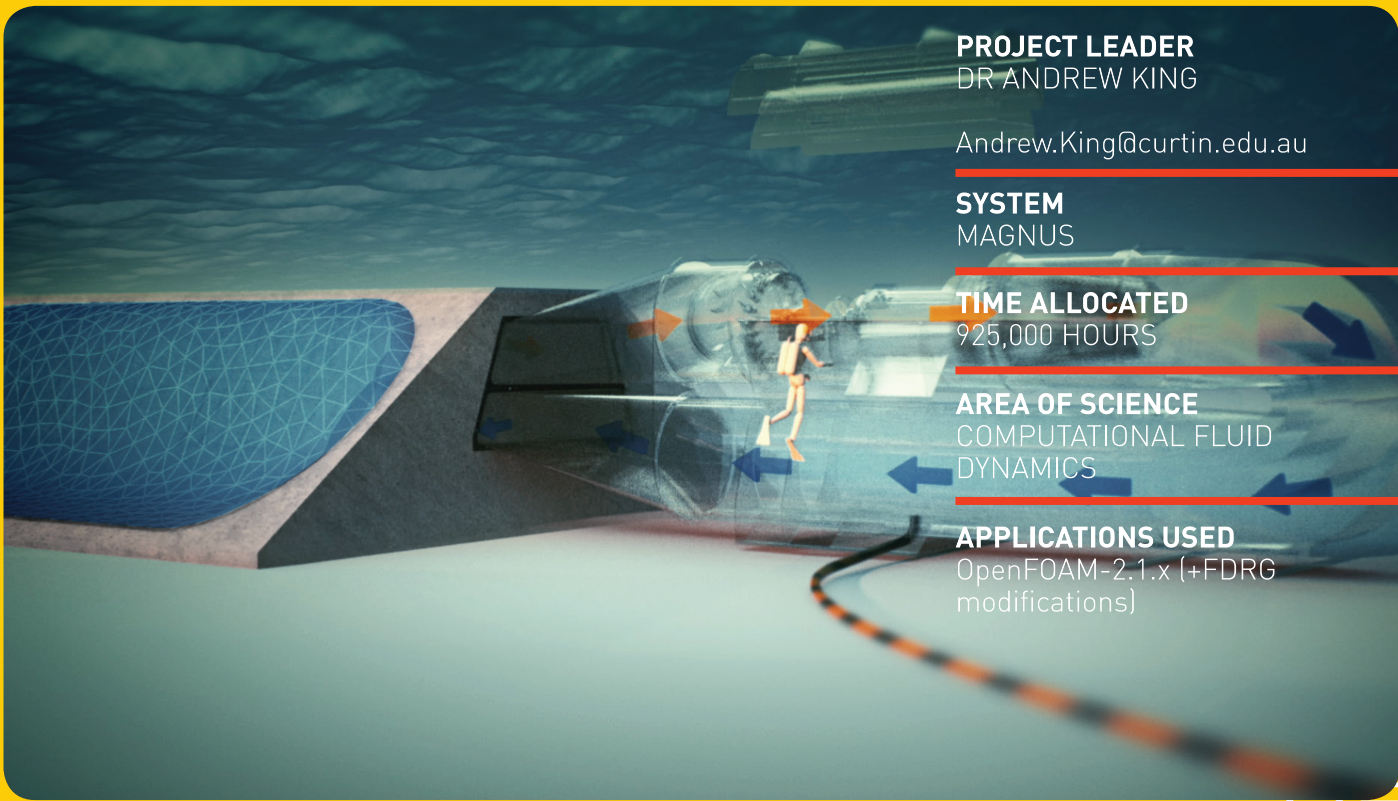
PAWSEY
supercomputing centre

PARTNER INSTITUTION

Curtin University

MAKING WAVES IN CLEAN ENERGY



PROJECT LEADER
DR ANDREW KING

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SYSTEM
MAGNUS

TIME ALLOCATED
925,000 HOURS

AREA OF SCIENCE
COMPUTATIONAL FLUID DYNAMICS

APPLICATIONS USED
OpenFOAM-2.1.x (+FDRG modifications)

mWave air flow

Low-cost, sustainable energy is currently at the forefront of global market demand. One leading edge concept that is beginning to generate international interest is wave power. Wave power involves harnessing the power of the ocean's waves and converting it to electricity through a wave energy converter (WEC). Dr. Andrew King, from Curtin University's School of Civil and Mechanical Engineering, is working with Perth company Bombora Wave Power to trial and refine the "mWave" wave energy converter. Using the world-class supercomputing infrastructure at Pawsey, Dr. King and his team can develop a series of mathematical models on water, air, and membrane fluid mechanics to predict the volume of electricity that can be generated. Through the use of the supercomputers, the feasibility of mWave production can be made into accurate predictions and succeed as a cutting-edge renewable energy solution for Australia.

2016

Mid-scale test site at Como Jetty, Western Australia

CHARACTERISATION AND POWER PREDICTION FOR A NOVEL WAVE ENERGY CONVERTER

THE CHALLENGE

In collaboration with award-winning company Bombora Wave Power, Dr. King aims to develop optimal designs and prototypes of the mWave suitable for an oceanic environment. The mWave technology would need to endure storm conditions at sea, yet remain cost-effective enough for global market production. The complexity of the WEC technology, however, and the lengthy timeframe that parametric studies require to be conducted, presented a challenge for the research team.

"The mathematical models are nonlinear, tightly coupled and extremely challenging to solve," said Mr. Shawn Ryan, executive director of Bombora Wave Power.

Access to high-performance computing resources would allow for Computational Fluid Dynamics (CFD) and lay the foundation for the accurate, and complete understanding of the power capture of the mWave. The project called for computing infrastructure that was beyond the capability of standard computing facilities.

THE SOLUTION

Using Magnus, the most powerful supercomputer in the Southern Hemisphere, Dr. Andrew King, and his team has been able to advance the designs of the mid-scale prototype. Using fully coupled CFD models to understand and optimise the full potential of the innovative technology, it has significantly reduced the timeframe and cost of developing of mWave.

"Computer simulations enable us to build confidence in our mWave wave energy converter design by getting the design closer to the technical solution," said Mr. Ryan.

"Developing Wave Energy technology is very complex and expensive, so testing prototypes with the assistance of the supercomputer, prior to building full-scale devices, is essential in order to de-risk the technology sufficiently to attract investors."

OUTCOME

Following the mWave designs created through CFD techniques on Pawsey's state-of-the-art supercomputers, the wave energy converter prototype was constructed. The mid-scale prototype has a series of air-inflated rubber membranes that are mounted to a concrete seafloor structure and arranged at an angle to capture the power from the incoming waves.

In 2015 the mWave prototype was tested in the Swan River in Western Australia.

The test found that each unit is rated at 1.5MW (megawatts) with the potential to supply sustainable electricity to 500 homes or deliver 1GL (gigalitre) of desalinated water each year: equivalent to eliminating carbon emissions from approximately 825 cars.

"The models and simulations have built real confidence in how our "mWave" will perform when installed at full scale. Running multiple simulations simultaneously is a great way to compare different design iterations and configurations," said Mr. Ryan.

"Bombora is continuously researching and developing ways to optimise and refine the design and configuration of a mWave farm to get the maximum possible conversion of wave energy into electricity, at the lowest possible price."

The Bombora Wave Power project is working toward being able to commercialise the low-cost technology which will give Australia a strategic advantage in positioning itself as a major contributor in sustainable energy technology.

"Without access to a supercomputer, confidence in the mWave's ability to generate competitively priced, high volumes of energy, would be considerably less," said Mr. Ryan.

Ongoing research into wave energy will continue to facilitate the design and improvement of cutting edge WEC technology. The Pawsey Supercomputing infrastructure will be an integral part of this process.