ASX ANNOUNCEMENT

24 March 2021

Commencement of New International Technical Collaborations

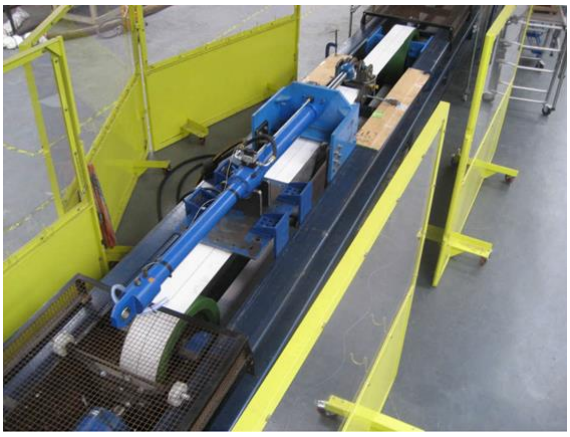
Carnegie is pleased to announce the commencement of two new international technical collaborations supporting continued advancement of the CETO power take-off (PTO) and mooring systems.

- Belt Joint Industry Project (JIP) Formation to design and test belts for wave energy converter applications and commencement of the first stage of the project
- IMPACT Project Technical Advisory Board participation to direct and guide the European funded IMPACT Project (Innovative Methods for Wave Energy Pathways Acceleration through Novel Criteria and Test Rigs). This project aims to accelerate testing device development and reduce technology cost through the development of a Dual Hardware-In-The-Loop testing platform

Belt Joint Industry Project:

Wave energy developers Carnegie Clean Energy, CalWave Power Technologies, Marine Power Systems (MPS), and Oscilla Power have entered into a Collaboration Agreement to undertake a Joint Industry Project (JIP) to advance an innovative belt design that will support the commercialisation of rotary PTO systems for CETO like wave energy converters.

Rotary PTOs take the linear motion of a buoyant body and convert it to rotary motion. The Belt is a key enabler of this technology. By wrapping around a drum, the Belt turns the connected generator as the wave energy converter (WEC) moves, thereby generating electricity. The Belt must endure high cycling and exposure to the marine environment. As many developers face similar challenges, Carnegie brought together a consortium of wave developers and will use an open innovation approach to collaboratively advance the development of this component. Through the JIP, the partners will share knowledge and advance the technology together including sharing the cost of input from specialist engineering contractors.



Previous belt testing by Tension Technology International (Photo: TTI Testing Ltd)

21 North Mole Drive, North Fremantle WA 6159
PO Box 39, North Fremantle WA 6159
+61 8 6168 8400
www.carnegiece.com

ABN 69 009 237 736

With the Collaboration Agreement in place, the JIP has recently engaged Tension Technology International (TTI) to conduct the first stage of the project, a landscaping study of economic and durable belt solutions for rotary PTOs in Wave Energy Converters.

Advances in the belt technology will benefit Wave Energy Converters such as Carnegie's CETO technology in several ways including allowing a reduction in drum diameter. This maximises motor speed and increases efficiency which will support increased power production and enable reductions in the Levelised Cost of Energy (LCOE).

TTI, the contractor for the first stage of the project, has years of experience in marine mooring construction and testing, including previous experience with WECs. Pending successful outcomes in Stage 1, the consortium anticipates undertaking further work to pursue additional collaborative belt design and testing activities.

Belt JIP Collaborative Partners:	
Marine Power Systems	A wave energy technology developer whose technology can be configured to deliver wave power (WaveSub), floating wind power (WindSub) or a combination of both (DualSub). Based in the UK.
Oscilla Power, Inc	A wave energy technology developer currently progressing their Triton and Triton-C converters for utility and remote communities. Based in the USA.
CalWave Power Technologies Inc.	A wave energy technology developer whose xNode converter is customised towards the needs of end users in marine markets, specifically AUV charging. Based in the USA.
Carnegie Clean Energy	A wave energy technology developer focused on the development and commercialisation of the CETO wave energy converter. Based in Australia.
Stage 1 Contractor:	
Tension Technology International (TTI)	An independent research, design and development company. TTI's services include design, engineering and testing of fibres, wire and fibre ropes, chain, cables, umbilicals, fabrics, mooring systems, riser protection nets and subsea tethers. It has consultants based in the UK, Holland, USA and China.

IMPACT Project – Development of a Novel Testing Platform

Carnegie was invited to join the Technical Advisory Board (TAB) for the IMPACT project being undertaken by five partners across Europe: VGA Srl (Italy), Yavin Four Consultants (Portugal), SINTEF Energy Research (Norway), SINTEF Ocean (Norway) and University College Cork MaREI (Ireland).

Funded by the European Union's Horizon 2020 research and innovation programme, the three-year €3.3m IMPACT project aims to accelerate testing device development and reduce the technology cost as part of a global advancement in wave energy converter technologies.

"The main objective of IMPACT is to design and manufacture two novel test rigs covering up to 75% of WEC subsystems that affect the WEC's levelized cost of energy (LCOE). The innovative 250kW Dual Hardware In-the-Loop testing platform, novel test criteria and metrics

aim to reduce the test time by 50% while increasing the WEC reliability," explains Federico Gallorini, R&D manager at VGA and IMPACT project coordinator.

The proposed 250kW Dual Hardware-In-the-Loop (DHIL) testing platform is based on a technology which expands the capabilities of the already established Hardware-In-the-Loop technique.

The DHIL platform combines two test rigs. One rig is for testing the drivetrain from the input mechanical force to grid compliant power in linear or rotary cases. The second rig is for testing structural components, seals and mooring lines, in dry or wet environments.

Previous testing campaign at Carnegie's Fremantle Research Centre (c. 2011)

Carnegie was pleased to join the Technical Advisory Board to share experience from component design and previous testing as well as provide guidance to ensure successful project outcomes. Through this work and other parallel endeavours, we foster the Carnegie partner eco-system which is one of our strategic pillars.

Approved for release by the Chairman and Company Secretary

For more information

Carnegie Clean Energy Limited

+61 8 6168 8400

enquiries@carnegiece.com

www.carnegiece.com