



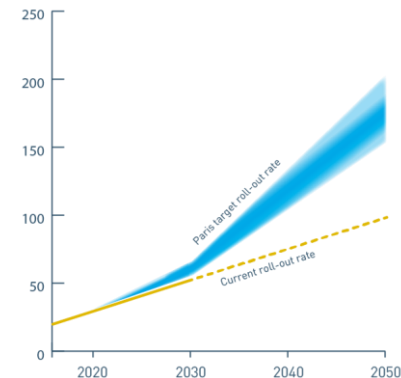
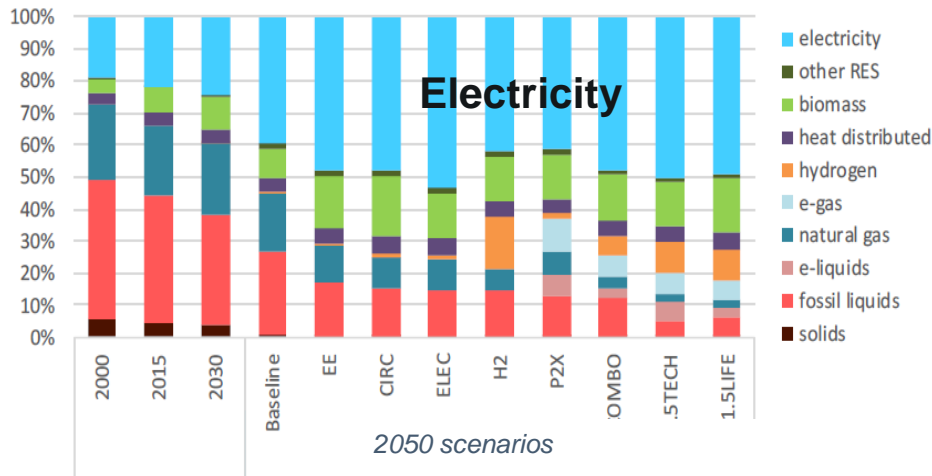
North Sea
Wind Power Hub
Programme

North Sea Wind Power Hub

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Project Scoping



The energy transition and North Sea offshore wind



Limiting global warming to well below 2 °C and pursue below 1.5 °C, ...

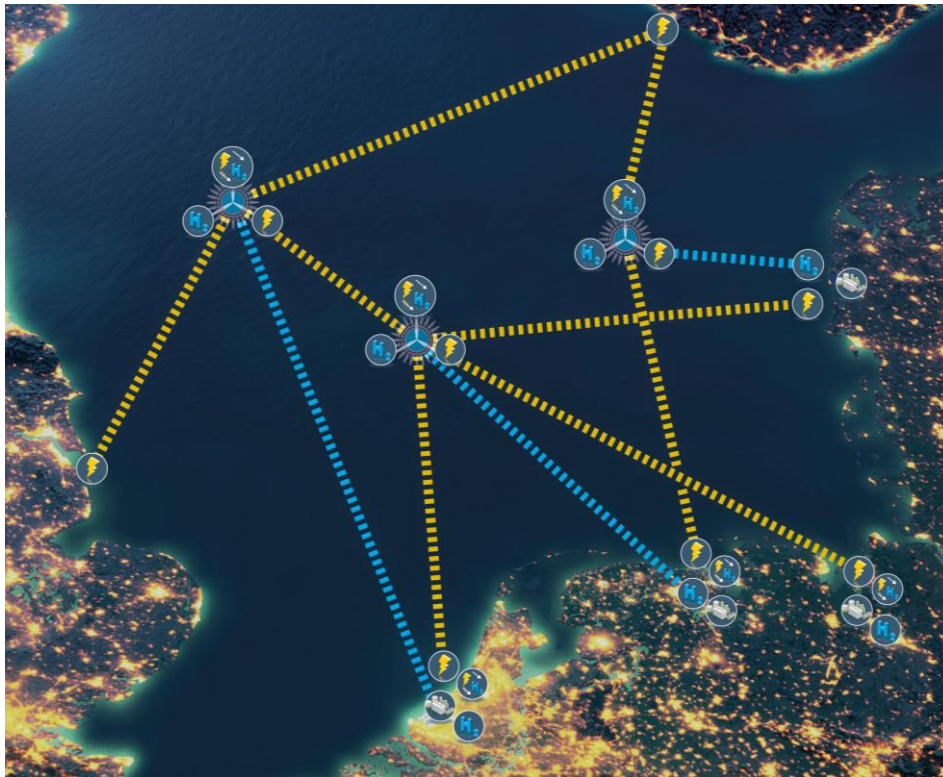
... requires a swift and massive change in the energy system, ...

... including ~180 GW offshore wind, 50-80 GW of inter-connectors⁽¹⁾, 140 TWh of seasonal storage and

... an accelerated and steady deployment of offshore wind internationally coordinated








¹ Translate COP21: 2045 outlook and implications for offshore wind in the North Seas (Ecofys 2017)

Modular hub-and-spoke concept for offshore wind

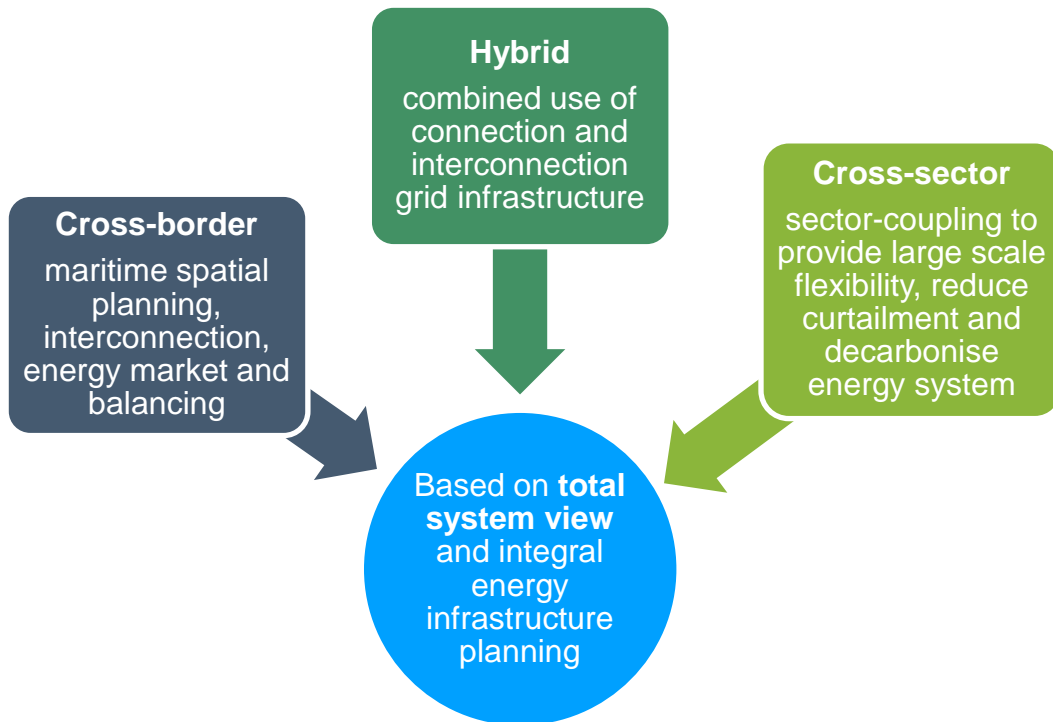


Grid integration is key issue for large-scale offshore wind

- Connecting 180 GW of offshore wind with 'conventional' approach (radially) is not possible
- A strong offshore connected grid reduces onshore congestion and need for grid reinforcements
- Significant seasonal storage will be required for the North Sea countries towards 2050.
- Power-to-Gas will be needed in the future to address seasonal storage, balancing and long distance energy transport

-  Electricity connection point
-  H2 connection point
-  P2X conversion
-  Gas to power conversion
-  Electricity connection
-  H2 connection
-  End User

Change in approach is required to enable hybrid projects





What is needed to enable offshore hybrid projects?

- **Political ambition and intensive cooperation between countries**
- **Long term targets and investment perspective** for wind farms and offshore infrastructure (incl. anticipatory investments)
- **Incentives to internationalise national projects**
- **Cost-benefit analysis methodology (CBA)** for offshore hybrid projects
- **Clarity on price formation and market setup** for offshore wind farms at a hub
- **Interoperability of HVDC systems:** creating standards or incentives for the interoperability of systems from different suppliers