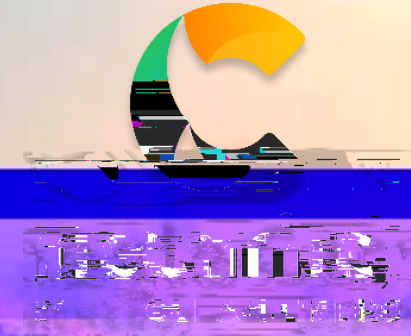


ORE Supergen Conference  
12 October 2017



# ORE Challenge Workshop

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# DISCLAIMER

The information contained herein has been prepared solely for informational purposes and is not an offer to buy or sell or a solicitation of any offer to buy or sell any security or to participate in any trading strategy or to enter into any transaction. If any offer of securities is made, it shall be made pursuant to a definitive offering memorandum prepared by or on behalf of any fund or other issuer which would contain material information not contained herein and which would supersede this information in its entirety.

# Carnegie Wave Power

>£80m invested to date through to 6<sup>th</sup> generation

One of the leaders in wave energy technology. CETO 5: grid-conn9 G(-)]TET@MC /P #1 18 Tf1 0 0 1 500.98 3

# Carnegie's Open Innovation R&D Portfolio

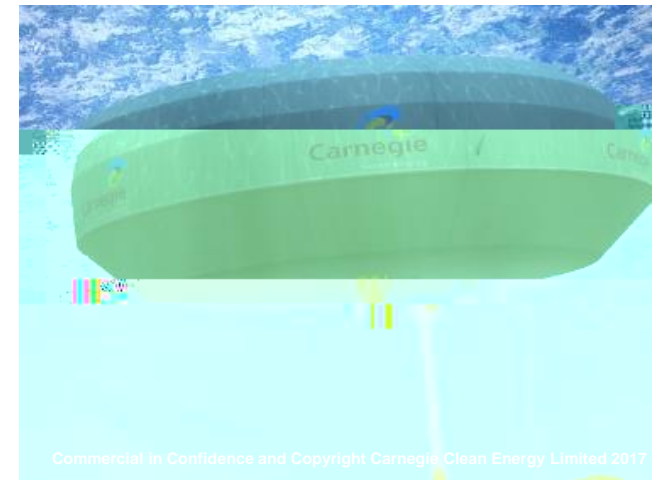
7.5m portfolio of collaborative R&D

Wave Energy Scotland (WES) funded projects:

C-Gen PTO, University of Edinburgh

Reinforced Polymers for Wave Energy (RePower) project with DNV GL and the National Composites Centre

RotoHybrid



# Main Challenge for Wave

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Cost Reduction

Make wave energy attractive to investors

Policy Vacuum

At a very simplistic level, wave energy costs are forecast to come down due to:

# Research Opportunities

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## 3 Research Areas

# Research Challenges

## Applied Research

Analytical tools to speed yield and survival load modelling and resource assessment Reducing the need and cost to tank test, speeding up CFD testing and leveraging linear models as appropriate - New extreme wave load method developed

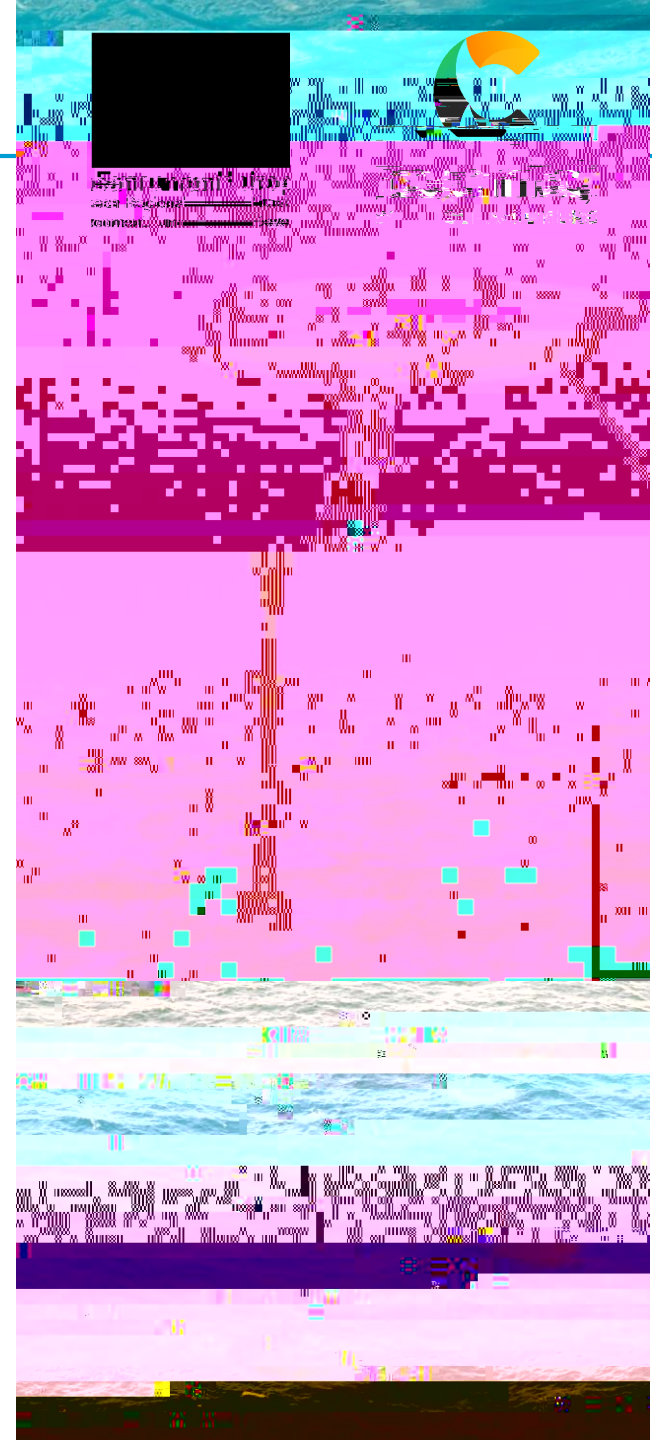
Novel Hydraulic, electric and control designs for PTO

Auto latching and release mooring connectors

Reducing cost of subsea foundations

Active buoyancy variation?

Active surface area variation?



# Research Challenges

## Applied Research

Cost and weight of structures

Application of new materials to CETO WEC (composites, 3d printed components)

Use of new materials for mooring lines

Composite mechanical springs can they be applied to WECs?

Cyclic bending over sheave of ropes what is the optimum material for very high cycle, high force WEC application?

Development of very high efficiency hydraulic machines

Electrical connectors wet mate connectors in particular.





# Research Challenges

## Operations

Reducing site development costs    novel approaches to geophysical and geotechnical site investigation, energy forecasting and environmental monitoring

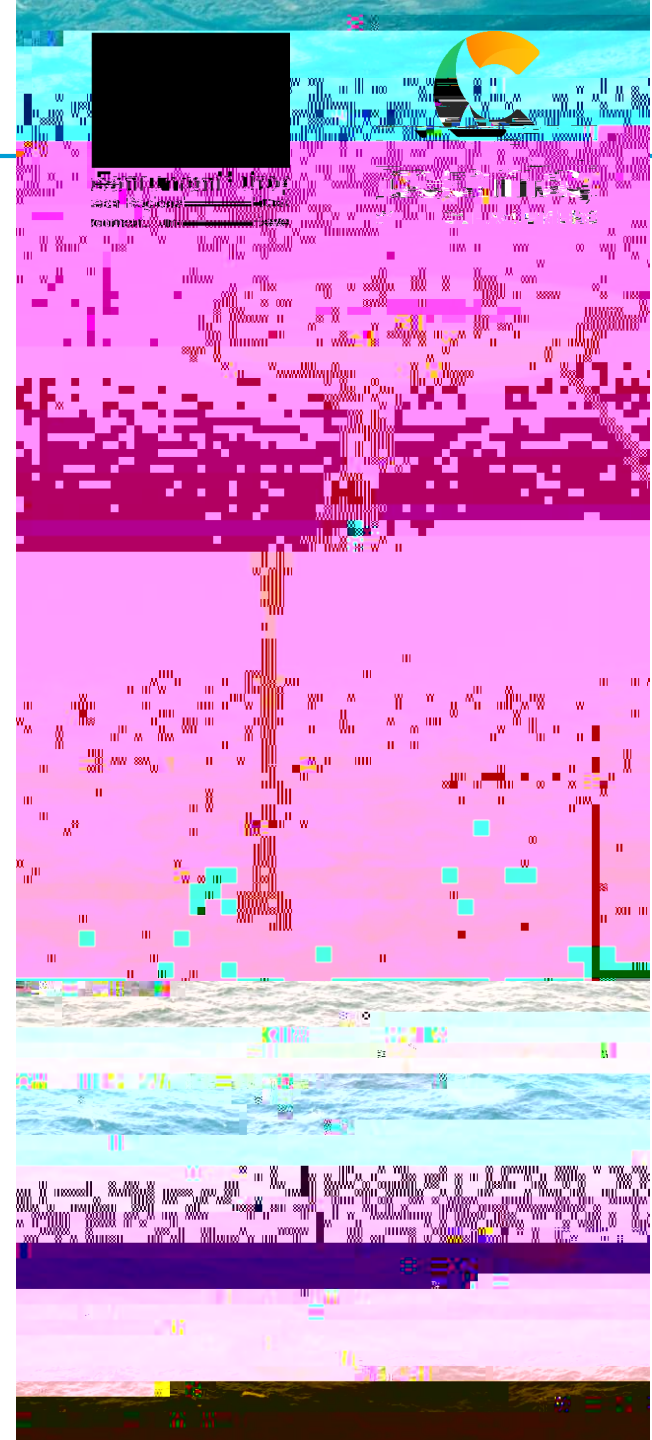
Analysing cost of performance vs. survivability

Do advanced control methods (and increased yield) actually pay-off when considering cost of equipment?

Array level planning and cost reductions

Accurately estimating Maintenance and reliability

Array planning



# Way Ahead

Moving past TRL to CRL - Commercial Readiness

Project Planning    Understanding project cost and risk

Make it easier to get in the water beyond test sites    developing standardised legislation and templates for permitting and approval in absence of existing legislative framework

Investor confidence, Insurance

Fostering Industry Collaboration to reduce development costs and share knowledge

Applied Industry lead Research



**Angus Nichols**

