

Energy Islands- Design Proposal

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Overview

SHE Engineering is a group of six MEng Civil Engineering students from Heriot-Watt University, completing their final year design project. The aim of this project is to investigate the sustainability of wind energy in Scotland. Following extensive research and stakeholder engagement, the design proposal for this project is to design an energy island in the North Sea.

What is 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.

Currently countries in Europe are producing plans and designs for energy islands but none are a reality yet. 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.

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.

Our Proposal

From September to December 2023, the group researched wind energy in Scotland which led to the decision of designing an energy island in the North Sea. The initial phase led to a short options appraisal between three locations for an energy island, off the coast of Aberdeen, Edinburgh and Shetland. Aberdeen and Shetland were chosen as the most desirable locations for our project and will be used to inform our design going forward.

The next steps are to determine the feasibility of a man-made energy island off the coast of Aberdeen, converting an existing island in Shetland to be an energy island and also developing and using repurposed oil and gas infrastructure. From January to April 2024 the energy island will be designed, the construction details will be specified, both the economic and carbon costing for each option will be carried out and there will be a detailed options appraisal for all three options.



Figure 2- Energy Island in Denmark Proposal

Man-Made Energy Island

The first option is to design an energy island off the coast of Aberdeen. This would include choosing the island location, dimensions, materials, energy storage, energy production methods and pipeline/cable connections. This proposal would be based on the design of the energy islands which are being proposed by Denmark.

Designing a man-made energy island would have multiple benefits including the ability to choose the



Figure 1 – United Nations Sustainable Development Goals

most suitable location and our island being tailored to the needs of the infrastructure which will be on it, such as energy storage facilities.

Converted Existing Island

A second option would be to turn an already existing, uninhabited island into an energy hub. This would involve similar infrastructure to that which would be on a man-made island, but there would be no need for the design and construction of the island itself, which would reduce the carbon cost significantly.

Around Shetland, there are many small, uninhabited islands which are a similar area to that of the energy island proposed in Denmark. This option would involve designing the energy storage, energy production methods and pipeline/cable connections, significantly reducing the carbon and economical cost when compared to a man-made energy island.

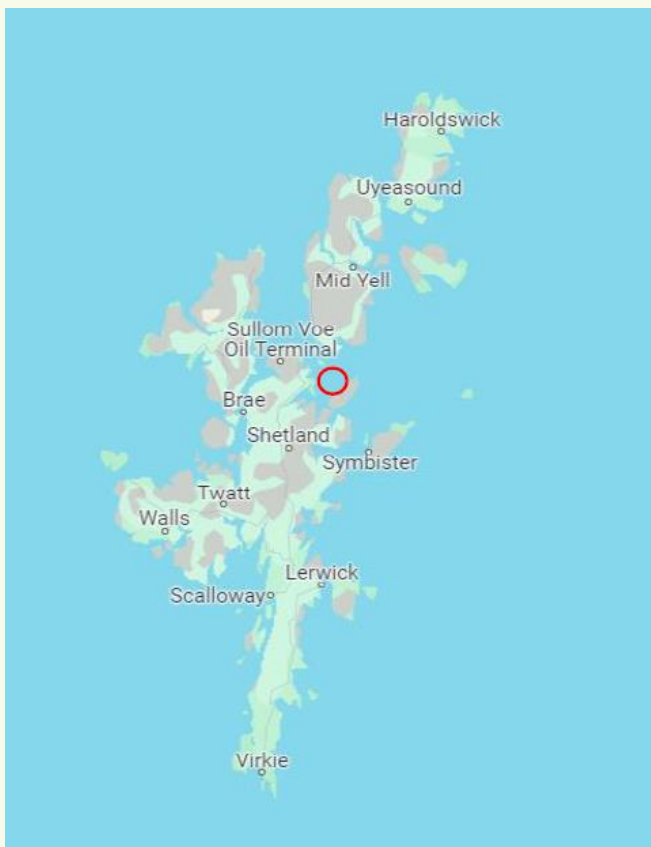


Figure 3 – Map of Shetland highlighting proposed location for the energy island.

Oil and Gas Repurposed Infrastructure Energy Island

The final option is to design an energy island by using the existing infrastructure from oil and gas production, which is likely to be decommissioned in the future. By doing this, the decommissioning process for oil and gas rigs would be researched and adapted to be suitable for

an energy island. The island dimensions, materials, energy storage, energy production methods and pipeline/cable connections would follow the strengthening of the decommissioned oil and gas rigs. The location of the energy island will be based around the location of the existing oil and gas rigs- for this report, Golden Eagle and Buzzard production platforms in the North Sea would be used.

By using existing oil and gas infrastructure, which will be decommissioned in the future, the carbon cost is significantly decreased. However, there is still the possibility that the cost to strengthen and repurpose this infrastructure may have high economical costs.



Figure 4 – Golden Eagle Production Platform in the North Sea



Figure 5 – Buzzard Production Platform in the North Sea

Link to accompanying questionnaire-

<https://forms.gle/m6a5RA3dCMnRnpLk7>

Link to our proposal video-

<https://forms.gle/m6a5RA3dCMnRnpLk7>