INTERCONNECTING THE BALTIC SEA COUNTRIES VIA OFFSHORE ENERGY HUBS

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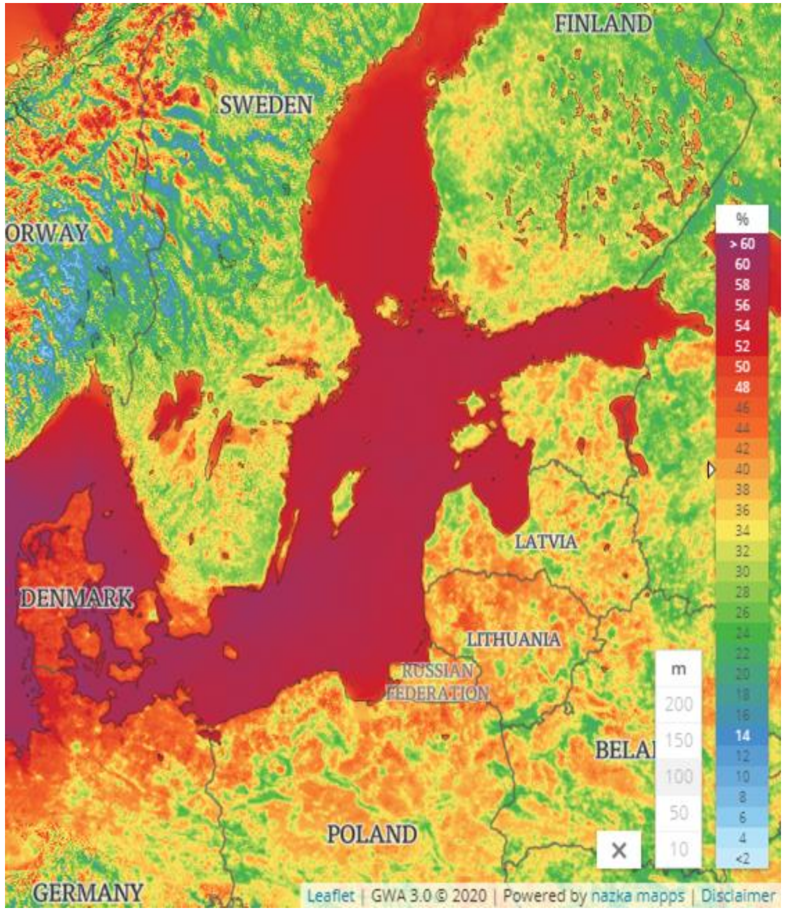
INTRODUCTION

- The main objective of BaltHub is to study the cost-effectiveness of Baltic Sea offshore energy hubs for driving green transition in Baltic Sea countries.
- Potential benefits of offshore energy hubs in the Baltic Sea
  - Including the meshed offshore grid to connect them
- Range of scenarios towards 2050 are studied
  - With different levels of electrification
- Balthub partners
  - DTU (Wind + Management)
  - TalTech
  - Sintef
  - Kaunas Technical University



Wind power capacity factors in the Baltic Sea region (https://globalwindatlas.info/)

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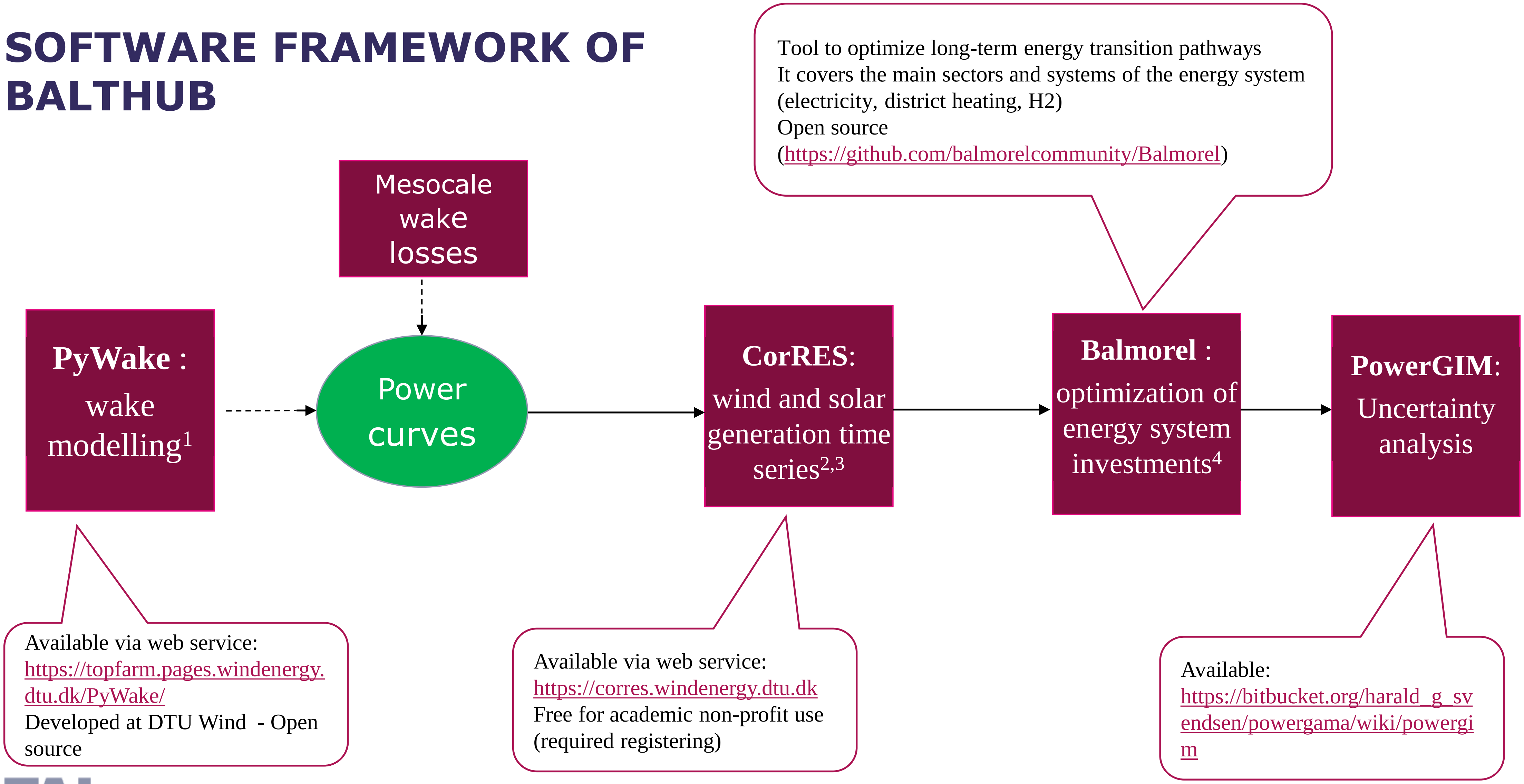
SOFTWARE FRAMEWORK OF BALTHUB



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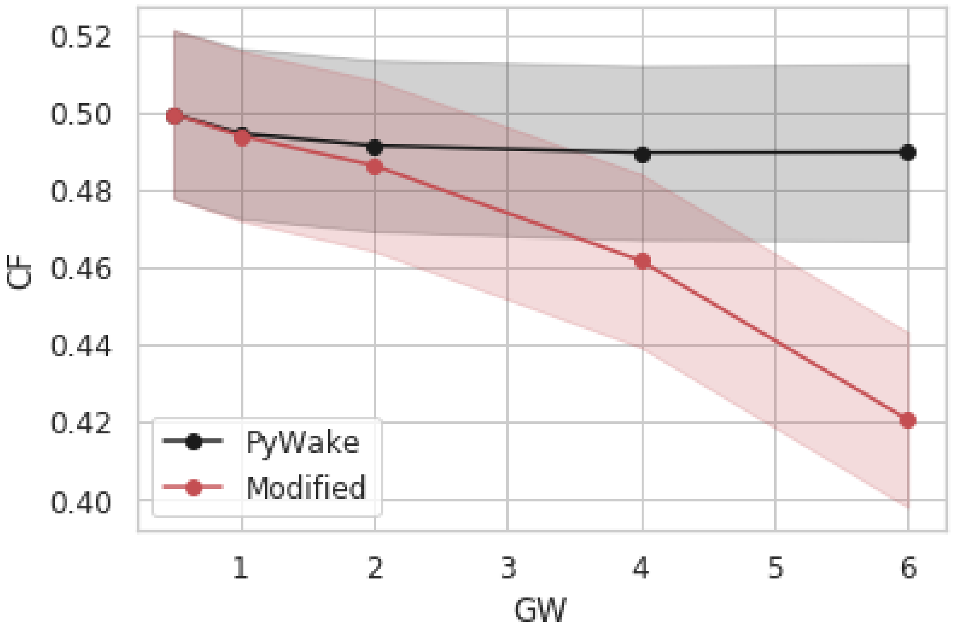
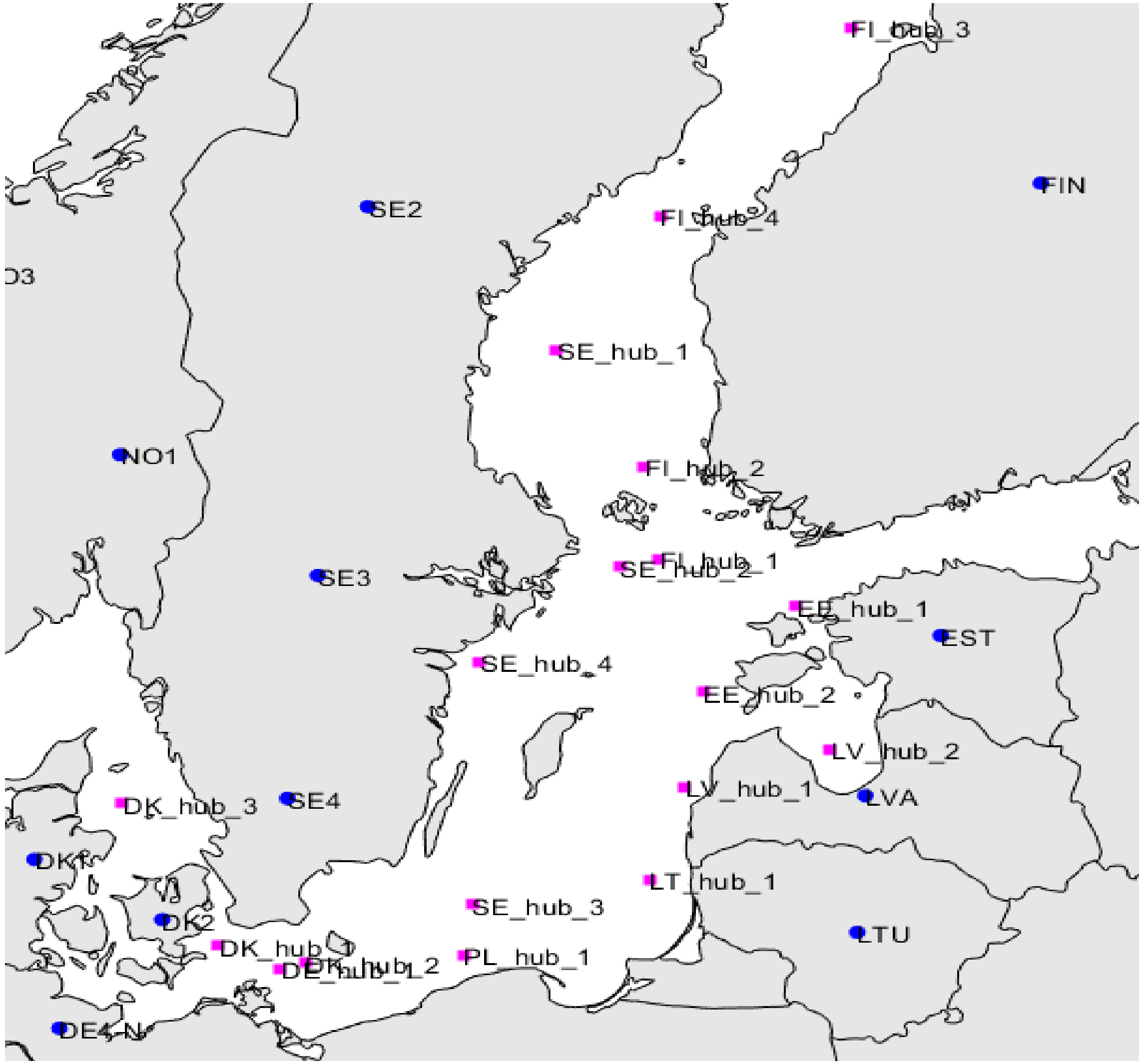
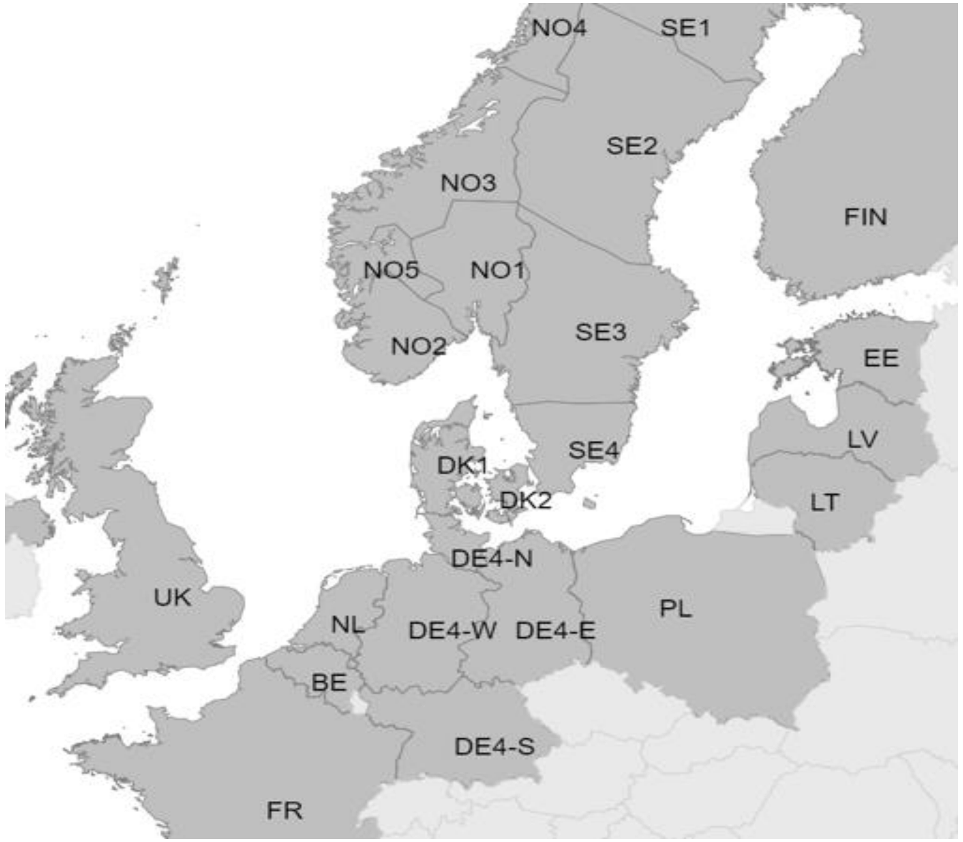
MODELLIONG OFFSHORE ENERGY ISLANDS
WAKE LOSSES





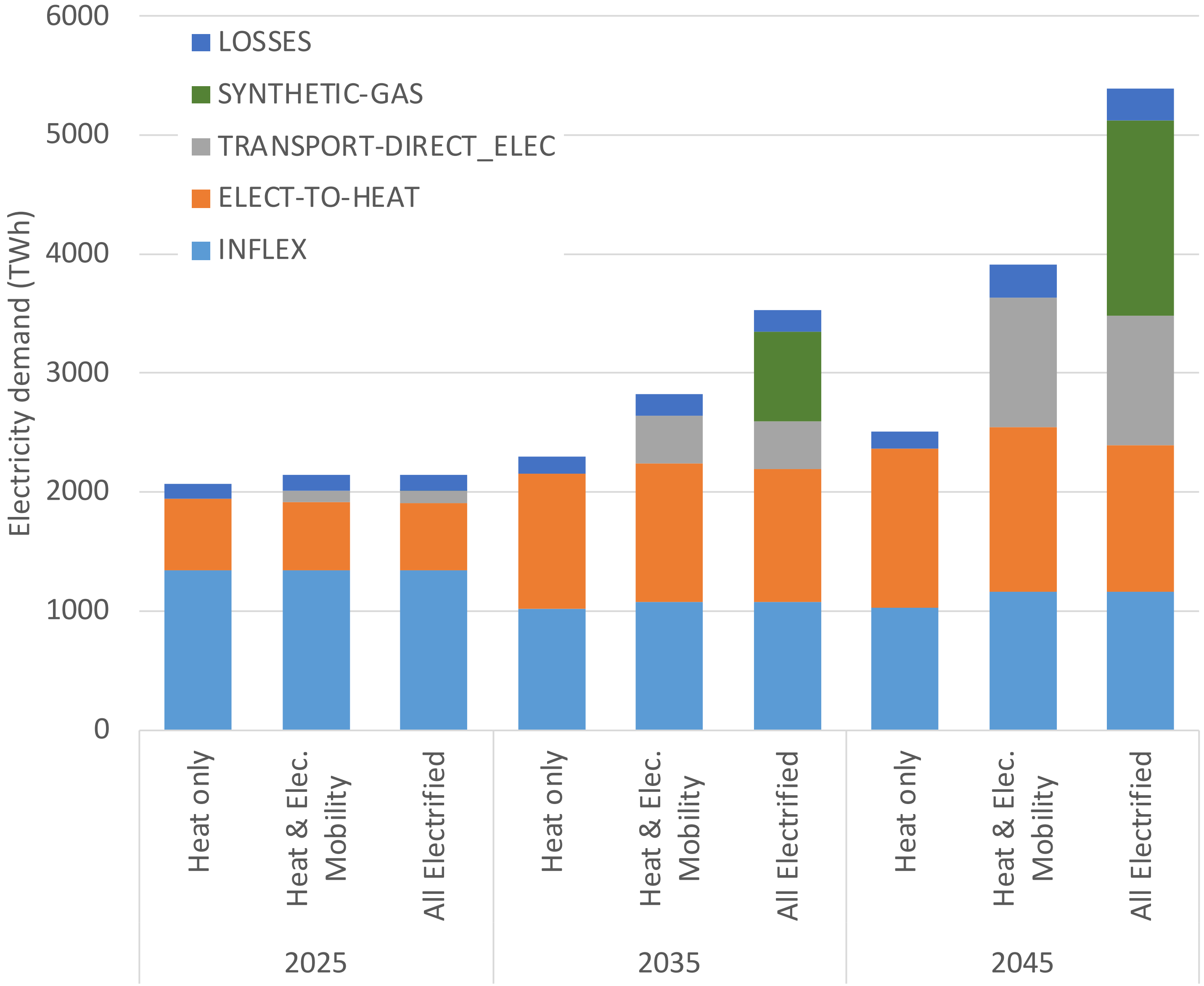
STUDIED SCENARIOS



Scenario	Electric heating (household & industry)	Electric mobility	Hydrogen demand (industry & transport fuels)
Heat only	Optimized	-	-
Heat and Elec. Mobility	Optimized	Operation optimized	-
All Electrified	Optimized	Operation optimized	Operation optimized

All analysed countries shown in dark grey. The Baltic Sea region countries are: Denmark (DK), Sweden (SE), Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), and Germany (DE).

RESULTS (ALL ANALYZED COUNTRIES): ELECTRIC LOAD



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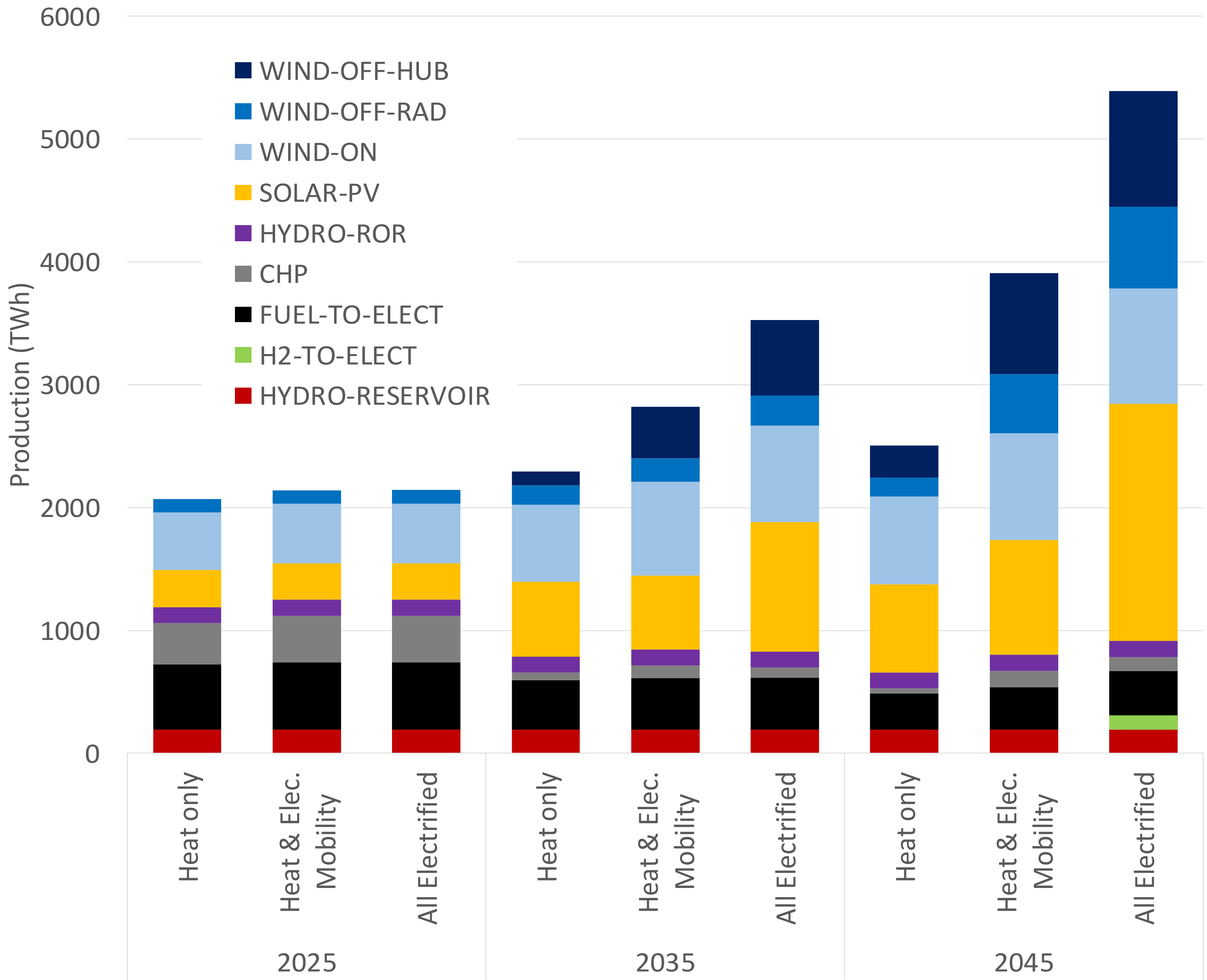
RESULTS (ALL ANALYZED COUNTRIES): ELECTRICITY GENERATION



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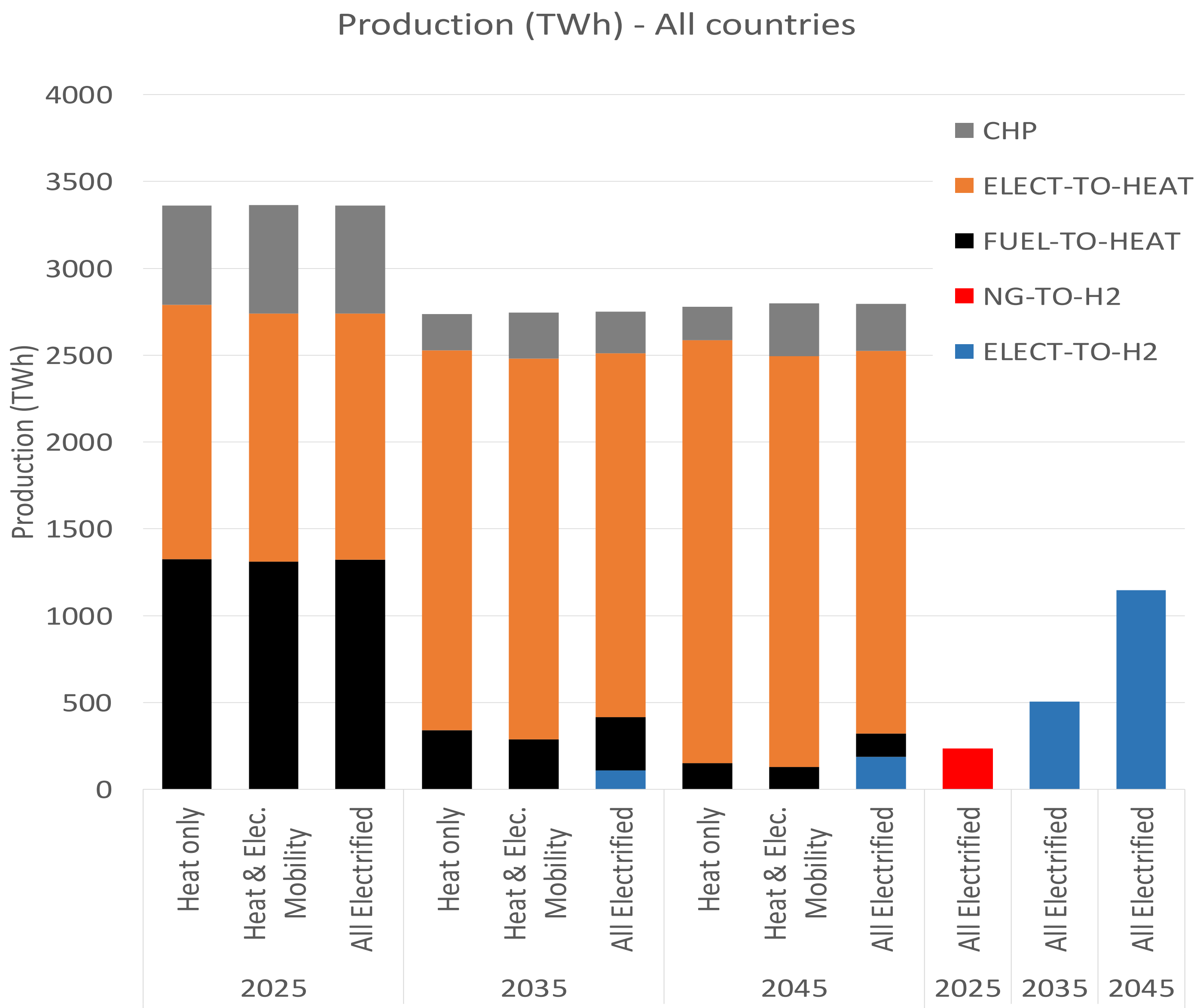
RESULTS (ALL ANALYZED COUNTRIES): HEAT AND HYDROGEN GENERATION



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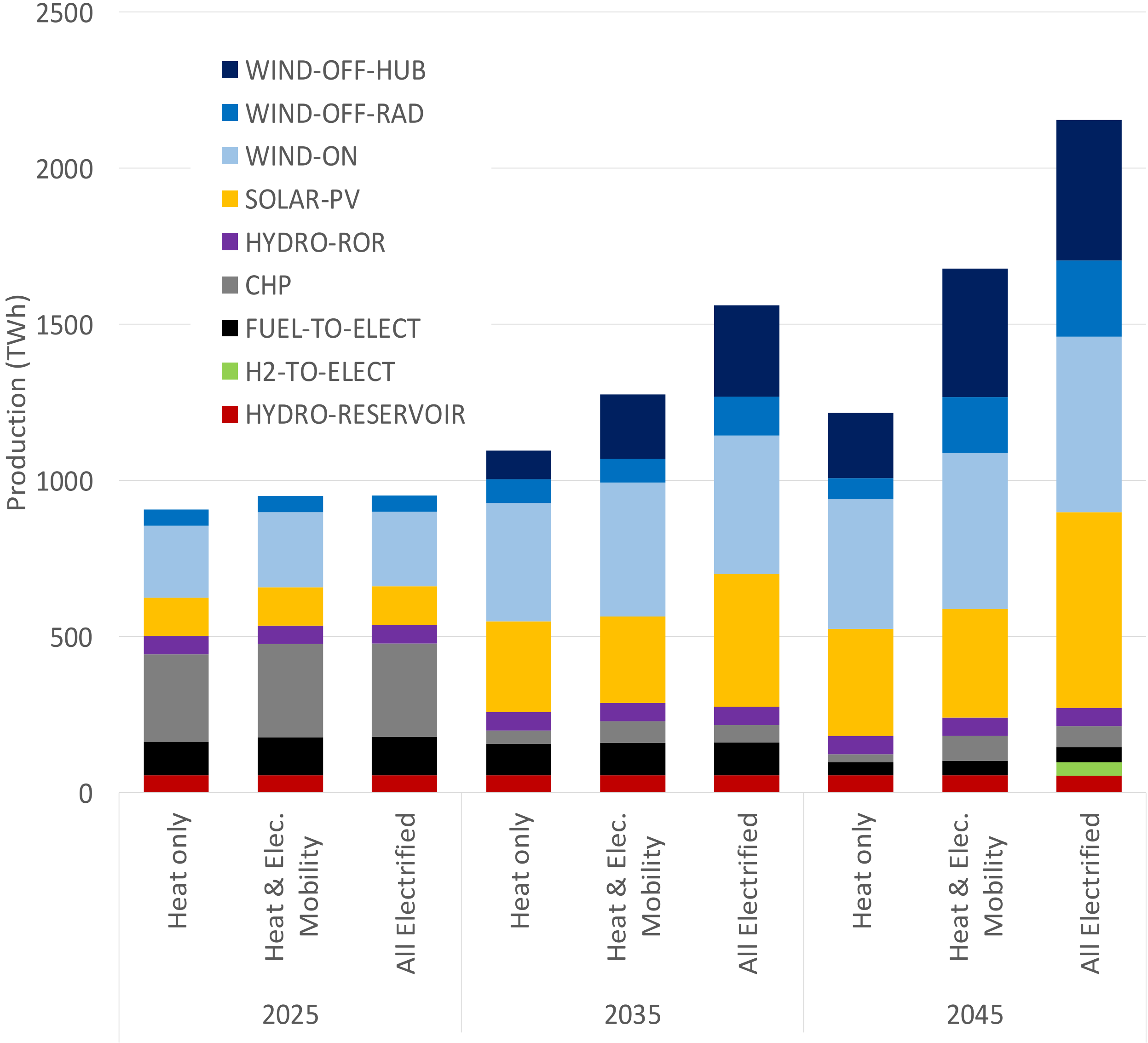
RESULTS:
BALTIC SEA REGION

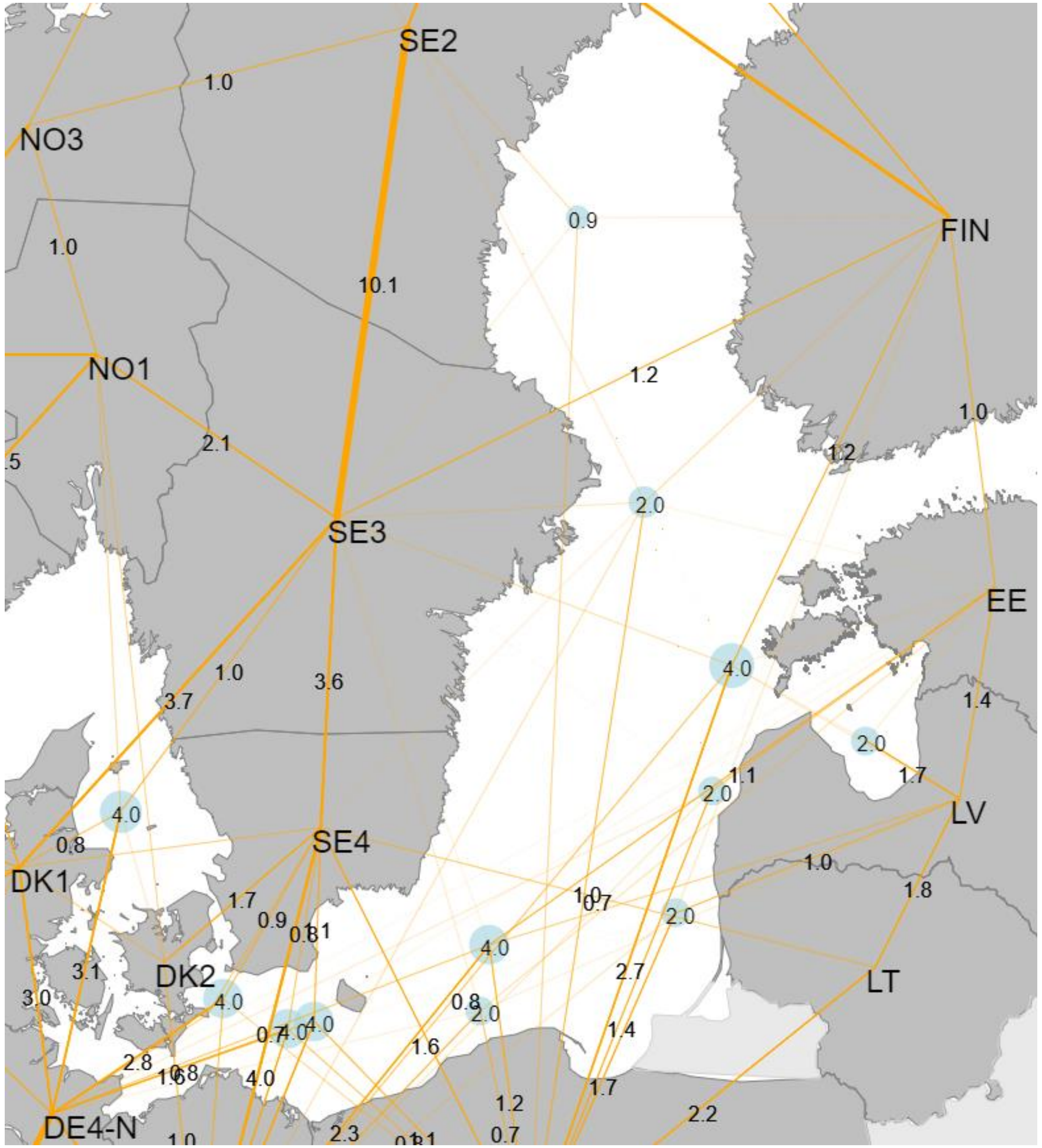


https://windeurope.org/intelligence-platform/product/our-energy-our-future/

Offshore GWs per sea area in the most electrified scenario:

Sea area	2025 (GW)	2035 (GW)	2045 (GW)
North Sea	**15**	**158**	**238**
Radial	15	35	53
Hub		123	186
Baltic Sea	**6**	**32**	**82**
Radial	6	14	47
Hub		17	35
Atlantic Ocean	**7**	**13**	**65**

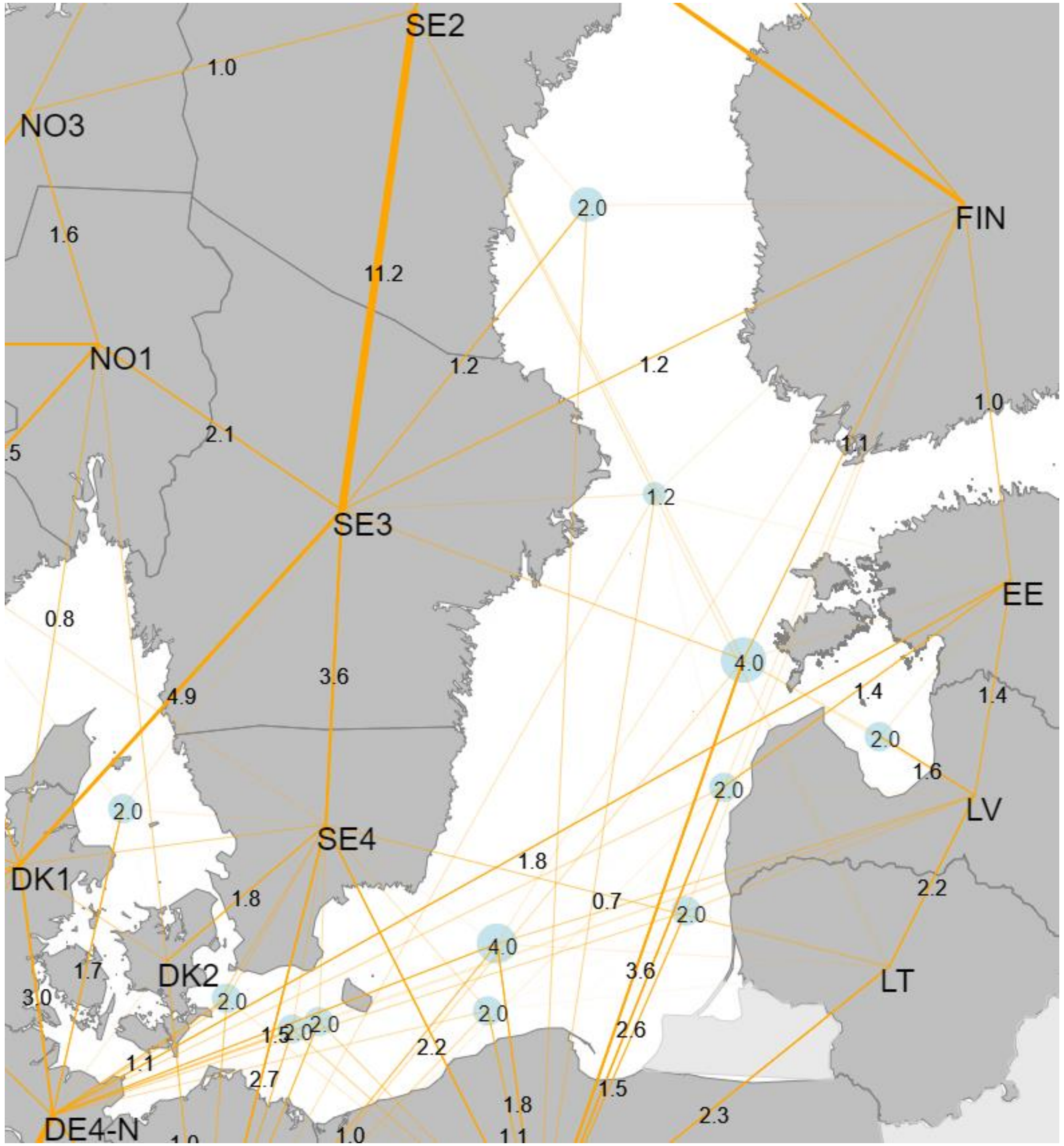
HUBS INVESTED – ALL ELECTRIFIED



	2045 (GW)
Baltic Sea	**82**
Radial	47
Hub	35

- Note: unfeasible small lines may appear in the maps, as the results are from linear optimisation
- MIP optimisation, to find more realistic line sizes, is being carried out

HUBS INVESTED – HEAT & ELEC. MOBILITY



	2045 (GW)
Baltic Sea	**58**
Radial	31
Hub	27

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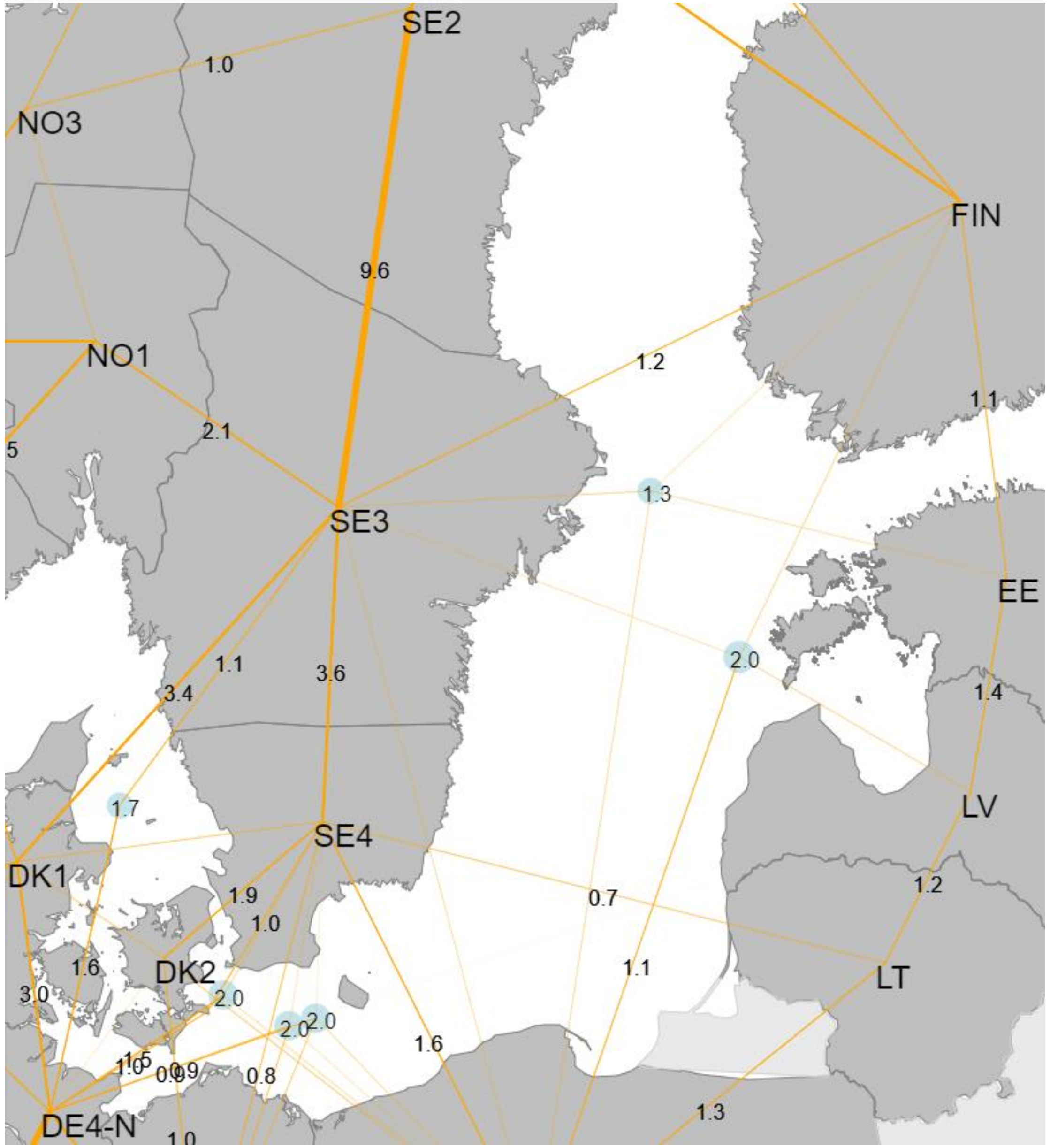
HUBS INVESTED – HEAT ONLY



Some of the hubs remain competitive compared to radially connected offshore wind even in the least electrified scenario

	2045 (GW)
Baltic Sea	**15**
Radial	4
Hub	11

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CONCLUSIONS

- The largest deployment of offshore hubs occurs when the energy system is highly electrified
  - Offshore wind becomes the dominant wind technology by 2050 in the most electrified scenarios
- Southern part of Baltic Sea sees the strongest development of hubs
  - Poorest wind resource locations seen unsuitable for offshore energy hubs
- Overall deployment of offshore wind less compared to the North Sea
  - The optimal hub sizes in the Baltic Sea are foreseen to be smaller than in the North Sea
- The hubs are utilised to interconnect the onshore power systems of the Baltic Sea region’s countries
  - More detailed MIP runs being carried out to analyse optimal line sizes
- The grid simulations ongoing with PowerGIM to explore robust grid expansion strategies

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