

The 11th NEDO-CDTI Joint Workshop

“Technologies for Hydrogen Valley in Spain and Japan – Regional H2 Value Chain”

Hydrogen



Storage, Transport and distribution
of offshore Green H2

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Co-founder and Managing Director

BlueNewables





BlueNewables Intro



21 → 24

Offshore Engineers



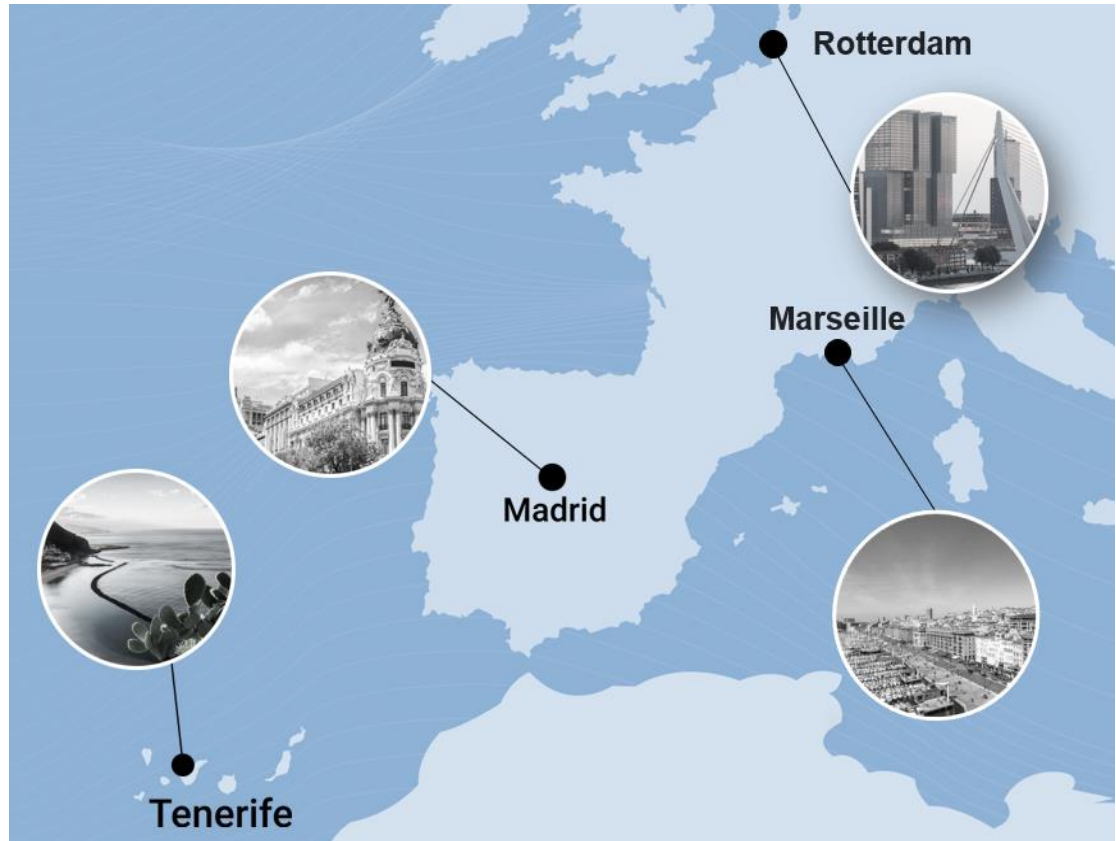
> 140 years

Cumulative Experience in Offshore Engineering



5

Technologies/patents under development



BlueNewables Offshore Solutions

WIND-bos

- Spar
- Steel + concrete
- Innovative installation procedure
- Patent pending
- Consortium Korea-Spain (waiting resolution)

S-bos

CT-bos

- Semi and TLP
- Concrete
- Patent pending
- Handover agreement with Acciona

G-bos

PV-bos

- Lattice cat
- Steel
- Patent pending
- Handover agreement in progress with Energy developer

Technologies- Tank Testing Videos



OCEANIDE (FRANCE) . Typical 50yr storm North Sea Hs=10.1m ; Tp=14.1s



CEHIPAR (Spain) . Typical 50yr storm North Sea Hs=10.1m ; Tp=14.1s



IH Cantabria (Spain) . Typical 50yr storm North Sea Hs=10.1m ; Tp=14.1s



Plymouth (UK) . Typical 50yr storm Canary Island Hs=5m ; Tp=12s



OCEANH2 Project

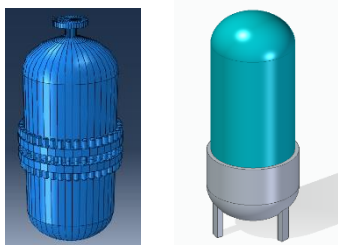
OCEANH2





Storage and Transport

Storage Method

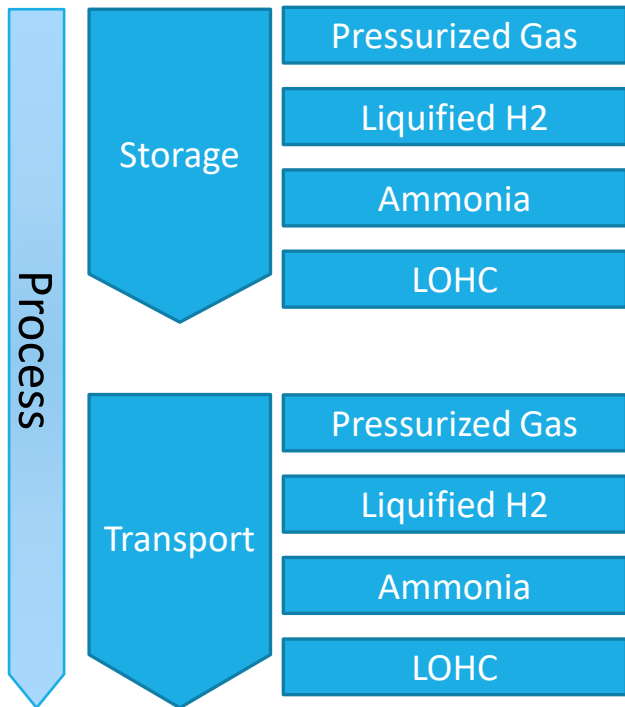


Offshore Technology Solution



Bottom Fixed

Floating



Vessel

Pipe

Vessel

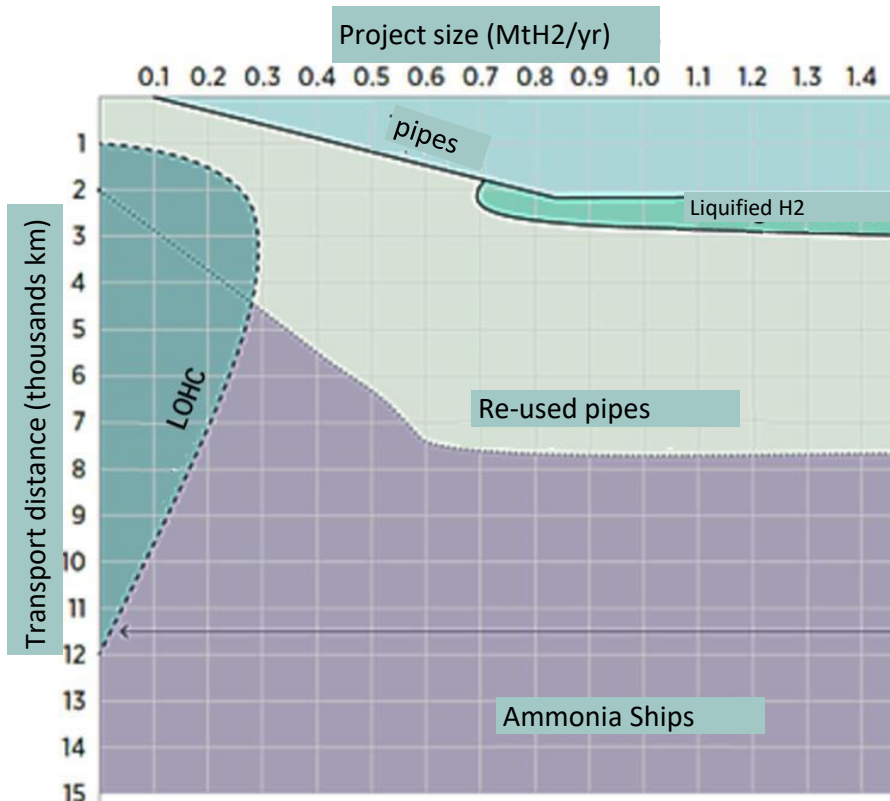
Pipe





Storage and Transport

Transport Methods



<https://energypost.eu/whats-best-for-hydrogen-transport-ammonia-liquid-hydrogen-lohc-or-pipelines/>



Main challenges and solutions

OCEANH2

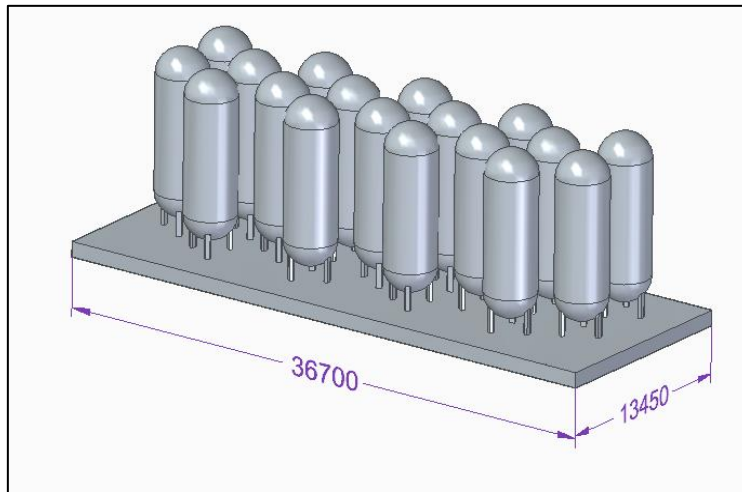
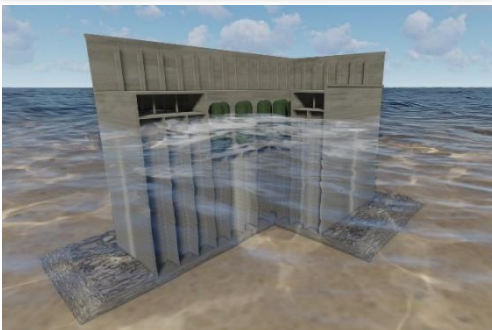
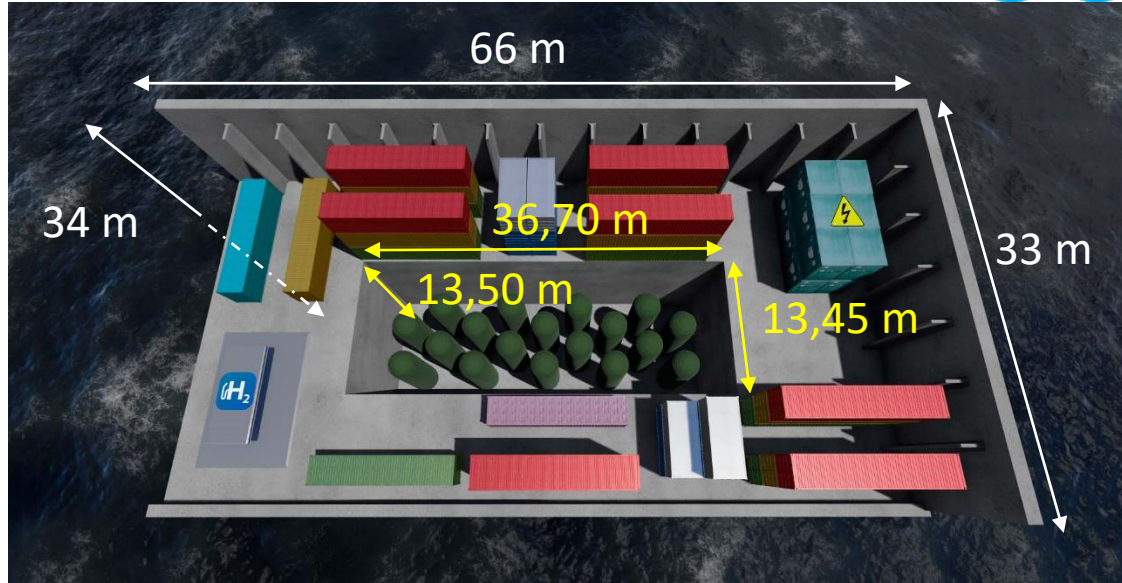
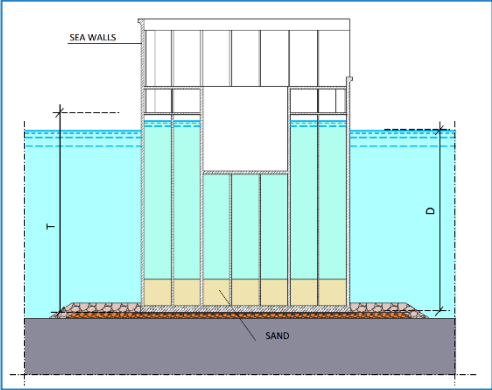




OceanH2- Storage on Bottom Fixed



OCEANH2



Layout, containerised solution

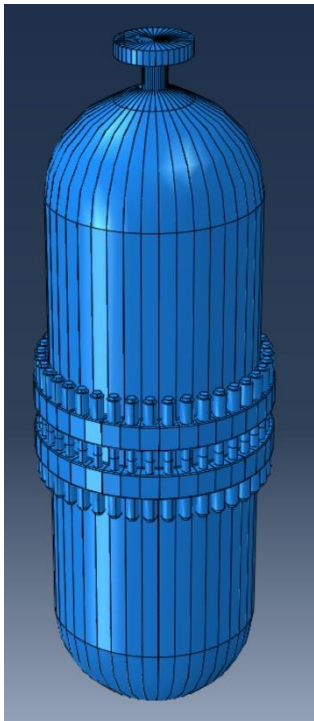
- ✓ 1 unique GBS unit
- ✓ 18 innovative compressed H₂ units
- ✓ 25 MW of electrolyzers installed
- ✓ 1 desalination plant
- ✓ 1 Low Voltage transformation centre
- ✓ Compressors
- ✓ Pressure regulation and measurement (P. R&M) station
- ✓ Pressure measurement (P. M) station
- ✓ 1 H₂ fuelling station
- ✓ 1 H₂ pipeline



OceanH2- Storage on Bottom Fixed



OCEANH2



**Innovative design metallic,
two hulls united by bolts**

ASME Boiler and Pressure Vessel
Code-Section VIII



**Innovative design
composite**

ASME Boiler and Pressure Vessel
Code-Section X

Findings

- + Composite allows **higher pressure** for same size.
- + Composite **stores more H2** for same size.
- + Composite allows **lighter structures** (10 times less weight): lower costs for logistics and installation.
- + Composite material is **resistant to marine corrosion**: lower maintenance cost.
- + Designs **validated with manufacturer**: geometry viable with existing manufacturing techniques.
- + **Similar costs**: composite is more expensive but less material is used.

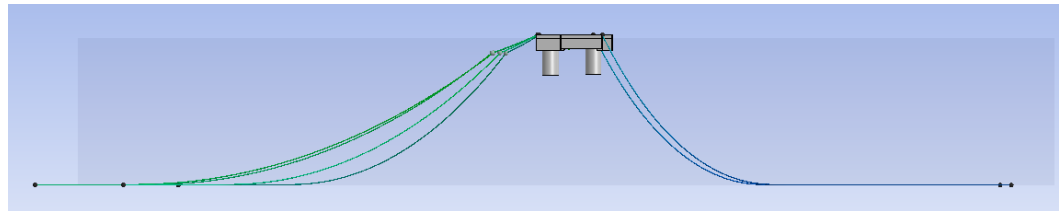
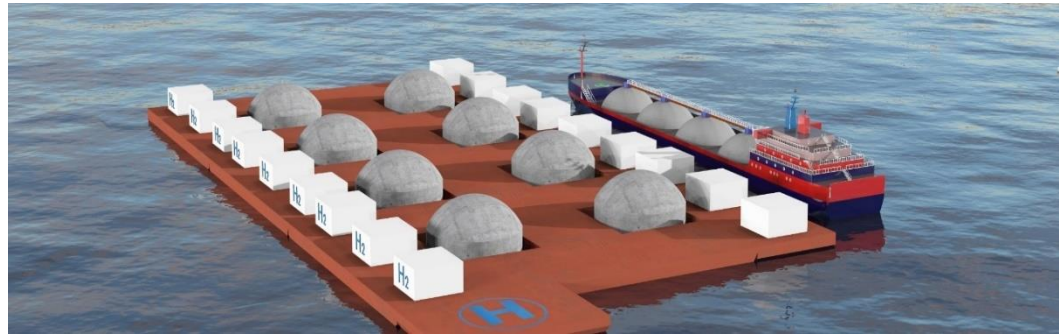
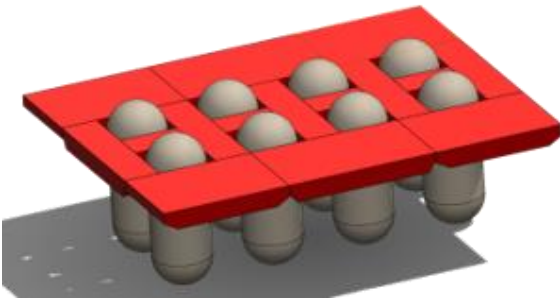
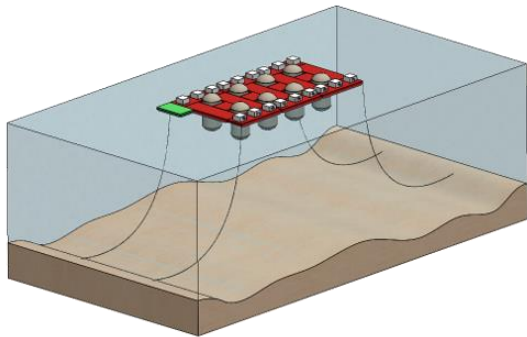
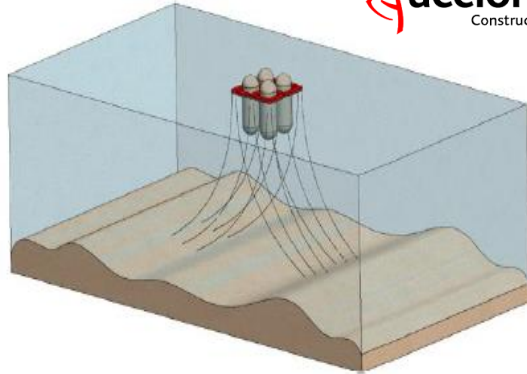
Challenges

- Safety at Sea**
- Economies of scale**
- Modularity**
- Maintenance**
- Economies of scale**



OceanH2- Storage on Floating Platform

OCEANH2



Layout, floating solution

- ✓ 1 unique modular floating unit
- ✓ Floating Vessels H₂ Compressed 50 bar – 18ton
- ✓ H₂ generation installed onboard (electrolysers, desalination, Compression, electric Transformation Plant, control etc)
- ✓ Offloading and transport by barge or pipe.



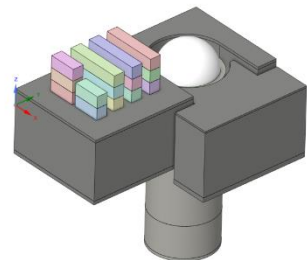
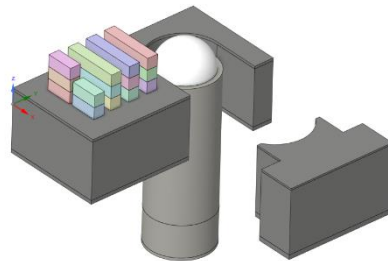
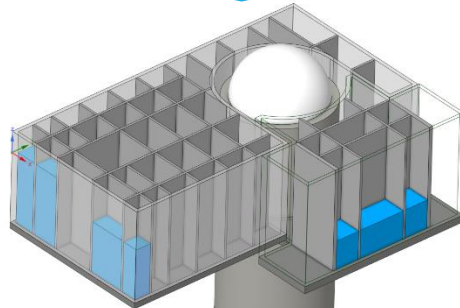
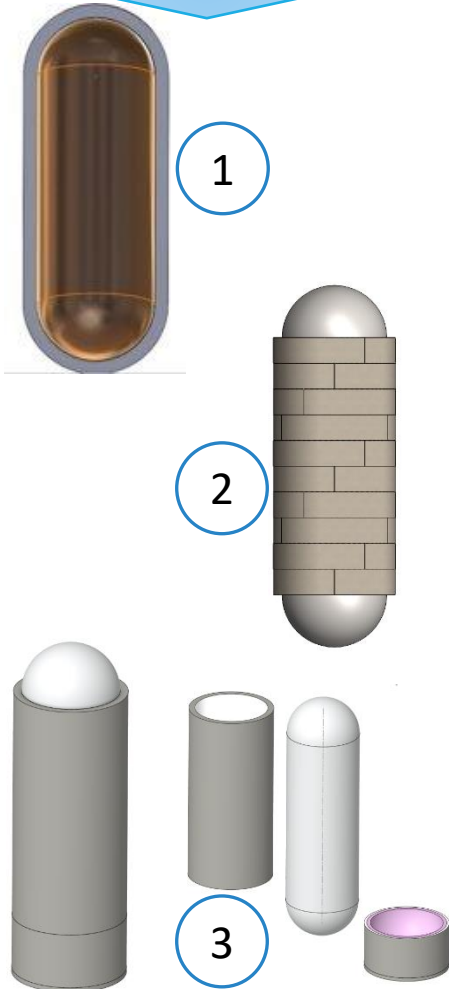
OceanH2- Storage on Floating Platform

OCEANH2



H2 Vessels Design evolution

Concrete Hulls Installation Sequence



Findings

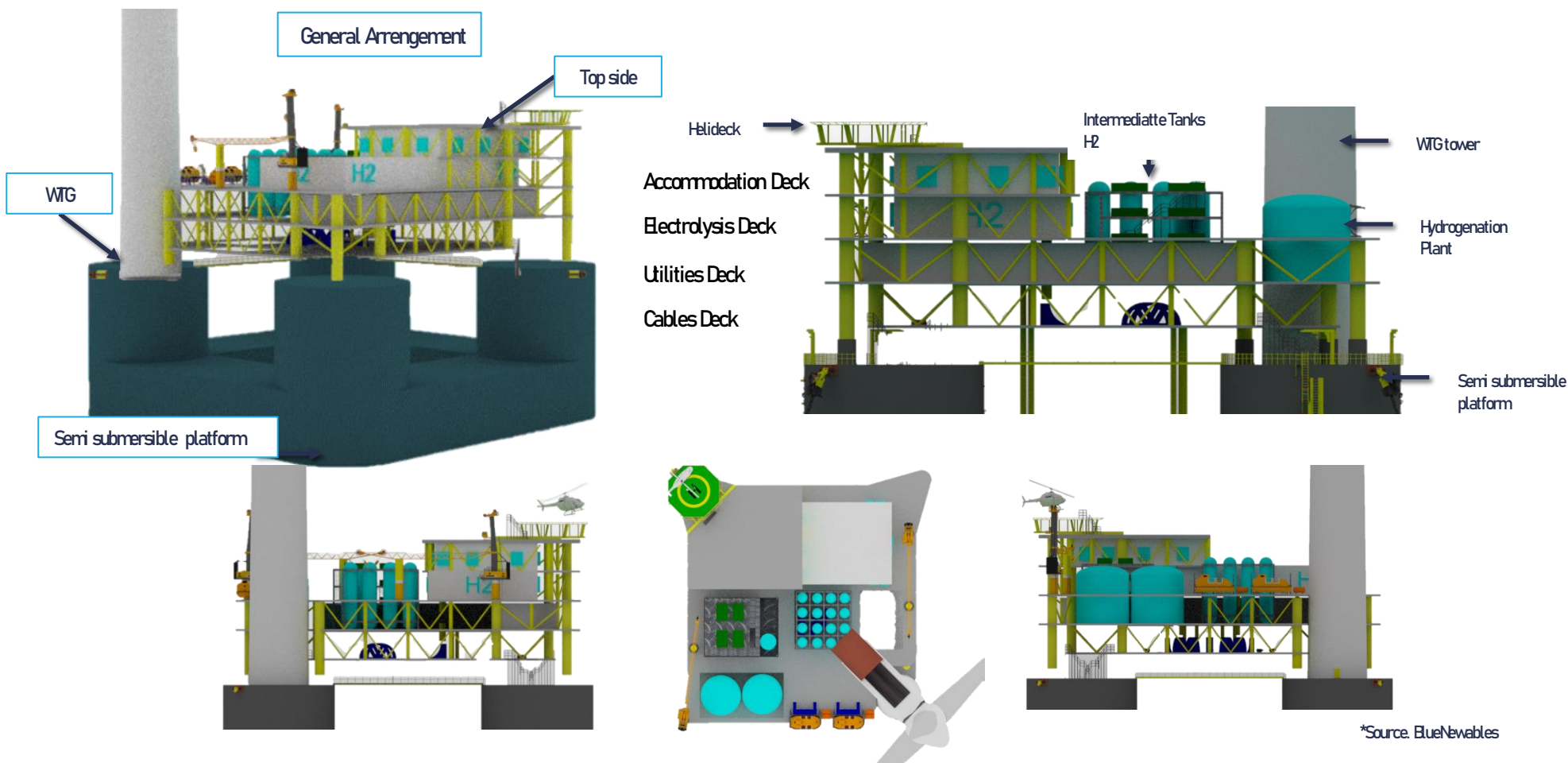
- Feasible floating H2 storage structure*
- Concrete as an alternative to steel*
- Un-expensive traditional mooring system*

Challenges

- Locking gate and locking systems*
- Connections between barges and vessels*
- Relative motions between barge and storage vessel*
- Suitability for **extreme** conditions*



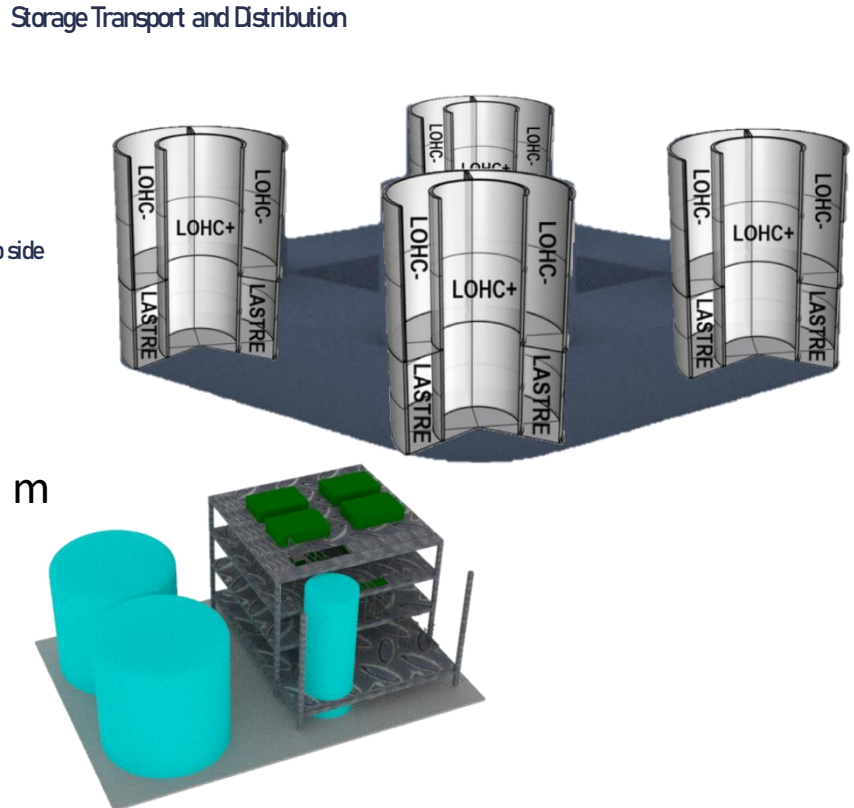
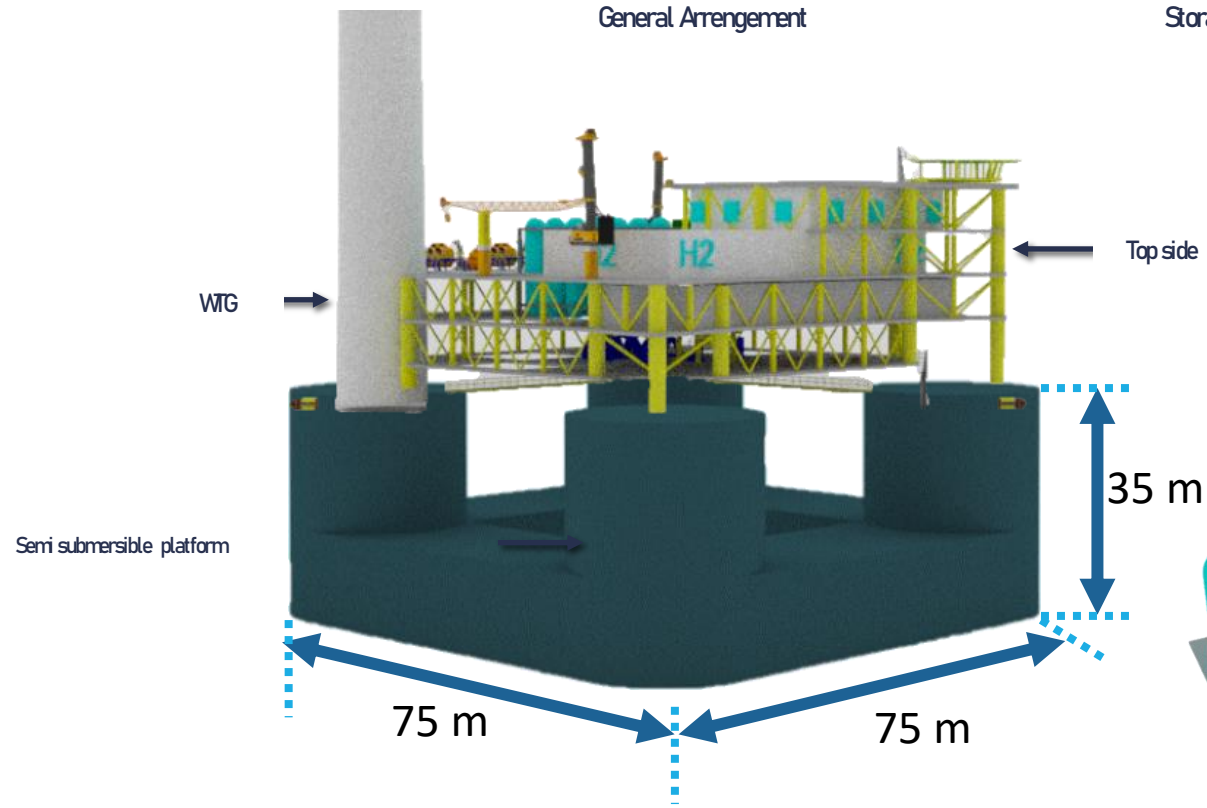
BlueNewables H-FPSO*. Centralized platform.



*Source: BlueNewables



BlueNewables H-FPSO*. Centralized platform.



*Source. BlueNewables



Ideas for a Japan – Spain collaboration

- ✓ Exploring opportunities for development of large scale H2 ecosystem between countries
 - Assuming a global market. International Trading of green H2.

✓ Storage

- **Research, Development and Design of H-FPSO**
 - Water depth is large in Spain and Japan → Floating solutions are required. GBS is limited to certain locations.
 - Research on bespoke units for Floating Production, Storage and Offloading of Hydrogen
- **Offloading Systems**
 - “Ship to ship” operations in open waters need to be investigated.
 - Tailored equipment and machinery
- **Liquified Organic Hydrogen Carriers**
 - Further research on LOHC to optimize ratio of Energy per m3.
- **Tailored Components Development**
 - Subsea dynamic pipes/hoses
 - Tailored equipment and machinery (pressurized vessels, valves and ancillaries)
- **LCOE optimization**
 - Industrial plan. National Scale and international scale.
 - Smart fabrication methods. Industrialization
 - Modularization of structures and components



Ideas for a Japan – Spain collaboration

✓ Transport

- R&D and Design of transport ships
 - Liquefied H2. (Similar to LNG carriers)
 - Pressurized ships
 - LOHC vessels (Similar to oil tankers)
- R&D on Fixed and Floating Regasification Units
 - Global market, similar to LNG, where FSRUs are needed to transform H2 (liquid) y H2 (gas)



LH2 Carrier Suiso Frontier. Kawasaki heavy industries



LH2 Carrier. Moss Maritime



LH2 Carrier. C-Job Naval Architects

http://www.ocnus.net/artman2/publish/Business_1/Korean-Design-for-Hydrogen-Producing-FPSO.shtml



Thank you!

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