Baltic InteGrid

Towards a meshed offshore grid in the Baltic Sea

Orsted

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Ørsted develops energy systems that are green, independent and economically viable

- Revenue (2018): DKK 76.9 bn
- EBITDA (2018): DKK 30.0 bn
- 6,080 employees
- Active in Scandinavia, United Kingdom, Germany, The Netherlands, USA, Taiwan and Japan

**Offshore**
- Global leader in offshore wind with 5.6 GW operational capacity
- Develop, construct, own and operate offshore wind farms
- Significant and attractive build-out plan of 3.4 GW towards 2022
- Ambition of 15 GW installed offshore wind capacity by 2025

**Onshore**
- US onshore wind portfolio with 813 MW operational capacity
- Develop, construct, own and operate onshore wind farms
- 184 MW under construction and a pipeline of more than 1.5 GW
- Energy storage solutions with the first 20 MW battery storage project in operation
- Solar: first large-scale solar PV project Permian Solar 250 MW

**Bioenergy**
- #1 in Danish heat and power generation with 25% of market
- Converting heat and power plants from coal and gas to biomass
- Innovative waste-to-energy technology (Renescience)

**Customer Solutions**
- Develop green, innovative and cost efficient solutions for our B2B customers
- Provide competitive route-to-market for own and customers’ generation portfolio
- Optimize activities within natural gas
- Market trading operations to optimize hedging contracts

**Major Shareholders (voting share %)**
- Danish State 50%
- Seas NVE 10%
- Capital Group 5-10%
Unparalleled experience and track record

Ørsted offshore wind global footprint

North America
- Bay State Wind
- South Fork
- Block Island
- Ocean Wind
- Garden State
- Skipjack
- Coastal Virginia

Europe
- Walney Extension
- Walney 1 & 2
- Isle of Man
- Barrow
- Burbo Bank Ext.
- Burbo Bank
- West of Duddon Sands
- Westernmost Rough
- Hornsea 1
- Hornsea 1 & 2
- Hornsea 2
- Hornsea 3 & 4
- Race Bank
- Horns Rev 1 & 2
- Gode Wind 1
- Gode Wind 2
- Gode Wind 3
- Gode Wind 4
- Borkum Riffgrund 1
- Borkum Riffgrund 2
- Borkum Riffgrund West 1 & 2
- OWP West
- Anholt
- Avedøre
- Vindeby
- Nysted

Asia Pacific
- Formosa 1.1
- Formosa 1.2
- Greater Changhua projects

Unparalleled experience and track record

1991
- 25+ years of experience and track record in the offshore wind power sector
- 5.6 GW Constructed capacity
- ~ 2,450 Dedicated employees
- ~ 3,4 GW under construction

2018
- 26 offshore wind farms in operation
- 13 million people with clean electricity
- ~ 1,150 turbines World's leading operator
- 23 Partnerships

Ørsted Offshore overview
At the forefront of making the industry cost competitive

Multiple levers to drive down cost in offshore wind

1. Scale
   - Turbines and rotor size
   - Sites
   - Vessel size
   - Cable capacity

2. Innovation
   - Foundation design (e.g. monopiles)
   - Electrical

3. Industrialisation
   - Transition from single supply to multiple global suppliers

Rapid technological development
Wind turbine rotor diameter, year of commissioning

- Boeing 747, 76m
- 80 m
- 90 m
- 107 m
- 120 m
- 154 m
- 164 m
- 220 m

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Costs reduced ....

Offshore wind cost
EUR/MWh

<table>
<thead>
<tr>
<th>Project</th>
<th>Year</th>
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<tbody>
<tr>
<td>Walney Extension 2014</td>
<td>156</td>
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<td>Race Bank 2015</td>
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<td>East Anglia 2015</td>
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<td>Borkum Riffgrund 2015</td>
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<td>Horns Rev III 2015</td>
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<td>Borssele I &amp; II 2016</td>
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<td>Kriegers Flak 2016</td>
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<td>Borssele III &amp; IV 2016</td>
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<tr>
<td>Hornsea 2 2017</td>
<td>65</td>
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<tr>
<td>Cluster 1 2017</td>
<td>62</td>
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</tbody>
</table>
Levelised cost of electricity for different technologies

The rapid cost reductions in the industry, have made offshore wind power competitive relative to conventional power generation based on fossil fuels

EUR/MWh 2016 prices

Source: Bloomberg New Energy Finance (BNEF) for CCGT and Coal plants for Northwest Europe, Danish Energy Agency and BNEF for Offshore Wind.
For offshore wind: Including cost of transmission – Calculated as Levelised revenue (subsidy and market price) of electricity over 25yrs lifetime as a proxy for the levelised cost of society. 3.5% real discount rate used. *Generic Offshore Wind, Northwest Europe, FID 2012. In 2012 our goal was to reduce offshore wind costs to 100 Euro/MWh in 2020, ** Hornsea 2, UK, *** Hinkley Point, UK. Same approach as for Offshore Wind. Strike price of 92.5 £/MWh in 2012 real prices. Lifetime of 60yrs, 91% capacity factor.
Industry matured and now ready to take off, with accelerated build out

Note 1: Excluding Russian EEZ
Cost reductions makes offshore wind highly relevant in the Baltic Sea

Baltic Sea¹
- Lower wind speeds
- Shallower water depths
- Less extreme sea states, and
- Shorter distances to shore

Source: BVG Associates for WindEurope
The Baltic Sea can be an innovation hub for the next generation of offshore wind.

1. Demand for renewables is the driver of cluster size

2. Increasing the interconnection is driven by access to price areas

3. Time value of money is a key driver behind modular clusters

- Hybrid interconnector
- Interconnected cluster
- Interconnected modular cluster
- Single line
- Radial cluster
- Radial modular cluster

Sites / time

Price areas
Can hybrids taken offshore wind and transmission to a new level

**Legal Aspects**
- Definitions of hybrids and unbundling rules

**Permitting and Planning**
- Cross-border/EU planning (enough sites are allocated to offshore wind and interconnectors)

**Renewable energy support**
- Is convergence needed or is compensation a possibility when direction of flow of electricity is uncertain - RES contribution to national share?
- Available EU funding?

**Transmission cost allocation:**
- Cost/benefit sharing of interconnectors / (Joint) investor participation (e.g. public-private partnerships) and funding mechanisms
- Regulated income – cap and floor regulation?

**Market setup Implementation/codification:**
- Can the market setup deliver incentives for an efficient market

**Technology development:**
- How can the further develop of multi terminal technology solutions be supported?
Summary – regulatory questions

Next step – to get started!

• Governments to identify suitable areas for offshore wind and foster innovative grid solutions

• Enable organic growth of the supply chain and further cost reductions

• Develop national energy and climate plans with goals for offshore wind aligned with the road to a zero emission 2050 target

• Include joint tenders and other means of collaboration in national energy and climate plans
Innovation is in Ørsted’s DNA

- First mover on new wind turbine technology
- Optimised methods for foundation design
- At forefront of implementing installation concepts
- Front runners in maturing the supply chain for offshore wind
- Digitalization concepts, applications and processes
- Extensive collaboration with universities and research institutions globally