



Carnegie Wave Energy Limited

*Pathway to delivering a commercial
CETO technology*

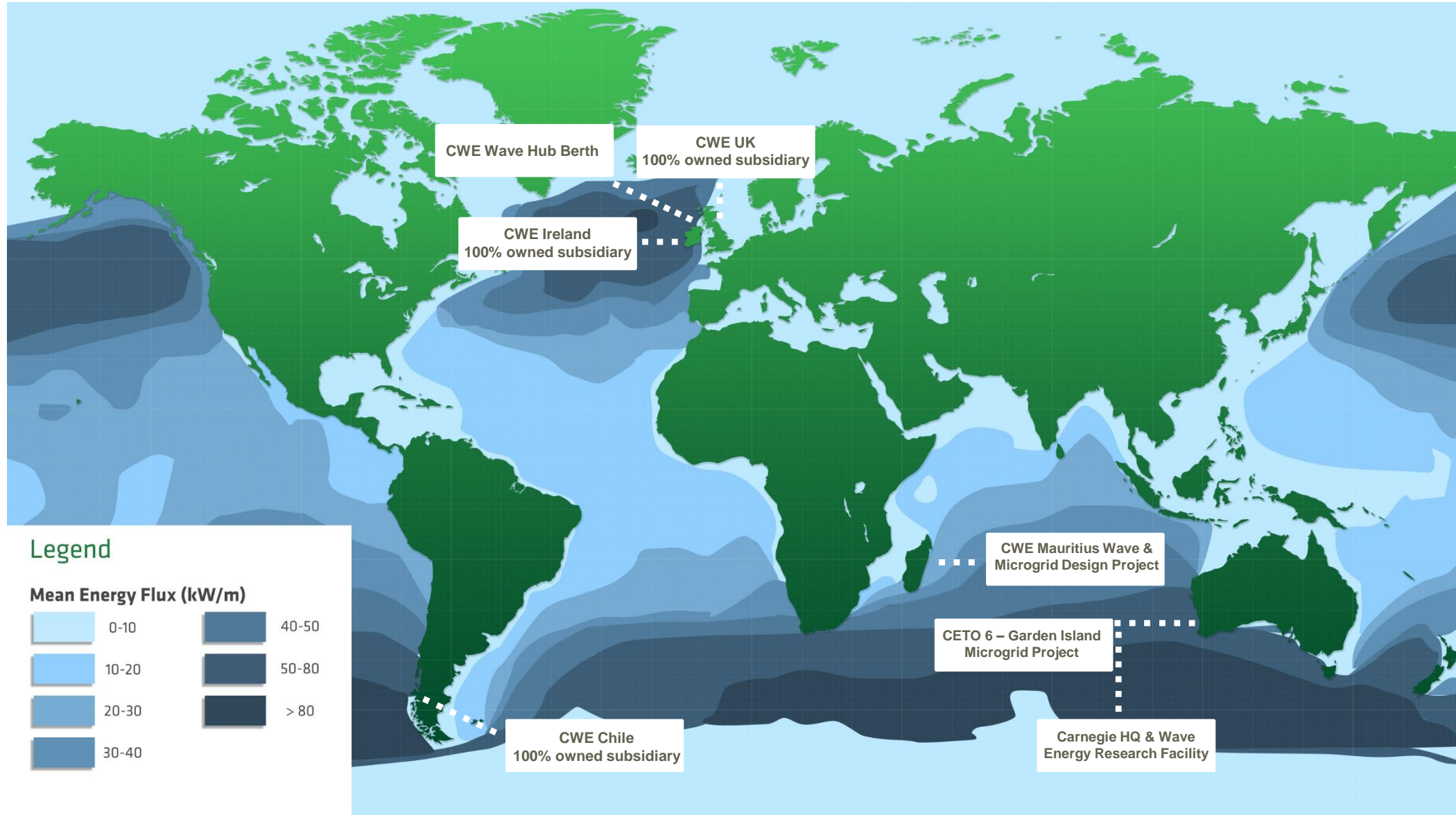
Mr Tim Sawyer
CEO, CWE UK

Disclaimer

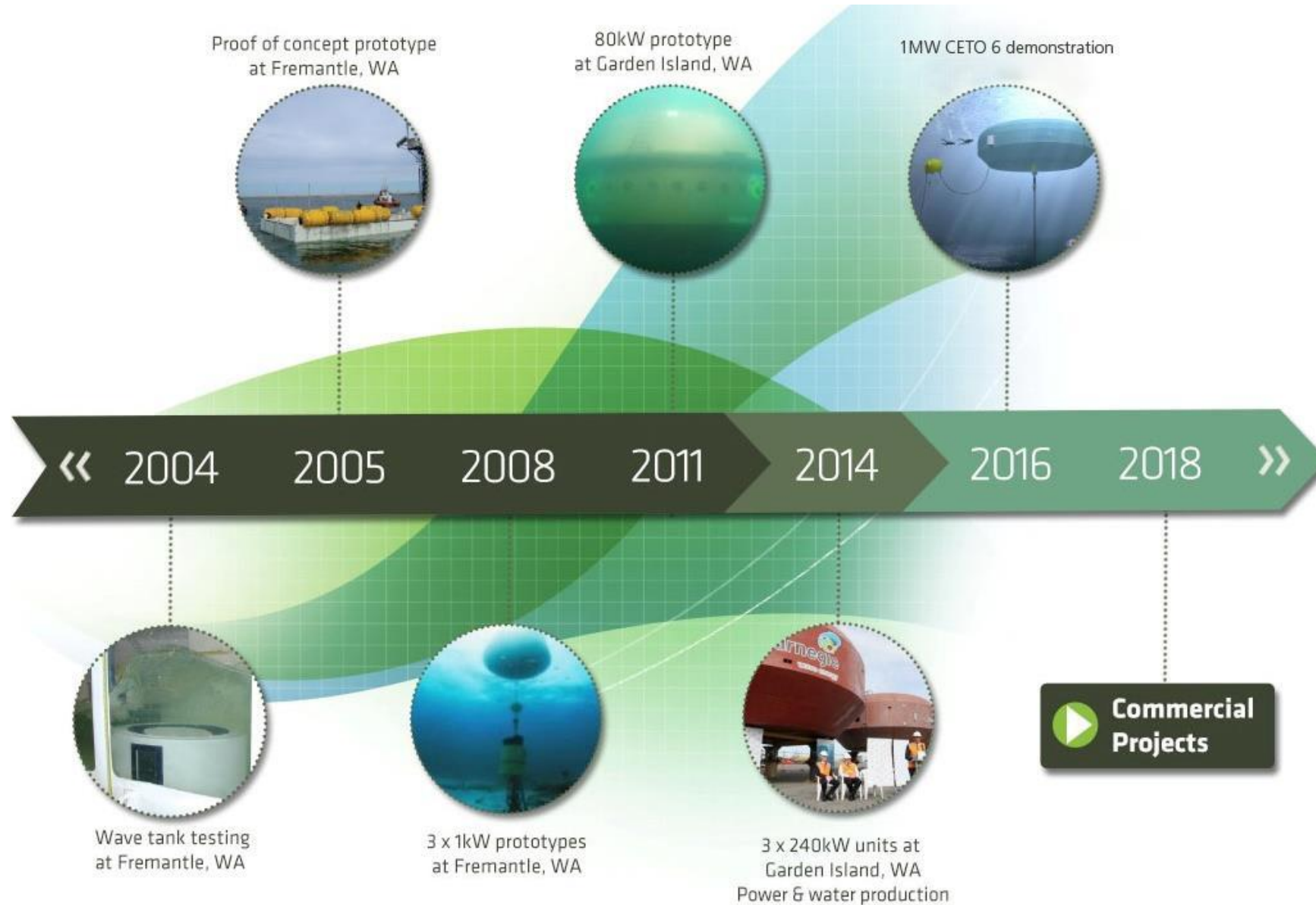
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Global Reach



Technology Development & Commercialisation



An aerial photograph showing three wave energy converters (WECs) in the ocean. Each WEC consists of a central vertical structure with a red and white striped top, surrounded by a circular green buoy. The ocean is dark blue with small, choppy waves. The text 'The Perth Wave Energy Project' and 'CETO 5' is overlaid in the bottom left corner.

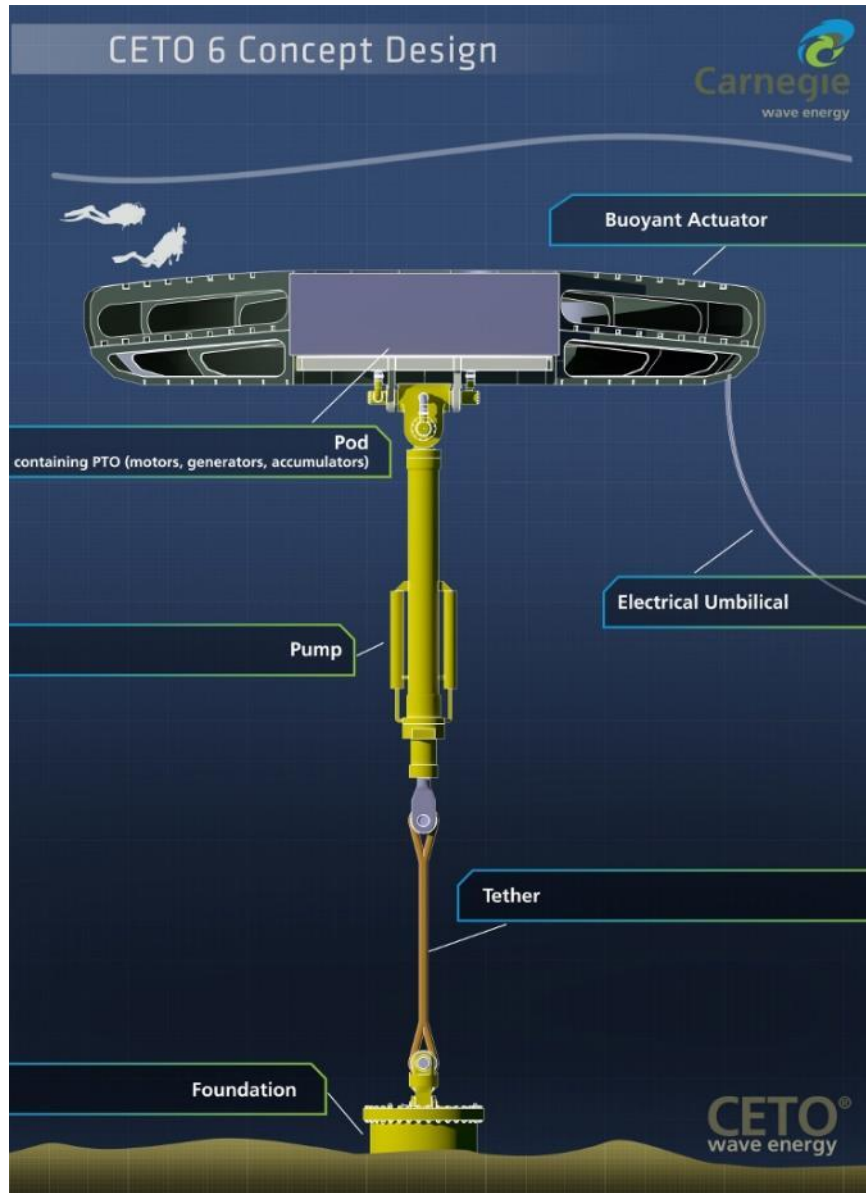
The Perth Wave Energy Project

CETO 5

The Perth Wave Energy Project – CETO 5



- Garden Island, Western Australia
- Demonstrated CETO 5 technology including:
 - Three WECs
 - Power delivery to grid
 - Wave powered, reverse osmosis desalination
 - <1 day CETO WEC installation
 - >14,000 operational hours over 4 seasons and 12 months
- Designed and delivered by Carnegie
- Measured CETO 5 results confirmed modelled forecasts
- Measured results confirm CETO 6 forecasts

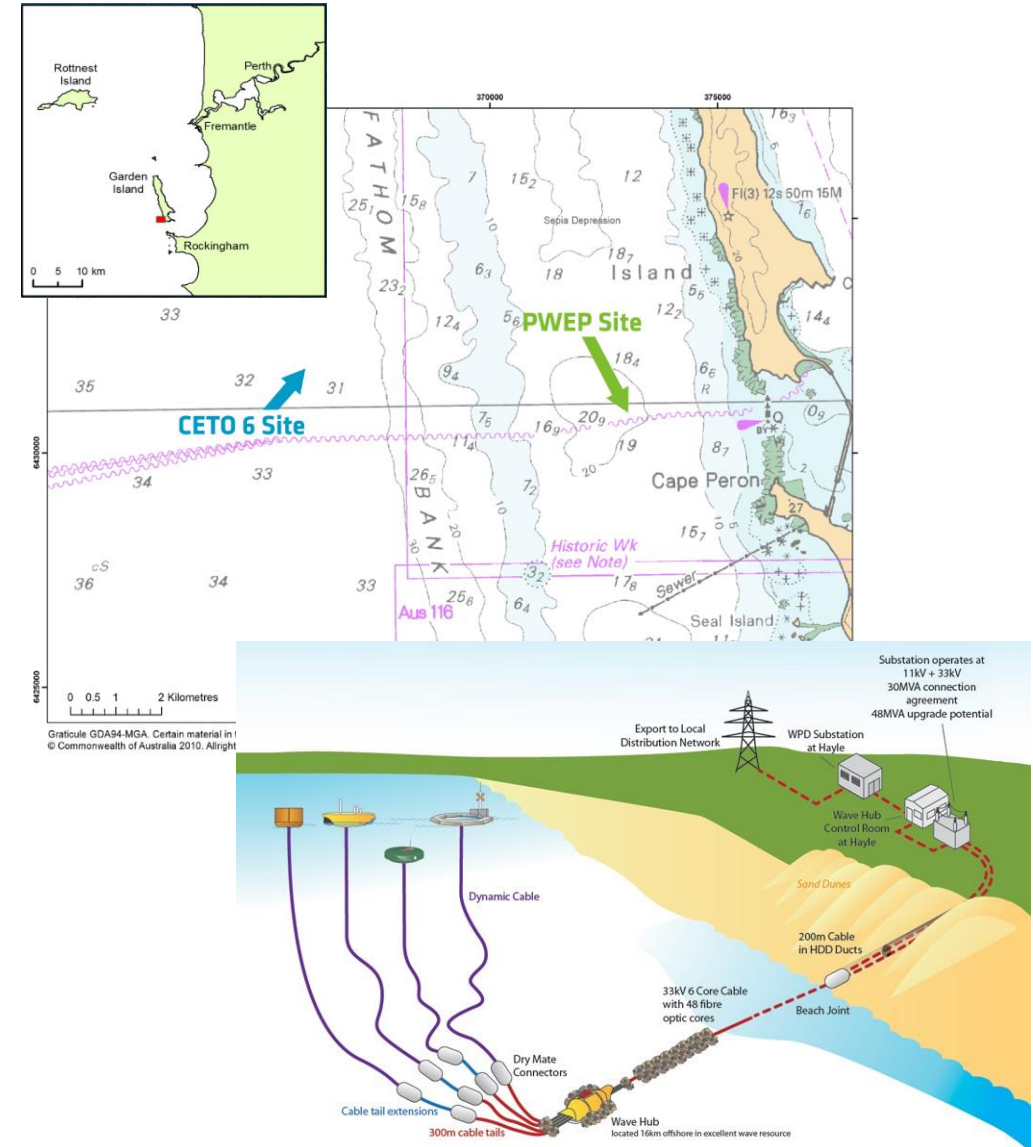


- Development based on:
 - CETO 5's in-ocean operational hours and data analysis
 - CETO 6 wave tank testing, including University of Plymouth
 - Internal modelling and design development
 - Engagement with UK/EU and Australian supply chain.
- Approx. four times the output of CETO 5
- Power generation inside the buoyant actuator allows more advanced control capability
- Rapid installation and retrieval (no offshore heavy lifts)
- Electrical export cable delivers power onshore avoids hydraulic transmission losses
- Tidal range compensation
- Nearshore and more distant to shore wave sites suitable.

CETO 6 – Demonstration Projects

- Garden Island, Western Australia
 - Funded by CWE, \$20 m CBA debt funding and \$11m ARENA grant
 - Design start 2013, Concept Design Oct 2015, Detailed Design & Construction 2016/17

- Wave Hub, Cornwall, UK
 - £42 million wave energy test site
 - 30MW export capacity, upgradable to 48MW
 - Tariff support and Government grants
 - CWE & Government Funding
 - Concept Design 2016, Detailed Design & Construction 2017/18

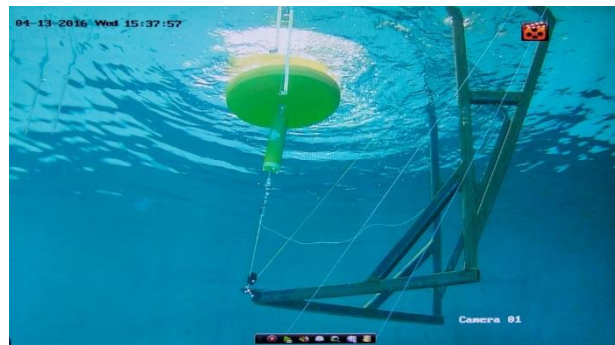


Ongoing R&D focused on Highest Opportunity Areas

- £6m portfolio of externally funded, collaborative R&D
- University of Plymouth wave tank testing programme completed April 2016
- University of Dublin collaboration to optimise hydrodynamics performance through BA shape studies
- University of Western Australia (UWA) projects focussed on cost and performance optimisation:
 - Foundation design and loads
 - Optimal number, size, arrangement and location of wave energy converters
- University of Adelaide development of control strategies to increase efficiency of CETO
- Partner in the SUPEGEN funded “E-Drive” linear generator project with University of Edinburgh applied to CETO
- Wave Energy Scotland (WES) funded Artemis hydraulic motor digital displacement technology applied to CETO
- Atlantis Resources collaboration agreement focused on electrical architecture.

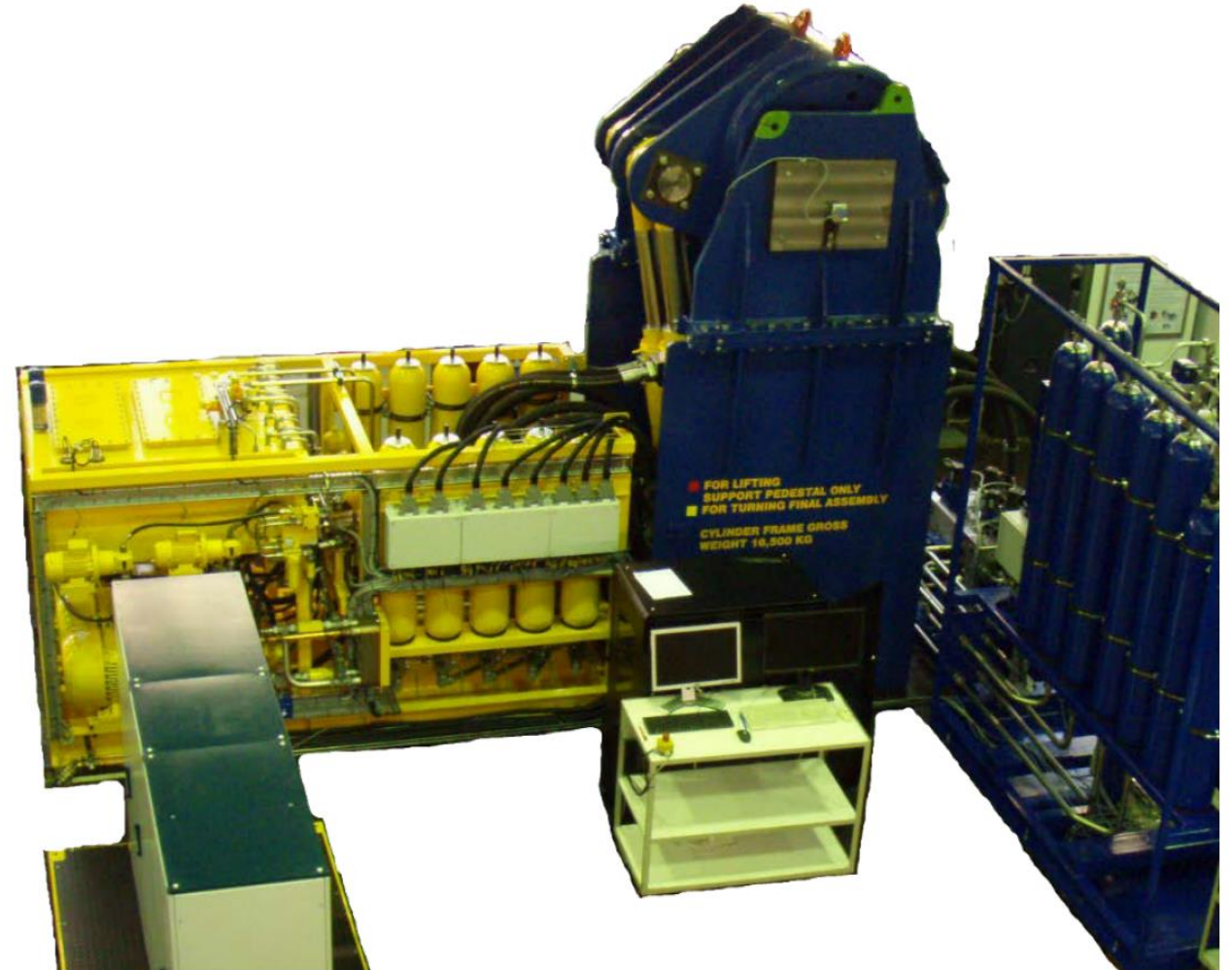


**DISCOVER
WITH
PLYMOUTH
UNIVERSITY**

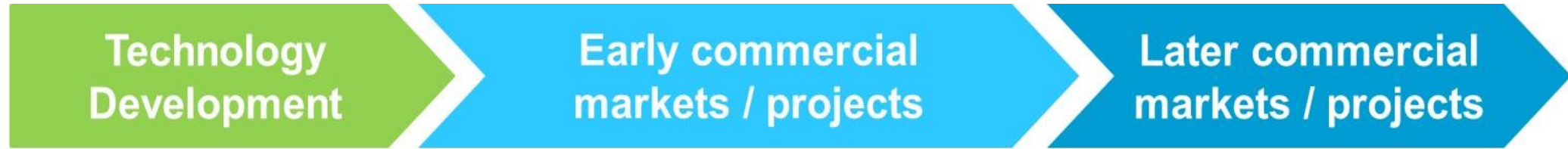


CETO Hydraulic Electric Test rig

- CWE purchase of former Aquamarine PTO test rig at the Institute for Fluid Power Drives and Controls (IFAS) at RWTH Aachen University in Germany.
- Supports ongoing CETO PTO test program including:
 - Component performance under a realistic duty cycle
 - System durability, functionality & efficiency.
- Ongoing collaboration with IFAS
- Continuing to work with Bosch Rexroth on PTO design and delivery



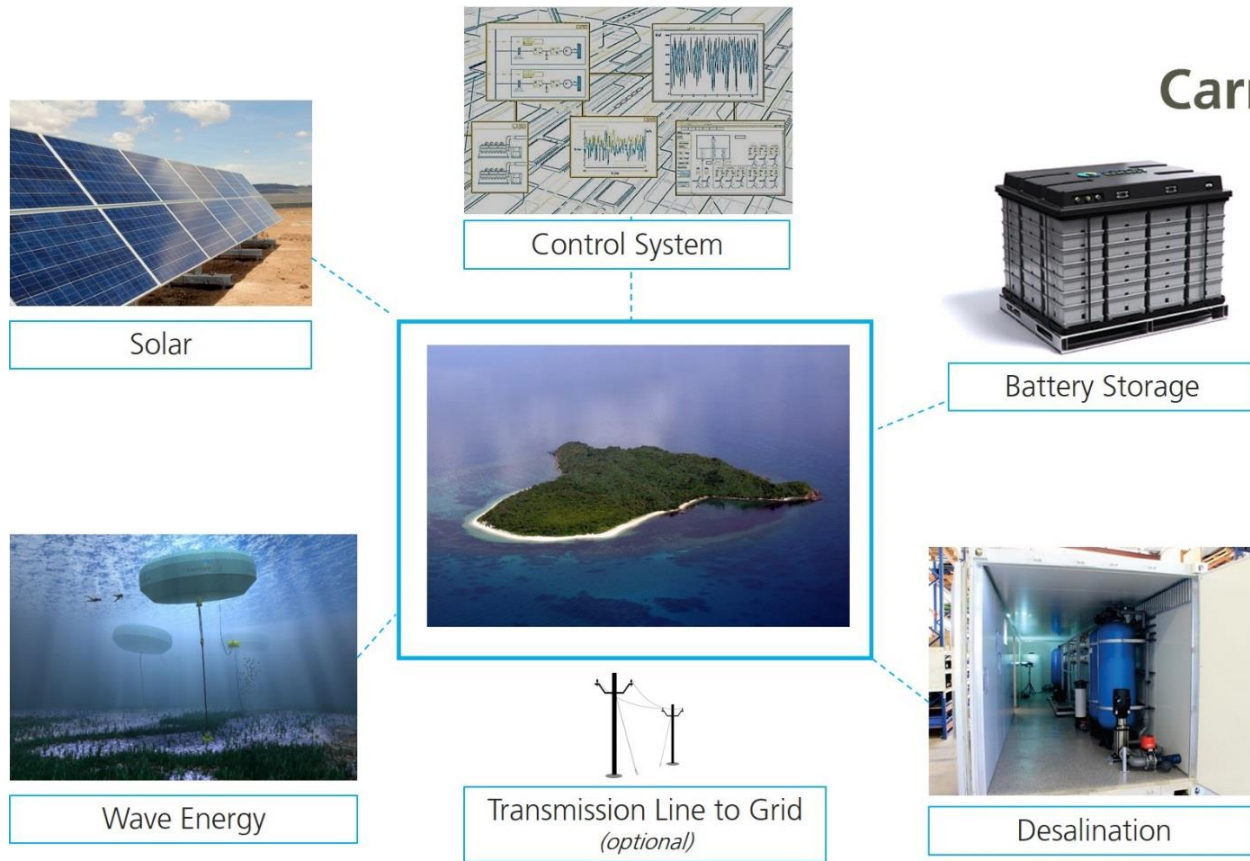
Commercialisation of CETO – UK/EU and Islands



Commercialisation via two key initial markets:

- UK/EU: taking advantage of sites, funding, tariffs and supply chain.
- Islands: taking advantage of high power tariffs, competitive advantage of wave (consistency and footprint).

Wave-Integrated Microgrids – Expanding Our Capability



- Multiple energy generation sources
- Sophisticated control systems and storage
- Takes advantage of temporal variation, reducing energy storage and diesel generation.
- Desalination allows higher levels of renewables, as a form of energy storage
- Garden Island Microgrid (GIMG) will be the world's first wave integrated renewable microgrid project.
- Delivering Mauritian wave and microgrid design project
- 35% stake in and strategic alliance with leading Australia microgrid EPC, Energy Made Clean.



Key Achievements & Upcoming Wave Developments

CETO 5 Perth Wave Energy Project

- ✓ 3 units, 14,000 hours, computational models validated
- ✓ Exported power and water to the Australian Department of Defence

CETO 6 Project, Western Australia

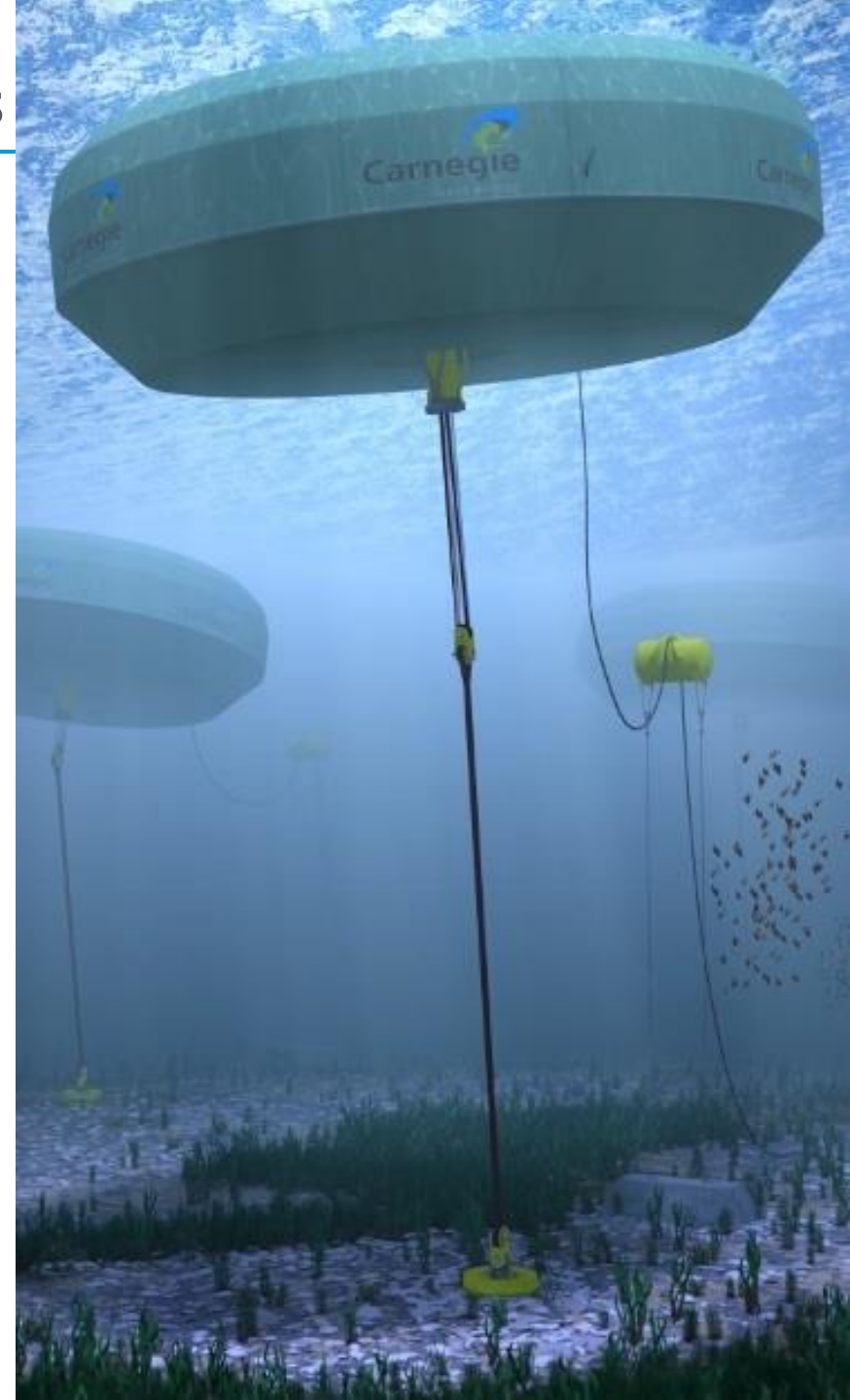
- ✓ CETO 6 concept design complete
- Construction to start 2016.

CETO 6 Project, UK

- ✓ Development started 2015, Construction 2018
- Funding progress expected in coming months

Microgrids

- Mauritian project delivery
- Garden Island project funding progress expected in coming months





Questions?

Carnegie Wave Energy Limited

www.carnegiwave.com