OCEAN ENERGY

Waiting in the waves

Simec Atlantis, one of the world's most active tidal energy companies, prepares a turbine for installation.
Photo: Simec Atlantis

The urgency of the climate crisis means it's high time to get serious about harnessing the power of the oceans. *Andrew Mourant* looks at how the wave and tidal sector is finally beginning to be established at several sites around the world.

Investment in wave and tidal energy has long been inhibited by the sheer cost of building in the ocean. What's more, there's the risk of storm damage to consider, as well as maintenance costs and the sensitivity of marine environments. More money and research are needed if ocean energy is to catch up with other renewables. This means co-operation on a big scale: research institutes, funding bodies, public authorities, utilities and the supply industry all need to get on board.

Industry optimists claim the potential of the sea is enormous. In October, network body Ocean Energy Europe (OEE) predicted that 2.9 GW could be deployed annually by 2030 around the continent, accounting for 92% of global output. Costs could be reduced so that price of tidal energy would be €90 per MW, while wave power would cost €110 per MW.

By 2050, OEE predicts wave and tidal sources could deliver 100 GW of capacity – equivalent to 10% of Europe's electricity consumption. Crystal ball-gazing from those with a vested interest should be treated cautiously, but as collaborations mature, there may be grounds for optimism.

In February 2020, the European Marine Energy Centre (EMEC), which provides sea testing facilities, listed 97 wave and tidal projects globally. Tidal is farther ahead in contributing to the worldwide grid than wave, which has had a chequered history, and for which technologies are still evolving.

Waking up to wave power

The world's first commercial operation, Pelamis Wave Power's Agucadoura farm off Portugal's north-west coast, was short-lived. Its three generators began producing 2.25 MW in September 2008. The long-term aim was to generate 22.5 MW for state-run power company Energias de Portugal. But the project was plagued with technical and financial problems. The global credit crunch put a stop to the reinstallation of faulty generators and the farm shut down.

The Sotenäs wave energy project, off Sweden's west coast, was also ill-fated. Construction began in 2010 and it was commissioned in 2016. Using energy-capturing buoys, it was intended to provide an output of about 10 MW, making it the world's largest demonstration project of its kind. Its design comprised a coupled linear wave energy generator attached to the seabed, connected via a line to a buoy on the sea's surface.

Sotenäs was jointly financed by power generator and retailer Fortum, wave technology company Seabased, and the Swedish energy authority. Research and development involved specialist academics at Uppsala University. However, by January 2019, the project ground to a halt after Seabased, citing 'multiple factors', liquidated the subsidiary company that made its generators and buoys.

The difficulty with wave energy technology lies in the complexity of harnessing its power. Attempts to do so lead to many and varied designs – there's no shortage of trial projects. Swedish firm Eco Wave Power (EWP) is among the pioneers. Since 2014, it has operated an off-grid pilot power station in Jaffa Port, Israel. The station allows for the testing of new components along with floater designs and materials. In October 2018, EWP was awarded an Israeli government grant to expand the station to 100 kW and connect to the Israeli national grid.

EWP is also active in Gibraltar, where, in 2014, it signed a 5 MW power purchase agreement with the local government and electricity authority. The station, still in development, sits at a former World War II ammunition jetty.

Could a revival of wave power in Portugal be on the cards? Recently EWP joined forces with Portuguese engineering and construction company Painhas. EWP's role is to provide technical support for a 20 MW project being developed in a concession agreement with the port authority of Leixoes.

Tidal test runs

Although Europe is a stronghold of tidal research and development, the world's largest power plant is found in South Korea at Lake Sihwa, with a capacity of 254 MW. Opened in 2011, the $560m project was financed by the South Korean government.

Now Korea's Institute of Ocean Science and Technology (KIOST) has contracted EMEC to help develop a tidal energy test site on the Jang-Juk Strait in Korea's southwestern sea. It will have a 4.5 MW grid capacity and is

expected to be operational by 2022. EMEC's technical support for KIOST includes reviewing the cable layout, protection and maintenance, electrical infrastructure, and grid connection.

Before Lake Sihwa came on stream, the La Rance tidal power plant in Brittany – capacity 240 MW and built between 1961 and 1966 – was the world's biggest. Its barrage, spanning the Rance estuary, is 145 m long. Power is generated through 24 reversible bulb turbines with a rated capacity of 10 MW each.

In terms of developing tidal power, the UK's marine energy tech firms have a long global reach. Edinburgh-based Simec Atlantis (SA), for instance, is involved several projects in Asia. SA is providing the turbine and onshore systems for China's largest tidal current demonstration project, part of a programme funded by the State Oceanic Administration (SOA). In April, a demonstration 18 m SG500 turbine was deployed at a grid-connected test site near Daishan, operating at 500 kW capacity.

In Indonesia, SA is working with SBS International on delivering up to three 150 MW tidal stream projects around the islands of Bali and Lombok. A 10 MW demonstration phase is due to start next year. SA and SBS will deploy 24 m rotor diameter AR2000 turbines across all phases. Power will be sold to Indonesia's state-owned electrical utility company PT Perusahaan Listrik Negara under a 30-year agreement. The total cost of the commercial array has been estimated at $750mn.

SA is also working with Gujarat Power Corporation to complete the concept design and consent process for a 250 MW project in the Gulf of Kutch, north-west India. Gujarat has a long coastline, and the Ranwara Shoals create a shallow region through which flow is accelerated, ideal for deploying tidal turbines.

The Gujarat state government has funded studies for the first 50 MW of a commercial scheme. Part of SA's role is to monitor policy developments within the Ministry of New and Renewable Energy – the current focus is on developing other sites.

In Japan, SA is providing a full AR-Series turbine system (turbine, foundation, cable and onshore infrastructure) under a lease agreement for a state-funded project in the Goto Islands. This was due to be installed in late November 2020.

Closer to home, the MeyGen tidal energy project will be one of world's biggest upon its completion – boasting an expected output of around 400 MW. Located in the Pentland Firth off the north coast of Caithness, Scotland, the project is 77% owned by SA.

In April 2018 MeyGen Phase 1A entered its 25-year operations phase. Since then, its four turbines have exported more than 30 GWh to the grid. The offshore lease currently permits up to 398 MW of tidal stream capacity to be installed and while MeyGen currently only has grid capacity for up to 252 MW, the site is capable of supporting the full project buildout.

Commercial bids

Energy World readers may recall EMEC's Managing Director Neil Kermode reflecting recently that UK government policy towards marine power has hardly been conducive to rapid progress. Mustering all hands to deck could be the answer, at least if the momentum behind the Anglo-French Tidal Stream Industry Energiser Project (TIGER) is any indication. Its mission is to show that tidal stream energy is a maturing technology which, with revenue support, could lead to production costs becoming competitive.

TIGER, which will last three years, launched in October 2019. It comprises 19 partners from the UK and France – a broad base of turbine developers, ocean energy demonstration sites, research bodies, and local and regional authorities. It was awarded €28m of EU money via the Interreg programme, to install up to 8 MW of generating capacity at sites around the south coast of England and the north of France.

According to Interreg, the theoretical tidal energy capacity in the Channel region is nearly 4 GW, enough to power up to 3mn homes. Besides trying to prove that such energy can, in stages, become cheaper, it aims to develop a UK/France supply chain. There's a focus on reducing component and installation costs, alongside improving system reliability.

Carolyn Reid, Programme Manager for Interreg France (Channel) England Programme, says the aim is to halve the generating costs of tidal stream energy from €300 per MW to €150 per MW by 2025, and to increase uptake. 'TIGER has enabled collaboration between organisations in the UK and France that may otherwise never have happened,' she says. In turn, costs should fall by 'learning through doing'.

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Interreg is keen to see installations at tidal channels and headlands, and with varying types of turbine. EDF-Hydro's open-sea test site at Paimpol-Bréhat in France will be upgraded to accept a wider range of turbine technology. In August, current and acoustic measurements were carried out there by SEENEOH, EDF and Bretagne Ocean Power, with certification of the turbine's power curve being carried out by EMEC. The data will offer a better understanding of the environment and Paimpol-Bréhat's potential for prospective tidal power developers.

One of TIGER's most ambitious schemes is Raz Blanchard, north of the Channel Islands in lower Normandy, home to France's strongest tidal current. Normandie Hydrolliene, a joint venture between SA and regional development agency AD Normandie, has been established with the long-term ambition of harnessing up to 2 GW of power from the Alderney Race, the eight-mile strait running between Alderney and La Hague, France.

In June 2020, Normandy's prefecture approved the transfer of a 12 MW tidal power development lease to Normandie Hydroliennes. Tim Cornelius, CEO of SA, said this would enable immediate progress in developing of one Europe's largest arrays and exploit Normandy's 'huge untapped' tidal power.

Raz Blanchard will explore the possibility of delivering energy profitably for less cost than the current offshore wind feed-in tariff of €150/MWh (for projects delivered between 2021-23); and creating a demonstration array using French-built RAR2000, 2 MW horizontal axis turbines. The plan is for a full multi-hundred-megawatt array to be online by 2024.

Wealth of potential

Ocean energy has been quietly making a case for itself for years – and it has expanded incrementally across the world. Whether it ever comes to be as prominent as wind or solar is a now a matter of government will and support. There is, quite literally, a wealth of potential energy in the world's oceans just waiting to be harnessed. Ignoring it would seem like a tremendous waste. ●