

# Offshore System Integration

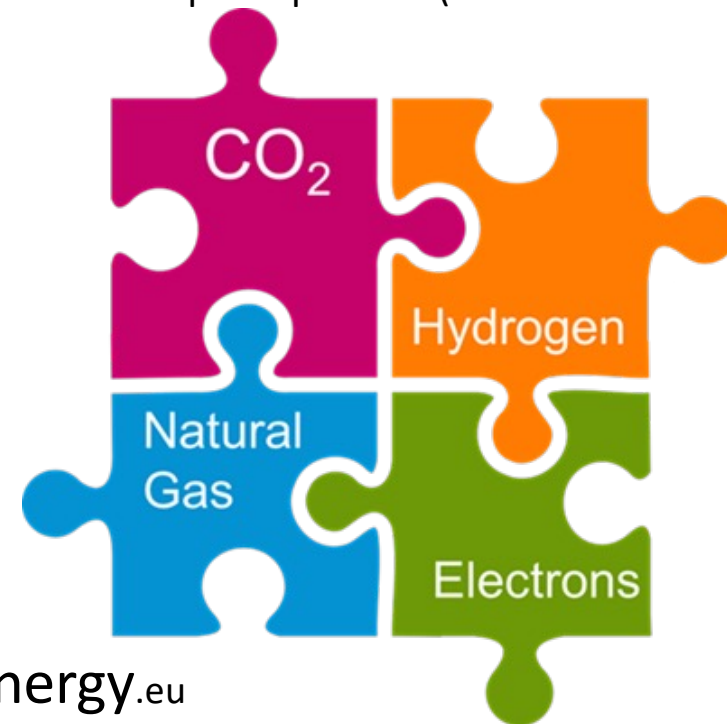
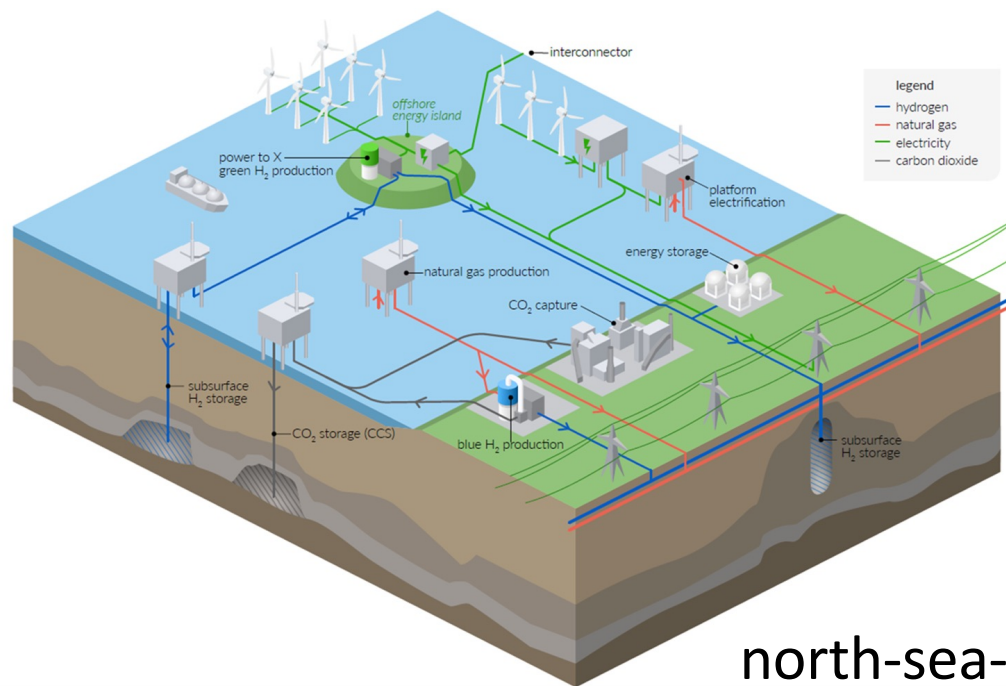
*Enabling the acceleration of the energy transition*

**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 CO<sub>2</sub> 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).



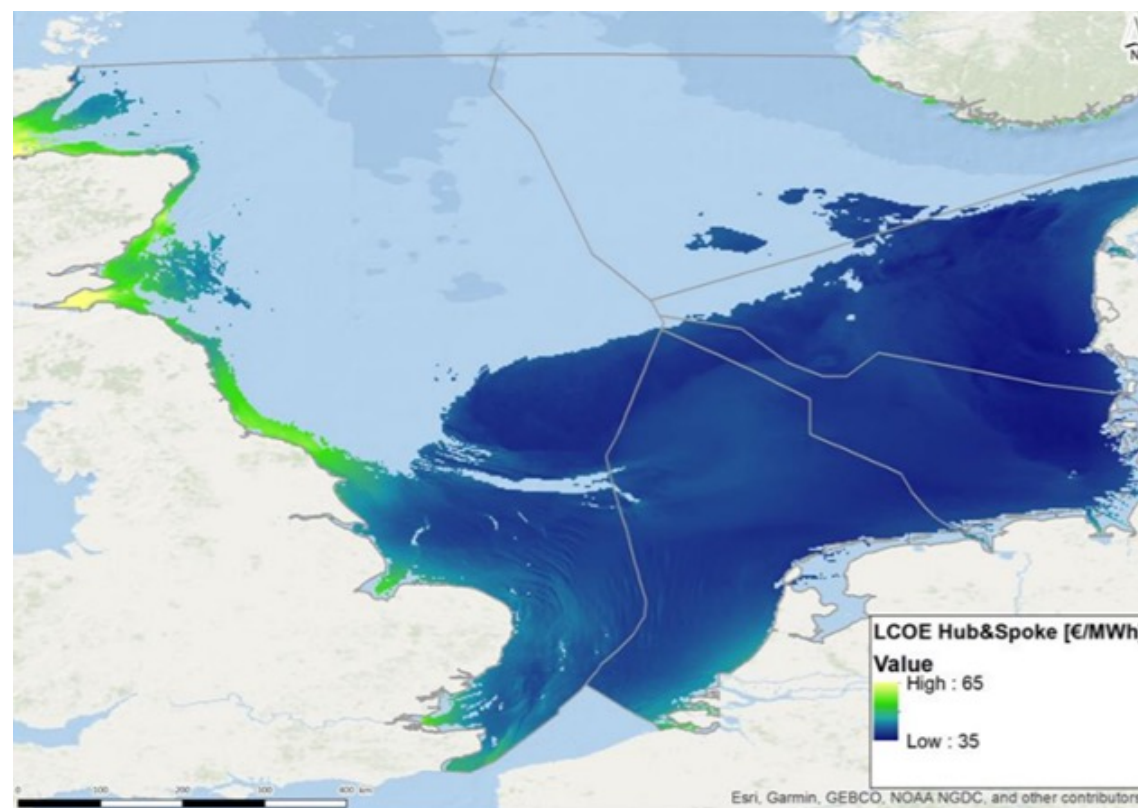
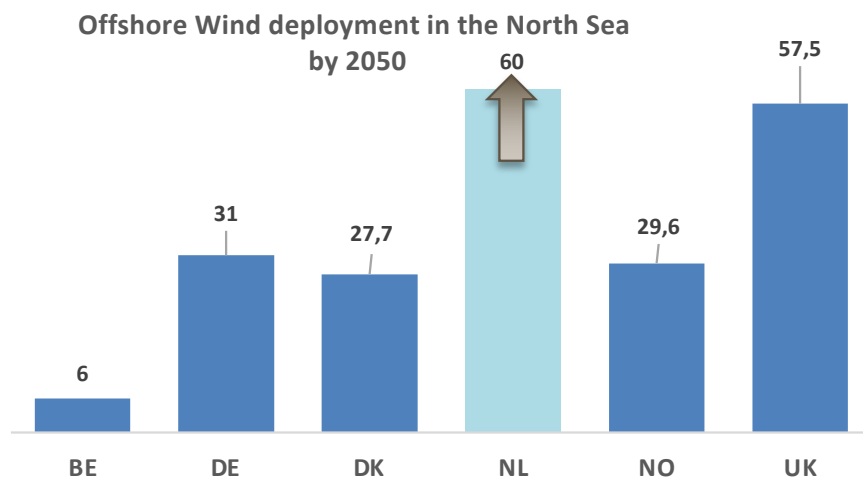
north-sea-energy.eu

# Offshore wind in the Netherlands and EU

## Vast potential and pivotal to reach Paris targets.

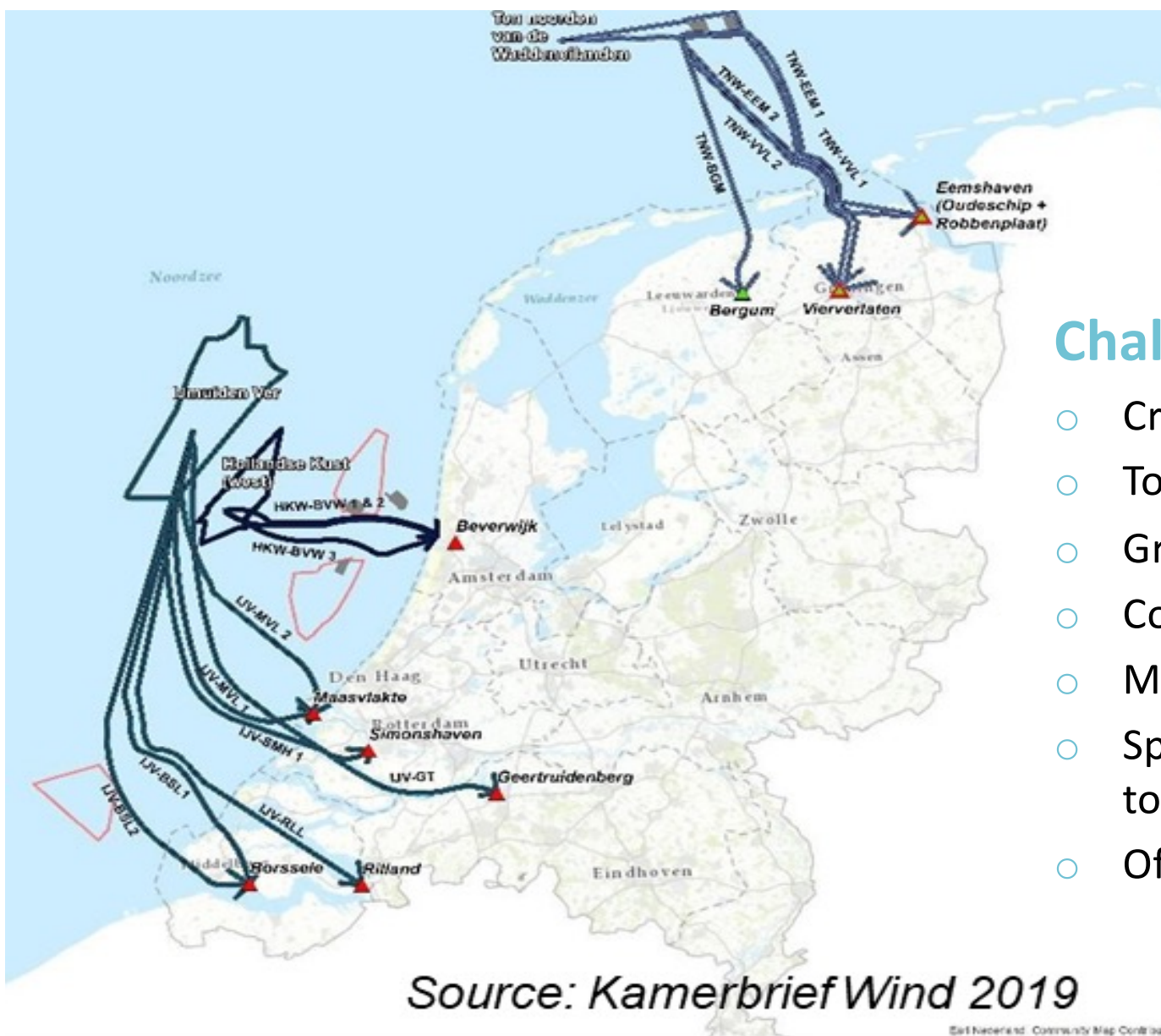
NL ambitions:

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



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



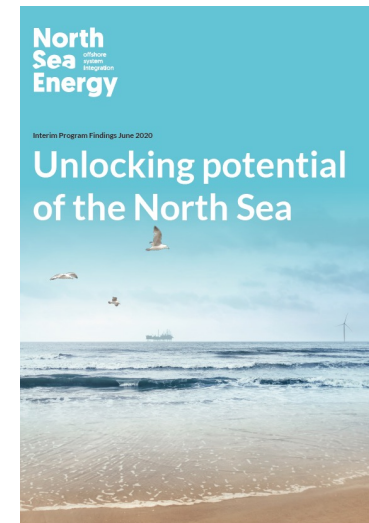
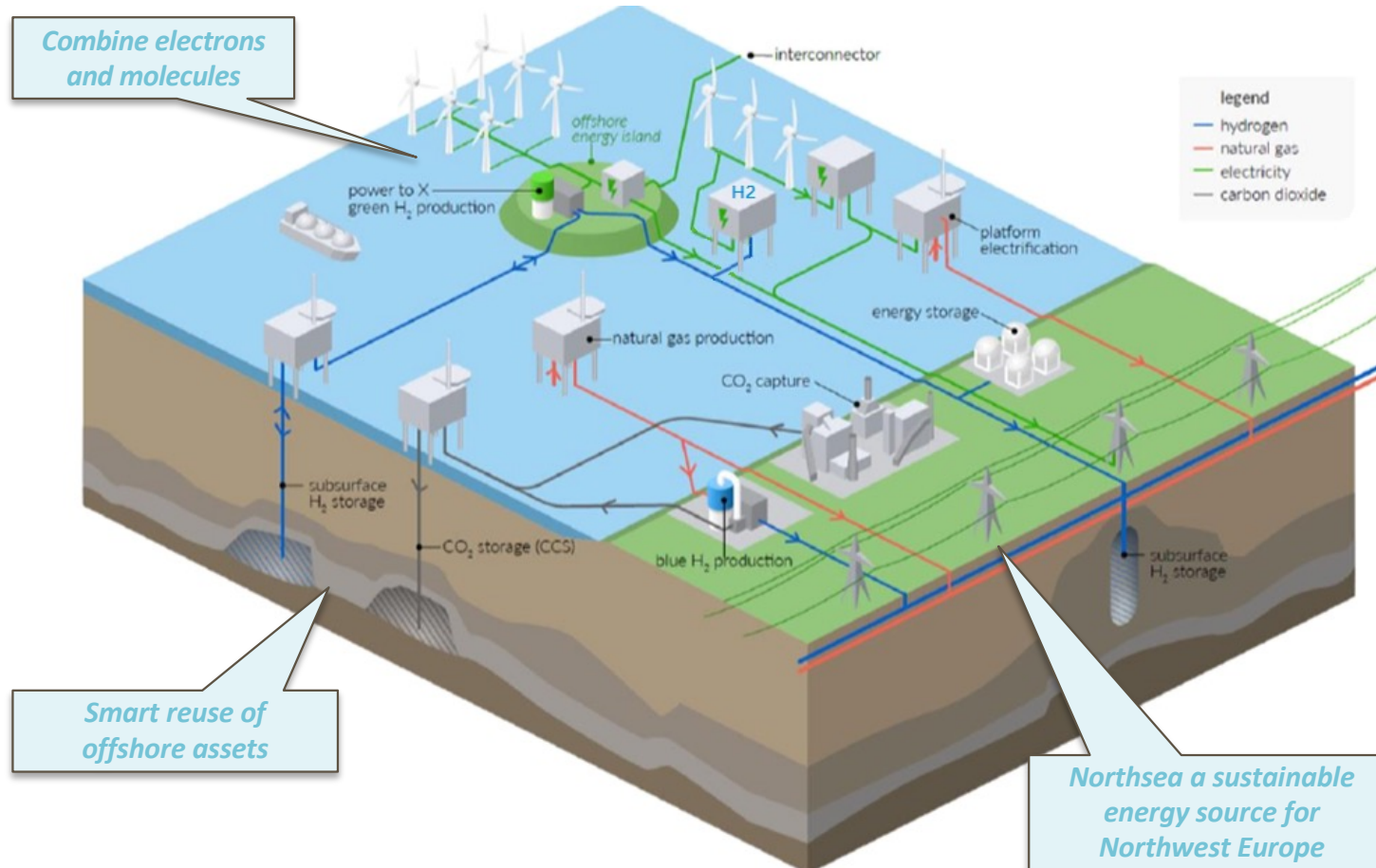


## Challenge:

- 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

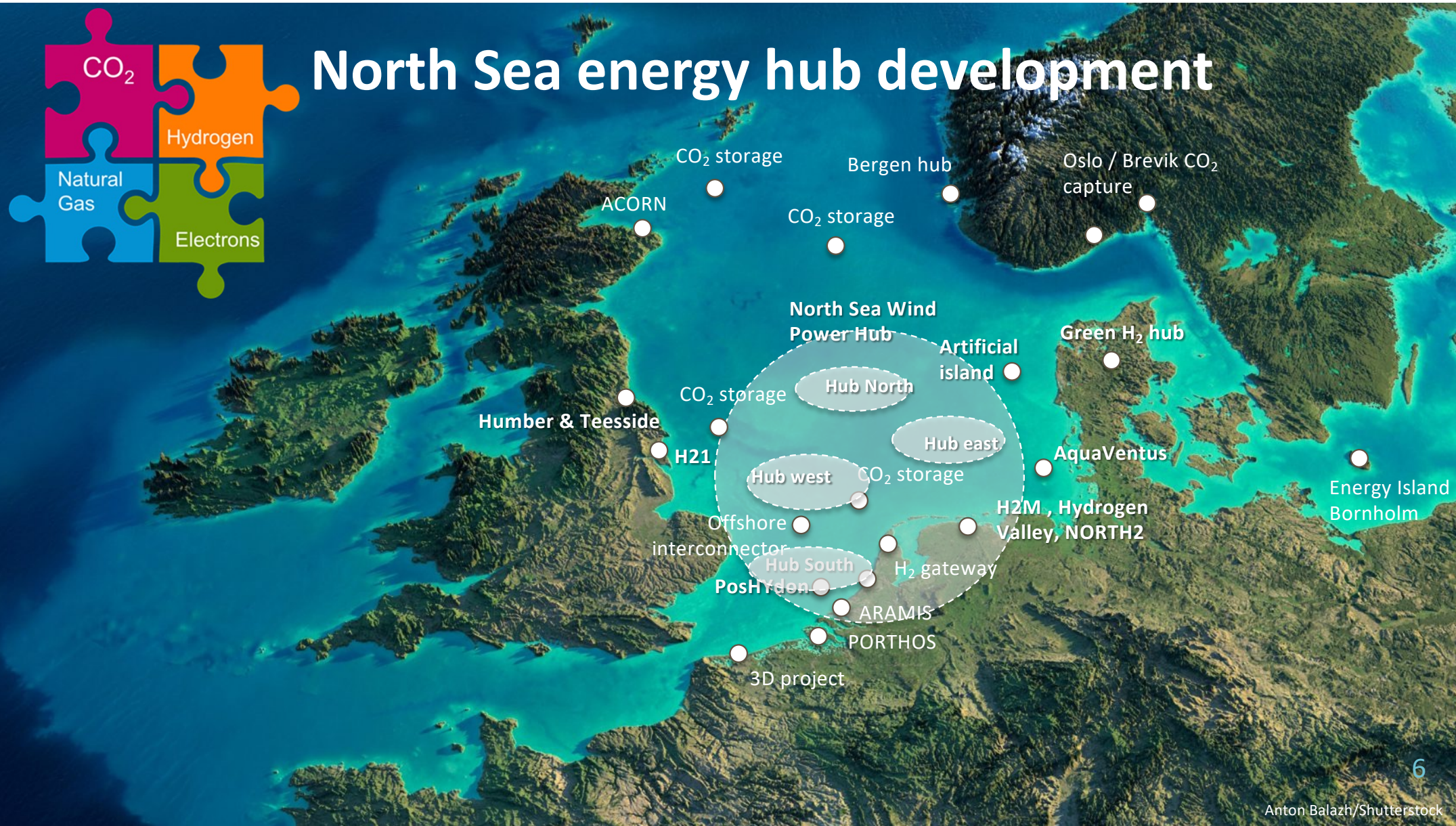
# Future: hubs, electrons and molecules

- Offshore wind
- Electrification
- H<sub>2</sub> production
- Energy storage
- CO<sub>2</sub> storage
- Energy Hubs



[www.north-sea-energy.eu](http://www.north-sea-energy.eu)





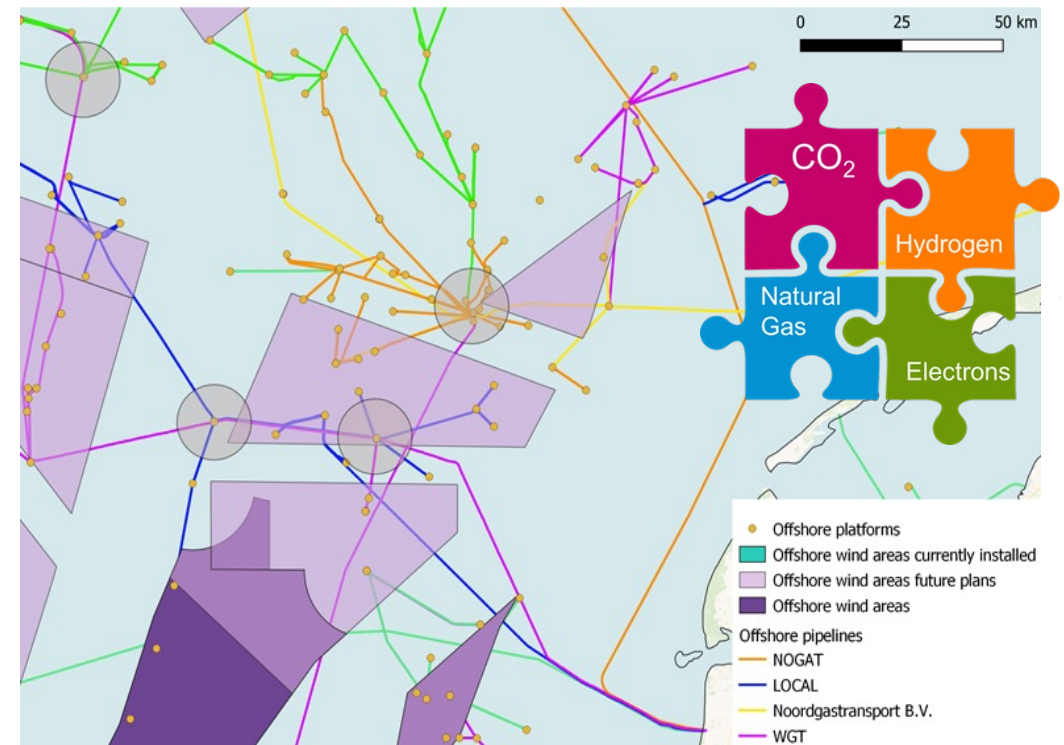


# Example for HUB WEST

## System integration and multifunctional spatial use

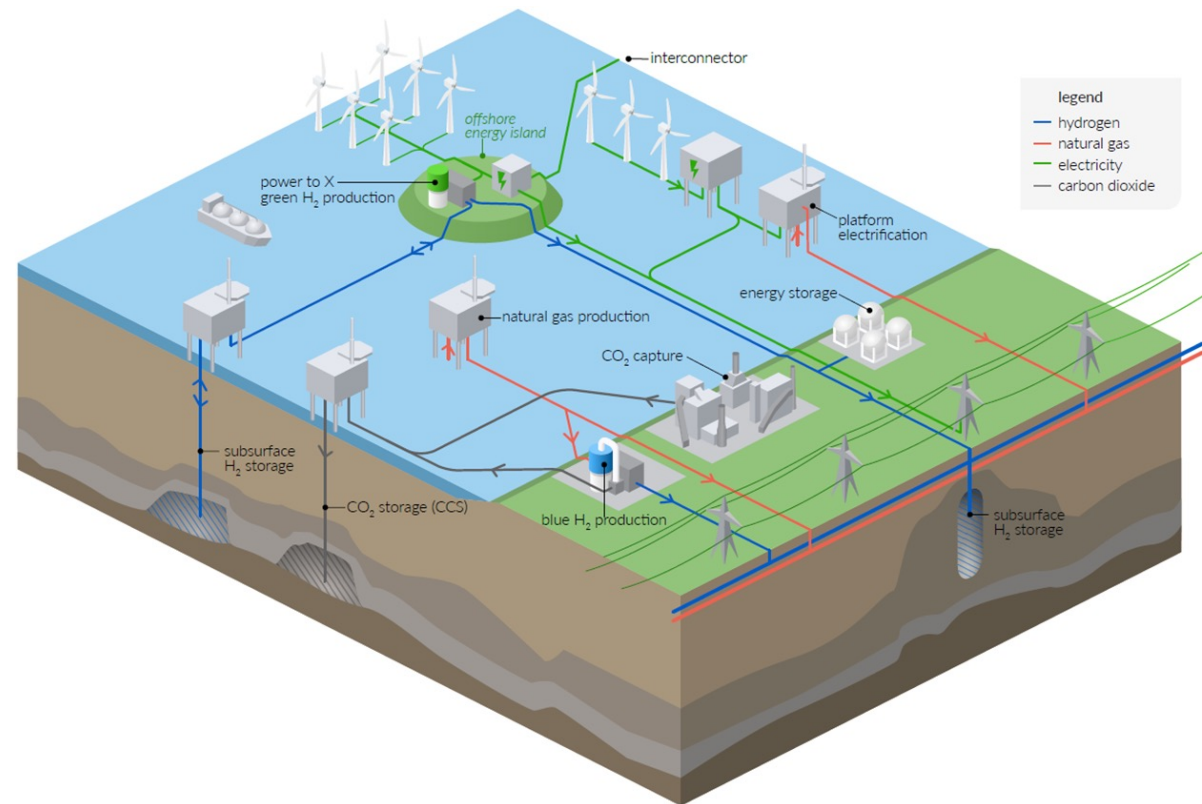
Joint developments in this Hub

- Gas production with electrification (K14)
- Wind development (Lageland)
- CO<sub>2</sub> transport and storage (Aramis)
- Green Hydrogen production (Pilot)
- H<sub>2</sub> transport (co-use, re-use, new)



# Potential Energy Hub functions

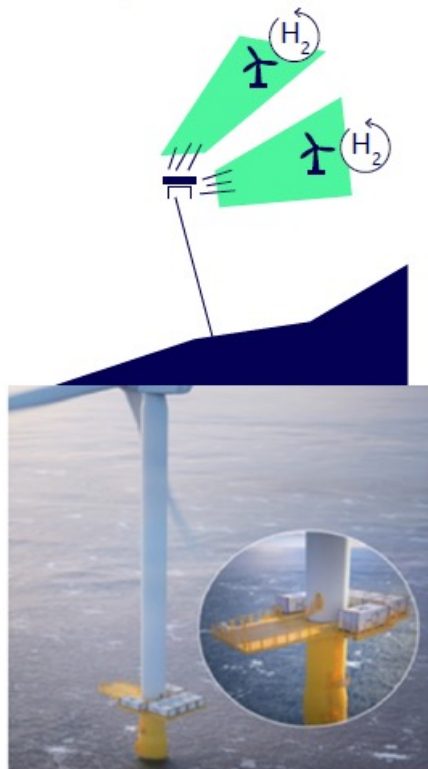
- Offshore Renewable Energy collection & Transmission
- CO<sub>2</sub> transport & storage
- **Green Hydrogen Production & Transport**
- Energy storage: subsurface hydrogen storage
- Electrification of hydrocarbon production
- Natural gas production (green field)





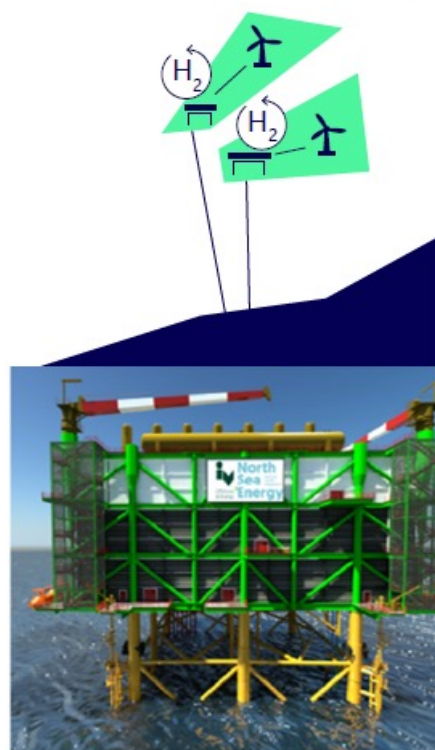
# Concepts for offshore hydrogen production

Electrolysis at the wind turbine side



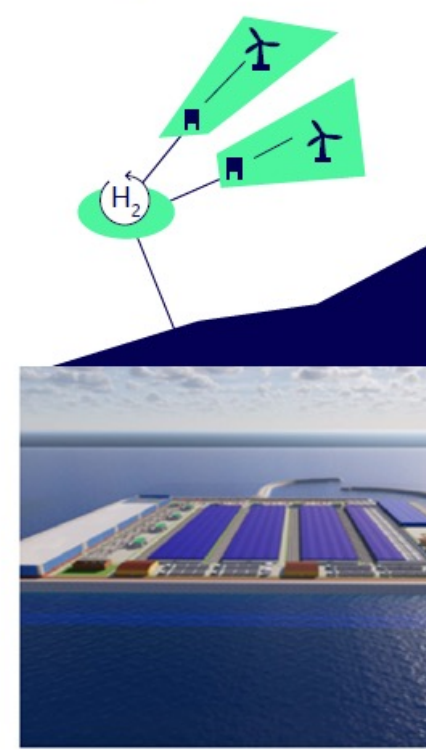
**Decentralised  
in the wind turbine**  
Scale: 10 – 20 MW

Electrolysis on one or more platforms



**Centralised  
on a platform**  
300 – 500 MW

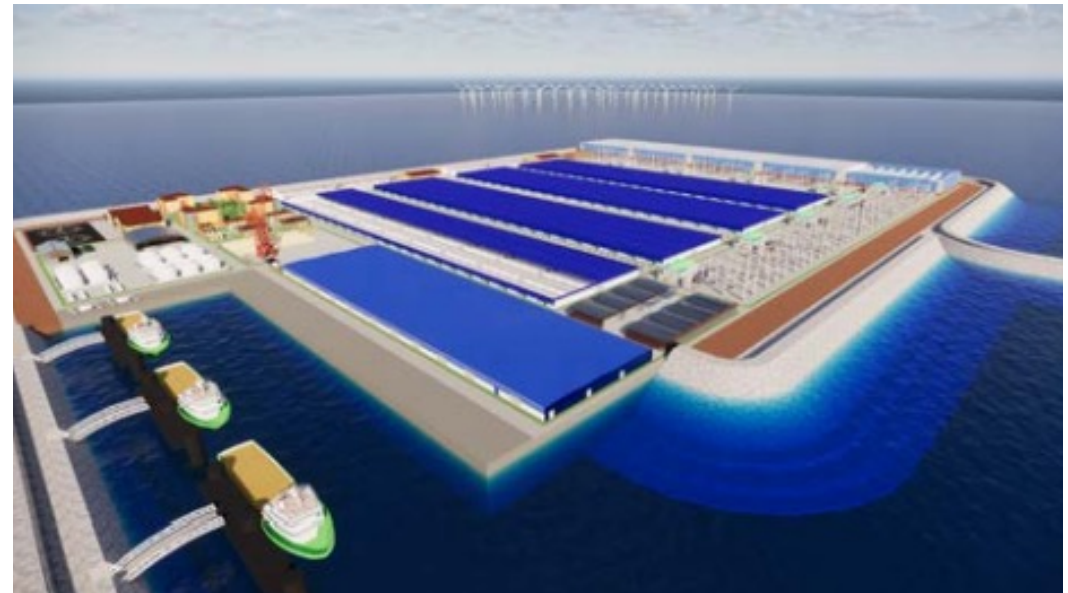
Electrolysis on an island



**Large scale  
on an island**  
1 – 10 GW

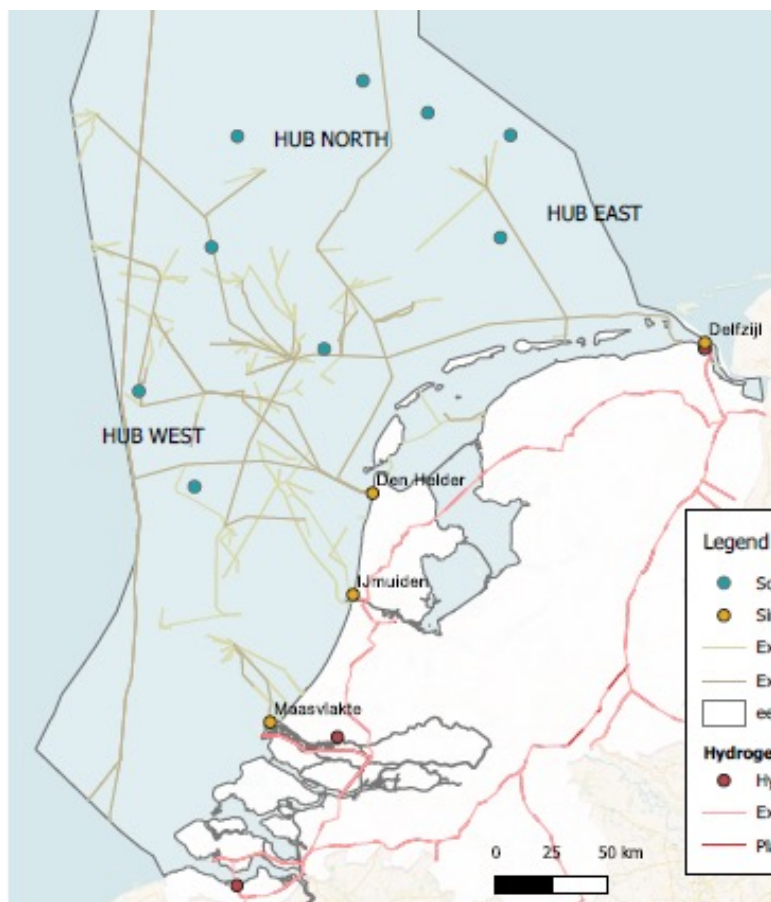
# Example: Hydrogen production offshore

- 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

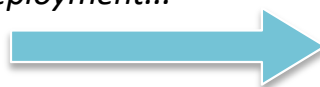


# North Sea Energy Infrastructure strategy

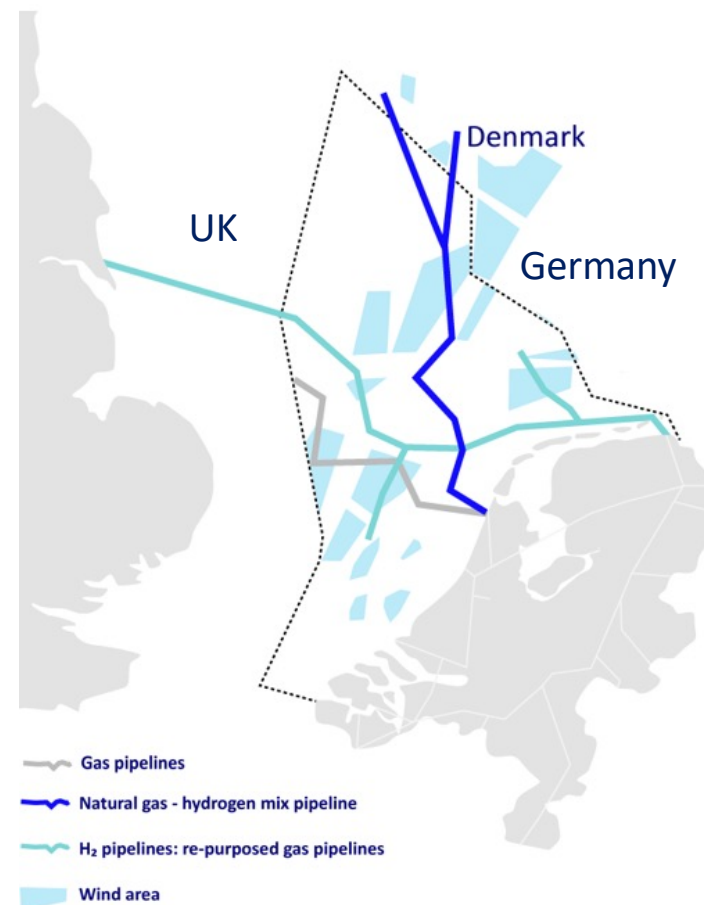
## Requires integration and interconnection



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



*...and reduce the cost of energy transport.*





## What we delivered in NSE4: across borders and disciplines (final publication on Nov 7)



## Techno-economic fundamentals



## 360° perspectives: international scope and perspectives from society and nature



## Identify barriers and new opportunities:

- Legal and policy framework North Sea countries
- Synergy in shared offshore logistics
- Safety considerations of offshore hydrogen production



## Action based roadmap towards net zero North Sea 2050

- Energy system modelling NW European energy system
- why, what, where, when, who

# North Sea Energy

offshore  
system  
integration



More information on NSE: [www.north-sea-energy.eu](http://www.north-sea-energy.eu)

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