European Forum
for Renewable Energy Sources

The installation and servicing of offshore wind farms

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SEA ENERGY
2002

SEA POWER
2002

- Started 1st July 2000
- 100% dedicated offshore wind
- 4 (5) vessels, 230 employees,
  85 mio Euro turnover
- Owned 100% by Dong Energy
- Siemens Windpower 49% owner in 2011
- Installed 700 turbines, 300 foundations

SEA JACK
2007

SEA WORKER
2008

SEA INSTALLER
2012

SEA SERVER
2013

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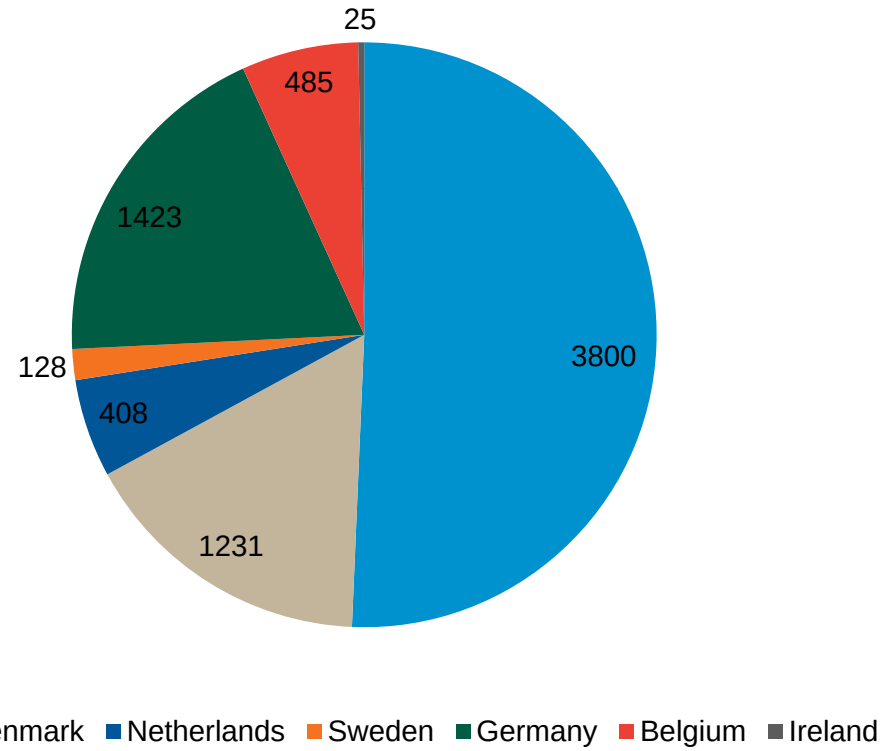
Presentation Structure

- **2002 – 2012 Market**
- Foundations
- Foundation installation
- Turbines
- Turbine installation
- Cables
- Cable Laying
- Other offshore activities
- The challenge
- Round Up

Installed Capacity / MW per Country

Year	Installed Cap. MW acc.	No. of Turbines
2002	222	112
2004	476	263
2006	849	359
2008	1404	554
2010	3500	1235
2012	7500	2330

Installed MW per country by the end of 2010



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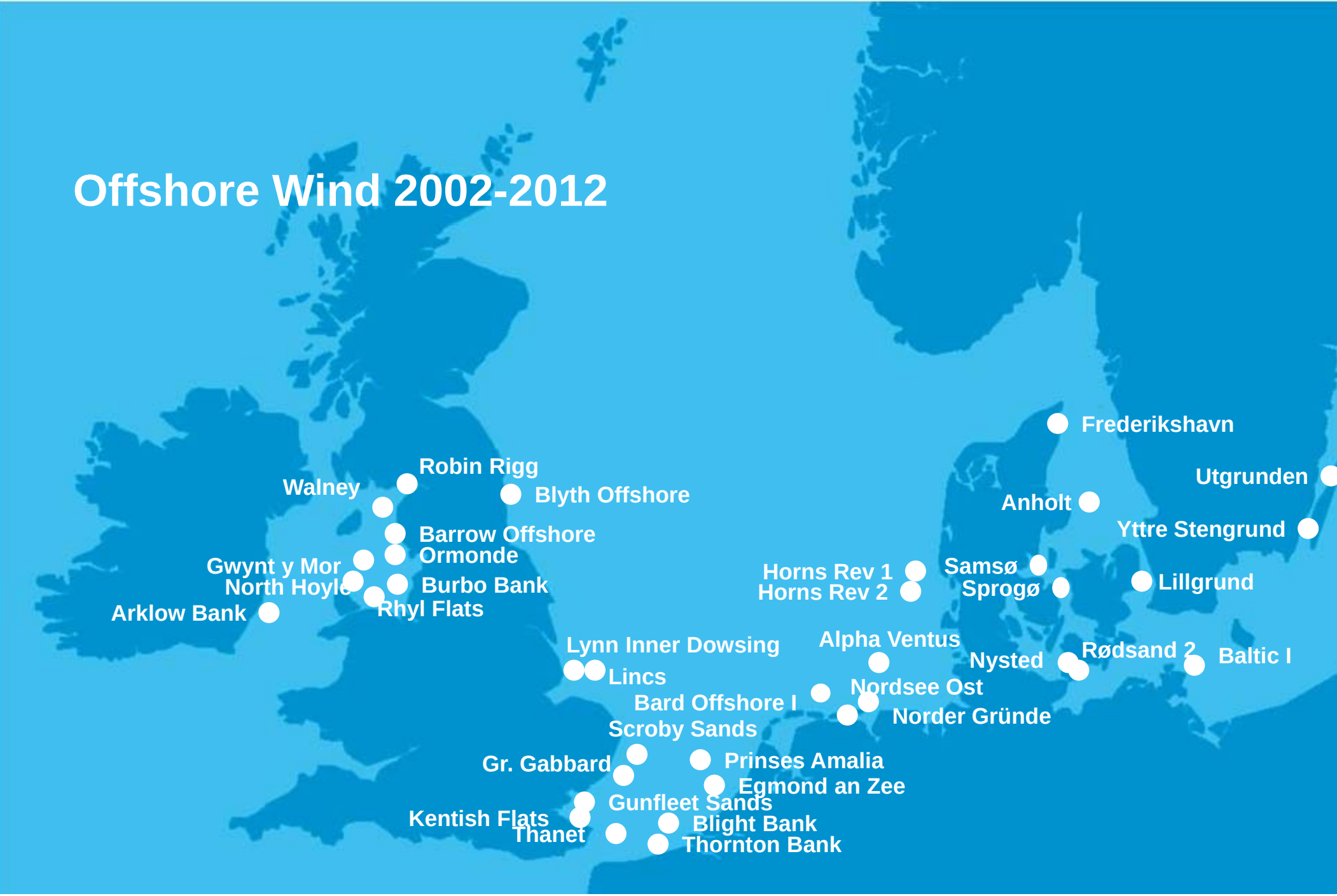
Offshore Wind 2002-2012



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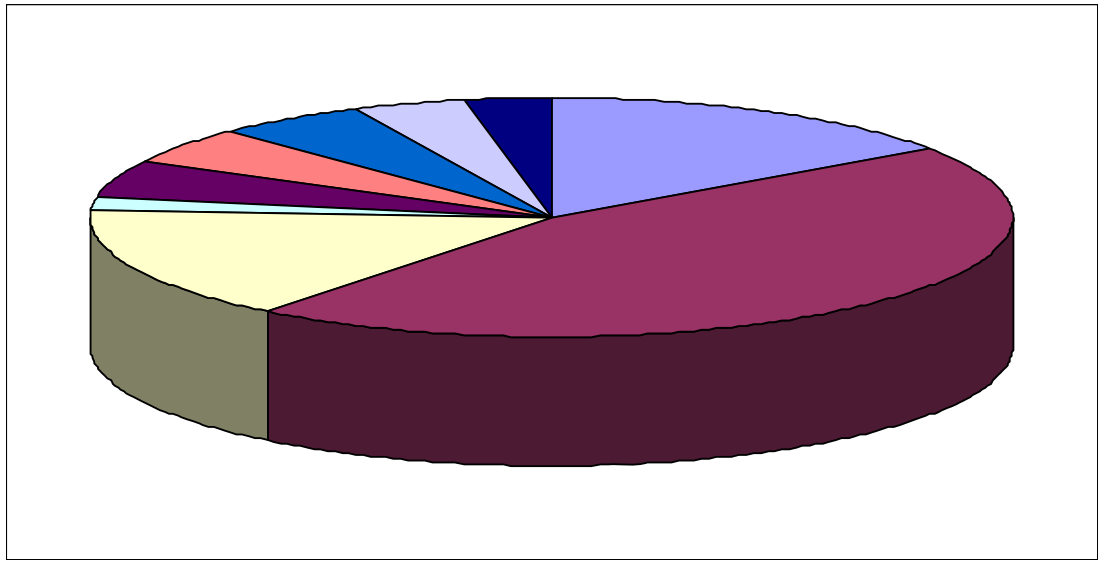
Typical Offshore Installation



Hardware:		**Software:**	
Foundations	15%	Installation Foundations	5%
Turbines	45%	Installation Turbines	5%
Cables	15%	Installation Cables	4%
Transformer Station	2%	Trafic Control/HSE/Project Management	4%
Scour protection etc.	5%		

2.5-3.0 Mil. Euro/MW

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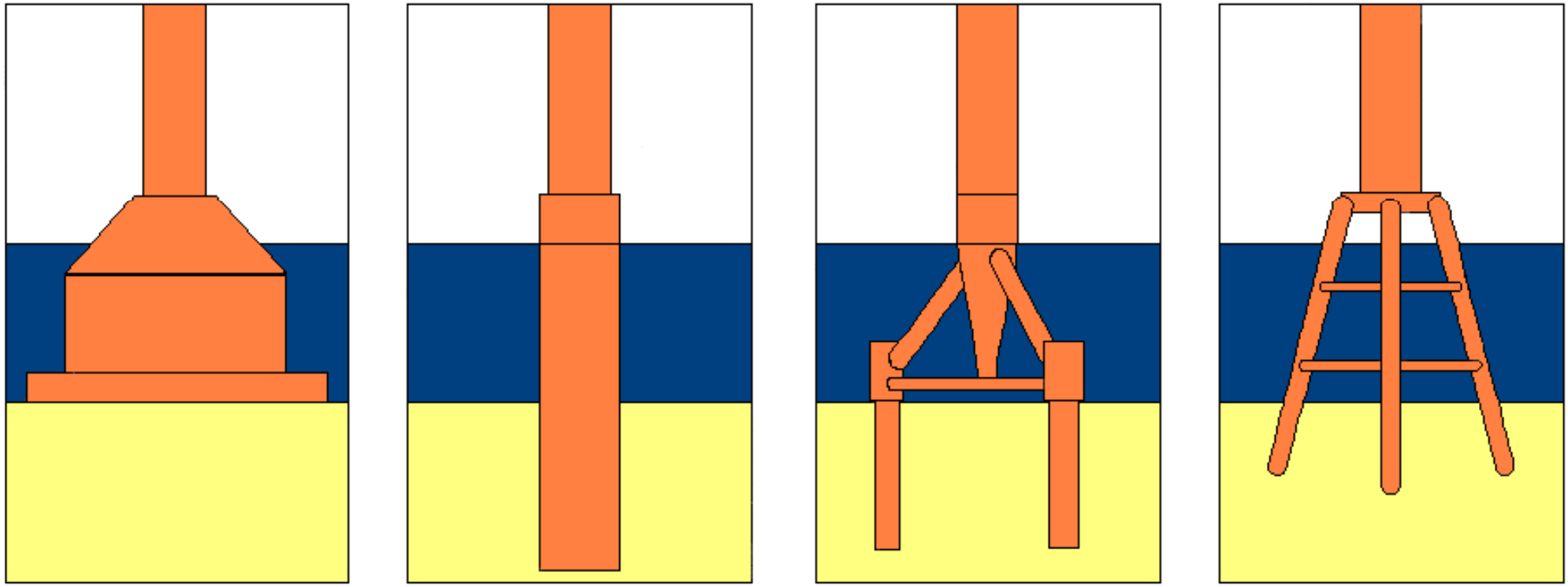
Offshore Foundations



Installation of Gravity Foundations

Nysted

Lillgrund

Thornton Bank

Rødsand II

Sprogø

Approx. 225 installed end of 2010

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Installation of Monopile Foundations

Horns Rev I &II

Kentish Flats

Scroby Sands

Prinses Amalia (Q7)

Egmond an Zee

Burbo Bank

Barrow

Robin Rigg

Lynn Inner Dowsing

Rhyl Flats

Gunfleet Sands

Thanet

Arklow

North Hoyle

Greater Gabbard

Blight Bank

Baltic 1

Walney 1

Total approx. 1000 installed end of 2010

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Jackets, Tripod, Tripile

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Installation and equipment

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Installation and equipment

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Installation and equipment

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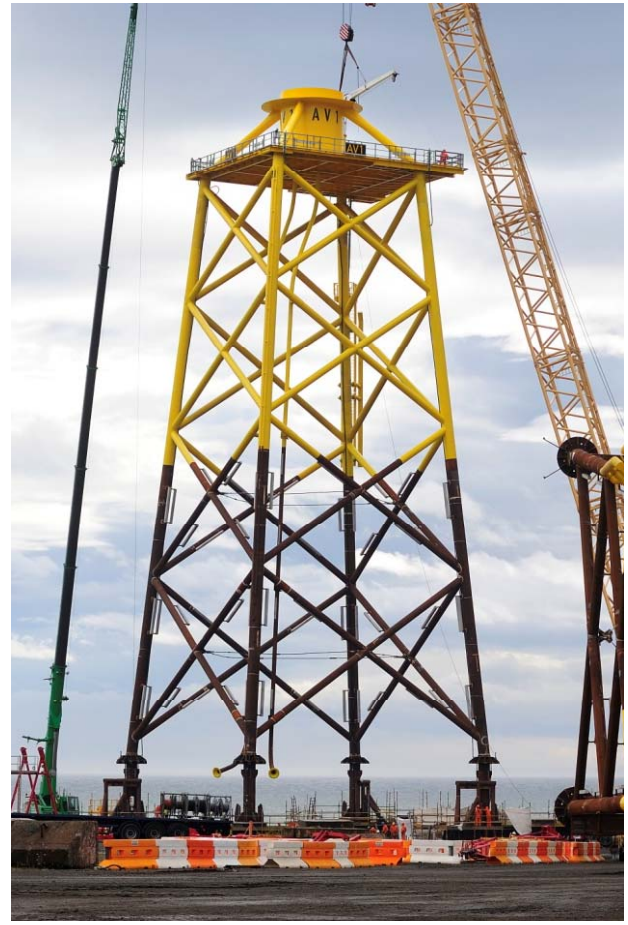
Installation and equipment



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Turbines

Siemens 2.3M	Units	Weight
1a	Hub	32.3
1b	Blades	9.2
1a + 1b	Hub + Blades	60
2	Nacelle	82
3	Tower (approx.)	130
(1+2+3)	Total Assembly	246

Siemens 3.6M	Units	Weight
1a	Hub	42.4
1b	Blades	17.2
1a + 1b	Hub + Blades	95
2	Nacelle	125
3	Tower (approx.)	180
(1+2+3)	Total Assembly	400

Turbines

Vestas V90, 3MW	Units	Weight
1a	Hub	40
1b	Blades	9+
1a + 1b	Hub + Blades	67+
2	Nacelle	70
3	Tower (approx.)	110
(1+2+3)	Total Assembly	247+

Vestas V112, 3MW	Units	Weight
1a	Hub	45
1b	Blades	11
1a + 1b	Hub + Blades	78
2	Nacelle	80+
3	Tower (approx.)	130
(1+2+3)	Total Assembly	288+

Turbines

Multibrid 5M	Units	Weight
1a	Hub	62
1b	Blades	49.5
1a + 1b	Hub + Blades	111.5
2	Nacelle	233
3	Tower (approx.)	200
(1+2+3)	Total Assembly	544

Repower 6M	Units	Weight
1a	Hub	84
1b	Blades	72
1a + 1b	Hub + Blades	156
2	Nacelle	316
3	Tower	285
(1+2+3)	Total Assembly	757

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Turbine Installations

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Turbine Installation

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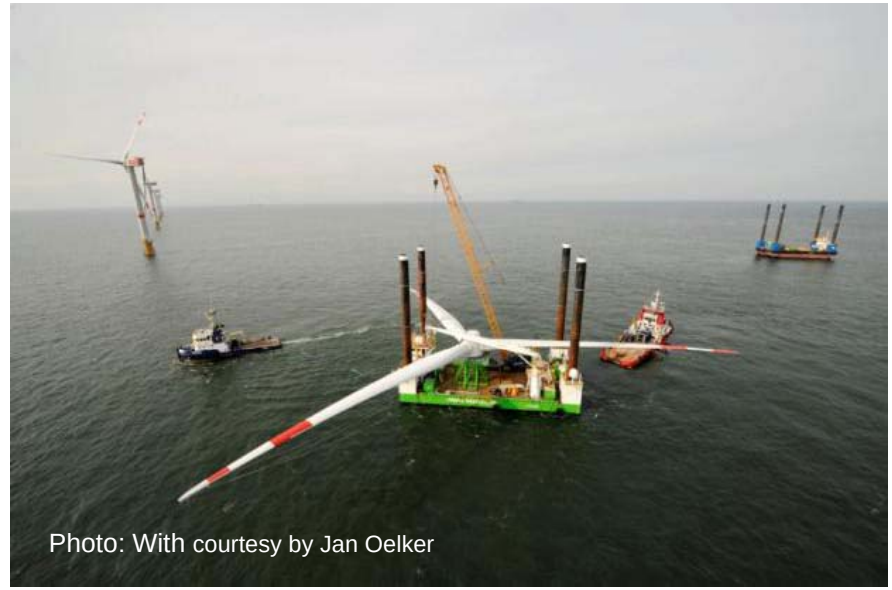
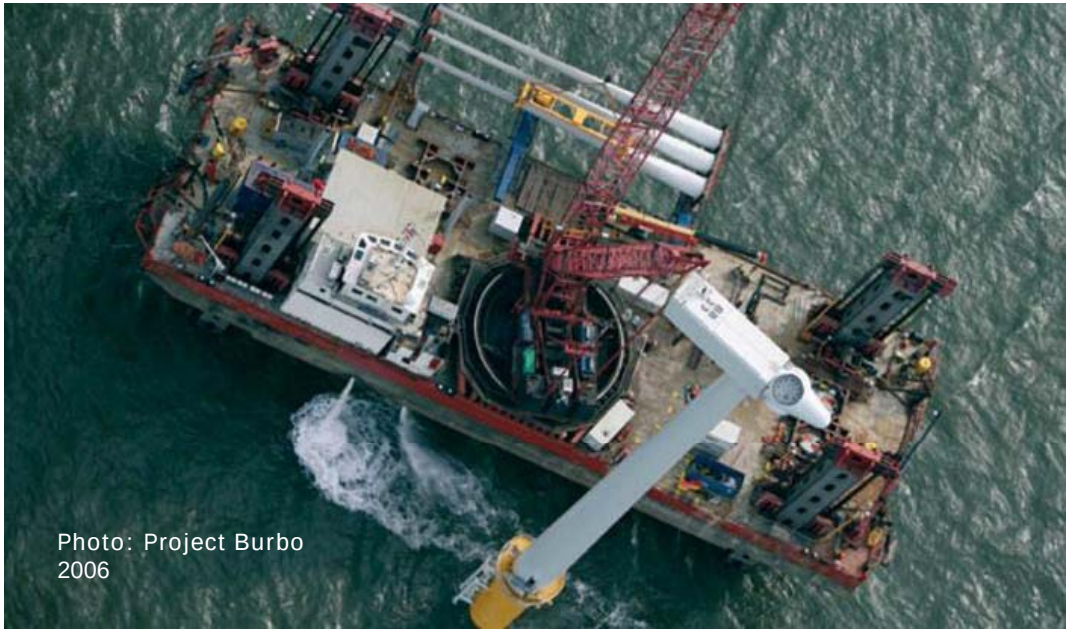
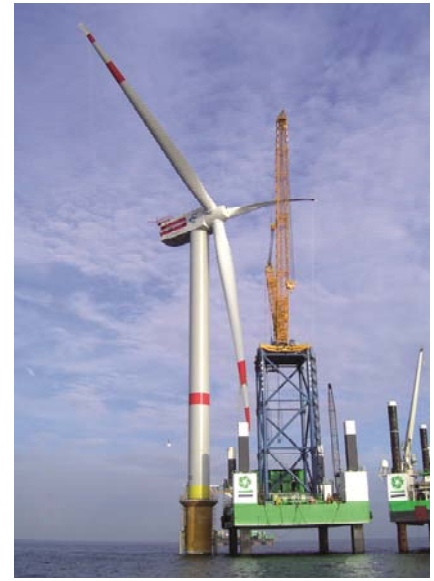
Turbine Installation



Siemens 3.6 MW Single Blade Installation



Repower 5.0 MW
Full Rotor Installation



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Feeding Offshore

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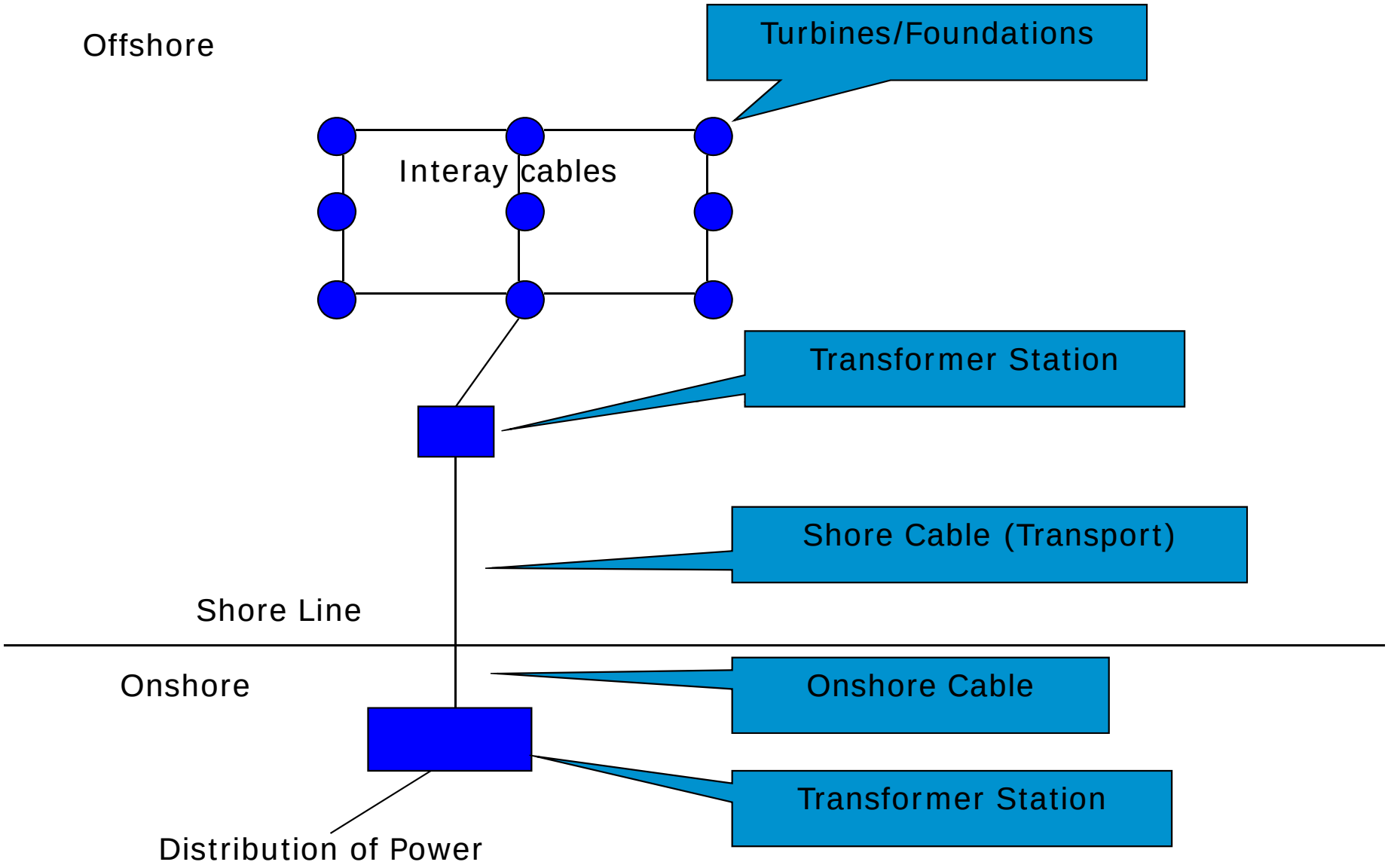

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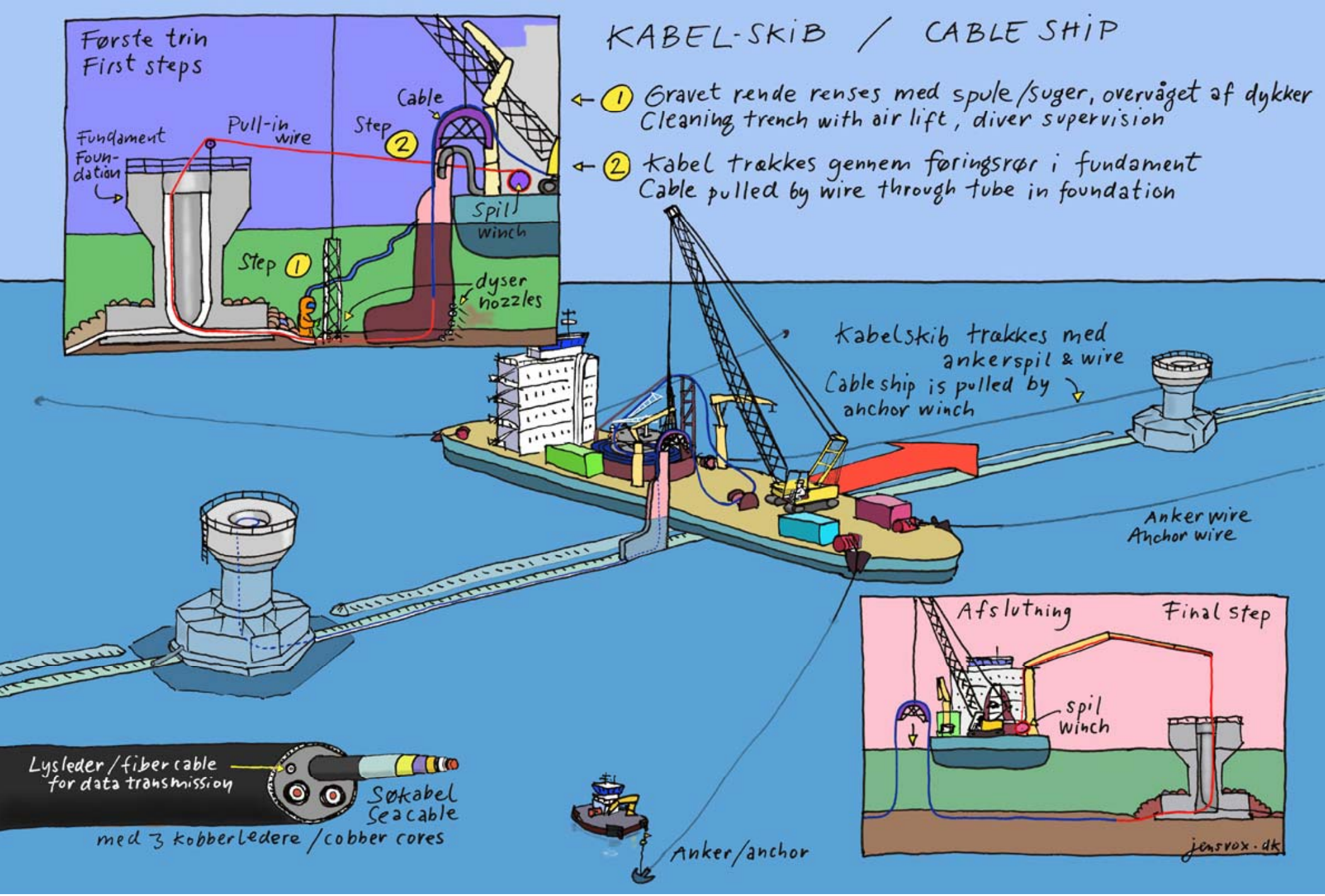

Cable laying

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Service - Lifetime

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Service

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Crew vessels


M/V Thjalfe


Catemaran

Service vessels

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Other vessels will be required as well…

- Cable laying vessels
- Personnel transfer vessels
- Tugs
- Hotel ships

Totally 52 different vessels involved in Horns Rev II.

Totally up to 30 different vessels on the site at a time.

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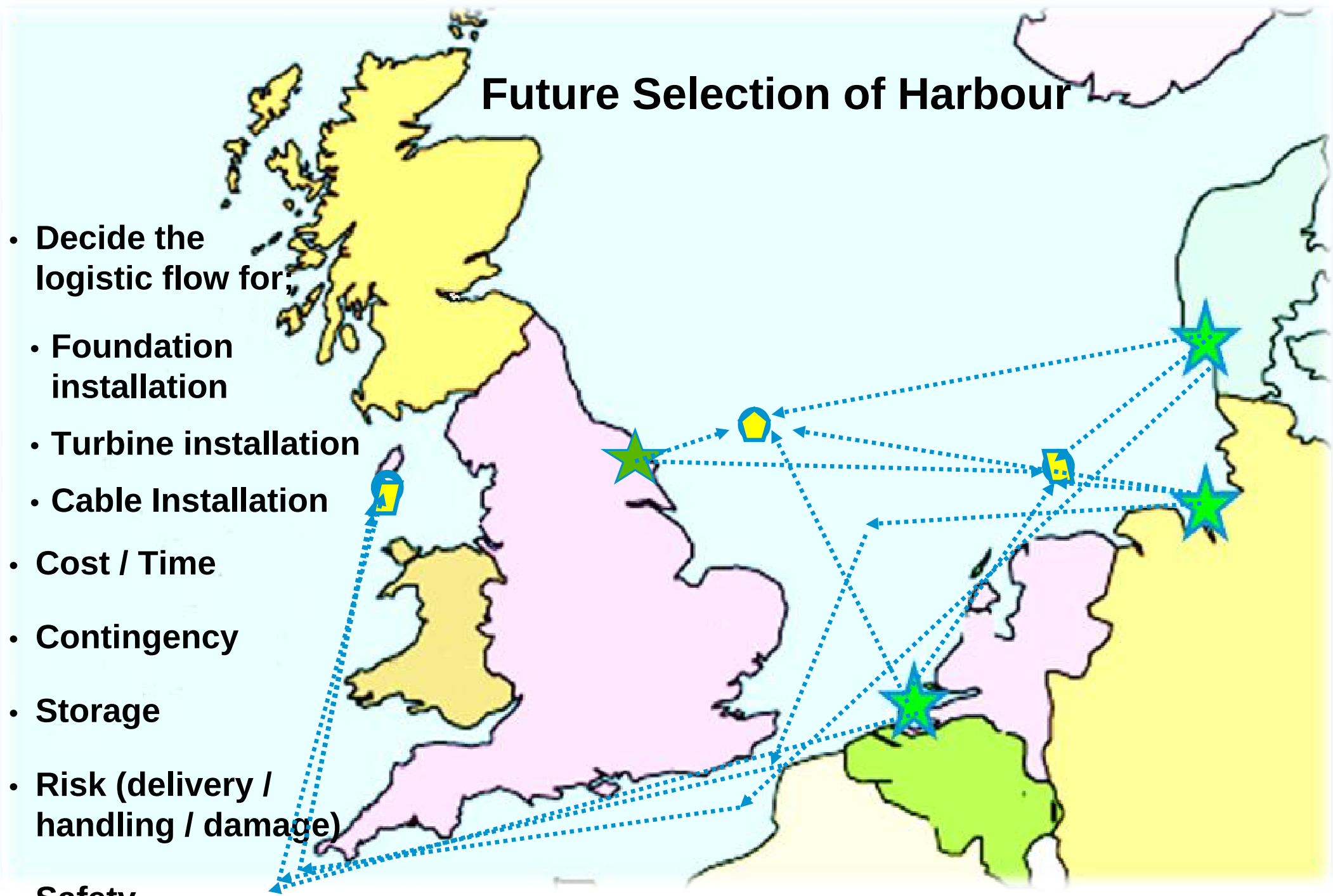
Future Selection of Harbour

- Decide the logistic flow for;
  - Foundation installation
  - Turbine installation
  - Cable Installation
- Cost / Time
- Contingency
- Storage
- Risk (delivery / handling / damage)
- Safety



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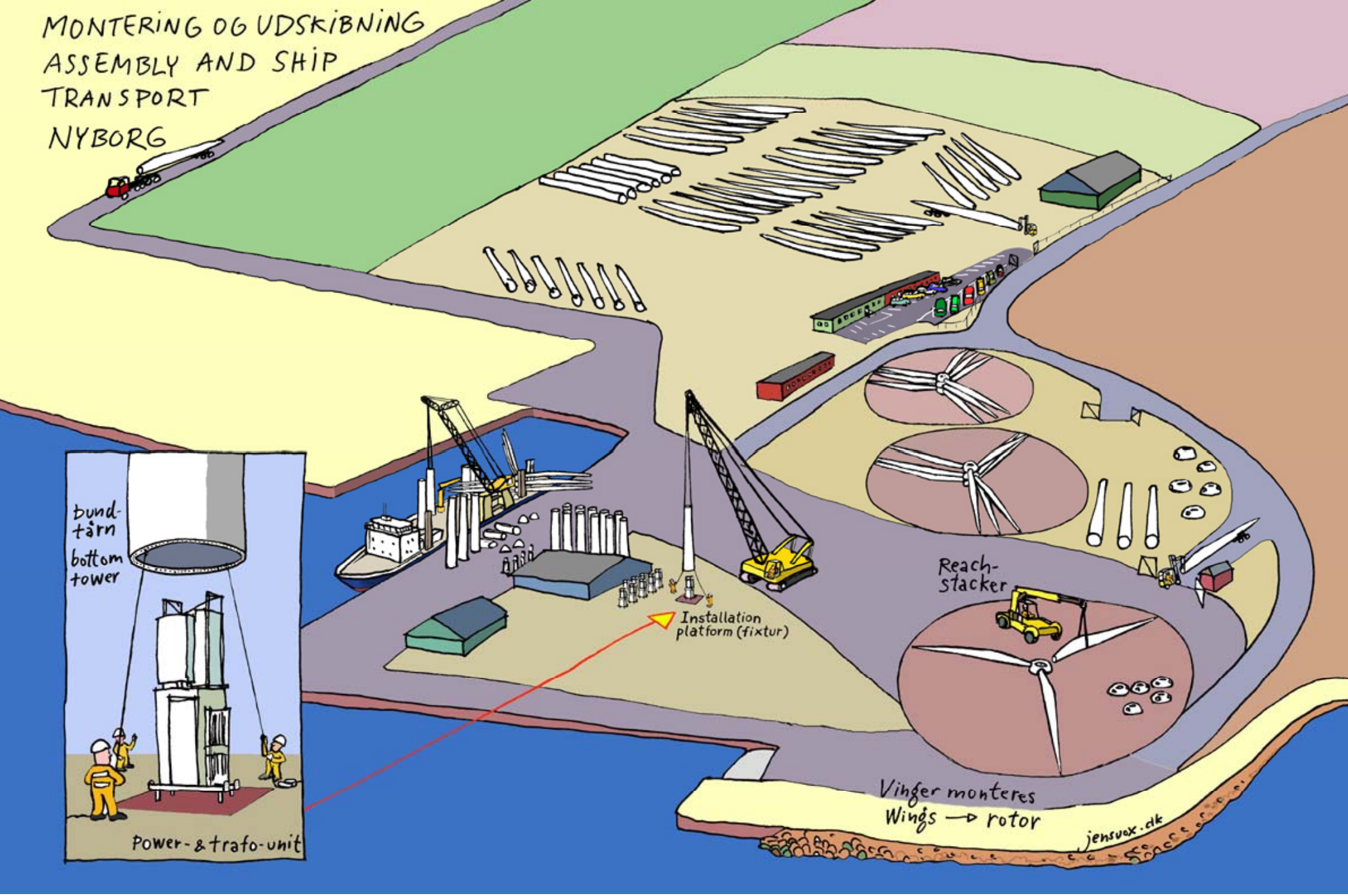


Port Logistics

Turbines

6,0 MW Turbine (Siemens/Vestas)

Rotor diameter :	126 m;
Hub Height :	90 m;
Total Weight at hub height (nacelle + blades) :	250-350 tons;
Weight of tower :	500 tons;

8,5 MW Turbine

Rotor diameter :	160 m;
Hub Height :	110 m;
Total Weight at hub height (nacelle + blades) :	800 tons;
Weight of tower :	1000 tons;

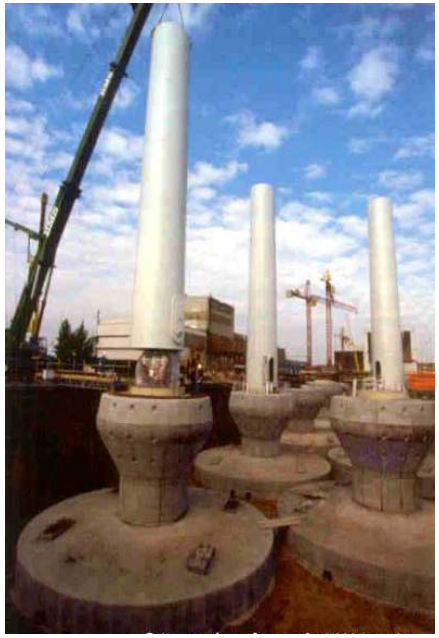
10 MW turbine (Clipper)

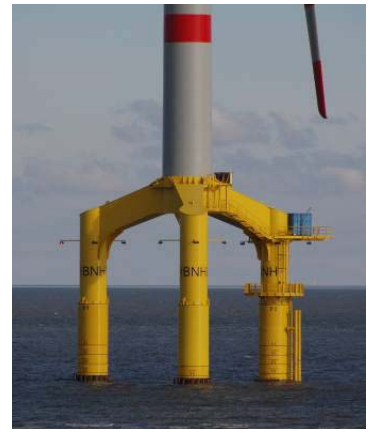
Rotor diameter :	*150 meter*
Hub height:	*100 meter*

Turbines

- 3 – 5 – 6 MW
- Vestas
- Siemens
- RePower
- Multibrid
- Gamesa
- BARD
- Alstrom
- Nordex
- 2-4 Chinese exporters

And foundations even larger and different …





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Floating Vessel Types

- DP vessels from O&G sector for piling operations
- Floating heavy lift cranes & shear leg cranes

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New Vessels
(from Oil & Gas)

Master Marine

SeaJacks

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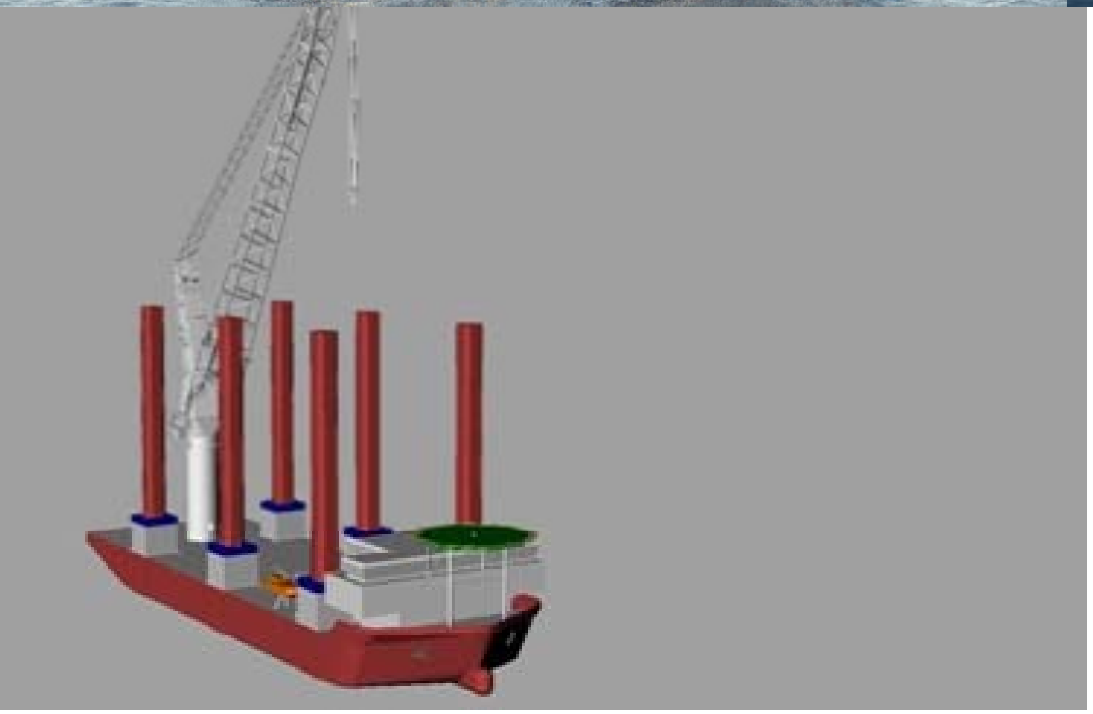
Typical design of new vessels



Logistikkonzept Installationsphase

RWE
The energy to lead

RWE Innogy

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From design to installation

- Conceptual design → 1 year
- Basic design → ½ year

- Detailed Design
- Class Approval etc. → 2-2½ year
- Construction

- Test → ?

1st vessel ready in 3-4 years.

- Start 2011-2012 → Usage 2015-2016

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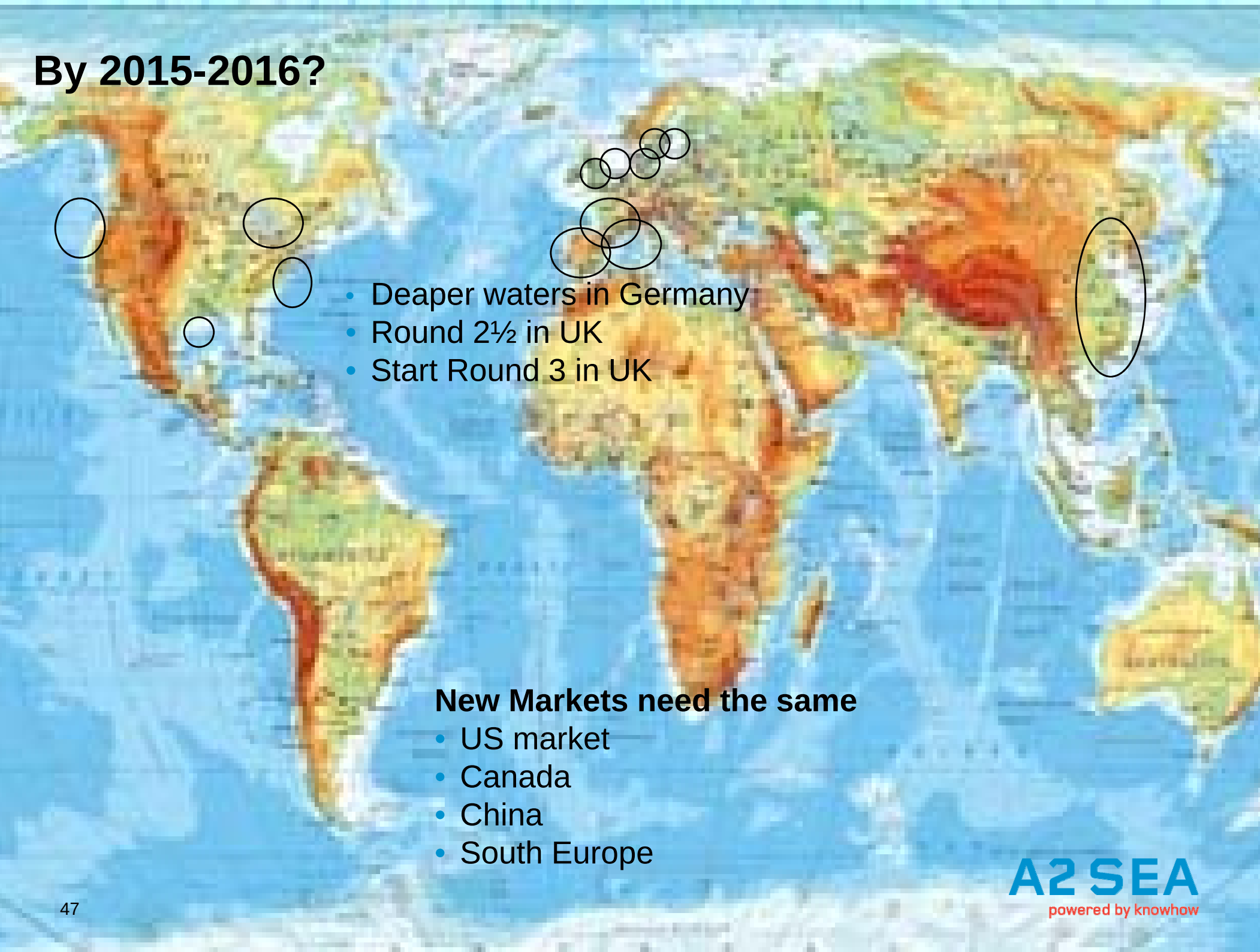
By 2015-2016?



- Deaper waters in Germany
- Round 2½ in UK
- Start Round 3 in UK

New Markets need the same

- US market
- Canada
- China
- South Europe

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Offshore wind - hardware

- Grid / Cables / Transformers
  - Distribution of 50 GW offshore wind in 2030
  - Cable production
  - Technology

- Foundations
  - Steel
  - Production facilities
  - New designs
  - Materials

- Turbines
  - Production
  - Development
  - Onshore - offshore

Offshore wind - software

- Harbours
  - Germany
  - UK
  - Others
- Vessels
  - Installation
  - Service
  - Other vessels
- Manpower / Know-how
  - NAREC, Newcastle UK
  - Bremen / Oldenburg, Germany
  - Esbjerg, Denmark
  - The Netherlands
  - From oil and gas
  - From shipping
  - Technical / engineering
  - Managers

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