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[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 for consideration.

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Announcements

UMERC Board of Directors

The Pacific Ocean Energy Trust (POET) recently announced the establishment of the University Marine Energy Research Community (UMERC). UMERC is sponsored by the US Department of Energy's (DOE) Water Power Technologies Office and is [seeking nominations](#) for the inaugural Board of Directors until 30 September 2021. Sign up for UMERC's email list [here](#).

DTOcean+ Software Suite Now Available

The DTOceanPlus project has released its final suite of advanced design tools for the selection, development, and deployment of ocean energy systems. The DTOcean+ open-source software suite and associated documentation are now available on [GitLab](#). Additional resources concerning the DTOceanPlus project are available [here](#).

Calls for Abstracts

The abstract deadline for the [Ocean Sciences Meeting \(OSM 2022\)](#) has been extended to 29 September 2021. Please consider submitting an abstract to Scientific Session OT15: Measuring, Modeling, and Mitigating Environmental Effects of Ocean Renewable Energy. OSM 2022 will take place online and in Honolulu, US from 27 February to 4 March 2022.

The International Oceanographic Data Exchange is accepting abstracts for the [International Ocean Data Conference 2022 - The Data We Need for the Ocean We Want](#), which will take place online and in Sopot, Poland on 14-16 February 2022. Abstracts are due 29 October 2021.

Funding & Testing Opportunities

The Blue Climate Initiative is welcoming applications from innovators and entrepreneurs for the [Ocean Innovation Prize](#), which is designed to inspire, fund and support innovations that mitigate climate change through ocean-related strategies. Applications are due 15 September 2021.

The US Testing Expertise and Access for Marine Energy Research (TEAMER) program is now accepting applications for its 4th Request for Technical Support (RFTS) through 16 September 2021. Applications will now be reviewed on a quarterly basis and those submitted after the due date will be considered for the next RFTS. Visit the [TEAMER website](#) for more details.

The Oceanic Platform of the Canary Islands (PLOCAN) has opened its [Summer Access Call for 2021](#). Applicants interested in accessing PLOCAN facilities and services are encouraged to contact PLOCAN before submitting their proposal. Applications are due 20 September 2021.

The Sustainable Energy Authority of Ireland and Lir National Ocean Test Facility are offering free-of-charge access to research and testing facilities for offshore renewable energy developers through the [Industry Access Programme](#). Applications are due 24 September 2021.

EuropeWave has launched its Pre-Commercial Procurement (PCP) programme, which aims to accelerate the design, development, and demonstration of cost-effective wave energy converters. The [Request for Tenders](#) for EuropeWave's PCP is open until 1 October 2021.

The Horizon Europe Framework Programme has launched the [European Innovation Council \(EIC\) Accelerator Challenges](#) to support small and medium enterprises developing game-changing innovations, including renewable energy. Applications are due by 6 October 2021.

The Danish Energy Agency recently opened a [Technology Neutral Tender](#) of aid for electricity generated by onshore wind turbines, open door offshore wind turbines, wave power plants, hydroelectric power plants, and solar installations. The deadline for bids is 22 October 2021.

Student & Employment Opportunities

The Environmental Research Institute at the University of the Highlands and Islands is 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 measurement platforms. Applications are due 20 September 2021.

The European Marine Energy Centre (EMEC) is looking for a [Technical Manager](#) to manage its team of technical specialists, as well as a [Head of Projects](#) to oversee EMEC's project portfolio. Applications are due 15 and 22 September 2021, respectively.

Upcoming Events

Upcoming Workshop

As part of POET's Ocean Renewable Energy Conference ([OREC 2021](#)), the Portal and Repository for Information on Marine Renewable Energy ([PRIMRE](#)) team is hosting a free, online workshop on 24 September 2021 from 8:00-10:00am PDT (3:00-5:00pm UTC). The workshop will provide an overview of PRIMRE, its Aggregate Search, and ways to contribute, as well as live demonstrations of the newest Knowledge Hubs, the Marine Energy Atlas and MRE Software. Registration information coming soon.

Upcoming Courses

Interreg North-West Europe's Ocean Power Innovation Network is hosting an online masterclass titled, "OPEX modelling for marine renewable energy technologies and projects", from 9:00-11:00am BST (8:00-10:00am UTC) on 15 September 2021. Learn more [here](#).

The RENOVABLES project, which aims to support the marine sector in the Euroregion, is hosting an online course on artificial intelligence for marine renewables and use cases in marine energy generation using deep learning on 22 September 2021. Learn more [here](#).

Upcoming Webinars

The US DOE Water Power Technologies Office (WPTO) is hosting a webinar titled, "WPTO in Alaska", from 5:00-6:00pm EDT (9:00-10:00pm UTC) on 15 September 2021, as part of its [R&D Deep Dive Webinar Series](#). During the webinar, WPTO representatives will share the work they're doing and offer insights into what could be next for water power in Alaska. Register [here](#).

The European Technology and Innovation Platform for Ocean Energy is hosting a webinar titled, "Environmental data transfer: the role of test centres", from 10:00-11:00am BST (9:00-10:00am UTC) on 16 September 2021. During the webinar, two European leading ocean energy test centres will discuss the potential, challenges, and opportunities of data transfer. Register [here](#).

The Selkie project, which aims to support the marine energy sector in Wales and Ireland, is hosting a webinar, "Raising Investment", at 9:00am UTC on 16 September 2021, as part of its [Meet the Expert event series](#). During the webinar, the GS Verde Group will explore ways businesses can acquire various types of funding and discuss real life examples. Register [here](#).

Upcoming Conferences

[Global OCEANS 2021](#) will take place on 20-23 September 2021 online and in San Diego, US.

[Seanergy 2021](#) will take place on 21-24 September 2021 in Nantes and Saint-Nazaire, France.

POET is hosting [OREC 2021](#) on 22-24 September 2021 online. View the agenda [here](#).

New Documents on *Tethys Engineering*

Flexible membrane structures for wave energy harvesting: A review of the developments, materials and computational modelling approaches – Collins et al. 2021

In the last decade, there has been a growing trend towards flexible body wave energy converters (WECs) enabled by rubber-like elastomeric composite membrane structures that can simplify all aspects of WEC design. Currently, there are few literature studies detailing the implementations of membranes into WEC design. This paper aims to overcome this by reviewing the developments, material selection and modelling procedures for novel membrane based wave energy converters (mWECs), providing the reader with a comprehensive overview of the current state of the technology. In the first half of this paper, all of the possible WEC implementation areas are reviewed which include the primary mover, power take-off (PTO) and other sub-assembly systems.

Modelling Deep Green tidal power plant using large eddy simulations and the actuator line method – Fredriksson et al. 2021

The Deep Green technique for tidal power generation is suitable for moderate flows which is attractive since larger areas for tidal energy generation hereby can be used. It operates typically at mid-depth and can be seen as a “flying” kite with a turbine and generator attached underneath. It moves in a lying figure-eight path almost perpendicular to the tidal flow. Large eddy simulations and an adaption of the actuator line method (in order to describe arbitrary paths) are used to study the turbulent flow with and without Deep Green for a specific site. This methodology can in later studies be used for e.g. array analysis that include Deep Green interaction. It is seen that Deep Green creates a unique wake composed of two velocity deficit zones with increased velocity in each wake core.

Review—Technologies and Materials for Water Salinity Gradient Energy Harvesting – Han et al. 2021

Sea water is the most abundant natural resource, accounting for more than 97% of total water resources. From a practical standpoint, it is very desirable to use seawater for conversion and energy production. Salinity gradient energy is the chemical potential energy difference between two kinds of water with different salt concentrations. It has a large energy density and is considered to be the most promising ocean energy. Here, we discuss the important features of energy production technologies with salinity gradient energy. The principles and related materials and important finding of the available technologies, such as pressure-retarded osmosis, reverse electro-dialysis, capacitive mixing, concentration capacitor, and mixing entropy battery, have been described in this review.

Impact of sloping porous seabed on the efficiency of an OWC against oblique waves – Khan & Behera 2021

The study examines the influence of a sloping porous bed on the efficiency of an oscillating water column (OWC) device facing oblique water waves. A vertical, surface piercing, thin plate near a rigid wall approximates the OWC. The system is simulated using a multi-domain boundary element method assuming the linear potential theory. The impact of varying sloping bed structural parameters and influence of the incident wave angle on the performance of the OWC is evaluated and discussed. The significance of this model to act as a breakwater protecting near-shore marine facilities is also highlighted. The OWC efficiency is found to be highly sensitive to the slope of the porous seabed, and seabed porosity is found to stabilize the resonant frequency against changes in water levels.

Quantifying the Effects of Wave-Current Interactions on Tidal Energy Resource at Sites in the English Channel Using Coupled Numerical Simulations – Hardwick et al. 2021

Numerical modeling of currents and waves is used throughout the marine energy industry for resource assessment. This study compared the output of numerical flow simulations run both as a standalone model and as a two-way coupled wave–current simulation. A regional coupled flow-wave model was established covering the English Channel using the Delft D-Flow 2D model coupled with a SWAN spectral wave model. Outputs were analyzed at three tidal energy sites: Alderney Race, Big Roussel (Guernsey), and PTEC (Isle of Wight). The difference in the power in the tidal flow between coupled and standalone model runs was strongly correlated to the relative direction of the waves and currents. The net difference between the coupled and standalone runs was less than 2.5%.

An extensive thermo-economic evaluation and optimization of an integrated system empowered by solar-wind-ocean energy converter for electricity generation – Case study: Bandar Abbas, Iran – Assareh et al. 2021

In parallel with efforts to shift human societies' reliance from fossil fuel to renewable resources, in this paper, three green-based energy generation configurations were proposed and examined thermoeconomically. Afterwards, the one with the highest performance was selected for further investigation. The chosen system was empowered by an ocean thermal energy convertor (OTEC), a wind turbine, and a solar flat plate panel. The system was modeled by Engineering Equation Solver (EES) software to conduct sensitivity analysis by assessing the impact of changes in objective parameters on the net power output, thermoelectric generator (TEG) power output, exergy efficiency, and cost ratio.

News & Press Releases

U.S. Department of Energy Announces Finalists Advancing to Final Stage of “Waves to Water” Desalination Prize – US DOE

The Office of Energy Efficiency and Renewable Energy recently announced five winners in the CREATE Stage of the Waves to Water Prize, a competition focused on using the

power of waves to develop clean energy-powered desalination technologies to help provide potable water to communities in need. Wave-powered desalination technologies hold the potential to deliver clean drinking water to communities in need—for example, in disaster recovery scenarios, as well as to remote and coastal communities. Over three years, the Waves to Water Prize provides innovators a pathway from initial concept to field-testing their wave energy-powered desalination devices. CREATE is the fourth of the five-stage Prize, with total funds of up to \$2.5 million. Competitors in the CREATE stage had 180 days to build a functional prototype or proof of concept of their system.

Doing what no one else has, full scale wave energy generation – Wello

Wello, the Finnish wave energy conversion experts have been developing its own vision for wave energy conversion technology for over a decade. Wello had already deployed their original Penguin WEC-1, a full-scale prototype back in 2012 in Orkney, Scotland. During its deployment there were successes, some failures, lessons learnt, concepts proven, and ground-breaking technology pushed forward. Wello took all these lessons and put them into their newest wave energy conversion technology, a representation of utility to scale wave energy. Now Wello's Penguin wave energy converter has started to generate electricity to the local Basque grid from the ocean. This is a feat, that few other developers have managed, full-scale real world wave energy generation.

Minesto and electric utility SEV extend PPA and plan for scale-up in Vestmannastrandir – Minesto

Leading marine energy developer Minesto has signed a two-year extension of its Power Purchase Agreement (PPA) with the electric utility company SEV for Minesto's tidal energy site in Vestmannastrandir, Faroe Islands. In addition, a site extension analysis concludes that the current 200 kW Vestmannastrandir site has merits for expansion to a 4 MW commercial array. The PPA with SEV was first signed in February 2020 and comprises up to 2.2 MW installed capacity of Minesto's ocean energy technology in the Faroe Islands. The first phase of collaboration between Minesto and SEV, to integrate tidal energy through Minesto's Deep Green technology in the Faroe Islands, has focused on an EU-funded project where two grid-connected DG100 systems have been installed and operated in the Vestmannastrandir strait.

EU-SCORES Project aims to deliver 'world-first' bankable hybrid offshore marine energy parks – Dutch Marine Energy Centre (DMEC)

The €45 million marine energy project—European Scalable Offshore Renewable Energy Sources (EU-SCORES)—will pave the way for bankable hybrid offshore parks across Europe by 2025. Under the project lead of the DMEC, EU-SCORES will unlock the large-scale potential of wind, wave, and offshore solar systems. Kicking off in September 2021, the project partners will jointly build on two highly comprehensive and impactful demonstrations: (1) A 3MW offshore solar system by Oceans of Energy off the Belgian coast co-located with a bottom fixed windfarm and; (2) A 1.2MW wave energy array by CorPower Ocean in Portugal co-located with a floating wind farm. The demonstrations in

EU-SCORES aim to showcase the benefits of continuous power output by harnessing complementary power sources including wind, sun, and waves.

TTI launch NetBuoy™ Design Tool as part of the WES Materials Programme – Wave Energy Scotland

Under stage 3 of Wave Energy Scotland's (WES) "Structural Materials and Manufacturing Processes" programme, Tension Technology International Ltd (TTI) have developed the NetBuoy™ design tool which is now available via their [new dedicated website](#). The goal of the Structural Materials and Manufacturing Processes programme has been to bring down the cost of wave power through the use of new and alternative materials and processes. NetBuoy™ integrates two enabling technologies for cost competitive wave energy – impermeable membranes to manufacture buoyant modules, and fibre rope nets to encapsulate the buoyant modules. The net applies distributed restraint loads and agglomerates them back to structural 'hard' points. This is essential in enabling the use of membrane buoyant modules as they cannot be restrained otherwise.

Tidal energy manufacturer secures £6.4m investment from Scottish National Investment Bank – Nova Innovation

Tidal energy pioneer Nova Innovation has secured £6.4 million from the Scottish National Investment Bank to fund manufacturing and distribution of its innovative subsea tidal turbines. The investment will see Nova increase its presence across the UK and expand into new global markets. The Edinburgh-based company's innovative 100kW tidal turbines have been transforming the power of the sea into clean, predictable energy in Shetland since 2016. The Bank's investment will also fund ongoing research and development into marine energy. By harnessing innovation and improving accessibility to renewable energy in remote rural communities, the investment in Nova Innovation aligns with all of the Bank's missions.