FLOATING OFFSHORE WIND CENTRE OF EXCELLENCE

Delivered by CATAPULT Offshore Renewable Energy

MANUFACTURING CONCRETE FLOATING WIND FOUNDATIONS IN SCOTLAND

Image: Saitec

Discretionary project funded by RWE

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INTRODUCTION BY RWE

Scotland is a key market for RWE. We have 10 onshore wind farms, 14 hydro power stations, one offshore wind farm and a strong pipeline of development projects. We are fully committed to helping Scotland achieve its ambitious climate change targets.

The future global potential of offshore wind depends on delivering floating wind. The ScotWind leasing round offers an exceptional and unique opportunity for Scotland to establish itself as a global leader in the floating wind market and to stimulate meaningful investment in Scottish manufacturing facilities that would create thousands of jobs.

In particular, producing concrete floating substructures in Scotland could deliver high levels of cost competitive local content but there is a lack of industry research into this opportunity. RWE commissioned a report from the Offshore Renewable Energy (ORE) Catapult to address this knowledge gap by investigating whether there were any 'red flags' that could prevent this activity happening here, and to consider what steps should be taken to unlock the opportunity.

Positively, as this summary report shows, Scotland is well positioned to manufacture concrete floating substructures with the potential to create high levels of local content.

Looking to the future, RWE is now keen to build a broad coalition that can work together to make this a reality. This will involve working with other developers, substructure designers, public agencies, the supply chain and port owners. There are still barriers to overcome to make this a reality but we think the economic prize for Scotland means it is worth the effort.

ACKNOWLEDGEMENT

This document is a summary of a study commissioned by RWE as a discretionary project within ORE Catapult's Floating Offshore Wind Centre of Excellence (FOW CoE).

The FOW CoE would like to acknowledge and thank the concrete substructure designers who responded to the request for information, plus the companies that participated in the supply chain workshop. The insights into substructure designs, manufacturing methodologies and Scottish supply chain capabilities were invaluable in performing this Scottish concrete substructure supply chain assessment.

CONTEXT

Floating wind substructure designs are typically based on concepts used in the offshore oil and gas industry. These oil and gas concepts involved the use of both steel and concrete as the primary substructure material, and this is also the case for floating wind. As with bottom-fixed wind, however, the floating wind industry has typically focused on the use of steel for substructure manufacture. This means that there is limited information in the public domain about the supply chain's capacity and capability to deliver concrete substructures.

In the context of the rapid growth of the floating wind market in Scotland, this study seeks to understand the potential for the Scottish supply chain to manufacture concrete floating offshore wind substructures.

APPROACH

ORE Catapult partnered with Arup and the Concrete Centre to deliver this project, with Arup delivering the majority of the technical work, the Concrete Centre facilitating supply chain engagement and ORE Catapult providing guidance on substructure design and technology development, port capability and capacity and floating wind market trends. This report provides a summary of the study, including recommendations on next steps.

The design requirements for floating concrete substructures were based on feedback from concrete substructure designers, which was consolidated to produce generic "barge" and "semi-submersible" designs supporting 15 MW turbines. Manufacturing and launch methodologies were developed based on the scenario parameter in Table 1.

	Barge	Semi-submersible
Length	50-55 m	55-65 m
Width	50-55 m	55-65 m
Total substructure mass (tonnes)	12,500 – 15,000	15,000 – 18,000
Quayside draught (excluding wind turbine generator (WTG))	< 10 m	
Quayside draught (including wind turbine generator (WTG))	< 12 m	
Location	Scotland	
Year	2030	
Wind farm capacity	500 MW	
Turbine rating	15 MW	
Number of turbines	33 units	
Target manufacturing period	12 – 18 months	

Table 1: Manufacturing and launch methodologies for barge and semi-submersible designs

Source (left to right): BW Ideol, Saitec, Olav Olsen, Mareal and University of Maine

This information was used in an industry workshop facilitated by the Concrete Centre, part of the Mineral Products Association, to assess the capability of the Scottish supply chain. Workshop attendees included representatives covering the full range of concrete industry constituent parts and contractors. The suitability of existing port facilities for construction and launch was assessed based on in-house port data.

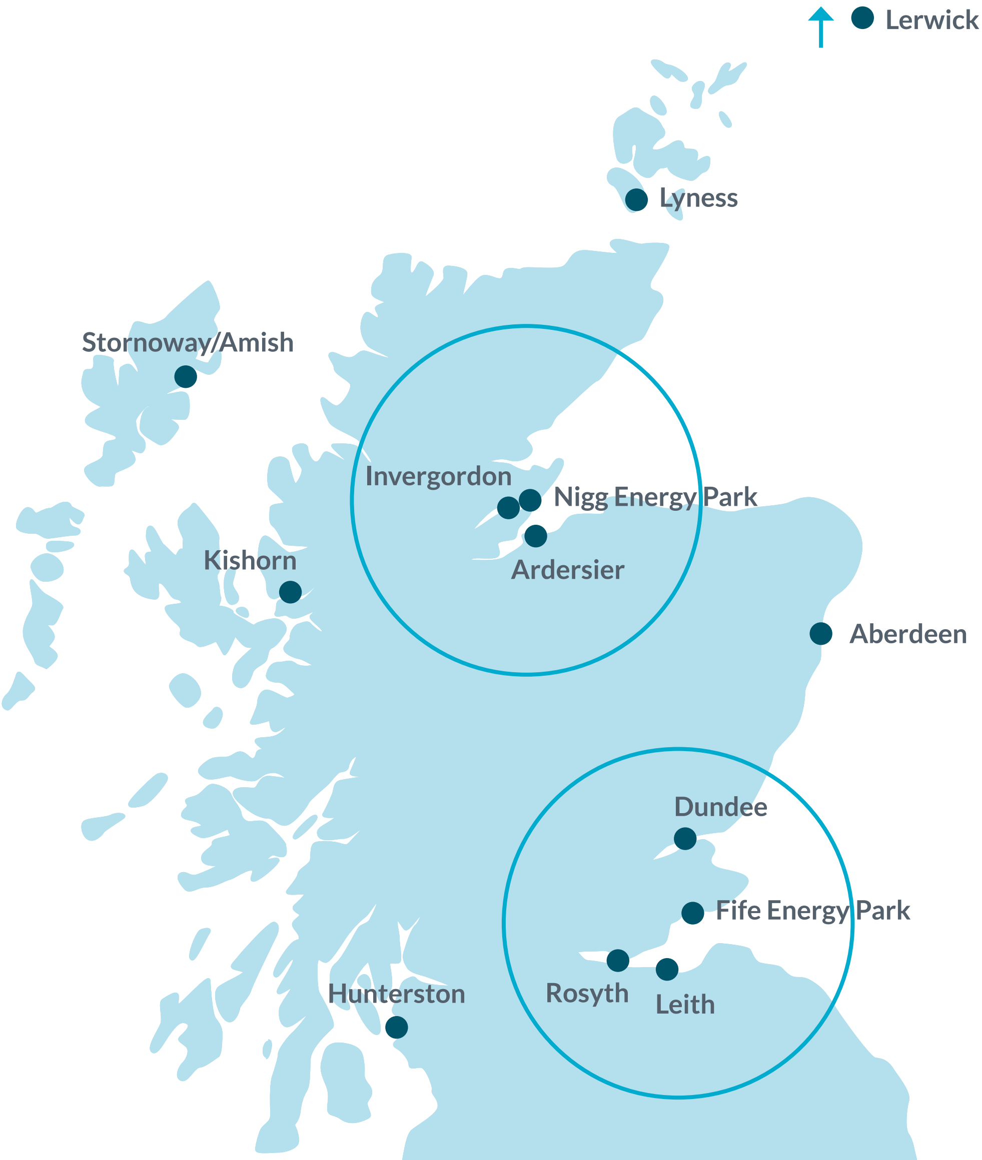

Figure 1: Ports and port clusters for concrete substructure manufacture

FINDINGS

SCOTLAND HAS THE CAPABILITY

The study found that the Scottish concrete supply chain already has sufficient capacity in most areas, including the supply of "lower carbon" concretes. While some constraints exist if supply is assumed to be exclusively from Scotland, the study concluded that there was enough time for these supply gaps to be closed.

	Could be fully sourced in Scotland (in baseline scenario)		Comments
	Now	2030	
Aggregates	Yes	Yes	• The baseline scenario is estimated to use ~30% of Scottish crushed rock aggregate supply. • There is significant logistical benefit to local sourcing.
Cement	Yes	Yes	• Carbon allocations influence cement production volumes. • Some lower carbon cement constituents are currently imported but are likely to be available in the UK by 2030. • A number of Scottish companies are already committed to net zero cement by 2050 and there is progress locally and globally on innovation to achieve this.
Rebar	Partially	Likely	• Only one rebar producer with sufficient capacity is available in the UK (Cardiff). Baseline scenario would use 10% of Cardiff producer's capacity. • The baseline scenario would exceed the current Scottish rebar supply capacity by 100%. • On-site facility for rebar cutting and forming would need to be set up at port.
Formwork	Likely	Yes	• Scottish-based suppliers would be able to supply for precast options. Slip forming (where required) would need specialist skills and rigs that are not currently manufactured in the UK.
Post-tensioning	No	Likely	• Currently no domestic supply in Scotland but inward investment likely with sufficient demand.

Table 2: Materials and availability in Scotland

THE ECONOMIC IMPACT IS LIKELY TO BE SIGNIFICANT

The study did not involve an economic assessment, but the findings do suggest that the creation of a manufacturing facility in Scotland would be significant in the context of the existing Scottish concrete construction industry's activity. For comparison, a concrete floating substructure manufacturing facility producing 33 x 15 MW units a year would utilise between two and four times the amount of concrete required for the Queensferry Crossing annually. Importantly, the study found that the Scottish concrete supply chain is experienced in establishing the local infrastructure and logistics necessary for a project of this scale.

GETTING THE RIGHT PORTS IS ESSENTIAL

Having the right port infrastructure is essential to enabling the cost-effective manufacturing of concrete substructures in Scotland. The study identified Hunterston, Kishorn, Port of Cromarty Firth (Invergordon) and Ardersier as high-potential Scottish facilities for concrete substructure manufacturing. These facilities all require development but were judged to be highly suitable for concrete substructure manufacture. Suitable capacity could be developed at other sites if investment was available.

Geographic clusters of potential sites were also identified, including the Cromarty Firth and the Forth and Tay. Clustering of port capacity, infrastructure and complementary activity would be beneficial to maximise capacity and available laydown area, and to share skills and develop the local supply chain.

The infrastructure required to support manufacturing includes adequate laydown areas, quayside to accommodate large transport and installation vessels, and sufficient entrance/quayside draft. Competition from other users for this kind of facility is a potential challenge, particularly oil and gas decommissioning and bottom-fixed offshore wind.

LOW CARBON CONCRETE

Given the volume of material that would be needed for substructure manufacturing, it is essential to prioritise the use of 'lower carbon' concrete, which uses lower carbon cements. These cements are a blend of cementitious materials and as a result can achieve a significantly lower carbon footprint for the concrete. The study found that some of these alternative materials are imported into the UK, but other materials, with domestic supply potential, are likely to be more available based on the timescales of this project.

Indeed, it is possible that the prospect of concrete floating substructure manufacturing should encourage academic and supply research in Scotland into low carbon concrete options, stimulating other industrial opportunities.

HOW TO TRIGGER SUPPLY CHAIN INVESTMENT

An important barrier to securing concrete substructure manufacturing in Scotland is the need for suppliers and port owners to be confident that they can secure enough orders to justify the high cost of setting up a site.

Industry feedback was that anticipation of an order of 33 units (as considered in the study) would probably not be sufficient to trigger the necessary investment in port improvement and site development and a longer pipeline of projects (or further project phases) would be required.

NEXT STEPS

To realise the opportunity of concrete substructure manufacturing in Scotland, further work is required. This should be undertaken collaboratively by developers, Scottish Government, development agencies and the supply chain. The following topics have been identified as early priorities for further investigation.

DEMONSTRATING THE BENEFIT TO SCOTLAND

- Benchmark the cost of concrete substructures constructed in Scotland against imported substructures to confirm they are a viable solution
- Quantify the holistic economic and employment impact of a concrete substructure manufacturing facility (including material supply)

MATERIAL SUPPLY

- Quantify the pipeline of floating wind projects that could use concrete substructures to define the potential scale and timing of future demand for material and components
- Investigate the timescales and triggers for increasing material supply within Scotland (and how this can be coordinated with floating wind demand)
- Produce a roadmap to accelerate and incentivise the development of low carbon concretes by Scottish academics and supply chain

PORT/SUPPLY CHAIN DEVELOPMENT

- Undertake more detailed research into the specific port infrastructure requirements needed for concrete substructure manufacturing facilities
- Engage with port owners to understand how Scottish ports (or clusters of ports) could meet demand, and to quantify the infrastructure investment needed
- Engage with suppliers to understand the cost structure of a manufacturing facility and the commercial triggers that would enable them to invest, e.g. the scale of committed project pipeline
- Investigate policy/funding mechanisms that could give confidence to port owners and suppliers to develop sites in time for ScotWind projects

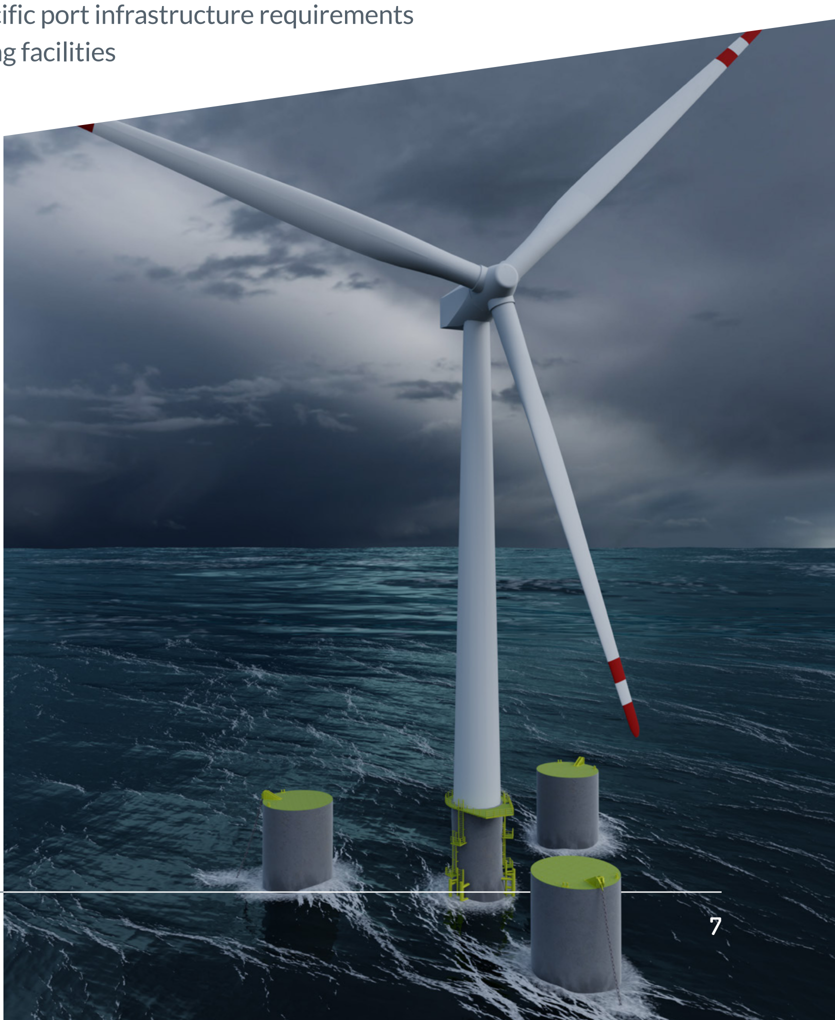

Image: Patented OO-STAR technology developed by Dr.Techn Olav Olsen AS and is 100% owned by Floating Wind Solutions AS

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