The background image shows a coastal scene with waves washing onto a sandy beach. In the distance, there is an offshore oil or gas platform and a wind turbine. Several seagulls are flying in the sky. The overall color palette is dominated by blues and greens, with a semi-transparent teal overlay on the left side.

**North
Sea
Energy** offshore
system
integration

Offshore System Integration

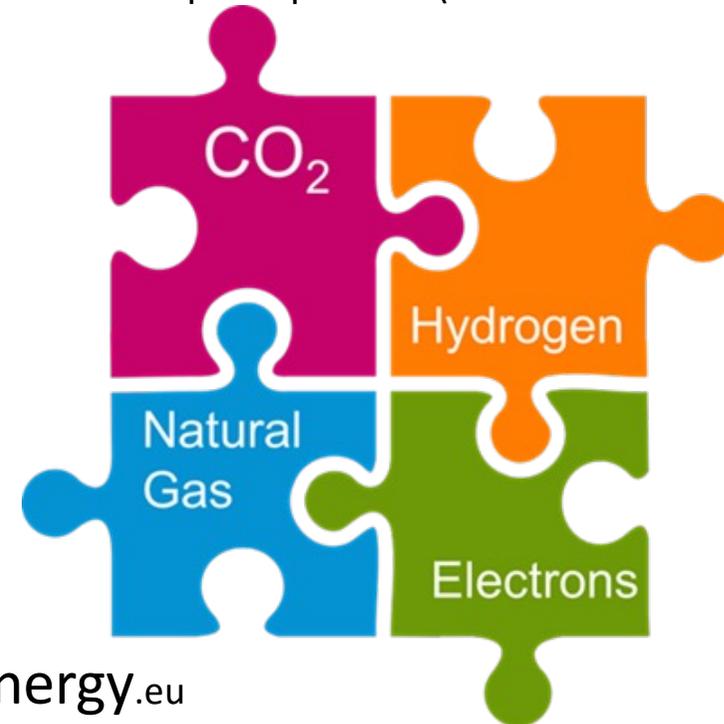
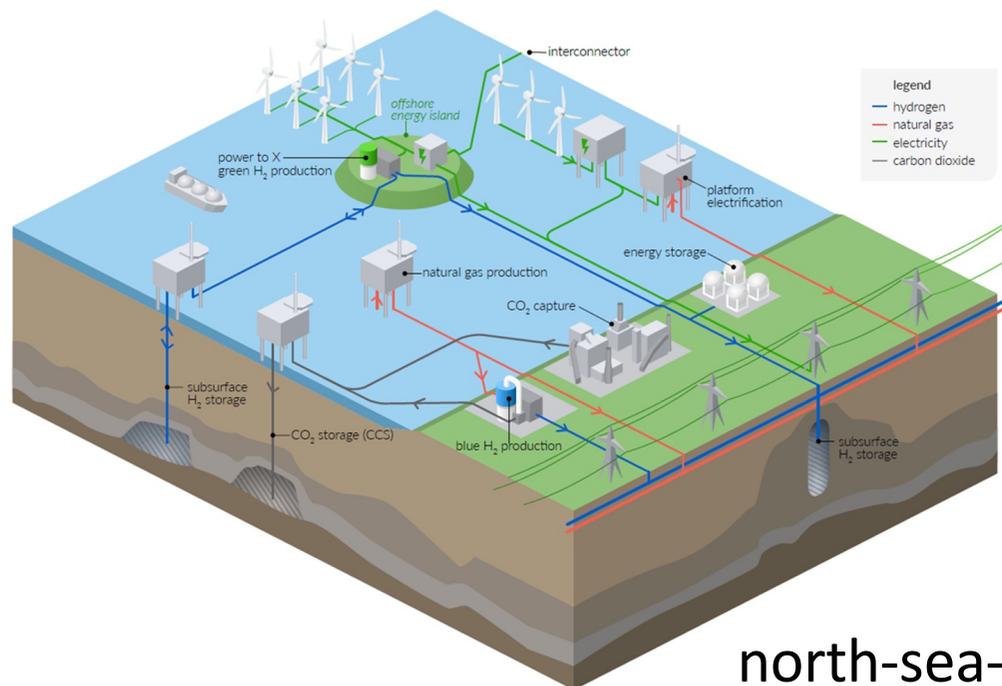
Enabling the acceleration of the energy transition

11 October 2022

Rene Peters – TNO / North Sea Energy Program

North Sea Energy Program

- NSE is a pre-competitive Shared Innovation Program to develop new concepts for offshore system integration
- Smart offshore connections will save society costs, time, space, ecological impacts and CO₂ emissions.
- Use the potential of the North Sea as a pioneer region for the European Green Deal & RePowerEU.
- Initiates pilots and projects to test and demonstrate innovative concepts in practice (such as PosHYdon).



north-sea-energy.eu

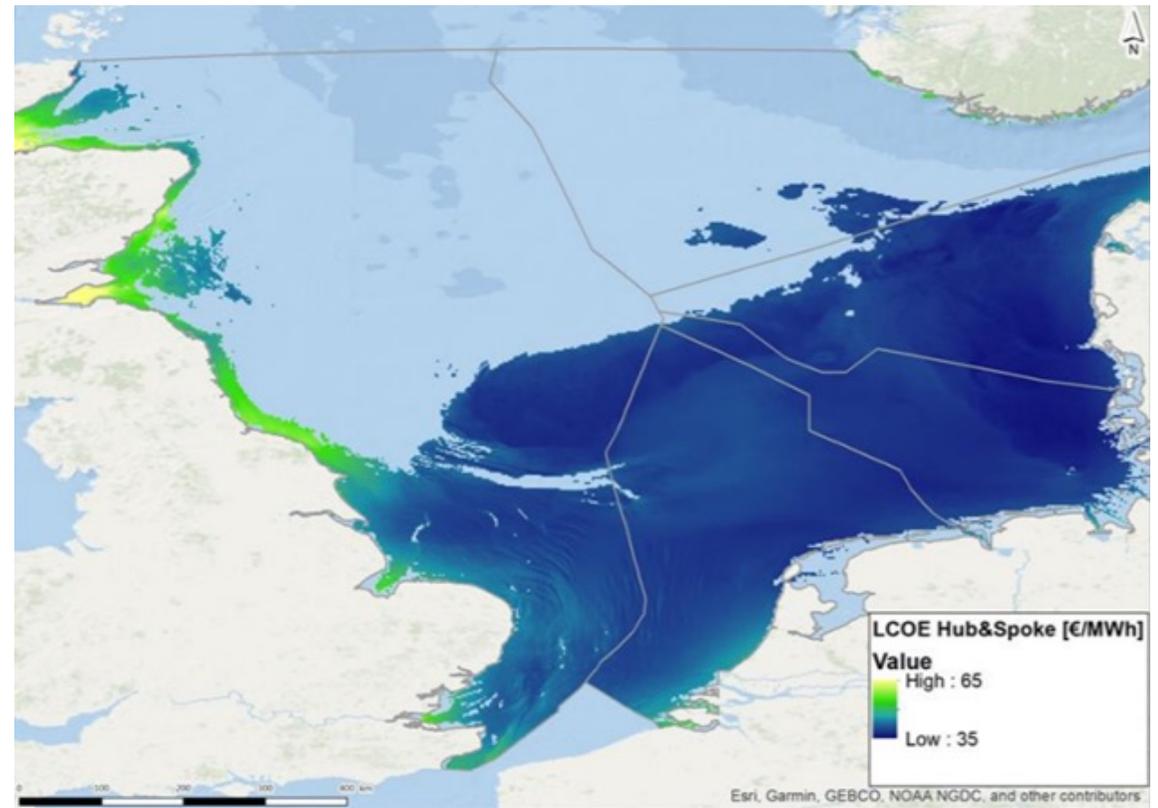
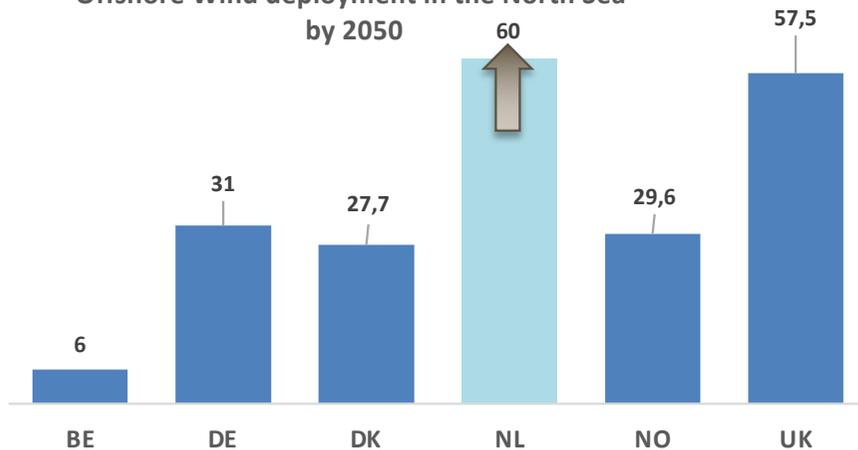
Offshore wind in the Netherlands and EU

Vast potential and pivotal to reach Paris targets.

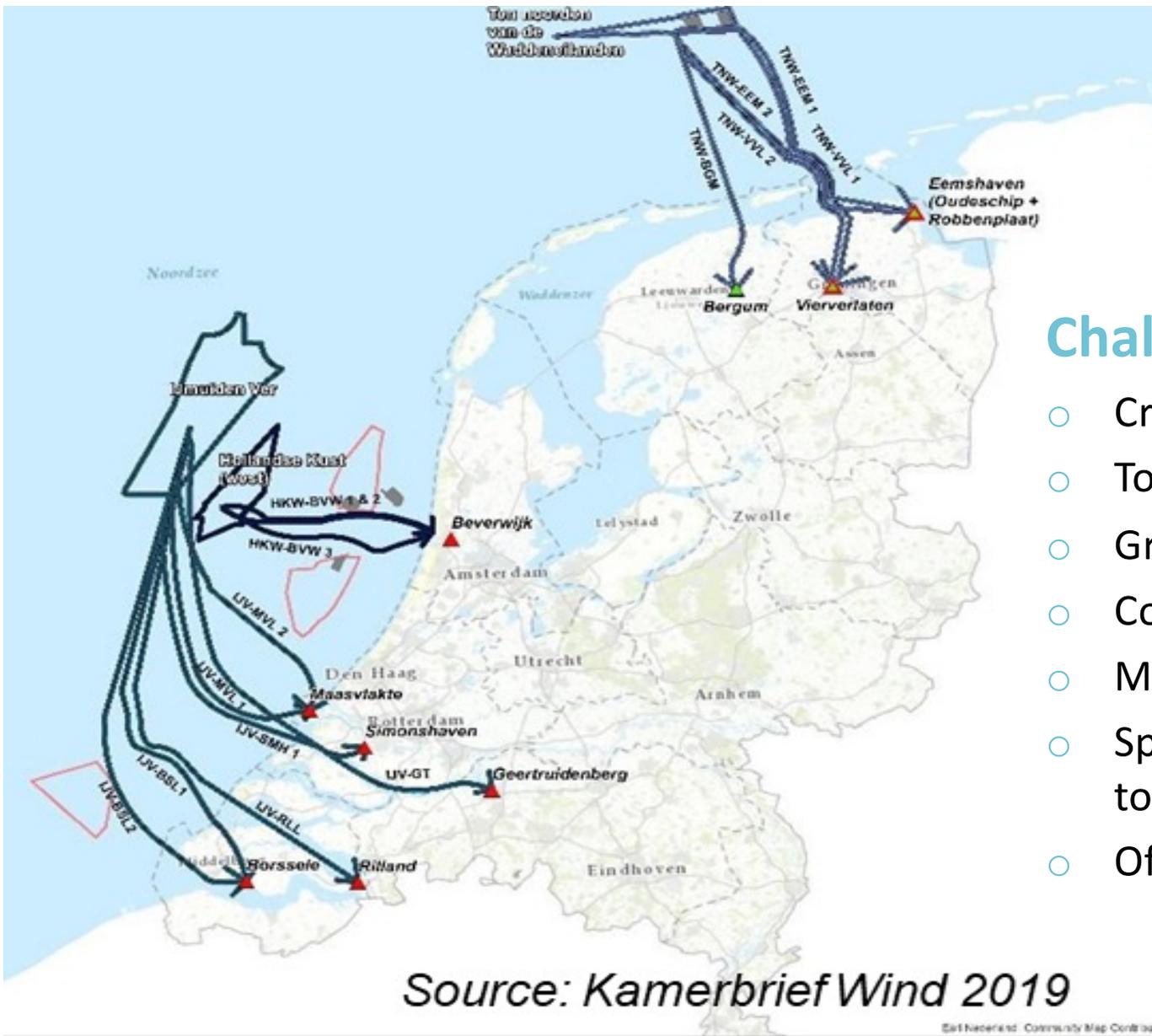
NL ambitions:

- 2023: 4.5 GW installed
- 2030: 21 GW installed – all electric
- 2040: 50 GW installed – partly H2
- 2050: 70 GW total capacity

Offshore Wind deployment in the North Sea by 2050



North Sea Wind Power Power Hub Consortium, "Cost evaluation of the North Sea - Offshore Wind Post 2030," 2019.

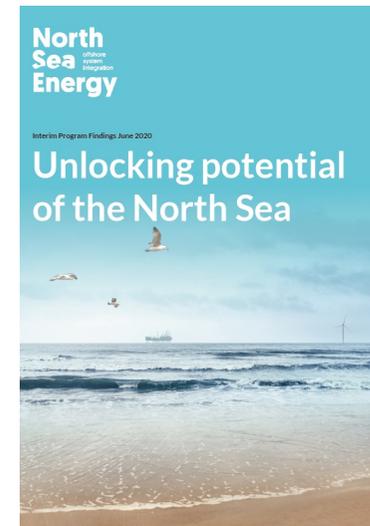
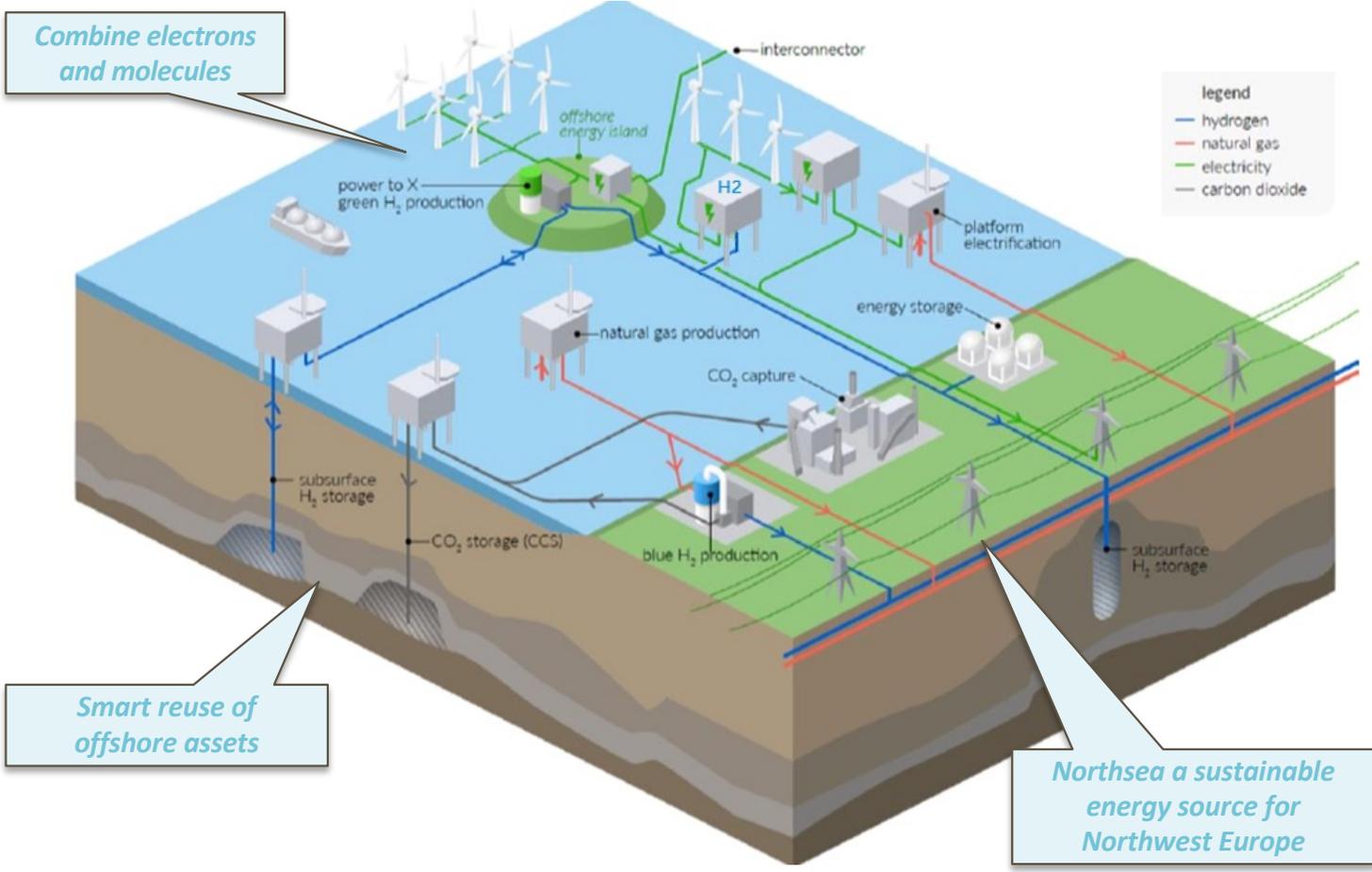


Challenge:

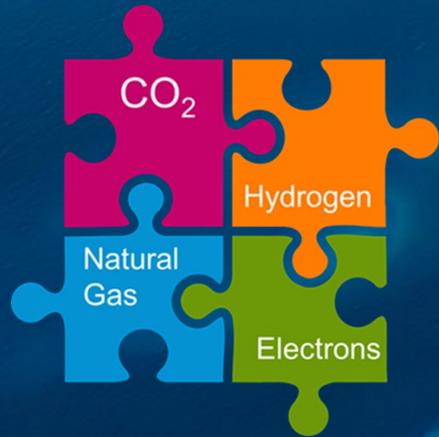
- Crossings Waddenzee area
- Total capacity of the grid
- Grid stability / energy storage
- Conversion near shore needed
- Maximum capacity reached at 2031
- Space limitations drives conversion towards offshore
- Offshore system integration needed

Future: hubs, electrons and molecules

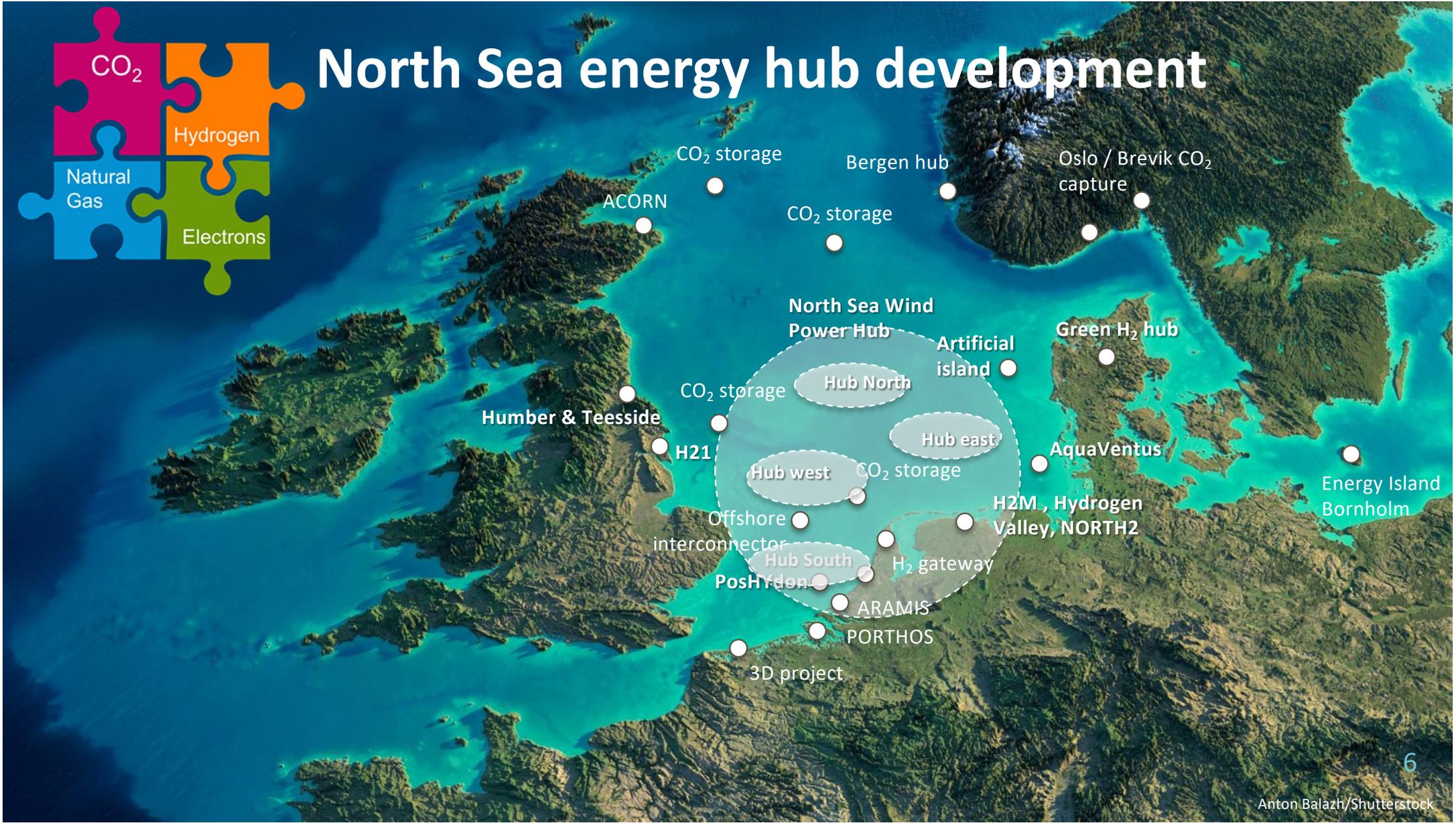
- Offshore wind
- Electrification
- H2 production
- Energy storage
- CO2 storage
- Energy Hubs



www.north-sea-energy.eu



North Sea energy hub development

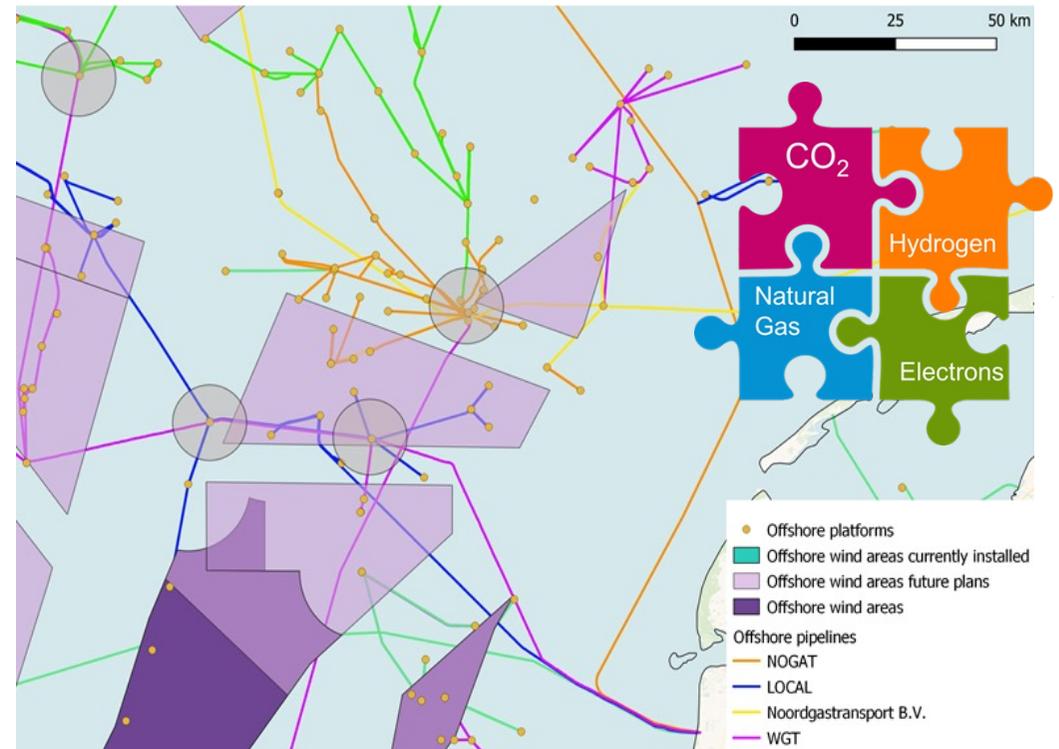


Example for HUB WEST

System integration and multifunctional spatial use

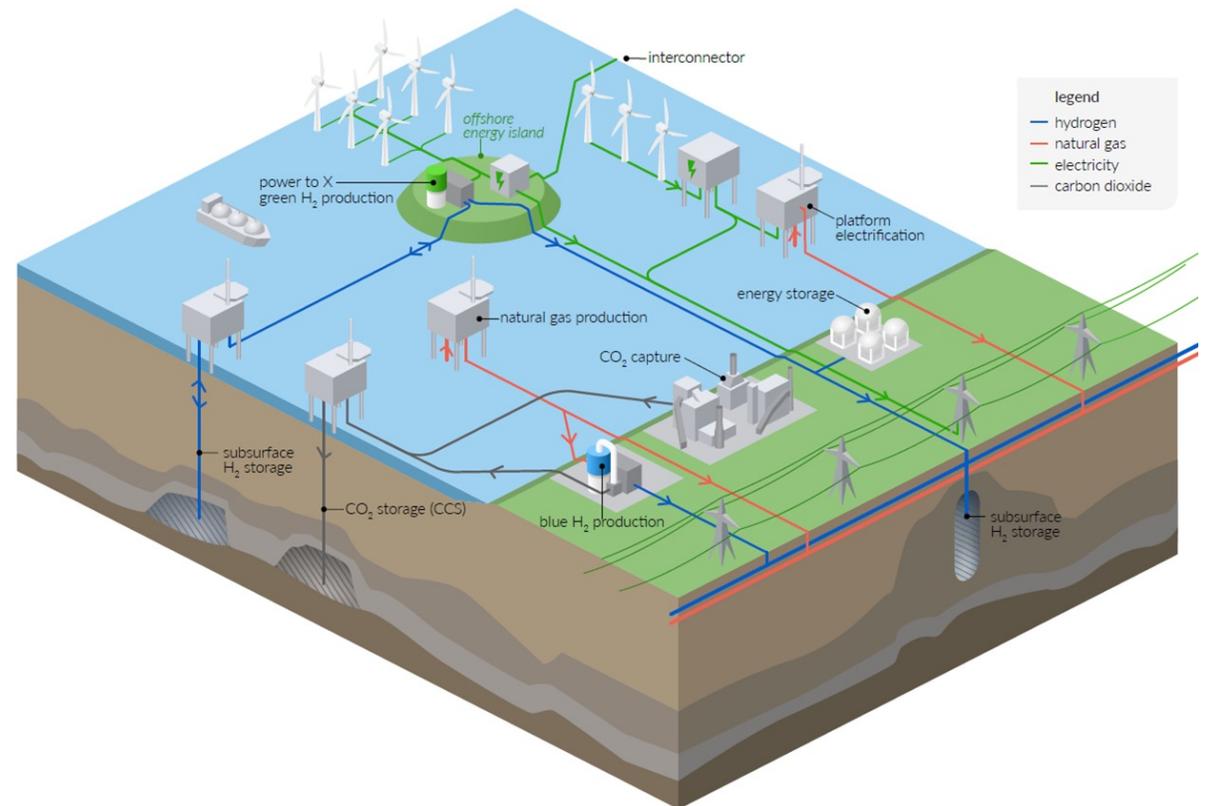
Joint developments in this Hub

- Gas production with electrification (K14)
- Wind development (Lagelander)
- CO2 transport and storage (Aramis)
- Green Hydrogen production (Pilot)
- H2 transport (co-use, re-use, new)



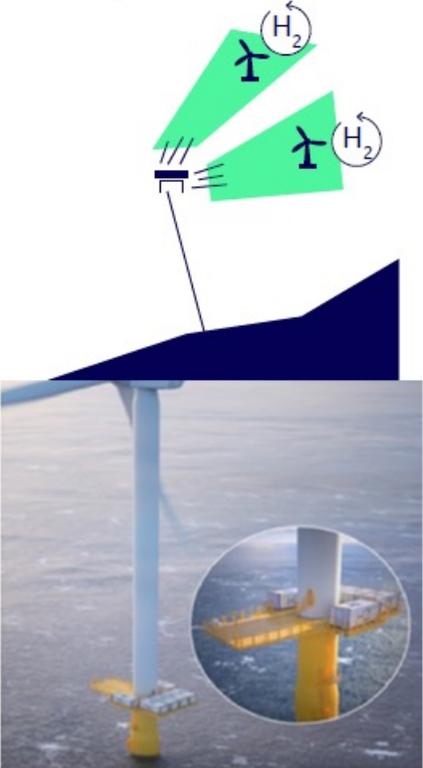
Potential Energy Hub functions

- Offshore Renewable Energy collection & Transmission
- CO₂ transport & storage
- **Green Hydrogen Production & Transport**
- Energy storage: subsurface hydrogen storage
- Electrification of hydrocarbon production
- Natural gas production (green field)



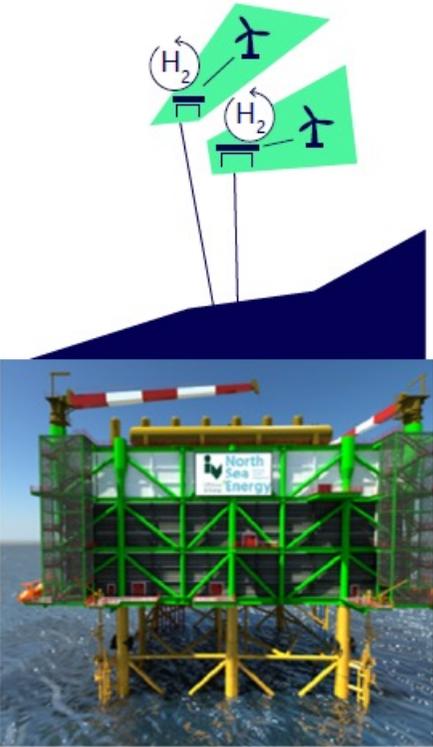
Concepts for offshore hydrogen production

Electrolysis at the wind turbine side



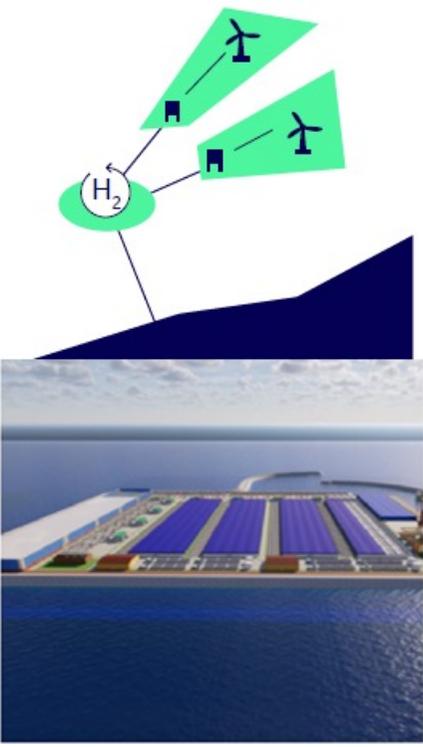
Decentralised in the wind turbine
Scale: 10 - 20 MW

Electrolysis on one or more platforms



Centralised on a platform
300 - 500 MW

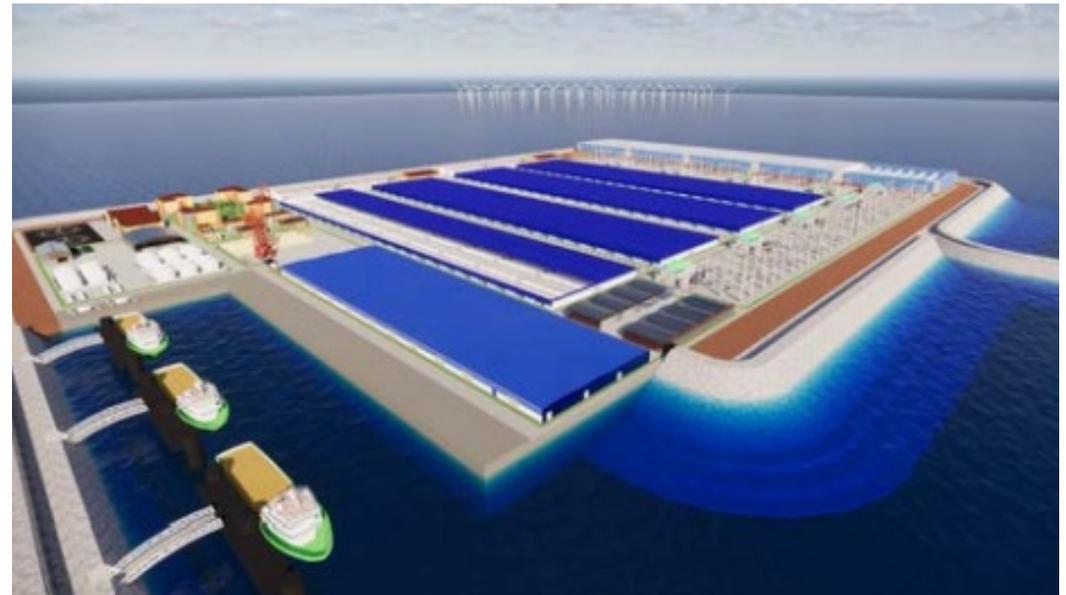
Electrolysis on an island



Large scale on an island
1 - 10 GW

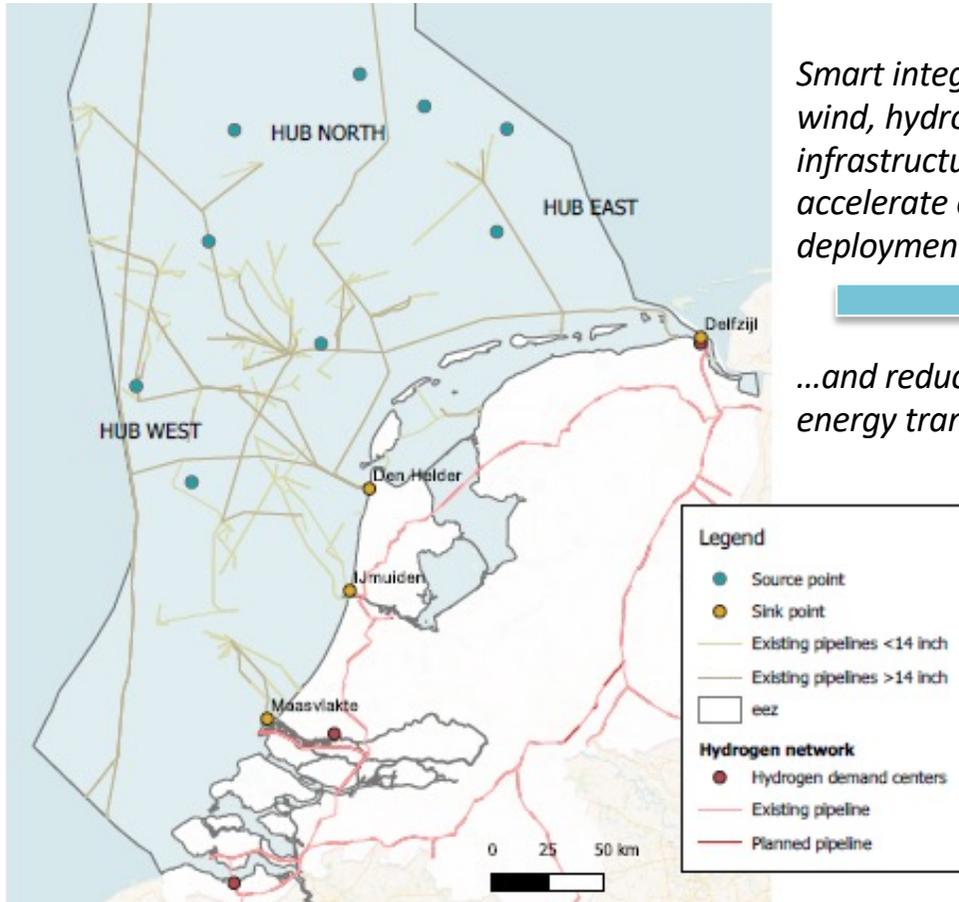
Example: Hydrogen production offshore

- Centralised or decentralised concepts
- Platform structures, artificial energy islands or in-turbine solutions
- Scale up of offshore hydrogen has other drivers than onshore hydrogen production



North Sea Energy Infrastructure strategy

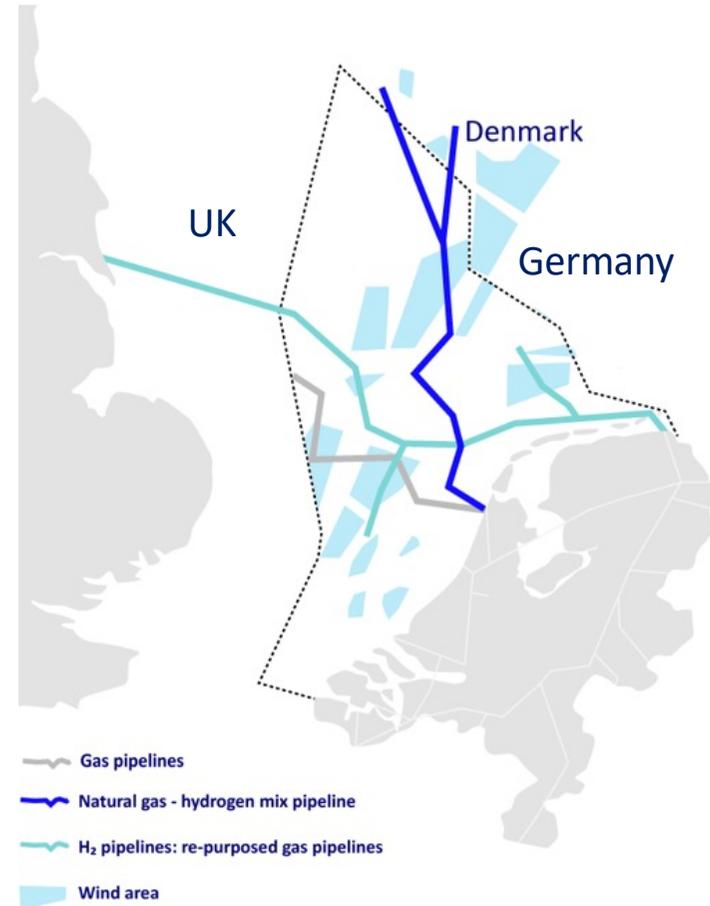
Requires integration and interconnection



Smart integration of wind, hydrogen and infrastructure can accelerate offshore wind deployment...



...and reduce the cost of energy transport.



North Sea Energy

offshore
system
integration



More information on NSE: www.north-sea-energy.eu

