

# Power to Change: Australia's Wave Energy Future

## Key Findings

- 1. Building 1,500MW of wave energy power stations by 2020 will create about 3,210 Australian jobs and generate enough clean electricity to power 1.2 million households. Building a total of 12,000MW by 2050 will create about 14,380 jobs.**
- 2. Wave energy will create jobs throughout Australia: wave energy power stations can be built in most coastal areas and existing Australian metal trades and industries could manufacture them for domestic and foreign markets.**
- 3. Near-shore wave energy can provide approximately four times our current national power needs. Harnessing just 10% of this could supply around 35% of Australia's current power demand.**
- 4. Baseload emissions-free energy resources like wave energy need targeted support today so that their development is fast and seamless tomorrow.**

## About the Participants

Carnegie Corporation Ltd (Carnegie) is an Australian, ASX-listed wave energy and clean technology developer. Carnegie employs around twenty scientists, engineers, tradesmen and commercial staff in Perth, Western Australia. CETO wave technology is Carnegie's flagship product.

WWF-Australia is part of the WWF-International Network; the world's largest and most experienced independent conservation organisation. It has close to five million supporters and a global network active in more than 100 countries. WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by:

- conserving the world's biological diversity
- ensuring that the use of renewable natural resources is sustainable
- promoting the reduction of pollution and wasteful consumption.

“Carnegie's CETO wave energy technology offers the potential to revolutionise power and water production globally. CETO harnesses the enormous renewable energy present in our ocean's waves and converts it into two of the most valuable commodities underpinning the sustainable growth of the planet; zero-emission electricity and zero-emission desalinated water.”

Dr Michael Ottaviano,  
*Carnegie Corporation Ltd*

“Wave power represents a new way forward. With incredible potential to deliver clean, renewable baseload power, this technology could help Australia, and many other countries, make the transition to a low-carbon economy. Wave energy more than any other renewable resource offers Australia an opportunity to lead the world.”

Greg Bourne,  
*CEO WWF-Australia*

Wave energy is one of the renewable energy resources with the greatest potential to transform our electricity sector and provide new jobs in sustainable industries. These jobs will be in regional Australian communities like Geraldton and Albany in Western Australia, Port MacDonnell in South Australia, Portland, Warnambool and Phillip Island in Victoria, and in the southern and central coasts of New South Wales.

# Wave Energy – Australia’s Natural Advantage

Australia’s estimated near-shore wave energy resources (171,000 MW) can provide approximately four times our current national power needs. By using just 10% of this resource (the amount of power which conservative estimates indicate can be practicably extracted), around 35% of Australia’s current power demand could be produced using Carnegie’s CETO technology alone.

## Wave Energy – an abundant resource

Wave energy is an ideal source of baseload power - it is highly predictable and reliable, particularly along the southern coastline of Australia where regular storms in the Southern Ocean deliver constant swells to the shoreline. Analysis indicates that waves from which CETO generates electricity exist over 97.5% of the time, making it a baseload resource.

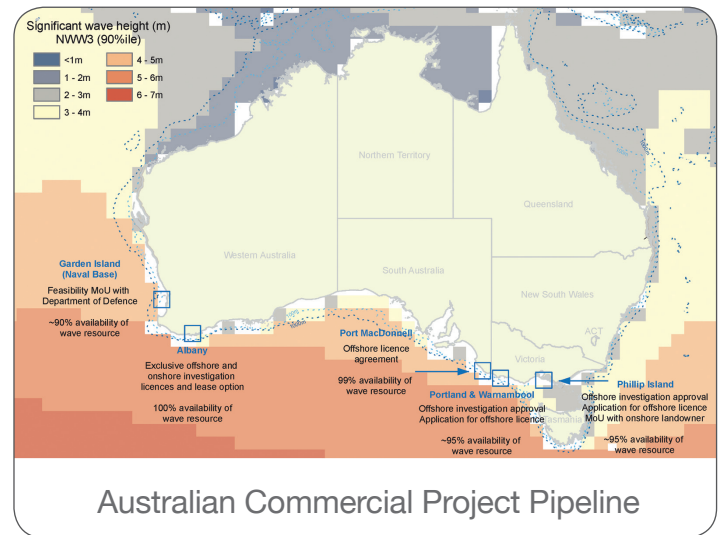
The coastline extending from Exmouth in the north-west along the southern coastline of Australia and up to Brisbane in the east provides favourable sites for harnessing wave energy. Given that 80% of Australia’s population lives within 100km of the coastline, this baseload resource offers Australia a comparative natural advantage - sitting on the doorstep of our major areas of energy demand.

Ideal wave energy sites in regional areas can be found along the mid-west and south-west parts of Western Australia, along the Limestone Coast of South Australia, Victoria, western Tasmania, and southern and central New South Wales. Further up both the east and west coasts, wave energy can be used as a source of ‘peaking’ power.

Carnegie forecasts that by 2020, approximately 1,500 MW of CETO wave energy capacity could be installed along the southern coastline of Australia, contributing around 4% of Australia’s forecast electricity needs – emissions-free.

To achieve this, the combined area occupied by CETO wave energy facilities is less than 1,000ha (3.2km<sup>2</sup>). Carnegie has already identified a number of potential sites for CETO projects that offer an ideal premium wave resource, good access to the electricity network and close proximity to suitable water depths.

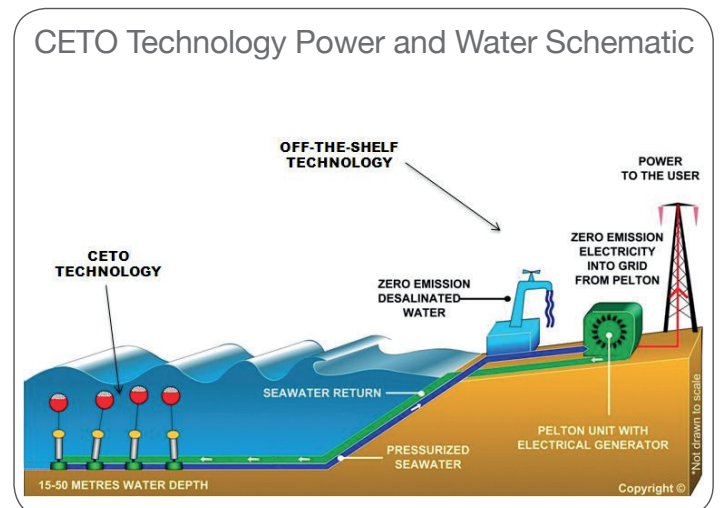
## How wave energy production works



Source: Carnegie Corporation Ltd.

There are different types of wave energy technologies. Carnegie’s CETO is used as an example - the first fully submerged wave power converter, the technology is comprised of two elements: a ‘buoyant actuator’ that collects the wave energy and the CETO pumping unit that pressurises the water. The buoyant actuator units move in a circular movement in the ocean wave, mimicking a molecule of water.

Anchored to the sea floor, the CETO pumping units pressurise the water and send it through a sub-sea pipeline to an onshore power generation facility which uses hydro-electric turbines. The electricity generation systems use established, proven technologies to generate emissions-free renewable electricity.



Source: Carnegie Corporation Ltd.



# Creating Jobs Across Australia

Carnegie anticipates that installing 1,500 MW of CETO wave energy capacity by 2020 will create an estimated 3,210 direct and indirect jobs. Projected expansion to 12,000MW by 2050 will result in the creation of a total of 14,380 jobs.

## Jobs from wave energy

Currently Carnegie employs around twenty scientists, engineers and commercial staff. Commercial deployment of Carnegie’s anticipated 1,500 MW of installed capacity by 2020 will create an estimated 3,210 direct and indirect jobs.

Each 50 MW of CETO capacity represents:

- \$75 million invested in local manufacturing and assembly of CETO units
- \$140 million in local supply of balance of plant equipment and services
- creation of around 100 direct jobs during manufacturing and construction through to commissioning, plus an estimated seven jobs for ongoing operation (90% of which would be at the local level).

Following commercialisation, Carnegie forecasts a rapid market uptake of the technology because of CETO technology’s efficiency in extracting energy from waves combined with wave energy being readily available.

## A manufacturing hub for local and export markets

Commercialising CETO requires a dedicated Australian manufacturing hub, using existing local manufacturing capacity for constructing pumps, buoyant actuators, hydraulic systems and equipment. This hub would supply demand for CETO plants as projects in Australia and overseas are developed, leading to an Australian-based wave energy manufacturing capability with export potential.

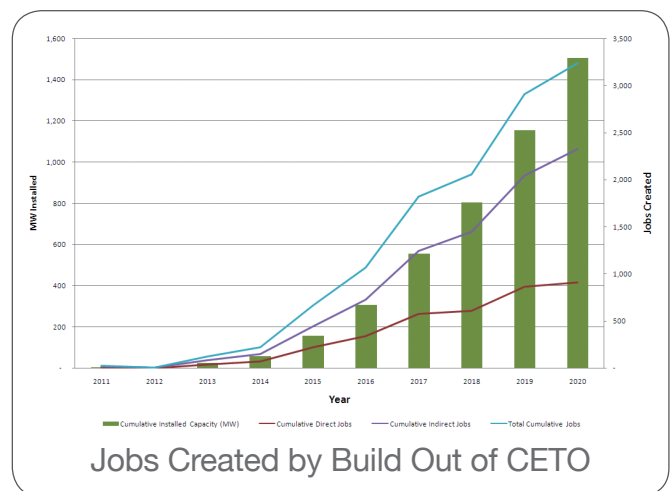
It is likely that the manufacturing hub would be located close to the site of the first commercial scale deployment of the technology. The manufacturing methods employed in producing CETO devices are readily adaptable to existing machining and fabrication capacity within the automotive and heavy engineering industry sectors. As a direct example, the CETO pumps for the current stage of development were procured from hydraulic manufacturing companies in Victoria and South Australia. The buoyant actuator is manufactured in Perth, Western Australia.

## Supply chain jobs

As the installed base of CETO wave installations grows, there will be a concomitant development of satellite industries in the maritime sector to service the operation and maintenance needs of the plants.

The specialist skills required are in many respects common to the oil and gas industry. As such, there would be an attraction for some established firms to diversify away from oil and gas operations to service wave farms, and in so doing, help to buffer these industries against future downturns in the oil and gas sector.

Investment in the build-out of CETO will translate into ongoing creation of manufacturing jobs at the local level and supply of construction and commissioning equipment and personnel. The balance of plant equipment can be sourced through local and interstate suppliers.



## Case Study : David Kessel Carnegie Corporation worker

Carnegie’s manufacturing manager is David Kessel, a tertiary qualified manufacturing engineer. Prior to joining Carnegie, David had over 15 years automotive manufacturing and design experience. As part of these roles, David oversaw the design and operation of automotive manufacturing facilities.

David joined Carnegie in mid-2007 when he saw an opportunity to apply his skills and make a positive contribution to the environment.

Reflecting upon his experience at Carnegie, David said, “having contributed to the car industry for so many years, my passion turned towards the environment and saving it for future generations”.

David’s role at Carnegie involves the procurement and supplier qualification of manufactured components, input into the CETO unit design, implementation and maintenance of quality systems, and final witness test inspection associated with the manufacturing of components. David is intimately involved in the development of the technology, transferring knowledge, skills and experience gained in the automotive manufacturing section for application to the production of Carnegie’s wave energy technology.

Case study and graph provided courtesy of Carnegie Corporation Ltd.

## The long term outlook

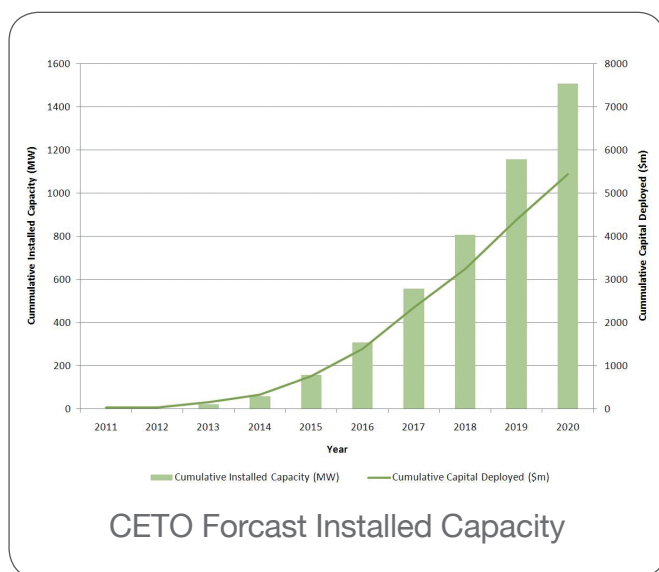
The Government's 20% Renewable Energy Target by 2020 is a welcome measure to grow renewable energy industries in Australia. However, the overwhelming beneficiaries are likely to be mature technologies such as wind and biomass – because they currently provide the cheapest form of renewable energy.

In the longer term, a carbon price will make carbon-intensive fossil fuels more expensive and clean renewable energy more attractive. However, in the short term it will do little to encourage immediate investment in technologies like wave energy which are further from commercialisation.

The dilemma is how to encourage less commercially developed baseload technologies like wave energy which are likely to play a crucial role in transitioning Australia's economy from reliance on polluting fossil fuel energy sources like coal.

## The challenge – we're running out of time

We are running out of time to reduce our emissions, both locally and globally, so we need to foster baseload technologies like wave energy rather than waiting until the carbon price signal matches the cost of development and deployment. The deep emission reductions we need to achieve by 2050 (at least 80% on 1990 levels) means we no longer have the luxury of waiting and building each new low emission industry from scratch when it is financially attractive to do so.



Source: Carnegie Corporation Ltd.

Government must foster concurrent development of these industries now because even at a comparatively small-scale, this reduces the chance of delays to larger-scale deployment in the future. The *CETO Forecast Installed Capacity Growth* graph (below left) illustrates how a small investment now leads to exponential growth in installed capacity by 2020.

## Fostering baseload renewable energy

We can adopt a combination or variety of approaches to foster baseload renewable energy including: increased support for research, development and demonstration, feed-in tariffs, 'banding' the renewable energy target to include a guaranteed market share for Australia's different renewable energy resources, and industry development measures. The imperative is for these policies to ensure that both higher and lower cost industries are developed concurrently.

1. Industry development funding: various government programs already provide grant funding for prospective technologies. For example:

- Climate Ready supports technology at an early stage: Research & Development, proof-of-concept and early-stage commercialisation activities
- The Renewable Energy Demonstration Program aims to accelerate commercialisation and deployment of new renewable energy technologies in Australia by assisting in demonstrating them on a commercial scale

2. Feed-in tariffs such as Germany's scheme for solar photovoltaic mandates resource-specific support for a renewable energy technology which provides a price guarantee for the energy supplier.

3. 'Banding' can incentivise investment in deploying emerging technologies simply by amending the Renewable Energy Target Scheme rather than introducing a new regulation. Banding uses the existing regulatory framework and still allows the market to decide what generation mix is appropriate.

This approach draws on the United Kingdom's banded scheme, which proposes awarding the equivalent of a quarter of a Renewable Energy Certificate per megawatt hour of electricity to established technologies such as landfill gas, one Certificate for wind and two for an emerging technology like wave energy. Scotland has identified that it has a natural advantage in wave energy and proposes five-time Certificate band to foster wave energy.