IRENA
International Renewable Energy Agency

OFFSHORE RENEWABLES

POWERING THE BLUE ECONOMY

KEY FINDINGS

Oceans hold abundant, largely untapped renewable energy potential, which could drive a **vigorous global blue economy** in the years ahead.

Along with promising ocean energy technologies, the fast-emerging blue economy includes other offshore renewables, such as floating solar photovoltaic (PV) arrays and high-capacity offshore wind turbines, along with renewable-powered desalination and aquaculture.

Offshore renewable energy technologies offer clear synergies – and technology and job transition opportunities – with the offshore oil and gas industry, in addition to desalination and aquaculture, among others.

The International Renewable Energy Agency (IRENA) has released two in-depth studies on the vast potential of the world's oceans:

FOSTERING A BLUE ECONOMY: OFFSHORE RENEWABLE ENERGY

INNOVATION OUTLOOK: OCEAN ENERGY TECHNOLOGIES

The two studies highlight sustainable energy development opportunities for island and coastal areas, including small island developing states (SIDS) and some of the world's least developed countries (LDCs).

Ocean and offshore energy development can therefore align closely with the **Sustainable Development Agenda for 2030**, as well as giving island and coastal communities climate-safe recovery options amid the COVID-19 pandemic.

IRENA's research sees the potential for 20-fold growth in ocean energy capacity by 2030.

What are offshore renewables?

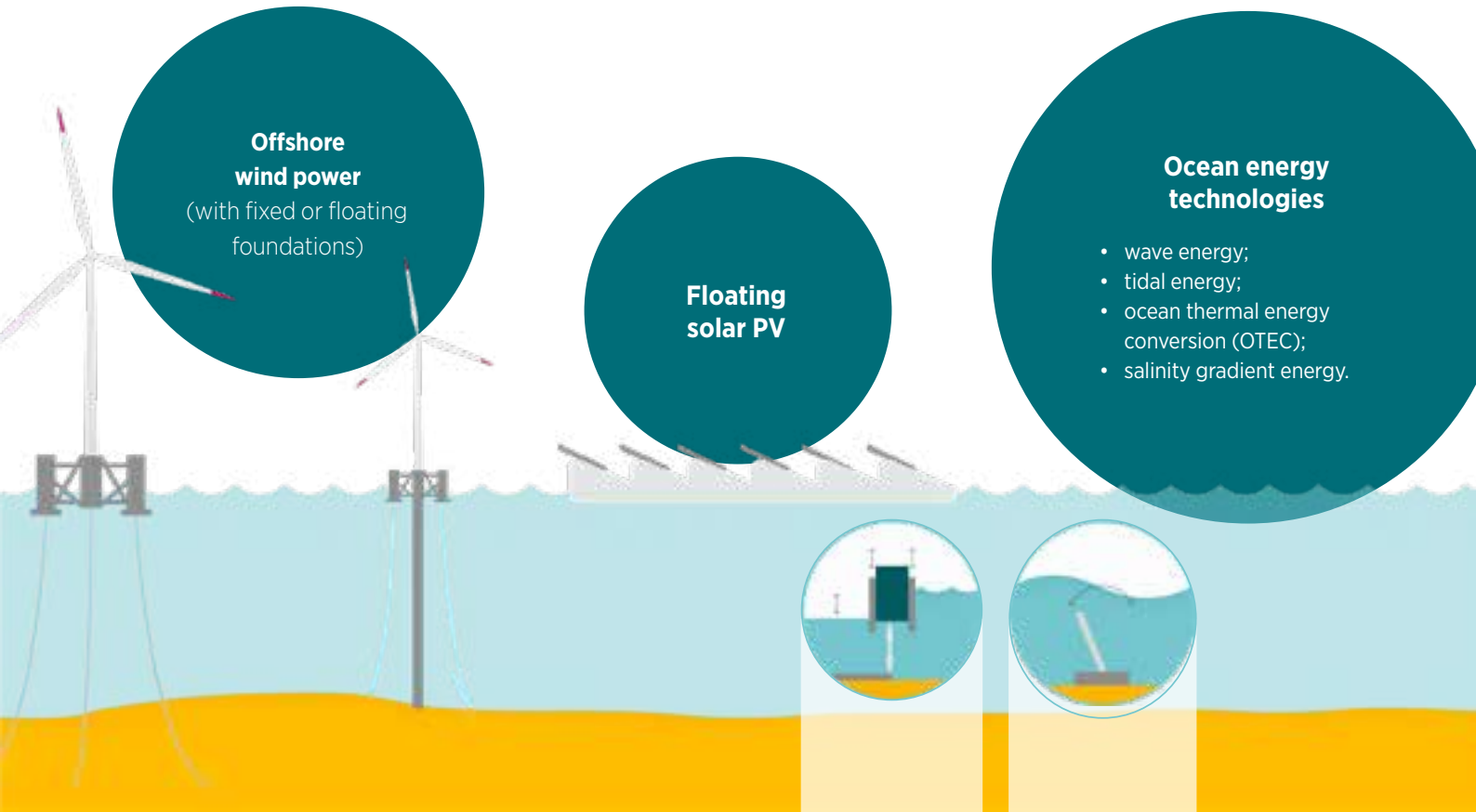
- Offshore renewables include:

Offshore wind power (with fixed or floating foundations)

Floating solar PV

Ocean energy technologies

- wave energy;
- tidal energy;
- ocean thermal energy conversion (OTEC);
- salinity gradient energy.



Benefits for SIDS and LDCs

- SIDS could become **major beneficiaries of the blue economy**, with offshore wind, floating photovoltaic (PV) and nascent ocean technologies helping to address acute small-island energy and water supply challenges.

Islands need:

  - ***Affordable and reliable access to electricity.*** *Renewables can replace costly power generation systems dependent on imported diesel and, with offshore options, reduce land-use pressure.*

  - ***Fresh, potable water supplies.*** *Renewable energy technologies can support sustainable local desalination.*

- Switching to renewables serves to **decarbonise power generation**, helping islands cut their carbon dioxide (CO_2) emissions, fulfil Paris Agreement pledges and contribute to the global fight against climate change.

- Offshore renewables, including ocean energy, can also meet needs for **shipping and cooling**.

- Remote or isolated coastal areas can face similar energy challenges, especially in LDCs. Offshore renewables can **create jobs, improve health, strengthen people's livelihoods** and foster wider socio-economic opportunities, including the provision of power for other offshore markets, such as **aquaculture, desalination and cooling**, while reducing the need to import costly fossil fuels.

- Offshore renewables can help to fulfil the **Sustainable Development Goals (SDGs)** adopted by the United Nations as global priorities for 2030.

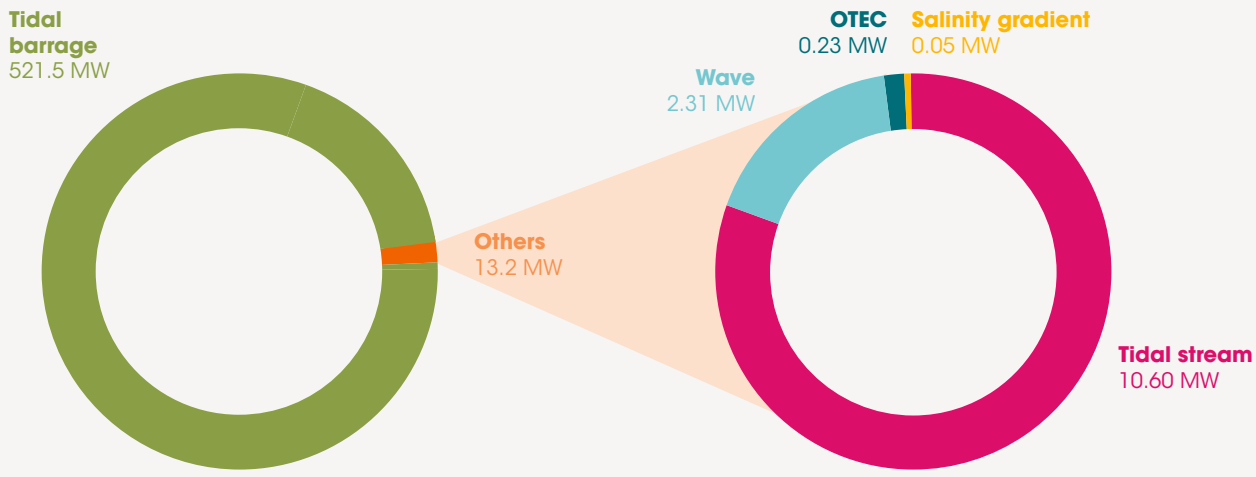
  - **SDG 7** aims to ensure affordable, reliable, sustainable and modern **energy access** for everyone.

  - **SDG 14** calls for conservation and sustainable use of **oceans, seas and marine resources**.

Ocean energy potential

- The cumulative installed capacity for ocean energy technologies worldwide currently amounts to **535 megawatts** (MW), which is negligible in comparison to the global installed capacity for all renewables today (around 2 600 gigawatts, GW).

Figure 1: Global ocean energy, 2020

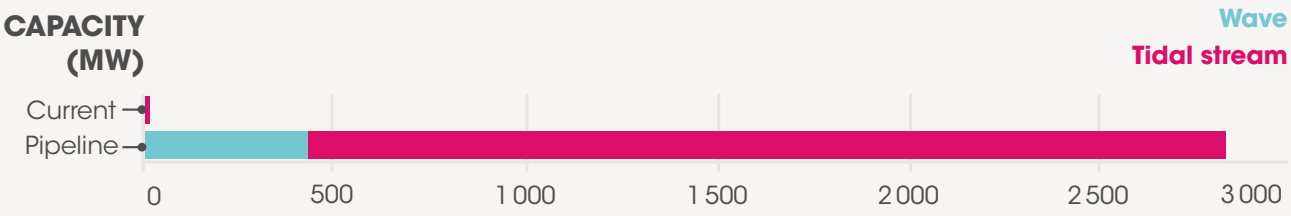


Source: IRENA ocean energy database

- From **tidal barrage technology** (521.5 MW; see Figure 1), which dominates the world's ocean energy output, mainly via three large projects in Canada, France and the Republic of Korea. However, the newly installed capacity, and ocean energy's expected future trend, is moving towards other technologies, such as tidal stream, followed by wave energy and ocean thermal energy conversion (OTEC).

- Tidal stream and wave projects currently being developed (excluding tidal range technology), if realised, would account for almost 3 GW of additional capacity worldwide (Figure 2). Most of this capacity exists in Europe (55%), followed by Asia and the Pacific (28%) and the Middle East and Africa (13%), with the remaining share being split between North America (2%) and South and Central America (2%).

Figure 2: Ocean energy projects worldwide: Current capacity versus expected pipeline



Note: Excluding tidal range technologies.

Source: IRENA ocean energy database

- Ocean energy could reach 10 GW of installed capacity by 2030, according to IRENA's projections.

- Ocean energy technologies offer high predictability, making them suitable to provide a continuous supply of power. This can be further complemented by variable renewable energy sources such as wind and solar PV.

- Ocean energy resources could theoretically generate between 45 000 terawatt-hours (TWh) and 130 000 TWh of electricity per year.

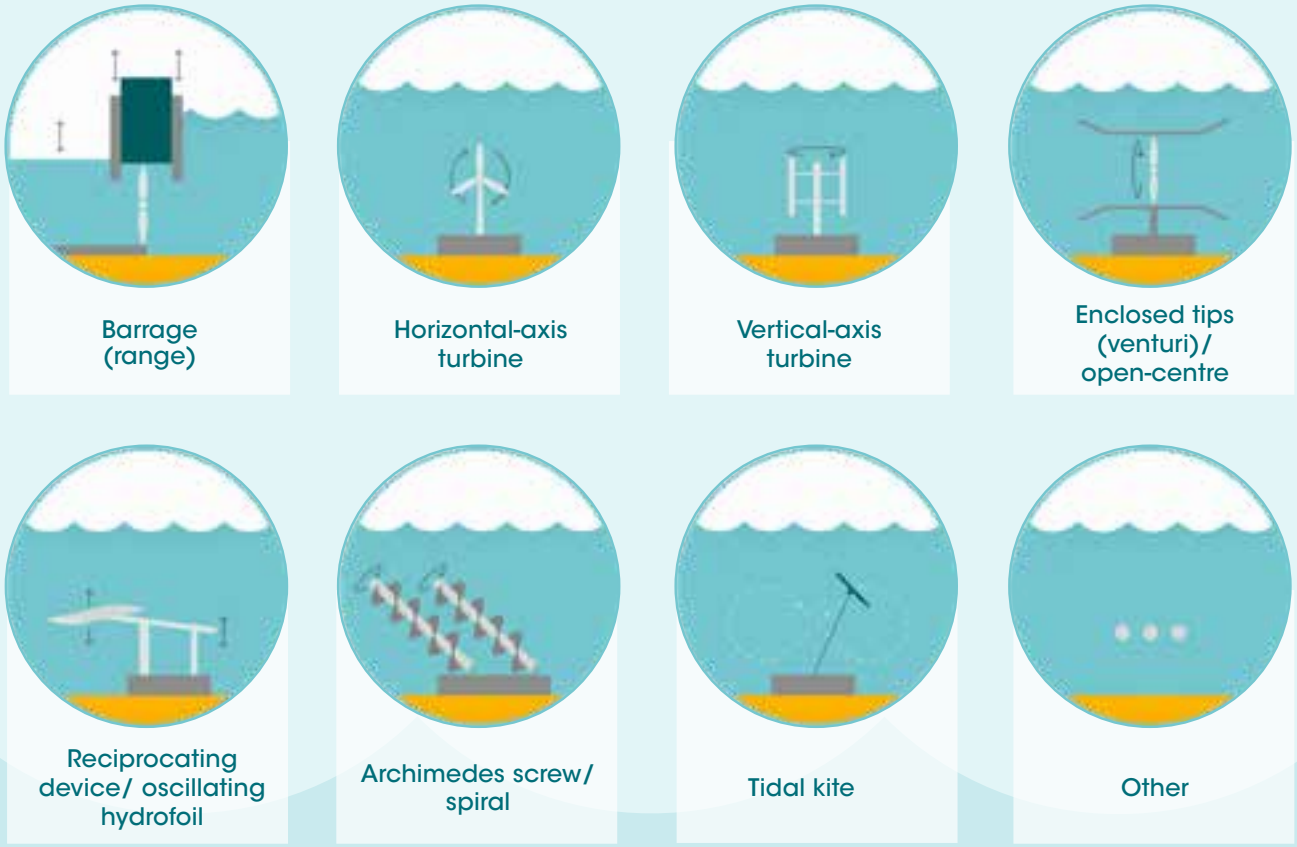
- Tidal stream and wave energy are being scaled up quickly, with 1 MW units coming online.

- Most ocean technologies are still at the prototype phase with some just starting to reach commercialisation.

Moving them forward calls for a focus on innovative business cases, accelerated research and development, financial support for initial development, and enabling policy and regulatory frameworks. It will also require more understanding of the technologies' environmental impacts, as well as regional co-operation on marine spatial planning.

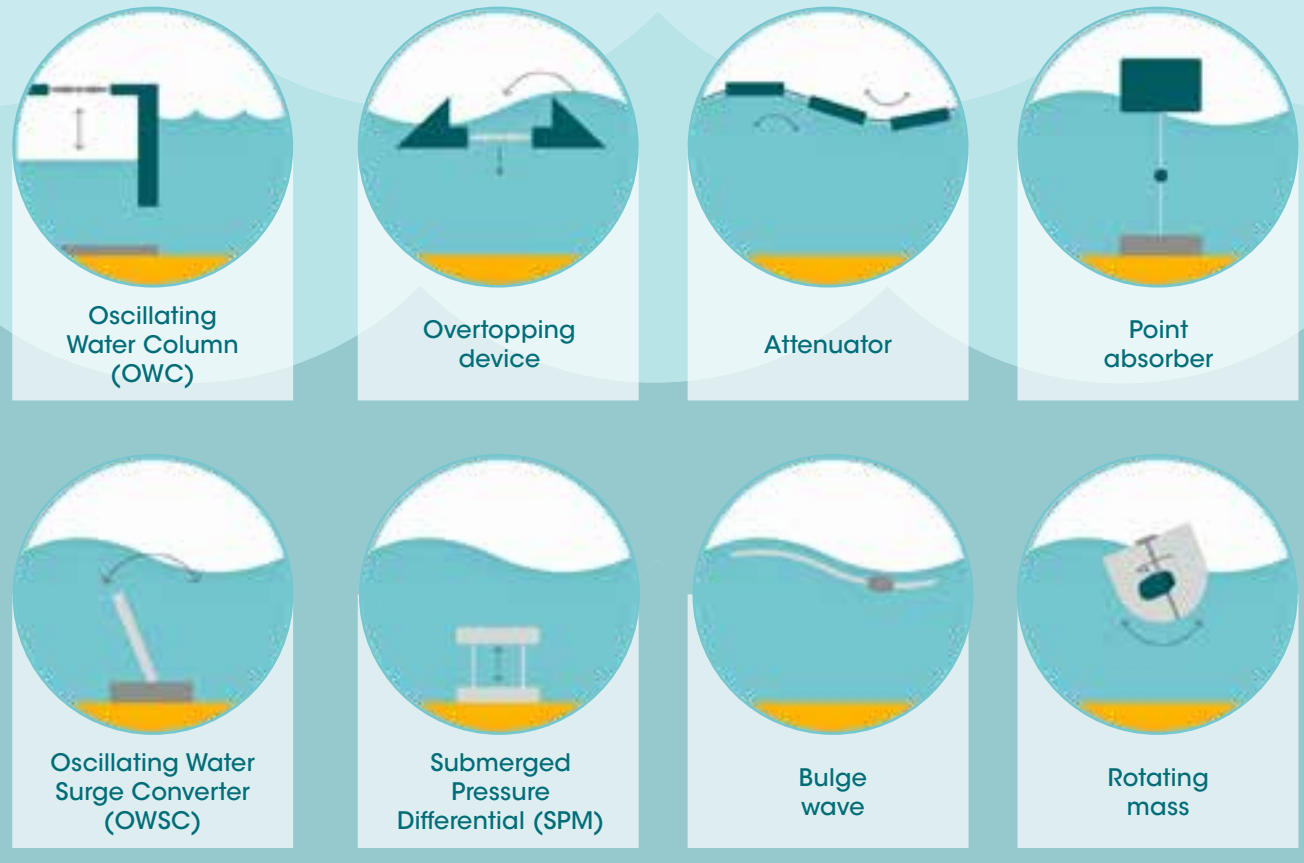
- While ocean energy is globally distributed, European countries such as Finland, France, Ireland, Italy, Portugal, Spain, Sweden and the United Kingdom, along with Australia, Canada and the United States, have been at the forefront of the market, with the largest number of projects tested, deployed and planned, as well as most project developers and device manufacturers.

Figure 3: Tidal energy technologies: examples of current prototypes



Based on IRENA, 2014 and EMEC, n.d.

Figure 4: Wave energy technologies: Examples of current prototypes



Based on EMEC, n.d., IRENA, 2014 and World Energy Council, 2016

Action on ocean renewables

- Europe aims at retaining its leadership in ocean energy development, maximising the benefits for the region through the recent offshore renewable strategy, a key element of the European Green Deal and part of the COVID-19 recovery package. Additionally, Canada is supporting the funding of its first floating tidal energy array of 9 MW, which is planned to be connected to Nova Scotia's power grid.

- Offshore renewable technologies, although not yet cost competitive with fossil fuels or more mature renewables, are set to become less costly over time, particularly as increasing deployment creates economies of scale.

- At IRENA's 10th Assembly in January 2020, member countries asked for expanded work on ocean energy and other offshore renewables. IRENA consequently aims to facilitate targeted collaboration on these key technologies, tailored to reflect the opportunities and challenges for future deployment in each country or region.

- In response to membership requests, IRENA established the Collaborative Framework on Ocean Energy / Offshore Renewables, which met in June and October 2020. Around 40 delegations from IRENA's Members and States in Accession took part, along with the Global Wind Energy Council and Ocean Energy Europe.

- Offshore renewables could be further promoted through engagement with the Group of 20 and through preparation of the agenda for the next major global climate conference, the 26th Conference of Parties to the United Nations Framework Convention on Climate Change (COP26).

This document summarises the findings of the studies ***Fostering a blue economy: Offshore renewable energy (IRENA, 2020)*** *(ISBN 978-92-9260-288-8)* and ***Innovation outlook: Ocean energy technologies (IRENA, 2020)*** *(ISBN 978-92-9260-287-1)*, both published by the International Renewable Energy Agency (IRENA), Abu Dhabi, in December 2020.

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