristics

- Deterministic
- Generation and transmission planning until 2050
- Sector-coupled model
- 47 nodes

Requirement #1: Spatial Granularity

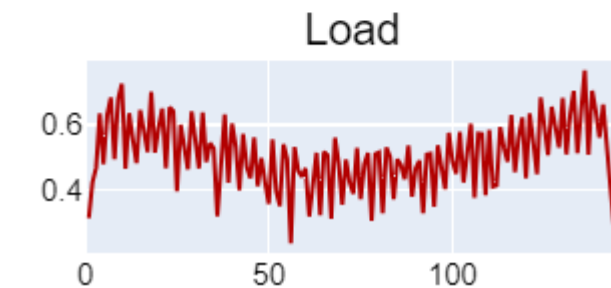
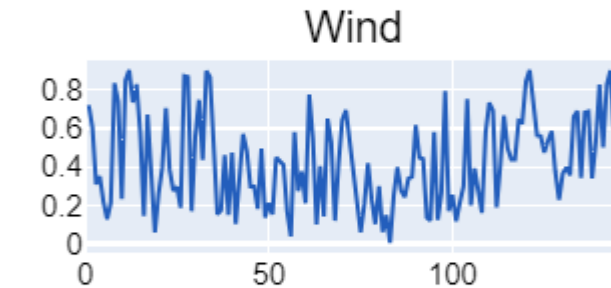
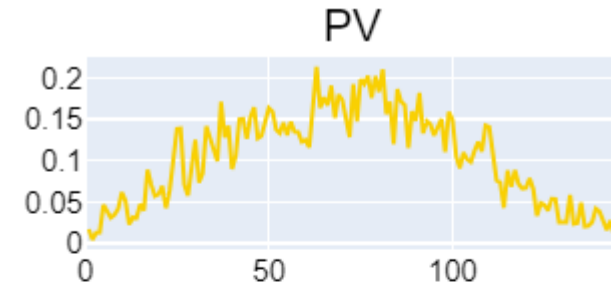
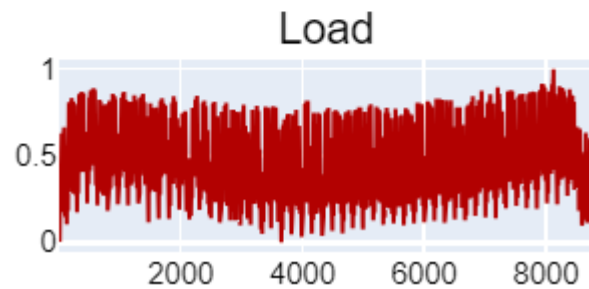
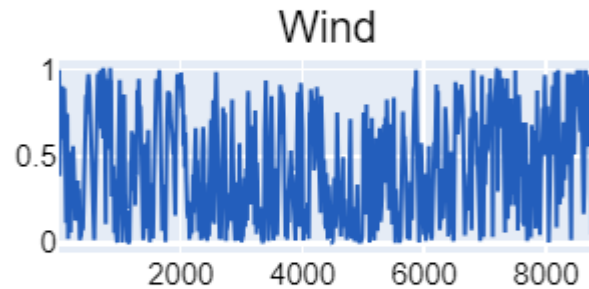
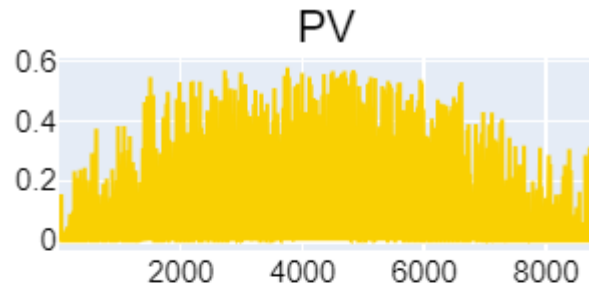


- 20 clustered offshore wind farms [1]
- Radial wind connection
- Updated offshore wind capacity factors [2]

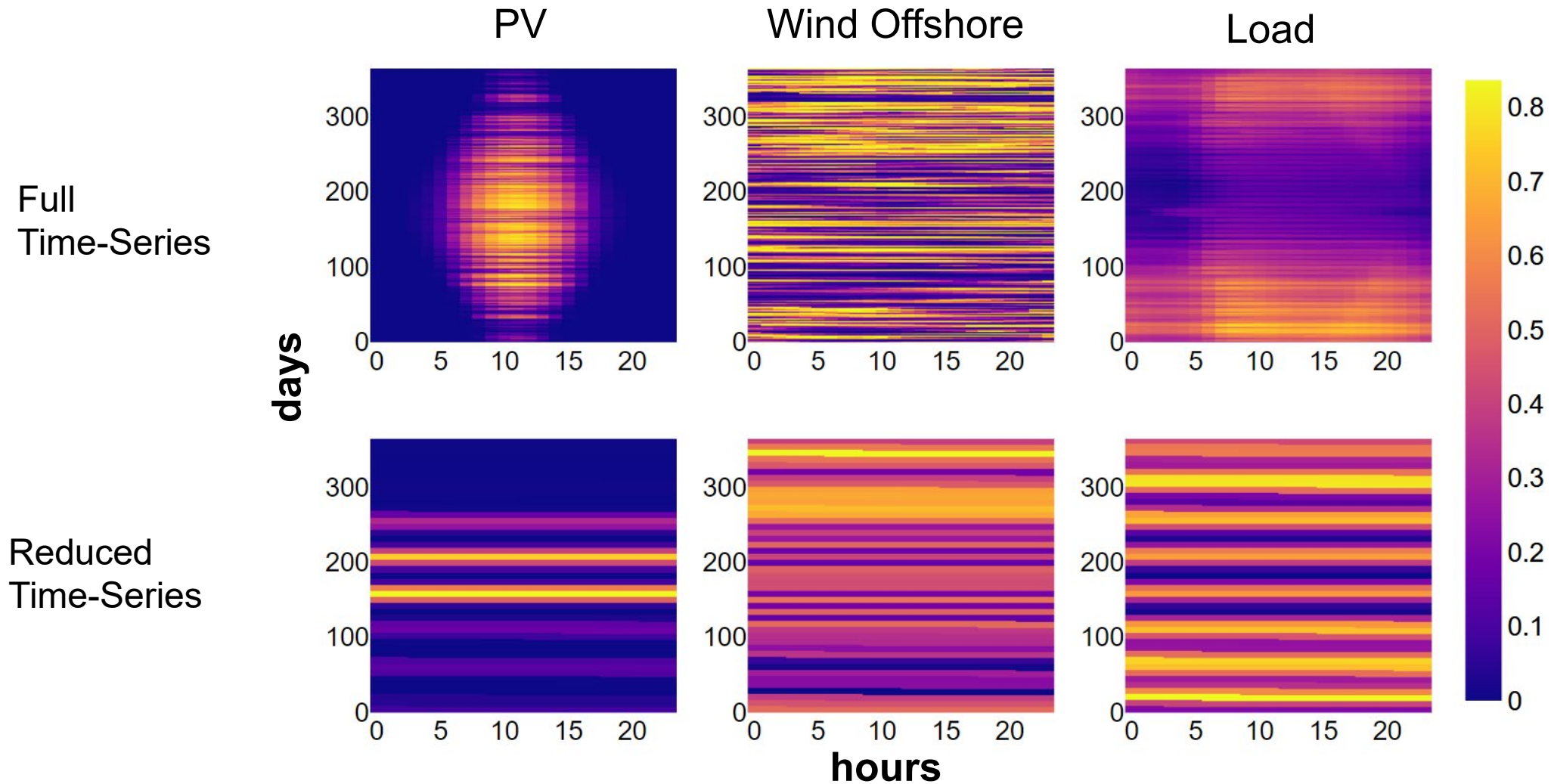
[1] EMODnet Human Activities portal, EMODnet, <https://emodnet.ec.europa.eu/en/human-activities>

[2] Project Memo: Hourly wind and solar energy time series from Reanalysis dataset, SINTEF Energi, https://sintef.brage.unit.no/sintef-xmlui/bitstream/handle/11250/2468143/AN%20171263_Hourly%20wind%20and%20solar%20power%20timeseries.pdf?sequence=1

Requirement #2: Temporal Granularity



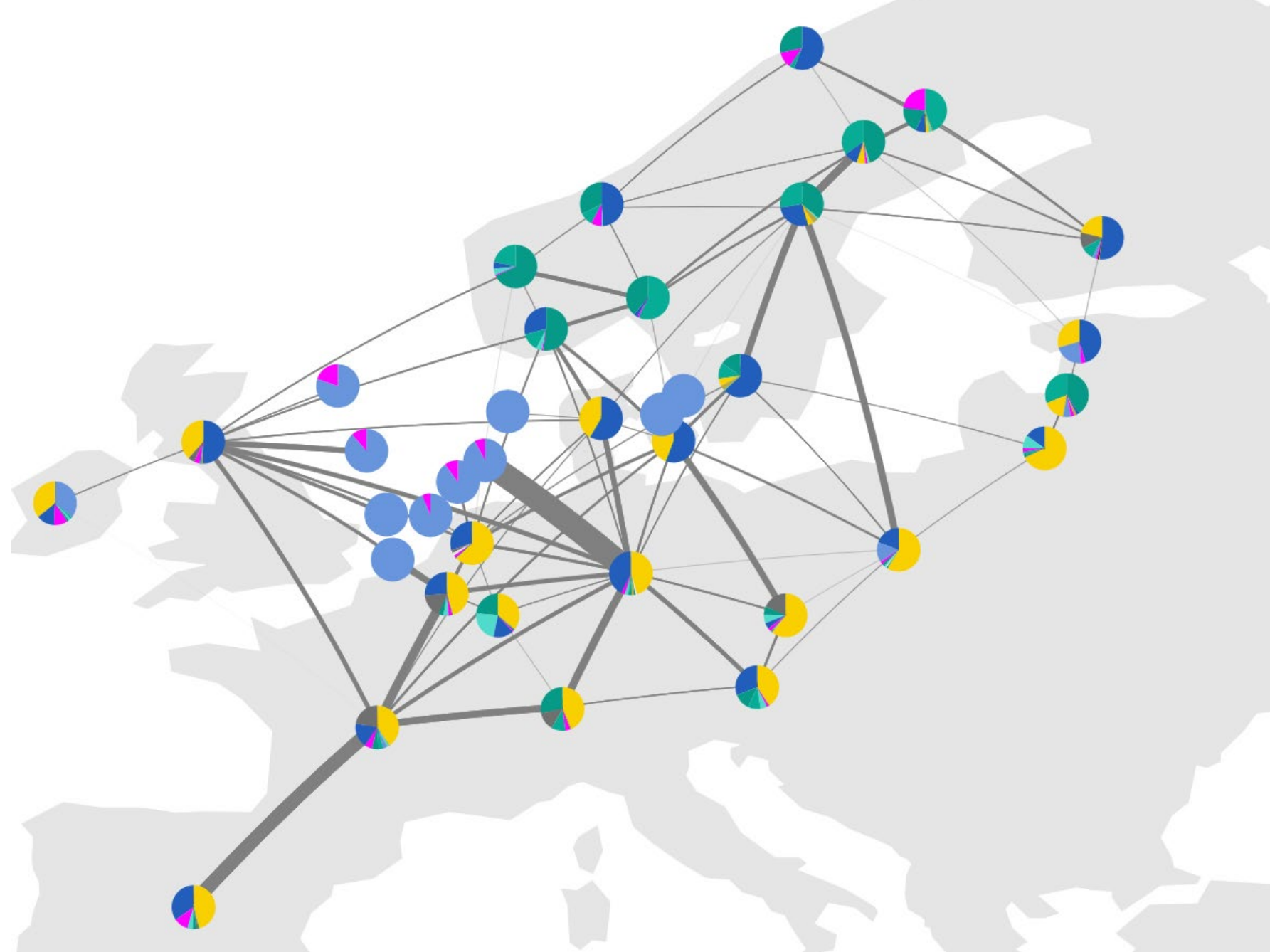
Time-Series Aggregation



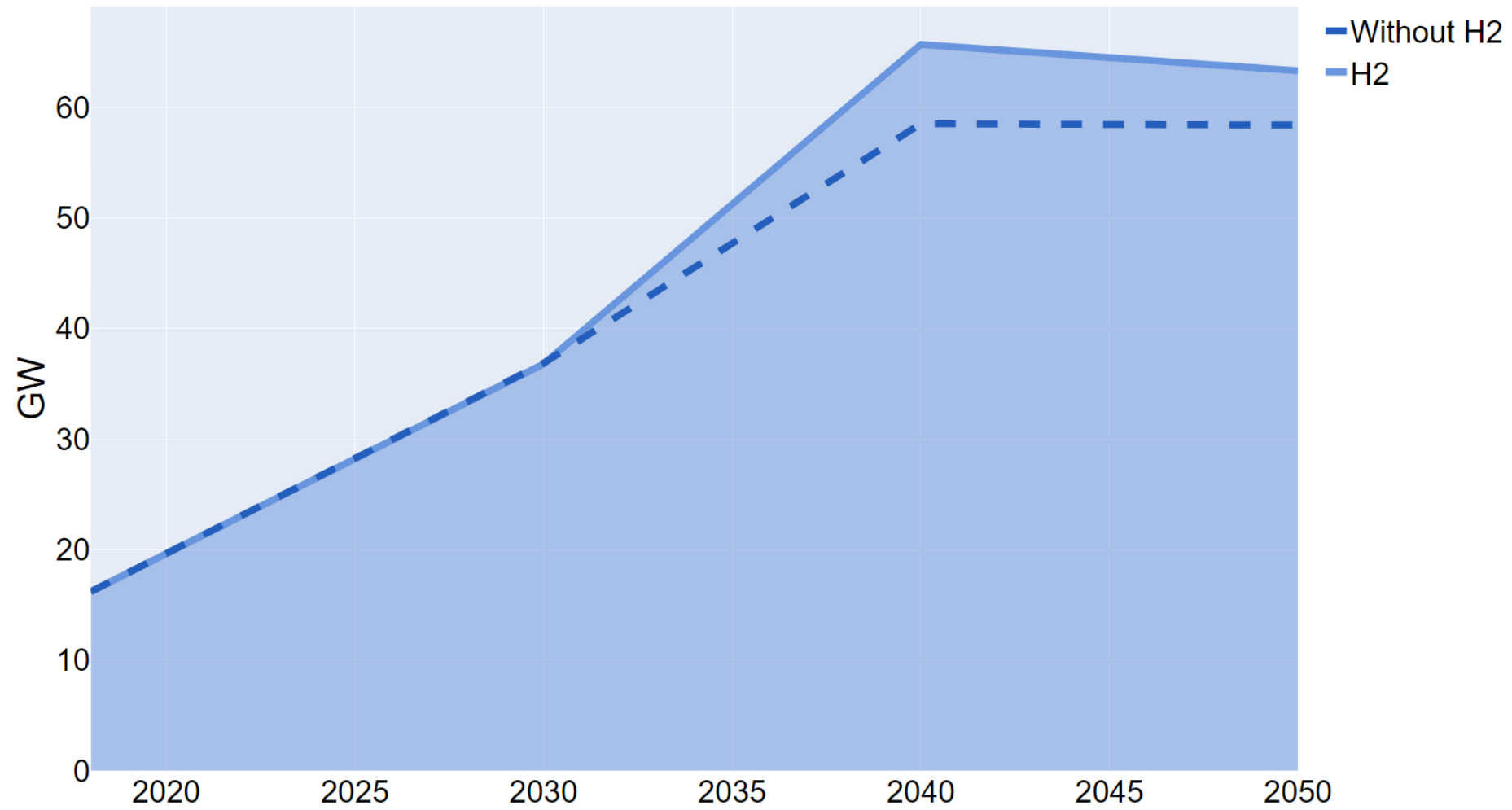
Methodological Challenges

- 1 Uncertain and volatile nature of wind energy
- 2 Modeling long-term and short-term dynamics

Results #1



Results #2



Conclusion

Findings

- Hydrogen can help with the integration of offshore wind

Further Steps

- Meshed grid representation
- Hydrogen network optimization
- Inclusion of short-term dynamics