Netwerk op zee &
North Sea Wind Power Hub

Presentatie voor
KIVI Jaarcongres 2020

01--12-2020

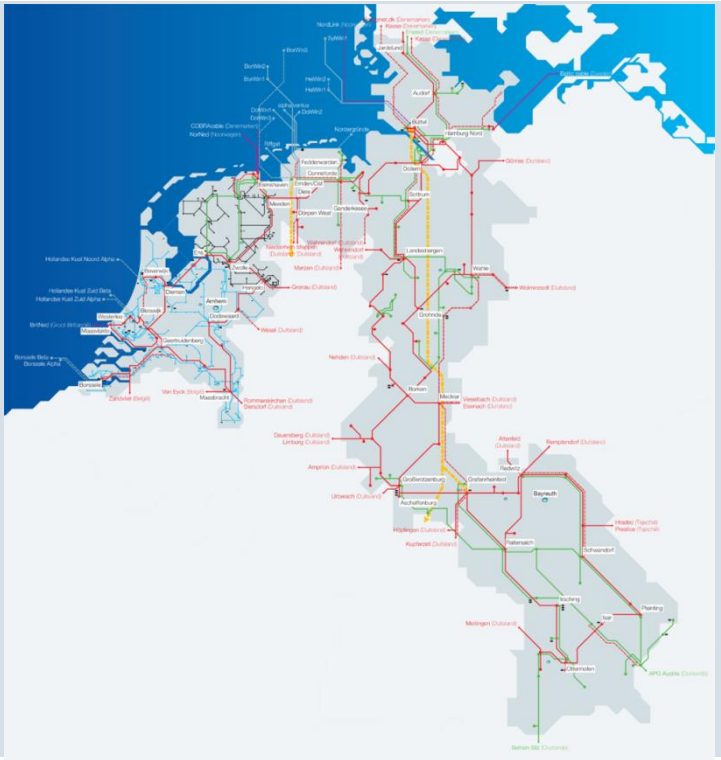
Jasper Vis

Inhoud

- TenneT
- Netwerk op zee in Nederland t/m 2030
- North Sea Wind Power Hub

TenneT at a glance

- Europe’s first cross-border grid operator for electricity
- 23.000 km high-voltage lines
- 4.700 km offshore cable
- 41 million end-users
- ~4.000 employees
- Asset base: EUR 20.4 bn
- 99,9986% security of supply

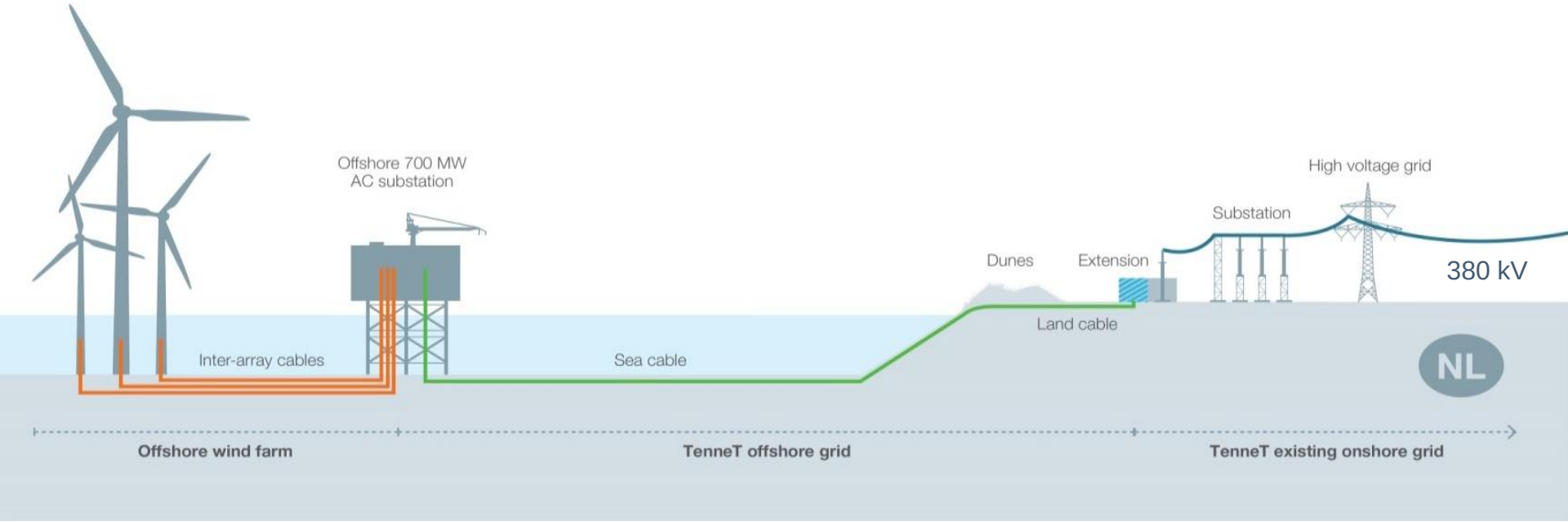


NL offshore wind roadmap 2023

- Five wind areas of 700 MW
- Lowest possible LCOE

Year	Capacity	Area
2019	700 MW	Borssele 1&2
2020	700 MW	Borssele 3&4
2021	700 MW	Hollandse Kust 1&2
2022	700 MW	Hollandse Kust 3&4
2023	700 MW	Hollandse Kust 5

Dutch offshore grid scheme

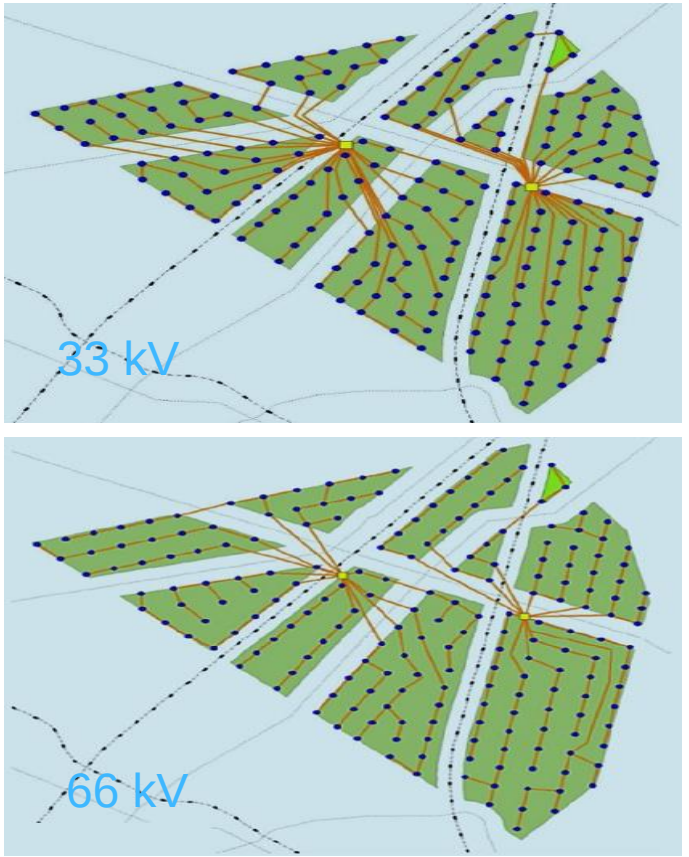


Array cables: 66 kV

Consultation with wind farm developers in 2015

Impact of using 66kV instead of 33kV array cables:

- Reduction of cable length: 25%
- Less cable crossings: 40%
- Reduction of number of J-tubes on platform
- Stimulating innovation in larger wind turbines
- Cost reduction



Standardised 700 MW AC Platform (220 kV)

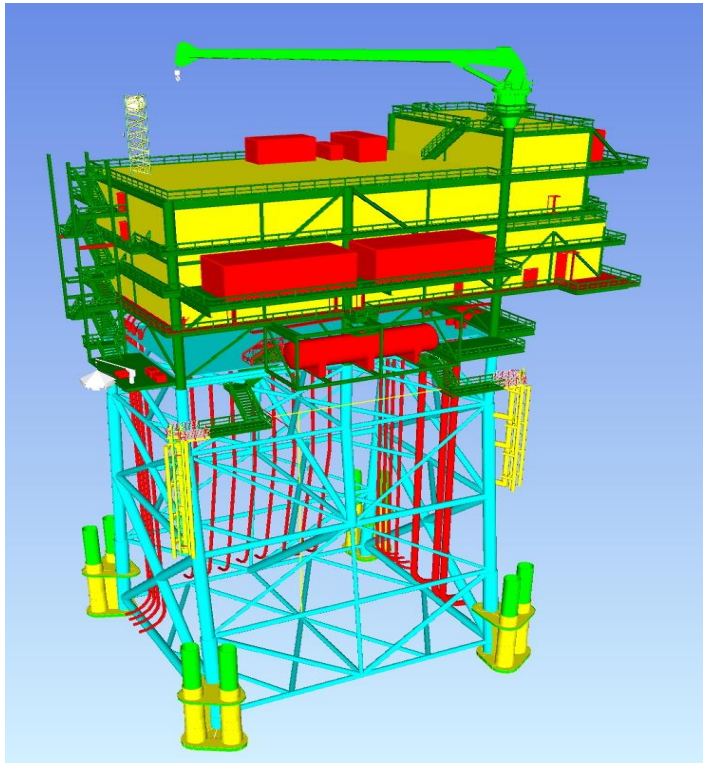
Lean design

No helideck

No diesel generator

Nice to have

Need to have



First Dutch platform ready for operation in September 2019: on time and within budget

Borssele Alpha

Second platform ready for operation in July 2020: within budget and 1 month earlier than planned

Borssele Beta

NL offshore wind roadmap 2030

- Phase II: 2024 - 2030
- Additional 6.1 GW
- Continuation near-shore 700 MW AC concept
- New: DC grid connection system

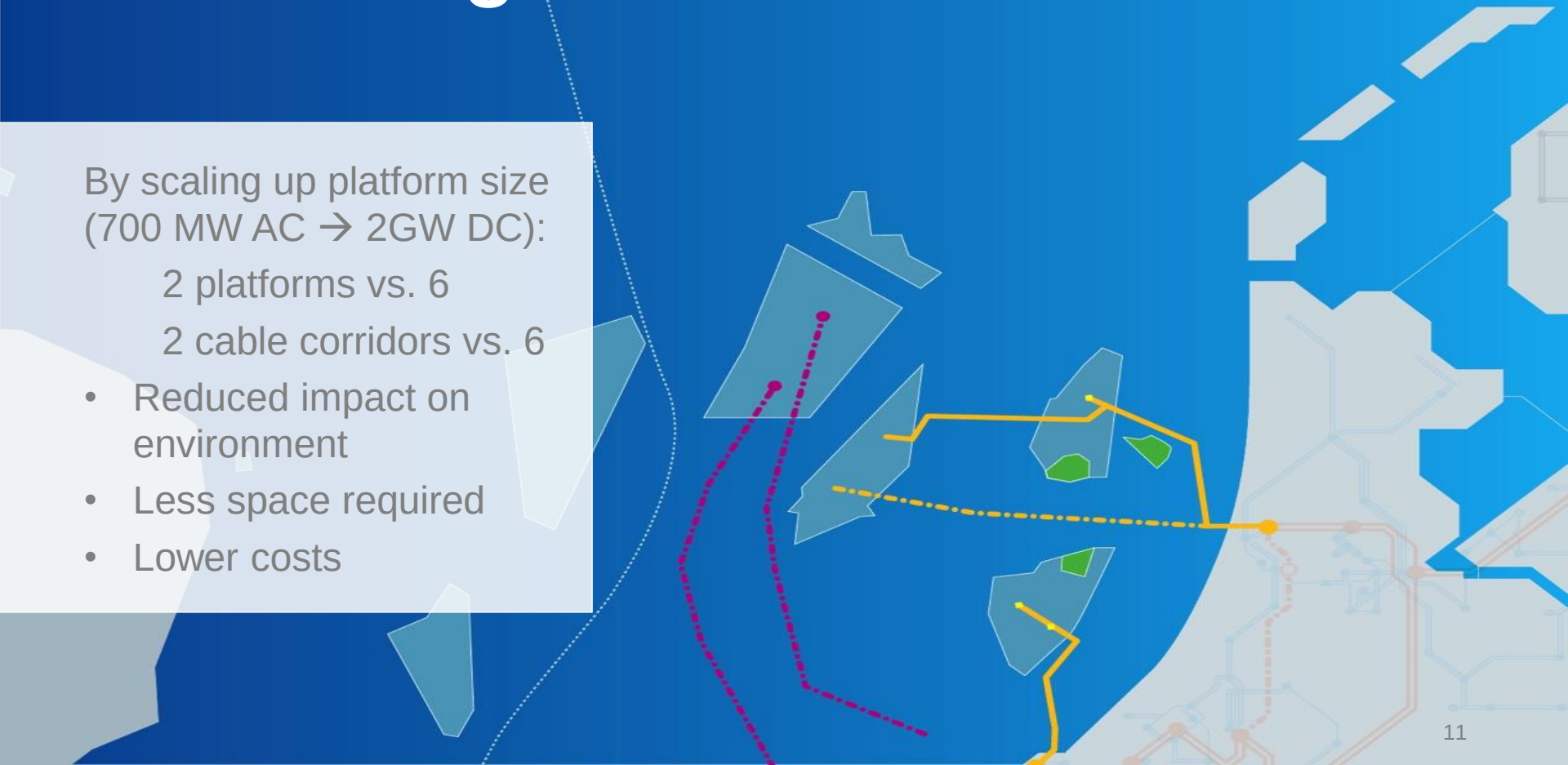
Year	Capacity	Wind zone
2024/2025	1,4 GW	Hollandse Kust (west)
2026	0,7 GW	Ten noorden v/d Waddeneilanden
2027-2030	4,0 GW	IJmuiden Ver

Offshore grid IJmuiden Ver

By scaling up platform size (700 MW AC → 2GW DC):

- 2 platforms vs. 6
- 2 cable corridors vs. 6

- Reduced impact on environment
- Less space required
- Lower costs

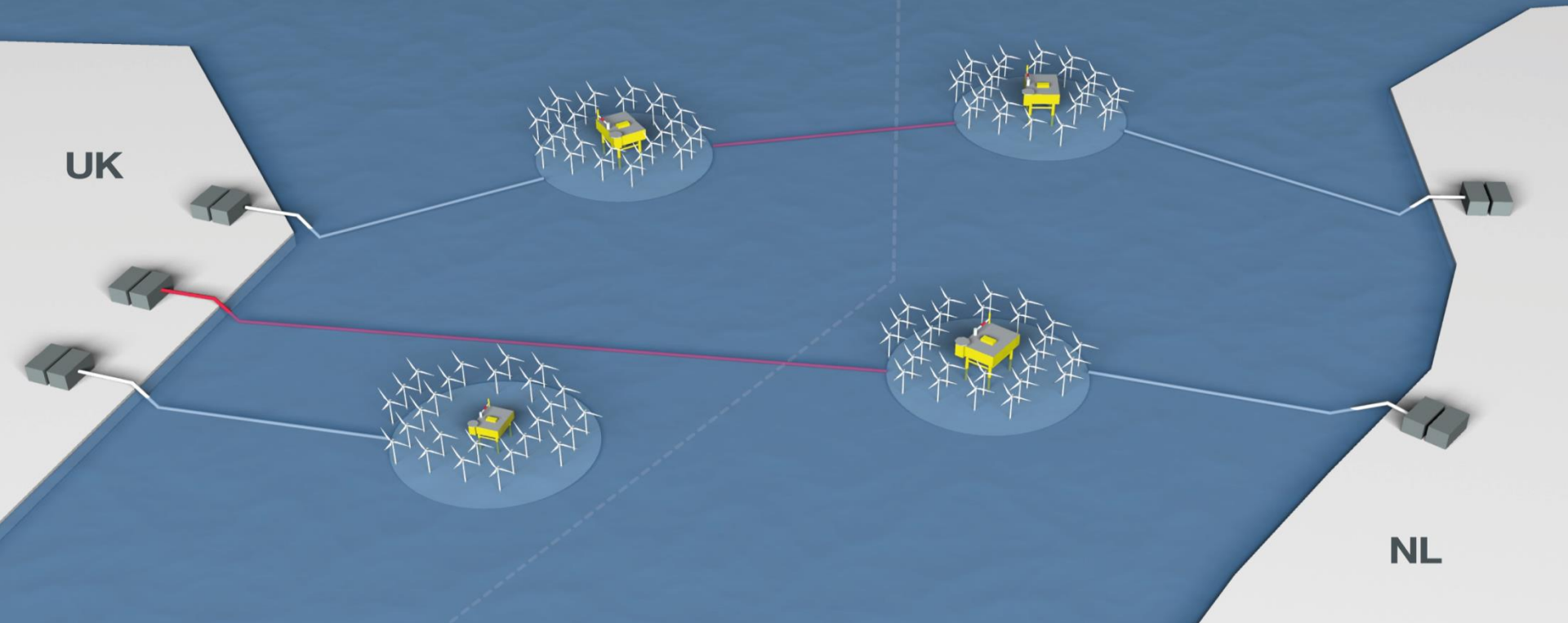


Standardised 2 GW HVDC offshore platform

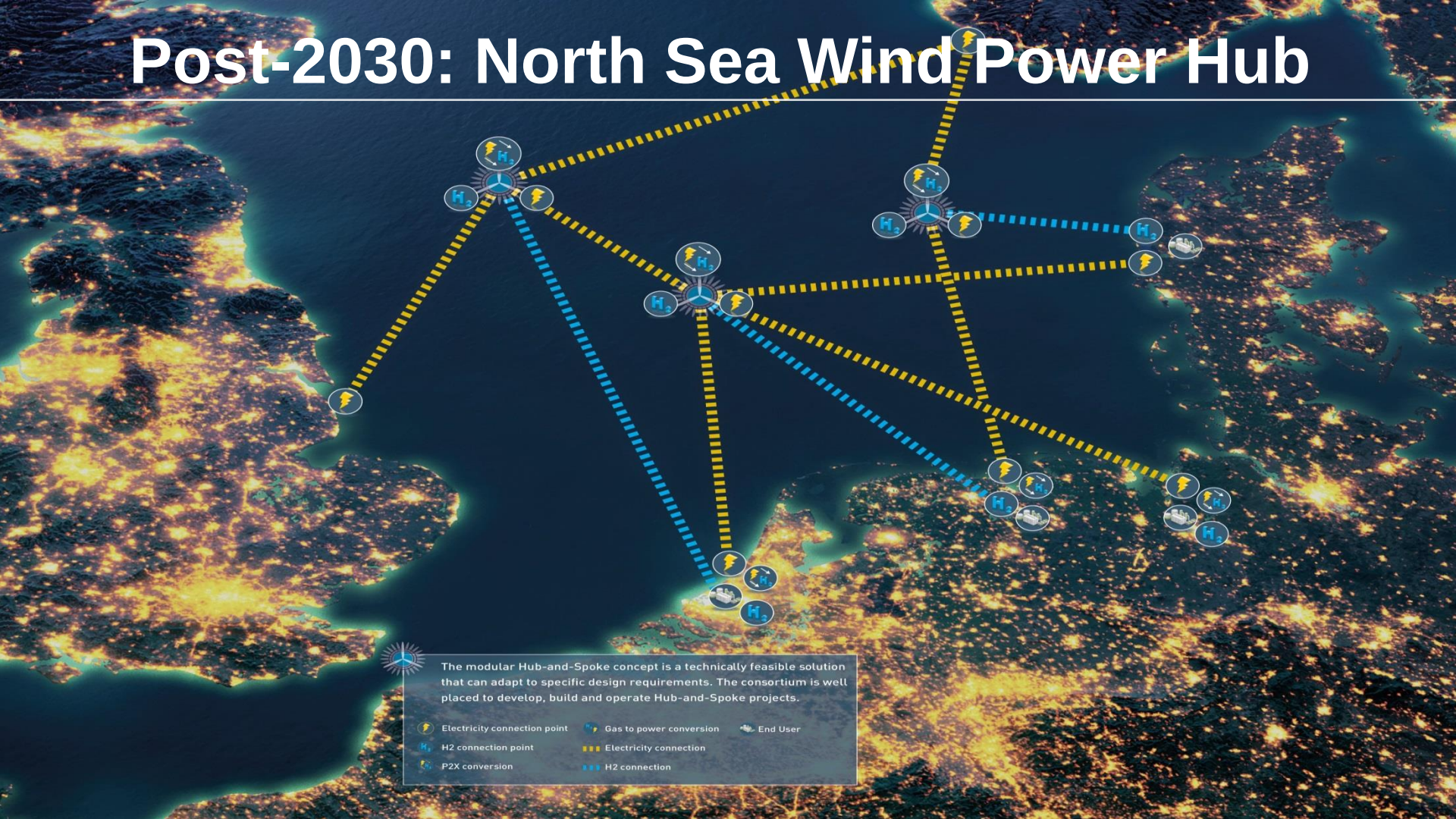
525 kV export cables

WindConnector NL - UK

Combining infrastructure for wind area further offshore with interconnection towards UK



Post-2030: North Sea Wind Power Hub



North Sea Wind Power Hub consortium

ENERGINET

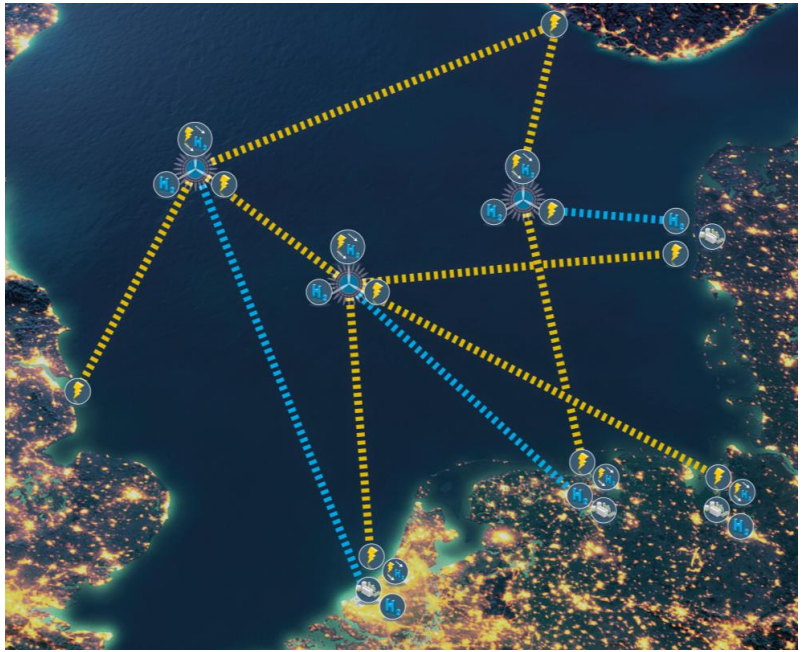
Danish transmission system operator working for a green, reliable and sustainable energy supply of tomorrow

gasunie

European energy infrastructure company serving the public interest by providing integrated infrastructure services

TenneT

Dutch-German electricity TSO and one of Europe's major investors in national and cross-border grid connections on land and at sea in order to establish the energy transition



From vision to modular programme

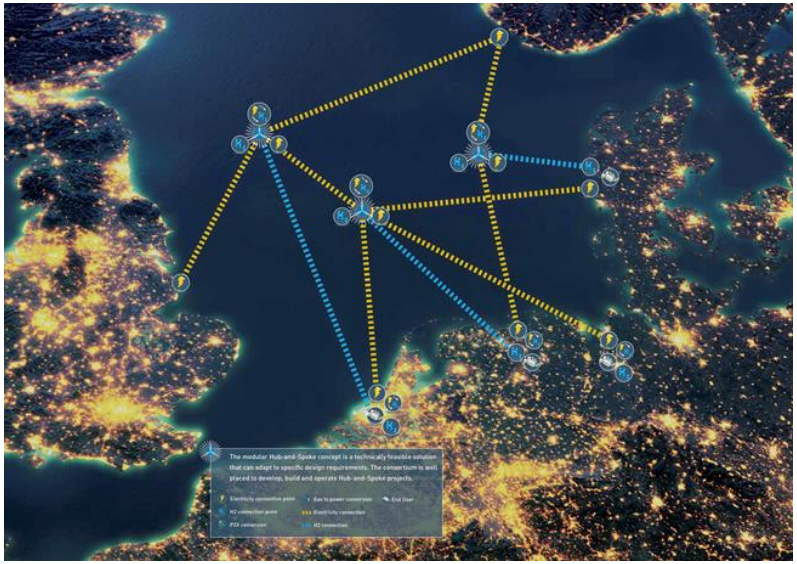
Hub-and-Spoke Modular concept

From vision as presented in 2016 – a 36 GW Hub & Spoke project based on a sand island on the Dogger Bank ....

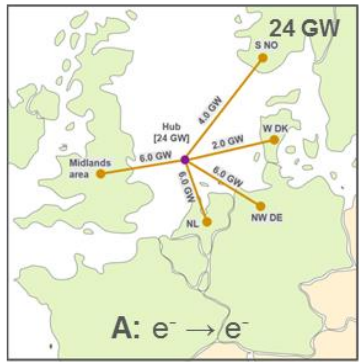
Broad assessment phase

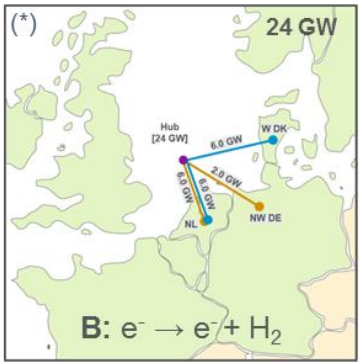
- >60 people involved from consortium companies
- >25 separate studies, including: regulatory, technical, economic, different island concepts, role of power-to-gas,
- >1500 pages of documentation

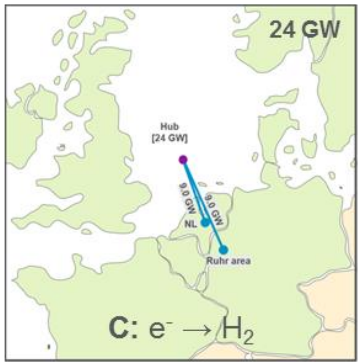
… to programme providing a **step-by-step approach** to unlock the vast offshore wind resource, integrating it into the onshore energy grids and continue high level of security of supply.

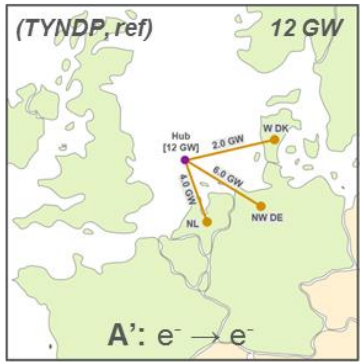


Different hub designs were assessed: different sizes, different electricity/H2 capacities and different foundations

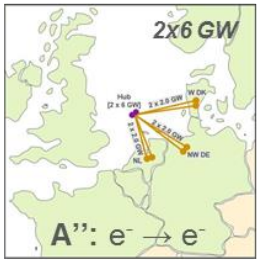


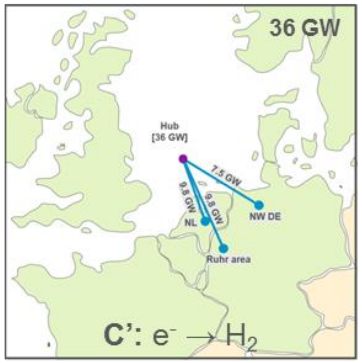






sensitivity





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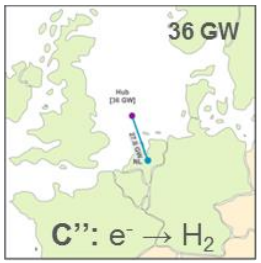


Different foundation technologies

	Caisson island	Sand island	Platform	GBS (tbc)
				
Water depth limitations	< 25m	<40m	<45m	larger 100m
Construction time (yrs)	3-4	6-8	3-4	3-4
Size limitations	6 GW	36 GW	2 GW	units up to 6 GW
Phasing & modularity	No	Not for hub	yes	Yes
Maturity	middle	middle	high	Units - high Linking - middle
Footprint on seabed	high	high	low	middle
Accessibility	limited sheltered	sheltered	unsheltered	unsheltered

Concept is technically feasible and cost effective

From Project to Program: modular Hub-and-Spoke concept is technically feasible.

Size and construction: Hub & Spoke project size approximately 10-15 GW.

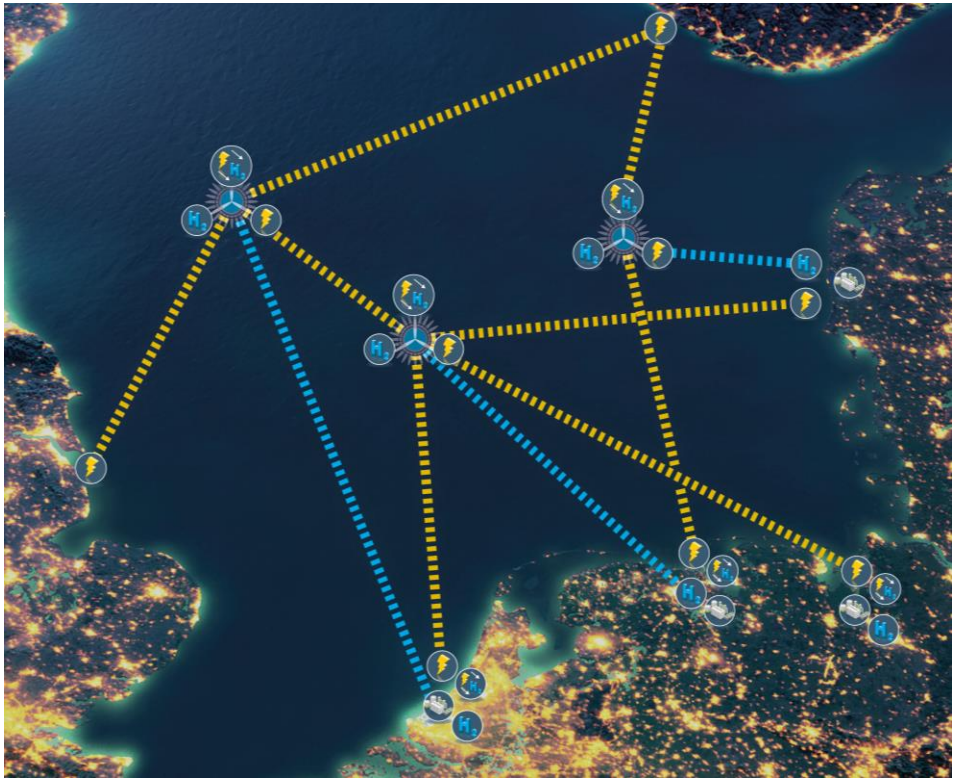
Grid integration: a strong offshore connected grid reduces onshore congestion and need for onshore grid reinforcement.

Seasonal storage: will be needed to integrate large amounts of offshore wind (~100-140 TWh required towards 2050 in North Sea countries).

Power-to-gas: will be needed to address seasonal storage, balancing and long distance energy transport.

Cost reduction: compared to radial connections for offshore wind farms.

The modular Hub-and-Spoke concept



Grid integration is key issue

- A strong offshore connected grid reduces onshore congestion and need for reinforcement
- 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

Developments in North Sea countries

Norway: offshore wind to be developed in the area Sørlige Nordsjø II which *"borders the Danish sector in the North Sea, and is relevant for direct export of electricity"*

Denmark:
- 3 GW energy island in the North Sea to be operational in 2030 with the possibility of future increase up to 10GW.
- Large area designated for offshore wind

UK:
- 40 GW offshore wind ambition for 2030
- Round 4 leasing for new offshore wind areas in North Sea
- Ofgem: *'discussing the potential for projects that integrate international interconnectors with offshore transmission networks with governments, other regulators and industry'*

The Netherlands:
- Roadmap for 11 GW offshore wind in 2030
- Spatial planning in progress for additional offshore wind areas for 20-40 GW

Germany:
- 20 GW offshore wind target for 2030. New 40 GW target for 2040
- Detailed spatial planning in place for future offshore wind farms
- NSWPH to be included in next grid plan (NEP2035) scenarios as a sensitivity

EC
- 'Strategy on offshore wind' as part of Green Deal
- NSWPH on 4th PCI list

Dank voor uw aandacht!

(op twitter: @vision23)

POWERED BY ENERGINET TenneT gasunie