LOCAL HERO

Floating offshore wind offers an enormous opportunity, both for the UK's energy security and for local supply chains – but we need to act fast. Tony Whitehead reports

It is the year 2035 and, off the coasts of Scotland, Wales and Cornwall, hundreds of huge new turbines are turning in the wind. They form a major part of the UK's transition to green energy and, unlike those nearer land, are situated in deeper offshore waters where wind speeds are often higher and more consistent. Because of this, they are not fixed to the seabed, but instead rise from vast floating substructures. Each is the size of a football pitch and the depth of a ten-storey building – the enormous mass necessary to provide stability for turbines themselves as tall as the Gherkin in London. Together these turbines will produce up to 24GW of power – more than eight times the output of the new Hinckley Point C nuclear plant.

This is no speculative vision, but part of a settled plan. The Crown Estate has already let some of the development leases for these extraordinary deep-water wind farms. By 2029, designs will have been finalised and the first of hundreds of floating substructures will be under construction.

Although Britain is a world leader in the deployment of offshore wind, this will be of a different order to anything seen before, according to Matt Hodson, chief operations officer of Celtic Sea Power. "The Crown Estate is about to let 4GW-worth of leases in the Celtic Sea, the deep waters to the south and west of Cornwall. This alone will probably involve deploying 270 substructures over a period of about six years, or nearly one a week. Depending on the design and materials used, the substructures can weigh up to 20,000 tonnes – so that is quite a call on local resources and supply chains."

A challenge but also, says Hodson, a once-in-a-lifetime economic opportunity: "Celtic Sea Power is owned by Cornwall Council and we want to ensure the benefits of offshore wind come back to our region. If we don't prepare now, there are any number of overseas interests who will jump at the chance to get involved."

The case for concrete

As to what kind of preparations are required, Celtic Sea Power recently presented a paper detailing how the region can supply the needs of floating offshore wind (FLOW) developers. There are different designs, but essentially substructures can be made from either steel or concrete. Several studies have suggested that concrete offers the lower-carbon procurement method, with reduced transport

Below The 88MW Hywind Tampen wind farm, developed by Equinor, consists of 11 turbines in 260-300m deep waters 140km off the coast of Norway. The turbines are mounted on floating concrete structures with a common anchoring system

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emissions being a major factor. A lifecycle analysis produced for the government’s Offshore Renewable Energy Catapult research programme found that a concrete semi-submersible substructure produced 36% of the emissions associated with an equivalent steel structure, and that concrete remained the lower carbon option even when a recycled steel option was used in place of virgin materials, and transport was excluded. This aligns with the findings of a Norwegian study by consultant DNV, which concluded that concrete substructures were between 2.5 and 5 times less carbon-intensive than steel, depending on the design and the end-of-life strategy.

“We believe the concrete option also has the potential to deliver vastly better returns for our local economy,” says Hodson. “Current steel fabrication facilities in the UK may struggle with the capacity to produce these things at the rate required – so if you choose steel, that work will probably end up being done elsewhere in the world, with the floating structures being shipped or towed to the Celtic Sea Region. That increases their carbon footprint, and the risks– both as a result of the hazards of the journey, and because of the volatility of the global steel market.” The UK is not the only country to be replacing its fossil fuel infrastructure, he adds, which will place added pressure on supply chains for critical materials.

A local solution

On the other hand, the UK does have an aggregate and concrete industry that could supply what is needed. “When we workshopped the concrete substructure scenario with our local concrete supply chain, they didn’t even blink,” says Hodson. “After all, they are currently turning over these kinds of quantities with Hinckley Point which, when complete, will contain 1.8 million m^3 of concrete. We also have sufficient steel reinforcement capacity in South Wales, and a number of major ports that can handle this kind of work.”

The arguments in favour of concrete substructures are, if anything, even more persuasive when applied to FLOW in the North Sea. With 24GW of generating capacity to be constructed here by 2035, the opportunities are proportionately bigger, and with economies of scale thrown in.

Paul O’Brien is senior development manager for the energy transition and net-zero team at Highlands and Islands

Photo: Ole Jørgen Bratland / Equinor

Photo: EDF Energy Renewables

Above Turbine substructures under construction. Each can weigh up to 20,000 tonnes

Enterprise, and also cluster manager for DeepWind – a supply chain organisation for offshore wind with over 850 members from industry, academia and the public sector. He says: "Steel does not have the opportunities for local content that concrete offers – so I'm glad to say most developers have been willing to consider concrete options. It's a local solution with a short supply chain – which makes it attractive in the light of the recent collapse of some global supply chains as a result of Covid and Ukraine. We have a very good civils industry here in the UK , and we know we can do it."

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O'Brien believes the case for concrete as a low-carbon solution could be strengthened if fabricators are able to deploy the latest concrete technology. "We already know that the embodied carbon of a concrete structure can be lowered by using cement substitutes like fly ash or blast-furnace slag, so we need to ensure supplies of those materials. Other newer forms of even lower carbon concrete are being developed – so they need testing and to be approved for use as soon as possible. Carbon content might be lowered further by replacing some rebar with composite or basalt alternatives."

FLOW developers are becoming more aware of concrete's advantages, he adds. "Nearly all have looked at concrete, and most have at least one concrete substructure in their shortlist."

With the size of turbines increasing, the number of substructures needed per GW is falling. "So the structures themselves are getting bigger, and the fabrication facilities are also going to have to be bigger. To justify their creation you need a certain throughput of business over time – ideally 25 to 50 substructures a year over many years. The Scottish market is easily big enough to justify that kind of capacity."

O'Brien does admit, however, that the sheer scale of such an operation could cause localised supply chain issues. "We do not, for example, want aggregate and cement for the concrete being trucked by road from multiple quarries and plants all over Scotland and beyond. Nor do we want substructure construction to be competing for resources with other major infrastructure projects elsewhere in the UK, such as new rail or nuclear projects. That's why it's important that we identify and secure the right resources now – particularly coastal quarries which can ship material direct to substructure fabrication facilities."

In practice, this means that well-located quarries must be ready to provide considerable amounts of aggregate, as well as limestone for cement, from around 2029, with the capacity to continue for many years. This will not happen automatically, says Mark Russell, executive director at the Mineral Products Association.

"To begin with, there is an issue with replenishment. Every year, we carry out our mineral planning survey where we track aggregate sales versus new permissions to extend existing quarries or open new ones. That is showing, on a 10-year average, that crushed rock is being used nearly twice as quickly as it is being replaced. Sand and gravel is running at a 63% replenishment rate." In other words, they are being used faster than new permissions are being granted. "We also forecast that consumption will rise in the coming years – and that's without factoring in mega-projects like offshore wind. So you either have to replace the reserve or find other ways to meet the demand."

Social value

The alternatives are not attractive, and especially so in the context of FLOW: either material travels further through the UK to supply the fabrication facilities (raising the carbon footprint of the material and putting pressure on road and rail systems) or material has to be imported from overseas – far from an optimal solution in terms of carbon, cost or social value. "Some of the regions concerned – Cornwall, South Wales, parts of Scotland – are places that could really benefit from this," says Russell. "It would be a huge opportunity missed if the business went abroad."

So how much social value could substructure fabrication deliver? Celtic Sea Power estimates that to produce 50 of the larger substructures per year would require 900 round-the-clock shift workers, creating more than 2,000 direct jobs on site. Many more would be created or supported throughout the aggregate industry supply chain. Hodson points out that Hinkley Point C has a "6,000-strong battle-hardened workforce with a proven capability of 27,000m^3 of concrete per month".

It seems fortuitous that Hinkley Point will be winding down just as FLOW is gearing up. Similarly, the offshore oil and gas industry has a large workforce skilled in both large-scale fabrication and offshore installations. As oil and gas extraction declines, those skills could support a Scotland-based substructure sector.

New extraction planning permissions can take between five and 10 years to secure – so planners and local authorities should already be considering what might be required if their areas are to fully benefit from the FLOW opportunity. Russell acknowledges, however, that quarrying is seldom popular, and of course planners have to listen to objections. "That's local

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democracy. So we have to help planners and local populations see why this material is needed and the very considerable benefits that could result. If we get this right, then FLOW will be economically game-changing for the regions involved."

He suggests two regulatory changes that might help to strike a balance between local concerns, regional prosperity and broader national interest. National and regional forecasts of demand used to be produced by government and were reflected in published guidelines for aggregates provision. These were an integral part of the Managed Aggregates Supply System that set out the amount to be provided in each region of England over a 15-year period. Unfortunately these have not been kept up-to-date, and each planning authority now relies on its own forecasts, which may underestimate the need and lead to under-provision.

"Localism does not really suit the needs of major national infrastructure," says Russell. "A return to something like the former system would help. It's local democratic accountability through the planning system that determines whether extraction can take place or not, so there has to be clear visibility about the national need, or it's very easy to say no." The government has listened to feedback from industry and is now working on new guidelines, he adds.

Secondly, says Russell, planning applications for major projects do not require developers to provide information on where their materials are coming from. "It seems odd that they have to be quite detailed about how they will dispose of waste, but it is simply assumed that the necessary materials will be supplied. And yet where they come from and how they are transported can have big impacts locally."

Nature restored

Something else that should help bring planners and local communities on side is the aggregate industry's admirable track record when it comes to restoring former quarries. "It is not always appreciated that our industry has been in the restoration business for a long time and we have a lot to be proud of," says Russell. "It is only from this year, for example, that housing and other developments must show a 10% net gain in biodiversity. Quarry operators have been achieving far more than that for many decades."

MPA members have so far delivered over 80km² of "priority" habitat through the restoration and stewardship of former extraction sites, deemed to be of principal importance conserving biodiversity, and the industry has a further 110km² of priority habitat planned as part of the restoration of existing sites.

Besides the close working relationships that MPA member companies have nurtured on the ground, the MPA has formalised partnerships with key conservation bodies including the Bumblebee Conservation Trust and the Freshwater Habitats Trust. Numerous other organisations also collaborate with MPA and its members, including most of the 46 local Wildlife Trusts, the Bat Conservation Trust and the Mammal Society. MPA also has a special relationship with the Royal Society for the Protection of Birds, which has taken the lead on the impressive Nature After Minerals project.

Russell points out that former extraction sites are also providing high-quality leisure facilities, such as the Cotswold Water Park, or space for housing, as at Chipping Sodbury, Gloucestershire, where the site of the former Barnhill Quarry has been transformed into a new neighbourhood.

These examples are good evidence that extracting essential materials seldom results in long-term loss for the areas concerned. Quarries can be restored. Economic opportunities like floating offshore wind, however, do not come along very often – and once lost, they are gone forever.

Below The Floodplain Forest Nature Reserve near Milton Keynes. The site was created in partnership with Hanson, which undertook gravel extraction and landform restoration between 2007 and 2016. The restored habitat was carefully designed to resemble the prehistoric condition of the floodplain

Photo: Nature After Minerals