

Global Wind Day

Seoul 2018



Fred. Olsen Ocean

Installation and O&M Solutions for the Offshore Wind Korea

Ludmila Mondino
Business Development Manager



Despite that **windy seas** are clutching at its coasts, bringing an **Inexhaustible Natural Resource – the Offshore Wind**

‘South Korea is called the Land of Morning Calm’

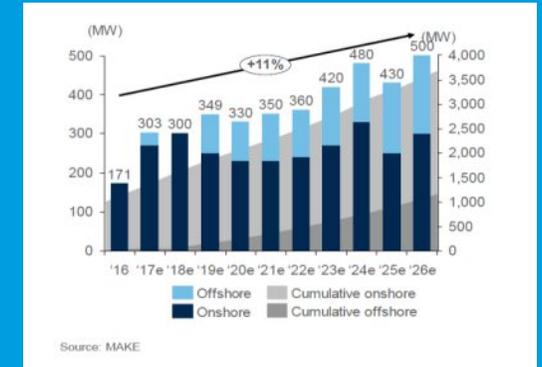


Offshore Wind Drivers and Business Context

- **Policy Support** through the 8th Basic Plan for Electricity Supply and Demand, increasing the share of renewable from 6.2% to 20% by 2030 and the Renewable Energy 3020 Implementation Plan proposing the deployment of 13GW offshore wind
- **30 MW Tamra**, a utility-scale offshore wind project, grid connected 1H/2017 accelerating further development

Market Progress:

- **60MW Southwest Offshore Demonstration** under construction (1st phase of 2.5GW)
- **99.2 MW Saemangeum** in pre-construction
- **22 projects under development** totalling ~ 7GW
- +5 GW across zones of potential and 1GW Floating Offshore wind



Fred. Olsen Related Companies



Renewable energy



100%

Fred. Olsen Renewables AS

Shipping/
Offshore wind



100%

Fred. Olsen Ocean Ltd.

Offshore drilling



51.9%

Fred. Olsen Energy ASA

Cruise



100%

Fred. Olsen Cruise Lines Ltd.

Other investments



54%

NHST Media Group AS

Bonheur ASA companies in Renewables

Listed Oslo Stock Exchange

Fred. Olsen Renewables



Wind farm owner operator

- 11 wind farms
- 679 MW capacity (~1,9TWh/yr)
- Development pipeline of 2,2 GW secured and under development

100% owned

Fred. Olsen Windcarrier



Jack-up installation

- 2 custom built jack-up installation vessels
- Turbine and foundation installation
- Op. and maintenance

100% owned

Universal Foundation



Wind turbine foundation

- The Carbon Trust's championed design
- 10+ MW WTGs
- Quick and silent installation
- No grouting

100% owned



Technical manpower

- ~850 personnel
- On and offshore
- Installation, Service & maintenance
- Main component exchange
- HV

75.5% owned



Renewables hub

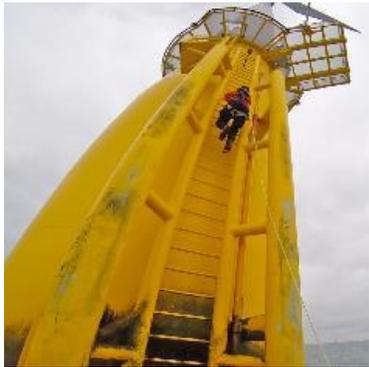
- Assembly
- Logistics
- Foundations
- Vessel repair and maintenance

Subsidiary of Fred. Olsen Energy

51.9% owned

Fred. Olsen related companies in renewables

Privately owned



Renewable Energy Consultancy and Service Provider

- Renewable energy consultants
- 360 degree lifecycle approach
- 350+ renewable experts



Communications and Service Provider

- Leading marine mgmt. and monitoring system SeaPlanner
- Supports near and farshore offshore projects
- Communication container solution 'SeaHub'



Wind Lidar System

- The original wind lidar est. 2007
- 1000+ deployments globally, 10m+ operational hours
- Cost effective alternative to traditional Met. Masts

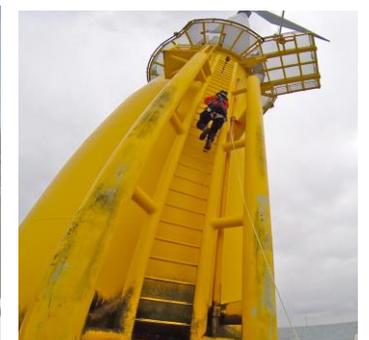
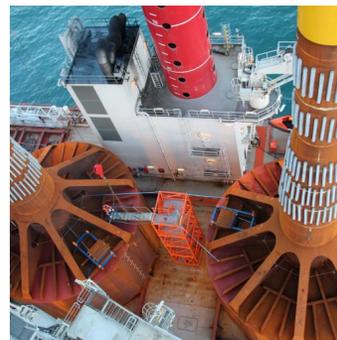
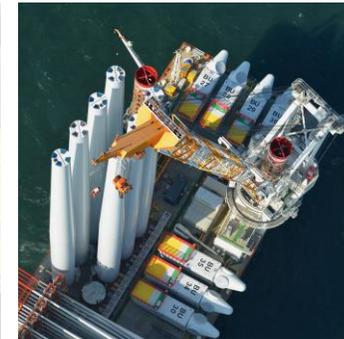


Pioneering Wave Energy Generator

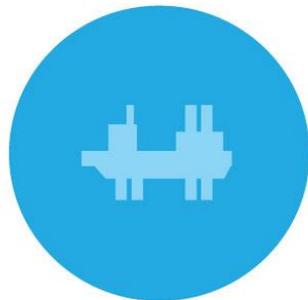
- Ground breaking reliability
- Continuous power output
- Currently deployed by US Navy off Hawaii

Fred. Olsen related companies have built a solid position in renewable energy

- 25 years in renewables
- 170 years in offshore, shipping and marine
- 10 established companies
- Employing ca. 1,500
- Working in over 40 countries
- Onshore wind; delivered **11 industrial scale onshore windfarms** with **679 MW** installed capacity (generation ~1.9 TWh/yr)
- Offshore wind; **installed 311 WTGs** with **1453 MW** installed capacity (5.2TWh/year)



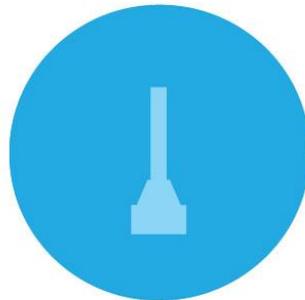
 **Fred. Olsen Ocean**



Fred. Olsen Windcarrier

100%

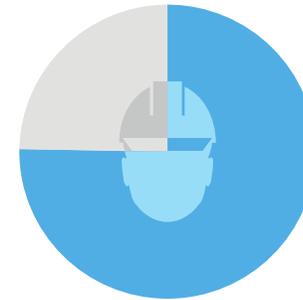
Jack-up installation
vessels



Universal Foundation

100%

Mono Bucket foundations



Global Wind Service

75.5%

Technical manpower



 Fred. Olsen Windcarrier

- Two custom built jack up vessels
- Wind turbine & foundation installation
- Operations & maintenance



 Universal Foundation

- Design championed by the Carbon Trust
- 10+ MW wind turbines
- Fast & silent installation
- No grouting



- >850 personnel on & offshore
- Installation, service & maintenance
- Main component exchange
- High Voltage (HV)

Health, Safety, Environment, Quality (HSEQ)

We are committed to being recognized as a leading organisation for HSEQ management

HSE:

- Zero incidents mindset
- Risk management is an integrated part of all activities
- Detailed HSE requirements defined to ensure safety at all levels
- Open reporting culture, focusing on learning

Quality:

- Our 'Improve Quality (iQ)' programme aspiration: *"Always right the first time and on time – with enthusiastically satisfied customers"*
- **ISO 9001, ISO 14001, OHSAS 18001 and Achilles certified**

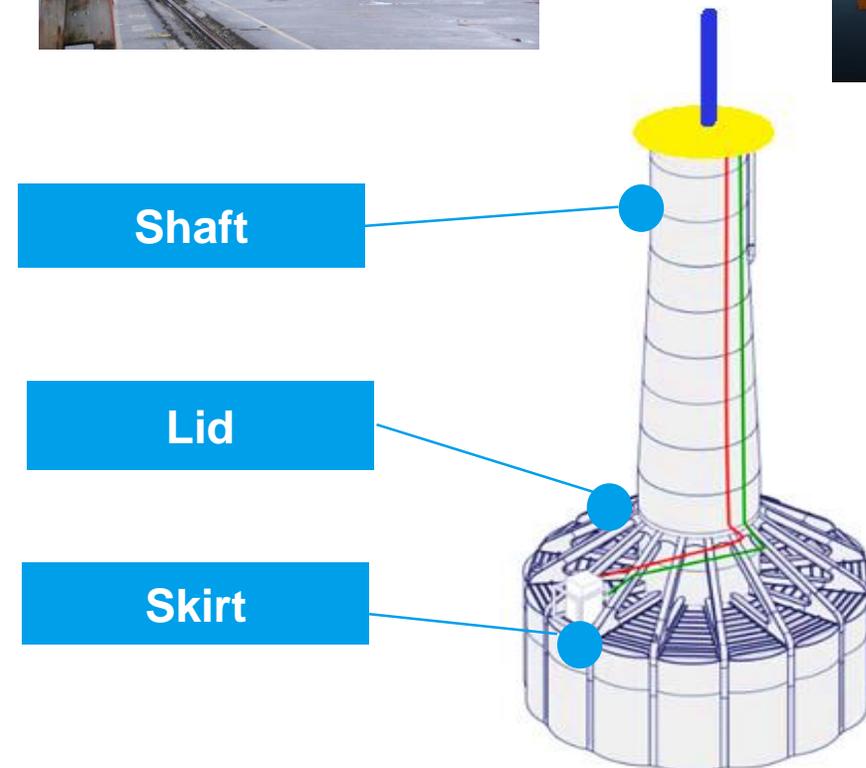
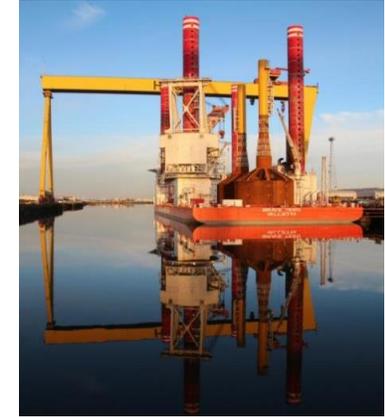


Foundation Design Solutions

Universal Foundation: The Mono Bucket Foundation Solution

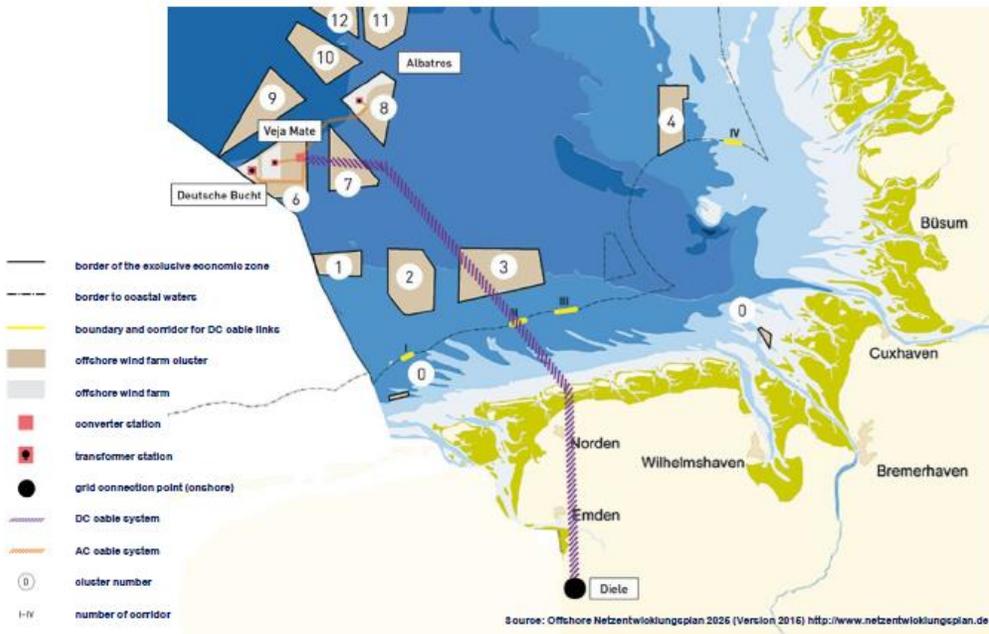
A hybrid design combining the **benefits of a gravity base foundation, a monopile and a suction bucket.**

- Noise-Free Installation
- Suitable for +10MW WTGs
- 20-25% lighter than monopiles
- Optimal range coverage: 20-55 metres
- No grouted connections - integrated transition piece
- No seabed preparations, integral scour prevention
- Single-lift or self-floating installation
- Completely removable – reducing the need for “Bank-Aval”
- Proven to reduce the LCOE



Universal Foundation in the Deutsche Bucht Pilot Project

DEUTSCHE BUCHT – 252MW



RECHARGE WIND



Mono Buckets used as foundations for recently decommissioned met-masts at the UK's Dogger Bank project site. Photo: Universal Foundation

New-breed Mono Buckets head for Deutsche Bucht debut

by Darius Snieckus in London

21 December 2017

2017
Detailed
Design

2018
Fabrication

2019
Installation
in Q2

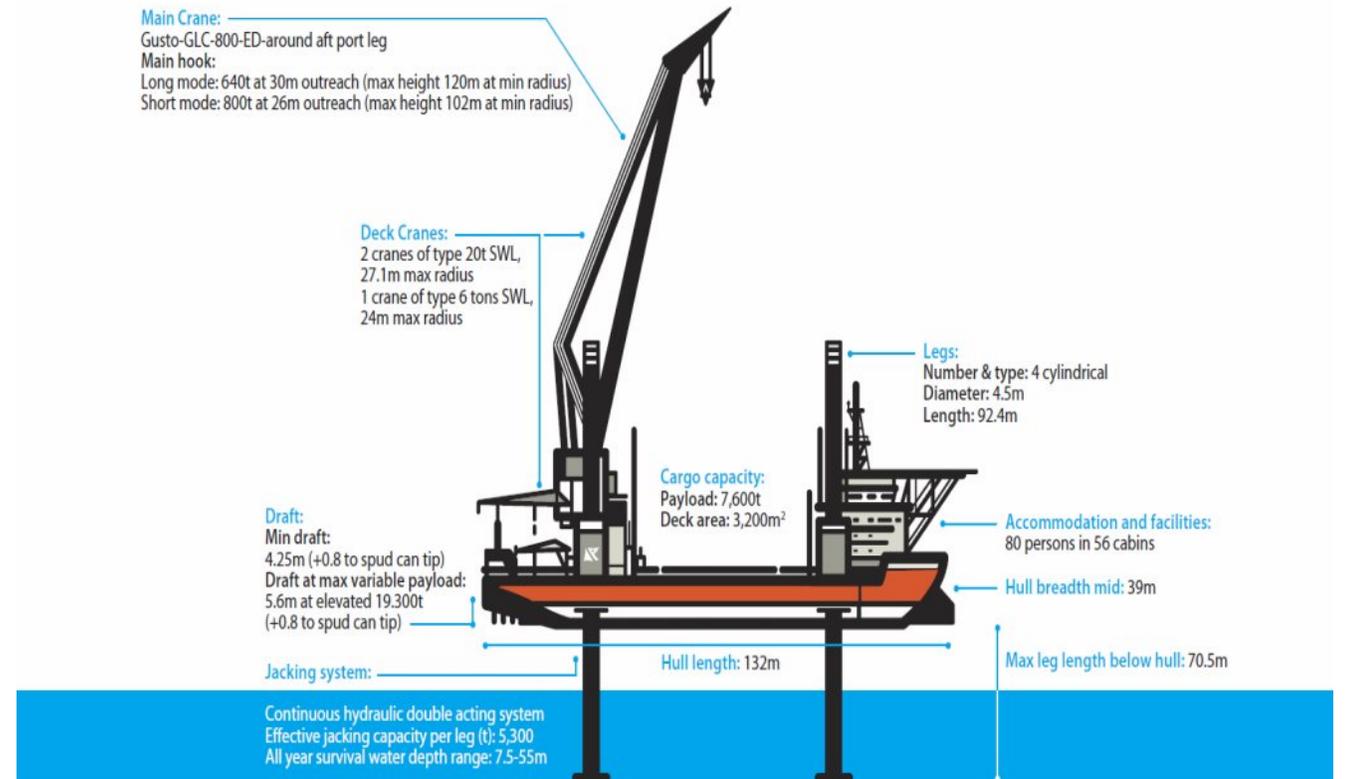
Construction Services

Transport & Installation Solutions in Offshore Wind Projects

Bold Tern & Brave Tern – our Specialist Jack-up Vessels

We offer clients all the key elements in the **Transport & Installation Scope:**

- ✓ Complete Design & Engineering
- ✓ Experienced Project Managers
- ✓ Supply chain management & logistics

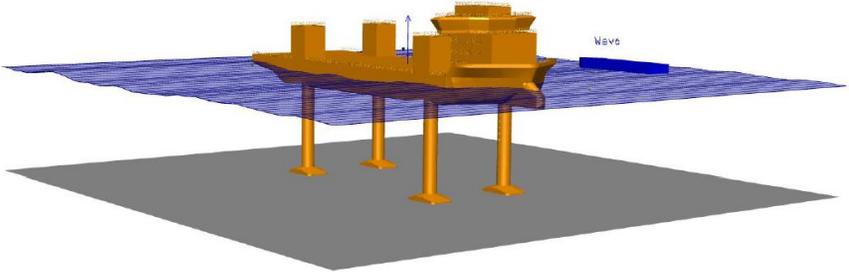


Lessons learned from projects with challenging soil conditions

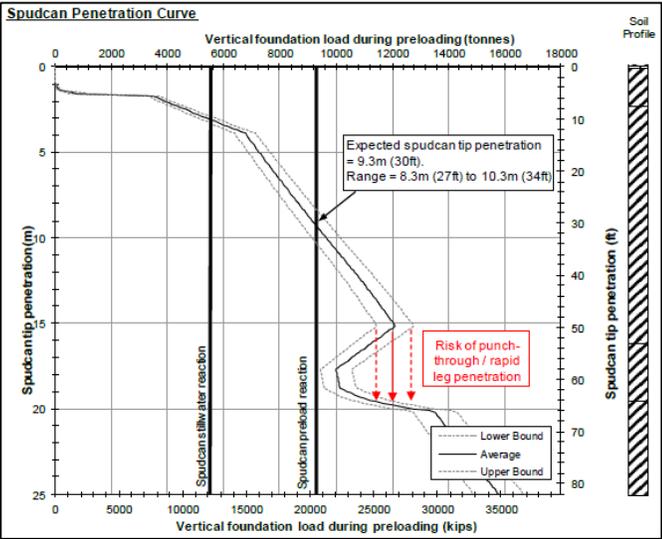
Jack-Up Operations & Geotechnical Aspects

Operational Experience at Challenging Sites of Operation		
OWF	Leg Penetration Range	Jacking Related Issues
Wikinger	1.1m – 14.7m	<ul style="list-style-type: none"> Punch-through risk Lateral variability (in-depth channels) Boulders
Galloper	5.8m – 12.4m	<ul style="list-style-type: none"> Deep penetrations Leg extraction “Relaxing” soils
Forewind	1.4m – 33.0m	<ul style="list-style-type: none"> Deep penetrations Leg extraction Insufficient leg length

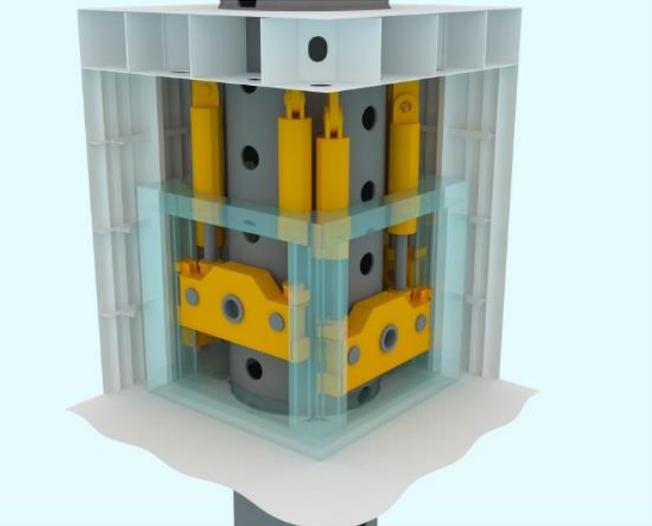
Preload Operation Prior Jack-Up



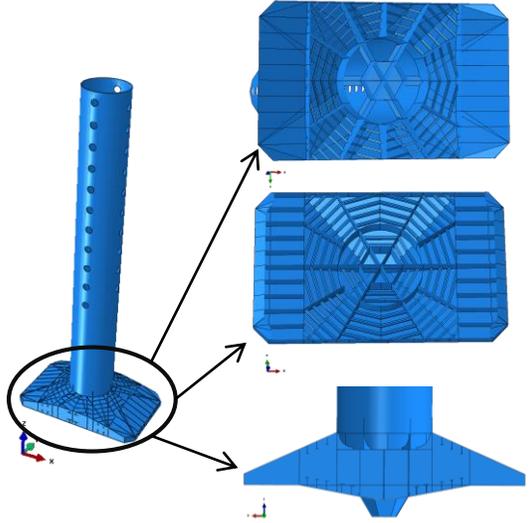
Leg Penetration Analysis (LPA)



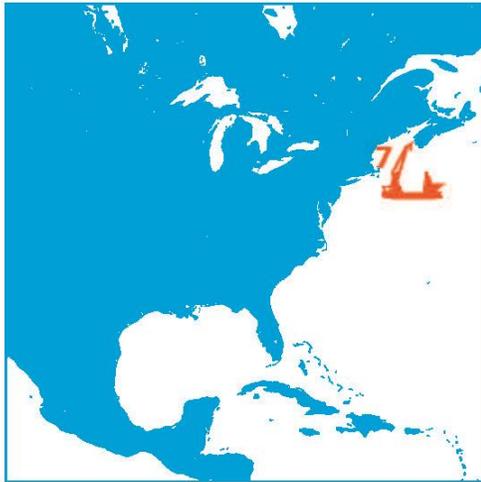
Continuous Hydraulic Jacking System



Spudcans with Jetting System



Installation Track Record



1
GERMANY
Riffgat
Siemens
2013
30 x SWT 3.6 MW

3
BELGIUM
Belwind
Alstom
2013
1 x Haliade 6.0 MW

2
GERMANY
BARD Offshore 1
BARD
2013
14 x BARD 5.0 MW

4
UK
Dogger Bank
Forewind
2014
2 x UF Foundations

5
GERMANY
Global Tech I
Areva
2014
75 x Areva 5.0 MW

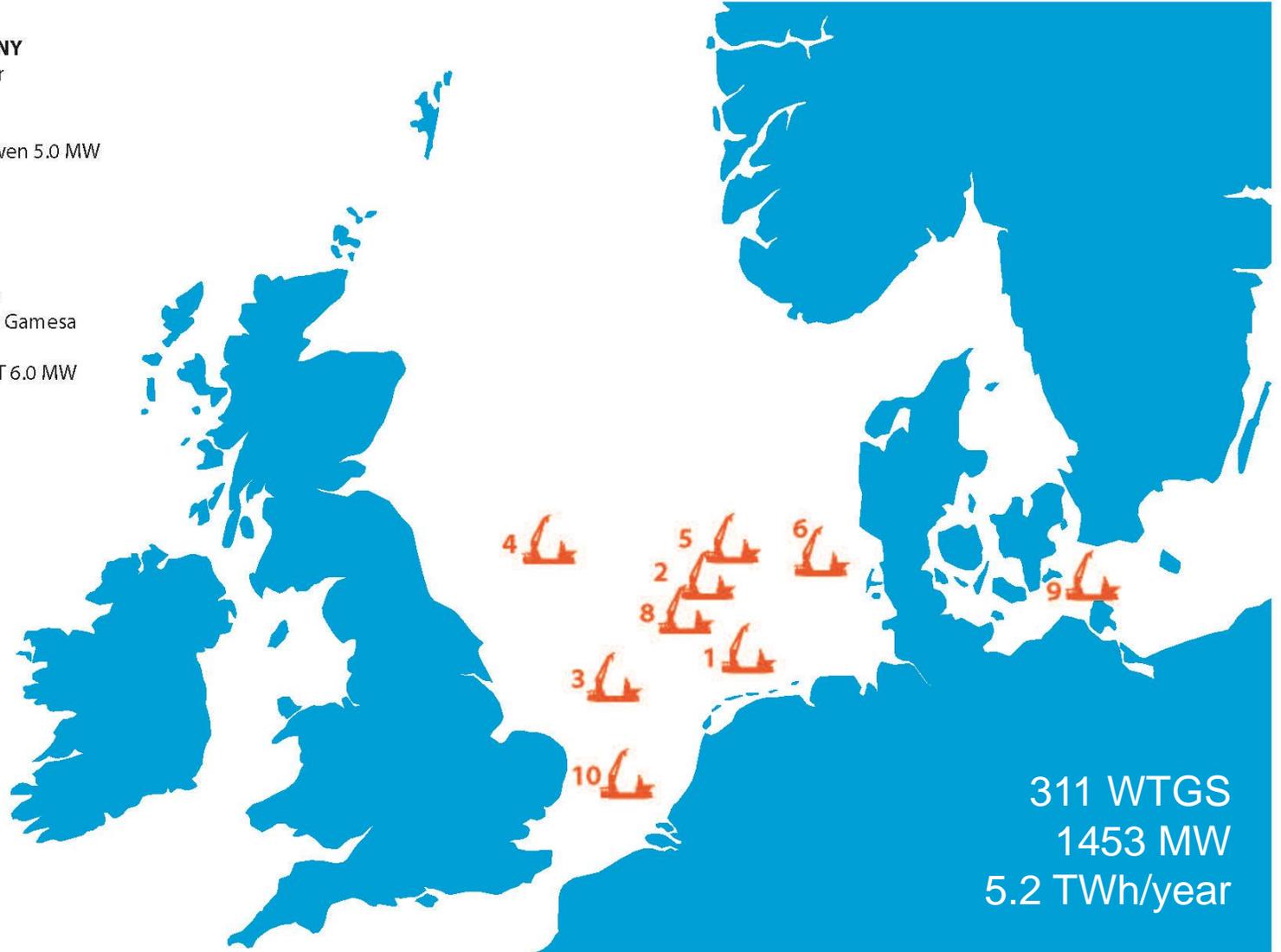
6
GERMANY
Butendiek
Siemens
2015
80 x SWT 3.6 MW

7
USA
Block Island
Deepwater Wind
2016
5 x GE 6.0 MW

8
GERMANY
Veja Mate
Siemens Gamesa
2017
19 x SWT 6.0 MW

9
GERMANY
Wikinger
Adwen
2017
70 x Adwen 5.0 MW

10
UK
Galoper
Siemens Gamesa
2017
17 x SWT 6.0 MW



311 WTGS
1453 MW
5.2 TWh/year

Operations & Maintenance

Fred. Olsen related companies provide Clients with **Complete O&M solutions:**

- ✓ Marine spread
- ✓ Resources
- ✓ Expertise for efficient scheduled and unscheduled operations and maintenance services.

We set up an alliance of family companies capable of delivering an integrated O&M offering in-house.

‘Best in Class’ scope of **integrated services** in the offshore wind:

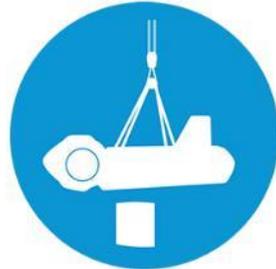
- Covering a wide scope of O&M services through a single contracting body at competitive prices.
- Reduce operational risks, management interfaces and contractual complexity through seamless coordination.
- Tailor made to meet particular Client’s requirements.



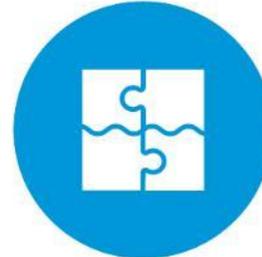
Our O&M Service Offerings



Inspections



Major component exchange



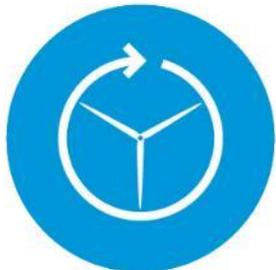
Integrated service campaigns



Blade repair



Advanced performance engineering



Decommissioning repowering and life extension



High voltage management and repair



Marine co-ordination and logistics

Combined O&M Offshore Experience

Country	Turbine type	Scope of work	Jack-up	CTV	Manpower
DK	2.0 MW	Service & maintenance, exchange of main components, 500h service		✓	✓
GER	2.3 MW	Service		✓	
IR	3.6 MW	Exchange Offshore of main components			✓
NL	3.0 MW	Service & maintenance			✓
NL	3.0 MW	Service & maintenance			✓
UK	2.0 MW	Service & maintenance			✓
UK	3.0 MW	Service & maintenance			✓
UK	3.6 MW	Service & maintenance		✓	✓
UK	3.6 MW	Service & Maintenance, exchange of main components, 500h service			✓
UK	3.6 MW	Service & Maintenance, exchange of main components, retrofit			✓
UK	3.6 MW	Service & maintenance			✓
UK	2.3 MW	Service & maintenance			✓
UK	3.0 MW	Service & Maintenance, exchange of main components			✓
UK	3.6 MW	Exchange of main components	✓	✓	
UK	3.6 MW	Exchange of main components	✓	✓	
NL	2.0 MW	Rolling blade exchange	✓		
GER	5.0 MW	Service & maintenance			✓
GER	6.2 MW	Service & Maintenance, exchange of main components	✓		✓
UK	3.6 MW	Exchange of main components	✓		
GER	3.6 MW	Exchange of main components	✓		
GER	>5 MW	Exchange of main components, blade repair	✓		
GER	>5 MW	Exchange of main components	✓		
UK	>5 MW	Exchange of main components	✓	✓	
GER	>5 MW	Exchange of main components	✓		
GER	<5 MW	Exchange of main components	✓		
UK	>5 MW	Exchange of main components	✓		
DK	3.6 MW	Retrofit			✓
NL	4 MW	Service Campaign			✓
DE	5 MW	500h service			✓



Expanding Renewable Energy Capacity in South Korea

- The utility-scale 30 MW Tamra project proves offshore wind's viability in South Korea
- Favorable policy landscape and an established local wind power supply chain
- KEPCO's role as leader in large-scale renewable projects (to comprise 11% of its total energy generation capacity by 2029)



Thank you!

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