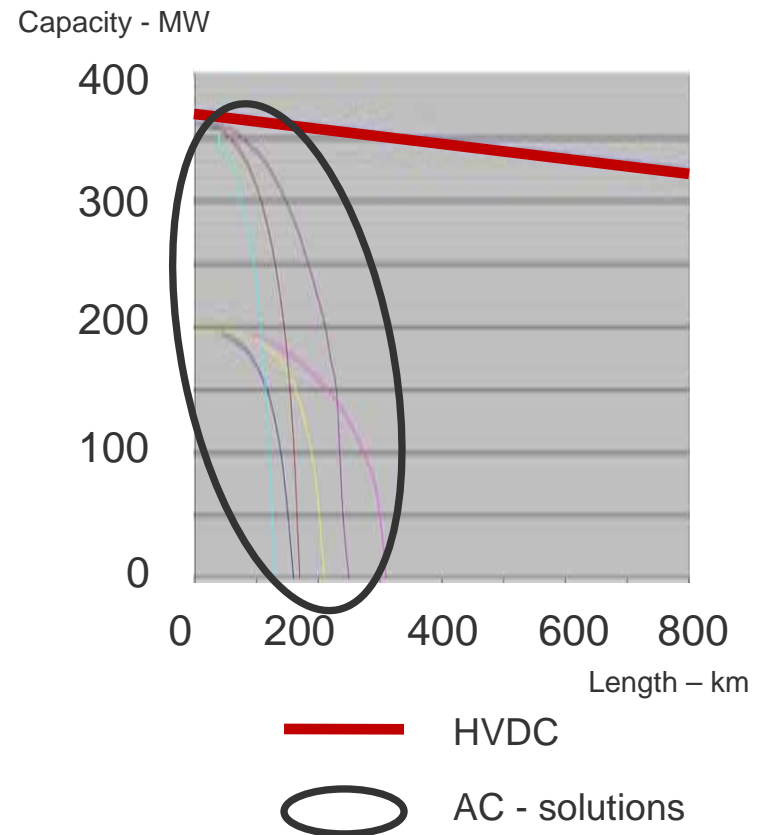


The future offshore grid - challenges and opportunities

Offshore Wind 2010, Liverpool, 30th June
Halvor Lie, Technical assistant to CEO, Statnett SF

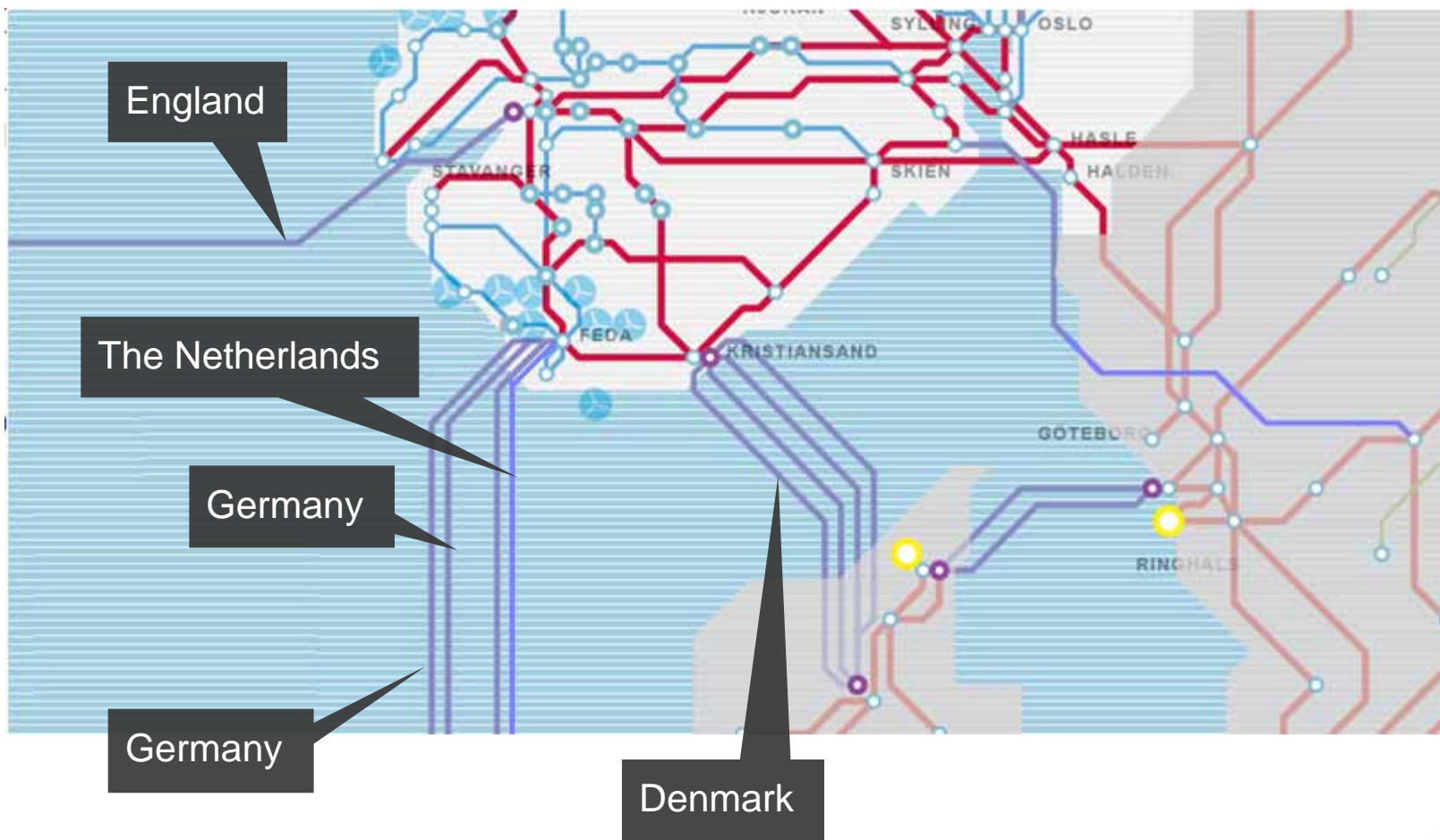
Offshore technology

- Long distances call for High Voltage Direct Current – HVDC
- HVDC – VSC
 - Flexibility
 - Voltage control
 - Robust against volatile loads
 - Black start without additional power sources
- VSC – development need to reduce losses in converters



Source: East Coast
Transmission Network Technical
Feasibility Study – 2008

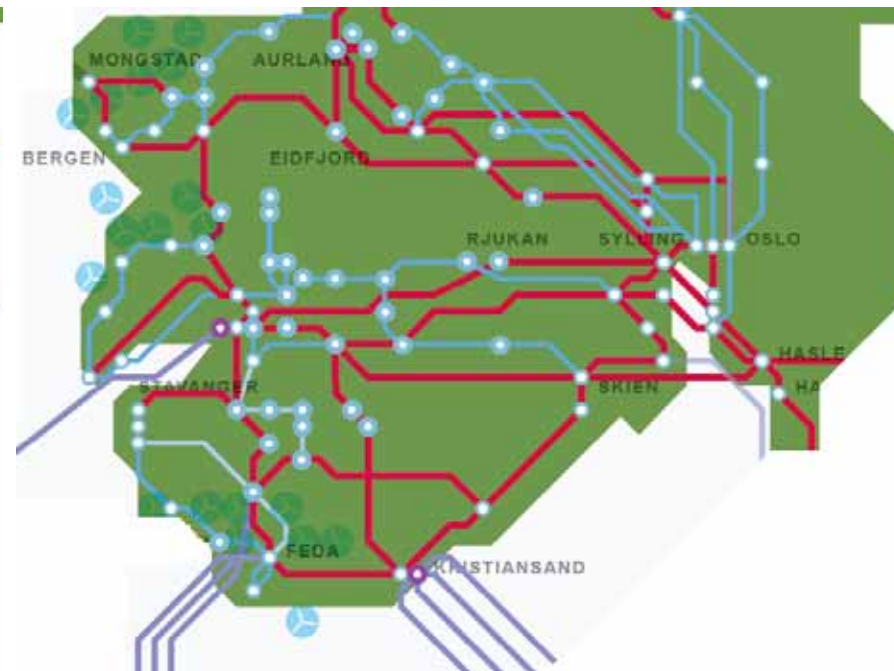
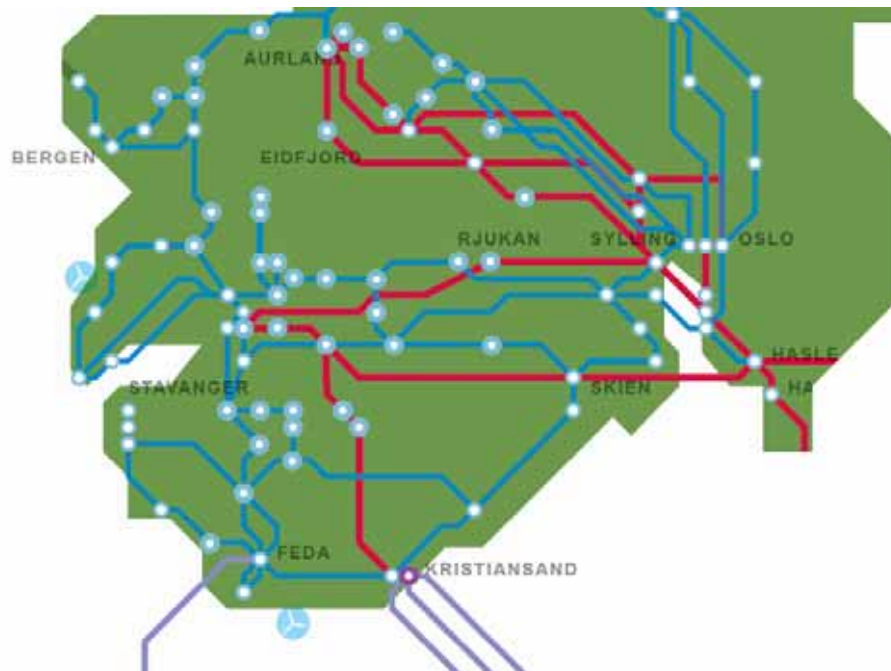
Planned interconnectors from Norway



Interconnectors result in need for stronger grid on land

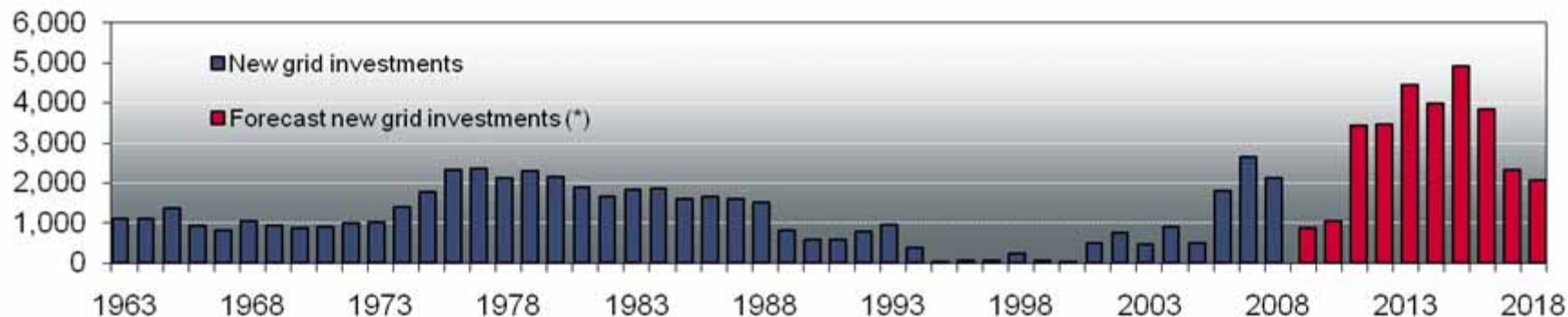
2010

2025

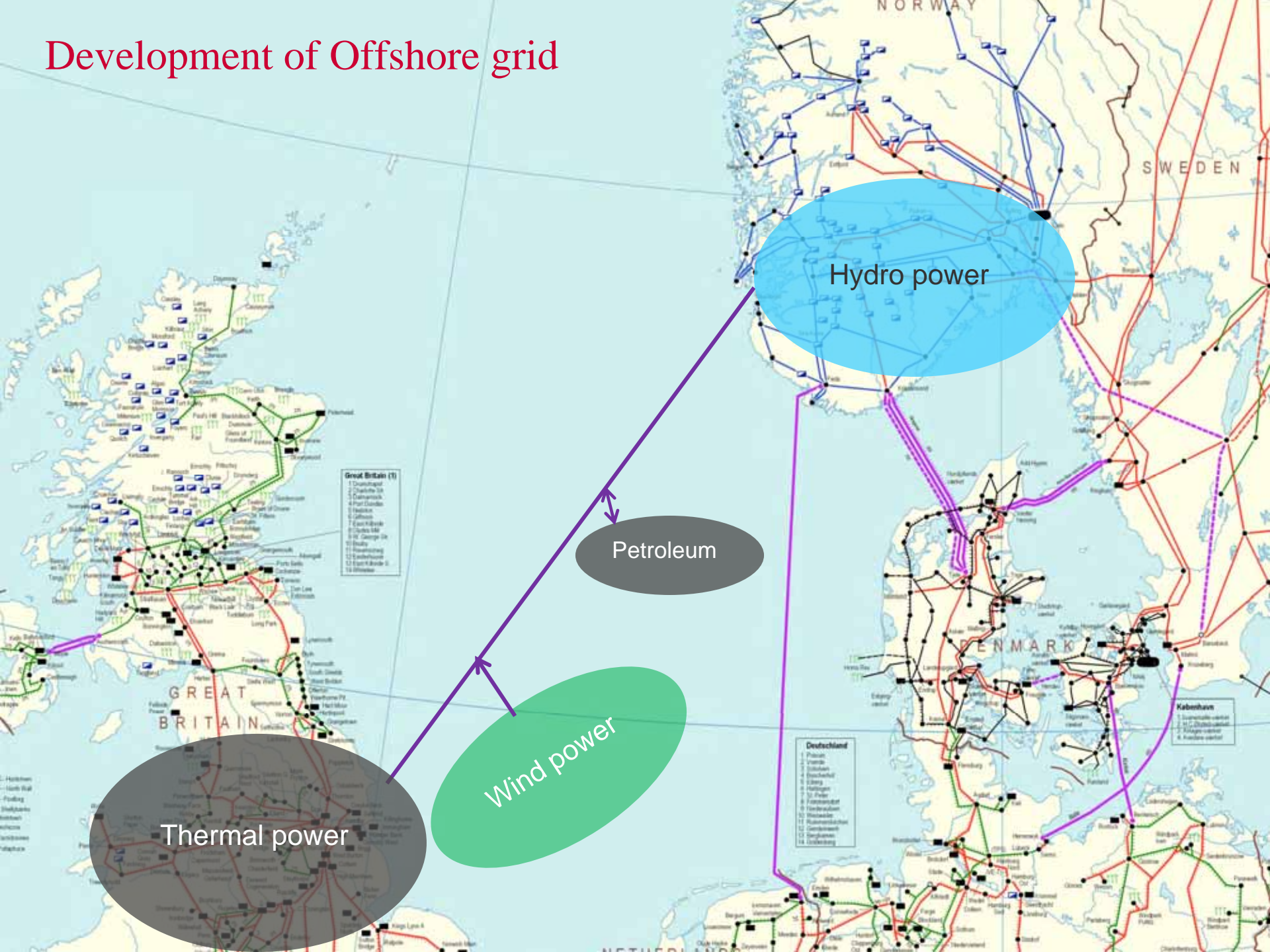


Mill NOK (real)

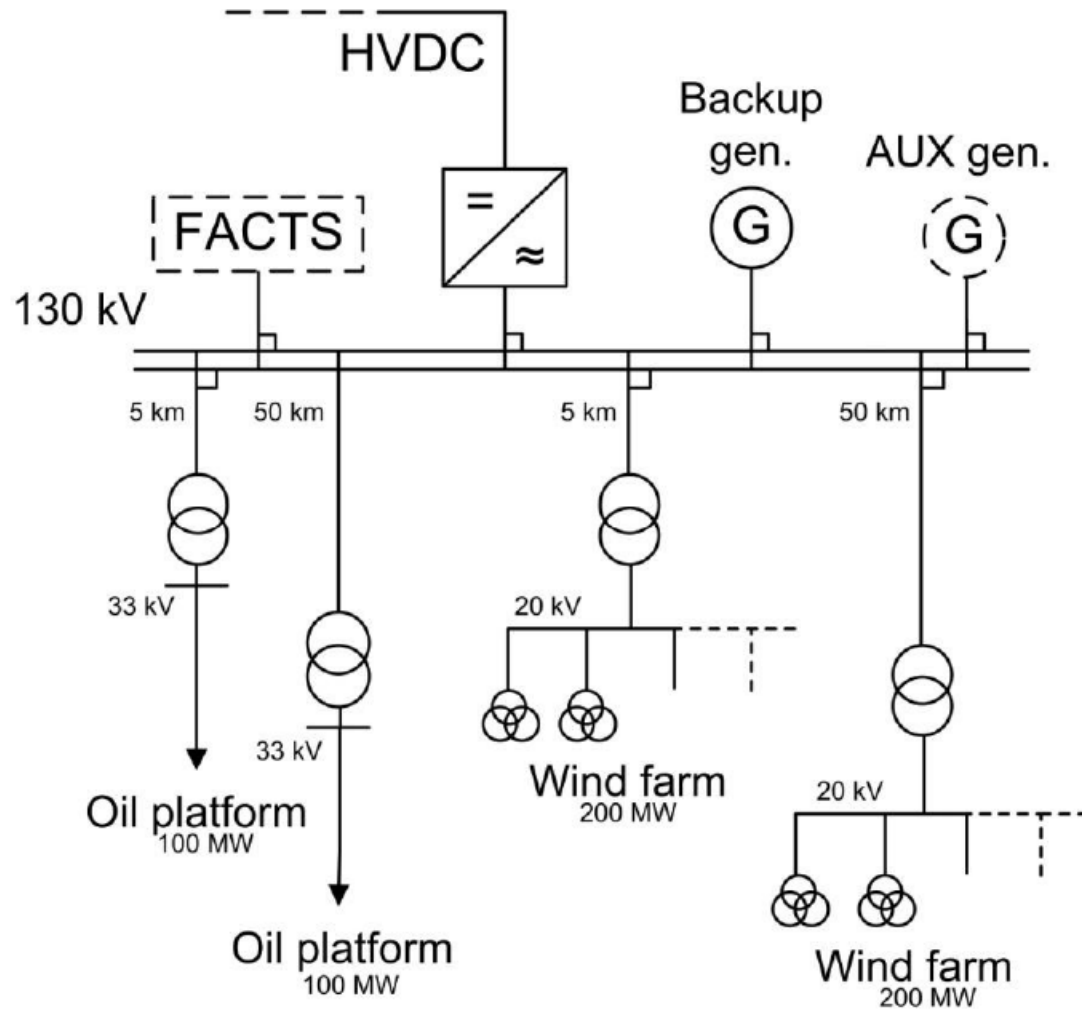
Investments in the main grid since 1963 and onwards



Development of Offshore grid

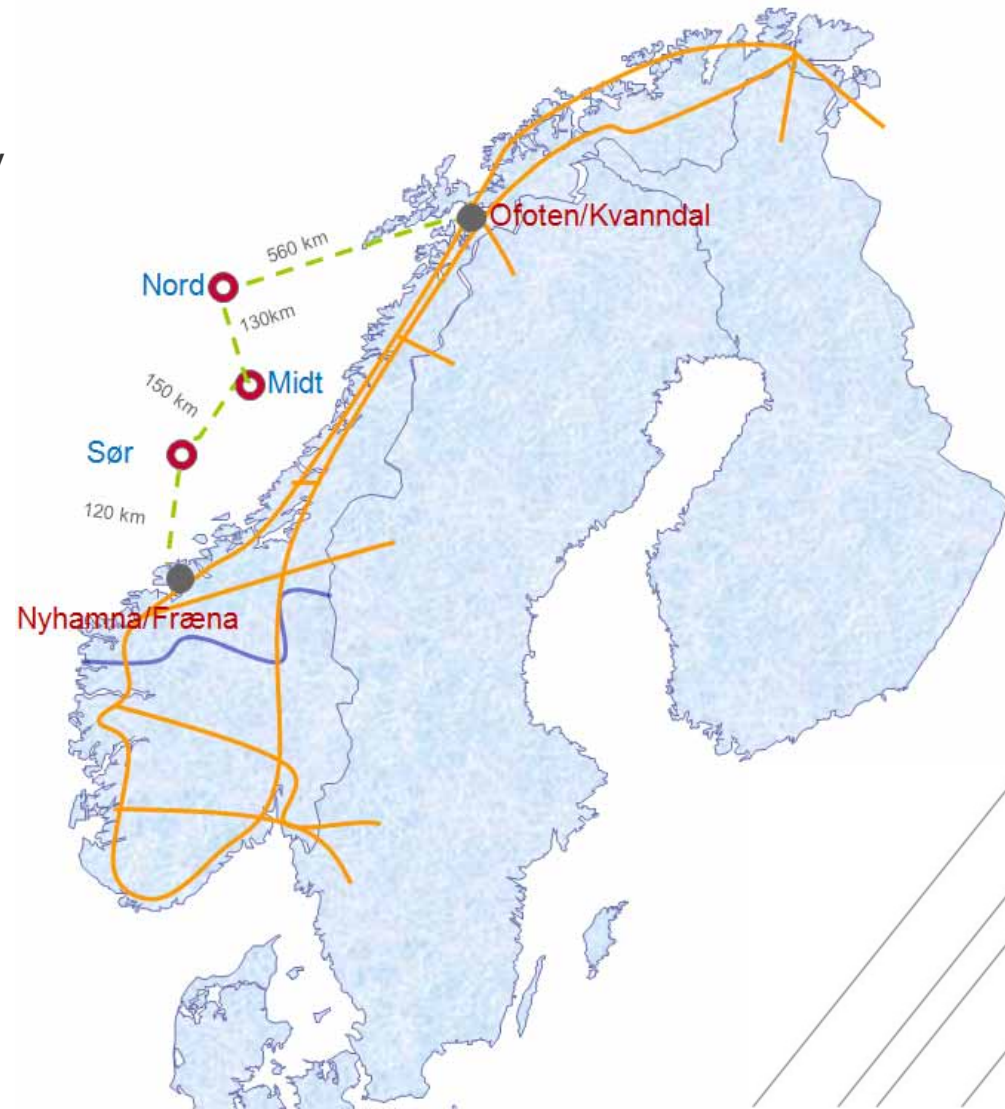


Offshore node





Offshore grid with floating nodes

- Example R&D with three "nodes"
 - Land terminals – 1000 MW capacity
 - Clusters for production and consumption – 400 MW capacity
- Meshed HVDC / HVAC grid
 - Redundancy
 - In parallel with AC-grid on land



Today's planning is mainly national

Wind park 

Offshore node 



Ekofisk

GB 33GW

GE 22GW

NL 6,5GW

R&D in Statnett

”Offshore grid – establishment and operation”

1 – Gradual development and co-operation

- Reports published with R&D institution - Solvina
 - ✓ Challenges within a DC-grid
 - ✓ Fault detection and protection scheme in a DC-grid

2 - Offshore node

- Model for 132 kV AC-node supplied from a DC-grid (Solvina)
- Workshops with Aker Solutions, ABB, Siemens and Areva
- SOLVINA-analysis of 132 kV AC-node 400 MW. Challenges and opportunities by combining offshore consumption and wind farm production in a 132 kV AC-grid connected to a DC-grid
- AKER SOLUTIONS, prestudy offshore node, fixed and floating

3 - Tapping of DC-cable

- Research on possibilities on how to tap power to low energy demanding consumers from large capacity cables

4 - Other research projects

- Economical contribution to larger offshore projects in R&D institutions

Offshore grid is technically feasible, but...

- Multi terminal VSC HVDC has not yet been delivered
- Only one contractor with a fixed (jacket) offshore project are operating
- DC breakers is a critical component
- High losses in VSC – AC/DC converters
- Deliveries from different suppliers have to interact in the same grid
- Demanding technical operation for on-land grid with many interconnectors

Offshore grid – regulatory challenges

- Different framework in different countries
- Developer prioritize areas with the most profitable solutions
- Some regulators do not allow direct energy flow from national renewable power plants directly to another nation
- Protectionist development – every nation and supplier eager for own industry development
- Different set of rules for grid connection
- Grid development on land caused by offshore wind – who pays?

Offshore power grid

- some reflections

- Focus for the time being is national goals and national thinking
- Modular development from national contractors in the southern part of the North Sea
- Different technical standards and markets at both ends of the interconnectors
- Electrification of oil and gas installations may contribute to development of an offshore power grid on Norwegian shelf
- Offshore wind may be a driver if the society is willing to pay the price, including subsidies

Main message

- Not very strong incentives for an international offshore grid
 - Though electrification of oil and gas installations may contribute in a positive way
- Offshore grid are technically feasible but are very demanding
 - Complicated structures with many countries involved – standardization and harmonization is needed
- Norwegian hydro power can contribute with balancing power in the European cooperation towards a low carbon society
- Statnett works actively through ENTSO-E related to interconnectors, a possible offshore grid and European market development
- **Offshore grid will become a reality when the drivers are strong enough**