PUBLIC COPY

Ørsted

Ocean Wind 2 Offshore Wind Farm

OREC Application

Attachments to Section 15

December 2020

Ørsted

Attachment 15.1 – Decommissioning Case Study

December 2020

Decommissioning of Vindeby
– THE WORLDS FIRST Offshore Wind FARM

Learnings from the Vindeby site

Ørsted

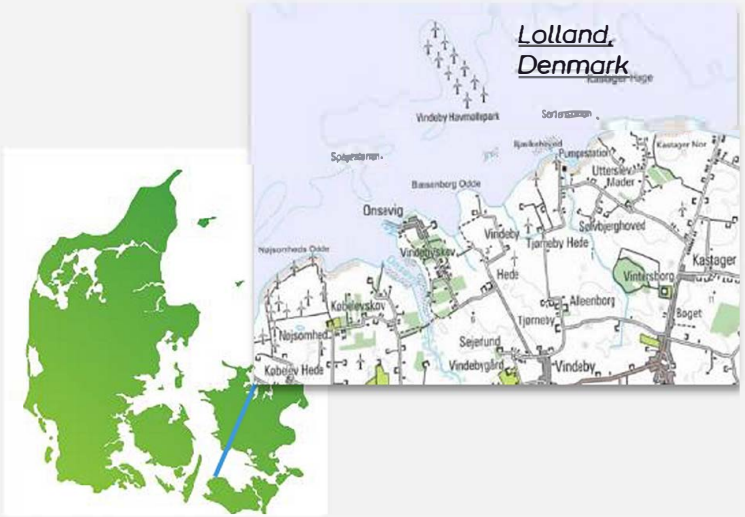
Lars Bie Jensen
23.1.2018

Offshore wind started 25 years ago with Vindeby in 1991

- **Vindeby was the world's first offshore windfarm**
- **Key milestone marking the beginning of the offshore wind industry**

Vindeby

- 4.95 MW installed capacity
- Inaugurated September 1991
- Lifetime production: ~ 243 GWh
- Built by Elkraft/SEAS
- Located ~1.5 km offshore near Vindeby Lolland

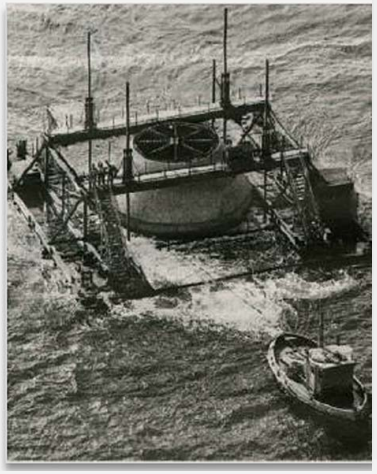


Wind turbines

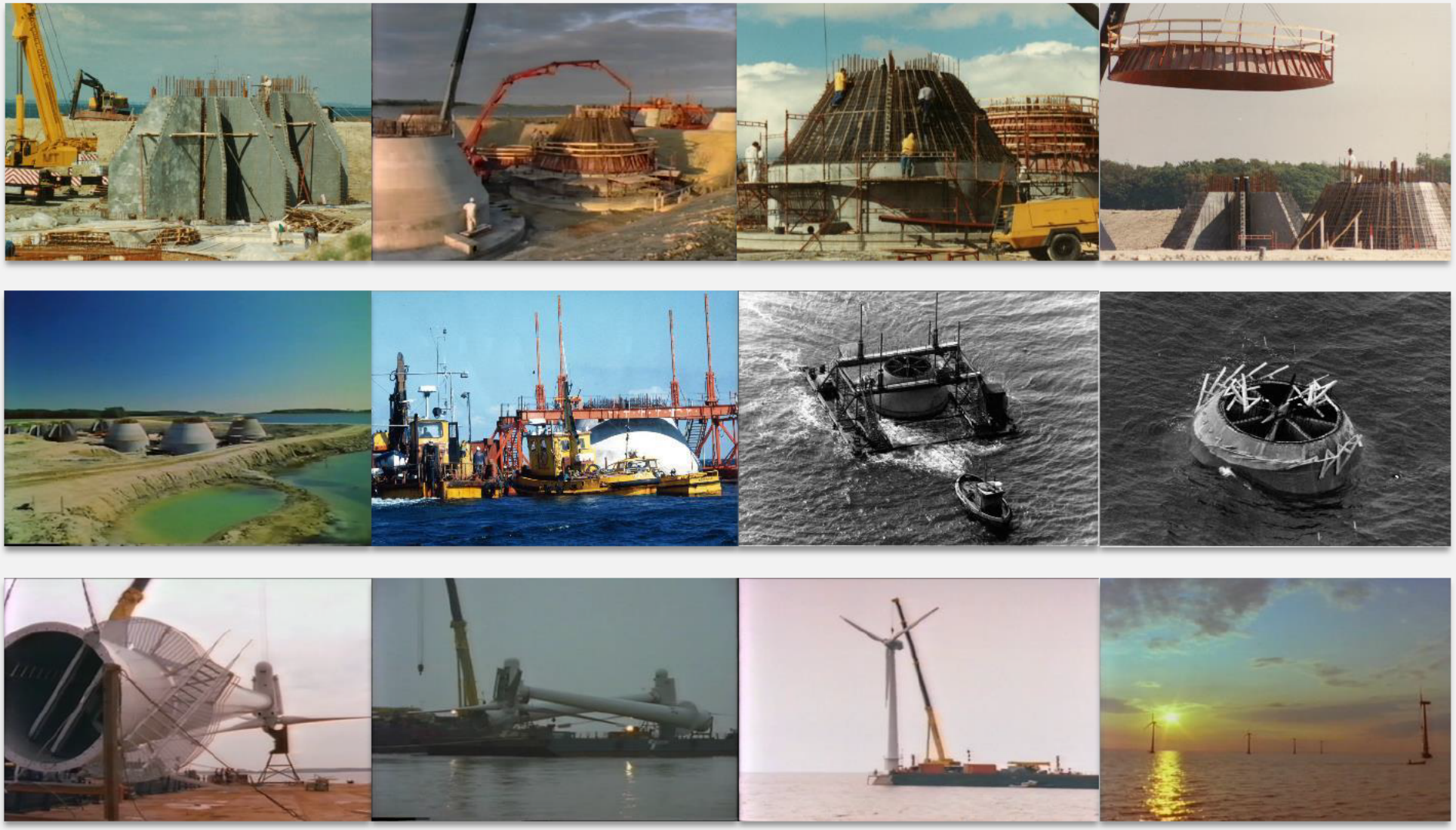
- *11 Bonus 450 kW*
- *Installed in one piece*
- *Hub height 35 m*
- *Blade length 17 m*
- *Service habour: Onsevig, Lolland*

Foundations

- *Gravity based*
- *5 m water depth*
- *Reinforced concrete shell filled with sand*
- *Weight ~1.500 t (filled) & ~ 500 t (dry)*
- *Built locally at Onsevig habour*



Construction of Vindeby 25 years ago



Why decommission Vindeby ?

Considerations started early 2015

- The consent was expiring in 2016 – extension could be applied for
- Most turbines were operational but needing increasing maintenance
- Blades, towers, foundations, cables could continue to produce, but maintenance of i.e. corroding bolts at flange was needed
- Inspection showed need to refurbish gearboxes to continue operation – not feasible given turbine size, power prices and cost of overhaul

Ørsted

Vindeby Decommissioning Consent

PUBLIC COPY

Consenting authority

The Danish Energy Agency DEA acts as a "One Stop Shop" for the consent for decommissioning incl. consultation of all relevant authorities on national and regional level.

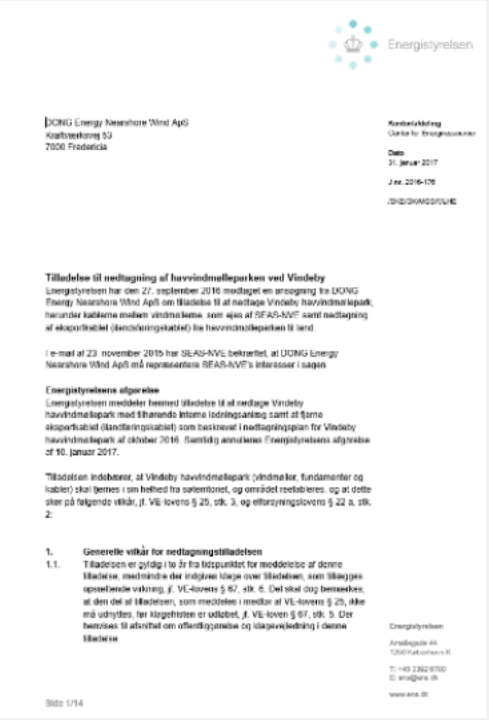
The onshore part was under the jurisdiction of the local municipality, which gave the consent to remove the onshore cables etc. (no offshore substation for Vindeby)

As this decommissioning is/was the first in Denmark no fixed process was in place

The DEA was open for a dialogue when decommissioning of Vindeby was due

The agreed approach became in essence the same as for building wind farms

- Application for decommissioning containing:
  - Method description and logistics
  - Environmental Impact Assessment (EIA)
- Consultation of relevant authorities
- Consent for decommissioning with conditions



Energistyrelsen

DONG Energy Nearshore Wind ApS
Kraftværksvej 53
7000 Fredericia

Kontorfællesskab
Center for Energiressourcer

Dato
30. januar 2017

J.nr. 2016-176

/SNEDSKAMDSVILHE

Tilladelse til nedtagning af havvindmølleparken ved Vindeby

Energistyrelsen har den 27. september 2016 modtaget en ansøgning fra DONG Energy Nearshore Wind ApS om tilladelse til at nedtage Vindeby havvindmøllepark, herunder kablerne mellem vindmøllerne, som ejes af SEAS-NVE samt nedtagning af eksportkablet (landtilføringskablet) fra havvindmølleparken til land.

I e-mail af 23. november 2015 har SEAS-NVE bekræftet, at DONG Energy Nearshore Wind ApS må repræsentere SEAS-NVE's interesser i sagen.

Energistyrelsens afgørelse

Energistyrelsen meddeler hermed tilladelse til at nedtage Vindeby havvindmøllepark med tilhørende interne ledningsanlæg samt at fjerne eksportkablet (landtilføringskablet) som beskrevet i nedtagningsplan for Vindeby havvindmøllepark af oktober 2016. Samtidig annulleres Energistyrelsens afgørelse af 16. januar 2017.

Tilladelsen indebærer, at Vindeby havvindmøllepark (vindmøller, fundamenter og kabler) skal fjernes i sin helhed fra søterritoriet, og området reetableres, og at dette sker på følgende vilkår, jf. VE-lovens § 25, stk. 3, og elforsyningslovens § 22 a, stk. 2:

1. **Generelle vilkår for nedtagningstilladelsen**

1.1. Tilladelsen er gyldig i to år fra tidspunktet for meddelelse af denne tilladelse, medmindre der indgives klage over tilladelsen, som tillægges opsættende virkning, jf. VE-lovens § 67, stk. 6. Det skal dog bemærkes, at den del af tilladelsen, som meddeles i medfør af VE-lovens § 25, ikke må udnyttes, før klagefristen er udløbet, jf. VE-loven § 67, stk. 5. Der henvises til afsnittet om offentliggørelse og klagevejledning i denne tilladelse.

Energistyrelsen
Amaliegade 44
1256 København K
T: +45 3392 6700
E: ens@ens.dk
www.ens.dk

Side 1/14

Ørsted

Project timeline

2015

- Jan – First strategic considerations as consent expires Sept 2016
- March – Technical report shows necessity to refurbish gearboxes to continue operation
- September – First talks to Danish Energy Agency on regulatory process
- October – Decision to decommission Vindeby is taken

2016

- January – Contract with NIRAS re. tender material, decom method and scrap/waste management
- April – Invitation to tender
- July – Environmental surveys (flora/fauna)
- August – Contract award
- September – Decommissioning plan and Environmental Statement sent to Danish Energy Agency

2017

- Jan – Approval from Danish Energy Agency (2 rounds)
- March – Start of decom. works
- May – Expected end of works (actual September)
- June/July – Environmental surveys (flora/fauna/sediment) (actual September-October)
- December – Final reporting to Danish Energy Agency

2020

- June/July – Environmental surveys (flora/fauna)

Decommissioning method

- **SSE – Turn key contractor**
- **Subcontractors to SSE:**
  - **BMS (Krangården) – Lifting services**
  - **Connected Wind – Turbine decommissioning**
  - **Barslund – Foundation decommissioning**

- **Decommissioning method**

Turbines: *Take down one blade first, then nacelle with 2 blades and finally the tower*

Foundations: *Open from the top, pump up ballast consisting of marine sand onto a barge and sail to position where it can be discharged into the ocean again.*

Foundations would be cut into smaller pieces and lifted onto barge and sailed to Nyborg harbour for further treatment using known procedures for scrapping concrete as bridges etc.

Cables: *Pulled directly up from seabed and rolled onto a hydraulic cable drum or cut to smaller pieces*

Handling: *All parts to be placed on a barge and sailed to Nyborg for further treatment*

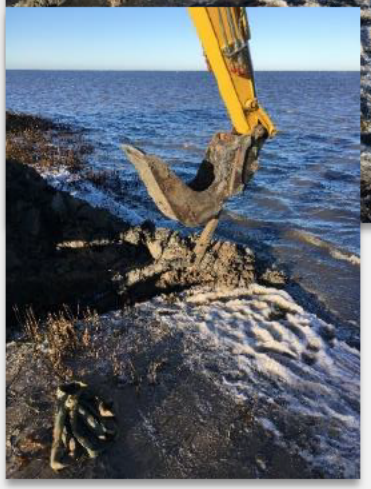
Removal of onshore facilities by SEAS-NVE* - February 2017

PUBLIC COPY







*Offshore and onshore cables property of SEAS-NVE

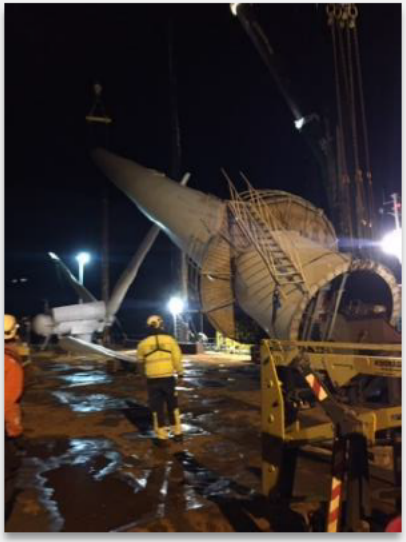
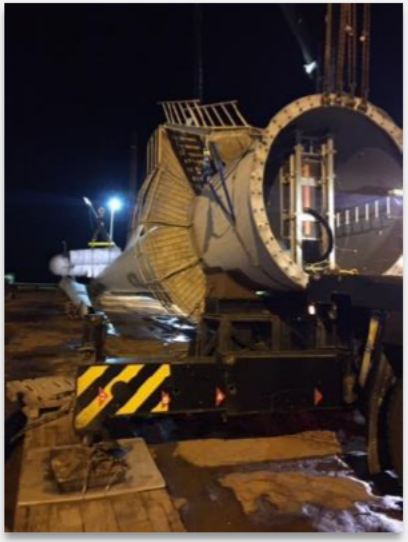
Ørsted

Dismantling of turbines




- **Blade length: 17 m**
- **Blade weight: 2.2 t**
- **Hub height: 37.5 m**
- **Nacelle weight: 27.6 t**
- **Tower weight: 20 t**

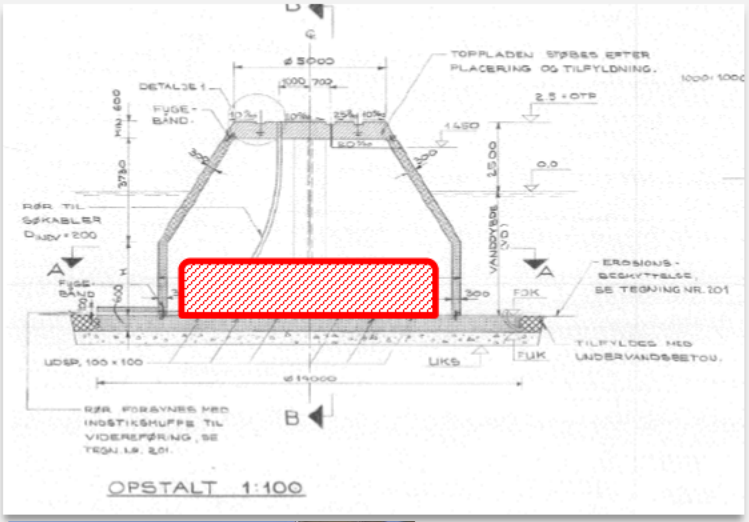


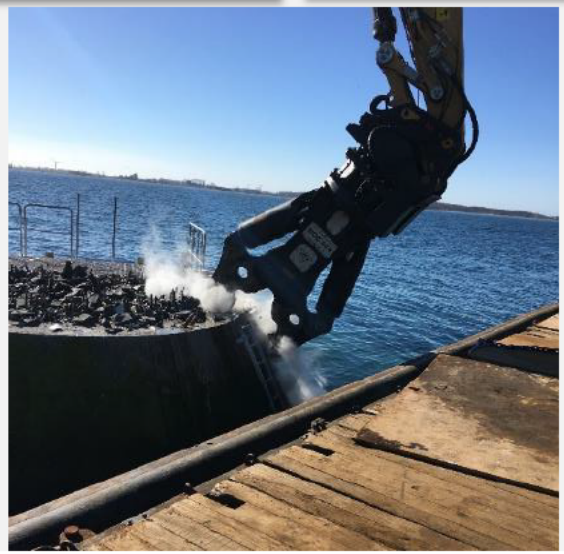



Ørsted


VINDEBY
DECOMMISSIONING

Dismantling – Foundations (start week 14 2017)

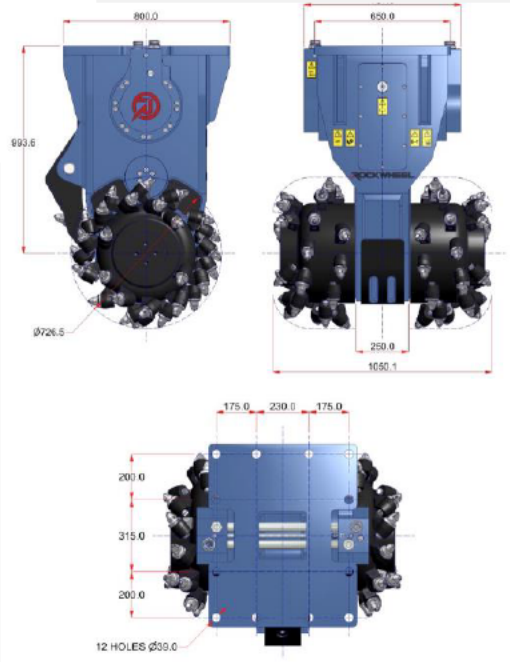




- Conical reinforced concrete gravitation foundations
- Concrete compressive strength 77,9 MPaHub
- Cylindrical part on top of bottom plate with a diameter of ca 10 m
- Bottom plate with 14 m in diameter and a thickness of 60 cm
- Foundations divided into eight internal chambers filled with “marine sand”
- Weight ranges between 710 and 1105 t with ballast (366 and 559 t without)

Ørsted

Dismantling – Foundations with Drum Cutter



Ørsted

Dismantling - Cables

Cables were pulled directly up from seabed and cut into smaller pieces

Cable pulling

Cables on deck

- Array cables and export cable - 12 kV, 3x150mm2 PEX-Cu-LRT subsea cable with 4 optical fibres
- Reinforced with zinc threads and asphalt
- 3 km array cables and 3 km export cable both buried to a depth of 1 m below sea level
- The array cables are at the cable entrances at the turbines covered with rocks and sandbags

Ørsted

Waste Management and Recycling

All non-reusable components were disposed of by certified companies that can handle the scrap fractions present

Cables and Electrical components

Metal and Concrete

Blades

BOBERG RECYCLING

ØSTFYN GENVINDING APS

Miljøskærm

Ørsted

Much effort has been put into influencing best practice in e.g. recycling & durability testing

PUBLIC COPY

1 miljøservice
Marin fouling/macroalgae

2 LM WIND POWER
Blades for testing

3 SIEMENS
Siemens Wind Power
2 piecs gearboxes for test and exhibition

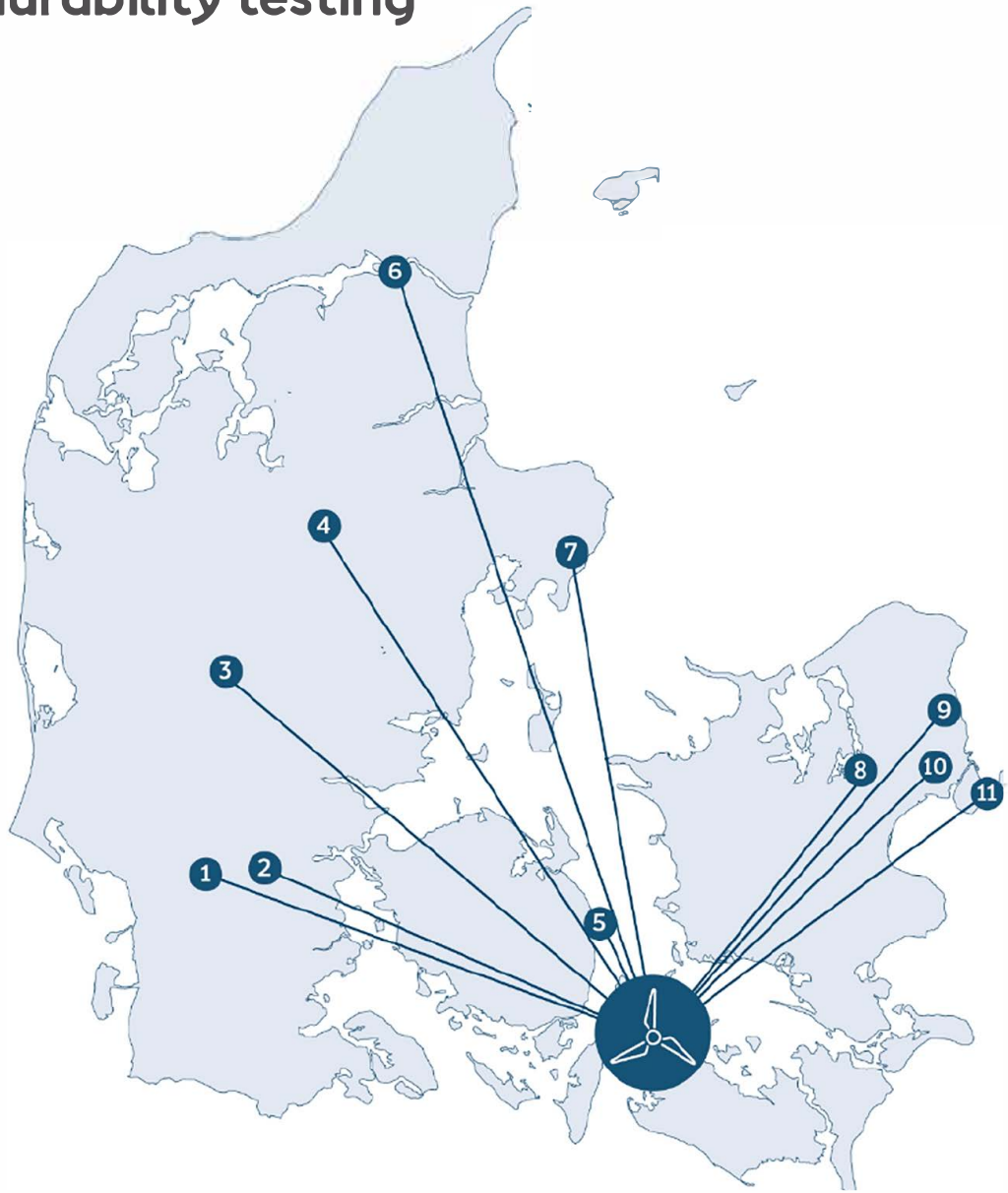
4 ENERGI MUSEET
1 piece complete turbine for exhibition

5 ØSTFYN GENVINDING APS
Concrete

EKOKEM
Saving natural resources
Contaminated concrete

Nyborg Jernhandel
v. Jesper H. Pedersen ApS
Iron reinforcement

H.J.HANSEN
Metal and steel



6 Miljøskærm
Reuse of blades

7 CONNECTED WIND SERVICES
2 complete turbines for spare parts and recycling

8 DTU Technical University of Denmark
Test of blades, gear boxes and concrete

9 HEMPEL
Inspection of paint and surface protection

10 CLEMCO DENMARK
Inspection of paint and surface protection

11 DONG energy
Examination of cable parts

Ørsted

Thank you