

ASX Announcement

13 November 2017

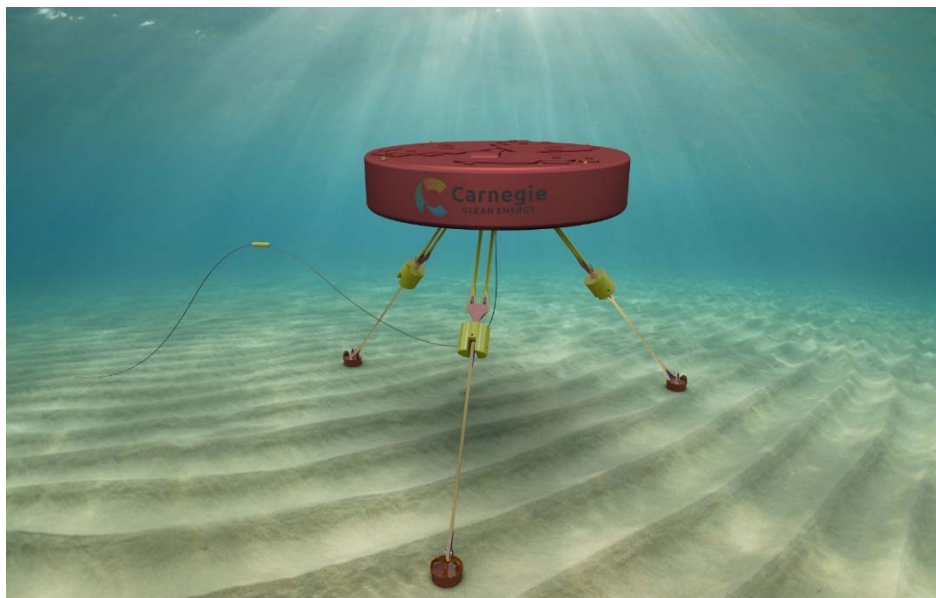
CETO 6 Design Update

- More powerful CETO 6 design release
- US Patent granted for new design
- New CETO 6 design to be deployed first at Albany Wave Energy Project

Carnegie Clean Energy Limited (ASX:CCE) is pleased to provide an update on the latest design developments to its commercial prototype, the CETO 6 unit. CETO 6 is the most advanced wave energy device globally. It builds on Carnegie's decade long development of CETO, and over the past two years, incorporates internal and external collaboration as well as significant time and resource investment to make a step change in performance.

The CETO 6 design builds on intellectual property first lodged by Carnegie in 2013 incorporating on-board power generation and multiple moorings and power take off (PTO) modules. The associated US patent, granted on the 6th of November, 2017, confirms the additional features as state of the art. These features boost power production and unit efficiency however also introduce additional complexity. Carnegie took a conservative development path to progressively introduce these features through its CETO 5 generation and only now with CETO 6, will these features be incorporated for the first time.

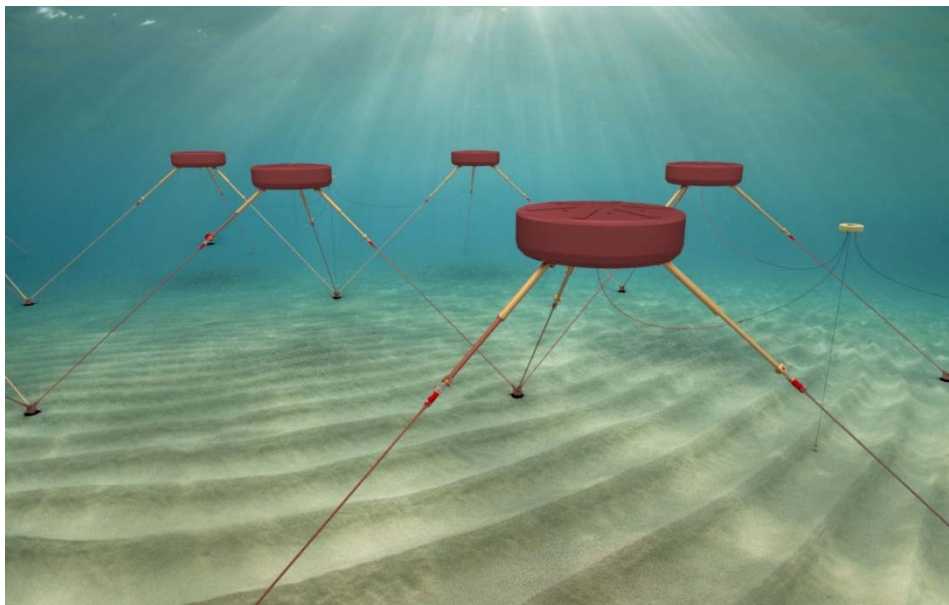
The new CETO 6 unit will have a nominal capacity of 1.5MW up from 1MW for the previous design. This capacity will vary in accordance with the specific site conditions for each project and the specific design tailored for a project site. The increase in energy production over the previous single moored CETO 6 unit design results in a more cost competitive unit able to compete with other mainstream renewable technologies, once it is manufactured in high volumes and incorporated in large projects.



CETO 6 unit incorporating multiple moorings and on-board generation

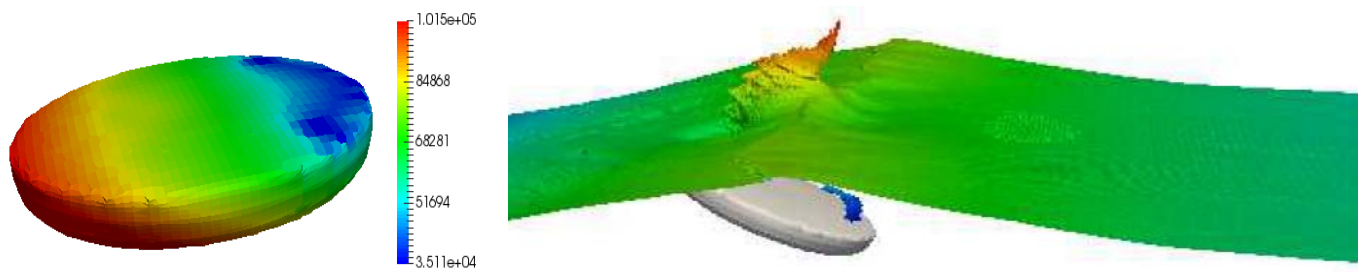
It is well understood from previous sector research that multiple moorings increase the amount of power that can be absorbed by a wave energy convertor as a result of capturing energy in heave (vertical), surge (horizontal) and pitch (rotational) motions. However, this has proved challenging to realise at large scale, given the inherent complexities involved in operating in the complex, open ocean environment. Multiple moorings also require multiple foundations for each unit, potentially increasing the cost of foundations per unit. However, each of the mooring lines and associated foundations in the new CETO 6 design are carrying less load and can therefore be smaller than the foundation for a single moored device.

Additionally, Carnegie has developed a networked arrangement for foundations for large scale wave farms that allows foundation sharing. This has been the subject of a research project between Carnegie and the University of Western Australia. The combination of decreased foundation size and the benefits of foundation sharing result in a significant reduction in foundation cost per CETO 6 unit.



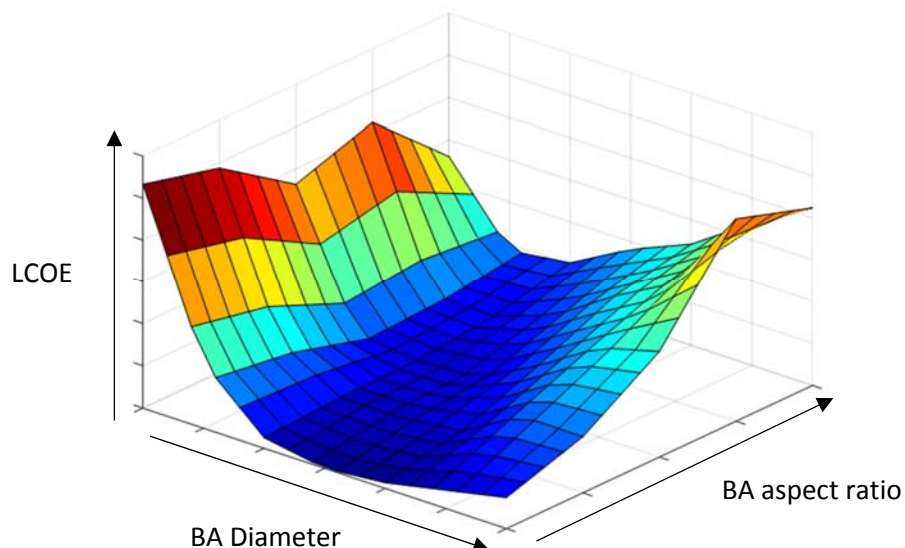
CETO 6 wave farm demonstrating foundation sharing

Another area of intensive research and analysis undertaken by Carnegie has been in understanding the movement of the Buoyant Actuator (BA) through the range of expected sea states, the consideration of different buoy geometries and the interaction of multiple mooring attachments. Carnegie has developed state of the art hydrodynamic modelling capabilities in-house and taken advantage of the computational power available at the Pawsey Supercomputer in Perth to undertake more than 20 billion simulations over the past 12 months to optimise the CETO 6 unit hydrodynamics. This involves the use of a panel of tools with increasing degrees of fidelity including frequency domain modelling, linear time domain modelling and non-linear solvers. This is an unprecedented amount of analysis in the wave energy industry globally and has unlocked significant power production and load optimisation benefits.



CETO 6 hydrodynamic analysis

Carnegie has also developed a number of proprietary tools such as a requirements database, a “design wave” technique allowing rapid simulation of extreme waves, Failure Mode and Effects Analysis (FMEA), Monte Carlo unit availability model based to optimise unit design for reliability and O&M activities, and a proprietary cost parametric model to enable the assessment of technical and commercial trade-offs for design selection decisions to ultimately optimise the levelised cost of energy.



An example of the CETO 6 parametric model output

Carnegie’s Chief Technology Officer, Jonathan Fievez, commented:

“More than ever at Carnegie, we’re aware of the increasing competitiveness of wind, solar and battery technologies. We challenged the CETO team to disrupt our own thinking and used collaborations with industry as well as taking our own internal analysis capabilities to go to the next level. We are very confident in the performance trajectory that we are taking with the updated CETO 6 design.”

Carnegie's CEO and Managing Director, Dr Michael Ottaviano said:

"We are delighted with the updated CETO 6 design. As other renewable technologies become more cost competitive, we need to continue to drive innovation into CETO and be prepared to disrupt our own thinking. Carnegie Clean Energy is determined to make our mark on the global renewable energy market with our CETO 6 wave energy technology. Wave energy is the last globally untapped renewable resource and in the best locations it delivers energy 24/7. By effectively harnessing the massive untapped resource in waves and converting it to energy, this technology will be game-changing."

About Carnegie Clean Energy Limited

Carnegie Clean Energy Limited is an Australian, ASX-listed (ASX: CCE) wave energy technology developer and solar/battery microgrid project developer. Carnegie is the 100% owner and developer of the CETO Wave Energy Technology intellectual property and is also 100% owner of leading Australian battery/solar microgrid Engineering Procurement and Construction (EPC) company Energy Made Clean (EMC). EMC specialises in the delivery of mixed renewable energy microgrid projects to islands and remote and fringe of grid communities. Carnegie is the only company in the world to offer a combination of wave, solar, wind, storage and desalination via microgrids which are ideally suited to islands, off grid communities and fringe of grid locations.

About Department of Primary Industries and Regional Development

The Department of Primary Industries and Regional Development (DPIRD) is committed to building vibrant regions with strong economies through jobs growth, economic growth and capable people. The Department is responsible for the effective planning, coordination and delivery of the State Government's regional development agenda. This includes the management of the Royalties for Regions investment program and maintaining effective relationships with key partners across government, industry and the community. The Western Australian State Government, via DPIRD, is investing \$15.75 million in grant funding into the Albany Wave Energy Project and a further \$3.75m into the Wave Energy Research Centre via the University of Western Australia.

About ARENA

ARENA was established by the Australian Government to make renewable energy technologies more affordable and increase the supply of renewable energy in Australia. Through the provision of funding coupled with deep commercial and technical expertise, ARENA provides the support needed to accelerate the development of promising new solutions towards commercialisation. ARENA invests in renewable energy projects across the innovation chain and is committed to sharing knowledge and lessons learned from its portfolio of projects and information about renewable energy. ARENA always looks for at least matched funding from the projects it supports and to date has committed \$1.1 billion in funding to more than 270 projects. For more information, visit www.arena.gov.au. ARENA has approved the transfer of \$11.7m in CETO 6 Project funding from Garden Island to Albany, subject to the signing of the detailed documentation.

For more information:

Dr Michael Ottaviano
CEO & Managing Director
Carnegie Clean Energy Limited
+61 8 6168 8400
enquiries@carnegiece.com
Website: www.carnegiece.com