MoorPower's First Operational Review

- MoorPower Demonstrator achieves goals during its initial operational phase, signalling ability to meet commercialisation pathway targets
- Over 2,000 hours of operations data gathered and analysed
- Commercial aquaculture partner's feeding barge motion and energy consumption data gathered and analysed
- Core design proven with MoorPower modules functioning as predicted
- Results validate power take-off architecture common to both CETO and MoorPower
- MoorPower numerical models validated using Demonstrator performance data and commercial feeding barge motion data, providing confidence in Carnegie's ability to forecast the performance of the Commercial MoorPower System for a variety of barges globally

MoorPower operating in waters off Fremantle, Western Australia

Carnegie Clean Energy Limited (ASX: CCE) ("Carnegie" or the "Company") is pleased to provide a progress update on the successful outcomes achieved during the initial operational phase of the MoorPower Scaled Demonstrator. This MoorPower Demonstrator Project, supported by the Blue Economy CRC and other partners, is a key step in the MoorPower commercialisation pathway, developing a sustainable and cost-effective energy solution for aquaculture and other offshore sectors.

The MoorPower Demonstrator was deployed and entered operation in January 2024 and has provided over 2,000 hours of operational data during its initial operational phase. It was brought back into port for routine inspection and planned maintenance in April 2024, with operations expected to re-

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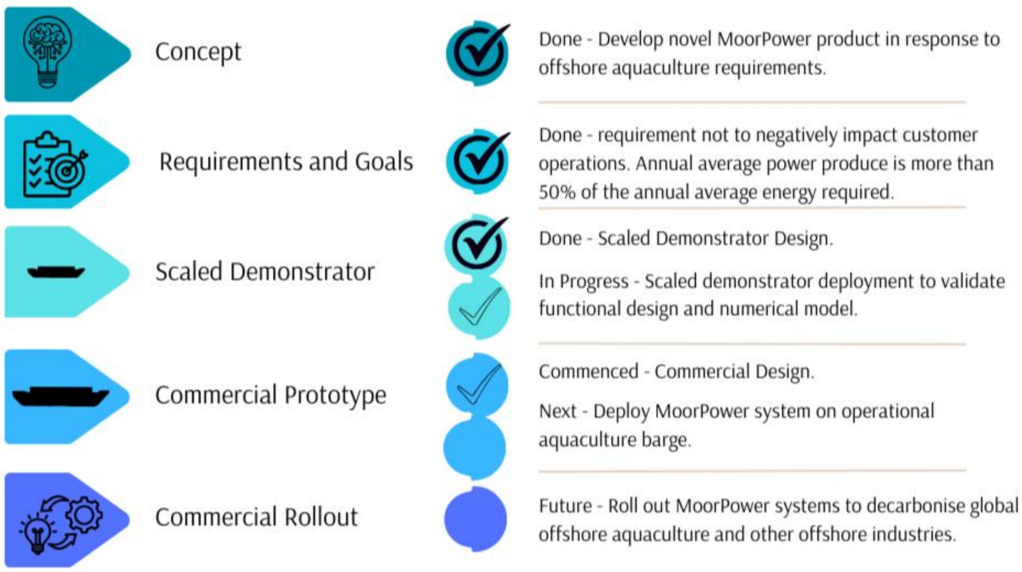
commence in the coming weeks. This initial operational phase (January – April 2024) was primarily in calmer months, which enabled the team to monitor the MoorPower modules and ensure they were functioning as engineered prior to the more significant anticipated sea conditions of the winter months to come.

During the initial operational phase, MoorPower endured a variety of sea states, with two notable events exceeding the average wave conditions typically present, demonstrating the durability of the MoorPower system, which will be further tested in the next winter operational phase.

Overall, the recent data gathered on the Demonstrator combined with recent data gathered from an operating feeding barge in Tasmania provide confidence that the Commercial MoorPower System will perform as expected and can deliver significant decarbonisation (reduced diesel requirements) and other benefits for operating feeding barges.

MoorPower Commercialisation Pathway

In reviewing MoorPower's performance during the initial operational phase, it is useful to refer back to the objectives, targets and intended outcomes of the MoorPower Demonstrator Project in the context of the technology's commercialisation pathway.



During MoorPower concept development the team set product requirements such as not negatively impacting operations and decarbonisation goals including diesel replacement targets:

- Initial goal: MoorPower systems to produce 50% of the annual average energy required
- Future goal: MoorPower systems to produce 100% of the annual average energy required

Following the requirement and concept phases, Carnegie:

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- Secured financial support from the Blue Economy Cooperative Research Centre for the MoorPower Scaled Demonstrator Project. This $3.4m project is delivered with funding support from the Blue Economy CRC and in close collaboration with a consortium of partners including two of Australia's largest aquaculture companies, Huon Aquaculture and Tassal Group. Academic and industry partners include DNV GL Australia, Advanced Composite Structures Australia, University of Tasmania, Climate KIC/Australian Ocean Energy Group, AMC Search and University of Queensland.
- Completed a preliminary design for the Commercial MoorPower System, to ensure the Demonstrator was aligned with and de-risked the future commercial product design.
- Completed detailed design for the MoorPower Scaled Demonstrator for deployment in Western Australia .
- Captured motion data from an operating feeding barge.
- Built MoorPower Demonstrator at Carnegie's research facility.
- Deployed and operated MoorPower Demonstrator in Western Australia.
- Validated MoorPower Numerical Models and Design.

The MoorPower Demonstrator, built in 2023 and deployed in January 2024, is the first physical production and operation of the MoorPower system.

The MoorPower Demonstrator Project was designed to deliver 2 key objectives and outcomes which are summarised in the below table.

Objectives	Outcomes
1. **Validation of MoorPower Design including:** • Module auto-alignment • Power train architecture • Electrical architecture • Control system strategy	Ensure the MoorPower System functions as designed and characterise functional performance.
2. **Validation of MoorPower Numerical Models utilising gathered data:** • Operating Feeding Barge Motions • Operating Feeding Barge Energy Consumption • Demonstrator performance	Ensure Numerical Models can accurately model and predict MoorPower System performance for a range of aquaculture sites, barge sizes and barge configurations.

The analysis and validation work completed over recent months has been delivered in order to confirm that the Demonstrator is delivering on the intended objectives and outcomes. This process is visually mapped in the below flow diagram with the findings outlined in detail in the next sections.

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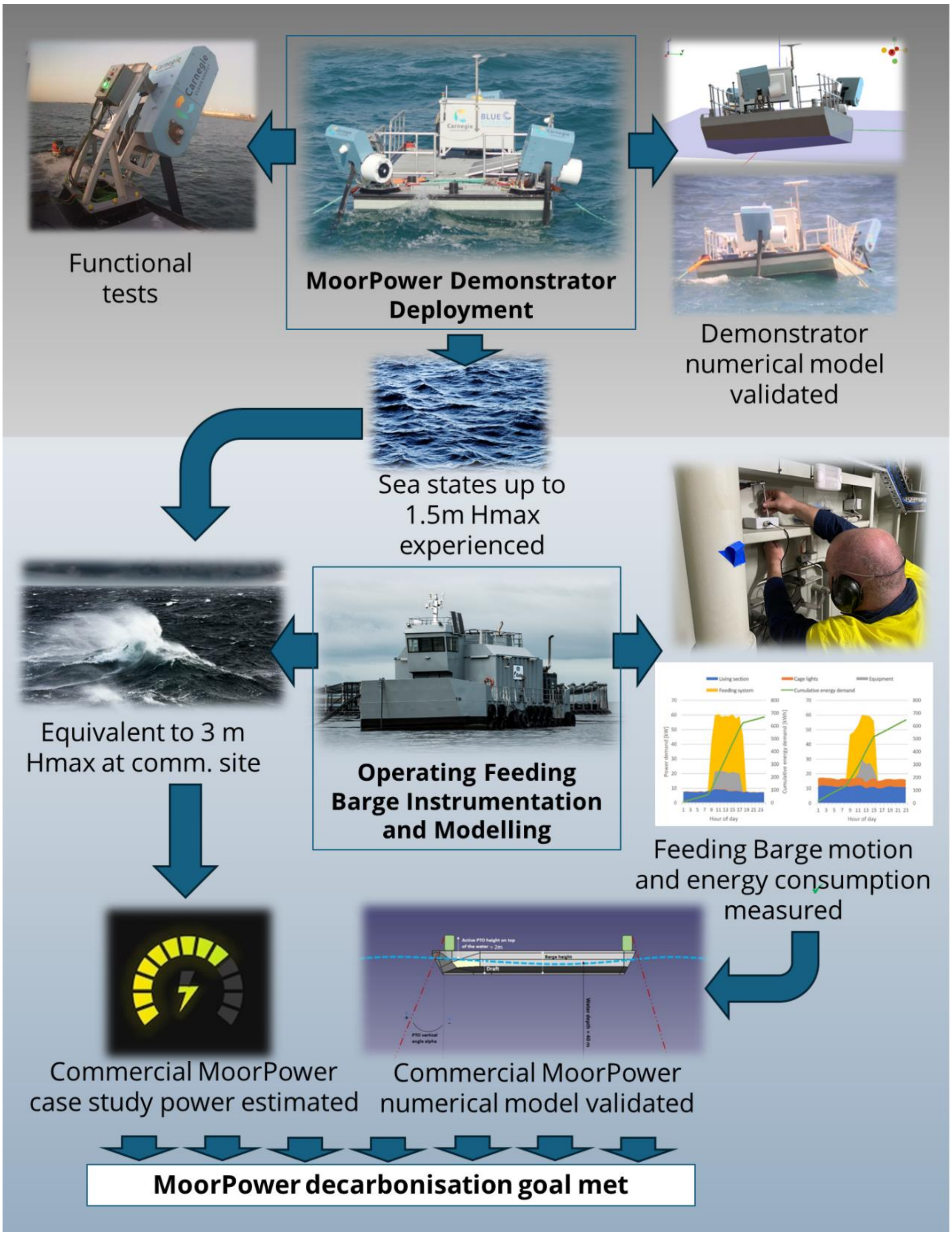

Analysis and validation process flow

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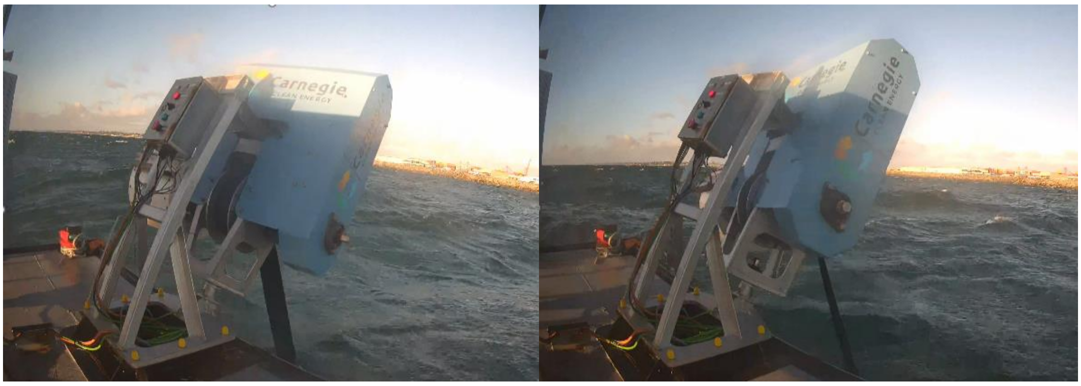
Objective 1: Validation of MoorPower Design

The deployed MoorPower Demonstrator serves as a functional test of the MoorPower technology which can be used to validate the design to de-risk the Commercial MoorPower System. The Demonstrator's functional performance has yielded encouraging results that surpassed the team's initial expectations and have validated the system's module auto-alignment, power train architecture, electrical architecture and control system strategy.

During the initial operational phase, the system was largely exposed to mild sea states with more significant winter sea states expected in the coming months. In March 2024, the system was exposed to its largest sea state to date. During this time, the Demonstrator experienced maximum wave height up to 1.5m, which when scaled to a commercial scale would be equivalent to maximum wave height of 3m at a representative commercial site.

Module auto-alignment

One of MoorPower's key features is its module auto-alignment, which allows the module to maintain alignment with its moorings despite the roll and pitch of the barge. The mooring lines connected to each of the MoorPower modules on the barge are anchored to fixed reference points on the seabed. When the barge moves due to the wave action, the orientation of the moorings with respect to the barge varies. The belts that terminate the moorings and wrap on the MoorPower module drums can become misaligned with their drum if the modules are fixed to the barge. This misalignment can be detrimental to the endurance of the belt and can create unwanted wear. To solve this problem, the team at Carnegie developed a concept that allows the drums to self-align with their respective mooring lines. This development involved extensive numerical simulations to optimise the position of the axes, centre of gravity and moment of inertia of the components.



Module reorienting automatically to maintain alignment of drum and belt

During the initial phase of operations, the team was pleased to see excellent functional performance of the module auto-alignment. The module carriage and belt maintained alignment as designed. No noticeable wear was observed on the belt during detailed inspection as part of the routine inspection and maintenance. This is of significant importance to Carnegie given it is a key feature for the Commercial MoorPower System to be deployed on operating barges and because elements of the auto-alignment are also present in the CETO system, including the upcoming ACHIEVE programme deployment in Spain.

Power train architecture

The architecture of MoorPower's power train has also been demonstrated. The power train architecture defines the physical arrangement of all components that capture and covert the motion of the barge into electricity, namely the drum, mooring tensioner, transmission system, gearbox and electrical generator. The functional performance of the power train has been validated through the successful generation of electricity during the initial phase of operations.

This marks the first offshore operational test of Carnegie's belt-based power take-off system and provides the team with critical data and learnings that are invaluable for both the Commercial MoorPower System and the CETO technology, which will be deployed in Spain through the ACHIEVE Programme.

Electrical architecture

The electrical architecture, shared between the Commercial MoorPower System and Carnegie's flagship CETO technology, has also proven successful in this Demonstrator project. The electrical architecture consists of a common DC bus that connects the main electrical components of the system. The DC bus handles the power flow coming from each of the module generator converters and dispatches this power to the battery converter and the various loads in the system. This success boosts confidence in both the Commercial MoorPower System and the upcoming CETO deployment in the Basque Country, Spain as part of the ACHIEVE Programme.

Control system strategy

The onboard control system has demonstrated robust functionality with 100% availability of the control system recorded during the operational period. The control system demonstrated the ability to transition reliably between different modes of operations such as power generation, stand-by and turned off. It also proved able to do so independently for each of the three MoorPower modules in the system which supports the future reliability of the system.

The controller also demonstrated its ability to accurately control the force applied in each of the module mooring lines independently. This is a key feature that enables Carnegie to optimise the full MoorPower system power performance. The control scheme targets an overall force to be applied in each mooring lines. This force varies with time as a function of various parameters. In the Demonstrator, the team found that controller operated as intended – it was able to track in real time the various parameters and apply, in a timely manner, the required torque to achieve the overall control force.

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Objective 2: Validation of MoorPower Numerical Modelling

Carnegie has developed a suite of numerical modelling tools which can be used to model, design and forecast the performance of the Commercial MoorPower System on offshore barges of various sizes, dimensions and characteristics. This capability is key to global commercialisation of the technology.

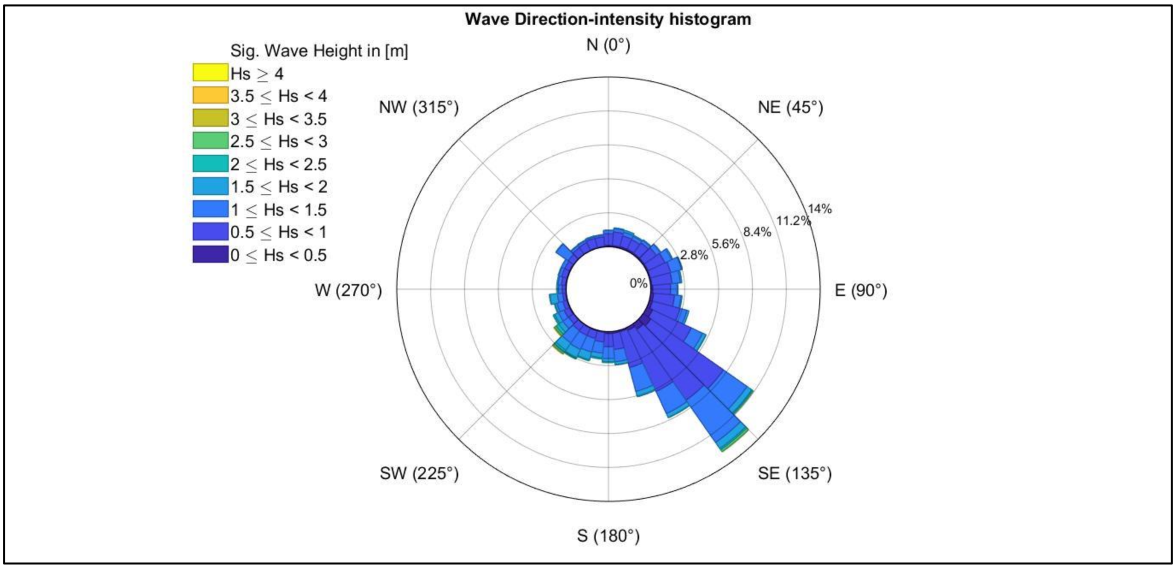
To validate that Carnegie's modelling tools are accurately modelling MoorPower and able to reliably predict performance, two key data sets have been analysed: the performance of the MoorPower Demonstrator deployed in Western Australia and motion data gathered from instrumentation placed on a partner's operating feeding barge in Tasmania.

In addition, to ensure that MoorPower is able to meet its decarbonisation goal of producing at least 50% of the annual average energy required by the host barge, instrumentation has been placed on a partner's operating feeding barge that captures the energy consumption of the barge.

By confirming that the model is accurately modelling the barge hydrodynamics and forces, Carnegie can validate the ability to accurately forecast the performance of the system. By understanding in depth how these operating barges are using energy, Carnegie can ensure that the system manages the power produced and stored to supply the required energy for the barge to meet operational and decarbonisation targets. These validation activities are outlined in more detail below.

Operating Feeding Barge Motion Data Validation

To validate that Carnegie's numerical models can accurately predict the amount of energy that MoorPower can capture and convert, motion data was gathered on an operating feeding barge in Tasmania for approximately a year. The corresponding wave condition parameters such as wave height, wave period and wave direction were also measured using a wave buoy deployed in the vicinity of the feeding barge.



Wave Direction-intensity histogram at Tasmanian Site

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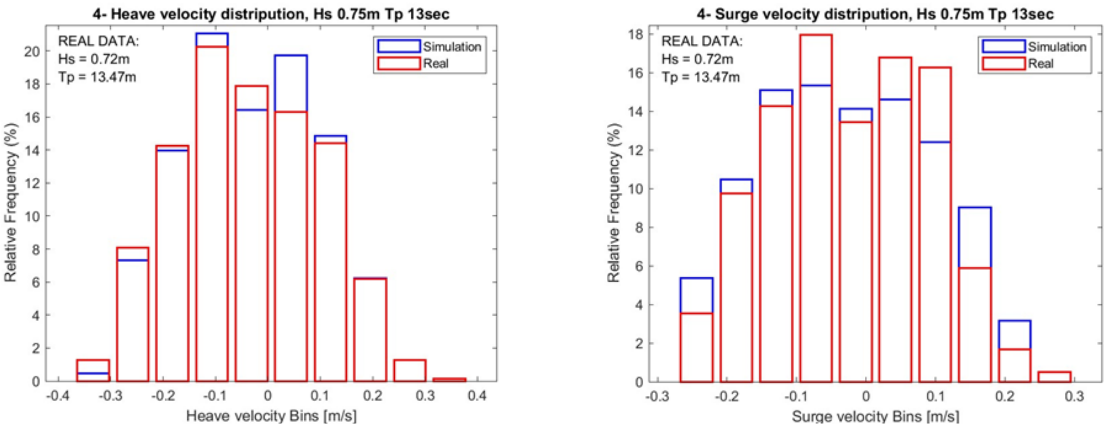
University of Tasmania, a partner in the MoorPower Demonstrator Project, installed an Inertial Measurement Unit (IMU) on a 600 tonne operating feed barge in Tasmania. The IMU was fitted in the plant room close to the barge's centre of mass and accurately measures acceleration (x, y, z directions) and angular velocity, transmitting this data to an on-barge processing PC, which in turn calculates the heave, surge and sway, pitch, roll and yaw.

Instrumentation being fitted to operating aquaculture barge in Tasmania

Data collected from the barge was then used to calculate the motion of the potential MoorPower module locations on the barge which was then used to calculate the potential wave power generation profile and correlate this with sea states.

This real motion data was analysed and found to have a good correlation with Carnegie's separate numerical modelling outcomes. This is illustrated in the two plots below showing a comparison between the measured and modelled barge modes of motions most contributing to power (heave and surge) for the most occurring sea state at the site. The results show an excellent match, thus validating Carnegie's ability to utilise numerical models to forecast the performance of MoorPower for offshore vessels such as feeding barges.



Comparison between the measured and modelled barge mode of motions

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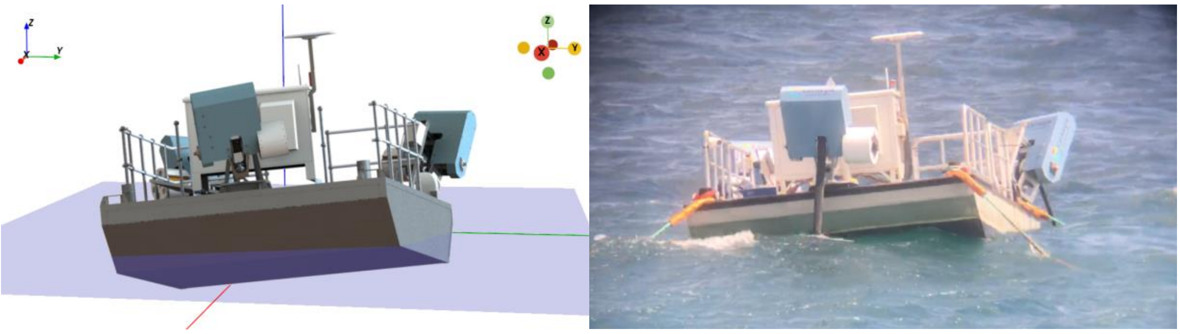
MoorPower Demonstrator performance validation

Carnegie has also validated its numerical modelling capability by analysing the performance of the Demonstrator in its real operating environment in Western Australia and comparing it against the numerical modelling simulations of the Demonstrator in those same conditions. This includes performance data from the MoorPower Demonstrator and utilises real wave data captured by Carnegie's own wave buoy (which captures data such as wave height, direction, and period).



Small scale barge motions compared with numerical model

Following analysis of several sea states, the team found a match between the modelled/expected performance of MoorPower in specific conditions and the actual performance of MoorPower in those conditions. This confirms that Carnegie can accurately predict the performance of the MoorPower system for future sites and various configurations. This is important as there are a wide range of sites, barges sizes and deck loading capacities, which all have an impact on MoorPower's ability to generate energy. Knowing that Carnegie can accurately forecast performance with all of these variables is a powerful tool in the commercialisation of the MoorPower technology.

Commercial MoorPower System performance estimates

Using the validated numerical models, Carnegie estimated the performance potential of a Commercial MoorPower System. Estimates indicate that an annual average electrical power of 30 kW can be produced at the site in Tasmania where the operating feeding barge motions was gathered. This number can be significantly increased at a more energetic site or if MoorPower were deployed on a newly built barge which would allow higher loads to be applied. This result is in line with Carnegie's initial modelling completed at the start of the project and, based on energy consumption data gathered, validates Carnegie's ability to achieve its initial product goal, to produce more than 50% of the annual average energy demand.

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Next Steps

Carnegie is encouraged by the performance of the MoorPower Demonstrator during its initial operational phase. Once the current inspection and planned maintenance regime is completed, the system will be redeployed for its next operational phase in the coming weeks.

The project will continue to collect and analyse data from the Demonstrator and operating feeding barges to inform the next stage of the technology's development, the development of the Commercial MoorPower System for deployment on an operating aquaculture asset. The Company will continue to share findings from these activities.

In early June the project partners will come together for a project meeting as part of the annual Blue Economy CRC Participants Workshop. A number of potential hosts of the first MoorPower Commercial System will also be in attendance to advance the commercial scale project.

This announcement has been authorised by the Chairman and CEO.

For more information

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ABOUT MOORPOWER

As the aquaculture sector expands its operations offshore, the demand for clean and reliable energy becomes increasingly critical. The reliance on diesel generators for energy-intensive offshore activities, such as feeding barges, brings with it a host of challenges, including high costs, environmental risks, and carbon emissions. This issue extends beyond aquaculture to encompass various moored vessels across the blue economy.

In response to this challenge, Carnegie Clean Energy developed MoorPower, a product that leverages the core principles of the CETO technology and the Company's extensive expertise to create an innovative wave converter system specifically designed for offshore energy demand applications. MoorPower is set to transform the way energy is harnessed offshore, with its initial target market being aquaculture barges and vessels that require electrical power while operating in remote offshore locations.

The MoorPower Demonstrator Project has support from the Blue Economy CRC and is being delivered in collaboration with additional partners as shown below.

ABOUT BLUE ECONOMY CRC

The Blue Economy Cooperative Research Centre (CRC) is established and supported under the Australian Government's CRC Program, grant number CRC-20180101. The CRC Program supports industry-led collaborations between industry, researchers and the community. With a 10-year life, the Blue Economy CRC brings together 43 industry, government, and research partners from ten countries with expertise in aquaculture, marine renewable energy, maritime engineering, environmental assessments and policy and regulation. Further information about the CRC Program is available at www.business.gov.au.

ABOUT CARNEGIE

Carnegie Clean Energy (ASX: CCE) is a technology developer focused on delivering ocean energy technologies to make the world more sustainable. Carnegie is the owner and developer of the CETO® and MoorPower® technologies, which capture energy from ocean waves and convert it into electricity. Using the latest advances in artificial intelligence and electric machines, Carnegie optimally controls our technologies to generate electricity in the most efficient way possible. The company has a long history in ocean energy with a track record of world leading developments. Based in Australia with a global presence, Carnegie's wholly owned international subsidiaries including CETO Wave Energy Ireland and Carnegie Technologies Spain are actively engaged in our product development.

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