

## Challenges of up-scaling to a grid connected array

PECC Energy Transition 2013-2014

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# Disclaimer

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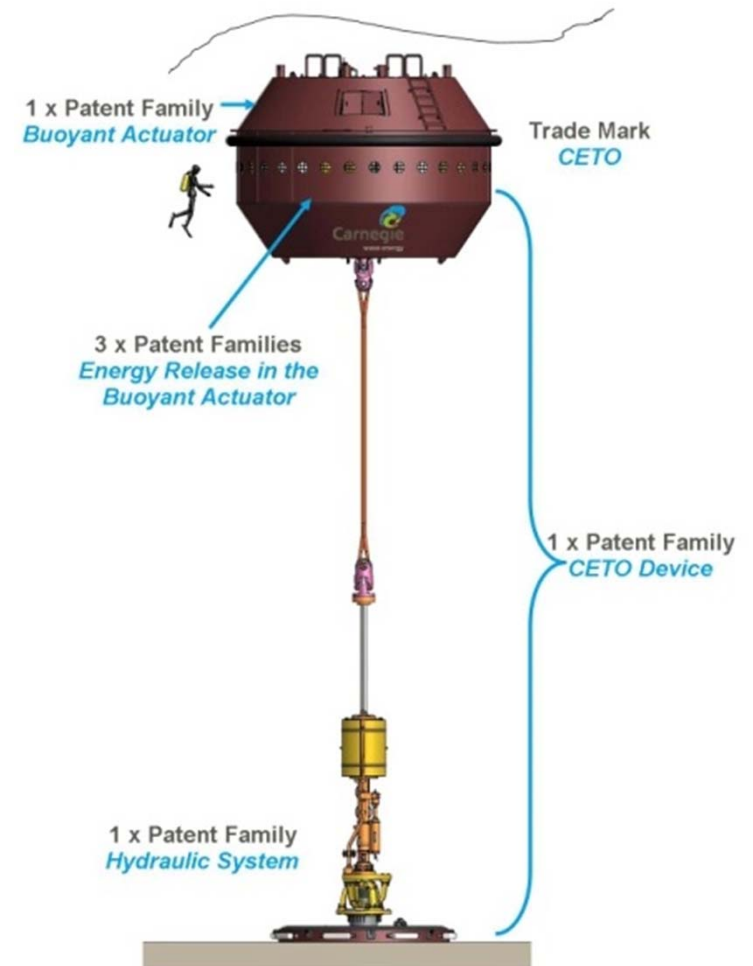
# Carnegie Introduction

- 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

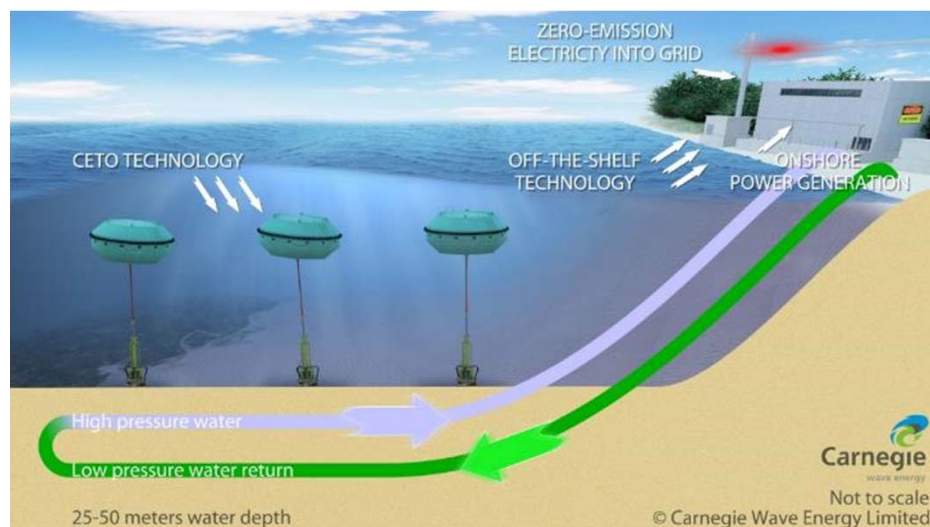
- CWE invests up to **\$1m per annum** in the management and maintenance of its intellectual property portfolio
- An Independent Expert's Report described the investment in CETO as having “...**created significant IP barriers to entry**...”.
- CWE's patent portfolio consists of **8 patent families** 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



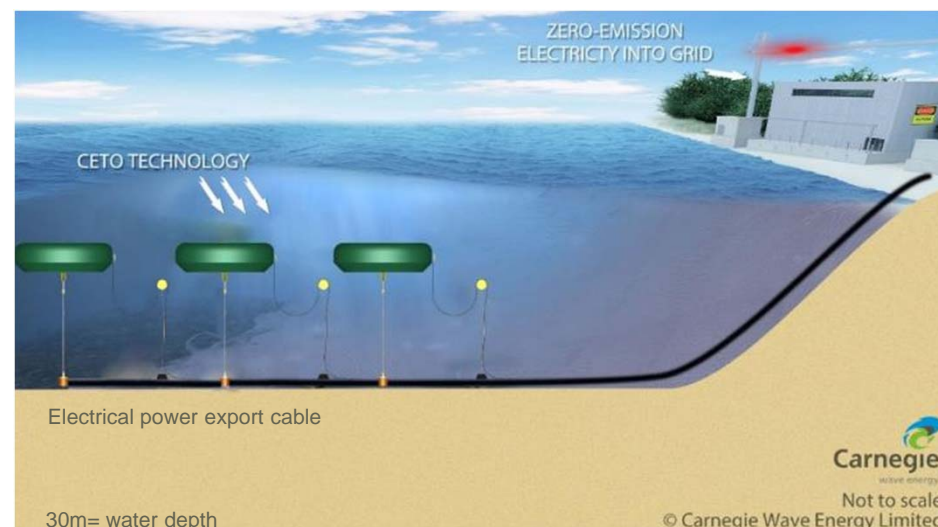


# CETO Technology

- 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



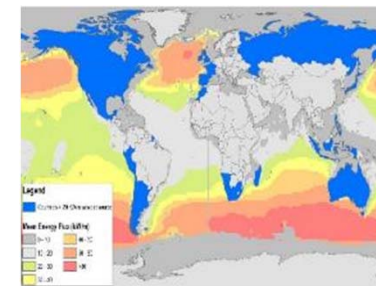
Wave tank testing @  
Fremantle, WA



3 x 1kW prototypes @  
Fremantle, WA



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



25MW commercial project  
(25 x 1MW units)



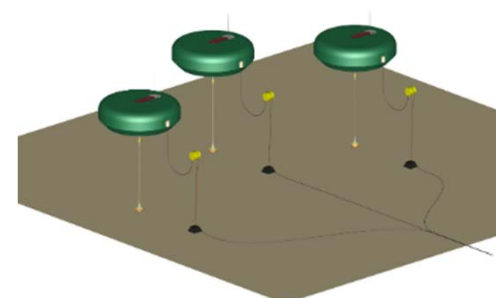
Proof of concept  
prototype @  
Fremantle, WA



80kW prototype @  
Garden Island, WA

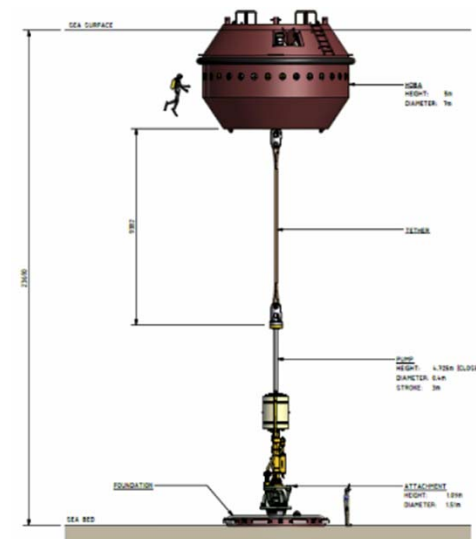
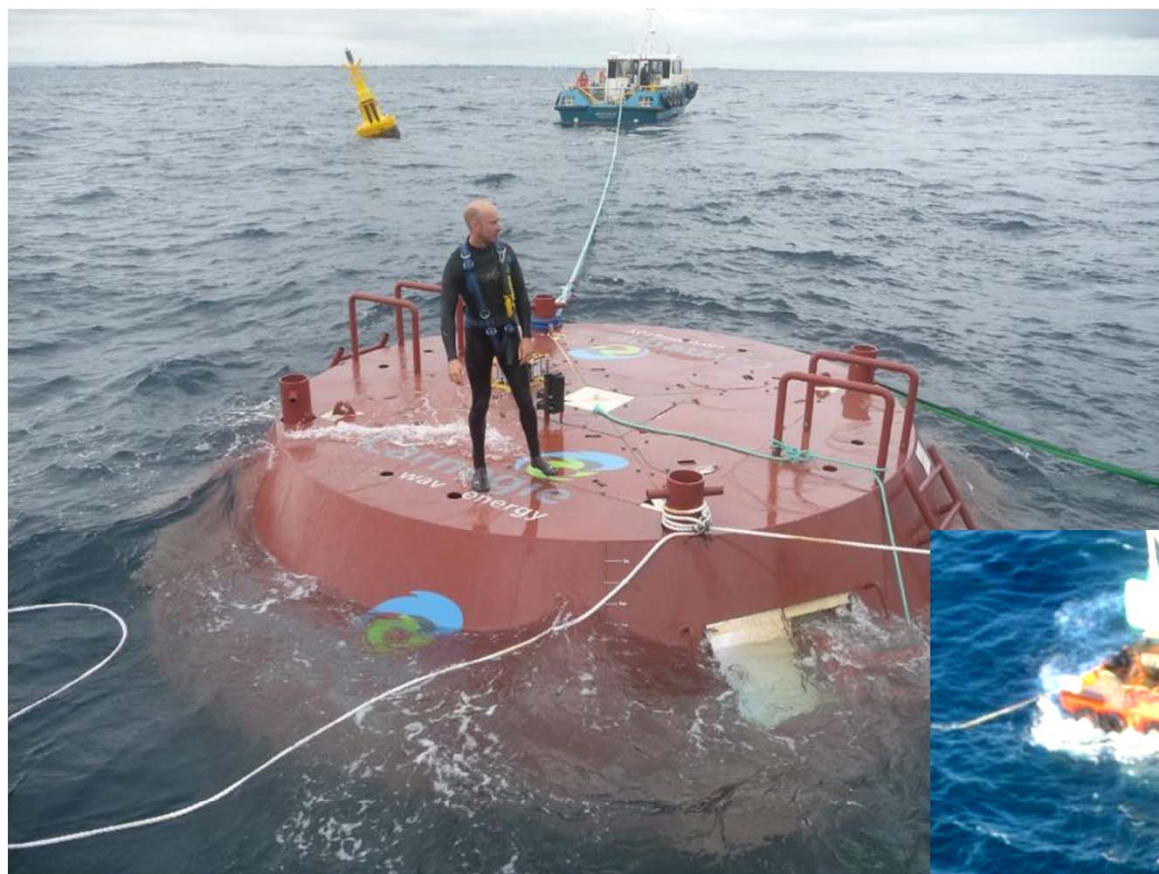


CETO6, 3MW demo  
(3 x 1MW units)





# 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*

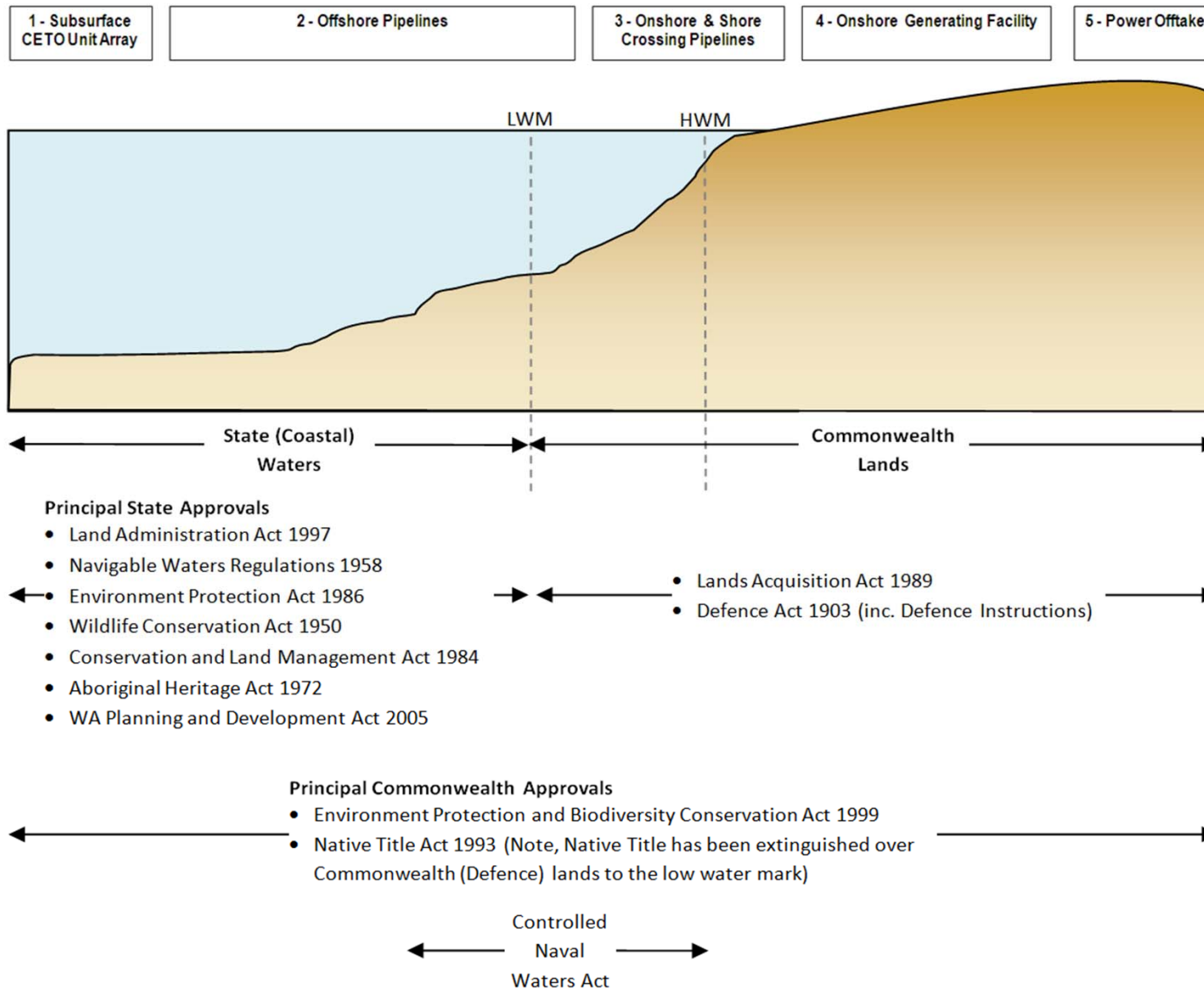


# Perth Wave Energy Project – Funding Support

- \$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)

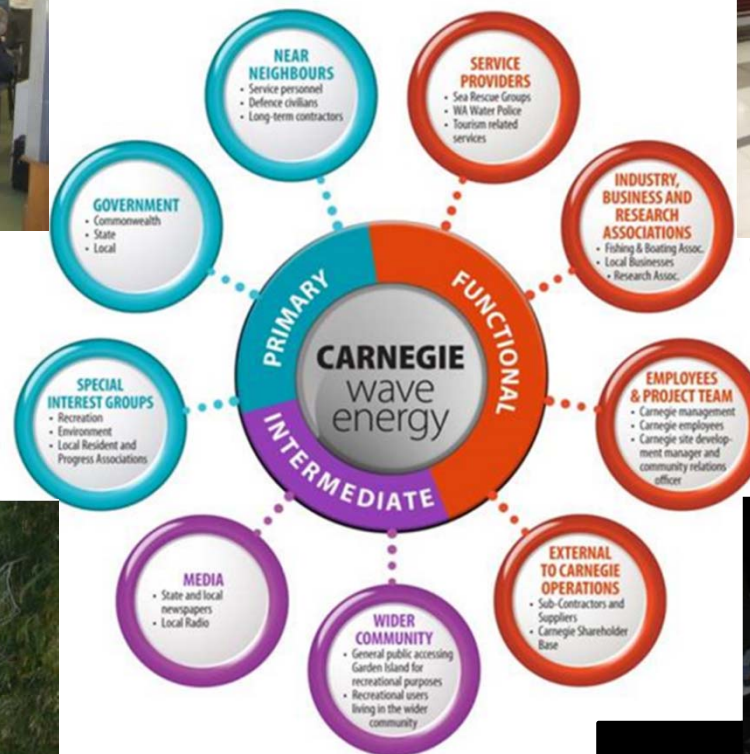
# PWEP: *Community Consultation*



Rockingham Volunteer Sea Rescue  
(13 Aug 2012)



Community Information Day (11 Aug 2012)



Boat ramp intercept survey (11 Aug 2012)



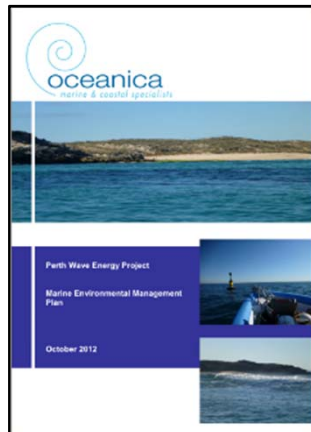
Fremantle Port's Maritime Day (30 August 2013)



# PWEP: *Environmental Assessment*

## Carnegie Environmental Risk Assessment

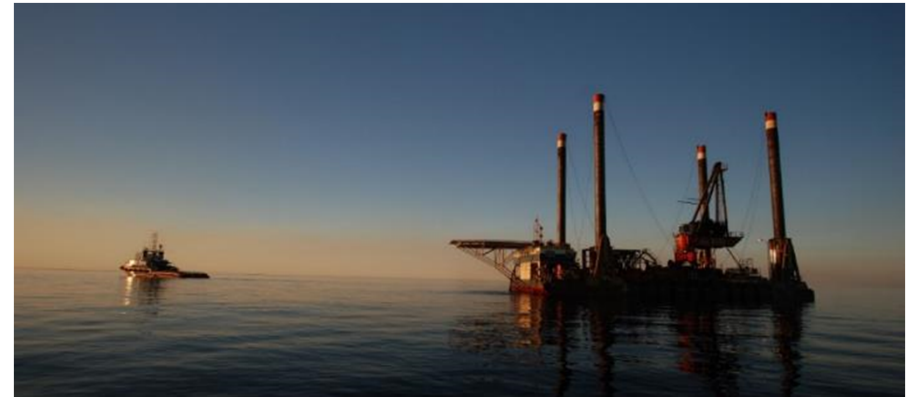
- Comprehensive, Due Diligence report
- Resulting management and mitigation measures were adopted
- Overall, PWEP assessed with no high or unacceptable risks or potential impacts remaining after management
- Large number of approved management plans





# 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



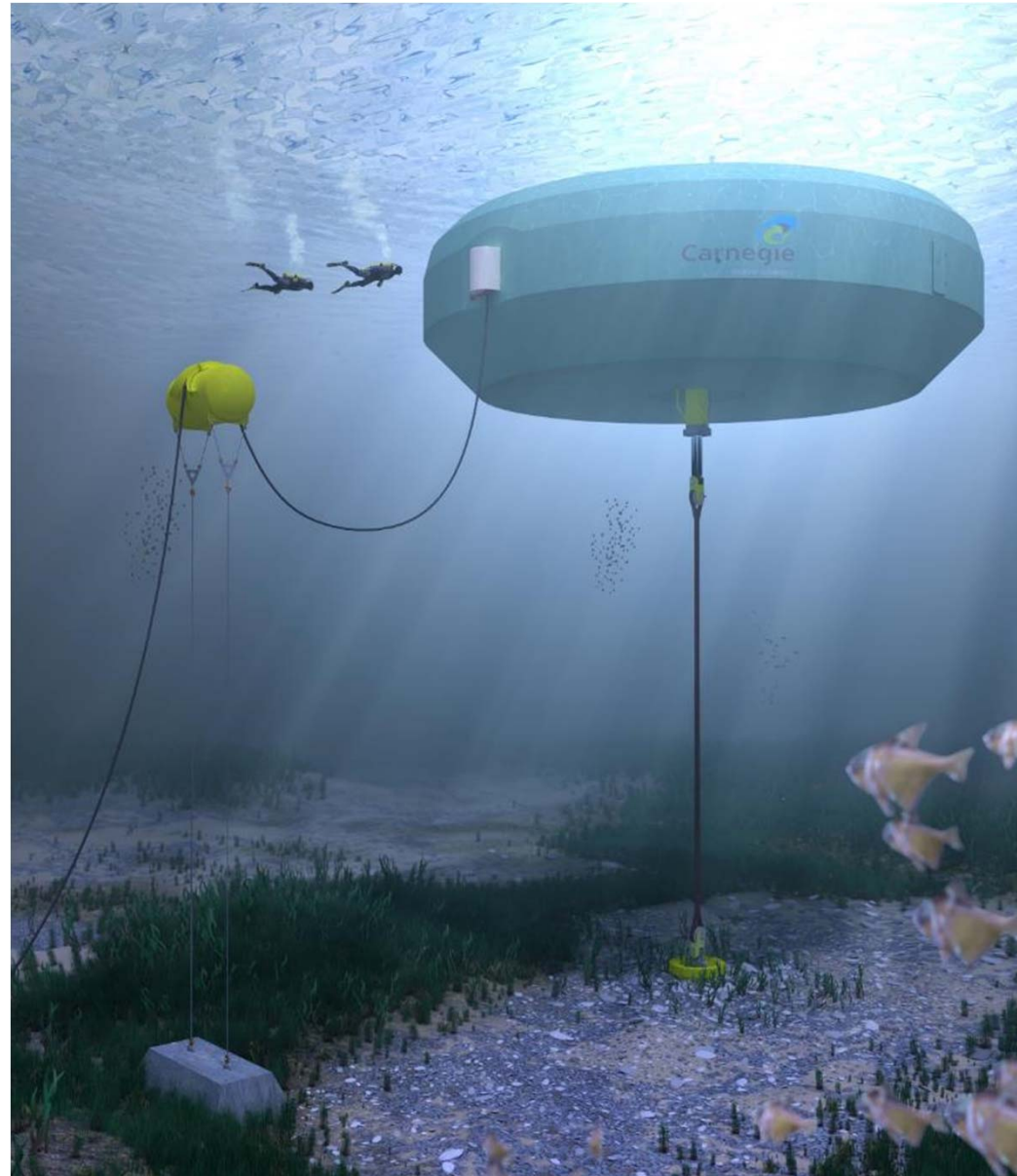
# Perth Wave Energy Project – Global Supply Chain



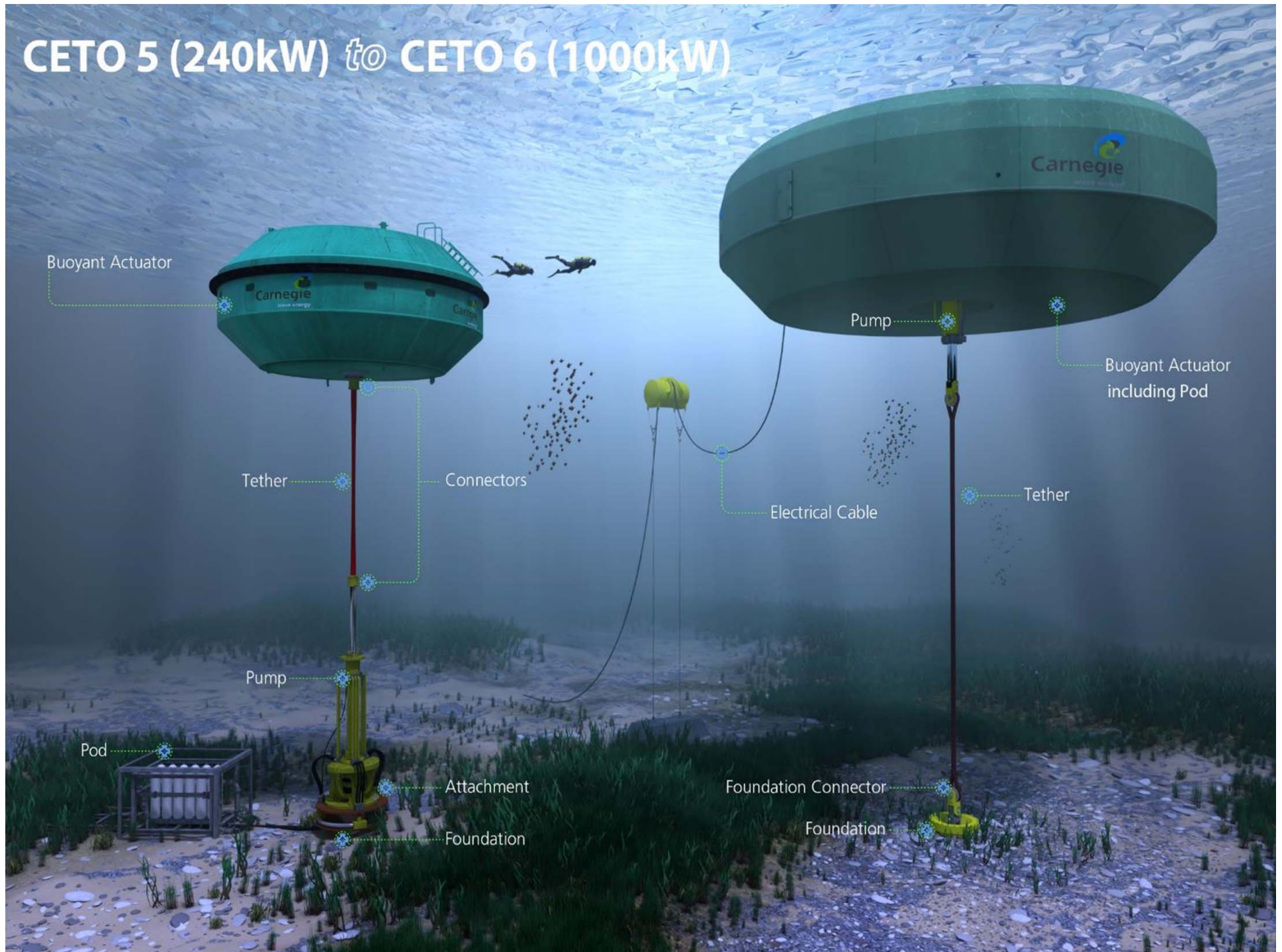


## CETO 6 – Next Generation Design

- 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

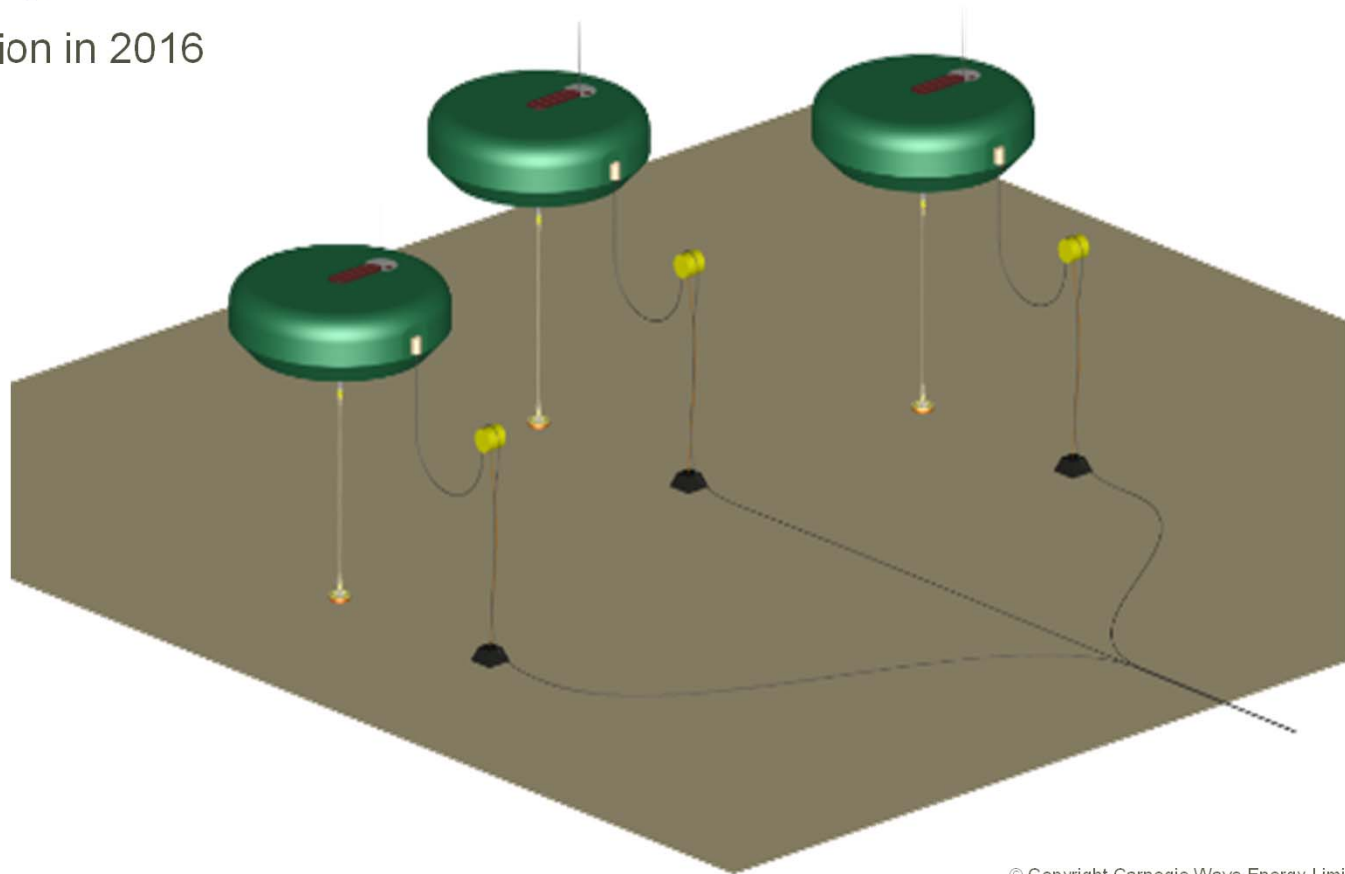


# CETO 5 (240kW) to CETO 6 (1000kW)



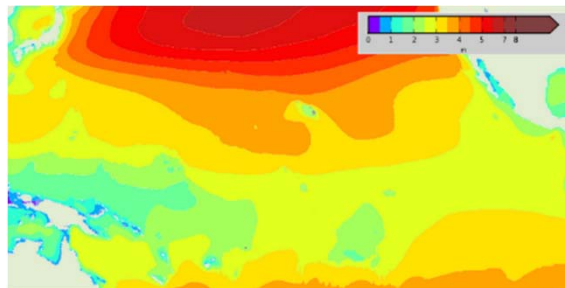
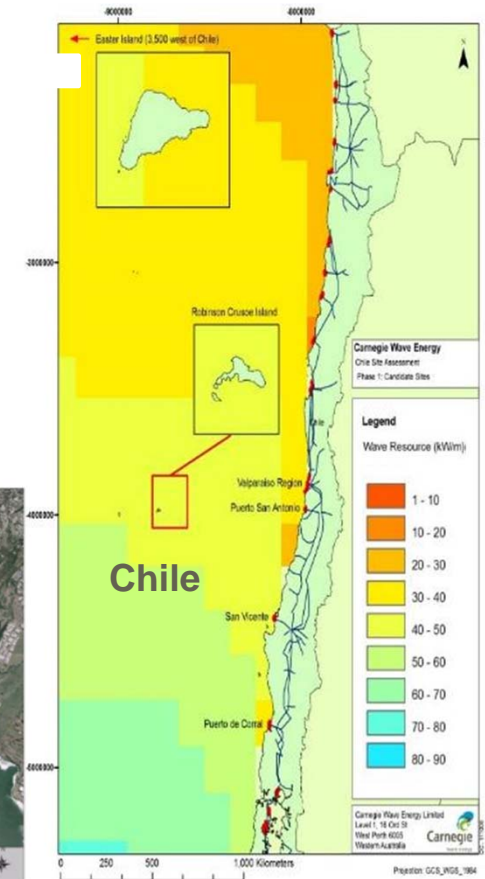
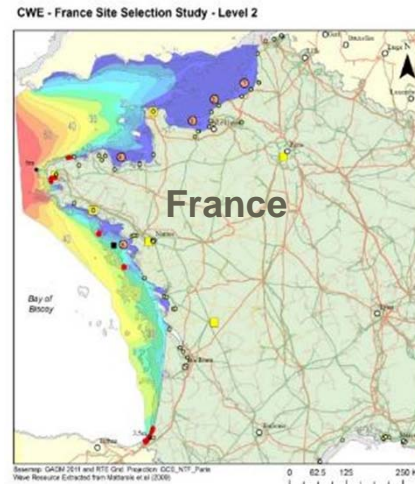
# CETO 6 Demonstration Array Project

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

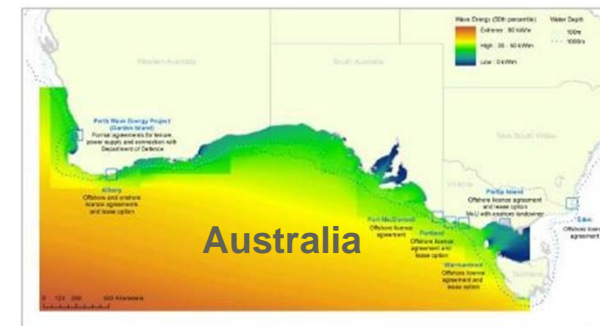
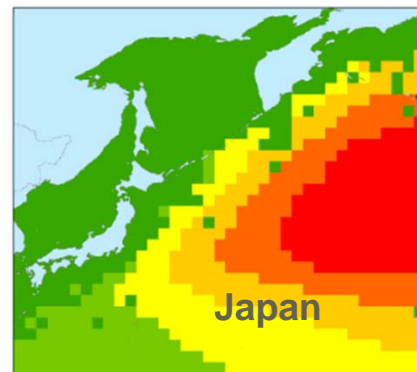
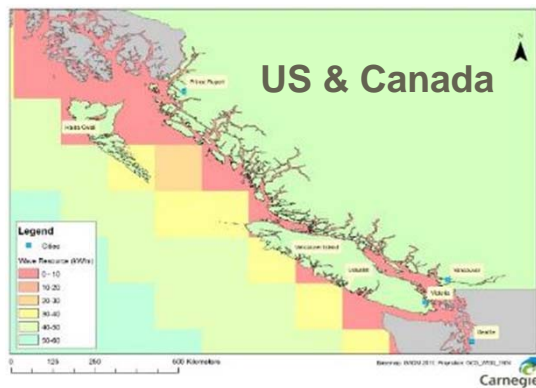




# Commercial Priority Markets - Snapshot



Remote Islands



# 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