Wind2Grid Project

Floating substations for offshore wind farms

EUSKAMPUS & JRL-ORE: VII Marine Energy Conference

Agenda

01 Wind2Grid project consortium

02 Context & origin of the project

03 Basic approach and main handicaps to solve

04 Project working lines & status of the project

Wind2Grid Project

Coordinator - Leader

IDOM

External advisor

MURUETA ASTILLEROS-SHIPYARDS

NAVACEL Process Industries

nautilus floating solutions

Pine

IBERDROLA

BLUG Credeblug, s.l.

ERREKA Fastening Solutions

OGERCO, S.A.

Galvasala

Viuda de Sainz

tecnalia MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

BCMATERIALS

Cluster Energía BASQUE ENERGY CLUSTER

FORO MARITIMO VASCO EUSKAL HERRIKO ITSAS FOROA THE BASQUE MARITIME FORUM

Duration: 33 months (2020-2022) **Proposal budget:** 6,8 M €

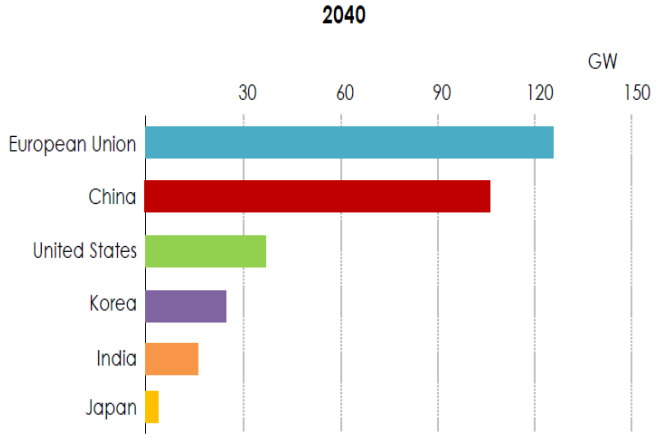
EUSKO JAURLARITZA GOBIERNO VASCO
EKONOMIAREN GARAPEN, JASANGARRITASUN ETA INGURUMEN SAILA
DEPARTAMENTO DE DESARROLLO ECONÓMICO, SOSTENIBILIDAD Y MEDIO AMBIENTE

Europar Batasuna Unión Europea
Fondo Europeo de Desarrollo Regional (FEDER) "Una manera de hacer Europa"
Eskualde Garapenerako Europar Funtsa (EGEF) "Europa egiteko modu bat"

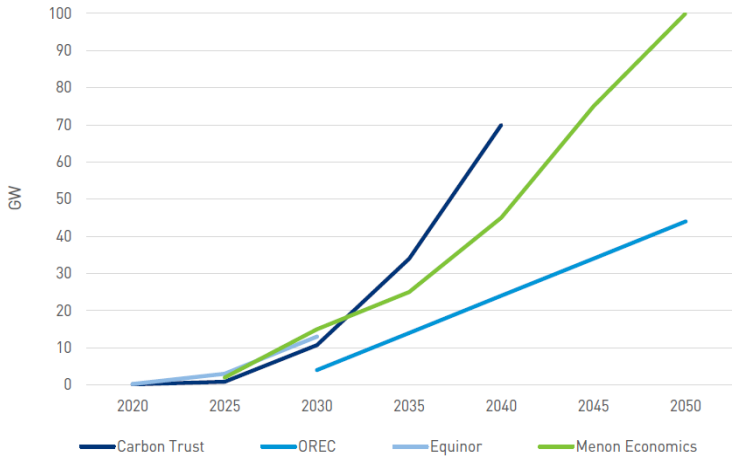
Proyecto financiado por el Departamento de Desarrollo Económico, Sostenibilidad y Medio Ambiente del Gobierno Vasco (Programa HAZITEK) y el Fondo Europeo de Desarrollo Regional (FEDER) Eusko Jaurlaritzaren Ekonomiaren Garapen, Jasangarritasun eta Ingurumen Saila (HAZITEK Programa) eta Eskualde Garapenerako Europar Funtsak finantziatutako proiektua (EGEF)

W2G

Context



Offshore sector growth forecast to 2040 according to *IEA Offshore Wind Outlook 2019*



Growth forecast for the floating offshore sector according to several sources

- Today's floating wind farms are in transition from demonstration farms to large-scale commercial wind farms **(≥ 200 MW)**

MARKET STUDY

	Europe	Asia	America
total power (MW) in the next projects (2024-2033)	**8250**	**8700**	**3646**
Country with biggest forecasted capacity in the region	**UK (4350 MW)**	**South Korea (4700 MW)**	**USA (4350 MW)**
Average power of wind farms (MW)	**687**	**511,7**	**607,7**
Average depth of forecasted wind farms (m)	**118,5**	**126,1**	**760,3**
average distance to coast (km)	**24,6**	**33,9**	**36,5**

Market study of floating wind farms. *Own elaboration*

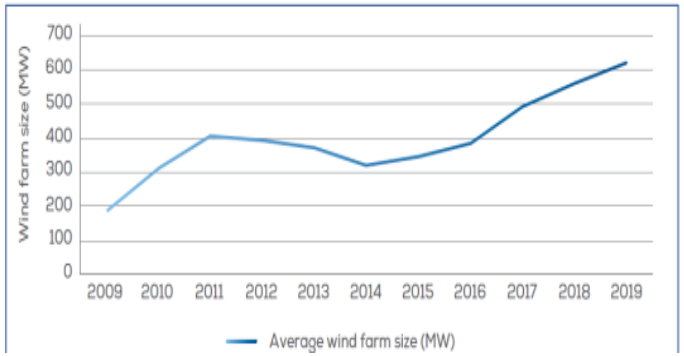
Origin of the project

From this market analysis, together with the other key factors such as the followings:

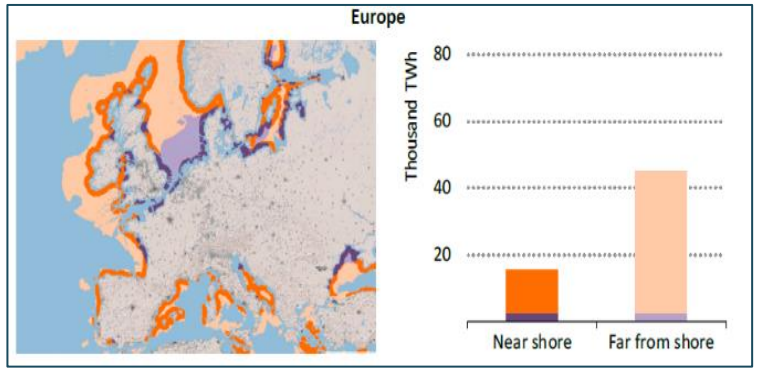
- Evolution of the offshore wind sector towards **deeper areas** (floating technology) and areas **further away** from the coast.
- The need for safe energy evacuation. **OSS as a key element.**
- **Few known initiatives** of FOSS development
- Continuous need for orientation towards lines of innovation that enable **LCoE reduction**:
  - Development of floating solutions: they shall be flexible, reliable, modular and with the possibility of hybridization to adapt to different powers and requirements.
  - Searching for new materials and anti-degradation systems.
  - Digitalization to optimize operation and decision making.
  - Facilitation of offshore substation O&M activities.

Basic approach

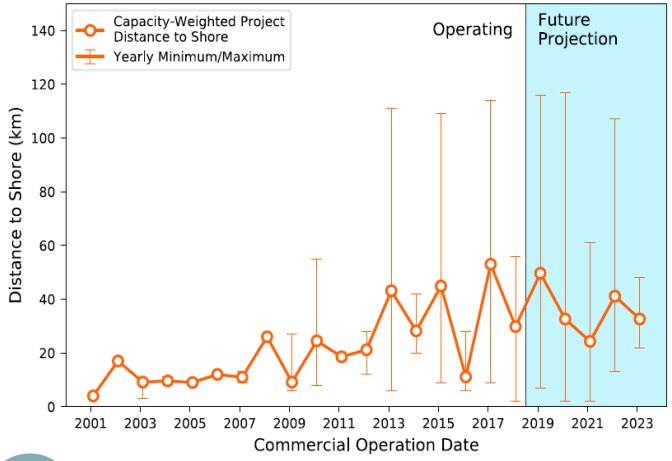
Based on the market analysis/projections and market drivers, a baseline approach has been defined, which is considered a good starting point for the requirements of future floating substations.



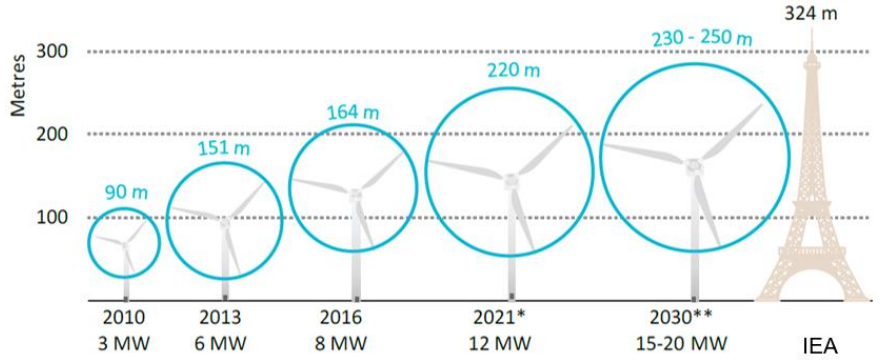
Power ≈ **500 MW**



Depth – 2 locations. Shallow water and deep water



Distance to shore ≈ **60 km**



WTG of **15 MW**

Basic approach

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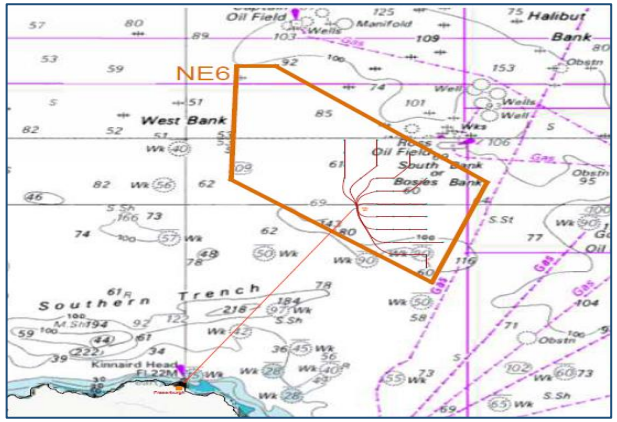
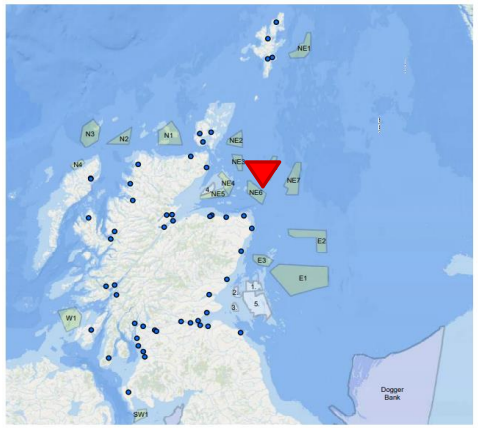
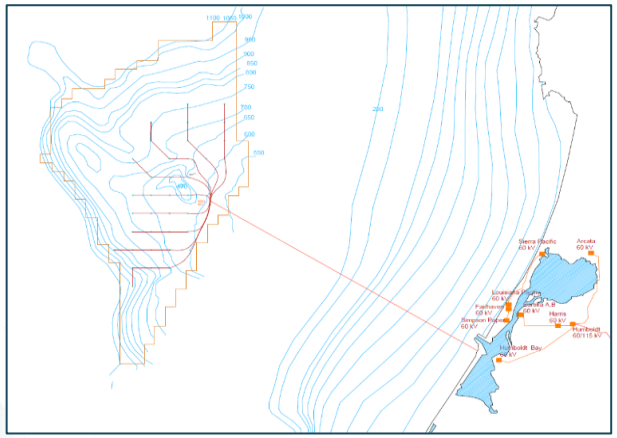
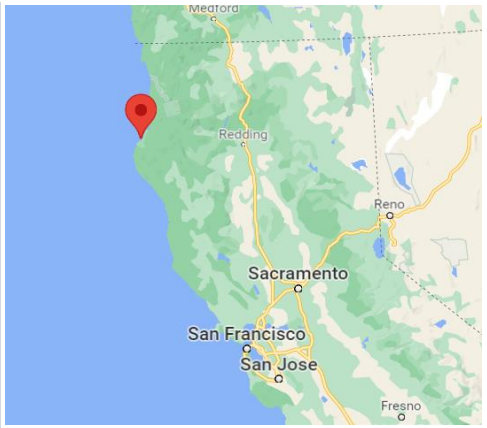




Scotland (Zone NE6) – shallow water ≈ 100 m – **short term**

36 x 15 MW wind turbines
totaling 540 MW
9 x 66 kV IAC, connecting 4 WTGs each
2 x 220 kV EC.





Humbolt (USA) – deep water, + 600 m – **long term**

Main handicaps to solve

HANDICAPS

1. Equipment → vibrations, movements, etc.

- Aceleration / movements (heeling angles, vibrations) → malfunctioning of transformers, GIS, etc.

Sea states

NEED FOR CHARACTERIZATION

2. Lack of regulation and recommendations

- Safety factors and design criteria

GOOD PRACTICE GUIDELINES

HITACHI ABB

TRANSFORMERS

Transformers for floating applications

Floating offshore substations and wind turbines

Floating substations and wind turbines are a rapidly emerging solution, for deep waters. Introducing even greater challenges for the already demanding offshore segment.

With a full offshore wind transformer portfolio, now enabled for floating, we are the partner of choice, from the nacelle to the connection point.

Supporting our customers to reach their goal of a carbon neutral future.

https://www.offshorewind.biz/2021/06/04/hitachi-abb-launches-floating-wind-transformers-portfolio/

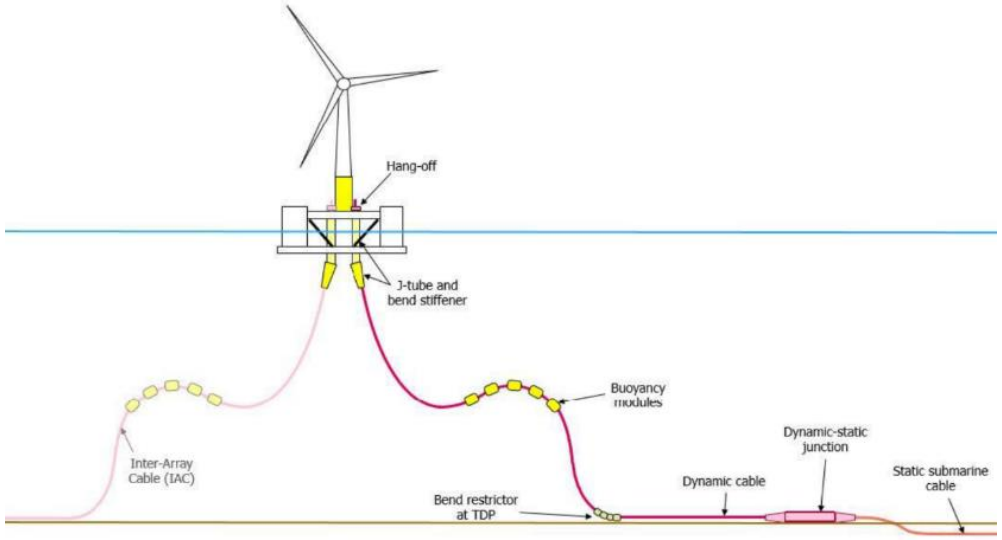
Main handicaps to solve

HANDICAPS

3. Dynamic cables

- There is no experience with dynamic cables above 66 kV for these power ratings.

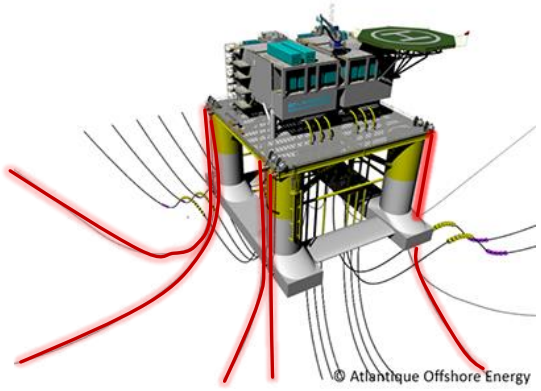
NEED FOR CHARACTERIZATION



- Cable connections: J-tubes in fixed solutions – lazy wave + mooring in floating Solutions. Consideration of different depths.

LAYOUT IMPLICATIONS

Dungeon offshore wind farm

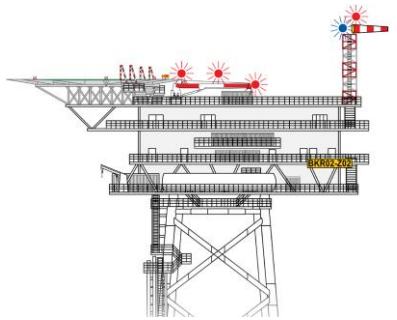


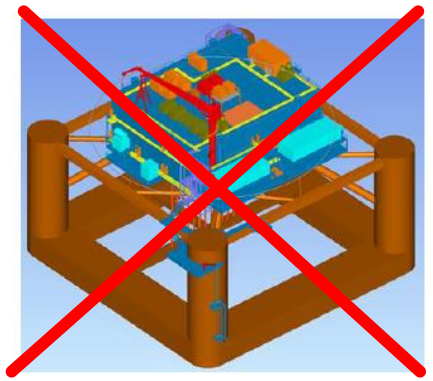
Conceptual design *Chantiers Atltantique*

Project working lines

1. TOPSIDE & FLOATER (PT1 & 2)

IDOM Pine nautilus floating solutions

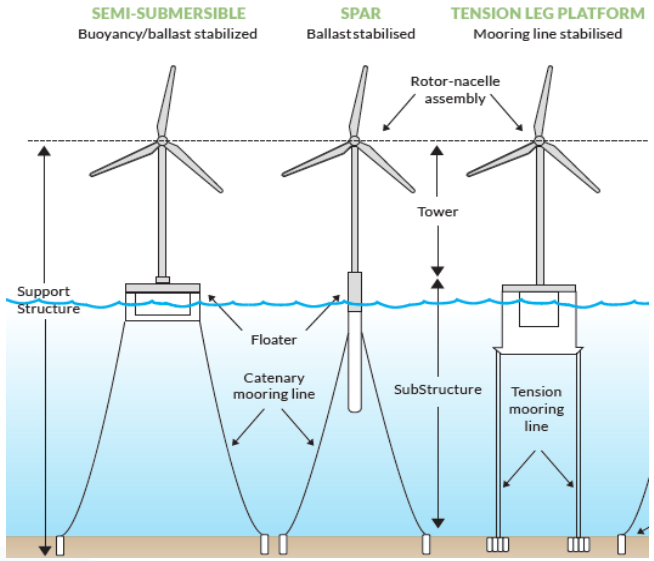




Differences with design used on fixed substations:

NO DIRECT TRANSITION

Selection of most suitable floater type → hydrodynamic behavior, fabrication & logistics, TRL state, etc.



Classification of floating structures. *Conditions for growth in the Norwegian offshore wind industry. 2019*

	Semi-sub	TLP	Spar
Pitch Stability	Buoyancy	Mooring	Ballast
Natural Periods	−	+	0
Coupled Motions	−	+	0
Wave Sensitivity	−	0	+
Turbine Weight	+	0	−
Moorings	−	+	−
Anchors	+	−	+
Construction & Intallation	+	−	−
Maintenance	−	+	0

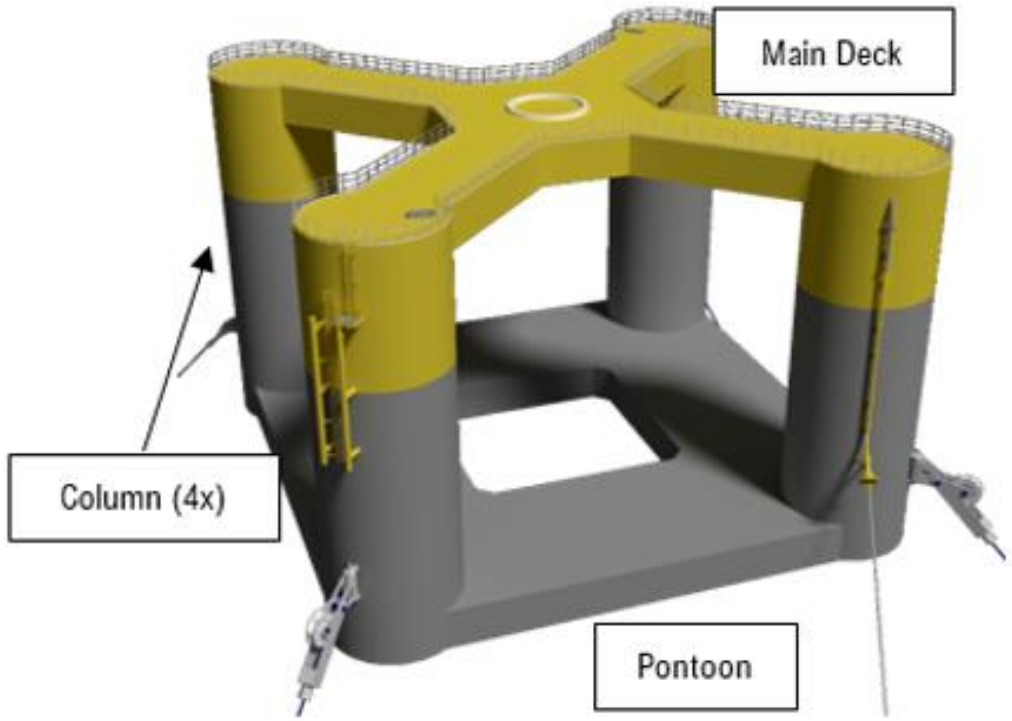
+ = relative advantage

0 = neutral

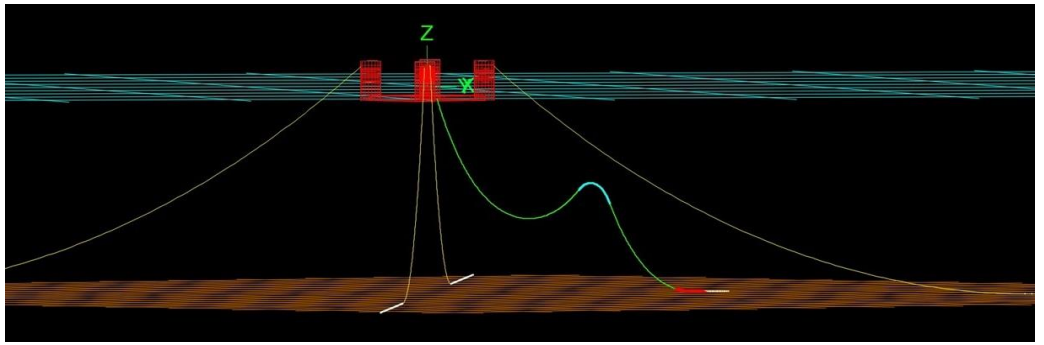
− = relative disadvantage

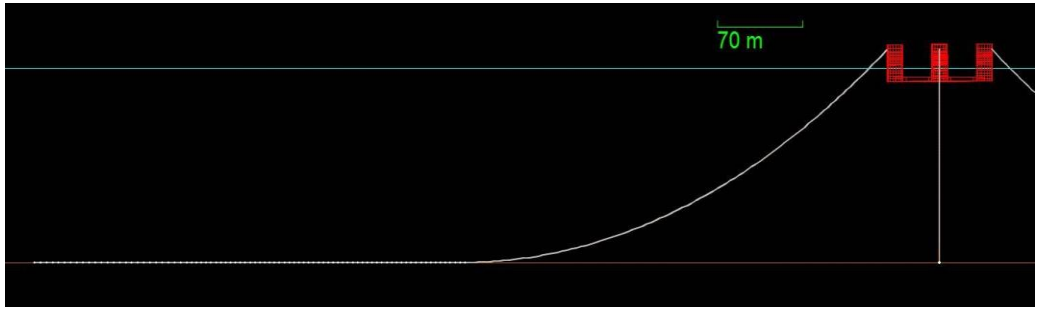
Project working lines

1. FLOATER (PT2)



NAUTILUS floating platform design





Design verification → HYDRODYNAMIC CHANEL TESTS

Project working lines

2. FABRICATION (PT4)

MURUETA ASTILLEROS - SHIPYARDS

NAVACEL Process Industries

Top side fabrication

- Definition of process and means of production

Floating platform manufacture

- Material requirements
- Special requirements
- Means of manufacture

Launching (floating assembly)

Possibilities: analysis of assembly in dry dock, shipyard, etc.

Assembly

Study of different alternatives: *methods, equipment, procedures*

Transportation

Study of transport procedures in the different phases

Offshore logistic

Identification of necessary means and new maneuvers for floating substations throughout their life cycle.

Identifying constraints from the earliest stages of design → Demonstrate the **technical and economic feasibility** of floating substations.

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Project working lines

3. NEW MATERIALS (PT3)

Materials

Analysis of new materials for application to offshore structures.

New formulations and characterization

Sensoring

Conducting concretes

Coatings

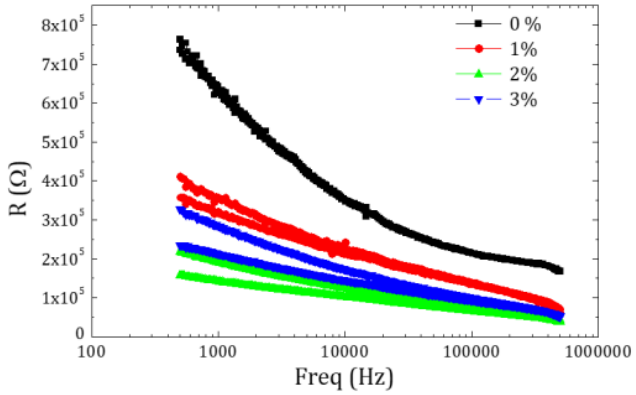
Materials

Coating reformulations

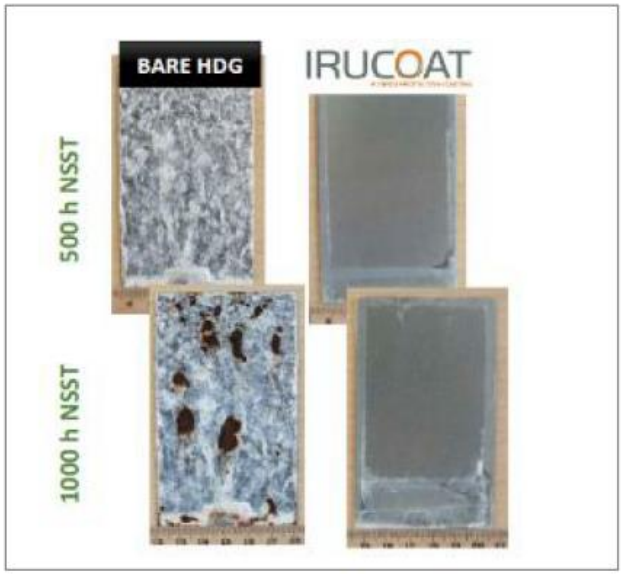
Variation of solvent, thicknesses, heat treatment, etc.

Top-coat caotings

Appearance of concrete samples with microfibres



Resistivity obtained from samples



Irucoat coating test samples

Project working lines

4. O&M (PT5)

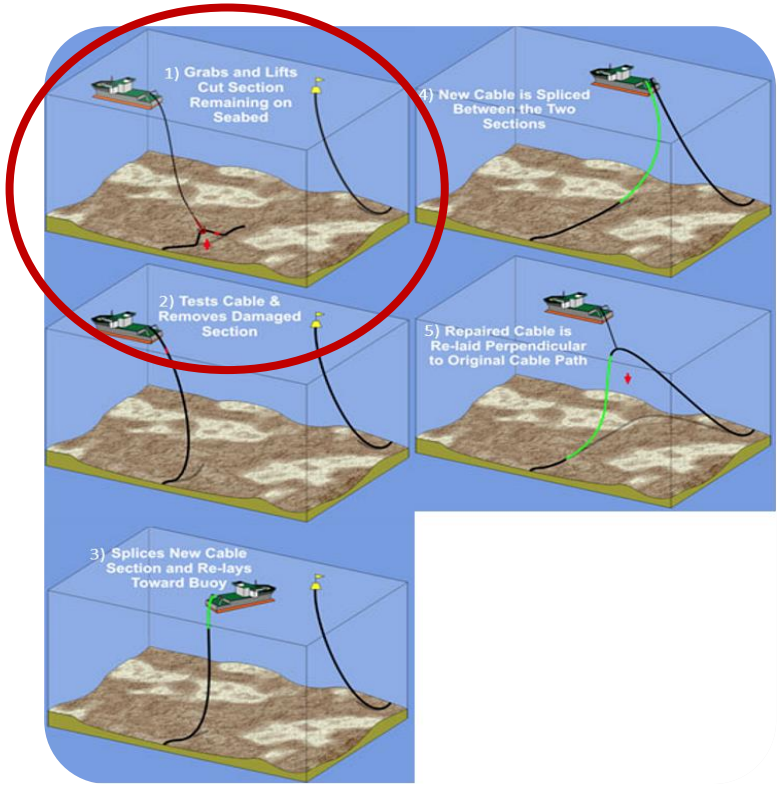
BLUG® Credeblug, s.l.

Subsea cable handler design

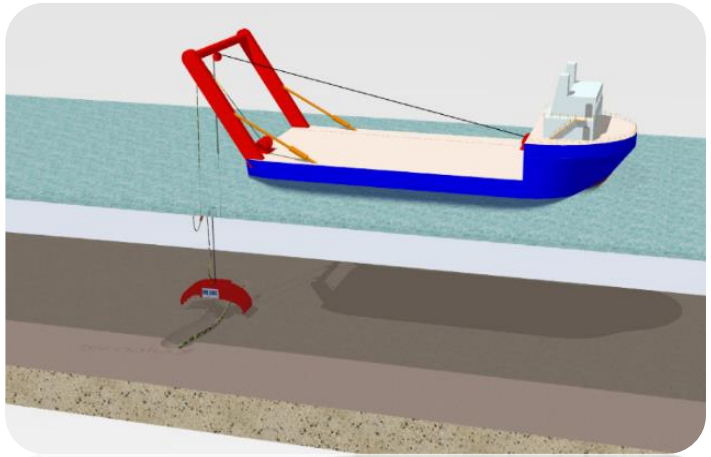
Design and manufacture of a cable collection clamp for maintenance and operation.
High technological value approach:

- → Avoiding cable damage
- → Increased reliability
- → Reducing costs

Example of traditional cable recovery



Phases in the handling of a submarine cable repairing



Concept sketch of the new handler

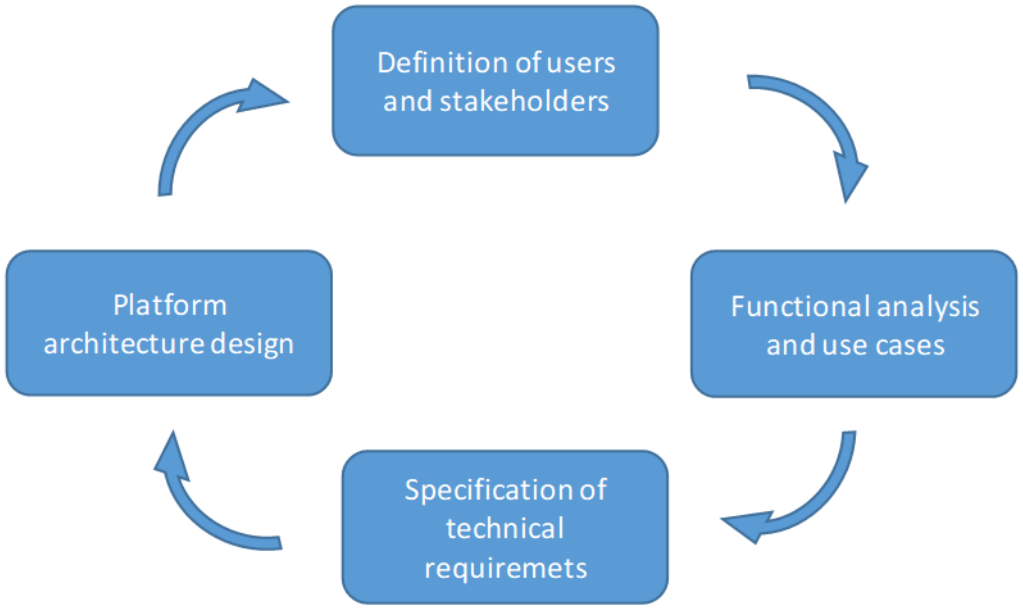
Project working lines

4. O&M (PT5)

* Development of an engineering logistics platform

Development of an asset management platform for the installation, operation and maintenance phases → **digitalization**

- Human resources management
- Material resource management
- Workflow and time control
- Platform access and security

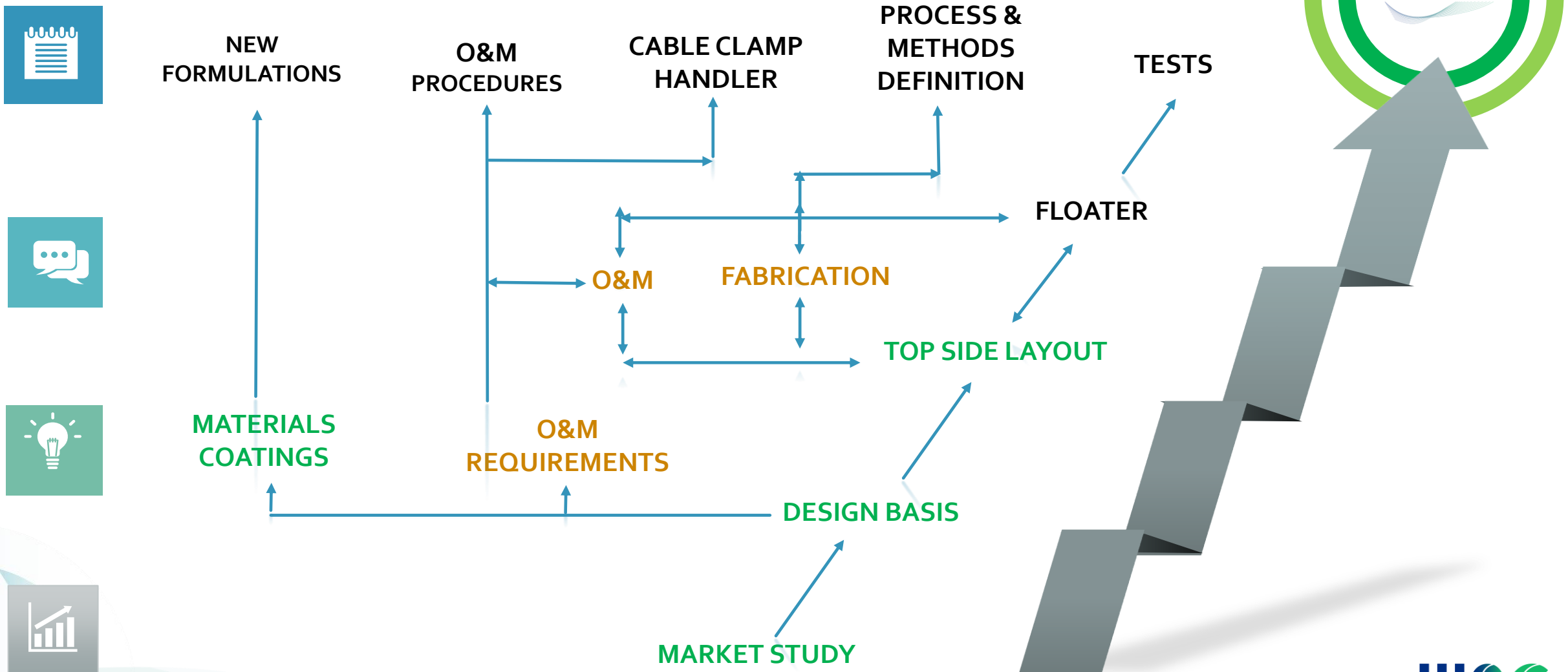


* Development of steel-concrete joints

Analysis of assembly alternatives to reduce the time and means required for the assembly of different parts of the floating substation.

Bolted joints monitoring →
Tightening load monitoring for easy maintenance.

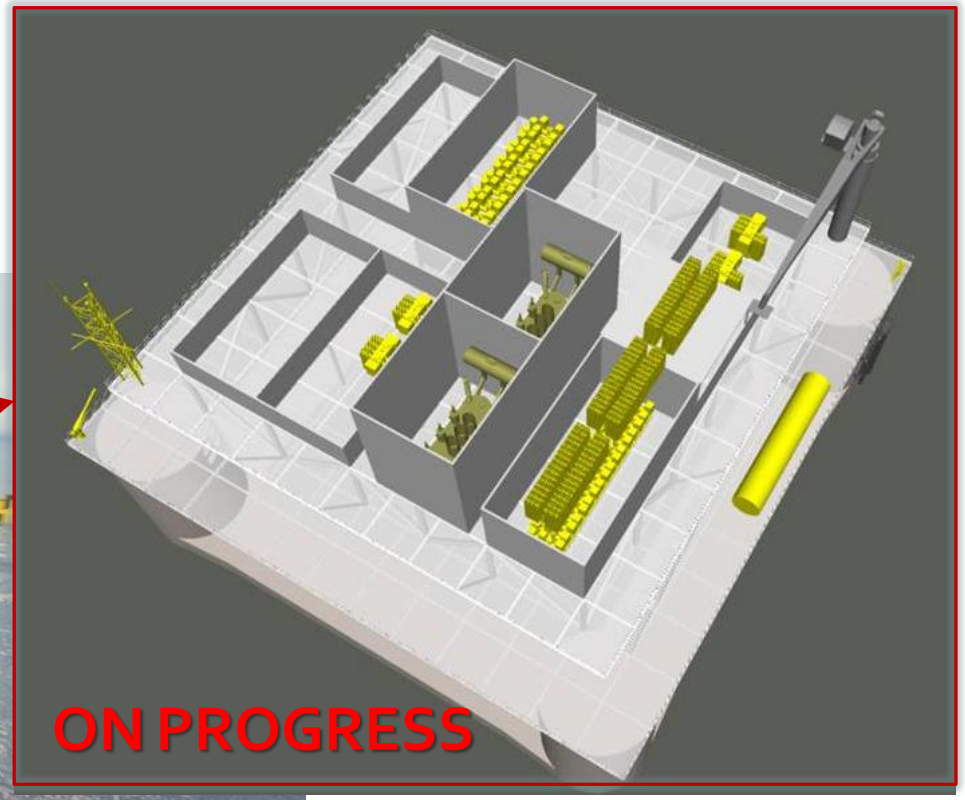
Status of the Project and next steps



Status of the Project and next steps

From this…

Status of the Project and next steps



...to this!

Thank you

https://www.wind2gridproject.com/es/

https://www.idom.com/en/new/offshore-wind-energy/

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