

Challenges of up-scaling to a grid connected array

PECC Energy Transition 2013-2014

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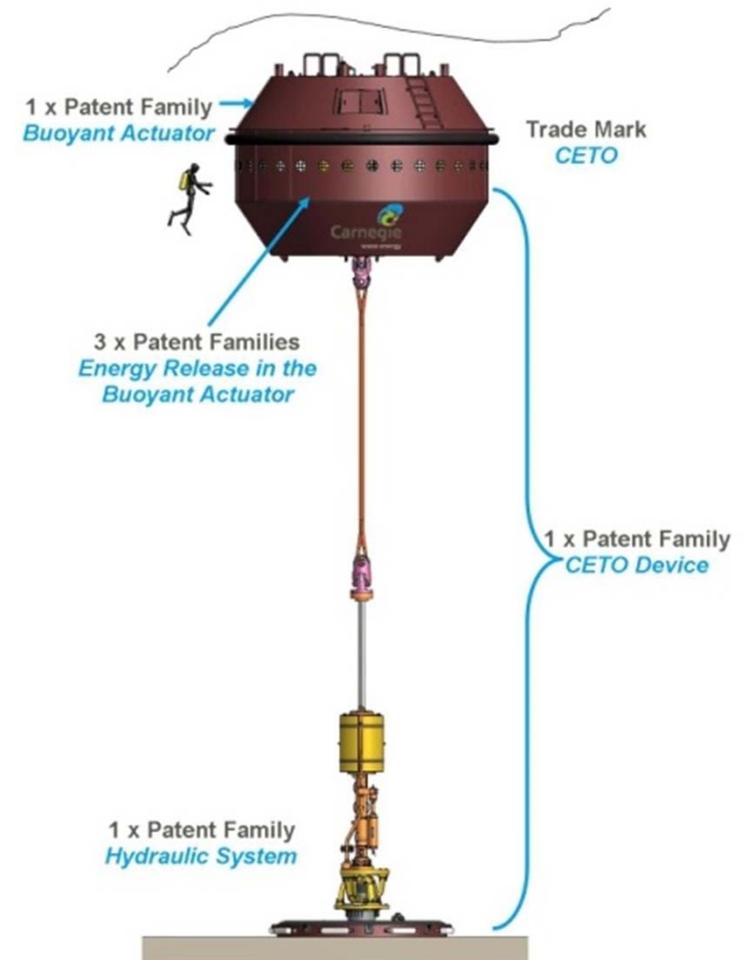
Carnegie Introduction

- Owner and developer of “CETO” wave energy technology
- 35 engineering, commercial, administration staff
- ASX listed, based in Fremantle, Western Australia
- Subsidiaries in UK, Ireland and Chile
- 120 Patents or patents pending globally
- Raised \$77m, spent \$95m to date on CETO
- EDF (French) is a CETO licensee



CETO Intellectual Property Management

- CWE invests up to **\$1m per annum** in the management and maintenance of its intellectual property portfolio
- An Independent Expert's Report described the investment in CETO as having “...created significant IP barriers to entry...”.
- CWE's patent portfolio consists of **8 patent families** covering the strategic elements of the CETO technology. There are more than **120 patents and patents pending**.
- Carnegie has also developed significant “**soft**” IP e.g. know-how, modelling, process design, control algorithms etc that is essential to successful technology design and operation

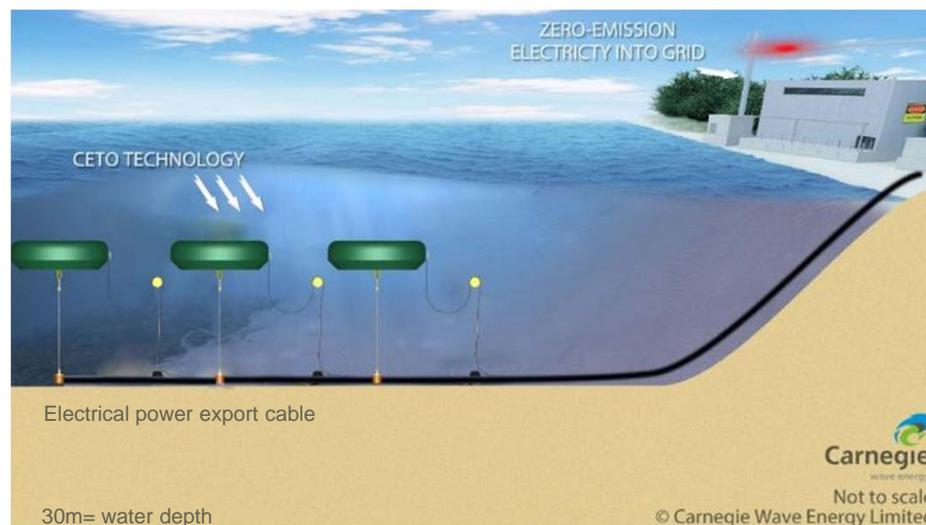


CETO Technology

- Fully submerged, point absorber
- Near-shore location or deepwater location
- Onshore or offshore power generation
- Power & water production with onshore production
- Modular design largely using proven subsea components



Near-shore location & onshore power & water



Deepwater location & offshore power production

Carnegie's Commercialisation Road Map



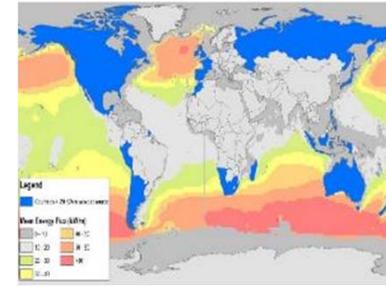
Wave tank testing @ Fremantle, WA



3 x 1kW prototypes @ Fremantle, WA



CETO 5, 3 x 240kW array
Power & water production
Western Australia.



25MW commercial project
(25 x 1MW units)



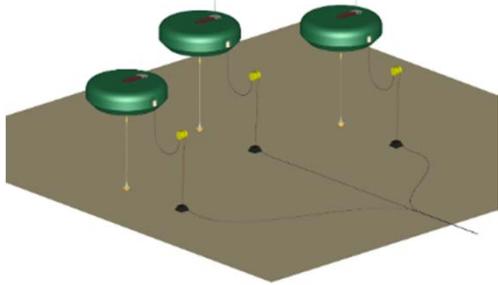
Proof of concept
prototype @
Fremantle, WA



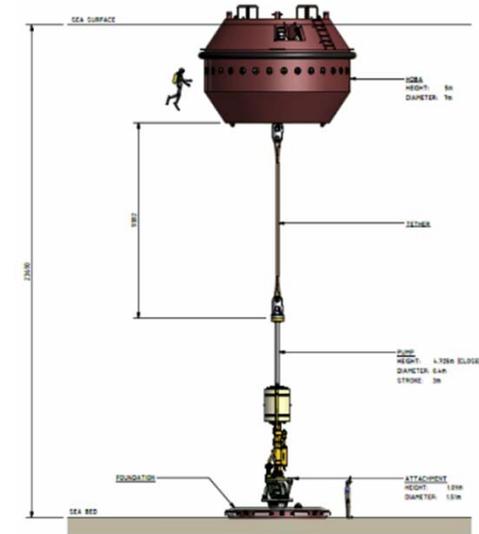
80kW prototype @
Garden Island, WA



CETO6, 3MW demo
(3 x 1MW units)



Track record of ocean testing – 80kW prototype



Perth Wave Energy Project

- Grid connected CETO array
- 3 x 240kW CETO 5 units, pipelines to shore
- Onshore power plant and grid connection
- Onshore reverse osmosis desalination pilot plant
- Construction and Commissioning in 2014



Perth Wave Energy Project - Desalination

- Integrates off-the-shelf reverse osmosis desalination technology with the CETO infrastructure.
- The Perth Project will be the first wave project to produce clean power and fresh water anywhere in the world.
- Cooperation agreement with Western Australian Government owned Water Corporation

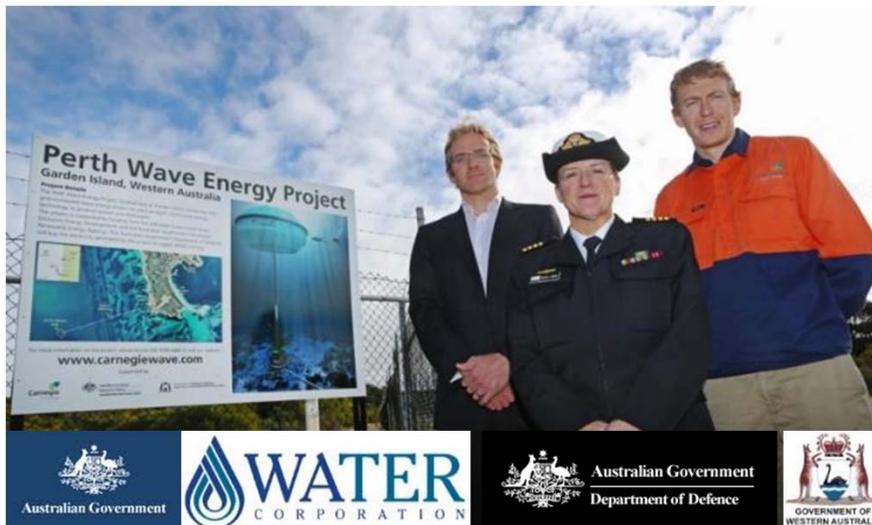
“Carnegie’s wave powered seawater desalination technology offers a novel and promising approach to achieving desalinated freshwater with zero greenhouse gas emissions”

Sue Murphy, CEO, Water Corporation

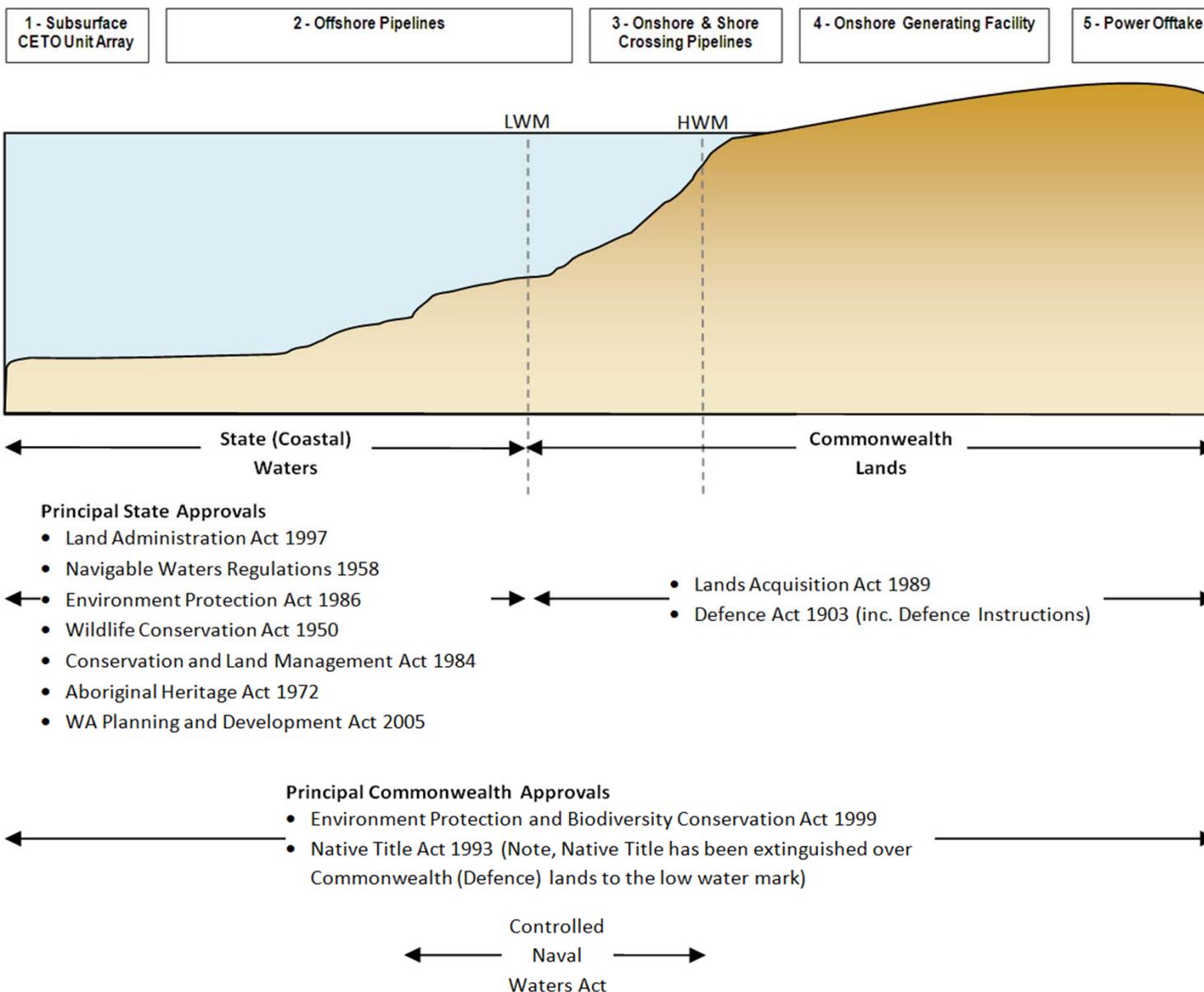


Perth Wave Energy Project – Funding Support

- \$13.1m Australian Government grant funding for power generation
- \$7.3m Western Australian State Government funding
- \$1.25m Australian Government grant funding for desalinated water production
- Power and water supply agreement with Australian Department of Defence



PWEP: *Legislative Framework*



PWEP: *Terrestrial & Marine Environment*



Heritage values of Garden Island, Western Australia (Department of Defence 2011)

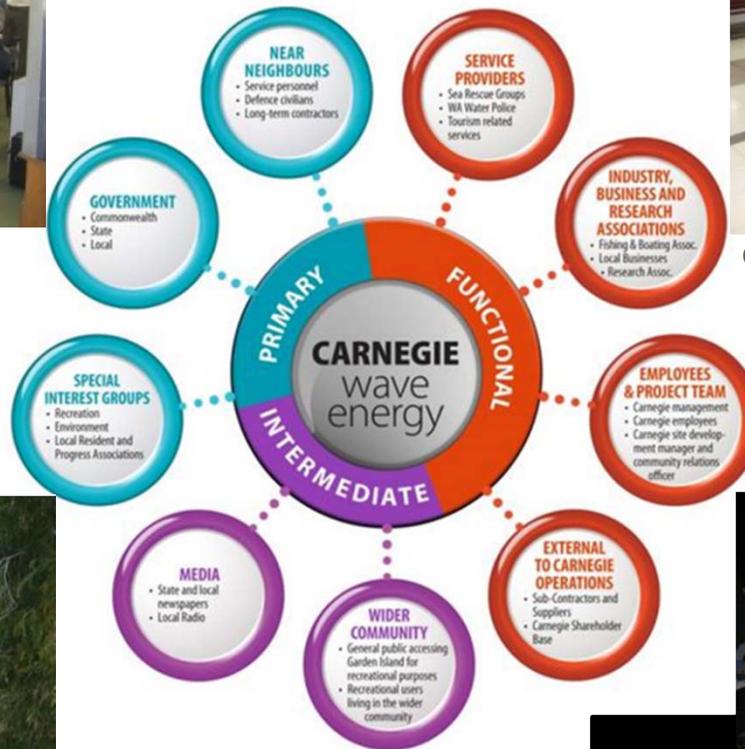
PWEP: *Community Consultation*



Rockingham Volunteer Sea Rescue
(13 Aug 2012)



Community Information Day (11 Aug 2012)



Boat ramp intercept survey (11 Aug 2012)

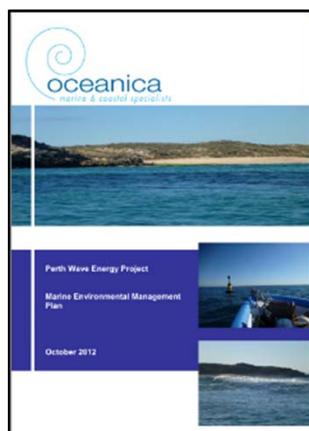


Fremantle Port's Maritime Day (30 August 2013)

PWEP: *Environmental Assessment*

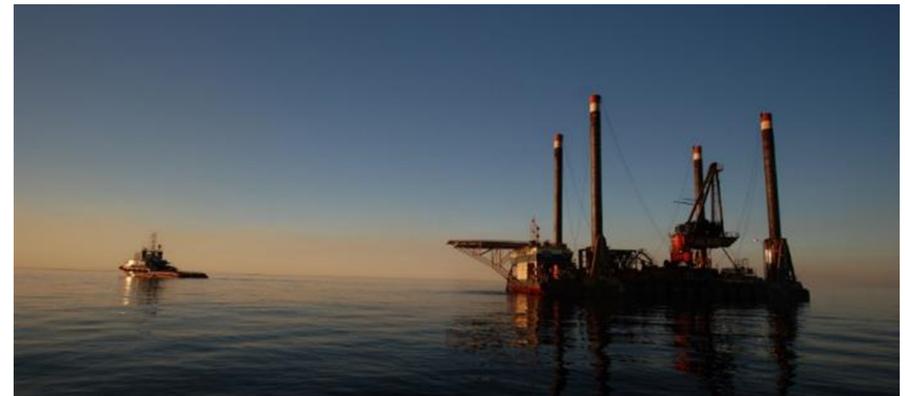
Carnegie Environmental Risk Assessment

- Comprehensive, Due Diligence report
- Resulting management and mitigation measures were adopted
- Overall, PWEP assessed with no high or unacceptable risks or potential impacts remaining after management
- Large number of approved management plans



Perth Wave Energy Project – Status

- Design, approvals, off-take, funding complete
- Offshore foundations installed
- Pipeline installed
- Buoyant actuators delivered

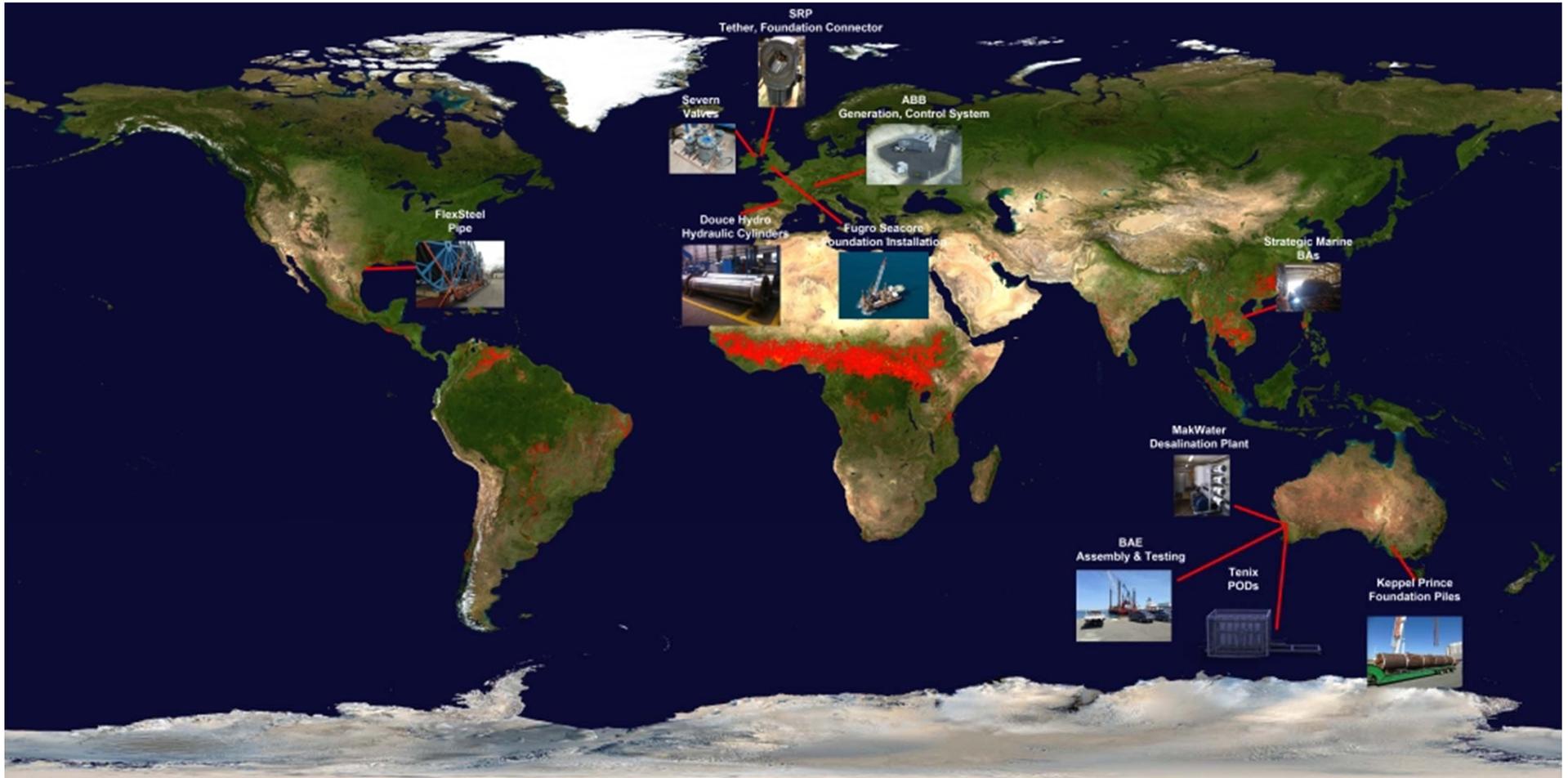


Perth Wave Energy Project – Status

- Offshore construction complete
- Onshore construction complete
- CETO Unit components delivered (buoy, pump, tether, attachment and energy relief)
- Assembly and onshore pre-installation testing commenced

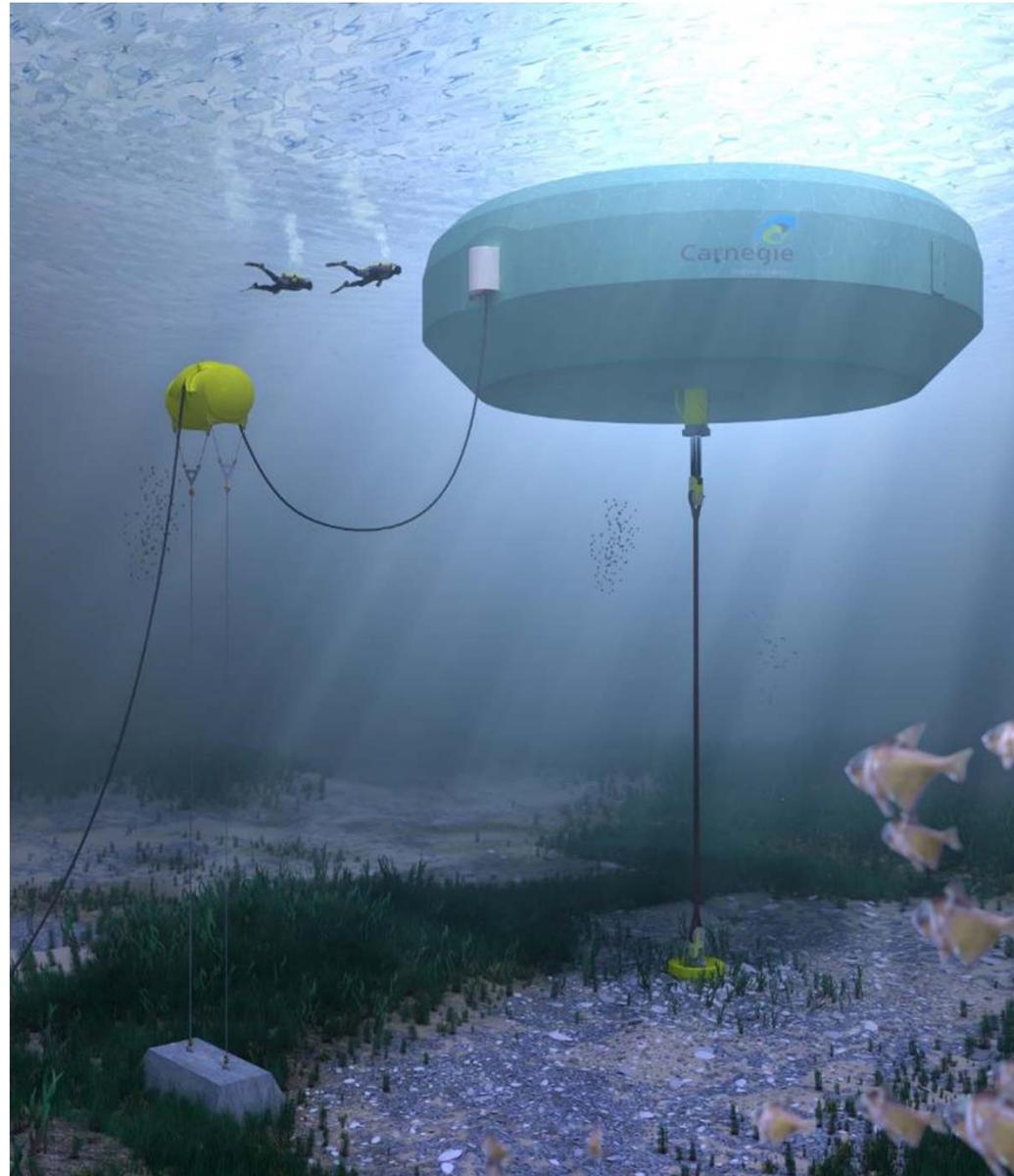


Perth Wave Energy Project – Global Supply Chain

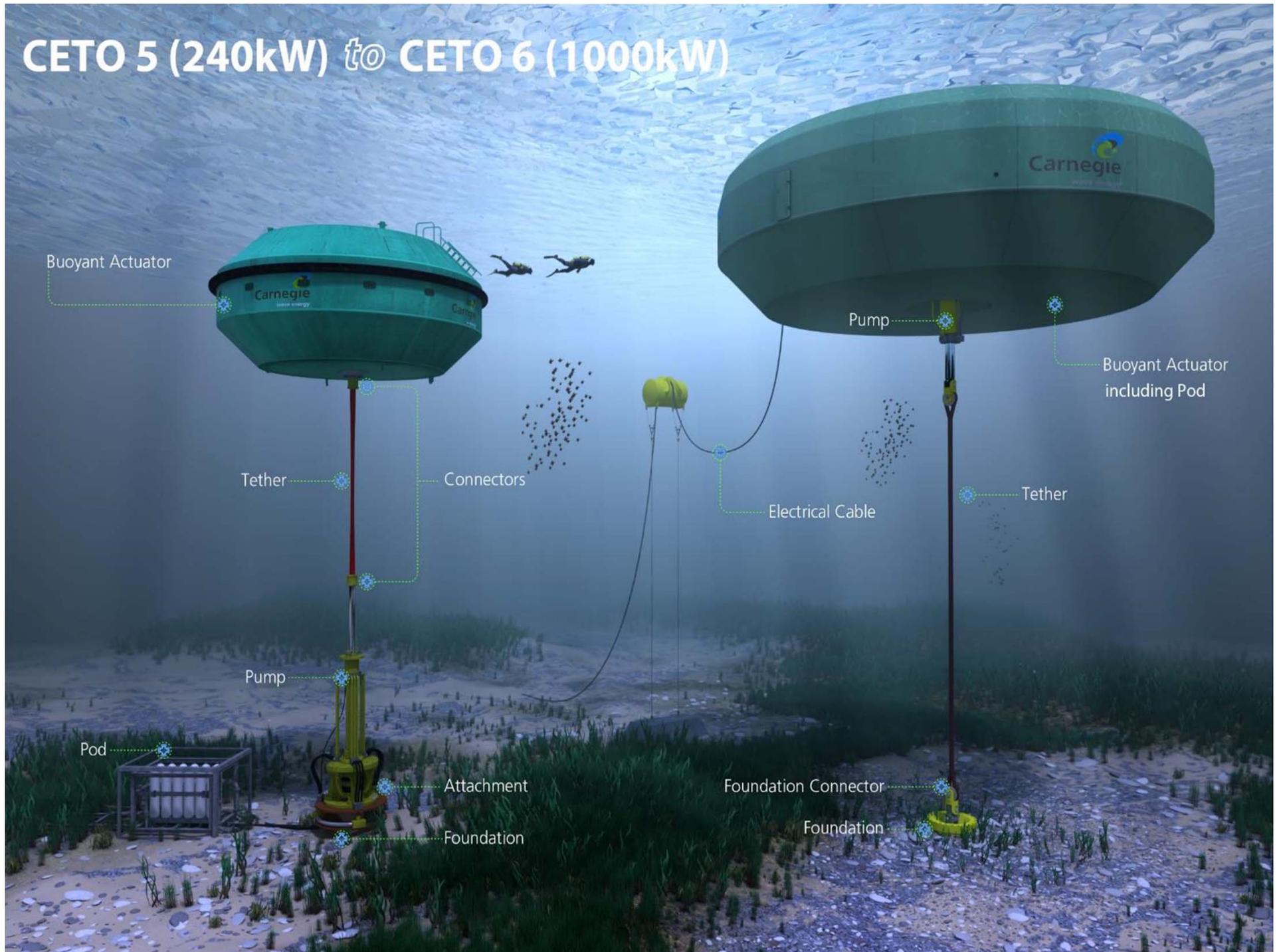


CETO 6 – Next Generation Design

- 1MW (1000kW) capacity unit
- ~50% increase in diameter over CETO 5 => 4 x increase in rated capacity
- First commercial production unit
- Cost competitive in large projects

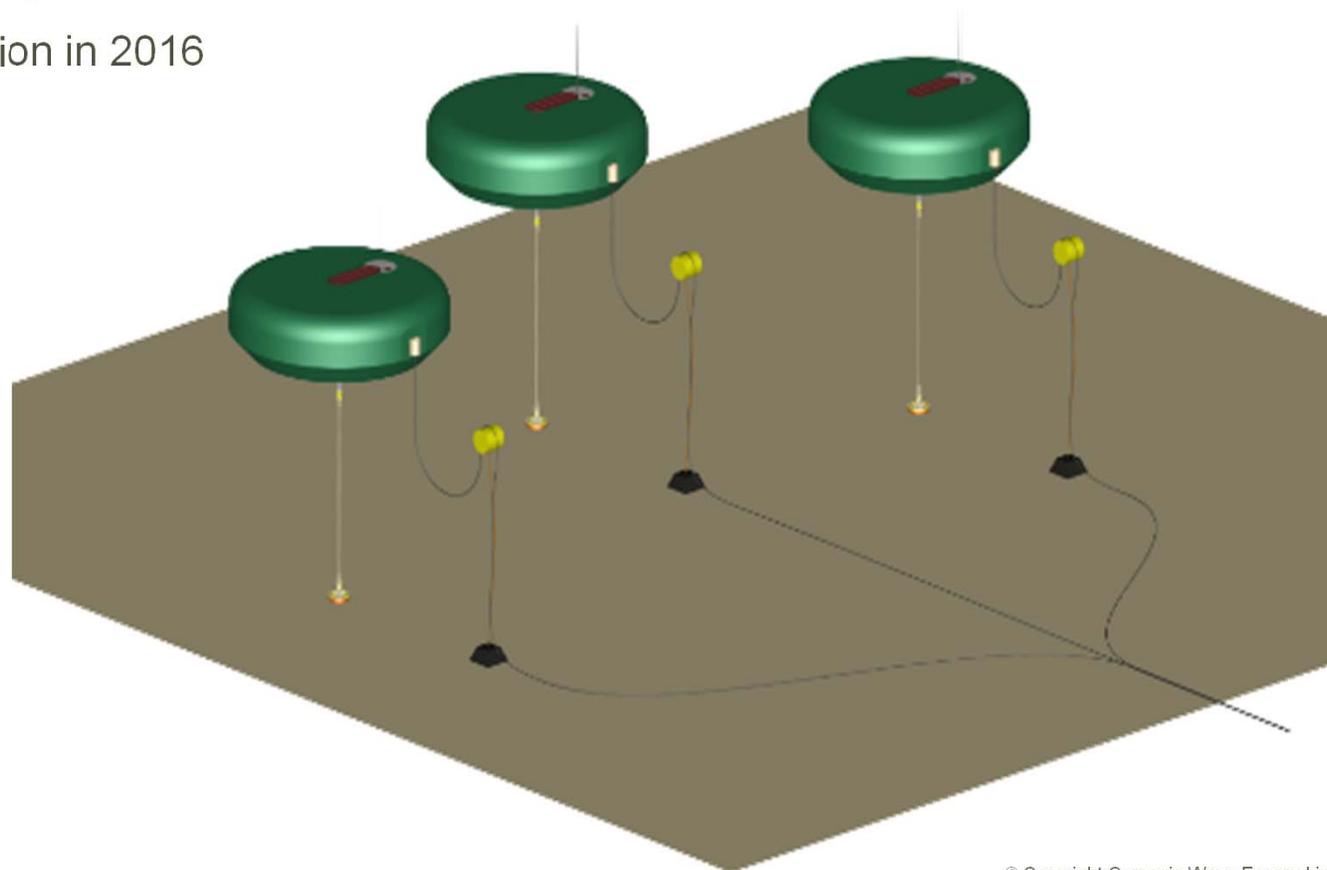


CETO 5 (240kW) *to* CETO 6 (1000kW)



CETO 6 Demonstration Array Project

- 3MW CETO 6 project: 3 x 1M CETO 6 units
- Target demonstration locations: Australia & International
- Concept design from 2013
- Detailed design starts 2nd half 2014
- Demonstration in 2016



Upcoming Milestones



- **2011-13:**
 - ✓ Single unit test (CETO 3) at project site
 - ✓ \$22m in Government grants secured
 - ✓ Power offtake with Dept of Defence
 - ✓ Detailed Design of Perth Project
 - ✓ Environmental & planning approvals
 - ✓ Start procurement & construction of Perth Project
- **2014:**
 - Power and water production from Perth project
 - First revenues from power and water sales
 - CETO 6 project design, location and funding
- **2016:**
 - Construction of 3MW CETO 6 project
- **2016+:**
 - First commercial sales