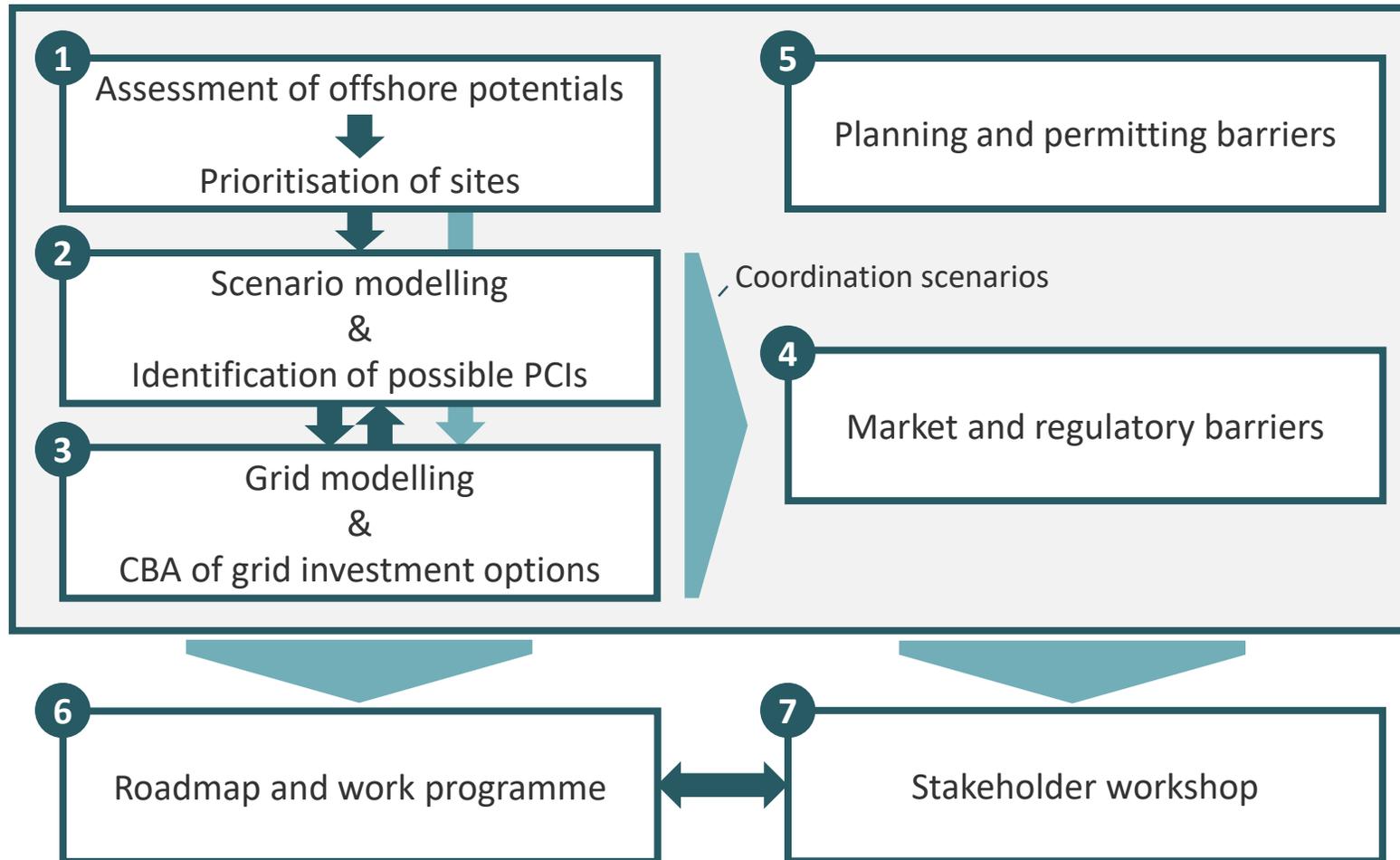


BalticLINES Stakeholder workshop Copenhagen – October 31st, 2018

SOME PRELIMINARY INSIGHTS FROM THE BEMIP OFFSHORE WIND COOPERATION STUDY

Berit Tennbakk, Partner, THEMA Consulting Group

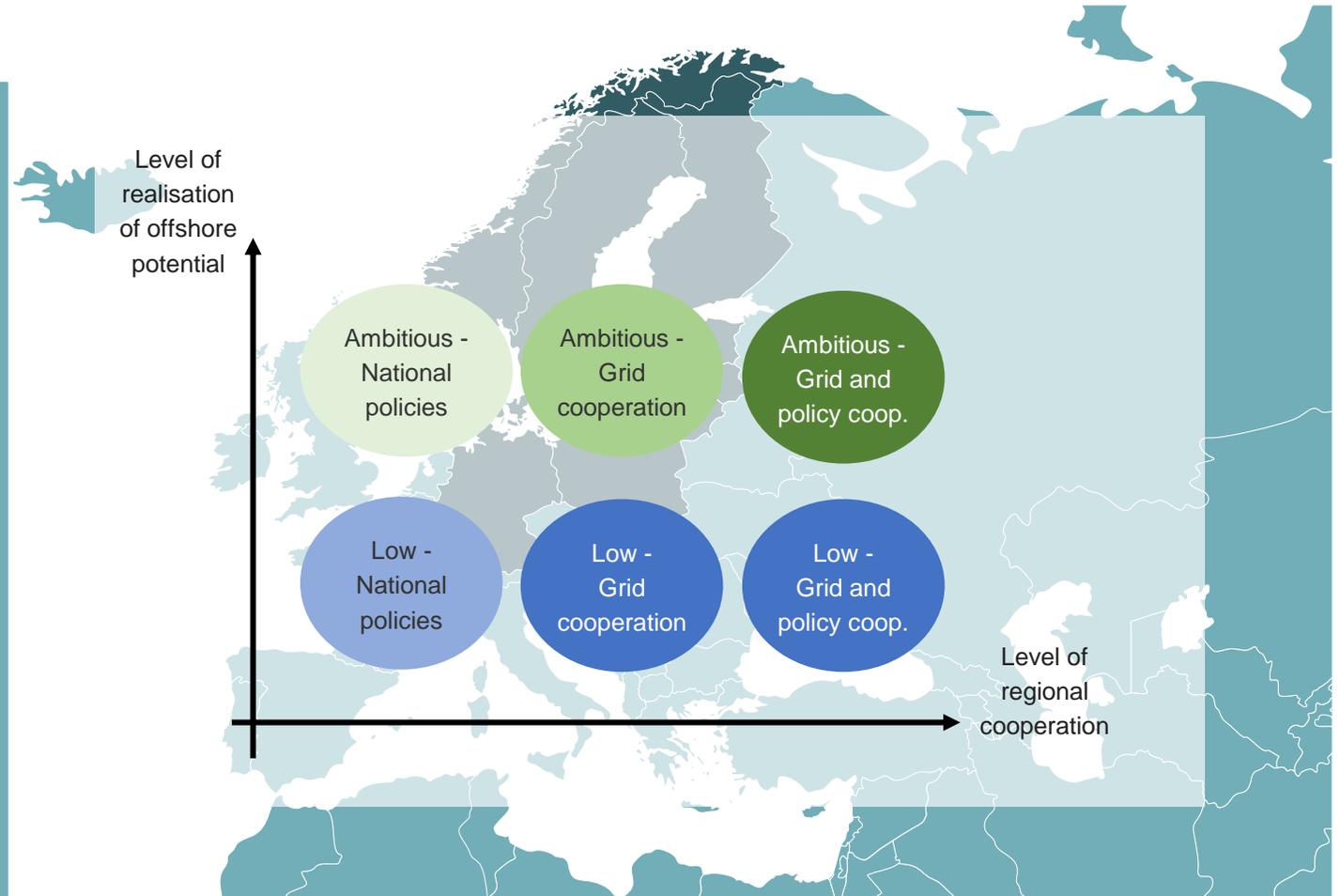
Overview of the BEMIP study



We model the power system under six different scenarios that explore the impact of regional cooperation in offshore wind deployment

SCENARIO SETUP

- Six scenarios for Baltic Offshore
 - Two levels of deployment
 - 17 GW in 2050
 - 32 GW in 2050
 - Three levels of regional cooperation
 - National policies (No regional cooperation)
 - Grid cooperation (Interconnections)
 - Policy cooperation (RES deployment)

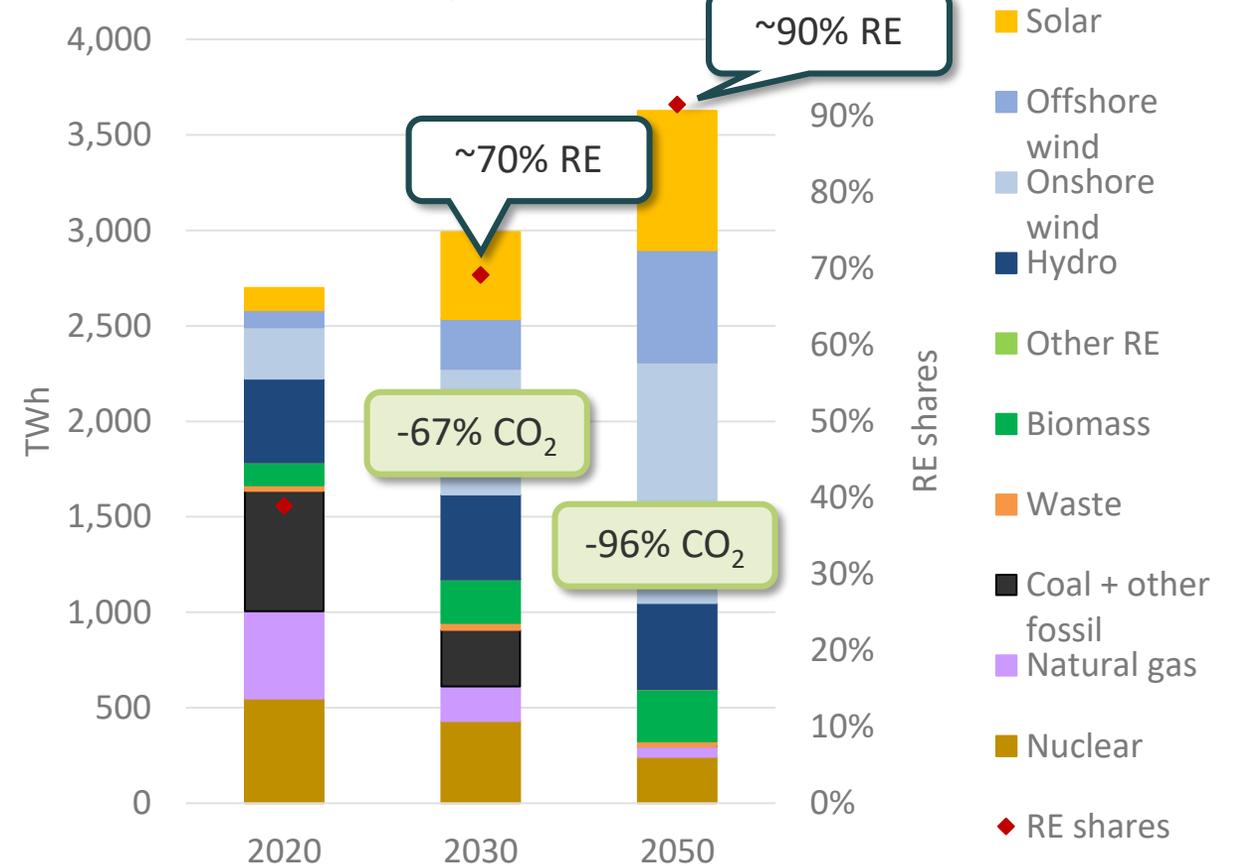


The modelling projections based on EUCO scenario imply a radical transformation of the power sector, which provides the context for the offshore wind results

POWER SYSTEM DEVELOPMENT AND KEY ASSUMPTIONS

- **Significant rise in RE shares**
 - High share of wind and solar power (46% in 2030, 71% in 2050)
- **Emissions reductions of up to 67% by 2030** (relative to 2005 level)
- In the long run, **new demand will be covered by RE**
 - Offshore wind can play a key role
- **Integration of variable renewable energy** is a key factor in determining the value of wind and solar power

POWER SYSTEM MIX (LOW NATIONAL POLICIES)



Representation of regional cooperation in the market modelling

SETUP OF ADVANCED CONNECTION OPTIONS

4 hubs for regional grid cooperation identified

- Input from Baltic InteGrid project
- Evaluation of promising locations
- LCOE for wind
- Value of transmission capacity
- Geographic proximity of sites

Regional grid cooperation on offshore deployment

- Around 45% of total capacity deployed at hubs in all scenarios
- Other capacity deployed with direct connection

Regional policy

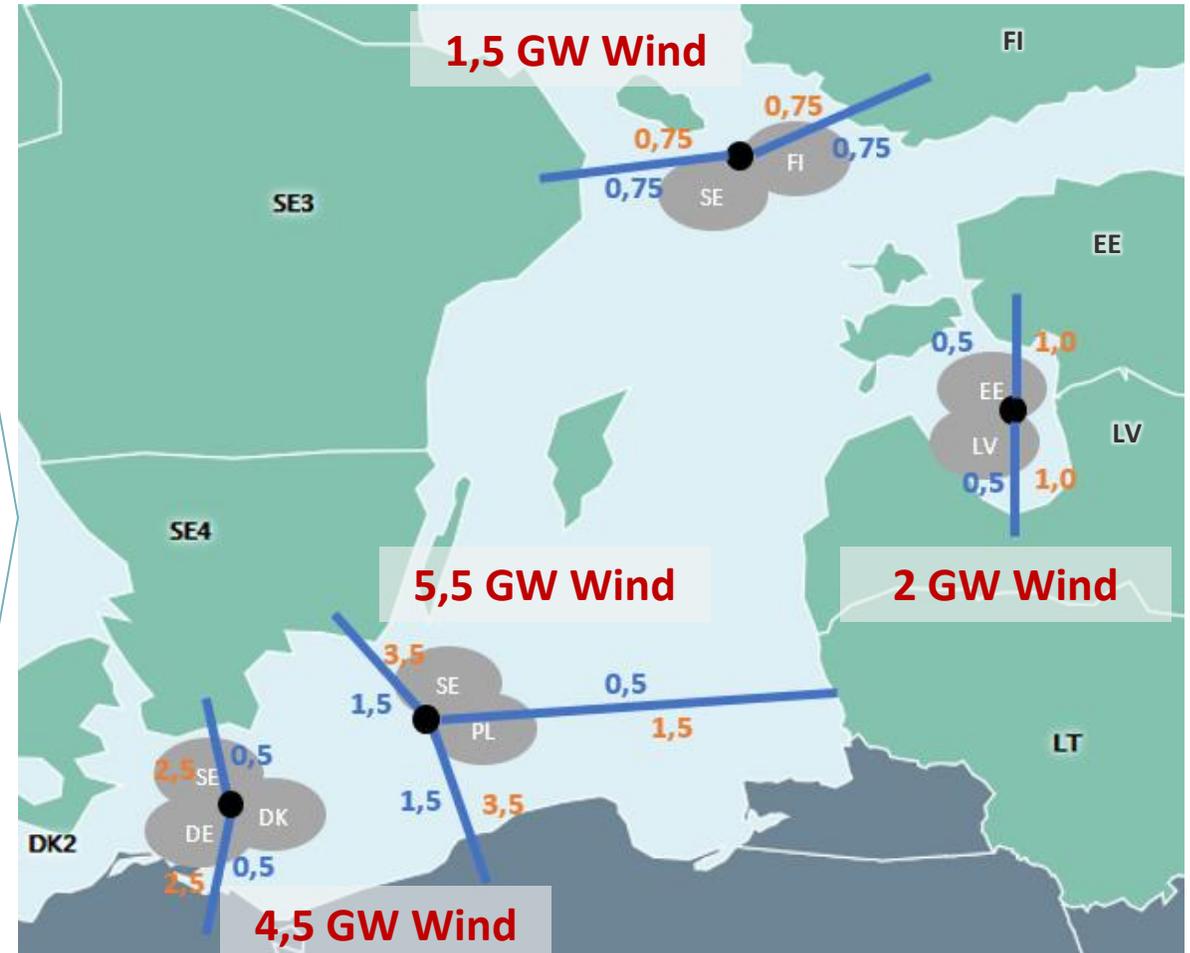
- Common deployment target for remaining capacity

2050 – Ambitious scenario

2030

2050

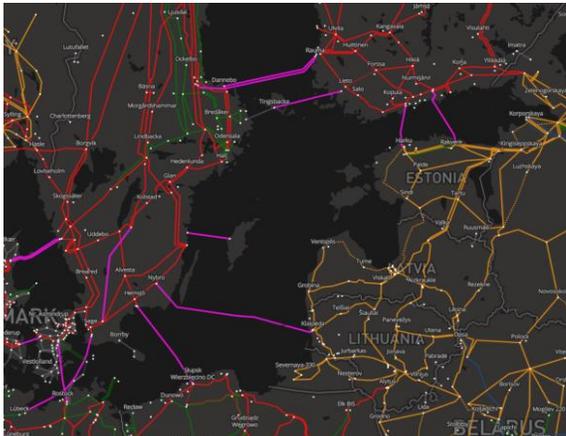
2 Transmission line capacity (GW) ● Offshore potential



Network impacts under each of the scenarios are also analyzed

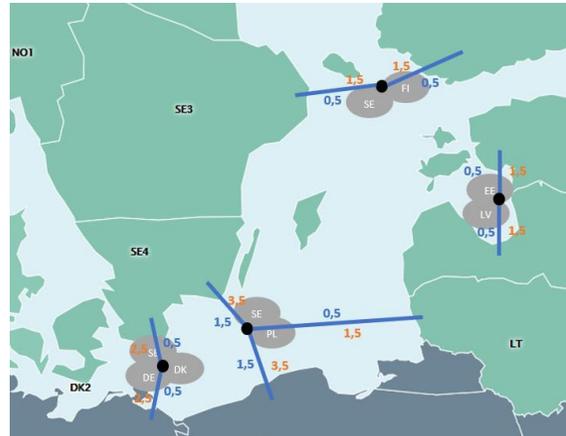
Detailed Grid Model of all BEMIP countries

- Detailed grid modelling of all BEMIP countries solved using a linearized power flow.
- Assessing the same offshore wind connections as in rest of modelling.



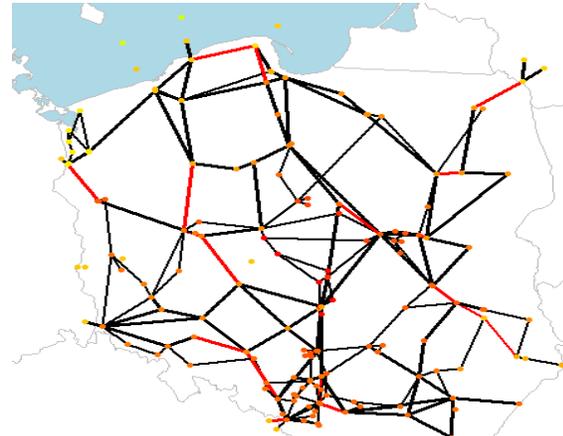
Modelling simple and advanced offshore connections

- Aligned assumptions with the power modelling results
- Modelling of advanced connection options developed in collaboration with EA.



Detecting congestions due to offshore wind deployment

- Identify, for all scenarios, a list of:
 - Areas with congestion
 - Congested lines
 - Cost estimates for upgrades
 - Critical offshore projects driving congestions



Cost Benefit Analysis

- Report detailing the cost and benefit elements of the possible grid investments

As with the power system modelling, the grid modelling needs to be seen in the context of its underlying assumptions

- In the grid model, we have included all countries bordering the Baltic Sea: Estonia, Lithuania, Latvia, Poland, Germany, Denmark, Sweden, Finland (Norway is also included as a part of the grid)
- All scenarios are compared with a base case scenario without offshore wind (base 2020, 2030 and 2050)

2020



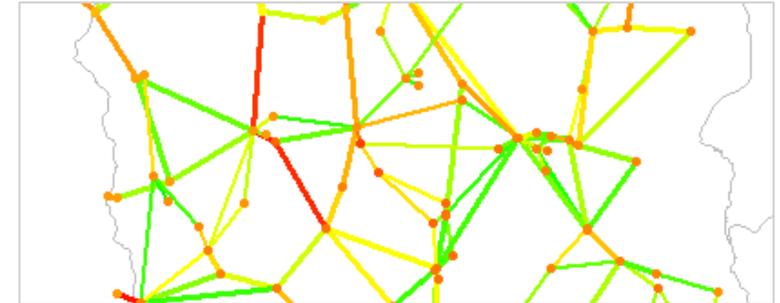
The grid today, and ongoing and known projects

2030



TYNDP
National plans

2050



Identification of grid congestions and shadow prices in a base case given expected increase in demand and changes in generation mix

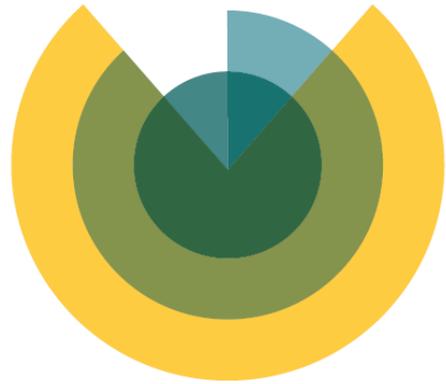
Summary of **preliminary** conclusions from the modelling

- Baltic offshore wind could be a cost-effective form of renewable generation, depending on cost developments and the CO2 price level.
- Offshore wind's value varies markedly across the region. The southern end of the Baltic Sea is more attractive for development owing to its proximity to centres of demand – but these areas are also subject to the greatest network congestion issues.
- Effort sharing policies would more efficiently realise the potential of the region as a whole – this is especially true given the regional variation in wind's market value.
- The value of the hub connection options we've examined increases over time – the trade flows they enable help support more efficient generation but also trigger a need for the reconfiguration of national grids.
- The main driver for grid upgrades in Poland and the Baltic States is increasing local demand, *not* offshore wind capacity.
- Efficient integration of offshore wind in the Baltic Sea Area requires careful consideration and coordination of interconnectors as well as internal grid development.

Administrative barriers for coordination differ by country

Survey includes stakeholder input and interviews

Spatial Planning and Data Management	<ul style="list-style-type: none">▪ Several shortcomings at the national level on data management, ranging from a lack of data to fragmented data spread across many providers▪ Data quality is often also an issue
Licensing Procedures	<ul style="list-style-type: none">▪ Complex and unclear processes (sometimes even if a one-stop shop is nominally in place)▪ Ineffective stakeholder engagement that fails to identify objections early in the process▪ Long or repetitive appeals processes that increase investor uncertainty
Regional Cooperation	<ul style="list-style-type: none">▪ TSO-level cooperation on offshore grid planning is not supported by any standing group tasked with considering the network requirements & potential solutions
Network Regulation	<ul style="list-style-type: none">▪ No tariffs or connection charges for generators, including offshore wind▪ No clear framework for allocating costs and benefits of offshore transmission assets, including interconnectors▪ Different regulatory models for TSO investments including interconnectors



THEMA
CONSULTING GROUP