



HybridEnerSeaHub JIP

Case Study for a Hybrid Energy Island | Investigating the use of floating modules in combination with reclaimed land to make islands more adaptive in every stage of their life time



To support cost-effective renewable energy production far out at sea there is a need for O&M support, efficient and safe energy conversion, transport and storage of renewable energy. The Joint Industry Project HybridEnerSeaHub aims to fulfil those needs with a comprehensive design of a partially floating energy hub in the North Sea.



Objective

Based on present developments and needs we aim to start the HybridEnerSeaHub JIP with the following objective:

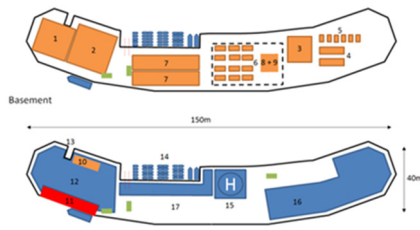
To develop an initial design of a partially floating maintenance and energy storage island and to investigate its feasibility in the North Sea.

The possibility of using floating modules will be investigated to support the functionality of the energy island in every stage of its life cycle. This modular approach could make the island more adaptive to the needs of future activities such as floating workshops, and storage facilities can easily be attached and relocated in the different stages of the offshore developments. This is an advantage since investments only need to be made when needed and the floating facilities can be re-deployed elsewhere once it has served the project's needs. Furthermore, a partially floating island may have a smaller impact on the sea life and surroundings than a large permanent reclaimed island. On the other hand motion requirements and mooring loads will possibly set a practical limitation for a floating island on the North Sea. Therefore a combination of floating modules connected to a reclaimed island will be investigated.

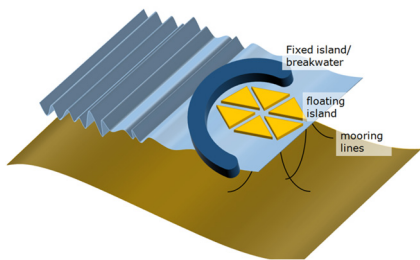
Research questions

In the present project the following research questions will be addressed:

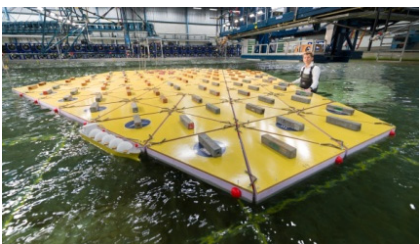
- What part of the energy hub should be fixed or floating?
- What is the optimum layout for the fixed part to give best shelter to the floating parts?
- Which motions levels are acceptable for a floating energy hub?
- How can motions be reduced (air cushion?)
- What size should the island have for certain functionalities?
- How large are the forces in the floating structure, mooring and couplings?
- What is the best design for the platform, couplings and moorings in order to sustain these forces over its lifetime?
- What are the estimated building costs for standardised concrete or steel modules?
- Which energy storage methods are available?
- What is the environmental impact of such a partly floating island?
- What is the impact of offshore wind on the LCOE?



Example of the different functionalities and corresponding footprint and how they can be incorporated in the island



Example of the shielding effect of the reclaimed island on the floating modules



Example of the model tests which will be performed within this JIP

Previous work

The project partners have a proven track record related to simulating and model testing concepts for floating and reclaimed islands at sea. Their combined expertise on construction, hydrodynamics, wave systems, soil interaction and logistics will lead to new insights in using floating modules combined with reclaimed islands at sea.

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Scope of work

The proposed scope of work is presented in a project plan. Project participants are invited to discuss the final scope of work. At present we foresee the following aspects to be included:

Work package 1: Design Basis

- 1.1 Investigate possible future functionalities of the island
- 1.2 Motion criteria related to various activities
- 1.3 Initial metocean dataset
- 1.4 Initial risk study

Work package 2: Fixed/Floating Hybrid Design Concept

- 2.1 Conceptual design floating island & mooring
- 2.2 Coastal study for the reclaimed island
- 2.3 Motion analysis of the floating modules

Work package 3: Environmental impact evaluation

- 3.1 Inventory of potential ecological functions of a hybrid island
- 3.2 Ecological risk assessment for sea life
- 3.3 Advice on design from an ecological perspective

Work package 4: Performance evaluation of the Hybrid Design Concept

- 4.1 Apply bathymetry/coastal study
- 4.2 Calculate hydrodynamics
- 4.3 Structural & fatigue analysis (hull, mooring & couplings)
- 4.4 Model test hybrid island for validation of the numerical models
- 4.5 Harbour safety study (optional)
- 4.6 Model test floating island with (underwater) breakwater (optional)

Work package 5: Business case evaluation

- 5.1 Life cycle assessment of functionality
- 5.2 Cost estimates for the islands

Work package 6: Project coordination

Project deliverables

The deliverables of this JIP can be used to take the next step in the design of a hybrid island to support cost-effective renewable energy production far out at sea. The JIP results can also be used for other island locations and applications. The most important deliverables of this project will be:

- Island design criteria for critical equipment (e.g. power transformation systems)
- Preliminary island and mooring design
- Design optimization for motions
- Environmental impact study
- Improved and validated numerical design tools
- Cost estimate for multiple island building methods
- Preliminary risk study

Organisation and schedule

The HybridEnerSeaHub JIP will be conducted as a 2½ year Joint Industry Project in close co-operation with energy companies, operators, yards, engineering companies and marine system suppliers. MARIN will act as JIP manager and sign participation agreements with all members. All participating companies will be represented in the JIP Steering Group with meetings during the Blue JIP week every 6 months. Presentations, reports and other relevant information will be posted on the confidential project website. The total project budget is 1 million Euro and the project will start October 1, 2019.