

Ocean Energy Europe 2017

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CARNEGIE OVERVIEW

Corporate power

- Carnegie is an ASX-listed developer of utility scale renewable energy projects. It is a global leader in the delivery of solar, battery, wave and hybrid energy solutions.
- Focused on the integration of complex systems – either EPC or BOO
- Business model across the full value chain of design, development, finance, construction, operation and maintenance
- 100% owner of microgrid specialist Energy Made Clean (EMC)
- 50/50 joint venture between EMC & Lendlease Services to deliver solar and battery systems nationally



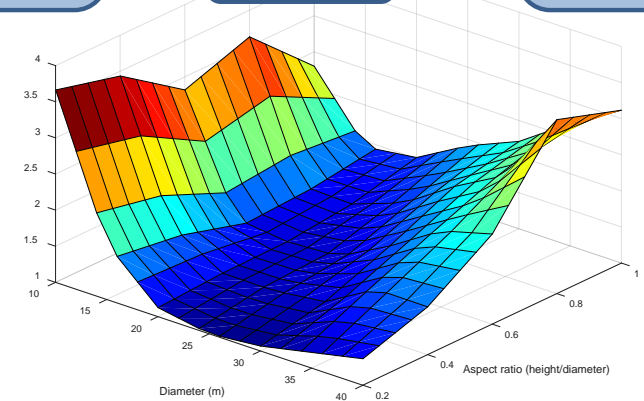
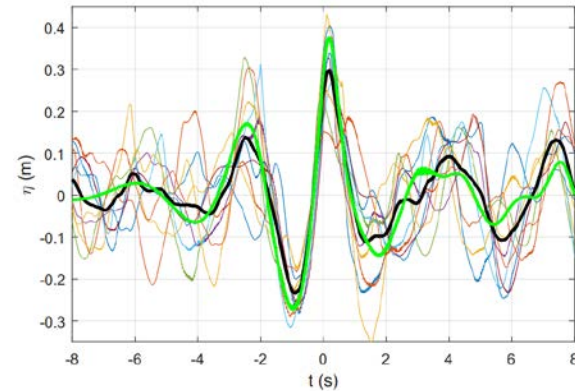
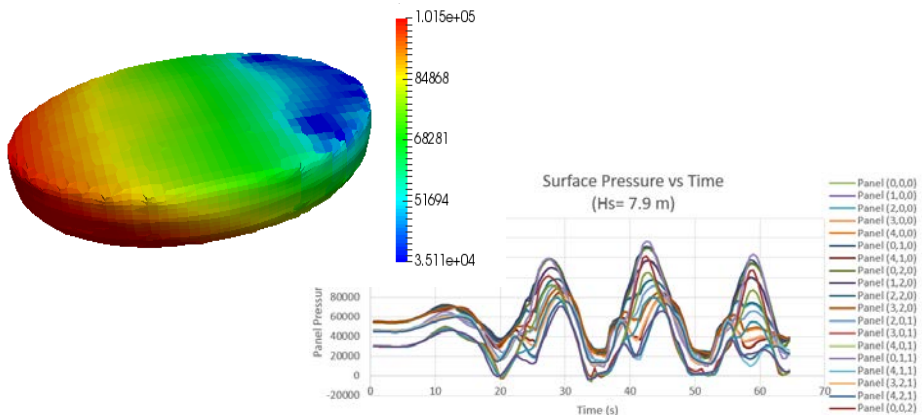
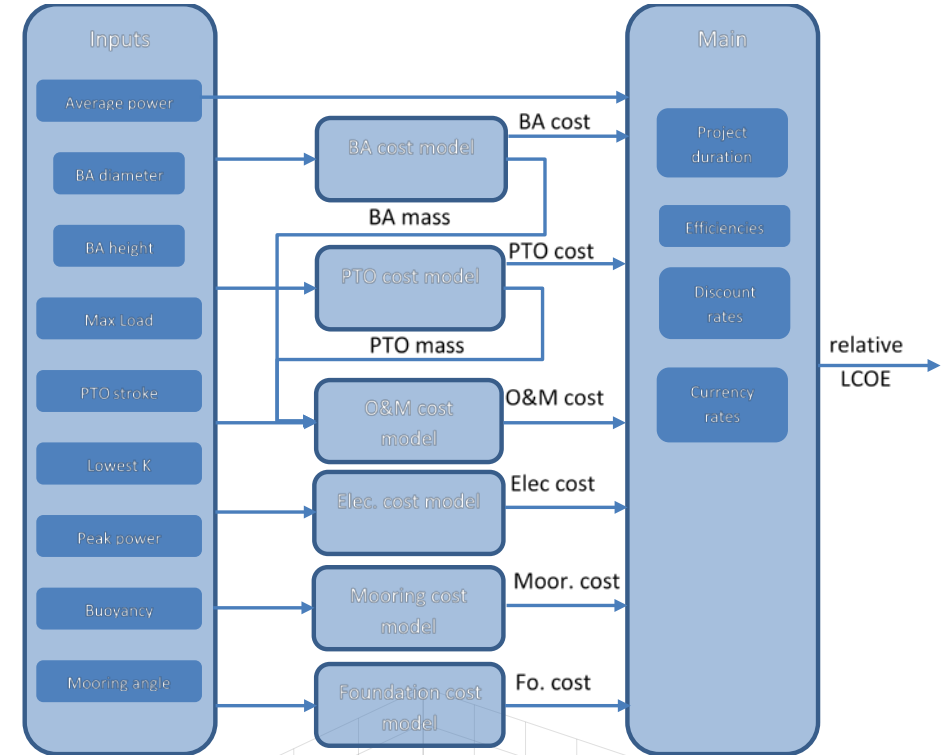
CARNEGIE FINANCIAL SNAPSHOT

- CCE
 - \$130m market capitalisation
 - \$13m cash
 - \$45m undrawn grants
- EMC FY17
 - \$12m revenues, \$8m loss
 - Current FY18 order book \$15m
 - \$2.5m cost efficiencies extracted for FY18



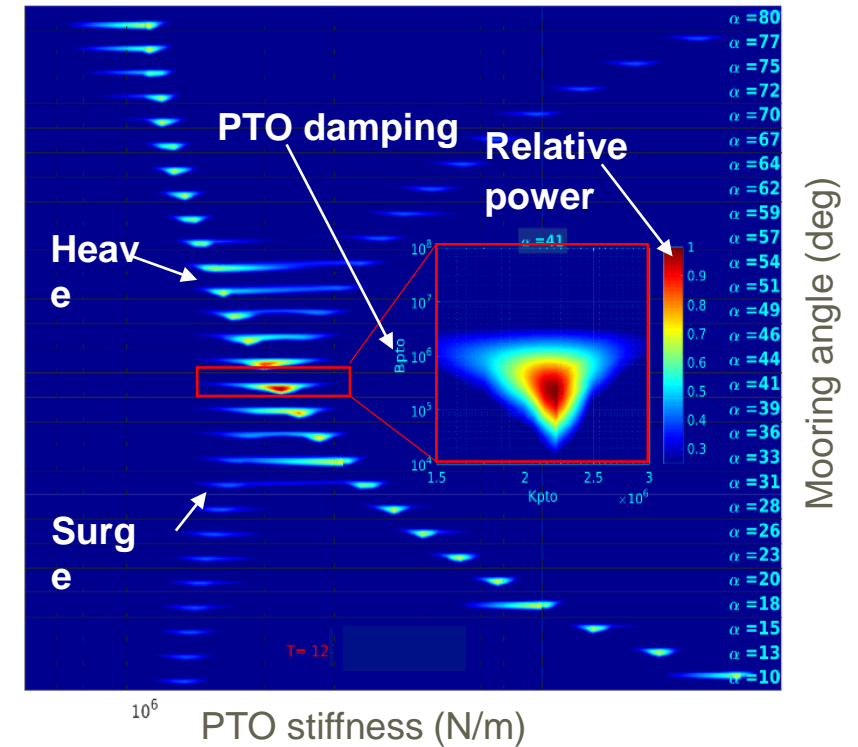
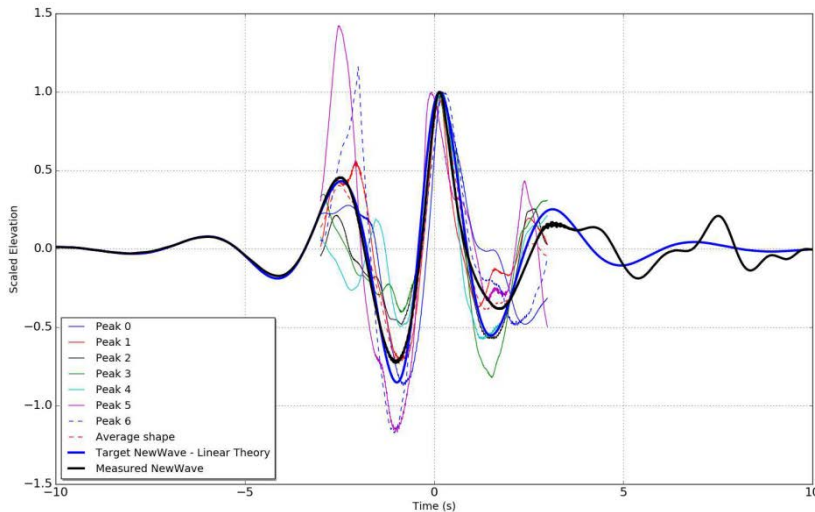
CETO DESIGN TOOLS

- ‘Cradle’ requirements database developed
- ‘Design wave’ technique developed
 - Allows short CFD runs to determine load and motion maxima. Significantly reduces tank testing requirements
- **Failure Mode and Effects Analysis (FMEA)**
- Proprietary **Cost parametric** model developed to perform design optimisation based on LCOE
- Proprietary **CETO availability model** developed. Based on Monte Carlo method (repeated random samplings). Optimise design for reliability and allow optimisation of O&M activities
- Tank and CFD results processing methods developed follow DNV standards
- **Accumulator sizing software** developed

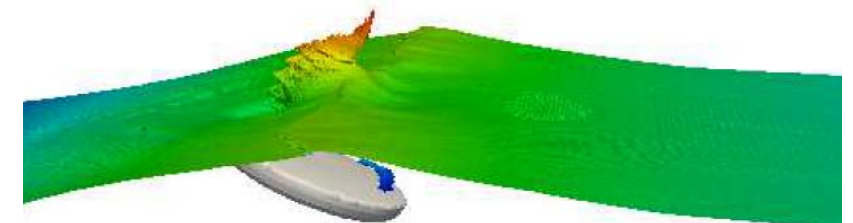


HYDRODYNAMIC MODELLING

- World class in-house hydrodynamic modelling capability utility first of kind methodologies and one of the world's largest supercomputers (Pawsey Supercomputer)
- Robust and iterative method in place using a panel of tools with various degrees of fidelity: Frequency domain model, Linear Time domain model, Non-linear (OpenFOAM) solver
- Linear time domain code run time improved by a factor 600
- “New wave” method developed to compute more efficiently loads and motions in extreme sea states



- Number of Frequency domain simulations: 17,530,768,200
- Number of Linear Time domain simulations: 700,000
- Number of CPU hours: 3,000,000



WAVE ENERGY

Albany Wave Energy Project

- EU43m project including WEC, foundations, cable and grid connection. EU34m in Govt funding (grant and tax credits).
- Delivery of world-first 1MW CETO 6 commercial prototype off Albany, south-west coast of Western Australia
- Albany site wave resource ca 50 kW/m, $H_s = 7m$, $H_{max} = 13m$, $H_s > 1m$ 95%, 2m $> 80\%$ exceedance.
- Site is adjacent to Synergy wind farm and Western Power SWIS network.
- Design and development underway. Installation scheduled for summer weather window 2019/20.
- Wave Energy Research Centre funded by EU2.3m WA Government grant also to be established in Albany



ARENA



CENTRE FOR OFFSHORE RENEWABLE ENERGY (CORE)

The Centre for Offshore Renewable Energy (CORE) will support the development of the offshore renewable energy industry including wave, tidal and offshore wind energy.

- Apply existing unique offshore energy capability to the development of offshore renewable energy supply chain and develop domestic and export opportunities.
- Deliver applied research meeting industry needs
- Carnegie's Research & Testing facilities used as living laboratories

1. Fremantle – Onshore Testing & Offshore Nursery Site

- Onshore Research Facility for Onshore Testing
- A shallow near shore site suitable for prototype and pilot scale testing
- Support infrastructure

2. Garden Island – Intermediate Demonstration Site

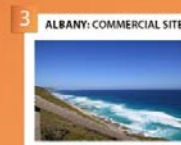
- A sheltered demonstration site suitable for large scale demonstrations
- Grid connected
- 4 x foundations and support infrastructure

3. Albany – Commercial Site

- An open ocean site suitable for commercial projects
- Grid connected
- New Infrastructure to built in Carnegie's Albany Wave Energy Project

4. Center of Excellence

- Perth and Albany bases for Research & Testing



THANK YOU

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