UNLOCKING THE OFFSHORE WIND POTENTIAL IN THE BALTIC SEA: ROLE OF POLICY AND REGULATION

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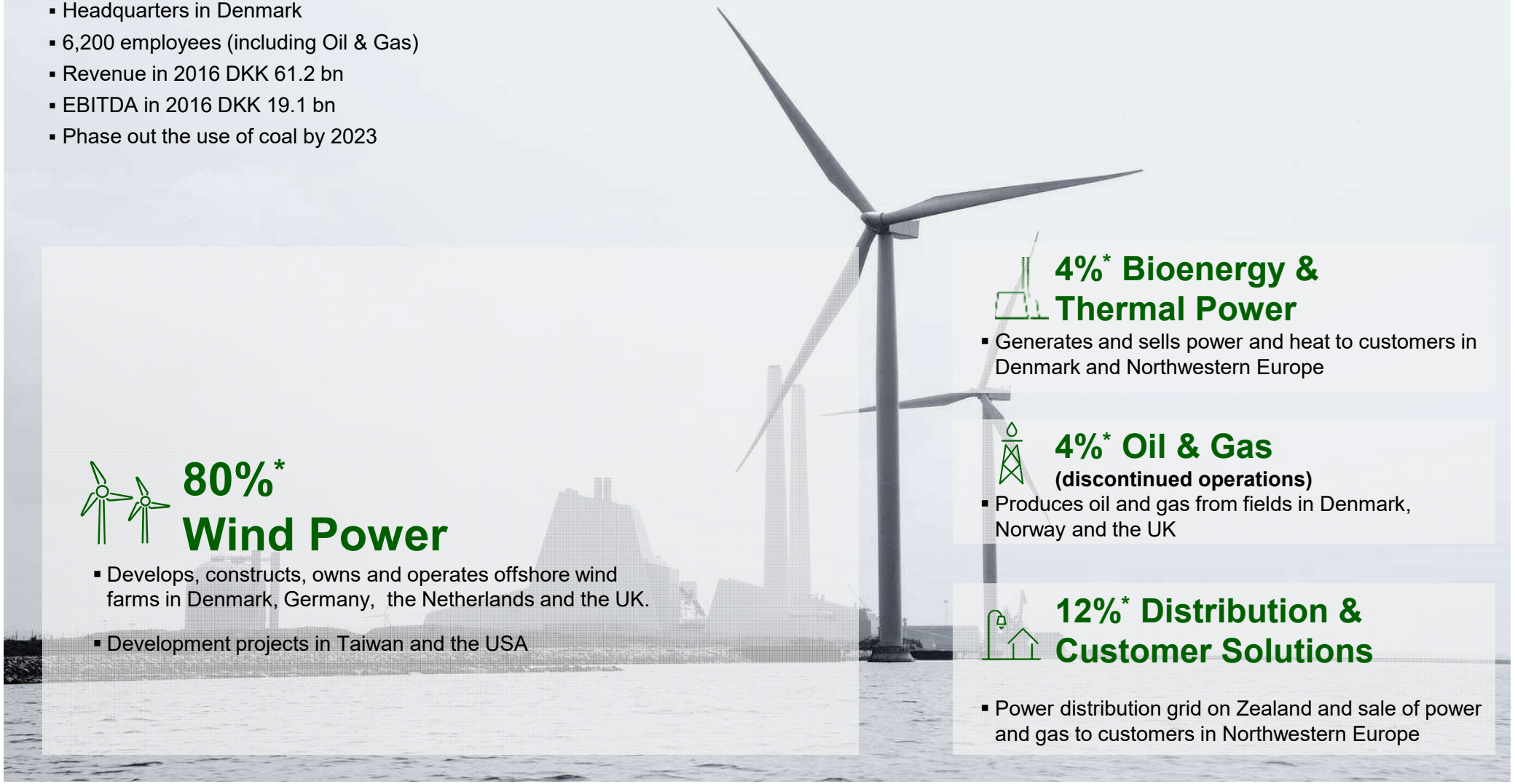
DONG energy

Content

Source: dong energy

DONG Energy at a glance

- Headquarters in Denmark
- 6,200 employees (including Oil & Gas)
- Revenue in 2016 DKK 61.2 bn
- EBITDA in 2016 DKK 19.1 bn
- Phase out the use of coal by 2023



80%* Wind Power

- Develops, constructs, owns and operates offshore wind farms in Denmark, Germany, the Netherlands and the UK.
- Development projects in Taiwan and the USA

4%* Bioenergy & Thermal Power

- Generates and sells power and heat to customers in Denmark and Northwestern Europe

4%* Oil & Gas

(discontinued operations)

- Produces oil and gas from fields in Denmark, Norway and the UK

12%* Distribution & Customer Solutions

- Power distribution grid on Zealand and sale of power and gas to customers in Northwestern Europe

* Share of the Group's capital employed

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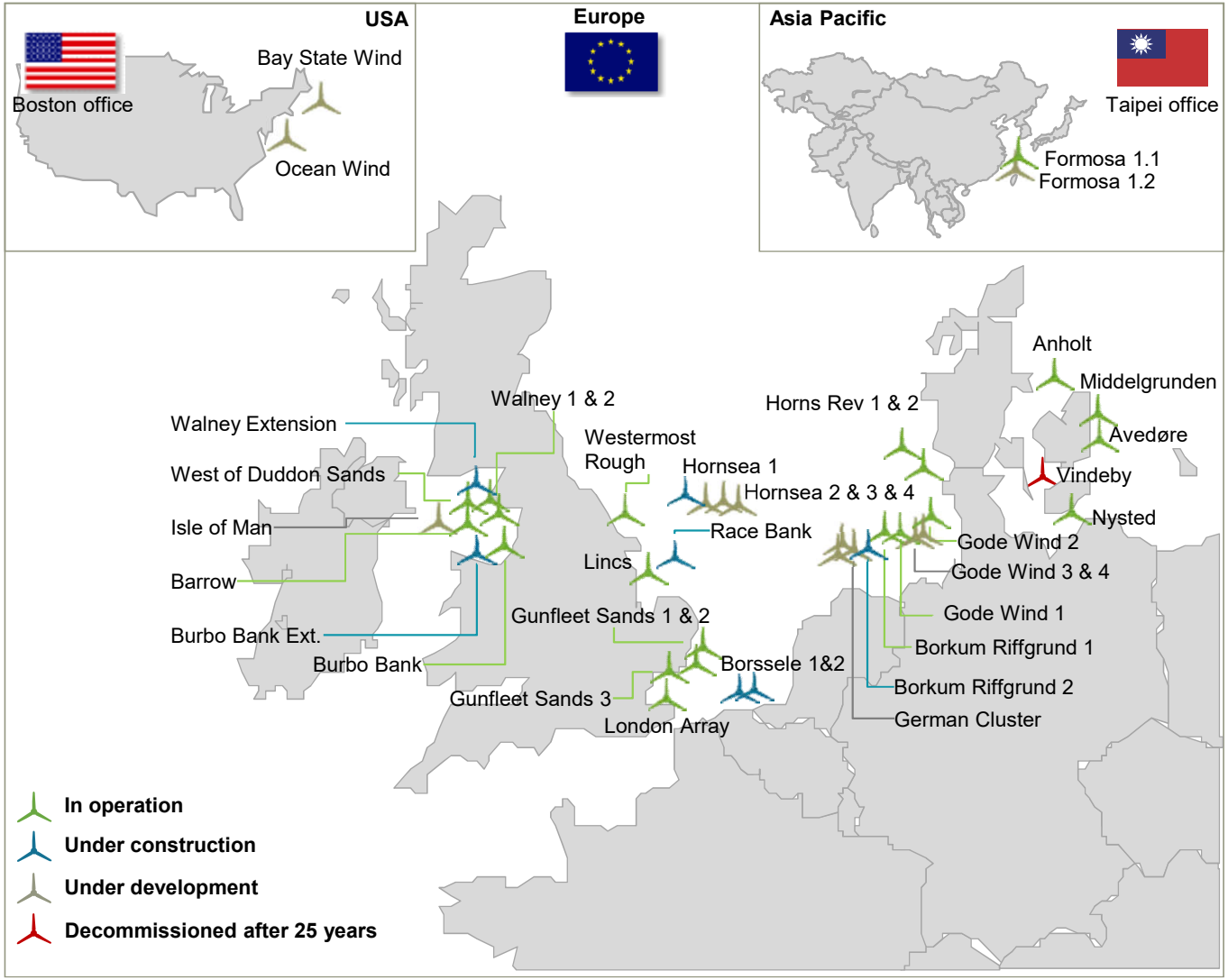
DONG Energy Wind Power overview

DONG Energy Wind Power geographical footprint



Unparalleled experience and track record

1991 — **25+ years of experience and track record in the offshore wind sector** — 2017

21 offshore wind farms in operation

7 offshore wind farms under construction

3.6 GW Constructed capacity

2,000 Dedicated employees

3.8 GW under construction

7.5 million Europeans with clean electricity

3.3 GW World's leading operator

14 Partnerships

DONG Energy Wind Power has built a strong integrated end-to-end business model

DONG Energy Wind Power core competencies

~2,000 Full-time employees[2]

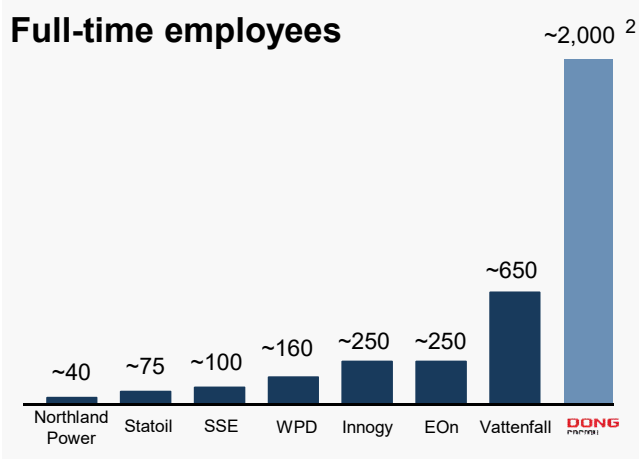
Develop *Identify and mature projects* **~110**

Build *Manage construction, sourcing and supply* **~1,150**

Operate *Conduct life-cycle maintenance* **~640**

Own *Attract capital through partnerships* **~100**

- ✓ Ability to **design and optimise** projects with a **'total life-cycle cost of wind farm'** mindset
- ✓ Experience and expertise along the entire value chain allow for **better understanding and management of risks**
- ✓ End-to-end model reduces LCoE through **fast** feedback and **learning** across the entire organisation

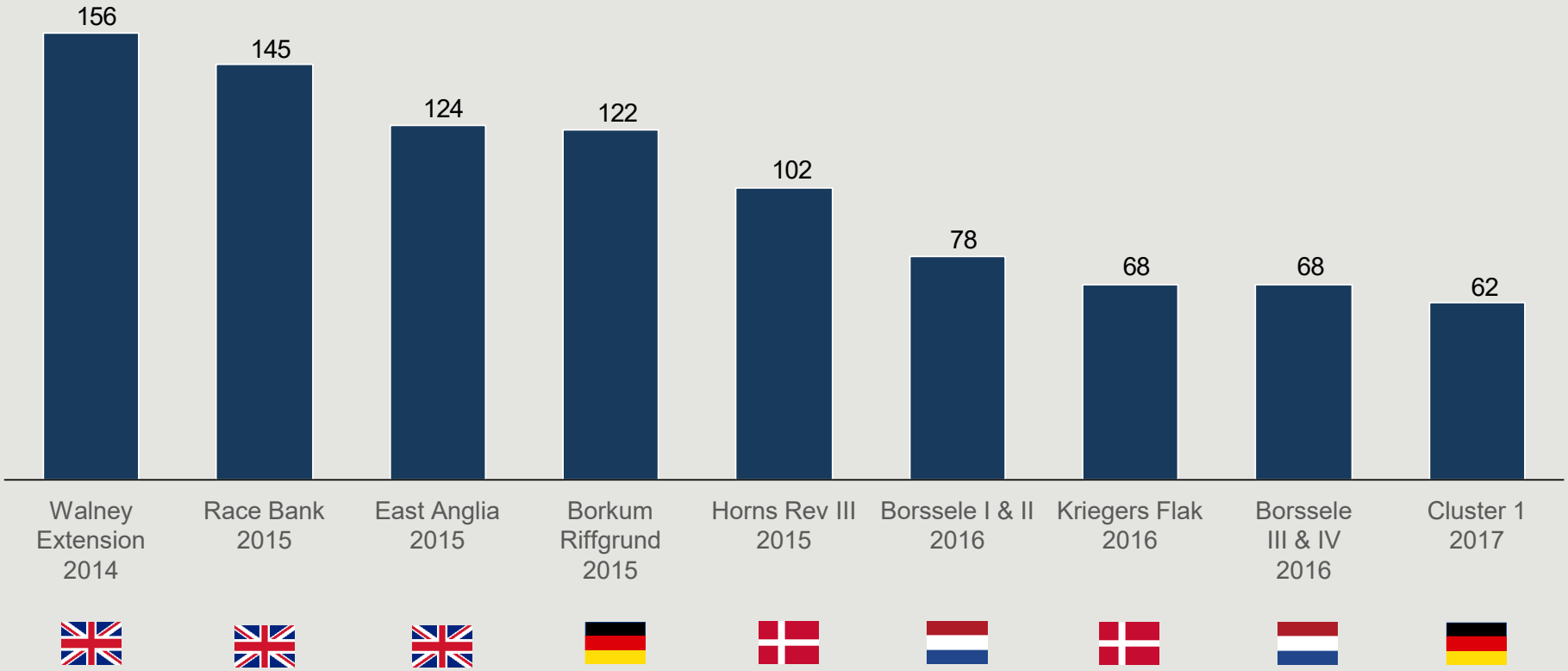


1. Front-end engineering design
2. Excluding CT Offshore and A2SEA as of January 2017

Offshore wind shows rapidly declining costs for society

Levelised costs for society of electricity, incl. transmission costs

EUR/MWh[1], 2016-prices, bid announcement year.



Sources: DECC; Danish Energy Agency; Energinet.dk; NEV (Dutch Energy Scenarios), Bundesnetzagentur

1. Levelised revenue (price) of electricity over the lifetime of the project used as proxy for the levelised cost to society. It consists of a subsidy element for the first years and a market income for the whole lifetime. Discount rate of 3.5% used to reflect society's discount rate. Market income based on country specific public wholesale market price projections at the time of contracting where available else an average of 5 analytics is used. For comparability across projects and because there is no transparency round the TSO costs of transmission a generic scope adjustment (incl. transmission and extra project development costs) have been applied. Due to the specific DC transmission set up in Germany cost estimates from the Offshore Netzentwiklungsplan 2017 have been applied.

We need to urgently adopt to the new reality

It is all about scale

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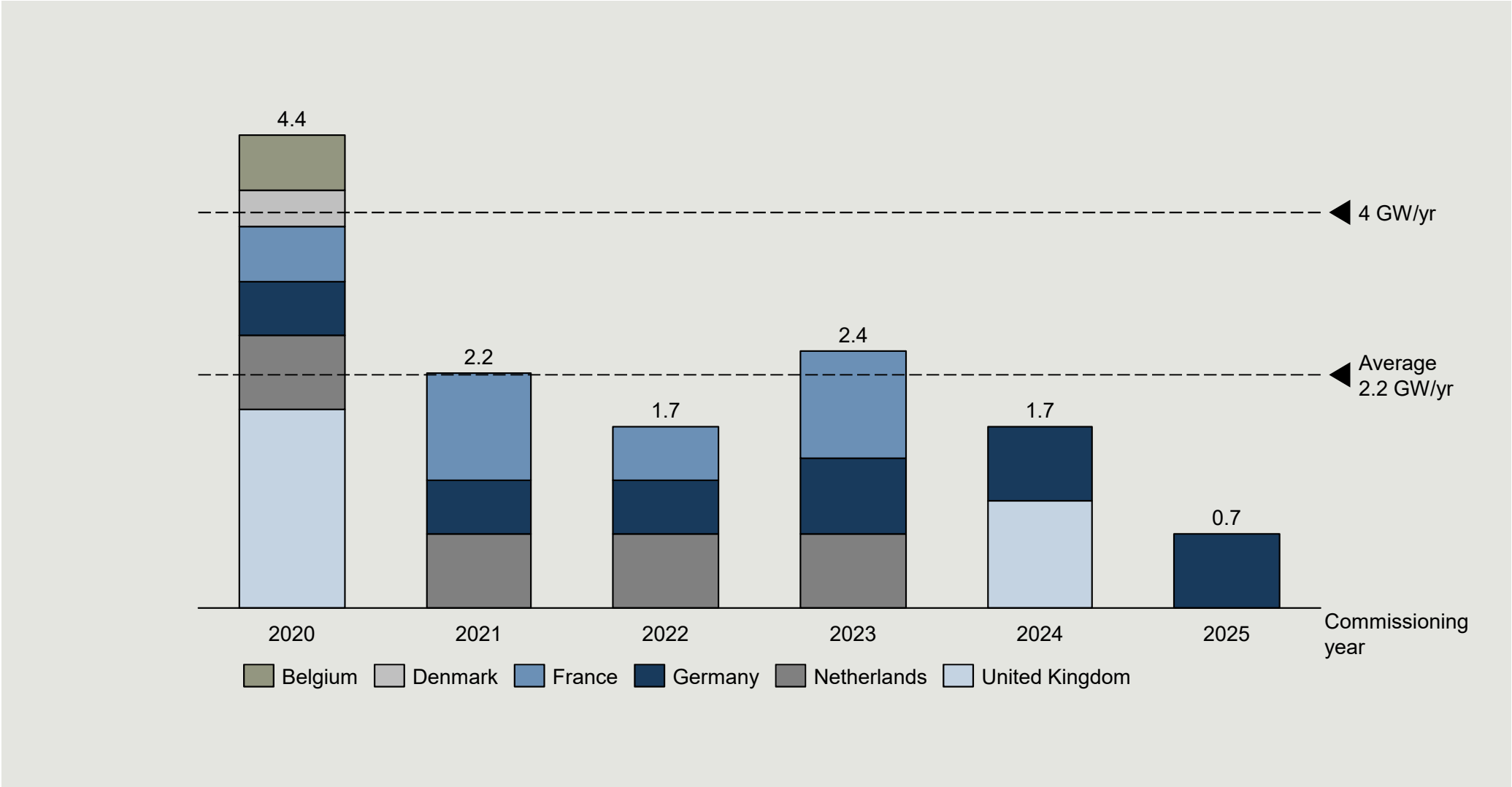
Never before was offshore wind more affordable, but ironically we see declining commitment



Data shows currently politically decided offshore wind energy pipeline, April 2017.
Sources: BNEF and DONG Energy

Public

An offshore turbine a day turns subsidies away

Electricity market regulation and design essential for subsidy-free offshore

High and stable price

Decommissioning of fossil based generators

Enhanced transmission grid

Electrification

Improved market design

Generation capacity and grid adjusted to decarbonisation and flexibility targets

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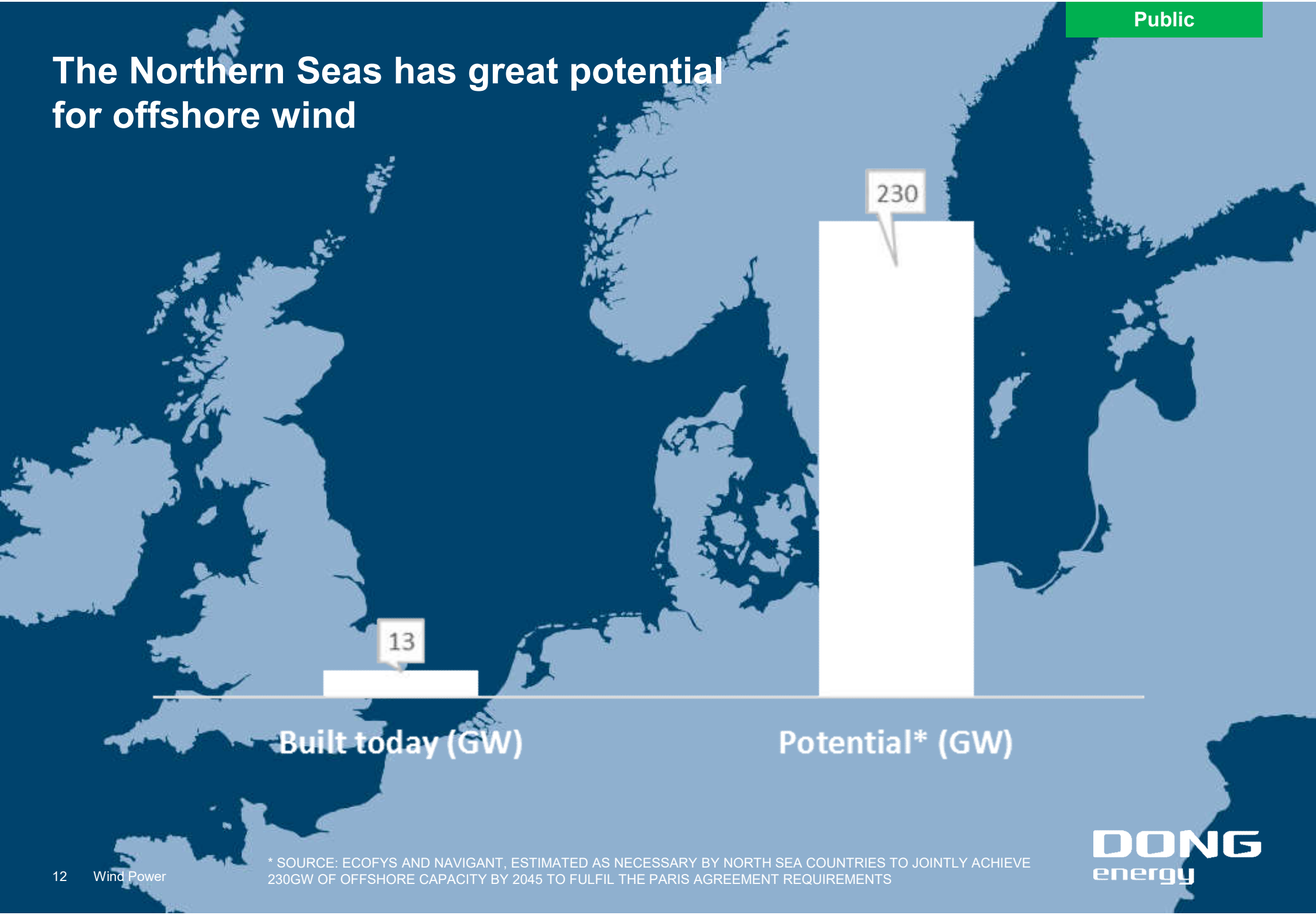
The Northern Seas has great potential for offshore wind



* SOURCE: ECOFYS AND NAVIGANT, ESTIMATED AS NECESSARY BY NORTH SEA COUNTRIES TO JOINTLY ACHIEVE 230GW OF OFFSHORE CAPACITY BY 2045 TO FULFIL THE PARIS AGREEMENT REQUIREMENTS

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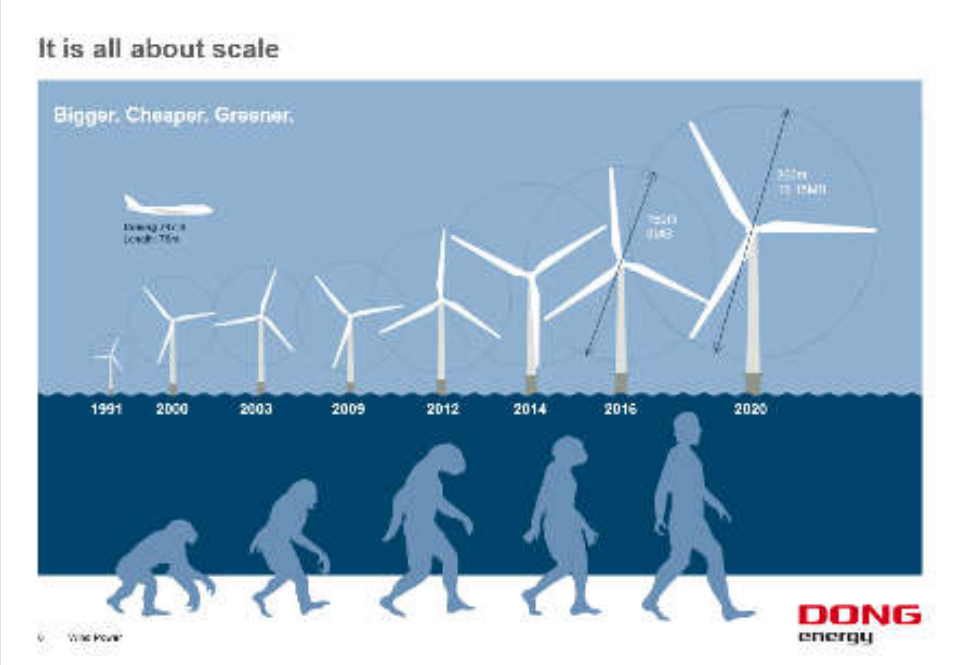
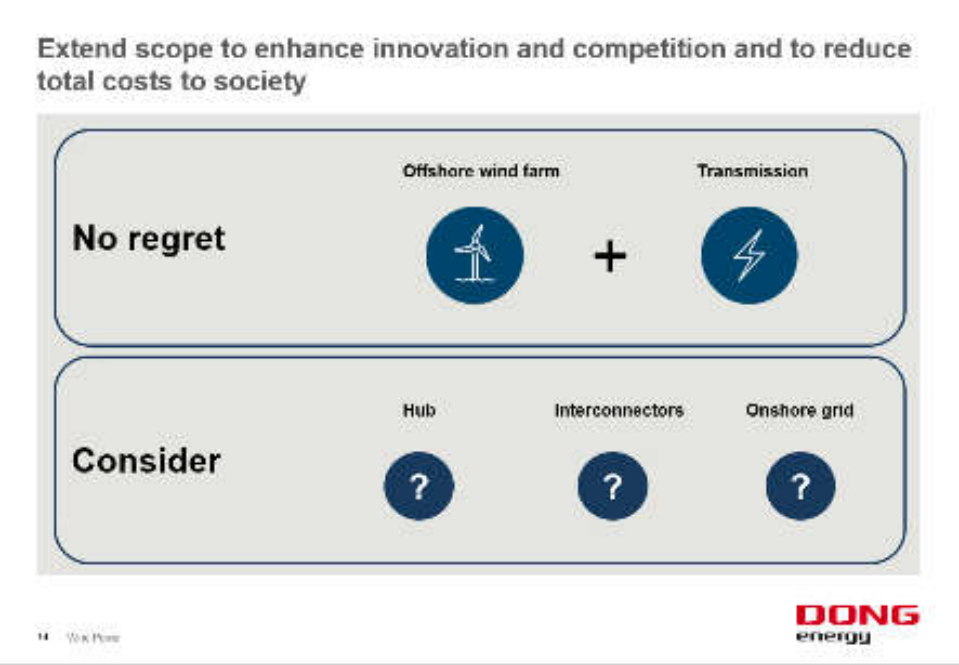
Key levers to unlock potential in any sea

Volume to continuously drive costs reductions through scale and competition



Grid development to access demand and drive cost reductions through competition and innovation



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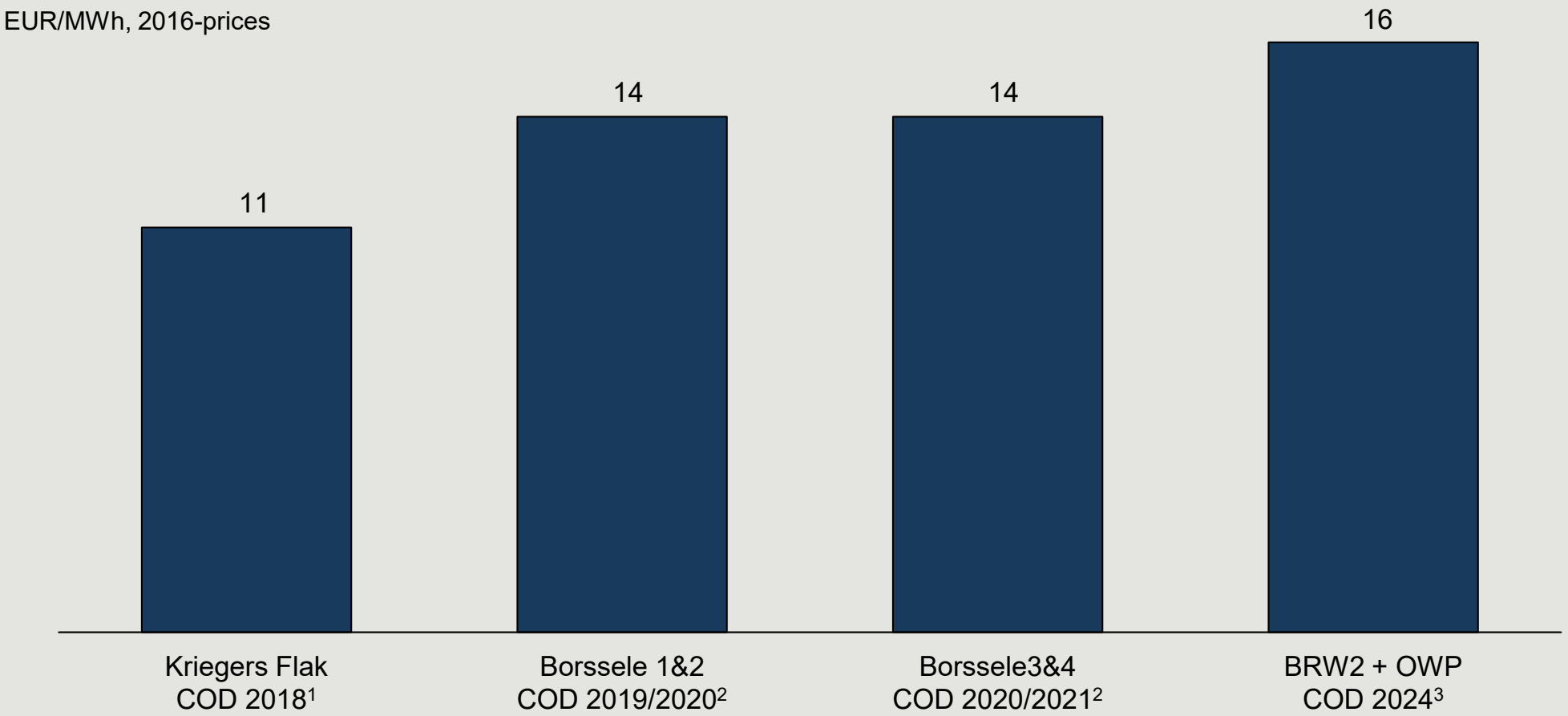
Prices for the transmission does not show a declining price trend across markets

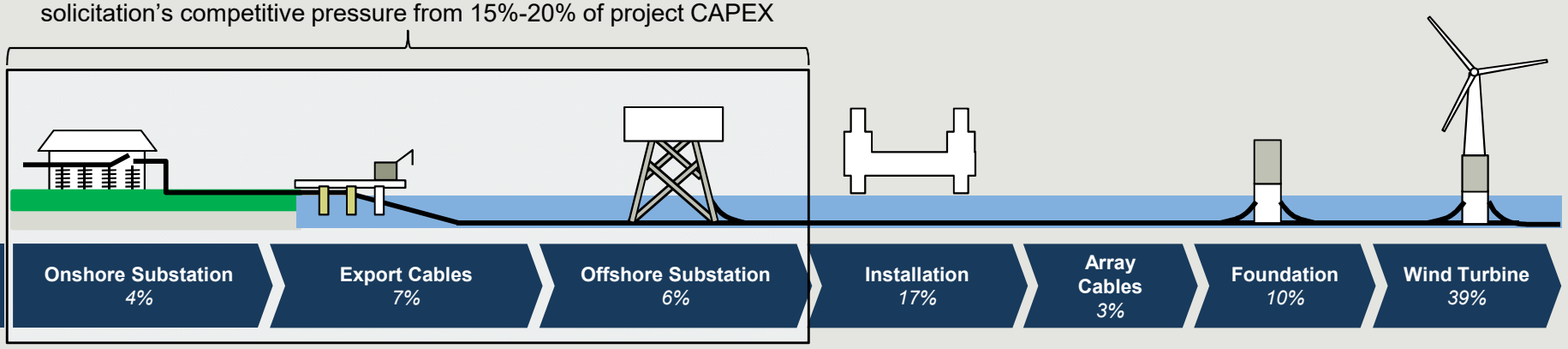


1 Transmission cost: Stated by the Danish Ministry as a written answer in Parliament. EFK spm 45, 25/11-2016
2 Transmission cost: Stated by TennT in July 2016 after Borssele 1&2 winning bid as an average for the five 700 MW tenders
3 Transmission cost: Derived from data in Offshore Network Development Plan 2017 – assumption that the 900 MW HVDC substation for cluster 1,3, and 7 will be fully utilised in the future. If not, higher costs apply.

Competitive pressure should be applied to the entire wind farm

CAPEX component breakdown of an offshore wind farm

Removing transmission assets from developer's scope removes the solicitation's competitive pressure from 15%-20% of project CAPEX



Segment & % of total CAPEX[1]	Onshore Substation	Export Cables	Offshore Substation	Installation	Array Cables	Foundation	Wind Turbine
	4%	7%	6%	17%	3%	10%	39%

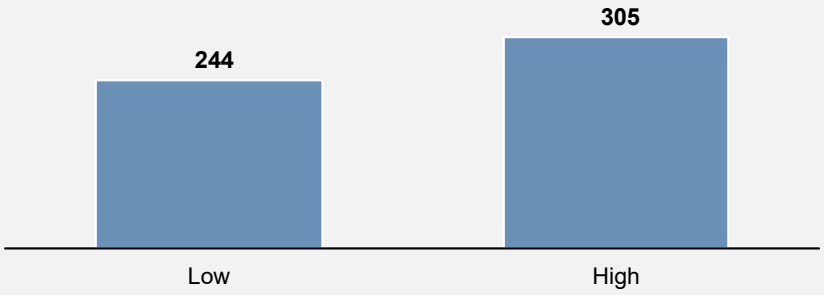
Competition has helped drive down the costs of transmission assets

- In the UK developers build transmission assets then divest them in the OFTO regime

✓ A large study found that this system had created significant savings for UK ratepayers
- Competition had helped move industry to efficiency frontier faster
- Competition created savings equivalent to a LCoE reduction of up to **EUR4,5/MWh**

Total savings created by competition in OFTO regime 2009-12[2]

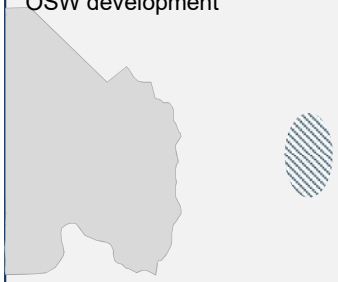
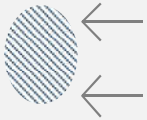
$EURm_{2014}$



1. Other costs account for 14% of total CAPEX and include contingencies, management reserves, resource costs, insurances and construction management. Data is average of select wind farms built towards 2020
2. Based on BDO&CEPA report. Low and high figures from counterfactuals 3 and 5 relating to savings of £205m-£256m due to developer involvement.Calculated by dividing total savings with total MW built in OFTO tender round 1, and adding this figure to CAPEX in GRA LCoE model on a 2023 CoD OWF.

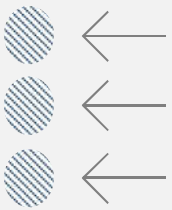
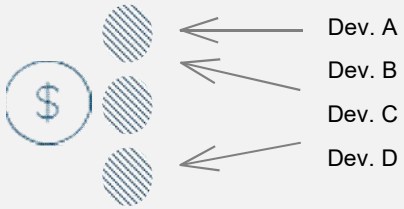
Source: EWEA; Bladt Industries; DONG Energy; Ofgem; BDO & CEPA 'Evaluation of OFTO Tender Round 1 Benefits'

Centralised model – Authority driven site selection process

1. Authorities chose **single site** for OSW development 	× Authorities may not be best to assess optimal possible sites with a focus on cost reduction × Analysis of previous DEA[1] site rankings suggest a risk of using sub-optimal sites[2]
2. Authorities do **extensive** site investigation work  ✓ *EIA prepared & consulted on to secure consent* ✓ *Geophysical survey* ✓ *3D geophysical model* ✓ *Geotechnical investigation (10%-20% of site locations)* ✓ *Integrated geological model*	× Letting developers do detailed site investigations would save DEA expensive consultancy services ✓ Authorities ensure an approved EIA prior to auction, this removes risk of winning projects being cancelled
3. Developers compete in auction for **site and support**  Site + support Dev. A Dev. B Dev. C Dev. D	× The site has a large impact on cost, and in a "single site auction" the choice of site is not exposed to competitive pressure

1. Danish Energy Agency
2. In DEA index 'Stor-skala havmølleparker i Danmark', April 2011' Rønne Banke was identified as best site after Kriegers Flak. Analysis of site characteristics suggest at least 3 sites were better (they contributed up to ~4,5€/MWh cost reduction compared to Rønne Banke based on DEA's data on wind speed, distance to shore, water depth and size of wind farm)
3: CPT: Cone Penetration Test

Decentral model – Developer driven site selection and site investigation to increase competition

1. Authorities chose **multiple sites** for development 	✓ This allows market players to use expertise in identifying best sites, reducing costs ✓ This introduces competitive pressure to site selection
2. Authorities carry out **very limited** site investigation work  ✓ *EIA prepared and consulted on to secure consents* ✓ *Geophysical survey* ✓ *Small geotechnical pre-investigation (1 borehole or 2 CPTs per site[1])*	✓ This is sufficient for developers to do concept selection, installation concept and preliminary design ✓ Authorities should still ensure EIA for site has been prepared and consulted on to avoid post-auction cancellations
3. Developers compete in "**multi site auction**" for site and support 	✓ Detailed site investigation done once as only winner carries these out ✓ Smaller players can still participate as there are consultancies capable of detailed site investigations ✓ Non-winning sites can be used again in later auctions

1: CPT: Cone Penetration Test

In the Baltic sea, shore is never far away…

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Key messages

→Offshore wind on track to subsidy free

→Baltic Sea has potential to benefit from subsidy free offshore, but countries in the region need to act

→Prepare for competition in site selection and investigation

→Combine offshore wind parks and transmission assets in projects to reduce costs through innovation and competition

→Facilitate market driven engagement of developers in offshore grid development in general

→Grand master plans risk locking in solutions and technology

→In the Baltic Sea, shore is never very far away…

 Source: dong energy

Thank your for your attention!