PROMOTioN
PROGRESS ON MESHED HVDC OFFSHORE TRANSMISSION NETWORKS

WP12 – Wind Scenarios, Concepts & Topology

Motivation

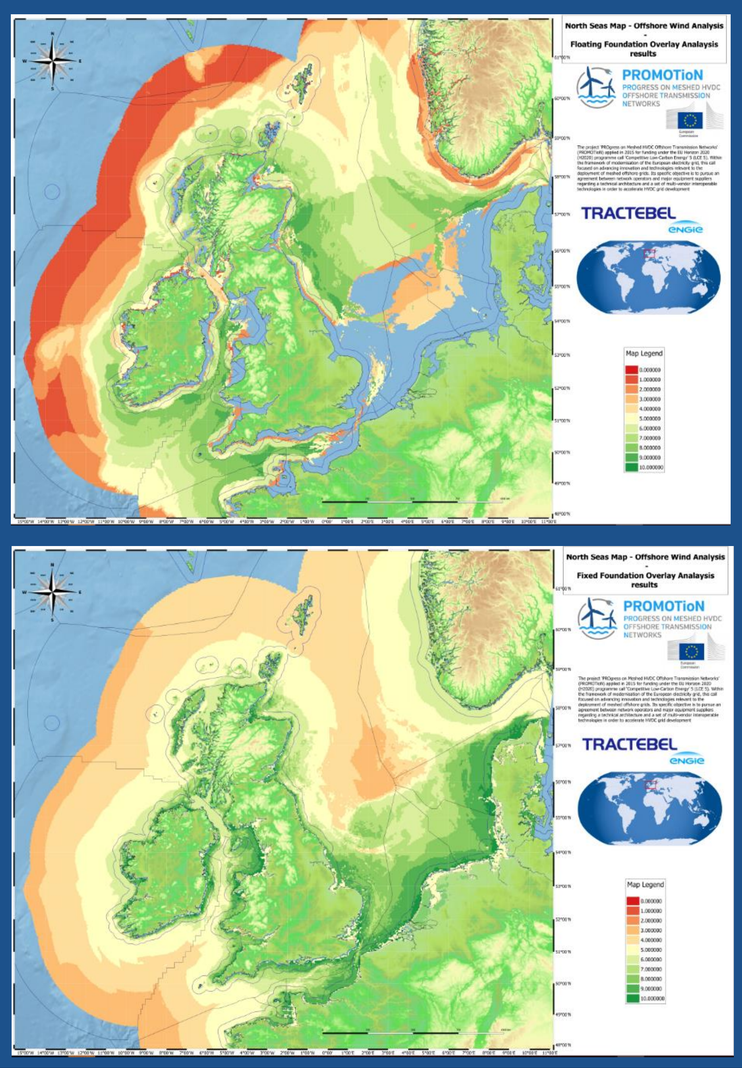
Efficient transmission of high amounts of offshore wind generation in the North Seas requires the development of a European offshore grid. The European H2020 project “PROMOTioN ” aims at alleviating technical, regulatory, economic, financial, legal and market barriers

Goal:

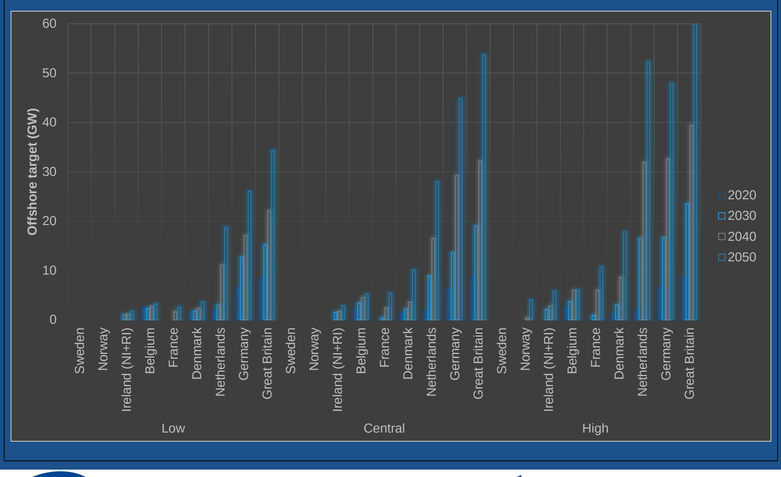
Develop recommendations for a practical deployment plan by:

1. Analysing topological development under contrasting scenarios
2. Using the developed topologies as inputs for a detailed cost-benefits analysis

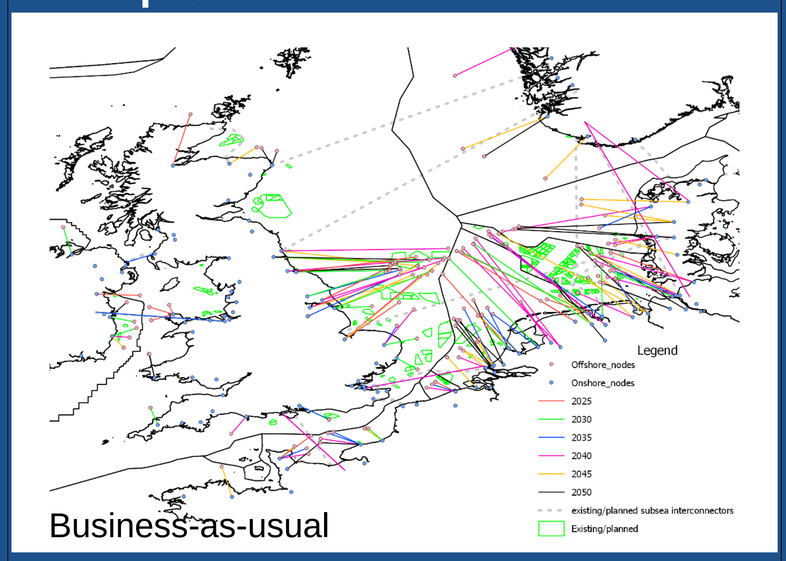
Step 1: Assessment of wind potential



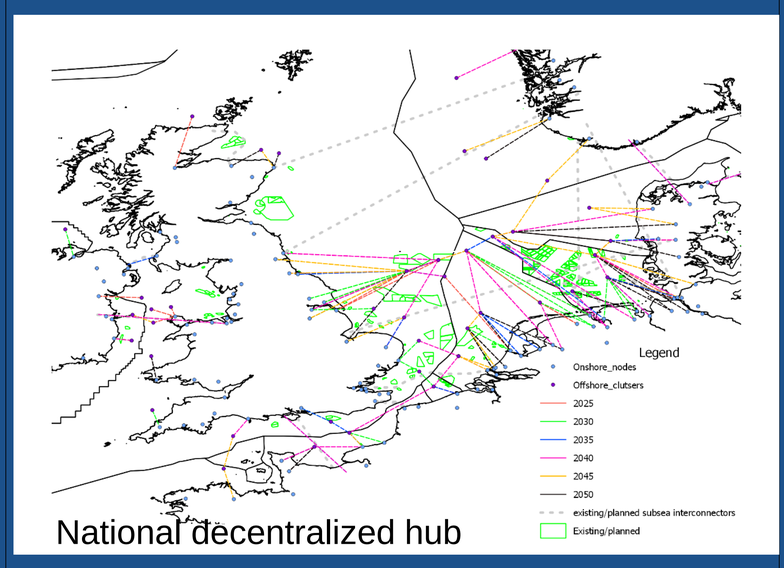
Step 2: Development of wind scenarios



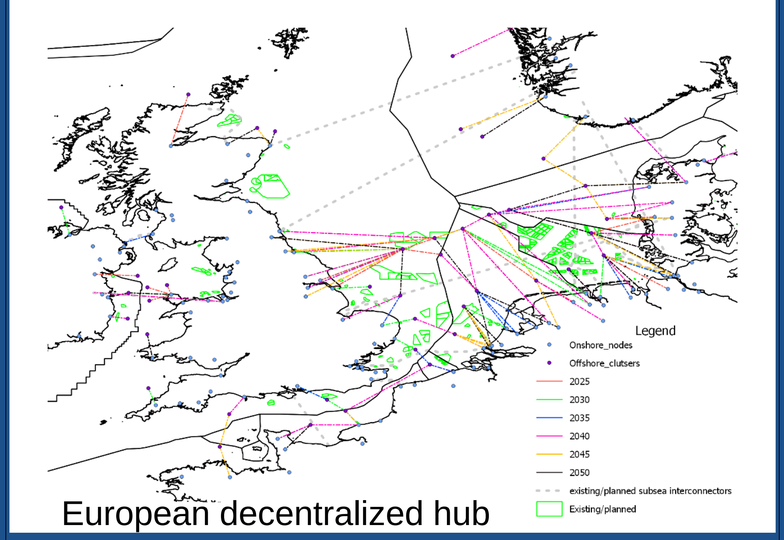
Step 3: Topologies for the high wind scenario and four development concepts



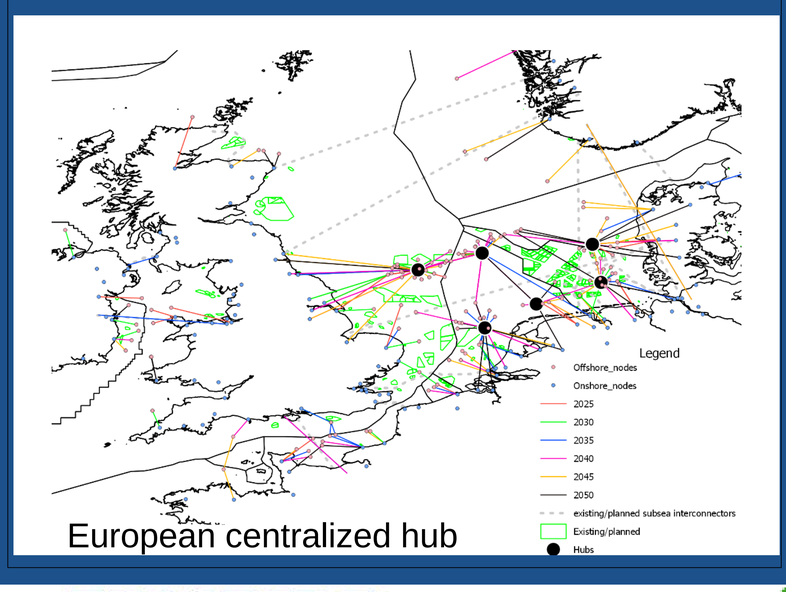
Business-as-usual



National decentralized hub



European decentralized hub



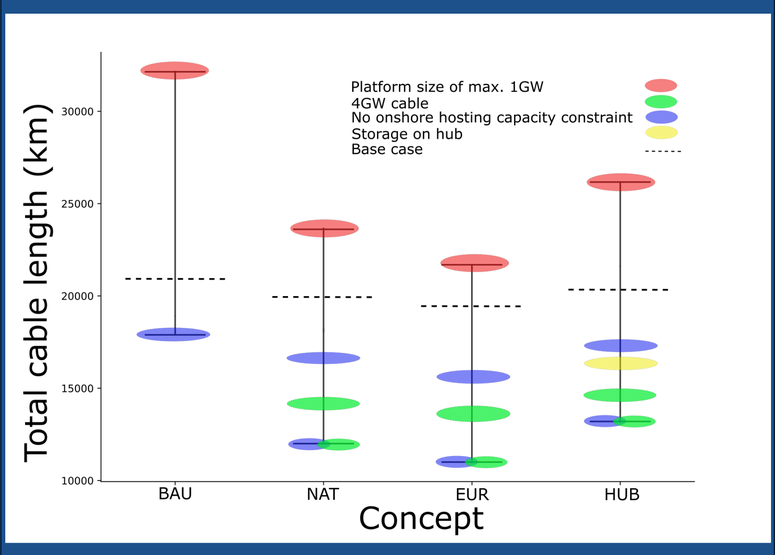
European centralized hub

Step 4: Demonstration of the technical viability

1. **Steady-state security analysis**
Voltage droop at HVDC converters allows the system to deal with post-contingency DC voltage violations.
Fast corrective actions (i.e. curtailment) required to deal with post-contingency branch overloads.

2. **Feasibility of the protection schemes**
Offshore HVDC grid can be protected for all simulated faults (single DC-line fault at several locations in normal and back-up clearing time) by proper selection of DCCBs or fault current limiting converters.

Step 5: Sensitivity analysis



Key messages towards a deployment plan

1. The total required cable length for the HVDC grid is sensitive to input assumptions. If the difference between concepts is small, the costs of other aspects (such as protection devices, platforms, advanced controls) have to be considered in detail during the pre-feasibility phase.
2. The most beneficial topology evolves gradually from a few multi-terminal connections to more complex structures.
3. The combined use of the offshore grid for wind evacuation and interconnectors is an important driver for meshing/multi-terminal.
4. The Business as Usual radial connection is competitive if the maximum offshore platform size and cable rating are similar. If this is not the case, the radial solution becomes significantly more expensive.
5. There is no unique way to protect an HVDC grid, the choice of the strategy will depend on costs and on the allowed impact (temporary loss of power infeed) to the onshore grid.
6. A centralized HVDC controller able to perform fast corrective actions (such as curtailment) or a preventive system split might be required in the proposed topologies to avoid overloads following a contingency.

TenneT TSO BV
John.moore@tennet.eu
Jelle.van.uden@tennet.eu

FGH
Felix.Rudolph@fgh-ma.de

Tractebel Impact
pierre.henneaux@tractebel.engie.com
olivier.antoine@tractebel.engie.com

The SuperGrid Institute
Serge.POULLAIN@supergrid-institute.com

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 691714.