Introtekst:

Stålkonstruktioner til havvindmølleparker

Igennem de seneste 50 år har Bladt Industries udviklet sig fra leverandør af små havneanlæg til leverandør af fundamenter til verdens største havvindmølleparker.

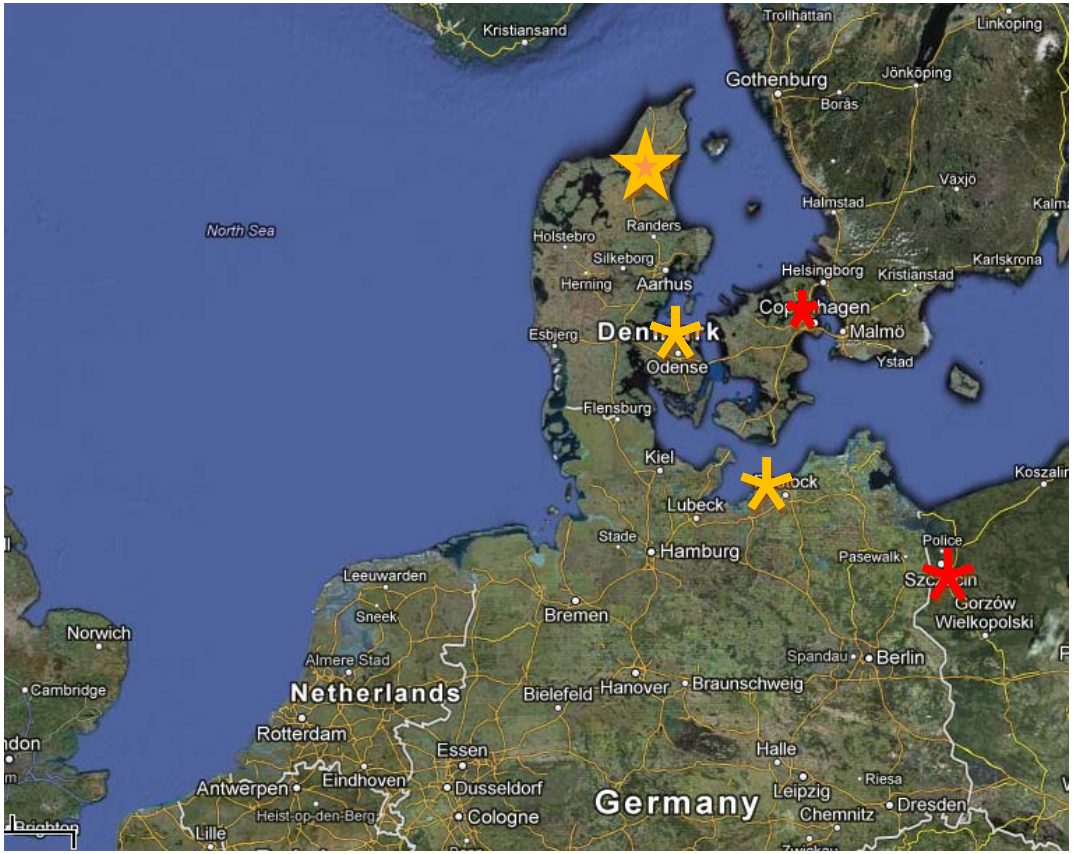
Vores fremstilling af offshore fundamenter herunder monopæle, overgangsstykker, XL fundamenter og jackets har givet os den nødvendige erfaring til at serieproducere fundamenter til store havvindmølleparker på verdensplan.

Med mere end 10 års erfaring inden for konstruktioner af offshore fundamenter til vindenergisektoren, har Bladt Industries, som et af de seneste projekter, leveret 111 monopæle og overgangsstykker samt den knap 2000 tons store transformerstation til Anholt Havvindmøllepark.

Morten Mørk, Bladt Industries A/S

About Bladt Industries A/S

- We are a **Steel Fabricator**
- Founded in 1965
- Turnover in 2012 Euro 305 mill.
- Locations: Denmark
  Germany
  Poland
- Employees (DK): 600
- Employees (GE): 100



Facilities – Aalborg, Denmark

Own quay with 9 m water depth

30 ha site area

Max units under cover 70x30x15 metres

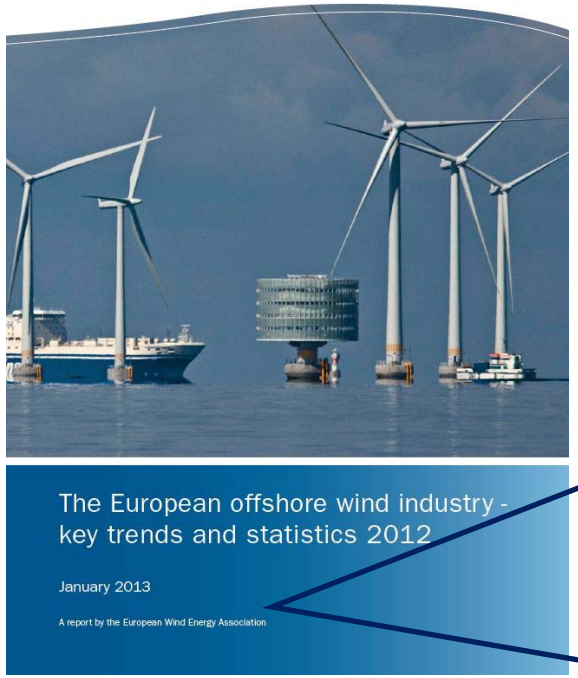
Facilities – Lindø, Denmark

30,000 m2 indoor production facilities

Direct by the sea

Market Leader

- 2012 saw Siemens as the leading turbine supplier, Bladt as the leading substructure supplier, Nexans and JDR as the leading inter-array cable suppliers, Prysmian as the leading export cable supplier, and DONG Energy as the leading developer.



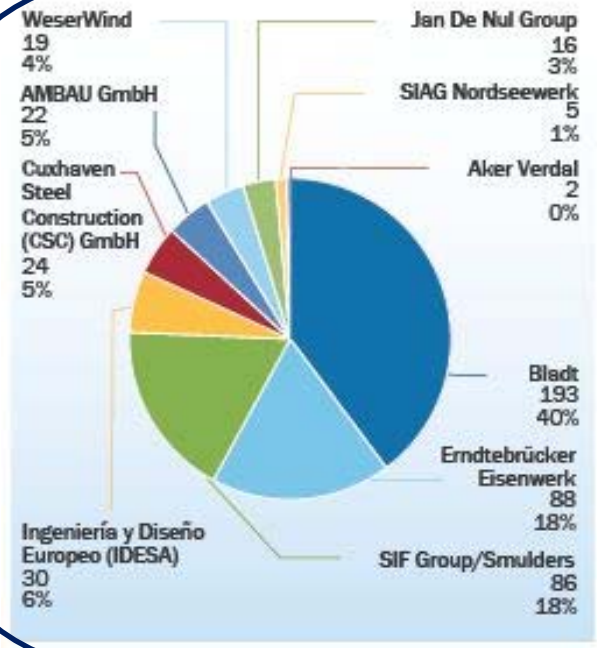


FIG 7: SHARE OF FOUNDATIONS INSTALLED IN 2012 BY MANUFACTURING COMPANY[3]

The continued growth of offshore wind has created significant opportunities across its supply chain. Sub-structures represent major construction projects for construction companies. Seven companies supplied foundations to offshore wind energy projects during 2012: Bladt (193 foundations: 40% of all foundations installed) EEW (88 foundations: 18%) and SIF group (86 foundations: 18%) were the market leaders, followed by IDESA (30 foundations: 6%), CSC (24 foundations: 5%), AMBAU (22 foundations: 5%), WeserWind (19 foundations: 4%), Jan De Nul Group (16 foundations: 3%), SIAG Nordseewerk (five foundations) and Aker Verdal (two foundations).

Bladt offshore wind projects

Offshore wind turbine foundations

1. Samsø, 10 MP, 2002, 13 m(1)
2. Egmond, 36 MP/TP, 2005-06, 18 m(1)
3. Horns Rev 2, 91 MP/TP, 2007-08, 17 m(1)
4. Belwind, 55 TP, 2008-09, 30 m(1)
5. Baltic 1, 21 TP, 2009-10, 19 m(1)
6. Walney 2, 51 TP, 2010-11, 30 m(1)
7. London Array, 175 TP, 2010-12, 23 m(1)
8. Gwynt y Môr, 160 TP, 2011-13, 32 m(1)
9. Anholt, 111 MP/TP, 2011-12, 17 m(1)
10. W. of Duddon, 108 MP/TP, 2012-13, 21 m(1)
11. Baltic 2, 39 TP, 2013, 30 m(1)
12. Baltic 2, 41 jackets, 2013-14, 42 m(1)
13. Butendiek, 80 TP, 2013-14, 20 m(1)
14. Borkum R., 77 MP/TP, 2013-14, 29 m(1)
15. Westermost R., 35 MP/TP, 2013-14, 22 m(1)

Offshore wind substations

- A Nysted, 2002-03
- B Q7/P. Amalia, 2006-07
- C Lillgrund, 2006-07
- D Robin Rigg, 2007-08
- E Gunfleet Sands, 2007-08
- F Rødsand B, 2008-09
- G Walney I, 2009-2010
- H Walney II, 2010-2011
- I Anholt, 2011-12
- J Borkum Riffgrund, 2012-13
- K Northwind, 2012-13
- L Nordsee Ost, 2013-14

Bladt Industries current production site

(1) Max. water depth of offshore wind farm (meters)

Anholt Offshore Wind Farm

Time Schedule

Contract Award:	15.02.2011
Design Release	01.05.2011
Fabrication start:	17.08.2011
Last foundation delivered:	20.07.2012

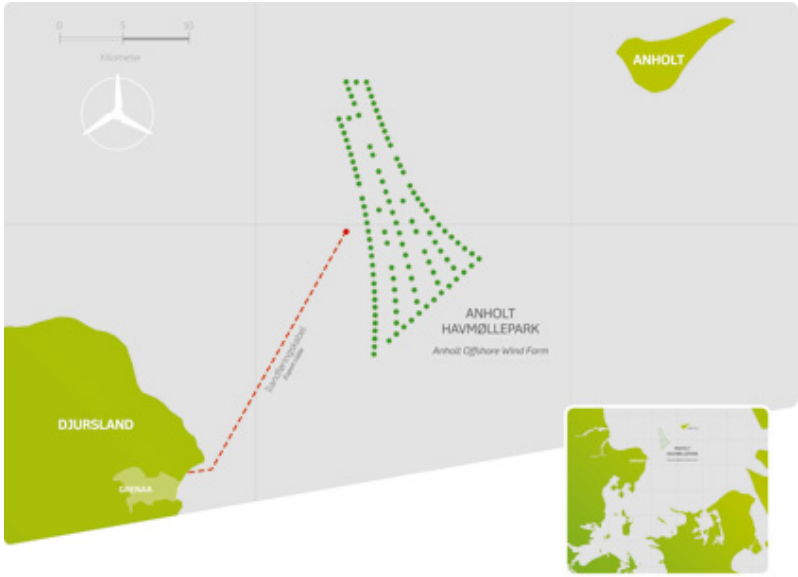
The foundations were designed by Rambøll and Main Contractor was MTHøjgaard.

Facts about Anholt OWF

111 x 3,6 MW Siemens turbines

20 km from shore

400 MW or 4% of Denmarks energy consumption



58.330 T of steel used for the wind farm

- 14.000 T for Transition Pieces (126 T per TP)
  - Ø5000/5600 mm x 65 mm – length 16,5 m
- 41.000 T for monopiles (in average 370 T per MP)
  - Ø4700/5350 mm – max length 47 m
- 3.330 T of secondary steel (approx 30 t per foundation)

BLADT INDUSTRIES

Facts about Anholt OWF

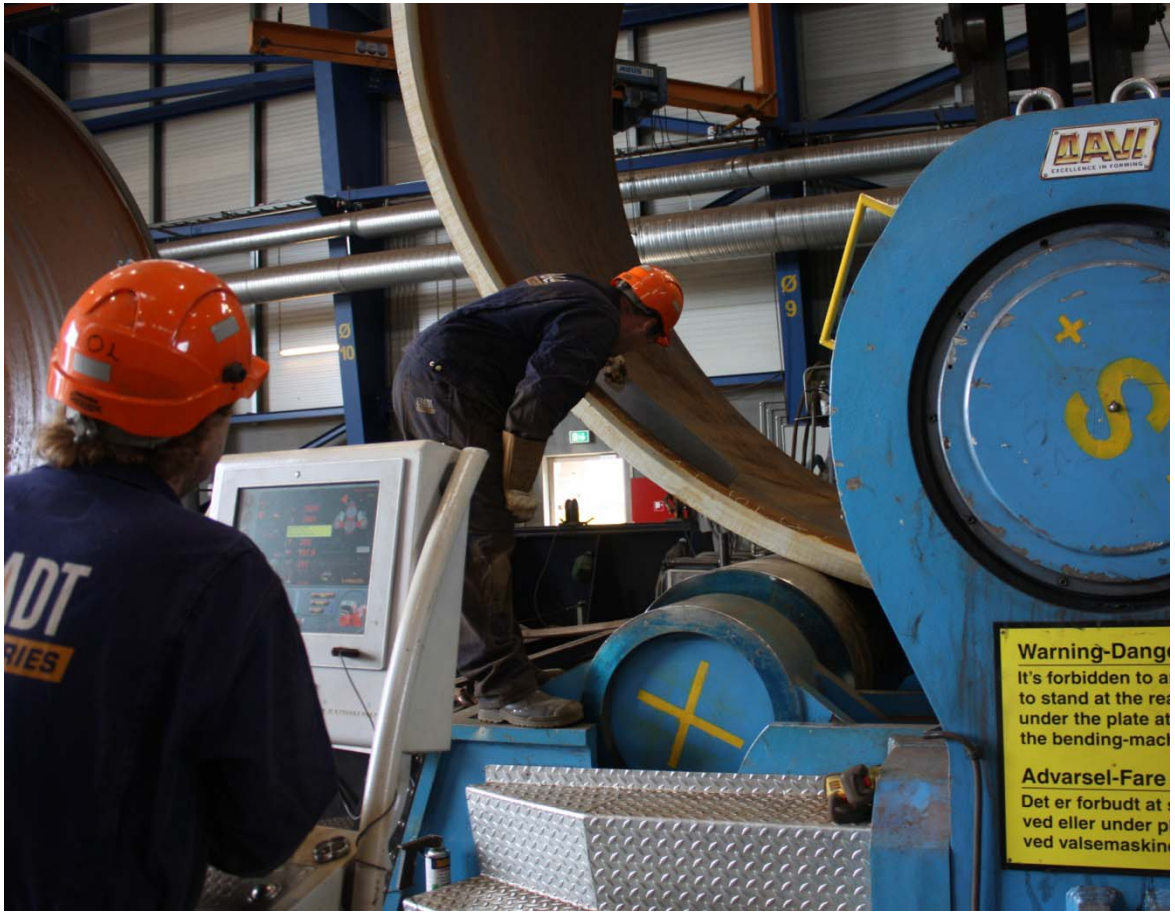
- 400.000 man hours spent – at Bladt ONLY!
- 20 subcontractors involved
- 10 steel mills involved
- Approx. 370.000 blue collar man hours
- 40 km of primary steel welds
- 444 internal and 111 external platforms
- 4,773 ladder rungs – 9.546 welds for ladder rungs
- 11.5 km Circular hollow sections used for SS
- 12 km Rectangular hollow sections used for SS
- 440 T of anodes
- 9,500 m^2 GRP grating

Basic Requirements

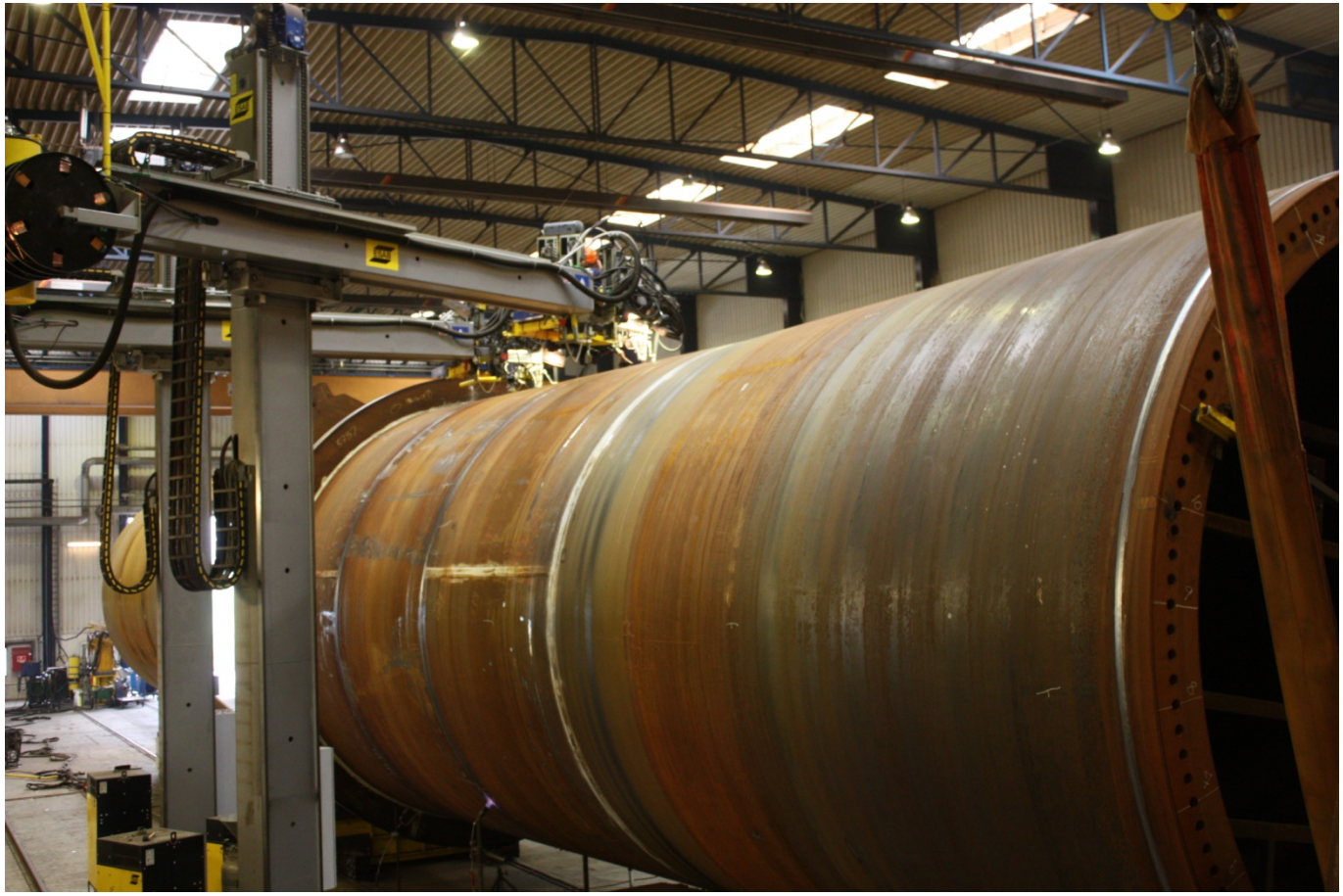
- Primary steel – S355ML/NL; 3.2 certificates
- Secondary steel – S355J2; 3.1 certificates
- 100% traceability on all elements
- 2 mm eccentricity on primary steel
- 100% NDT on all primary steel and main SS components
- DNV-OS-C401 compliant fabrication
- 810 micron 3 layer epoxy coating system
- Circumference tolerance 6 mm
- Out-of-roundness tolerance 12 mm
- 0,5% ovality
- Flange flatness tolerance 2,5 mm / 1,4 mm

Transition Pieces

Foundation fabrication…



Foundation fabrication…



Foundation fabrication…

Foundation fabrication…

Foundation fabrication…

Foundation fabrication…

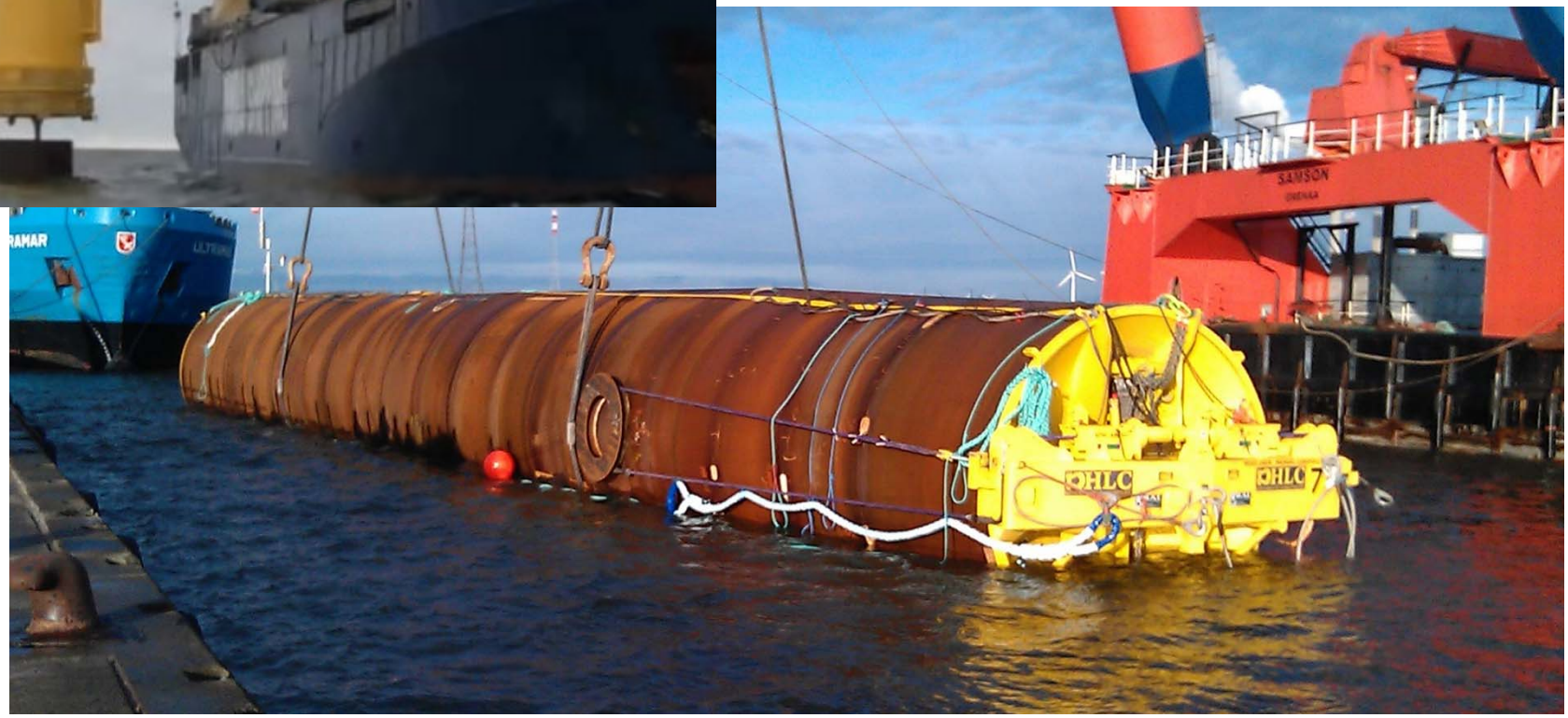
Foundation fabrication…

Foundation fabrication…

Foundation fabrication…

Foundation fabrication…

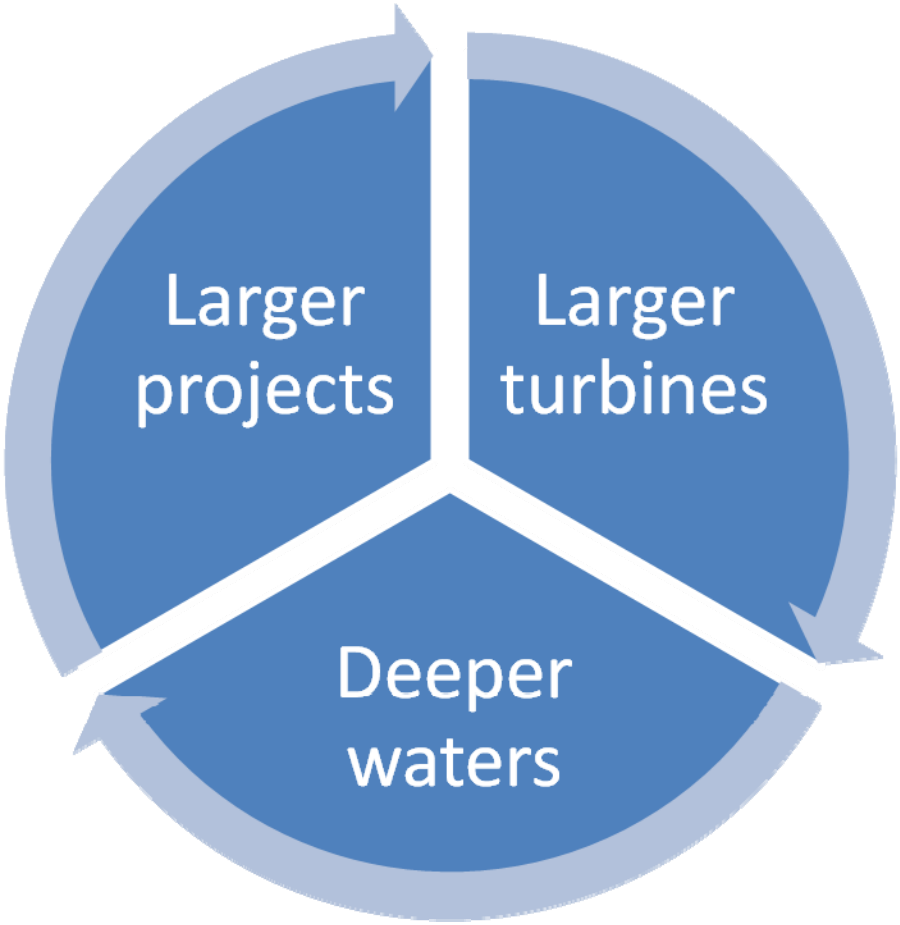
Foundation delivery…



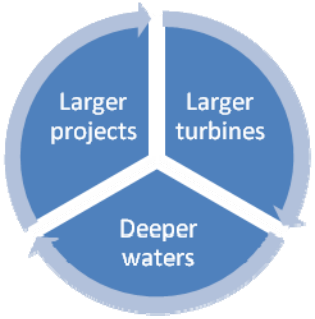
Anholt Substation

- no 10 delivered

Future Foundation - Trends



Future Foundation - Trends



XL – Monopile foundation project

33 m water depth & 6 MW Turbine

- Ø 7500 mm monopiles
- 65 m in length
- 1020 T heaviest monopile
- 875 T average monopile
- Ø 6000 / 6750 mm TP
- 400 T TP

Jacket foundation project

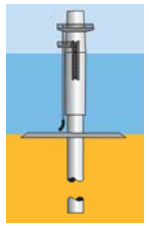
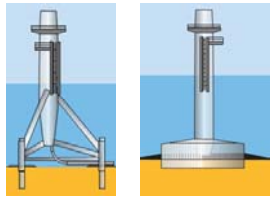
39 m water depth & 3,6 MW Turbine

- 650 T Jacket
- 24 m footprint
- 3-legged structure
- 3 pin piles @ 100 T

Jackets to play large role in the future

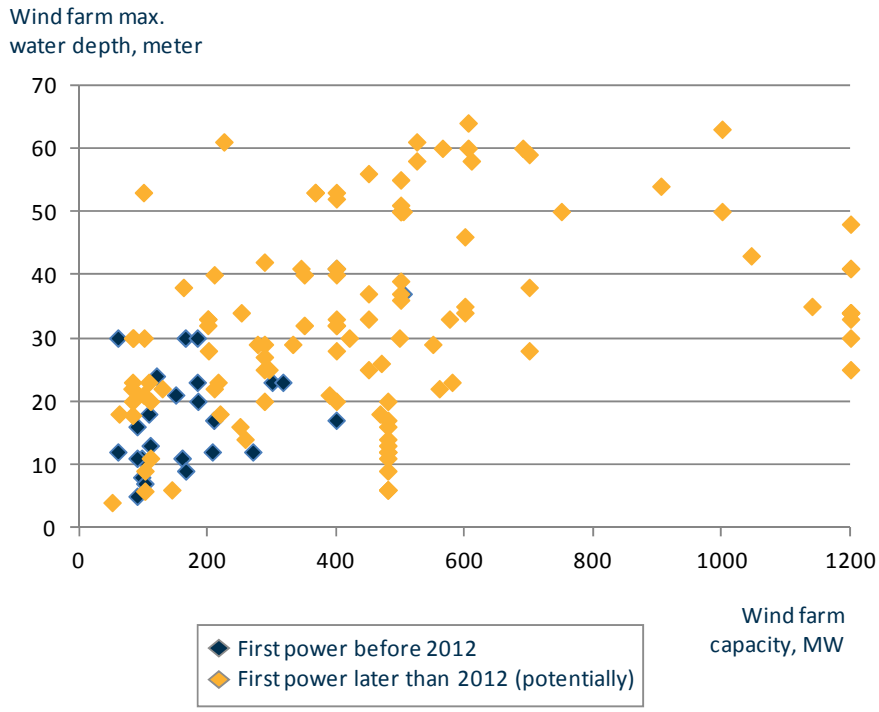
But monopiles are dominating technology currently

Foundation types

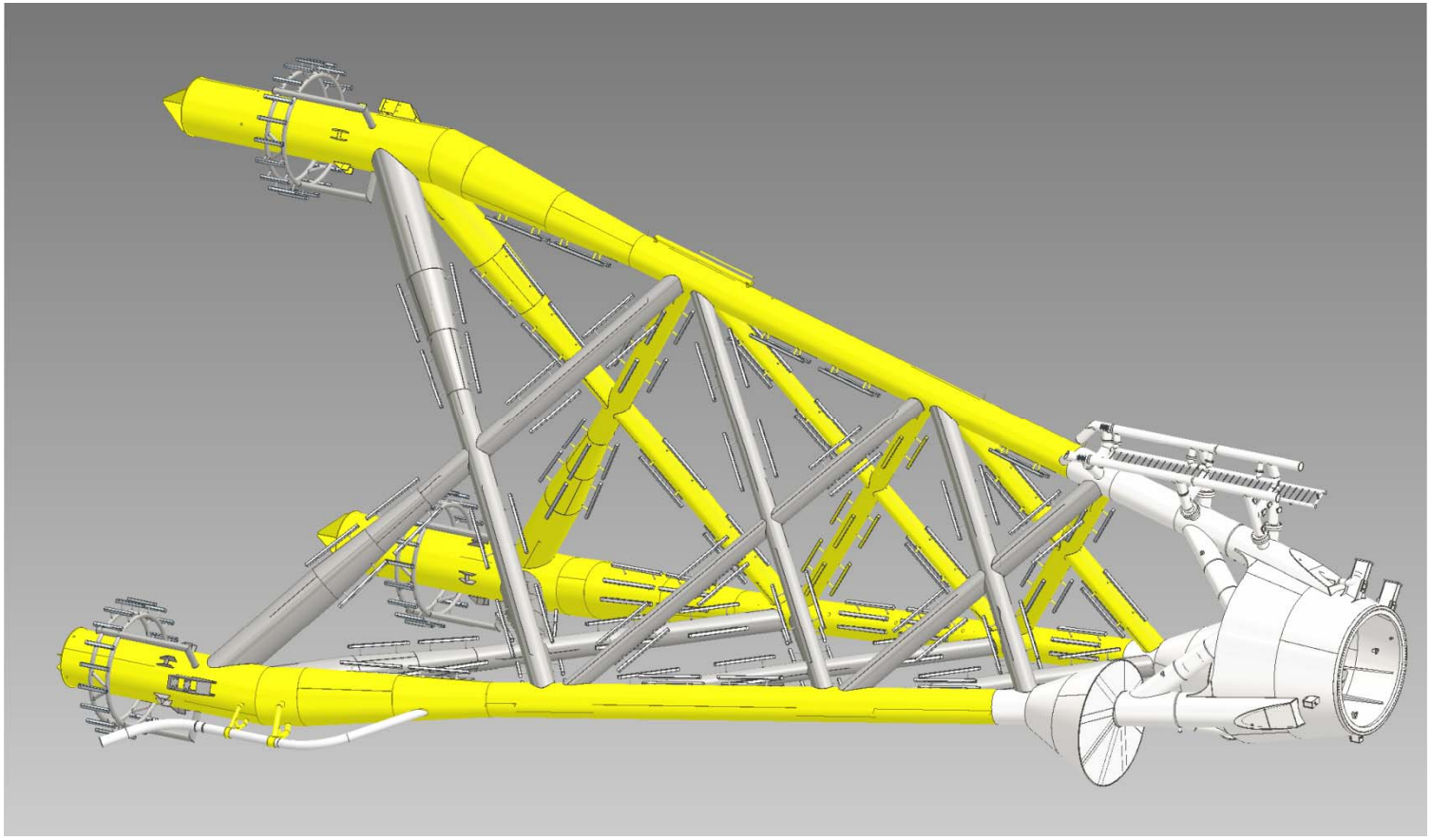
Type	Illustration	Application
Monopile		• 3 – 40 meter water depth
Jacket (Three or four legged structures)		• 25 – 55 meter water depth • Especially viable with larger turbines
Other (e.g. Tripods and Gravity Based Structures)		• In general less financially viable and technically feasible • 3 – 15 meter water depth (GBS); 25 – 55 meter water depth (tripod)

Wind farms moving into deeper waters

Wind farms by water depth and size (MW capacity)



Baltic 2 Jackets @ Lindø



Baltic 2 Jackets @ Lindø

Industry Challenges

1. Fully/not implemented standards (mixture of what is available combined with oil/gas standards)
2. Immature industry (entrepreneurship → industrialization → highest standards → contract management → cost of energy)
3. Complexity (the complexity increases project by project)

The right approach to reduce cost of energy has not yet been established in the industry.