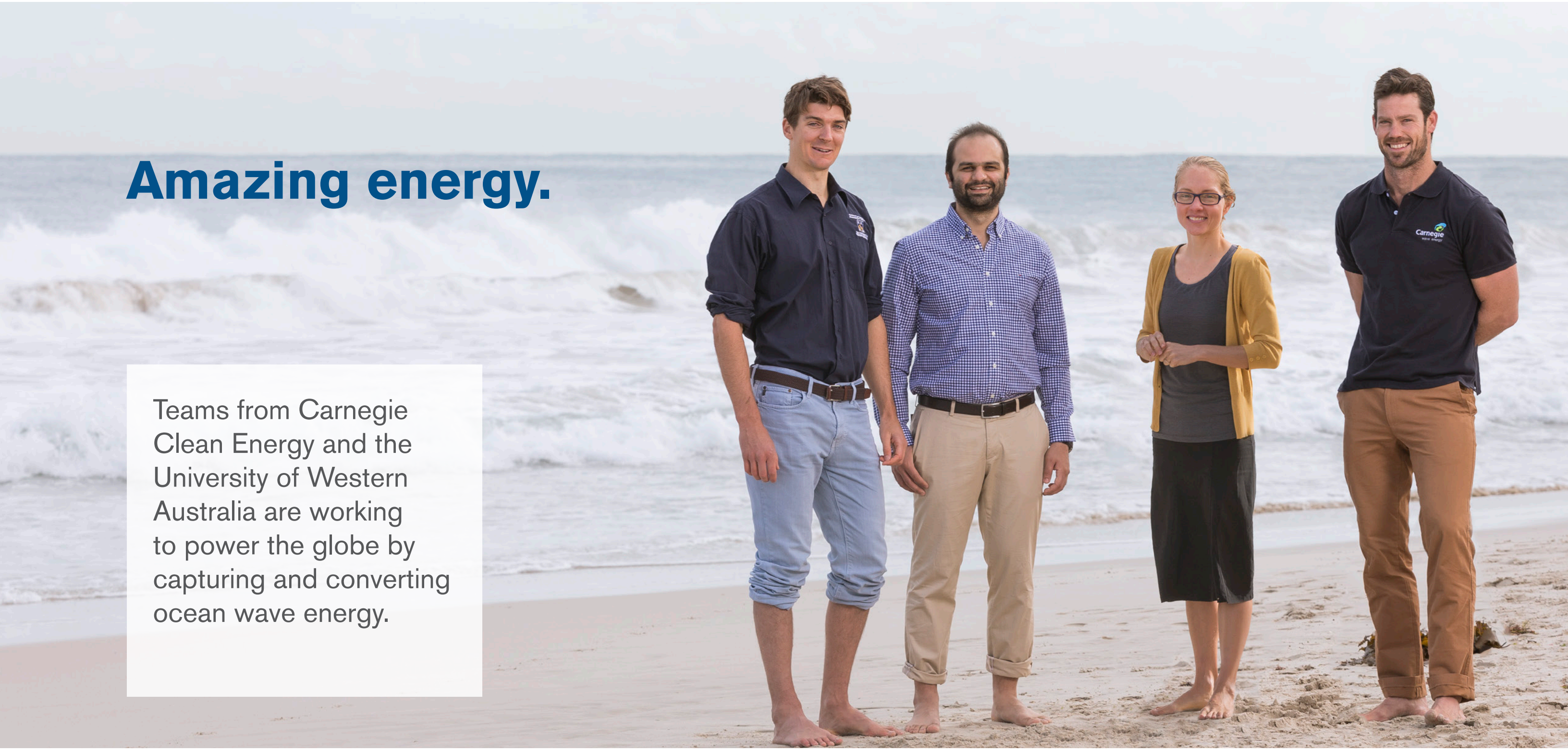
Amazing energy.



Teams from Carnegie Clean Energy and the University of Western Australia are working to power the globe by capturing and converting ocean wave energy.

"What's amazing about ocean wave energy is the enormity of the resource sitting there," says Ashkan Rafiee. "Whoever solves this riddle will make a huge impact on the world."

Dr. Rafiee is the hydrodynamics team leader for Carnegie Clean Energy — an Australian wave, solar and battery energy company well on its way to making wave power a reality. For the last decade, Carnegie has been developing a wave energy device that converts ocean swell into zero-emission, renewable power and desalinated freshwater. Dubbed "CETO," the device is already in use off of Western Australia's Garden Island, helping power the country's largest naval base.

But deploying wave energy technology at scale is another matter. "The potential is phenomenal," says Jonathan Fievez, Carnegie's chief technology officer. "The amount of energy hitting the coast alone could power half the country. But juxtaposed with that is the challenge of capturing it. We're dealing with an extremely harsh environment."

Between the saltwater, the unpredictable nature of waves and the overall extremes of an ocean environment, designing an optimum energy-capture device in terms of both durability and cost has been a challenge.

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To solve these last pieces of the wave energy riddle, Carnegie has teamed up with two complementary resources: researchers from the University of Western Australia's (UWA) Centre for Offshore Foundation Systems and "Magnus," the Cray supercomputer at Pawsey Supercomputing Centre.

"One of the big questions is how and whether the devices can survive large waves," says UWA's Hugh Wolgamot. "Compared to wind, the ratio of extremes to the ambient conditions in the ocean is much larger. And breaking waves are some of the most challenging physics to deal with in the ocean."

Taking the device from an R&D project to widespread commercialization will require driving the cost down. That requires understanding the physics of extreme waves. "Designing wave energy isn't just about understanding the power," says Dr. Rafiee. "It's understanding the extreme responses and loads in extreme wave conditions."

Dr. Wolgamot and colleagues Jana Orszaghova and Scott Draper are providing more understanding of those extreme waves — and thereby helping Carnegie validate the next generation of its device. The team started by establishing a "design wave" – a short sequence of waves that captured the most extreme behavior the device will experience. Then comes the nonlinear modeling and analysis using computational fluid dynamics (CFD) and the supercomputing power of Magnus.

"Supercomputing and CFD are providing more understanding of what's going on in those extreme waves," says Dr. Wolgamot. "It's hugely advanced the way [Carnegie] can design."
Dr. Rafiee agrees: "The amount of computations we can do today weren't possible 10 years ago. Now wave energy is really starting to become imminent. It's just around the corner."

PAWSEY SUPERCOMPUTING CENTRE

The Pawsey Supercomputing Centre supports researchers with supercomputing, data and visualization services across a range of scientific fields. Their supercomputer "Magnus" is a petascale Cray® XC™ system and is one of the most powerful systems in the Southern Hemisphere.

SYSTEM DETAILS

- Cray® XC™ series supercomputer
- Cray® Sonexion® storage system
- 1+ PF peak performance
- 93 TB memory
- 1,488 compute nodes
- 35,712 cores
- 3 PB Sonexion capacity