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RENEWABLES 2022
GLOBAL STATUS REPORT

2022

KEY FACTS

- **The ocean power industry** rebounded in 2021 as supply chains recovered from disruptions caused by the COVID-19 pandemic.
- **More than USD 180 million** in new investment flowed into the sector from diverse sources, including public funding programmes, private investment, initial public offerings and crowdfunding.
- **Maintaining revenue support** for ocean power technologies remains crucial for helping the industry achieve greater maturity.

OCEAN POWER

OCEAN POWER MARKETS

Ocean power technologies[i] represent the smallest share of the renewable energy market. Deployments increased significantly in 2021, with devices adding 4.6 megawatts (MW) of capacity to reach a total operating installed capacity of around 524 MW by year's end.[1]

Two tidal range systems – the 240 MW La Rance station in France and the 254 MW Sihwa plant in the Republic of Korea – account for the majority of this installed capacity. Tidal range systems operate similarly to hydropower; however, because potential locations are limited and large-scale environmental engineering is required, few proposals have been advanced to expand such systems.

The main focus of development efforts today is tidal stream devices and wave energy converters. Advancements in these technologies have been concentrated in Europe and especially in the United Kingdom, which has significant ocean power resources. Elsewhere, revenue support and ambitious research and development (R&D) programmes are spurring increased development and deployment in countries such as Canada, China and the United States.[2]

Tidal stream devices are approaching maturity, and pre-commercial projects are under way. Since 2010, around 40 MW of tidal stream capacity has been deployed, with around 15 MW currently operational.[3] Device design for utility-scale generation has converged on horizontal-axis turbines mounted either on the sea floor or on a floating platform.[4] Total generation exceeded 68 gigawatt-hours (GWh) as of the end of 2021.[5]

Wave power devices have yet to see the same level of design convergence. Developers generally aim to tap into utility-scale electricity markets with devices above 100 kilowatts (kW) and to meet specialised applications with devices below 50 kW.[6] Around 25 MW of wave power has been deployed since 2010, with around 3 MW currently operational.[7]

OCEAN POWER INDUSTRY

The ocean power industry rebounded in 2021 as supply chains recovered from disruptions caused by the COVID-19 pandemic and as significant new public and private investment flowed into the sector. Most capacity additions were test deployments, with developers continuing to demonstrate, refine and validate their technologies.

Six **tidal stream** devices totalling 3.1 MW were successfully deployed in 2021.

A 500 kW SIMEC Atlantis Energy (UK) tidal turbine was installed in Japan, producing more than 90 megawatt-hours (MWh) at high availability in its first five months[8] SIMEC's turbines also continued to generate power at the MeyGen array in Orkney, Scotland and have delivered more than 37 GWh since they entered into operation in 2016.[9] Also in Orkney, the European Marine Energy Centre (EMEC) deployed the 2 MW Orbital O2 device and the 2 MW Magallanes Renovables tidal platform.[10]

i Ocean power technologies harness the energy potential of ocean waves, tides, currents, and temperature and salinity gradients. In this report, ocean power does not include offshore wind, marine biomass, floating solar photovoltaics or floating wind.

In Canada, Sustainable Marine (UK) installed a 420 kW floating tidal energy platform in the Bay of Fundy, Nova Scotia, with grid connection scheduled for early 2022.[11] The French company Guinard Energies Nouvelles deployed two 3.5 kW devices, designed for use in isolated communities, in France and Togo.[12] Slow Mill Sustainable Power (Netherlands) commissioned a 40 kW device following prototype testing in the North Sea.[13] The Ocean Renewable Power Company (ORPC, US) deployed a second 35 kW RivGen unit in a remote Alaskan community, providing baseload power and reducing diesel consumption 60-90%.[14] **Wave power** projects continued to face significant delays, but 10 deployments occurred, totalling nearly 1.4 MW in capacity.[15]

Wello (Finland) deployed a 600 kW device at the Biscay Marine Energy Platform in Spain.[16] In China, the Penghu aquaculture platform completed 28 months of operation, and the 500 kW Zhoushan wave energy unit completed its first round of testing and a second unit was deployed.[17] Wave Swell Energy (Australia) installed a 200 kW floating oscillating water column device at King Island in Tasmania, and Azura Wave Power (New Zealand) deployed a 20 kW grid-connected device for testing at the US Navy's Wave Energy Test Centre in Hawaii.[18] Two small wave power plants were installed in breakwaters in the Republic of Korea and Norway, and a 1 MW breakwater project was agreed to in Portugal.[19]

Development of other ocean power technologies, such as **ocean thermal energy conversion** (OTEC), remains slow, and only a handful of pilot projects have been launched.[20] In 2021, São Tomé and Príncipe announced a public-private partnership to deploy a floating OTEC platform.[21]

Technology improvements and steep cost reductions are still needed for ocean power to become competitive in utility markets, and the industry has not yet received the clear market signals it needs to take the final steps to commercialisation. The lack of consistent support schemes for demonstration projects has proved especially challenging for developers, and dedicated revenue support is considered paramount for providing predictable returns until the industry achieves greater maturity.[22]

As of 2018, more than EUR 6 billion (USD 6.8 billion) had been invested in ocean power projects worldwide, of which 75% was from private finance.[23] A 2018 European Commission implementation plan estimated that EUR 1.2 billion (USD 1.4 billion) in funding was needed by 2030 to commercialise ocean power technologies in Europe, requiring equal input from private sources, national and regional programmes, and European Union (EU) funds.[24]

Although the sector remains highly dependent on public funding to leverage private support, the 2020 announcement of two large private investments totalling USD 13.7 million spurred additional momentum in 2021.[25] ORPC secured USD 25 million from an investment consortium; Eco Wave Power (Sweden) raised USD 9 million in its initial public offering; the owners of Minesto (Sweden) contributed EUR 4.4 million (USD 5.0 million) to support commercialisation; and three other developers – Nova Innovation (UK), Wavepiston (Denmark) and QED Naval (UK) – raised a total of USD 6.8 million through crowdfunding.[26]

Significant policy measures and public funding programmes were announced. The EUR 45 million (USD 51 million) EU-SCORES project and the EUR 21 million (USD 24 million) FORWARD-2030 project focus on the development of hybrid systems, such as ocean power co-located with wind, while the EuropeWave R&D programme will support the development of wave power by combining nearly EUR 20 million (USD 23 million) in national, regional and EU funding.[27]

The United Kingdom announced a GBP 20 million (USD 27 million) annual investment in tidal stream as part of its Contracts for Difference Scheme, aiming to drive technology development, lower costs and make tidal power more competitive with offshore wind power.[28] This could spur deployment of 30-60 MW between 2025 and 2027.[29] The five-year, GBP 10 million (USD 13 million) Ocean-REFuel project was launched to explore methods for converting ocean power into fuels.[30]

Deploying ocean energy at scale will require streamlined consenting processes.[31] Uncertainty about environmental interactions has led regulators to require significant data collection and strict environmental impact assessments, which can be costly and threaten the financial viability of projects and developers.[32] Current science suggests that the deployment of a single device poses little risk to the marine environment, although the impacts of multi-device arrays are not well understood.[33] This calls for an "adaptive management" approach that responds to new information over time, supported by more long-term data and greater knowledge-sharing across projects.[34]

Ocean power bounced back with 16 units deployed and **USD 180 million** in new investment.

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