



Floating Offshore Wind



Floating Wind – OBJECTIVES OF THIS PRESENTATION:



Basic concepts introduction.



Giving answers to the following questions:



WHY are we doing Floating Wind



WHAT have we done so far



WHAT are we doing now

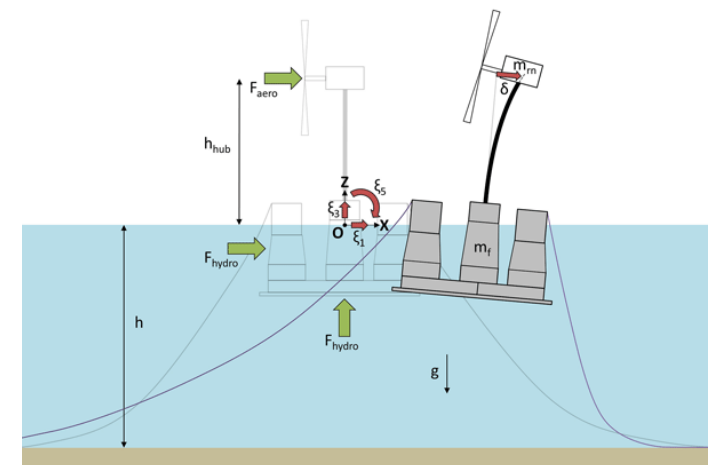
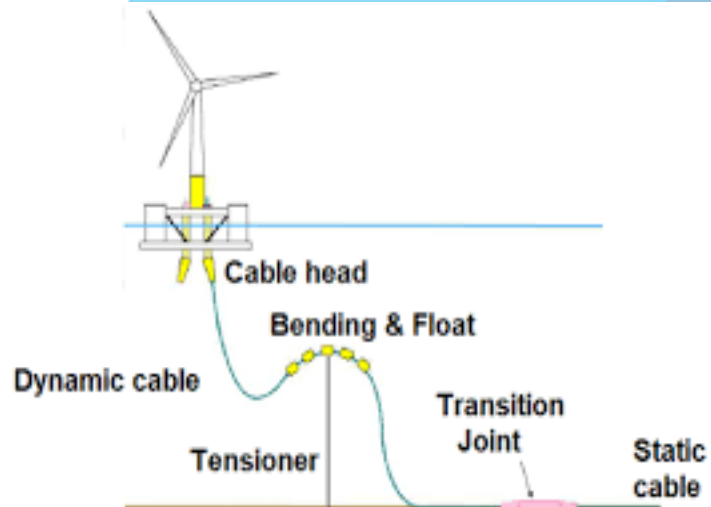
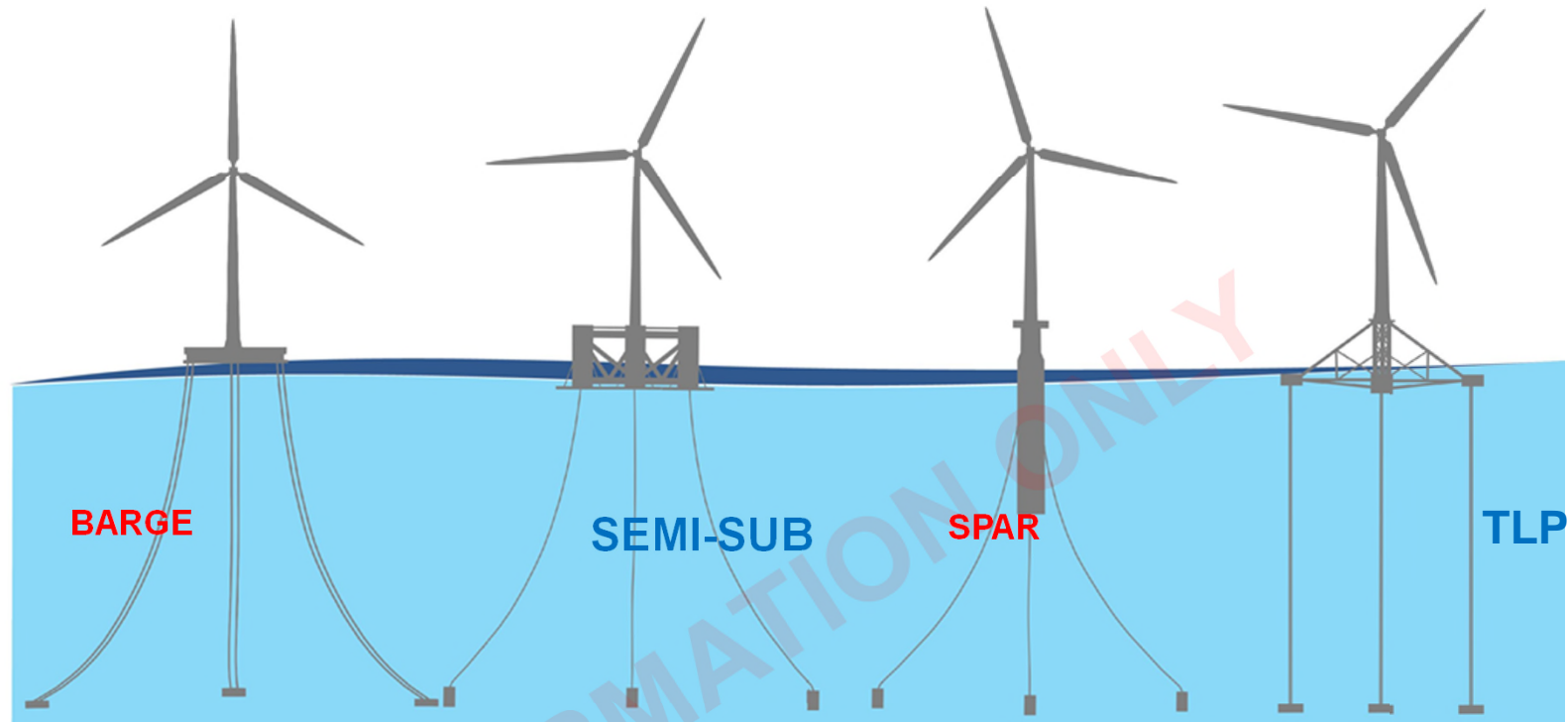


WHERE are we on the Floating Wind Market



Floating Wind Projects differential

Floating Wind – Basic Concepts



Floating Wind – Basic Concepts

Key differences Floating Wind Farm vs bottom fixed

- ① **No OEM is designing bespoke WTGs for floating. FOWT shall work with WTGs from the shelf.**
- ① **Only customization of WTGs for floating will be the control system and, in some extreme cases, the tower.** (Load case scenarios change)
- ① **FOWT shall match WTG conditions for guarantying power curve:**
 - Maximum tilting angle $\pm 7^\circ$ (operation), $\pm 10^\circ$ (survival).
 - Maximum acceleration 0.3G (operation), 0.5G (survival).
- ① **All certified FOWT match the above conditions.**
- ① **Dynamic cables vs static cables. Cables installation at very deep waters.**
- ① **Contract strategy: FOWT as turn-key package → EPCI consortiums**
- ① **O&M performance:**
 - Major doubt on accessibility and workability (H&S). We are on G+ working group.
 - Effect on components needs more reliable data. Data we have access to shows not significant impact on O&M cost.

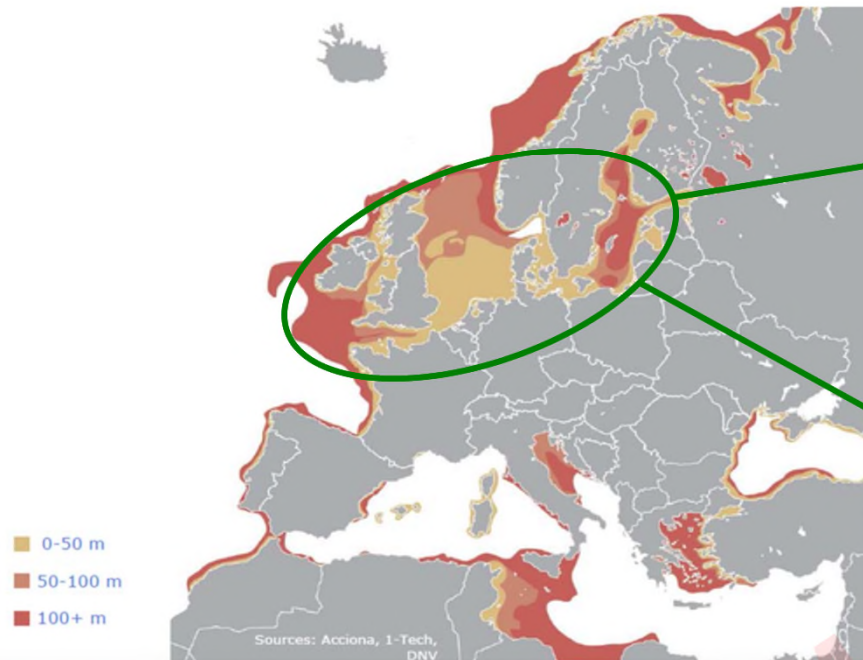
⊗ Basic selection tool is the “Business case analysis”:

- Turbines
- Floating Offshore Wind Platforms (FOWPs) footprint
- Meteocean conditions
- Restrictions (environmental, socio-economics)
- Grid connection point(s)
- DEVEX, CAPEX, OPEX

} Layout

New variable compared to bottom fixed foundations. The Floating Platforms are patented → We have to call for tender for FOWP + Manufacturer + Installer.

Floating Wind – WHY



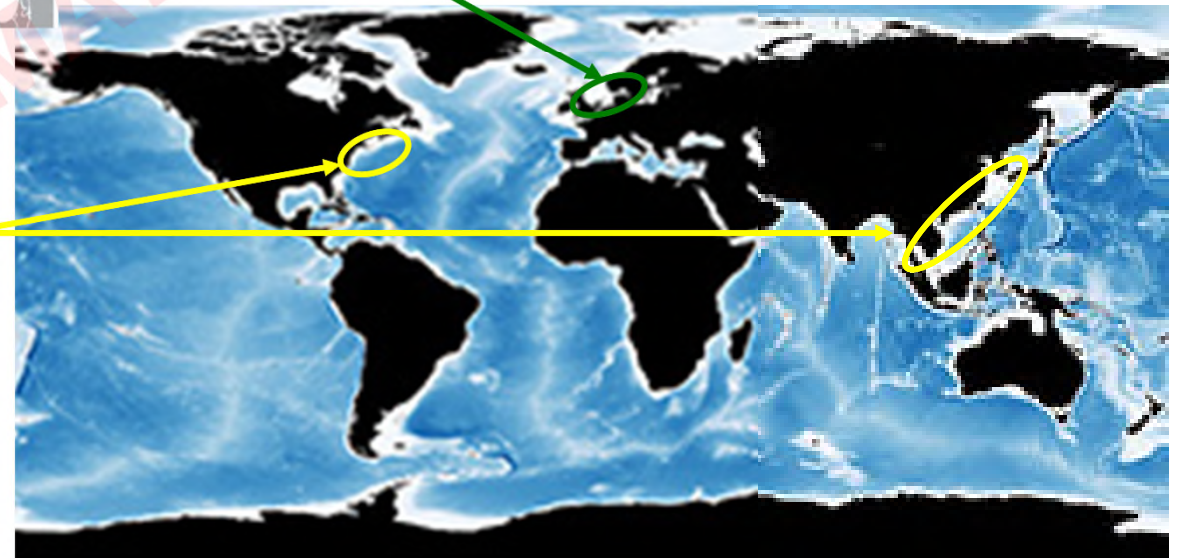
Source DNV-GL, 2014 via Carbon Trust

Most of current Offshore Wind Farm are located in this geographic “anomaly”:

European Continental shelf with shallow waters

Rest of the world has few locations with similar shallow waters conditions:

Next Offshore Wind Projects shall go deeper → FLOATING TECHNOLOGIES



Source: NASA's Earth Observatory

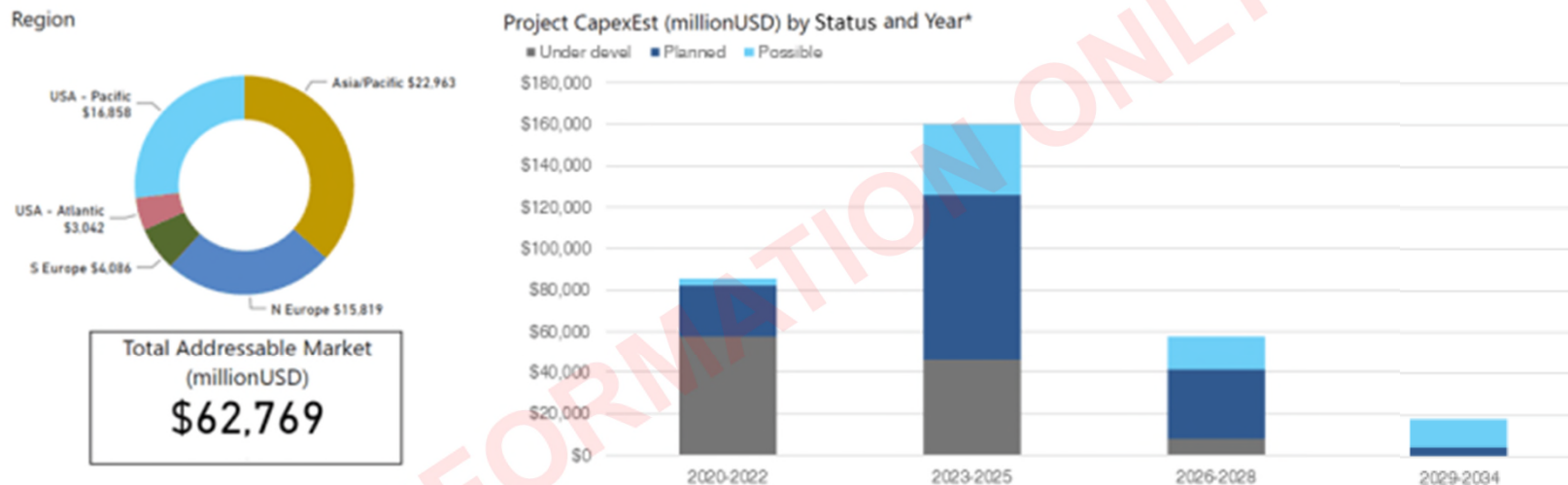
Floating Wind – WHY

Global Floating Wind Market is huge. We want to be a major player.



CapEx by Year

Under Development, Planned & Possible



- Projects with statuses equal to Under Development (highlighted in gray), Planned (shown in dark blue) or Possible (denoted in light blue) represent a Total Addressable Market of \$62.8 Billion. Under development and Planned statuses drive near-to-medium term activity levels from 2020 to 2025 whereas Planned and Possible statuses drive heightened activities through 2028 and beyond.
 - Asia/Pacific is the leading region with \$22.9 billion followed by USA-Pacific at \$16.9 billion, Northern Europe at \$15.8 billion, Southern Europe at \$4.1 billion and USA-Atlantic at \$3.0 billion.
- Charts, Tables and Graphs are sourced from our Q Vision Product Suite.

Volume 2

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Quest Floating Wind Energy, LLC

www.QuestFWE.com

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Source: Floating Wind Energy. 2019.

Floating Wind – WHY



Iberdrola's growth for Offshore Wind:

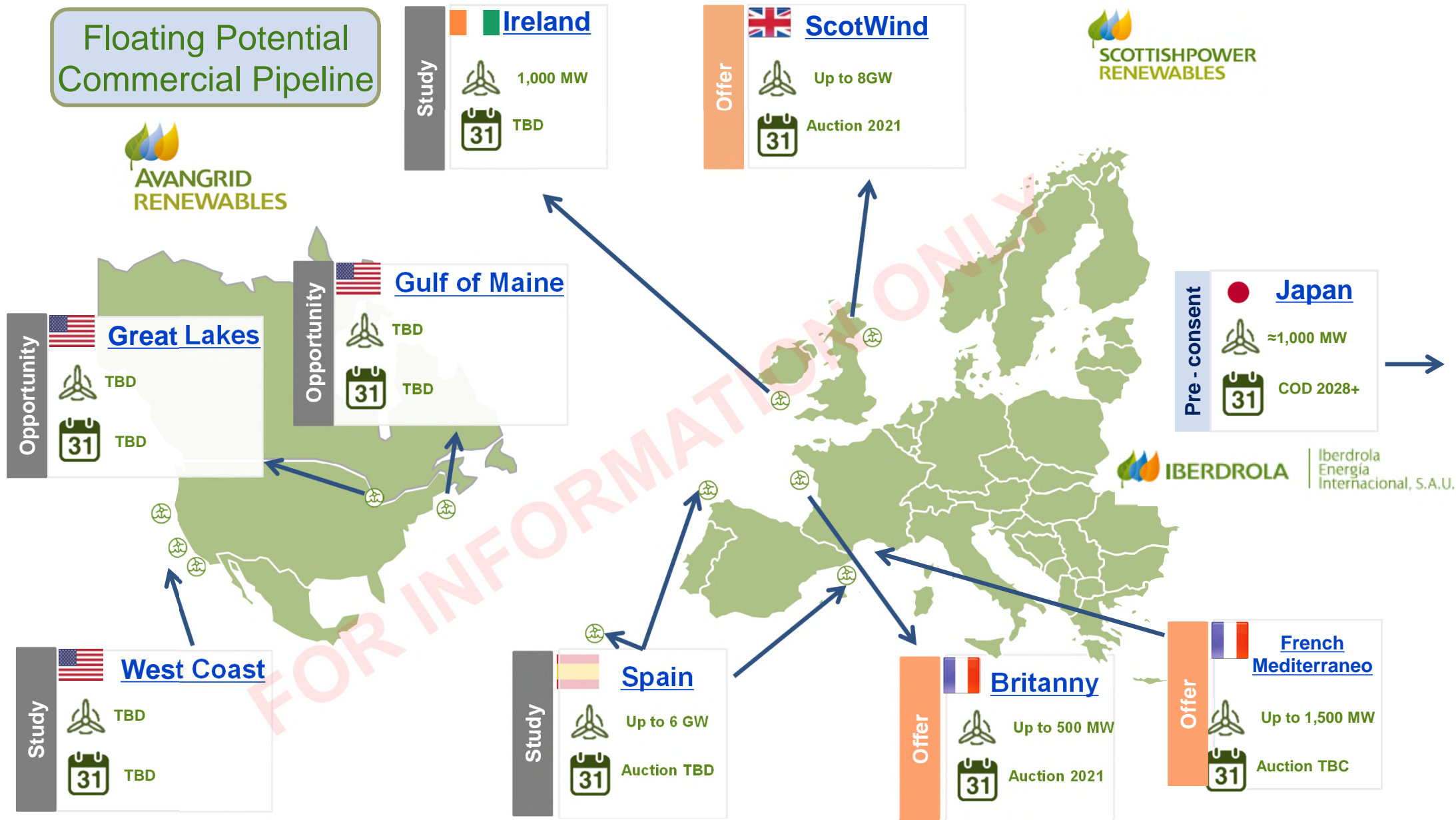
We want x4 2025 Offshore Wind capacity in 2030

Very challenging but feasible if the current pipeline goes ahead

FLOATING WIND WILL HELP REACHING SUCH TARGET:

- ① BETTER CAPACITY FACTOR
- ① NEW AREAS where bottom fix cannot reaches
- ① POTENTIAL COST REDUCTIONS. Most assembly activities at port, minimizing
- ① Expensive offshore activities. This a long term target for 2030.

Floating Wind – WHY



Floating Wind – **WHAT** have we done



IBERDROLA FLOATING WIND STRATEGY:

- ① We are technology agnostic.
- ② We evaluate the most suitable technology for each project.
- ③ We are doing projects and feasibility studies for reducing LCoE and reinforcing Supply Chains.
- ④ We implemented 4 workstreams for becoming leaders in Floating Wind:
 - I. Technical capacitation.
 - II. Demonstration Projects.
 - III. Installation of Floating Units on Iberdrola's bottom fixed ongoing projects.
 - IV. Fully Floating commercial size Projects.

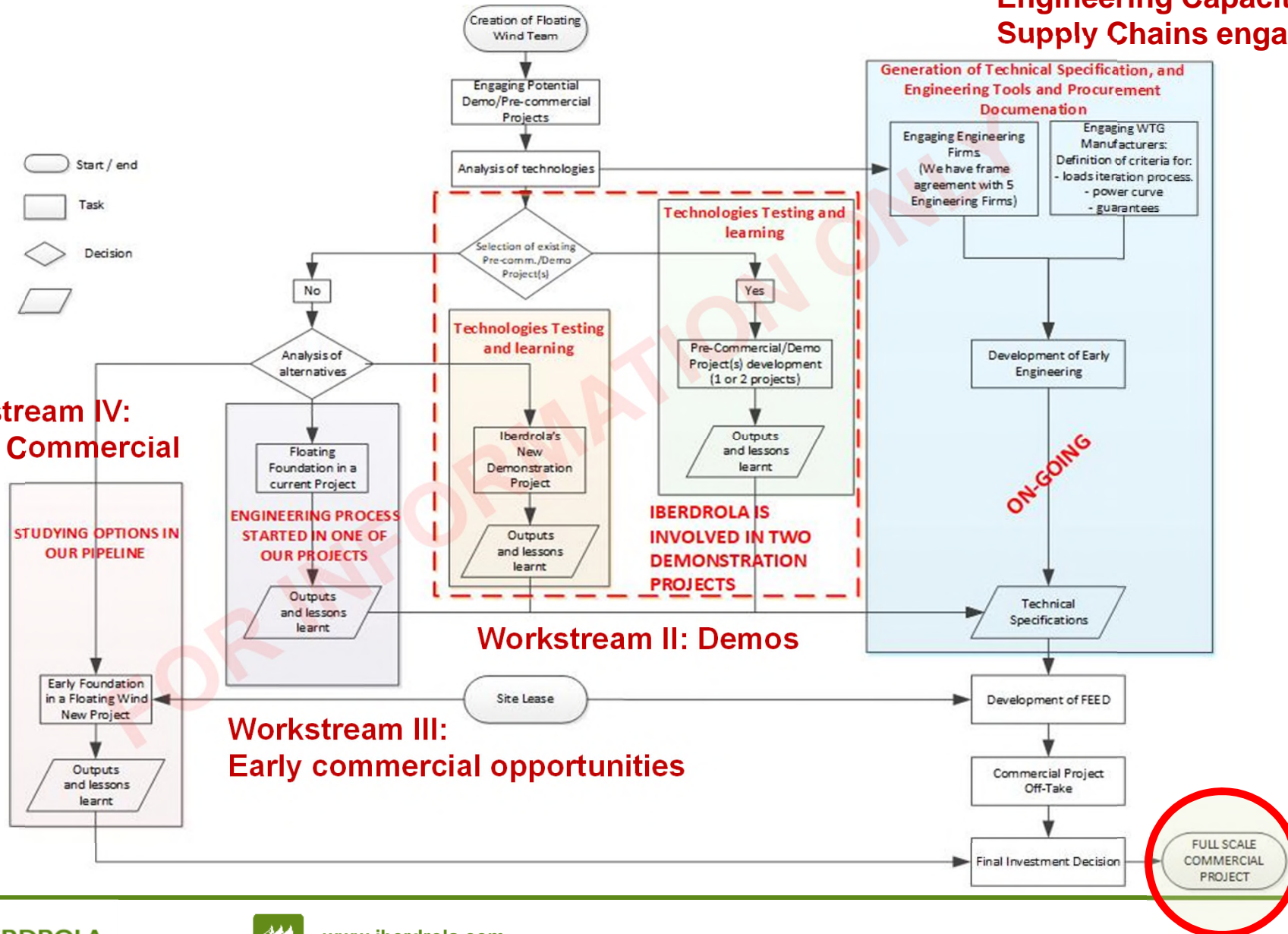
Floating Wind – WHAT have we done



Four parallel workstreams are progressing:

**Workstream I:
Engineering Capacitation and
Supply Chains engagement**

**Workstream IV:
Going Commercial**



Floating Wind – WHAT have we done



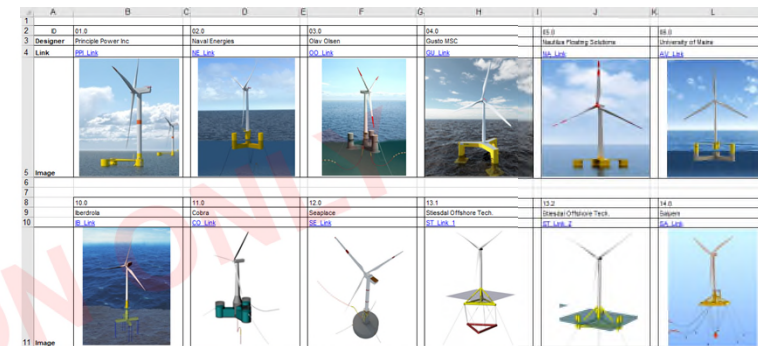
The analysis methodology is based in feasibility studies for potential sites:

- DTU turbines (digital load models) / We should start considering NREL digital models.
- Actual meteocean conditions.
- Actual ports and fabrication facilities assumptions.



The standardization of the analysis allows us:

- Compare technologies.
- Shortlist most suitable technologies for each site



As result of the systematic comparison:

- We have an holistic data base of floating technologies.
- We can easily parametrize and weigh each technology giving a first approach to the CAPEX and LCoE of a particular project.

TECHNOLOGY EVALUATION											
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Floating Wind – **WHAT** are we doing



Single Unit Projects:

- FLAGSHIP Project: concrete semi-sub platform. Turbine 10+ MW. Norway. KoM 17/09/2020.
- Steel semi-sub Project. Pre-FID launched.



Submission of offers to Commercial Auctions:

- ScotWind Round, 4-8 GB (UK).
- South Brittany 250 – 500 MW (France).



Purchasing Floating Wind pipeline:

- Japan.
- Ireland



Exploring New Markets for Floating Wind:

- USA.
- Spain.

Floating Wind – WHAT are we doing

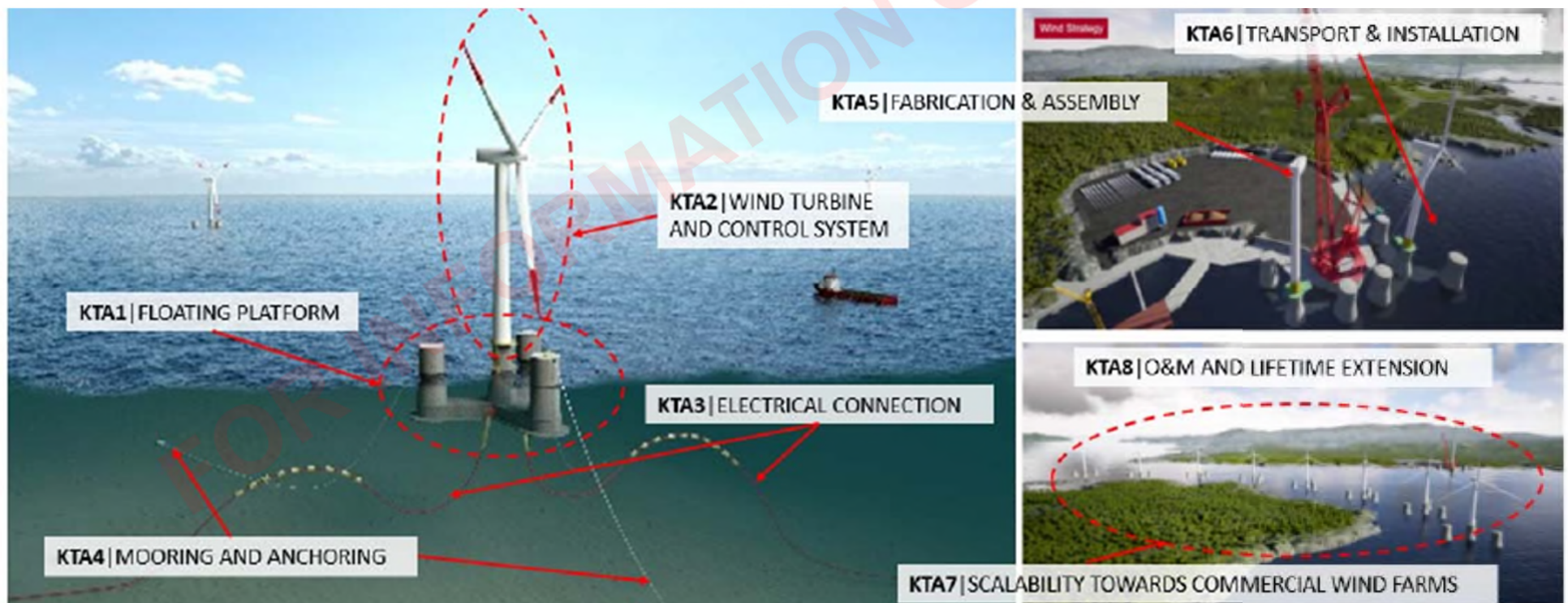


FLoAtinG offSHore wind oPtimizarion for commercialization

<https://flagshipproject.eu/>



This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement N° 952979



Floating Wind – **WHERE** are we



☐ **Now is time to challenge supplies chains and understand bottle necks for delivering COMMERCIAL Projects.**

☐ **The first commercial projects (multi-units) will overlap with some demonstration projects. Nevertheless:**

- Iberdrola intention is not testing any particular technology, but extrapolating results about FABRICABILITY, SUPPLY CHAINS, CAPEX, OPEX and LCoE.
- Only specific items would need bespoke projects (i.e):
 - TLPs solutions / very deep water technologies.
 - Shallow water moorings.
 - Crainless installation solutions.

Floating Wind – GOING COMMERCIAL



Key issues to make Floating Wind Farm Bankable



SUPPLY CHAIN BOTTLE NECKS !!!!!!!!!!!!!!!!!!!!!!!:

- FOWT manufacturing facilities.
- Marshalling and assembly ports.
- Mooring worldwide manufacturing capacities.
- Dynamic cables availability.

PATH: - diversification of supply chains concrete **AND** steel
- shortlisting technologies
- investment on facilities



INDUSTRIALIZATION of FOWT !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!:

- Fabrication rate shall be more than 2 unit/month (as a minimum) for bankable projects.
- CAPEX shall be reduced in order to achieve commercial competitive LCoE.

PATH: learning curve. PROJECTS VOLUME



FOWT are patented (IP owner has no industrial capacity):

- Contract strategy should avoid interfaces between IP and manufacturer.
- We should target EPCI for FOWT + mooring/anchors (+ dynamic cable) .

PATH: early engagement of the market to trigger EPCI consortia

Floating Wind – CONCLUSIONS

⊕ PROJECT DEVELOPERES WE ARE READY FOR GOING **COMMERCIAL**.

⊕ THERE ARE AVAILABLE AND RELIABLE FLOATING TECHNOLOGIES.

Would them be enough?. How many FOWT do we need for feeding a growing market?.

⊕ SUPPLY CHAINS CONCRETE **AND** STEEL.

Depending on project and LOCAL market.

⊕ SUPPLY CHAINS:

- Do we have all actors?: **YES** (Shipyards, OEM, O&G, Bottom Fixed suppliers, Eng.).
- Do we need adaptation?: **YES** (New standards, EPCI capacities, manufacturing facilities, bespoke studies for reducing uncertainties).

⊕ KEY TO SUCCESS: MAKING FLOATING WIND PROJECTS BANKABLE.

- INDUSTRIALIZATION of FOWT.
- VOLUMEN of projects.
- RELIABILITY of first floating projects.

} **LCoE REDUCTION**



Thank you for your attention.

Questions



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