This is an extract from the final report. To see the entire document, please see the 'Full documents' section on the website.

1. Background

Function of an energy island

Energy islands are hubs for offshore renewable energy connection and storage. They facilitate OSW to be constructed further away from the land, where wind is stronger, turbines can be bigger and more efficient and public nuisance is less.

An energy island is an ambitious, large-scale project but would give the host country and connecting countries energy security and the ability to expand offshore wind power exponentially. These hubs can be built on existing islands or manmade islands which connect to surrounding wind turbines and other renewable energy. On the island the energy can be processed and transmitted to countries on demand very efficiently. The general description diagrams for the energy island proposal are shown in Section 3.

As the North Sea is aiming to achieve net zero carbon, oil and gas infrastructure is becoming redundant. By utilising platforms, pipelines or connection routes, an energy island plan could help decarbonise the North Sea whilst reusing and reducing waste infrastructure.

Current Situation

Energy Islands are at the forefront of innovation, none have been constructed and few have been designed. Multiple of these installations will grow the green energy network vastly, but each should be designed to suit its unique location, to be minimally invasive on the environment, and make the best use of available resources.

Currently Denmark has concept designs for two energy islands (Danish Energy Agency, 2023). The first is an artificial island in the North Sea, around 100km from shore. It plans to feed wind energy back to shore and eventually connect neighbouring countries. The total estimated investment for the project is DKK 210 billion (£24 bn) (North Sea Energy Island, 2024). The construction of the island will only use 5% of the cost, with the rest being used for connections to countries, new offshore wind farms and infrastructure. The figures below show plans and variations of the design.

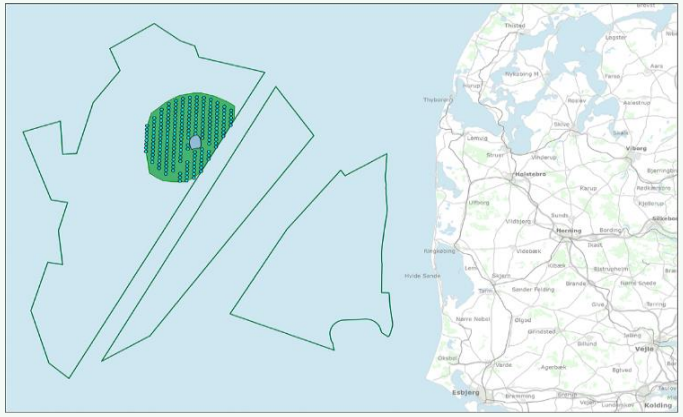

Figure 2- Map showing location of Danish energy island in North Sea (Danish Energy Agency, 2023)

Figure 3- Concept image of Danish Energy Island (BBC News, 2021)

Figure 4- additional concept image of Danish energy Island (GoTechies, 2021)

The second is the conversion of an existing island, Bornholm, in the Baltic Sea. This island will house the necessary equipment to connect surrounding offshore wind farms and distribute the energy to nearby countries. The figures below show the location and position of turbines and the island.

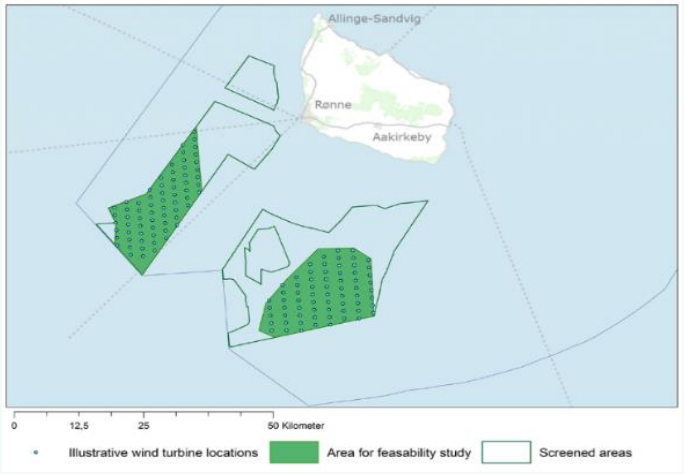

Figure 5- Schematic of the Bornholm energy island with wind farms marked in green. (Urland, 2020)

Figure 7 - Map showing location of the 2 Danish energy islands. (BBC News, 2021)

Belgium has also began designing an energy island 45km from their shore – “The Princess Elisabeth Island” (Elia Group, 2023). This development has been granted an environmental permit and is planned to be fully commissioned by 2030. However, the island is planned to be within a marine protected zone, making construction a challenge (Euractiv, 2023) Similar to the Denmark designs, the island will connect wind farms and distribute energy to Belgium, England and Denmark. The Island will be 6ha in size and be constructed from concrete caissons (Offshore Magazine, 2023). The completed island is estimated to cost more than €2 billion, not including the price of additional wind farms and connections to countries. The figure below shows the location and design concept.

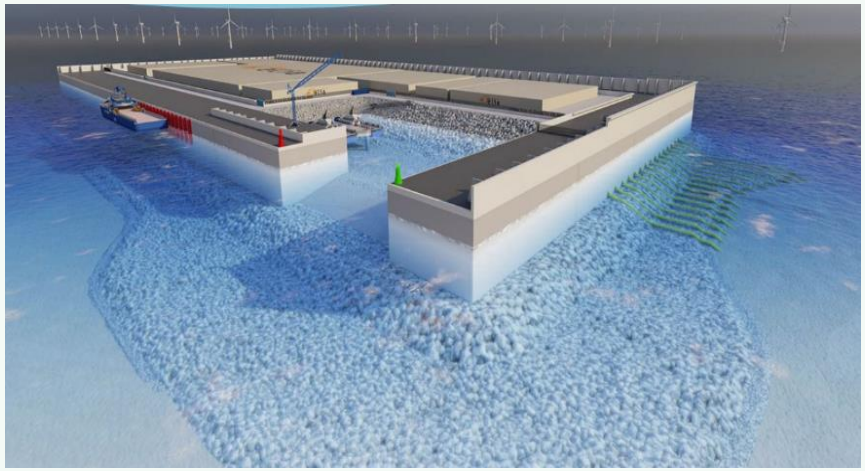

Figure 6 - Detailed design concept for Princess Elisabeth Island with nearby wind turbines. (Royal HaskoningDHV, 2023)

Figure 8- location of Energy Island off the coast of Belgium and the UK (Eliagroup, 2023)