



North Sea
Wind Power Hub programme

How to connect and integrate 180 GW of offshore wind?

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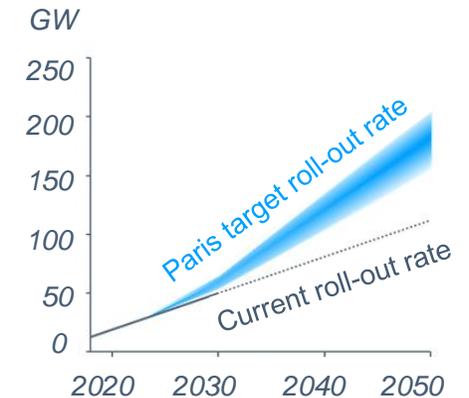
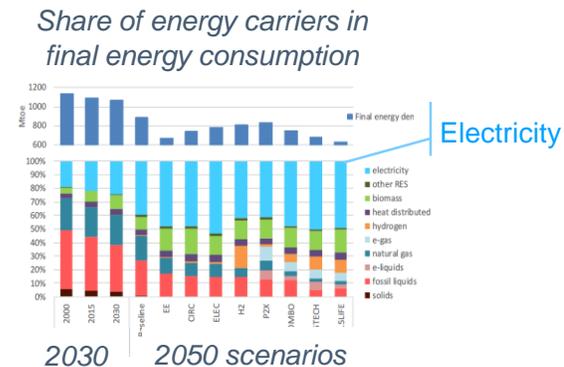


The energy transition and north sea offshore wind

The Paris agreement implies a radical change in the electricity generation mix for North Sea countries



PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11



Mitigate climate change impact by limiting global warming to well below 2 °C and pursue below 1.5 °C

A swift and massive change in the energy system is required

Including an estimated 180 GW of offshore wind and 50-80 GW of interconnectors⁽¹⁾

And requiring an accelerated and steady deployment based on cross border spatial planning

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



Grand vision and the North Sea Wind Power Hub

Developing 180 GW of offshore wind power in the North Sea, to be supplied to European markets, using a modular “hub and spoke” concept



- Offshore hubs in the North Sea could each connect up to 10-15 GW wind power and distribute generated power to European markets through a network of cables (spokes) and/or pipelines (H₂ production)
- From the hub, generated power will be transmitted to markets around the North Sea
- The network of transmission cables will also function as interconnectors, directly connecting European energy markets



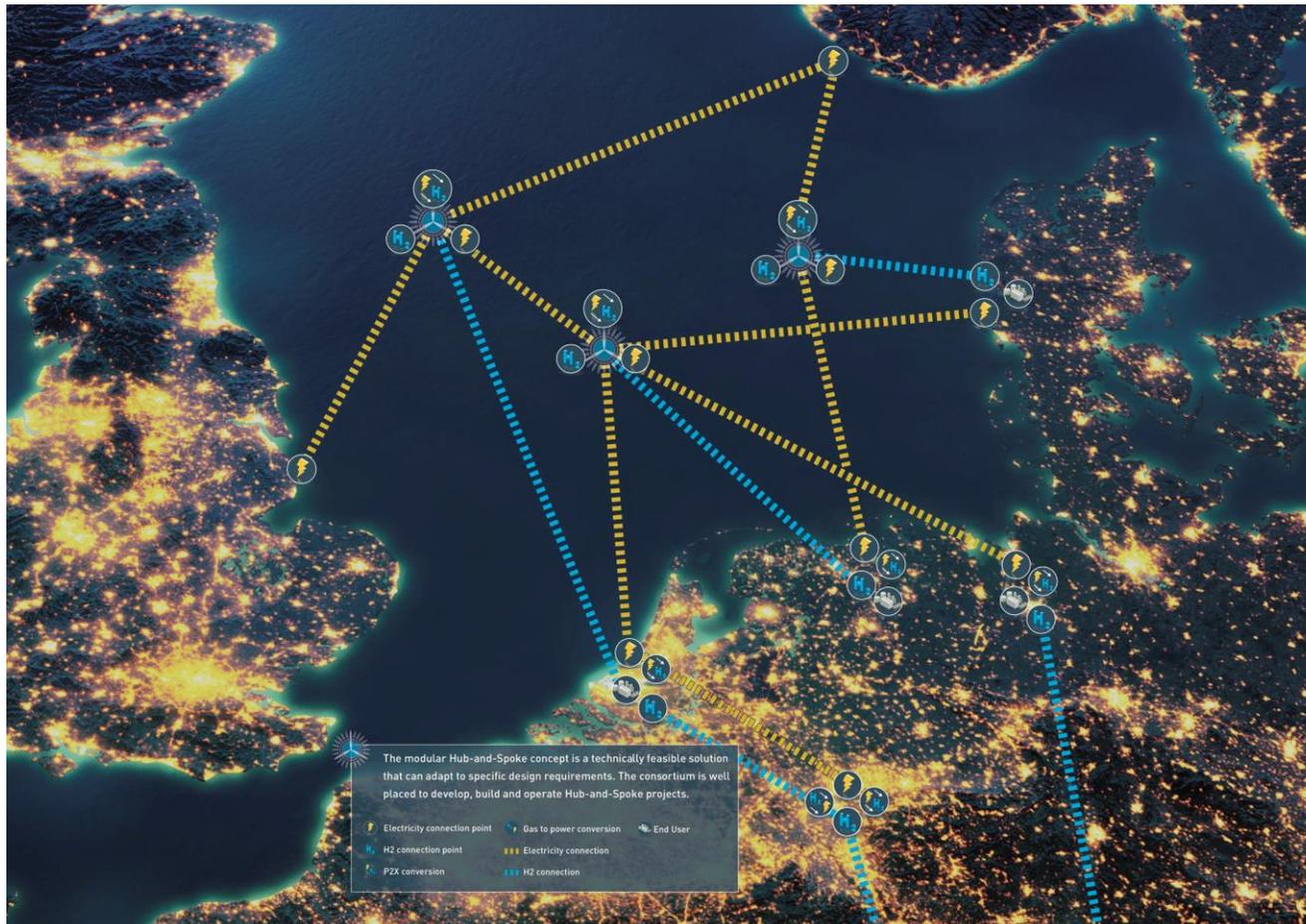
North Sea Wind Power Hub Consortium

TenneT Netherlands, TenneT Germany, Energinet, Gasunie and Port of Rotterdam joined forces to develop a large scale European energy system for offshore wind in the North Sea.



The NSWPH offers a unique concept

It provides a step-by-step approach and adaptability to balance scale, development times and environmental compatibility



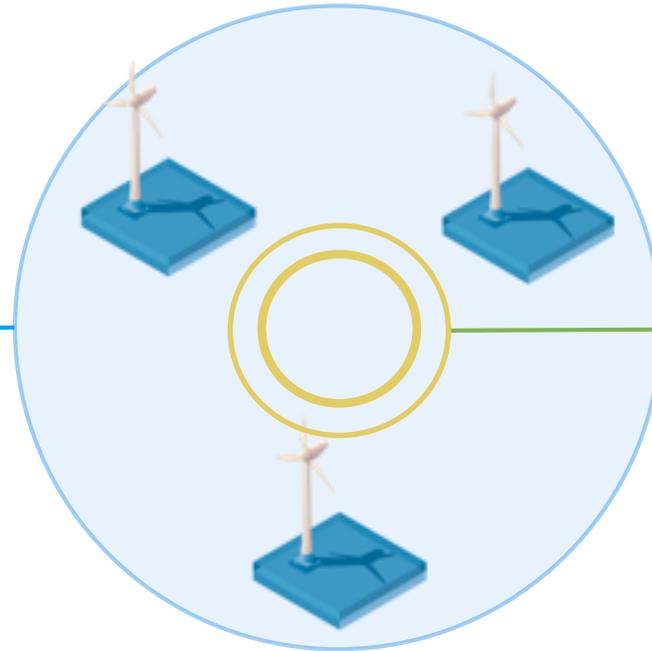
- ✓ *Combining offshore wind transmission and interconnection infrastructure*
- ✓ *International coordination will result in optimal onshore connection points*
- ✓ *P2X provides sector-coupling flexibility*
- ✓ *Reducing cost through increased asset utilisation*



Our two leg approach

Leg 1 North Sea International Coordinated Roll Out

Development of a long term holistic view on development and operation of the integrated infrastructure, in close cooperation with stakeholders, to ensure security of supply today and throughout the energy transition, at minimal societal cost and maximum likelihood of meeting the Paris climate goals.



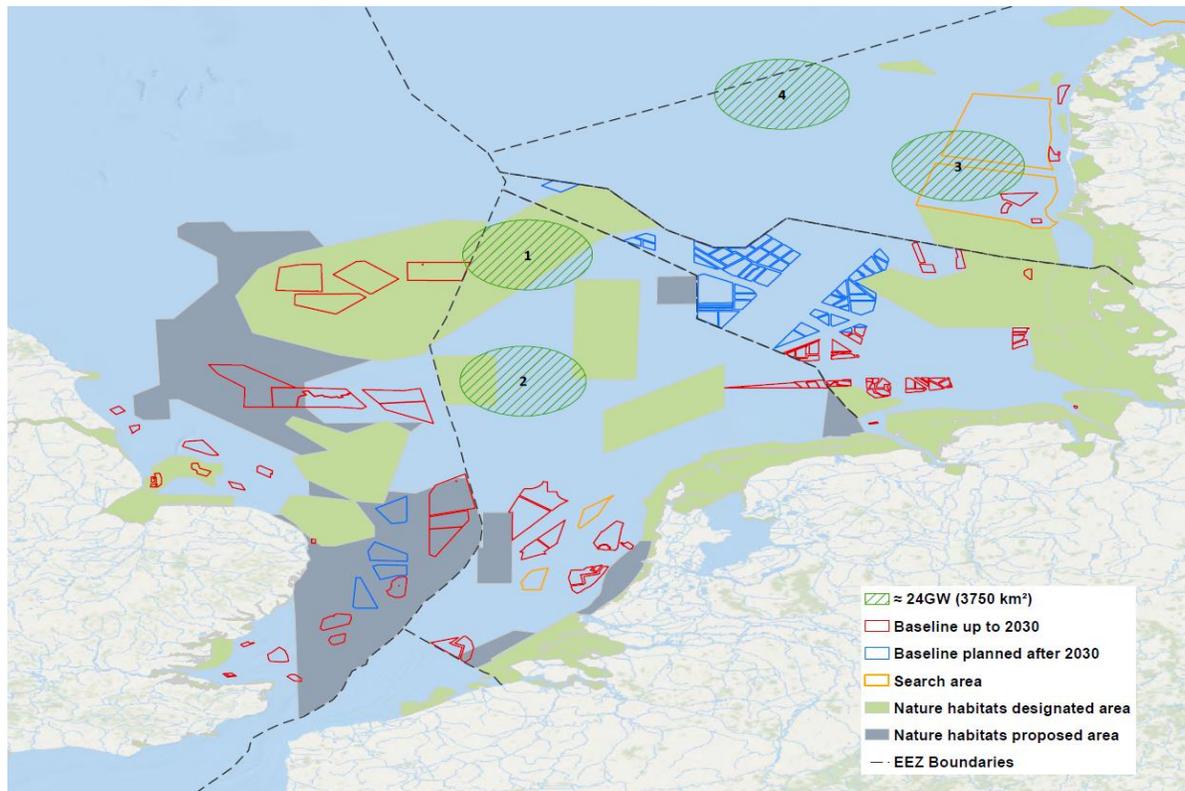
Leg 2 Towards the First Modular Hub & Spoke project

Initial feasibility studies to assess technical feasibility of the concept, potential environmental impacts, cost saving potential and requirements for adaptation of the market design and regulatory framework.



Consortium has broadened its investigations beyond DB

Several locations have been evaluated in addition to the initial Dogger Bank location to evaluate the main techno-economic driver dependence on location



Broadened investigative space:

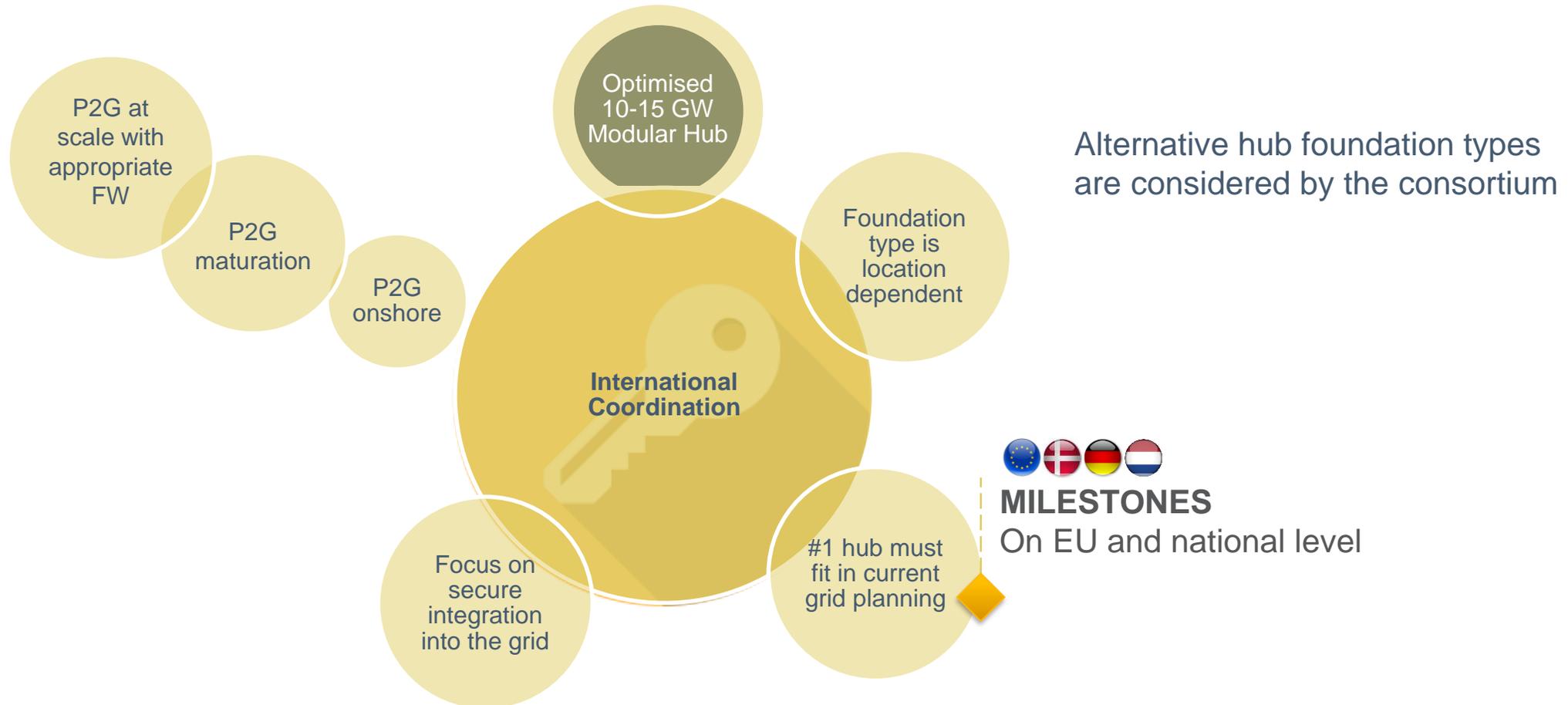
- Increased number of test locations to four
- Technical, Economical, baseline Environmental and Market and Regulatory analyses
- Alternative design options include sand filled island, caissons, platform and floating structure
- Significant attention to onshore grid integration and future security of supply issues, including the possible role of P2X in this respect

Disclaimer: These test locations do not indicate any preferred location selection



Findings

Key results from the assessment phase will allow us to narrow down on the options





The North Sea is intensely used

- 430,000 km^2 of Southern North Sea
- 220,000 km^2 with $<55m$ water depth
- 180 GW = $\sim 20,000 - 30,000 km^2$

ECO SYSTEM

EXISTING WIND FIELDS

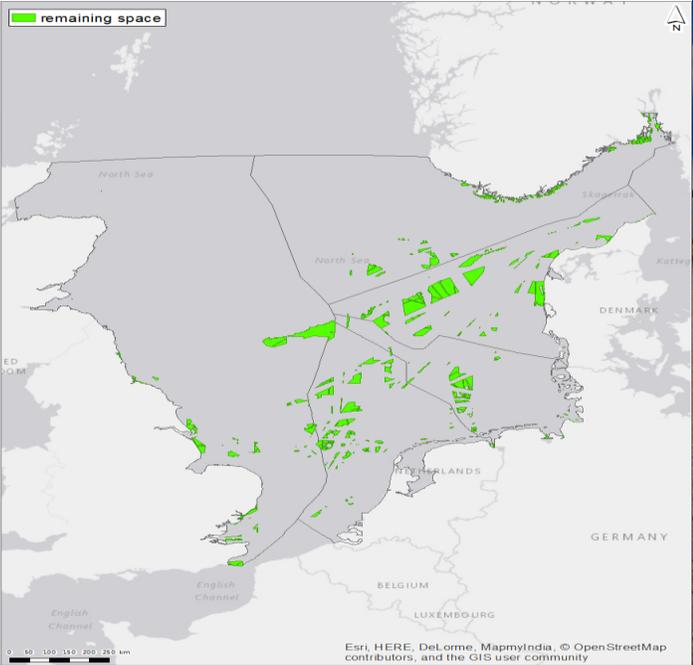
COMPLEX SHIPPING LANES

PIPES AND CABLES

HELICOPTER FLIGHT SAFETY ZONES

MILITARY AREAS

OIL AND GAS PLATFORMS



- Exclusionary approach leaves small, scattered space for OWFs



Consortium has intensified stakeholder engagement

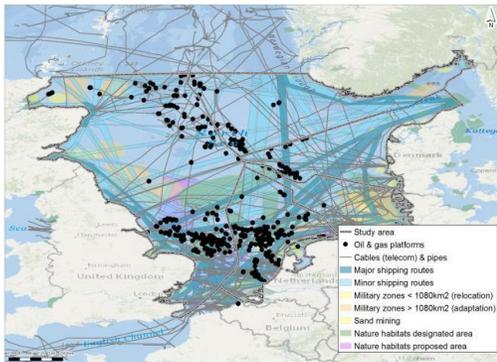


Discuss the vision with key stakeholders

- Emphasize the requirement for cross-border cooperation and co-utilization
- Jointly work towards timely achieving the COP21 goals (avoiding roll-out delays)

Feed the spatial planning debate

- Active outreach to important stakeholders. Transparent and open discussions with Governments, Industry and NGO's.
- Seeking joint understanding to work towards urgent regional spatial planning. Provide insight into spatial planning debate from techno-economic / security of supply perspective



Consult influential wind industry players

- Seek input from Industry on issues like: (i) Market arrangements, (ii) Interconnector accessibility and (iii) Key success factors.
- Support for findings Industry Report, willingness to support further maturing of the NSWPH programme



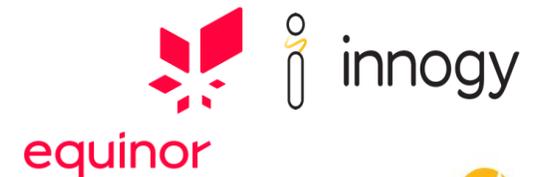


Industry report – dialogue with offshore wind farm developers

Identified key success factors that will help to realise the potential of offshore wind in the North Sea:

- Generating a holistic view of regional planning of the seabed across jurisdictions;
- Driving coordinated rollout of offshore wind projects across the North Sea;
- Efficient use of infrastructure that can accommodate the required level of offshore wind resource; and
- Establishing a long term visibility of capacity deployment targets denoting strong commitment towards offshore wind developments.

The NSWPH consortium engaged with leading offshore wind developers





Key messages from the industry

Our engagement with the leading and most influential OWF developers has resulted in three key messages from the industry – all supported by the NSWPH consortium:

- Efficient use of infrastructure for the effective integration of large scale offshore wind
- Combined Spatial Planning to achieve the ambitions of the Paris Agreement
- The OWF developers support to the further examination of techno-economic feasibility of the Hub and the conceptual design of the first project



The NSWPH invites the Dutch, Danish and German governments and the European Commission to consider setting up a cross-governmental consultation



In summary

Urgent action is essential to timely shape the boundary conditions that are required to meet the long term climate goals

- **A significant increase in the deployment rate of offshore wind is needed to meet the Paris Agreement climate targets in time**
- **Multi-use of the North Sea is required to accommodate the required offshore wind deployment**
- **Internationally coordinated spatial planning (how much, where and when) is necessary to**
 - Secure cost reduction from benefits of scale
 - Minimise environmental impact
 - Realise a robust and steady roll-out of offshore wind
 - Provide market certainty for supply chain ramp up
- **Onshore grid integration and flexibility options need to be developed in parallel to ensure security of supply for all consumers**



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