OIR
Australia's Offshore Energy Regulator

Harnessing wave energy

December 2022

The Offshore Infrastructure Regulator has responsibility for overseeing work health and safety, infrastructure integrity and environmental management for offshore infrastructure activities in the Commonwealth offshore area.

Riding the wave of change

The global wave energy sector has undergone significant change in recent years sparking interest in wave energy as a reliable source of renewable energy.

Substantial research into the potential for harnessing energy from waves has been undertaken to understand the challenges and opportunities associated with wave energy extraction. With over 250 wave energy developers worldwide[1] , there is considerable opportunity for further innovation and development of wave energy converters (WECs) with several devices in the prototype or commercial production phase.

WECs harness the energy of powerful naturally occurring wind waves and convert it into electricity, with the potential for additional outputs such as saltwater desalination. With wave activity both predictable and readily available, the potential for energy generation in Australia's nearshore and offshore areas is substantial.

The majority of Australia's premium wave energy resources are located along the southern margin as shown in **Figure 1** from Geraldton, Western Australia, encompassing South Australian and Victorian coastlines, through to the southern tip of Tasmania. This region represents world class wave energy conversion potential with abundant wave resources, proximity to coastal infrastructure, and associated land side manufacturing capability where energy demand exists. It is estimated that wave energy resources in this region could contribute as much as 11 % of Australia's energy needs by 2050[2].

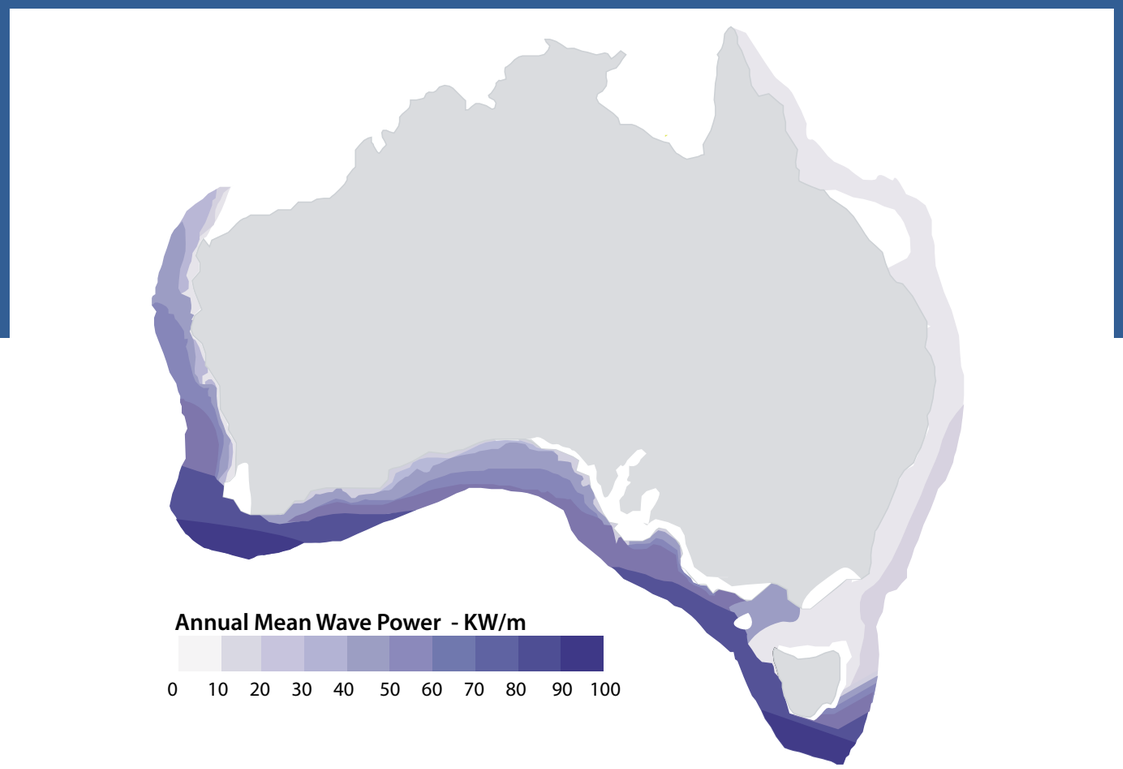


Figure 1. This map is for illustrative purposes only. Wave resource data has been adapted from the Australian Wave Atlas.

[1] Wave developers: EMEC: European Marine Energy Centre Limited
[2] CSIRO - Ocean Energy in Australia - CSIRO

What does a wave energy converter look like?

No single WEC design has been proven to be suitable for all offshore areas worldwide. With an extensive range of devices in development, designs are limited only by the specifics of the operating environment and the developer's imagination. Common forms of WECs are distinguished by the mechanism they employ to generate energy. These can include but are not limited to point absorbers, overtoppers, oscillating water columns, and attenuators.

Point absorbers such as those in **Figure 2** are similar to tethered buoys that sit on the surface of the water or are submerged below the water line. The motion of the waves causes the buoy to move up and down in the water column, engaging a mechanism attached to the seafloor or along the tethered buoy to drive electricity generation.

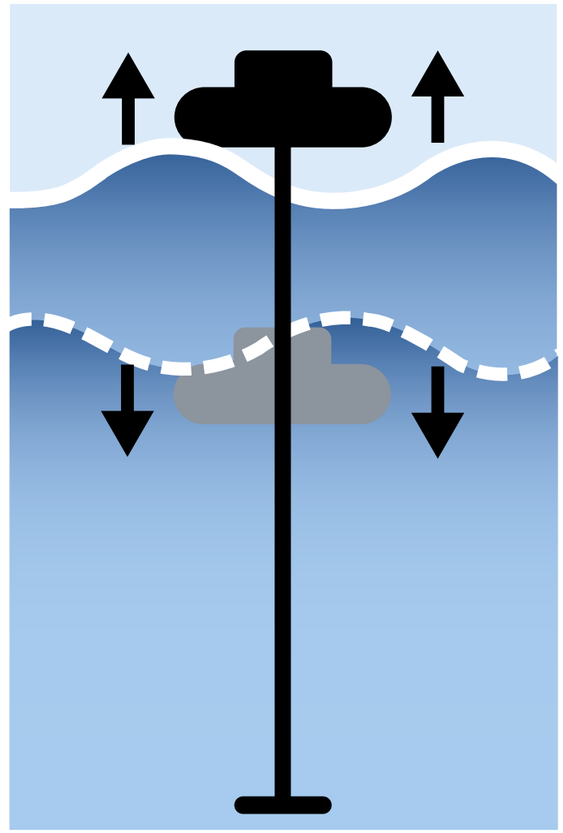


Figure 2: Example of point absorber technology

Overtoppers such as those in **Figure 3** act similar to hydroelectric generators. These devices can be fixed or floating structures. With each wave, water flows over the top of a reservoir wall, as the water within the reservoir is higher that the surrounding sea level it flows out through an outlet. Turbines placed within the outlet are driven by the outpouring of water which enable electricity generation

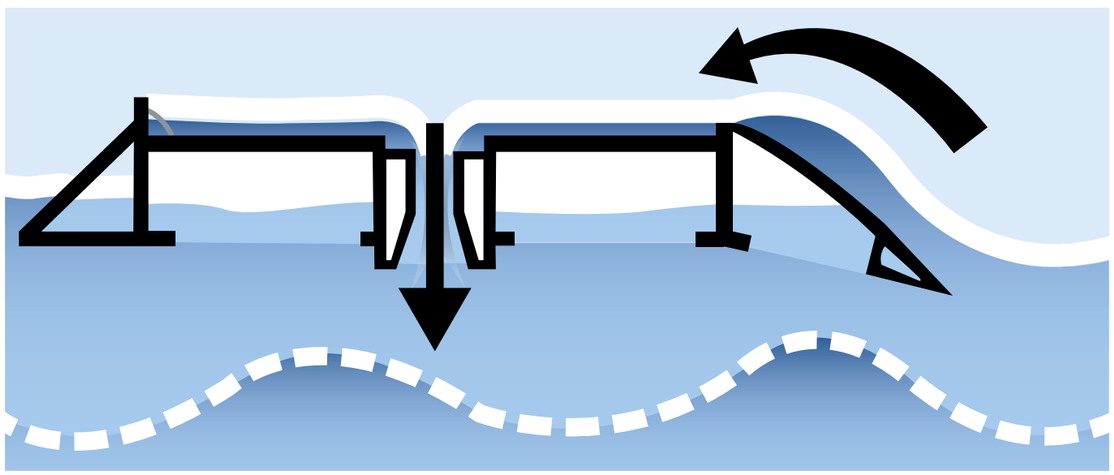


Figure 3: Example of overtopping device technology

Oscillating water columns such as those in **Figure 4** are generally fixed structures with a large cavity located below the waterline, similar to naturally occurring blowholes. The movement of waves in and out of the cavity drives air through a turbine located above the waterline, generating electricity with each wave.

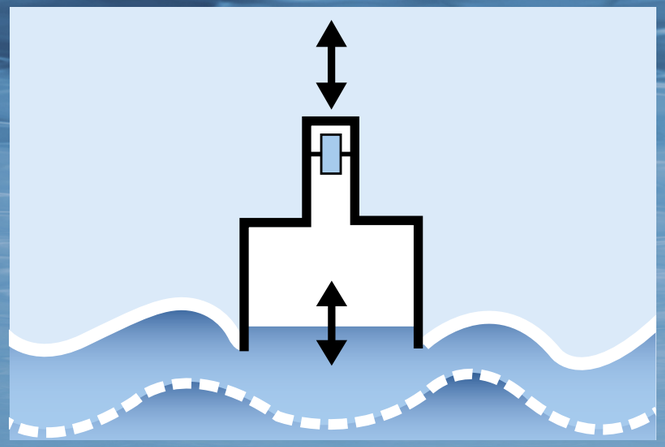
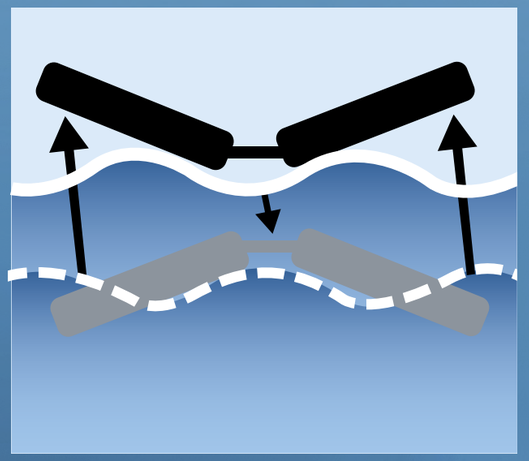


Figure 4: Example of oscillating water column technology



Attenuators such as those in **Figure 5** sit on the surface of the water, parallel to the waves, and use the motion of waves in both the horizontal and vertical axis. These large multi-section structures are tethered to the seafloor and use the rise and fall of waves to create a flexing motion that can be converted via energy systems to generate electricity.

Figure 5: Example of attenuator technology

Surge converters such as those in **Figure 6** are generally hinged paddles that are perpendicular to the wave direction. These paddles move back and forth and are attached to a pumping mechanism to generate electricity.

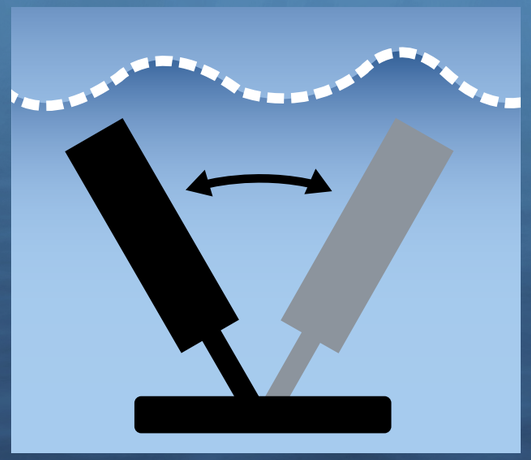


Figure 6: Example of surge converter technology

Where can you find a wave energy converter?

Just as there is an extensive range of WEC designs, WECs can be deployed in a variety of settings in the marine environment. WECs can operate in coastal and offshore environments and have the potential to connect with the entire water column from the sea floor, rising through the water column and emerging from the surface of the water. WECs generally do not sit high above the surface of the water and, in some cases, can be entirely submerged either resting on or tethered to the sea floor.

Standalone WECs units can be connected into arrays increasing energy generation potential. WECs can also be integrated into other offshore infrastructure including aquaculture facilities or be combined with other energy systems such as offshore wind turbines as represented in **Figure 7**. Integrating WECs with other offshore renewable energy systems has the potential to maximise energy generation and efficiency, reduce costs and potentially reduce environmental impacts

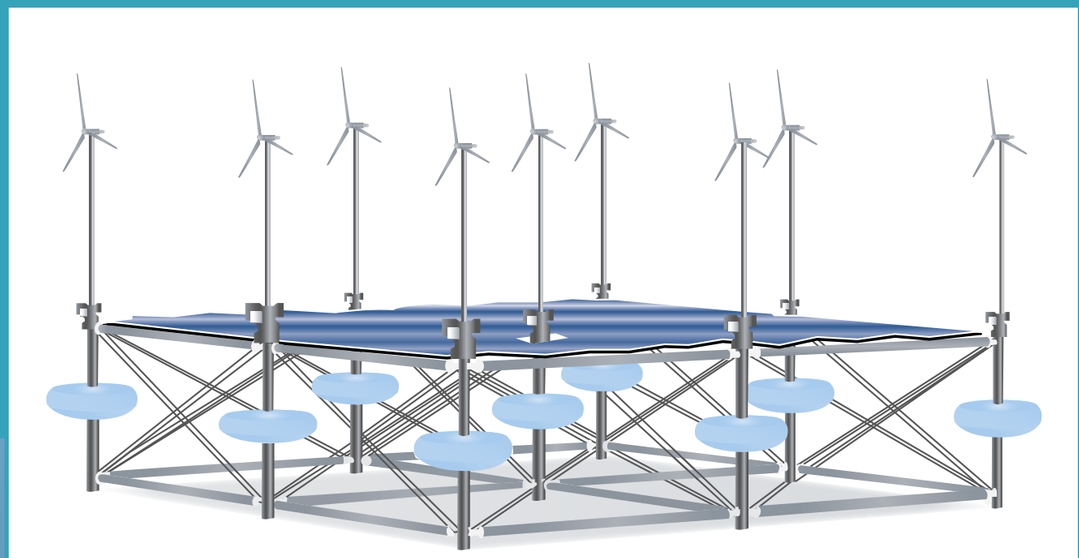


Figure 7: Example of an offshore wind and wave energy hybrid energy system.

The potential for wave energy in Australia

Australia possesses the largest wave energy resource of any country in the world. Total wave energy generation potential is over 1300 terawatt-hours per year, nearly five times Australia's energy requirements[3]. The potential for wave energy in Australia has been trialled through the installation and operation of prototype wave energy converters in state waters. Expansion into the Commonwealth offshore area offers the potential for greater wave heights and wave lengths, providing ideal conditions for wave energy production.

With the opening up of areas for future development Australia is well positioned to harness the wave of offshore renewables.

[3] CSIRO https://doi.org/10.4225/08/584af1865b172

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