MAKE
A Wood Mackenzie Business

*Analyst* PRESENTATION

**Delivering renewable energy insight™**

# Global Offshore Wind Technology Trend

18 September 2018

Andy Lee

Andy.Lee@woodmac.com

# Contents


- Offshore Wind Market Assessment
- Offshore Wind Turbine Technology Trend
- Offshore Wind Installation Technology Trend
- Offshore Wind O&M Technology Trend
- About MAKE/Wood Mackenzie Power & Renewables

MAKE
A Wood Mackenzie Business

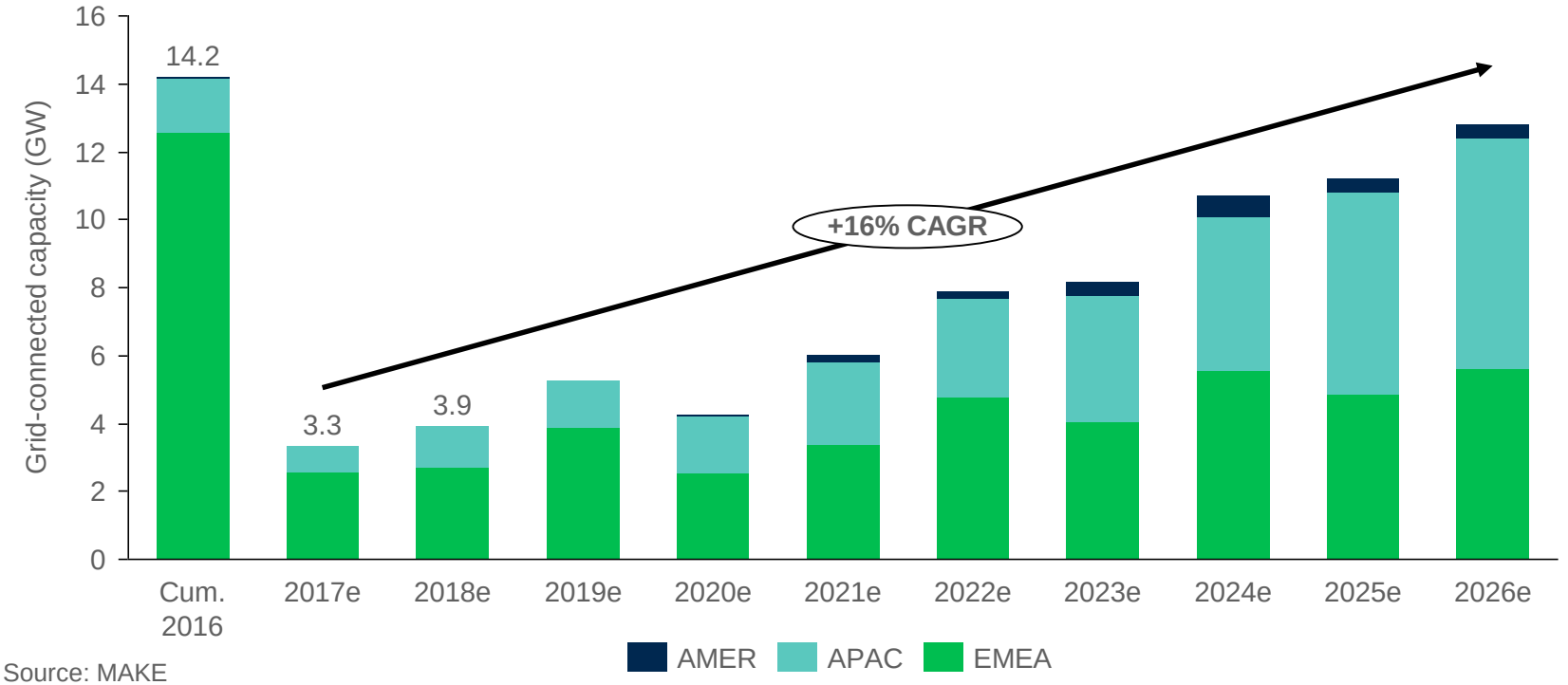
**Delivering renewable energy insight™**

# Offshore Wind Market Assessment

5 July 2018

# Global offshore wind capacity to reach 87GW by 2026

## Global offshore wind growth

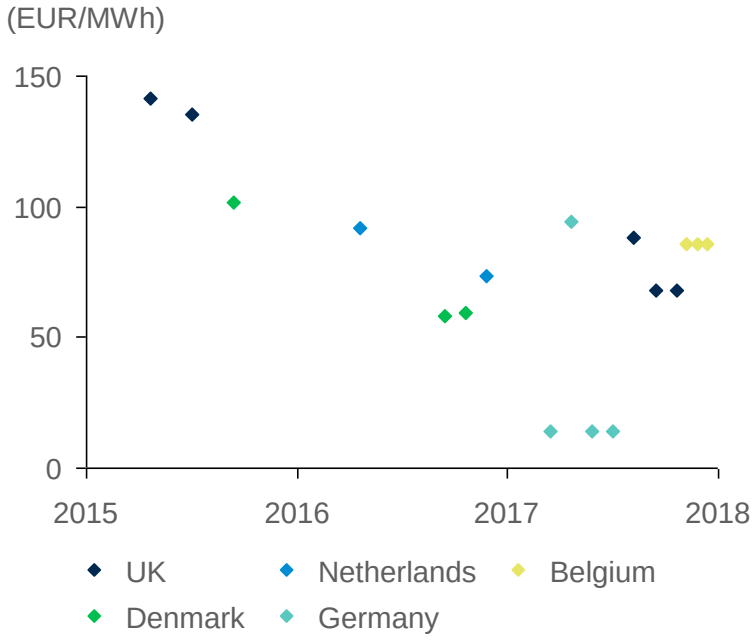



Source: MAKE

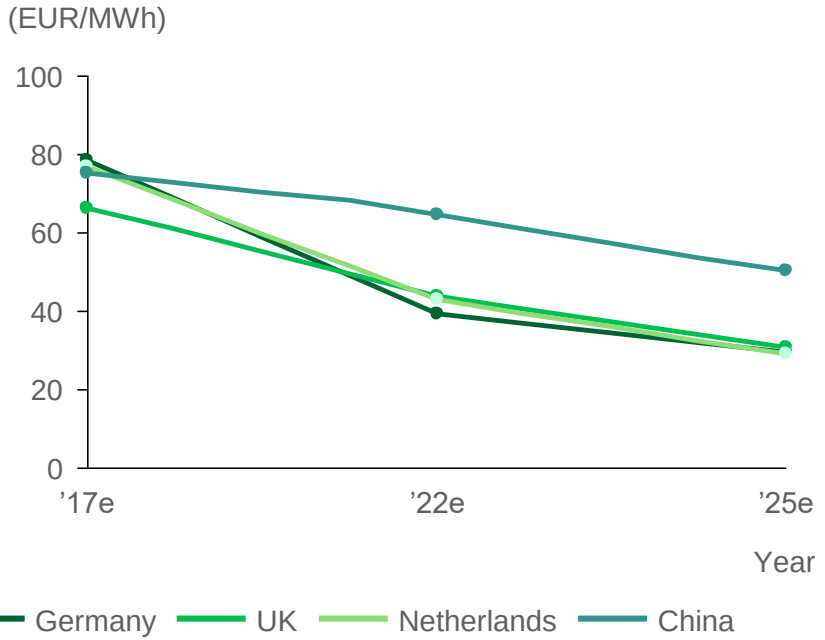
Growing momentum in China, Taiwan and the US amid subsidy wind down in Northern Europe as markets transition to competitive auctions.

# Record-low offshore subsidy prices increase confidence in sector

## Adjusted strike prices




## LCOE development, 2017-2026e




Note: Strike prices adjusted to 15-year periods, taking development and transmission costs into account.

Source: MAKE

China offshore wind market still have 9.4GW pipeline reserve before entering auction scheme. The change of incentive policy will drive offshore wind LCOE to decrease considerably.

# Offshore wind has cost down opportunities in multiple areas

## Major factors for LCOE reduction

### Turbines & plant

- Larger turbines and wind farms
- Increased reliability
- Scale effects and industrialisation

### Substructures

- Standardised and optimised offshore foundation design and design criteria
- Industrialised manufacturing

### Transmission

- eBoP optimisation of substation and transmission capex
- Innovative transmission solutions
- Improved grid access

### O&M

- Low OPEX drivetrains
- Turbine and component quality
- Condition monitoring, diagnostics, preventive maintenance

Source: MAKE, Siemens, MHI-Vestas

MAKE
A Wood Mackenzie Business

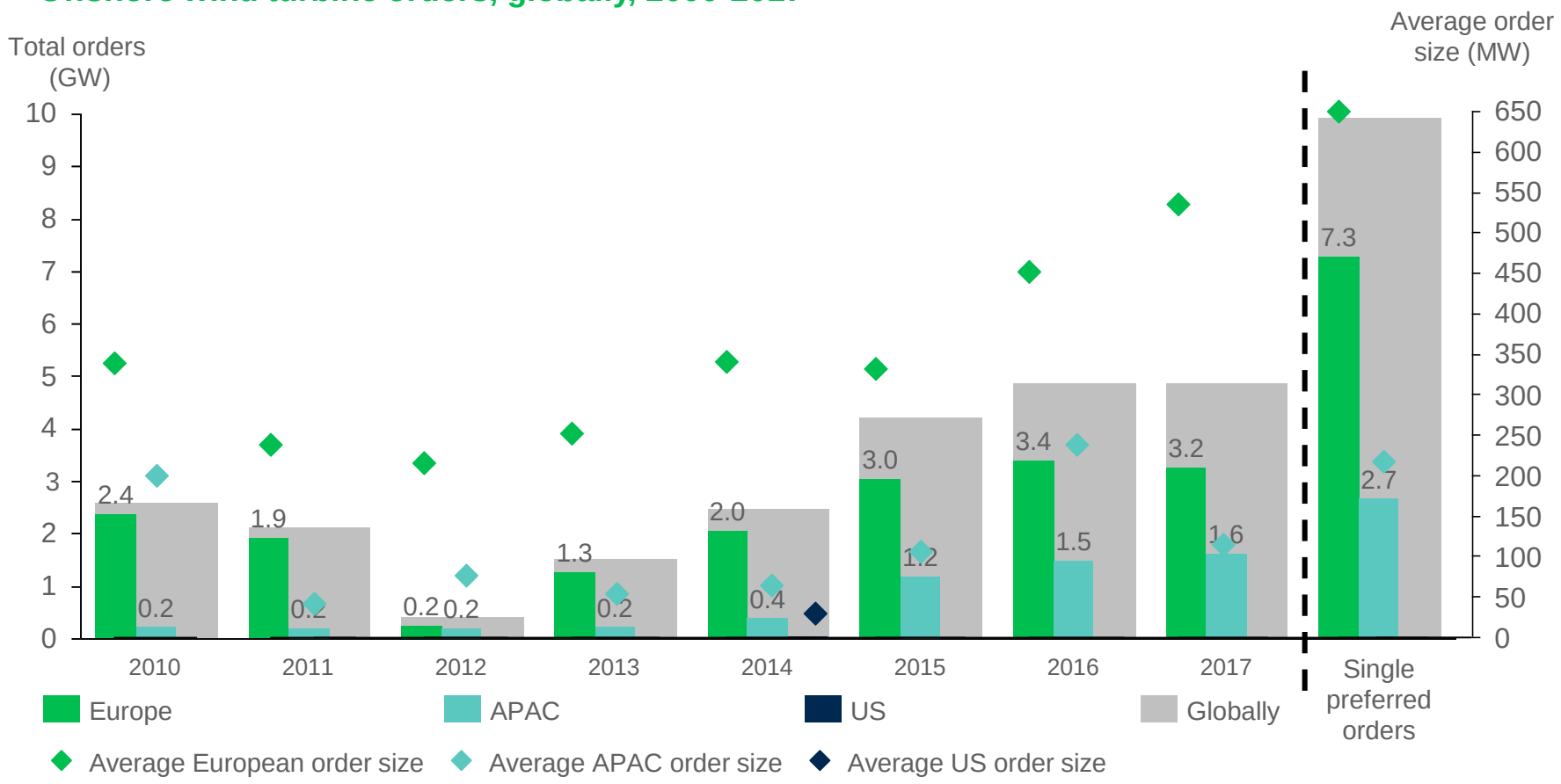
**Delivering renewable energy insight™**

# Offshore Wind Turbine Technology Trend

Offshore Wind Turbine Technology Trend

# Order intake is starting to pick up in China

## Offshore wind turbine orders, globally, 2000-2017

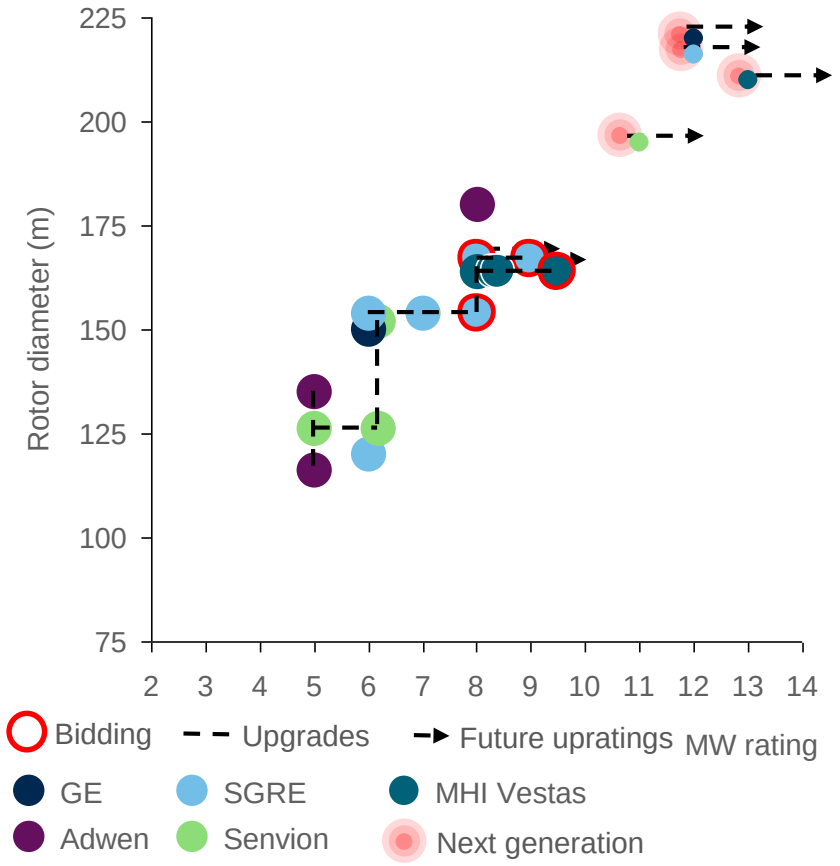



Source: MAKE

Offshore Wind Turbine Technology Trend

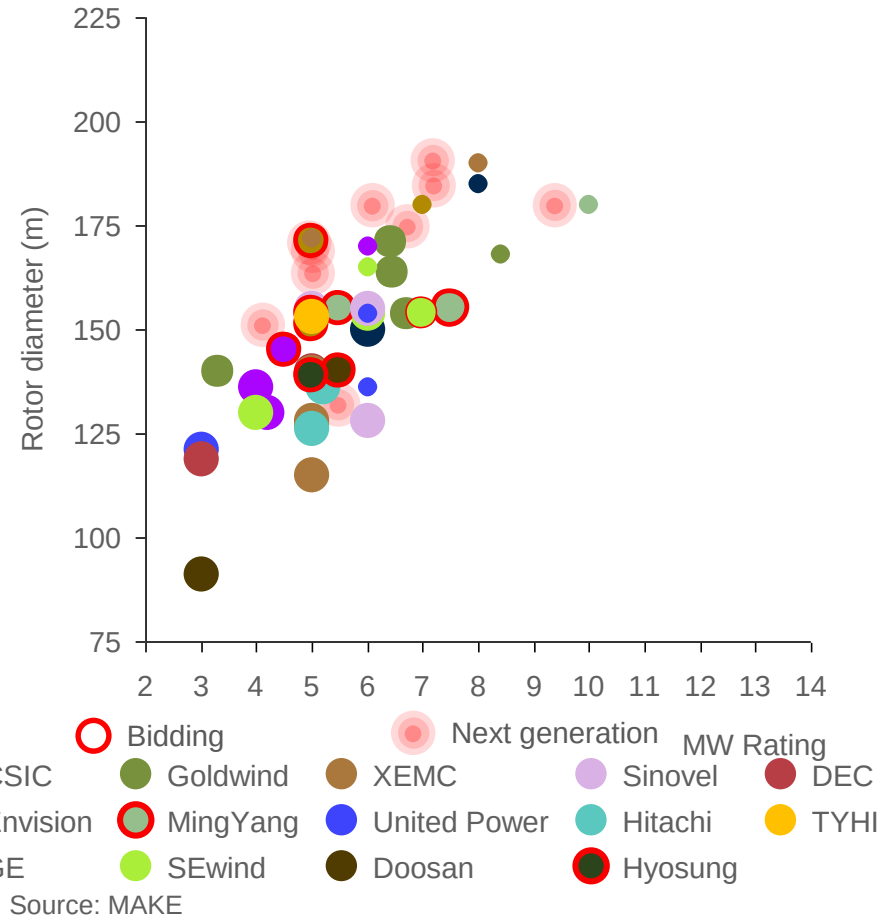
# Next generation turbines to exceed 15MW ratings

## Offshore turbine portfolio, Europe




Source: MAKE

## Offshore turbine portfolio, APAC

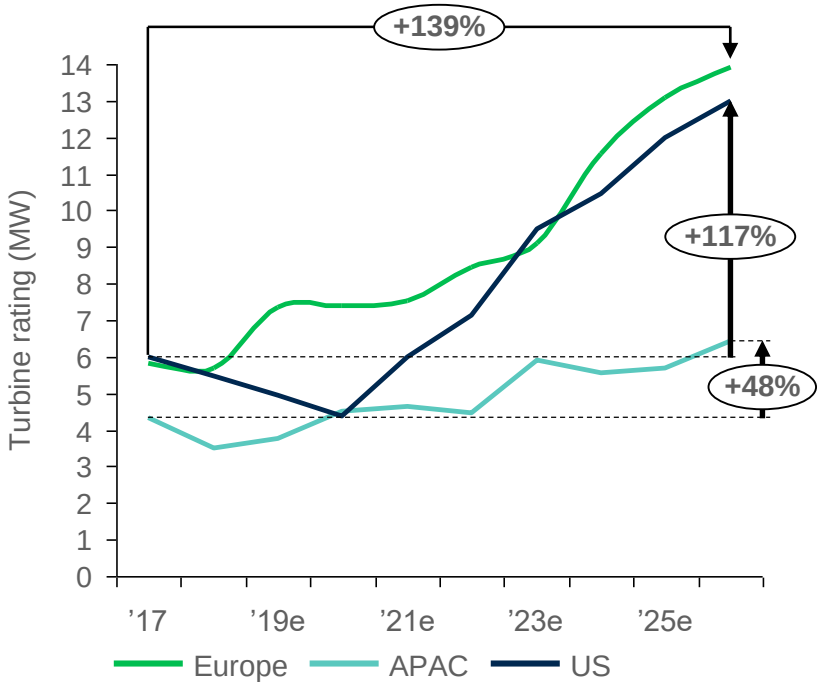



Source: MAKE

Offshore Wind Turbine Technology Trend

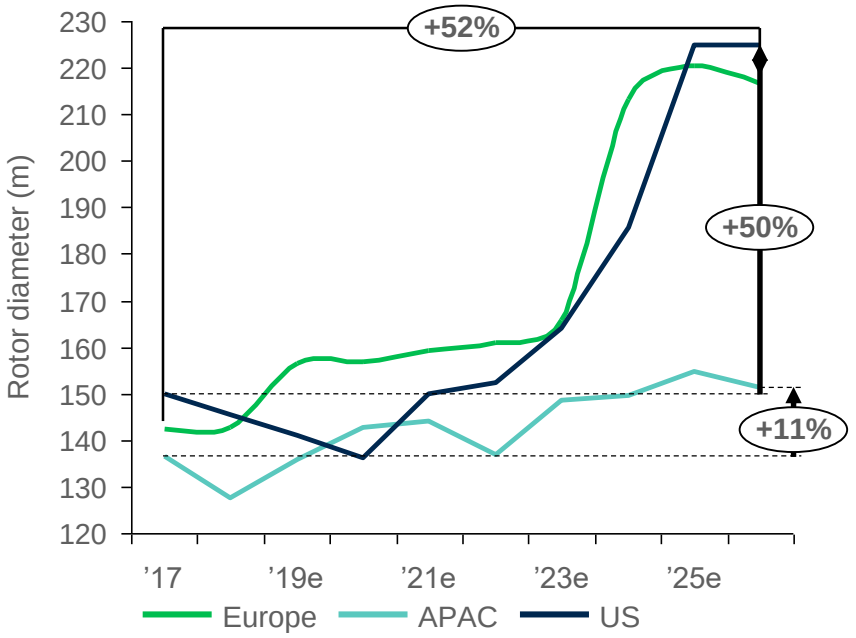
# Turbine rating to more than double over the next ten years

## Turbine rating, globally




Source: MAKE

## Rotor diameter, globally




Source: MAKE

Turbine upgrades to drive increases in turbine ratings towards 2023 in Europe, while the introduction of second generation 6MW turbines will drive medium-term boost in China.

MAKE
A Wood Mackenzie Business

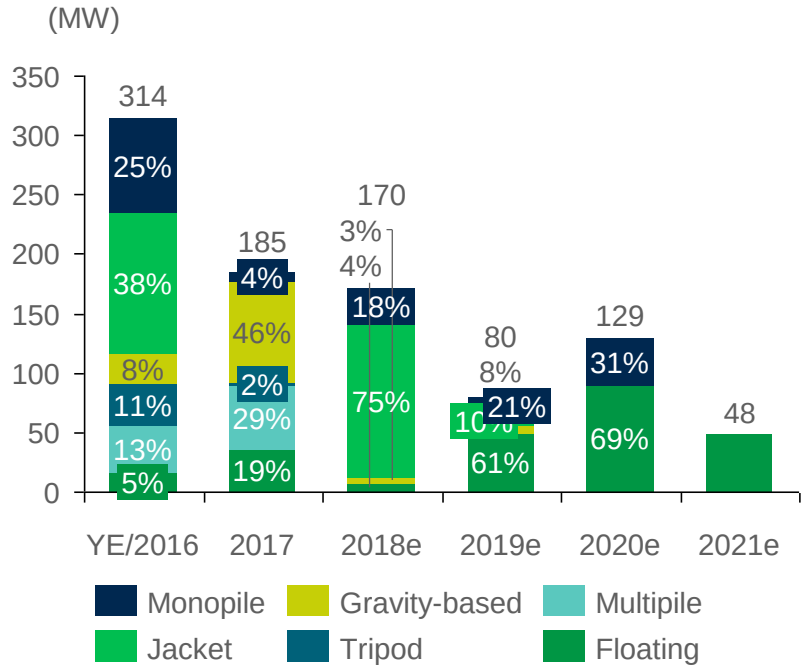
**Delivering renewable energy insight™**

# Offshore Wind Installation Technology Trend

Offshore Wind Installation Technology Trend

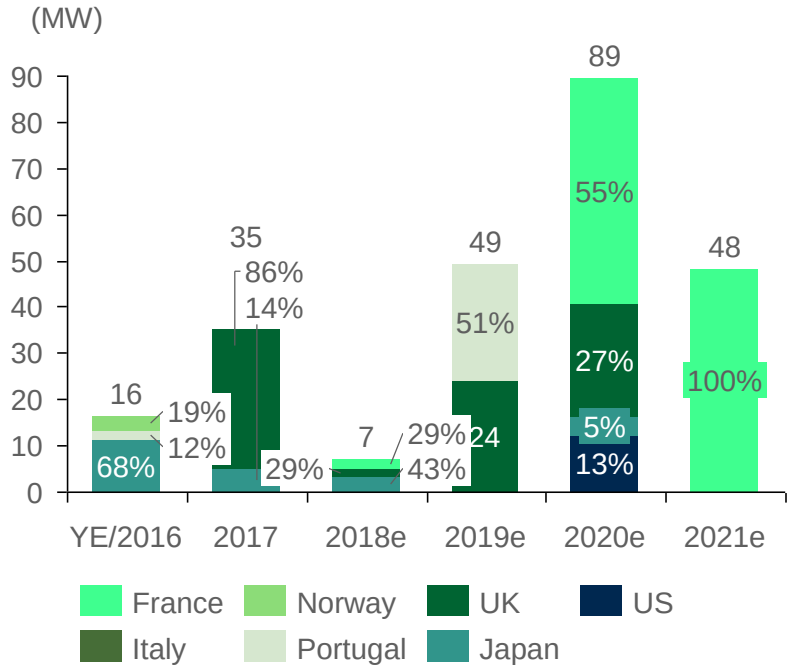
# Floating wind enters the pre-commercial stage in Europe

## Offshore demonstrators, globally




Source: MAKE

## Floating demonstrators, globally



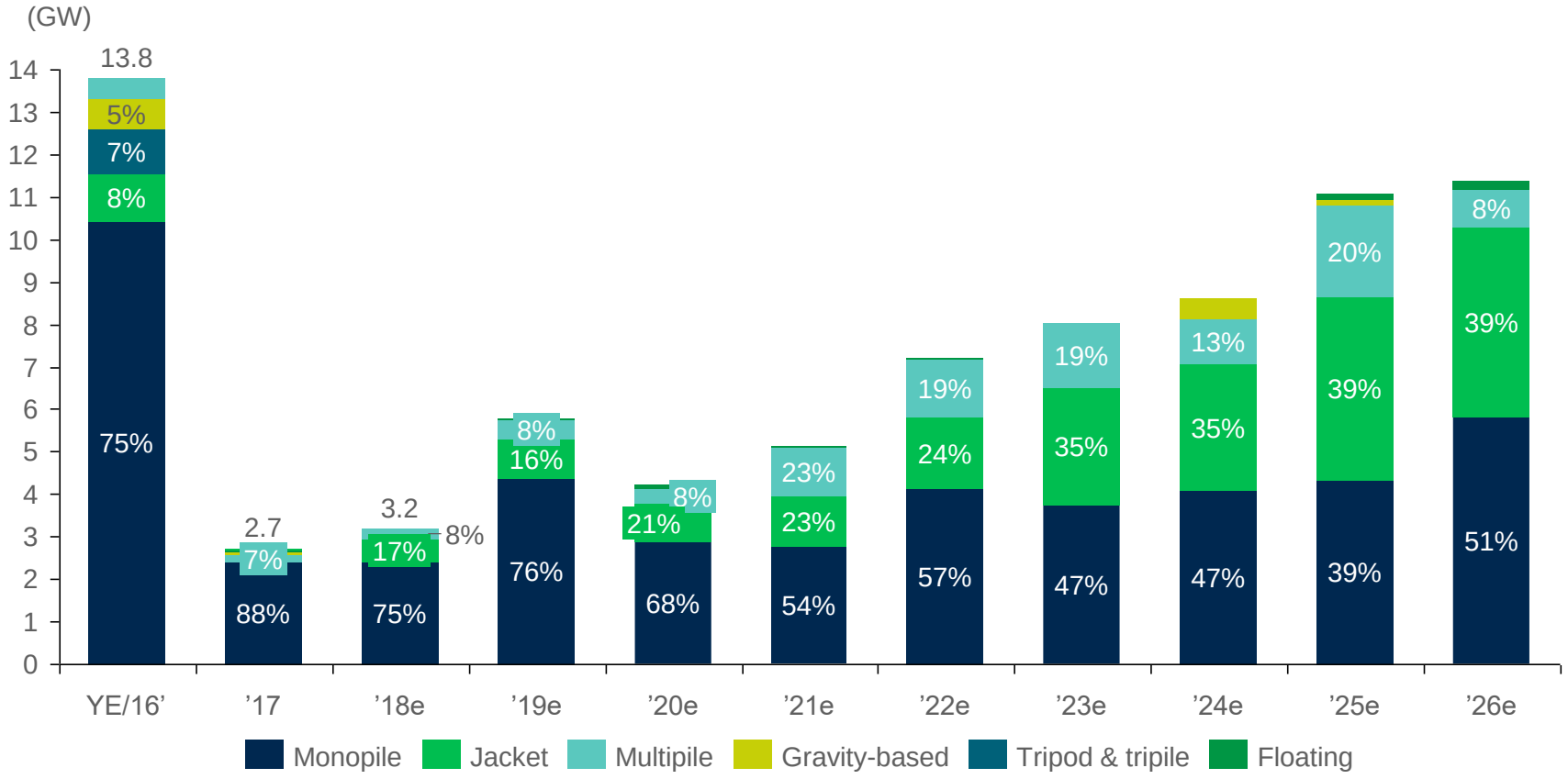

Source: MAKE

Suction bucket jackets to be rolled out commercially in Europe from 2019.
Next push will be for new monopile and gravity-based designs.

Offshore Wind Installation Technology Trend

# Jacket foundations will continually increase their share

## Global foundation forecast

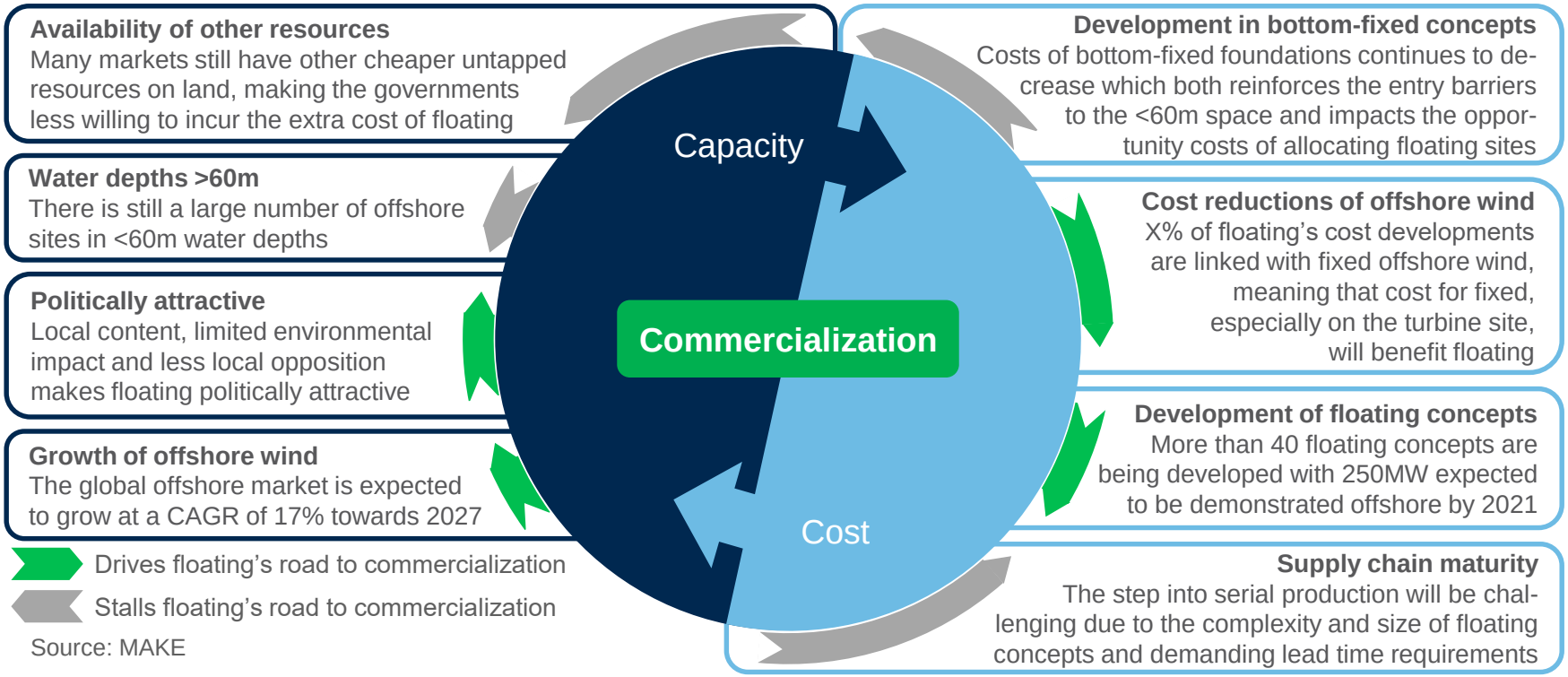



Source: MAKE

Offshore Wind Installation Technology Trend

# Governments will play a key role in floating wind's rollout

## The catch-22 of floating wind can stretch floating wind's road to commercialization



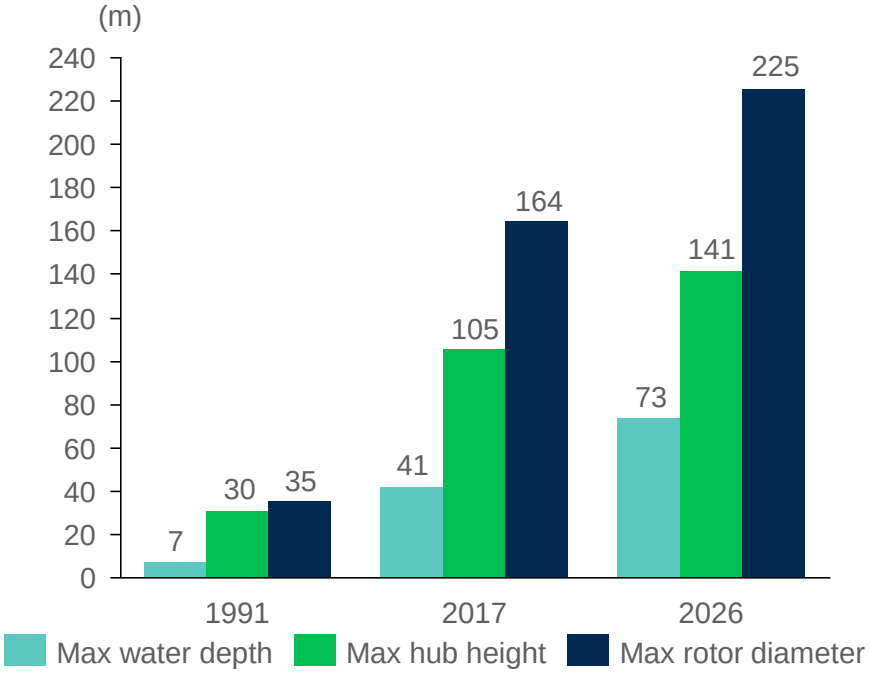

Source: MAKE

The catch-22 of floating wind: Capacity is needed in order to reduce costs of floating wind, but cost reductions are needed for governments to allocate capacity to floating wind.

Offshore Wind Installation Technology Trend

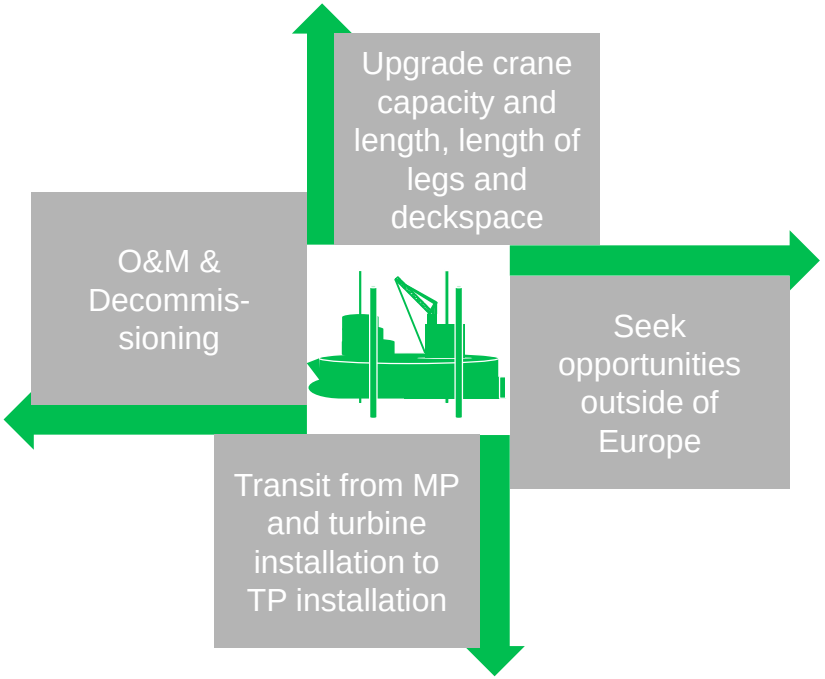
# Vessels built 2012-2014 are already being upgraded

## Turbine characteristics




Source: MAKE

## Lifecycle of vessels, Europe



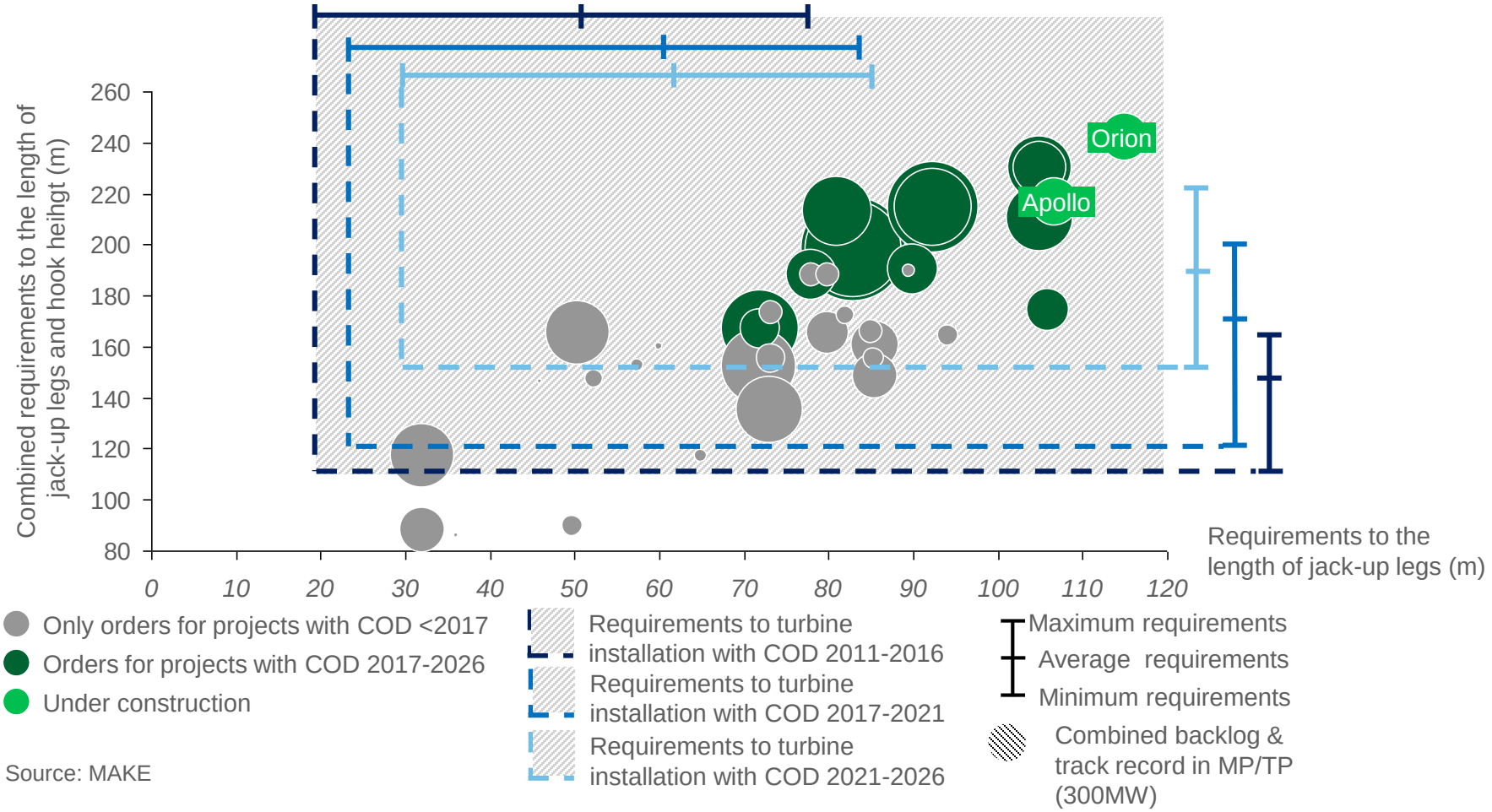

Source: MAKE

Vessel owners push to extend the lifetime of their vessels in the European offshore wind market as requirements for vessel installation continue to increase.

Offshore Wind Installation Technology Trend

# Next-generation turbines will challenge current fleet

## Turbine installation fleet and installation requirements, Europe




Source: MAKE

MAKE
A Wood Mackenzie Business

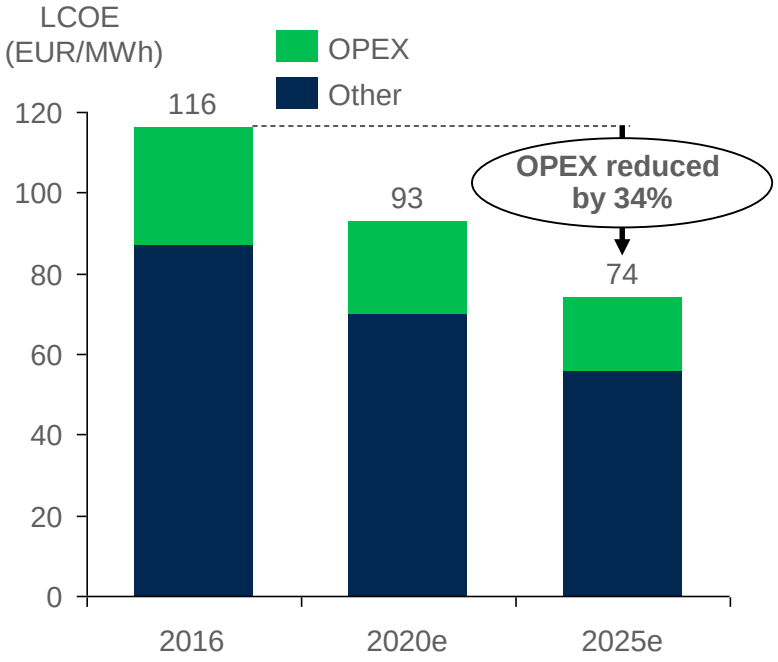
**Delivering renewable energy insight™**

# Offshore Wind O&M Technology Trend

Offshore Wind O&M Technology Trend

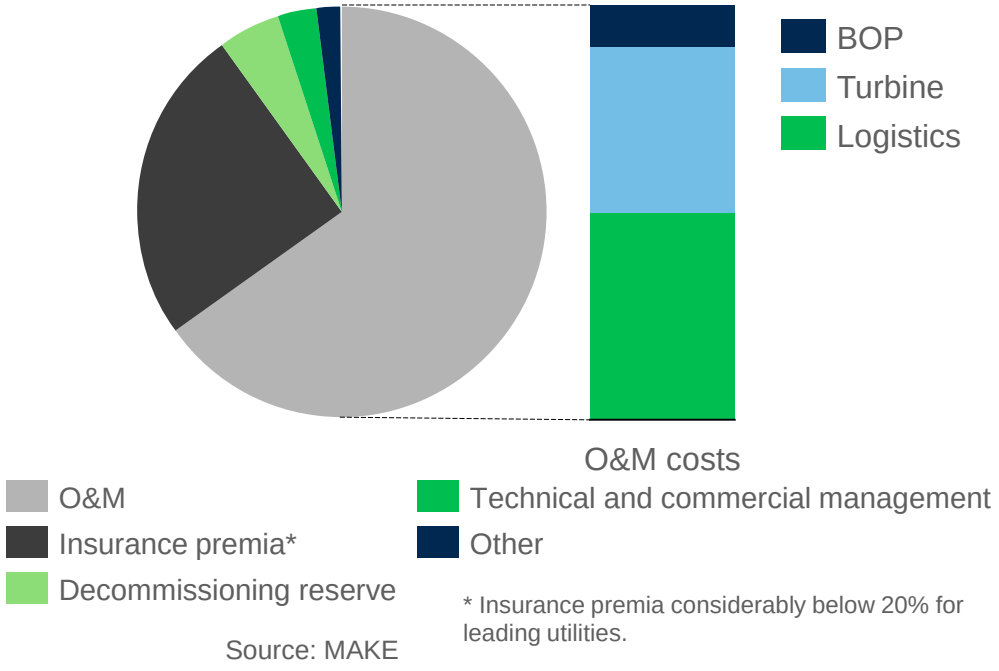
# OPEX and O&M costs to be reduced significantly

## OPEX in Europe, 2016-2025e




Source: MAKE

## OPEX breakdown, 2016




Source: MAKE

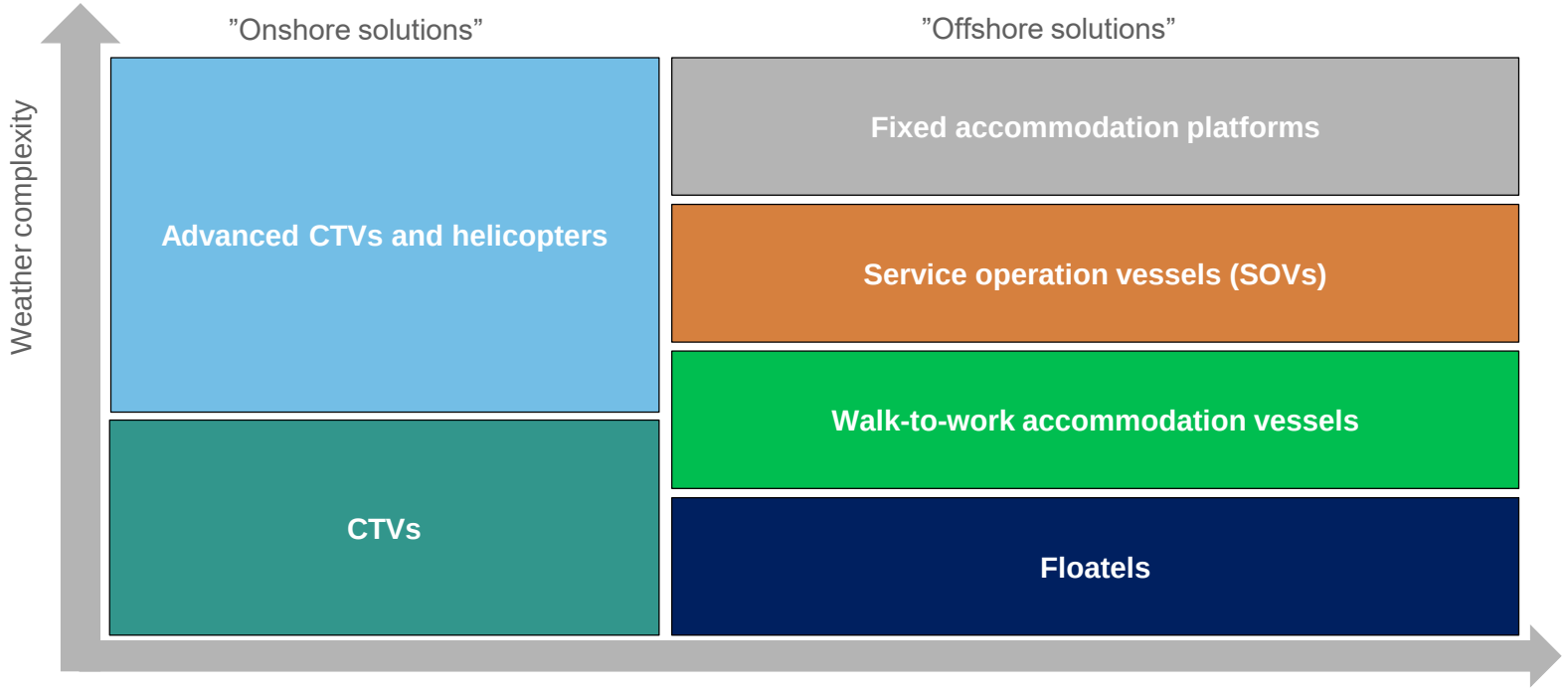
* Insurance premia considerably below 20% for leading utilities.

Operators are increasingly trying to optimize logistics costs through long-term commitments and utilization of crew transfer options across sites in order to lower LCOE.

Offshore Wind O&M Technology Trend

# Offshore logistics solutions

## Solutions available for offshore wind O&M crew transportation




Source: MAKE

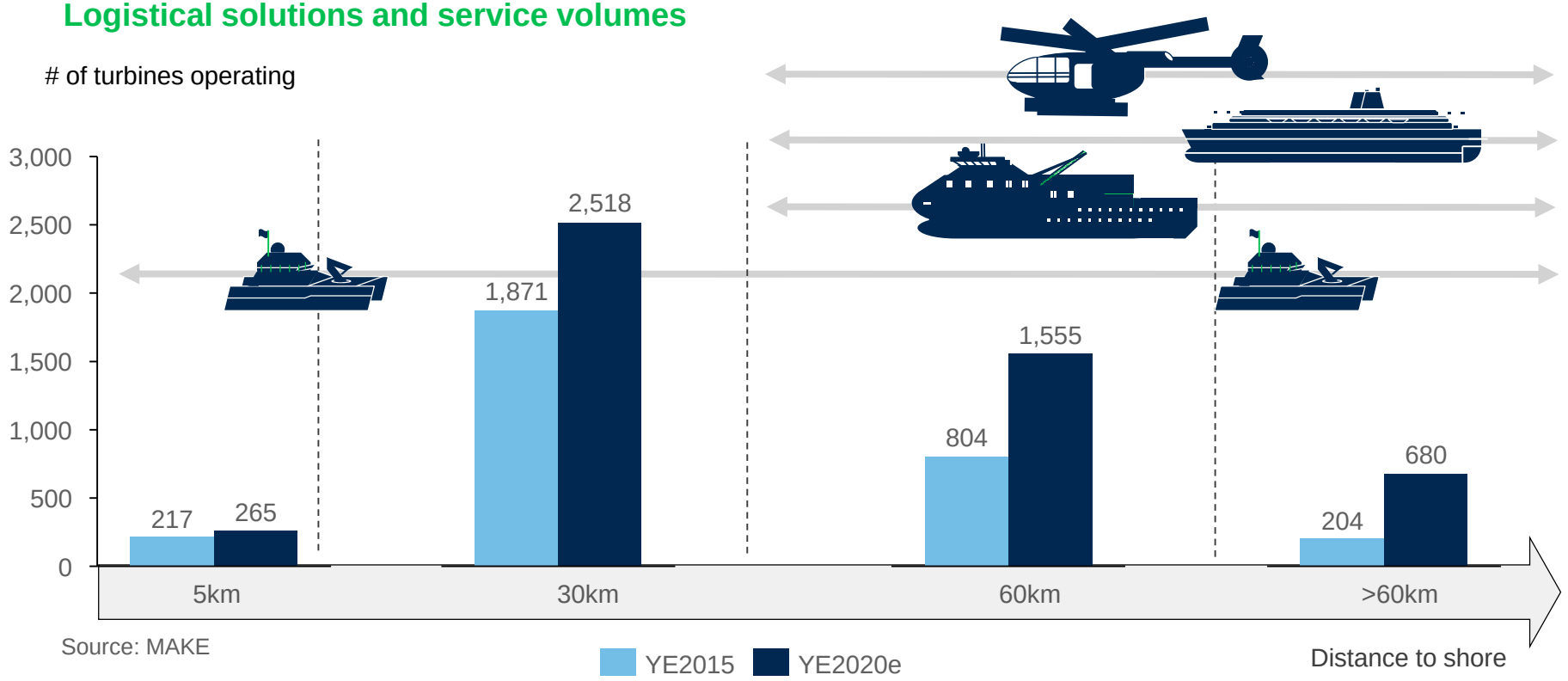
Note: "Offshore solutions" are typically in combination with CTVs, daughter crafts and/or helicopters.

For leading utilities and turbine OEMs, innovative and tailor made logistics solutions are key to ensure safety and reduce downtime.

Offshore Wind O&M Technology Trend

# 15% of operational projects deploy more than one means of transport

## Logistical solutions and service volumes




Source: MAKE

CTVs to be used alone for nearshore projects and in combination with SOVs and floatels for sites further from shore.

Offshore Wind O&M Technology Trend

# Few fixed platforms to date, but could be used as a way to extend the applicability of CTVs as projects move further from shore

## Early stage platform

1

**Only accommodation**

DONG Energy's Horns Rev 2 project was the first project to attempt to use a fixed platform. The platform has no Helipad and the project is located 30km from shore.

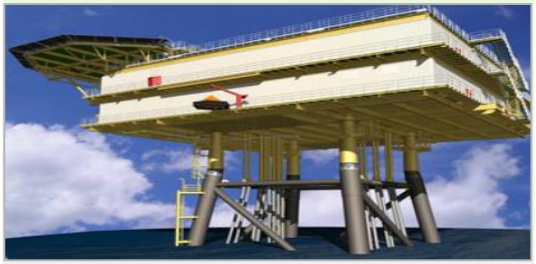
**Project:** Horns Rev 2
**Installation:** 2002
**Accommodation:** 24 people

## As-is today platform

2

**Accommodation with Helipad**

Vattenfall uses the platform to service Dantysk and Sandbank projects located 70 and 90km from shore, respectively. Used in combination with CTVs in summer time and helicopters in winter time.



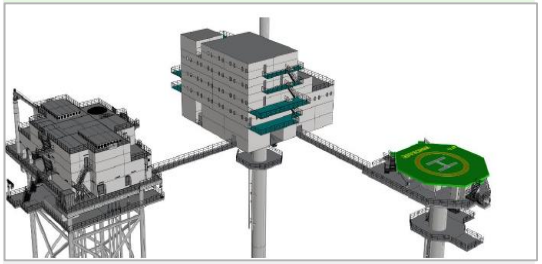
**Project:** DanTysk / Sandbank
**Installation:** 2015
**Accommodation:** 50 people

## Innovative platform

3

**Accommodation with HeliPort**

Fred Olsen Windcarriers's concept with separated accommodation, HeliPort and offshore substation. HeliPort allows for refuelling of helicopter and supports SOV and CTV operations.



**Project:** Unknown
**Installation:** Expected 2019
**Accommodation: >** 50 people

Source: MAKE

New innovative platform concept introduces a HeliPort, ensuring landing platform for SOVs and allowing helicopters to refuel. Could also be used for oil and gas applications.

MAKE
A Wood Mackenzie Business

**Delivering renewable energy insight™**

# About MAKE
# Wood Mackenzie Power & Renewables

About MAKE

# MAKE – Wind Power Focused Intelligence Provider

## Research and Consulting services

- **MAKE is one of the global wind industry's premier strategic consulting and research firms, serving the world's leading wind companies from all parts of the value chain from raw material suppliers to IPPs and utilities**
- **Research Products** – periodically published research reports and databases covering global wind market dynamics and in-depth insights, as great help to clients' decision-making processes
- **Consulting services** – customized advisory projects focusing on specific topics as technology trends, supply chain, O&M market, M&A, due diligence and much more

MAKE
A Wood Mackenzie Business

## Research Archive

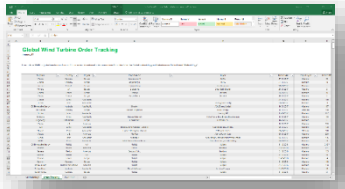
Regional Reports

Market/Sector Reports

Market Outlook Updates

Flash Notes

Databases



Research Notes

## About Wood Mackenzie Power & Renewables

# We guide companies leading the electricity transformation into the new energy economy with more offerings

In May 2017, MAKE joined Wood Mackenzie, a global Verisk Analytics business. MAKE's cutting-edge knowledge of the global onshore and offshore wind power market, as well as of global Solar PV Power from Greentech Research will be central to the future of Wood Mackenzie's power and renewables research and advisory.

Wood Mackenzie
A Verisk Business

MAKE
A Wood Mackenzie Business

gtmresearch
A Wood Mackenzie Business

### POWER AND FUEL

- Global Energy Markets
- North America Power
- Europe Energy
- China Gas & Power
- Southeast Asia Gas & Power

### WIND POWER

- Global Offshore Wind
- Wind Premium Plus Package
  - » Onshore & Offshore
  - » Market Reports
  - » Databases

### SOLAR PV

- Global Downstream Solar
- Solar demand monitor
- U.S. Solar market insights
- PV Module Supply Chain
- PV Systems & Technologies

### ENERGY STORAGE

- Global Energy Storage
  - » Supply Chain
  - » Cost & Technology
  - » Policy, Markets & Applications

### GRID EDGE

- Topical market reports
- Quarterly market briefings
- Executive council
- Data hub

MAKE
A Wood Mackenzie Business

Delivering renewable energy insight™

About MAKE

# MAKE – Wind Power Focused Intelligence Provider

**Andy Lee**
**Managing Consultant, APAC**

- Leads the consulting project execution in APAC region, mainly in China
- Focuses on wind turbine technology, wind farm solutions and overall value chains
- Analyses and develops various analytical frameworks, methods and models
- Closely monitors industry participants and provides insights to meet customers' business goals

## A sample of MAKE clients

HYUNDAI SECURITIES
HOULIHAN LOKEY
MAERSK BROKER
TECSIS
金风科技 GOLDWIND
SINOMA
Tekmar Energy
TPG
amsc
LM WIND POWER
SIEMENS
VATTENFALL
ENVISION Power of Will
SKF
HYUNDAI HEAVY INDUSTRIES CO.,LTD.
ABB
Gamesa
DONG energy
Vestas
Nordea
Goldman Sachs
Permira
Blue Equity
Climate Change Capital
MAINSTREAM RENEWABLE POWER
AINSCOUGH
MITSUBISHI
tpi
HSBC
SENVION
HEXCEL

# Contact


## Andy Lee

## Andy.Lee@woodmac.com


**consultmake.com**


*These materials, including any updates to them, are published by and remain subject to the copyright of MAKE Consulting A/S ("**MAKE**"), and are made available to clients of MAKE under terms agreed between MAKE and those clients. The use of these materials is governed by the terms and conditions of the agreement under which they were provided. The content and conclusions contained are confidential and may not be disclosed to any other person without MAKE's prior written permission. MAKE makes no warranty or representation about the accuracy or completeness of the information and data contained in these materials, which are provided 'as is'. The opinions expressed in these materials are those of MAKE, and nothing contained in them constitutes an offer to buy or to sell securities, or investment advice. MAKE's products do not provide a comprehensive analysis of the financial position or prospects of any company or entity and nothing in any such product should be taken as comment regarding the value of the securities of any entity. If, notwithstanding the foregoing, you or any other person relies upon these materials in any way, MAKE does not accept, and hereby disclaims to the extent permitted by law, all liability for any loss and damage suffered arising in connection with such reliance.*



**Denmark**
Sønder Allé 9
DK-8000
Aarhus
T +45 7026 6628

**U.S.**
117 N. Jefferson Street
Suite 400
Chicago, IL 60661
T +1 312 441 9590

**U.S.**
33 Bradford St
Concord
MA 01742
T +1 978 448 3186

**China**
No. 19, 470 Shaanxi Bei
Road, Jing'an District
Shanghai 200041
T +86 21 5286 0152

**Germany**
Neuer Wall 10
20354
Hamburg
T +49 40 822 15 3111