North Seas Offshore Energy Clusters Study

Findings

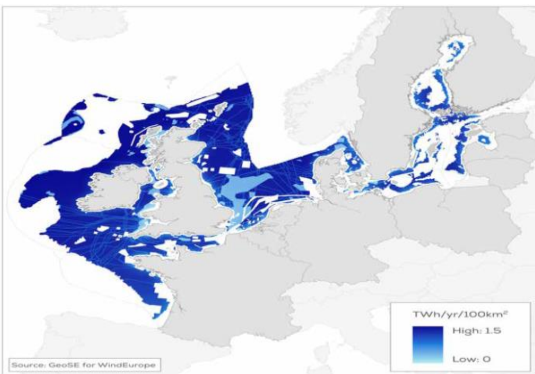
European Commission

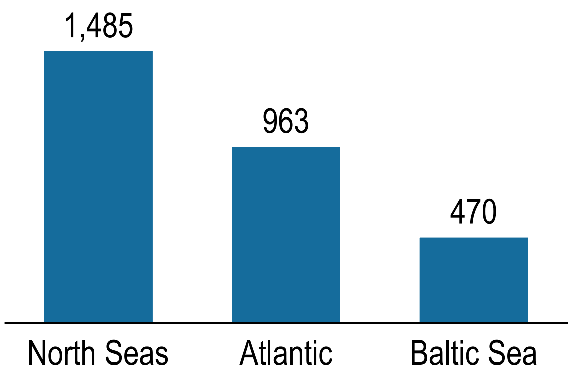
Bilbao, 02 April 2019

The North Seas have a vast offshore wind potential – Economically attractive potential depends on competitiveness vs. alternatives

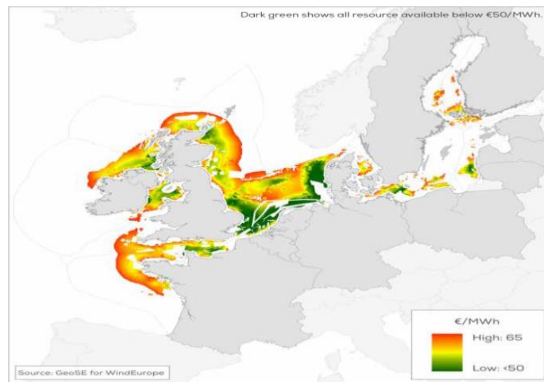
Technical and economically attractive potential

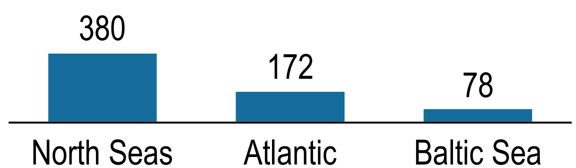
Technical potential [GW]





Economic attractive potential [GW]



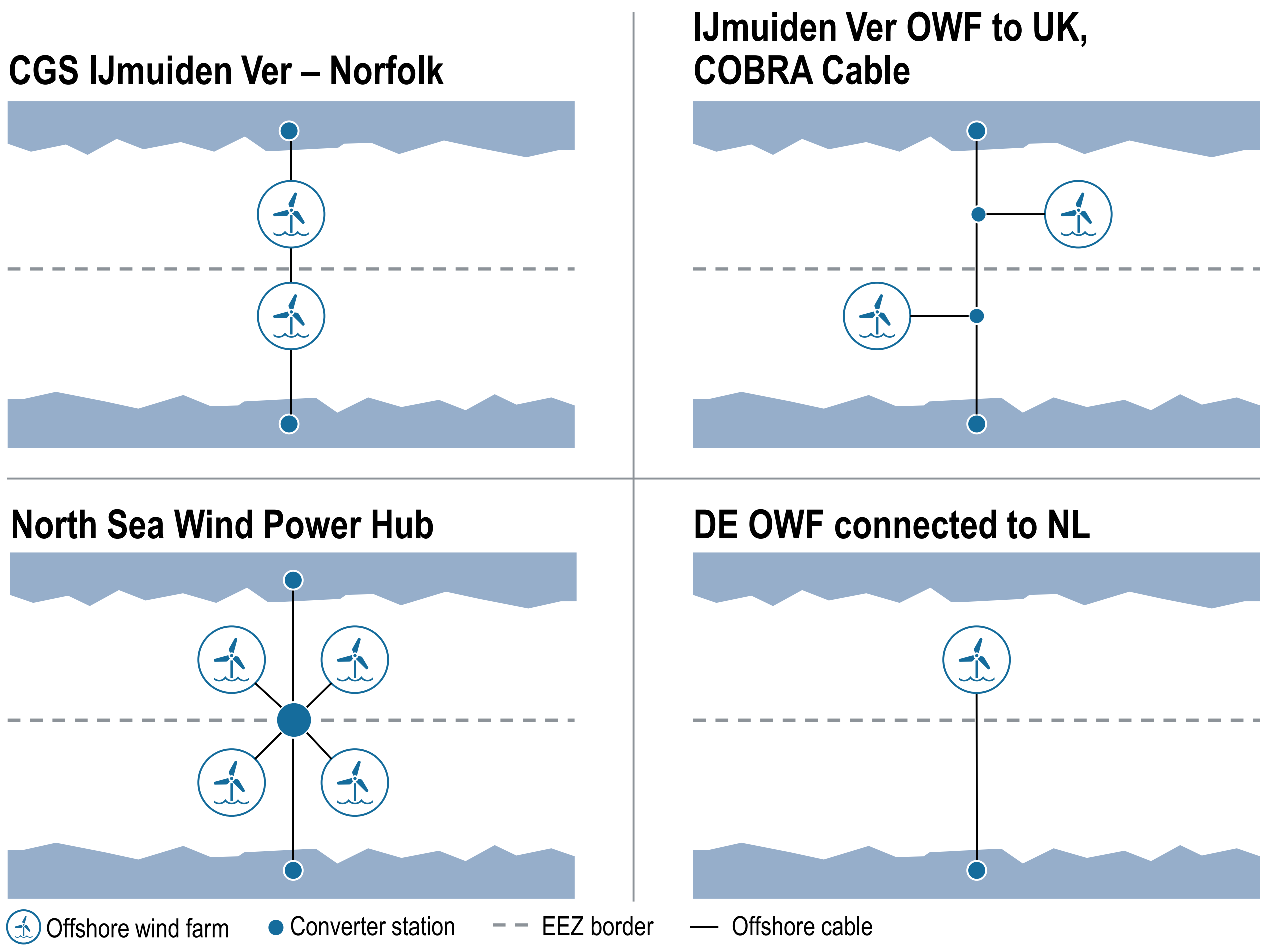


- Technical potential is the capacity that may be reached considering technical, geographical and space limitations – Without taking into account the grid constraints
- Economic attractive potential is the capacity that can be reached below a reference LCoE of 60 EUR/MWh – Reference is a CCGT power plant in 2030
- Economic attractive potential is dependent on further cost efficiencies along the value chain

Source: WindEurope; Roland Berger

Innovative grid concepts in hybrid projects can help bring costs of offshore wind development down

Hybrid project concepts



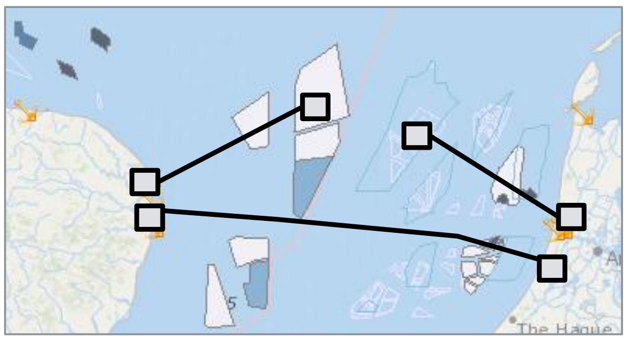
- Hybrid projects are transnational combinations of offshore power generation and transmission assets
- Ownership of such combined assets is typically in the hands of multiple stakeholders, e.g. multiple OWF developers and TSOs
- Analogous, permitting responsibility is typically in the hands of multiple countries' authorities

Source: Roland Berger

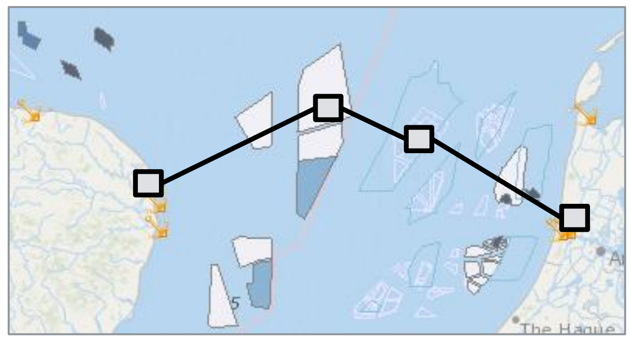
Hybrid projects are cost-efficient because they significantly reduce the need for physical infrastructure

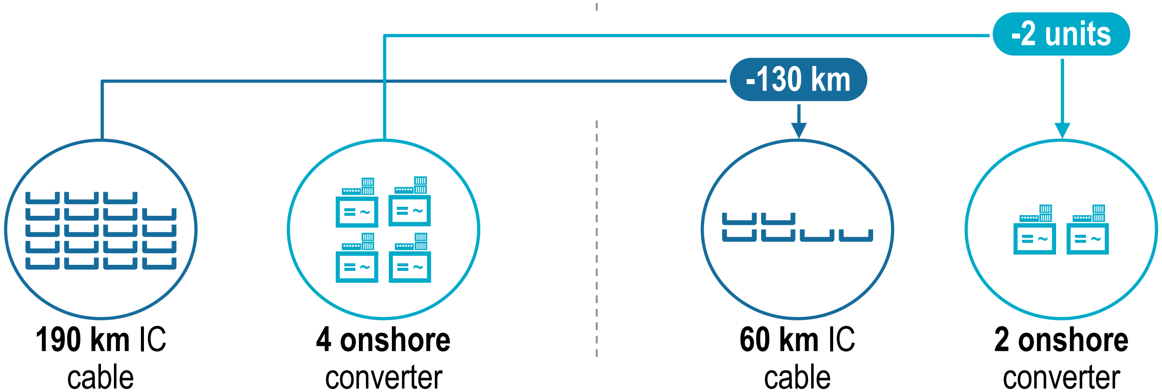
Benefits of hybrid projects (e.g. CGS IJmuiden Ver – Norfolk)

Reference case:
Stand-alone OWFs and IC



Hybrid case:
Combined grid solution





> Hybrid project eliminates need for infrastructure compared to reference case
  - 130 km of cable not needed
  - 2 onshore converters not needed

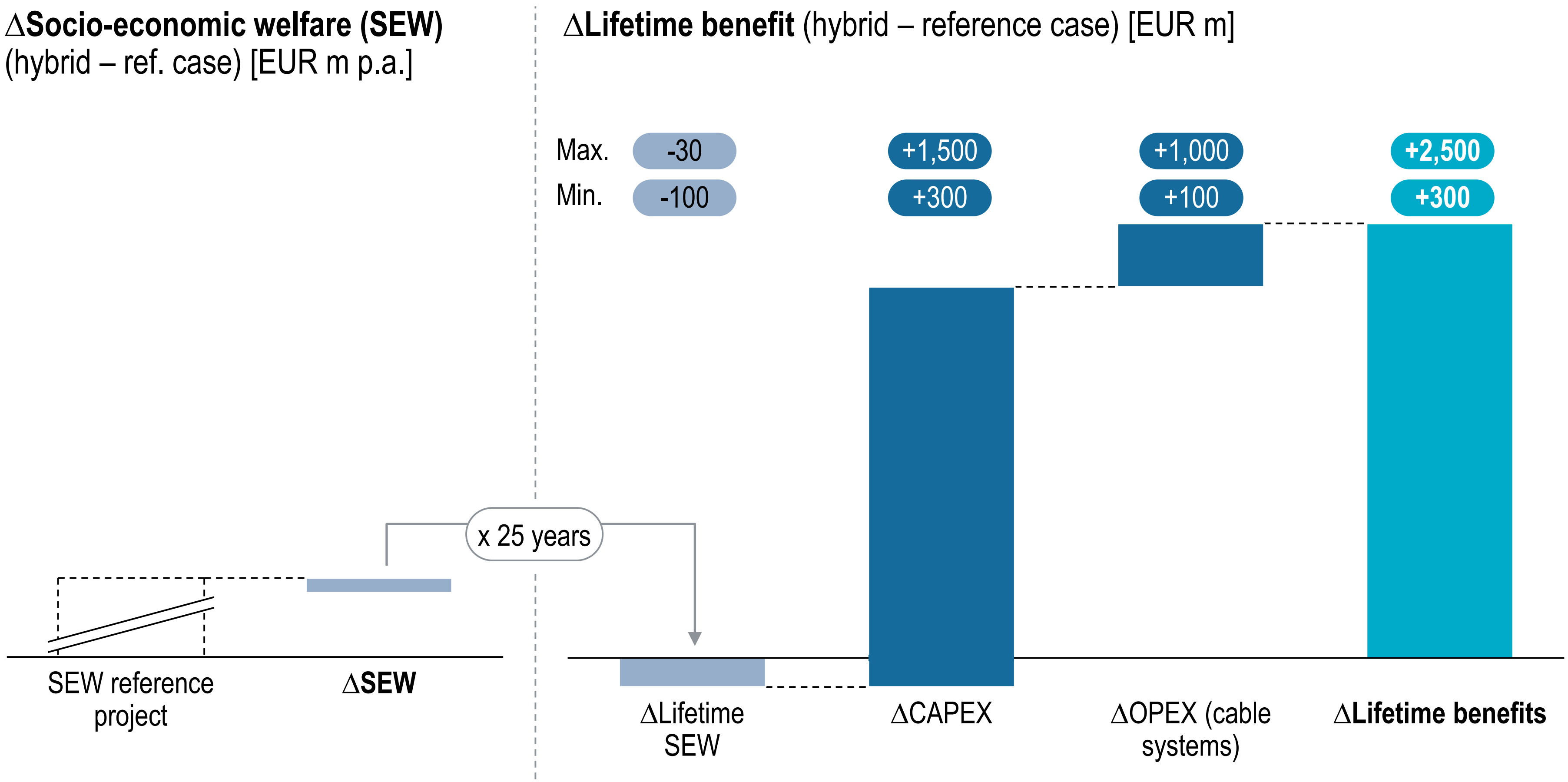
> Cost-efficiency of hybrid projects increases compared to reference case

Converter station — Transmission cable

Source: 4COffshore; DG Energy Joint Research Center; TenneT B.V.; Vattenfall; Roland Berger

By significantly reducing the need for physical infrastructure, hybrid projects reduce CAPEX and OPEX of offshore power generation

Significant lifetime benefits of hybrid projects[1)]

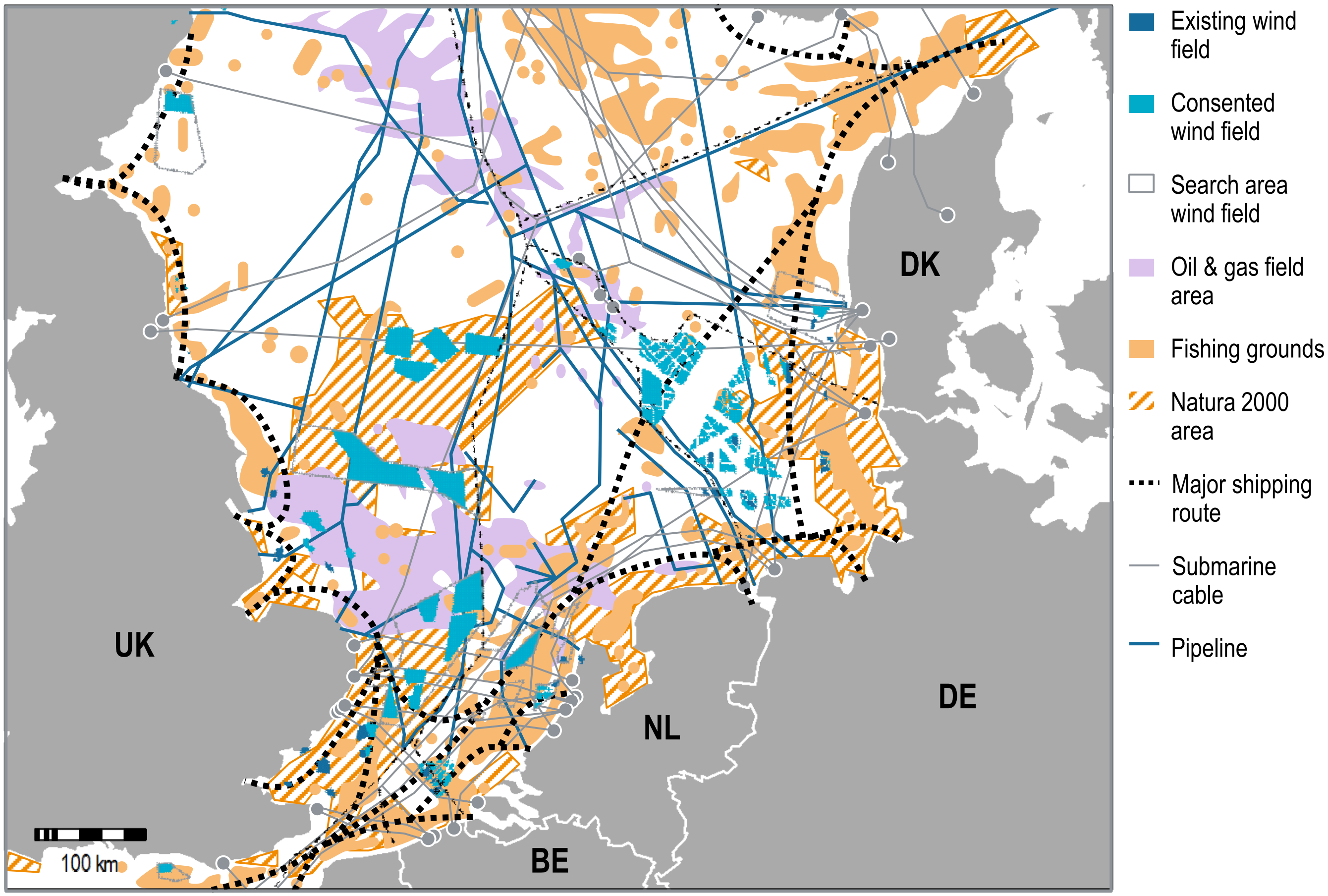


1) 8% discount factor

Source: Joint Research Center; Roland Berger

Additionally, hybrid projects are efficient in terms of maritime space used and thereby reduce the environmental impact

Reduced environmental impact through hybrid projects



- > Reduced space requirements for offshore infrastructure and cable systems
- > Efficient use of available resources in heavily used North Seas region (shipping, oil & gas, fishing, etc.)

Source: 4COffshore; Submarinecablemap; Globalfishingwatch; Natura2000; Offshore Magazine; Shipmap; Roland Berger

In summary, hybrid projects are efficient in terms of cost and maritime space used – How did we arrive at these results?

Study approach

1 Project identification

- Study initially considered 18 hybrid project ideas
  - **Identification** relied on **real assets**, meaning infrastructure either already in place or planned to be built
  - First screening of available assets and sensible concepts
- **Close stakeholder interaction** for identifying hybrid project ideas

Hybrid project ideas are based on real assets

2 Benefit assessment

- Study assessed 10 projects deemed feasible for potential future implementation in detail
- Benefit assessment for the selected projects evaluated **CAPEX**, **OPEX** and **SEW**[1)] **difference** compared to a reference case
- Required project details derived together with stakeholders

Hybrid projects generate lifetime benefits

3 Barrier mitigation

- Study evaluated barriers and developed mitigations to 5 projects for implementation
  - Focus on projects with a positive benefit assessment
- Project-specific **barrier assessment** and derivation of **Action Plan** to overcome barriers in close interaction with stakeholders

Hybrid project implementation requires to overcome barriers

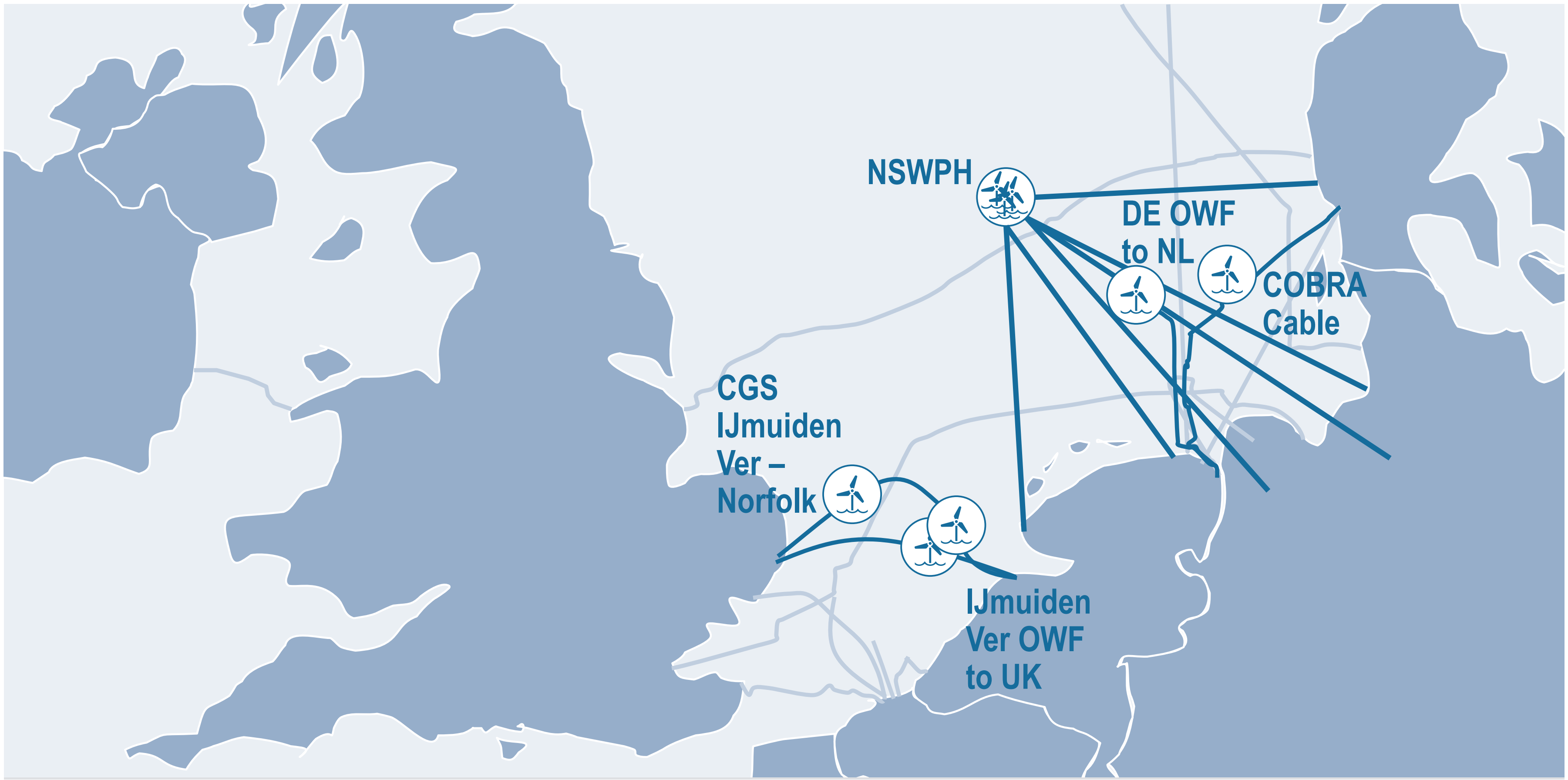
Practical study approach drives towards hybrid project implementation

1) In cooperation with the Joint Research Center of the European Commission

Source: Roland Berger

By evaluating various hybrid project ideas in the North Seas, we identified five hybrid projects with significant benefits

Selected hybrid project ideas[1)]



1) Location of offshore wind farms and cable routes indicative

Source: Roland Berger

The five beneficial hybrid projects include two IJmuiden Ver projects, COBRA Cable, DE OWF to NL and NSWPH

Assessment of selected hybrid project ideas

	ΔCAPEX[1]	ΔOPEX[1]	ΔSEW[1]	ΔLifetime benefits[1]
1 **IJmuiden Ver OWF to UK**	↑	↗	↘	↑
2 **CGS IJmuiden Ver – Norfolk**	↑	↗	↘	↑
3 Nautilus	↓	↓	↘	↓
4 UK OWF connected to BE	↓	↓		↓
5 **COBRA Cable**	↑	↗	↘	↑
6 **DE OWF connected to NL**	↑	↗	↘	↗
7 NeuConnect	↗	↘	↘	↗
8 CGS DE OWF – NL OWF	↘	↘		↘
9 **North Seas Wind Power Hub**	↗	↑		↑
10 "Project Irish Sea"	↘	↘	→	↘

1) ↑ if >5%, ↗ if between 5% and 0%, → if 0%, ↘ if between 0% and -5%, ↓ if <-5% benefits relative to total (cost)

Source: Joint Research Center; Roland Berger

We propose four concrete actions to overcome barriers to hybrid project development

Barriers and proposed actions

Barriers to implementation

> National focus of energy policy (legal and regulatory framework)

> Lack of proper de-risking instruments for developers

> Misalignment of costs and benefits among stakeholders

> Technical risks and onshore grid congestion

Recommended actions

A Implement project-specific, enforceable legal agreement to provide security for developers

B Provide public financial support to de-risk cross-border projects with pilot character

C Establish principles for allocation of costs and benefits among countries and stakeholders

D Widen the hybrid approach towards an integrated regional energy system approach (sector coupling)

Source: Roland Berger

National focus of energy policy hinders hybrid project development – HANSAs provide project-specific, enforceable legal framework

National focus of energy policy

Barrier description

> Despite a planned internal energy market in the EU, most countries still implement their own energy policies and rules
  – Uncertainty about jurisdiction over assets in hybrid projects and thus project develop. responsibility
  – Uncertainty about hybrid cable system classification
  – Uncertainty about tender processes for offshore wind farms involved in hybrid projects
  – Uncertainty about market arrangements

> **National focus** of energy policies and rules **hinders development of hybrid projects**

Recommendation

Hybrid Asset Network Support Agreements (HANSAs)

> Provide security for developers through project-specific, enforceable legal agreements between countries

Short-term certainty and long-term effects

> Ensure that specific mitigation measures designed to overcome relevant barriers are developed and implemented

> Offer both short-term certainty and the possibility of informing future legal frameworks – e.g. the European Commission considers how to takle hybrid cable system classification

Source: Roland Berger

Lack of de-risking instruments for developers of hybrid projects – Instruments like Connecting Europe Facility provide starting point

Lack of proper de-risking instruments for developers

Barrier description

> Hybrid projects are riskier than conventional offshore developments
  – Largely untested
  – Require collaboration between multiple parties
  – Must integrate several projects into one

> Developers need incentives to switch from a conventional offshore project to a hybrid project concept during early project stages

> **Lack of public funding** to de-risk hybrid concepts **hinders hybrid project development**

Recommendation

Public financial support

> Helps developers and investors to de-risk pilot hybrid projects

> Allows for early-stage alignment across assets and countries

EU's Connecting Europe Facility (CEF)

> Example of public funding programme to support, among others, the development of hybrid projects which have a PCI status

> Additionally, CEF Energy for "Renewable cross-border cooperation" will provide co-financing for early-stage ideas which are not eligible based on a PCI status, such as DE OWF to NL

Source: Roland Berger

Transnational character of hybrid projects results in misalignment of costs and benefits among stakeholders – Clear principles needed

Misalignment of costs and benefits among stakeholders

Barrier description

> Knowledge on costs and benefits of a hybrid project are key for stakeholders

> Without cost and benefit transparency there is no commitment to hybrid project development

> Each hybrid project generates a unique set of costs and benefits, which can be unfairly distributed
  – Country A may carry the burden of grid connection costs
  – Country B may benefit from cheaper electricity

> **Lack of clear principles** governing the fair allocation of costs and benefits **hinders hybrid project development**

Recommendation

Principles for fair allocation of costs and benefits

> Allow to redistribute costs and benefits fairly across involved project developers and other stakeholders – e.g. also an agreement on revisiting a fair cost and benefit allocation after the commissioning of a hybrid project can make sense

> Act as a starting point for the development of project-specific solutions in the context of hybrid projects

Source: Roland Berger

Technical risks of high capacity offshore generation, onshore grid connection and onshore grid congestion – Sector coupling needed

Technical risks and onshore grid congestion

Barrier description

> Hybrid approach allows to significantly increase utilisation of available offshore wind potential

> Increases in offshore generation capacity increases reliance on individual generation assets and transmission infrastructure

> Developers need flexibility to combine all available technologies in order to maximise benefits

> Mandated, **disintegrated energy systems hinder hybrid project development**

Recommendation

Sector coupling

> Allows to widen the hybrid approach towards an integrated energy system

> Reduces strain on transmission systems

> Allows to store energy during times of oversupply

Power-to-gas technology

> Represents a type of power conversion technology, which converts electricity into gas

> Proposed hybrid projects such as the North Sea Wind Power Hub provide can provide a testing ground for this energy system approach

Source: Roland Berger

Roland Berger
THINK:ACT