CARNEGIE CLEAN ENERGY

ASX ANNOUNCEMENT [ASX:CCE]

Report to Shareholders

Quarter Ended 31 March 2021

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QUARTER HIGHLIGHTS

- Generated CETO modelling data equivalent to 300 years of physical deployment, demonstrating the value of Carnegie's Digital Development Pathway
- Advanced Intelligent Controller development yielding significant improvements in energy production
- Presented new vision for spin-off product at Blue Economy CRC Workshop to power offshore infrastructure
- Kicked off two new international collaborations
- Achieved debt free status with $2.8m of debt extinguished due to Convertible Note conversion
- Received $1m cash following options conversion
- Reached 2.5 GWh of energy generation at Garden Island Microgrid

"The progress this quarter has been great to see and the team has been working together better than ever. The new avenues of exploration in control and wave-powered infrastructure are particularly exciting"

CEO – Jonathan Fievez

ISSUED 29 JANUARY 2021

CETO DEVELOPMENT

The Carnegie team has continued its focus on optimising the CETO system for the lowest cost and highest energy production by advancing and implementing the innovation streams previously highlighted, including intelligent control, hydrodynamics and system design, and advanced power take-off system. Significant strides have been made since the start of the Digital Development Pathway.

One of the focus areas of the current Digital Development Pathway has been on utilising the Company's extensive modelling and simulation capabilities to speed up the optimisation of the CETO system design. Recent efforts have proven the value of this approach, with the team's unprecedented modelling effort dedicated to refining the system architecture having modelled the equivalent of 300 years of physical deployment within the past six months. This in-depth modelling data is a powerful design tool whilst being extremely capital efficient. It has generated a valuable evidence base for strategic partners, demonstrating that the CETO technology deployed in future projects can be reliable and cost effective.

Another core focus area has been the development of Carnegie's Intelligent Control capability. This includes elements such as the previously developed Wave Predictor as well as the controller which tells the CETO unit how to operate in the most effective manner. This is important because implementing Intelligent Control for CETO can significantly improve energy production and thereby reduce the cost of energy. The team has been progressing a number of controllers using a mixture of approaches ranging from Model Predictive Control (MPC) to Machine Learning and Reinforcement Learning. These controllers are being developed internally as well as with a variety of collaborative partners, such as Hewlett Packard Enterprises on the Reinforcement Learning controller. All of the controllers being developed have shown improvements on the baseline Spring Damper controller. During the current quarter, Carnegie will further optimise the controllers and begin to take steps to implement them on control hardware in preparation for tank testing later in the year.

The Power Take-Off (PTO) design continues to advance, shaped by the overall system design work. In particular, methods to constrain peak loads have been developed leading to reduced demands on the PTO. This has the dual benefit of increasing the number of suitable products (mainly electrical generators) to meet the specification whilst also lowering costs considerably.

Some of the recent CETO highlights this quarter include:

- Numerical simulations to optimise the scale and architecture of the CETO design have been completed. Final architecture and scales have been selected which now allows the design of the CETO unit and components to enter a more detailed phase.

- Progressed Carnegie's Intelligent Control products and demonstrated material improvements from baseline control strategies. Advanced control provides significant opportunities for cost reduction and continues to be a key area of focus.
- PTO requirements have been optimised using the learning from the advanced controller's development. This approach leads to a much more efficient use of the equipment capability and ultimately a significant reduction of cost. The selection of the scale and architecture now allows the team to select the components of the PTO and engage more closely with suppliers.
- Advanced the design of the Mooring Tensioner and prepared for start of coupon/material testing at University of Queensland as part of the Carnegie-led $1.6m Mooring Tensioner project. Project partners include Advanced Composite Structures Australia, University of Queensland and Australian Ocean Energy Group.
- Commenced Joint Industry Project with other wave energy developers to collaborative advance the design of the belt which forms part of the power take-off system.

New Spin-Off Product Vision

In March, Carnegie launched its vision for a new wave power product at the Blue Economy Cooperative Research Centre (BE CRC) Annual Participant Workshop in Brisbane.

The new product concept is a spin-off that incorporates aspects of Carnegie's CETO technology and know-how into a novel wave powered system for use in offshore energy demand applications. The first market for this product would be aquaculture barges and vessels that require energy for electrical loads operating offshore. As the aquaculture sector moves further offshore into highly energetic conditions, Carnegie's new wave power product could address the challenge of securing clean and reliable energy and replace the diesel generation that would otherwise be required.

Artist's impression of Carnegie's new wave powered system incorporated onto a feeding barge utilised by the aquaculture industry (system highlighted on barge)

Adapting Carnegie's CETO power take-off (PTO) and control systems to create this new product will expand the market for Carnegie's CETO intellectual property (IP) and will also provide further component innovation and testing which would feedback valuable technical and testing data into Carnegie's CETO technology delivering improved performance.

Carnegie has a bold long-term vision for how this product could be incorporated with other complementary power solutions such as batteries and/or hydrogen to support the growth of a diverse, sustainable blue economy globally. This system could provide power for a variety of energy loads offshore, with potential in aquaculture and beyond.

While launching the product vision in Brisbane at the BE CRC Workshop, Carnegie's CEO also had the opportunity to participate in panel discussions and a variety of collaborative discussions with other CRC members. In line with the BE CRC and Carnegie's interest in the potential of hydrogen in the Blue Economy, this also included touring Griffith University's on-campus hydrogen storage and conversion facility.

Carnegie CEO on panel discussion at BE CRC Annual Participant Workshop (left) and visiting Griffith University's Hydrogen Facility (right)

CETO Collaborations

Carnegie continues to maintain and develop close collaborations with industry and research partners such as local engineering firms, specialised international suppliers and engineering groups, other wave energy developers, University research groups, the Australian Ocean Energy Group and collaborative research and industry groups.

Several key collaborative projects and relationships are underway including with Hewlett Packard Enterprise (HPE), Microsoft, Blue Economy Cooperative Research Centre and Oceantera, as well as two new international collaborative projects announced this quarter:

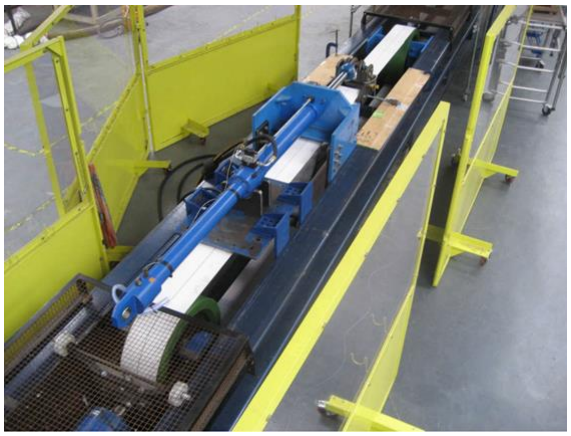
- Belt Joint Industry Project (JIP) formed to design and test belts for wave energy converter applications and commenced the first stage of the project.

- Joined the IMPACT Project Technical Advisory Board 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

During the quarter, wave energy developers Carnegie Clean Energy, CalWave Power Technologies, Marine Power Systems (MPS), and Oscilla Power 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 linear motion 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)

With the Collaboration Agreement in place, the JIP 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.

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.

Hewlett Packard Enterprise (HPE)

Carnegie and Hewlett Packard Enterprise continue working together through the existing Collaboration Agreement to develop a reinforcement learning (RL) based controller for the CETO technology. RL is a subset of the broader field of artificial intelligence and allows the algorithms to learn from experience and rewards it receives. This new controller has shown promise in the simulations conducted and work is ongoing with excellent support from HPE.

Blue Economy CRC Mooring Tensioner Project

The Blue Economy Cooperative Research Centre (BE CRC) awarded $850,000 of grant funding to support the Mooring Tensioner for Wave Energy Converters (MoTWEC) Project, a $1.6 million project led by Carnegie with partners Advanced Composite Structures Australia (ACS-A), University of Queensland (UQ) and ClimateKIC representing the Australian Ocean Energy

Group (AOEG). This Project fits in with Carnegie's other ongoing digital development work and is focused on developing a novel Mooring Tensioner, a key component that will support the use of rotary power take-off systems and associated cost reductions for wave energy converters. The project is progressing well and coupon testing of the chosen composite material is expected to commence shortly at the University of Queensland. Later this year, Carnegie will commence physical testing of a scaled Mooring Tensioner at a bespoke test rig to be built at Carnegie's Research Facility.

CORPORATE ACTIVITIES

During the quarter, Carnegie achieved debt free status for the first time in many years following the conversion of the full $2.8 million in Convertible Notes.

In addition, unlisted options to the value of just over $1 million have been exercised during (and subsequent to) the quarter, adding to the Company's cash reserves and providing additional funding to deliver on the technology pathway.

In January, Carnegie announced that Garden Island Microgrid had resumed normal operations following the temporary disconnection required by the Department of Defence due to electrical upgrade works being undertaken on HMAS Stirling. Cumulative generation from the system since the start of operations reached 2.5 GWh during the quarter.

Financial Notes

At the end of the Quarter, the Company had approximately $3.7 million in cash reserves.

Note 6 to Appendix 4C:

Payments to related parties of the entity and their associates were made during the quarter. In total, approximately $61,000 was paid to Directors and associates for salaries, superannuation and contracted services.