

The development of renewable energy technology is critical to Australia's clean energy future. Marine energy is currently under-utilised in Australia, despite the potential for marine energy to provide for at least 35% of our baseload power needs¹.

Australia's coastline could provide a reliable source of renewable energy. It also presents an opportunity for Australia to take the lead in a growing global industry. Having already developed some of the world's leading marine energy technology, Australia should maximise its abundant natural resources and proven expertise to create new employment opportunities in marine energy, particularly in regional areas. Australia could also become a world leader in marine energy skills training.

1 What is marine energy?

Marine energy harnesses the ocean's tides, currents or waves to produce electricity. With oceans covering around 75% of the world's surface, the abundance of marine energy make it an increasingly attractive form of renewable energy. The World Energy Council estimates global wave resources at around 2 million megawatt (MW) or twice the world's power consumption². Compared with other forms of renewable energy such as wind or solar, the world's oceans provide a predictable and high density source of renewable energy.

There are two main sources of ocean energy: tidal and wave.

Wave energy

Wave energy is generated by a combination of wind-waves and long period swell. Wind-waves are created by the action of local winds on the surface of the ocean. They are generally a short wavelength and low amplitude, with relatively little embedded energy. Swell, on the other hand, is generally produced by storm activity hundreds of kilometers away. Strong storm winds transfer energy to the ocean surface, creating waves which multiply over great distances. Through a process known as dispersion, the mixed waves at the surface tend to separate as they multiply over extended distances, resulting in long wavelengths and relatively regular waves ideal for energy extraction. Swell is the most common form of wave energy exploited by marine technologies. It is captured using floating or submerged buoys, floating platform point absorbers, and oscillating water columns.

Tidal energy

Tidal energy is generated by the force of gravity interacting with the earth, moon, sun and oceans. This force causes the surface of the ocean to bulge, which then spreads around the ocean as very long waves. The constant gravitational pull, combined with the propagation of the tides, result in a complicated but predictable response in the ocean, creating a predictable energy source.

Tidal energy can be harnessed from either the potential energy of high versus low tides, or from the kinetic energy of the tidal stream where height differences cause fast currents to develop around islands or coastal constrictions. In Australia, the highest tidal ranges typically occur in tropical regions with tidal ranges in excess of 9 metres, such as those observed at Derby in north-west Western Australia. Harvestable tidal streams are available at a limited number of specific locations around Australia.

There are two main types of tidal energy technologies: tidal barrage and tidal current.

*For more information on marine energy technologies see the [Marine Energy Sector Report \(p.12 - 14\)](#).
www.cleanenergycouncil.org.au/cec/technologies/marine.html*

¹ Government of Western Australia, Office of Energy <http://www.energy.wa.gov.au/2/3698/64/wave.pm> (Accessed 6 September, 2011)

² AquaGen, Why Wave Energy?, <http://www.aquagen.com.au/market> (Accessed 8 September, 2011)



2 Australia's comparative advantage

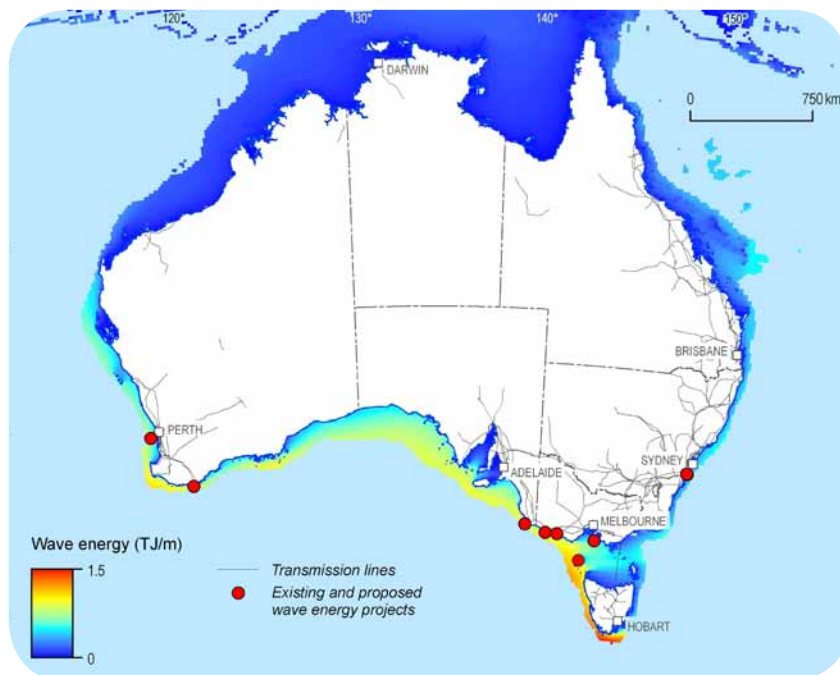
Across the globe, marine energy is increasingly seen as a reliable, inexhaustible and largely underdeveloped source of energy. According to the UK's Carbon Trust, the marine energy industry could be worth up to AU\$707 billion globally by 2050. Australia, blessed with some of the world's best ocean resources and committed to meeting 20% of its energy needs with renewable energy by 2020, is well placed to become a world leader in this growing industry.

An abundant resource

Australia possesses a comparative advantage in the global marine energy industry. According to the CSIRO, only 2% of the world's coastal waters have wave power densities great enough for extracting wave energy. Australia has some of the world's best marine energy resources, concentrated mainly along its southern coastline. For example, the total wave energy between Geraldton in Western Australia and the southern tip of Tasmania (crossing the 25m depth isobar) could meet the total electricity requirements of Australia about five times over (over 1300 terrawatt-hours/year).³

Figure 1 Total annual wave energy delivered in an average year (TJ/m) in Australian shelf waters

Source: Hindcast data is for the period March 1997 to February 2008. Grid cell size is 0.1⁴



³ CSIRO The potential of Wave Energy, March 2011, <http://www.csiro.au/files/files/p10e6.pdf> (Accessed 7 September, 2011)

⁴ Department of Resources, Energy and Tourism, Resources Australia Energy Resources Assessment Chapter 11 Ocean Energy, 2010, http://adl.brs.gov.au/data/warehouse/pe_aera_dgaee_002/aeraCh_11.pdf (Accessed 6 September, 2011)



Close proximity

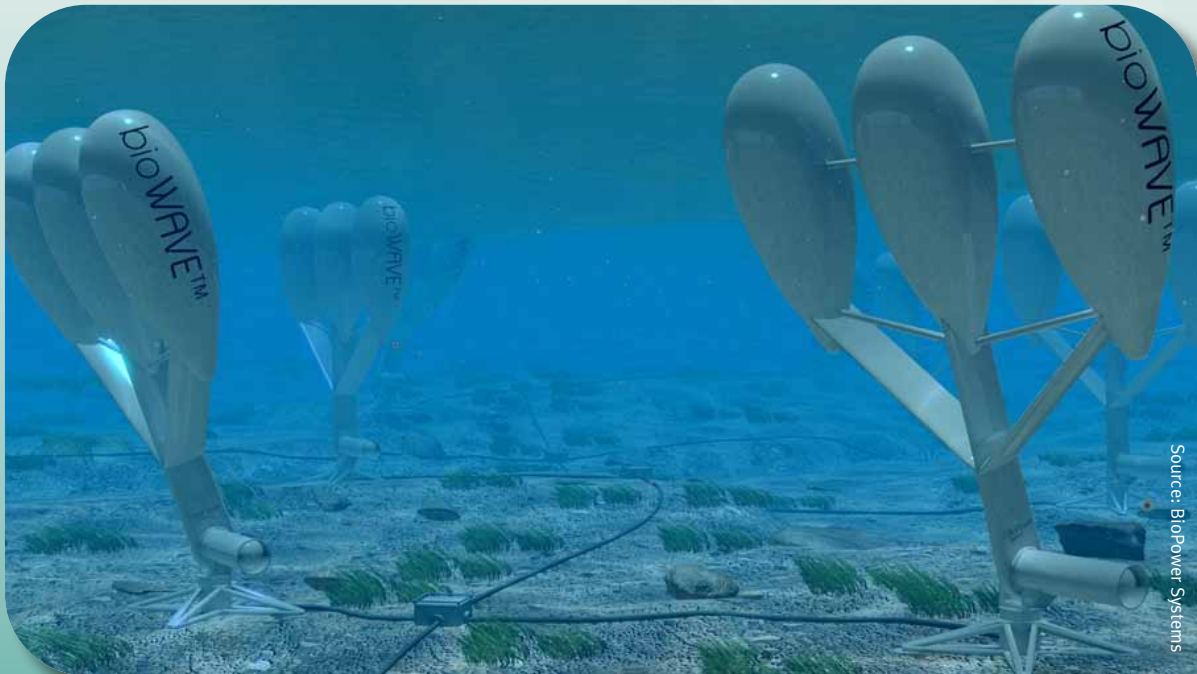
With over 80% of Australia's population living within 5km of the coast, marine energy makes sound economic sense.⁵ The close proximity of the ocean to existing infrastructure and demand reduces the cost of construction and transmission – increasing its feasibility as a low emissions, renewable energy source in a carbon-constrained world.

Technological advantage

Australia not only has access to some of the world's best marine resources, but is also responsible for developing some of the world's leading marine technologies. Continuing a long history of innovation, Australian companies have developed and patented tidal and wave energy technologies which are being used around the world, including France, Ireland, the UK and the USA. With world-class research facilities and a highly-skilled workforce, Australia is in a prime position to further develop its marine energy technology industry.

Investment opportunity

The growing awareness of Australia's marine energy potential, both in terms of resources and expertise, is increasingly attracting private investment from around the world. For example, Aquagen an Australian wave developer, recently attracted a six figure sum in private investment. However, if Australia is to fully exploit its abundant marine resources, it must have a stable, long-term policy environment that supports clean energy innovation and investment.



⁵ Marine Energy Position Paper, Clean Energy Council. 2010. <http://www.cleanenergycouncil.org.au/cec/policyadvocacy/position-papers/marine.html> (Accessed 7 September 2011)



Clean Energy Council



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The Clean Energy Council is the peak body representing Australia's clean energy sector. It is an industry association made up of more than 500 member companies operating in the fields of renewable energy and energy efficiency.

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3 Australian industry snapshot

There are currently 18 marine energy companies operating around Australia. These companies are continuing to design and develop a range of tidal and wave technologies.

Australian tidal energy companies and their technologies have already proved technically viable with pre-commercial and commercial projects in Canada, Northern Ireland, Scotland, France and New Zealand. The strongest tidal kinetic energy resources in Australia are located along the north-western and north-eastern coastline of Australia. Accordingly, the majority of Australian tidal energy companies are looking towards Queensland and the Northern Territory as ideal locations in which to develop tidal projects. Interest has also been shown both in Victoria and Tasmania, with potential locations including the Port Phillip Heads, San Remo and King Island. Projects currently feature either tidal turbines or seabed mounted devices and range from prototype development to pilot and pre-commercial testing. A key tidal demonstration project, located in Clarence Strait in the Northern Territory, involves 200 turbines. Operating at full capacity, the turbines could generate over 400 megawatt-hours of energy.

Wave energy projects are also being developed in a number of states around Australia, including Queensland, Victoria and Western Australia. Having patented some of the world's leading wave energy technologies, Australian wave energy companies are keen to apply their proven technologies to the Australian context. Ranging from 250kW pilot trials to 5MW commercial-scale tests, projects employ a range of designs including buoyancy units and submerged models capable of producing both electricity and desalinated water, as well as surface level Oscillating Water Columns.

The marine energy companies are members of the Clean Energy Council.

The following marine energy companies are:

www.aquagen.com.au
www.biopowersystems.com
www.carnegiewave.com
www.oceanlinx.com
www.aquagen.com.au
www.biopowersystems.com
www.carnegiewave.com
www.oceanlinx.com
www.cleanenergycouncil.org.au

Australia has some of the best marine resources in the world.

Harnessing these resources presents Australia with an opportunity to take the lead in a rapidly expanding global industry. With the right policy support in place, marine energy can play a vital role in driving new investment, creating jobs, and providing Australia with a low emissions, renewable energy source.



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