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Principle Power

AWEA WEBINAR SERIES 2020 - MARKET SESSION

The Prospects for Floating Wind in Asia-Pacific

DAVID EDWARDS
Business Development, Principle Power

LEOPOLDO BELLO
Managing Director, Vryhof

IGNACIO PANTOJO TITOS
Floating Offshore Wind Dept. Manager, Iberdrola

TUESDAY, 8 DECEMBER 2020 - 3 PM SGT

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The Prospects for Floating Wind in Asia-Pacific

TUESDAY, 8 DECEMBER 2020 - 3 PM SGT

Introduction

Asia Wind Energy Association

The Asia Wind Energy Association was established in December 2016 to become the leading trade association for the wind energy sector in Asia Pacific.

The association acts as the regional platform for all wind power industry stakeholders to collectively promote the best interests of the wind power sector.

The Asia Wind Energy Association is supported by a wide variety of stakeholders from the offshore and onshore wind industry.

Asia Wind Energy Association

Information

www.asiawind.org

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Asia Wind Energy Association

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138 Market Street, Singapore
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Asia Wind Energy Association

Asia Wind Energy Association Corporate Partners

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Today Speakers

Asia Wind Energy Association

Ignacio Pantojo Titos

Floating Offshore Wind Dept. Manager - Iberdrola

In my current position, I am responsible for engaging the Floating Offshore Wind sector in order to develop and provide the best floating solution for the projects to come of Iberdrola.

The last 10 years I have been working in the Offshore Wind Sector in different engineering and management roles. My last position before becoming Iberdrola's Wind Float Department Manager was Engineering Manager of East Anglia One Wind farm in UK. Previously, as Principal Engineering Manager of ScottishPower Offshore Wind Business, I took part in launching several projects in Europe and USA, and creating general engineering procedures for the Offshore Wind Business.

During almost 25 years of professional experience I have participated in more than 20 projects of industrial and power generation facilities, mainly wind farms and combine cycle power plants; and I have been involved in more than other 25 projects of urban planning, hydrology and water quality projects. I have had international assignations in South America, Middle East and several West and East European Countries.

Asia Wind Energy Association

David Edwards

Business Development - Principle Power

David Edwards is a business development professional at Principle Power. He is responsible for business development and partnership activities related to Japan and Asia. He speaks Japanese fluently and has over 15 years of experience working in Japan, including at leading companies such as Sony and NEC. He graduated from the Stern School of Business at New York University with a Master's degree in Business Analytics.

Asia Wind Energy Association

Leopoldo Bello

Managing Director - Vryhof

Commuting between Rotterdam and Houston he is responsible for company activities worldwide and focuses on making Vryhof the trusted partner to offshore industry's leading companies, delivering innovative and customer-focused anchoring and mooring solutions. He believes in partnering with clients to jointly redefine solutions. Leo is personally committed to support the advancement of floating renewals and has been directly involved in several projects and its installations. He is an Industrial Engineer specialized in Operations Research and Robotics and holds a Master on Business Administration from Harvard Business School.

Presentation
Ignacio Pantojo - Iberdrola Renewables

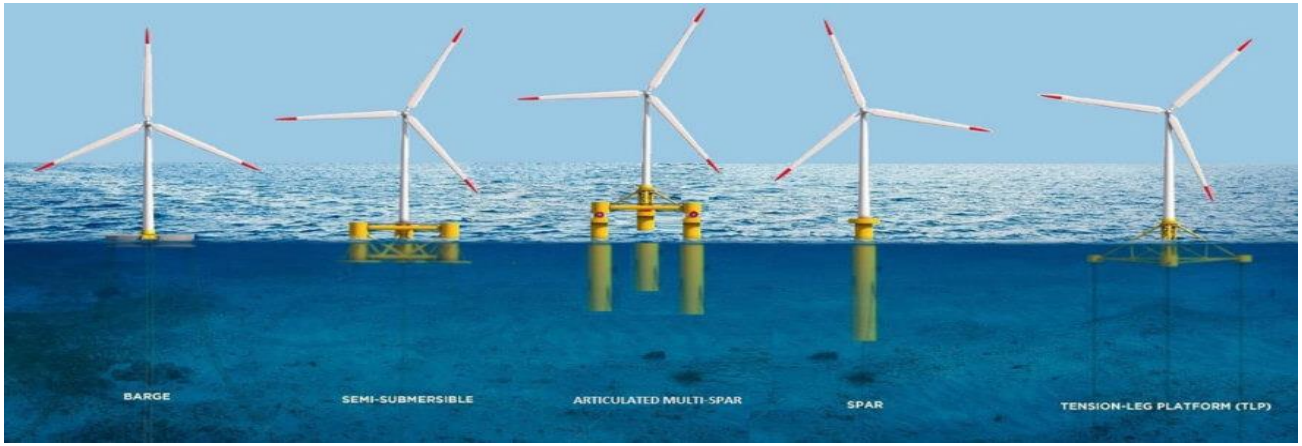
Floating Offshore Wind

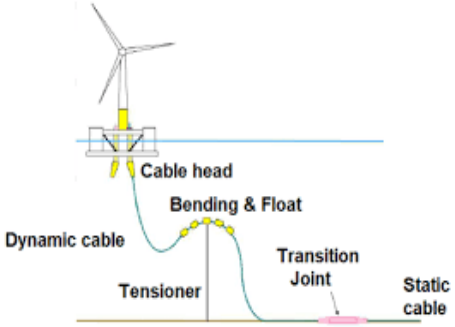
Floating Wind – Strategy

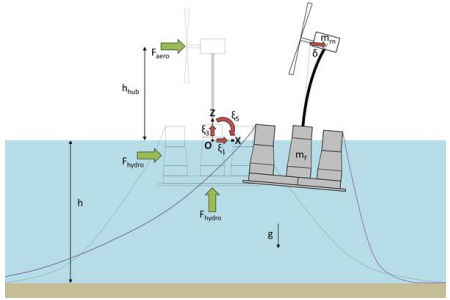
IBERDROLA FLOATING WIND STRATEGY:

- We are technology agnostic.
- We evaluate the most suitable technology for each project.
- We are doing demonstration projects and feasibility studies for reducing LCoE.
- We have implemented 4 workstreams for becoming leaders in Floating Wind.

Floating Wind – Basic Concepts







Floating Wind – Basic Concepts

Selection of Areas and project sizes:

Basic selection tool is the “Business case analysis”:

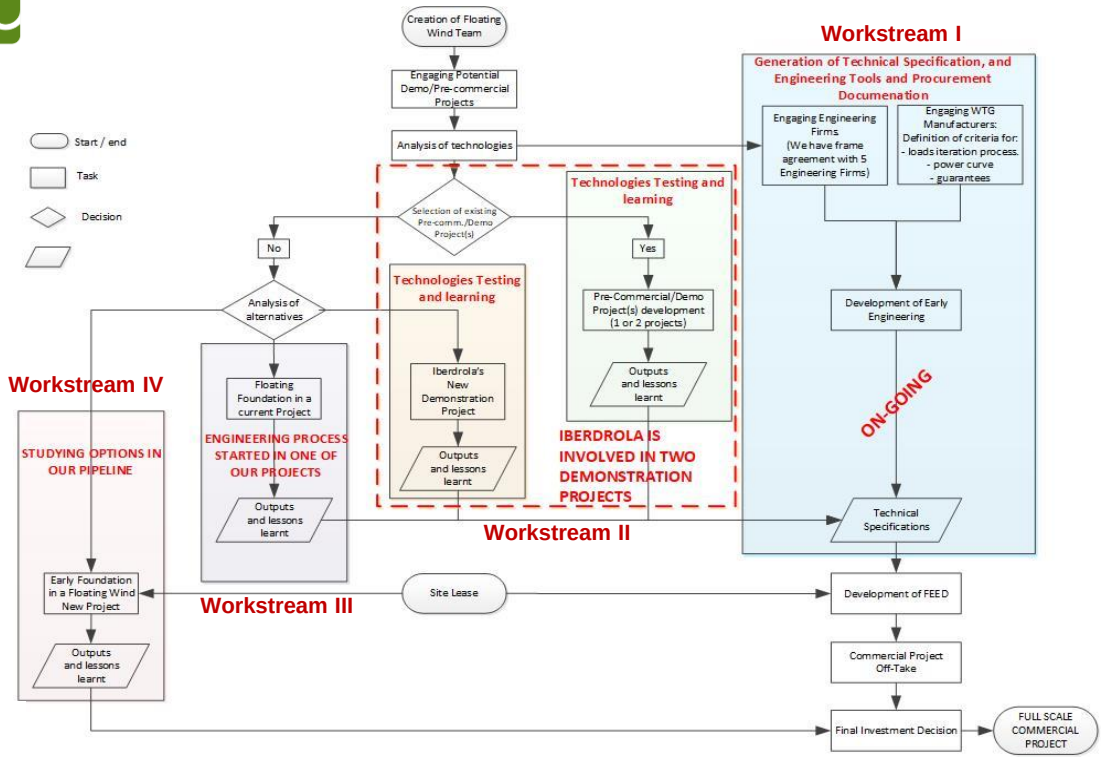
- Turbines
- Floating Technology(ies)
- Meteocean conditions
- Restrictions (environmental, socio-economics)
- Grid connection point(s)
- DEVEX, CAPEX, OPEX

} Layout

For Floating Wind we have implemented 4 workstreams for being ready for commercial projects.

Floating Wind – Workstreams: What are we doing

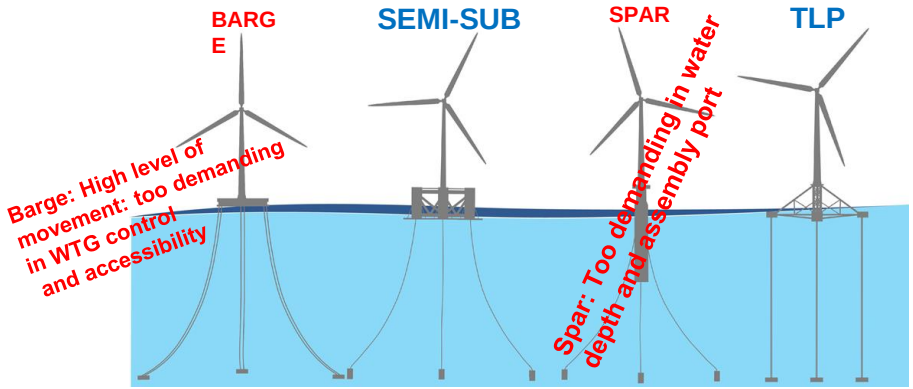
Four parallel workstreams are progressing:



Floating Wind – Workstreams I. Technical Capacitation

Workstream I: technical capacitation

- Engineering firms have been engaged for early engineering works and modeling.
- Preparation of Technical Specifications for calling for tender of supply of floating platforms.
- Calling for tender for Owner Engineering scopes.
- Early analysis of floating technologies and pre-feasibility studies:



Floating Wind – Workstreams I. Technical Capacitation

We have analyzed 18 different technologies getting estimated LCoEs.

Among others:

PPI:

- Highest TRL (7).
- Reliable.

SBM

- Potential TRL7 in 2021.
- High potential of LCoE Reduction.

Naval-Ener.

- Reliable.
- Manufacturing understanding.

Ideol

- TRL 6.

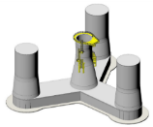
Stiesdal

- TRL 6.
- High potential of LCoE Reduction

Saitec

- TRL 6 in 2021.
- High potential of LCoE reduction

Olav-Olsen



- Potential TRL6 in 2021.
- Reliable in concrete.

Nautilu

- Potential TRL6 in 2022.
- Reliable in steel.
- Manufacturing adapted to shipyards

Floating Wind – Workstreams II. Demonstration Projects

Workstream II: Demonstration Projects

- We have been awarded with a 25 MM € grant from the European Commission (EC), for developing a semi-sub structure in concrete for WTG > 10 MW.

Project **FL**o**A**tin**G** off**SH**ore w**I**nd o**P**timizarion for commercialization

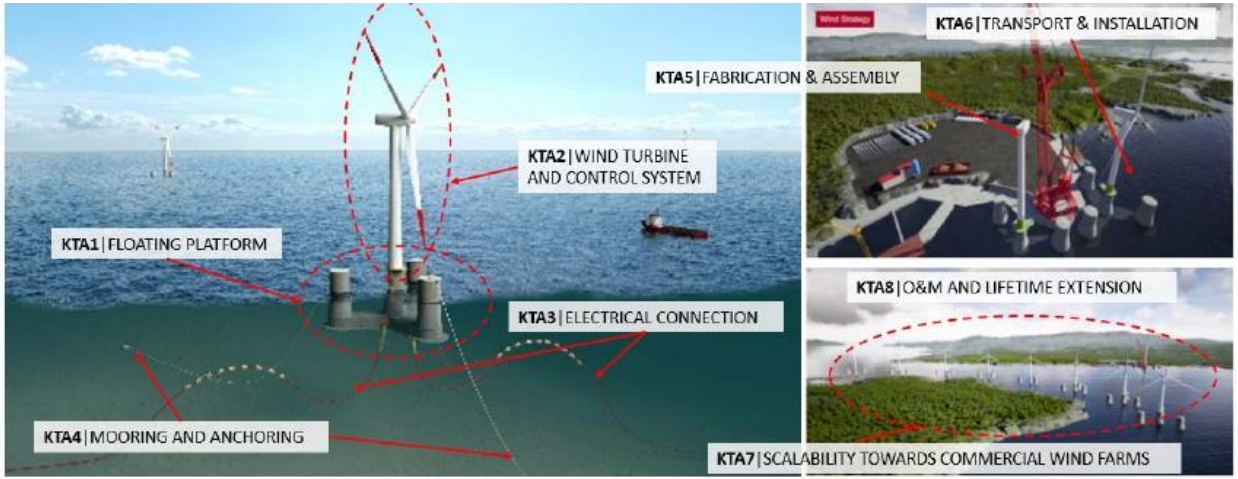
No.	Participant organization name	Country	Type of entity | role
1 (CO)	IBR - Iberdrola Renovables Energía S.A.	ES	LARGE – Floating Offshore Wind Farm Developer / LCoE optimisation and Business case
2	OO - Olav Olsen	NO	SME – Concept developer / Floating platform and mooring engineering
3	KVAE - Kvaerner	NO	LARGE – EPCI Contractor / Substructure fabrication
4	CENER – Centro Nacional de Energías Renovables	ES	RESEARCH CENTRE - WTG loads and interactions
5	CM - Core Marine	ES	SME – Engineering of Marine operations, power cable configuration and mooring systems
6	DTU - Technical University Denmark	DK	UNIVERSITY – Scalability, aero-servo-elastic models, wind farm digital twin, Life Assessment, Operation and Maintenance
7	UNIT - Unitech Subsea	NO	LARGE – Dynamic Cable supplier and demo operator
8	MET - Marine Energy Test Centre	NO	RESEARCH CENTRE – Test centre owner and grid connection
9	EDF	FR	LARGE – Floating platform utility (Mediterranean Sea focus)
10	DNV-GL	DE	Large - Certification Body, advisor for future guidelines and certification requirements
11	IHC - IH Cantabria	ES	LCA and Environmental Impact Assessment
12	ZABALA	ES	SME – Dissemination and communication

Floating Wind – Workstreams II: Demonstration Projects

Workstream II: Demonstration Projects- FlagShip Project

General Objective:

Reduction of LCoE to 40-60€/MWh in 2030 for Floating Offshore Wind technology, driven by economies of scale, competitive supply chain and technological innovations

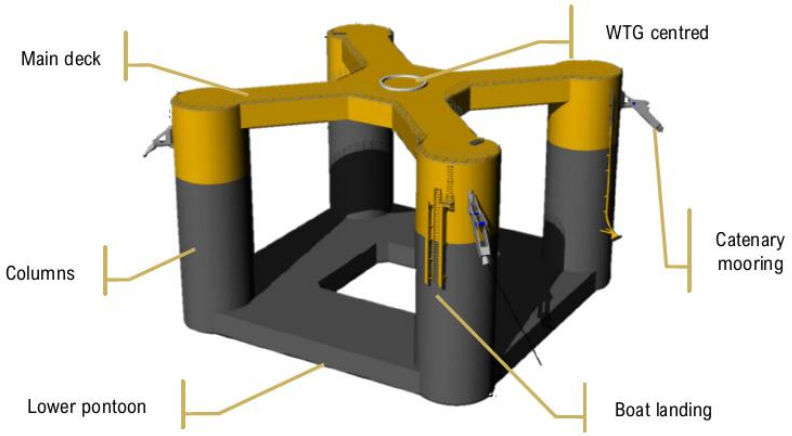


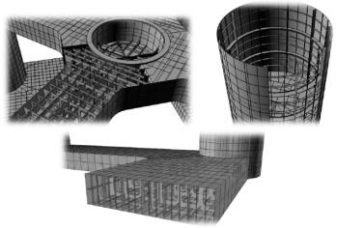
Floating Wind – Workstreams II: Demonstration Projects

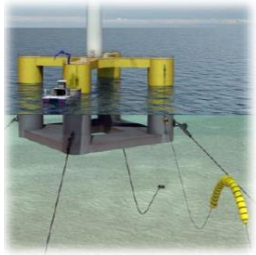
Workstream II: Demonstration Projects- nautilus (under evaluation)

General Objectives:

- Testing semi-sub platform in steel.
- Supporting and developing Spanish industrial supply chain for floating projects.
- Industrialize fabrication process → reduction of LCoE.







Floating Wind – Workstreams II: Demonstration Projects

Workstream II: Demonstration Projects- nautilus

- Fabrication facilities and supply chain focused in North Spain.
- Test site still not decided. Most likely in Canary Islands (Spain).
- Minimum two years testing of a WTG 2 -5 MW.

Floating Wind – Workstreams III: Floating on OWF Pipeline

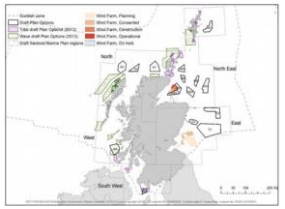
Shallow Float (under evaluation):

- Baltic Eagle is a 50 bottom fix foundations project in the German Baltic Sea.
- We are analyzing the opportunity of installing two floating platform (Shallow Float) connected to that Wind Farm.
- Main challenges:
  - Shallow waters, about 45 m. Mild meteocean conditions
  - Seabed conditions: 10 -20 m layer of unconsolidated muds with no bearing capacity.
- Main targets:
  - Prove floating solutions are feasible in shallow waters, saving installation costs and risks.
  - Getting innovation tariff from German Authorities, about a 50% higher than commercial tariff.

Floating Wind – Workstreams IV: New Floating Projects

ScotWind:

- 5 projects to be selected for submission, 6 currently in down-selection consideration.



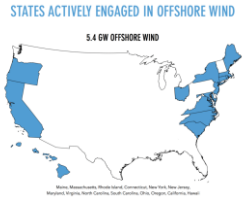
French Round for South Britany:

- Stablished first contact with SBM and Naval Energies for studying potential French partners and/or suppliers.

Other locations in in Europe (to be disclosed)

USA:

- Analyzing potential supply chain,
- Evaluation on convenience of Demo Projects



Floating Wind – Workstreams IV: and now …. ASIA

Japan:

- Iberdrola reaches an agreement with Macquire Capital for acquiring Acacia Renewables .

1: Saga 2: Satsuma 3: Tokushima – fixed
4: Tokushima – floating 5: Tottori 6: Wakayama

Challenges in the Asian Floating Wind Market:

- Asian offshore wind market, specially floating, is in a very early stage of development.
- Huge potential for growing would means:
  - Stress on supply chains (steel vs concrete, or complementary supply chains).
  - Stable country regulations and foreseeable tariffs.
  - Local partners.
- Technical challenges:
  - Deeper waters than in Europe: impact on moorings and dynamic cables.
  - Special met oceanic conditions: bespoken turbines for the Pacific.

Thank you for your attention.

Questions

Contact:

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Floating Offshore Wind Team Manager
Iberdrola Renewables
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Presentation
David Edwards - Principle Power

Floating Offshore Wind: Ready for Deployment

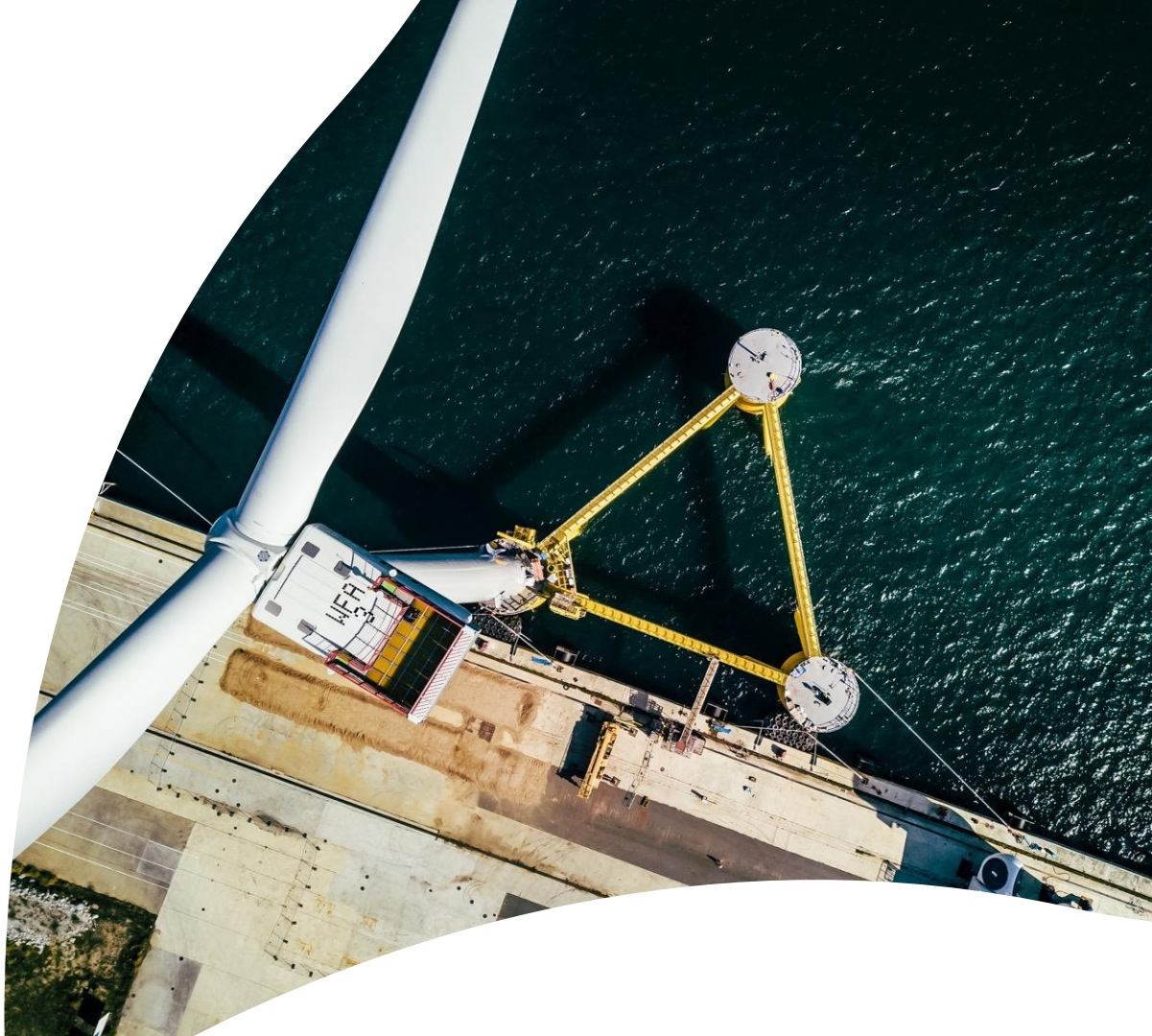
AWEA Webinar 2020

David Edwards, Business Development Manager

8 December, 2020

Principle Power

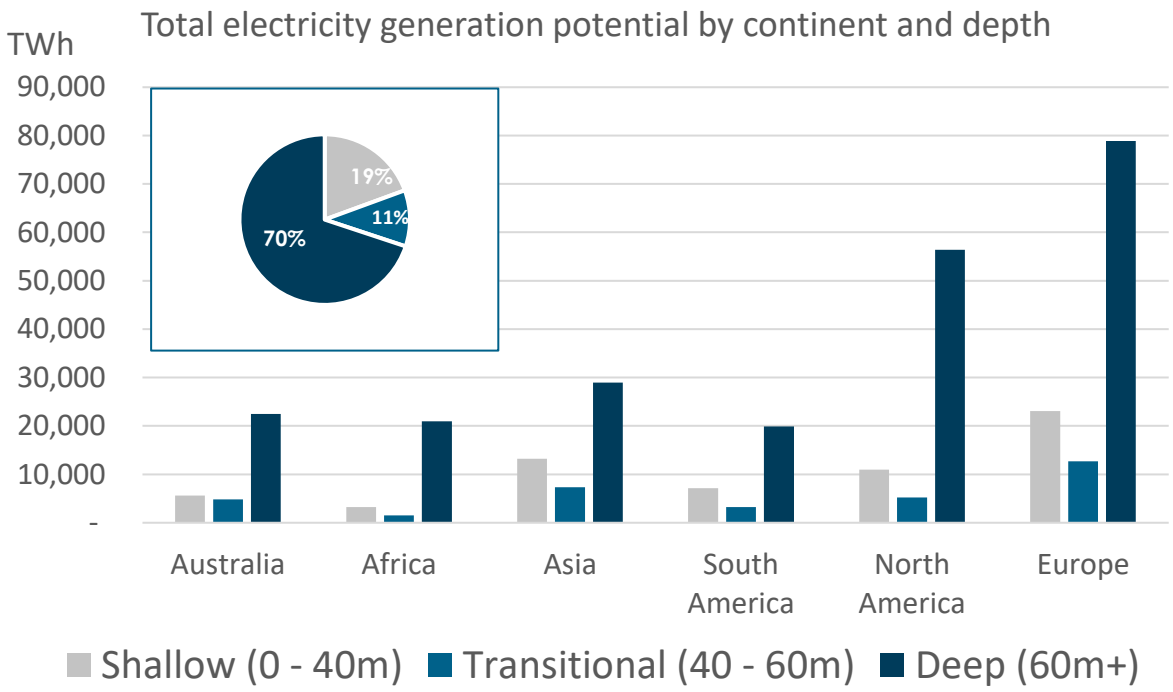
Globalizing floating wind



1. **Principle Power – who are we?**
2. **Global floating offshore wind market forecast and drivers**
3. **Principle Power activities and lessons learned**
4. **Unlocking the Japan market potential**

Market environment – floating offshore wind potential

We believe floating offshore wind is the key to unlocking the full potential of deep sea



>80% of the offshore wind resource is in waters deeper than 40 m, creating high demand for proven, cost-competitive floating offshore wind solutions

[1] Bosch, J. et al. (2018): Temporally explicit and spatially resolved global offshore wind energy potentials, in: Energy, vol. 163, pp. 766-78, https://www.sciencedirect.com/science/article/pii/S036054421831689X

Company introduction

Principle Power: Globalizing floating wind

Founded in 2007, Principle Power has grown to be a global leader in the floating offshore wind industry

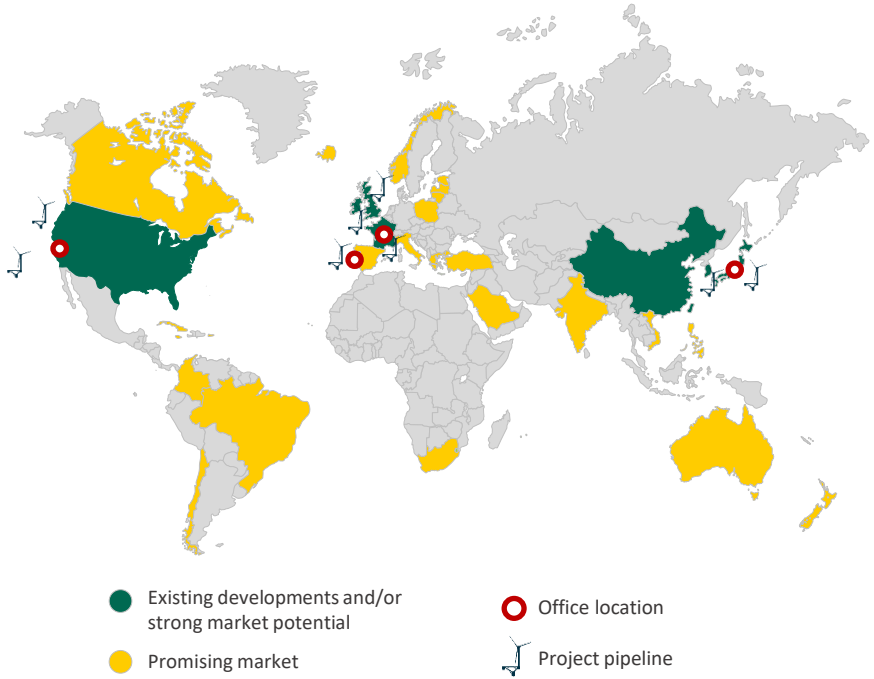
Headquarters in California with offices in Portugal, France, UK, Japan and ~100 employees with 20 different nationalities

Backed by global energy and utility leaders and involved in partnerships with influential industry players

Globally patented and proven floating platform technology that under deployment in precommercial projects totaling 105 MW

Important global project pipeline secured & serving clients in all key floating offshore wind markets

principlepowerinc.com

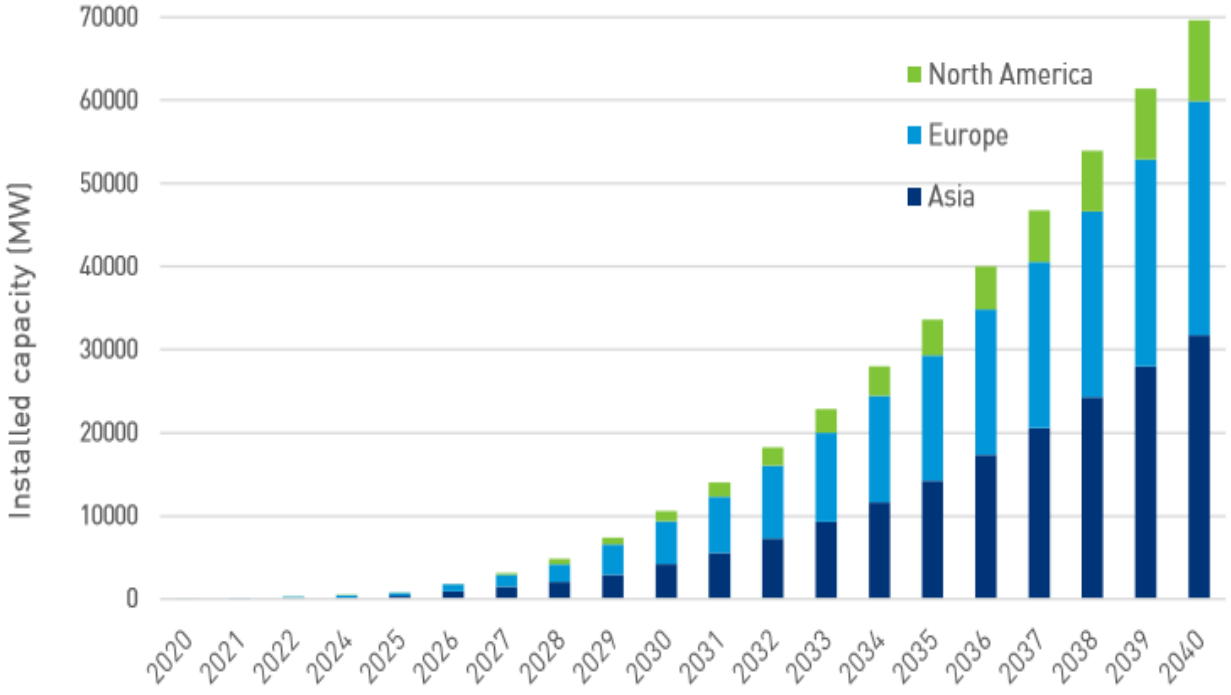


Major companies are actively positioning themselves for commercial-scale floating wind projects

The current pipeline of floating wind projects under development exceeds 30 GW

Commercial projects and market growth to 2040

The Carbon Trust JIP expects up to 10.7GW of floating wind by 2030 and 70GW by 2040



Ranges:

- 2030: 4 to 13 GW
- 2040: 28 to 120 GW

Size/location of deployment dependent on:

- conducive gov't policies,
- supportive regulatory framework
- Tech. innovation/cost reduction

Carbon Trust (2020): Floating Wind Joint Industry Report – Phase 2 Summary Report, https://www.carbontrust.com/resources/floating-wind-joint-industry-project-phase-2-summary-report

Strong pipeline of small commercial & large-scale commercial projects under parallel development

Small commercial projects are under execution and are paving the way for large-scale commercial projects

2 WindFloat projects operating

27 MW

WindFloat Atlantic in Portugal and WindFloat 1 in Scotland

2 WindFloat projects under execution

80 MW

Projects under way in Scotland and France operation between 2020 and 2022

Exclusive large-scale commercial projects

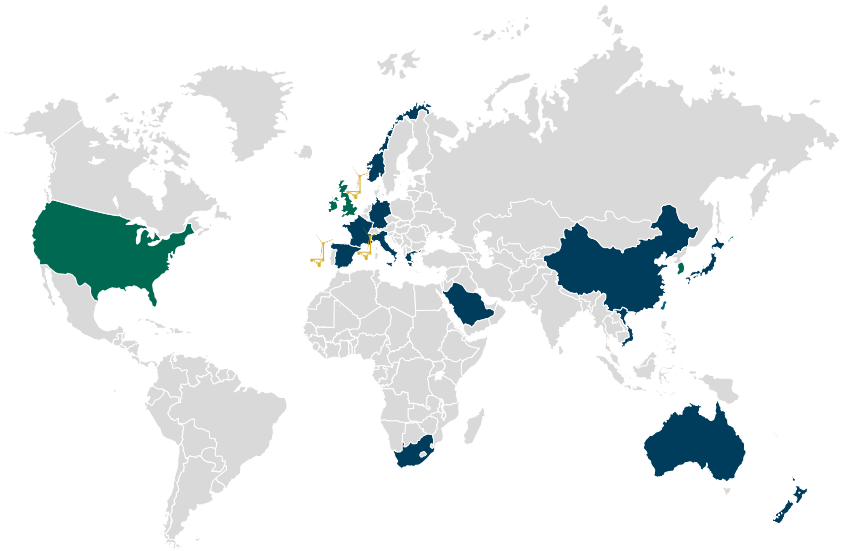
3.8 GW

Commercial projects under development where Principle Power has secured rights to deploy technology

Known projects – Technology not selected

28 GW

Additional commercial-scale floating projects under development worldwide



WindFloat Atlantic is fully commissioned, proving the technology at full scale

WindFloat Atlantic - 25 MW, 2019

- 3x 8.3 MW MHI Vestas
- 20 km out; 100 m deep
- Local Shipyard Construction
- Certified by American Bureau of Shipping
- Feed-In Tariff revenue mechanism
- Equity Financing complete w/ strong international sponsors
- First Bank Financed Floating Wind Farm

WindFloat Atlantic serves as a springboard for the industry

Precommercial projects provide indispensable lessons for future commercial projects

Lessons Learned

1. Empirical data increase design confidence and bankability
2. Interface between floating foundation designer and WTG is highly important;
3. Refinements gained through experience:
   - Design choices and fabrication methods
   - Logistics processes and specification of enabling equipment
   - Engineering workflow
   - Contract structure & risk management

Preparing for Industrialization: understanding the challenge

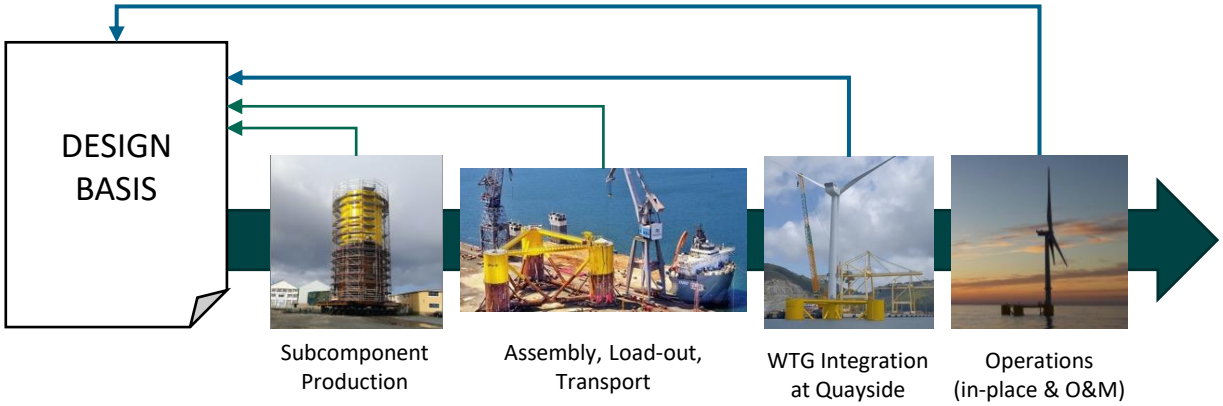
*Commercial scale project requirements are **very different** than precommercial projects*

Project Execution Plan Requirements:

- >100k tons of fabricated steel
- >100 mooring legs
- Installed in 1-2 years

Selection of Design Basis Constraints:

- Site Conditions
- WTG Technology
- Class Requirements
- Fabrication Yard Capabilities & Limits
- Local Content Requirements
- Temp. Limitations (e.g., quayside draft)



Floating's Potential to Unlock the Japan Offshore Wind Market

*Japan Wind Power Association expects **at least 10GW** of Offshore Wind Projects by 2030 of which **4GW is expected to be floating offshore wind***

Floating offshore wind is uniquely positioned to address the challenges of the Japanese offshore wind market

JAPAN MARKET CHALLENGES INCLUDE:	WINDFLOAT ADVANTAGES INCLUDE:
• DEEP WATER SITES	• PROVEN ABILITY IN 60M+ SITES
• TYPHOONS, EARTHQUAKES, AND TSUNAMI	• ROBUSTNESS IN EXTREME CONDITIONS (+17M WAVES AND 41 M/S WIND SPEEDS)
• SHALLOW PORTS AND LIMITED JACK-UP VESSEL AVAILABILITY	• ABILITY TO USE SHALLOW PORTS AND STANDARD VESSELS
• COMPLEX LOCAL RELATIONS, ESP. WITH FISHERIES	• ABILITY TO SITE IN THE BEST WINDS AWAY FROM FISHING GROUNDS AND OTHER "CONFLICTED" AREAS

Conclusions

- Small commercial projects provide indispensable experience and track-record to mature and de-risk floating technology for use in commercial scale projects.
- The 30 GW of floating projects under development globally provide the market pull for sector industrialization, with projects ongoing.
- Floating wind can unlock substantial resources for offshore wind in Japan delivering economic and environmental benefits, while creating enormous opportunities for the supply chain.

Presentation
Leopoldo Bello - Vryhof

Floating Wind Mooring Challenges

Leopoldo Bello

VRYHOF

#vryhof #securingthefuture

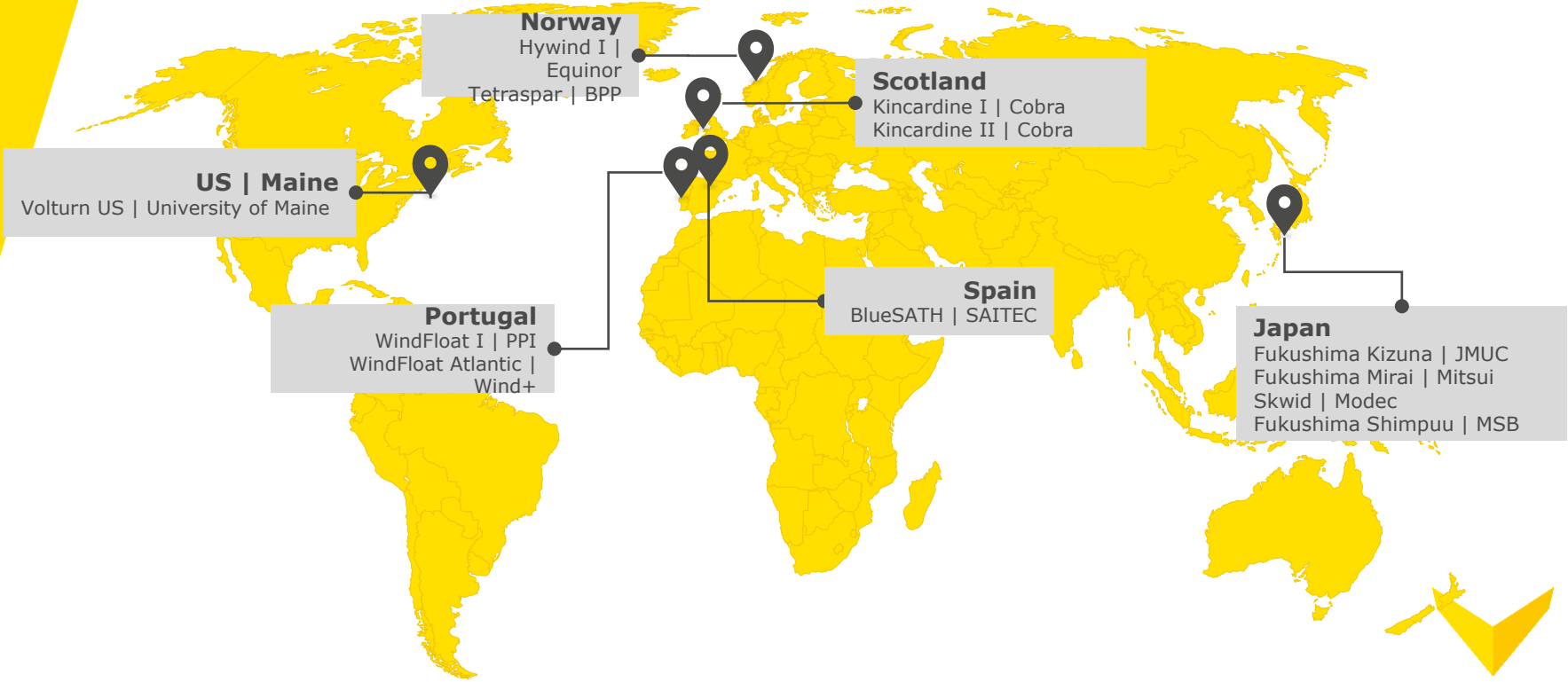
Our expertise as Mooring Solutions Provider:

- Geotechnical assessment
- Design analysis of mooring systems & anchoring points
- Supply & management of full mooring projects
- Installation procedures, tooling & offshore supervision

Largest track record in floating wind

VRYHOF

Track Record | Floating Wind



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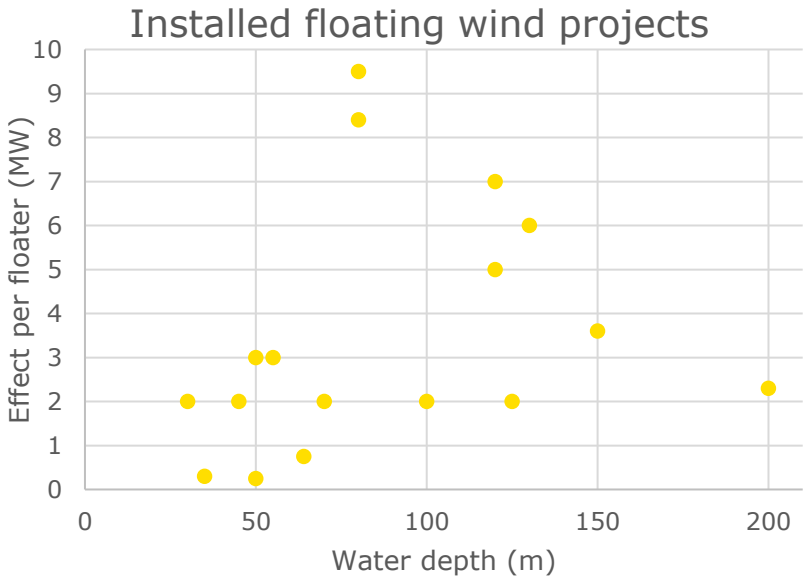
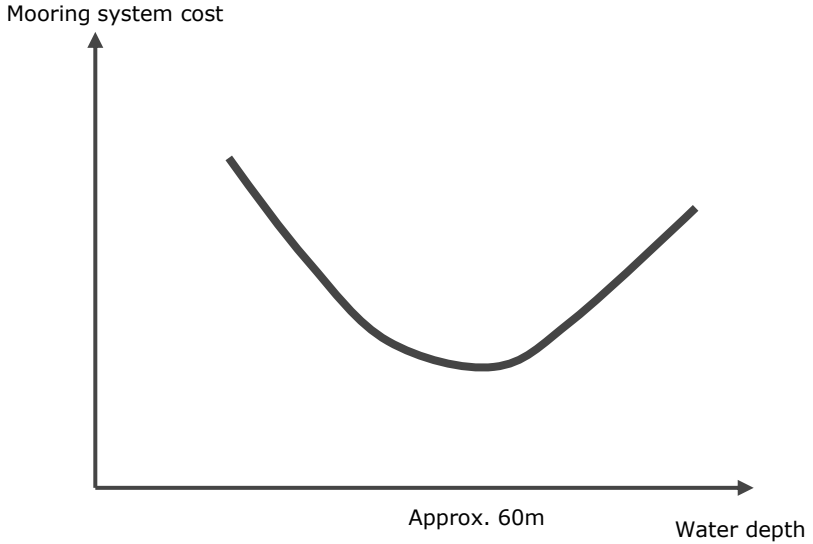
Floating wind & water depth | The big picture





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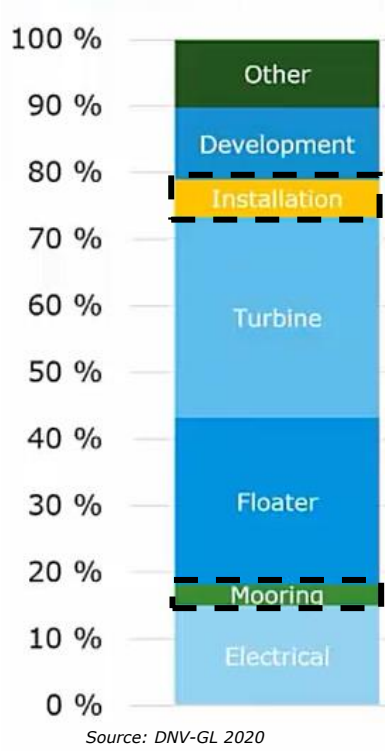
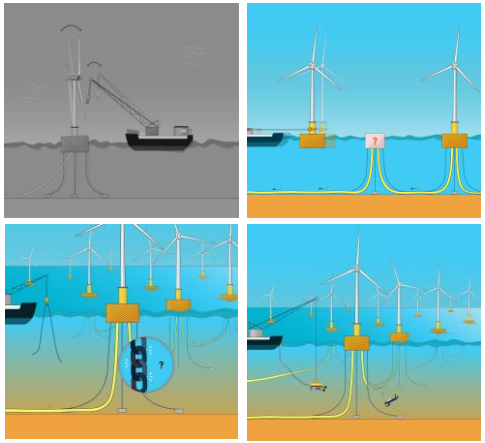
Moorings cost | The big picture



Source: DNV-GL 2020

- ± 5-10% CAPEX of a scale farm project
- Impact on installation cost
- Potential for optimization is real



Source: Carbon Trust Floating Wind

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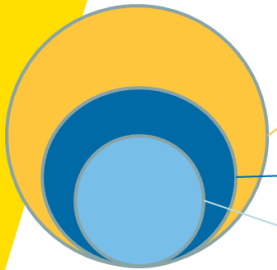
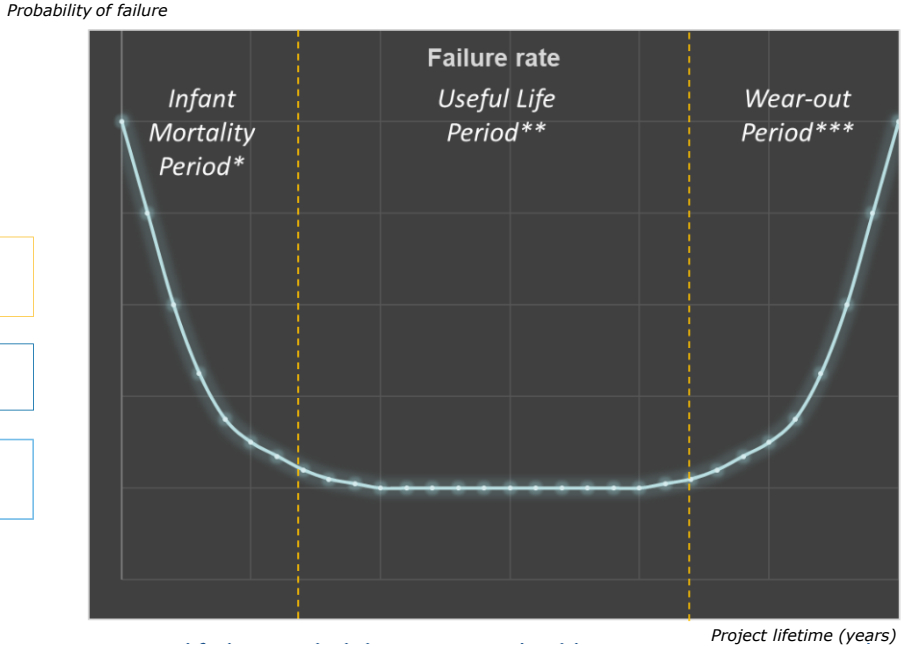
Mooring Systems | Probability of Failure



1.0 x 10^{-2} : Annual probability failure for MODU moorings

2.5 x 10^{-3} : Annual probability failure for permanent mooring systems

Magnitude of 10^{-3} : Annual estimated probability of failure for FOW moorings



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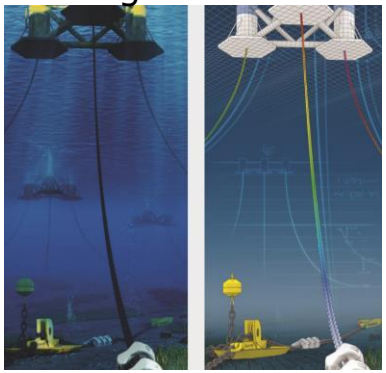
Mooring developments | Approach for lifetime

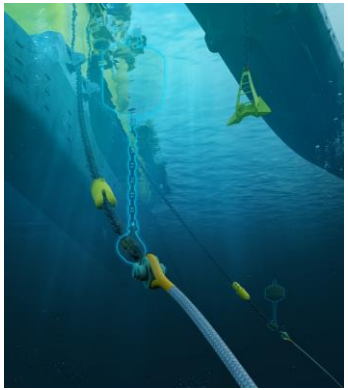
Digital twins



MIMS

AUV Inspection

Installation



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Decommissioning and Repairs.
it will happen... design for it
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Q&A Session

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Question 1

What are the plans for Iberdrola in Japan? What do you see as the key challenges for floating wind in Japan?

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The Prospects for Floating Wind in Asia-Pacific

TUESDAY, 8 DECEMBER 2020 - 3 PM SGT

Question 2

As the offshore wind market in Asia-Pacific (ex-China) is relatively new, should the industry not first focus on fixed foundations?

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Question 3

What are the prospects for floating wind in Taiwan?

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Question 4

What are the key differences between Europe and Asia-Pacific with regards to implementation of floating wind?

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Question 5

Besides Japan and South Korea, which are other likely markets for floating wind in Asia-Pacific?

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Question 6

Will the call for tender for supply of platform be send to technology owners or also to EPCI contractor which are technology agnostic?

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Question 7

What elements of the floating foundation will have the biggest impact for driving down cost?

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Question 8

What kind of floater is Iberdrola considering for the Shallow Float project in the Baltic? And what size turbine?

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Question 9

Are there prospects for starting demo floating projects for South-East Asia (coral triangle) where offshore wind development for fixed structures is currently not an option for the majority of the feasible locations.

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Question 10

What would be the main challenges to scale up the windfloat project to 100 units? Any lessons learnt?

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Question 11

What sort of water depths would be the maximum for floating technology?

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Question 12

What challenges, if any, have you had with seabed conditions for mooring. How critical is the site investigation phase compared to fixed foundation designs?

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Question 13

From a floating foundation point of view - where do you see the biggest cost reduction drivers?

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Question 14

What MW turbine capacities do you foresee on offshore wind in year 2030 and beyond?

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Question 15

In your opinion, which national market in the APAC region is going to move forward first? Is there a time frame we are expecting the industry to take off in that country?

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Thank You