

# TETHYS ENGINEERING BLAST



**19 November 2021**

*Tethys Engineering* is an online knowledge base that facilitates the exchange and dissemination of information on the technical and engineering aspects of marine energy. The bi-weekly *Tethys Engineering Blast* highlights new publications in the [Tethys Engineering Knowledge Base](#); relevant announcements, opportunities, and upcoming events; and news articles of international interest. If you have specific content you would like circulated to the greater marine energy community, please send it to [tethys@pnnl.gov](mailto:tethys@pnnl.gov) for consideration.

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## **Announcements**

### MHK Graduate Student Research Program

The US Department of Energy (DOE) Water Power Technologies Office and Oak Ridge Institute for Science and Education are now accepting applications for the [Marine & Hydrokinetic \(MHK\) Graduate Student Research Program](#). The program is open to doctoral students at US institutions and provides access to relevant expertise and resources. Applications are due 10 December 2021.

### EnergyTech University Prize

The US DOE Office of Technology Transitions recently launched the [EnergyTech University Prize](#), a collegiate competition challenging multidisciplinary student teams to develop and present a business plan that leverages DOE national laboratory-developed and other energy technologies. The Explore Phase will close on 31 January 2022.

### Calls for Papers

*Energies* is accepting submissions for several Special Issues, including "[Geometry and Design Optimisation of Wave Energy Converters](#)" (due 20 December 2021) and "[Permanent Magnet Machines for Wave Energy Converters](#)" (due 20 January 2022). *Energies* is also accepting submissions to the Topical Collection, "[Women's Research in Wind and Ocean Energy](#)".

The *Journal of Marine Science and Engineering* is accepting submissions for several Special Issues, including "[Marine Application of Fiber Reinforced Composites](#)" (due 20 December 2021), "[Mooring Systems of Floating Offshore Structures for Emerging Industries](#)" (due 15 January 2022), and "[Advancements in Marine Renewable Energy and Renewable Powered Marine Vehicles](#)" (due 20 February 2022).

### Funding & Testing Opportunities

The US Testing Expertise and Access for Marine Energy Research (TEAMER) Program is now offering limited [open water support for marine energy testing](#) through its facility network. Applications for the next TEAMER Request for Technical Support are due 16 December 2021.

The Horizon Europe Framework Programme recently launched a funding opportunity titled, "[Demonstration of wave energy devices to increase experience in real sea condition](#)". Proposals are due 5 January 2022.

The European Maritime, Fisheries and Aquaculture Fund has launched a Call for Proposals to support strategic collaboration in the Atlantic, Black Sea, and Western Mediterranean. Proposals for Topic 1, "[Innovative multi-use projects combining offshore renewable energy with other activities and/or with nature protection in the Atlantic](#)", are due 12 January 2022.

The Horizon Europe Framework Programme also recently launched two funding opportunities titled, "[Next generation of renewable energy technologies](#)" and "[Innovative foundations, floating substructures and connection systems for floating PV and ocean energy devices](#)". Proposals for both are due 23 February 2022.

### Student & Employment Opportunities

Pacific Northwest National Laboratory is seeking two [Post Doc Research Associates](#) to conduct modeling projects in several topic areas, including offshore wind, wave, tidal stream, and ocean current energy. Applications are due 19 November 2021.

The University of Plymouth is seeking an [ORE Integration Research Fellow](#) to investigate the integration of offshore renewable energy (ORE) using hydrogen and comparative analysis of the socioeconomic and environmental aspects. Applications are due 21 November 2021.

The Environmental Research Institute at the University of the Highlands and Islands are recruiting for a [Research Fellow - Offshore Renewable Energy and the Environment](#) to work with Ørsted to design novel environmental and ecological monitoring techniques and next-generation oceanographic measurement platforms. Applications are due 22 November 2021.

The Swinburne University of Technology is seeking a [Postdoctoral Research Associate](#) to work on an Australian Research Council-funded project that aims to produce strategies for protecting coasts from storms using wave energy converters. Applications are due 26 November 2021.

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## Upcoming Events

### Upcoming Course

In partnership with Interreg North-West Europe's Ocean Power Innovation Network, Sirris is organizing a [masterclass on corrosion solutions for offshore renewable energy devices](#) from 12:00-3:00pm UTC on 2 December 2021. Register for free [here](#).

### Upcoming Workshops

The University Marine Energy Research Community (UMERC) is hosting the second workshop in its series, *Collaborating to Create a Marine Energy Research Landscape*, on three dates:

- [Tuesday, 30 November 2021 from 9:00-11:00am PST \(5:00-7:00pm UTC\)](#)
- [Wednesday, 1 December 2021 from 8:00-10:00am PST \(4:00-6:00pm UTC\)](#)
- [Thursday, 2 December 2021 from 10:00am-12:00pm PST \(6:00-8:00pm UTC\)](#)

The OceanSET project is hosting its [3<sup>rd</sup> OceanSET Knowledge Sharing Workshop](#) online at 9:00am UTC on 8 December 2021. The workshop will present results of a survey carried out across ocean energy device developers in Europe, and provide an update on the EuropeWave pre-commercial procurement programme and upcoming wave energy projects. Register [here](#).

### Upcoming Webinars

Offshore Renewable Energy Catapult is launching a series of half-hour lunchtime events, [The Tidal Power Express Event Series](#), to introduce key tidal power innovators. The first event, at 1:00pm UTC on 24 November 2021, will feature Nova Innovation. Register [here](#).

Marine Energy Wales and Marine Renewables Canada are hosting a joint [webinar](#) from 3:00-5:00pm UTC on 1 December 2021 to promote international shared learning across the marine renewable energy sector. Register [here](#).

The US DOE's Water Power Technologies Office is hosting a webinar from 11:30am-1:00pm EST (4:30-6:00pm UTC) on 7 December 2021 to present the relevant [Phase 1 Release 2 Topics](#) for its [Small Business Innovation Research and Small Business Technology Transfer programs](#), which provide financial support for climate and energy R&D projects. Register [here](#).

The Copernicus Marine Service is organizing a [webinar](#) on 30 November 2021 from 9:00-11:00am UTC to share its global ocean data products and knowledge that can be used to support sustainable blue economies and ocean conservation in Africa. Two [training workshops](#) will also be held on 7-8 December 2021 from 9:00-11:00am UTC. Register for all three events [here](#).

### Upcoming Conferences

Marine Renewables Canada is hosting the [Marine Renewables Canada 2021 Annual Conference](#) on 24-25 November 2021 in Halifax, Nova Scotia. Register [here](#).

WavEC Offshore Renewables, in collaboration with the Embassy of Japan in Portugal, is hosting the [WavEC Annual Seminar](#) on 30 November 2021 online. Register for free [here](#).

The Supergen Offshore Renewable Energy (ORE) Hub is hosting the [4<sup>th</sup> Supergen ORE Hub Annual Assembly](#) on 18-20 January 2022 in Plymouth, UK and online. To accompany the event, the Hub is also hosting an [Early Career Researcher Forum](#) on 18 January 2022. Register for free.

#### Event Update

[OCEANS 2022 Chennai](#), scheduled for 21-24 February 2022, will now take place as a hybrid event, with the option to attend the conference in Chennai, India or virtually. Register [here](#).

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## **New Documents on *Tethys Engineering***

### **[Effects of free surface on a flapping-foil based ocean current energy extractor](#) – Deng et al. 2021**

We study numerically the effects of free surface on a flapping-foil based ocean current energy extractor. A two-dimensional NACA0015 foil, subjected to a coupled pitching and heaving motions, at a fixed Reynolds number of 900, and varied Froude numbers between 0 and 2, is considered. We fix the non-dimensional frequency at  $f^* = 0.16$  and pitching amplitude at  $\theta_0 = 75^\circ$ . The previous studies suggested that an energy extracting efficiency up to 0.30 could be achieved in a single-phase fluid flow at these specific parameters. In the current study, as the free surface is considered, we report that both the submergence depth and Froude number affect the energy extracting efficiency. As the submergence depth increases from  $H = 1$  to  $H = 20$ , for all the Froude numbers considered, the efficiency converges eventually to 33.7%.

### **[Niche Applications and Flexible Devices for Wave Energy Conversion: A Review](#) – Renzi et al. 2021**

We review wave energy conversion technologies for niche applications, i.e., kilowatt-scale systems that allow for more agile design, faster deployment and easier operation than utility scale systems. The wave energy converters for niche markets analysed in this paper are classified into breakwater-integrated, hybrid, devices for special applications. We show that niche markets are emerging as a very vibrant landscape, with several such technologies having now achieved operational stage, and others undergoing full-scale sea trials. This review also includes flexible devices, which started as niche applications in the 1980s and are now close to commercial maturity. We discuss the strong potential of flexible devices in reducing costs and improving survivability and reliability of wave energy systems.

### **[A unique ocean and solar based multigenerational system with hydrogen production and thermal energy storage for Arctic communities](#) – Temiz & Dincer 2022**

Arctic communities are suffering from food and energy shortages and their high logistic costs. An innovative ocean and solar-based energy, food, fuel, and water production system is developed for Arctic communities, including Nunavut's polar hamlets. The ocean thermal energy conversion with ammonia trilateral Rankine cycle, concentrated solar plant, bifacial photovoltaic, cascaded heat pump, multi-effect desalination and polymer electrolyte membrane (PEM) electrolyzer and fuel cell systems are integrated with hydrogen production and utilization and two tanks thermal energy storage systems. A food production system that includes a fish farm, a greenhouse, and a food drying facility is integrated into the system. Water and hydrogen productions are carried out with multi-effect desalination and PEM electrolyzer systems, respectively.

### **Optimal power extraction of a two-stage tidal turbine system based on backstepping disturbance rejection control – Yin & Zhao 2021**

This paper investigates the optimal power generation control for a two-stage horizontal-axis tidal turbine system based on backstepping disturbance rejection control (BDRC), which is a new control framework for high-order nonlinear systems. The tidal turbine system is designed with the main structure being described. The dynamics of the tidal turbine system is then formulated based on the integration of the dynamics of its constitute components. The tidal turbine experiences large uncertainties and unknown dynamics from non-uniform operating thrust and fatigue forces, variations and turbulence in tidal flow velocities induced by waves and wind. The proposed BDRC is a unique control concept which has superior performance in dealing with these large uncertainties without requiring much information about the turbine dynamics.

### **Future wind and wave energy resources and exploitability in the Mediterranean Sea by 2100 – Lira-Loarca et al. 2021**

A state-of-the-art regional assessment of future wind and wave energy resource in the Mediterranean Sea and the projected changes with respect to hindcast is presented. A multi-model EURO-CORDEX ensemble of future wind field and wave climate conditions with a spatial resolution of  $\approx 10$ –12.5 km and 3–6 h temporal resolution in the Mediterranean Sea is used for the assessment of future changes wind power, wave energy and combined exploitability under the climate change scenario RCP8.5. The results allow to identify climate change impacts in wind and wave power potential and the projected changes in the locations in the Mediterranean basin that were considered suitable for joint exploitations in previous studies. The future ES-Index allows to assess the optimized temporal-availability of combined wind and wave resources in a changing climate.

### **Osmotic engine converting energy from salinity difference to a hydraulic accumulator by utilizing polyelectrolyte hydrogels – Bui et al. 2021**

Efficient harvesting of the mixing energy from the salinity gradient between sea and river water remains a challenge. Recently, utilization of the swelling/shrinking properties of hydrogels has been explored as a new means for extracting this energy. However, former investigations are mainly limited to examining the performance of the hydrogels when

lifting applied weights, and calculating the energy that could potentially be extracted. In this study, we demonstrate a novel osmotic engine with a mechanical energy transmission prototype, which can convert and store the green mixing energy in a form that can be utilized to perform mechanical work. The osmotic engine includes a cylinder containing the hydrogel, an oil-hydraulic cylinder and a hydraulic accumulator.

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## News & Press Releases

### [Mocean Energy Blue X wave machine completes sea trials](#) – Mocean Energy

Mocean Energy's Blue X wave energy machine has returned to dock after a successful five-month test period at sea. In the last few days the 20-metre long, 38-tonne wave machine has been towed from the European Marine Energy Centre's Scapa Flow test site to Kirkwall and has been lifted onto Hatston Pier, where it will be cleaned, inspected, and maintained until next year's testing programme commences. The innovative 10kW prototype began its test phase in mid-June and since then has completed 154 days at sea, delivering steady outputs of up to 5 kW and safe instantaneous peaks of 30 kW, and operating in sea states up to 2.3 meters maximum wave height. Next year, the wave pioneers plan to put the device to sea in Orkney again and will connect the machine to a subsea battery to power a remotely operated autonomous underwater vehicle.

### [Orbital Marine Power secures strategic investment from TechnipFMC to accelerate global tidal energy market presence](#) – Orbital Marine Power

Orbital Marine Power (Orbital) has established a strategic partnership with TechnipFMC to accelerate the global commercialisation of Orbital's pioneering tidal energy technology. Scotland-based Orbital recently completed the construction and installation of the world's most powerful tidal stream turbine, the O2, in the waters off the Orkney Islands, Scotland. It has been exporting low carbon electricity to the UK grid since July 2021. TechnipFMC is a leading technology provider to the traditional and new energy industries with a proven track record of successfully delivering large-scale, fully integrated offshore energy projects to customers around the world. The companies will now work together to accelerate the market scale-up and deployment of Orbital enabling technology in tidal energy projects.

### [TEAMER Network Director Announces RFTS 4 Technical Support Recipients](#) – TEAMER

On November 9, 2021 the U.S. Testing Expertise and Access to Marine Energy Research (TEAMER) program selected 9 projects through its fourth Request for Technical Support (RFTS) for testing expertise and access to numerical modeling, laboratory or bench testing, and tank/flume testing and expertise within the growing TEAMER Facility Network. The awards reflect a total funding amount of more than \$1.1 million. Supported by the U.S. Department of Energy and directed by the Pacific Ocean Energy Trust, TEAMER accelerates the viability of marine renewables by providing access to the



nation's best facilities and expertise to solve critical challenges, build knowledge, foster innovation, and drive commercialization.

### **CorPower Portugal shares wave energy mission through community outreach project – CorPower Ocean**

CorPower recently opened its Portuguese base to the public and school students to share its pioneering work in wave energy, and vision to support the future green energy transition. The community outreach project took place over a two-day period in October as part of a broader tour organised by APDL (Administração dos Portos do Douro, Leixões e Viana do Castelo, S.A.). In Summer 2020, CorPower forged a deal with APDL, investing a total of 16 million euros to build a Manufacturing, R&D and Service Centre in the sea port, for widescale production of wave energy converters. The recent open day afforded an opportunity to update the local community on rapid progress towards CorPower's first commercial scale demonstration, plus involvement in the €45million pan-European EU-SCORES Project aiming to deliver the world's first bankable hybrid offshore energy park – linking wave and wind power.

### **MPS Appoints Black & Veatch to System Engineering and Coordination Role – Marine Power Systems**

Black & Veatch has been selected to help guide Marine Power Systems (MPS) across subsystem design coordination, systems engineering and the certification of MPS's unique and flexible floating wind and wave energy generation hardware. Working as an extension of MPS's technical team, Black & Veatch will lead specific elements of the project, providing technical quality assurance and helping identify and manage technical and programme risk. MPS are now working on the deployment of a grid connected commercial megawatt scale wind and wave device in northern Spain at the Biscay Marine Energy Platform (BiMEP) as well as the deployment of a pre-commercial scale array at the European Marine Energy Centre (EMEC), Orkney.

### **Wave Swell Energy embarks on €1.6M capital raise – Offshore Energy**

Australian wave energy company Wave Swell Energy (WSE) has launched a capital raising round of Au\$2.5 million (€1.6 million) to fund a technology enhancement program under its Bluefire project. The private placement of ordinary WSE shares is open for subscription until 31 December 2021. The proceeds will permit WSE to undertake Bluefire project, a comprehensive technology enhancement program that will consolidate on the success and learnings from the UniWave200 project to commercialise the technology. Key aims of this project will be a reduction in capital expenditures (CAPEX), an improvement in performance efficiency, and maximising of the reliability of the technology.