Anholt Offshore Wind Farm

Site visit 11 April 2019

Ørsted

Ørsted's team

Jan Holst Møller
Head of Anholt Operations

- Responsible for Anholt Offshore Wind Farm
- Located in Grenaa.

Jens Nybo Jensen
Senior Communication Advisor

- Corporate Media Relations.
- Anholt project communication manager

Lasse Sundahl
Senior Lead Revenue Advisor

- Revenue estimation and whole sale electricity market design

Sune Strøm
Regulatory Affairs Wind Power

- Regulatory affairs, framework/conditions for offshore wind energy and stakeholder engagement

Agata Staniewska
Senior Market Developerv

- Responsible for Polish market.
- Located in Warsaw.

Ørsted

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

Ørsted

- 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

Major Shareholders (voting share %)

• Danish State	50%
• Seas NVE	10%
• Capital Group	5-10%

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

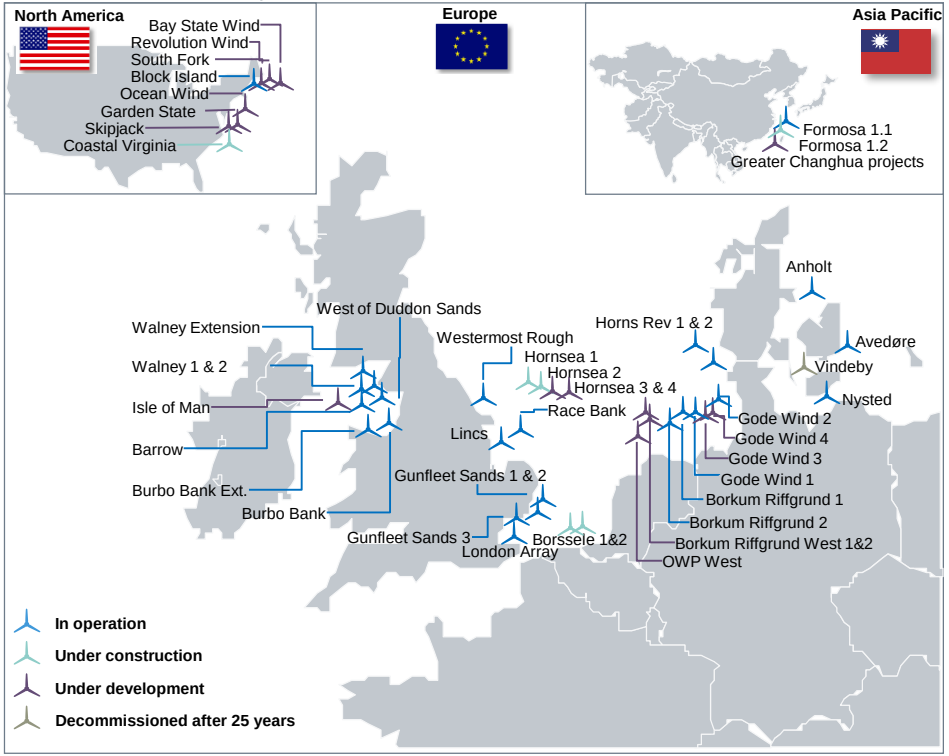
- #1 in Danish heat and power generation with 25% of market
- Converting heat and power plants from coal and gas to biomass
- Innovative waste-to-energy technology (Renescience)

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

Ørsted Offshore overview

Ørsted offshore wind global footprint



Unparalleled experience and track record

1991 — 25+ years of experience and track record in the offshore wind power sector — 2019

26 offshore wind farms in operation

5 offshore wind farms under construction

5.6 GW Constructed capacity

~ 2,450 Dedicated employees

3.4 GW under construction

13 million people with clean electricity

~ 1,150 turbines World's leading operator

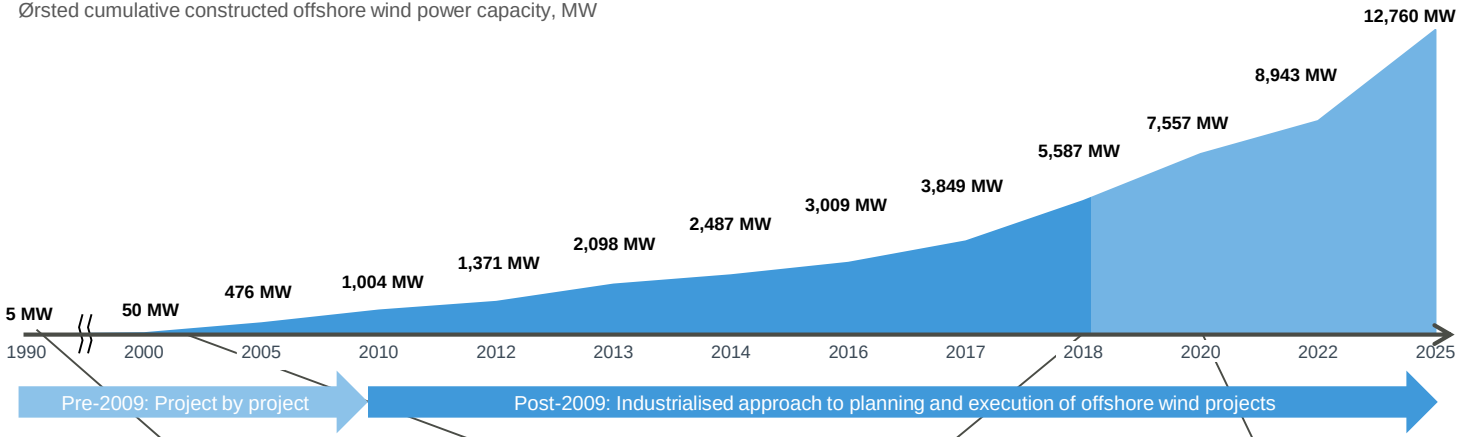
23 Partnerships

Ørsted

Ørsted pioneered the offshore wind industry …

Unrivalled track-record in offshore wind

Ørsted cumulative constructed offshore wind power capacity, MW



Selected projects

Vindeby	Horns Rev 1	Walney Extension	Hornsea 1
First offshore wind farm in the world	**First large scale offshore wind farm in the world**	**The largest operational offshore wind farm in the world**	**The world's largest offshore wind farm once constructed**
 5 MW	 160M W	 659 MW	 1,218 MW
Turbine capacity: 0.45 MW	Turbine capacity: 2 MW	Turbine capacity: 7-8.25 MW	Turbine capacity: 7 MW
Nr. of turbines: 11	Nr. of turbines: 80	Nr. of turbines: 87	Nr. of turbines: 174
Rotor diameter: 35 m	Rotor diameter: 80 m	Rotor diameter: 154-164 m	Rotor diameter: 154 m
Distance to shore: 1.8 km	Distance to shore: 18 km	Distance to shore: 19 km	Distance to shore: 120 km

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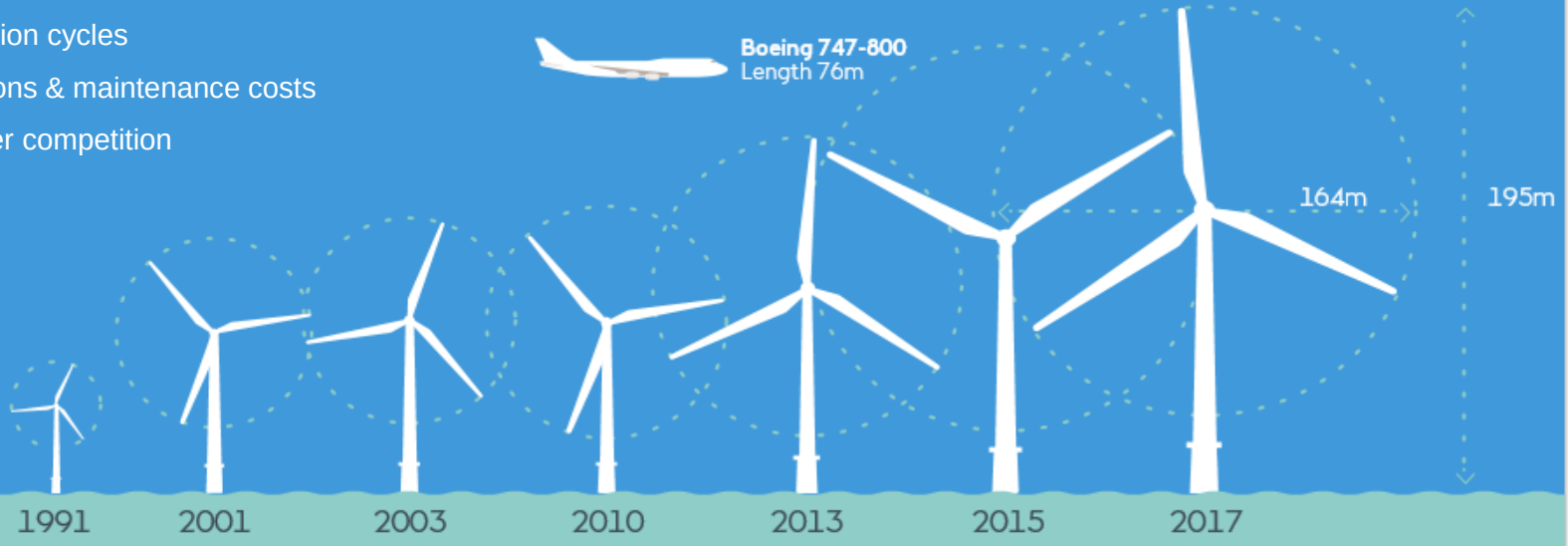
We have systematically driven down cost of offshore wind

Key cost reduction levers

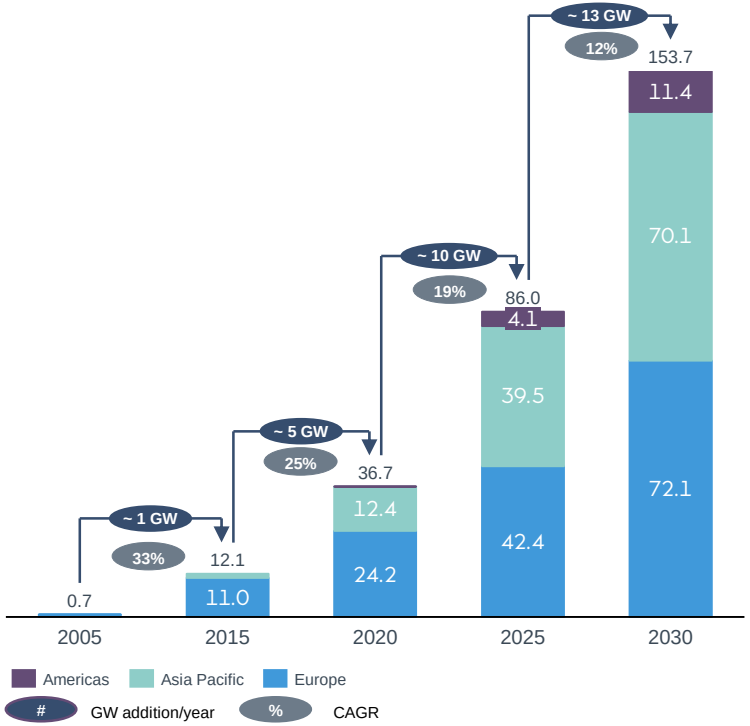
- Develop larger sites
- Install larger turbines
- Innovate and reduce costs across all components
- Reduce installation cycles
- Reduce operations & maintenance costs
- Increase supplier competition



By 2030 offshore wind power will be truly global...

Strong growth in established and new offshore wind power markets

Installed capacity, GW



Source: Bloomberg New Energy Finance (BNEF), 2H 2018 offshore wind market outlook

Offshore wind capacity with firm political commitment[1]

Targets in existing footprint markets

- The UK government has a CfD roadmap with bi-yearly auctions of 2-4GW towards 2030 to reach 30GW
- Target of 15GW offshore wind by 2030
- Offshore Wind Energy Roadmap 2030 outlines 11.5GW by 2030 through 1GW per year post 2023
- MA 2027 (2035) target: 1.6 (3.2) GW. VA 2028 target: 2.0GW. NJ 2030 target: 3.5GW. NY 2030 target: 2.4GW.
- Current 2025 target of 5.5GW which has already been reached through grid allocation and price auction
- Outlined plan for three 800MW (2.4GW) offshore wind projects before 2030 by the Danish Government leading to a total of 5GW in 2030
- Authorities of Belgium have announced plans for offshore wind targets of 2.2GW by 2020 and 4GW by 2030

~81GW

Targets in next horizon markets

- The Indian government has target of 5GW before 2022 and 30GW by 2030
- The South Korean government has a total wind target of 18GW by 2030 of which 13GW is allocated to offshore wind
- France has a 2023 target of 3GW installed and 6GW in the pipeline post 2023

~46GW

Note 1: Firm political commitment is defined by a country's public offshore wind target by 2025/2030

Ørsted


ANHOLT OFFSHORE
WIND FARM

Anholt Offshore Wind Farm

- Denmark's largest offshore wind farm
- Inaugurated: 4 September 2013
- Capacity: 400MW
- Turbines: 111 Siemens SWT 3.6 - 120
- Area: 88 km2
- Location: between the peninsula of Djursland and the island of Anholt in the sea of Kattegat
- 400,000 households with CO_2 -free power
- Constructed: 2012-2013
- Ørsted: developed, constructed and operates
- Ownership: Ørsted (50%) PD (30%) PKA (20%)

Ørsted pka PensionDanmark

Ørsted

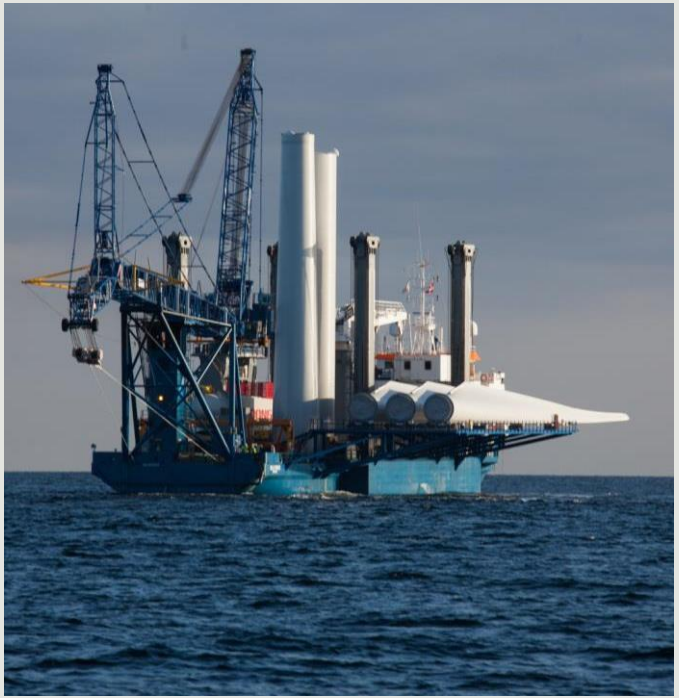
Economics of Anholt offshore wind farm

- Ørsted is guaranteed 105.1 øre/kWh (no price regulation) for the first 20 TWh, equivalent to approx. 12 years, equals 140 €/MWh
- After this, the electricity is sold on market terms without subsidies
- The capital investment for the farm is approx. 10 bn DKK
- Grid connection approx. 1.3 bn DKK
- Total investment 1.5 bn EUR
- The concession lasts for 25 years
- 15-year contract with PensionDanmark and PKA on operation and planned maintenance of the farm

Anholt offshore wind farm timeline

Time	Activity
February 2008	**Political agreement of the establish-ment of a 400 MW wind farm**
April 2009	DEA release tender specifications
April 2010	DEA receive tender
2 July 2010	**Concession granted Ørsted**
July 2010	Geological surveys commenced
Autumn 2011	Shore landing cable work commenced
January 2012	**Start offshore construction**
January 2012	Foundation construction commenced
March 2012	Transformer platform work commenced
June 2012	Laying-out of cables in the wind farm commenced
September 2012	Erection of wind turbines commenced
October 2012	First electricity
Summer 2013	**Entire wind farm operational**

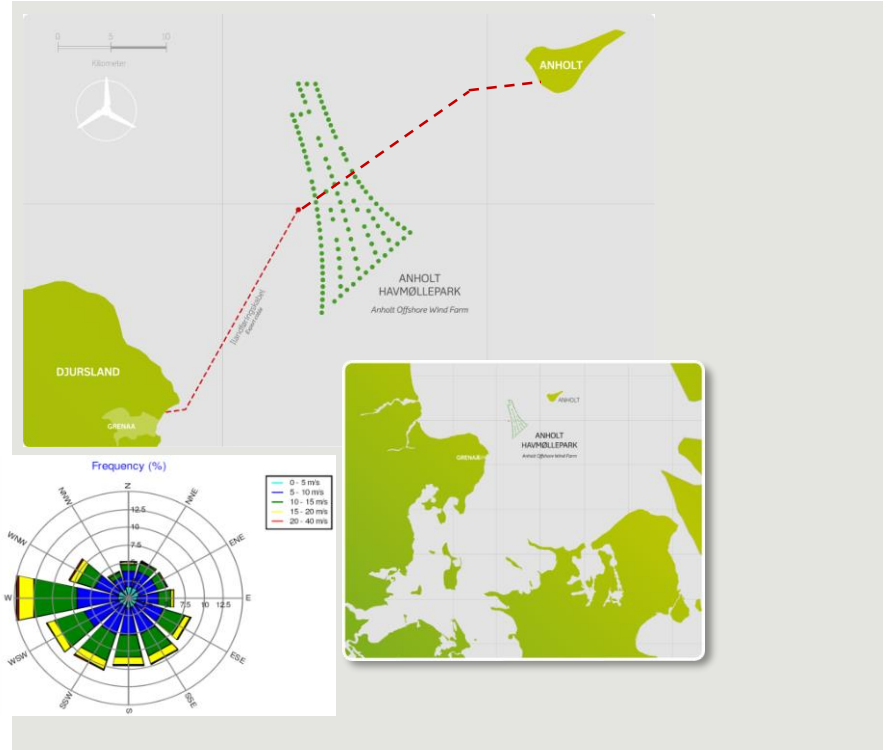
3 years



Construction

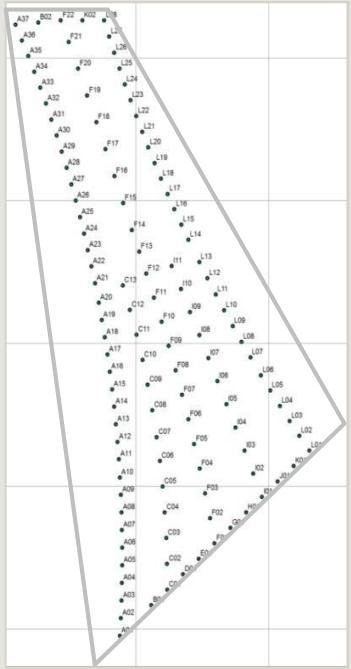
Anholt offshore wind farm – the site

- 111 wind turbines located 20 km from Grenå and 15 km from the island of Anholt.
- Optimised layout concept aims at maximising annual energy production considering soil conditions, turbine / foundation loads and other physical constraints.
- Concentrated rows of turbines on the edge of the wind farm and more disperse rows inside. This has previously shown higher production than a standard grid layout.
- Turbine distances are approx. 600 meters at the edge and approx. 900-1300 meters inside the wind farm.



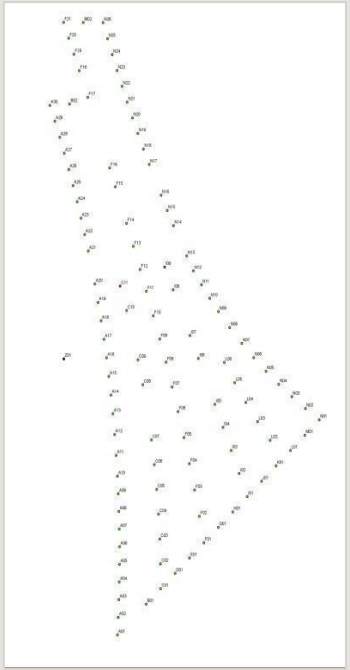
Anholt offshore wind farm – layout

Original park layout



- Allowed to use 88 km2 out of 144 km2
- Original park layout based on geophysics
- Indications of soft subsoil
- Detailed analysis showed subsoil challenges at some positions
- Some positions had to be abandoned and replaced

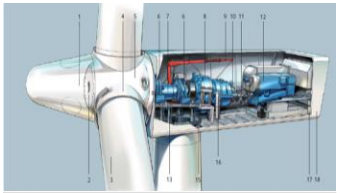
Final park layout optimised



- Minimum shadow effect
- Highest production
- Geotechnical limitation
- Installation vessels
- Foundation costs

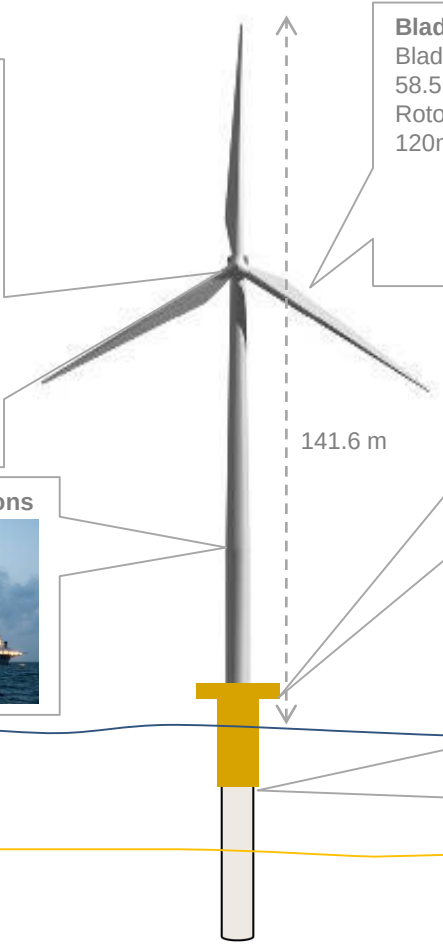
111 structures

Nacelle / Turbine



1 Spinner	10 Brake disc
2 Spinner bracket	11 Coupling
3 Blade	12 Generator
4 Pitch bearing	13 Yaw gear
5 Rotor hub	14 Tower
6 Main bearing	15 Yaw ring
7 Main shaft	16 Oil filter
8 Gearbox	17 Generator fan
9 Service crane	18 Canopy

Tower – built from 3 tower sections



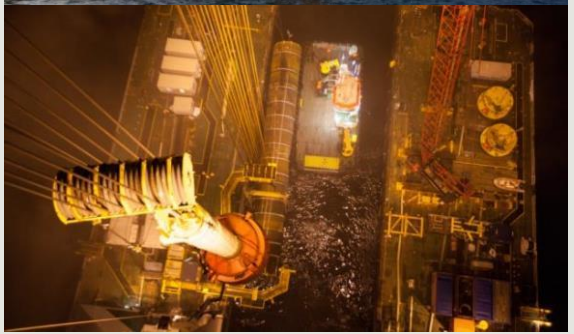
Blades
Blade length: 58.5m
Rotor diameter: 120m

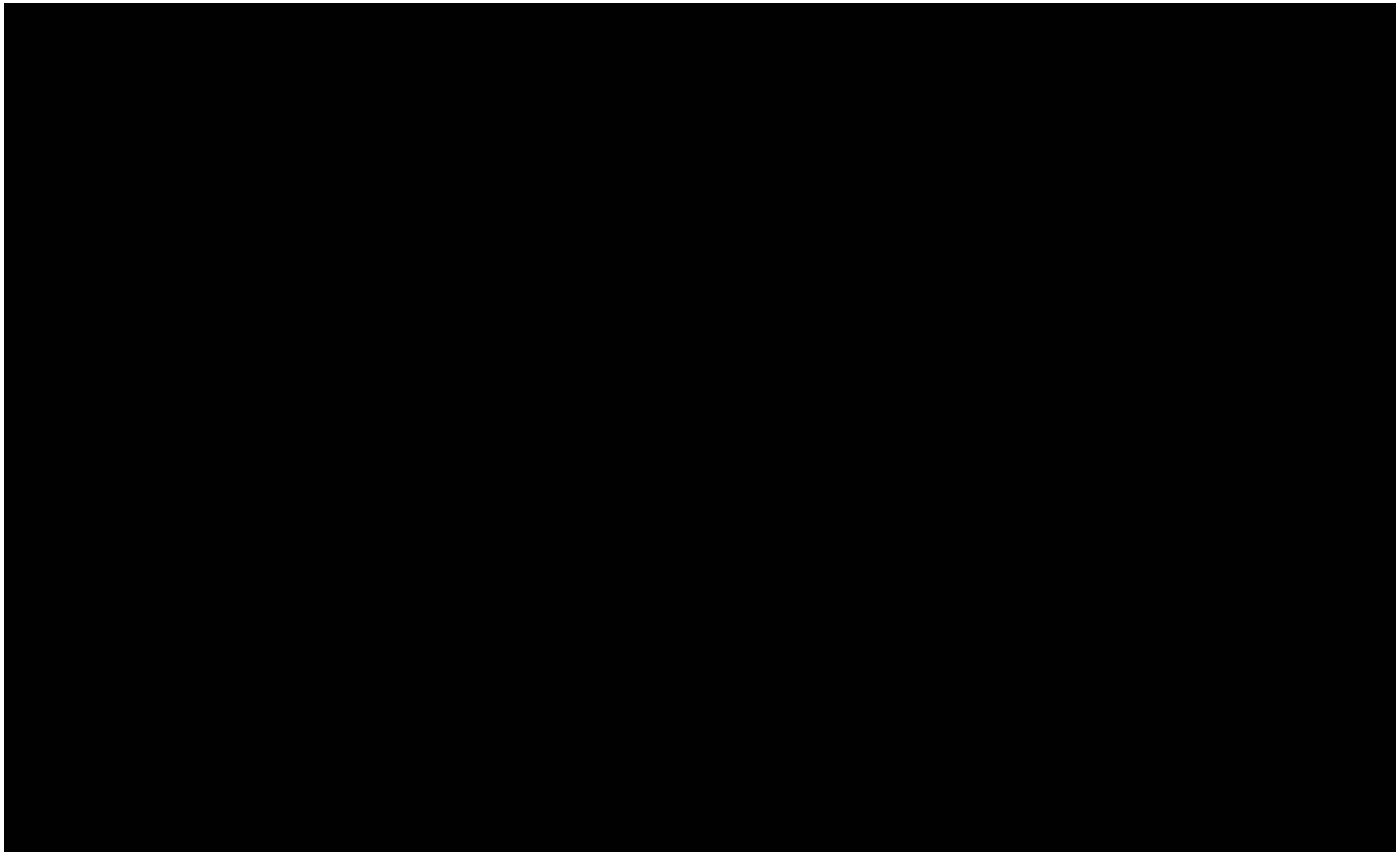
Transition Piece
Secures monopile on tower/turbine and has boat landing and access ladder for service vessels

Monopile
Hammered 20-30m into the seabed

First monopile – Aalborg, Denmark

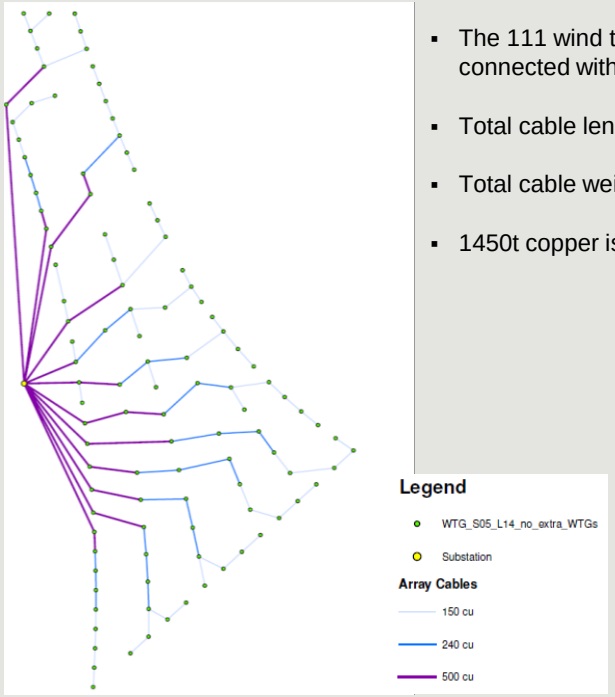
Installation of monopiles with HLV Svanen
January to July 2012





Installation transition piece with Jumbo Javelin
April to July 2012

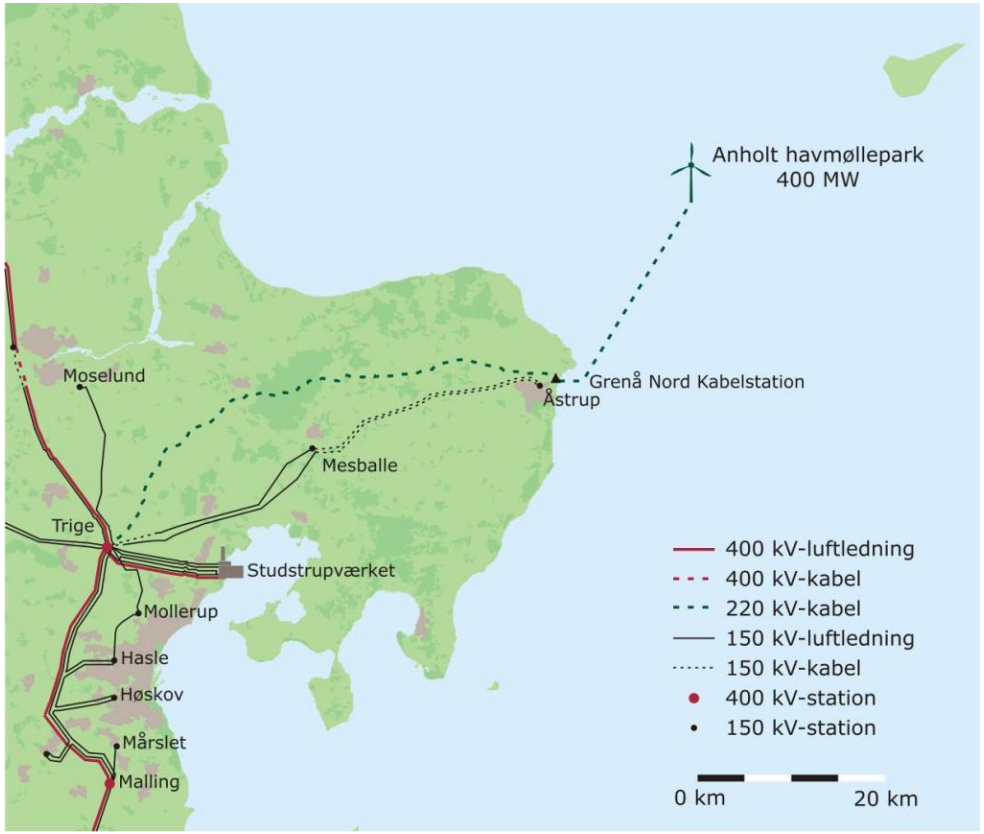
Cable installation within the wind farm
June to September 2012



- The 111 wind turbines are divided into 12 groups. Each group is connected with sea cables to the substation.
- Total cable length inside wind farm: 160km
- Total cable weight: 3900t
- 1450t copper is needed for the production of the cables

Grid connection and offshore transformer

Offshore and onshore cable connection



Turbine installation with 4 different vessels up to 3 at same time

Wind turbine installation
September 2012 to May 2013

Wind turbine installation

SEA WORKER

A2SEA

Jack-up barge

Non self-propelled

2 turbines per load-out

January to May 2013

39 turbines installed

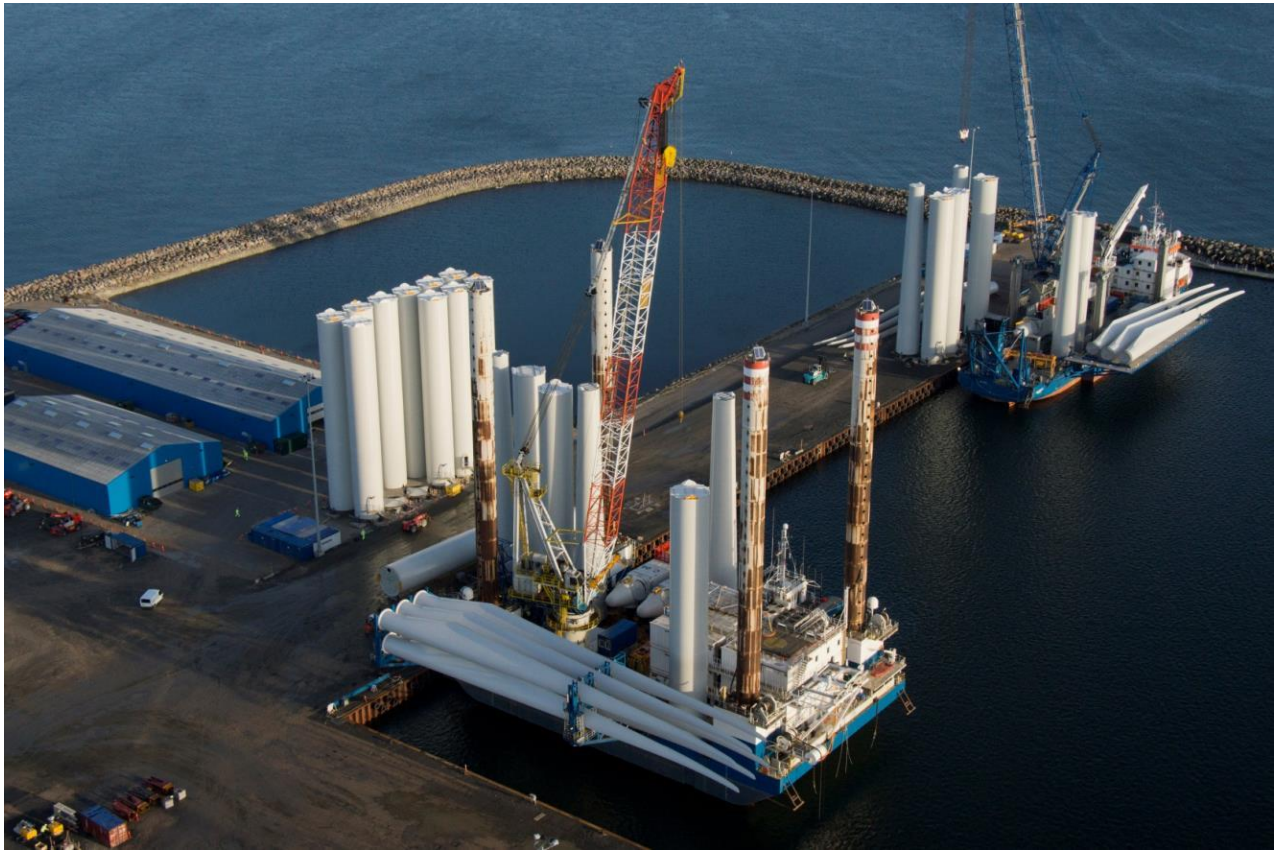
Working 24 / 7

SEA POWER installing blade

Grenå harbour used for load out of turbines and service facilities

Siemens pre-assembly site at Grenå – 130,000 m^2, 90 persons

The installation vessels jack-up loading turbines

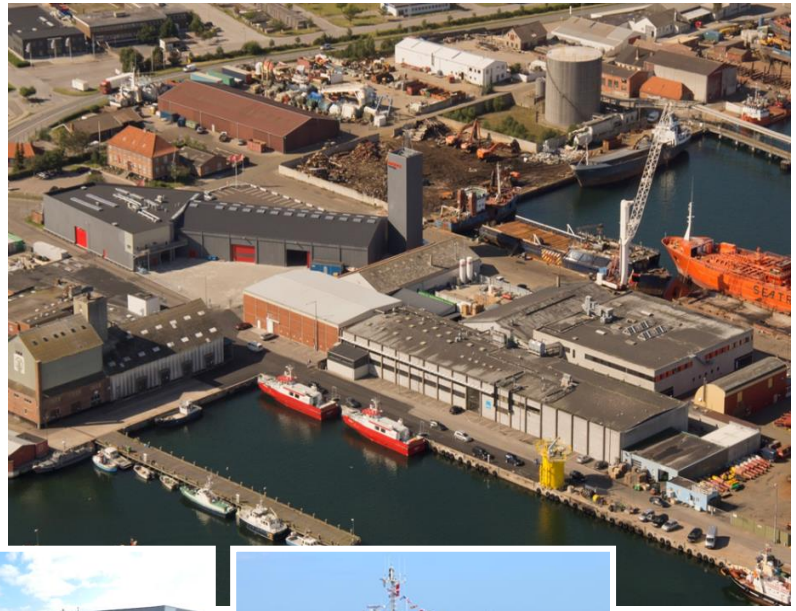


Working through winter months

Hotel vessel for up to 100 persons and 40 crew members

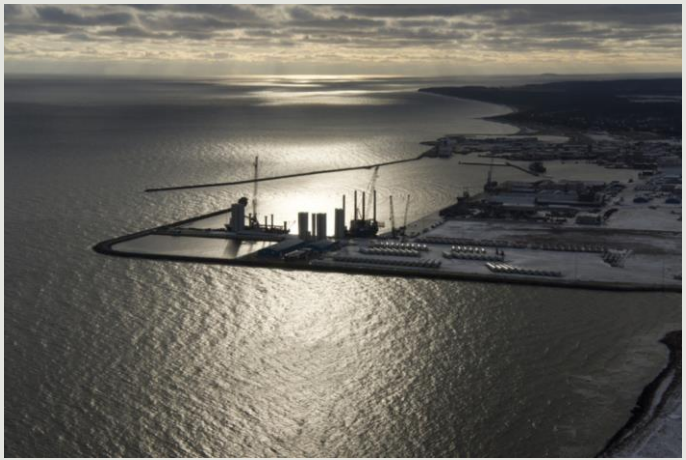
Base harbour in Grenå

- Base during construction and operation
- Rebuild existing buildings to provide office and storage facilities for O&M activities
- Workforce of 70 people permanently located in Grenaa
- 3 service vessels based in Grenaa



Anholt offshore wind farm –Denmark's largest construction site

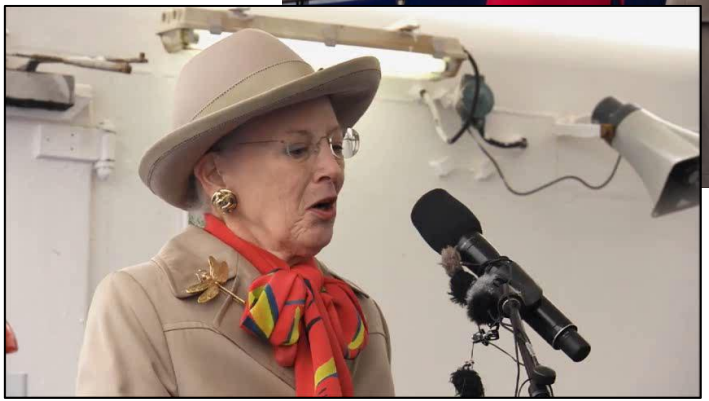
Anholt offshore wind farm creates ripple effect



- The project creates approx. 8,000 jobs in the construction period*
- Orders for almost 7 billion DKK with Danish-based companies
- Orders for more than 450 million DKK and 330 jobs with local suppliers
- Operations with a crew of approx. 70 employees is established in the service buildings in Grenå
- Three service vessels permanently based in Grenå

* The Danish Energy Agency and Danmarks Statistik have estimated the total net employment effect in Denmark at 8,000 jobs in the construction phase.

Inauguration speech by H. M. Queen Margrethe 4th September 2013



Our vision

Let’s create a world that runs entirely on green energy

Ørsted

Extra slides

Ørsted transformed from black to green energy