



# ANNUAL REPORT

AN OVERVIEW OF OCEAN ENERGY ACTIVITIES IN 2025

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## About IEA-OES

### **Ocean Energy Systems (OES) is a Technology Collaboration Programme (TCP) within the International Energy Agency (IEA)**

The **International Energy Agency (IEA)** works to ensure reliable, affordable and clean energy for its 29 Member Countries and beyond. Founded in 1974, the IEA was initially designed to help countries coordinate a collective response to major disruptions in the supply of oil such as the crisis of 1973/4. While this remains a key aspect of its work, the IEA has evolved and expanded. It is at the heart of global dialogue on energy, providing authoritative statistics and analysis.

The IEA examines the full spectrum of energy issues and advocates policies that will enhance the reliability, affordability and sustainability of energy in its 29 Member Countries and beyond. The four main areas of focus are:

- **energy security:** promoting diversity, efficiency and flexibility within all energy sectors;
- **economic development:** ensuring the stable supply of energy to IEA Member Countries and promoting free markets to foster economic growth and eliminate energy poverty;
- **environmental awareness:** enhancing international knowledge of options for tackling climate change;
- **engagement worldwide:** working closely with non-member countries, especially major producers and consumers, to find solutions to shared energy and environmental concerns.

**Technology Collaboration Programmes (TCPs)** are independent, international groups of experts that enable governments and industries from around the world to lead programmes and projects on a wide range of energy technologies and related issues. TCPs currently cover topics related to:

- efficient end-use (buildings, electricity, industry, transport);
  - cleaner fossil fuels (greenhouse-gas mitigation, extraction, supply, transformation);
  - renewable energy and hydrogen (technologies and policies for deployment);
  - cross-cutting issues (modelling, technology transfer, project financing);
  - fusion power (safety, physics, materials, technologies).
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#### **Disclaimer:**

The Ocean Energy Systems (OES) is organised under the auspices of the International Energy Agency (IEA) but is functionally and legally autonomous. Views, findings and publications of the Ocean Energy Systems (OES) do not necessarily represent the views or policies of the IEA Secretariat or its individual Member Countries.

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# IEA-OES Cabinet

## CHAIR

### **Dr. Ir. Matthijs SOEDE**

EC, DG Research & Innovation

With a PhD in Chemical Engineering from Delft University of Technology, he began his career at the Netherlands' Ministry of Economic Affairs. Since 2008, he has been with the European Commission's DG Research and Innovation. He is a member of the IEA REWP and since 2021 co-lead and Mission Director for the MI Clean Hydrogen Mission.



## SECRETARY

### **Dr. Ana Brito e Melo**

WavEC Offshore Renewables

Civil Engineer with a PhD in Mechanical Engineering, she began her career with the wave energy team at Instituto Superior Técnico, University of Lisbon. She joined WavEC in 2003 and currently serves as the Chief Operating Officer. Additionally, she has held the role of Executive Secretary of the IEA-OES since 2002.




**VICE-CHAIR**
**Professor Christophe Gaudin**

University of Western Australia

Professor at the University of Western Australia in Perth. He founded Marine Energy Research Australia, supporting innovative offshore renewable energy technologies. Currently, he also directs the UWA Oceans Institute, a research hub with 250+ members specializing in marine biology, ocean science, engineering, and more.

**VICE-CHAIR**
**Dr. Srikanth Narasimalu**

NTU

Leading R&D through industry collaborations in offshore renewables and maritime digitalization and decarbonization since 2012 at ERI@N, NTU, Dr Narasimalu Srikanth is a Senior Principal Research Scientist and Programme Director. He holds two doctoral degrees in Mechanical & Materials Engineering and in Technology and IP Management. He chairs Singapore's renewable energy standards efforts and represents Singapore in the IEC TC114 and TC88.


**VICE-CHAIR**
**Mr. Tim Ramsey**

USA Department of Energy

Since 2025, he has been with the U.S. Department of Energy (DOE) and currently serves as the Program Manager for the Water Power Technologies Office's Marine Energy Program, leading the Program's efforts to conduct R&D on Marine Energy applications. He holds a Bachelor of Science in Chemical Engineering from Ohio University.



# Chairman's Message

**Matthijs Soede**

European Commission

IEA-OES Chairman (2023-2026)



Congratulations!

The IEA Technology Collaboration Platform on Ocean Energy Systems started officially in 2001, and that means that the platform exists now for 25 years. We have an anniversary, and being 25 years young, it is good to look at what has been realised and to look forward.

Twenty-five years ago, ocean energy was largely a research ambition. Today, we see technologies operating for longer durations. More devices are spending longer periods in the water and going through repeated cycles (deploy, learn, improve, redeploy), instead of short one-off trials. Long-term operation, especially grid-connected tidal, is building confidence that devices can operate reliably in harsh conditions.

In more countries, there is a clearer regulatory framework and growing international alignment. The progress documented in this report demonstrates that sustained collaboration is essential to transforming innovation into credible clean energy solutions. Ocean energy is being included more often in wider energy-transition plans. Many countries are making it easier to test at sea and get permits by updating national plans, laws and regulations. Market pull is starting to strengthen in some countries.

These are all positive signs, and they help to create an ecosystem that is needed to scale up an emerging technology, such as ocean energy. Scaling up now will be very important and together we will need to see how this can happen in the next years. Last year, we presented the “Ocean Energy and Net Zero” roadmap (towards 300 GW by 2050). It gives strategic directions around four priority pillars: Market Pull, Technology Push, Infrastructure, and Regulatory development (MTIR). It is important that we continue to develop concrete actions in line with these directions. To be successful, we will need to be alert, creative and persistent. It is still a long way, and we will need to help each other by exchanging experiences and knowledge and this is what we try to do with our work in the OES TCP.

I am inviting you to read the annual report carefully and take note of what is happening in the different member countries; to get inspiration, new ideas and to think about future collaborations.

I am looking forward to the ICOE 2026 conference, which will be organised this year in The Hague (The Netherlands). It is clearly a place to meet, to exchange experiences, to discuss the way to the market and to reinforce existing cooperation and build new collaborations. I am already looking forward to it and it would be great to meet you there (again)!

At the end of this foreword, I would like to say thank you to all the members for their contributions to this 2025 annual report, and of course, a special thanks to Ana Brito e Melo, who is heading our secretariat and taking so much care for all our reports and communications!

**Dr. ir. Matthijs Soede**  
Chair IEA Ocean Energy Systems  
Technology Collaboration Platform

# Executive Summary

**Ana Brito e Melo**

IEA-OES Executive Secretary



# Introduction

IEA-OES is the International Energy Agency's Technology Collaboration Programme (TCP) dedicated to ocean energy systems (OES). Through the TCP framework, participating countries collaborate to accelerate research, innovation and deployment by sharing knowledge, developing common methodologies and delivering joint studies and Tasks that address technical, environmental and policy challenges. IEA-OES operates under the IEA Committee on Energy Research and Technology (CERT) and reports through the Renewable Energy Working Party (REWP). Activities are funded by participating members and implemented in close coordination with the IEA Secretariat, benefiting from the IEA's established governance framework while retaining the flexibility needed to respond to evolving priorities.

As of December 2025, the IEA-OES has 20 active Member Countries along with the European Commission, establishing a robust international network. This diverse membership includes governmental bodies, utilities, universities, research organisations, energy agencies, and industry associations, providing a rich range of perspectives and interests.

One key advantage of joining IEA-OES is gaining an international perspective on ocean energy opportunities and challenges shaping the sector, supported by access to trusted and comparable information, practical guidance, and shared lessons from real projects. Membership also gives countries a direct role in shaping international priorities, strengthens visibility for national programmes, and helps reduce development and consenting risks through shared knowledge on environmental monitoring and regulatory pathways. This collaborative environment supports faster learning, stronger partnerships, and a more coordinated global approach to advancing ocean energy technologies and solutions.

The active members are: Australia, Belgium, Canada, China, Denmark, European Commission, France, Japan, Korea, India, Ireland, Italy, Monaco, New Zealand, Netherlands, Portugal, Singapore, Spain, Sweden, United Kingdom, and United States of America. Small Island Developing States (SIDS) DOCK, representing 32 small islands and low-lying developing states across the globe, participates as an Observer.

This Annual Report presents the collaborative work of IEA-OES, emphasizing key achievements and recent global developments. It addresses ocean energy policies, research advancements, and deployment progress across member countries, highlighting the collective impact and progress of this international cooperation.

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The work of the IEA-OES covers all forms of energy generation in which sea water forms the motive power through its physical and chemical properties, i.e. wave, tidal range, tidal and ocean currents, ocean thermal energy conversion and salinity gradients. IEA-OES connects organisations and individuals working in the ocean energy sector to accelerate the viability, uptake and acceptance of ocean energy systems in an environmentally acceptable manner.

# Key Achievements in 2025

## International Vision for Ocean Energy

In 2025, IEA-OES promoted the "Ocean Energy and Net Zero: An International Roadmap to Develop 300 GW of Ocean Energy by 2050" and to support its implementation IEA-OES structured its activities around four priority pillars: Market Pull, Technology Push, Infrastructure, and Regulatory development (MTIR). These pillars reflect the key enabling conditions identified as critical to achieving large-scale, responsible deployment of ocean energy globally. Each OES Task should aim to contribute to one or several of these priority areas, ensuring that the programme's technical, policy and knowledge-sharing activities are coherent, complementary and strategically aligned. Complementary in-depth studies were initiated in 2025 aimed at strengthening the policy framework required to deliver the ambitions set out in the roadmap.

## Integration of Social Acceptability into the Stage-Gate Metrics International Framework for Ocean Energy

In 2025, IEA-OES continued to promote the adoption of the *Stage-Gate Metrics International Framework for Ocean Energy*, which led to discussion on the integration of social acceptability as a relevant component. Since its inception in 2017, the framework has offered a robust approach for technical review and evaluation in the ocean energy sector, ensuring thorough due diligence in technology development. With the discussion on the inclusion of social acceptability in the framework, the IEA-OES acknowledges that the success of ocean energy projects depends not only on technical and environmental considerations but also on fostering public trust and support.

## Ongoing Outreach and Engagement under the OES-Environmental Task

In 2025, the OES-Environmental strengthened its role as a global reference for understanding and managing the environmental effects of marine renewable energy. This Task is led by the U.S. Department of Energy (DOE) and implemented by Pacific Northwest National Laboratory (PNNL). Key achieve-

ments included the dissemination of outreach materials based on the 2024 State of the Science Report, continued expansion of the Tethys knowledge base, and further advancement of the Risk Retirement Framework. The Task also initiated work on an approach to assess environmental acceptability, developed use cases for off-grid applications, and continued analysis of system-wide effects such as array-scale impacts, cumulative effects and ecosystem responses, including a targeted focus on tropical and subtropical ecosystems. Outreach and engagement remained a priority through workshops, webinars, conferences and online resources, supported by active participation from 15 nations and the European Commission.

## Ocean Thermal Energy Conversion (OTEC)

In 2025, activities on OTEC were focused on a targeted engagement with the Ocean Thermal Energy Association (OTEA) and the development of a Memorandum of Understanding to be signed in 2026, aiming to foster knowledge exchange, enhance international cooperation and increase the visibility and promotion of OTEC worldwide. Two publications led by the OES OTEC group: the *White Paper on OTEC* (2021), and the *Economics of OTEC* (2024), represent significant milestones in improving the understanding of the technology's economic viability and deployment potential.

## Collaborative Efforts on Numerical Modelling for Wave Energy Converters

The IEA-OES Numerical Modelling for Wave Energy Converters Task continued to strengthen international collaboration aimed at improving the accuracy and reliability of numerical tools for wave energy applications. In 2025, Task activities focused on advancing benchmark studies that compare numerical model results against high-quality experimental data, with the objective of enabling meaningful quantitative assessment of model performance. Discussions during a side event held at the 16th European Wave and Tidal Energy Conference (EWTEC) in Funchal, Madeira, highlighted the need to pro-

gressively address more complex test cases, including more realistic power take-off (PTO) and mooring system representations.

### Collaborative Efforts on Numerical Modelling for Tidal Energy

The IEA-OES Tidal Energy Modelling Verification and Validation task strengthened international confidence in tidal resource and power prediction by bringing modelling teams together through online workshops. The group compared modelling approaches and advanced verification and validation methods using shared case-study discussions, including better use of field data, improved coupling between large-scale ocean models and device-scale tools, and deeper analysis of how turbines and array layouts can affect local flows and resource estimates.

### ICOE - International Conference on Ocean Energy

The International Conference on Ocean Energy (ICOE), the flagship global event of the ocean energy sector organised biennially under the auspices of IEA-OES, will take place in 5-7 October 2026 in The Hague, the Netherlands, following the successful 2024 edition. In 2025, Ocean Energy Europe (OEE) joined efforts with the Dutch Energy from Water Association (EWA) to deliver this event. IEA-OES actively accompanied and supported the process

of OEE and EWA coming together to jointly organise this event, ensuring alignment with the objectives and standards of the ICOE conference series.

### Collaborative initiatives, promoting awareness and expanding membership

IEA-OES focuses on worldwide collaboration, sharing information and connecting with diverse people involved in ocean energy. The goal of IEA-OES is to increase its impact by spreading key messages and promoting ocean energy in international events. The IEA-OES actively participated in initiatives that significantly contribute to the sector's advancement, including the International WATERS Network, the International Network on Offshore Renewable Energy (INORE) and the international standards IEC-TC 114 for wave and tidal energy technologies. The IEA-OES also remained dedicated to broadening its global membership, encouraging new members worldwide. In 2025 Brazil was formally invited by the ExCo to join the IEA-OES.

### Looking Ahead

Looking ahead, 2026 will be a milestone year for IEA-OES as the programme marks its 25th anniversary. It will also be the year in which the Strategic Plan for the next 5-year term (2027-2031) is prepared, building on the achievements and lessons of the previous term.



## Country Highlights in 2025

In 2025, ocean energy policy and development across OES member countries followed a clear trend: ocean energy technologies were increasingly integrated into broader energy-transition strategies, even where there were still few support schemes created specifically for “ocean energy”. In several countries, national plans were updated, laws were revised and regulations were adjusted to make it simpler to test projects at sea and obtain permits. Public support continued to be directed mainly towards research and development, pilot projects, and test infrastructures.

At the same time, market progress remained uneven. A few countries began to offer clearer pathways for revenue for the energy produced (or signaled future tenders and access to auctions), while others continued to rely mainly on innovation funding and case-by-case approvals.

Ocean energy continued to move from R&D and prototype testing towards a more mature phase. Three signs show this progress: devices spent more time in the water, greater integration with real-world applications, and strengthening enabling conditions (infrastructure and regulations).

Instead of only short trials, more projects are now running for longer periods and going through repeated cycles: deploy, learn, improve, and redeploy. Long-term operation, especially for tidal energy connected to the electricity grid, helps prove that devices can work reliably in tough sea conditions. This kind of real operational experience is important for building investor confidence and scale-up to multi-device arrays.

Another clear trend is the growth of hybrid solutions and shared offshore use space. Ocean energy is increasingly combined with other activities, such as desalination, hydrogen production, powering offshore monitoring equipment, supporting harbour and island microgrids, and integration with solar, wind and storage. These combined solutions can make projects more cost-effective, especially for islands, remote coastal areas and offshore locations where energy is harder and more expensive to supply.

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**More testing in real-world conditions and clearer rules continued to bring ocean energy closer to becoming an increasingly investable sector, country by country.**

Finally, many countries continued to improve enabling conditions for deployment: open-sea test sites, facilities to test key components, grid connections, and marine testing of materials and coatings. At the same time, clearer support programmes and permitting approaches are helping projects move from pilots towards early commercial deployment. Overall, the sector is building confidence step by step, using real evidence, expanding practical applications, and strengthening the conditions needed for responsible growth.

Overall, 2025 was a year of steady progress, with policy and technology moving forward: Countries strengthened the enabling conditions through clearer recognition, improved maritime planning and greater coordination with other offshore activities. Projects generated more real-world operational evidence. Together, these steps helped improve confidence and move ocean energy gradually from early prototypes towards more investable projects with stronger prospects for continuity and responsible growth.

## ASIA



## China

### POLICIES

- **Big legal move:** China's Energy Law is now in force, and it clearly supports scaling up ocean energy as part of the shift to cleaner, low-carbon energy.
- **First joined-up national plan:** several ministries have issued a shared set of "Guiding Opinions on Promoting the Large-scale Utilization of Ocean Energy". It sets out five main areas of work: mapping the resource, scientific and technological innovation, pilot and demonstration projects, industrial development environment and encouraging international cooperation.
- **More "sharing at sea":** the National Energy Administration is encouraging ocean energy to be developed together with other offshore activities, including sharing space and infrastructure, to use marine areas more efficiently.
- **A route into green power markets:** China is signaling that ocean energy could be included in green power certificates and green electricity trading, so projects can sell power through the same mechanisms as other renewables.

### PROJECTS

- **LHD Tidal Current Power Station (Zhejiang):** continued stable operation for over 8 years; its megawatt-class "Endeavour" unit (deployed and grid-connected in 2022) exceeded 40 months continuous operation by end-2025, with cumulative grid-connected generation over 6.2 million kWh.
- **Three Gorges Zhoushan tidal current demonstration:** continued grid-connected demonstration operation and provided three public test berths for full-scale prototypes (China's first tidal current demo with public test berths and services).
- **Wave-energy-powered deep-sea aquaculture ("Penghu"):** completed long-cycle cross-year aquaculture trials, validating safety and reliability under extreme marine conditions; the concept is now being replicated in multiple provinces.
- **"Nankun" MW-scale floating wave power platform:** continued offshore testing/operation; reported overall wave-to-electricity efficiency  $\geq 26\%$  in real-sea conditions and demonstrated potential to supply stable clean electricity for remote islands.
- China **advanced OTEC R&D for island energy applications** in 2025 and progressed towards the design of a 200 kW modular floating OTEC power station.



## Republic of Korea

### POLICIES

- **Clear national target:** The Ministry of Oceans and Fisheries set a goal for ocean energy to deliver 2.3 million tonnes of CO<sub>2</sub> reductions by 2050, and this is driving several R&D and commercialisation programmes.
- **Step-by-step development plan:** The “2030 Ocean Energy Development Plan” lays out a phased route: expand R&D and open-sea testing → build large farms → grow domestic supply and exports → create certification systems and supportive policies.
- **Wider energy policy context:** National policy is moving toward a more “balanced mix” of renewables and nuclear. In March 2025, two new special acts were adopted to speed up offshore wind rollout and expand grid infrastructure, helping unlock delayed projects and support new ones.
- **Korea’s main market tools:** Renewable Portfolio Standard (RPS) is complemented by tradable Renewable Energy Certificates (with higher REC weightings already set for tidal technologies but wave still pending real output data), and the government has also expanded a fixed-price bidding scheme from solar to wind to secure renewable supply and improve investment certainty.
- **Public funding:** In 2025, MOF invested around 11.5 billion KRW, focused on green hydrogen production using ocean energy and on developing an OWC wave power plant.

### PROJECTS

- **KRISO Wave Energy Test Site (WETS), west of Jeju Island:** operating since 2019 with 5 test berths (incl. Yongsoo OWC pilot plant) and grid connection infrastructure; used for multiple real-sea trials and expanding interest from international partners.
- **Yongsoo OWC green hydrogen plant:** a demonstration plant installed independently at sea (remote/automatic operation), currently validating hydrogen production from real wave power and simulated wind power.
- **Chuja Island breakwater-integrated wave power:** a 30 kW OWC pilot plant at Mook-ri Port is under long-term operation for performance evaluation and technology verification; integrated into a micro-grid with ESS, aimed at island applications with limited land availability.
- **KIOST** operates a 4.5 MW open-sea tidal test site at Uldolmok and a BladeLab for full-scale rotor blade strength testing, supporting its 1 MW tidal converter development.



## India

### POLICIES

- **National leadership:** Coordination on ocean energy continues mainly through Ministry of New and Renewable Energy (MNRE) and the Ministry of Earth Sciences (MoES), with NIOT (MoES) spearheading indigenous technology development across wave, tidal, OTEC and salinity-gradient for grid and off-grid use.
- **Standards and international alignment strengthened:** India became a participating member of IEC TC 114 and leads a national technical committee on marine energy (ETDC 54).
- **Resource and planning foundations improved:** The Integrated Ocean Energy Atlas is mapping ocean energy potential across India's EEZ to guide future siting and investment.
- **Funding comes from several ministries:** Support is spread across MNRE (wave/tidal and related applications like desalination), MoES (including Deep Ocean Mission and other missions), and DST (research funding and fellowships).
- **OTEC focus:** The Deep Ocean Mission is the main public driver for OTEC and ocean freshwater generation, with preparation of plants underway.

### PROJECTS

- **OTEC-powered desalination:** NIOT is at an advanced stage establishing a 100 m<sup>3</sup>/day plant at Kavaratti Island (Lakshadweep), including completed fabrication milestones for key open-cycle turbine components and process equipment.
- **Deep-sea demonstration planning is progressing under the Deep Ocean Mission:** a floating-platform demonstration is planned combining a 100 kW closed-cycle OTEC module and an open-cycle OTEC desalination system, alongside plans for a hybrid floating renewable plant (floating solar + wind) in Lakshadweep.



## Singapore

### POLICIES

- **Net-zero by 2050** remains the national direction, implemented through the Singapore Green Plan 2030.
- Singapore positions itself as a **“Living Lab,”** enabling clean-tech companies to pilot and validate innovations locally before scaling them to international markets.
- Singapore supports clean-tech innovation with major **public funding** (S\$800m+ for R&D and S\$55m for low-carbon energy projects), plans to reinvest over S\$1bn of carbon tax revenues to help businesses decarbonise, and a S\$90m maritime decarbonisation fund led by the Maritime and Port Authority with industry.
- **Strong public support for clean-tech:** Public programmes fund a broad clean-tech ecosystem (energy, water, buildings, land-efficient solutions) and carbon tax revenues are intended to be reinvested to help companies decarbonise.
- **A key enabler:** ERI@N (NTU) plays a central role in enabling marine/offshore renewables, including standards work and technical support to developers.

### PROJECTS

- **Sentosa Tidal Test Site:** deployed customised tidal turbines and is using generated electricity for local loads (e.g., boardwalk lighting), while testing supporting solutions like anti-biofouling coatings and hybrid concepts.
- **Offshore floating solar for aquaculture:** ERI@N deployed an offshore floating solar system to supply energy to aquaculture farms (a high-energy-demand use case), reducing reliance on diesel and supporting environmental monitoring.
- **Public Utilities Board (PUB) floating solar deployments:** 1.5 MWp systems at Bedok and Lower Seletar Reservoirs were deployed to supply clean electricity for water infrastructure operations (demonstrating scalable nearshore “in-water” renewables integration).
- **REIDS microgrid testbed:** operating multi-partner microgrids supplying real loads (approx. 200 kWh/day to the NEA facility), providing a platform to validate hybrid renewable + storage systems relevant to island/coastal applications.
- **Renewable-powered water generation systems** deployed on southern islands, replacing diesel-based supply models for island energy/water needs.
- **Raffles Lighthouse hybrid renewable energy farm:** feasibility work is planned/underway on combining floating solar with tidal turbines.

# EUROPE



## European Commission

### POLICIES

- **Continued EU-level direction for ocean energy** under the Green Deal/Energy Union/SET-Plan, and the 2023 offshore renewables communication, which sets ocean energy ambitions at 100 MW by 2027 and 1 GW by the end of the decade or early 2030s.
- **Advanced implementation of the Net-Zero Industry Act** (in force since June 2024), with a May 2025 delegated act that explicitly lists tidal stream and wave technologies under “other offshore renewable technologies” (while noting the sector still lacks standardised components).
- **Reinforced investable frameworks via the EU electricity market design reform** (in force since July 2024), which strengthens longer-term contracting and de-risking instruments relevant to innovative renewables.
- **Strengthened cross-sector planning and blue economy coordination** through the European Ocean Pact (adopted June 2025), including plans for an “Ocean Act” by 2027 and stronger sea-basin coordination building on Maritime Spatial Planning.
- **Maintained strong public funding channels for ocean energy** through Horizon Europe and the Innovation Fund (ocean energy listed as a net-zero technology), plus BlueInvest and other finance instruments to support scaling.

### PROJECTS

- **EU deployments remain mostly demonstrator / early pre-commercial:** only 0.5 MW of new installed capacity was added in 2024 (mainly tidal stream), and many TRL 6-7 deployments are not grid-connected and therefore not fully captured in official statistics.
- A **pipeline of EU-supported demonstration and scale-up projects** continued to mature via Horizon Europe and Innovation Fund pathways, including preparations for tidal pilot farms and wave farm demonstrations, plus “critical technologies” projects that target subsea components, monitoring and controls needed for arrays.
- **Innovation Fund project preparation progressed for larger tidal pilots in France** (NH1 12 MW and FloWatt 17 MW) and wave farm scale-up (VianaWave 10 MW in Portugal; Saoirse project in Ireland), signalling EU support moving from single devices toward pre-commercial arrays.



## UK

### POLICIES

- **Contracts for Difference (CfD) is the UK's core market mechanism for ocean energy:** recent allocation rounds created a UK tidal stream project pipeline of around 122 MW for deployments by 2029.
- **CfD is being restructured:** AR7 is now offshore wind only, and AR7a covers non-offshore wind technologies; Tidal stream and wave are placed together in Pot 2 (less-mature/less-established technologies pot). Results are expected in February 2026.
- UK-wide direction is being shaped by the **Clean Power 2030 Action Plan**, plus the Modern Industrial Strategy (10-year plan) and its Clean Energy Industries Sector Plan, which emphasise faster delivery, supply chains, ports, networks and UK industrial capability (even if wave/tidal are still treated as earlier-stage than top priority industries).
- **Great British Energy (GBE) is being positioned as a new public investor/developer:** its Strategic Plan (published December 2025) sets targets to 2030 and includes an “Offshore Energy” investment focus, with a venture-style route for high-growth technologies.
- **Scotland:** net zero target of 2045 (earlier than the UK-wide 2050), a draft Climate Change Plan for 2026–2040 (to be finalised in 2026), and policy/consenting levers via devolved powers; continued strong tidal stream progress, reinforced by CfD awards and Horizon Europe-supported pilot farms at EMEC.
- **Wales:** policy support combines targets (renewables and net zero) with direct enabling investment, notably through Morlais test site and grid expansion funding, plus continued support for Marine Energy Wales as the coordinating stakeholder body.
- **Cross-sector coordination** is increasing **via the UK Marine Energy Taskforce** (launched June 2025 under the UK Marine Energy Council), set up to produce a 12-month roadmap and recommendations across site development, financing, innovation and supply chain growth.

### PROJECTS

- **MeyGen (Pentland Firth):** remains the world's largest operational tidal stream project; Phase 1 has four 1.5 MW turbines operating since 2018, with the longest-running turbine exceeding six years of uninterrupted operation; a record 372 MWh was exported in March 2025 and cumulative generation reached 84 GWh by November 2025.
- **Proteus Marine Renewables:** advanced commercial tidal deployment in 2025, completing major offshore servicing at MeyGen (returning two turbines to service and recovering one for upgrades) while progressing new pipelines; Proteus' 1.1 MW AR1100 turbine became the first grid-certified tidal turbine deployed in Japan in 2025.
- **Nova Innovation:** Shetland Tidal Array continues long-duration operation, generating for more than nine years and accumulating over 86,600 operating hours; currently advancing the design and testing for their next-generation tidal turbine.

- **Orbital Marine Power:** the O2 turbine continued long-term operation at EMEC (Orkney), building the performance, reliability and environmental dataset needed to de-risk scale-up to the next 2.4 MW O2-X.
- **Mocean Energy:** the Blue X achieved over 13 months of reliable offshore operation, demonstrating continuous off-grid renewable power for subsea/offshore users.
- **OceanEnergy:** the 1 MW OE35 is being built through winter 2025/26, with offshore deployment scheduled to start in April-June 2026.



## Ireland

### POLICIES

- **Climate Action Plan 2025** reaffirmed Ireland's targets (50% emissions reduction by 2030; net zero by 2050) and underpinned very ambitious offshore renewable energy goals (at least 37 GW by 2050).
- Government published the **Future Framework for Offshore Renewable Energy - 2025 Review**, updating progress across the 29 actions and setting the next-year action plan to keep Ireland's plan-led offshore regime on track.
- Marine consenting and spatial planning advanced through the **National Marine Planning Framework (NMPF)** and the Designated Maritime Area Plan (DMAP) process: work began on a National ORE DMAP aiming to designate enough sea area to deliver 20 GW of offshore renewables by 2040.
- **Market support** continued via auction-based schemes (RESS/ORESS): ORESS 2.1 progressed in 2025 under the new plan-led approach, including provisional award of development rights for the ~900 MW Tonn Nua site.
- **Public funding and test-infrastructure access** remained strong through SEAI's RD&D programme and the SEAI/Lir NOTF industry access calls (2025 call funded 7 projects: 4 wave, 3 tidal).

### PROJECTS

- **Ocean Energy Ltd:** deployed its full-scale OE-35 wave energy converter buoy at the US Navy's Wave Energy Test Site (Hawaii), with SEAI co-funding alongside the US Department of Energy.
- **AMETS Floating LiDAR Buoy:** strengthened "in-water" enabling capacity with deployment of a floating LiDAR buoy to gather wind/wave/metocean data to support future floating wind and wave developments.



## Denmark

### POLICIES

- **No standalone national policy:** Denmark does not have a dedicated “Ocean Energy Policy”; ocean energy is supported through broader climate goals and funding programmes, while offshore wind remains the main marine energy focus.
- **Marine Spatial Planning (“Havplan”)** is the main offshore planning instrument; wave energy converters are not yet specifically designated in offshore/nearshore planning but would fall under broader renewable energy zones.
- There are currently no dedicated feed-in tariffs or revenue support schemes for wave energy; the approach is mainly project funding, with an **ambition to add revenue support** once demonstration projects prove viability (similar to the historic wind model).
- **Main funding channel:** EUDP (Energy Technology Development and Demonstration Programme) is the central national funding channel for pre-commercial renewable energy technologies, including ocean energy; in 2025 it was funding six wave-energy-related projects in Denmark.
- **Standards engagement continues:** Denmark remains active in IEC TC 114 mirror work and maintenance teams, supporting consistent methods for wave performance assessment and early testing.

### PROJECTS

- **Wavepiston:** continued sea testing at the PLOCAN test site (Gran Canaria), with key components tested.
- **Exowave:** planning a 100 kW North Sea prototype deployment near Hanstholm (Phase 1 funded by EUDP), as a step toward an ambition of a larger Danish wave plant before 2030.
- **Crestwing:** preparing to relaunch its “Tordenskiold” prototype for offshore testing before summer 2026, following technical upgrades.



## Sweden

### POLICIES

- **Early-stage enabling framework:** ocean energy is recognised in Sweden’s national maritime strategy (2015), but the national marine spatial plans adopted on 10 February 2022 did not earmark specific areas for it, and there is still no dedicated market incentive; support remains mainly through existing R&D and demonstration funding routes.
- **Where funding usually comes from:** the main public channels that can support ocean energy projects include the Swedish Energy Agency, the Swedish Research Council (VR), VINNOVA, and sometimes regional authorities.
- **International co-funding option:** Sweden also supports participation in the Clean Energy Transition Partnership (CETPartnership), with the Swedish Energy Agency acting as a funding body for Swedish partners.

### PROJECTS

- **Minesto:** continued grid-connected testing and upgrades at Faroe Islands with Dragon 12 (1.2 MW) and Dragon 4 (100 kW); in 2025, Dragon 12 was upgraded with a slightly longer tether, increasing power performance; continued to prepare for the next step, a 10 MW array in the Faroe Islands.
- **CorPower Ocean:** progressed the HiWave-5 demonstration programme, preparing full-scale testing of an integrated wave energy converter under a structured verification methodology.
- **Söderfors marine current converter:** a 7.5 kW vertical-axis turbine + permanent magnet generator remains operational in the Dal River, connected to the local grid.
- **Lysekil wave research site:** the test site remains installed (11 WECs; 260 kW installed capacity) but devices are not operational; permitting was extended for 10 additional years from 2024.
- **Marine materials “in-water” testing:** the Kristineberg marine testbed continued field verification of anti-fouling/corrosion protection solutions.



## Netherlands

### POLICIES

- **No specific ocean energy policy or targets yet.** It's mostly handled under wider plans for renewables, innovation, and offshore “system integration”, with responsibilities shared across several ministries.
- **Market mechanisms:** ocean energy is eligible for SDE++ support (CO<sub>2</sub>-avoidance based), but in practice access remains limited because the technologies are not yet mature enough to compete effectively.
- **Demo funding is available, but not used yet:** The DEI+ programme is open to ocean energy pilot/demonstration projects, but no ocean energy projects have been approved so far.
- **Visibility and momentum:** the Netherlands will host ICOE-OEE 2026 in The Hague (5-7 October 2026), which is expected to showcase Dutch innovation and strengthen international collaboration.

### PROJECTS

- **Water2Energy:** grid-connected, long-duration tidal current performance testing at Vlissingen Harbor through 2025 (Offshore For Sure, Interreg). Optimised blades + automatic pitch control delivered ~20% efficiency improvement.
- **SeaCurrent:** validated its TidalKite™ system in a controlled freshwater environment during 2025 (system upgrades, safety programmes, endurance and watertightness), building readiness for sustained marine operation.
- **WECO:** Kaizen 2.0 wave energy converter completed assembly and dry tests, then deployed just off Scheveningen for short sea trials, validating rapid deployment method.
- **Slow Mill Wave Power:** short sea trial of the Slow Mill-40 demonstrator “Danica” off The Hague, confirming energy generation in moderate waves and validating a simple, diver-free install/decommissioning approach.
- **Symphony Wave Power:** completed onshore dry-testing of its membrane-based PTO, confirming stable performance and reliable turbine operation, positioning the device for offshore deployment in 2026.
- **Wedge Global:** deployed its floating W1 wave energy system to power FLORA (Floating Radar) for bird/bat monitoring within the Ecowende offshore wind farm concession area, demonstrating an offshore “power-for-services” use case.
- **AE-WaveHexapod:** rebuilding its onshore test set-up into an offshore-ready version and planning survivability tests near IJmuiden in late summer 2026, supported by the Just Transition Fund.
- **REDstack:** operated a pilot Reverse Electrodialysis (RED) plant in Spain under the EU-funded HYREWARD project.
- **Dutch Wave Power:** building a large-scale wave energy converter for offshore demonstration in 2026.
- **Equinox Ocean Turbines:** preparing the deployment in summer 2026 of its 1:10 scale ocean current turbine.



## Belgium

### POLICIES

- **Federal government agreements (2025):** introduced new governance measures, notably a High Council for Energy Supply to provide independent calculations/advice, and a strengthened interfederal energy pact to improve long-term coordination between federal and regional authorities.
- **Ocean energy is recognised mainly through innovation and enabling actions** rather than dedicated market support, and Belgium’s policy discussion highlights the need to broaden renewables progress beyond offshore wind, creating space for emerging options like ocean energy as part of a more diversified portfolio.

### PROJECTS

- **Blue Accelerator (Ostend):** continued development of an open-sea test platform (15-year permit) designed to help scale technologies from lab testing to nearshore prototype trials.
- **Coastal & Ocean Basin (Ostend):** progressing as a major new physical testing facility for offshore renewables (wave + current generation capability).



## Spain

### POLICIES

- **Policy continuity:** Spain continues to support ocean energy under its updated NECP/PNIEC 2023-2030 (approved September 2024), with the 2021 Offshore Wind and Marine Energies Roadmap still the key reference for wave and tidal.
- **Easier rules for small demo projects:** Innovative marine energy installations below 20 MW are exempt from competitive tendering, while still requiring full permitting, EIA, and maritime concessions.
- **Faster “plug-and-play” for R&D platforms:** A 2025 decree introduced measures to facilitate authorisations and grid connection for demonstrators on marine R&D platforms.
- **Marine spatial planning continues:** POEM (approved 2023) remains the basis for sea-space planning, and Spain has progressed work toward the next MSP cycle through multi-stakeholder workshops.

- **No ocean-energy-only scheme, but auctions exist:** Ocean energy can compete under the general renewables auction framework, including the “Other Technologies” category (20 MW auction every two years).
- **Port upgrades under the Recovery, Transformation and Resilience Plan (PRTR):** PORT-EOLMAR funds strategic port infrastructure upgrades to boost logistics capacity and strengthen Spain’s offshore wind and ocean energy supply chain.

## PROJECTS

- **Mutriku Wave Power Plant:** continued operation as the world’s oldest grid-connected wave plant; cumulative export since 2011 reached 3.43 GWh. In 2025 it hosted testing of an IDOM OWC turbine and prepared for EuropeWave test campaigns starting in 2026.
- **HarshLab:** major milestone in Sept 2025, connected to BiMEP’s electrical grid, enabling full-scale mechanical/electrical equipment testing under real marine conditions with continuous data acquisition. 2025 campaigns included anti-corrosion/anti-fouling coatings and corrosion-monitoring sensors.
- **PLOTEC:** 1:5 scale OTEC prototype (“Don”) deployed at PLOCAN (Canary Islands); long-term offshore trials initiated to validate the storm-resistant floating hull, moorings and cold-water intake concept.
- **Wavepiston:** continued offshore validation at PLOCAN of seawater-hydraulic PTO components and control strategy.
- **Carnegie CETO (ACHIEVE):** component procurement/fabrication and onshore PTO/system integration testing progressed in 2025, preparing deployment at BiMEP in 2026 (supported by EuropeWave, EVE and IDAE/RENMARINAS DEMOS).
- **IDOM MARMOK-A-5:** retrofit completed and mooring/umbilical pre-installed; awaiting the right conditions to install at BiMEP for early 2026 deployment.
- **DESALIFE:** preparing a full-scale wave-powered desalination buoy off north Gran Canaria, aiming to validate fully off-grid reverse-osmosis desalination powered by waves.



## Portugal

## POLICIES

- **Updated national direction through the revised PNEC 2030 (approved in 2025):** keeping offshore renewables as part of the decarbonisation and energy security agenda and setting targets of 2 GW offshore wind and 0.2 GW wave energy installed capacity by 2030.
- **Approved the offshore Renewable Energy Allocation Plan (PAER)** via Council of Ministers Resolution No. 19/2025, updating the Maritime Spatial Plan (PSOEM) and defining offshore areas sized to accommodate 9.4 GW (technology-neutral, but designed around floating offshore wind compatibility).

- **Strengthened the offshore demonstration enabling framework** through the “Technological Free Zone” (ZLT) for offshore renewables near Viana do Castelo, with the specific regulation for this ZLT published in 2025.
- **Confirmed the permitting pathway for private use of maritime space** (TUPEM), with the Directorate-General for Natural Resources, Safety and Maritime Services (DGRM) as the approving authority and Directorate-General for Energy and Geology (DGEG) coordinating licensing when projects relate to energy/renewables; simplified modality applies for R&D/pilots (authorisation up to 10 years).

## PROJECTS

- **CorPower Ocean:** CorPower advanced its C4 sea trials and next-generation C5 development and secured major EU funding and investors (including support for the 10 MW VianaWave project).
- **Eco Wave Power** (nearshore, breakwater-mounted wave energy technology: progressing toward a first 1 MW phase at Porto/Leixões with the Port Authority (APDL).



## Italy

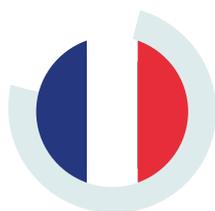
## POLICIES

- **Update Energy and Climate Plan:** The updated plan says “energy from the sea” can be valuable because it is more predictable than some other renewables, and it highlights good Mediterranean areas for wave energy; it also stresses the need to focus R&D to avoid fragmentation and converge toward optimal solutions.
- **Planning for 2026–2028:** the Department for Marine Policies opened a stakeholder consultation in June 2025 to shape the next “Piano del Mare” (Marine Plan) for 2026–2028.
- **Funding to test solutions on small islands:** Italy’s Recovery Plan includes the “Green Islands” programme, aimed at smaller non-connected islands, supporting packages of measures (renewables, efficiency, water, mobility, waste/circular economy). The programme has a €200 million budget.
- **Incentives are opening the door:** Italy’s FER 2 framework supports “innovative” or higher-cost renewables, and it explicitly includes tidal, wave and other marine energy technologies. The overall objective is 4.6 GW by end-2028, and marine renewables share a dedicated 200MW quota (together with floating PV).

## PROJECTS

- **REWEC (OWC in breakwaters):** two full-scale REWEC installations integrated into port breakwaters at Civitavecchia and Salerno currently represent the main full-scale wave energy applications deployed in Italy.
- **OBREC at Port of Naples:** overtopping wave energy device built into the San Vincenzo breakwater in 2015 (world’s first overtopping device integrated into an existing coastal defence); a medium-term monitoring campaign is starting with a completely new PTO.

- **PeWEC:** 50 kW wave energy prototype under design, with a target for deployment at the MOREnergy Lab's Pantelleria test site in 2027 for long-term real-sea monitoring.
- **WEPA:** 15 kW hybrid (wave + PV + micro-wind) prototype being revamped, with planned sea installation in 2026 and combined performance and environmental monitoring.
- **Seapower:** the GEMSTAR system, a "kite" tidal stream energy device, reached TRL 6 and a new innovative mooring system has been developed. A prototype was also deployed in the Strait of Messina under a microgrid system developed in collaboration with the University of Reggio Calabria and a local company, Elettra Srl.



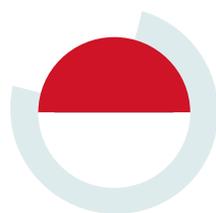
## France

### POLICIES

- The **National Strategy for the Sea and Coastline (SNML) 2024–2030** is a key umbrella framework: marine renewable energies are included as one of its objectives to support carbon neutrality by 2050.
- **New funding window:** In 2025, the Green Fund added a "Sea and coastline" measure, supporting coastal resilience and the blue economy, including initiatives linked to decarbonising offshore activities.
- **Tidal tender on the horizon:** France's next Multi-year Energy Plan (PPE 2025–2035) was not published in 2025, but draft versions point to strong tidal current potential and consider a first commercial tidal tender (250 MW) at Raz Blanchard, with a contract award target around 2030 (subject to grid and cost studies).
- **OPEN-C Foundation** took over the concession for the Paimpol–Bréhat tidal test site (decree dated 18 September 2025), aiming to position it as a national platform for new demonstrators.

### PROJECTS

- **Seaturns:** the 1/4-scale IFREMER test-site demonstrator was redeployed until Feb 2025 (following an initial Oct 2023–Sept 2024 campaign) to complete assessment and reported outcomes included confirming a good level of production. Full-scale 200 kW demonstrator assembled in summer 2025, with sea trials planned for 2026.
- **Dikwe:** 330 kW wave energy demonstrator integrated into the Boulogne-sur-Mer breakwater is scheduled for early 2026.
- **FloWatt:** plan for a 17 MW pilot farm (six 2.8 MW turbines) in Raz Blanchard by 2028; backed by France 2030 support (€75m investment aid + 20-year feed-in tariff) and a €20m EU Innovation Fund grant.
- **Normandie Hydroliennes NH1:** plan for a 12 MW pilot farm (four 3 MW turbines) in Raz Blanchard by 2028; selected for EU Innovation Fund support (€31.3m).



## Monaco

### POLICIES

- **Climate ambition is a top national priority** under H.S.H. Prince Albert II's leadership, with Monaco committed (NDC) to cut GHG emissions by 55% by 2030 and 67.6% by 2035 (vs. 1990), and to reach carbon neutrality by 2050.
- **Ocean energy seen through a “climate + sustainable city” lens:** Monaco's interest in ocean energy is mainly linked to its climate and sustainability goals, and it puts a lot of emphasis on international cooperation.
- **Public funding tool:** the National Green Fund helps finance emissions reduction, energy efficiency, renewable energy, and cleaner mobility (funded through a mix of electricity-related contributions and the government budget).
- **Innovation support:** the government has a venture capital vehicle (SACDE) to help innovative Monaco-based companies grow.
- **Renewables supply approach:** Monaco and its utility (SMEG) created Monaco Renewable Energies (MER) to develop renewable power projects outside Monaco (mainly solar and wind), aiming to cover Monaco's electricity needs with renewable generation capacity.

### PROJECTS

- **Seawater heat pumps are Monaco's flagship “in-water” renewable solution:** first installed in 1963, now around 80 systems supply ~17% of Monaco's total energy consumption (about 191 GWh/year), providing heating in winter and cooling in summer for many coastal buildings.
- **Scale-up pipeline (planned/being connected):** two new seawater-heat-pump-based heating/cooling networks have been commissioned and buildings are being connected; expected to serve ~3,500 homes, avoid ~6 ktCO<sub>2</sub>eq (about 8% of Monaco's total emissions), and produce ~26,000 MWh of fully decarbonised energy.

# OCEANIA



## Australia

### POLICIES

- **Net-zero and decarbonisation agenda stayed central:** Australia updated its 2035 emissions target to 62–70% below 2005 levels and is pursuing this through a Net Zero Plan (clean electricity, electrification/efficiency, clean fuels, new technologies, carbon removals).
- **Grant fundings:** The Australian Renewable Energy Agency (ARENA) received an additional \$7.1bn (2024–25 Budget) for pre-commercial innovation, but there are currently no ARENA projects exclusively focused on ocean energy.
- **Offshore rules are evolving:** The Offshore Electricity Infrastructure Act framework continued to develop, including 2025 consultations and changes that reduced fees/levies (especially for research and transmission licences) and expanded scope to cover emerging offshore energy options.
- **National ocean plan:** Consultation on an Australian Sustainable Ocean Plan started in 2024 and continued through 2025; expected to be released in 2026.
- **Revenue support exists, but not for offshore:** The Capacity Investment Scheme expanded to 40 GW, but no offshore energy projects are currently supported.
- Support for ocean energy at state/territory level remains limited overall, with Western Australia a notable supporter (e.g., backing Marine Energy Research Australia, 2018–2025).
- Overall state support remains modest, with Western Australia a notable supporter (including backing Marine Energy Research Australia in past years).

### PROJECTS

- **Albany M4 wave energy demonstrator (UWA-MERA):** it was deployed Nov 2024 in King George Sound; retrieved/redeployed multiple times and finally recovered in Apr 2025 after 131 days at sea; generated power for over 300 hours, including 24 hours continuous operation.
- **Carnegie Clean Energy progressed on two fronts in 2025:** in Australia it moved from the successful Moor-Power scaled demonstrator to preliminary design for a full commercial pilot targeting offshore aquaculture, while internationally it advanced the ACHIEVE programme toward deploying its first grid-connected CETO unit in Europe at BiMEP (Spain) in 2026, supported by EuropeWave and Spanish/Basque funding.



## New Zealand

### POLICIES

- **Offshore Renewable Energy Bill (ORE Bill) advanced:** it passed its second reading in Parliament and is expected to become law in 2026, proposing a two-stage permitting regime (feasibility + commercial permits), requirements for consultation, decommissioning obligations, safety zones, and enforcement provisions; it explicitly covers waves, tides and ocean currents.
- **Policy momentum is currently shaped by offshore wind:** the ORE Bill was largely driven by offshore wind developers, creating potential synergies for ocean energy.
- **Public funding landscape is changing:** a new Applied Doctorates Scheme launched in 2025 to bridge research and industry.
- **Research sector restructuring:** the National Institute of Water and Atmospheric Research (NIWA) and the Institute of Geological and Nuclear Sciences (GNS) merged to form Earth Sciences New Zealand (ESNZ), with renewables support in its strategy; Callaghan Innovation closed (ending an agency that had supported marine energy developments historically).

### PROJECTS

- **Wave energy at aquaculture sites:** Aquafarming Marine Energy Solutions New Zealand Ltd deployed and tested two wave energy device concepts at aquaculture farms, one self-floating and one designed to attach to floating aquafarming structures.
- **Mana Wairua Energy (MWE):** progressed the Ruka Marine Turbine prototype with final build targeted for 2026 subject to securing sufficient funding.
- **Azura Wave Power:** advanced a wave energy demonstration in Tahiti (led by Are Uira SAS) to validate the value of wave-generated electricity for the local grid; technical analysis is complete and the project is moving into the next development phase.
- **University “in-water” devices:** the University of Auckland Waves and Dynamics Research Group continued developing and ocean-testing wave-powered and tidal-powered environmental observation buoys.

# NORTH AMERICA



## Canada

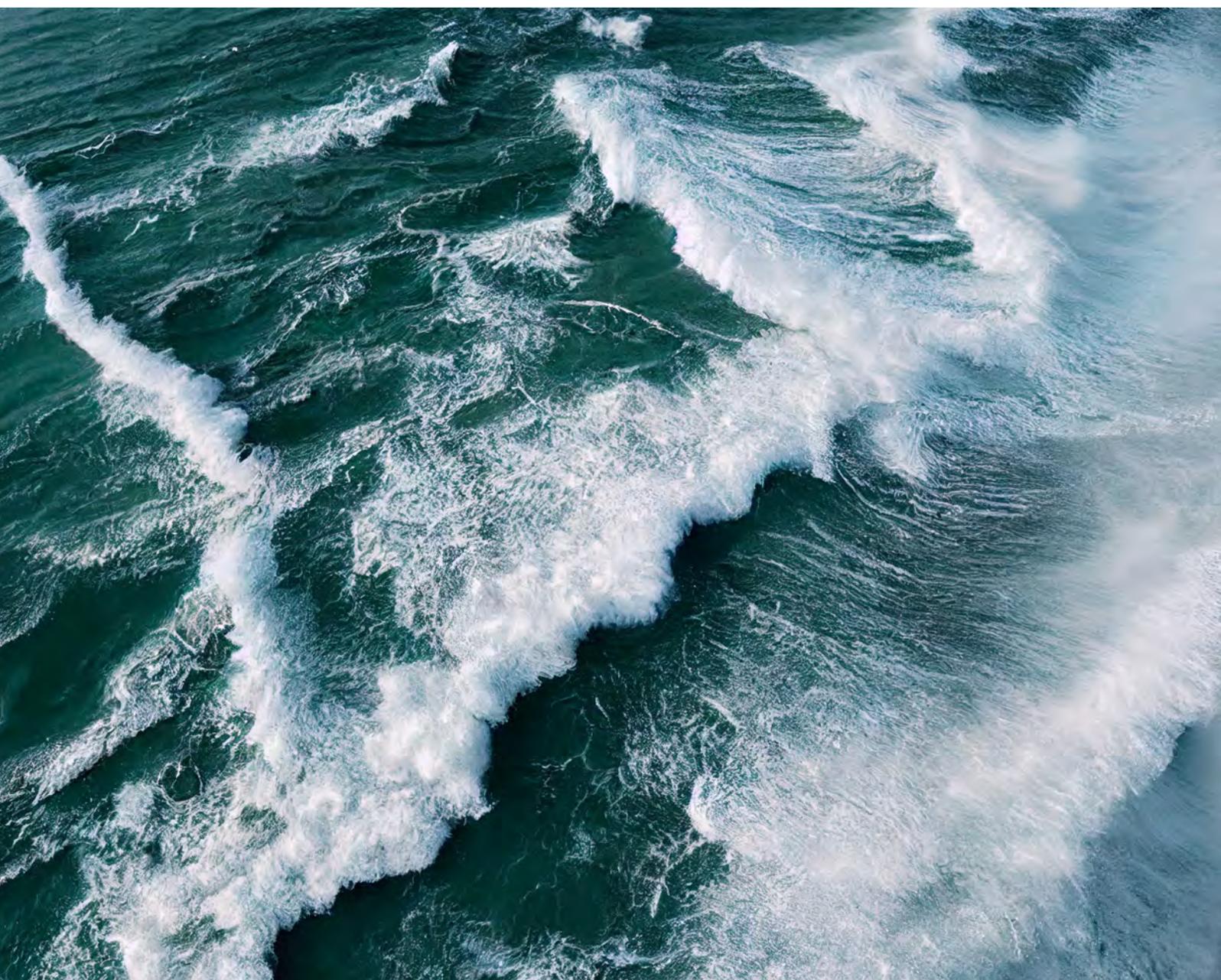
### POLICIES

- **New legal foundation for offshore renewables:** Bill C-49 was implemented in 2025, creating the legislative basis to regulate offshore renewables (including wind, wave and tidal) in the jointly managed Nova Scotia and Newfoundland & Labrador offshore areas, and renaming/expanding the offshore petroleum boards into offshore energy regulators
- **Faster federal approvals for major projects:** Bill C-5 created a Major Projects Office (in force June 2025) to streamline approvals for projects considered in the national interest, using a “one-window” approach.
- **Nova Scotia strengthened its offshore rules:** Bill 149 (“Powering the Offshore Act”) aimed to make offshore renewables easier to develop; for tidal, it allows licence merging to improve certainty and supports power purchase agreements.
- **Newfoundland & Labrador aligned laws:** Amendments proclaimed in June 2025 aligned provincial rules with the federal marine renewables framework, including updates on tenure, safety, environment, and regulator powers.
- **Investment incentives expanded:** Budget 2025 introduced and expanded measures that support investment and R&D, including commitments around clean electricity tax credits, and existing clean technology/manufacturing credits that can apply to wave and tidal.
- **More structured environmental oversight for tidal:** Tidal permitting and monitoring advanced under a staged, adaptive approach, linked to fisheries authorisations and supported by new funding for monitoring in the Bay of Fundy.
- **River energy mapping:** The National Research Council (NRC) released a high-resolution database to identify strong river hydrokinetic sites, supporting future in-water projects—especially relevant for remote, rural and Indigenous communities.

### PROJECTS

- **Canada’s test sites strengthened “deployment readiness” in 2025:** FORCE implemented a new independent governance model and awarded additional berths expanding the Bay of Fundy pipeline. Blind Channel advanced permitting and community consultation and completed major microgrid and subsea infrastructure.
- **ORPC:** advanced the Mackenzie River RivGen project (NWT) with ~C\$600k federal support and began October 2025 field measurements to prepare deployment and reduce diesel use; also supported river flow data campaigns (e.g., Yukon River).

- **Eauclaire Tidal & Orbital:** awarded 12.5 MW in Nova Scotia (two 15-year PPAs plus FORCE berth/grid rights) and received DFO approval for staged deployment of up to three O2-X turbines, progressing engineering, monitoring and financing.
- **New Energy Corporation:** secured a USACE prototype contract and advanced tidal demonstration planning in Canada (West Coast and Bay of Fundy), with further milestones expected in 2026.
- **Nova Innovation:** continued planning its 1.5 MW Petit Passage (Nova Scotia) tidal project, updating the design with newer technology.
- **Yourbrook Energy Systems:** advanced the Kamdis Tidal Power Demonstration (FEED study due 31 March 2026) with the Haida Nation for diesel reduction, and developed new deployment leads in BC and Labrador.



# Open Sea Test Sites

Around the world, test sites continued to prove their value as essential platforms to de-risk ocean energy technologies. Open-sea testing facilities play a critical role in accelerating progress by enabling trials across a range of Technology Readiness Levels (TRLs) and environmental conditions, and by providing practical services from prototype testing and performance evaluation to operational refinement and data collection in real sea states. Pioneered by institutions such as the European Marine Energy Centre (EMEC) in the UK, many of these facilities also offer experienced teams that can help developers navigate technical requirements and regulatory processes, easing the pathway from concept to commercial deployment.

## CANADA

TEST SITE NAME	LOCATION
Fundy Ocean Research Centre for Energy (FORCE)	Minas Passage, Bay of Fundy, Nova Scotia
Canadian Hydrokinetic Turbine Test Centre (CHTTC)	Winnipeg River, Manitoba

## USA

TEST SITE NAME	LOCATION
U.S. Navy Wave Energy Test Site	Kanohe Bay, Hawaii
Pacific Marine Energy Center PacWave North Site	Newport, Oregon
Pacific Marine Energy Center PacWave South Site	Newport, Oregon
Pacific Marine Energy Center Lake Washington	Seattle, Washington
Pacific Marine Energy Center Tanana River Hydrokinetic Test Site	Nenana, Alaska
Jennette's Pier Wave Energy Test Facility	Jennette's Pier, North Carolina
U.S. Army Corps of Engineers (USACE) Field Research Facility (FRF)	Duck, North Carolina
Center for Ocean Renewable Energy	Durham, New Hampshire
UMaine Offshore Intermediate Scale Test Site	Castine, Maine
UMaine Deepwater Offshore Renewable Energy Test Site	Monhegan Island, Maine
OTEC Test Site	Keahole Point, HI
Marine Renewable Energy Collaborative (MRECo) Bourne Tidal Test Site (BTTS)	Bourne, Massachusetts
Southeast National Renewable Energy Center - Ocean Current Test Facility	Boca Raton, Florida

## UNITED KINGDOM

TEST SITE NAME	LOCATION
European Marine Energy Centre (EMEC)	Orkney, Scotland
FaBTest	Falmouth Bay in Cornwall
Marine Energy Test Area (META)	Milford Haven Waterway in Pembrokeshire
Morlais Tidal Demonstration Zone	West Anglesey
Perpetuus Tidal Energy Centre (PTEC)	South Coast of the Isle of Wight

## IRELAND

TEST SITE NAME	LOCATION
Galway Bay Marine and Renewable Energy Test Site	Galway Bay
AMETS	Belmullet, Co. Mayo

## PORTUGAL

TEST SITE NAME	LOCATION
Viana do Castelo test site	Viana do Castelo
Aguçadora test site	Aguçadora

## SPAIN

TEST SITE NAME	LOCATION
BiMEP	Basque Country
Mutriku Wave Power Plant	Basque Country
Oceanic Platform of the Canary Islands (PLOCAN)	Canary Islands
Punta Langosteira Test Site	Galician coast

## MEXICO

TEST SITE NAME	LOCATION
Port El Sauzal	Ensenada, Baja California
Station Puerto Morelos	Puerto Morelos, Quintana Roo

## NETHERLANDS

TEST SITE NAME	LOCATION
REDstack	Afsluitdijk
Tidal test site Ameland	Ameland
Wave test site Texel	Texel

## SWEDEN

TEST SITE NAME	LOCATION
The Lysekil wave energy research test site	Lysekil

## DENMARK

TEST SITE NAME	LOCATION
DanWEC	Hanstholm
DanWEC NB	Nissum Bredning

## BELGIUM

TEST SITE NAME	LOCATION
Blue Accelerator	Port of Ostend

## FRANCE

TEST SITE NAME	LOCATION
SEM-REV, wave and floating offshore wind test-site	Le Croisic
SEENEOH estuarine and ¼ scale tidal site	Bordeaux
Paimpol-Brehat, tidal site	Bréhat
Sainte-Anne du Portzic, scaled wave and floating wind test-site	Brest

International coordination among test centres is increasingly important to maximise learning. Networks such as International WaTERS provide a valuable forum for exchange between test sites, helping to share operational experience, harmonise approaches where possible, and strengthen collaboration on common challenges such as infrastructure needs, monitoring requirements and “balance of plant” issues. By connecting facilities across countries, the International WaTERS network helps amplify the collective impact of test sites and supports a more coherent global pathway for ocean energy technology development and demonstration. IEA-OES recognises the key role of International WaTERS in strengthening collaboration and knowledge exchange among ocean energy test sites worldwide.

## JAPAN

TEST SITE NAME	LOCATION
NAGASAKI-AMEC (Kabashima) floating wind Site	Goto, Nagasaki
NAGASAKI-AMEC (Naru) Tidal Site	Goto, Nagasaki
NAGASAKI-AMEC (Enoshima •Hirashima) Tidal Site	Saikai, Nagasaki

## CHINA

TEST SITE NAME	LOCATION
National Marine Test Site (Weihai)	Weihai, Shandong Province
National Marine Test Site (Zhoushan)	Zhoushan, Zhejiang Province
National Marine Test Site (Zhuhai)	Zhuhai, Guangdong Province

## REPUBLIC OF KOREA

TEST SITE NAME	LOCATION
KRISO-WETS (KRISO-Wave Energy Test Site)	Jeju
Korea Tidal Current Energy Centre (KTEC)	Jindo

## SINGAPORE

TEST SITE NAME	LOCATION
Sentosa Tidal Test Site	Sentosa island

# 01

## Overview of OES



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**The International Energy Agency’s (IEA) Ocean Energy Systems (OES) Technology Collaboration Programme is an intergovernmental collaboration between countries, to advance research, development and demonstration of technologies to harness energy from all forms of ocean renewable resources for electricity generation, as well as for other uses, such as desalination, through international co-operation and information exchange.**

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IEA-OES embraces the full range of ocean energy technologies:

- **Waves**, created by the action of wind passing over the surface of the ocean;
- **Tidal Range** (tidal rise and fall), derived from the gravitational forces of the Earth-Moon-Sun system;
- **Tidal Currents**, water flow resulting from the filling and emptying of coastal regions as a result of the tidal rise and fall;
- **Ocean Currents**, derived from wind-driven and thermohaline ocean circulation;
- **Ocean Thermal Energy Conversion (OTEC)**, derived from temperature differences between solar energy stored as heat in upper ocean layers and colder seawater, generally below 1000 m;
- **Salinity Gradients**, derived from salinity differences between fresh and ocean water at river mouths.

Offshore wind, marine biomass or submarine geothermal, which occupy sea space but do not directly utilize the properties of seawater, are not included in the IEA-OES remit.

Most ocean energy technologies are being developed to produce electricity, although some of them are being developed to deliver other or multiple products, derived from the physical and chemical properties of seawater (e.g. fresh water and sea water air conditioning).

## Vision

“As the **authoritative international voice on ocean energy**, we collaborate internationally to accelerate the viability, uptake and acceptance of ocean energy systems in an environmentally sustainable manner”.

## Mission

The OES mission is to support a framework of activities that:

- **Stimulate** research, development and deployment of Ocean Energy Systems in a manner that is beneficial for the environment and provides an economic return for those involved.
- **Support** governments, agencies, corporations and individuals in the development and deployment of Ocean Energy Systems.
- **Educate** people globally on the nature of Ocean Energy Systems, the current status on development and deployment, and the beneficial impacts of such systems, improve skills and enhance research.
- **Connect** with organisations and individuals working in the ocean energy sector for knowledge exchange to accelerate development and enhance economic and environmental outcomes.

## 1 Stimulate research, development and deployment

**Objective: Stimulate collaborative work between OES country members to address challenges faced by the ocean energy sector avoiding duplication**

- Foster and secure a strong commitment from all member countries and stimulate the participation of new countries in the OES to strengthen international collaboration and enhance OES's outreach worldwide.
- Continue to support and set up OES working groups on specific topics (wave and tidal modelling and OTEC development) with increased input from stakeholders (industry, government and research).
- Continue to work on developing strategic tasks such as LCOE, environmental issues, jobs creation and market opportunities.

## 2 Support governments, agencies, corporations and individuals in the development and deployment of Ocean Energy Systems

**Objective: Enhance the impact of OES's work and remain the primary source worldwide of high-quality information**

- Develop shared key messages (e.g. via position papers and policy briefs), incorporating outcomes of technology improvements and environmental integration.
- Stimulate policymakers regarding the social, environmental and economic benefits of ocean energy, and stress that government policies remain crucial to attract investment.
- Collect and share recent research, market, policy and technological updates, in ocean energy developments in OES Member countries.
- Provide valuable inputs to the REWP and the IEA network; contribute to relevant IEA publications, events and other initiatives.

## 3 Educate people globally on the nature of Ocean Energy Systems

**Objective: Provide a platform for information exchange and discussion to increase awareness and understanding of the potential and benefits of ocean energy**

- Collect and analyse information from country members on projects (WebGis Database), policies, consenting processes, capacity outlook, etc.
- Discuss and analyze good practices to achieve successful and cost-effective wide-scale deployment of ocean energy technologies, for utility-scale as well as niche markets, on a multi-country approach.
- Shaping the international discussion and continuing the series of public webinars/workshops and presence in international events; stimulate the participation of delegates in national events to spread OES activities worldwide.
- Highlight to stakeholders important developments, accomplishments in the ocean energy sector; provide relevant information and advice on ocean energy technologies and policies, from R&D to market deployment.

## 4 Connect with organisations and individuals and exchange information

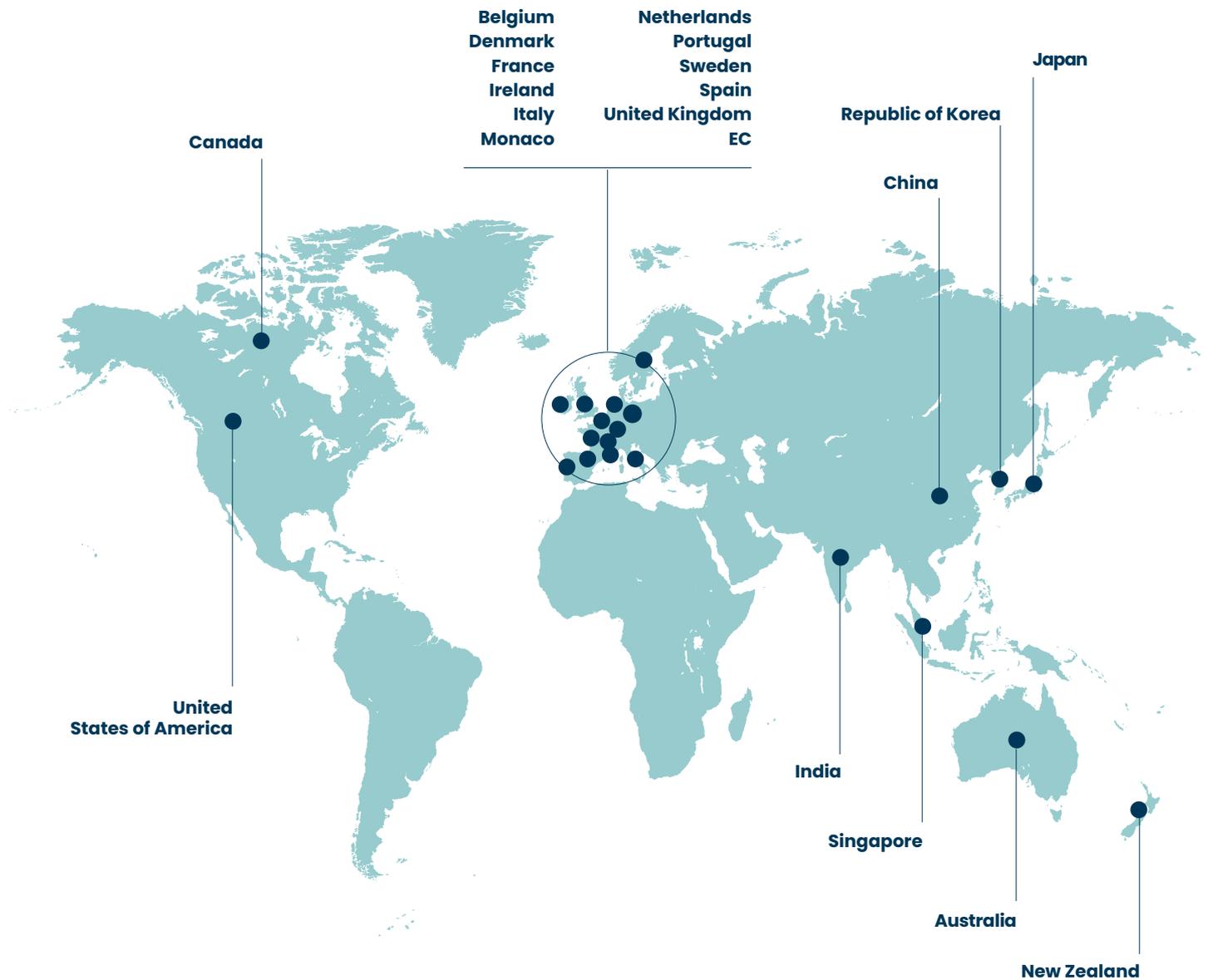
**Objective: Enhance cooperation with stakeholders and international organizations to share expertise and pool resources**

- Expand interaction with research and industry in specific OES tasks.
- Increase cooperation with other TCPs to identify opportunities for knowledge transfer and joint tasks: address synergies, gaps and cross-cutting issues.
- Collaborate with international organizations, in particular, the International Renewable Energy Agency (IRENA), the World Ocean Council (WOC), the International Standards on Ocean Energy (IEC TC114), and support other multilateral initiatives engaged with ocean energy technologies such as International Network of Ocean Renewable Energy (INORE) a network of young researchers whose main focus is on offshore renewables.
- Continue to lead and host the International Conference for Ocean Energy (ICOE) series.

# Membership

The International Energy Agency (IEA) Technology Collaboration Programme on Ocean Energy Systems (OES) was initiated by three countries in 2001 and has been growing steadily. As of December 2025, 21 Member Countries<sup>1</sup> and the European Commission are members of the OES.

National governments appoint a Contracting Party to represent the country in the Executive Committee (ExCo). The Contracting Party can be a government ministry or agency, a research institute or university, an industry association or even a private company. Governments also nominate alternates, who may represent the government at ExCo meetings, if the nominated representative is unavailable. Consequently, there is a diversified representation of interests in the ExCo, which is seen as a key strength of the organization.



## Contracting Parties

YEAR OF SIGNATURE	COUNTRY	CONTRACTING PARTY
2001	<b>Portugal</b>	Instituto Superior Técnico (IST)
	<b>Denmark</b>	Ministry of Transport and Energy, Danish Energy Authority
	<b>United Kingdom</b>	Department of Energy and Climate Change (DECC)
2002	<b>Japan</b>	Saga University
	<b>Ireland</b>	Sustainable Energy Authority of Ireland (SEAI)
2003	<b>Canada</b>	Natural Resources Canada
2005	<b>United States of America</b>	United States Department of Energy (DOE)
2006	<b>Belgium</b>	Federal Public Service Economy
2007	Mexico	The Government of Mexico (non-active member)
2008	<b>Spain</b>	TECNALIA
	<b>Italy</b>	Gestore dei Servizi Energetici (GSE)
	<b>New Zealand</b>	Aotearoa Wave and Tidal Energy Association (AWATEA)
	<b>Sweden</b>	Swedish Energy Agency
2010	<b>Republic of Korea</b>	Ministry of Oceans and Fisheries
2011	<b>China</b>	National Ocean Technology Centre (NOTC)
2013	<b>Monaco</b>	Government of the Principality of Monaco
2014	<b>Singapore</b>	Nanyang Technological University
	<b>The Netherlands</b>	Netherlands Enterprise Agency
2016	<b>India</b>	National Ocean Technology Institute (NIOT)
	<b>France</b>	France Energies Marines
	<b>European Commission</b>	European Commission
2018	<b>Australia</b>	Blue Economy CRC

# Executive Committee

The IEA-OES work programme is managed by an Executive Committee (ExCo), which is responsible for overseeing ongoing projects and identifying new strategic areas for collaborative research. The ExCo comprises representatives from each participating country or organization, with a list of members provided in Appendix 1. The committee meets biannually to make decisions on management and discuss implementation aspects of the work programme.

To support general administrative and communication matters, all Contracting Parties contribute annually to the OES Common Fund. This fund may also be used to facilitate coordination of ongoing R&D projects, launch new initiatives, organize workshops on prioritized topics, and commission studies or reports. However, it does not cover the costs of direct R&D activities; research should be funded by participants involved in a specific task. The annual membership fee is USD 7,805.00.

The day-to-day decision-making to implement the annual Work Programme is managed by the Cabinet. In 2025, Dr Purnima Jalihal stepped down from the Executive Committee and vice-chair position, following her retirement. In October 2025 ExCo meeting, a new Vice-Chair, Dr Srikanth Narasimalu from Nanyang Technological University (NTU), was elected. The cabinet is now formed by:

- **Chair:** Matthijs Soede, European Commission
- **Vice-Chair:** Purnima Jalihal, India
- **Vice-Chair:** Srikanth Narasimalu, Singapore
- **Vice-Chair:** Tim Ramsey, USA
- **Secretariat:** Ana Brito Melo, Portugal

The ExCo Secretariat, managed by WavEC Offshore Renewables, is located in Lisbon, Portugal. The common fund account holder is, since October 2024, the National Laboratory of the Rockies (NLR) (formerly the National Renewable Energy Laboratory, NREL)

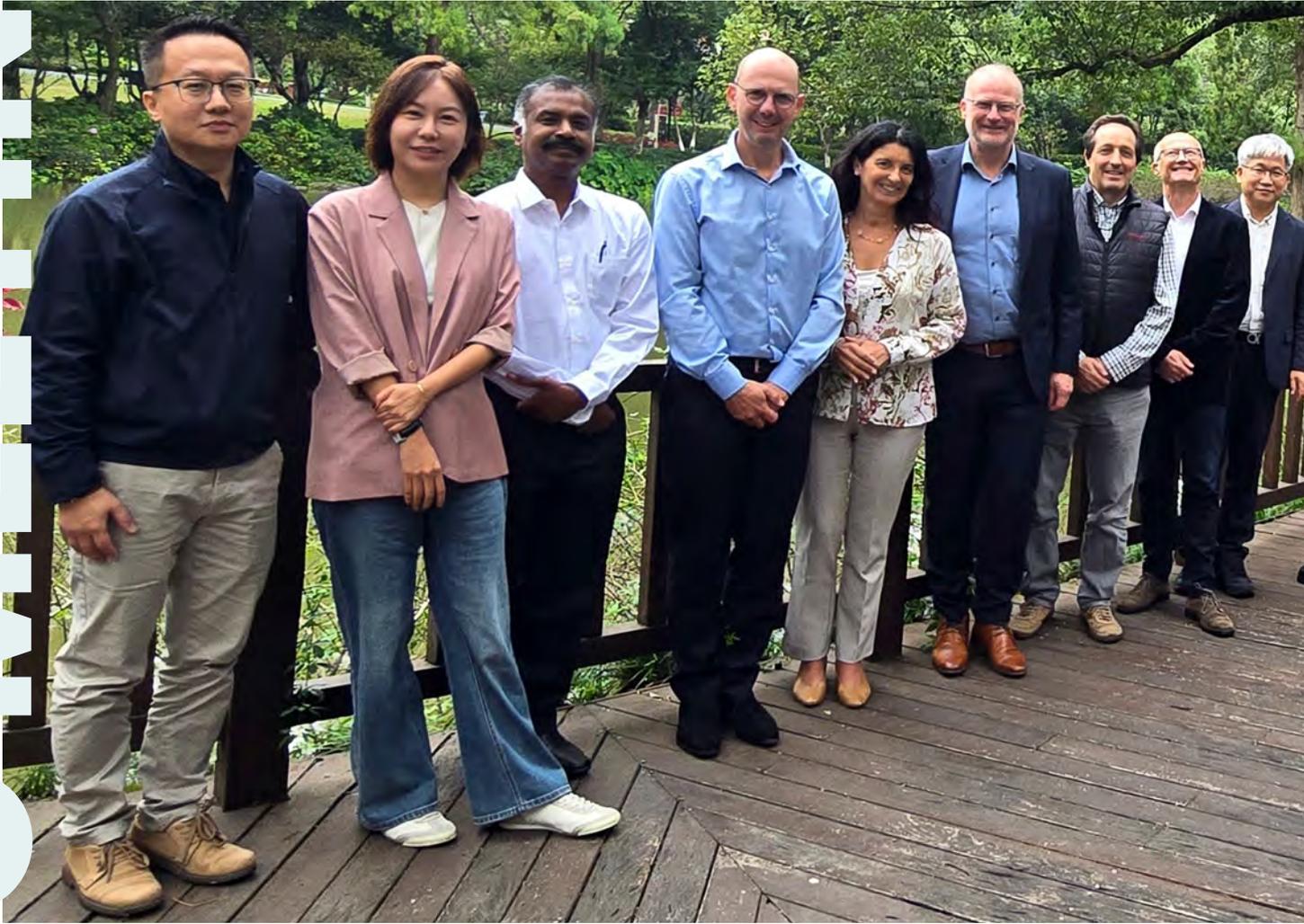
In 2025, the following ExCo meetings occurred:

- The **51st ExCo meeting** was held virtually in two sessions on March 12-13, 2025, with 24 participants.
- The **52nd ExCo meeting** was held in Hangzhou, China, on October 20-21, attended by 18 participants.

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The IEA-OES work programme is managed by an Executive Committee (ExCo), which is responsible for overseeing ongoing projects and identifying new strategic areas for collaborative research.

# 52ND EXCO MEETING



Following the ExCo meeting in China, delegates participated in a technical workshop organised by the National Ocean Technology Center (NOTC), which provided a very good overview into China's developments in ocean energy projects led by companies and universities. The meeting concluded with a technical site visit to the LHD Tidal Current Power Generation Station in Zhoushan, warmly hosted by LHD, whose team provided valuable insights into the project and shared their operational experience and lessons learned.



↑  
52nd ExCo meeting was held in Hangzhou, China, on October 20-21

→  
Workshop

→→  
Technical visit to the LHD Tidal Current Power Generation Station in Zhoushan



# Work Programme

The collaborative research work carried out by the OES is organized into specific projects using two distinct approaches:

- **Large Projects:** These are conducted by a group of countries interested in a particular topic, with only participants in the project contributing. When three or more contracting parties support a proposal and sufficient funding is raised, a new research project can be initiated. One of the proposing parties typically becomes the Operating Agent, responsible for managing the project and its budget. Participation by ExCo members is voluntary, and is typically based on cost-sharing, task-sharing, or both.
- **Small Projects:** These projects are of interest to all members and are usually funded by the Common Fund, ensuring equal contribution from all members. Typically, an interested volunteer member prepares the Terms of Reference for any proposed task. Delegates are then invited to bid for participation, and applications are evaluated by a sub-committee of 3-4 voluntary ExCo members. The work is carried out by a group of members through cost- and task-sharing, and may also include external experts.

At present, the following projects have been initiated:

## Work Programme

TASK NO.	TITLE	LEAD BY	STATUS
1	Review, Exchange and Dissemination of Information on Ocean Energy Systems	Portugal	Active
2	Development of Recommended Practices for Testing and Evaluating Ocean Energy Systems	Denmark	Completed
3	Integration of Ocean Energy Plants into Distribution and Transmission Electrical Grids	Canada	Completed
4	Assessment of Environmental Effects and Monitoring Efforts for Ocean Wave, Tidal and Current Energy Systems	United States	Active
5	The Exchange and Assessment of Ocean Energy Device Project Information and Experience	United States	Completed
6	Worldwide Web GIS Database for Ocean Energy	United Sates	Active
7	Cost of Energy Assessment for Wave, Tidal, and OTEC at an International Level	UK	Completed
8	Consenting Processes for Ocean Energy on Member Countries	The Cabinet	Active
9	International Ocean Energy Technology Roadmap	The Cabinet	Active
10	Wave Energy Converters Modelling Verification and Validation	Denmark	Active
11	Investigation and Evaluation of OTEC Resource	Japan	Active
12	Stage Gate Metrics International Framework for Ocean Energy	European Commission	Active
13	Tidal Energy Converters Modelling Verification and Validation	Singapore	Active
14	Ocean Energy Jobs Creation: Methodological Study and First Global Assessment	France	Completed
15	Alternative Markets on Ocean Energy	The Cabinet	Active

## Interaction with IEA

The **IEA Governing Board** holds the governance of the International Energy Agency (IEA). It is supported by several Standing Committees that are made up of member country government officials.

The **Committee on Energy Research and Technology (CERT)** coordinates and promotes the development, demonstration and deployment of technologies to meet challenges within the energy sector. The CERT has established four working parties:

- Working Party on Fossil Energy;
- Working Party on Renewable Energy Technologies;
- Working Party on Energy End-Use Technologies;
- Fusion Power Co-ordinating Committee.

The IEA-OES is part of the Working Party on Renewable Energy Technologies (REWP). In 2025, IEA-OES participated in the 87th REWP meeting, Monday 31 March - 01 April 2025.

IEA-OES also participated in the IEA Technology Collaboration Programme (TCP) Universal Meeting, contributing to cross-TCP exchange within the wider IEA community.

In 2025, IEA-OES contributed to the review of the ocean energy data to the *IEA Clean Energy Demonstration Projects Database*, supporting the inclusion and visibility of ocean energy technologies within this global IEA data platform: <https://www.iea.org/data-and-statistics/data-tools/clean-energy-demonstration-projects-database>

IEA-OES also contributed to the peer review of the IEA's *State of Energy Innovation 2025*, published in April 2025: <https://www.iea.org/reports/the-state-of-energy-innovation-2025>

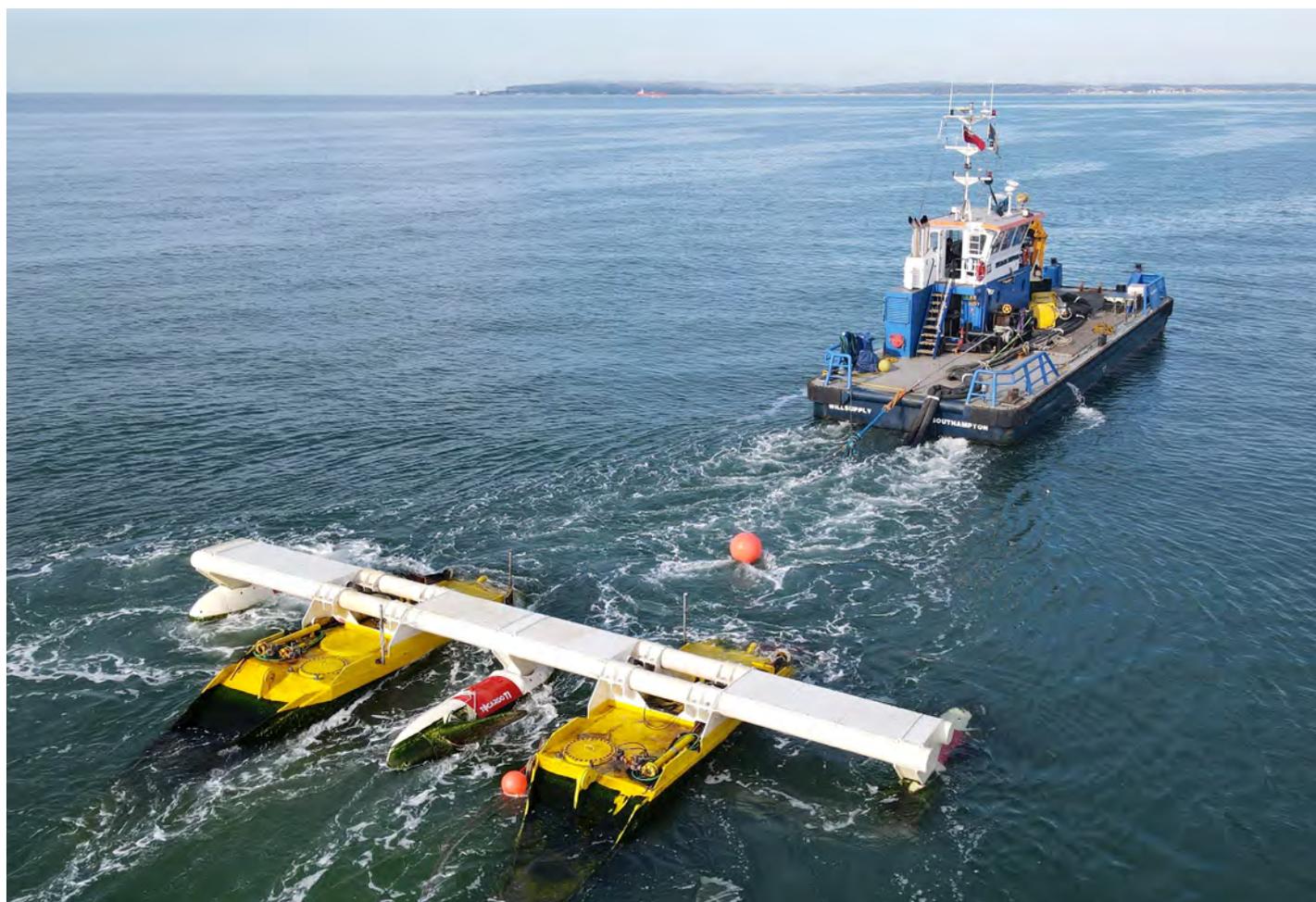


Image courtesy of QED Naval

# 02

## Communication and Dissemination

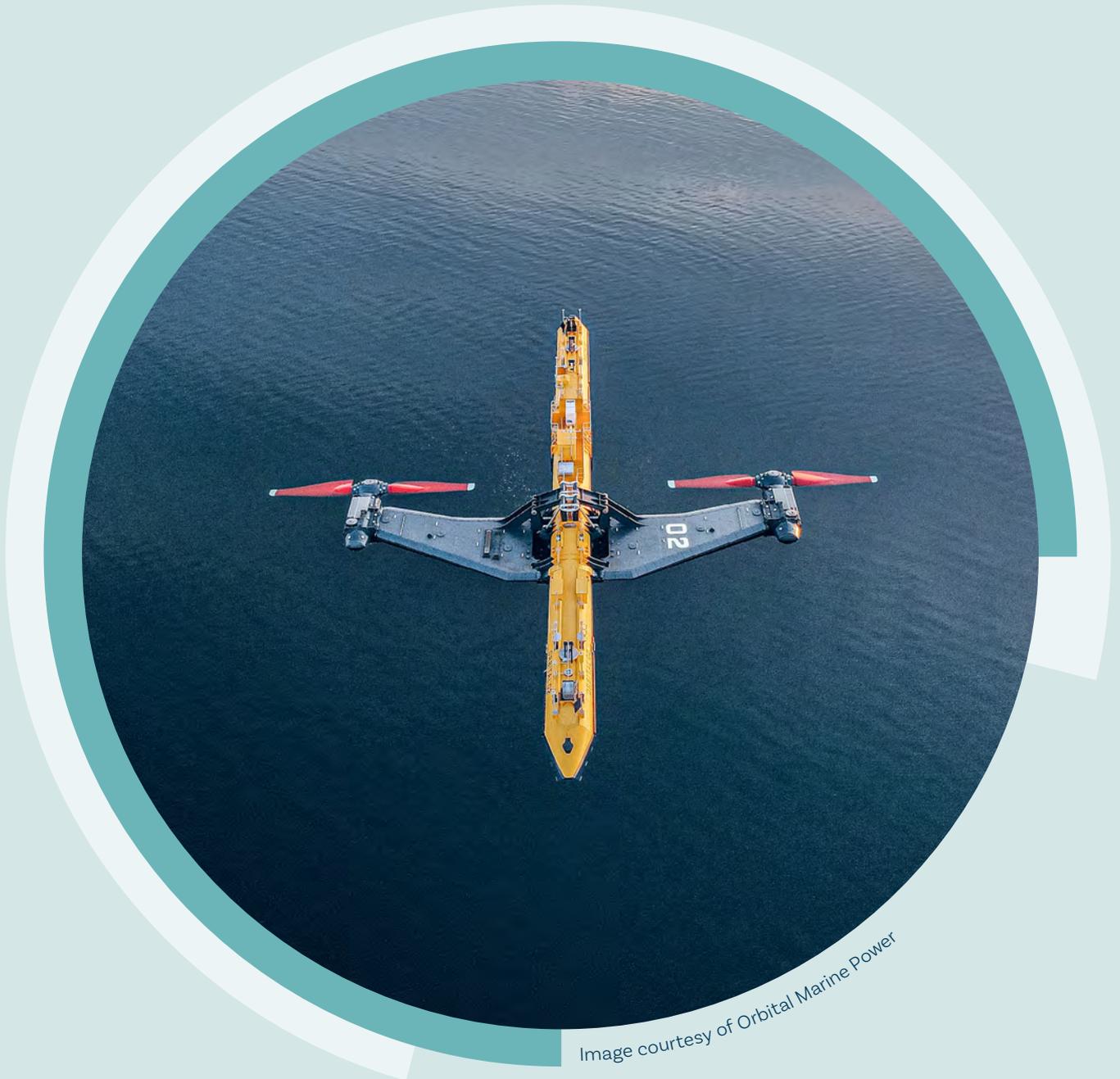


Image courtesy of Orbital Marine Power

# Overview

In 2025, IEA-OES continued its long-standing Task on the review, exchange and dissemination of information on ocean energy systems. This ongoing Task remains a core activity of the programme, supporting international knowledge sharing on the technical, environmental, economic and policy aspects of ocean energy. This Task aims to ensure that reliable, up-to-date information on ocean energy developments is accessible to policymakers, researchers, industry and other stakeholders, reinforcing the role of IEA-OES as a trusted global reference for ocean energy knowledge.

In 2025, communication and dissemination activities continued to ensure visibility of IEA-OES work, while a significant share of effort was directed towards preparing two major deliverables for 2026:

the 25th anniversary of IEA-OES and the next five-year Strategic Plan. Communication support focused on developing content to accompany these initiatives, alongside the ongoing promotion of programme activities and outputs.

Throughout the year, IEA-OES news, publications and event participation were shared primarily through the website, which remains the central platform for disseminating official information, and through regular updates on LinkedIn to reach a wider professional audience. In parallel, IEA-OES participated in several international events and strengthened collaboration with a number of external initiatives, which are presented in the following section, helping to extend the programme's reach and maintain active engagement with the wider ocean energy community.

## January

**Annual briefing** to the IEA presenting the latest IEA-OES achievements

## February

Publication of the **IEA-OES Annual Report 2024**

## March

**OES Participation** in ISAMRE 2025, Chennai (organised by NIOT)

51st **Executive Committee Meeting**

## August

**OES Participation** in the Blue Economy Forum, Mexico

## June

**OES Participation** in the *One Ocean Science Congress*, Nice, France

## May

Publication of ***Ocean Energy – Perspectives on Progress***

## September

**OES Plenary** session presentation at EWTEC 2025

Publication of an **IEA-OES paper** in the EWTEC conference proceedings

**Participation and Sponsorship** of *International WaTERS Workshop*

## October

52nd **Executive Committee Meeting** in China

**Participation in the Workshop** organised by the China National Ocean Technology Center (NOTC)

**Site visit** to the LHD Tidal Current Power Generation Station

## November

Engagement with International WaTERS: **Summary of Findings and Lessons Learned** prepared by EMEC (publication forthcoming)

## December

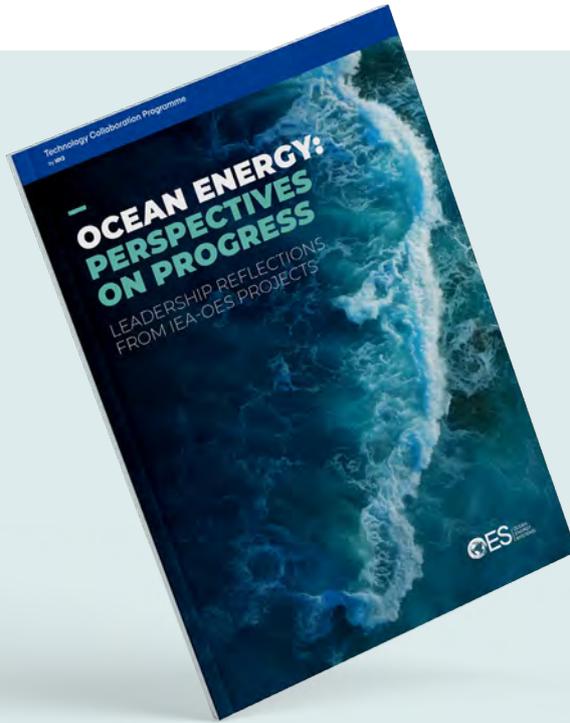
Preparation of the **IEA-OES 5-year Strategic Plan** (to be released in 2026)

# Key Publications and Events

## Publication of a Series of Interviews

The publication *Ocean Energy: Perspectives on Progress* highlights the impact of IEA-OES activities across environmental, technical, policy and communication domains. It gives voice to the experts directly responsible for delivering OES Tasks. The publication highlights the IEA-OES impact: OES-Environmental is now a global reference for environmental assessment through the Risk Retirement Framework, Tethys and the evolving State of the Science work. It also shows how the Evaluation and Guidance Framework is helping structure

innovation support and improve alignment among public funders. Progress in wave and tidal numerical modelling demonstrates the value of international benchmarking to reduce uncertainty. The publication further reflects IEA-OES's sustained role in maintaining momentum on OTEC, while noting persistent cost and funding barriers, and it reinforces the need to align technology push and market pull policies under a shared international vision supported by strong communication and knowledge sharing.



## Participation in International Events

In 2025, IEA-OES delivered presentations and actively contributed to a range of international events, strengthening the visibility of ocean energy and promoting international collaboration:

- **One Ocean Science Congress** – Nice, France, 3–6 June 2025
- **ISAMRE 2025** organized by NIOT – Chennai, 18–19 March
- **3rd International Forum on the Blue Economy and Growth** – Mexico, 20 August
- **EWTEC** – 7–11 September
- **International Waters Workshop** – 4 September 2025

### One Ocean Science Congress United Nations Ocean Conference 2025

IEA-OES participated in the One Ocean Science Congress, held in Nice, France, from 4–6 June 2025, as a Special Event of the 3rd United Nations Ocean Conference. Organised by CNRS and IFREMER and endorsed by the United Nations Decade of Ocean Science for Sustainable Development. The event focused on advancing ocean science and highlighting the role of the ocean in addressing global challenges such as climate change, sustainability and biodiversity protection.

IEA-OES contributed to the panel session “*Blue Energy: Global and Local Pathways for Ocean Energy Innovation*”, organised by Costa Rica. During this intervention, IEA-OES presented its role in advancing international cooperation on ocean energy, highlighting the programme’s ongoing Tasks and its contribution to knowledge sharing, policy development and technology progress. This was an opportunity to position ocean energy within broader ocean and climate discussions at United Nations level and to raise visibility of IEA-OES activities within the global ocean science and policy community.



### 3rd International Forum on the Blue Economy and Growth

IEA-OES was represented at the 3rd International Forum on the Blue Economy and Growth (FIECA), held at Anáhuac University in Cancún, Quintana Roo (Mexico), on 20–22 August 2025. The forum convened government bodies, research organisations, industry and civil society around a broad blue economy agenda, covering themes such as sustainable fisheries and aquaculture, ecological restoration, maritime transport, ocean diplomacy, blue finance and technological innovation. IEA-OES visibility was ensured through a keynote intervention by Dr Michael Law-





EWTEC 2025, Plenary Session, 8 September 2025

son (U.S. NLR), Delegate of the United States to the IEA-OES Executive Committee, delivered under the thematic axis on hydrocarbon extraction and mining and their implications, contributing an ocean energy perspective to wider discussions on ocean governance and sustainable development.

### European Wave and Tidal Energy Conference (EWTEC) 2025

IEA-OES participated in the European Wave and Tidal Energy Conference (EWTEC) 2025, held in September in Madeira, Portugal, one of the leading scientific conferences dedicated to wave and tidal energy research. The conference was attended by around 350 participants, from the research community, with strong international representation beyond Europe.

As part of the programme, IEA-OES presented a paper co-authored with the Operating Agents of its Tasks, highlighting the role of the programme in supporting technology development, environmental sustainability, policy frameworks and international collaboration in ocean energy. This was an opportunity to engage directly with researchers, raise awareness of recent IEA-OES publications and initiatives. In addition, two IEA-OES side workshops were organised during the week, focusing on wave energy numerical modelling (Task 10) and environmental acceptability under OES-Environmental, both of which were well attended.

### International WaTERS Workshop

IEA-OES supported and participated in the International WaTERS Workshop, held in Madeira and co-organised by EMEC, prior to the EWTEC. The workshop was attended by 29 representatives from 18 ocean energy test sites across 10 countries, providing a dedicated forum for exchange among facilities supporting the testing and demonstration of ocean energy technologies. The programme of this event included updates from participating test sites, a thematic session on balance of plant considerations, and breakout discussions addressing organisational challenges, technical priorities and the future of the International WaTERS network. A key outcome of the discussions was the exploration of closer alignment between International WaTERS and IEA-OES, with a view to strengthening coordination, visibility and long-term stability for the network while reinforcing the OES mission to support global ocean energy development.



International WATERS Workshop, 5 September 2025

# Collaboration with International Initiatives

IEA-OES continued its long-standing support to the **International Network on Offshore Renewable Energy (INORE)** in 2025. INORE is a global network of graduate students, postdoctoral researchers and early-career professionals working on offshore renewable energy. Established by early-stage researchers, the network promotes international collaboration, knowledge exchange and professional development through seminars, workshops, symposia and networking activities.

In 2025, IEA-OES supported the OES-Blue Energy Collaborative Scholarships (OES-BECS) call for applications, providing targeted financial support to enable collaborative research among INORE members. The OES-BECS grants support research expenses and mobility costs, facilitating access to specialised facilities, international research visits and the presentation of joint work at conferences.

IEA-OES also sponsored the two key INORE events in 2025: the North American Symposium held in Boston, USA, June 2025, and the European Symposium held in Aalborg, Denmark, September 2025.

**SIDS DOCK** is a United Nations (UN) - recognised international organisation established in 2015, addressing climate change, resilience, and energy security in small islands. SIDS DOCK represents 32 small islands and low-lying developing states across the globe. It is so named because it is designed as a “DOCKing station,” to connect the energy sector in SIDS with the global markets for finance and sustainable energy technologies. SIDS Dock is Observer of the OES.

IEA-OES has a formal liaison with the **International Electrotechnical Commission (IEC) Technical Committee (TC) 114, Marine Energy - Wave and Tidal Energy Converters**. IEC-TC 114 aims to develop international standards for wave and tidal energy technologies. A number of ExCo members serve as project leaders or participants in some of the TC114 working groups, providing technical information for future standards.

The **International Conference on Ocean Energy (ICOE)** is the flagship global conference of IEA-OES, held every two years to provide an international perspective on progress in ocean energy. IEA-OES leads the process of selecting the host and works to ensure the event remains a truly global meeting point for professionals, researchers and policymakers focused on wave, tidal and ocean currents, ocean thermal energy conversion (OTEC) and salinity gradient technologies. ICOE is recognised as an important platform for knowledge exchange, networking and dialogue on emerging trends, and it helps shape the policy and market discussions that will influence the sector’s development.

The next edition, ICOE-OEE 2026, will be hosted jointly by Ocean Energy Europe (OEE) and the Dutch Energy from Water Association (EWA) in The Hague, the Netherlands, on 5-7 October 2026, combining ICOE with OEE’s annual conference. Key outcomes from the previous edition are captured in the publication **ICOE 2024 Key Takeaways**.



# 03

## Key Task Achievements



Image courtesy of Corpower Ocean

# OES Environmental

## Coordinator

### Samantha Eaves

US Department of Energy (DOE)  
Allegheny Science & Technology

## Partners

Bureau of Ocean Energy Management (US)  
National Oceanic and Atmospheric  
Administration (US)

## Technical Consultants

### Andrea Copping and Lysel Garavelli

Pacific Northwest National Laboratory

## Project Duration

Phase I: 2010 - 2013

Phase II: 2013 - 2016

Phase III: 2016 - 2020

Phase IV: 2021 - 2024

Phase V: 2025 - 2028

## Introduction

Phase 5 of OES-Environmental was authorized in September 2024 by the IEA-OES Executive Committee, officially started in October 2024, and will continue through 2028.

The major accomplishments of OES-Environmental during 2025 included:

- Developing and disseminating outreach materials to share the findings of the *2024 State of the Science Report* on environmental effects of marine renewable energy (MRE) around the world. The *2024 State of the Science Report* was released at the International Conference of Ocean Energy (ICOE) in September 2024.
- Expanding the knowledge base on the environmental effects of MRE for the MRE community through ongoing information collection and curation of the scientific literature that is stored and made accessible through [Tethys](#).
- Using Tethys as the platform to collect, curate, and disseminate data and information collected on marine energy developments and research projects, including the OES-Environmental “[metadata forms](#)”.
- Continued work on the risk retirement process and resources that included updates to all existing stressor-receptor interaction evidence bases, the creation of a new evidence base for the displacement interaction, and the development, socialization, and finalization of the [Best Management Practices \(BMPs\) for Risk Retirement](#).
- Initiating the assessment of the environmental acceptability of MRE devices and beginning to develop the approach.

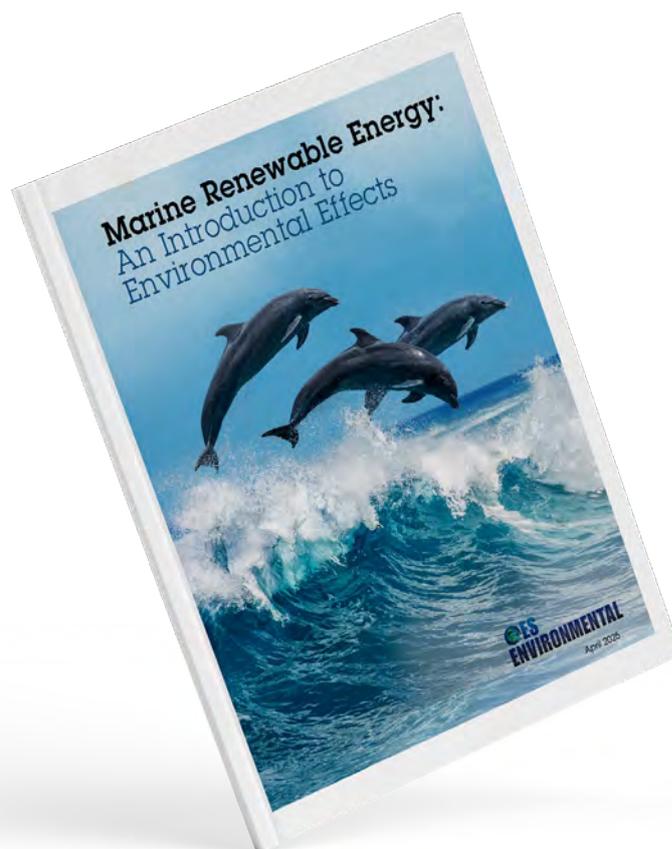
- Developing use cases to better understand the environmental effects of off-grid MRE applications.
- Continuing the assessment of system-wide environmental effects of MRE, including effects of scaling up from single devices to arrays, cumulative effects of MRE, and ecosystem effects of MRE.
- Analyzing the information available on the environmental effects of MRE in tropical and subtropical ecosystems.
- Convening an expert working group that includes OES-Environmental country analysts and international experts to investigate the link between the social and economic effects and environmental effects of MRE.
- Continuing outreach and engagement to the MRE community through workshops, webinars, conferences, and online materials with particular emphasis on regulators, advisors, MRE device developers, and researchers.

Fifteen nations are currently participating in Phase 5 of OES-Environmental: Australia, Canada, China, Denmark, France, India, Ireland, Japan, South Korea, Portugal, Singapore, Spain, Sweden, the United Kingdom, and the United States (US), as well as the European Commission. The US continues to lead the initiative, with Pacific Northwest National Laboratory (PNNL), one of the Department of Energy's national laboratories, serving as the Operating Agent and implementing the project.

This report describes the accomplishments of OES-Environmental in 2025 in more detail.

## 2024 State of the Science Report

In 2025, an outreach campaign was carried out to share the findings of the *2024 State of the Science* report to increase the visibility and reach of the report to existing audiences (MRE regulators, advisors, developers, researchers), STEM (Science, Technology, Engineering, and Mathematics) students (kindergarten through graduate school) and teachers, and the general public. To communicate key findings of the report and provide audiences with an overview of Phase 5 of OES-Environmental, a [Tethys Story](#) was developed and published. The [Marine Renewable Energy: An Introduction to Environmental Effects brochure](#) was updated with information contained in the *2024 State of the Science* report. The updated brochure familiarizes readers with MRE, the



most up-to-date scientific information around potential environmental effects, and the level of risk presented by each stressor-receptor interaction for small numbers of devices (one to six). The updated brochure is available on the [educational resources Tethys page](#) and was supplied to new regulators in many of the OES-Environmental nations.

## Working with OES-Environmental Analysts

During 2025, PNNL continued to organize and lead meetings with the OES-Environmental country analysts to coordinate cooperative work, approximately every three months. These meetings aim to discuss current OES-Environmental activities, receive input and feedback from OES-Environmental country analysts on these activities, and provide an opportunity to learn about current MRE development in each country. Each country analyst is asked to present updates on MRE development and environmental research in their respective countries and regions once every two years.

As part of their work with OES-Environmental, each nation's analyst continually shares information

within their country, including introducing Tethys, gathering content for Tethys, and providing contacts with organizations in their country to identify relevant monitoring, data collection, research funding, and implementation activities. These activities set each analyst up as the ambassador for OES-Environmental within their country. The OES-Environmental analysts reach out to colleagues in their respective fields to initiate investigations into key areas of environmental effects that will assist the MRE industry or OES-Environmental work.

During 2025, the country analysts were involved in the development and review of [regulator surveys](#), which were initially deployed in 2017-2021. In collaboration with analysts, the survey questions were updated to align with the current regulatory context in Australia, Canada, France, Ireland, Portugal, Spain, the United Kingdom, and the United States. Additionally, the survey was translated into Spanish and Portuguese. In 2025, surveys were completed in Australia, Canada, Ireland, the United Kingdom, and the US, with those in other OES-Environmental countries to follow.

## Metadata on MRE projects and research studies

During 2025, OES-Environmental, with support from Aquatera Limited and the country analysts, continued to collect and update information on new wave, tidal, and other MRE technology projects, as well as ongoing research studies, stored as [metadata forms](#) on Tethys. Existing metadata forms are updated annually by working with the country analysts, developers, and researchers. As of November 12, 2025, there are 208 metadata forms – 154 project sites and 61 research studies on Tethys. Of the 213 forms, 143 no longer require updates – 89 project sites and 64 research studies (the projects were completed, never deployed, no longer in the water, or canceled; research studies were completed). In 2025, 43 forms were updated. The metadata forms continue to link into the [Monitoring Datasets Discoverability Matrix](#), an interactive tool that classifies monitoring datasets from already permitted/consented projects, analogous industries, and research studies, for six key environmental stressors. The forms are also highlighted in the [Management Measures Tool](#), OES-Environmental's online tool to find management or mitigation measures used in past or current MRE projects.

## Dissemination of information on environmental effects

Ongoing work to collect, curate, and make accessible existing information on MRE environmental effects for Tethys continues to expand the platform and reach ever-growing audiences. Tethys supports OES-Environmental outreach, engagement, and dissemination by hosting materials on the public OES-Environmental page, hosting various tools and educational resources for users, and sharing announcements in the Tethys Blast. There are currently 4,410 documents that address environmental effects of MRE available on Tethys. The Tethys Blast is sent bi-weekly to the broad MRE community of more than 3,600 individuals.

## Risk retirement

During 2025, OES-Environmental updated all the stressor-receptor interaction [evidence bases](#) using information from Chapter 3 of the *2024 State of the Science* report. In addition to updating the existing evidence bases with new journal articles and reports, a new evidence base with 22 documents was created for the [displacement](#) interaction. The evidence bases are curated lists of journal articles and reports that provide the most helpful and objective data/research on each stressor-receptor interaction for MRE. The six existing [stressor-specific guidance documents](#) were also updated on Tethys, based on new information from the *2024 State of the Science* report. These documents provide an overview of the scientific information that is known for each stressor-receptor interaction and the status of risk retirement for each.

To assist MRE developers, regulators, advisors, and consultants with implementing the risk retirement process and support consenting dialogues with regulators, OES-Environmental developed a set of [Best Management Practices \(BMPs\) for Risk Retirement](#). The BMPs consist of a series of succinct statements that describe the optimal application of the risk retirement methods, written in a manner that is accessible and actionable for the MRE industry, regulators and advisors, and other stakeholders. The BMPs build on the information within the *2024 State of the Science* report that details the risk retirement process. They have been reviewed and iteratively improved by the OES-Environmental country analysts and MRE developers who participated in

an expert forum (see [Expert Forum section](#) below). The BMPs are intended to be used by MRE device or project developers with environmental expertise or by a third-party consultant or subject matter expert whose role is to evaluate environmental risks.

## New research areas on environmental effects of MRE

Additional questions surrounding the environmental effects of MRE were identified during 2024 and were the focus of work during 2025. The four new research areas of OES-Environmental for Phase 5 are environmental acceptability of MRE devices, environmental effects of off-grid MRE applications, system-wide effects of MRE, and social and economic effects of MRE.

### Environmental Acceptability

OES-Environmental is assessing the concept of environmental acceptability for MRE devices and developed the following definition:

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**“Guidance allowing for harnessing MRE resources efficiently while limiting risks to the environment (marine animals, habitats, ecosystems), assuring compliance with environmental regulations and promoting environmental benefits”.**

To improve the environmental acceptability of MRE devices, OES-Environmental has been characterizing the MRE device archetypes for wave and tidal energy, describing their specific features, and assessing how each relates to stressor-receptor interactions. This information will be used to provide tailored advice to developers, regulators, and stakeholders for MRE device selection, design, and operation. OES-Environmental developed a preliminary matrix with categories that are relevant for assessing the environmental acceptability of MRE devices: device archetypes, device components, physical and technical site characteristics, and receptors. The matrix will be reviewed by subject matter experts in 2026 through expert forums and workshops.

## Social and Economic Effects of MRE

OES-Environmental continued efforts to better understand the potential social and economic effects of MRE and how these are linked to environmental effects. A literature review was completed to evaluate any new information on social and economic effects of MRE published after the writing of the 2024 *State of the Science* report. The review focused on identifying linkages between social and economic effects and environmental effects of MRE; these effects are defined as social or economic effects resulting from interactions between MRE systems and the marine environment. The literature review highlighted the complex relationships between environmental interactions and socioeconomic outcomes, indicating a need to further understand the specific effects of environmental interactions on these groups. Following completion of the literature review, OES-Environmental created an international working group of experts from OES-Environmental member countries to further assess the potential linkages between environmental effects and social and economic effects of MRE. The working group will identify key indicators for assessing environmentally linked social and economic effects, examine how these effects vary by scale and type of MRE development, and evaluate their influence on decision-making.

### Environmental Effects of Off-Grid MRE Applications

With the potential for more off-grid applications of MRE, OES-Environmental has been investigating the environmental effects of these opportunities, as they may differ from grid-scale devices or large arrays. This exploration has involved the creation of use cases covering a diversity of at-sea applications as well as small community energy needs, to represent as many different off-grid MRE projects as possible. For these use cases, environmental conditions unique to the areas considered, such as listed species, sensitive habitats, migratory patterns, and MRE resource availability were considered. Socio-economic aspects were also considered, like other uses of the area or potential benefits and concerns associated with the hypothetical projects. These environmental conditions and socioeconomic aspects were incorporated to evaluate the site-specific risks, inform recommendations for monitoring and mitigating these risks, and identify specific potential consenting challenges.

## System-Wide Effects

OES-Environmental continued to investigate information on environmental effects of large-scale arrays and on MRE integration and interaction with other anthropogenic stressors and ocean uses at the ecosystem scale. The journal manuscripts on the application of an ecosystem approach to the MRE context, as well as on the assessment of cumulative effects of MRE with other human activities at sea, have been submitted to scientific journals and are currently undergoing the peer-review process prior to publication. Under this new research area, OES-Environmental continues to focus on assessing the unique environmental considerations for MRE deployments in tropical and subtropical regions. While development of MRE projects continues to expand worldwide, there remains a need to examine the specific environmental effects of MRE on the unique habitats and ecosystems of tropical and subtropical regions. To better understand how these effects may differ, OES-Environmental updated the available literature, building on previous work presented in the *2024 State of the Science* report, to identify new information on the environmental effects of MRE deployments in tropical and subtropical ecosystems.

## Outreach and engagement

In 2025, to help educators and students find relevant materials on the environmental effects of MRE, OES-Environmental created an online interactive [Educational Resources Guide](#) which organizes the existing educational resources by age group and provides curated selections for students and educators. To amplify the Educational Resources Guide and associated resources developed by OES-Environmental, contact was made with STEM groups to share the information.

Additionally, the [Marine Renewable Energy Coloring Book](#) was updated in 2025 to include figures from the *2024 State of the Science* report. The Coloring Book contains printable pages with illustrations and figures of MRE technologies and environmental interactions paired with educational information on MRE and environmental effects research for young STEM students. All the materials and resources created for outreach to STEM audiences remain available on the Tethys [MRE Educational Resources page](#). All the illustrations created for the *2020 State*

*of the Science* and *2024 State of the Science* reports are now available in the [Tethys Engineering Illustration Library](#).

In 2025, OES-Environmental coordinated opportunities to engage with students. OES-Environmental participated in two US-based [Marine Energy Collegiate Competition](#) (MECC) Industry Connection interviews with Oakland University and Oregon State University, providing undergraduate and graduate students with an opportunity to learn about the environmental and socioeconomic effects of MRE and relevant OES-Environmental resources. In January 2025, OES-Environmental contributed to the US-based [National Ocean Sciences Bowl](#) (NOSB) with a variety of MRE environmental effects-related questions. NOSB is an academic competition for US high school students to learn and test their knowledge in the ocean sciences. Multiple questions provided by OES-Environmental were used in the competition, and it was reported by the NOSB coordinator that students were able to correctly answer them, indicating an interest in and awareness of MRE. In September 2025, an online [Marine Energy Career Panel](#) was hosted. Panelists discussed their backgrounds, education, career paths, and current work. There were 70 online participants.

## Workshops

OES-Environmental hosted two workshops during 2025, bringing together researchers to understand how environmental effects may differ for off-grid applications of MRE and to work towards consensus on how the concept of environmental acceptability can inform consenting processes, and accelerate deployments for the MRE industry:

- An in-person workshop with 54 people at the joint US-based [2025 Ocean Renewable Energy Conference \(OREC\)/ University Marine Energy](#)



[Research Community \(UMERC\) Conference](#) focused on the environmental effects of off-grid MRE applications, with an interactive session to examine and discuss potential environmental effects of hypothetical use cases.

- An in-person workshop with 22 people at the 2025 [European Wave and Tidal Energy Conference \(EWTEC\)](#) focused on the environmental acceptability of MRE devices with a presentation of the recent work OES-Environmental conducted on environmental acceptability, as well as a facilitated group discussion around the environmental acceptability of wave energy devices for underwater noise and tidal energy devices for collision risk.



## Expert forum

In 2025, OES-Environmental hosted an [online expert forum](#) with MRE developers on the best management practices (BMPs) for applying the risk retirement process. There were 11 attendees. The forum included two discussion-based sessions focused on receiving feedback on the use of the risk retirement process by MRE developers and gathering input on the BMPs and their application. Feedback from the expert forum was used to update and finalize the BMPs.

## Conferences and papers

During 2025, the OES-Environmental team presented their research through presentations, posters, and workshops at two conferences. The conferences and each contribution from the team are detailed in the table below.

In addition, the OES-Environmental team published one journal article in 2025: [Copping et al. \(2025\): Effects and management implications of emerging marine renewable energy technologies](#)

**Table 1. Conferences at which OES-Environmental presented during 2025**

Conference	Date and Location	Contributions
<b>Ocean Renewable Energy Conference (OREC)</b> University Marine Energy Research Community (UMERC)	12-14 August Corvallis, US	<b>Poster:</b> Linkages between environmental, social, and economic effects of marine renewable energy  <b>Presentation:</b> Updates on OES-Environmental  <b>Workshop:</b> Environmental effects of off-grid marine renewable energy applications
<b>European Wave and Tidal Energy Conference (EWTEC)</b>	7-11 September Madeira, Portugal	<b>Poster:</b> Environmental effects of marine renewable energy off-grid and micro-grid applications  <b>Presentation:</b> Minimizing environmental risks to progress the marine renewable energy industry  <b>Workshop:</b> Environmental acceptability of marine renewable energy devices

# Performance Metrics International Framework for Ocean Energy

## Team

Led by the European Commission

and delivered by Wave Energy Scotland (WES)

## Introduction

A more rigorous technical review approach for the ocean energy sector has been recognised to be important at this stage, making use of improved evaluation methods and metrics that are currently applied in due diligence review and evaluation of ocean energy technologies. Considering the experience and lessons learned for more than two decades of ocean energy technology and market development, detailed monitoring of progress and success should have the following characteristics:

- Need to differentiate among the various needs of the development stages from R&D, Prototype, Demonstration, to Pre-Commercial and Industrial Roll-out.
- Need to define specific criteria for each development stage.
- A connection must be made between the performance criteria and the availability of certain types of support in the form of public and private funding.
- The process should use continued feasibility checks on the OE technology potential with an increasing focus on LCOE as the technology matures.

After an initial period of focusing on the technological feasibility, where the only metric used was the successful technology evolution to higher TRL levels, economics and other social acceptance criteria have been identified to be considered at an early development stage for ocean energy technology.

## Objectives

Task 12 aims to provide a robust, internationally agreed framework to support the structured development, evaluation and funding of ocean energy technologies. The Task focuses on establishing common principles, metrics and processes that enable objective assessment of technology progress across different stages of development, while supporting transparency, comparability and informed decision-making across the sector.

The core objectives of Task 12 are to:

- Build and maintain international consensus on the evaluation of ocean energy technologies across their development lifecycle;
- Provide clear guidance on appropriate technical, environmental, economic and social activities at each stage of technology development;
- Support consistent and evidence-based decision-making for public funding, investment and project progression;
- Promote knowledge sharing and collaboration between countries, funding agencies, developers, researchers and other stakeholders;
- Reduce development and investment risk by enabling transparent comparison of technologies and development pathways.

Through the application of a common evaluation framework, Task 12 seeks to deliver benefits for the full ocean energy ecosystem, including clearer expectations and communication between stakeholders, consistency in terminology and assessment approaches, increased confidence and trust in technology performance, and more efficient allocation of public and private funding to technologies with the highest potential for commercial success.

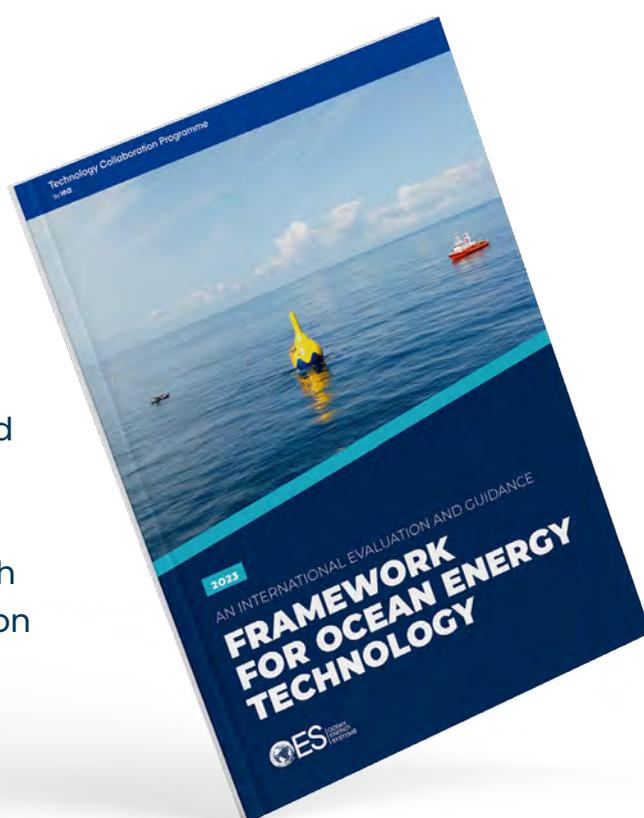
A key objective of the Task is to support alignment between public funding schemes, standards, certification processes and private investment requirements. By encouraging uptake of the framework by public funders and other users, Task 12 contributes to smoother transitions between funding stages and jurisdictions, and to the development of globally transferable technologies. This includes ongoing work towards a shared “technology passport” concept, enabling the streamlined transfer of technologies and data between national programmes and into later-stage investment and deployment.

## Achievements

In 2025, IEA-OES Task 12 advanced work on social acceptance as a critical enabling factor for the deployment of ocean energy, with a particular focus

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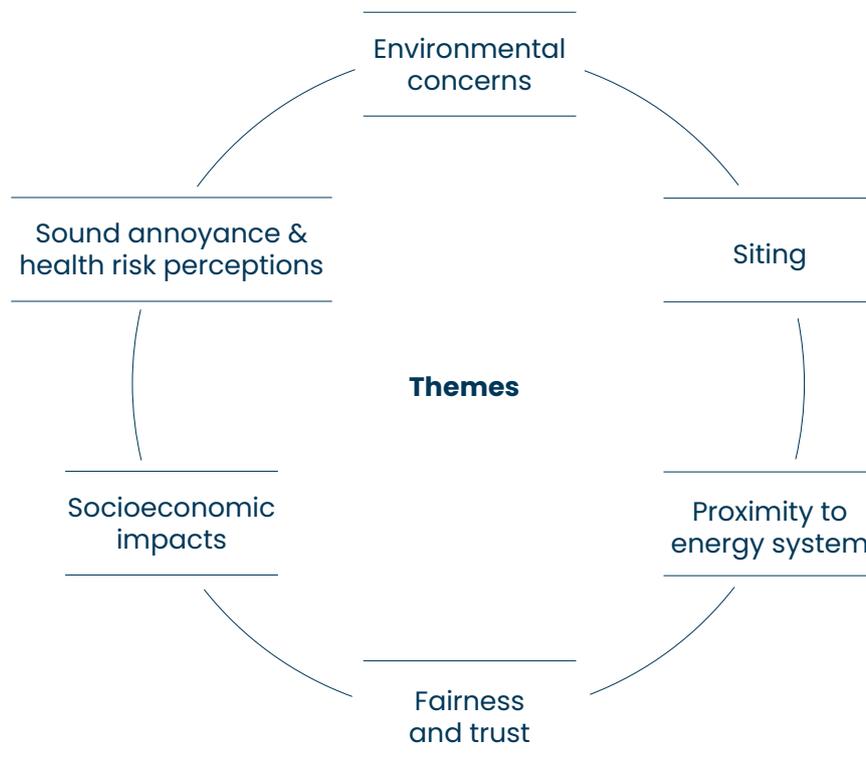
In 2025, IEA-OES Task 12 advanced work on social acceptance as a critical enabling factor for the deployment of ocean energy, with a particular focus on its integration into the IEA-OES Evaluation and Guidance Framework.



on its integration into the IEA-OES Evaluation and Guidance Framework. Task activities concentrated on developing a clearer definition of social acceptance in the context of ocean energy and on reviewing existing literature to identify key drivers, barriers and gaps in current approaches. The Task highlighted the importance of considering social acceptance alongside technical, environmental and economic performance, recognising its influence on project timelines, investment confidence and long-term deployment success.

Task 12 produced a comprehensive literature review and gaps analysis, identifying six recurring themes influencing social acceptance, including environmental concerns, siting and proximity, stakeholder engagement, fairness and trust, socioeconomic impacts, and perceptions related to sound and health.

Building on this analysis, the Task explored how social acceptance metrics could be incorporated across different stages of technology development, from subsystem and device testing to array deployment and full project implementation.



One of the most significant contributions of the IEA-OES Evaluation and Guidance Framework is its uptake within major national and international funding mechanisms. This framework ensures that only validated technologies progress through successive stages of development, thus contributing to reducing investment risk, improving transparency and enabling comparability across projects and jurisdictions.

The use of standardized metrics allows funding agencies to assess projects more consistently and

facilitates cross-border collaboration and coordination. The framework is already applied by several prominent institutions, including:

- Wave Energy Scotland within its competitive procurement programmes,
- The European Commission in ocean energy-related calls under the Horizon Europe programme,
- The U.S. Department of Energy through the Water Power Technologies Office funding process,
- EuropeWave pre-commercial procurement programme.

# Wave Energy Converters Modelling

## Coordinator

**Dr. Kim Nielsen**

Development v Kim Nielsen, Denmark

## Participating Countries

Australia, Belgium, Canada, China, Denmark, Faroe Islands, France, Greece, Ireland, Italy, Japan, The Netherlands, Norway, Portugal, South Korea, Spain, Sweden, the UK and the USA

## Scope

The numerical modelling task on Wave Energy Converters (WEC) under the OES was initiated in 2016 by experts from 13 countries with the objective to improve confidence in the prediction of power production from Wave Energy Converters using numerical tools.

As part of the project, several WEC concepts will be modelled and thereby the project will help build confidence in the performance of selected wave energy converters, with three main long-term goals:

- To establish confidence in the use of numerical WEC models
- To identify uncertainty related to simulation methodologies.
- To establish well-validated standards for evaluating WEC concepts.

## Achievements in 2025

In 2025, Task 10 progressed through continued international coordination and targeted national support. The Danish partners progressed with support from the EUDP coordinated by Aalborg University (Morten Kramer), and in the US, the Teamer program enabled specific CFD modelling carried out by national laboratories, including NLR (former NREL) and Sandia.

Modelling efforts continued along the two established benchmark tracks, the “OWC case” and the “Sphere case”, which attract participants using different numerical approaches and tools, supporting broader comparison and learning across the community.

Task 10 also strengthened its engagement with the wider research community through a dedicated session at EWTEC 2025 focused on verification and validation of numerical models for wave energy converters. A face-to-face meeting, chaired by Harry Bingham (DTU), provided a forum align the group on the road ahead based on the experience gained.

### The OWC case

In 2025, the numerical simulation of the DTU OWC small-scale model test continued. This test case with a single OWC chamber placed on the side wall of a 0.6-meter-wide wave flume at DTU, with focus on the experimental realisation and numerical modelling of the controlled chamber valves.

During 2025, progress has been made on the numerical simulation of these challenging valve cases and results compiled in a paper submitted to the EWTEC conference [1].

### The Sphere case

Is running in parallel, the development of test cases using a sphere to validate the hydrodynamic loads related to radiation and diffraction, as well as waves generated in the basin, has continued with an experimental setup at Aalborg University.

To measure the radiated wave loads on the sphere, the AAU team has developed a new setup, and the sphere is attached to an actuator to measure the radiation forces while oscillating in still water. The plan is to develop the sphere case further with validation test cases, including different PTO settings.



Meeting at the 16th EWTEC in Funchal, Portugal, 9 September 2025

## Future plans

The plan for the future development of the OES Task 10, as discussed at the meeting at EWTEC, will include a third track, “Floating WEC” as a new test case resembling a generic floating WEC with a simplified mooring system. Future OES Task 10 Webinars will be announced with specific topics and possibly invited speakers presenting new research. The active members on the OES Task 10 mailing list include 100 participants from 20 countries.

## Acknowledgement

The project was initiated with support from Bob Thresher from NREL, and today, Thanh Toan Tran is the point of support. Thanks also to Morten Kramer from Aalborg University and Harry Bingham from DTU for their lead on presenting the results in recent and upcoming journal papers. Thanks to OES for their support in arranging workshops, to EUDP for their continued support of the Danish team, and to Teamer for their support of the project. And thanks to all attending, contributing time and effort.

## References

- [1] [One-way energy absorption in OWC chambers – passive vs. active venting](#)
- [2] [Benchmark study of the DTU OWC chamber with both two-way and one-way absorption](#)

# Tidal Energy Modelling Verification and Validation

## Coordinator

**Dr. Narasimalu Srikanth**

Energy Research Institute @ NTU, Singapore

## Participating Countries

Australia, China, France, Germany, Indonesia, India, Ireland, Republic of Korea, Malaysia, Philippines, Sweden, UK and USA

## Objective

The numerical modelling task on Tidal Energy was initiated in 2018 by experts to improve confidence in the prediction of power production from tidal energy using numerical tools.

The project focuses on numerical modelling of tidal energy to develop a standard methodology for modelling in harnessing tidal energy, with the following long-term goals:

- Survey numerical modelling approach used in tidal-current-based energy projects;
- Verification and validation of modelling tools & methodology against specific case studies.

## Introduction

Various models are being developed to locate such promising sites by analysing flow velocities and power density. The precision of these models depends on the quality of their input data and the accuracy with which they represent hydrodynamic processes, ranging from detailed 3D simulations to simplified 2D depth-averaged approaches. These models serve as a valuable first step in identifying potential tidal energy locations, which can later be validated through field measurements.

The International Tidal Energy Working Group seeks to establish standardized methods for modelling tidal energy resources. This effort aims to enhance stakeholder confidence by delivering consistent, reliable data on global tidal energy potential. The group unites international research teams to exchange methodologies and findings from tidal

resource assessments. The main objectives of this workshop are as follows:

- To survey various numerical modelling approaches used in tidal-current based energy projects
- Verification and validation of modelling tools & methodology against specific case studies
- To analyse various control parameters influencing the tidal energy resource prediction.

## Achievements

The Energy Research Institute @ NTU (ERI@N) in Singapore organizes online workshops on a biannual basis. These workshops bring together experts and teams from international tidal energy research groups. Based on the discussion on the workshops, the topics that are investigated are as follows:

### Modelling focused

- Coupling of ocean models with CFD models for turbine site match making.
- Better methods of validating ocean models.
- Available open source ADCP and tide gauge data for validation of tidal models.
- Hydrodynamic impacts of tidal current generation.

### Site turbine matchmaking

- Coupled 3d tide wave ocean models to parameterize realistic conditions to inform device-scale studies.
- Parametrization of tidal turbines in the ocean model.
- Estimation of firm power and the highest yield of tidal turbines as part of deterministic tidal resource prediction.
- Inclusion of techno-economic aspects and environmental effects.
- Effects of power extraction on water level, current speed and residual current.

### Shortcomings of analytical models

- Analytical models neglect turbulent mixing and 3d structure flow and thus underestimate the turbine efficiency.

Some of the key findings in the workshop discussions are as follows:

- Data Assimilation compensates the overestimation of tidal energy resources with a reduction of RMSE by 19 % on average.

- The power coefficient fluctuates significantly and decreases with increasing depth.
- The power coefficients also fluctuate periodically as the turbine encounters waves, with a frequency consistent with the encounter frequency.
- The surface wave also showed periodic fluctuations with decreasing amplitude and increasing wavelength.
- Narrow channels in temperate waters exhibited substantial flow perturbations, with variations depending on whether the tide was ebbing or flooding. During the ebbing tide, flow changes were relatively small in magnitude and remained confined within the channel. In contrast, during the flooding tide, the perturbations became more pronounced, particularly near areas where water exiting the site entered a wide, shallow basin. It was also observed that reducing turbine density considerably diminished flow disturbance, that energy extraction at one site slightly reduced the resource at another, and that deploying two turbines had a negligible impact on ambient current speeds.
- In the case of vibrational tidal exchange flow between two seas of differing densities, a thicker interfacial layer developed under the new boundary conditions, with smoother variations in velocity and density across the interface. This indicates enhanced mixing dynamics and momentum transfer between the layers. Furthermore, the upper layer flow was found to be more dynamic than that of the lower layer.

## Future plans

Further workshops will focus on the Alaska case study, where individual teams will share their simulation models along with validation data and results with other members for the new case study. Each group will also share their individual reports related to this case study. A detailed technical report will then be prepared and submitted to OES by combining these individual reports. This comprehensive report will cover key aspects such as the effect of seabed roughness on tidal resource prediction, wave-current interaction, and the influence of tides, winds, river flow, and sea surface heat flux. It will also examine the effects of salinity and temperature on resultant tidal velocity and direction, both qualitatively and quantitatively. Finally, participants will collaborate to prepare a joint journal paper for submission to a scientific publication.

# Ocean Thermal Energy Conversion (OTEC)

## Coordinator

**Professor Ikegami**

Saga University, Japan

## Participating Countries

Japan, China, Korea, India, France and USA

## Introduction

This Task aims to support the development and uptake of the OTEC technology through coordinated knowledge sharing and collaboration. The group works to improve visibility of global OTEC progress, disseminate reliable information and lessons learned, and help address key barriers to deployment, including technological challenges, cost and infrastructure constraints, and limited market awareness.

## Achievements

In 2025, IEA-OES strengthened international cooperation on OTEC through the preparation of a Memorandum of Understanding (MoU) with the Ocean Thermal Energy Association (OTEA). Building on the sustained activities of the OES Working Group on OTEC, the MoU establishes a structured framework for collaboration focused on knowledge exchange, strategic coordination and increased visibility of OTEC developments worldwide. Throughout the year, IEA-OES and OTEA engaged in dialogue to define priority areas of cooperation, including information sharing on sector progress, joint outreach and communication activities, stakeholder engagement, and opportunities for OTEA to contribute to relevant IEA-OES Tasks and initiatives. The MoU also provides a basis for monitoring joint activities and exploring regular collaborative actions and is scheduled to be formally signed in 2026.



This progress builds on a series of earlier milestones that have progressively strengthened the OES knowledge base on OTEC. An initial state-of-the-art report compiled by the Working Group provided a comprehensive overview of OTEC activities and projects worldwide. In 2021, the publication of the *White Paper on OTEC* further advanced this work by presenting a set of strategic recommendations aimed at supporting the uptake and development of OTEC technology.

Recognising the need for a stronger evidence base on costs, IEA-OES developed a dedicated study on the economics of OTEC in response to the limited availability of reliable cost data. The report published in 2024 provided valuable insights into OTEC cost structures, key cost drivers, and the main challenges and opportunities shaping future deployment.

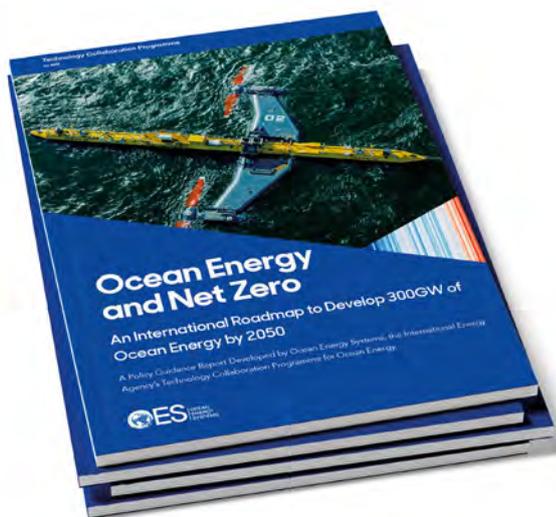


Image courtesy of Saga University

# Market Pull, Technology Push, Infrastructure, and Regulatory Development (MTIR)

## Introduction

In 2025, following the publication and global promotion of Ocean Energy and Net Zero: An International Roadmap to Develop 300 GW of Ocean Energy by 2050, IEA-OES structured its programme around four priority pillars: Market Pull, Technology Push, Infrastructure, and Regulatory development (MTIR).



The roadmap sets out an ambitious strategy to accelerate ocean energy deployment and highlights the scale of potential benefits by 2050, including major contributions to jobs, economic value and emissions reductions. After a strong focus in 2024 on promoting this International Vision for Ocean En-

ergy, the MTIR structure provides a clear implementation framework to ensure that IEA-OES activities are aligned with the enabling conditions required for large-scale, responsible deployment worldwide. Each IEA-OES Task is expected to contribute to one or more MTIR pillars, ensuring coherence across technical, policy and knowledge-sharing work and supporting the transition from demonstration to commercial scale.

## Achievements

In 2025, the Executive Committee operationalised the MTIR framework by confirming it as the organising structure for programme priorities and by initiating targeted, evidence-based work to support implementation. Building on the Ocean Energy and Net Zero policy guidance report, the ExCo agreed to deepen analysis and strengthen delivery across the four MTIR pillars: market pull policies, technology push policies, ocean energy infrastructure requirements, and regulatory and legislative frameworks.

As a first step, dedicated studies addressing market pull, technology push and infrastructure were commissioned and developed during 2025, with publication planned for 2026. These studies are intended to provide practical guidance for policymakers and funding bodies, complementing the existing roadmap and supporting member countries in translating the international vision into concrete national and regional action.

# 04

## International Activities on Ocean Energy

Image courtesy of Blue Economy CRC



# Australia

## Report prepared by:

**Irene Penesis** — Blue Economy CRC

**Christophe Gaudin** — University of Western Australia

**Philip Marsh** — Blue Economy CRC

## Overview

In 2025, Australia made significant strides in advancing ocean energy, particularly through wave energy deployments. Two demonstration devices supported by the Blue Economy CRC were successfully deployed and retrieved, marking a milestone for projects in Australian waters: the MoorPower™ pilot off Fremantle (WA), led by Carnegie Clean En-

ergy, and the M4 project off Albany (WA), led by The University of Western Australia. In addition to these deployments, several companies and research institutions advanced research and design activities and experimental testing, including Carnegie Clean Energy, WaveX, and the University of Western Australia.

## Supporting Policies for Ocean Energy

### National strategy

In 2025, the Commonwealth Government maintained a strong policy focus on achieving net-zero emissions and advancing decarbonisation initiatives through a range of policies, acts, and plans. Notably, the federal government updated its emissions reduction target to achieve a 62-70% decrease below 2005 levels by 2035, representing a significant step up from the previous 2030 target of a 43% reduction. To achieve these goals, the [Net Zero Plan](#) outlines how Australia can transition to a low-emissions economy while fostering economic growth, reducing cost pressures on households and businesses, and creating new jobs. The plan emphasises five key priorities to guide this transition: delivering clean electricity across the economy, lowering

emissions through electrification and efficiency, expanding the use of clean fuels, accelerating the deployment of new technologies, and scaling up net carbon removals.

### National Renewable Energy Priority List

The Commonwealth Government released the [National Renewable Energy Priority List](#) in collaboration with states and territories to provide coordinated support for regulatory planning and environmental approvals for key renewable energy projects across Australia. The inaugural list identifies 56 priority projects, including 24 transmission projects and 32 generation and storage projects. If approved through Commonwealth, state and territory processes, these projects could deliver an additional

16 GW of generation capacity and approximately 6 GW of storage capacity nationwide. No offshore projects are included in the inaugural list of priorities, which focuses essentially on onshore wind and solar generation.

### Commonwealth Renewable & Clean Energy Policies

The 2024–25 Federal Budget added \$7.1 billion to the Australian Renewable Energy Agency (ARENA) for pre-commercial innovation. However, none of the current ARENA projects are exclusively focused on ocean energy. The overall emphasis remains on net-zero initiatives like hydrogen, solar, wind, and the Powering Australia Plan.

Other funding and focused initiatives specifically related to ocean energy remained limited to [ARC-funded projects](#), and the following key developments:

#### Sustainable Ocean Plan

Following the release of the draft Australian [Sustainable Ocean Plan](#), public consultation began in August 2024. Throughout 2025, the Commonwealth Government reviewed feedback and worked toward securing endorsement from Australian, state, and territory governments. As of January 2026, the final version of the Australian Sustainable Ocean Plan has not been released yet.

#### Offshore Electricity Infrastructure Act

The [Offshore Electricity Infrastructure Act](#) 2021 sets the rules for developing and operating offshore energy projects and transmission links. In 2025, the government continued consulting on ways to make financial security requirements more flexible, improve data sharing, and allow public input on management plans for commercial projects. On 14 November 2025, regulatory changes introduced temporary relief from fees and levies under the cost recovery framework for up to two years. The updated regulations waive annual levies for feasibility and research licences, halve levies for transmission and infrastructure licences, and cut application fees from \$300,000 to \$20,000 for research licences and to \$150,000 for transmission licences. Draft guidelines for research and demonstration licences were also opened for comment between August and October 2025, and feedback is now under re-

view. The Act also was updated to cover emerging technologies, including hydrogen-at-sea generation, transmission, and storage.

## State and territory strategy

In addition to Commonwealth initiatives, state and territory governments continue to advance renewable energy through onshore zones and transition plans. Support for ocean energy remains limited, with Western Australia notable for backing [Marine Energy Research Australia](#) for the period (2018-2025).

## Market incentives

### Capacity Investment Scheme

The Capacity Investment Scheme (CIS) is an Australian Government initiative designed to accelerate investment in renewable energy generation, such as wind and solar, and clean dispatchable capacity, such as battery storage. By providing a long-term revenue safety net, the scheme reduces financial risk for investors and ensures more renewable energy projects are built. Initially targeting 32 GW of new capacity nationally, the CIS was expanded in July 2025 to 40 GW, raising renewable generation targets from 23 GW to 26 GW and clean dispatchable capacity from 9 GW to 14 GW. Rolled out between 2024 and 2027, regular auctions for generation and dispatchable capacity will support around \$73 billion in investment in Australia's electricity sector. However, no offshore energy projects are currently supported.

### Renewable Energy Target Scheme

The Renewable Energy Target (RET) scheme encourages renewable electricity generation by aiming to reduce greenhouse gas emissions from the electricity sector through the Large-scale Renewable Energy Target that sets out to deliver 33,000 gigawatt hours of extra renewable electricity each year and the Small-Scale Renewable Energy Scheme for smaller scale systems.

## Public funding programmes

Australia supports ocean energy development through various national and state funding programmes. At the Commonwealth level, the Australian

Renewable Energy Agency (ARENA) drives pre-commercial innovation, bolstered by \$7.1 billion in funding announced in the 2024-25 Federal Budget. However, no current ARENA projects directly target ocean energy.

The Cooperative Research Centre (CRC) program facilitates collaboration between industry and research sectors, which supports the Blue Economy CRC, as well as the CRC-P program which supports

Australian industry's ability to compete and produce in the short term. CRC-P project support includes funding for WaveX in partnership with University of Western Australia (UWA) and the Norwegian Geotechnical Institute (NGI). In 2025 the Australian Research Council (ARC) funded ocean energy projects across institutions such as UWA, Royal Melbourne Institute of Technology (RMIT), Swinburne University, University of Adelaide, and the University of New South Wales (UNSW).

## Research & Development

Significant investment in ocean energy R&D projects occurred in 2025 through the following activities:

### Blue Economy Cooperative Research Centre

The [Blue Economy CRC-Co](#) Ltd, established in 2019 under the Australian Government's Cooperative Research Centre Program, is an independent not-for-profit advancing Australia's blue economy. Positioned near the world's largest seafood and energy markets, Australia has immense potential to grow sustainable marine industries. With over AU\$300 million in funding, the CRC unites 43 partners from industry, research, and government across ten countries to tackle offshore food and energy production challenges, driving innovation in aquaculture, offshore engineering, and renewable energy over a 10-year program.

During 2025 the Blue Economy CRC continued to build on its impressive portfolio of [projects](#) that actively support and underpin the growth of ocean energy in Australia. Highlights of progress in 2025 funded by the Blue Economy CRC include:

- **[MoorPower Commercial Pilot: Preliminary Design Project](#)**: follows the successful completion of the [MoorPower Scaled Demonstrator Project](#) in 2024. Building on the lessons learned from the demonstration and in close collaboration with future end users, the project aims to deliver the required detail to unlock investment in a Commercial Pilot Project, which would be the first commercial application of the MoorPower technology in the aquaculture industry.
- **[Seeding Marine Innovation in WA with a Wave Energy Deployment in Albany](#)**: funded by the Blue

Economy CRC, WA Department of Primary Industries and Regional Development and UWA, a prototype version of the M4 (short for 'Moored MultiModal Multibody') Wave Energy Converter was deployed in King George Sound, Albany in 2024 and retrieved in 2025 following 131 days at sea.

- **[Ocean Wave Energy in Australia](#)**: project released a pivotal [report](#) at ICOE2024 outlining the ocean wave energy landscape in Australia, highlighting the exceptional characteristics of the Australian wave energy resource and demonstrating that there is particular value in terms of the dispatchability of wave energy. Funded by the Blue Economy CRC, this report was a collaborative effort led by UWA-MERA, and partners CSIRO, Griffith University, Australian Maritime College/University of Tasmania, Swinburne University of Technology, the University of Adelaide, BMT, Wave Swell Energy and Carnegie Clean Energy. This work was presented at EWTEC 2025 by the lead authors.
- **[Mooring Tensioner for WECs - MoTWEC](#)**: led by Carnegie Clean Energy has completed its final testing cycles. The MoTWEC Project tackles the cost and energy storage challenges of wave energy conversion through this novel Mooring Tensioner technology. This lightweight, durable energy storage component is a component that supports the use of rotary generators in Wave Energy Converters (WEC), significantly improving efficiency. Building on the MoTWEC Project, Mooring Tensioners were incorporated on Carnegie's 2024 deployment of the MoorPower device as part of the Scaled Demonstrator project and will also be deployed at a larger scale during Carnegie's ACHIEVE Programme deployment of CETO at BiMEP in 2026.

- **Modelling and operation of a hydrogen microgrid with 700 kW electrolyser:** Blue Economy CRC is constructing and commissioning the first DC hydrogen microgrid in Hobart, Tasmania in 2024-2025, producing hydrogen to power fuel-cell buses and support research into the provision of electricity and hydrogen to relevant industries, particularly aquaculture. Production of hydrogen at the facility continued through 2025.
- **DC Microgrids for Offshore Applications:** examined the barriers to setting up pure-DC microgrids and create a bench-scale pure-DC hydrogen microgrid for experiments
- **Alternate energy solutions for aquaculture:** Seafood Industry Australia (SIA) and the Blue Economy CRC have joined forces to deliver FRDC project [2023-080: Alternative energy solutions for aquaculture](#), which seeks to provide a wholistic decarbonisation decision platform as the aquaculture industry builds its climate resilience.
- **System level modelling to improve the performance of Offshore Sustainable Power:** which supports the development of the Blue Economy CRC's offshore hydrogen DC microgrid infrastructure, where advanced electrical and power system analysis and modelling tools are utilised to identify and achieve optimal performance scenarios.
- **Marine Spatial Planning for a Blue Economy:** In October 2025, following extensive feedback on the draft reports, the project released the final re-

ports for [Guiding Principles for an Australian MSP Framework](#), [Implementing the Australian MSP Framework](#), and [Key Enablers for Implementation of the Australian MSP Framework](#).

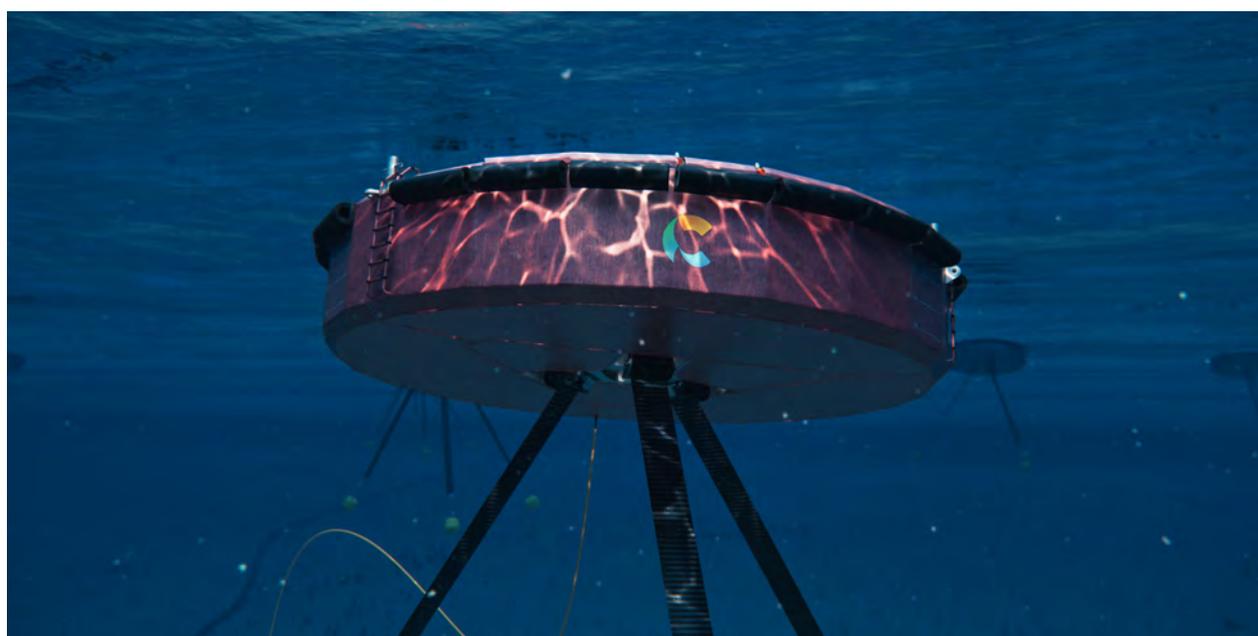
- **Risk-based Procedures for Safe and Reliable ORES:** that aims to develop a framework for risk assessment methods, decision-support tools and a set of procedures that will enhance the safety, value-adding and cost-effectiveness of ocean energy.
- **Developing Production Systems for Offshore Kelp Mariculture:** progressed on the commissioning of a kelp trial research farm in Tasmania's Derwent River that will use a novel wave-powered pump developed by the Australian Maritime College (UTAS) to deliver nutrients to the facility.

### Commonwealth Scientific and Industrial Research Organisation (CSIRO)

CSIRO, together with the Australian Energy Market Operator (AEMO), industry partners, and key stakeholders, released in 2025 [GenCost 2024-25](#), its annual report providing updated cost estimates for future new-build electricity generation in Australia.

### Carnegie Clean Energy

Through the [ACHIEVE Programme](#), Carnegie has continued to advance towards the deployment of CETO at the Biscay Marine Energy Platform (BiMEP).



Carnegie's CETO Technology

Ocean energy R&D moved beyond “promising concepts” into the hard work of de-risking commercial deployment: universities and industry strengthened the technology base through novel PTO and mooring innovations, advanced modelling and experimental validation, improved generator and control approaches.

The fully submerged, point absorber wave energy converter will represent the first grid connected CETO unit in Europe. With €7.05M (\$11.66m AUD) support for the project secured through the Europe-Wave PCP Programme, The Basque Energy Agency (Ente Vasco de la Energia), and the Spanish Government’s RENMARINAS DEMOS Programme. To date, activities for the ACHIEVE Programme have included the detailed design, procurement and subsequent manufacture of components of the CETO Unit in preparation for assembly and deployment.

In 2025, Carnegie signed memorandum of understanding (MOU) with BiMEP to explore opportunities for a 6MW CETO array deployment at the test site, building on the experience gained through the ACHIEVE Programme.

During the year, Carnegie was announced as the reference technology for the COIN Project, focused on control-oriented innovations for wave energy farms. The project was awarded €4m to develop and advance cutting-edge innovations to significantly enhance the reliability, survivability, and sustainability of future wave energy farms.

Following the successful offshore operation of the MoorPower Scaled Demonstrator in North Fremantle (WA), the focus shifted to the full-scale application with the MoorPower Commercial Pilot Pre-

liminary Design Project, aimed at delivering wave energy to the offshore aquaculture sector. Funded by the Blue Economy CRC, Carnegie partnered with Huon Aquaculture, Advanced Composite Structures Australia, the University of Tasmania, and key subcontractors to deliver preliminary design activities. This work built on the successful validation of MoorPower technology and bridged the gap between the completed Scaled Demonstrator and the first Commercial Pilot, refining the design for commercial-scale aquaculture applications and laying the groundwork for deployment on an operating feeding barge.

### Royal Melbourne Institute of Technology (RMIT)

In 2025, RMIT University, supported by the ARC, continued work on an innovative Linkage Project ([LP240100007](#)) to develop a modular, speed-amplified linear generator for wave energy conversion. The project combines advanced hydrodynamic and magnetic simulations with prototype construction and testing, aiming to improve performance, reduce energy costs, and enable sustainable wave energy utilisation along Australia’s coastline.

### Swinburne University

Funded by the ARC, Linkage Project [LP180101109](#) “Controlling coastlines while generating power” aims to produce strategies for protecting coasts from damaging waves using farms of wave-energy machines, which also generate electricity. The project is led by Swinburne University in partnership with the University of Adelaide and University of New South Wales, and industry partner organisations Moyne Shire Council and Mid-West Ports Authority and is close to completion. A very fast, experimentally validated semi-analytic model enabled massive numerical optimisation of wave farms for coastal protection. Experimental testing of optimised arrays of OWCs in UNSW’s Water Research Laboratory 3D wave basin demonstrated a clear wave-energy reduction zone forming behind the array and reduction of the erosion of a mobile shoreline sediment tracer model. It was also shown theoretically and experimentally that reduction of problematic infragravity waves was feasible using wave-energy converters. The work was reported in five Q1 articles, eight refereed conference papers, and seven broadcast-media interviews.

## University of Adelaide

In 2025, the University of Adelaide advanced its ocean renewable energy research through major ARC-funded initiatives and industry partnerships. Supported by the ARC and Carnegie Clean Energy (IE230100545), UoA conducted an extensive experimental campaign on indirect position estimation for the CETO wave energy system using a Stewart-Gough (hexapod) platform in preparation for full-scale deployment in Spain. Under the ARC Linkage Project (LP180101109) led by Swinburne University of Technology, UoA carried out wave-flume experiments on broadband power absorption by arrays of diverse wave energy converters. UoA also commenced a new ARC Discovery Project led by the University of Western Australia (DP250104899) on the nonlinear hydrodynamics of floating offshore wind turbines and wave energy converters. In addition, UoA was awarded two Industrial PhD projects focused on offshore cable hydrodynamics, co-funded by the Department of Education, CSIRO, and Aurora, targeting cable stability during installation and long-term operation.

## University of Western Australia

Alongside the significant activities at the UWA-MERA test site, UWA-MERA continues to successfully collaborate on research and development with a range of partners.

In 2024, a UWA-MERA collaboration with Perth-based wave energy developer WaveX achieved significant milestones in advancing its D-Spar wave-powered generator technology. The company was awarded AU\$2.4 million federal grant through the Cooperative Research Centres Projects (CRC-P). This project is a collaboration with the University of Western Australia (UWA) and the Norwegian Geotechnical Institute (NGI) Perth, focusing on evaluating the performance of shared helical anchors for offshore renewable energy. In addition, WaveX received a AU\$40,000 Innovation Booster Grant (IBG) from the Western Australian State Government to integrate advanced control systems into its D-Spar wave-powered generator. In October 2024, WaveX completed its second round of 1:100 physical model testing at UWA's Coastal and Offshore Research Laboratory. The campaign featured a fully instrumented model capable of measuring power output from all three corners of the D-Spar under a wide range of test conditions. Building on insights from

previous campaigns, the model setup was refined, and several subsystem components—including end stops, passively controlled power take-off (PTO), survival mode methods, mooring and anchors, and concentric spar guides—were tested to validate their performance at scale. The company also made significant progress in numerical modelling, completing both frequency-domain and time-domain models in collaboration with UWA.

A UWA-MERA collaboration with CorPower Ocean continued during 2025 on the ARC Linkage Project [“Efficiently unlocking full-scale WEC dynamics for industry cost reduction”](#) (LP210100397). This project has been advancing understanding of nonlinear dynamics of wave energy converters, with particular focus on nonlinearities in the wave frequency range. A unique set of experiments has been conducted at UWA, which allows separation of different sources of hydrodynamic nonlinearity. This allows identification of the most prominent terms which can be focused on in subsequent development of numerical models with improved fidelity and efficiency suitable for engineering design. In 2025, UWA welcomed CorPower CTO for a period of 3 months under a Gledden Fellowship to strengthen collaboration.

Through the Matariki Research Seed Funding 2024, and in collaboration with Uppsala University, the University of Otago, and CorPower Ocean, research is underway to advance ocean renewable energy systems using physics and machine learning. This work aims to develop new understanding and predictive capabilities for wave energy converter (WEC) dynamic instabilities through physics- and data-driven approaches.

## WaveX

[WaveX](#) is a private Western Australian company focussed on the commercialisation of its Wave Powered Generator (WPG) IP called the D-Spar™. Since then and in close collaboration with UWA, WaveX' proprietary WPG's have accelerated up the TRL scale, with ABL-Group (OWC) issuing a Statement of Feasibility in June 2024. WaveX now has EOIs from a major gas utility and global aquaculture supplier.

In close collaboration with UWA, WaveX Completed its most robust tank testing to date with a grant from the Western Australian government department of Jobs Tourism Science and Innovation (JTSI). It included storm survivability, regular and irregular

wave testing and decay tests. Their 1:40 scale prototype successfully generated power during open water trials - a major validation milestone - run by student Hugh Edwards, UWA.

Supported by CRC-P Round 16 funding, their Albany Pilot with Shared Anchors remains on time and on budget (in collaboration with UWA) - a key value inflection point for WaveX and its shareholders. They continue to advance planning for their next stage of development, including progressing towards first PPA, and full-scale deployment.

## Technology Demonstration

### Existing open sea test sites

Australia has a wave energy test site focused on early-stage technology development (low TRLs). New regulatory frameworks under the [Offshore Electricity Infrastructure Act \(OEI\) 2021](#) and related legislation enable both commercial and R&D deployments within declared offshore areas in Commonwealth waters. However, no projects have been deployed in these areas to date, with all field sites currently limited to state waters.

### University of Western Australia – Marine Energy Research Australia

The University of Western Australia (UWA) operates its offshore renewable energy hub through Marine Energy Research Australia (MERA), based at Albany with a Perth node and access to advanced labs at UWA. Supported by the WA Government and Blue Economy CRC from 2018 to 2025, MERA led the Albany M4 wave energy project, developing King George Sound as a future nursery test site for offshore energy prototypes.

## Projects in the water

### The Albany M4 project

On 8 November 2024, UWA-MERA deployed the M4 (Moored MultiMode Multibody) wave energy demonstrator in Albany, 450 km south of Perth. This milestone follows nearly four years of collaboration between UWA-MERA, the Blue Economy CRC, the University of Manchester, RMIT and WA's Department of Primary Industries and Regional De-

## Wave Power Engineering

Wave Power Engineering is developing their patented Wave Mill Technology. With over a decade of R&D, the system offers a 25-year lifespan and cost efficiency suitable for utility-scale deployment worldwide. The company was recently named a finalist for the 2025 Oceantic Network Ventus Awards, in the Viterna Award for Engineering Excellence category, for its work in decarbonizing the island nation of Indonesia.

velopment (DPIRD). The M4 is a hinged attenuator line-absorber WEC developed by Prof. Peter Stansby (University of Manchester) and M4 Wave Power Ltd. Extensive numerical modelling and wave-tank testing have informed its design, with published results demonstrating both high energy capture efficiency and strong survivability.

The M4 Albany project aimed to raise awareness of wave energy's potential in Australia, demonstrate local supply chain capability through domestic design and manufacturing, advance the technology's readiness level by optimising the PTO and control system, and showcase wave energy's role in decarbonising local industry through collaboration with aquaculture. It is also the world's first open-access wave energy demonstrator with operational and performance data to be released in the public domain. The M4 is 24 m long, weighs about 42 tonnes, and has a rated capacity of  $2 \times 5.5$  kW. The AUD 4.8 M project involves multiple partners: the Australian Maritime College (wave tank testing), University of Queensland (hydrodynamic optimisation), BMT (mooring and structural design, environmental assessment), University of Manchester (PTO design), and RMIT (PTO development).

After its initial deployment on 8 November 2024, the M4 was retrieved for inspection on 27 November, redeployed on 17 December, retrieved again on 26 January 2025, returned on 13 February, and finally recovered on 26 April 2025 after 131 days at sea. During this period, it generated power for over 300 hours, including 24 hours of continuous operation, with a maximum significant wave height of 2 m. Peak mean power was ~2 kW (over 20 min),



M4 operating at sea (Nov. 2024)

with instantaneous peaks reaching 20 kW, with analysis of results currently underway.

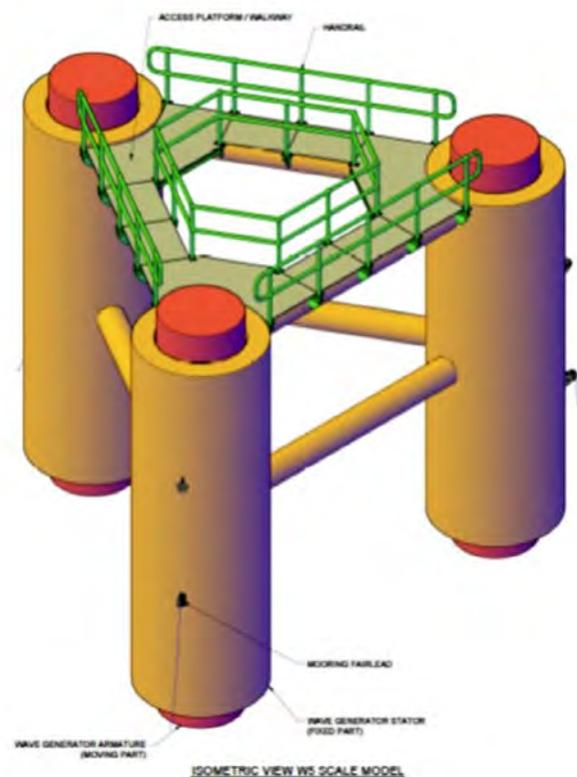
## Projects planned for deployment

### Carnegie Clean Energy

Carnegie Clean Energy, through its subsidiaries CETO Wave Energy Ireland and Carnegie Technologies Spain, is set to deploy the first CETO wave energy converter unit in Europe at the BiMEP testing site in Bilbao in 2026. This project is supported by a multi-faceted funding approach, with support from the EuropeWave PCP Programme, Spain's RENMARINAS DEMOS Program and the Basque Energy Agency.

### WaveX

WaveX has signed an MOU with UWA for the W5 project using WaveX D-Spar™ technology. This project is leveraging the lessons learned and knowledge gained by the deployment of the M4 device in King George Sound in Albany, and seeks to demonstrate the full system at prototype scale in an open wa-



WaveX D-spar system (WaveX, 2025)

ter environment, fully demonstrating the PTO integration (active), structure survivability, shared anchors and dynamic inter-array cables. The system is designed as a D-Spar configuration, measuring 8 meters in width with a 7.56 meter draft when fully ballasted. It will use a catenary mooring system and deliver an estimated 10 kW of power. The project is funded through private investment and Commonwealth grants, including a \$2.4 million CRC-P grant

with UWA and NGI to trial innovative helical anchors. Deployment is planned for Albany, Western Australia, during 2026–27.

### Mocean Energy

Mocean Energy is exploring a potential deployment in Western Australia in collaboration with UWA. A feasibility study is currently underway, with the project targeting deployment in 2028.

## Specific Initiatives for International Cooperation

### National Marine Energy Standards Committee – EL066

The Marine Energy standard committee marked its fifth year of operations and continued work in standards development, with members collaborating with international expert committees on tidal resource assessment and characterisations, ocean

thermal energy conversion resource characterisation and biofouling of marine energy devices. Activities included Australian representation at two International Electrotechnical Commission (IEC) 2024 Technical Committee No. 114: Marine Energy – Wave, tidal and other water current converters plenaries in April and October 2025.

## Relevant National Events

### Relevant events in 2025

#### Blue Economy CRC Participants Workshop: Tasmania

The [2025 Participants Workshop](#) showcased the real-world impact of Blue Economy CRC research through innovative on-ground and in-water projects. It brought together the leadership team, research and industry Participants, strategic partners, and PhD students from across Australia and around the globe. The event highlighted key achievements from the past year, previewed upcoming initiatives shaping sustainable ocean resources, and fostered valuable connections across the blue economy network.

#### Blue Economy CRC Webinar Series

In 2025 the [Blue Economy CRC](#) hosted seven webinars on covering workforce development, marine planning, offshore renewables, hydrogen, seaweed cultivation, collaboration, and blue economy insights.

### Relevant events planned for 2026

#### AORES 2026

The 2026 Australian Ocean Renewable Energy Symposium (AORES) will be held in Adelaide in November 2026 (dates to be confirmed). The Symposium aims to foster collaboration within Australia's ocean renewable energy community and to share knowledge and ideas among industry, researchers, and other stakeholders in the ocean energy sector.

# Belgium

## Report prepared by:

**Vicky Stratigaki** – Department of Civil Engineering, Ghent University

**Jan Hensmans** – Federal Public Service Economy, Directorate-General Energy

## Overview

Ghent University has coordinated the European COST Action CA17105 “WECANet, an open pan-European Network for Marine Renewable Energy with a focus on wave energy” funded by the European COST Association, which involves 31 countries. WECANet focused on scientific excellence and inclusiveness by fostering training, networking and collaboration in Europe for wave energy. The Coastal Engineering Research Group (CERG-UGent) is an international player in the field of Blue Energy with its pioneering research tools. CERG-UGent focuses on the research topics of wave and tidal energy, offshore floating wind turbines and other floating structures, and is a pioneer in investigating parks of energy devices.

Ghent University is a strategic partner in the Infradev MARINERG-i project coordinated by the MaREI Centre at University College Cork Ireland, which brings together all the European countries with significant testing capabilities in offshore renewable energy.

The Flemish Agency for Innovation and Entrepreneurship (VLAIO) is supporting since 2018 the ‘Blue Cluster’ which was set up aimed at large companies and SMEs active in the blue economy sector, including marine energy.

The West Flanders Development Agency (POM West-Flanders), responsible for implementing the

socio-economic policy of the Province of West Flanders, supports the development of the blue energy sector by strengthening innovation capacity, business infrastructure and internationalisation opportunities for companies active in offshore and ocean energy. POM promotes the advancement of marine renewable technologies through close cooperation between industry, research partners and regional stakeholders.

The Fabriek voor de Toekomst Blue Energy of POM West-Flanders was established to give companies in the blue energy industry every opportunity to grow through innovation. It guides offshore firms towards suitable test and demonstration environments—such as the Blue Accelerator maritime test platform—and supports workforce development, new technologies and international collaborations.

In addition, POM has introduced TUA West (Technical University Alliance West Flanders) to reinforce cooperation between the region’s higher-education institutions and to make technical expertise more accessible to the industry, in particular to the many SMEs in blue growth domains. This alliance strengthens knowledge transfer and ensures that companies can draw on applied research and specialised expertise to support their innovation needs.

## Supporting Policies for Ocean Energy

### National strategy

Belgium's renewable energy policy continues to align with EU climate and energy targets for 2030. Offshore and land-based wind remain central pillars of the Belgian and European decarbonisation trajectory. Belgium maintains its contribution of an 18.3% share of renewable energy in gross final energy consumption by 2030, in line with EU requirements, although the European Commission's 2026 assessment of the updated National Energy and Climate Plan (NECP 2025) stresses that additional renewable deployment efforts are needed, particularly to strengthen the national trajectory beyond offshore wind. A system of Tradable Green Certificates (TGCs) remains in place to support onshore renewable generation, with the level of support determined through periodically updated business-case exercises involving developers, suppliers, investors and financial institutions.

Alongside this, the 2025 federal government agreements introduced several new structural measures influencing renewable and ocean energy policy. These include the establishment of a High Council for Energy Supply to provide independent calculations to the government, and a strengthened "inter-federal energy pact" designed to improve long-term coordination between federal and regional authorities in the energy transition. These reforms place a stronger emphasis on energy security, competitiveness, and the development of reliable renewable capacity.

To maximise national renewable electricity output, Belgium is significantly expanding offshore wind capacity in the Princess Elisabeth Zone. Federal plans foresee between 3.15 and 3.5 GW in this zone, increasing Belgium's total offshore wind fleet to around 5.8 GW by 2030, nearly tripling today's installed capacity. An important innovation supporting this expansion is Elia's Princess Elisabeth Energy Island, the world's first offshore energy hub, which will collect wind power from the zone and host hybrid interconnectors with the UK and Denmark. This project strengthens Belgium's role as a North Sea energy hub and supports long-term grid integration for renewables.

At the level of maritime planning, Belgium approved its Marine Spatial Plan 2026–2034 in early 2026. The plan outlines long-term priorities for the Belgian North Sea, including space for innovation, renewable energy development, multi-use areas and environmental protection, ensuring a framework that facilitates future offshore and marine energy activities.

Marine renewable energy remains an emerging but strategically relevant industry for Flanders. The Flemish Agency for Innovation and Entrepreneurship (VLAIO) supports the Blue Cluster, the Flemish spearhead cluster for the sustainable blue economy, which—together with industry and academic partners—regularly updates its offshore renewable energy R&D roadmap. The West Flanders Development Agency (POM West-Flanders) supports blue energy innovation through initiatives such as the Fabriek voor de Toekomst Blue Energy, providing companies with access to innovation support, workforce initiatives, infrastructure and test facilities, including the Blue Accelerator platform, wave flumes of Ghent University and the Coastal & Ocean wave Basin. POM also convenes a recurring core group for blue energy, bringing together key players from academia, industry and government.

### Market incentives

Although Belgium does not yet have dedicated market incentives for ocean energy (tidal, wave), marine renewable energy is recognised in national and Flemish strategies as an emerging sector with high growth potential. Current support mechanisms focus on enabling infrastructure, innovation funding and test facilities rather than revenue support, including the Blue Accelerator platform, wave flumes of Ghent University and the Coastal & Ocean wave Basin.

Furthermore, the Marine Spatial Plan 2026–2034, approved in January 2026, allocates space in the Belgian North Sea for innovation and pilot activities. This updated planning framework offers a structured pathway for pilot-scale marine energy deployments and multi-use concepts in co-location with offshore wind.

## The Blue Cluster

The Blue Cluster is a spearhead cluster organisation bringing together more than 200 private companies, research bodies and public partners active in the sustainable blue economy. Its mission is to strengthen the competitiveness and international position of the Flemish blue economy by fostering innovation, collaboration and knowledge exchange. The Blue Cluster is officially recognised by the Flemish Government as a spearhead cluster for blue growth and works closely with Flanders Innovation & Entrepreneurship and Flanders Investment & Trade as part of the region's strategic mission-oriented cluster policy.

The Blue Cluster focuses on innovation and internationalisation trajectories that stimulate blue growth, while also acting as a sector federation defending the interests of companies active in maritime, offshore and ocean-related industries. As a broad networking platform, the cluster connects numerous organisations that operate (fully or partially) in a marine environment. By integrating ambitious SMEs into the cluster ecosystem and its R&D and demonstration projects, the Blue Cluster accelerates their technological development and access to international markets.

Beyond its project portfolio, the Blue Cluster plays a leading role in shaping the long-term blue economy strategy for Flanders. It provides structured policy advice to the Flemish authorities and contributes to the development of Flemish and European ocean-related innovation agendas, including marine spatial planning, offshore renewable energy, marine security, circular bio-based resources and digitalisation. In the context of the upcoming reform of the Flemish cluster policy, the Blue Cluster is expected to take on an even stronger mission-driven role, with increased emphasis on internationalisation, SME involvement and addressing societal transitions. Below, the Renewable Energy Roadmap of the Blue Cluster is presented.

## The Fabriek voor de Toekomst Blue Energy

To support businesses in West Flanders in growing both regionally and internationally through innovation, the Province of West Flanders established several cluster platforms within the Provincial Development Agency (POM West-Flanders) to proactively

Although Belgium does not yet have dedicated market incentives for ocean energy (tidal, wave), marine renewable energy is recognised in national and Flemish strategies as an emerging sector with high growth potential.

prepare its key industries for the future. The Fabriek voor de Toekomst Blue Energy, focusing on offshore wind, wave, tidal and related marine technologies, is located along the Belgian coast and in the Ostend area. Through coordinated partnerships between local, provincial and Flemish actors, SMEs are supported in their sustainable, future-oriented development. Services range from practical business support to promotion, research, specialised training and access to infrastructure.

## Public funding programmes

Every year, POM West-Flanders launches its short-term innovation programme known as "Quick Wins", supporting collaborative SME-driven innovation projects with up to 50% co-funding. These projects typically aim to deliver pilot installations, test setups or prototypes, and form part of POM's broader innovation strategy supporting sectors such as Blue Energy, offshore technology, materials, and digitalisation. This programme fits within POM's mission of strengthening innovation capacity in West Flanders, as reflected in its active funding calls and development support for blue-economy companies throughout 2025–2026.

The Federal Energy Transition Fund remains one of Belgium's key instruments for supporting energy-related R&D, including innovation in offshore renewable energy in the Belgian Exclusive Economic Zone. Each year, as required by the Royal Decree of 9 May 2017, the Directorate-General Energy opens a new call for proposals to fund research, innovation, infrastructure and SME-oriented projects in five strategic energy domains, including renewable

energy in the North Sea. Funded projects must contribute directly to Belgium’s energy transition objectives and comply with the eligibility criteria linked to R&D, research infrastructure, SME innovation and innovation clusters.

The Blue Cluster, recognised as a Flemish spearhead cluster for the sustainable blue economy, continues to receive a dedicated annual budget through Flanders Innovation & Entrepreneurship (VLAIO) to co-fund industry-driven R&D projects. These proj-

ects must involve at least three Flemish companies and respond to the offshore renewable energy roadmap updated by the cluster and its academic and industry partners. The framework supports marine renewable innovation, multi-use offshore concepts, and new technologies aligned with Flemish blue-economy priorities. The Blue Cluster is actively involved in national and EU-level strategy development, as evidenced by its participation in 2025–2026 marine policy and blue-economy initiatives.

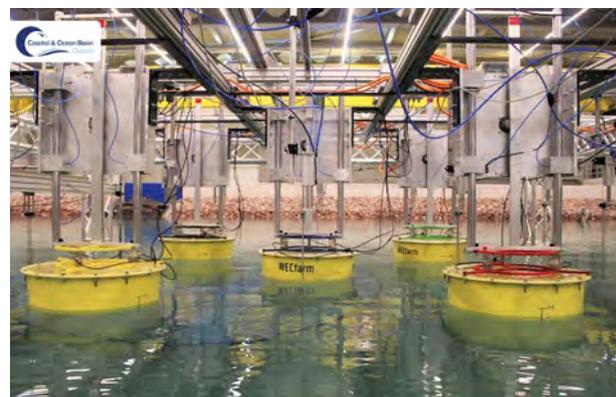
## Research & Development

### Fundamental research projects at the Coastal Engineering Research Group of Ghent University (UGent-CERG) dedicated to ocean energy research

The Coastal Engineering Research Group (UGent-CERG, <http://awwww.ugent.be>) is led by Professor Peter Troch, and is situated within the Department of Civil Engineering.

UGent-CERG has a large experience in the field of marine renewable energy and coastal and offshore engineering, performing integrated research using physical and numerical modelling and field measurement campaigns. The main infrastructure and know-how include prototype field measurements, wave flumes/basin for physical scale modelling, and numerical tools. The specialized staff members of the research group are involved in national and international projects on coastal defence, ocean energy conversion and offshore structures. UGent-CERG has a strong pioneering role in Belgium in marine renewables and offshore moored floating structures. Moreover, UGent-CERG is coordinating the new Coastal & Ocean Basin (COB), which has a focus on offshore renewable energy technologies and coastal and offshore structures.

The research within UGent-CERG focuses on wave-structure interaction, wave overtopping, offshore renewable energy, development of numerical models, experimental research in the laboratory and data analysis. UGent-CERG has supported a substantial number of fundamental research projects and PhD researchers on these topics, as these are core scientific topics for the group. The Research Foundation Flanders (FWO, <https://www.fwo.be/>) and the UGent Special Research Funds



The experimental setup of the five-WEC array the Coastal and Ocean Basin Ostend: overview and detail. Research by: Vervaeke, T., L. Cromheeke, N. Quartier, M. Streicher, V. Stratigaki, and P. Troch. 2025. “Wave Basin Testing of Hydrodynamic Interactions in Centralized Controlled Wave Energy Converter Arrays for Irregular Short- and Long-Crested Waves.” *APPLIED OCEAN RESEARCH* 156. doi:10.1016/j.apor.2025.104467.

funded PhD research projects and three post-doctoral Fellowships, carried out at UGent-CERG. All of these research topics focus on the numerical and experimental modelling of offshore moored floating energy devices and structures, and Wave Energy Converter arrays/farms. Moreover, FWO (the

Flemish Research Foundation) funded the development, construction and testing of WEC array scale models in the Coastal and Ocean Basin in Ostend. The WECfarm testing took place in 2023 and was carried out by researchers of UGent-CERG.

At CERG there are currently three running PhD research topics dedicated to wave energy, supervised by Professor Peter Troch and Dr. Vicky Stratigaki:

- Numerical hydroelastic analysis of moored flexible offshore floating structures (PhD researcher: Rafail Ioannou);
- Integrated Smoothed Particle Hydrodynamics platform for modelling marine renewable energy technologies and moored floating structures validated using experimental modelling. (PhD researcher: Laurens Cromheeke);
- Time-domain wave propagation modelling for assessing the impact of WEC farms on the wave field and the local morphodynamics and sediment transport (PhD researcher: Paulino Meneses Gonzalez).

### Fundamental research projects at the Coastal Engineering Research Group of Ghent University (UGent-CERG) dedicated to Nature-Inclusive-Design of offshore infrastructure

At CERG there are currently three running PhD research topics dedicated to Nature-Inclusive-Design

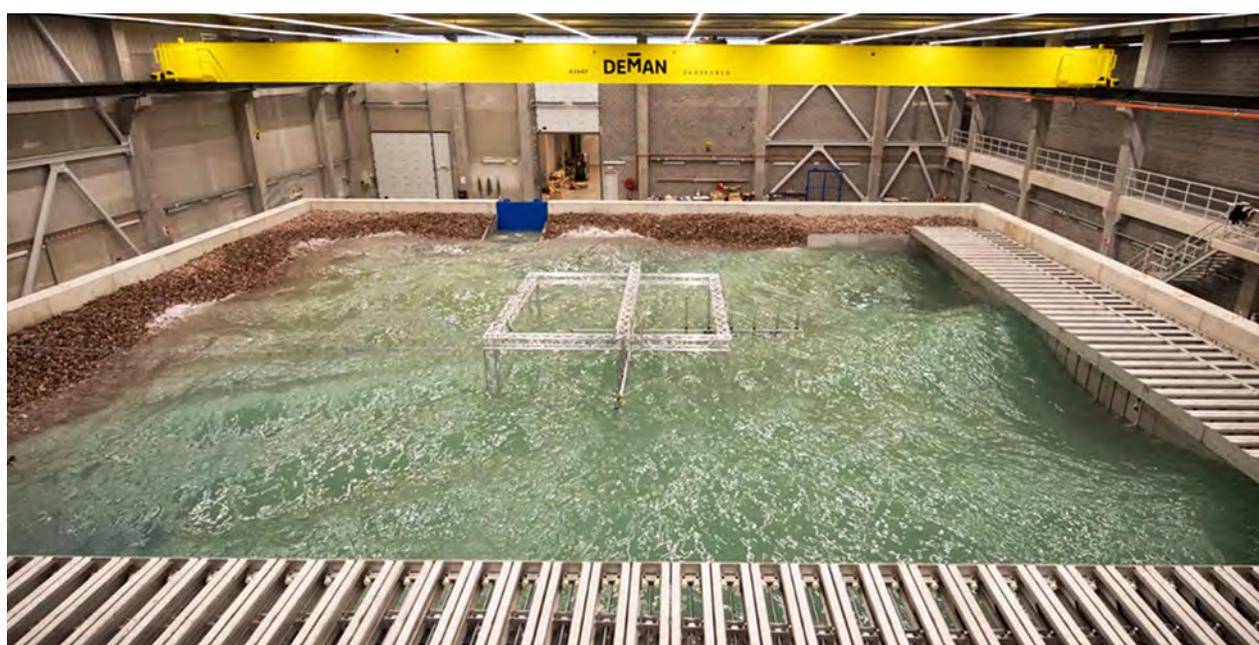
of offshore renewable infrastructure and coastal infrastructure funded by VLAIO, supervised by Professor Peter Troch, Dr. Vicky Stratigaki and Dr. Benham Shabani:

- Design and installation of bivalve mollusc reefs for biodiversity restoration purposes and nature-inclusive design of adapted marine infrastructure: (PhD researcher: Giorgio Santinelli);
- Establishing a scientific basis towards financing and monitoring value capture and value delivery of coastal and marine nature-based solutions. (PhD researcher: Michail Theodoridis).

### Coastal & Ocean Basin

The facility is targeting the fields of renewable energy and coastal and offshore engineering, and is co-funded by the Hercules foundation, VLAIO (Flanders Innovation & Entrepreneurship) and the Flemish Ministry of Mobility and Public Works. The exploitation will be managed by Ghent University, KU Leuven and Flanders Hydraulics Research. The basin will be equipped with a unique combination of a narrow paddle wave generator in L-shape and a bidirectional current system, to achieve high-quality short-crested waves at almost any relative angle with the current.

The COB is 30.0m long by 30.0m wide and has a variable water depth up to 1.4m, allowing for test conditions from coastal to near offshore applica-



The Coastal & Ocean Basin, together with the new towing tank, forms the Flanders Maritime Laboratory, located at Ostend Science Park (Ostend, Belgium).

tions. A pit located in the middle of the basin allows experiments with mooring lines at a depth in excess of 4.0m. The facility is fully equipped with a state-of-the-art Qualisys motion tracking system.

Ghent University is very active in the Blue Energy - Blue Growth - Blue Economy sectors, with the Coastal Engineering Research Group led by professor Peter Troch being specialized in Marine Renewable Energy, Marine Technology, and Coastal & Offshore Engineering ([www.ugent.be](http://www.ugent.be)).

### MARINERG-i

The Coastal Engineering Research Group of Ghent University (UGent-CERG) is a strategic partner in the H2020 MARINERG-i project coordinated by the MAREI Centre at University College Cork Ireland, which brings together all the European countries with significant testing capabilities in offshore renewable energy. Ghent University is participating in MARINERG-i with marine energy technologies testing infrastructure, which includes wave flumes and the new Coastal and Ocean Basin ([www.cob.ugent.be](http://www.cob.ugent.be)).

The MARINERG-i - Offshore Renewable Energy Research Infrastructure is setting out to become the leading internationally Distributed Research Infrastructure in the Offshore Renewable Energy (ORE) sector, with a network of test facilities spread across Europe. In June 2021, it was announced that MARINERG-i was, from that moment onwards, included in the ESFRI Roadmap as the new distributed infrastructure for dealing with Green Deal targets. ESFRI, the European Strategy Forum on Research Infrastructures, is a strategic instrument to develop the scientific integration of Europe and to strengthen its international outreach.

ESFRI has established a European Roadmap for Research Infrastructures (new and major upgrades, pan-European interest) for the next 10-20 years, stimulates the implementation of these facilities, and updates the roadmap as needed. The ESFRI Roadmap arguably contains the best European science facilities based on a thorough evaluation and selection procedure. It combines ESFRI Projects, which are new Research Infrastructures in progress towards implementation, and ESFRI Landmarks, successfully implemented Research Infrastructures enabling excellent science.

### The “Blue Accelerator” test platform

The Blue Accelerator project was initially introduced by the Flemish consortium of Ghent University (Coastal Engineering Research Group - UGent-CERG), the Public Provincial Economic Development Agency of West Flanders (POM West Vlaanderen), the Flanders Marine Institute (VLIZ), the Technical University Alliance for economic transformation in West Flanders (TUA West) and VITO NV. The Blue Accelerator project aims at providing a smooth development path for marine energy and maritime technology from early design stages to scaled models at the UGent wave flume and the Coastal & Ocean Basin (both managed by UGent-CERG), and to a scaled prototype at the Blue Accelerator open sea test site. The Blue Accelerator is a maritime innovation and development platform and testing site for offshore blue economy research and industry projects. It is a versatile testing site, which allows performing tests



Location of the Blue Accelerator test site



Interior of the Blue Accelerator platform



The Blue Accelerator open sea test site at Ostend, Belgium.

above, on, and underwater, offering a broad range of services, e.g. marine sensors, fast communications and transfer data system, energy supply in a secure and safe environment following the offshore industry standards and in-land storage space. POM West-Flanders holds a 15-year exploitation permit. The Blue Accelerator consortium is aiming to offer a grid connection by 2023 for offshore renewable energy projects.

The Blue Accelerator platform is located about 500 m off the port of Ostend. At this location, the average water depth is about 10 m and the tidal range is 4 m. The testing zone is delimited by a circular area with a diameter of 440 m. The annual average significant wave height,  $H_s$ , and the energy period,  $T_e$ , are 0.65 m and 4.9 s, respectively, with a wave power of 4.33 kW per metre of wave-front (wave energy resource assessment from historically recorded data at 51.247°N, 2.928°E). A long-term statistical study has predicted extreme values up to 8.5 m of wave height, when considering a return period of 100 years. Ocean currents between 0.15-0.9 m/s can be found at the Blue Accelerator testing site, with values up to 1.87 m/s.

### ELBEPlus project

The ELBEPlus project brings together seven leading European clusters—including The Blue Cluster in Belgium—to build a pan-European blue energy cluster with global ambitions. The project focuses on strengthening industrial value chains in wave energy, tidal energy and fixed/floating offshore wind, while analysing barriers, new opportunities and emerging markets for marine energy technologies. It is supported by the EU COSME programme for cluster excellence and internationalisation. The project con-

tinues to operate as part of Europe's blue-economy cluster collaboration activities.

More information:

<https://www.blauwecluster.be/project/elbe-plus-european-leaders-blue-energy>

### Reefcovery project – Nature-Inclusive-Design of offshore infrastructure

Before 1900, beds of the European flat oyster (*Ostrea edulis*) were widespread across Europe. Due to historical bottom-disturbing fishing practices and parasites, they almost completely disappeared. Yet, they are extremely valuable habitats. Flat oysters are also known as ecosystem engineers because they form reefs that serve as shelter and feeding grounds for many other species. In doing so, they support diverse marine life and enhance biodiversity. Moreover, they provide various other ecosystem services: they purify the water and capture (excess) nitrogen. Closer to the coast, they also stabilise the seabed, which increases our resilience to the impacts of climate change.

To restore oyster reefs, hard substrates or surfaces are needed for the oysters to attach to. In marine projects, often rocks, gravel, and other hard materials are used, for example, to protect the foundations of wind turbines or offshore marine infrastructure, caissons, or subsea cables against erosion from currents and waves, or from anchors and fishing nets. This material is therefore perfectly suited for the development of oyster reefs.

The Reefcovery project investigates how oyster reef restoration can be integrated into the nature-inclusive design of offshore infrastructure. For this, innovative techniques are being developed that enable the large-scale construction and implementation of oyster reefs. In this way, nature restoration can be integrated into marine infrastructure activities in the North Sea, such as the future Princess Elisabeth Island, and beyond.

In 2024, Reefcovery investigated which substrates are best suited to support the development of new oyster reefs. The project specifically focused on reef substrates commonly used in offshore infrastructure, through research performed at Ghent University. In the laboratory of the Aquaculture & Artemia Reference Center and in collaboration with Jan De Nul Group, who designed and constructed additional testing infrastructure, 'remote setting'

techniques have been tested and developed to let oyster larvae attach to various types of substrates under different conditions. This means the oysters were allowed to settle on these substrates in a controlled environment. Both artificial reef substrates and natural materials such as rock fill used in marine infrastructure construction have been tested, also in collaboration with the Magnel-Vandepitte Laboratory for Structural Engineering and Building Materials and ResourceFull.

A fall pipe model from the Coastal Engineering Research Group (CERG) has been developed to study how to efficiently install large volumes of reef substrate material using fall pipe vessels. The most promising materials will later be installed in combination with offshore infrastructure in the North Sea and actively monitored.

Reefcovery is funded by the Flemish Government (VLAIO) within the Blue Cluster focus areas, and is an interdisciplinary collaboration between industry partners - Jan De Nul, DEME, Resourcefull - and three research groups from Ghent University: Laboratory of Aquaculture & Artemia Reference Center, Coastal Engineering Research Group, and Magnel-Vandepitte Laboratory.

The project is coordinated by Dr. Vicky Stratigaki.

More information at:

<https://www.jandenul.com/news/restoring-oyster-reefs-offshore-infrastructure>

## BELREEFS project

The BELREEFS consortium is implementing Belgium's first active offshore restoration of native flat oyster (*Ostrea edulis*) reefs in the North Sea. The project has already progressed to full-scale field activities: during the summer of 2025, oyster restoration techniques were applied offshore and new oyster reefs were successfully installed. Even though BELREEFS is a dedicated restoration initiative, it provides essential operational knowledge that complements and advances nature-inclusive design developments for offshore infrastructure.

BELREEFS is commissioned by the Federal Public Service Health, Food Chain Safety and Environment within the European LIFE Belgium for Biodiversity Programme, and is carried out by a multidisciplinary consortium including Jan De Nul, the Institute of Natural Sciences, Shells & Valves, and Mantis Consulting, in alignment with the Native Oyster Resto-

ration Alliance (NORA). The project targets offshore gravel bed areas where flat oyster reefs historically occurred. Extensive seabed characterisation and environmental monitoring conducted in 2024 supported the selection of optimal pilot sites, taking into account hydrodynamic conditions and levels of human activity.

A key component of the project is the implementation of spat-on-substrate approaches, produced both via hatchery-based methods and remote settings near the deployment areas. 'Mother Reef' substrates, produced by Oyster Heaven have been used. Oyster larvae were sown on these substrates and cultivated for several weeks. This was done partly in a nursery in the Netherlands, Stichting Zeeschelp, and in Ostend, where the team also developed techniques to do this locally, close to the ship's departure point. The BELREEFS techniques were tested and operationalised during the 2025 installations, alongside evaluations of substrate stability and biodegradability to ensure long-term reef establishment. The field campaign further included tailored deployment strategies designed to maximise spat survival and accommodate offshore logistical and environmental constraints.

Comprehensive monitoring programmes assess reef development, biodiversity enhancement, and ecological functioning over time, generating the evidence base for adaptive management and up-scaling. Importantly, the practical insights gained through BELREEFS—on transport sensitivities, offshore handling, large-scale deployment and performance of spat-on-substrate methods—provide valuable applied knowledge that will inform the future integration of ecological restoration principles into nature-inclusive offshore infrastructure design.

The project is coordinated by Dr. Vicky Stratigaki.

More information at:

<https://www.jandenul.com/news/200000-young-oysters-installed-belgian-north-sea>

## SWiM

The SWiM project (Floating Solar and Wind in the Belgian Marine Zone) investigates how floating solar photovoltaics can be sustainably integrated within Belgian offshore wind farms. As floating PV technologies move toward offshore deployment, major knowledge gaps remain regarding structural behaviour, environmental impact, and their combined

operation with large-scale wind turbines. SWiM addresses these gaps by analysing existing offshore PV concepts, assessing ecological and spatial constraints, and developing technical guidelines for multi-use energy parks (“Mariparks”) in the Belgian North Sea. The project also models energy yield complementarity and electrical integration, recognising that offshore solar and wind resources peak in different seasons. Funded by the Belgian Energy Transition Fund, SWiM brings together industrial and academic partners to produce policy recommendations and practical design rules for future commercial multi-use zones at sea.

More information at:

<https://www.bluecluster.be/news/new-project-combines-wind-and-solar-energy-in-belgian-north-sea>

### Soiltwin

Today, we see an industry-wide mismatch between design expectations and the as built dynamics related to monopile foundations. This mismatch results in a sub-optimal (fatigue) design and ultimately a higher cost for offshore energy. It is the general consensus of both academia and industry that this is due to errors in the interaction between the monopile and the surrounding soil. Current soil-structure interaction models are not “tuned” to correctly assess the soil stiffness at small displacements for short and large diameter piles, i.e. monopiles. This project, a collaboration between Ghent University (UGent-CERG) and the Vrije Universiteit Brussel, therefore aims to calibrate those models by updating them based on Finite element analysis and lab-experiments at the Coastal and Ocean Basin (COB) and on-site measurements.

More information at:

<https://owi-lab.be/soiltwin>

### EnerGhentIC

EnerGhentIC is the interdisciplinary energy research community of Ghent University, uniting over 38 professors and more than 200 researchers from five faculties to tackle the energy transition. Its mission is to drive impact by stimulating research, technology development and long-term valorisation across a wide range of energy themes, including offshore wind, marine and blue energy systems, energy storage, smart grids, renewables integration and soci-

etal aspects of the energy transition. EnerGhentIC supports education and training for both students and professionals, and it serves as a strategic gateway between academia, industry and policymakers.

Recent activities include major collaboration initiatives such as the 2026 EnergyFest, where EnerGhentIC brings together industry partners, researchers and policymakers for knowledge sharing, matchmaking and showcasing UGent’s energy expertise. The organisation also plays a key role in Ghent’s climate-neutrality strategy through a formal cooperation agreement with the City of Ghent, enabling joint piloting of innovative energy solutions in real urban districts. EnerGhentIC continues to act as liaison in industrial collaborations (e.g. Belgian Offshore Platform, OWI-LAB, and sectoral alliances) and as valorisation manager in applied and collaborative research projects.

### BlueBridge

**BlueBridge** is the blue-economy incubator and innovation centre of the **Ostend Science Park**, located in the inner port of Ostend. It acts as a central hub for companies, start-ups, researchers and public stakeholders active in the **marine, maritime and offshore sectors**, including blue energy, aquaculture, marine biotechnology, coastal innovation and circular maritime technologies. BlueBridge serves as the main access point to the blue-economy ecosystem in Ostend, offering office space, coworking facilities, event infrastructure, business support services and access to specialised training environments such as The Reef, a high-tech training lab for offshore energy skills.

BlueBridge is embedded in the broader innovation ecosystem of Ostend Science Park, which combines top-tier UGent research, real-life test facilities (e.g. the Coastal & Ocean Basin), and commercial opportunities for blue-economy companies. Research groups and consortia connected to UGent—such as Marine@UGent and EnerGhentIC—provide expertise in fields including aquaculture, blue biotech, marine engineering, coastal defence and blue energy. BlueBridge works closely with POM West-Flanders, Ghent University and the Port of Ostend to facilitate sustainable business growth and strengthen Flanders’ position as a leading blue-economy region.

More information:

<https://www.bluebridge-osp.be>

# Canada

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## Overview

Marine renewable energy development continued to gain momentum across Canada in 2025, supported by coordinated federal and provincial action through legislative reform, regulatory progress, and targeted research and development investments.

A major milestone was reached early in the year when amendments to joint federal-provincial legislation in Nova Scotia and Newfoundland and Labrador, the “Accord Acts” were proclaimed, formally establishing a regulatory regime for offshore renewable energy on areas of federal seabed in Canada. The legislation amends existing offshore petroleum laws to establish a comprehensive regulatory framework for marine renewable energy development in the Canada-Nova Scotia and Canada-Newfoundland and Labrador Accord Act offshore areas. These measures establish the offshore energy regulators that will oversee the next phase of responsible tidal, wave, and offshore wind energy development in Canada.

The tidal energy sector also achieved significant regulatory breakthroughs and secured new federal investments in 2025. Eaucraie Power Ltd. and partner Orbital Marine Power expanded their Bay of Fundy project pipeline by securing two additional berths, increasing contracted capacity to 12.5 MW, and obtaining a *Fisheries Act* Authorisation for up to three O2-X devices under Fisheries and Oceans Can-

ada’s (DFO) revised staged and adaptive approach. In parallel, the Government of Canada announced a \$10 million investment through the Energy Innovation Program to advance environmental monitoring in the Bay of Fundy, supporting projects led by the Fundy Ocean Research Centre for Energy (FORCE) through the Ocean Sensors Innovation Platform and by Acadia University to reduce uncertainty around fish-turbine interactions in the Minas Passage.

On the West Coast, the Blind Channel Test Centre advanced as a national demonstration site, with PRIMED and BMT Canada completing major upgrades to the community energy system integrating tidal energy with battery storage and solar power. Important underwater and onshore power connections were also completed, bringing the system closer to full operation with the goal of showcasing how community renewable energy systems can reduce reliance on diesel in remote and rural areas.

In northern Canada, ORPC continued to advance river-based hydrokinetic energy development, including progress toward deploying a RivGen turbine in the Mackenzie River and completing flow data collection in the Yukon River. Together, these initiatives highlight the growing role of marine and river current technologies in delivering clean, reliable energy solutions for remote and off-grid communities in the North.

## Supporting Policies for Ocean Energy

### National strategy

#### Government of Canada

2025 saw the implementation of Bill C-49, *An Act to amend the Canada-Nova Scotia Offshore Petroleum Resources Accord Implementation Act and the Canada-Newfoundland and Labrador Offshore Petroleum Resources Accord Implementation Act*, establishing the legislative foundation for the development and regulation of offshore renewable energy projects in Canada's jointly managed offshore-areas, such as offshore wind, wave, and tidal energy, off the coasts of Nova Scotia and Newfoundland and Labrador. It also renamed the Canada-Nova Scotia Offshore Petroleum Board and the Canada-Newfoundland and Labrador Offshore Petroleum Board to the Canada-Nova Scotia Offshore Energy Regulator (CNSO-ER) and the Canada-Newfoundland and Labrador Offshore Energy Regulator (CNLOER), reflecting the expansion of their mandates to include regulatory oversight of the full lifecycle of offshore renewable energy projects within the two jointly managed offshore areas. This marked a significant milestone in positioning Canada for responsible, long-term growth in the offshore clean energy sector.

In 2025, the Government of Canada established the new Major Projects Office (MPO) with the intent of fast-tracking “nation-building” projects. MPO was established through Bill C-5, the *Building Canada Act*, which came into force in June 2025, as part of Canada's effort to improve oversight and coordination of large-scale infrastructure and energy projects. The MPO has the authority to streamline federal regulatory approvals, advance projects deemed in the national interest, and act as a single point of contact for proponents, Indigenous partners, and government departments. By centralizing project oversight and regulatory guidance into a “one window approach”, the MPO aims to accelerate project delivery while maintaining strong governance and accountability. In the fall, *Wind West*, a province-led proposal to connect Nova Scotia's offshore energy westward, was identified by the MPO as a Transformative Strategy for further refinement and development. If *Wind West* advances, it could help

attract private investment and set a course for long term wind resources development in the Maritime provinces.

#### Newfoundland and Labrador

In June 2025, the province of Newfoundland and Labrador proclaimed amendments to the Canada-Newfoundland and Labrador Atlantic Accord Implementation Act to align provincial law with federal marine renewable energy legislation. It enables the regulation and development of tidal, wave and other offshore renewable energy projects, establishes a land tenure system for submerged lands, updates safety and environmental protections, and modernizes the offshore regulator's powers.

#### Nova Scotia

In 2025, Nova Scotia passed Bill 149, the *Powering the Offshore Act*, in an effort to improve the province's legal framework to accelerate offshore renewable energy development. The Act strengthens support for offshore wind and tidal energy projects, streamlines licensing processes, and enables power purchase agreements that bring clean energy to Nova Scotia's communities. Notably for tidal energy, the legislation enables the merging of marine renewable energy licences, making it easier for tidal projects in the Bay of Fundy to advance by offering more certainty and flexibility for developers, addressing previous challenges in the sector. It also clarifies regulatory and tax provisions for energy infrastructure, providing greater certainty for investors and developers. In addition, the passage of Bill 471 *Advancing Nova Scotia Opportunities Act* in 2024 brought into force amendments to the *Canada-Nova Scotia Offshore Petroleum Resources Accord Implementation Act*, allowing for the alignment of provincial legislation with federal legislation.

### Market incentives

In Canada's 2025 budget, two incentives, the *Productivity Super Deduction and enhancements to the Scientific Research and Experimental Development (SR&ED) incentives*, offer avenues for the marine

renewable energy sector to reduce costs. The Productivity Super-Deduction provides accelerated write-offs and, in many cases, full first-year expensing for clean-energy equipment, manufacturing and processing assets, R&D infrastructure, and other productivity-enhancing investments, lowering capital costs for companies developing tidal, wave, and hydrokinetic river current energy. At the same time, expanded SR&ED incentives support increased research, prototyping, and technology development that could support marine renewable energy.

## Research & Development

### Acadia University Tidal Energy Institute

Acadia University re-established a leadership role in the tidal R&D landscape in 2025, receiving \$2.63 M of federal funding for a project aimed at reducing uncertainty in fish-turbine collision risk in FORCE's Minas Passage tidal energy area. The project in collaboration with FORCE, Ocean Tracking Network (OTN), and DFO uses fish tracking technology to understand movement patterns and inform assessments of potential interactions with tidal turbines for six key species. The project brings together field data and modelling to better understand fish-turbine interactions and support the development of environmental monitoring guidance for tidal energy.

Acadia is advancing marine energy research and collaboration by revitalizing the Fundy Energy Research Network (FERN) to enhance data sharing and knowledge exchange among tidal energy stakeholders. The Acadia Centre for Estuarine Research is also supporting offshore wind research, including mapping seabed species with drop-camera surveys in partnership with DFO and the University of Massachusetts, and facilitating exchanges of highly qualified personnel with UMass.

### Centre for Ocean Applied Research (COAST)

COAST added the new BC Marine Energy Decarbonization Hub (the Hub) as a core initiative in partnership with the University of Victoria. The provincially and federally funded Hub aims to build on decades of clean energy research conducted at the University of Victoria by the Institute for Integrated Energy Systems (IESVic), Pacific Regional Institute for Ma-

The Federal government also included a commitment in Budget 2025 to introduce legislation to implement the 15% Clean Electricity Investment Tax Credit. This refundable tax credit for eligible investment into systems that produce clean electricity bolsters existing credits including a 30% Clean Technology Investment Tax Credit for wave, tidal and other clean energy technologies, and a 30% Clean Manufacturing Investment Tax Credit for new machinery and equipment used to manufacture or process key clean technologies.

rine Energy Discovery (PRIMED) and Accelerating Community Energy Transformation (ACET). The Hub will support marine renewable energy and decarbonization technology development, testing, and commercialization by leveraging existing infrastructure and capacity.

Additionally, COAST in partnership with Canadian Coast Guard through Innovate BC's Integrated Marketplace hosted an innovation challenge to accelerate the commercialization of marine energy technologies. The challenge's objective is to transition remote, land-based operational sites along the coast of BC from diesel generation to renewable energy systems using wave, tidal or solar solutions. The fund awards successful applicants with \$100,000 or 50% of eligible project costs to carry out the work. More challenges incentivising marine renewable energy solutions are expected to come in 2026.

### Fundy Ocean Research Centre for Energy (FORCE)

Key priority areas at FORCE in 2025 included funding opportunities for the novel OSIP project, advancing Indigenous participation in tidal energy, and the implementation of new governance mechanisms.

FORCE's R&D activity expanded significantly in 2025 with the Government of Canada's \$8.2 M investment in the Ocean Sensor Innovation Platforms (OSIP) project. OSIP is developing the world's first autonomous floating tidal energy environmental monitoring platform and a fully instrumented submersible platform, enabling both sea-surface and subsea data collection. Sensors tested on these platforms will capture critical information

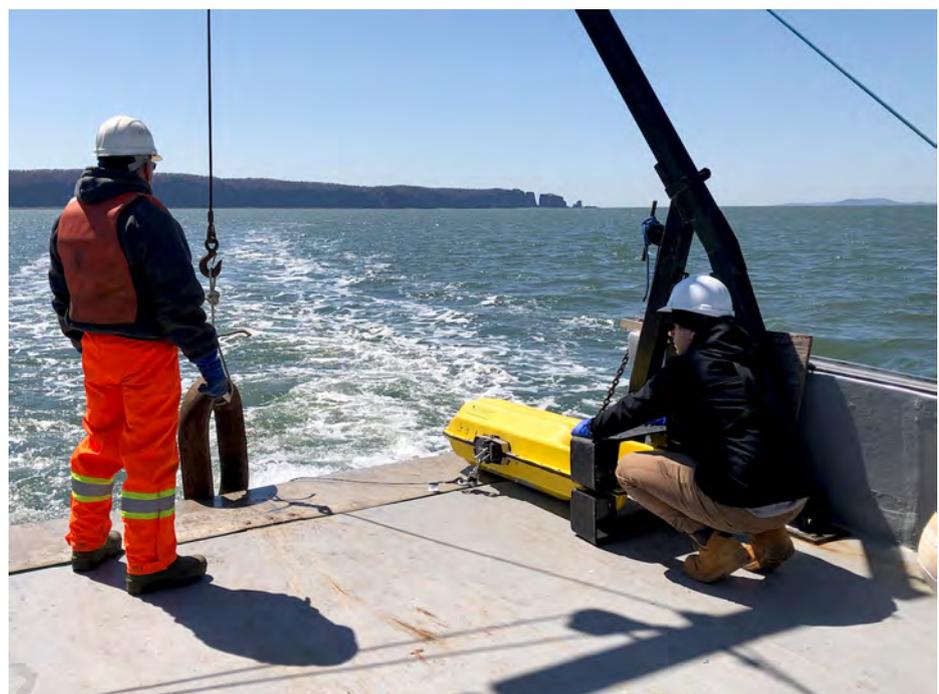
on fish-turbine interactions, helping address one of tidal energy’s greatest challenges: accurately measuring and managing environmental risk. OSIP directly supports the Task Force on Sustainable Tidal Energy Development in the Bay of Fundy’s recommendations and complements Acadia University initiatives to reduce uncertainty around ecological impacts. Key partners include Natural Resources Canada (NRCan), Acadia University, the Confederacy of Mainland Mi’kmaq (CMM), Pacific Northwest National Laboratory, OTN, and the University of the Highlands and Islands Environmental Research Institute, with additional input from developers, DFO, researchers, and suppliers.

A priority at FORCE in 2025 has been advancing deeper Indigenous participation in tidal energy by working with First Nations Chiefs, CMM, and Mi’kmaq communities to embed Netukulimk (respectful resource use) and Etuaptmumk (Two-Eyed Seeing) into project planning, including hosting a dedicated session with Mi’kmaq leadership at the 2025 Marine Renewables Conference. In April, FORCE co-led a Mi’kmaq delegation to Orkney, Scotland to observe the Orbital O2 commercial tidal turbine, learn from EMEC’s community-integrated model, and gather insights on monitoring, fisheries compatibility, partnerships, and early engagement. CMM, in collaboration with FORCE, has also launched a 10-12 month Mi’kmaq Ecological

Knowledge Study (MEKS) to document traditional use, cultural values, and environmental priorities in the project area.

Other ongoing initiatives at FORCE include:

- **HydroAware:** Leveraging AI to improve fish tracking using acoustic telemetry and emerging tag-less detection. In 2025, FORCE deployed a platform with three cameras and continuous video uploads to train the AI fish-detection model, which has already begun successfully detecting fish. Standardized contrast and reflective targets were added later in the year to enhance visibility assessment and further strengthen AI training.
- **Field Studies with Acadia Tidal Energy Institute (ATEI):** FORCE and ATEI are testing new and existing monitoring technologies-including optical cameras, AI, and varied sensor configurations-to evaluate water clarity, turbidity, and equipment performance in tidal conditions.
- **Coordinated Acoustic Telemetry:** FORCE works with DFO, OTN, CMM, and ATEI to align telemetry deployments, enabling broader tracking of tagged fish movements.
- **Adaptive Environmental Effects Monitoring Program (AEEMP):** FORCE contributed to DFO’s AEEMP guidance document, providing developers with a framework to meet federal environmental requirements under the Fisheries Act and Species at Risk Act.



Preparing to deploy acoustic receivers at FORCE site

R&D focused on removing the biggest real-world barriers to deployment: environmental risk uncertainty, site/resource data gaps, and practical pathways to replace diesel in remote communities.

### National Research Council (NRC)

In 2025, the Ocean, Coastal and River Engineering Research Centre of the National Research Council of Canada (NRC-OCRE) addressed a major barrier to renewable river energy deployment by releasing Canada's first national, high-resolution Canadian River Hydrokinetic Energy (CRHE) Database. The database maps rivers with significant flow-rate across Canada and provides detailed information on depth, width, velocity, and potential power generation. It enables communities, developers, and policymakers to identify high-potential river sites before investing in on-the-ground studies, supporting the shift away from diesel generation in remote, rural, and Indigenous communities. NRC also completed an analysis identifying communities located near strong resource areas and estimated the potential diesel reductions achievable per turbine installation.

In parallel, NRC carried out an extensive experimental program in its controlled cavitation tunnel to study the performance of a horizontal-axis hydrokinetic turbine developed with CanmetENERGY-Ottawa and Université Laval. Cavitation happens when tiny bubbles form in water due to rapid pressure changes, which can reduce a turbine's efficiency and damage the blades over time. The tests looked at how these bubbles form and grow under different conditions and how they affect turbine performance. The resulting data will be publicly available to help improve turbine design and support the development of more reliable and efficient turbines for fast-flowing rivers and ocean sites.

NRC also advanced research on frazil ice which are tiny crystals that form in very cold, fast-moving water before surface ice appears. These crystals can travel with the current and build up on turbines and other in-water structures. NRC studied how frazil ice forms, moves, and interacts with equipment to better understand risks such as clogging and performance loss, helping improve the design of renewable energy systems for cold, ice-prone environments.

### Natural Resources Canada - CanmetENERGY-Ottawa

In 2025, CanmetENERGY-Ottawa (CE-O) has continued to advance its new project cycle, focusing on the development of marine technologies, improved resource assessment tools, and support for the continued growth of marine renewable energy across Canada.

As mentioned, CE-O participated in a research program exploring cavitation alongside partners NRC and Université Laval, and carried out hydrokinetic and tidal resource assessments to help identify high-potential deployment locations with NRC. Additionally, in Quebec, modelling supported by data from ORPC and Hydro-Québec was used to map sections of the St. Maurice River, successfully identifying potential sites for river turbine installations. In British Columbia, CE-O partnered with PRIMED at the University of Victoria to develop a high-resolution hydrodynamic model of Quatsino Sound, providing robust data to support future tidal energy development and informed site selection.

In addition, CE-O and Carleton University developed a physics-informed machine learning framework to predict river flow conditions where limited data exists. This approach was used to produce resource assessment maps for medium and large rivers in the Yukon and Northwest Territories, supporting better planning for river-based renewable energy opportunities in northern communities.

### University of Victoria

The University of Victoria (UVic) continued to advance a range of wave energy and clean energy initiatives in 2025, collaborating with local suppliers, industry partners, researchers, and Indigenous communities. This work is led through PRIMED, which focuses on reducing uncertainty and risk for

first-of-a-kind community-based marine renewable energy projects. Key projects and activities undertaken in 2025 included:

- UVic led tidal and wave resource assessment fieldwork to support communities exploring marine renewable energy opportunities. Live field data is now available through the PRIMED website, and regional hindcast datasets generated through PRIMED's wave model are accessible via MERACAN.
- PRIMED continued to engage with provincial and federal agencies throughout 2025 to integrate the latest knowledge and best practices into British Columbia and Canada's regulatory frameworks for marine renewable energy while identifying supportive policies to advance the industry.
- PRIMED is working with several coastal First Nations to assess the feasibility of tidal energy for powering communities and supporting local economic activities.
- The team continued to refine the PRIMED Grid Modelling Code, an open-source tool for evaluating how marine renewable systems integrate with microgrids, which is gaining traction among researchers and private-sector users.
- PRIMED supported ORPC with an acoustic doppler current profiler deployment in the Yukon River, providing equipment and technical assistance for setup, rigging, and retrieval. The instrument, deployed in September 2024 and recovered in June 2025, will deliver valuable data to inform future hydrokinetic energy development in the region.

## Technology Demonstration

### Existing open sea test sites

#### FORCE

FORCE is Canada's lead centre for the demonstration of in-stream tidal energy technologies and continues to lead various research initiatives and gather knowledge about tidal energy, support technology demonstration.

FORCE implemented a new governance model independent of developers, supported by a new licensee agreement, advisory committee, birth fee structure and strategic plan, strengthening its role as a site steward and coordinator. These changes create a more transparent, sustainable framework for provincial tendering and future deployments by clarifying developer responsibilities, protecting FORCE's infrastructure and regulatory commitments, and aligning with provincial marine renewable energy strategy.

In 2025, the Province of Nova Scotia and FORCE awarded Eauclaire Tidal Limited Partnerships two additional berths, allowing the company to pursue a total of 12.5 megawatts (MW) of energy across three sites. Along with the berths, Eauclaire received tidal energy licences and power purchase agreement with Nova Scotia Power. To learn more, reference [4.3 Projects Planned for Development](#).

#### Blind Channel Test Centre

At Blind Channel Test Centre, PRIMED continued to advance regulatory and consultation components of its project in close coordination with federal, provincial, and Indigenous governments. Additionally, the Blind Channel Test Centre saw several infrastructure improvements to the site, and new environmental monitoring protocols.

PRIMED and BMT Canada completed Field Certification (CSA SPE-1000) of the 115 kW/h containerized battery energy storage system and microgrid controller at the Marine Technology Centre. It was successfully installed along with a 46 kW ground-mounted solar PV array. Together, the solar, tidal, and battery systems are designed to maximize renewable energy use and reduce diesel use in the community.

Significant subsea infrastructure has also been completed, including the installation of a submarine power cable and subsea junction box. The cable was landed onshore and terminated into the onshore substation in August 2025.

To support responsible development, PRIMED has established an environmental monitoring program in partnership with Marine Situ, featuring automated detection using optical cameras and imaging sonar to build global knowledge on collision risk with

tidal energy. Plans are also in place to deploy a hydrophone with Ocean Networks Canada to capture complementary acoustic data to strengthen monitoring efforts.

## Projects in the water

### Ocean Renewable Power Company (ORPC) Canada

In 2025, ORPC advanced multiple marine and hydrokinetic energy initiatives across Canada that support community-scale clean power solutions. A major focus this year was the Mackenzie River hydrokinetic project near Fort Providence, Northwest Territories, where the proposed submersible RivGen turbine advanced to its next phase with nearly \$600,000 in federal funding from the Clean Energy for Rural and Remote Communities Program to support data collection and field activities. Field work for this site began in mid-October 2025, with instruments being deployed to gather river flow information that will inform turbine sizing and future deployment planning, aiming to generate renewable electricity without a dam and reduce reliance on diesel generation in the region.

ORPC also collaborated with partners such as the University of Victoria's PRIMED program on an acoustic doppler current profiler deployment in the Yukon River to collect high-resolution flow data for potential future river energy projects.

## Projects planned for deployment

### Eauclaire Tidal & Orbital Marine Power

In 2025, Orbital Marine Power and its partner Eauclaire Tidal Ltd. continued advancing their flagship Canadian tidal stream program in the Minas Passage, Bay of Fundy, in collaboration with FORCE. In November, the Province of Nova Scotia selected Eauclaire/Orbital as the sole proponent under the 2025 tidal energy procurement process, awarding 12.5 MW through two 15-year power purchase contracts, along with seabed access and electrical connection rights at FORCE. This expands the contracted development pipeline to support six O2-X floating tidal turbines at the site.

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**In 2025, several marine renewable energy developers in Canada continued advancing community-scale tidal, wave, and hydrokinetic projects, progressing site studies, permitting, engineering, and partnerships to support future clean power deployments in remote and coastal regions.**

Additionally, DFO issued a *Fisheries Act* Authorisation for up to three O2-X devices, making it the first project to move forward under Canada's revised staged and adaptive deployment approach. This framework begins with a single device, with additional deployments guided by real-time environmental data. Each O2-X turbine is rated at roughly 2.5 MW, enough to power about 2,000 homes, with the initial three-turbine phase expected to deliver 7.5 MW of predictable, emissions-free electricity to the Nova Scotia grid.

Throughout 2025, the project advanced engineering design, site layout planning, mooring and installation preparation, adaptive environmental monitoring and reporting, Indigenous and community engagement, and project financing efforts, all aimed at enabling the first deployment and setting the stage for future scale-up.

### New Energy Corporation

In 2025, New Energy Corporation (NEC) made progress in both Canada and international markets. NEO secured a prototype development contract with U.S. Army Corps of Engineers, creating an important opportunity to advance operational energy technologies. This work will support the development of hydrokinetic solutions designed to enhance power generation in remote and off-grid environments.

NEC also continued its work in Canada, collaborating with partners and local stakeholders on Canada's West Coast to develop a framework for tidal energy demonstration and adoption. These

efforts are focused on reducing reliance on fossil fuels and strengthening energy resilience in coastal communities. Additionally, in the Bay of Fundy, NEC advanced project planning for its tidal energy demonstration project. Key milestones and further development progress are anticipated in 2026.

Further, NEC continued to expand its international commercial presence, with project opportunities under development in several markets, including the United States, the Caribbean, and Asia.

### Nova Innovation

Nova Innovation continues to plan for the installation of its 1.5 MW tidal energy project in Petit Passage, Nova Scotia. The design of the project is currently being updated to utilise newer technology developed by Nova which will improve the efficiency and long-term viability of the project.

### Yourbrook Energy Systems

In 2025, Yourbrook Energy Systems Ltd. continued advancing the Kamdis Tidal Power Demonstration project, with the FEED study funded by NRCan's Clean Energy for Rural and Remote Communities

program scheduled for completion on March 31, 2026. The study will support the project's collaboration with T'Il Yahda Energy of the Haida Nation to reduce diesel use and greenhouse gas emissions on Haida Gwaii. Additionally, discussions progressed with potential customers in British Columbia and Labrador, expanding opportunities for the deployment of Yourbrook's tidal energy technology.

### Yuquot Wave Energy Project

In 2025, the Yuquot Wave Energy Project, led by the Mowachaht/Muchalaht First Nation, successfully completed its feasibility and design study and conditionally secured funding through a competitive Natural Resources Canada program to support full project build-out. The team is actively pursuing additional matching funds to advance detailed design and construction. This year also celebrated the community's vision and connection to the project with a short film showcased at Yuquot Summerfest 2025, highlighting the cultural importance of Yuquot to the Mowachaht/Muchalaht First Nation people and the exciting potential of wave energy for the community which can be found here: [Yuquot Summerfest 2025](#).

## Specific Initiatives for International Cooperation

This year, ORE Catapult, UK's leading technology innovation and research centre, and COVE, a Canadian marine technology and innovation hub, began collaborating under a Memorandum of Understanding to advance offshore renewable energy technologies. The partnership focuses on accelerating innovation and technology development while sup-

porting sustainable growth in the offshore renewable energy sector across both countries.

Additionally, Marine Renewables Canada continued to meet quarterly with the UK Marine Energy Council, Marine Energy Wales, and the U.S. National Hydropower Association to share policy updates and developments across their respective jurisdictions.

## Relevant National Events

### Relevant events in 2025

Marine Renewables Canada 2025 Annual Conference November 12-14, Halifax, Nova Scotia

### Relevant events planned for 2026

Marine Renewables Canada 2026 Annual Conference November 17-19, Ottawa, Ontario.

# China

## Report prepared by:

**Mr. Peng Wei** — Director, National Ocean Technology Center

**Mr. Wang Ji** — Researcher, National Ocean Technology Center

**Mrs. Wang Fang** — Researcher, National Ocean Technology Center

## Overview

In 2025, China implemented a series of plans and policies to promote green and low-carbon development and to accelerate the development of marine renewable energy. China continued to advance the large-scale utilization of ocean energy by issuing and implementing the Guiding Opinions on Promoting the Large-scale Utilization of Ocean Energy. Demonstration projects for tidal current energy

and wave energy were implemented, including the launch of the 100-MW Zhoushan tidal current energy project in Zhejiang Province. China also supported the cultivation of new ocean energy technologies, continuously expanded application scenarios, and accelerated the industrialization of the ocean energy sector.

## Supporting Policies for Ocean Energy

### National strategy

**The Energy Law of the People's Republic of China** officially entered into force. The Energy Law emphasizes accelerating the green and low-carbon transition of energy development and provides a strong legal foundation for building a clean, low-carbon, safe, and efficient modern energy system. The Law explicitly states that the State encourages the large-scale development and utilization of ocean energy.

The Ministry of Natural Resources, the National Development and Reform Commission, the Ministry of Industry and Information Technology, the Ministry

of Finance, the Chinese Academy of Sciences, and the National Energy Administration jointly issued **the Guiding Opinions on Promoting the Large-scale Utilization of Ocean Energy**. As China's first dedicated ocean energy planning document jointly issued by multiple ministries, the Guiding Opinions clarified the strategic significance and development positioning of ocean energy and deployed key tasks in five areas: resource potential assessment, scientific and technological innovation, pilot and demonstration projects, industrial development environment, and open and cooperative development.

The National Energy Administration issued the Guiding Opinions on Promoting Integrated Development

of New Energy, proposing to explore shared use of infrastructure between ocean energy development and various marine activities to enhance three-dimensional marine spatial utilization efficiency.

## Market incentives

The National Development and Reform Commission and National Energy Administration jointly issued the “Guiding Opinions on Promoting New Energy Consumption and Regulation,” proposing to promote the standardized, orderly development and consumption of offshore wind power.

The National Energy Administration and other departments jointly issued the “Guiding Opinions on Promoting High-Quality Development of Energy

Equipment”, proposing to improve the quality and efficiency of renewable energy equipment such as wind power, solar power, and hydropower, while simultaneously developing biomass, geothermal, ocean energy, and other clean energy power generation and comprehensive utilization equipment.

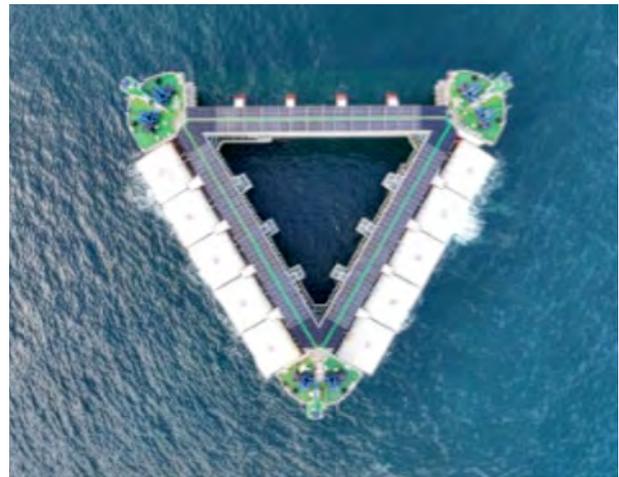
The National Development and Reform Commission and other departments issued the “Opinions on Promoting High-Quality Development of the Renewable Energy Green Power Certificate Market,” proposing to accelerate the expansion of green power trading scale and steadily promote wind power, solar power, biomass power generation, geothermal power generation, ocean energy power generation, and other renewable energy projects to participate in green power trading.

## Research & Development

### Wave energy

China made continuous progress in wave energy technology R&D. The megawatt-scale floating wave energy power generation platform “Nankun”, jointly developed by China Southern Power Grid Guangdong Power Grid Co., Ltd. and the Guangzhou Institute of Energy Conversion of the Chinese Academy of Sciences, continued offshore testing and operation. The “Nankun” has an overall triangular structure with strong typhoon resistance, capable of operating under various sea conditions to provide stable and clean power supply for islands. The platform conducted nearshore tests in Wanshan, Zhuhai in 2023. After completing performance tests of the power generation system in nearshore waters, August conducted offshore grid-connected power supply tests. Offshore sea trial period, the platform achieved an overall efficiency of  $\geq 26\%$  under real sea conditions, verifying the capability and feasibility of wave energy for powering remote islands.

To further improve power generation and reduce electricity costs for offshore mobile energy platforms, since 2024, the Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences, has led relevant research teams to develop key technologies for integrated wind-solar-wave-storage energy supply platforms, creating a new model for three-dimensional, intensive multi-energy complementary power supply at sea.



“Nankun” at Sea



Integrated Wind-Solar-Wave-Storage Energy Supply Platform



"Dongbo No.1" at Sea

In 2025, the 10-kW oscillating water column (OWC) wave energy power generation device "Dongbo No.1", independently developed by Dongfang Electric Corporation, completed over 1,800 hours of continuous power generation under real sea conditions.

In 2025, a new oscillating water column wave energy converter prototype jointly developed by Harbin Engineering University and Harbin Electric Machinery Company Limited successfully passed laboratory testing. The prototype features a novel water column resonance chamber structure, opening a new path for the miniaturization and intensification of wave energy utilization technology.

Dalian University of Technology explored array development technology for wave energy converters verified in laboratories and conducted a pool model demonstration verification to meet the needs for large-scale development and utilization of wave energy resources.

Tsinghua University developed various series of oscillating float-type wave power generation system prototypes, including single-float and double-float configurations, and conducted laboratory test verification.

In 2025, Northeast Normal University designed and developed a new type of pneumatic wave energy converter energy capture component based on self-pitching turbine technology, with model testing research expected to be applied in backward-bent duct type pneumatic wave energy converters.



Wave Energy Converter Array Test



Oscillating Float-Type Wave Power Generation System Prototype



Pneumatic Wave Energy Converter Model Test

## Tidal current energy

Zhejiang University continued R&D on megawatt-scale tidal current turbines based on previous 60-kW, 120-kW, and 650-kW prototypes. A 1:20 scale model completed water tank testing, verifying array energy capture efficiency under boundary constraints.

Chinese universities and research institutions, including Northwestern Polytechnical University and Shanghai Jiao Tong University, have carried out relevant work in tidal current energy technology research and development and test verification.

## Ocean thermal energy conversion (otec)

Supported by the National Key R&D Program, Southeast University led research on “Methods and Technologies for Ocean Thermal Energy Conversion and Utilization.” The project focused on the need for sustainable power supply to remote islands in the South China Sea, proposing an efficient ocean thermal energy conversion solution based on the Kalina cycle, and developed a comprehensive ocean thermal energy utilization system integrating power generation, refrigeration, and seawater desalination. In 2025, the project team constructed a two-stage organic Rankine cycle power generation platform driven by ocean thermal energy (3kW power output) and conducted system performance tests.

In 2025, the Guangzhou Marine Geological Survey continued ocean thermal energy technology research, established a 1kW OTEC system simulation test platform, carried out design of a 200kW modular floating ocean thermal energy power station, and built a pilot production line for deep seawater desalination and concentrate preparation.

## Technology Demonstration

### Offshore test sites

The Ministry of Natural Resources of China continued to promote the construction of the National Marine Comprehensive Test Sites and enhance testing capabilities. In 2025, the National Ocean Technology Center completed annual operation and maintenance work for three marine energy



1:20 Scale Model Pool Test of Tidal Current Turbine



Partial Tidal Current Turbine Tests



Island-Based Ocean Thermal Energy Power Generation



On-site Testing of Wave Energy Converter

test sites in Weihai, Zhoushan, and Zhuhai. For the “Dongbo No.1” wave energy converter developed by Dongfang Electric (Fujian) Innovation Research Institute Co., Ltd., cumulative on-site testing services for power characteristics and power quality characteristics were conducted for over 30 days, and on-site test analysis reports were issued for indicators including output power, wave-to-electricity conversion efficiency, and voltage deviation.

## Demonstration projects

### LHD Tidal Current Power Station

The Zhejiang LHD Tidal Current Power Station continues to operate stably, with over 8 years. In 2022, the first megawatt-class tidal current energy generation unit “Endeavour” developed by this project was deployed and connected to the grid. By the end of 2025, the unit has been operating continuously for over 40 months, with cumulative grid-connected power generation exceeding 6.2 million kWh.



LHD Tidal Current Power Station

### Three Gorges Tidal Current Demonstration Project

The Zhoushan tidal current energy demonstration project constructed by China Three Gorges Corpo-

ration continued grid-connected demonstration operation and provided public testing berths for full-scale prototypes. In 2024, the project met design specifications. The project has three tidal current energy public test berths, providing offshore testing services for full-scale tidal current energy engineering prototypes. It is China’s first tidal current energy demonstration project with public test berths and service capabilities. In 2025, the project continued demonstration operation.



Three Gorges “SG500A/B” Tidal Current Generation

### Wave Energy Deep-Sea Aquaculture Platform

The semi-submersible wave-energy-powered aquaculture platform “Penghu”, developed by the Guangzhou Institute of Energy Conversion, successfully completed long-cycle cross-year aquaculture trials, verifying safety and reliability under extreme marine conditions.

Based on the “Penghu” successful demonstration operation experience, the Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences, achieved technology export to other provinces, successively developing semi-submersible aquaculture platforms including “Pusheng Marine Ranch No.1,” “Mintou No.1,” and “Haiwei No.1,” for promotion and application in Hainan, Guangdong, Fujian, Guangxi, and other regions.



“Penghu” Wave Energy Aquaculture Platform

## International Cooperation

From October 20 to 22, 2025, the 52nd Executive Committee Meeting of the IEA Ocean Energy Systems Technology Collaboration Programme (IEA OES-TCP) was held in Hangzhou, hosted by the National Ocean Technology Center. Representatives from more than ten member countries attended the meeting. Technical seminars and field visits were organized to promote international exchange and cooperation.

On October 23, 2025, the 2025 APEC International Workshop on Integrated Application of Marine Observation Technologies and Ocean Energy was held in Hangzhou, focusing on multi-scenario ocean energy applications and blue economy development.



## Relevant National Events

In 2025, the China National Ocean Energy Industry Development Alliance was officially established, more than 100 representatives from 58 alliance member units across China attended, aiming to promote collaborative innovation, technology transfer, and industrial development.

In 2025, China organized its first dedicated ocean energy equipment investment and financing roadshow to accelerate commercialization of mature ocean energy technologies.



Representatives of China's National Ocean Energy Industry Development Alliance



Ocean Energy Equipment Investment and Financing Roadshow

# Denmark

## Report prepared by:

Kim Nielsen

Development v Kim Nielsen

## Overview

The [Danish Partnership for Wave Power](#) connects the Danish developers, universities, suppliers and service industries. The Partnership promotes a roadmap for development and emphasizes a long-term commitment to Danish politicians to achieve the goal of converting the Danish Wave Power Potential of 4GW into useful clean power.

The Danish wave energy converters (WEC) developers are all international frontrunners (as we Danes see it), building on shared national and international wave energy research and development experience initiated after the energy crisis in 1973 in the UK and Denmark, followed in the late 1970s. The Danish Wave Energy activities in 2025 are described in some detail in the following sections.

## Partnerskabet for bølgekraft

Vi samler den danske sektor for havenergi

**Bølgeenergi er:**

- Mere vedvarende, ægte grøn energi til rette tid som partner til vind og sol
- En skånsom gevinst for vores natur, havmiljø og dyreliv
- En sektor i vækst og udvikling med kæmpe potentiale for Danmark og resten af verden.

**Det danske økosystem for hav- og bølgeenergi består af:**

- Udviklingsvirksomheder inden for bølgeteknologi og -anlæg
- Forskere, universiteter og GTS-institutter, nationale og internationale udviklingsprogrammer, herunder EUDP
- Test- og udviklingsområdet ved Hanstholm
- Specialiserede underleverandører og servicevirksomheder fra den danske offshore og maritime sektor.

**MØD**  
alle de danske  
bølgeenergiudviklere  
på [wavepartnership.dk](http://wavepartnership.dk)

## Supporting Policies for Ocean Energy

### National strategy

Denmark's "National Ocean Energy Policy" is not a standalone framework but a combination of strategies, funding programs, and integration into national climate goals. The country supports wave energy R&D through EUDP, guided by the [Wave Power Strategy \(2013\)](#) and [Roadmap \(2015\)](#), while waiting for the technology to reach commercial maturity.

Offshore wind dominates current marine energy planning, but wave energy has the potential to contribute to a fossil-free Denmark.

Denmark uses Marine Spatial Planning (MSP) mainly for activities offshore. Wave Energy Converters are not yet specified in the offshore and nearshore planning, but will fall under the zones specific for renewable energy in the "[Havplan](#)".



Illustration of the different zones of activity in the sea around Denmark.

### Market incentives

Currently, there are no dedicated feed-in tariffs or subsidies for wave energy. The hope is to replicate the success of Danish wind power: combining project funding with revenue support once demonstration projects prove viability.

### Public funding programmes

Funding via EUDP (Energy Technology Development and Demonstration Programme): established in

2007, it provides grants for pre-commercial projects in renewable energy, including ocean energy. Typical projects have a duration of 3–4 years, with 3–5 partners, and a budget in the region of DKK 2–15 million, with a 40–60% cost share. EUDP has supported nearly 600 projects, raising technologies from lab validation (TRL 4) to near-commercial readiness (TRL 7).

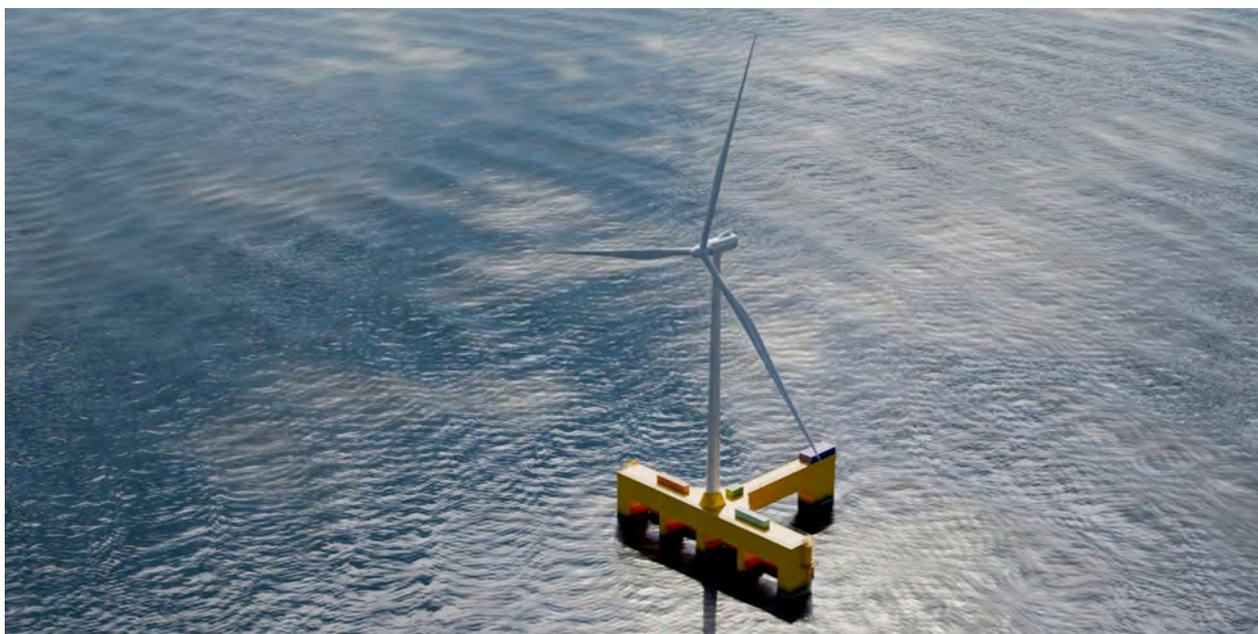
In 2025, EUDP was funding 6 projects related to the Danish Wave Energy Development, which will be described below.

## Research & Development

Researchers from both **Aalborg University (AAU)** and the **Technical University of Denmark (DTU)** are collaborating with the wave energy developers on research projects typically funded by EUDP or the EU. Also, research activities on ocean energy are conducted in-house by each WEC developer and results are to some extent shared under the Partnership meetings.

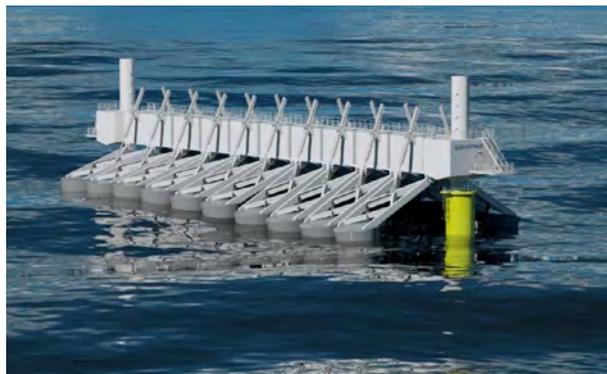
### Key Projects:

- OES Task 10 on Numerical Modelling and Verification.** The funding covers the Danish participation in the Task of the international collaboration on modelling Ocean Energy Converters under OES. It is led by AAU and includes DTU, FPP and Development v Kim Nielsen. The project brings together researchers and technology developers from several countries working together on comparing modelling results of specified test-cases in an open and honest manner, which creates confidence in the results.
- SHY – Seawater Hydraulic PTO,** Horizon Europe, Seawater HYdraulic PTO using a dynamic passive controller for wave energy converters, is led by **Wavepiston** with the industry and research partners DTU, Maynooth University, Marine Systems Modelling, Julia F. Chozas, Applied Renewable Research, PLOCAN, FibronPipe and Leser. The project is funded by the EU Horizon Europe programme.
- COHSI-WEC project** Composites, Hybrid testing and Simulations, EUDP (€3m budget) is led by **Wavepiston** and concerns the development and testing of a lighter, cheaper, and more robust version of its energy collector. DTU and AAU are partners in the project on accelerated testing, numerical modelling, and wave tank testing of their new flexible blades. Full-scale offshore testing of the novel concept is scheduled for completion at PLOCAN, Gran Canaria.
- The HydroFlex** project, coordinated by **Floating Power Plant** (FPP) and involving Aalborg University (AAU) as a partner, focuses on optimizing a combined system of floating wind energy and hydrogen storage, with the potential to integrate wave energy. Floating wind turbines enable the utilization of marine areas that are inaccessible to conventional, fixed-anchored turbines due to water depth, thereby tapping into previously untapped wind energy potential. The HydroFlex project aims to enhance this combined system, with plans to test and demonstrate the new design on a laboratory scale. The final full-scale demonstration is intended to take place within the framework of the SEAWORTHY project.
- The SEAWORTHY project:** (Sustainable dispatchable Energy enabled by wAve-Wind OffshoRe platforms with onboard HYdrogen) is a groundbreaking commercial-scale endeavour that inte-



grates wind, wave, and hydrogen technologies to deliver clean, dispatchable offshore power. Supported by a €26 million grant from the European Commission's Innovation Fund, SEAWORTHY aims to demonstrate the commercial viability of this integrated approach. The project will deploy a platform featuring a 4.3 MW wind turbine, which has already been procured. The wind power will be combined with hydrogen and wave power in a staged approach. The platform is set to be installed at the PLOCAN test site off the coast of Las Palmas, Gran Canaria, Spain, making it the world's first offshore renewable energy-based "green energy on demand solution".

- **Demonstration of a market-mature, profitable, efficient and reliable wave energy plant** is led by **Crestwing** funded by EUDP to optimize and test the PTO system (power take-off) on a test bench at Aalborg University in Esbjerg. Further, **Crestwing** has ongoing research at the Technical University of Denmark (DTU) involving PhD candidate Gergely Kovács, supervised by Professors Yanlin Shao (also member of the Danish mirror group of IEC TC 114) and Jens Honoré Walther and supported by Rune Pilgaard Bloom (Crestwing). Gergely has published the first of two scientific articles entitled "CFD and experimental study of a model-scale two-body hinged raft wave energy converter." In this study, a model of the Crestwing prototype "Tordenskiold" was investigated using a combination of computational fluid dynamics (CFD) simulations and controlled laboratory experiments. The results demonstrate good agreement between numerical and experimental data under moderately nonlinear and nonlinear wave conditions, thereby validating the CFD approach for modelling complex wave-structure interactions.
- The study highlights the importance of nonlinear effects in the performance assessment of hinged raft wave energy converters and confirms the suitability of CFD as a tool for detailed design analysis. These findings represent an important first step toward the optimization of the device, with the ultimate aim of improving energy capture performance and reducing the levelized cost of energy.
- **Wave Star** is working on scaling up their half-scale Wave Star to a full-scale 6 MW Wave Star that will be 120 meters long, with 20 floaters of



diameter 10 meters, 10 floats on each side of the main structure, driving a hydraulic PTO. The structure is fixed to the seabed at a water depth of 20-28 meters and can be protected from storms by hydraulically lifting the floats out of the waves and additionally lifting the entire structure out of the waves. In the future, three wave machines of each 6 MW Wave Star will be built together at a star point with a total of 18 MW. A 15 MW wind turbine will be mounted on this. The entire structure is a floating construction and can be placed in great water depths.

- **WEPTOS** is working on the **EUDP project** "Design and construction of a 1 MW full-scale WEC with 4.5 m rotors suitable for deployment in multiple sea states, including the Danish North Sea, the Mediterranean and regions in Asia."
- **Wave Dragon** is focusing on the development of a 3MW wave power project at Gran Canaria's PLOCAN. The plant consists of a 1.5 MW wave power converter equipped with 2 750 kW wind turbines. Wave Dragon has a long history and much of the historic information and reports can be found on Wave Dragon's new Webpage.

- **OceanSwellEnergy** plan to convert used ships to harness wave energy. The idea is to use single-hull vessels of suitable size/length with OWC's attached to the outside skin on both sides of the hull, coupled to turbines for power conversion to electricity.
- **WaveStarEnergy** could be an up to 250 m long bottom-fixed structure that can be placed in a depth of 20 m, with multiple floats, it will be able to produce up to 6MW.
- **KNSwing** is investigating the incorporation of the OWC system into floating structures. In collaboration with DTU, investigating using active control valves for increased one-way absorption.
- **IEC Standards:** Dansk Standard (DS) is the Danish partner under the international collaboration on standards IEC TC 114: *Marine energy - wave, tidal and other water current converters*. In 2025, Per Velk from DS went on pension and he has been followed by Jonas Dyhr Schneider. The Danish

mirror group consist of Steen Grønkjær Thomsen (Wavepiston), Erik Friis Madsen (Bølgekraftforening), Yanlin Shao (DTU) and Kim Nielsen (Partnerskabet for Bølgekraft). The group met in October 2025 to discuss the latest development under IEC TC 114. Denmark participates in the maintenance groups of:

- MT 62600-100 Power performance assessment of electricity production by wave energy converters. [Kim Nielsen](#)
- MT 62600-103 Guidelines for the early-stage development of wave energy converters: Best practice and recommended procedures for the testing of pre-prototype scale devices. [Kim Nielsen](#)
- PT 62600-104 Guidelines for Research and Development of Small/Tiny Wave Energy Converters. [Yanlin Shao, DTU](#)
- AHG 12 River power performance. [Erik Friis Madsen](#)

## Technology Demonstration

### Projects in the water

[Wavepiston](#) has deployed its Wave Energy Converter in the sea at PLOCAN, Gran Canaria.



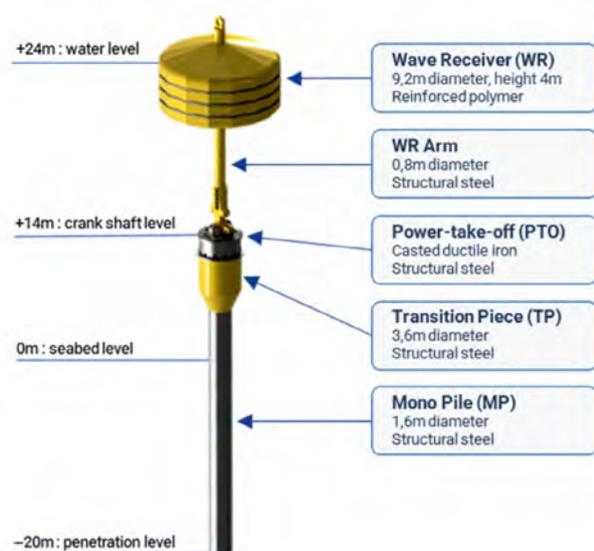
Vital components of the system are being tested and results analysed during 2023-25 in the process toward complete system integration and power production. Wavepiston is a modular, submerged wave

surge attenuator that generates both electricity and desalinated water. Submerged sails surge forth and back, activating pumps that produce high-pressure seawater pumped to a platform or the shore.

### Projects planned for deployment

[Exowave](#) is a bottom-fixed surge WEC generating both electricity and desalinated water. The project is planned to be deployed near Hanstholm. The project [250 MW wave power in the Danish North Sea by 2030](#) - Phase 1 is funded by EUDP, €1.3m and aims at deploying a 100 kW prototype in the North Sea. Exowave is planning to be able to establish a 250 MW wave power plant together with an offshore wind farm before 2030 in Danish waters. The purpose of Phase 1 is to develop and demonstrate a wave power plant with an associated water turbine generator that must be able supply approximately 100 kW of electricity. The project is executed, and concluded an efficiency of the PTO from shaft input power to hydraulic power of 76% to 78% at various pressure setting from 30 bar to 60 bar. The project finished October 2025 with a successful

factory acceptance test of the PTO together with DNV. The full scale 0,35 MWp Exowave WEC Cell is shown below:



2025 Exowave Factory Acceptance Test of PTO

**Crestwing** is preparing to relaunch its prototype, Tordenskiold, for offshore testing before the summer of 2026. Crestwing has, during 2025, been fo-

cused on legal structuring, technical development, financing, and business development.

The new business case involves floating power barges that deliver renewable electricity offshore, enabling charging of electric vessels and supplying power to applications such as aquaculture, oil and gas installations, and offshore wind farm construction and operations.

The technology has undergone further optimization and system upgrades, reducing technical risk and implementing design improvements that prepare the system for future scale-up and commercial deployment.



Tordenskiold (30 × 7.5 × 2.3m with a weight of 65 tonnes)

## Specific Initiatives for International Cooperation

The Danish WEC developers are collaborating with suppliers, engineers, and scientific institutions, as well as engaging through conferences, industry showcases, and international demonstration activities. The cooperation activities extend across several regions, including the UK, Sweden, Norway, the Netherlands, Spain, the United States, and the wider EU. These cross-border interactions support technology validation, supply-chain development, and shared learning on offshore renewable energy and electrification solutions.

## Relevant National Events

In 2025, there were two events that united the Danish WEC Developers. The first was “The Day of Wave Power” (“Bølgeenergiens dag”), hosted by Horten. The second, “Folkemødet på Bornholm”, took place on the small “sunshine” island of Bornholm in the Baltic Sea and gathered Danish politicians and the public. A wide range of topics was discussed, including wave power.

In 2026, the same two events are planned: “Bølgeenergiens dag” in March 2026 and “Folkemødet på Bornholm” in June 2026.



Michael Henriksen (Wavepiston), Lars Wigant (Exowave) and Ruth Bloom (Crestwing) on the stage promoting Wave Power!

# European Commission

## Report prepared by:

**Matthijs Soede** – European Commission

**Evdokia Tapoglou** – EC, Joint Research Centre

## Overview

The European Commission is supporting the development of the ocean energy sector through an array of activities: the Green Deal, the Energy Union and the SET-Plan in particular, and also by stimulating a sustainable blue economy in the EU<sup>i</sup>.

In October 2023, the European Commission presented a communication ‘**Delivering on the EU offshore renewable energy ambitions**’<sup>ii</sup>. It proposes to increase Europe’s offshore wind capacity, including floating wind, to at least 111 GW by 2030, which is nearly twice as high as the ambition set out in the Offshore Renewable Energy Strategy published in November 2020. For ocean energy, it adjusted the timeline, stating that 100 MW of ocean energy capacity is achievable by 2027 and 1 GW by the end of the decade or early 2030’s. EU ocean energy deployment remains modest, with 0.5 MW of new installed capacity added in 2024. Within the EU, France and the Netherlands hold the majority of cu-

mulative tidal-stream capacity, while Portugal and Spain lead wave deployments.

The Commission published as well a revised SETplan<sup>iii</sup> addressing cross-cutting issues, like digitalisation, circularity, clean energy materials, societal needs and skills to accelerate the clean energy transition.

The European Commission cooperates closely with its Member States to increase support for ocean energy and to encourage them to include trajectories for marine renewable energies in their 2030 National Energy and Climate Plans.

The European Commission continued to support ocean energy development via its EU funding programmes. The Horizon Europe programme has launched new calls in 2024. The Innovation Fund support programme was launched in 2020 and published new calls in 2024 for projects on net zero technologies with deadlines in 2025 (24 April 2025). Ocean Energy is listed as a net-zero technology.

## Supporting Policies for Ocean Energy

### European strategy

The European Commission presented the [European Green Deal](#)<sup>iv</sup> in 2019. It is the most ambitious package of measures that should enable European citizens and businesses to benefit from a sustainable green transition. The Green Deal has led to several communications and directives in the following years to achieve its targets.

The [Offshore Renewable Energy Strategy](#) is the key policy initiative released in 2020 to support the development of ocean energy in the EU. It places significant emphasis on the need to continue the cost-reduction of ocean energy technologies to enable the uptake of wave and tidal energy technologies in the EU energy system. In October 2023, the Commission states in its new communication ‘Delivering on the EU offshore renewable energy ambitions’<sup>v</sup> that the EU has made good progress in ocean energy development since the launch of the Offshore Strategy. This has been achieved notably with EU funding for R&I (Horizon Europe/Innovation Fund). However, progress is needed in many areas such as design and validation of ocean energy devices, logistics and marine operations. 100 MW of ocean energy capacity is achievable by 2027 and 1 GW by the end of the decade or early 2030’s.

REPowerEU is a plan for 1) saving energy, 2) producing clean energy and 3) diversifying their energy supplies. The plan sets out a series of measures to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition, while increasing the resilience of the EU-wide energy system. It is backed by financial and legal measures to build the new energy infrastructure and system that Europe needs. It is confirmed that renewables are the cheapest and cleanest energy available, and can be produced domestically, reducing our need for energy imports. REPowerEU will speed up the green transition and spur massive investment in renewable energy.

Following REPowerEU, the European Commission proposed the Net-Zero Industry Act (NZIA) in March 2023. The NZIA entered into force on 29 June 2024 (Regulation (EU) 2024/1735) and is now due to be implemented. It creates the necessary conditions to facilitate investments in net-zero technology manufacturing projects and makes it easier for proj-

ect promoters to build up net zero industrial manufacturing. It does so by addressing the core drivers of net-zero technology manufacturing investments through measures such as i) lowering the administrative burden for net-zero manufacturing projects by streamlining administrative requirements and facilitating permitting, ii) ensuring access to information, iii) facilitating access to markets in public procurement procedures and auctions, as well as schemes aimed at supporting private demand by consumers and iv) supporting innovation through regulatory sandboxes. The EU aims to strengthen its domestic manufacturing capacities of key clean technologies and to increase the competitiveness and resilience of its industry. In 2025, implementation advanced via a Commission Delegated Regulation (23 May 2025) updating NZIA Annex sub-categories and ‘primarily used components’. Under ‘Other offshore renewable technologies’, the Delegated Act explicitly lists tidal stream energy technologies and wave energy technologies as final products; however, no ‘primarily used components’ (PUCs) are defined for either category, reflecting the current lack of standardised components in the sector.

In parallel, the EU electricity market design reform entered into force on 16 July 2024 (amending Directive (EU) 2024/1711 and Regulation (EU) 2024/1747). The reform reinforces the use of longer-term contracting and de-risking instruments, supporting investable frameworks for innovative renewables.

The revised Renewable Energy Directive introduces an indicative target for Member States to dedicate at least 5% of newly installed renewable energy capacity by 2030 to innovative renewable energy technologies, which include ocean energy. To support implementation, the Commission published, on 2 July 2025, a recommendation and guidance identifying barriers and enabling measures for innovative technologies, explicitly referencing ocean energy. The Commission encourages Member States to include targeted policies to support the deployment of ocean energy technologies in the revised National Energy and Climate Plans (NECPs). The national plans outline how the EU Member States intend to address energy efficiency, renewables, emissions reductions, interconnections, and research and innovation. The European Commis-

sion received from all Member States final updated plans in 2024/2025. Only Portugal provides an indicative target of 0.2 GW for the development of ocean energy to contribute to the objective of 1 GW of ocean energy by 2030. Member States were encouraged to include trajectories, thorough planning and targeted installed capacities for deployment of renewable technologies for the next 10 years, with an outlook to 2040, in their final NECPs.

As part of the Clean Energy Technology Observatory the Joint Research Centre of the European Commission has published the report ‘Ocean energy in the European Union - 2025 Status Report on Technology Development, Trends, Value Chains and Markets’<sup>vi</sup> It provides an evidence-based analysis feeding the policy making process and hence increasing the effectiveness of R&I policies for clean energy technologies and solutions. It monitors EU research and innovation activities on clean energy technologies needed for the delivery of the European Green Deal and assesses the competitiveness of the EU clean energy sector and its positioning in the global energy market.

Maritime spatial planning (MSP) is a necessary tool to allocate sea space for different uses of the sea using an ecosystem-based approach and to ensure long-term co-existence and preservation of the ecosystems. The Commission has established an EU MSP Platform for sharing knowledge and experiences, prepared guidance on managing tensions with sectors in competition with ORE and issued best practices for multi-uses of space and cross-border cooperation.

Competitiveness has become a focus for EU policy, including with regard to net-zero technologies. Conclusions of the European Council of April 2024 urged to strengthen the EU’s competitiveness<sup>1</sup>. The new Competitiveness Compass sets out a set of measures to strengthen the EU’s competitiveness in the coming years, building directly on the in-depth analysis from the Draghi report<sup>2</sup>. The Draghi report emphasises the economic opportunities clean technologies represent for the EU, as an innovation leader in clean technologies<sup>3</sup>. At the same time, the

report highlights the main barriers holding back the EU’s competitiveness and calls for an aligned and targeted strategy, taking into account differences between industries. Additionally, the 2025 progress report on competitiveness of clean energy technologies notes that specific attention is needed to increase the economic viability and to bring innovative technology to the market<sup>4</sup>.

In June 2025, the European Commission adopted the European Ocean Pact as a single, coordinated framework bringing together EU ocean-related policies. The Pact spans six priorities, including competitiveness of the sustainable blue economy, support to coastal and island communities (including outermost regions), and strengthening ocean research and innovation. For ocean energy, the Pact is relevant because it foresees an ‘Ocean Act’ by 2027, building on a revision of the Maritime Spatial Planning Directive to strengthen cross-sector planning and sea-basin coordination, and it explicitly recognises that offshore activities—including offshore energy—are increasing pressure on limited maritime space, reinforcing the need for coordinated co-existence approaches.

## Market incentives

In 2020, the European Commission launched the [Innovation Fund](#) succeeding the NER 300.

The Innovation Fund is one of the world’s largest funding programmes for the demonstration of innovative low-carbon technologies and it will provide more than EUR 10 billion of support over 2020-2030 for the commercial demonstration of innovative low-carbon technologies, aiming to bring to the market industrial solutions to decarbonise Europe and support its transition to climate neutrality. The Innovation Fund improves the risk-sharing for projects by giving more funding in a more flexible way through a simpler selection process and is also open to projects from energy-intensive industries. The Innovation Fund focuses on highly innovative technologies, such as ocean energy, and big flagship projects within Europe that can bring on significant emission reductions.

1 European Council (2024), Conclusions from the special meeting of the European Council (17 and 18 April 2024); European Council (2024), Budapest Declaration on the New European Competitiveness Deal (7-8 November 2024).

2 COM(2025) 30 final.

3 Mario Draghi, *The future of European competitiveness*, 2024.

4 COM(2025) 74 final

The Commission supports the ocean energy sector via BlueInvest. This programme aims to boost innovation and investment in sustainable technologies for the blue economy, by supporting readiness and access to finance for early-stage businesses, SMEs and scale-ups. The BlueInvest pilot initiative managed by the European Investment Fund, provides financing to underlying equity funds that strategically target and support the innovative blue economy. This sector can play an important role in the transformation to a carbon-neutral economy by 2050, an ambition announced in the [European Green Deal](#). The programme is backed by the European Fund for Strategic Investments, the financial pillar of the Investment Plan for Europe. This is consistent with CETO evidence that EU venture capital and private equity investment in ocean energy is emerging (EUR 56 million in 2024), but continued de-risking and predictable revenues remain critical for scaling.

## Public funding programmes

Horizon Europe is the successor of Horizon 2020 and the total budget for Research and Innovation is 95.5 billion EUR. The programme started in 2021 and includes topics on ocean energy development under the Climate, Energy and Mobility subprogramme.

CETO report indicates that since 2014, over EUR 365 million has been invested in ocean energy technology projects under Horizon 2020 and Horizon Europe (H2020: 75 projects totalling over EUR 310 million; Horizon Europe: 18 projects totalling EUR 55 million). EU funding in signed ocean energy projects reached over EUR 31 million in 2024, recovering from lower levels in 2022-2023.

In 2022, a call for projects was opened for the demonstration of sustainable tidal energy farms (EU funding budget 40 million euros). Two projects have been selected for funding (SEASTAR and EURO-TIDES).

## Research & Development

An overview of awarded Horizon 2020 and Horizon Europe R&D projects in the last four years and which are still ongoing or just finished, is presented in the table below, focusing on the objective of the newly announced projects. In 2025, eight ocean energy related projects started, five related to wave energy and the remaining considering all types of ocean

In 2023, a call was opened for the demonstration of wave energy farms (EU funding budget 38 million euros). The call was closed in January 2024. 2 projects have succeeded to complete these preparations (ONDEP and Powerfarm EU).

A call for the development of critical technologies for future ocean energy farms was opened in 2024 with a closing date in 2025. Projects could focus on innovative materials, technologies for operation and monitoring, use of artificial intelligence and subsea infrastructure (EU funding budget 8 million Euro). 2 projects have been funded under this call (COIN and FOREST).

The Innovation Fund launched in the end of 2025 a call for net-zero technologies with a total budget of 2.9 billion EUR. Ocean energy is acknowledged as one of these technologies. If the project is successful, the proposed technology should move to the next stage of a large-scale demonstration or first-of-a-kind commercial production. This specific call seems suitable for further development of ocean energy towards the market.

The European Maritime, Fisheries and Aquaculture Fund (EMFAF) is the follow-up of the EMFF programme and runs from 2021 to 2027 and supports the EU common fisheries policy (CFP), the EU maritime policy and the EU agenda for international ocean governance. It provides support for developing innovative projects ensuring that aquatic and maritime resources are used sustainably.

The InvestEU Programme will bring together under one roof the multitude of EU financial instruments currently available and expand the successful model of the Investment Plan for Europe, the Juncker Plan. With InvestEU, the Commission will further boost investment, innovation and job creation.

energy. As indicated by the MTIR framework of the IEA-OES, it is important to invest in infrastructure. A project has been funded to develop an integrated Research Infrastructure for offshore renewables. Information about projects in previous years can be found in earlier IEA-OES annual reports or in the CORDIS database <https://cordis.europa.eu/projects>.

Year	Acronym	Title	Technology developer	Focus
2026	<b>Powerfarm EU</b>	Proving Offshore Wave Energy Farms in Europe	CORPOWER OCEAN AB	Led by CorPower Ocean, the POWER-Farm EU team will deploy the a wave energy farm – a 2.5MW installation composed of 7 world-leading CorPower wave energy converters (WECs) – in the highly energetic North Atlantic ocean near the Orkney Islands.
2025	<b>INESCTEC.OCEAN</b>	Centre of Excellence in Ocean Research and Engineering	INESC TEC	The EU-funded INESC TEC.OCEAN project will establish a centre of excellence in Portugal focused on OR&E, covering key areas such as marine structures, marine robotics, ocean energy and ocean AI digitalisation. The project aims to create a leading hub for science, technology and entrepreneurship, enhancing Portugal's research and innovation culture. Serving as a model for the field, the centre will integrate research, innovation and training to meet market needs and drive the blue economy forward, fostering collaboration between academia, industry and other stakeholders.
2025	<b>WinFES</b>	AI-enabled design and optimization of fully coupled wind-wave integrated floating energy system	University of Liverpool	The project aims to reduce the cost of floating offshore wind by integrating wave energy converters on the same platform and moorings, using AI to optimise wind-wave integrated floating energy systems for higher efficiency and improved motion stability. It will develop fully coupled aero-hydro-servo-elastic models, validate them via real-time hybrid testing, and apply machine learning plus multi-objective optimisation to predict system responses and identify Pareto-optimal designs for deep-sea deployment.

2025	<b>TOLWEC</b>	TOLWEC: Fault diagnosis and fault-tolerant control for reliable wave energy converters	National University of Ireland Maynooth Wavepiston	TOLWEC aims to make wave energy converters more economically viable by developing a multi-level framework for fault diagnosis and fault-tolerant control across the main WEC subsystems (primary converter, power take-off, and electric power converter). By enabling earlier fault detection, maintaining energy production during failures, and optimising the use of sensors and actuators, it targets lower operating and repair costs without significantly increasing installation complexity.
2025	<b>WEC-Pro</b>	Progressing Wave Energy Conversion via Large-Scale Additive Manufacturing	Polytechnic University of Turin	WEC-Pro aims to accelerate wave energy commercialisation by using Large-Scale Additive Manufacturing (LSAM) to simplify WEC design and production and dramatically cut costs—potentially by more than 10×—while upgrading modelling and optimisation tools to include LSAM-specific constraints. The project will develop open-source tools and benchmarking datasets and demonstrate the approach by building and tank-testing fully LSAM-produced models of two WEC concepts (near-shore PivWEC and offshore PeWEC) at INSEAN in Rome.
2025	<b>FOREST</b>	Future Ocean Renewable Energy System Technologies	The European Marine Energy Centre	FOREST will advance ocean energy by developing and validating more durable and reliable subsea components and AI-enabled monitoring tools—such as a 33kV dynamic cable and hub, quick-connector systems, and an optical measurement platform to track device and cable health and optimise array performance—tested at EMEC’s wave and tidal sites.
2025	<b>COIN</b>	Control-Oriented INnovations for future wave energy farms	<a href="#">TU Braunschweig</a>	COIN helps advance ocean (especially wave) energy toward commercial viability by tackling key design and operational challenges with three control-focused innovations: a smart connector system for peak-load limiting and damage prevention, AI-based real-time wave prediction, and a digital-twin health monitoring and health-aware control framework.

2025	<b>CORPACK</b>	CorPack - Turnkey building block for scaling novel wave energy technology into competitive utility-scale wave farms	CORPOWER OCEAN AB	Wave energy could provide around 10% of global electricity and help deliver reliable 24/7 clean power, but past technologies have struggled with durability and cost, limiting investor confidence. CorPower Ocean has demonstrated a storm-protected, high-efficiency wave energy converter (TRL 7) that captures over 5× more power per equipment than prior solutions and is now seeking EIC support to standardize and scale it into 10-30 MW CorPack clusters and utility-scale wave farms, targeting 600 MW installed by 2032.
2025	<b>SeaDream</b>	Sustainable Marine Energy and Ecosystem Resilience Advancement through Digital Technologies and Real-Time Crisis Management		SeaDream is developing a high-resolution, operational at-sea water quality data service that combines local monitoring with advanced modeling. It delivers new information services to improve renewable energy generation and storage decisions without compromising environmental objectives, alongside a collaborative research and training program (secondments, workshops, summer schools) that accelerates uptake across academia, industry, and other stakeholders.
2024	<b>ORION</b>	Novel Digital Components for International Renewable Energy Value Chains	SINTEF AS	The project project will accelerate the twin energy transition of the energy value chain stakeholders by delivering a modular toolbox of digital breakthrough components and validating these components in the use cases of hydro, solar, and wave energy operations across four continents.
2024	<b>Farm-Noise</b>	Farm-noise: AI-based optimization to minimise tidal turbine noise and the impact on marine fauna	Technical University of Madrid	The project will develop simulation-informed surrogate models of tidal turbines and their acoustic footprint to enable the design of large tidal farms that are both energy-productive and significantly quieter. The project will then use machine-learning (reinforcement learning) optimisation and control to automatically balance energy yield and noise emissions for specific sites, accounting for ambient conditions and local fauna.

2024	<b>ONDEP</b>	Ondas De Peniche	AW Energy	Transforming untapped wave energy potential into a reliable and clean energy source for Europe. The ONDEP project aims to harness wave energy to provide clean, reliable power across Europe. It will establish a 2MW wave energy farm in Peniche, Portugal, featuring four WaveRoller® units—making it one of the largest bottom-fixed wave energy farms in the world.
2024	<b>MegaWAvePTO</b>	Modular Electrical Generator PTO system for Wave Mega PTO Wave	CGEN CETO Wave Energy Ireland Mocean Energy	The MEGA WAVE PTO project aims to provide an enabling technology to transform ocean waves into clean, reliable energy. Through this project, an innovative, scalable, reliable, and easily maintainable all-electric modular power take-off (PTO) system for wave energy devices, ranging from kW to MW capacities, will be developed. MEGA WAVE PTO will provide a system that will be adaptable to various sea conditions at different installation sites and able to continue operating even in the event of a partial failure.
2024	<b>SHY</b>	Seawater Hydraulic PTO using dynamic passive controller for wave energy converters	Wavepiston A.S.	The SHY-project is aimed at advancing wave energy by developing key components of a seawater hydraulic power-take-off (PTO) system, coupled with an advanced control strategy. This dual focus aims to reduce the levelized cost of energy (LCOE) while concurrently minimising the environmental impact.
2024	<b>UR4energy</b>	UR4energy: Underwater Robots for efficient ocean energy harvesting	Norwegian University of Science and Technology	UR4energy will tap into vortex wake energy source by developing an efficient way to harvest it by using Underwater Robots.
2024	<b>POHOWEP</b>	Performance Optimization of a Hybrid Offshore Wind-Wave Energy Platform	N/A	POHOWEP is a project which aims to (1) combine a FOWT with Oscillating Water Columns (OWCs) to harness both wave and wind energies and (2) improve the stabilization of the FOWT using the OWCs as an active structural control.

2024	<b>MARES</b>	Marine Reciprocating Superconducting Generator (RSG)	Several companies	MARES aims at developing a next generation of ultrahigh force Superconducting Direct Drive PTOs for wave energy conversion.
2024	<b>MARINERG-i_PP</b>	Marine Renewable Energy Distributed Research Infrastructure - Preparatory Phase	University College Cork	The world is transitioning to more sustainable energy sources and offshore renewable energy has the potential to make a significant contribution. MARINERG-i is developing a plan for an integrated European Research Infrastructure, an independent legal entity, designed to facilitate the future growth and development of the Offshore Renewable Energy sector.
2023	<b>EURO-TIDES</b>	EUROpean Tidal energy pilot farm focused on Industrial Design, Environmental mitigation and Sustainability	Orbital Marin Power Ltd (UK)	EURO-TIDES has been to deliver a 9.6 MW farm of four 2.4MW Orbital tidal energy devices of the same series. The farm will operate in full operational conditions for >10 yrs, expected deployment in 2027.
2023	<b>SEASTAR</b>	Sustainable European Advanced Sub-sea Tidal Array	Nova Innovation Ltd	In the SEASTAR project, coordinator Nova Innovation (Nova) leads a world-class team to deliver a 4 MW array of 16 tidal stream turbines at the EMEC Fall of Warness tidal site in Orkney - the world's first large tidal farm considering the number of tidal turbines.
2023	<b>off-coustics</b>	Minimisation of the offshore wind and tidal turbine acoustic footprint on marine life	Universidad Politecnica de Madrid	For renewable energies to be sustainable in the future, their impact and harmful effects on the environment should be minimum. Off-coustics combines numerical simulations and experiments to provide insights into the physics governing the aero/hydro-acoustic generation and propagation for offshore wind and tidal farms.
2022	<b>MAXBLADE</b>	Maximising tidal energy generation through Blade Scaling & Advanced Digital Engineering	FMC Technologies	The project will specifically focus on delivering a 70% increase in rotor swept area of the technology by addressing design, reliability, condition monitoring, maintenance and control issues relating to tidal turbine blades.

2022	<b>SUREWAVE</b>	Structural Reliable Offshore Floating PV Solution integrating circular concrete floating breakwater	SINTEF	The project will develop and test an innovative concept of Floating Photo-Voltaic (FPV) system consisting of an external floating breakwater structure acting as a protection against severe wave-wind-current loads on the FPV modules, allowing increased operational availability and energy output, thus unlocking the massive deployment of Offshore FPV.
2022	<b>PLOTEC</b>	Tested Optimised Floating Ocean Thermal Energy Conversion Platform	PLOCAN	The project aims to achieve a successful demonstration of novel designs and materials for an ocean thermal energy conversion (OTEC) platform capable of converting solar heat energy stored in the oceans surrounding the Overseas Countries and Territories of the EU, Small Islands and Developing States, and the Asian and African continent into reliable, baseload power with an economical cost model.
2022	<b>NATURSEA-PV</b>	Novel Eco-Cementitious materials and components for durable, competitive, and bio-inspired offshore floating PV structures	Tecnalia	The main objective of the project is to improve the overall lifetime, reliability, and maintainability of marine substructures for offshore floating PVs and thus reduce its LCOE. It will develop innovative structural designs capable of handling the marine conditions, at the same time ensuring the durability and minimizing (un) installation costs.
2022	<b>WEDUSEA</b>	Wave Energy Demonstration at utility Scale to Enable Arrays	New Wave Technologies Ltd (Ocean Energy)	The project led by Irish Wave Energy Developer, Ocean Energy, will demonstrate a grid connected 1 MW OE35 floating wave energy converter (known as the OE Buoy) at the European Marine Energy Test Site (EMEC) in Orkney, Scotland.
2021	<b>EU-SCORES</b>	European Scalable Complementary Offshore Renewable Energy Sources	Corpower	This project will present the benefits of continuous energy production with small space requirements via complementary energy sources (wind, sun and waves). An offshore photovoltaic system will be installed in Belgium co-located with a bottom-fixed wind farm, and a wave energy array in Portugal co-located with a floating wind farm.

2021	<b>FORWARD-2030</b>	Fast-tracking Offshore Renewable energy With Advanced Research to Deploy 2030MW of tidal energy before 2030	Orbital Marine Power	This project will develop a multi-vector energy system that will combine predictable floating tidal energy, wind generation, grid export, battery storage and green hydrogen production.
2021	<b>EuropeWave</b>	Bridging the gap to commercialisation of wave energy technology using pre-commercial procurement	Several wave energy developers	The project will build on the work of Wave Energy Scotland to help Europe's wave energy innovation community transition to commercial viability. To do this, the project uses an innovative 'pre-commercial procurement' approach to identify and fund the most promising wave energy technologies from developers across Europe.

An overview of awarded Innovation Fund projects is presented in the table below. These will be milestones for the ocean energy sector. Due to its nature the actual deployment of the innovative demonstrators/arrays might take some years. The NH1 and FLOWATT projects have been invited for grant preparations. Most likely the projects will start in 2025

Year	Acronym	Title	Technology developer	Focus
2025	<b>NH1</b>	Raz Blanchard project	Normandy Hydroliennes	Raz-Blanchard project is the installation of four x 3MW underwater tidal turbine to generate electricity for a total output of 12MW at Raz Blanchard.
2025	<b>FLOWATT</b>	Construction of a first-of-a-kind pilot tidal energy farm pilot with capacity of 17 MW in French waters at Raz Blanchard that contains 80% of EU's tidal Stream Energy.	Hydroquest	Construction of a first-of-a-kind pilot tidal energy farm pilot with capacity of 17 MW in French waters at Raz Blanchard that contains 80% of EU's tidal Stream Energy.
2024	<b>VianaWave</b>	<a href="#"><u>Accelerating the transition to net zero with large-scale generation of clean electricity from ocean waves</u></a>	Corpower ocean	The projects aim to develop and operate a 10 MW pre-commercial wave energy farm leveraging CorPower's Wave Energy Converter technology. The farm will be located of the coast of Portugal.

2024	<b>SAO</b>	The Saoirse Wave Energy Project	Corpower ocean	The Saoirse wave energy project will be located off the west coast of Clare, and consist of a 5MW wave energy conversion array of approximately 15-16 wave energy units, some 4 kilometers from the coast. Expected entry into operation Q1/2030.
2024	<b>SEAWORTHY</b>	Sustainable dispatchable Energy enabled by wAve-Wind OffshoRe plaT-forms with on-board Hydrogen	Floating Power Plant (DK)	Seaworthy is a mid-size prototype demonstration project aiming to demonstrate dispatchable renewable power supply through smart integration of wave energy converters, a wind turbine, and a full hydrogen system (electrolyzer, storage, and fuel cells) in a single semisubmersible platform.  The goal of the demonstrator, to be tested in Spain, is to advance proprietary PNS-P2X technology from TRL6 to TRL8, by building, testing and operating prototype at a scale considered suitable representative for validation of commercial-scale applications. Expected entry into operation Q3/2028.

Flowatt - [https://ec.europa.eu/assets/cinea/project\\_fiches/innovation\\_fund/101191281.pdf](https://ec.europa.eu/assets/cinea/project_fiches/innovation_fund/101191281.pdf)

NH1 - [https://ec.europa.eu/assets/cinea/project\\_fiches/innovation\\_fund/101191445.pdf](https://ec.europa.eu/assets/cinea/project_fiches/innovation_fund/101191445.pdf)

SAO - [https://ec.europa.eu/assets/cinea/project\\_fiches/innovation\\_fund/101133237.pdf](https://ec.europa.eu/assets/cinea/project_fiches/innovation_fund/101133237.pdf)

SEAWORTHY - [https://ec.europa.eu/assets/cinea/project\\_fiches/innovation\\_fund/101133097.pdf](https://ec.europa.eu/assets/cinea/project_fiches/innovation_fund/101133097.pdf)

Vianawave [https://ec.europa.eu/assets/cinea/project\\_fiches/innovation\\_fund/101191202.pdf](https://ec.europa.eu/assets/cinea/project_fiches/innovation_fund/101191202.pdf)

The European Maritime and Fisheries and Aquaculture Fund (EMFAF) (2021-2027) seek to promote a growth and job based recovery in Europe in the Blue Economy. The fund supports coastal communities in diversifying their economies, finances projects that create new jobs and improve quality of life along European coasts and makes it easier for applicants to access financing. The fund has financed some smaller projects in the past years focussing on environmental aspects supporting ocean energy technology development.

## Ocean Energy EMFAF projects awarded since 2020

More information via

[OpenDataPortal for the European Structural Investment Funds - European Commission](#) | [Cohesion Open Data](#)

Year	Acronym	Title	Technology developer	Focus
2022	<b>FLORA</b>	FLORA (Floating Radar) is an autonomous, in-situ ocean station powered by wave energy and designed for continuous, long-term operational oceanography including bird tracking.	Wedge	The core energy system is based on a [point absorber type] wave energy converter integrated with battery storage. This technology has been developed by us over the past 10 years as a wave energy converter which will now be hybridized with photovoltaic capacity. The real innovation of the project will be the technical compatibility that we will enable between our existing system and a 3D bird radar as well as the associated telemetry.

## Technology Demonstration

### Existing open sea test sites

Currently there are multiple open sea test facilities in the EU, with the most prominent being:

- **BiMEP** (Biscay Marine Energy Platform), a multi-purpose test site located in the Bay of Biscay, off the coast of Armintza in the Basque Country, Spain.
- **Aguçadoura** test site located in Portugal for testing wave and wind technologies.
- **PLOCAN** (Plataforma Oceánica de Canarias), a wave and floating wind test site located in the Canary Islands, off the coast of Gran Canaria, Spain. It is specifically designed to accommodate large-scale prototypes.
- **SmartBay**, a multi-purpose test site located in Galway Bay, Ireland, offering a range of facilities for testing wave, tidal, and offshore wind energy technologies, including a 200-meter long wave tank and a 0.5-MW tidal test site.

### Projects in the water

Ocean energy deployments in the EU remain largely at demonstrator / early pre-commercial scale. In 2024, the EU added 0.5 MW of new installed capacity, mainly from tidal stream, including a 0.5 MW SeaCurrent installation in the Netherlands. Within the EU, France and the Netherlands hold the majority of cumulative tidal stream capacity, while Portugal and Spain lead wave deployments. Many deployments are at TRL 6-7 and are not grid-connected; as a result, they are often not reflected in official capacity and production data.

### Projects planned for deployment

Projects that are currently consented or under construction in the EU account for 36MW and are predominantly located in Denmark, France, the Netherlands, Italy and Spain.

## Relevant Publications

### Communication on the Green Deal

[https://commission.europa.eu/publications/communication-european-green-deal\\_en](https://commission.europa.eu/publications/communication-european-green-deal_en)

### Communication Delivering on the EU offshore renewable energy ambitions

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2023:0668:FIN>

### Communication Revision of the Strategic Energy Technology (SET) Plan

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2023:0634:FIN>

### Communication Net Zero Industry Act

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52023PC0161>

<https://eur-lex.europa.eu/eli/reg/2024/1735/oj/eng>

### Directive promotion of energy from renewable sources

[https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive\\_en](https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive_en)

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023L2413>

### 2025 progress report on competitiveness of clean energy technologies

[https://energy.ec.europa.eu/publications/2025-progress-report-competitiveness-clean-energy-technologies\\_en](https://energy.ec.europa.eu/publications/2025-progress-report-competitiveness-clean-energy-technologies_en)

### Clean Energy Technology Observatory: Ocean energy in the European Union - 2025 Status Report on Technology Development, Trends, Value Chains and Markets

<https://publications.jrc.ec.europa.eu/repository/handle/JRC144366>

### The EU Blue economy report 2025

<https://op.europa.eu/fr/publication-detail/-/publication/0a4a79d8-353f-11f0-8a44-01aa75ed71a1/language-en>

i [https://ec.europa.eu/oceans-and-fisheries/ocean/blue-economy/sustainable-blue-economy\\_en](https://ec.europa.eu/oceans-and-fisheries/ocean/blue-economy/sustainable-blue-economy_en)

ii COM(2023) 668 final

iii COM(2023) 634 final

v COM(2023) 668 final

vi [https://setis.ec.europa.eu/publications/clean-energy-technology-observatory-ceto/ceto-reports-2023\\_en](https://setis.ec.europa.eu/publications/clean-energy-technology-observatory-ceto/ceto-reports-2023_en)

# France

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Marine Hydrodynamics Laboratory, IFREMER

## Overview

The Green Fund's Sea and coastline measure supports projects aimed at strengthening coastal resilience and developing a sustainable blue economy. It is an important lever for implementing the National Strategy for the Sea and Coastline (2024-2030). Encouraging initiatives that promote the sustainable exploitation of maritime resources and the energy transition of offshore activities is part of its priorities.

The OPEN-C Foundation becomes the concessionaire for the Paimpol-Bréhat tidal energy test site, previously operated by EDF. The site is ready to welcome new tidal energy demonstrators and projects.

Even though no new devices were deployed in 2025, various developers have announced the deployment of prototypes (wave energy systems) or farms (tidal turbines) over the next few years (2026-2028).

## Supporting Policies for Ocean Energy

### National strategy

#### French strategy for energy and climate – Multi-year Energy Plan (2025–2030, 2031–2035)

Provided for in the Energy Code since 2015, the Multi-Year Energy Program (PPE) is a tool for steering France's energy policy. It defines the priorities for action in France's energy policy to help achieve carbon neutrality by 2050. It sets quantified targets in the areas of energy consumption and production for the next ten years. Each PPE covers two successive five-year periods. The third PPE, established for the period 2025-2035, is the result of five years of studies and consultations.

The 3<sup>rd</sup> PPE, initially to be delivered in 2025, has not been published yet. However, even though in terms of Marine Renewable Energy, targets are based primarily on the development of offshore wind power, the potential associated with tidal currents is clearly identified in the preliminary 3<sup>rd</sup> PPE, which provides for the possible launch of a commercial tidal energy tender for 250 MW at Raz Blanchard (Alderney Race), with the aim of awarding the contract by 2030. Depending on the results of the first tender and the evolution of technology costs, it also provides for one or more additional tenders, particularly in the same area. The timing will be specified based on the network studies launched by RTE for the connection of these projects.

## Public funding programmes

### The Green Fund's Sea and coastline measure

The Green Fund supports local investments to accelerate the ecological transition in the regions.

In 2025, a new measure dedicated to the sea and coastline was added to the Green Fund to accelerate the transition of maritime activities and implement the National Strategy for the Sea and Coastline (2024-2030).

The Green Fund's Sea and coastline measure supports projects aimed at strengthening coastal resilience and developing a sustainable blue economy. It is an important lever for implementing the National Strategy for the Sea and Coastline (2024-2030), as well as strategic documents for coastal areas and maritime basins.

It incorporates three priorities.

- Preserving and enhancing the coastline: supporting the responsible use of coastal areas and their preservation in the face of climatic and anthropogenic pressures.
- **Supporting the sustainable development of the blue economy: encouraging initiatives that promote the sustainable exploitation of maritime resources and the energy transition of offshore activities.**
- Promoting the ecological transition of maritime infrastructure and heritage: supporting the adaptation of port, maritime, and coastal infrastructure to environmental challenges.

The National Strategy for the Sea and Coastline (SNML) is a joint initiative of the French government, local authorities and the various stakeholders in the sector, including associations, users, trade unions and scientists. The development of marine renewable energies to help achieve carbon neutrality by 2050 is one of the 18 objectives identified in the SNML 2024-2030.

## Research & Development

### Eol-Mer Research Group

Created in 2021 and renewed in 2025 for the period 2026-2029, the EOL-EMR Research Group (Groupe De Recherche - GDR) aims to structure the French academic community involved in wind, marine renewable, and hydraulic energy issues.

Research groups are structures supported by the CNRS (French National Center for Scientific Research) with the common goal of promoting exchanges between CNRS scientists, academic partners, companies, and other stakeholders.

In the field of ocean energy, the GDR Eol-Mer brings together a dozen members from the academic community, whose work focuses in particular on the reliability of converters, their optimization, and improving their survivability in severe storm conditions, with the aim of contributing to making the sector economically viable.

In addition to networking activities for project management, the GDR EOL-Mer contributed in particular to the organization of two workshops in 2025.

The first, dedicated to numerical and experimental methods for the development of tidal turbines, organized by Ifremer and supported by the GDR EOL-

EMR, the Verti-Lab joint laboratory, and industrial partners HydroQuest and Normandie Hydroliennes, provided an opportunity to take stock of ongoing developments in experimental and digital tools that enable the study of tidal turbine response to variations in environmental conditions (regardless of the type of technology) and the accurate estimation of the energy potential of tidal turbine sites.

The second workshop organized by the GdR EOL-EMR, was an opportunity to bring together a large community working on MRE, ranging from the physical sciences to the humanities, to discuss their work.

### OPTILE

The OPTILE project, coordinated by France Energies Marine was completed in 2025.

The objective of the project was to design low-carbon, high-availability power systems for isolated and islanded grids using offshore renewables beyond wind. The project's core is a multi-criteria optimization framework spanning generation, storage, control and grid architecture. It jointly evaluates cost, CO2 footprint, reliability, availability and maintainability across the asset lifecycle, with embedded lifecycle assessment. Marine resources focus

on wave and tidal energy and can be hybridized with offshore wind and floating solar PV, coupled with advanced storage and power conversion. Operational strategies integrate demand-side management to reduce peaks and improve dispatchability.

## Technology Demonstration

### Paimpol-Bréhat tidal test site

The [OPEN-C Foundation](#) becomes the concessionaire for the Paimpol-Bréhat tidal energy test site, previously operated by EDF. The finalization of the transfer of the EDF site to the OPEN-C Foundation was formalized by the prefectural decree of September 18, 2025, approving the new concession for the use of public maritime property.

Since 2023, the OPEN-C Foundation coordinates, develops and manages offshore test sites for floating offshore wind, tidal power, wave energy, offshore hydrogen and floating photovoltaics.

The Paimpol-Bréhat site is ready to welcome new tidal energy demonstrators and projects.

There has been considerable interest, and a consultation process launched in June 2025 will enable the selection of the project(s) that will be tested there between 2027 and 2030.

The outcome of the project is a set of validated design methods and reference architectures enabling bankable, resilient, and decarbonized marine-powered microgrids.

### Interreg SHINES

Open-C Foundation is the lead partner of the SHINES project, (2025-2028) funded by the European Union via Interreg NWE, which aims to create a market framework conducive to the development of tidal energy in North-West Europe. The project main objectives include:

- Real-world testing of three innovative tidal turbines at test sites in France and the Netherlands to validate their performance and integration into the energy mix.
- The development of a strategy targeting 16 high-potential areas in North-West Europe, based on a resource atlas and action plans for the 10 most promising sites.
- Engaging organizations (public, private, and environmental stakeholders) to form local communities of practice to promote the social acceptability of hydrokinetic projects in the regions.



## Projects planned for deployment

### Wave energy

#### Seaturns

The demonstrator at scale  $\frac{1}{4}$  of the Wave Energy Converter developed by the company [Seaturns](#) and initially deployed between October 2023 and September 2024 on the IFREMER open sea test site was redeployed until February 2025 to complete the assessment of the system.

These tests allowed to :

- Confirm a good level of production
- Validate the power export concept
- Study the response of the dynamic cable

In June 2025, Seaturns announced the completion of a successful fundraising round, raising €2.5 million to finance full-scale testing and the launch of the commercialization phase.

Over the summer 2025, a full-scale demonstrator (9m length, 6m diameter, 200 kW power capacity) was assembled with the objective to conduct full-scale sea trials in 2026.

This stage aims to:

- Validate the dynamic behavior of the float in real sea conditions.

- Improve and validate maintenance and operation procedures.
- Confirm the reliability of the energy conversion system (PTO).

The results obtained will enable preparations to be made for the industrialization phase and commercial deployment of the technology from the end of 2026.

#### Dikwe

The [Legendre Group](#) started the construction of the first full-scale demonstrator for the Dikwe project, a wave energy device that combines coastal protection and renewable electricity generation.

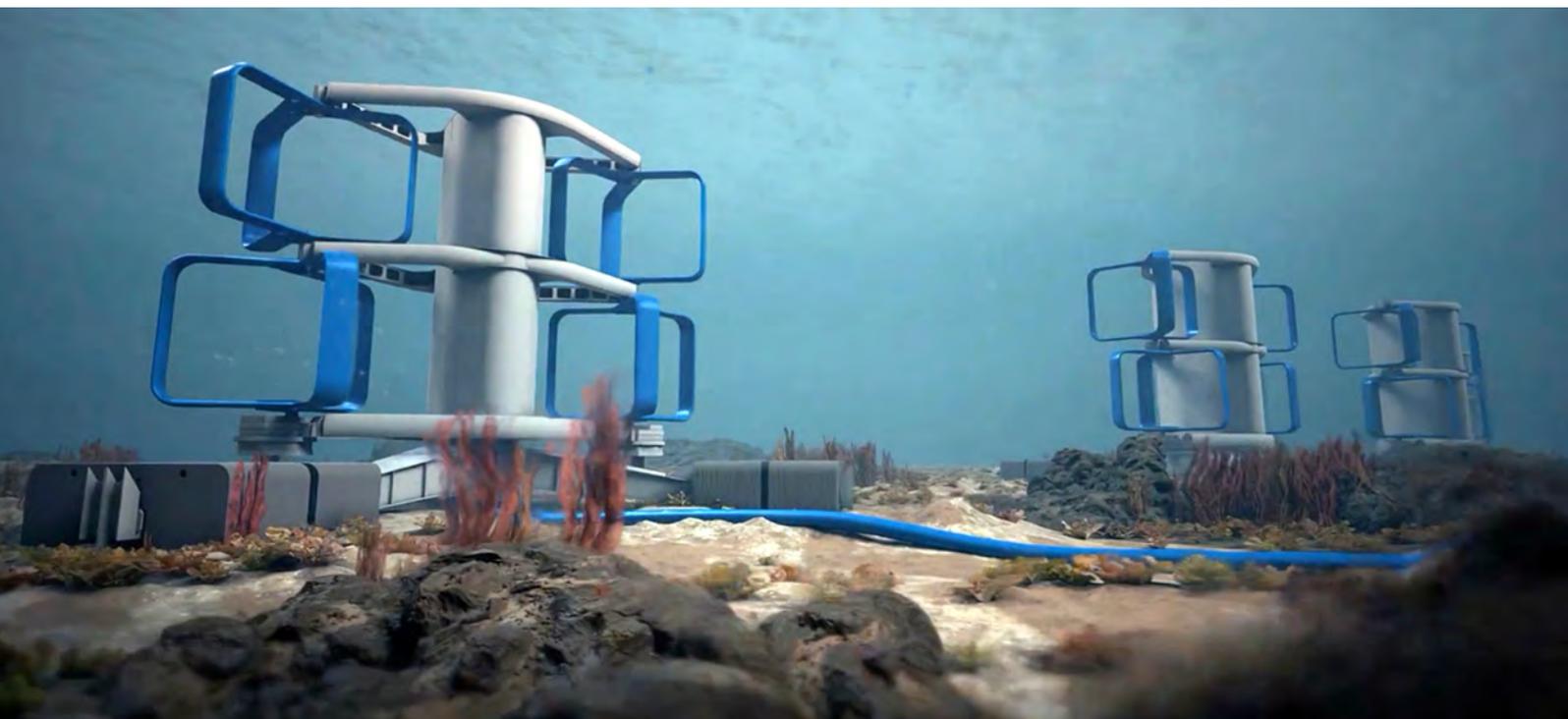


Dikwe project (Legendre©)

The installation of the 330-kW demonstrator to be integrated into the breakwater protecting the port of Boulogne-sur-Mer (France) is scheduled for early 2026.



Seaturns full-scale demonstrator (Seaturns©)



Flowatt project (Hydroquest©)

The technology of caissons equipped with flaps can be integrated directly into a breakwater (inshore) or positioned further offshore, depending on the needs and configuration of the sites.

In order to facilitate the development and deployment of this concept, Legendre and GEPS Techno created in 2025 the joint venture [Wave-Op](#).

## Tidal energy

### FLOWATT

The partners in the FLOWATT project ([Hydroquest](#), [Qair](#), [CMN](#)) have set themselves the goal of deploying a pilot farm in Raz Blanchard by 2028.

This farm will consist of a set of six vertical-axis tidal turbines with a unit capacity of 2.8 MW, for a total installed capacity of 17 MW.

This development project is accompanied by an R&D program, TidalRace, involving various academic partners.

The FloWatt project has received support from the French government (France 2030) in the form of €75 million in investment aid (grants and repayable advances) and a 20-year feed-in tariff for the electricity produced. FloWatt also benefits from a €20 million grant from the European Union's Innovation Fund.

### Normandie Hydroliennes

The NH1 project led by [Normandie Hydroliennes](#) aims to deploy a pilot farm in Raz Blanchard in 2028.

This farm will consist of four AR3000 horizontal axis turbines with a unit capacity of 3 MW, for a total installed capacity of 12 MW.

Normandie Hydroliennes has been selected as a winner of the European Union's Innovation Fund for its NH1 tidal energy project. It will receive €31.3 million in funding to accelerate the development and deployment of this pilot farm.



NH1 Project (Normandie Hydroliennes©)

### Floating PV

[SolarInBlue](#), the company behind the Sun'Sète and Méga Sète projects, has announced the deployment of a floating photovoltaic farm in early 2026.

This pre-commercial demonstrator, with a capacity of 1 MW, will be installed to supply the port of Sète-Frontignan with carbon-free electricity. This Méga Sète project builds on the technological ad-

vances and expertise gained from the deployment of the first demonstrator, Sun'Sète (inaugurated in 2023), which it will replace. The project is funded by ADEME as part of the France2030 program.

## Specific Initiatives for International Cooperation

**MARINERG-I** (Marine Renewable Energy Infrastructure) is a pan-European Distributed Research Infrastructure (DRI) dedicated to advancing the Offshore Renewable Energy (ORE) sector. By consolidating existing research resources, MARINERG-i fosters innovation and sustainability in technologies such as wave, tidal, floating wind, and floating solar. Currently in its Preparatory Phase (2023–2026), MARINERG-i is finalising its establishment as a European Research Infrastructure Consortium (ERIC) to be fully operational by 2029.

MARINERG-i aims to provide open and easy access to a distributed network of world-class facilities and services to a broad community of researchers, developers, and industry leaders worldwide. Its mission is to foster innovation and provide reliable, evidence-based insights to decision-makers to tackle the global climate crisis through the advancement of Offshore Renewable Energy (ORE).

The French Research Infrastructure (RI) **THEOREM** combines the hydrodynamic test facilities of If-

remer Centrale Nantes and Foundation Open-C, the mechanical test facilities for foundations and structures of the Université Gustave Eiffel, and the mechanical and hyperbaric test facilities for marine environment materials and structures of Ifremer, along with the associated skills and experience of these three establishments.

The pooling of these resources and skills aims to support research, development, and innovation projects in the ocean engineering and marine engineering sectors and in particular the Marine Renewable Energy industry.

One objective of the Research Infrastructure, already a partner in the MARINERG-I project, is to become the French representative (national node) of the future MARINERG-I ERIC. Hence, in 2025 and in parallel with its contribution to the MARINERG-I project in its preparatory phase, THEOREM continued its efforts with the French Ministry of Higher Education and Research to obtain all the agreements necessary to achieve this objective.

## Relevant National Events

### Seanergy

The Seanergy Conference is the main annual conference and exhibition in France addressing ocean energy. In 2025, it was held in Paris (June 17-18) and addressed both offshore wind energy and ocean energy. It brought together about 3,000 French and international stakeholders (manufacturers, experts, researchers, institutions, public authorities, etc.), alongside 200 exhibitors.

The Seanergy 2026 exhibition and conference will be held in Nantes (May 19-20).

### United Nations Ocean Conference

The third United Nations Ocean Conference was held in Nice, France (June 9 to 13, 2025). Co-orga-

nized by France and Costa Rica, this global summit brought together 15,000 participants from more than 130 countries to address major challenges:

- Protecting marine biodiversity
- Preserving the deep sea
- Combating illegal fishing and pollution
- Accelerating the maritime energy transition

Marine Renewable Energy (MRE) was part of the discussion and is identified as part of the Nice Action Plan. MRE is a strategic lever for the energy transition and considered as essential to achieving climate goals. MRE provides leverage for the development of innovation. It requires stronger scientific and technical collaboration between countries, as well as financial support to promote large-scale development.

# India

## Report prepared by:

**G. Venkatesan**

National Institute of Ocean Technology (NIOT)

## Overview

India's revised coastline of 11,098 km presents significant opportunities for harnessing ocean energy through wave, tidal, thermal, and salinity gradients for both grid-connected and off-grid applications. The National Institute of Ocean Technology (NIOT), under the Ministry of Earth Sciences, is spearhead-

ing the development of indigenous ocean energy technologies, including initiatives under the Deep Ocean Mission focused on ocean energy and freshwater, the establishment of an OTEC-powered offshore desalination plant, and a hybrid renewable energy plant.

## Supporting Policies for Ocean Energy

### National strategy

India continued to advance its ocean energy ambitions, driven by the Ministry of New and Renewable Energy (MNRE) and the Ministry of Earth Sciences (MoES). India strengthened its global presence by becoming a participating member in the International Electrotechnical Commission's Technical Committee on Marine Energy (IEC TC 114) and actively contributed to the formulation of international standards for ocean energy technologies, including the Ocean Thermal Energy Conversion (OTEC) Power assessment standard. Notably, India now leads a National Technical Committee on Marine Energy (ETDC 54) to review and formulate standards for ocean energy, and participates in the development of international standards as a P-member of IEC TC 114.

The Integrated Ocean Energy Atlas, developed by the Indian National Centre for Ocean Information Services (INCOIS) under the Ministry of Earth Sciences (MOES), is a significant milestone. This comprehensive atlas maps the ocean energy potential within India's Exclusive Economic Zone (EEZ), providing valuable insights for future ocean energy development.

### Market incentives

The Indian government supports ocean energy development through multiple ministries and departments, with the Ministry of New and Renewable Energy (MNRE) funding projects on wave, tidal, and desalination technologies, the Ministry of Earth Sciences (MoES) supporting research under the Deep Ocean Mission, Mission Mausam, and the

REACHOUT programme, and the Department of Science and Technology (DST) providing research funding and fellowship support.

## Public funding programs

Under the Deep Ocean Mission funded by the Ministry of Earth Sciences (MoES), a Detailed Project Report is being prepared for a 10 MW closed-cycle Ocean Thermal Energy Conversion (OTEC) power plant and a 5 MLD open-cycle OTEC-powered offshore desalination plant. In addition, the National

Institute of Ocean Technology (NIOT) will undertake a deep-sea demonstration project to generate energy and freshwater on a floating platform using ocean thermal gradients, comprising a 100 kW gross closed-cycle OTEC module and a 1 lakh litres per day open-cycle OTEC desalination system at a water depth of about 1,200 metres, along with plans to establish a hybrid renewable energy plant utilizing floating solar and wind energy. Furthermore, NIOT is at an advanced stage of establishing a 100 m<sup>3</sup>/day OTEC-powered desalination plant at Kavaratti Island in the Union Territory of Lakshadweep.

## Research & Development

### Energy from ocean thermal gradient

Under the Deep Ocean Mission objective of detailed engineering design for a high-capacity offshore platform-mounted OTEC-powered desalination plant, the process equipment design has been finalized and platform and mooring design activities have commenced based on the finalized equipment layout. Future priorities include the implementation of a demonstration project to showcase offshore energy and freshwater generation using Ocean Thermal Energy Conversion (OTEC), along with the



Flash Chamber



Under Ground Intake sump

establishment of a hybrid renewable power plant utilizing floating solar and wind energy in the Lakshadweep Islands. Furthermore, NIOT is establishing an onshore green renewable energy plant based on OTEC technology at Kavaratti Island to power a new desalination plant and address the island's water needs, with key milestones achieved, including completion of fabrication of open-cycle OTEC turbine components and process equipment, and construction of critical civil structures.

### Collaborative projects under DOM

A range of numerical and experimental research activities covering floating OTEC platforms, deep-sea conduits, green hydrogen, salinity-gradient systems, and ocean thermal gradient-based desalination are being undertaken by academic and national R&D institutions in India in collaboration with the National Institute of Ocean Technology (NIOT) under the Deep Ocean Mission (DOM).



Plant building to house process equipment

## Specific Initiatives for International Cooperation

- **International Symposium on Advancements in Marine Renewable Energy (ISAMRE-2025) – 17-18 March 2025**, organised by the National Institute of Ocean Technology (NIOT), Chennai, bringing together global ocean energy leaders, researchers, and industry experts to discuss advancements in marine renewable energy and related technologies.
- **The 7th International Conference on Ocean Engineering (ICOE-2025) – 14-18 September 2025**, hosted by the Department of Ocean Engineering, Indian Institute of Technology Madras (IIT Madras), Chennai, focusing on the Blue Economy, sustainable ocean engineering and renewable energy systems.
- **Participation in Emerging Science, Technology and Innovation Conclave (ESTIC-2025) – 05 November 2025**, where NIOT and MoES showcased India's ocean renewable energy innovations and engaged with international researchers and stakeholder.

# Ireland

## Report prepared by:

**Victoria Verner and Brendan Cahill**

Sustainable Energy Authority of Ireland (SEAI)

## Overview

Ireland has one of the best offshore renewable energy resources in the world, with a sea area of 490,000 square kilometres which is approximately seven times the size of the country's landmass.<sup>1</sup>

Ireland has committed to halving greenhouse gas emissions by 50% by 2030 and reaching net zero by 2050. The Climate Action Plan 2025<sup>2</sup> (CAP25) is the third statutory annual update to Ireland's Climate Action Plan under the Climate Action and Low Carbon Development (Amendment) Act 2021 and provides a roadmap for achieving these targets. Ireland's offshore renewable energy (ORE) targets to help achieve this are ambitious, aiming to create at least 37GW of ORE generation capacity by 2050,

which is approximately six times our current peak electricity demand. By achieving this target, Ireland has the opportunity to develop an ORE sector to serve our growing domestic needs, create new industrial opportunities in energy intensive sectors, and to grow an ORE industry of a scale that can compete globally.

While fixed and floating offshore wind are expected to play the dominant role in providing energy from our ocean, wave energy, and other forms of ocean energy can contribute if they secure a route to commercial viability, building on Ireland's long track record of innovation in this sector.

## Supporting Policies for Ocean Energy

### National strategy

#### Future Framework for Offshore Renewable Energy – 2025 Review<sup>3</sup>

The Future Framework for Offshore Renewable Energy includes 29 key actions to develop Ireland's long-term, plan-led approach to offshore renewable energy. The Future Framework includes 29 key actions to develop on Ireland's strategic long-term approach and national ambition. One component

of the Future Framework Policy Statement is a built-in annual review process to ensure consistency with Ireland's evolving ORE sector and to reaffirm Government's commitment to energy targets. The Future Framework 2025 Review, published in May 2025 captures ORE sectoral progress in the last year. This report provides a detailed progress update on each of the 29 actions under the Future Framework as well as an updated action plan for the coming year.

<sup>1</sup> [Transition of Offshore Renewable projects announced](#)

<sup>2</sup> [Climate Action Plan 2025](#)

<sup>3</sup> [Future Framework for Offshore Renewable Energy](#)

## Policy development for Marine Consenting

In response to the requirements of the EU Directive 2014/89/EU, the Irish government established the National Marine Planning Framework (NMPF) during 2021. The NMPF brings together all marine-based human activities, outlining the Government's vision, objectives, and marine planning policies for each marine activity. The NMPF sets out the proposed future approach to the adoption of spatial designations for marine activities including offshore renewable energy development, whilst taking account of the existing network of designated European sites under the Birds and Habitats Directives<sup>4</sup>.

As part of the NMPF and set out in the Maritime Area Planning Bill, an Offshore Renewable Energy (ORE) Designated Maritime Area Plan (DMAP) has been established to set out Ireland's future development for ORE. The DMAPs will develop a multi-activity area plan which will promote the co-existence and co-location of offshore renewable activity with other marine usages and activities. In 2024, the south coast DMAP was approved by the Oireachtas (Houses of the Irish Parliament) which has identified four sites for the future development of offshore wind-farms off the south coast of Ireland. In May 2025, the Minister for Climate, Environment and Energy, Darragh O'Brien, announced the commencement of work on the preparation of a National Offshore Renewable (ORE) Energy Designated Maritime Area Plan (DMAP), with the aim to designate sufficient maritime area to deliver a target of 20GW of offshore renewable energy by 2040.

## Offshore Renewable Energy Technology Roadmap<sup>5</sup>

This document maps the pathway to harnessing Ireland's ORE potential to drive. The Roadmap assesses the potential 2050 operating capacity of key ORE and offtake technologies across four scenarios with different levels of ambition. While the Roadmap indicates that fixed and floating offshore wind should play the dominant role in providing energy from our ocean, wave and other forms of ocean energy can contribute if they secure a route to commercial vi-

ability. A review of the 50 published recommendations commenced in 2025.

## SEAI Offshore Renewable Energy Innovation Roadmap

To build on and complement the 2024 ORE Technology Roadmap, an Innovation Roadmap is being developed to support the development of the technologies and ancillary activity required to achieve Ireland's deployment ambitions. This study will consider the research, innovation, funding, and enabling mechanisms required to accelerate progress across the sector, including wind, wave and other emerging ORE technologies. The consultation phase of this work has commenced with the aim of completing the exercise in 2026.

## Market incentives

The Renewable Electricity Support Scheme (RESS) provides support to renewable electricity projects in Ireland. It is an auction-based process where renewable energy projects compete against each other by bidding their lowest price offer to win contracts to provide electricity at the bid price for a twenty-year period. With a primary focus on cost effectiveness, the RESS delivers a broader range of policy objectives, including:

- Providing an Enabling Framework for Community Participation through the provision of pathways and supports for communities to participate in renewable energy projects.
- Increasing technology diversity by broadening the renewable electricity technology mix.
- Delivering an ambitious renewable electricity policy to 2030.
- Increasing energy security, energy sustainability and ensuring the cost-effectiveness of energy policy.<sup>6</sup>

In 2023, Ireland ran its first-ever Offshore Renewable Energy (ORESS) auction, which procured just over 3GW of capacity from four offshore wind projects, which will deliver over 12 TWh of renewable electricity per year. The second offshore auction (ORESS 2.1) commenced in 2025 after the approval of the inaugural south coast DMAP under the new plan-led

<sup>4</sup> National Marine Planning Framework

<sup>5</sup> Offshore Renewable Energy | Technology Roadmap | SEAI

<sup>6</sup> Renewable Electricity Support Scheme (RESS)

regime. Within this competitive process, ESB and Ørsted Joint Venture won the provisional rights to develop the Tonn Nua site in a competitive auction<sup>7</sup>. Currently in an early phase of development, once completed, the site will span 306 square kilometres with expected capacity output of approximately 900MW, enough energy to power almost one million homes based on the wind prevalence in the area.

Additionally, the Government is working towards the next planned auction for Area B in the South Coast DMAP. Work with EirGrid to develop grid connection options for the site, named ‘Lí Ban’, is already at an advanced stage, and DCEE is making arrangements for geophysical, metocean and other surveys to inform this auction.<sup>8</sup>

## Public funding programmes

### SEAI Research, Development and Demonstration Fund

The SEAI National Energy Research Development and Demonstration (RD&D) Funding Programme invests in innovative energy RD&D projects that contribute to Ireland’s transition to a clean and secure energy future. The key programme objectives include the following:

- Accelerate the development and deployment in the Irish marketplace of competitive energy-related products, processes, and systems.
- Support solutions that enable technical and other barriers to market uptake to be overcome
- Grow Ireland’s national capacity to access, develop and apply international class RD&D

## Research & Development

### Nationally Funded R&D Projects

SEAI maintains a comprehensive and searchable database of energy research projects supported by national funding, including ocean energy focused projects awarded to companies to advance technology solutions and to academic institutions to deliver fundamental and cross-cutting research<sup>9</sup>.

- Provide guidance and support to policymakers and public bodies.

This programme operates annual calls for proposals and has been an active funder of ocean energy-related projects in recent years.

### SEAI/LIR NOTF Industry access programme

The Sustainable Energy Authority of Ireland (SEAI) funds an industry access programme at the LIR National Ocean Test Facility (NOTF) at University College Cork to enable the testing and progression of ORE technologies through the early development stages before open sea testing. The industry access fund is open to any type of ORE technology (wave, wind, tidal, floating solar) that can be tested at the Lir NOTF. In 2025, the programme opened a fifth call for applications of ORE technologies that are eligible to test their scaled-down physical model at the test site. A total of seven projects, four wave and three tidal applications, were successful from the competitive process, funding a total of 35 days of tank testing time.

### Clean Energy Transition Partnership

SEAI is one of 40 funding agencies active in the annual Clean Energy Transition Partnership (CETP) Joint Calls, which pool national and regional R&I funding with EU co-funding. SEAI has supported ocean energy-related projects under Call Module 2025-03 A/B: *Advanced renewable energy (RE) technologies for power production*.

### EU Funded R&D Projects

Ocean Energy projects that Irish partners participated in during 2025 through European-funded programmes include:

- **H2020, EU-SCORES:** The project ‘European Scalable Offshore Renewable Energy Source’ will demonstrate the combination of offshore wind

<sup>7</sup> [ESB and Ørsted Joint Venture wins the provisional rights to develop the Tonn Nua site in offshore wind auction](#)

<sup>8</sup> [ORESS Tonn Nua Offshore Wind Auction](#)

<sup>9</sup> <https://www.seai.ie/seai-research/research-database>

with wave- and offshore solar PV energy. This will pave the way for bankable multi-source offshore parks across Europe by 2025. These multi-source parks will use offshore space more efficiently and balance the electricity grid to achieve a resilient and cost-effective 100% renewable energy system. Exceedence Ltd are the Irish project partners.

- **H2020, FOWARD2030:** The project ‘Fast-tracking Offshore Renewable energy With Advanced Research to Deploy 2030 MW of tidal energy before 2030’ aims to accelerate the commercial deployment of floating tidal energy. The project consortium seeks to develop a multi-vector energy system which will combine predictable floating tidal energy, wind generation, grid export, battery storage and green hydrogen production. Irish partners are MaREI-UCC.
- **HORIZON EUROPE, WEDUSEA:** Wave Energy Demonstration at Utility Scale to Enable Arrays will demonstrate a grid-connected 1 MW OE35 floating wave energy converter (known as the OE Buoy) at the European Marine Energy Test Site (EMEC) in Orkney, Scotland. Ocean Energy and the University College Cork are the Irish project partners.
- **HORIZON EUROPE, SEETIP Ocean:** SEETIP supports the activities of both the European Technology & Innovation Platform for ocean energy (ETIP Ocean) and the Strategic Energy Technology plan (SET Plan) Ocean Energy Implementation Working Group. SEAI are project partners of SEETIP. The project was completed in 2025.
- **HORIZON EUROPE, SEASTAR:** In the SEASTAR project, coordinator Nova Innovation (Nova) leads a world-class team to deliver a 4 MW array of 16 tidal stream turbines at the EMEC Fall of Warness tidal site in Orkney - the world’s first large tidal farm, which will contain more tidal turbines than are currently deployed worldwide. Irish partners include Wood Group Kenny Ltd. and Ocean Wave Venture Ltd.
- **HORIZON EUROPE, MEGA WAVE PTO:** The MEGA PTO Wave project aims to provide an enabling

technology to transform ocean waves into clean, reliable energy. Through this project, a smart, scalable system will be created that adapts to changing conditions and keeps working even if a part of the system experiences a fault. Sea Potential (Ireland) Limited (formally Pure Marine Gen Ltd) and CETO Wave Energy Ireland Ltd are the Irish partners of the project.

- **HORIZON EUROPE, SHY:** The SHY project will develop a composite linear pump and controller valve that uses seawater as the working fluid and enable the use of a dynamic passive controller to maximise the power capture. The National University of Ireland, Maynooth are the Irish partner.
- **Innovation Fund, SAO:** The Saoirse Wave Energy Project is a first-of-a-kind 5 MW wave energy development project that was initially to be developed off the coast of County Clare by ESB. However, the project now plans to move to another European site<sup>10</sup>.
- **Interreg NWE: Offshore Renewable Energy Sustainability Alliance (ORESAs):** is a consortium of diverse partners from industry, government and research institutes, from 5 NWE countries, aiming to address challenges and accelerate the transition to sustainable offshore renewable energy by empowering SME’s to convert their innovation to lasting solutions. SEAI and Exceedence Ltd are project partners.
- **Interreg Atlantic Area: High Potential Test Sites (HiPoTeSis)<sup>11</sup>:** The HiPoTeSis project aims to accelerate the industrialisation of floating offshore wind by enhancing cooperation between European test sites. Coordinated by Fondation OPEN-C, it brings together five partners from the Atlantic façade (SEAI, BIMEP, CEO, PLOCAN and OPEN-C) and three associated partners (IREC, EMEK, CNR), providing a broader perspective that includes other European maritime basins.
- **Interreg NWE – Showcasing Hydrokinetic Energy Innovations for Northwest European Energy Sovereignty (SHINES)<sup>12</sup>:** The SHINES project aims to demonstrate three innovative technologies in real-world conditions with the goal of proving that

<sup>10</sup> ESB Emerging Technology Insights 2025

<sup>11</sup> HiPoTeSis – Atlantic Area

<sup>12</sup> Home | SHINES

hydrokinetic energy can play a key role in Europe's energy transition. The Irish partners in SHINES are ORPC Ireland, the Marine Institute, and ÉireComposites Teo, and the project will include resource characterisation of potential tidal energy deployment locations in Irish waters.

- **Clean Energy Transition Partnership CETP - Instant Force & Model Predictive Control for Ocean Energy Power Take-Off with high Fidelity (INFINITY)<sup>13</sup>**: The main objective of INFINITY is to develop an innovative power take-off (PTO) design and a non-linear control system that can accelerate wave energy deployment in Europe by address-

ing the technical and financial barriers that have limited commercialisation. Multi partner project – Irish partner is the National University of Ireland, Maynooth.

- **Clean Energy Transition Partnership CETP - SEASNAKE+<sup>14</sup>**: The main objective of SEASNAKE+ is to scale-up and demonstrate (TRL6-7) the dynamic medium voltage cable (dMVC) with improved lifetime by: easy clean paint; in-line in-situ paint application chamber; in-situ cleaning robot; giving the cable new and scalable protection system and monitoring system. Multi partner project – Irish partner is Ocean Wave Venture Limited.

## Technology Demonstration

### Test infrastructure

#### Lir National Ocean Test Facility<sup>15</sup>

The Lir National Ocean Test Facility (NOTF) is a world-class centre for renewable energy and marine research, located in the UCC Beaufort Building in Ringaskiddy, Co. Cork. Lir is a custom-designed test facility that features upgraded and expanded tanks and equipment for the testing of small-scale Ocean Energy renewable devices with TRL ranging from 1 to 4. Lir is an essential part of Ireland's Ocean Energy research and testing infrastructure and provides a significant launch pad for both national and international marine renewable energy developers. Testing infrastructure includes:

- A Deep Ocean Wave Basin (circa 1:15 scale testing).
- The Open Ocean Emulator, an ocean wave basin with a sophisticated 2-sided paddle system and a two-sided absorption system (circa 1:50 scale testing).
- A wave and current flume with coastal/tidal testing capabilities (circa 1:50 scale testing) and a wave demonstration flume.
- Mechanical and electrical workshops.

- Electrical testing infrastructure, including a smart grid and a series of linear and rotary rigs used to test power take-off and energy storage.

#### Atlantic Marine Renewable Energy Test Site (AMETS)

The Atlantic Marine Energy Test site, located west of Belmullet Co. Mayo, is being developed by the SEAI to facilitate testing of full-scale wave energy converters and floating offshore wind technology devices in an open ocean environment.<sup>16</sup>

#### MARINERG-i<sup>17</sup>

Is developing a scientific and business plan for an integrated European Research Infrastructure, designed to facilitate the future growth and development of the Offshore Renewable Energy sector. MARINERG-i is coordinated by University College Cork.

## Projects in the water

#### Ocean Energy Ltd.

Deployed its 826-ton wave energy convertor buoy, the OE-35, at the US Navy's Wave Energy Test Site

<sup>13</sup> INFINITY – Hybrid testing of the “InfinityWEC” wave energy converter power-takeoff (PTO) system, with lifetime-aware model-predictive control algorithms.

<sup>14</sup> SEASNAKE+ | CETPartnership

<sup>15</sup> Lir National Ocean Test Facility

<sup>16</sup> Ocean Test Sites In Ireland | Ocean Energy | SEAI

<sup>17</sup> Our Facilities that we operate from | MARINERG-i

(WETS) on the windward coast of the Hawaiian Island of Oahu<sup>18</sup>. SEAI provided funding support to this project alongside the US Department of Energy.

### AMETS Floating LiDAR Buoy

SEAI deployed a floating LiDAR buoy at AMETS in September 2025 to collect crucial wind, wave, and metocean data to support the assessment of renewable energy potential in the Atlantic and inform future development of floating wind and wave energy technology.<sup>19</sup>

## Projects planned for deployment

### WEDUSEA

The WEDUSEA project will demonstrate a grid-connected 1MW OE35 floating wave energy converter being developed by Irish company Ocean Energy at the European Marine Energy Centre's test site in Orkney, Scotland. The project has a planned deployment date at the end of 2026. The project includes multiple Irish partners: Ocean Energy, University College Cork, Exceedence Ltd and Gavin and Doherty GeoSolutions.

## Specific Initiatives for International Cooperation

### Atlantic Maritime Strategy- Pillar III - Marine Renewable Energy<sup>20</sup>

The main objective of the European Commission's Atlantic Action Plan 2.0 is to unlock the potential of the blue economy in the Atlantic area while preserving marine ecosystems and contributing to climate change adaptation and mitigation. The plan includes four pillars that are interconnected and trans-regional by nature and address key challenges and aim to foster sustainable blue growth and contribute to greater territorial cooperation and cohesion in the EU Atlantic area.

Pillar III Marine renewable energy (MRE) sets one specific goal; namely, to promote carbon neutrality through MRE in the Atlantic area. It sets out a num-

ber of actions to encourage innovation and foster collaboration between the four Member States to help them achieve the goal. In July 2024, the third term of Pillar III commenced with Ireland reappointed as the Pillar lead for Marine Renewable Energy (Action Plan 2024-2026).

### Ocean Energy Implementation Working Group – SET Plan

Ireland representation on working group, the groups objective is to develop research and roadmaps that set out the goals and actions for the wave and tidal sector. The working group is composed of representatives from the EU countries, regions and other stakeholders.<sup>21</sup> Membership of this group will continue into 2026.

<sup>18</sup> [Irish wave energy pioneer deploys grid-scale device at US Navy Test site in Hawaii - Ocean Energy Europe](#)

<sup>19</sup> [Green Rebel awarded floating LiDAR contract for Irish wind and wave energy test site - Offshore Energy](#)

<sup>20</sup> [Homepage | Atlantic Strategy](#)

<sup>21</sup> [Ocean Energy - SETIS - SET Plan information system - European Commission](#)

## Relevant National Events

### Events in 2025

- **European Maritime Day 2025:** From May 22–23, the city of Cork became the heart of Europe’s maritime conversation as it welcomed over 1,000 participants from across the continent and beyond for European Maritime Day. The need to accelerate climate adaptation and expand offshore renewable energy was emphasized as essential to achieving Europe’s climate neutrality goals. Drawing on recent sustainability reports, experts highlighted the importance of scaling up wind, wave, and other marine renewables, while recognizing the increased spatial demands this growth will bring.
- **The 12th Atlantic Stakeholder Platform Conference (ASPC 2025)** took place on November 13, 2025, in Galway, Ireland, under the theme “Tides of Cooperation: The Atlantic Strategy as a Catalyst for the European Ocean Pact”. Hosted during Ireland’s presidency of the Atlantic Strategy Committee, it showcased Atlantic Action Plan 2.0 achievements.
- **Research to Policy Seminar Series: Navigating the Future:** Research and Innovations shaping offshore renewable energy: SEAI places a priority on ensuring that the research it funds is connected to policy development. The objective of the Research to Policy Seminar series is to ensure that energy policy development and implementation are informed by the most current expertise available, and that researchers are aware of current and future energy policy priorities. A dedicated session focused on offshore renewable energy research took place on 13th May 2025

### Relevant events planned for 2026

- **Atlantic Strategy Pillar III:** this webinar - organized by Atlantic Pillar Coordinator III in collaboration with the Ireland National Hub - *Bridging the Gap: Addressing Barriers to Large-Scale MRE Innovation Deployment Across Atlantic Regions*, brings together policymakers, developers, and research stakeholders to explore the systemic obstacles limiting MRE roll-out and to exchange experiences from across Atlantic member states. January 2026
- **Maynooth Wave Energy Workshop 2026:** 10th workshop hosted by the Centre for Ocean Energy Research (COER) at National University of Ireland, Maynooth, covering a range of topics across wave energy conversion with two technical sessions, and an industry and policy session.
- **Marine Renewables Industry Association:** The MRIA represents and promotes the development and implementation of policy for Marine Renewables Emerging Technologies. The annual MRIA Forum takes place annually in February of each year.
- **SET Plan Conference:** The 20th Strategic Energy Technology (SET) Plan Conference will be held in Ireland in late 2026 in connection with the Irish Presidency of the EU.

# Italy

## Report prepared by:

Luca Benedetti, Matteo Gianni, Antonio Rizzi

Gestore dei Servizi Energetici

## Overview

In the wake of the past years, 2025 was also characterized by a reduced rhythm of marine projects development. Nevertheless, some relevant advances concerning ocean energy occurred, especially regarding projects with an already defined development path, which continued their way towards technological maturity. From a strategic point of

view, relevant preparatory work has been carried out for the implementation of new public funding plans, considering both capital grants and market incentives, also including NRRP resources. These changes are described in the report, together with the annotation of the most relevant 2025 events.

## Supporting Policies for Ocean Energy

### National strategy

#### NECP 2024

In 2024 an updated version of the National Energy and Climate Plan (NECP) was presented, defining national strategy towards 2030 targets. Although the largest contributions in the electricity sector are expected from photovoltaic and wind energy, all energy sources should play an important role. In NECP it is highlighted that energy resource deriving from the sea (marine energy) has great potential both for the amount of power available globally and for its power density, estimated to be over 20 times that of the wind resource, and its greater predictability. In Europe, the availability of marine energy resources is greatest along the Atlantic coast (Ireland and Scotland). However, the Mediterranean Sea also offers interesting opportunities for both energy production and technology development.

From ENEA assessments, it emerged that the areas with the highest wave energy potential are the western coasts of Sardinia and the Sicily Channel, where the average energy flow fluctuates between 10 and 13 kW/m. Strengthening the role of energy from the sea in the Mediterranean now appears more of a necessity than a choice, as evidenced by the growing interest of local authorities (e.g. the Italian ANCIM - National Association of Minor Island Municipalities). A great effort is therefore underway by the national scientific community to develop devices for converting wave motion into electrical energy, following shared methodologies for the evaluation of their level of technological maturity (TRL) and converging towards a limited number of optimal solutions that avoid the dispersion of funding and skills. Research and development activities are supported by financing instruments that operate on two levels: (i) basic research for innovative technologies and (ii) the development of pilot and demonstra-

tion projects. The objectives of national research and development activities are in line with those established by the “Ocean Energy” working group of the European Strategic Plan for Energy Technologies (SET-Plan). In this context, Italy, represented by ENEA, presides over the collaborations between the Member States interested in energy from the sea. The R&D activities are also in line with those proposed by the Joint Research Program Ocean Energy of the European Energy Research Alliance (EERA).

## NRRP

The National Recovery and Resilience Plan (NRRP), the national plan functional to access the funds allocated in the Next Generation EU area, aims at giving a strong impulse for a rapid restart after the pandemic impact on the country’s society and economy. Within NRRP, a specific investment (Green Islands) provided dedicated resources to the development of innovative plants and solutions, including marine energies.

## 2026–2028 Marine Plan

In June 2025, the Department for Marine Policies launched a consultation with public and private stakeholders to gather opinions and input for the preparation of the 2026-2028 Marine Plan. The web portal of the Department of Marine Policies contains the contributions of the stakeholders who authorized its publication, divided by each area of the Marine Plan, including the marine energy section, in which 5 contributions were received as of June 2025 from the BIG Consortium, CONISMA (National Interuniversity Consortium for Marine Sciences), OGS (National Institute of Oceanography and Experimental Geophysics), CNS (National Council of Geologists) and Edison.

## Market incentives

With the Decree of 7 August 2025, the Ministry of the Environment and Energy Security (in agreement with the Ministry of Agriculture) introduced amendments to the RES 2 Decree (Decree 06/19/2024), which was issued to support the production of renewable electricity from innovative technologies or with high generation costs, through the definition of incentives that stimulate their competitiveness and allow them to contribute to achieving the 2030 decarbonisation objectives. The objective of the RES 2 is to build 4.6 GW of plants by 31 December 2028 us-

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**Strengthening the role of energy from the sea in the Mediterranean now appears more of a necessity than a choice, as evidenced by the growing interest of local authorities.**

ing a series of technologies, including energy plants from tidal energy, wave motion, other forms of marine energy and offshore floating PV, with a dedicated quota of 200 MW. The first competitive procedure for such technologies is expected in 2026.

The Directive 2014/89/EU on Marine Spatial Planning is also relevant for the specific Blue Energy Sector, as it establishes a framework for the implementation of maritime spatial planning and integrated coastal management by Member States, aimed at promoting the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources. The Directive has been transposed into the Italian legislation via the Lgs. D. 201/2016.

## Public funding programmes

The “Green Islands Program” was launched by the Ministry of the Environment and Energy Security. The Program has a budget of 200 million Euros provided by Investment 3.1 of the National Recovery and Resilience Plan (PNRR), Mission 2 Component 1. The Program is aimed at promoting the improvement and strengthening, in environmental and energy terms, the Municipalities of the 19 smaller non-interconnected Islands, through the promotion of renewable energies, the implementation of integrated energy and water efficiency projects, sustainable mobility, waste cycle management and circular economy. The Program is aimed at the 13 Municipalities of the 19 non-interconnected smaller islands. Among the projects presented by the municipalities in April 2022, the installation of systems for the production of renewable energy from wave motion is planned on two islands. In September 2022, through a directorial decree, a formal approval was given to the presented projects, which will have to be realized by August 2026.

## Research & Development

### Research activities: companies

#### RSE

Ricerca sul Sistema Energetico SpA has always been engaged in analyses, studies and research applied to the entire energy sector. Through the funding of the Ricerca di Sistema fund, which supports the research and development activity aimed at technical and technological innovation of general interest to the electricity sector in Italy, RSE has been carrying out activities on ocean energy since 2012. The main focus is the mapping of marine energy resources along the Italian coastline, which can be retrieved from the Integrated Atlas for the National Energy System and Renewable Sources (<https://atlanteintegrato.rse-web.it/>).

#### ENEA

The national agency for alternative energies has long been involved in ocean energy research. ENEA has developed two innovative models to estimate the production of energy from the sea, thanks to high-resolution forecasts of waves and tidal currents in the Mediterranean:

- **MITO:** capable of providing forecasts on the temperature, salinity and speed of sea currents with spatial detail ranging from 2 km up to a few hundred meters, as in the case of the Straits of Gibraltar, the Dardanelles and the Bosphorus;
- **WAVES:** the wave prediction system that guarantees resolution up to 800 meters in marine and coastal areas with high energy potential. Both models use the ENEA supercomputer “CRESCO6”.

In the Mediterranean Sea, the areas with the highest potential for wave energy are the western coasts of Sardinia and Corsica, but also the Strait of Sicily and the coastal areas of Algeria and Tunisia, where the average energy flow fluctuates between 10 and 13 kW/m. In addition to the waves, a novelty has been introduced in the model: local tides and those transmitted from the Atlantic through the Strait of Gibraltar have been included.

In Italy, tidal energy can be extracted mainly in the Strait of Messina. Together with the Strait of Gibraltar, this area shares the record as the most prom-

ising site in the Mediterranean: in fact, thanks to the exploitation of its currents that reach speeds of over 2 meters per second, the production of energy could reach 125 GWh per year, an amount sufficient to meet the energy needs of cities like Messina itself.

#### Cluster BIG

Cluster “Blue Italian Growth” (BIG) is the only National Technology Cluster for the Italian Maritime Economy, established and recognized by the Ministry of Universities and Research to strengthen the connection between research and business, universities and industries, and the public and private sectors. The CTN-BIG brings together over 90 universities, research centers, businesses, and trade associations, with the aim of promoting not only innovation and competitiveness in the Blue Economy system, but also technology transfer, which is essential for transforming the results of scientific research into concrete, applicable solutions in the maritime sector. The Cluster plays a key role in the dissemination and adoption of advanced technologies, facilitating dialogue and collaboration between the various players in the supply chain. In this way, the CTN-BIG actively contributes to the coordination and achievement of the objectives of the Italian Blue Economy Plan, both nationally and internationally, promoting the sustainable and competitive development of the Italian Blue Economy. The Sea Plan has already represented a fundamental step in coordinating national maritime policies. In light of the rapid environmental, technological, and geopolitical transformations currently underway, the CTN-BIG proposes that it be integrated with concepts that strengthen the integration of maritime spatial planning, technological innovation, and environmental sustainability, also in light of the most recent technological developments.

#### CNR – National Research Council

The National Research Council is the largest research body in Italy, a network of 88 Institutes under 7 departments covering multi-disciplinary areas. The Department for Engineering, Energy, Transport and IT is actively involved in multi-disciplinary research in the Offshore Renewable Energy (ORE) sector. A key contribution is given by the In-

stitute of Marine Engineering (Istituto di Ingegneria del Mare, CNR-INM). The Institute was founded in 2018, integrating the expertise, experience, and history of three CNR institutes: the Marine Technology Research Institute (formerly INSEAN, established 1927), the Genoa and Palermo branches of the Institute of Intelligent Systems for Automation (ISSIA), and the Institute of Acoustics and Sensors “Orso Mario Corbino” (IDASC). Expertise in the modelling, testing and demonstration of marine transport and offshore structures is applied to studies for the sustainable exploitation of marine renewable energy sources.

CNR-INM is internationally recognized for the experimental research carried out in hydrodynamics testing infrastructures, among the largest globally, for applications to the ORE sector. Cross-cutting research topics include underwater acoustics and robotics, materials and structures, energy system management and grids. The research approach is multidisciplinary by taking advantage of collaborations with other CNR institutes working on the environmental and societal implications of the maturation of the ORE sector. In this context, INM is a partner in an international research project with grants for trans-national access to testing facilities (EU-funded MaRINET and MaRINET-2, RisEnergy projects, 2011 to present). The research infrastructures at CNR-INM are also candidated to lead the Italian node of Marinerg-i, a project for the creation of the European Distributed Research Infrastructure to accelerate the maturation of Offshore Renewable Energy. The project is in the roadmap of ESFRI, the European Forum for Research Infrastructures, and Italy is a prospective country.

### MOREnergy Lab

The MOREnergy Lab, a specialized research center within Politecnico di Torino, serves as a primary Italian and European hub for the development and validation of offshore renewable energy technologies. The lab’s research scope is broad and interconnected, covering the engineering and optimization of wave energy converters, floating offshore wind turbines, and floating solar systems. This expertise extends into the broader blue economy, incorporating advancements in clean waterborne mobility and the use of satellite remote sensing for precise marine monitoring. By integrating these diverse fields, the lab addresses the technical challenges of the

energy transition through a holistic approach that includes advanced design, prototyping, and multi-stage testing. To bridge the gap between laboratory results and real-world application, the MOREnergy Lab manages a strategically located, consented offshore testing site in Pantelleria, Sicily. This sea area, measuring 300 by 600 meters with a water depth of 30 meters, is uniquely positioned in one of the most energetic regions of the Mediterranean Sea. The site is ideal for full-scale testing of technologies specifically designed for the Mediterranean climate, while also providing a representative environment for the medium-scale testing of devices intended for harsh oceanic conditions. Beyond its engineering and technical monitoring services, which include detailed metocean analysis and environmental impact assessments, the MOREnergy Lab provides technical advice to local municipalities as well as policymakers. As a regional partner of the Clean Energy for EU Islands Secretariat, the lab leverages its technical data to guide the decarbonization of insular ecosystems.

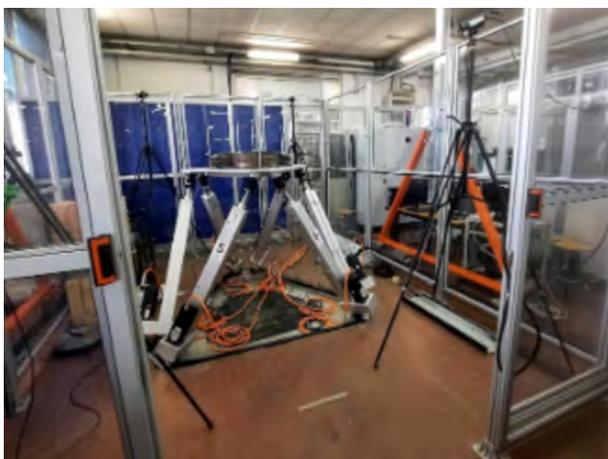
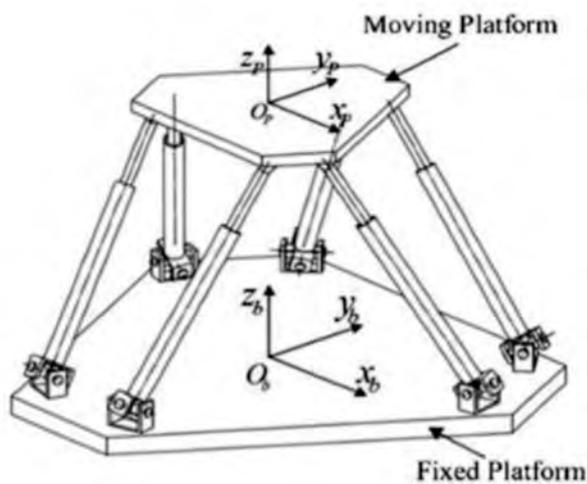
The MOREnergy Lab has developed an open-access web-based platform (MORE-EST; <http://www.moreenergylab.polito.it/more-est-platform/>), that gives users access to wave and wind energy resources in any location in European seas and oceans, as well as some maritime spatial planning information and examples of productivity evaluation. It has been designed to support maritime stakeholders in the exploitation of wave and wind energy resources, offering wave data for the period 2010 to 2019, as well as the power matrix of different wave energy converters. The platform can be used to support the energy transition and decarbonisation efforts in Europe, but the future tools might be expanded to feature data on the entire globe and will include the techno-economic analyses and productivity assessments of wave energy arrays and offshore wind farms.

The **COIN** (Control-Oriented INnovations for future wave energy farms) has been officially launched on November 1, 2025, with the support of the European Commission under the Horizon Europe program. With a total budget of four million euros, COIN brings together nine leading organizations across Europe to develop innovative solutions to improve the reliability, survivability, and sustainability of future wave energy power plants. Coordinated by the Technical University of Braunschweig (Germany),

COIN responds to the Horizon Europe call for proposals: Critical technologies for future ocean energy farms. The project will last 48 months and aims to advance ocean energy technologies to TRL 5 (Technology Readiness Level), bridging the gap between prototypes and commercial viability. The MOREnergy Lab, will play a central role in the development of advanced control systems to maximize energy yield and device life.

### MORE Lab Stewart Platform

To validate numerical models concerning the dynamics of systems and subsystems, the subject of study in the MORE Lab, a six-degree-of-freedom motion platform, also called the Stewart Platform, is available. The platform comprises six linear electro-mechanical actuators combined to make a hexapod capable of realising the motion trajectories.



**Figure 1:** Stewart platform in the hexapod configuration

The need for such instrumentation lies in simplifying experimental testing, which, in the most general case, would involve the floating device and its subsystems and related experimentation in naval tanks or relevant environments. Using a motion platform, on the other hand, it is possible to prototype the individual system of interest and impose the kinematics to which it would be subjected in the naval tank.

MOST is a collaborative effort between the MORE Energy Lab and the WEC-Sim developers at Sandia National Laboratories and the National Renewable Energy Lab. MOST (Matlab for Offshore Simulation Tool) functions within the WEC-Sim environment to simulate various offshore structures, including floating wind turbines, hybrid wind-wave energy converters, and platforms with multiple turbines.

### SeaPower SCRL

SeaPower ([www.seapowerscrl.com](http://www.seapowerscrl.com)) is a non-profit research center participated by University of Naples Federico II. Its legal form is a non-profit limited liability consortium company with a board of directors and is assisted - where applicable - by a technical scientific committee. The company benefits from the dedicated work of about 20 highly qualified professionals with multidisciplinary expertise in aerospace, mechanical, environmental, computer, electrical, and electronic engineering, and also hosts Phd and graduation thesis students coming from Italy and foreign Countries. Founded with the aim of developing systems for spreading the distributed generation of renewable energy from fluid sources, the company is primarily engaged in research and development projects focused on the development of innovative technologies for renewable energy generation from marine/tidal and river currents, wave energy, onshore and offshore floating wind power, advanced agrivoltaics and floating photovoltaic systems, including their associated mooring and anchoring solutions. At the same time, it also develops projects for large PV and wind plants for private customers. SEAPOWER carries out a broad range of activities covering the entire innovation chain, from theoretical research to applied experimentation and industrial implementation. The company is actively involved in prototyping and testing, ranging from the development and validation of scaled and full-scale prototypes of both ocean and wind devices to laboratory and real-environment testing, including wind tunnel, towing tank, structural, offshore and

field tests. Its expertise extends to the full lifecycle management of renewable energy projects, from feasibility studies and resource assessment to detailed engineering, permitting, construction, grid connection, and operation and maintenance, while also promoting technology transfer, training, and the dissemination of research results. In recent years, the group has focused its activities primarily on projects related to floating offshore wind, tidal current energy and wave energy.

### Vague – Valorisation de l'énergie produite par la mer

The Vague project, funded through the European Interreg program, spotlights the Mediterranean to test new technologies capable of transforming wave motion into renewable energy. Coordinated by the Liguria Region and supported by universities, port authorities and Italian and French scientific partners (University of Toulon and the Port System Authority of the Northern Tyrrhenian Sea), the initiative aims to build a new industrial sector in the sustainable marine energy sector, opening up concrete prospects for the decarbonization of the national energy system. Scientific input also comes from the University of Genoa, which adopts an integrated approach, using numerical models to simulate wave motion in the Upper Tyrrhenian Sea and identify the most productive sites. In parallel, physical tests are being conducted in a wave channel and experimental trials in the open sea. The port of Savona is among the sites chosen for future trials. The project will last three years, with completion scheduled for February 2028.

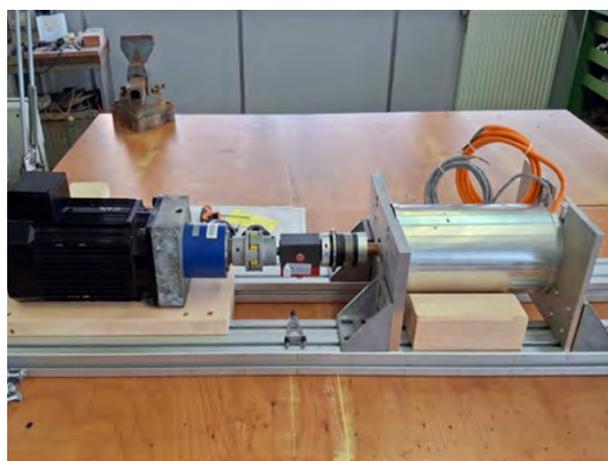
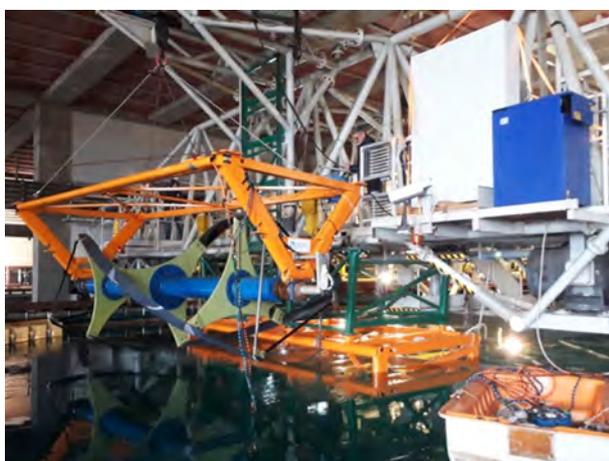
## Research activities: infrastructures and testing facilities

Italian Institutions offer many facilities where marine renewable energy systems can be developed and demonstrated. This includes laboratory-scale infrastructures where system hydrodynamics, power conversion and structural response are studied at low and medium TRL. Small and medium-scale prototypes are tested in wave flumes and wave tanks where a specific sea state can be artificially created, and power production and device survival assessed. A few field testing sites are also present for prototype demonstration.

### CNR-INM flume and towing tanks

CNR-INM headquarters in Rome offer world-class research infrastructures for the development, assessment and demonstration of marine renewable energy systems. This includes:

- the “Pugliese” calm water towing tank, 470 m long, 13.5 m wide and 6.5 m deep, one of the largest globally for studies on offshore renewable energy. The tank is equipped with a towing carriage powered by 4x92 kW motors that can achieve a maximum speed of 15 m/s;
- the “Castagneto” wave-towing tank, 240 m long, 9.0 m wide, 3.5 m deep, with towing carriage maximum speed of 15 m/s. The tank is equipped with a single-paddle wavemaker to generate regular as well as random sea states;



**Figure 2:** Research and innovation on tidal energy at CNR-INM: towing tank tests of a full-scale RivGen turbine by ORPC Co. (left) and the dry test bench facility for research on small-scale turbine PTO (right).

- the Circulating water Channel, one of the largest depressurized flume tank globally hosting research and consultancy projects on offshore renewable energy. The test section is 12 m long, 3.6 m wide and can be partially filled with 2.3 m water depth. Two impellers with MW rated power force water flow up to 5 m/s. Pressure in the test section can be reduced to 30 kPa for cavitation studies.

These infrastructures are used for research and innovation project on offshore renewable energy systems with TRL up to 5. The dimensions of the tanks and the high-speed towing capacity of the carriages allows to test large-size devices. Under the collaboration with the U.S. company ORPC Co., a full-scale prototype of crossflow hydrokinetic turbine with capture area of 9m<sup>2</sup> was tested in 2024 and the demonstration of an innovative design with increased capture area is planned for Q1 2026.

### University of Naples Wave/Towing Tank

The dimensions of the towing tank and carriage general and particular characteristics allow to test relatively large models and to obtain very good tank-sea correlation. Resistance and powering characteristics have been conducted both for conventional ship and for fast planning hulls. Furthermore, multi hull configurations like catamaran, trimaran and pentamaran ship models have been subject of research during last years. At the head of the basin a segmented flap type wave generator is installed. It is composed by eight 1.125 m wide paddles with depth of 1.5 meters and 17 degrees maximum stroke made from glass fibre reinforced polyester with a closed cell foam core.



**Figure 3:** Wave generator

### VGA

VGA srl is a Small-Medium Enterprise (SME) founded in 2011 as an engineering company specialized in the design, development and operation of test rigs, energy storage solutions, actuation systems and high-tech equipment. VGA started in 2018 with their activities in the ocean renewable energy sector, exploiting their knowledge in test rigs applied to wave energy conversion technologies. In particular, during 2025 VGA was involved in the following projects:

- **MORE** (Clean Energy Transition Partnership): the “Next Generation Marine Materials for Resilient Offshore Renewable Energy Devices” project focuses on harmonizing small- and large-scale multi-degradation rigs, to create a fast track for validation of materials and subcomponents used in the offshore renewable energy sector. VGA provided the design of an updated multi-degradation rig.
- **INFINITY** (Clean Energy Transition Partnership): the project aims at developing an innovative power take-off (PTO) design and a non-linear control system to improve the reliability and cost effectiveness of wave energy. VGA’s role involved the review of the PTO and control system preliminary design to ensure their successful integration within the SWEET Lab’s drivetrain test rig.
- **EuropeWave** (Horizon 2020): the ACHIEVE project aims at deploying the CETO6 wave energy converter prototype, integrating new innovative technologies with a focus on optimising performance. VGA, working as subcontractor of the project lead CETO Wave Energy Ireland, updated the structural components rig setup to test a belt (used in CETO



**Figure 4:** Belt tested on the structural components rig as part of the EuropeWave ACHIEVE project (component characterization and endurance tests).



**Figure 5:** The SWEET Lab drivetrain test rig.

as mooring and mechanical power transmission system) for characterization and endurance purposes. Moreover, VGA provided support in the drafting of the CETO technology drivetrain test plan and setup.

- **SWEET Lab.** The Structured Wave Energy Equipment Test Laboratory (SWEET Lab) was inaugurated in April 2024 at VGA facilities in Deruta during the IMPACT Wave Energy Rig Testing Workshop. The laboratory integrates two different test rigs targeting the development of wave energy converter technologies. The drivetrain test rig, able to host either linear or rotary for PTOs from different types of wave energy converters (WECs) and simulate their interaction with the electrical grid. Two transnational accesses to the SWEET Lab (one each rig) were awarded under the Horizon Europe RISEnergy project, with tests taking place in 2026.

### Natural Ocean Engineering Laboratory (NOEL)

NOEL in Reggio Calabria is a unique facility of the Mediterranean University of Reggio Calabria, for field studies of waves and marine structures, leveraging methodologies typical of indoor ocean basins. Located in the Straits of Messina, it benefits from met-ocean conditions that create wind-generated seas with wave heights ( $H_s = 0.20\text{--}0.80\text{ m}$ ) and peak periods ( $T_p = 2.0\text{--}3.6\text{ s}$ ), ideal for scaled testing of Mediterranean or oceanic storm scenarios. NOEL's

outdoor facility allows marine structure testing under controlled conditions, with scale models ranging from 1:30 to 1:10, achieving TRLs of 5-7. The large-scale setting enables accurate dynamic representations and reliable results, unlike indoor facilities where complex interactions are difficult to model. Spanning 44,043 m<sup>2</sup> with depths up to 59 m, NOEL supports long-duration experiments under natural wind and waves, reducing costs and enabling 24/7 data acquisition. Recent experiments included a 1:15-scale prototype of a floating multi-use platform combining aquaculture with energy harvesting technologies. During recent experiments, a 1:15-scaled prototype of a floating multi-use Blue Grow Farm (BGF; <https://thebluegrowthfarm.eu/>) platform was equipped with an array of sensors.



**Figure 6:** Floating platform of the Blue Growth Farm project, in the NOEL laboratory

The platform was designed to combine an automated offshore aquaculture plant with wave and wind energy harvesting technologies. A scaled 10-MW wind turbine and an array of U-shaped OWC wave energy converters were placed in the front side of the hull. Datasets from this experiment will be used in the project. (Grant agreement ID: 774426 - Supported within Horizon 2020).

Experimental activities are carried out in the near-shore water area, where prototype models and sensing instruments are deployed to study wave dynamics, hydrodynamic forces, and energy conversion processes. The instruments are connected via underwater and land-based cables to the electronic station, allowing continuous data transmission and visualization. During symposia and training events, visitors can follow the experiments in real time through live monitoring systems, enhancing the educational and demonstrative value of the research. For details see [www.noel.unirc.it](http://www.noel.unirc.it)

### Marine Renewable Energy Lab (MaRELab)

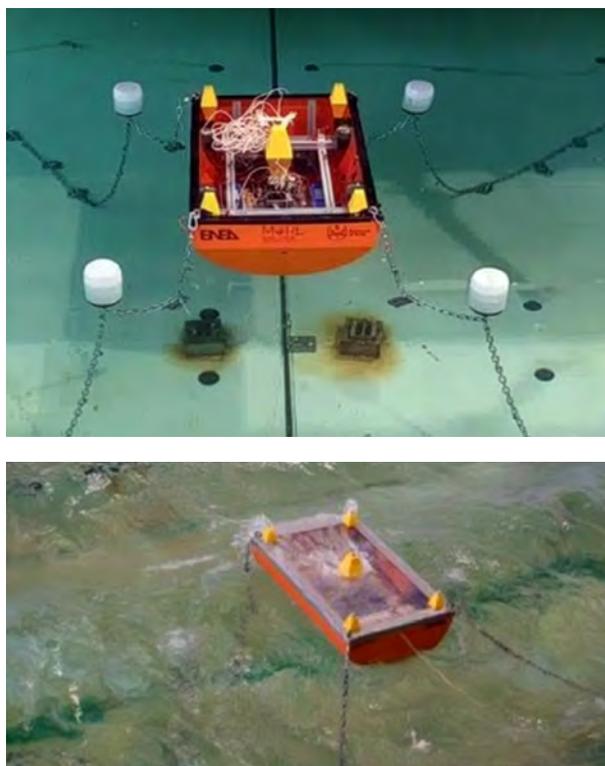
Marine Renewable Energy Lab (MaRELab) is the first onshore/offshore infrastructure financed by the Ministry for Environment and Energy Safety (MASE), for testing full and model scale prototypes aimed at harvesting energy from marine renewable sources. It is a real environment testing site located in the port of Naples, in proximity of the final part of San Vincenzo artificial breakwater. The laboratory covers an area of about 4 km<sup>2</sup>, including 40 meters along the breakwater, and moving 300 meters in the seaside from this. Just few meters from the breakwater, it is possible to reach about 30 meters deep, allowing the correct scaling of the behaviour of platforms in deep and intermediate waters. Due to its facilities, MaRELab enables to test different kind of devices. On the breakwater area for example is currently installed the OBREC device (Overtopping BReakwater for Energy Conversion), that exploits the overtopping phenomenon in order to produce energy.

## Innovative converters

### PeWEC

The MOREnergy Lab collaborates with ENEA on the development of the PeWEC (Pendulum Wave Ener-

gy Converter), a wave energy conversion technology funded under the Ricerca di Sistema Elettrico Programme Agreement. The PeWEC has currently reached Technology Readiness Level (TRL) 5, having been validated through experimental testing at different scales in wave tanks. A 50 kW prototype, with overall dimensions of 7.5 × 6.5 × 3.6 m, is presently under design. The objective is to deploy the prototype at the MOREnergy Lab test site in Pantelleria in 2027, where it will be used for long-term performance monitoring and assessment of system behaviour in real sea conditions, with the aim of further validating the technology.



**Figure 7:** Testing phase of the 1:25 prototype at the University of Naples naval tank

### WEPA

The MOREnergy Lab collaborates with the Azienda Speciale Parco di Porto Conte, the managing authority of the Porto Conte Regional Natural Park and the Capo Caccia - Isola Piana Marine Protected Area in Alghero (Sardinia), on the development of the WEPA (Water Energy Point Absorber) wave energy converter. WEPA is an innovative 15 kW floating hybrid prototype that harnesses wave energy and integrates photovoltaic panels and a micro wind turbine on its surface. MOREnergy Lab supports

the Azienda Speciale Parco di Porto Conte, which is a partner in the European Interreg VAGUE project. The objective of the collaboration is to revamp the device, deploy in situ environmental monitoring systems, install the device in 2026 at sea, and subsequently monitor both performance and environmental data to validate the technology in real operating conditions.

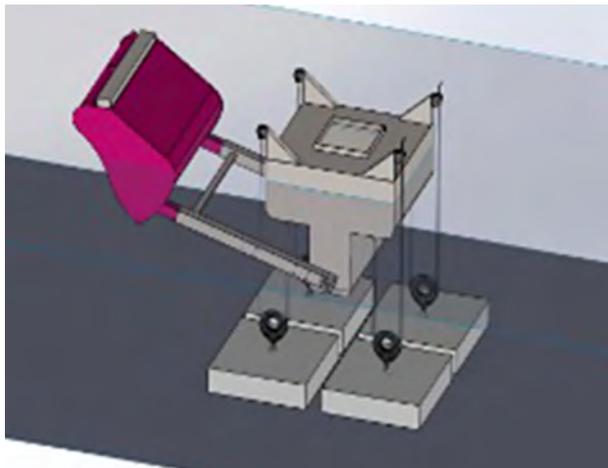
### Pivot-Offshore: Floating Wave Energy Technology

Pivot-Offshore represents the evolution of the Pivot system, developed in 2015 for coastal installations, which has proven high conversion efficiency from wave to electric power. The new patented version is a floating offshore system capable of operating in the open sea, far from the coast, reducing visual impact and expanding the potential for resource ex-

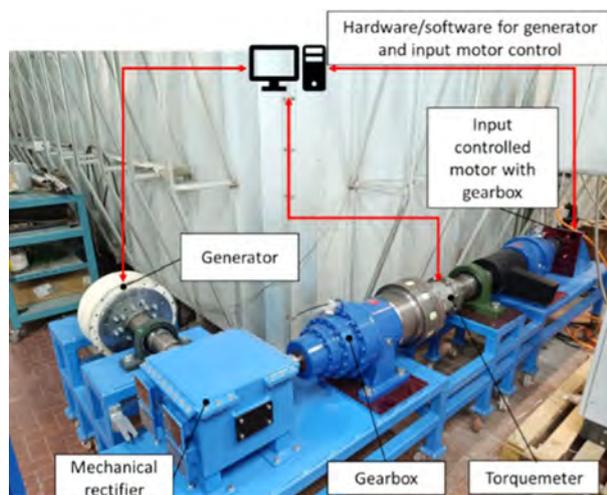
ploitation. The device consists of two hinged floating bodies: a main platform—anchored to the seabed with tensioned mooring lines—and a hydrodynamically optimized oscillating buoy, which transforms wave energy into mechanical motion, then converted into electrical energy through a unidirectional rotation generator. The project involves two main phases: the first, in progress, involves laboratory dry tests on a test rig to simulate, in a software/hardware in the loop framework, wave motion and verify the performance of the drivetrain and rectifier. The second will involve tank testing on a complete system model. At present, the prototype has been designed, the dry test bench has been realized, and the numerical model has been developed.

### MEGA WAVE PTO

Create a smart and scalable system that adapts to changing marine conditions, continuing to operate even if part of the system fails. This is the mission of the research project entitled “MODULAR ELECTRICAL GENERATOR PTO SYSTEM FOR WAVE - MEGA WAVE PTO”, a European initiative dedicated to the use of energy from ocean waves. Selected to access funding from the Horizon program, MEGA WAVE PTO brings together expertise from seven European countries with the aim of creating a PTO (power take-off) generator connected to sustainable supply chains and capable of accelerating the commercialization of wave energy. The consortium also includes two Italian companies: Cheros Srl and the Institute of Mechanical Intelligence of the Sant’Anna School of Pisa. MEGA PTO Wave will develop a scalable system, capable of adapting to different installation sites and therefore to different marine conditions. The solution that provides these characteristics uses modular machines combined with magnetic gears and incorporates adaptable electrical and power electronic technologies. One of the identifying elements of the project will, in fact, be its ability to continue to function even in the event of a partial failure. In this context, the research group will adapt to the system a series of mechanisms, structures and intelligent materials developed in the field of marine energy and capable of combining efficiency, lightness, flexibility and adaptability. It will also design the control system, using optimization and “machine learning” techniques to maximize production and reduce the possibility of system failure.



**Figure 8:** 3D cad view of a wave tank test model for a pivoting offshore



**Figure 9:** The 3 kW dry test bench, installed in the Dept of Industrial Engineering of the University of Naples Federico II

### SiZable Energy – Spar buoy platform

In 2024, an experimental hydroelectric storage system (Spar Buoy) was developed, a particular type of buoy characterized by excellent stability against wave motion. These Buoys were used by SiZable energy during experimental tests conducted in the Natural Ocean Engineering Laboratory (NOEL; [www.noel.unirc.it](http://www.noel.unirc.it)) in the sea of Reggio Calabria. Their purpose was to keep the floating tank of the miniaturized floating electric storage system in place. A new experimental test is planned for 2026, in the NOEL lab, in Reggio Calabria.



**Figure 10:** Positioning of the SiZable Energy platform on the Reggio Calabria seafront

## Technology Demonstration

In Italy, there is an increasing interest in the exploitation of wave and tidal energy converters. In particular, wave converters integrated into conventional breakwaters have gained more and more interest among the port managers, as they offer the opportunity of energy self-sufficiency for the infrastructures in conjunction with a limited increase in costs and with ease of maintenance. Italian companies engaged in the supply chain for wave and tidal energy converters detain long-term experience and innovation capacity, which can support all the specific, high-tech steps of the design and produc-

tion process. The most promising devices that have been developed and improved in the last few years are reported below.

### Wave converters

#### REWEC3

The REWEC technology (Resonant Wave Energy Converter) represents an advanced pathway in Italy for the transition from research and development activities to full-scale applications in port infra-



**Figure 11:** REWEC in the port of Salerno

structures. REWEC is a fixed oscillating water column (OWC) device integrated into port breakwaters, allowing conventional coastal protection infrastructures to operate also as wave energy converters. The technology has been validated through long-term research and development activities based on small-scale and medium-scale testing conducted at the Natural Ocean Engineering Laboratory (NOEL) of the Mediterranean University of Reggio Calabria. This development pathway resulted in the deployment of two full-scale REWEC installations integrated into port breakwaters, located in the ports of Civitavecchia and Salerno, currently representing the main full-scale wave energy applications deployed in Italy.

At the Port of Salerno, the REWEC caisson breakwater includes 30 independent absorption pneumatic chambers. Within the framework of the ongoing “Green Campania Ports” project, a monitoring system is currently active on three adjacent REWEC chambers, aimed at evaluating system behaviour under real operating conditions. The installation of a fully operational air turbine is planned by the end of 2026, allowing electricity generation tests and performance validation. Overall, the REWEC technology represents a mature and scalable solution for wave energy conversion in port settings.

### Overtopping Breakwater for Energy Conversion (OBREC)

The first OBREC device was built into the Port of Naples’s San Vincenzo rubble mound breakwater in 2015. It was the world’s first overtopping device wave energy converter (WEC) built into an existing coastal defense structure. Inspired by the concept of the SSG (Seawave Slot-cone Generator), the



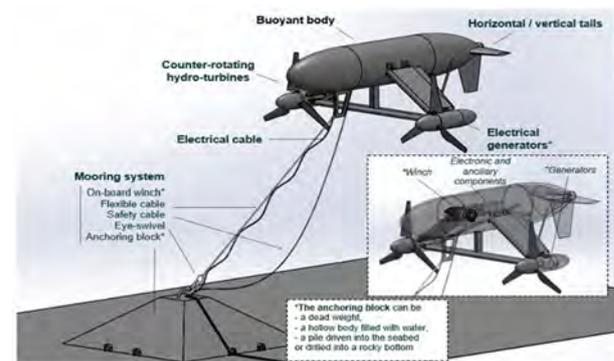
**Figure 12:** View of the engine room of the OBREC.

OBREC was designed as a simpler unit, in which a “zero moving parts” strategy was adopted. OBREC has been recognized as a promising WEC from the National Renewable Energy Laboratory (NREL) in the USA (<https://www.nrel.gov/water/coastal-structure-integrated-wave-energy-converters.html>). With a completely new PTO, a medium-term monitoring campaign is starting. The goal is to enhance the capacity factor and to develop the very-low-head saltwater-turbine sector.

## Tidal turbines

### GEMSTAR technology

GEMSTAR is a multi-patented, an innovative and cost-competitive system designed to convert the kinetic energy of water currents into electricity, with specific optimization for tidal-stream applications.



**Figure 13:** Gemstar system

The system consists of a buoyant main body supporting two hydro-turbines and is anchored through a *single-point mooring* system composed of a cable and an on-board winch, which allows the device to be positioned at the desired operating depth. GEMSTAR automatically self-aligns with reversing tidal currents, remains always fully submerged and maintains a stable position during power generation, behaving like a “kite” in a fixed position and requiring minimal spatial footprint. The *single-point mooring* concept, combined with the buoyant structure, represents the core innovation of the technology. This approach enables deployment in deep-water sites, significantly reduces installation, maintenance, and decommissioning costs, and allows for rapid, safe, and straightforward operations. Thanks to its buoyancy, GEMSTAR can be easily towed to the installation site using a small vessel and then submerged to the target depth via remote con-



**Figure 14:** Gemstar in three main conditions

trol of the on-board winch. Maintenance and decommissioning operations are equally simple, as the system can be brought back to the surface by merely releasing the tension in the mooring cable.

Recently, a second innovative mooring system has also been developed and patented to further increase the ratio of performance/cost. GEMSTAR delivers an estimated LCOE up to 25% lower than competing solutions. GEMSTAR has already reached TRL 6. Designed in Italy and protected by patents, it has received international recognition and passed technical assessments from major organizations. The most recent recognition is the Seal of Excellence, awarded under the EIC Accelerator program. The next goal is to build a 500 kW prototype (commercial scale) and to test it in an operational environment.

### MECS project

The **MECS** (Multi Energy Compensator System) project was funded by the Italian Ministry of University and Research (MUR) and included in a cascade call for proposals under Spoke 2, “Clean energy production, storage and saving”. Seapower collaborated with the University of Reggio Calabria and a local company, Elettra Srl, to design a digital microgrid system for the integrated management and balancing of energy produced from a mix of renewable sources. It features an energy management system that continuously regulates power flows to meet the assigned load, prioritizing renewable sources and, when necessary, drawing from the energy storage system or the electrical grid. The system was finally tested in the Strait of Messina.



**Figure 15:** Launch of the Gemstar Prototype at the installation site

## Specific Initiatives for International Cooperation

The final version of the NECP provides that regional cooperation on RES with neighbouring countries (Malta, Croatia, Austria, Greece and France) could also be based on the sharing of offshore plant development projects (offshore wind, tidal, wave motion) and the related maritime shipbuilding industry, on the opening of support mechanisms, on electricity interconnections, gas pipelines and natural gas supplies.

## Relevant National Events

### Events 2025

- **March 5-7, Rimini** — Key: the Energy Transition Expo
- **June 5-7, Santa Marina Salina (ME)** — Green Salina Energy Days 2025
- **June 11-12, Palermo** — MID.MED Shipping & Energy Forum
- **June 27, Palermo** — Sicily Talk 2025
- **July 9, Genova** — Sea economy 2025
- **July 9-11, Rome** — Blue Forum 2025 and presentation of the 13th National Report on the Economy of the Sea 2025
- **September 29 - October 2, La Spezia** — Seafuture by Italian Blue Growth
- **October 1-2, Milan** — Italian Energy Summit 2025
- **October 23-26, Trapani** — XXXIV edition of the Sea Review
- **November 11, Rome** — Sea Festival
- **November 18, Castellammare del Golfo (TP)** — Presentation of the “A Sea of Energy” project. Aspects and prospects of marine energy for the sustainable development of coastal communities.

### Events planned for 2026

- **March 4-6, Rimini** — Fiera KEY - The Energy Transition Expo

# Monaco

## Report prepared by:

**Jérémie Carles**

Head of the Climate and Energy Division

Department of Environment - Monaco

## Supporting Policies for Ocean Energy

### National strategy

On the instigation of H.S.H. Prince Albert II, the environment and subjects related to sustainable development are among the most important political priorities in the State of Monaco, on both a national and international level. The actions of the Princely Government take into account the topics of biodiversity, preservation & management of natural resources and the reduction of greenhouse gases emissions and also a specific policy towards the establishment of a sustainable city.

The Principality of Monaco joined the OES in June 2013. This action was part of the Government targets for combating climate change and recognizing the relevance of international cooperation.

Monaco is a coastal country with 2,08 km<sup>2</sup> of area, bordered by the Mediterranean Sea, with a coast length of 3829 m. The Government pursues a sustainable development policy aimed at achieving full compliance with the Principality's undertakings.

According to their National Determined Contributions, in line with the provisions of the United Nations Framework Convention on Climate Change and the Paris Agreement, Monaco is committed to reduce the greenhouse gas emissions by 55% in 2030 and by 67.6% in 2035 compared to the reference date of 1990. Monaco is also committed to achieve carbon neutrality in 2050.

In 2023, greenhouse gas emissions decreased by 41.1% compared to 1990 (last published data).

### Public funding programmes

Within the framework of the Paris Agreement, a National Green Fund has been created and is financed by a contribution generated through the sale of electricity and the Government budget.

This fund is dedicated to finance actions in favour of the reduction of the GHG emissions and the energy efficiency, the development of renewable energies and the clean mobility.

Furthermore, the Government holds 100% of the shares of a venture capital firm, known as “Société d’Aide à la Création et au Développement d’Entreprise” (SACDE), the aim of which is to support innovative Monegasque companies.

In parallel, the Government and the SMEG (Monegasque electricity and gas company) jointly creat-

ed MER (Monaco Renewable Energies) to develop renewable energy production projects, particularly photovoltaic and wind energy, outside Monaco.

The objective is to cover the needs of the Principality with renewable electricity production capacities.

## Technology Demonstration

### Projects in the water

In Monaco, the sea is used as a renewable energy source to support the development of seawater heat pump systems. The first seawater heat pump in Monaco dates back to 1963. Today, around 80 seawater heat pumps supply approximately 17% of the energy consumed in the Principality (about 191 GWh/year).

Many coastal buildings benefit from this reversible system, providing heating in winter and air conditioning in summer.

### Projects planned for deployment

Two new heating and cooling networks connected to seawater heat pumps have been commissioned, and the buildings are being connected. They are expected to supply 3,500 homes and eliminate 6 kt-CO<sub>2</sub>eq of greenhouse gas emissions (approximately 8% of Monaco’s total emissions).

These networks will produce around 26,000 MWh of fully decarbonized energy.



# New Zealand

## Report prepared by:

**Alona Ben-Tal, Vladislav Sorokin, Millan Ruka, Stephanie Thornton and Craig Stevens**

Aotearoa Wave and Tidal Energy Association (AWATEA)

## Overview

A brief summary of key achievements in 2025:

- A new Offshore Renewable Energy Bill has passed its second reading in the New Zealand Parliament.
- Aquafarming Marine Energy Solutions New Zealand Ltd has deployed and tested two different wave energy devices at aquaculture farms, one self-floating, another attachable to floating aquafarming structures.
- Azura Wave Power undertook a design engineering study to achieve a reduced levelised cost of electricity (LCOE) for its 100kw wave energy converter.
- Azura Wave Power's "Advancing Offshore Wave-Powered Desalination for Aotearoa's Blue Economy" study was approved and accepted by the New Zealand Applied Doctorates Scheme for a research project in collaboration with the University of Canterbury.
- Mana Wairua Energy visited French Polynesia and started building relationships grounded in shared historic and Indigenous cultural ties.
- A/Prof Alona Ben-Tal, Chair of AWATEA, gave a talk about AWATEA's activities at the 2025 Offshore Renewable Energy Forum, New Plymouth, New Zealand.
- Prof Craig Stevens (ESNZ/Uni. Auckland) was interviewed on Radio New Zealand on how underwater turbines could help power New Zealand.

## Supporting Policies for Ocean Energy

### National strategy

A new Government bill, the "Offshore Renewable Energy Bill" (ORE Bill), is currently before the New Zealand Parliament. The bill has passed its second reading and is expected to become law in 2026. The bill proposes a framework for selecting and managing offshore renewable energy developments, which include a two-stage permitting regime (feasibility permits and commercial permits),

consultation requirements, including specific requirements for consultation with Māori groups, obligations regarding decommissioning of ORE infrastructure, provisions for safety zones around ORE infrastructure and provisions for administration, monitoring, and enforcement. Although motivated by offshore wind, the bill specifically mentions waves, tides and ocean currents as possible renewable energy resources.

## Market incentives

The new ORE Bill was mostly lobbied for by offshore wind energy developers, and this provides an opportunity for synergy between offshore wind and ocean energy. At the same time, a Fast Track Approval Bill that passed into law in late 2024 has had a negative impact on offshore wind investment in New Zealand<sup>1,2</sup>.

The growing aquafarming in New Zealand, the increasing energy demand and the existence of isolated communities near the shore also provide opportunities for the development of ocean energy.

## Public funding programmes

A new Applied Doctorates Scheme was established in 2025 and is designed to bridge the gap between groundbreaking scientific research and industry.

## Research & Development

The New Zealand public research sector was restructured in 2025. From the perspective of ocean energy, this included the merger of the National Institute of Water and Atmospheric Research (NIWA) and the Institute of Geological and Nuclear Sciences (GNS) to form the Public Research Organisation Earth Sciences New Zealand (ESNZ). ESNZ includes in its corporate strategy emphasis on research supporting renewable energy in terms of resource assessment, technology development and operational support. In addition, the restructure resulted in the closure of Callaghan Innovation. This agency and its preceding organisations had been responsible for several marine energy developments over the past two decades.

The Waves and Dynamics Research Group at the University of Auckland has been developing and

In its inaugural round, the Scheme called for research projects that explore the broad theme of energy research that is future-focused, including renewable energy technologies. Azura Wave Power's "Advancing Offshore Wave-Powered Desalination for Aotearoa's Blue Economy" study was approved for a research project in collaboration with the University of Canterbury (more details are provided below).

While this has been an excellent development, other public funding programs have had a reduction in budget (the Marsden Fund) or been put on hold for a year (the Endeavour Fund). This is because of a major restructure of the research sector in New Zealand, including the merging or closure of research institutes and a consolidation of funding programmes into a centralised entity Research Funding New Zealand.

ocean testing wave-powered and tidal-powered environmental observation buoys.

Throughout 2025 and in partnership with Northwest Energy Ventures, Azura Wave Power undertook a design engineering study to achieve reduced LCOE for its 100kw wave energy converter. The study was funded by the US Department of Energy and will be completed by 31 March 2026.

New Zealand's Applied Doctorates Scheme approved Azura's Wave Power's research project entitled "Advancing Offshore Wave-Powered Desalination for Aotearoa's Blue Economy". The study will be implemented in collaboration with the University of Canterbury. The selection process for a suitable PhD student is underway, with the selected candidate to commence the program between April and May 2026.

<sup>1</sup> <https://newsroom.co.nz/2025/12/12/offshore-wind-firm-exits-nz-as-seabed-mine-seeks-consent/>

<sup>2</sup> <https://www.4coffshore.com/news/jera-nex-bp-announces-withdrawal-from-new-zealand-wind-scene-nid32265.html>

## Technology Demonstration

### Projects in the water

**Aquafarming Marine Energy Solutions New Zealand Ltd** has deployed two different wave energy devices at aquaculture farms, one self-floating, another attachable to floating aquafarming structures.

### Projects planned for deployment

**Mana Wairua Energy (MWE)**, which holds the intellectual property for the Ruka Marine Turbine (RMT, a floating surface-operating turbine, elongated in design that harnesses tidal and river currents), has completed approximately 65% of its prototype.

The prototype will be completed in 2026, provided an adequate funding source can be secured.

Devices by the **Waves and Dynamics Research Group at the University of Auckland** and **Aquafarming Marine Energy Solutions New Zealand Ltd** will continue to be deployed and tested in the short term in various locations in NZ.

**Azura Wave Power** is actively engaged in a wave energy demonstration project in Tahiti, led by Are Uira SAS, a French Polynesian company. The demonstration project aims to validate the benefits of wave energy-produced electricity for the Tahitian electricity grid. The technical analysis has been completed, and the project lead is preparing for the next phase of development.

## Specific Initiatives for International Cooperation

The MWE team visited French Polynesia in July 2025, meeting with three Mayors of Raiatea Island and a leading marine energy company in Papeete, building relationships grounded in shared historic and Indigenous cultural ties. MWE now looks forward to delivering an RMT prototype for French Polynesia, designed to harness the region's powerful South Pa-

cific Ocean currents as they move through its reef atolls and narrow tidal outlets.

Members of AWATEA participated in online seminars organised by the Blue Economy CRC (a Cooperative Research Centre under the Australian Government's CRC Program).

## Relevant National Events

### Relevant events in 2025

- The **2025 Offshore Renewable Energy Forum** took place in New Plymouth, New Zealand, 1-2 April 2025. Prof. Alona Ben-Tal, Chair of AWATEA, gave a talk about AWATEA's activities.
- The **21st Asia Pacific Vibration Conference (APVC 2025)** took place in Auckland, New Zealand, 24-27 November 2025. The conference included several talks on marine energy.
- **Prof. Craig Stevens** (ESNZ/Uni. Auckland) was **interviewed on Radio New Zealand** on [how underwater turbines could help power New Zealand](#). The interview was triggered by [an international study](#) that reviewed global tidal stream energy resources and identified New Zealand as a location where the energy potential relative to total demand was most favourable.

### Relevant events planned for 2026

There are plans for a **workshop** organised by AWATEA in collaboration with the New Zealand branch of the American Society of Civil Engineers (ASCE) either in 2026 or 2027.

# Portugal

## Report prepared by:

**Ana Andrade** – General Directorate for Energy and Geology

**Luis Gato** – IST Técnico Lisboa

**Ana Brito e Melo** – WavEC

## Supporting Policies for Ocean Energy

### National strategy

Portugal's energy sector policy aims to decarbonise the energy supply and reduce energy import dependency primarily through broad electrification and a rapid expansion of renewable electricity generation, along with increased energy efficiency. The Directorate-General for Energy and Geology (DGEG), within the Ministry for the Environment and Energy, has the main responsibility for the development and implementation of policies, regulation, control and knowledge for energy-related activities, while the Directorate-General for Natural Resources, Safety and Maritime Services (DGRM), within the Ministries for Agriculture and Sea and Infrastructures, has similar responsibility for sea-related ones.

National strategy concerning offshore renewable energy follows the Industrial Strategy and Action Plan for Ocean Renewable Energy (EI-ERO, published in 2017), the Roadmap for Carbon Neutrality 2050 (RNC 2050, published in 2019), and the National Energy and Climate Plan 2030 (PNEC 2030, published in 2020, and reviewed as approved in 2025). PNEC 2030 is a key national instrument of national energy and climate policy for the decade. In conjunction with other instruments such as the National Strategy for Hydrogen, published in 2020, the latest ver-

sion calls for GHG emissions reductions of 55% by 2030 versus 2005 levels, including the targets of assigning 2 GW of offshore wind and 0.2 GW of waves installed capacity until 2030.

To attain these targets, the Situation and Ordering Plan of the National Maritime Space (PSOEM) was automatically updated in 2025 with the approval of the offshore Renewable Energy Allocation Plan (PAER, via Resolution of the Council of Ministers No. 19/2025). PAER defined maritime areas located offshore the Portuguese continental coast for the deployment of renewable power plants at commercial level of technology development. Despite being technology neutral, in total these areas were sized to accommodate 9,4 GW of floating offshore wind, a technology compatible with local bathymetry data and expected to attain maturity sooner than waves energy technology.

According to statements from the Minister in charge of Environment and Energy, a subset sized to 2 GW has been announced for the first offshore wind energy auction. Governmental Dispatch No. 4752/2025 determined in 2025 that the auction would follow a centralized sequential model, expectedly to be initiated by the offering of seabed rights for area studies. The same Dispatch created

## Portugal creates the regulatory certainty and infrastructure planning needed to attract investment, accelerate project pipelines, and open a credible route for wave energy to follow alongside floating offshore wind.

a working group that made recommendations on which areas from PAER would be made available for 2 GW deployment and on details of the design of the auction, particularly the pre-qualification stage. The initial auction framework, enabled by PAER, is expected to pave the way for the development of wave energy, even more if following NZIA indications regarding non-price criteria on energy system integration and innovation.

In 2022 the government introduced Decree-Law No. 15/2022, outlining the organization and operation of the National Electric System (SEN), namely transposing 2018/2001 EU Directive (on the promotion and use of renewable energy), with simplified regulation for hybridisation and storage. Additionally, this decree established Technological Free Zones (ZLT) in the energy area, including one devoted to offshore renewables, covering 7.63 km<sup>2</sup> located 17 km off Viana do Castelo city, at the continental coast (coordinates defined via Order No. 298/2023). This offshore test zone is strategically located next to WindFloat Atlantic project, Europe's pioneering floating wind farm. DGEG is assigned as the managing entity of energy related ZLTs and, in 2025, the regulation for ZLT near Viana do Castelo was published via Order No. 96/2025/1.

### National Strategy for the Sea 2021–2030

Portugal's energy sector policy is acknowledged and complemented across other sectors. The National Strategy for the Sea 2021–2030, released in 2021 by the Directorate-General for Sea Policy (DGPM), currently under the Ministry for Agriculture and Sea, aims to enhance the contribution of the ocean to Portugal's economy and promote a healthy ocean

that increases the welfare of the Portuguese people. It centers around 10 objectives, including combatting climate change, decarbonizing the economy and promoting renewable energy, stimulating scientific knowledge, technological development and blue innovation. The corresponding Action Plan was published in September 2021 containing over 180 concrete measures to execute until 2030, for each area, including relevant actions for Marine Renewable Energies. In 2025, two reports monitoring the National Strategy were published, presenting statistics for 2023 and 2024 for services and value of the blue economy.

The ENM 2030 and the Action Plan can be assessed at: <https://www.dgpm.mm.gov.pt/enm-21-30>

### Atlantic Strategy – Supporting the Atlantic Action Plan

Portugal, Spain, Ireland and France are represented in the Atlantic Strategy Committee (ASC). The ASC is the governing body of the Atlantic Strategy adopted in 2011 by the European Commission in response to repeated calls from stakeholders for a more ambitious, open and effective cooperation in the Atlantic Ocean Area. In this context, the Atlantic Action Plan 2.0 was approved aiming to unlock the potential of the sustainable Blue Economy in the Atlantic area while preserving marine ecosystems and contributing to climate change adaptation and mitigation of environmental hazards. The new action plan includes four pillars, one of which is on Marine Renewable Energy. As part of the coordination of Pillar IV - Healthy Oceans and Resilient Coasts activities, in 2025 Portugal hosted the stakeholder engagement event 'From the Atlantic to the Mediterranean: Coastal Resilience & a Healthy Ocean', focusing synergies between the Sea Basin Strategies, the Ocean Pact, and the Atlantic Pillar IV.

More information:

<https://atlantic-maritime-strategy.ec.europa.eu/en/news/2025-implementation-report>

### European Marine Energy Board (ENB)

The European Marine Board is the leading European think tank in marine science policy. It provides a platform to advance marine research and to bridge the gap between science and policy. The European Marine Board is a unique strategic pan-European Forum for seas and ocean research and technolo-

gy. As an independent, self-sustaining, non-governmental advisory body, the European Marine Board transfers knowledge between the scientific community and decision makers, promoting Europe's leadership in marine research and technology.

In 2022, the EMB activity was focused on preparing an update on status and recommendations related to marine renewable energy, highlighting the current knowledge and research gaps in marine science. This publication was released in 2023.

In 2023, the European Marine Board released a report titled "European Offshore Renewable Energy: Towards a Sustainable Future". This report was prepared by a working group formed by members from Greece, Ireland, UK, Italy, France, Norway and Portugal (represented by WavEC). The report emphasizes the urgent need for responsible and sustainable management of the offshore renewable sector, providing a comprehensive overview of the technical, environmental, and socioeconomic aspects of the offshore renewable sector, with a specific focus on the European context. The Impact Report released in 2025 indicates how such publication has been widely cited in academic and grey literature and acknowledged its usefulness by OES and the EC.

### Maritime Spatial Planning Policy - National Maritime Spatial Plan (PSOEM)

The Maritime Spatial Plan covers the entire national maritime space, from the baselines to the outer limit of the continental shelf, integrating inland maritime waters, the territorial sea, the exclusive economic zone and the continental shelf, including beyond 200 nautical miles. National legislation on the management of the maritime space is published in Law No. 17/2014 and Decree-Law No. 38/2015.

The Maritime Spatial Plan (PSOEM, <https://www.psoem.pt/>) is an instrument for planning the national maritime space and constitutes an essential tool for the policy of the sea. This plan, PSOEM, identifies existing uses/activities and exclusion areas. Potential uses/activities are incorporated in the Allocation Plan. The Allocation Plan is the instrument that allows the attribution of a Permit of Private Use of National Maritime Space (TUPEM). Once approved, it becomes integrated into PSOEM.

In 2022, after the public announcement by the government of their intention to launch auctions for 10 GW offshore wind, it was decided to review the

PSOEM for the integration of potential areas for offshore renewable energies, both for commercial and research projects. After an extensive public consultation process, in 2025 the Allocation Plan for offshore Renewable Energy was approved (PAER, Resolution of the Council of Ministers No. 19/2025) and potential areas for commercial exploitation of 9,4 GW of renewable energy in the national maritime space along the western coast of mainland Portugal were integrated in PSOEM. The definition of these areas also required a plan for the development of port and grid infrastructures, namely with identification of connection points to the electrical grid, and the establishment of procedures for offshore renewable energy bids (e.g. as determined by Dispatch No. 11404/2022 and Dispatch No. 4752/2025).

In addition to maritime space for commercial exploitation of renewable energy, PAER also defined areas for developing technologies, acknowledging those already present in PSOEM (ZLT off Viana do Castelo, Aguçadoura and Peniche) and enlarging into 5,6 km<sup>2</sup> the area off Aguçadoura.

### Permits for Private Use of the National Maritime Space (TUPEM)

The right to privately use the national maritime space is granted by concession, license, or authorization, formalized in the form of 'permits of private use of the maritime space', briefly TUPEM. The authority responsible for TUPEM approval is the Directorate-General for Natural Resources, Safety and Maritime Services (DGRM), which shall ensure the consultation of other public services and bodies.

Whenever TUPEM is associated with the use or activity related to geological resources, energy resources and renewable energy, including their infrastructure, the Directorate-General of Energy and Geology (DGEG) is the coordinator of the entire licensing process. The request for TUPEM is submitted online at DGRM website (<https://www.dgrm.pt/en/web/guest/as-om-tupem>).

There are different TUPEM modalities according to the duration of the deployment and type of activity. For scientific research, or non-commercial pilot projects installed for a maximum of 10 years, just an authorization is required. It can be issued for any location in the Portuguese maritime space, provided no other conflicting activity is already there located.

## Public funding programmes

### Foundation for Science and Technology (FCT)

The Foundation for Science and Technology (FCT) is a national funding agency under the responsibility of the Ministry for Science, Technology and Higher Education whose mission is to boost Portugal's RD&D capabilities in all scientific fields. FCT provides RD&D funding through several programmes, including tenders for RD&D projects, grants, scholarships, support of public-private RD&D collaboration and direct funding of public research institutions.

In 2023, FCT became a participant in the inaugural co-funded call of the Sustainable Blue Economy Partnership (SBEP). This initiative involves 36 funding organizations across 23 countries, collectively supporting research and innovation actions in the blue economy, with financial support from the European Commission. Its strategy takes into consideration the R&I agendas of the sea basins (Mediterranean, Black Sea, Baltic and North Sea) and the Atlantic Ocean and builds on lessons learned from previous initiatives (e.g. OCEANERA-NET).

### National Innovation Agency (ANI)

The National Innovation Agency (ANI) is a state-owned agency supporting technology and business innovation to strengthen Portugal's competitiveness in global markets. The ANI's responsibilities include stimulating private RD&D investment, promoting partnerships between Portugal's RD&D entities and industry, and increasing the participation of Portugal's RD&D entities and industry in international RD&D programmes.

ANI also runs the Interface Programme that certifies and funds Technological Interface Centres in several areas including renewable energies, using FITEC - Innovation, Technology and Circular Economy Fund that aims to support policies to enhance scientific and technological knowledge and its transformation into innovation.

### Directorate-General for Maritime Policy (DGPM)

DGPM is a public administration body of the Ministry of the Sea responsible for developing, evaluating and updating the National Ocean Strategy, designing and proposing the national maritime policy, developing the maritime spatial planning strategy and management, monitoring and participating in the development of the Integrated Maritime Policy of the European Union and promoting national and international cooperation on maritime affairs. DGPM is currently engaged in a variety of scientific marine and maritime research topics (including socio-economy sciences related to the Ocean, monitoring of the Blue Economy, and monitoring of the Portuguese contribution to the UN SDG 14 Goal), but also in Ocean Literacy and translational aspects between academia and industrial sectors.

DGPM is a national operator of the EEA and Norway Grants, operating the Blue Growth Programme. Its main objective is to increase value creation and sustainable growth in the Portuguese blue economy, and to promote research, education and training in marine and maritime areas. In 2025 Iceland, Liechtenstein and Norway have signed a new cooperation agreement with Portugal for the EEA and Norway Grants 2021-2028 period.

More information:

[EEA Grants - Blue Growth Programme](#)

## Research & Development

### WavEC Offshore Renewables

WavEC is a private non-profit organization created in 2003 with a strong research and innovation component and a broad spectrum of specialized services in Marine Renewable Energies and Engineering Solutions for the ocean economy, incorporating technological, economic, environmental, social and

legislative aspects. Its mission is to accelerate the energy transition in an economical, safe and sustainable way and promote the growth of the blue economy. WavEC is formally recognised by the National Innovation Agency (ANI) as a **Technology and Innovation Centre (CTI)**. CTIs are entities dedicated to the production, dissemination and transmission

of knowledge, aimed at companies and economic value creation, contributing to the pursuit of public policy objectives, within the framework of priority specialisation areas, whether national or of the regions in which they operate.

### IST Instituto Superior Técnico

Two groups were active on ocean energy at Instituto Superior Técnico (IST), University of Lisbon:

- **Institute of Mechanical Engineering (IDMEC)** with a decades-long history in wave energy conversion studies - following previous years, the activity at IDMEC has been concentrated on wave energy conversion, especially the development of new types of oscillating water column converters (OWCs) and self-rectifying air turbines. An important area of research at IDMEC is latching control of floating and fixed-structure OWC converters, taking advantage of new types of air turbines fitted with fast valves.
- **Centre for Marine Technology and Engineering (CENTEC)** whose involvement in ocean energy is more recent - Ocean energy is a major area in the diversified activity of CENTEC/IST. The activities at CENTEC in ocean energy involved a wide range of topics covering waves, tidal currents and offshore wind. The characterization of the wave energy resource (and to a much lesser extent tidal and offshore wind energies) at various oceanic locations in the world has been one of the dominant topics. The study of ocean energy conversion, focused mainly on wave energy converters, with numerical theoretical/modelling and model testing of several types of devices and arrays, and also PTOs (namely hydraulic-circuit PTOs) and moorings.

### FEUP – CIIMAR (Marine Energy and Hydraulic Structures Research Group)

The Marine Energy (ME) team's main topics of research revolve around the development, design, and optimization of technologies to harness marine renewable energy resources as well as the engineering design of coastal and maritime structures to cope with marine environmental actions, using either numerical modelling or physical model testing in experimental facilities (wave basin and/or wave-current flume). The ME group is strongly committed to the research and innovation of cross-cutting, sustainable and advanced technologies or

Ocean energy R&D is strengthened by WavEC's role as a recognised Technology and Innovation Centre bridging research and industry, alongside leading university teams at IST and FEUP/CIIMAR that advance wave and tidal technologies.

solutions to harness and withstand marine blue energy, mitigate climate change effects and support the societal transition to a low carbon sustainable economy. Current research activities focus on: the development and testing of ocean technologies, hydrodynamic modelling, dynamics of floating structures, moorings, wave energy converters, offshore wind foundations, resource assessment and characterization, risk assessment and extreme events prediction, met-ocean data statistical modelling, reliability analysis, breakwater and harbour design, wave-structure interaction, coastal and offshore aquaculture, energetic sustainability, among others.

### Key R&D projects

Ocean energy R&D projects are carried out predominantly by European consortia. Below, we present a selection of key projects that are running in 2025 or were initiated in 2025.

#### Funded by the Horizon Europe programme

##### COIN (Control-Oriented INnovations for future wave energy farms)

Launched on November 2025, COIN is a Horizon Europe Research and Innovation Action (RIA) with

a total budget of €4M running until 31 October 2029. The project targets key barriers to bankable wave-energy farms by developing “control-oriented” innovations that improve reliability, survivability and operational performance. The core developments are: (1) a novel mechanical/electrical connector concept for moorings and subsea infrastructure to limit peak loads and prevent damage; (2) AI-enhanced, real-time wave prediction (radar + buoys) for second-by-second control inputs; and (3) digital-twin-based health monitoring and health-aware control to reduce downtime and extend useful life. WavEC is leading the Integrated LCA and LCOE Modelling for Wave Energy Converters, developing comprehensive models to assess both the economic viability and environmental impact of wave energy technologies, including building detailed lifecycle cost models covering assembly, installation, operation, maintenance, and decommissioning of devices, as well as full life cycle assessments in line with ISO 14040/14044 standards. WavEC also leads the development of a techno-economic framework for calculating the LCOE and scenario analyses to understand how site conditions and design choices influence performance and sustainability. WavEC also leads major communication and engagement efforts of the project.

### **FOREST (Future Ocean Renewable Energy System Technologies)**

Also launched on November 2025, FOREST will run until October 2028, with an EU contribution/total budget of ~€4 M. Coordinated by EMEC (Orkney, Scotland), FOREST focuses on “ancillary” subsea systems that are critical for scalable ocean-energy arrays, addressing durability, reliability, maintenance cost and performance monitoring. It will deliver and validate three main innovations: (1) 33 kV super dynamic cables and a connection hub for ocean-energy arrays; (2) a subsea cable quick-connector system to simplify deployment and maintenance; and (3) an AI/ML-enabled optical measurement platform for cable/device health monitoring and array performance optimisation, with testing at EMEC’s wave and tidal sites. WavEC leads the project’s communication, dissemination, and stakeholder engagement work. Beyond communications, WavEC leads the Impact Assessment Methodology, developing a methodology to quantify how innovations affect array performance (e.g., LCOE, reliability, sustainability, survivability). WavEC also leads the validating

and reporting project KPIs, positioning this analysis as a backbone for go-to-market planning. WavEC will also produce scalability assessments and business cases/roadmaps to support market adoption of the most promising innovations.

### **MEGA WAVE PTO**

Is a €4 M Horizon Europe and UKRI project coordinated by WavEC, running from 2024 to 2028. The project focuses on the development of a highly modular and innovative power take-off system for wave energy, integrating advanced axial-flux magnetic gear and generator technologies and adaptable power electronics. The objective is to improve efficiency, sustainability and manufacturability while reducing costs across the full lifecycle, from installation to recycling. In the project, WavEC leads the “validation from the user/market side” of the technology. In practice, the work of WavEC focus on: (i) developing the Operation & Maintenance (O&M) strategy, (ii) carrying out the Life Cycle Assessment (LCA), and (iii) assessing techno-economic/economic feasibility to quantify benefits and identify improvement opportunities.

### **PLOTEC**

Running from 2022 to 2026, focuses on the demonstration of novel floating platform designs and materials for Ocean Thermal Energy Conversion (OTEC), with testing in the Canary Islands. Within this project, WavEC’s main contribution is to lead the project work on impact assessment and to translate results into usable messages for decision-makers and the wider sector. WavEC carried out the techno-economic and sustainability analysis of the OTEC solution, performing a full Life Cycle Assessment and calculating LCOE. WavEC also leads key knowledge-transfer outputs, including White Papers and Policy Recommendations focused on accelerating OTEC uptake, especially for Small Island Developing States and other priority regions.

### **EU-SCORES**

Initiated in 2021 will run until 2027, aims to demonstrate and unlock the large-scale potential of multi-source offshore renewable energy farms across different European sea basins. The project includes a co-located offshore solar and fixed wind demonstration in Belgium and a wave energy array co-located with floating offshore wind in Portugal. Led by DMEC and involving 18 partners, including WavEC, INESC TEC and EDP Labellec, EU-SCORES demon-

strates how combining wind, wave and solar resources leads to a more resilient and stable power system, higher capacity factors and a lower total cost per MWh. These aspects will also improve the business case for the production of green hydrogen within these parks. The full-scale demonstrations will prove how the increased power output and capacity installed per km<sup>2</sup> will reduce the amount of marine space needed, thereby leaving more space for aquaculture, fisheries, shipping routes and environmentally protected zones.

### Funded by the Ente Vasco de la Energía (EVE, Basque Country)

EVE launched a Pre-Commercial Public Procurement Procedure to develop a replacement for the ageing air turbine technology at the Mutriku wave power plant, meeting challenging requirements for performance, controllability, reliability, maintenance, and affordability. Instituto Superior Técnico & IDMEC, together with the Portuguese turbine manufacturer company Kymaner, formed the NOVATUM consortium to respond to the TurboWave Challenge.

The proposed solution is a self-rectifying axial-flow impulse air turbine with multi-row guide vanes. The prototype development was successfully completed at the end of Phase 2 of the TurboWave project, by experimentally testing a 1/1.6 scale complete PTO model, including the air turbine, safety valve, electrical generator, frequency converter, control system and grid connection, on the IST 55 kW variable flow test rig, Lisbon, Portugal, in a hardware-in-the-loop modelling, simulation the PTO operation in characteristics sea states condition at the MWPP.

### Funded by the National Foundation for Science and Technology (FCT)

#### Carbon-free Ports

Conducted by IDMEC/IST and LNEC, the project provides a sustainable solution for port decarbonization, addressing the growing energy needs of port operations through intelligent, efficient, and economical modular wave energy systems (CEOs). The project will design and study multi-resonant CEO systems, a new turbine, and new operational configurations and intelligent control strategies to increase system efficiency.



NOVATUM PTO prototype: Test rig assembly with turbine in inhalation mode.



Aguçadora test site landstation and view to the offshore ocean site



## Technology Demonstration

### Test sites

Near Viana do Castelo, at an offshore location with water depths of 85-100 meters (and envisaged in 2018 for relocating the Pilot Zone of São Pedro de Moel), Portugal's pioneering floating offshore wind project, WindFloat Atlantic, with a capacity of 25 MW and covering approximately 11 km<sup>2</sup>, has been operational since July 2020.

In January 2022, the government introduced the offshore Technological Free Zone (ZLT) through Decree-Law No. 15/2022. Located near Viana do Castelo and adjacent to the WindFloat Atlantic project, this 7.63 km<sup>2</sup> zone is dedicated to the testing and demonstration of emerging technologies under real-world conditions.

In Aguçadoura, another test site with an area of 5.6 km<sup>2</sup> at a water depth of 45 m is primarily used for research and demonstration projects. The Swedish developer CorPower has made considerable progress in advancing its flagship wave energy project, HiWave-5, within this designated area. Projects in this site can benefit from the support of the private entity Companhia de Energia Oceanica (CEO), owned by INESC TEC and WavEC Offshore Renewables, and proprietary of the test site landstation. In 2024, CEO became part of a new platform for offshore demonstrations in Europe, called High Power Test Sites (HiPoTeSis). The HiPoTeSis initiative is a cooperation platform for five demonstration sites

in Europe, which aims to safeguard the interests of offshore testing at European level. In addition to the CEO, the other four sites are in Spain (through the Biscay Marine Energy Platform and the Oceanic Platform of the Canary Islands), France (through the OPEN-C Foundation) and Norway (represented by Mari Energi Testcentre).

### Eco Wave Power Plant

Eco Wave Power (Israel-founded wave energy company) is developing a first-of-a-kind, megawatt-scale wave energy project in the Porto area (North Portugal) in partnership with the port authority APDL (Administração dos Portos do Douro, Leixões e Viana do Castelo). The project is based on integrating wave energy converters into existing harbour infrastructure (breakwaters), with the initial phase targeting a 1 MW installation. During 2025 the developer reported starting infrastructure preparation works and more recently reported progress including completion of wave/loading assessments (with MetOcean Consult) and submission of an execution plan to APDL, signalling a move from planning toward construction and grid connection targeting 2026 (subject to final approvals).

### CorPower Ocean

CorPower has systematically continued its demonstration program aimed at proving the power generation capacity, survivability and Operations & Maintenance with cyclic retrieval and deployment of its C4 Wave Energy Converter. The C4 prototype device has generated knowledge that informed the design of the next generation C5 production machines where type-certification by DNV is targeted. During 2025 numerous WEC subsystems went through design review and components were ordered, aligned with the deployment of the next generation of WECs.

CorPower Ocean was awarded major funding and onboarded new strategic investors in 2025. The company was awarded €17.5 million by the European Innovation Council (EIC) Accelerator to accelerate commercialization of its wave energy technology, and secured a €40 million grant from the EU Innovation Fund to support the development of a 10 MW wave farm project, VianaWave, off the coast of northern Portugal.

A geophysical survey was completed off the coast of Aguçadoura, northern Portugal, mapping ~340 hectares — a crucial step toward realising the VianaWave 10 MW pre-commercial project.

## Relevant International Events

### 2025

#### 16th European Wave and Tidal Energy Conference (EWTEC)

IDMEC/IST organised the 16th European Wave and Tidal Energy Conference from September 7 to 11, 2025, which joined more than 340 participants from five continents in the Portuguese island of Madeira for this leading scientific and technological meeting. For five days, researchers, engineers, investors, industrialists, and policymakers discussed the advancement of technology in wave and tidal energy, from fundamental research to operation, certification, legal framework, and practical applications — such as large-scale electricity production, or smaller-scale electricity production for aquaculture or military applications, such as powering surveillance systems in the open ocean.

More information: <https://ewtec.org/ewtec-2025/>

### 2026

#### RENEW 2026 - 7th International Conference on Renewable Energies Offshore

Will be held at Congress Centre on the IST Alameda campus in Lisbon, 20 - 22 October 2026.

More information: <http://www.centec.tecnico.ulisboa.pt/renew2026/>

# Republic of Korea

## Report prepared by:

Jin-Hak Yi

Korea Institute of Ocean Science and Technology

## Overview

The Ministry of Oceans and Fisheries (MOF) set a target for a carbon dioxide reduction by 2050 of 2.3 million tCO<sub>2</sub> from the ocean energy sector. Many R&D projects are being carried out to support this ministry's carbon-negative target and ocean energy commercialization. Korea Research Institute of Ships and Ocean Engineering (KRISO) has successfully constructed and operated a 30 kW OWC WEC and is currently operating this device. KRISO is advancing the technology for the operation of the 30kW OWC WEC. In addition, a new R&D project is being conducted to build a wave farm composed of several OWC WECs with a total capacity of 90 kW or higher, with fabrication of the OWC structure scheduled to commence in 2026 and to be completed within the same year, followed by the initiation of demonstration testing. KRISO has also

built a green hydrogen production plant at 500 kW Yongsoo OWC WEC, and produced green hydrogen with wave power. Korea Institute of Ocean Science and Technology (KIOST) is operating the tidal energy open sea test site with a component testing laboratory (BladeLab@KIOST). The rotor blade of a 1MW class horizontal axis tidal current energy converter, tested in the BladeLab@KIOST in 2025, and the test scheme with facilities and procedures was accredited by KOLAS(Korea Laboratory Accreditation Scheme) as a testing laboratory according to the annex of the IEC TS 62600-3. Several international cooperations are being conducted, including ODA (Official Development Assistance) projects with the Marshall Islands and Fiji by KRISO, and the Korea-China bilateral collaboration planning project by KIOST.

## Supporting Policies for Ocean Energy

### National strategy

Within the 2030 Ocean Energy Development Plan, the ministry's action plan for developing and disseminating ocean energy systems, a strategic plan was established for tidal and wave energy development. This plan was divided into four steps: (1) the expansion of R&D in ocean energy and the establishment of open-sea test sites; (2) the construction of large-scale ocean energy farms; (3) the entrance

into the global market and the expansion of domestic supply; and (4) the establishment of an ocean energy certification system and supporting policies. The new long-term roadmap on ocean energy development has prepared and submitted to the MOF by the Korea Institute of Marine Science and Technology, and a study on the measures to promote the ocean energy industry has been carried out and submitted to the MOF by the Korea Maritime Institute.

Regarding the national energy strategy, the national energy policy has shifted from a nuclear-focused approach to an emphasis on a balanced energy mix of renewable and nuclear sources, as the new government has been formed. To promote and accelerate renewable energy development, two special acts were established in March 2025. The first is the special act on the promotion of offshore wind power deployment and industrial development, to accelerate offshore wind power deployment and foster industrial growth. The second one is the special act on expanding the national power grid infrastructure. It is expected that the many delayed offshore wind power projects and new projects can be initiated more quickly, and that the relevant industries can be developed.

## Market incentives

The Renewable Energy Portfolio Standard (RPS) was established in 2012 to compel utility companies with a capacity greater than 500 MW to provide obligatory portions of their total electricity production from renewable energy, based on the Acts on the Development, Utilization, and Supply Promotion of Renewable Energy legislation. The market incentive plan, known as the tradable Renewable Energy Certificate (REC), supplements this RPS policy. The weighting value of REC is currently given as 2.0 for tidal current, 1.0 for tidal barrage with an embankment, and 2.0 for tidal barrage without an embankment. In contrast, the value of REC for wave energy is not given at this moment, and it is expected to be set by analyzing the actual power output data from the demonstration project of WEC operated in Korea. The first REC was issued for the Uldolmok Tidal Power Pilot Plant in 2022, based on the records to generate electricity from

## Research & Development

In 2022, the R&D project to produce green hydrogen with wave power began, and a hydrogen production plant was built at the Yongsoo OWC WEC at sea in 2024, and it is currently being commissioned. The R&D project of the multi-modulus OWC WEC connected to the breakwater is underway, and the OWC structure construction is scheduled for 2026 after completing the design of the OWC structure.

The national energy policy has shifted from a nuclear-focused approach to an emphasis on a balanced energy mix of renewable and nuclear sources.

tidal current energy. Even though the fundamental renewable energy policy is the RPS, the fixed-price bidding system, initially applied to solar power, has been expanded to wind power since 2022 to foster the domestic wind energy industry, ensure stable procurement of mandatory renewable supply, and promote investment stability for power producers.

## Public funding programmes

MOF provides public funding for ocean energy R&D programs, including demonstration projects, and 17.8, 13.3, 12.5, and 9.8 billion KRW in 2021, 2022, 2023, and 2024, respectively, were invested in developing ocean clean energy technologies and tidal energy systems. In 2025, 11.5 billion KRW was invested in developing green hydrogen production technology using ocean energy and in developing an OWC wave power plant.

For developing the national standards in the field of ocean energy systems, the technical specifications published by IEC TC114 were basically harmonized. In addition, the project is confirming whether it is applicable in Korean and Asian environments. The first ocean energy technical standard on terminology was published as KS C 0561-1 by harmonizing the IEC TS 62600-1 and additional terms related to

the Ocean Thermal Energy Conversion (OTEC), and it was selected as one of the outstanding accomplishments among new Korean industrial standards in 2024. In 2023, three ocean energy technical standards, from IEC TS 62600-100, 200, and 201, were submitted to the Korea Agency for Technology and Standards, and one standard, IEC TS 62600-20, was also submitted in 2024. They have been pub-

lished as KS C IEC TS 62600-20, 100, 200, and 201 in 2025, the new Korean Industrial Standards. The standardization activities are expected to lead to the advancement of ocean energy technologies in connection with existing R&D accomplishments, and technical standards and certification systems can activate the ocean energy industry.

## Technology Demonstration

### Projects in the water

The KRISO-Wave Energy Test Site (WETS), located in the western part of Jeju Island, has been in operation since 2019. KRISO-WETS features 5 test berths, including the Yongsu OWC pilot plant, two berths at 15 m, one at 40 m, and one at 60 m water depth. Each berth supports a 4.5MW maximum output capacity and 5MW capacity in total, and there is a plan to expand the capacity to meet the requests from floating offshore wind developers. A dry-mate type connector, ADCP, and buoy type wave measurement instrument, and onshore and offshore substations are provided. Several small projects were conducted using the test site, such as wave energy devices developed by Jeju Univ. in 2020, a digital twin for WEC by KRISO. Also, unmanned underwater vehicles, radars, and lidars are being tested using this

facility. In addition, preparations are currently underway for the relevant design and permitting processes to support demonstration testing through the installation of a 3 MW floating horizontal-axis offshore wind turbine in 2028, followed by a 300 kW floating vertical-axis offshore wind turbine in 2029. In 2025, a real-sea demonstration of green hydrogen production integrated with wave energy generation was successfully conducted. Furthermore, an additional offshore demonstration of green hydrogen production was carried out under simulated floating offshore wind power generation conditions, utilizing floating offshore wind data. Building on these demonstration results, there has been growing international interest from countries such as Australia and Norway in conducting real-sea tests

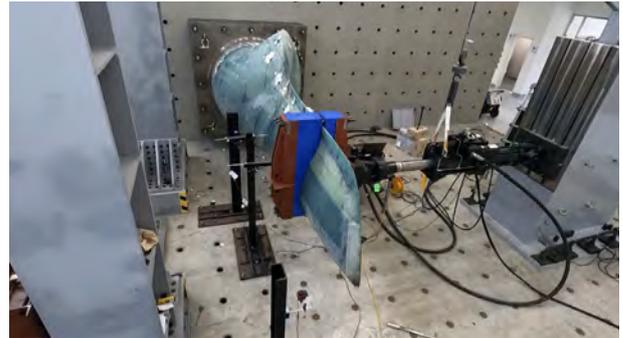
<b>Open sea test of marine renewable energy converters</b>	<ul style="list-style-type: none"> <li>• Yongsu wave power plant (KRISO, '16)</li> </ul>		
	<ul style="list-style-type: none"> <li>• Array-type wave power (Jeju Univ., '20)</li> </ul>		
	<ul style="list-style-type: none"> <li>• Korea standard 62600-100 (KRISO, '22)</li> </ul>		
	<ul style="list-style-type: none"> <li>• Wave power Digital Twin (KRISO, '19-'23)</li> </ul>		
<b>Floating wind turbine &amp; Marine green hydrogen</b>	<ul style="list-style-type: none"> <li>• Marine green hydrogen (KRISO, '24-)</li> </ul>		
	<ul style="list-style-type: none"> <li>• Floating wind turbine (planned, Doosan Enerbility, '28-)</li> </ul>		
	<ul style="list-style-type: none"> <li>• Floating vertical axis offshore wind turbine (planned, KRISO, '29-)</li> </ul>		
<b>Marine equipment</b>	<ul style="list-style-type: none"> <li>• ROV test (KRISO, '20)</li> </ul>		
	<ul style="list-style-type: none"> <li>• Unmanned Vehicle (KRISO, '21)</li> </ul>		
	<ul style="list-style-type: none"> <li>• Seabed measurement device test (KRISO, '23)</li> </ul>		
	<ul style="list-style-type: none"> <li>• PNT GPS test (KRISO, '24)</li> </ul>		
	<ul style="list-style-type: none"> <li>• LiDAR test (GMT, '24-'25)</li> </ul>		

Projects at the KRISO-WETS (Courtesy: KRISO)

at the KRISO Wave Energy Test Site (WETS), with an increasing number of inquiries regarding its utilization. By conducting more test projects, it will come closer to operating this facility without additional financial support from the Korean government.

KIOST has established and operates an open sea test site to support performance testing and evaluation of tidal energy converters and their components. To facilitate the strength evaluation of rotor blades up to 12 meters in length, the Tidal Energy Component Testing Laboratory (KIOST BladeLab), with a maximum displacement of 1.5 m and a maximum load of 500 kN, was established at the KIOST Busan Headquarters in March 2021. Additionally, a 4.5 MW open sea test site was constructed in December 2023 at the Uldolmok Strait in Jindo, Jeollanamdo, to assess power performance and to measure mechanical loads under real-sea conditions. KIOST has also developed a 1 MW commercial-scale tidal energy converter. The structural strength of its blades was tested at the KIOST BladeLab in 2024 and 2025. Using this facility, KIOST became the first in Korea to receive KOLAS (Korea Laboratory Accreditation Scheme) accreditation for load testing of tidal energy converters' rotor blades in 2025. KIOST is also pursuing expansion of KOLAS accreditation for power performance assessment, mechanical load measurement, and material testing of tidal energy converters.

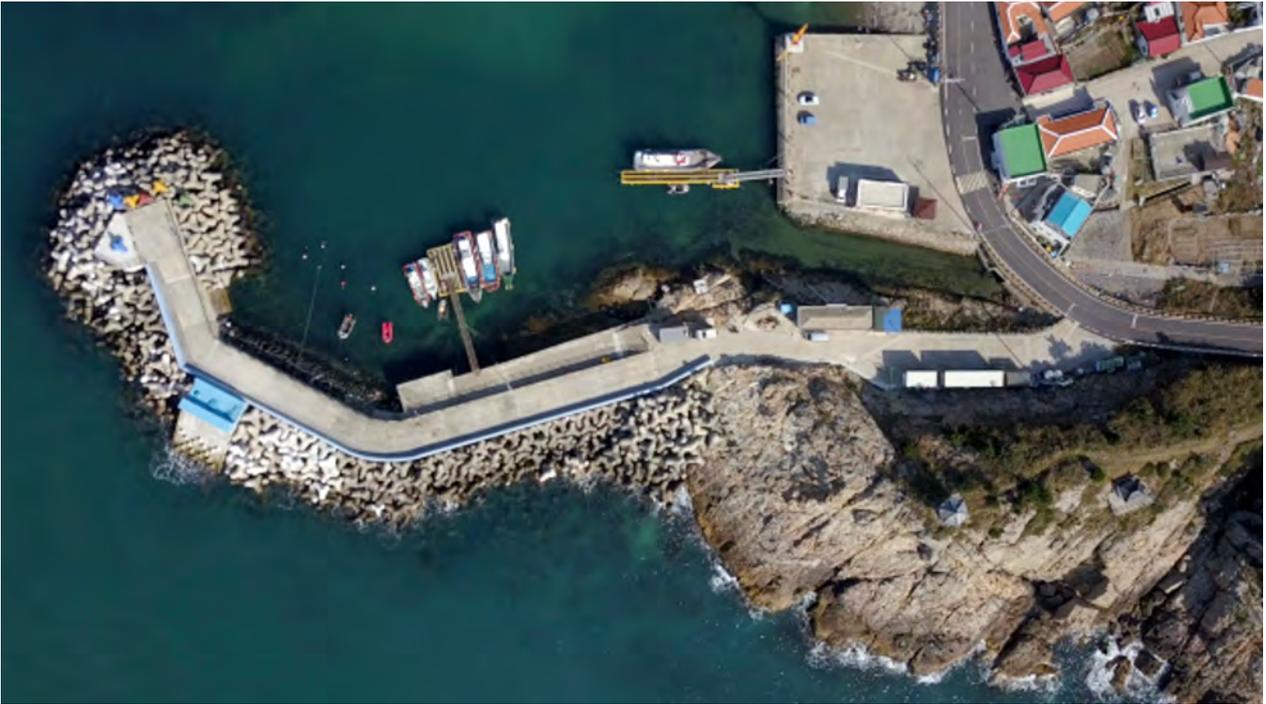
At the end of 2024, the KRISO established a demonstration plant for green hydrogen production at the OWC Wave Energy Converter (WEC) near Jeju Island. The demonstration plant is installed independently at sea, and all facilities are automatically controlled and operated remotely. Following successful pilot operations, the facility is currently validating the stability of hydrogen production under varying power loads from actual wave energy and simulated wind power. The system utilizes PEMWE (Proton Exchange Membrane Water Electrolysis), integrated with seawater desalination and a specialized seawater-based cooling system. With a maximum capacity of 20 Nm<sup>3</sup>/h, the project will expand in 2026 to embed hydrogen storage tanks and fuel cells. In the next stage, it is planned to convert the produced hydrogen back into electricity to supply power to the facility's own operation.



BladeLab@KIOST and actuators for blade strength testing (Courtesy: KIOST)



Hydrogen Production Plant on Yongsoo OWC WEC (Courtesy: KRISO)



Overview of Mook-ri OWC Plant (Courtesy: KRISO)

**KRISO is running an OWC pilot plant integrated into a microgrid at a remote island breakwater, building long-term performance evidence and paving the way for scalable multi-module deployments.**

In the KRISO-led R&D project to develop 30kW wave energy converters applicable to breakwaters in remote islands, the Pilot Plant was built at the Mook-ri port in Chuja Island (Located between Jeju Island and the mainland) and is conducting performance evaluation and technology verification through long-term operation. This Pilot Plant adopts the OWC-type wave power generation method, and it is the second plant developed in South Korea. In order to install the plant on the slope of the breakwater, a slope-type OWC chamber was adopted. The TTP (Tetrapod) was removed from the front of the breakwater slope in Mook-ri Port, and the OWC Chamber produced by the pre-cast method was installed. This attempt, which was applied to a

micro-grid with the integration of the OWC power plant and the ESS system, represents a highly effective approach to utilizing ocean energy in islands with limited land availability and relatively large marine space, and is being continuously developed through ongoing power generation as well as active research on optimal power control, with the potential for wide-scale application.

## Projects planned for deployment

KRISO is currently advancing a project focused on the development and deployment of oscillating water column (OWC) devices for integration into newly constructed breakwaters. The project aims to install three or more multi-module OWC chambers with a total capacity exceeding 90 kW. Initiated in 2023, Homigot Port in Pohang, located on the East Sea, has been selected as the demonstration site. The permitting and consent procedures were completed in 2025; accordingly, fabrication of the structural components and the power take-off (PTO) system is scheduled to commence in 2026, and installation is planned to be completed by 2026. A test operation phase will follow in 2027. The project will assess the feasibility and scalability of large-scale OWC farms and aims to advance the technology readiness lev-

el (TRL) of wave energy converters from Level 6 to Level 8, thereby supporting broader deployment in future wave energy projects in Korea.

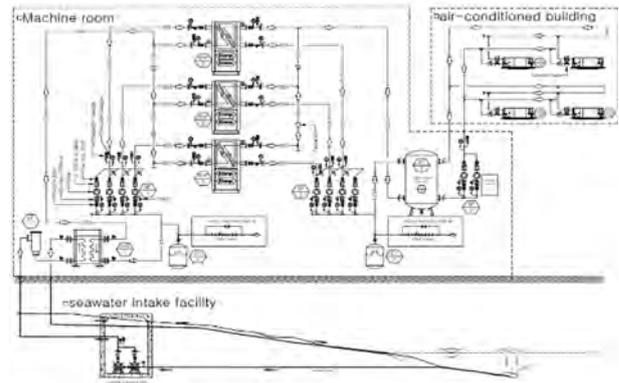
## Official Development Assistance (ODA) project

KRISO is carrying out an Official Development Assistance (ODA) project using seawater energy resources. The Marshall Islands ODA project (Capacity Building of the Republic of Marshall Islands in Achieving SDGs through OTEC Technology, 2023-2026) aims to contribute to achieving the Sustainable Development Goals (SDGs) by strengthening the self-sufficiency capacity for energy, drinking water, and food of the coastal villages of the Marshall Islands by supplying OTEC, seawater cooling, seawater desalination, and hydroponic cultivation technologies using deep ocean water. The project includes operating a sustainable seawater utilization academy (SSUA) education program, installing 50kW OTEC and 150RT seawater cooling, supplying a 20m<sup>3</sup>/day seawater desalination system, and 100 sets of hydroponic cultivation systems to the Marshall Islands. So far, the SSUA program has been established and operated, the design of major seawater plants such as OTEC has been carried out, and the installation of major infrastructure, such as deep seawater intake pipes, will begin this year.

The Fiji ODA project (Establishment of pilot-scale green campus in Fiji USP campus by utilizing the ocean thermal energy and renewable energy, 2024-2026) installs and operates a seawater cooling system using surface seawater on the USP campus in Fiji, and conducts capacity building education on seawater cooling, desalination, and hydroponics using seawater. This year, it is planned to promote the design of a seawater cooling system and a seawater intake pipe.



SSUA education program in Marshall Islands ODA project (Courtesy: KRISO)



150RT SWAC Design and 50kW OTEC Turbine-generator (Courtesy: KRISO)

## Specific Initiatives for International Cooperation

Korea is preparing a new project to promote technical cooperation with China on marine energy test sites and to strengthen networks among East Asian countries. The specific objective is to establish a framework for knowledge sharing and collaboration between the operators of Korean and Chinese marine energy test sites. This project is supported by the Korea-China Joint Ocean Research Center, which was jointly established by the governments of Korea and China. This joint research is expected to contribute to the advancement of marine energy technologies, enhance technological reliability, promote the marine energy industry, strengthen technical cooperation frameworks, and support improvements in relevant policy and regulatory frameworks.

# Singapore

**Report prepared by:****Dr. Narasimalu Srikanth**

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## Overview

Singapore's national renewable energy strategy emphasizes diversification of clean energy, innovation-driven R&D, and energy security within the city-state's spatial and physical constraints. The country has committed to net-zero emissions by 2050, supported by a progressive carbon tax, and is implementing the Singapore Green Plan 2030, which includes measures such as low-carbon electricity imports, energy storage expansion, and the exploration of emerging renewable technologies. Public funding programs, including over S\$800 million for R&D and low-carbon energy projects, alongside co-funding schemes, green finance incentives, and sectoral decarbonisation funds, have created a strong ecosystem for innovation. Singapore also supports early-stage demonstration projects through "Living Lab" initiatives, enabling clean technology firms to pilot, validate, and scale solutions locally while engaging with industry and regulatory stakeholders.

The Energy Research Institute @ Nanyang Technological University (ERI@N) has been central to advancing offshore and marine renewable energy in Singapore and Southeast Asia. Its work spans tid-

al, wave, ocean current, floating solar, and offshore wind technologies, complemented by expertise in microgrids, energy storage, and intelligent energy systems. ERI@N leads national and international standards efforts, serving as Singapore's national committee chair and IEC TC88 delegate for offshore wind, contributing to enterprise and international standards for marine electrification, floating solar biofouling (TC114), and tidal systems. Key demonstration projects include the Sentosa Tidal Test Site, Kranji Reservoir floating solar, offshore aquaculture solar deployment, harbourcraft electrification trials (Penguin and Lita Ocean), REIDS microgrid testbed, and INSPIRASI NTU in Indonesia. Regionally, initiatives such as SEACORE and the Singapore-China MoU with NOTC advance collaborative research in wind, wave, and tidal resource assessment. Singapore also continues to expand cross-border renewable energy integration, with conditional approvals for electricity imports from Cambodia, Laos, Malaysia, and Indonesia, reinforcing the city-state's role as a regional hub for low-carbon energy innovation and deployment.

# Supporting Policies for Ocean Energy

## National strategy

Singapore’s national renewable energy strategy focuses on diversifying clean energy, supporting innovation and R&D rather than depending solely on subsidies, and strengthening energy security within spatial and physical constraints. Singapore has committed to net zero emissions by 2050 with a stepped increase in carbon tax as part of that transition, indirectly incentivising low-carbon technologies. Singapore Green Plan 2030 includes Energy Reset measures to import low-carbon electricity, scale up storage, and explore emerging low-carbon alternatives. Singapore’s agencies such as Enterprise Singapore and energy/renewables bodies support marine/offshore energy R&D, innovation collaborations, and pilot testing in Singapore.

Marine spatial planning in Singapore differs from the integrated national frameworks seen in some other jurisdictions. There is no single, comprehen-

sive marine spatial planning law or authority that allocates marine space across all uses in a unified manner. Instead, marine areas are managed through a sector-based regulatory approach, with different agencies responsible for shipping, port operations, environmental protection, coastal development, and seabed use. This approach reflects Singapore’s status as one of the world’s busiest maritime hubs, where navigational safety and port efficiency are dominant considerations. As a result, while marine spatial planning is discussed in academic and regional policy contexts, it has not been formalised as a distinct policy instrument specifically supporting ocean energy development.

If an ocean energy project needs to be proposed in Singapore, approvals would likely involve multiple agencies, including the Energy Market Authority for power generation matters, the Maritime and Port Authority for navigational and marine safety considerations, and environmental authorities for impact



assessments and regulatory compliance. In the absence of a dedicated ocean energy licensing framework, project proponents would need to navigate existing energy, maritime, and environmental regulations on a case-by-case basis. For those who are interested in deploying ocean energy systems such as tidal turbines, wave energy systems, etc., Energy Research Institute @ NTU (ERI@N) is available to support device and project developers with necessary support through a research collaborative agreement (RCA) to follow-up with government agencies to perform necessary Environmental Impact Assessment and the Resource mapping studies and the Site-Device matching with the necessary techno-economics evaluation.

## Market incentives

Singapore provides a well-established set of broader clean energy and sustainability incentives that could indirectly support such projects. These include tax-based measures that reduce the cost of investing in renewable and energy-efficient technologies, such as enhanced capital allowances, accelerated depreciation, and reduced corporate tax rates for qualifying green investments. The government also offers co-funding and grant schemes that support research, innovation, pilot projects, and productivity improvements in clean technologies, which are relevant for early-stage marine and offshore energy development. In addition, Singapore has built a strong green finance ecosystem, with incentives for issuing green and sustainability-linked bonds and access to blended finance funds that channel cap-

## Research & Development

ERI@N, with core funding support from the Energy Market Authority, focuses its research on sustainable energy systems, energy-efficient infrastructure, and the broader socio-economic dimensions of energy transition. The institute aims to function as a centre of excellence for cutting-edge research, development, and demonstration activities that deliver meaningful impact both regionally and internationally. It has built strong capabilities in offshore and marine energy technologies, including wind, wave, tidal, and floating solar, supported by expertise in enabling areas such as energy storage,

ital into low-carbon infrastructure. Together with the country's progressively rising carbon tax, these mechanisms create market signals that encourage emissions reduction and investment in cleaner energy solutions, even though ocean energy itself is not yet a policy priority for domestic deployment.

## Public funding programmes

Ocean-based renewable energy has been identified by ERI@N as a promising alternative energy option, particularly for isolated coastal and island communities, and forms part of its targeted research agenda. In parallel, Singapore actively promotes its role as a "Living Lab," encouraging clean technology firms to pilot, validate, and demonstrate new solutions locally before deploying them at scale in international markets. To support this innovation ecosystem, the Government has committed more than S\$800 million in public funding toward research and development in areas such as energy, water, sustainable buildings, and land-efficient solutions. An additional S\$55 million has been allocated to support a portfolio of projects focused on low-carbon energy technologies. Beyond R&D funding, the Government has indicated its intention to reinvest over S\$1 billion in carbon tax revenues collected during the initial five years of the scheme to help businesses transition toward more energy- and carbon-efficient technologies. Complementing these efforts, the Maritime and Port Authority of Singapore has partnered with leading industry stakeholders to establish a S\$90 million decarbonisation fund aimed at accelerating emissions reduction within the maritime sector.

microgrids, and intelligent energy systems. These combined strengths allow ERI@N to address the full innovation chain, spanning advanced materials development, device fabrication, system modelling, and large-scale integration and optimisation.

Within ERI@N, the Renewables and Low Carbon Generation research programme is dedicated to improving efficiency, lowering costs, and accelerating the uptake of offshore renewable technologies, with particular attention to the unique technical conditions found in tropical environments. The programme places strong emphasis on early

engagement with industry partners to bridge the gap between research and commercial deployment. Close collaboration with government agencies ensures alignment with regional policy and infrastructure needs, while partnerships with local and international renewable energy companies help identify and address critical technology gaps. As part of its applied research efforts, ERI@N has developed a hybrid tidal- and solar-powered mooring buoy designed for Singapore's low-current tropical waters, supporting ocean environmental and seawater quality monitoring. Beyond technology development, ERI@N is actively involved in shaping the regulatory and standards landscape for marine energy in Singapore. Working with Enterprise Singapore, the institute has contributed to the localisation and adoption of international marine energy standards under the IEC TS 62600 framework, with four technical specifications from the IEC TS 62600 series customised and formally adopted as Singapore Standards.

ERI@N also plays a leading role in Singapore's offshore wind sector, with representation as the national committee chair and Singapore's delegate to IEC TC88, the international technical committee for wind turbine systems. Through this leadership, ERI@N contributes to the development and harmonization of technical standards, guidelines, and best practices for offshore wind design, installation, and operation. The institute's involvement ensures that Singapore's offshore wind projects align with global safety, performance, and reliability standards, while supporting local capacity building, research, and the integration of renewable energy into the national and regional power systems.

In Singapore, collaboration between academia, industry, and research institutions is strengthening innovation in the maritime and offshore sectors. The Energy Research Institute @ Nanyang Technological University (ERI@N) Joint Industry Programme (JIP) is a collaborative platform designed to support the design, development, and deployment of ocean energy technologies in Singapore waters, with a pathway for regional scale-up across Southeast Asia. The programme brings together technology developers, marine engineering companies, utilities, and government stakeholders to co-develop solutions for tidal, wave, ocean current, and other marine-based renewable energy systems. Leveraging NTU's research expertise, test-bedding capabilities,

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**ERI@N is strengthening research and development across the full offshore renewables innovation chain, combining technology development, system modelling, testing and demonstration, and industry engagement to accelerate the transition from research results to real-world deployment.**

and close engagement with regulatory and maritime authorities, the JIP enables site-specific design, resource assessment, environmental and navigational impact studies, and pilot demonstrations in Singapore's complex marine environment. Successful technologies and learnings from Singapore deployments are then positioned for adaptation and replication in suitable Southeast Asian markets, supporting the region's transition towards sustainable and low-carbon ocean energy solutions. The Singapore Institute of Technology has entered into a memorandum of understanding with DNV, a global leader in classification and maritime risk services, to work jointly on maritime decarbonisation, digitalisation, and the development of autonomous ship operations. In parallel, Seatrium Limited and the Agency for Science, Technology and Research have signed an MoU to explore research opportunities in new energy technologies and artificial intelligence, with the aim of developing advanced products and engineering solutions for offshore and marine applications. These efforts are further reinforced by TCOMS, which has also partnered with Seatrium and A-STAR on initiatives focused on new energies and AI for offshore and marine use cases. Complementing these partnerships, the Singapore Maritime Research Conference 2025 adopts the theme "Powering Research in Digitalisation and Decarbonisation," underscoring the growing emphasis on research in areas such as artificial intelligence, cybersecurity, and next-generation maritime technologies.

## Technology Demonstration

### Projects in the water

#### Sentosa – ERI@N Tidal Site

The Sentosa Tidal Test Site is a collaborative initiative between the Sentosa Development Corporation (SDC) and ERI@N, supported by funding from the Ministry of Trade and Industry's Core Innovation Fund. The project aims to demonstrate the feasibility of tidal energy extraction as a sustainable power source in Singapore, while creating opportunities to develop and test local technologies for harnessing energy in the narrow channel between Singapore and Sentosa. Recent progress at the test site includes the deployment of customized tidal turbines mounted on floating barges & Pylons, as well as the evaluation of innovative concepts such as floating solar systems and anti-biofouling coatings to enhance field performance. Electricity generated from the site has been used to power lighting along the boardwalk and has informed the development of floating tidal turbine systems. For optimal energy capture, tidal generators are ideally suited at natural coastal features, such as channels and estuaries, where water flow is naturally converged and amplified. The Sentosa test bed benefits from enhanced flow conditions due to the narrowed channel between Singapore and Sentosa and the presence of bridge piers, which provide additional man-made flow convergence.



Pylon Integrated Tidal Turbine at Sentosa



Floating Solar deployment in Kranji Reservoir

#### Floating Solar System Deployment

- Construction of a new large-scale floating solar installation at Kranji Reservoir began in 2025, following the completion of environmental assessments that concluded the project would not cause significant harm to local biodiversity. When completed, it will be Singapore's largest floating solar farm and will play an important role in advancing the country's renewable energy ambitions. The project is designed to deliver up to 141 megawatt-peak of solar capacity, equivalent to about 112.5 megawatts in alternating current, which is compatible with Singapore's power grid and electrical systems. According to the environmental study, the installation will contribute approximately seven percent toward Singapore's target of achieving two gigawatt-peak of installed solar capacity by 2030. The facility is expected to become operational between 2027 and 2028.
- PUB called a tender to conduct engineering studies for the deployment of two smaller floating solar PV systems at Bedok and Lower Seletar Reservoirs. Following up from the successful studies, PUB awarded a contract to local engineering firm to build the system. 1.5 MWp floating solar PV systems are deployed on the reservoir surfaces adjacent to Bedok Pumping Station and the Lower Seletar Pumping Station, taking up 2% of Bedok Reservoir's and 0.5% of Lower Seletar Reservoir's surface areas. These two floating solar PV systems can collectively generate enough energy to

power about 800 four-room HDB flats and reduce PUB's carbon emissions by around 1.5 Kilotonnes annually.

- ERI@N has deployed an offshore floating solar system to supply energy to aquaculture farms, marking a pioneering effort in leveraging renewable energy for open-ocean aquaculture in Singapore. Offshore aquaculture is highly energy-intensive, requiring power for water aeration to maintain oxygen levels, automated feeding systems, environmental monitoring, and water purification to sustain healthy aquatic conditions. Traditionally, these operations have relied on diesel or other non-renewable energy sources, which are costly and environmentally damaging. The floating solar system provides a sustainable alternative, either supplementing or fully replacing conventional energy sources, thereby reducing carbon emissions and promoting cleaner, more efficient aquaculture practices.



ERI@N's Offshore Floating Solar

- Following the successful deployment, ERI@N also contributed to the development of new biofouling standards (TC114), addressing the challenges of marine growth on offshore renewable energy structures and helping ensure better performance, durability, and reliability for floating solar and other marine energy systems.

## Projects planned for deployment

### Ocean Renewable Energy Farm

ERI@N, in collaboration with the Maritime and Port Authority (MPA) of Singapore, is advancing the electrification of harbourcraft through the development of maritime electric charging technologies. The institute has contributed to the establishment of enterprise standards for safe and efficient marine

electrification, enabling scalable adoption across Singapore's port and shipping operations. Demonstration projects, including deployments on vessels such as Penguin and Lita Ocean, showcase the feasibility and performance of electric propulsion in real-world harbour environments, highlighting reduced emissions, improved energy efficiency, and Singapore's commitment to sustainable maritime operations.

Plans are also underway to explore the development of a renewable energy farm in the waters surrounding Raffles Lighthouse, with a feasibility study set to begin in the fourth quarter of this year. The Maritime and Port Authority of Singapore (MPA) has earmarked a 30-hectare area around the site for potential installation, which could include floating solar panels on the water surface and tidal turbines beneath. If implemented, this project could become Singapore's first large-scale hybrid facility combining solar and tidal energy. The electricity generated from the farm is expected to support the charging of electric harbour craft, in line with upcoming regulations requiring all new harbour craft from 2030 to be fully electric, compatible with cleaner biofuels, or capable of using net-zero fuels such as hydrogen. This initiative forms part of Singapore's broader strategy to achieve net-zero emissions in the maritime sector by 2050. MPA is studying the feasibility study of developing a hybrid renewable energy farm, which will assess the environmental impacts of the proposed energy farm and develop strategies to mitigate any potential concerns.



Raffles Lighthouse in Pulau Satumu

### Renewable Energy Integration Demonstrator-Singapore (REIDS)

The Renewable Energy Integration Demonstrator - Singapore (REIDS) is a Singapore-based R3D (Research, Development, Demonstration, and Deploy-



Renewable Energy Integration Demonstrator-Singapore

ment) platform focused on designing, testing, and demonstrating solutions for sustainable, affordable energy access across Southeast Asia, as well as advancing the future of urban electricity distribution. REIDS promotes systemic research and development across the energy sector, supporting both corporate and public stakeholders in Singapore and strengthening their capabilities in the rapidly expanding renewable energy and microgrid markets. The REIDS Low Voltage Microgrid Cluster (LVMGC) testbed on Semakau features seven industrial partner microgrids (MG1-MG7), three NTU microgrids (REIDS Hub, MGO, and NTU MG), and two sets of shared assets and LV/MV switchgear components. Beyond R&D, the testbed provides partners with a unique platform to demonstrate their technologies to global companies and decision-makers who frequently visit the facility. The deployed microgrids are designed to serve real electricity loads. Currently, the REIDS project provides an average of approximately 200 kWh daily to the NEA facility on Semakau Landfill, with plans to expand supply to meet the full electricity demands of both the NEA and Barramundi Asia, a fish nursery located on the landfill.

Inspirasi NTU builds on the success of the Renewable Energy Integration Demonstrator – Singapore (REIDS) by extending renewable energy research, demonstration, and deployment to Indonesia.

The initiative focuses on integrating diverse renewable energy resources, including solar, wind, and marine energy, into microgrids and urban electricity systems in Indonesian communities. Leveraging lessons learned from REIDS, Inspirasi NTU emphasizes technology adaptation for local conditions, capacity building, and sustainable energy access, while providing a platform for testing hybrid microgrid solutions, energy storage, and smart grid technologies. Through collaborations with Indonesian government agencies, industry partners, and local communities, Inspirasi NTU aims to advance affordable, resilient, and low-carbon energy solutions, supporting the broader Southeast Asian energy transition.

### Deployment of Clean Energy Powered water generation system in Southern Islands of Singapore

Singapore's southern islands are well-known leisure destinations, with energy and water demand largely shaped by tourism activities and the presence of government facilities. These islands host a range of visitor amenities, including bungalows and campsites, as well as recreational and cultural attractions such as beaches, temples, fishing areas, and picnic sites, alongside essential public infrastructure. At present, electricity on the islands is generated using diesel, while water supplies are transported

from the mainland. In response to rising demand for both resources, the Energy Research Institute @ Nanyang Technological University, with backing from the Singapore Land Authority, has introduced a clean energy driven water production system and renewable energy solutions on one of the islands. This renewable-powered water generation system has been successfully deployed on Kusu Island and Pulau Hantu Besar, and plans are underway to replicate the approach across other southern islands.



Renewable system deployed in Kusu Island, Singapore to meet the energy needs of the island

## Specific Initiatives for International Cooperation

As part of its broader strategy to decarbonize the economy, Singapore is prioritizing the reduction of its carbon footprint while ensuring reliable energy supply. By 2035, the country aims to meet roughly 30% of its energy demand through imports, which could include renewable sources such as solar, hydrogen, or other clean energy generated regionally from neighbouring countries. This approach supports Singapore's ambitious goals for cutting greenhouse gas emissions and accelerating the transition to low-carbon energy solutions.

In a significant milestone, the Energy Market Authority (EMA) has granted Conditional Approval to Keppel Energy Pte. Ltd. to import 1 gigawatt (GW) of electricity from Cambodia. This marks EMA's first Conditional Approval for electricity imports and represents a key step toward Singapore's target of sourcing up to 4 GW of low-carbon electricity by 2035. The approval confirms the preliminary technical and commercial feasibility of the project, allowing Keppel Energy to proceed with securing the necessary regulatory licenses. The initiative builds on the Energy Cooperation Memorandum of Understanding signed between Singapore and Cambodia in October 2022, reinforcing both countries' commitment to regional decarbonization and cross-border electricity collaboration. Keppel Energy plans to generate the imported electricity primarily from solar, hydropower, and potentially wind, supported by battery energy storage systems (BESS) or pumped storage hydropower (PSH), and transmit it via new subsea cables spanning over 1,000 km.

Singapore is also currently importing up to 100 megawatts (MW) of renewable energy from

Laos through the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP). In addition, EMA is piloting a 100 MW electricity import from Malaysia, with YTL PowerSeraya appointed as the importer, using the existing interconnector between the two countries over a two-year period.

5 private entities are also given Conditional Approvals by EMA to import 2 GW of electricity from Indonesia:

- Pacific Medco Solar Pte Ltd (formed by PacificLight Renewables Pte. Ltd., Medco Power Global Pte. Ltd. and Gallant Venture Ltd.) for an import capacity of 0.6 GW
- Adaro Solar International Pte. Ltd. (formed by PT Adaro Clean Energy Indonesia) for an import capacity of 0.4 GW
- EDP Renewables APAC for an import capacity of 0.4 GW
- Vanda RE Pte. Ltd. (formed by Gurin Energy Pte. Ltd. and Gentari International Renewables Pte. Ltd.) for an import capacity of 0.3 GW
- Keppel Energy Pte. Ltd. for an import capacity of 0.3 GW

The Southeast Asia Ocean Renewable Energy (SEA-CORE) initiative by the Energy Research Institute @ Nanyang Technological University (ERI@N) is a regional effort aimed at advancing the research, development, and deployment of ocean renewable energy technologies in Southeast Asia. SEA-CORE focuses on harnessing resources such as tidal, wave, ocean current, and thermal energy by integrating multidisciplinary research, technology demonstration, policy and regulatory support,

and capacity building. The initiative seeks to bridge gaps between academia, industry, and government agencies, enabling pilot projects, fostering regional collaboration, and supporting the development of enabling frameworks to accelerate the adoption of ocean renewable energy as part of Southeast Asia's sustainable and low-carbon energy transition.

A Memorandum of Understanding (MOU) has been signed between Nanyang Technological University, Singapore and National Ocean Technology Centre, China for joint collaborative research on Next Gen-

eration Tropical Marine Renewable Energy Technologies towards Singapore-China Carbon Neutral Goals which was facilitated by Energy Market Authority in Singapore on October 2024. This MoU was also signed between Deputy prime minister of Singapore and Deputy prime minister of China on Beijing in Nov 2024. Presently, Nanyang Technological University, Singapore and National Ocean Technology Centre, China is working on wind, wave and tidal resource assessment studies of Southeast Asia and South China waters.

## Relevant National Events

### Singapore International Energy Week (SIEW)

The Singapore International Energy Week (SIEW) is an annual platform that brings together energy professionals, policymakers, and industry commentators to exchange best practices and explore solutions across the global energy landscape. The 18th edition, SIEW 2025, was held on 27<sup>th</sup> – 31<sup>st</sup> October, 2025 under the theme “Envisioning Energy Tomorrow, Building Systems Today,” focused on key discussions such as enhancing regional energy interconnectivity, promoting collaboration in research, development, and deployment of energy technologies, addressing infrastructure and financing challenges, and creating a resilient, people-centred energy system for the future. With over 23,000 delegates in attendance, the event focused on how collaboration, connectivity, and capabilities are reshaping regional energy systems. SIEW 2025 also had Roundtable sessions focused on the following:

- **Asia's Energy Future: Building a Diverse and Resilient System** - This Roundtable brought together policymakers, industry leaders, and experts to discuss how these solutions can reduce emissions, enhance energy security, and drive sustainable growth. It examined the latest trends in technology, investment, and policy shaping Asia's transition, and explore the frameworks and partnerships required to accelerate adoption. The dialogue also highlighted how regional cooperation can enable the infrastructure and markets need-

ed for a cleaner, more resilient, and dynamic energy system in the decades to come.

- **The Evolving Role of Nuclear in the Future Energy System - Co-hosted with the World Nuclear Association**, this strategic roundtable analysed the accelerating adoption of nuclear energy worldwide. Discussions were focused on countries' approaches to increasing nuclear capacity in their energy mix, showcasing technological innovations with special emphasis on the advancement of small modular reactors (SMRs) and their deployment strategies. It also examined the evolving energy demands of Southeast Asia and explore how nuclear energy could help address these requirements effectively.
- **The AI-Energy Nexus: Transforming the Transition to Low-Carbon Power** - This roundtable explored the transformative role of AI in advancing cleaner energy initiatives, with a particular focus on its applications in optimising energy grids and managing the surging energy demands of AI itself. It also addressed the challenges of sustainable AI implementation, including the carbon footprint of digital infrastructure and the need for robust policies to support its responsible adoption. Industry experts focused into how AI can accelerate efforts to reduce carbon emissions, particularly in Asia, a region grappling with high energy demand, significant carbon emissions, and the increasing power needs of AI infrastructure.

## Asia Conference on Renewable Energy and Environmental Engineering (AREEE)

The 2025 6th Asia Conference on Renewable Energy and Environmental Engineering (AREEE 2025) was held in Singapore during March 22- 24, 2025. The aim of the conference was to provide a premier platform for environmental engineers and researchers to present their works and to share experiences and ideas in Renewable Energy Storage and Hydrogen Systems, Wastewater Treatment and Biodegradation, AI/ML-Driven Civil and Environmental Solutions with experts and scholars from around the world. The conference program featured keynote and plenary sessions, oral and poster presentations. Distinguished speakers were invited to deliver keynote speeches and invited talks on emerging technologies in renewable energy and environmental engineering.



AREE 2025

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# Spain

## Report prepared by:

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## Overview

In 2025, Spain consolidated its suitable environment for ocean energy research, demonstration, and early stage deployment. The regulatory framework—anchored in the updated Integrated National Energy and Climate Plan (NECP/PNIEC 2023–2030)—continued to provide long-term visibility for marine renewable energies, while new legislative developments such as Royal Decree RD 997/2025 strengthened the enabling conditions for R&D platforms and test infrastructures. Spain also advanced its Maritime Spatial Planning framework (POEM), ensuring structured stakeholder participation toward the second cycle of MSP.

Significant progress was achieved in technology development and demonstration across wave, tidal, and OTEC technologies, supported by national and EU-funded programmes. Test sites such as Bi-MEP (Armintza and Mutriku) and PLOCAN hosted major milestones, from advanced turbine testing to offshore prototype deployments. Spain's innovation ecosystem—combining industry, research centres, universities, and public agencies—continued to expand its capabilities in key areas such as PTO systems, digital twins, structural materials, and environmental monitoring, reinforcing the country's role in advancing Europe's offshore renewable energy transition.

## Supporting Policies for Ocean Energy

### National strategy

In **2025**, Spain continued to solidify its regulatory and governance framework for **marine renewable energies**—including wave, tidal and other ocean energy technologies—without issuing a dedicated new national strategy. The strategic context remained anchored in the **Integrated National Energy and Climate Plan (NECP / PNIEC 2023–2030)**, updated and approved by Royal Decree 986/2024 in September 2024, whose provisions guided policy implementation.

On Ocean Energy, the overall policy context remains guided by the *Roadmap for Offshore Wind and Marine Energies* (published in 2021), which remains the primary high-level reference for the sector.

### Regulatory Framework (2025)

The Royal Decree **986/2024** applies to **marine energy technologies** beyond offshore wind and confirms that **innovative installations below 20 MW**

remain **exempt from competitive tendering**, thereby facilitating early-stage demonstration deployments. Full environmental and administrative procedures remain mandatory (Environmental Impact Assessment, concession for maritime/terrestrial public domain, etc.), while detailed parameters of competitive allocation for larger projects will be further defined through subsequent Ministerial Orders.

In November 2025, the **Spanish government approved Royal Decree RD 997/2025 of November 5, 2025, which approves urgent measures to strengthen the electricity system**. In particular, “Article 8. Administrative authorizations for standard generation projects on R&D platforms” includes provisions to facilitate the deployment of test platforms and R&D projects in the energy sector, facilitating plug-and-play connections for technology demonstrators on R&D technology platforms in the marine environment.

### Marine Spatial Planning (MSP)

Spain’s **Maritime Spatial Plans (POEM)** – approved in 2023 under RD 150/2023 – continued to serve as the spatial governance basis in 2025. During the year, **Spain advanced the Second Cycle** of MSP through multistakeholder workshops coordinated by MITECO and CENEAM, ensuring representation of marine renewable energy developers and research institutions in discussions on coexistence, environmental protection and spatial prioritization.

### Market incentives

There are no specific market incentives for ocean energy in Spain, but for renewable energy installations in general.

Royal Decree 413/2014, of June 6<sup>th</sup>, established that the support for new renewable facilities is granted through competitive public tender processes. Through these auction processes, bidders propose the initial value for the investment that they will be willing to accept, and the MW auctioned are allocated to the most competitive offers (the lower ones).

Royal Decree 960/2020, of November 3<sup>rd</sup>, which regulates the economic regime of renewable energies for electricity production facilities and Order TED/1161/2020, of December 4<sup>th</sup>, which regulates the first auction mechanism for the granting of the economic regime of renewable energies, will allow to start the tender calendar for the next years.

Spain is strengthening its electricity system while enabling faster deployment of marine energy test projects through simpler authorisations.

The above-mentioned Order TED/1161/2020 establishes a tender of 20 MW every two years focused on “Other Technologies”, where ocean energy is included.

### Public funding programmes

In 2025, Spain advanced the execution of EU-funded support schemes for marine renewables under the **Recovery, Transformation and Resilience Plan (PRTR)**:

- **RENMARINAS DEMOS Programme:** Continued to disburse funds for pilotscale marine renewable energy projects and testing infrastructures. Several beneficiaries, including national test sites, progressed in project execution and received approved prepayments during 2025, reinforcing Spain’s commitment to demonstration activities.
- **PORTEOLMAR Program - Regulatory Order TED/1488/2025** (December 2025): On 19 December 2025, Order TED/1488/2025, of 17 December, of the Ministry for Ecological Transition and Demographic Challenge (MITERD) was published, establishing the regulatory bases for granting aid to investment projects for the physical adaptation of national port infrastructure in ports of general interest for the deployment of offshore wind and other marine renewables in Spain (PORT-EOLMAR Program), within the framework of the Recovery, Transformation and Resilience Plan financed by the European Union - NextGenerationEU. These regulatory bases had previously been launched for public consultation in July 2025. The purpose of this PORT-EOLMAR Aid Program is to strengthen Spanish and European strategic autonomy in the Offshore wind & ocean energy value chain, in particular by enabling only unique

“infrastructure projects” by port authorities in strategic locations and with high capacity requirements, which significantly improve the logistical capabilities of port infrastructures both on land and at sea, through the construction or adaptation of docks and new operating areas in their rear zone, with all the necessary logistics for the deployment of offshore wind and other marine renewables energies and their value chain in Spain. On 23 December 2025, MITERD, through the Institute for the Diversification and Saving of Energy (IDAE), published and launched the Call for Aid, on a competitive basis, which will be resolved during 2026 by identifying and publishing the beneficiary actions, including the Eligible Costs committed and the aid granted.

- **PRTR-wide Adjustments – Order TED/1444/2025:** This “omnibus” update refined the regulatory bas-

es of several PRTR programs managed by IDAE, improving alignment with EU State aid rules and affecting programs applicable to marine renewables, including RENMARINAS DEMOS.

Spain also provides access to broader national R&D funding programmes that, while not specific to ocean energy, are widely used by developers and research institutions in the sector. Instruments from CDTI—such as PID and CIEN—support industry-led innovation through collaborative projects, while the State Research Agency (AEI) funds fundamental and applied research through competitive national calls. These mechanisms have been effectively leveraged to advance ocean energy technologies in areas like materials, PTO systems, and environmental monitoring, complementing sectorspecific programmes and strengthening Spain’s overall innovation ecosystem for marine renewable energy.

## Research & Development

### TurboWave

The Basque Energy Agency (EVE) launched the TurboWave project in late 2022. This Pre-Commercial Procurement initiative aims to accelerate the development of cost-efficient, safe and reliable air turbine technologies that match the needs of the wave energy sector in general and the specific technical requirements of the Mutriku Wave Power Plant (MWPP). The TurboWave project is expected to progress through 3 phases: “Concept development”, “Design refinement and laboratory testing”, and “Manufacture and on-site testing of prototypes at Mutriku wave power plant”.

In 2025, the project saw the successful completion of the four previously awarded Phase II contracts (projects) from the following developers:

- Advanced Simulation Technologies – New Wave Technologies (Consortium)
- Arrecife Energy Systems
- IDOM Consulting, Engineering, Architecture
- Kymaner – IDMEC (Consortium)

The TurboWave initiative continued with the launch of the call for tenders for the award of two Phase-III contracts. Phase III activities include detailed design and manufacture of the solutions under de-

velopment, as well as a minimum of 12 months of testing in real operational conditions in the Mutriku Wave Power Plant.

After careful evaluation of the received proposals by a panel of internal and independent experts, contracts were finally awarded in June 2025 to Arrecife and IDOM. Project activities will span from 2025 to 2027, with turbines planned to be installed in MWPP as early as April 2026.

### EuropeWave

**Horizon 2020 project EUROPEWAVE** was launched in January 2021 and has the objective to bridge the gap to commercialisation of wave energy technology using pre-commercial procurement. The project brings together over €22.5m of national, regional and EU funding to provide the boost to Europe’s wave energy innovation community necessary to transition to commercial viability. WES (Wave Energy Scotland) is the coordinator of the project and acts as lead procurer in the ‘Buyers Group’ formed by WES (Scotland) and EVE – Basque Energy Agency (Basque Country). The consortium is completed by Ocean Energy Europe, the sector’s representative body, which will enable the widest possible engagement with those influential stakeholders able to

maximise the environmental, economic and social benefits of wave energy technology for Europe. In 2025, the project consortium granted an extension to the project, allowing for the activities to carry on until January 2028.

In 2025, significant progress was achieved on engineering activities towards open-sea testing activities for 3 developers:

- Mocean Energy managed to secure the “Authorisation to Proceed” from the Buyer’s Group, green-lighting their planned deployment of Blue-X system with an improved PTO that features a Vernier Hybrid Machine (VHM) as key innovation, in the pre-consented area of Copinsay (UK).
- IDOM Consulting, Engineering, Architecture, made a significant step towards their full system deployment, carrying out the mooring and umbilical systems installation and finalising the onshore preparation works, as well as securing all the necessary permits to enable an early 2026 deployment of their MARMOK-A-5 device. As part of a broader set of de-risking activities, their novel variable pitch air turbine was tested in Mutriku Wave Power Plant during the second half of the year
- CETO Wave Energy Ireland made progress on the manufacture, assembly and onshore testing of the constituent elements of their wave energy device, planned to be deployed in Summer 2026. These testing activities included PTO testing, control system development and integration, as well as mechanical stress tests of mooring elements, connectors and other critical components.

The EuropeWave project consortium organized a side event at OEE 2025 to engage stakeholders and promote project outcomes.

## MAXBlade

The MAXBlade project, funded under the HE programme, aims to deliver essential blade and rotor innovations to improve performance, reduce cost, increase reliability, survivability, recyclability and bankability of tidal stream technologies. In 2025, an extensive experimental campaign started at TECNALIA’s DANTE and HarshLab marine laboratories to test different blade coatings samples from Orbital Marine Power, their antifouling properties and dynamic frictional resistance under realistic conditions.

More information: <https://maxblade.tech/>

## JRL-ORE

The Joint Research Laboratory on Offshore Renewable Energy was created in 2017. Based on the Basque Country, the JRL-ORE is a diverse scientific community composed of around 60 researchers from TECNALIA, BCAM and the University of Basque Country. The JRL-ORE is committed to the training of future professionals for offshore renewables, being linked to the Master in Renewable Energy in the Marine Environment coordinated by the University of the Basque Country (REM+ Master <https://www.master-remplus.eu/>).

In 2025, among other projects, the JRL-ORE coordinated RUL-ET (Remaining Useful Life of Mooring Systems and Umbilicals for Offshore Renewables), which is described below.

More information: <https://jrl-ore.com/>

## RUL-ET

The RULET project uses Artificial Intelligence to improve predictions of the remaining useful life of moorings and umbilicals—critical components for future floating offshore renewable systems. Led by Tecnalia, the project aims to enhance reliability and reduce operational costs by developing data and software libraries for structural health assessment, along with three Albased models focused on life prediction, uncertainty management, and maintenance decisionsupport. It will also generate four application examples, including detailed use cases for moorings and umbilicals in two operational contexts.

The consortium is made up of six entities: a multi-location centre: TECNALIA (coordinator); a centre of basic research and excellence: BASQUE CENTER FOR APPLIED MATHEMATICS (BCAM); two universities: MONDRAGON GOI ESKOLA POLITEKNIKOA and UPV/EHU (with the departments of energy engineering and mathematics); a business R&D unit: VICINAY MARINE INNOVACIÓN and a supply-demand intermediary: the BASQUE ENERGY CLUSTER. The project has a duration of two years (2024-2025) and is funded by the Department of Industry, Energy Transition and Sustainability of the Basque Government (ELKARTEK 2024 Programme).

## COIN

In addition, in late 2025, Carnegie commenced its key role as the technology partner in the COIN (Control-Oriented INnovations for future wave energy farms) Project, a €4 million collaborative project. Fully funded by the European Commission under the Horizon Europe Programme, the COIN Project is focused on developing and advancing cutting-edge innovations to significantly enhance the reliability, survivability, and sustainability of future wave energy farms.

## MAR+

In 2025, the MAR+ project strengthened Spain's role in marine renewable energy by advancing a unified, standards-aligned framework for laboratory testing of wave energy and floating offshore wind. Key progress included harmonised test methodologies, documentation for future accreditation and major improvements in experimental and numerical capabilities, such as large OWC campaigns and expanded hydrodynamic datasets for digital twin development.

The project also deepened collaboration with international standardisation and certification bodies and reinforced links with European testing infrastructures. These efforts support the creation of an accredited laboratory cluster and will enable future realsea validation activities, including upcoming work at the Mutriku OWC plant using the digital twin framework.

## INNOMAR Project

The INNOMAR project<sup>1</sup> (Innovative solutions for promoting ocean renewable energies and environmental monitoring in the Galicia test site of Punta Langosteira) will develop a floating multi-connector structure, with different kinds of sensors, for devices that generate renewable electricity at sea, while monitoring what happens in the area. It will promote technological development and generate environmental, socio-economic, and marine biodiversity knowledge.

The INNOMAR project will contribute to the promotion of the use of renewable energy resources

in Galicia, increase their contribution to the energy mix and reduce external dependence, through technological development and studies related to the marine environment, biodiversity and ocean renewable energies.

It focuses on developing new solutions that make the opportunities offered by the test site of ocean energies at Punta Langosteira (Arteixo), a site dedicated to the testing and development of prototypes that use MRE to generate electricity.

It includes the design, development and implementation of a structure that will include a floating and sensorised multi-connector for the interconnection of renewable electricity generation prototypes and the generation of knowledge about possible effects of the devices on the marine environment. Data will be collected from the environment using cameras and sensors to monitor the presence of birds, marine mammals and fish.

## MARES

MARES is a Project granted by the European Commission in May 2024 under Project Number 101172746 in the framework of the call HORIZON-CL5-2024-D3-01. The main goal of the Project is to validate two superconducting technologies for a Wave Energy PTO, one based on REBCO tapes while the other uses MgB2 wires, both applied to a reciprocating generator based on a Switched Reluctance Machine. The envisaged advantage of using superconductivity for this application is the considerable increasing of the PTO force density, which would allow to make more forceful PTOs with the same dimensions as conventional ones and consequently augmenting the energy that can be extracted from the waves.

The project aims at building a 2kN force prototype to be tested at the Laboratory, and the consortium integrates 10 partners from 5 different countries.

The project officially started the first of October 2024 and during the first year, technical activities have concentrated on the calculation and design of the Prototype, including the electromagnetic design which allows the dimensioning of the machine, the superconductor selection, the definition of the

<sup>1</sup> Its global budget is over M€5.7 and has been 60% co-financed by the European Union, through a grant of more than M€3.4 million from the *Ministry of Science, Innovation and Universities*, under the *Demand-driven Innovation Promotion Line for Public Procurement of Innovation (ERDF Fund)*.

cryogenic system and also the first proposals for the power converters which include some special features over those used in non-superconducting machines. Besides internal meetings and workshops, the project has generated 4 papers in 3 congresses and 1 Review Paper in a prestigious review.



3D design schemes of the MARES Superconducting Linear Generator.

## Technology Demonstration

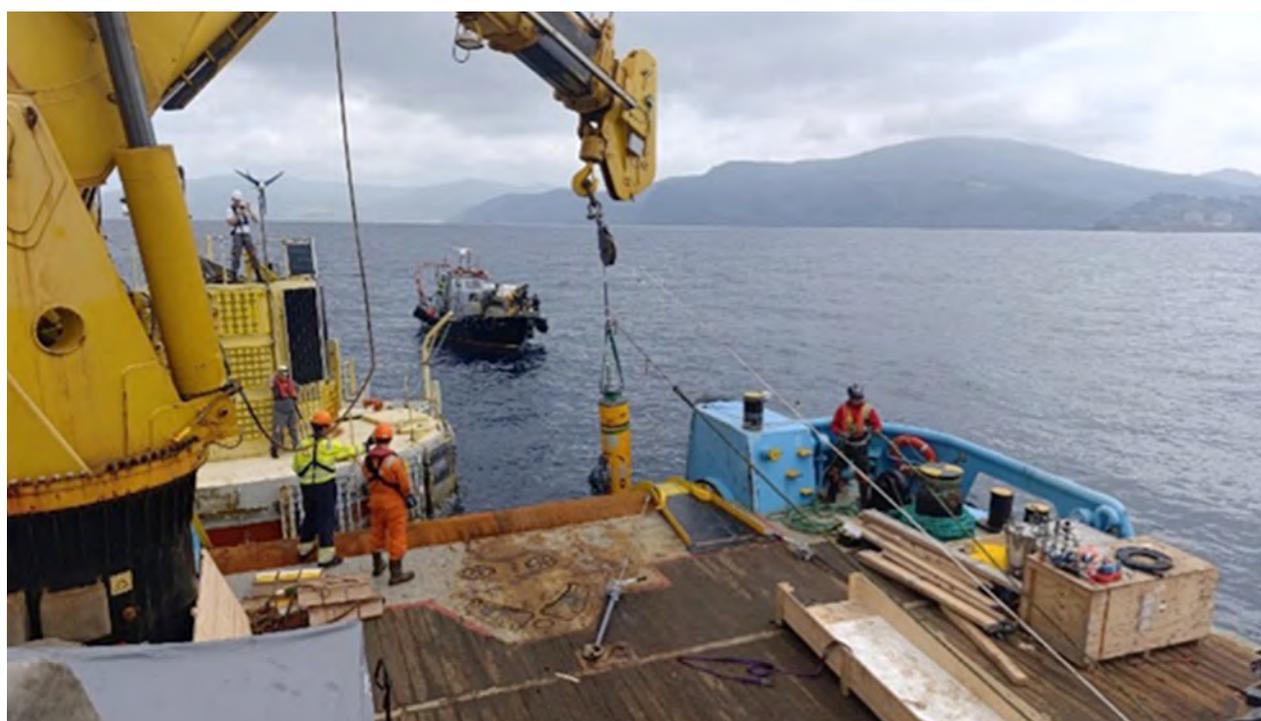
### Projects in the water

#### Mutriku Wave Power Plant

This wavepowered electricity generation plant, the oldest of its kind in the world, has completed another year of operation. The energy exported to the grid since it was commissioned (July 2011) has reached 3.43 GWh. During 2025, it hosted a test of an OWC turbine prototype developed by IDOM, which will later be installed at the BiMEP test site (Armintza), and the plant is now being prepared to host the two tests that will begin in 2026 under the **EuropeWave project**.

#### HarshLab

**HarshLab**, installed at BiMEP in 2022, achieved a major milestone in September 2025 when it was connected to the BiMEP electrical grid through an umbilical cable linked to the offshore underwater network. This new electrical connection enables fullscale testing of mechanical and electrical equipment under real marine conditions, continuous data acquisition, and improved operation and maintenance strategies for ocean energy systems. TECNALIA is integrating advanced technologies—AI,



HarshLab - Installation of the electrical cable at BiMEP

numerical modelling and operational data—to enhance the design, efficiency and safety of offshore renewable prototypes and future commercial devices, contributing to Europe’s Net Zero goals.

Throughout 2025, HarshLab hosted several testing campaigns, including advanced trials on anticorrosion and antifouling coatings, as well as unique tests on corrosion monitoring sensors to assess structural degradation and remaining service life. The laboratory also proved its resilience by safely withstanding severe winter storms in the Bay of Biscay. To ensure structural integrity, the team monitored its mooring lines—anchored 65 m deep—using a small ROV and carried out additional tests on mooring components and umbilical cables.

More info at: <https://harshlab.eu/>

## PLOTEC

Ocean Thermal Energy Conversion (OTEC) platform (floating hull + cold-water intake concept). Deployed (Oct 2025); long-term offshore trials initiated, next phase includes installing and connecting the cold-water pipe to complete full structural testing

The PLOTEC project, funded by the EU’s Horizon Europe program, began in November 2022 and will run during 2026, with a budget of €1.32 million. The project aims to demonstrate a new storm-resistant ocean thermal energy conversion (OTEC) platform, which can generate continuous clean power by exploiting the ocean’s thermal gradient. A 1:5 scale prototype, named **“Don”** is being tested at the PLOCAN test site in the Canary Islands, where it underwent initial deployment by October 2025. The trial is set to span 12 months, with data collection continuing through 2026.

The project is coordinated by PLOCAN (Spain) and involves key partners such as Global OTEC (UK), Wa-



vEC (Portugal), Quality Culture (Italy), AGRU (Austria), and the University of Plymouth (UK). The project’s primary focus is on validating critical components, including the platform’s cylindrical hull, mooring system, and cold-water intake pipes. These components are essential for ensuring the platform’s resilience in storm-prone conditions, with the goal of proving the viability of OTEC technology in challenging ocean environments. If successful, PLOTEC could offer valuable insights for the future development of full-scale OTEC systems.

## SHY Project

SHY (Seawater HYdraulic PTO using dynamic passive controller for wave energy converters) is a Horizon Europe project (2024–2027) led by Wavepiston to develop and validate key components of a seawaterhydraulic powertakeoff (PTO) and an advanced control strategy that targets lower LCOE and higher reliability. The approach couples a composite linear pump and a controller valve using seawater as the working fluid, with validation staged from hardwareintheloop testing to openwater trials at PLOCAN’s test site in Gran Canaria. The consortium includes DTU, Maynooth University, Fibron Pipe, LESER, Marine Systems Modelling, Applied Renewables Research, Julia Fernández Chozas and PLOCAN. Total EU support is ~€3.81M under Grant 101147456.

At PLOCAN, Wavepiston has already installed and operated fullscale energy collectors and a first offshore test bench, building on the earlier W2EW (Wave to Energy & Water) line that combined wavedriven electricity and desalination; the SHY work now uses that platform to validate two PTO prototype generations, with a secondgeneration upgrade planned to increase energy capture and durability. Public updates note first fullscale collector installations in 2024 and continued offshore validation, with PLOCAN’s own project pages flagging SHY as an ongoing 2024–2027 effort and planning for iterative prototype deployment (“first” then “second” generation) at the site.

## Projects planned for deployment

### ACHIEVE Programme

In 2025, Carnegie Technologies Spain (a subsidiary of Carnegie Clean Energy) advanced the ACHIEVE



Programme in preparation for deployment of a scaled CETO unit at the Biscay Marine Energy Platform (BIMEP) test site in the Basque Country. Key activities during the year focused on procurement, fabrication and assembly of CETO Unit components, site preparation and subsystem testing in advance of deployment in 2026.

Through Carnegie's ACHIEVE Programme, a scaled CETO wave energy converter is being manufactured and tested in preparation for deployment at the Biscay Marine Energy Platform (BIMEP) in summer 2026. The upcoming operational phase will test and optimise CETO's performance in real-world ocean conditions, utilising BIMEP's grid-connected infrastructure.

Before commencing offshore operations, the programme is undertaking a strategic onshore testing campaign, including Power Take-Off (PTO) testing with SKF and dry system integration, to ensure operational readiness for the 2026 launch.

The ACHIEVE Programme is supported by the EuropeWave Programme, the Basque Energy Agency (EVE) and the Spanish Government (IDAE) via the RENMARINAS DEMOS Programme. This support has been instrumental in advancing the local supply chain and integrating sophisticated control technologies, including artificial intelligence and electric machines, to maximise generation efficiency.

### MARMOK-A 5

In the context of Phase 3 of the **EuropeWave project**, IDOM has completed the retrofitting of MARMOK-A-5, as well as the pre-installation of the mooring and umbilical cable. At the time of writing, IDOM was awaiting the necessary conditions to install MARMOK-A-5 at BiMEP.

The innovations focus mainly on improving the efficiency and reliability of the power take-off in three subsystems: the rotor, with a novel design that increases conversion efficiency through a variable pitch mechanism and performance-enhancing features; the electric generator, with an ad hoc design offering good efficiency across the entire power range and resistance to peak power; and a control strategy based on machine learning, together with a reinforcement learning algorithm.

### DESALIFE

DESALIFE is a pioneering European project that will test a fullscale wavepowered desalination buoy off the ArucasMoya coast in northern Gran Canaria. Led by Ocean Oasis Canarias with partners such as ITC, ULPGC, PLOCAN and elitoral, the project aims to validate a zeroemission reverseosmosis system powered entirely by wave motion, requiring no grid electricity.

The pilot will generate around 1.66 million m<sup>3</sup> of fresh-water during the testing period—enough to supply roughly 15,000 people per day—while avoiding more than 2,300 tons of CO<sub>2</sub> emissions. The €10million initiative seeks not only to prove the technology in real sea conditions, but also to demonstrate its potential scalability for other islands facing water scarcity, offering a sustainable alternative to energy-intensive onshore desalination plant.

## WECHULL

The **WECHULL+ project**, funded with €3 million through the CET Partnership program, aims to transform the use of concrete in offshore renewable energy. Building on the success of WECHULL, this initiative, launched in 2023, focuses on developing a sustainable and circular concrete material

for floating substructures in the renewable energy sector. Led by RISE Research Institutes of Sweden, it involves eight research institutions and industry partners across Europe. The project seeks to reduce concrete's carbon footprint by replacing over 70% of traditional cement with alternative materials.

In 2025, WECHULL+ was constructed, and offshore validation is planned for 2026 at scaled prototypes (1:5 WEC floater and 1:3 ballast system for floating PV) in real ocean environments, including PLOCAN in the Canary Islands. These trials aim to enhance installability, reliability, and operability. The project will also refine predictive modelling tools and establish local production processes for scalability. Additionally, it will conduct stakeholder engagement and public awareness campaigns to promote the adoption of this sustainable concrete in offshore applications.

## Specific Initiatives for International Cooperation

### ELBE Eurocluster

The European cluster alliance ELBE (European Leaders of Blue Energy), led by the Basque Energy Cluster, was selected in 2022 by the European Commission as the “Eurocluster” initiative for offshore renewable energy. This Eurocluster is part of the European Commission's Industrial Strategy, structured around 16 priority industrial ecosystems, one of which is the “Renewable Energy Industrial ecosystem”, which is the focus of this initiative.

The ELBE Eurocluster alliance gathers seven European leading clusters: Pôle Mer Méditerranée (France), Offshore Vast (Sweden), Energy Cluster Denmark (Denmark), GCE Node (Norway), Blue Cluster (Belgium), Pomeranian Offshore Platform (Poland) and BEC, as the coordinator of the alliance. Over 3 years, the clusters in the alliance are carrying out joint activities to support European SMEs in the sector around networking, innovation, adopting new technologies, training, and internationalisation.

## Relevant National Events

The city of Barakaldo hosted **OREgaua**, the European Researchers' Night dedicated to Offshore Renewable Energy, on September 27th. This major event attracted more than 3,000 citizens, offering them the opportunity to discover the science behind ORE. The initiative is part of the **ORE4citizens MSCA** project (<https://oregaua.org/>), led by TECNALIA in collaboration with the partners of the JRL-ORE. Its main goal is to bring science closer to society and foster STEM careers among students, all within the context of offshore renewable energy.

As part of the same project, over 3,500 primary and secondary school students have taken part in guid-

ed tours, hands-on experiments, and talks in the field of ORE led by experienced researchers.

**World Maritime Week (WMW)** held a new edition in March 2025, gathering international stakeholders for conferences, exhibitions, and technical visits focused on innovation, knowledge exchange, and networking across the maritime sector. The event featured technology showcases, sectorspecific sessions on shipbuilding, fisheries, ports, and marine renewable energy, along with structured networking activities to strengthen industry collaboration.

# Sweden

## Report prepared by:

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## Overview

In 2025, Sweden's ocean energy sector made steady progress across technology development, research, and international collaboration. Minesto continued to advance tidal energy deployment at Vestmanasund, Faroe Islands, upgrading its Dragon 12 device with a longer tether that increased power performance by 25%. CorPower Ocean progressed with the HiWave-5 demonstration, preparing full-scale ocean testing of its wave energy converter under an established verification methodology. Additional prototype and component-level testing was undertaken by Swedish research groups, including KTH's continued development of droplet-based electricity generation and Uppsala University's work on marine current converters.

Research and innovation activities remained strong across government-funded programmes, with notable advancements in model-predictive control for power-take-off systems, shared mooring concepts for floating wind-wave configurations, next-generation marine materials, and tribological design principles for wave-energy systems. Multiple projects within the Clean Energy Transition Partnership (CETPartnership) and national programmes contributed to improved system reliability, material durability, and long-term cost-effectiveness.

Overall, the 2025 activities strengthened Sweden's capabilities in ocean energy research, supported the maturation of key technologies, and prepared the ground for new demonstration projects planned for 2026 and beyond.

## Supporting Policies for Ocean Energy

### National strategy

The overall objective of the Swedish energy policy is to create the conditions for efficient and sustainable energy use and a cost-effective Swedish energy supply with low negative impact on health, environment, and climate and to facilitate the transition to an ecologically sustainable society. The policy is based on the legislation established within the EU and the objective builds on the same three pillars of

EU's energy cooperation which aims to reconcile security of supply, competitiveness and environmental sustainability. The Swedish energy and climate goals include the following targets:

- By 2045 at the latest, Sweden must have net zero emissions. The emissions from the Swedish territory should be reduced with at least 85 percent from 1990 (land use not included).
- By 2030 an energy-efficiency target of 50% more efficient energy use compared with 2005. The tar-

get is expressed in terms of energy relatively to GDP.

- In 2040, electricity production must be 100 per cent fossil-free.

Ocean energy is one of many areas included in Sweden's national maritime strategy, which identifies areas where action is needed to promote a sustainable development in the Swedish maritime sector. This strategy was enacted in 2015 by the Ministry of Enterprises, Energy and Communications. In February 2022, the Government adopted three marine spatial plans for its territorial waters and Exclusive Economic Zone. Marine spatial planning will form the basis for governmental agency and municipal decisions regarding the most appropriate usage of a marine area. To date, no specific area has been designated for ocean energy usage.

## Market incentives

Sweden's longterm energy policy relies on technologyneutral economic instruments, including a carbon tax and participation in the European Union emissions trading system (EU ETS). However, there are currently no marketbased instruments in place that specifically incentivise the deployment of ocean energy technologies, and no dedicated marine areas have yet been designated for ocean energy use under Swedish marine spatial planning.

## Research & Development

Swedish companies, universities and institutes have been involved with several research and development projects during 2025. This section contains examples of ocean energy system research projects with Swedish partners. Some projects constitute the Swedish parts of international project consortia within the CETPartnership, which is jointly funded by the CETPartnership funding partners and EU co-funding. Other projects receive funding from national programs and funding agencies or are funded by the respective institutions.

### Uppsala University, Department of Electrical Engineering, Division of Electricity

**AI in wave power:** In several innovative projects, the group has developed and used machine learning to

## Public funding programmes

Swedish governmental agencies support academic and private sector R&D at various stages of technology maturity. Funding providers include:

- Swedish Energy Agency (SEA, [www.energimyndigheten.se](http://www.energimyndigheten.se)), which is responsible for facilitating a sustainable energy system in Sweden. To this end the agency funds relevant research, business and technology development and technology demonstration.
- Swedish Research Council (VR, [www.vr.se](http://www.vr.se)), which is tasked with funding fundamental research and research infrastructure for a wide range of topics.
- Swedish Innovation Agency (VINNOVA [www.vinnova.se](http://www.vinnova.se)), which supports business and technology development through funding.

In addition, regional authorities may also grant funding. Ocean energy projects can apply for funding within existing programmes such as, for example, *Framtidens elsystem*, *Pilot- och demonstrationsprojekt*, *Verifiering av innovation med kund* and *Utveckla en affärsidé*. The Swedish Energy Agency is also involved in the Clean Energy Transition Partnership (CETPartnership), which is a collaboration between national/regional funding organisations in European Members States and Associated Countries that aims to accelerate the energy transition.

predict and control the dynamics and performance of wave power plants and wave farms in realistic wave conditions.

**Hybrid wind-wave power:** A promising direction to reduce the cost of wave power and to better utilize renewable energy at sea is to combine wind and wave power in hybrid systems. The research group has developed validated CFD models for floating offshore wind and in combination with wave power plants.

**Coupled physical systems:** Wave power plants are not only affected by waves, but also by tides and other ocean currents. This has been studied with reliable CFD methods, and the conclusion is that non-linear effects arise that affect the dynamics and performance of the wave power plant.

**Dry test rig:** During 2025, the research group has achieved emulation of irregular wave profiles using a robotized test rig setup, for in-house dry testing of wave energy converter PTOs at Uppsala University. One PhD student defended his thesis on this test rig. In 2026, the robotized dry test rig will be complemented with an Eddy Current break for real time emulation of different wave energy converter PTOs. A new control system, allowing implementation and evaluation of AI enabled control models will also be integrated to the setup.

### Enhancing Shared mooring system design for floating Offshore wind farms (ESOMOOR)

Shared moorings and extensive use of mooring lines made of polyester and polyamide materials could be the next game-changers to further lower the LCOE of floating wind farms, yet these innovations have not been systematically validated. ESOMOOR aims to provide experimental and simulation-based prototype demonstrations of these innovations in an integrated system environment, elevating the associated technologies to a higher TRL and increasing the confidence of end users in applying shared mooring systems and fibre ropes in future large-scale wind farm deployments. The improved understanding of safety concerns, design procedures, enhanced simulation tools and modelling techniques, along with open validation data, will be ready for use and validation by the industry. ESOMOOR's success will advance floating offshore wind technology, bolster industry confidence, and deploy to the market. Certified use of fibre ropes in mooring will alleviate pressure on the supply chain.

*Funding: CETPartnership. Project coordinator: Chalmers Tekniska Högskola AB. Swedish project partner(s): Norrsidan Innovation AB*

### Tidal energy technology Leaps using a novel torque dense Generator (TidaLGen)

TidaLGen is further developing an efficient direct-drive generator for marine current power and demonstrating how this technology can enable more competitive ocean-energy solutions. In collaboration with three leading European developers of marine current power, the generator system (including the power converter), the power plant, and the array layout will be co-optimized – with the goal

From universities to industry and EU-funded consortia, Sweden is advancing technologies that cut cost and risk while boosting technology readiness through validated prototypes and test-site demonstrations, accelerating the path from lab innovation to deployable wave and tidal systems.

of reducing the Levelized Cost of Energy (LCOE) by up to 25%. The key technical challenges include optimizing and validating new designs for both the generator and the current-power device, developing a new topology for electrical power conversion with modular design and higher voltage levels, and evaluating the potential system-level benefits. The aim is that, after the project, the technology's technical and commercial potential will have been validated and that follow-on projects for full-scale demonstration will have been initiated.

*Funding: CETPartnership. Project coordinator: Hagnesia Wind AB. Swedish project partner(s): Minesto AB.*

### Instant Force & Model Predictive Control for Ocean Energy Power take-off with High Fidelity (INFINITY)

A wave energy system usually consists of a wave buoy on the surface and a "power take-off" (PTO) drivetrain, which converts mechanical motion into electrical energy. Cost-effectiveness requires an efficient, low-maintenance and robust PTO system. INFINITY is a Clean Energy Transition Partnership (CETP) project focused on advancing wave energy technology through the development and dry-testing of a next-generation PTO system combined with advanced real-time control. The project applies co-design of mechanical PTO hardware and model-predictive control to increase energy capture while reducing structural loads, improving reliability, and supporting lower levelized cost of energy (LCOE). Emphasis is placed on accelerated dry-testing and hybrid testing methodologies to de-risk technology development prior to offshore deployment. As a test case, the project uses a point

absorber called “InfinityWEC”, developed by Ocean Harvesting Technologies AB.

The INFINITY consortium comprises six partners from Sweden, Ireland and Italy. The project is coordinated by RISE Research Institutes of Sweden and includes Ocean Harvesting Technologies (technology developer and use case), Maynooth University, Politecnico di Torino, VGA Srl (dry-testing and validation infrastructure) and NILU Climate and Environment Institute (environmental and life-cycle assessment).

*Funding: CETPartnership. Project coordinator: RISE Research Institutes of Sweden AB. Swedish project partner(s): Ocean Harvesting Technologies AB, NILU Klimat- och miljöinstitut AB.*

### **Sustainable Concrete Material Leading to Improved Substructures for Offshore Renewable Energy Technologies (WECHULL+)**

WECHULL+ addresses the coming environmental challenges faced by the large quantities of technologies to be deployed in our oceans. WECHULL+ will demonstrate a new, sustainable, circular and reliable concrete material suitable for floating substructures in the offshore renewable energy sector; to model, test and validate it in the real ocean environment. WECHULL+ objectives and activities are based upon the learnings and proof-of-concept (TRL3) of a new sustainable concrete mix with high-performance in marine environment, carried out within the WECHULL project. WECHULL+ takes these efforts to a European level, where experts in the field of material sciences, predictive modelling, field testing, critical loads assessment, biofouling, technology development, extreme load analysis, social sciences and environmental impact assessment, are brought together to validate and verify the WECHULL+ concrete material and its real application through sample and prototype testing (lab and ocean). Partners in the project are RISE (SE, coordinator), TUDelft University (NL), Gdańsk University (PL), Ocean Harvesting Technologies (SE), CETO Wave Energy Ireland (IE), SolarDuck (NL - left the consortium during 2025), PLOCAN (ES), and Pekabex (PL).

*Funding: CETPartnership. Project coordinator: RISE Research Institutes of Sweden AB. Swedish project partner(s): Ocean Harvesting Technologies AB.*

### **Laser-Optimized Technologies for Utilization of Structured Surfaces in Power Take-Offs (LOTUS-PTO)**

The LOTUS-PTO project aims at enhancing wave and tidal energy systems by using laser surface texturing to improve biofouling resistance, tribological performance, and durability of critical components, such as power takeoffs (PTO). By mimicking natural surfaces, the project seeks to optimize surface textures for antifouling and wear resistance to boost efficiency and cut maintenance costs, aligning with the EU Green Deal’s goals for carbon neutrality by 2050. Advancing from proof of concept (TRL3) to ocean environment validation (TRL5), the project uses simulations, experimental testing, advanced microscopy, computer vision, and AI to optimize textures. It supports commercialization of ocean renewables and eco-friendly offshore technologies. The project aligns with the call focus on cross-cutting offshore renewable technologies, emphasizing improved performance, and eco-friendly antifouling technologies and materials.

*Funding: CETPartnership. Project coordinator: RISE Research Institutes of Sweden AB. Swedish project partner(s): Göteborg University, Ocean Energy Systems AB.*

### **SEASNAKE+ Industrial upscale of surface protection system & fibre optic-based condition monitoring for the SEASNAKE MVC (Medium Voltage Cables)**

The main objective of SEASNAKE+ is to scale-up and demonstrate (TRL6-7) the dynamic Medium Voltage Cable (dMVC) with improved lifetime by; easy clean paint; in-line/in-situ paint application chamber; in-situ cleaning robot; new and scalable protection and monitoring system. The SEASNAKE+ dMVC will be validated first at small scale in nearshore condition in two different sites (Swedish west coast and Mediterranean Sea) and at full-scale in real ocean environment in Mediterranean Sea. SEASNAKE+ objectives & activities are based upon the learnings and proof-of-concept (TRL4) carried out within the previous SEASNAKE (OCEANERANET). SEASNAKE+ expands those efforts on European level as key gaps and opportunities have been identified during the projects for scaling up the production and integrate the protection system application into the

production along with new sophisticated and innovative ways to measure cables movement (shape sense) and failure modes in an integrated fiber optic solution.

*Funding: CETPartnership. Project coordinator: RISE Research Institutes of Sweden AB. Swedish project partner(s): NKT Sweden AB, Chalmers Tekniska Högskola AB, I-Tech AB.*

### **The influence of offshore wind parks on shipping**

The project is a pre-study to develop a method to understand the impact of wind farms on ice formation and what consequences this may have for winter shipping. The project will produce a compilation of the knowledge that exists today regarding the impact of wind farms on ice formation, how this in turn can affect winter shipping, as well as an analysis of planned areas and what effect they may have on shipping and ice breaking in winter in the Baltic Sea.

*Funding: The Swedish Agency for Marine and Water Management. Project coordinator: Chalmers Tekniska Högskola AB. Project partner(s): Aalto University, Finland.*

### **FOREST – Future Ocean Renewable Energy System Technologies**

The oceans offer vast potential for renewable energy, and subsea components are key to unlocking scalable ocean energy deployments. Yet challenges remain around survivability, reliability, maintenance costs and performance monitoring of ancillary systems. The EU-funded FOREST project is tackling these barriers with innovations in subsea components and digital technologies, including: a 33 kV dynamic cable and spar connection hub for ocean energy arrays; a quick connector system to streamline deployment and maintenance; and an AI-enhanced optical measurement platform to measure cable and device health. Validated at test sites in Orkney, these innovations will boost the reliability and efficiency of critical ancillary systems, optimizing array performance, cutting costs and accelerating global ocean energy deployment.

*Funding: Horizon Europe – Climate, Energy and Mobility. Project coordinator: THE EUROPEAN MARINE ENERGY CENTRE LIMITED, UK. Swedish project partner(s): Sub Connected AB.*

The oceans offer vast potential for renewable energy, and subsea components are key to unlocking scalable ocean energy deployments. Yet challenges remain around survivability, reliability, maintenance costs and performance monitoring of ancillary systems.

### **Next Generation Marine Materials for Resilient Offshore Renewable Energy Devices (MORE)**

MORE (Next Generation Marine Materials for Resilient Offshore Renewable Energy Devices) proposes the creation of a new robust methodology with improved tools for material selection and validation to harmonize testing procedures capable of generating the next generation of materials for Offshore Renewable Energy devices, to overcome the present energy and environmental challenges. This will be achieved by considering tribocorrosion (wear accelerated by corrosion) and multi-degradation (tribocorrosion accelerated by fatigue) in a field highly affected by these degradation mechanisms. This is a new material selection methodology for the renewable energy sector compared to the current incomplete conventional material selection and validation process (DNV Guidelines!). This project will allow the offshore renewable energy sector to reach their milestones in a more resilient and realistic way, giving it an edge against its current fossil fuel competitors like the Oil and Gas sector.

*Funding: CETPartnership. Project coordinator: RISE Research Institutes of Sweden AB. Swedish project partner(s): CorPower Ocean AB.*

### **Smart mooring for safe and efficient ocean energy production (SMARTMOORING)**

SMARTMOORING develops intelligent mooring technologies for offshore energy systems. The concept is based on fiber optic measurement technol-

ogy that provides information about the mooring component's shape, load, vibration pattern and temperature along the entire length of the component. The project is expected to take the technologies, integrated into mooring components, from TRL2 to TRL5. SMARTMOORING's technologies will be demonstrated in two use cases: wave energy converters from CorPower Ocean and tidal energy systems from Minesto. The improved mooring systems will contribute to marine energy units with higher reliability, better power conversion efficiency and lower LCOE. The technologies that are developed also have relevance outside the marine energy area, for example for floating wind/solar energy and applications outside the energy sector.

*Funding: CETPartnership. Project coordinator: RISE Research Institutes of Sweden AB. Swedish project partner(s): CorPower Ocean AB, Minesto AB.*

### Wave Energy Converters – integration of tribological design principles

The project aims to improve the development of wave energy converters by supporting the integration of tribological principles into the design process. Tribology is the science of friction and wear. Tribological components such as bearings and lubricants are present in every wave energy device and can have high failure rates, which in turn affects both energy production and the cost of electricity for wave-power concepts. Within the project, tribological knowledge will be applied to the ocean-energy sector, helping ensure that this sector avoids the kinds of mistakes that were made during the early development of the wind-energy industry.

*Funding: Swedish Energy Agency, program Marin energy conversion. Project coordinator: KUNGLIGA TEKNISKA HÖGSKOLAN. Swedish project partner(s): CorPower Ocean AB, NoviOcean AB, Nynas AB, Axel Christiernsson International AB.*

### Dynamic Sealing Systems for Wave Energy

The project will map existing technologies, the typical technical requirements for the subsystems, and the prevailing operating conditions. Based on this analysis, the project will develop, test, verify, and evaluate cost-effective and sustainable dynamic sealing systems for linear reciprocating motion, to create the technical conditions necessary for long

maintenance-free lifetimes of wave energy converters and thereby strengthen their economic viability.

*Funding: Swedish Energy Agency, program Marin energy conversion. Project coordinator: Uppsala University.*

### Energy Transition for Remote Islands and Communities (ETRIC)

The ETRIC project is an innovative energy transition initiative focused on harnessing tidal energy through cutting edge technology and integrating it with the electrical grid of a remote island in the Faroe Islands. This project aims to advance tidal energy generation by introducing a unique tidal current energy technique that enhances efficiency, scalability, and environmental sustainability, while building upon existing solutions and expertise at SEV, Minesto, CaptureEnergy and IVL.

At the heart of ETRIC is a novel turbine design capable of generating its own high tide flow at flow speeds as low as 0.7 m/s. This new technology maximizes energy absorption from diverse tidal currents and optimizes efficiency across a broader range of flow rates compared to conventional turbines. Its ability to adapt to varying conditions ensures consistent and reliable energy production, even in the dynamic marine environments surrounding the Faroe Islands to supply energy.

*Funding: Swedish Energy Agency, program Pilot and demonstration. Project coordinator: Minesto AB. Swedish project partner(s): Capture Energy AB, IVL Svenska Miljöinstitutet AB.*

In addition to the above research support the Swedish Energy Agency in collaboration with Business Sweden supports Swedish companies in market development in the Southeast Asia region and Taiwan.

### Electricity generators from weak sea/ocean waves

In this project KTH has preliminarily verified the feasibility to utilize the recently-invented triboelectric polymer-based droplet-based electricity generators (DEGs) to harvest energy from small ocean waves [Nature 578, 392 (2020)]. A preliminary prototype of the power-take-off component of the WECs has been developed and the on-shore tests indicate the possibility to use the weak ocean waves in Stockholm to obtain sufficient vertical displacement to

pump up water droplets to continuously drive the DEGs, although continuous operation of the WECs requires mechanical design to improve the connection between the wave-driven linear motion and the pumps. In 2025, the main achievement was to substantially improve (almost double) the output power density of the present individual DEGs and demonstrate the feasibility for upscaling. The key results have been published in Nature Communications 16, 8530 (2025).

*Funding: Swedish Energy Agency.*

*Project coordinator: KTH.*

### Marine current power: Extracting power from slow water currents

Uppsala university is developing and testing a marine current converter, designed for low water speeds. It uses a vertical axis direct driven turbine connected to a permanent magnet generator. The university has designed and constructed the generator, turbine and electrical system design.

*Funding: StandUP for energy.*

*Project coordinator: Uppsala University.*

## Technology Demonstration

### Projects in the water

#### Lysekil wave energy research test site – Lysekil, Sweden

The Lysekil wave energy research test site on the west coast of Sweden is installed but the wave energy converters are not operational. It has 11 wave energy converters with a total of 260 kW installed. The working permission for the Lysekil research test site has been extended with 10 more years from 2024.

More information: [The Lysekil Project - Department of Electrical Engineering - Uppsala University](#)

#### Testbed for Marine Materials – Fiskebäckskil, Sweden

The testbed for materials in marine environment was inaugurated in 2021 and offers development, testing and verification of antifouling systems, corrosion protection and environmental assessment. The testbed for materials in marine environment is located at the Kristineberg Marine Research and Innovation Center in Fiskebäckskil (Skaftö) on the west coast of Sweden. The facility gathers expertise, laboratory resources and field infrastructure.

More information: [Testbed in Kristineberg - materials in marine environment | RISE](#)



**Figure 1:** Kristineberg Marine Research and Innovation Center in Fiskebäckskil, Sweden. (Source: RISE)

### HiWave-5 Demonstration project

CorPower Ocean (CPO) has developed a new type of wave energy converter (WEC) capable of producing electricity from ocean waves with more than five times the energy per tonne of device compared with previously known technologies. This technology has been developed and verified in collaboration with leading industrial and academic partners, including EDP, Iberdrola Engineering, WavEC, EMEC, KTH, RISE, NTNU, and the University of Edinburgh.

The purpose of this new project is to ocean-test a fully integrated, full-scale WEC at Technology Readiness Step 4, followed by a pilot array in Step 5. The project aims to demonstrate the CPO WEC technology in accordance with a structured five-step verification methodology established by ETIP-Ocean and Wave Energy Scotland, with the goal of achieving a fully commercial, certified, and bankable wave energy product, while minimizing time, cost, and risk.

*Funding: Swedish Energy Agency. Project coordinator: CorPower Ocean AB.*

### Minesto –Vestmannasund, Faroe Islands

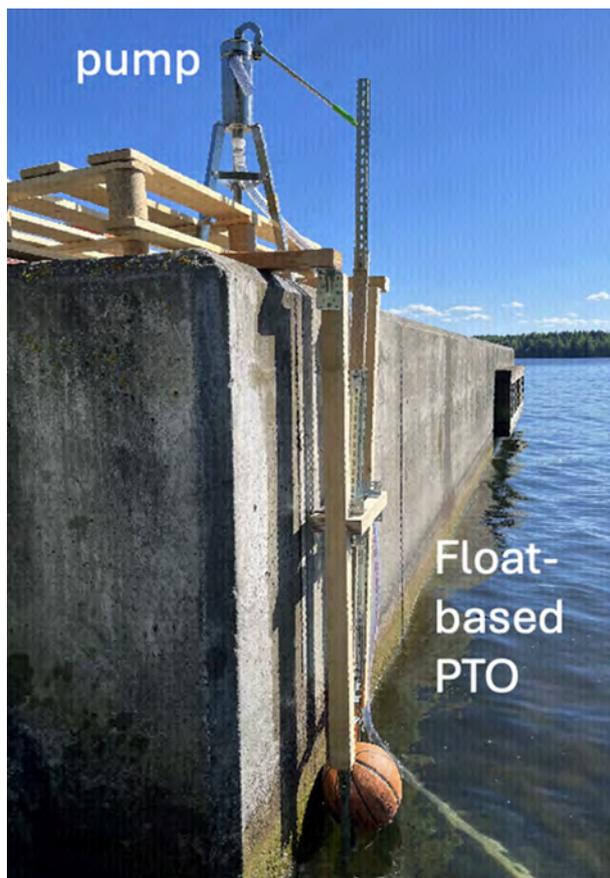
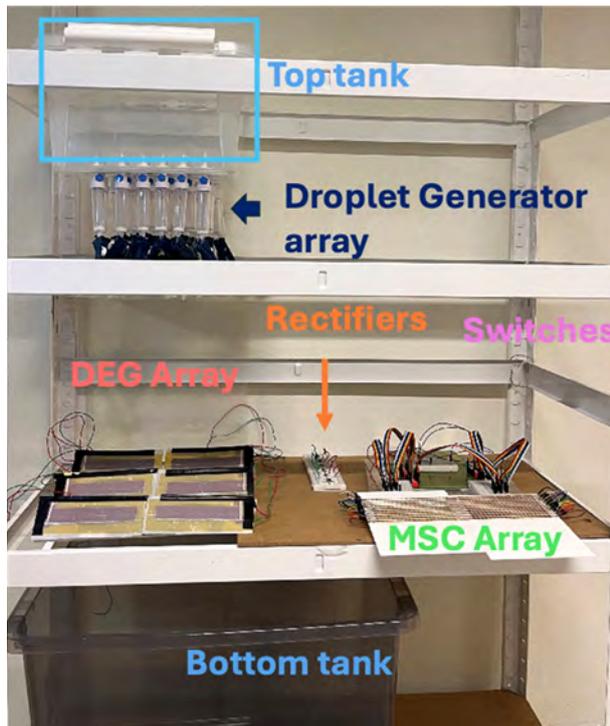
Minesto continued to test, operate, and upgrade the Dragon 12 (1.2 MW) and upgrade the Dragon 4 (100 kW) power plants units at its grid-connected site in Vestmannasund, Faroe Islands. Most notably in 2025, Dragon 12 was upgraded with a slightly longer tether, enabling a 25% increase of power performance, strengthening the company's path toward commercial-scale deployment.

### KTH – Lidingö Island, Sweden

KTH has designed and fabricated a prototype of a DEG-based WECs (Figure 3). It is based on a water circulation system that comprises a top tank, a droplet generator array, a DEG panel, a bottom tank and a mechanic pump and a power take-off component. The water stored in the top tank is transferred into droplets through the droplet generator arrays. The droplets drive the DEG panel to produce electricity and then drop into the bottom



**Figure 2:** Dragon 12 and Dragon 4 at quayside in Vestmannasund (Source: Minesto)



**Figure 3:** Photographs of the DEG-based WEC prototype and float-based power take-off (Source: KTH).

tank. The mechanic pump connects a power take-off component to use the energy of small waves to pump up water from the bottom tank back to the top tank to complete the circulation system.

The electricity generated in the DEG panels can be stored in micro-supercapacitors to supply electronics, such as LEDs.

In the WECs, the electricity generation part (Figure 3, left) has little correlation with the power take-off (Figure 3, right) as long as the latter can supply sufficient water to the top tank of the former. For this reason, and due to limited time and resources, a near-shore test was performed solely on the power take-off part. The test site was situated at a coast around the Lidingö island close to Stockholm. It was found that small waves can drive the float-based power take-off (PTO) component to generate vertical displacement > 20 cm. This makes it in principle possible to drive the water circulation system in the WEC. However, due to the lack of professional design for the mechanical connection between the pump and the PTO, the use of small waves to drive the pump has not been demonstrated.

### SEASNAKE+

Within the SEASNAKE+ project equipment for dynamic testing of paint systems in natural sea water at the Kristineberg marine test site has been constructed and deployed (see Figure 4).

Paint systems and coatings: studies have been performed concerning formulation with and without biocides, properties like addition, blistering, and cracking after accelerated ageing like UV.



**Figure 4:** The paint system test site (Source: RISE)

## UU - Söderfors, Sweden, in the river Dal (Dalälven)

A 7.5 kW marine current converter, with a 5-bladed vertical axis turbine coupled to a permanent magnet generator is operational in the river Dal (Dalälven) in Söderfors. The system is connected to the local utility grid.

## Projects planned for deployment

### Minesto AB

Minesto is preparing for installing equipment and systems from the ETRIC project, demonstrating a tidal energy power plant for baseload electricity production to microgrids in Vestmannastrandir, Faroe Islands. Minesto collaborates with microgrid technology provider Capture Energy, Faroese utility company Sev and IVL Swedish Environmental Research Institute to demonstrate a unique tidal-based microgrid solution that provides baseload power. In parallel with the project, Minesto has added an integration of local end-user applications of tidal energy in the Faroe Islands to strengthen customer involvement. Minesto continued to prepare for the next step the Hestfjord Dragon Farm, a 10 MW array of utility scale kites in Hestfjord, a nearby strait to Vestmanna in the Faroe Islands. Continued preparations include environmental monitoring activities, system specifications, investment case creation and assessment of tidal flow conditions. This 10 MW array is the first step in Minesto's 200 MW buildout plan for the Faroe Islands.



Figure 5: Marine current converter in Söderfors

### WECHULL+

The prototype in the Wechull+ project is planned to be deployed at the PLOCAN marine test site by the Canary Islands in 2026 to verify structural integrity and test the rate of biofouling in a realistic situation.

### SEASNAKE+

Medium Voltage Cables with anti-fouling and/or easy-to-clean surface are planned to be deployed both in Sweden and in the Mediterranean. Evaluation of the anti-fouling surface and cleanability will be made.

## Specific Initiatives for International Cooperation

### Cooperation between Chalmers Tekniska Högskola AB and RISE Research Institutes of Sweden AB

The collaboration with Swedish development companies and the Marine technology division at Chalmers, continues to grow. Joint project applications are prepared to secure EU funding together with several industry partners, including Waves4Power, Novige AB, CorPower Ocean AB, Seaflex AB, and NKT. In parallel, the cooperation expands

to other universities, especially those outside Sweden, including partners in the UK, Denmark, Norway, Portugal, France, and Germany. These partnerships strengthen both our technical capabilities and our international research network.

### Uppsala University

Several cooperations have resulted in published articles during 2025. Among these are collaborations with MIT, USA; Renewables Grid Initiative, Germany;

Lund University; RISE, Sweden; Politecnico di Torino, Italy; University of Plymouth, UK; and University of Salerno, Italy. A research collaboration has been initiated with the University of Western Australia (UWA), Australia, funded by Matariki seed funding via Uppsala University.

## Minesto AB

Minesto AB's international cooperation efforts in 2025 included extensive stakeholder engagement, technology validation, and participation in high-level delegations across key global markets. The company hosted a seminar in Torshavn outlining its 200 MW roadmap for the Faroe Islands, completed an independent DNV technical review of its Dragon-class technology, and continued to attract international study visits to its demonstration site. Minesto advanced its global outreach through participation in the Swedish Energy Agency's Global Innovation Accelerator for Asia, a major SKF brand campaign that reached over 500 million viewers, and representation at World Expo 2025 in Osaka. The company also joined high-level Swedish delegations to South Korea and Canada to explore partnerships in green transition and ocean energy and took part in major industry and policy events such as InnoEnergy's Business Booster in Lisbon and the Nordic-Taiwan Sustainable Energy Forum in Taipei. Additional inter-

national engagements included the UN Ocean Conference, COP30, the WEF pre-COP meeting in Geneva, and an EU Business Hub mission to South Korea.

## CorPower Ocean

CorPower's international cooperation efforts in 2025 included partnership with NTNU (Norwegian University of Science and Technology) to integrate AI into wave-energy control and performance optimisation under the WACE project.

Also, CorPower signed a development agreement with UK-based Equipmake to develop a bespoke generator and SiC inverter system. The aim is to improve manufacturability and de-risk future deployment programmes.

In May 2025, CorPower signed a berth agreement with EMEC (Orkney, Scotland) for a 5 MW wave energy array at Billia Croo—strengthening the regional ecosystem around the UK's established marine-energy infrastructure and creating a clearer route from single device to array deployment.

CorPower also became a Lead Partner of Ocean Energy Europe in October 2025, while continuing board-level representation—an indicator of deeper engagement in regional sector-building, standard-setting priorities, and collective market development across Europe.

## Relevant National Events

Chalmers Tekniska Högskola AB arranged seminars with participants from England and Norway as well as the international conference ICSOS2025 in Göteborg, Sweden: <https://www.icsos.info/past-conferences/2025/289df64>. The ICSOS2026 is planned to be held in October 2026, Istanbul, Turkey.

On 8 October, Minesto AB invited investors and the public with an interest in technology and energy systems to a unique opportunity to experience

firsthand the tidal energy kite Dragon 4 "Íðunn" as she was brought home for a break from duty at the company's demonstration site in the North Atlantic. The event attracted around 150 guests. In addition, international guests were invited to an exclusive showcase of the Dragon, where Minesto had the opportunity to welcome the Philippines' Ambassador to Sweden and Indonesia's Ambassador to Sweden.

# The Netherlands

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## Overview

2025 was a year of consolidation and growth for the Dutch ocean energy sector. Key achievements include continued technology development, long-duration testing, and strengthened collaboration between research, industry, and public authorities. Efforts focused on improving performance, environmental understanding, and the evidence base for future deployment.

Looking ahead, 2026 will be a landmark year, with the Netherlands hosting **ICOE-OEE 2026 in The Hague**, bringing together over 500 international experts. This offers a unique opportunity to showcase Dutch innovation, validate technologies in real-world conditions, and create a lasting regional and international legacy for the sector.

## Supporting Policies for Ocean Energy

### National strategy

The Dutch national strategy does not yet have a bespoke ocean energy policy with specific deployment targets. Instead, ocean energy sits within broader renewable energy and innovation frameworks that enable technology development but currently focus most strongly on offshore wind and system integration. Multiple ministries intersect on this agenda — KGG for climate and renewable targets, EZ for industry and innovation policy, and I&W for maritime planning and environmental stewardship — creating a multi-faceted but non-specialised policy landscape for ocean energy that emphasises innovation and integration rather than direct targeted support.

### Market incentives

The market incentive framework for ocean energy in the Netherlands remains unchanged compared to 2024. Ocean energy technologies are, in principle, eligible under the **SDE++** scheme, which supports the deployment of renewable energy based on avoided CO<sub>2</sub> emissions. However, due to the current maturity levels of ocean energy technologies, practical access to this scheme remains limited.

### Public funding programmes

The Netherlands does not have a dedicated national funding programme for ocean energy with earmarked budgets.

**DEI+****Demonstration Energy and Climate Innovation**

The DEI+ programme is open to pilot and demonstration-scale ocean energy projects. To date, however, no ocean energy projects have been approved under this scheme.

**NWO****Netherlands Organisation for Scientific Research**

NWO provides funding opportunities for fundamental and applied research relevant to ocean energy, primarily through competitive research calls.

**MMIP****Multiannual Mission-driven Innovation Programmes**

Ocean energy is indirectly addressed within the MMIP framework, particularly in relation to system integration, offshore energy innovation and long-term energy transition objectives, though without dedicated ocean energy funding lines.

Ocean energy R&D in the Netherlands combines strong applied support with coordinated university- and EU-backed programmes that deliver the tools, materials, and demonstrations needed for deployment, such as digital ocean twins, eco-friendly designs, validated wave/tidal components, and multi-source offshore energy park pilots.

## Research & Development

**Deltares** supports R&D developments in the ocean energy sector via research and specialistic advice services. In addition, Deltares organizes an SME challenge twice a year for technology developers: (<https://www.deltares.nl/en/about-us/alliances/sme/free-access-to-the-deltares-experimental-research-facilities-for-smes-and-start-ups>).

This program offers innovators free access to Deltares' experimental facilities, enabling them to develop their technology and progress along the TRL ladder. Various technology developers have successfully used this opportunity to mature their concepts. At the end of 2025, performance tests of the fish-save turbine developed by Fish Flow Innovation were carried out as part of this initiative.

In 2025 several research projects were conducted in the Netherlands related to wave and tidal energies from Delft University of Technology (TUD). Lead collaborator, and coordinator has been the Marine Renewable Energies Lab ([www.tudelft.nl/ceg/mrel](http://www.tudelft.nl/ceg/mrel)) lead by Dr George Lavidas.

Starting with European Regional and Coastal Seas in a Rapid Changing Climate (**EU-INTERCHANGE**) a Horizon Europe funded project where MREL is the Coordinator, aimed at developing a Digital Ocean

Twin with historical and projected Climate Change wave conditions from 1990-2100, built for All European seas. The project delivers high-resolution simulations (2-5 Km at hourly resolution) and user-friendly services that enable climate impact assessment, coastal planning and decision support for public authorities and Blue-Economy sectors, covering wave energy and offshore wind.

**BETTER** (Building the nExT generaTion of marine Eco-friendly wind faRm) is an MSCA Doctoral Network that assembles a diverse, multidisciplinary team to train a new generation of Doctoral Candidates (DCs) capable of addressing ambitious scientific objectives. The participation of MREL in this project, with 2 PhDs is revolved in the assessment and development of noise generation and propagation models for wave energy floaters and floating wind across different regions.

**WECHULL+** (Sustainable Concrete Material Leading to Improved Substructures for Offshore Renewable Energy Technologies) is an NWO and CETP funded project, aimed to demonstrate a new, sustainable, circular and reliable concrete material suitable for wave energy converters. WECHULL+ objectives and activities are based upon the learnings and proof-

of-concept of a new sustainable concrete mix with high-performance in marine environment, carried out within the WECHULL project. WECHULL+ takes these efforts to a European level, where experts in the field of material sciences, predictive modelling, field testing, critical loads assessment, biofouling, technology development, extreme load analysis, social sciences and environmental impact assessment, are brought together to validate and verify the WECHULL+ concrete material and its real application through lab and real wave energy testing in real sea conditions.

**EU-SCORES** (European Scalable Offshore Renewable Energy Sources) is a H2020 Green Deal Project, led by the Dutch Marine Energy Centre (DMEC) with MREL (TUD) leading WP6, will demonstrate the combination of offshore wind- with wave- and offshore solar energy. This will pave the way for bankable offshore multi-source energy parks by 2025 across Europe and beyond. These multi-source energy parks will use offshore space more efficiently and balance the electricity grid to achieve a resilient and cost-effective 100% renewable energy system.

**ORESAs** The Offshore Renewable Energy Sustainability Alliance (ORESAs) is a consortium of diverse partners from industry, government and research institutes, from 5 NWE countries aiming at combin-

ing energy production with nature-inclusive design. The Interreg-NWE project is coordinated by DMEC and both Weco and Slow Mill Wave Power were selected for the first Accelerator round.

#### Offshore Proof

Offshore Proof is an Interreg NWE project led by Campus@Sea that aims to develop a network of IECRE-compliant offshore renewable energy test sites. In the Netherlands, the project supports the deployment and validation of innovative offshore technologies, with a particular focus on wave energy. As part of the Dutch activities, Ghent University's BlueGent department is carrying out a Socio-Environmental Cost Analysis (SECA) for Dutch wave energy cases, strengthening the evidence base for market uptake and regulatory acceptance.

#### Offshore For Sure

Offshore For Sure is an INTERREG VLA/NED project led by Bluespring that aims to accelerate the deployment of innovative offshore energy technologies through physical pilot projects and advanced Digital Twins. The project demonstrates five Dutch-led solutions – Oceans of Energy, FLASC, Dutch Wave Power, Tocardo, and Water2Energy – combining real-world testing with data-driven optimisation to reduce risk, improve performance, and support commercialisation.

## Technology Demonstration

### Projects in the water

#### Water2Energy

Water2Energy conducted grid-connected, long-duration performance testing throughout 2025 at Vlissingen Harbor as part of the Offshore For Sure



project, funded via INTERREG Flanders/Netherlands. Testing included an optimized blade design and an automatic pitch control system. Results demonstrated a 20% efficiency improvement over the previous model, increasing output from 50 kW to 60 kW at a water speed of 2.5 m/s, directly translating into more clean energy from tidal currents.

#### SeaCurrent

SeaCurrent validated its TidalKite™ system in a controlled freshwater environment throughout 2025. The campaign tested recent system upgrades, including safety programmes, as part of de-risking future deployments. Endurance trials on the Power Take-Off (PTO) unit confirmed its robustness, and long-term watertightness was verified, ensuring readiness for sustained operation in harsh marine conditions.

## WECO

Weco completed a series of onshore and offshore tests in 2025. Onshore, the full assembly of the new Kaizen 2.0 was followed by dry testing of the Power Take-Off (PTO) unit and control system. Offshore, the wave energy converter (WEC) was deployed just off Scheveningen for short sea trials. Supported by the Kansen voor West innovation program, these tests validated Weco's rapid deployment method and marked a key milestone in the development of the Kaizen WEC technology.

## Slow Mill Wave Power

Slow Mill conducted a short sea trial of its Slow Mill-40 wave energy demonstrator, 'Danica,' off the coast of The Hague. The trial confirmed the device's ability to generate energy in moderate wave conditions, matched the results from tank and dry tests, and validated its simple, diver-free installation and decommissioning process.

## Symphony Wave Power

In 2025, Symphony Wave Power (SWP) completed an onshore dry-test campaign of its power take-off (PTO) system. The tests confirmed that the membrane-based PTO performed as designed, showing stable, repeatable behaviour under cyclic loading without unexpected wear. The bidirectional turbine operated reliably, closely matching model predictions, while system pressure dynamics followed expected spring behaviour, enabling controlled resonant motion. In October, the first pressure tests were successfully conducted, following Lloyd's Register approval in September. These milestones mark a key step toward offshore deployment in 2026.

## Wedge Global

Deployed their W1, a floating Wave Energy Conversion System to harness electricity from ocean waves. The W1 is powering the world's most advanced floating radar platform for real-time monitoring of birds and bats: the FLORA (Floating Radar). The installation was in a selected zone within the Ecowende wind farm concession area (51 km offshore). ([source](#))

## AE-WaveHexapod

Working on rebuilding their onshore test site to an offshore version. AE-WaveHexapod is planning



on performing survivability tests near the port of IJmuiden, supported by the Just Transition Fund. The test is planned for the late summer of 2026.

### REDstack

REDstack, in cooperation with PureWaterGroup has operated an RED pilot plant in Spain in the EU-funded HYREWARD project. Using treated domestic sewage as the fresh water and brine from a desalination plant as the salt water flow. Follow up is anticipated in Spain, Australia and India.

## Projects planned for deployment

### Dutch Wave Power

Dutch Wave Power is constructing a large-scale prototype wave energy converter for demonstration at Offshore Test Site NL (OTS-NL) in 2026, as part of the Offshore For Sure project. The pilot will validate power output, structural robustness and ecological impacts under real offshore conditions.

### Slow Mill Wave Power

Slow Mill Wave Power is preparing an offshore demonstration and endurance test of its Slow-

mill-40 wave energy converter at OTS-NL in 2026. The test programme will focus on performance, autonomous operation and survivability. In 2027, a full-scale system is planned to become operational, supplying renewable electricity to Texel island.

### WECO

WECO will continue onshore testing followed by long-duration offshore deployment of its Kaizen 2.0 system at OTS-NL, aimed at validating reliability and performance under extended operational conditions.

### Symphony Wave Power

Symphony Wave Power will conduct full-scale prototype testing at EMEC (Orkney) in the second half of 2026, alongside project development for a pre-commercial pilot with a customer in 2027.

### Equinox Ocean Turbines

Equinox Ocean Turbines is preparing to deploy its TT5 (1:10 scale) ocean current turbine in the Marsdiep in summer 2026. This pioneering demonstration will be the first of its kind in Dutch waters, validating the turbine's innovative design under real tidal conditions and marking a key step toward future commercial-scale deployment.



Dutch Wave Power prototype under construction at Rometal shipyard, ahead of 2026 deployment at Offshore Test Site NL as part of the Offshore For Sure project.

## Specific Initiatives for International Cooperation

### Dutch Mirror Committee IEC TC 114

In 2025, membership of the Dutch Mirror Committee for IEC TC 114 was expanded. The committee is chaired by Peter Scheijgrond (Campus@Sea / Bluespring) and strengthens international alignment on standards for marine and ocean energy.

### Offshore Proof (Interreg NWE)

Launched in 2025 and led by Campus@Sea, Offshore Proof focuses on strengthening cross-border cooperation by developing a North-West European network of IECRE-accepted offshore renewable energy test sites.

### Offshore For Sure (Interreg VLA/NED)

Ongoing and led by Bluespring, Offshore For Sure supports bilateral Dutch-Flemish collaboration through the demonstration of innovative offshore energy technologies using physical pilots and Digital Twin approaches.

### TEAMER collaborations (USA)

Initiated in 2025, TEAMER collaborations with WECA and Equinox Ocean Turbines connect Dutch innovators with U.S. testing facilities, enabling transatlantic knowledge exchange, technology validation, and early market access.

## Relevant National Events

### Relevant events in 2025

#### OEEC 2025

Dutch organisations actively contributed through presentations, project showcases and networking, highlighting the Netherlands' role in advancing ocean energy innovation, testing infrastructure and international collaboration.



Roundtable discussion at OEEC 2025 on policy recommendations to accelerate the development of the ocean energy sector.

### Relevant events planned for 2026

#### International WaTERS Workshop

Hosted by Campus@Sea as part of the Offshore Proof project in connection with ICOE-OEE 2026, building on the initiative by EMEC to bring together international test sites, researchers and developers to strengthen cooperation on offshore testing, certification and standardisation.

#### ICOE-OEE 2026, The Hague (5-7 October)

Hosted by the Dutch Energy from Water Association (EWA), positioning the Netherlands as a focal point for global ocean energy dialogue, policy exchange and industry engagement.



Official announcement of ICOE-OEE 2026 in The Hague, marking the Netherlands' role as host of the global ocean energy community.

# United Kingdom

## Report prepared by:

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on behalf of the Department for Energy Security and Net Zero, UK Government

## Overview

As the UK moves further into a decade defined by the twin imperatives of rapid decarbonisation and economic growth, there has been a mounting impetus at the heart of UK Government to accelerate the transition to a clean, secure, and resilient energy system. Central to this shift is the recognition that the pathway to Net Zero must not only reduce emissions, but also deliver tangible socioeconomic benefits felt across all regions of the UK. Ensuring that communities see and experience the value of the energy transition—through skilled jobs, industrial revitalisation and enhanced energy security—has become a defining feature of the wider Net Zero mission.

Against this backdrop, the year-on-year advances of the UK's ocean energy sector have further demonstrated the opportunities arising from tidal stream and wave energy technologies forming a more meaningful part of the future energy system. Tidal stream is now entering its first phase of commercial deployment. It stands at the cusp of delivering predictable, renewable power at utility scale, with UK developers leading the global race to achieve

large-scale deployment. Wave energy, while earlier in its development pathway, continues to demonstrate progress through sustained innovation, positioning it as a longer-term opportunity within a diverse and flexible clean power mix. Taken together, the commercialisation and eventual export of these homegrown technologies offer a pathway to secure substantial economic value. By situating their long-term development, manufacture and deployment here in the UK, they offer a potential route to reinvigorate UK industrial competitiveness and boost our national energy security. Finally, the development of these clean energy technologies and their underpinning supply chain will help to answer the growing need for a stronger and more decisive UK response to the ongoing climate crisis.

Throughout 2025, the UK has consolidated its position as a global leader in the development and deployment of ocean energy technologies. Continued support through the UK's flagship Contracts for Difference (CfD) mechanism in the last four Allocation Rounds means that, for the first time, tidal stream technologies will play a sustained and more mean-

ingful role in the national energy system, with more than 120 MW now contracted for deployment by 2029. The UK's internationally recognised expertise in wave energy—built through decades of targeted innovation programmes—has also enabled the sector to position itself as a global hub for testing, validation, and early-stage technology development. At the same time, the UK continues to work closely with European partners through a range of collaborative R&D and demonstration projects, helping accelerate innovation and drive technological breakthroughs across both tidal stream and wave energy.

However, as the sector matures, it must continue to address several persistent challenges. The scale-up of commercial deployment will require a step-change in domestic supply chain capability, ensuring that UK companies can meet growing demand and retain the economic value created by the sector. Sustained innovation remains essential, not only to continue driving down costs, but to ensure that UK developers remain globally competitive. Finally, maximising the socioeconomic contribution of the sector will require coordinated policy action, clear long-term ambition and a commitment to strengthening public confidence in the benefits of emerging technologies.

These challenges are surmountable, and the momentum currently building across the sector suggests that the UK is well-placed to meet them. Ocean energy now offers not only a route to decarbonisation, but a means of strengthening the UK's industrial base and ensuring that the transition to Net Zero is equitable and enduring.

An expanded version of this chapter, with an increased number of entries, has been used in the publication of the 2025 UK Ocean Energy Annual Review, and is available [here](#).

### Tidal Stream Energy Highlights

- The UK governments Contracts for Difference (CfD) scheme has undergone significant restructuring. Auctions will now comprise two separate allocation rounds: AR7 for offshore wind and AR7a for non-offshore wind technologies. AR7a includes two technology pots, with Pot 2 covering both tidal stream and wave. Unlike previous rounds, Pot 2 does not include any ring-fenced funding for specific technologies. AR7a results are expected February 2026.

As the sector matures, it must continue to address several persistent challenges. The scale-up of commercial deployment will require a step-change in domestic supply chain capability, ensuring that UK companies can meet growing demand and retain the economic value created by the sector.

- Proteus Marine Renewables have partnered with SKF to deliver advanced technology for MeyGen, the world's largest tidal stream array operated by Ampeak Energy in the Pentland Firth. SKF recently set a new world record for tidal turbine performance, with its 1.5 MW systems operating continuously for over six years without unplanned maintenance.
- In May 2025, the Welsh Government completed a £2 million equity investment in tidal energy firm Inyanga Marine Energy Group, reinforcing the Welsh Government's commitment to making Wales a world centre of emerging tidal technologies.
- Orbital Marine Power have secured licences to deploy up to three O2-X devices at the Canadian Fundy Ocean Research Centre for Energy. In addition, Orbital Marine Power has also secured a multi-million-pound investment from PXN Ventures, a leading venture-focused investment firm, to advance its commercial projects.

### Wave Energy Highlights

- Mocean Energy has continued to advance its prototype device, the Blue X, which has achieved over 13 months of reliable offshore operation. Delivered alongside a Tier 1 integrator and several oil and gas operators, this world-first pilot advanced turn-key, off-grid, "always-on" renewable power solutions.
- Scotland, through Wave Energy Scotland, continued to play a leading role in international collaboration efforts by delivering the EuropeWave device development programme in partnership

with the European Commission, Ente Vasco de la Energía (EVE), and Ocean Energy Europe.

- Swedish wave energy developer CorPower Ocean have been selected to lead the €30 million Horizon Europe POWER-Farm Project, alongside UK partners European Marine Energy Centre (EMEC) and The University of Edinburgh. Testing undertaken at EMEC will focus on addressing the competitiveness and bankability of wave farms, unlocking potential for large-scale testing and deployment at EMEC.
- OceanEnergy, through the EU-funded WEDUSEA project, is advancing its 1 MW OE35 floating wave energy converter and commencing an ambitious build programme through winter 2025/26 in preparation for deployment at EMEC's Billia Croo wave test site.

## Cross-sector Highlights

### UK Marine Energy Council Marine Energy Taskforce

The UK Marine Energy Taskforce (MET) was launched in June 2025. The MET is an industry-led initiative established by the UK Marine Energy Council (MEC), which has acted as the sector's voice since its launch in 2018. The Taskforce was initiated with the support of the Minister for Energy, Michael Shanks, and is financially supported by The Crown Estate and Crown Estate Scotland.

Conceived as a focused 12-month cross-sector programme, the MET has been tasked with developing a roadmap and a set of recommendations to help realise the UK's marine energy potential. Its work is structured around four core themes critical to sec-

tor growth: site development, financing, innovation, and supply chain growth.

The MET consult with representatives from the UK, Welsh and Scottish Governments, alongside key bodies such as Mission Control and Great British Energy. The Taskforce brings together industry leaders to develop a series of recommendations for government. These recommendations will address challenges associated with these four themes and seize the opportunity represented by the marine energy sector.

### The Supergen ORE Hub Ocean Energy Policymakers Toolkit

[The Offshore Renewable Energy \(ORE\) Policymakers Toolkit](#), a joint collaboration between Supergen ORE Hub and the University of Edinburgh, continues to expand its evidence base for ORE policy and industrial strategy. Originally launched in 2023, the Toolkit has now released two additional reports.

In March 2025, an updated and expanded version of the second report in the series, 'What is the Value of Innovative Offshore Renewable Energy to the UK Economy?' was published, reflecting recent changes in the economic landscape and providing a more detailed quantification of jobs across the ORE sector.

Building on this, a sixth report, 'Disruptive Innovation and Industrial Modernisation: Pathways to Securing Offshore Renewable Energy Supply Chain Competitiveness', has been completed. This report examines the role of the underpinning supply chain and explores how the UK can better capture the economic value associated with the growth of the ORE sector. The report was launched in January 2026.

## Supporting Policies for Ocean Energy

### National UK energy strategy

The design and implementation of energy policy in the UK reflect a complex mix of reserved, devolved and shared competencies. Responsibility is divided between the UK Government—where the research, development and implementation of energy policy at the national level sits primarily with the Department for Energy Security and Net Zero—and the devolved administrations in Scotland, Wales and

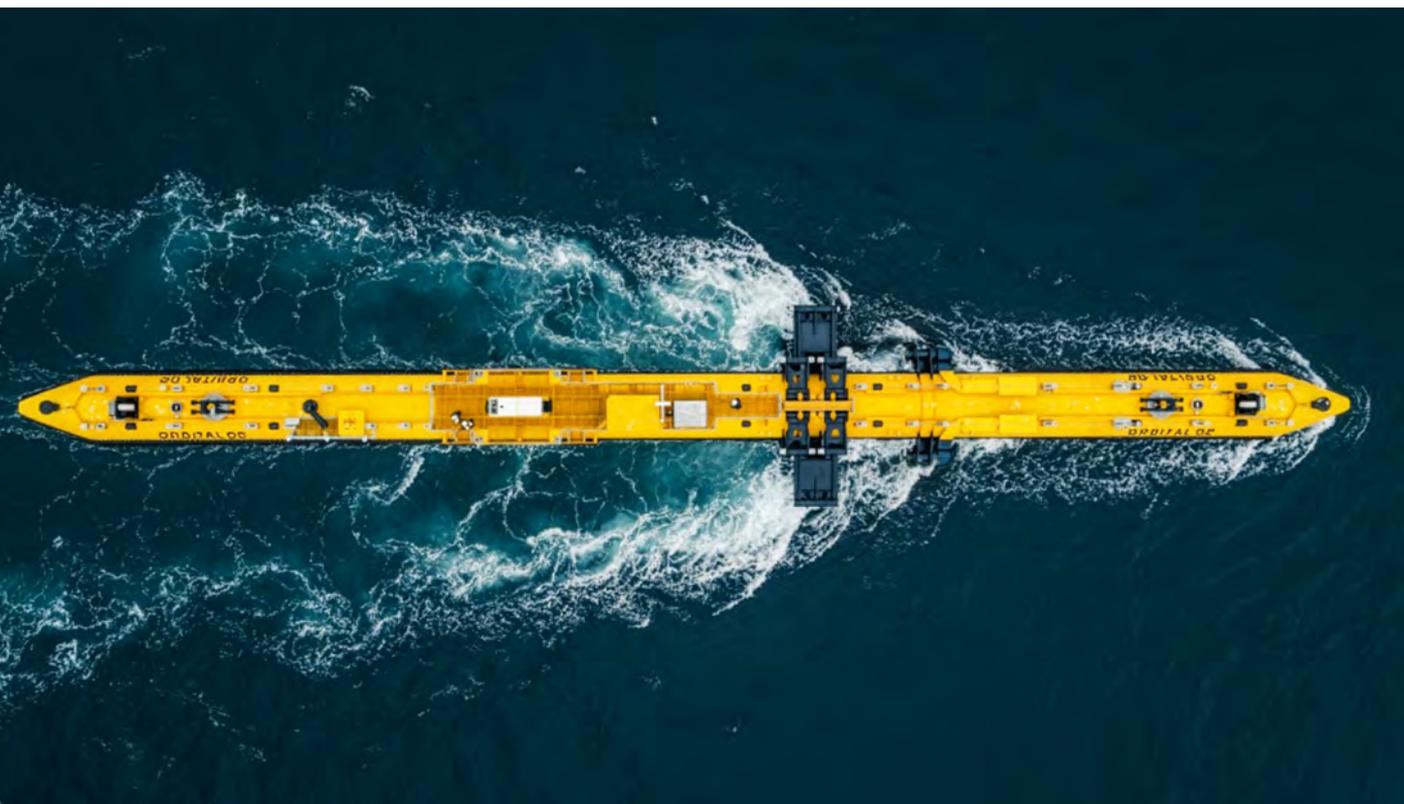
Northern Ireland, each of which exercises differing degrees of autonomy over policy decision-making. While the delivery of a future clean energy system is a shared ambition across both national and devolved governments, there is some divergence in the net zero timelines adopted across the UK. For example, the Scottish Government has committed to achieving net zero by 2045, compared with a 2050 target for the rest of the United Kingdom.

Within the UK, energy policy is largely devolved to the Northern Ireland Executive. It is broadly reserved to UK Government in respect of Scotland and Wales, limiting the ability of Scottish and Welsh Governments to make decisions and policy independently of UK Government. However, the ability to enact policy which is designed to tackle climate change, through policy levers such as the promotion of renewable energy, energy efficiency, electricity generation, and transmission development is devolved to some extent. This provides each of the devolved governments with at least some powers to determine their overall domestic energy mixes.

## United Kingdom

2025 marked the first full year of the current UK Government, a year in which it firmly positioned the development of the UK as a clean-energy superpower as one of its central missions while in office. This ambition has been reflected in the clearer positioning of Great British Energy (GBE) and the ongoing implementation of the Clean Power 2030 Action Plan, as well as a series of major policy announcements aimed at accelerating the transition to a Net Zero energy system. Key developments include:

- **The UK's Modern Industrial Strategy**, launched in June 2025, is a focused 10-year plan to boost long-term economic growth by making it easier and faster for businesses to invest and expand, while fostering a more competitive and resilient UK economy. Central to this strategy is the identification of eight priority sectors (identified as the IS-8) which together account for around one-third of UK GDP. Clean energy industries are among these priorities, with government recognising their potential to serve as both engines of growth and foundations of a sustainable economic future. This approach is also backed by a clear commitment to supporting innovation, with £86 billion of R&D investment specifically set aside to target the IS-8 sectors. The Industrial Strategy also places emphasis on the Supply chains and foundational sectors that underpin the growth of these key industries, considering areas such as electricity networks, ports, critical metals, composites, and steel.
- **The Clean Energy Industries Sector Plan**, part of the UK's Modern Industrial Strategy, outlines the necessary steps to ultimately lower the overall cost of energy and improve industrial competi-
- tiveness for the UK's clean energy industries. The Sector Plan primarily focuses on frontier clean energy industries where the UK has the greatest growth potential, which includes industries such as offshore wind, nuclear fission, hydrogen and heat pumps. While it does not include wave and tidal stream within the IS-8, the Plan acknowledges the vital role that more nascent clean energy technology areas will play in future years, with the UK Government committing to continuing to support the development of these technologies. This Plan also connects the growth and clean energy missions by stressing the role of supply chains in delivering overall clean energy resilience and competitiveness.
- **The Great British Energy Strategic Plan**, launched in December 2025, outlines GBE's long-term objectives and its priorities for the next five years. Between now and 2030, GBE will aim to deliver at least 15 GW of clean energy generation and storage assets, and mobilise £15 billion of private finance; support over 1,000 local and community energy projects, boosting community ownership; and support at least 10,000 jobs, including skills and locations historically dependent on oil and gas. It outlines that GBE will operate as both a project developer and equity investor, ensuring that the British public have a meaningful stake in the full lifecycle of clean energy deployments. To achieve this outcome, GBE has set out three priority areas for near-term investment: GBE Local; Onshore Energy; and Offshore Energy. While references to other sectors are limited, GBE does indicate that these are the types of technologies that could be supported by the newly formed GBE Ventures, with the potential for this GBE arm to take minority positions in projects and companies that have high growth potential and a strong UK innovation footprint. This strategic plan also considers the importance of coordinating investment in parallel with GBE's newly announced Energy, Engineered in the UK (EEUK) programme. EEUK is a £1bn funding programme designed to unlock industrial opportunities from the energy transition and to ensure the UK develops enduring capabilities in the clean energy technologies of the future.
- Finally, despite being launched in December 2024, the **Clean Power 2030 Action Plan** continues to fundamentally shape UK Government energy policy and is key to maintaining overall momentum



Orbital O2 in operation off Orkney (Credit: Orbital Marine Power)

across the clean energy sector. While the 2030 timeline limits the role for tidal stream and wave energy technology, the Action Plan highlights that the UK's ability to deploy these innovative technologies at scale could be important to the UK's achievement of longer-term decarbonisation objectives.

Taken together, these policy developments signal a renewed national commitment not only to expanding the UK's clean energy capacity but also to strengthening the domestic supply chains that will underpin this transition. Within this landscape, the ocean energy sector must continue to advocate for its place in the long-term plan, ensuring that tidal stream and wave energy—technologies uniquely aligned with the UK's natural strengths—are fully recognised for the value they can bring. Delivering a sustainable, diverse and resilient energy mix, that harnesses all of the UK's resources will be essential to achieving Net Zero in a cost-effective and secure manner. As understanding grows of the contribution that wave and tidal stream energy could make in underpinning and strengthening the national energy system, it is vital that these sectors remain integrated into the UK's broader vision for a clean-energy future.

## Scotland

Scotland continues to hold the most ambitious climate targets within the UK, with the Scottish Government committed to achieving net zero emissions of all greenhouse gases by 2045. Meeting these ambitions will be challenging, as highlighted in April 2024 when the Climate Change Committee advised that Scotland's interim target of reducing greenhouse gas emissions by 75% by 2030 was at risk. In response, the Scottish Government adapted its delivery framework, announcing the replacement of annual emissions targets with a system of multi-year carbon budgets. This approach is supported by a statutory strategic delivery plan setting out how emissions reductions will be achieved, with updated plans to be published at least every five years. Alongside these strategic frameworks, the Scottish Government also exercises devolved powers over spatial planning, marine planning and consenting, providing important policy levers to shape the pace, scale and location of renewable energy deployment and associated supply chain development.

In November 2025, the Scottish Government published the draft version of Scotland's Climate Change Plan (to be finalised in 2026) covering the

years 2026–2040. This plan places a renewed emphasis on the development of renewable energy within Scotland, which extends to creating jobs and developing skills within this industry. The plan also emphasises a need for ongoing collaboration between national and devolved governments as 30–60% of the emissions reduction required in Scotland, Wales, and Northern Ireland will be in areas of policy that are mostly reserved to UK Government. Finally, this Plan makes clear that the renewable energy sector in Scotland will provide the foundation of the nation’s future energy system, offering a sizeable opportunity for economic growth.

While the plan makes clear that Scotland’s future renewable capacity will rely heavily on the development of offshore and onshore wind, other more nascent technologies, such as tidal stream and wave energy, can also play a role in the longer term. The Scottish Government has committed to continuing to support the development of these sectors in its Climate Change Plan. This is particularly important as Scotland’s location on the western edge of Europe and its unique geography of sea-ways and firths, exposes it to a combination of intense winds, powerful Atlantic waves and fast-flowing tidal currents.

Scotland has also benefited from the formation of the Offshore Wind Directorate, a Scottish Government department responsible for the development of policy related to offshore renewables, marine energy, and sectoral marine planning. Scotland has also completed the world’s largest commercial offshore wind leasing round in ScotWind. Developer commitments could see an average spend of £1.5 billion in Scotland across the ScotWind offshore wind projects. The Scottish Government has also committed to invest up to £500 million over five years to leverage private investment in ports, manufacturing and fabrication to support sector needs. Given the technological and supply chain overlaps between the Scottish offshore wind and ocean energy sectors, tidal stream and wave energy developers may also stand to benefit if their requirements are taken into consideration at an early stage.

In the last few years, Scotland’s ocean energy sector has continued to make substantial progress as wave and tidal stream developers progress on the journey towards commercial-scale deployment. Sustained success in the bidding process for CfD means that there is now nearly 84 MW of tidal stream energy

set for deployment in Scotland by the end of 2029. This represents a significant proportion of the global allocated capacity for tidal stream and highlights Scotland’s position as a pioneering the development and deployment of tidal stream technologies. Finally, in addition to the CfD awards, three pilot farms at EMEC have been successful in gaining significant support through Horizon Europe funding:

- Scottish tidal stream developer Nova Innovation are leading the SEASTAR project, which aims to deploy a 4 MW tidal farm of 16 tidal stream;
- Scottish tidal stream developer Orbital Marine Power are leading the EURO-TIDES project which aims to deploy a 9.6 MW tidal farm of 4 tidal stream turbines;
- Swedish wave energy developer CorPower Ocean have been selected to lead the €30 million POWER-Farm Project which aims to test and deploy a 5MW farm.

## Wales

Wales remains committed to its target of decarbonising the energy sector, accelerating renewable energy deployment and reaching net zero greenhouse gas emissions by 2050, with interim targets of a 63% reduction by 2030 and 89% by 2040. In 2025, the Climate Change Committee advised that the Welsh Government’s existing carbon budget and interim targets remain credible and evidenced. Alongside its emissions targets, Wales has, for nearly a decade, maintained an ambition for 70% of electricity consumption to be met from renewable sources by 2030, which was further strengthened in 2023 through a new commitment to 100% renewable electricity by 2035. While Welsh Government strategies continue to prioritise offshore wind and solar in the near term, tidal stream and wave energy are recognised as longer-term opportunities due to Wales extensive coastline, strong tidal currents, and energetic wave conditions in the Celtic Sea.

In 2025, the Welsh Government strengthened its support for ocean energy through a combination of equity investment and regional infrastructure funding. It holds an £8 million equity stake in the Morlais tidal stream demonstration zone, while a further £8.87 million has been committed through the North Wales Growth Deal to support the Cydnerth grid expansion phase, bringing total project investment to over £16 million. Completion is expected in late 2026, with the project anticipated to support

up to 230 jobs and generate up to £30 million in net additional GVA for North Wales. In parallel, the Welsh Government also took a £2 million equity stake in tidal stream technology developer Inyanga Marine Energy, supporting the demonstration phase of its Hydrowing technology at Morlais.

Several additional project milestones occurred during the year. Tidal technology developer Inyanga announced UK-based contractors for manufacturing, system integration, and offshore operations on its upcoming CfD supported 20 MW HydroWing array. 2025 also saw the launch of a Welsh Government-backed R&D collaboration to develop next-generation tidal turbine blades. The project brings together the Advanced Manufacturing Research Centre Cymru, Morlais developer Menter Môn, and ORE Catapult’s Welsh team, alongside Spanish partners Magallanes Renovables and D3 Applied Technologies. Funded under the VInnovate Wales programme, the project aims to design more efficient and durable tidal stream blades, laying the groundwork for future cost reductions.

Early-stage technology testing continued at the Marine Energy Test Area in Pembrokeshire. CGEN Engineering and Swansea University’s “Tidegen” project, funded by Innovate UK, completed a series of real-sea trials of a next-generation, modular tidal generator at METAs Warrior Way site in early 2025. Separately, Innovate UK awarded £750k to Checkmate Flexible Engineering for its “Môr Neidr” (Welsh for Sea Snake) wave energy converter project.

Marine Energy Wales (MEW), the industry-led stakeholder group, continued to coordinate activity across government, industry, academia and local supply chains. In 2025, MEW’s core public remit was renewed with a further three years of Welsh Government funding, providing continuity for policy engagement, market development and supply-chain mobilisation across Wales. MEW also co-led a major cross-technology advocacy milestone, launching “Wind, Solar and Tidal Stream: Unleashing the Full Value of Welsh Renewables” in partnership with RenewableUK Cymru and Solar Energy UK. The report positions tidal stream as a meaningful contributor to Wales renewables growth and quantifies its prospective economic contribution at £696 million in gross value added between 2025 and 2035, supporting average annual employment of 700 jobs over the period.

## Market incentives

### Contracts for Difference

The Contracts for Difference (CfD) scheme is the UK government’s flagship program for supporting low-carbon electricity generation. CfDs provide long-term price stabilisation through a two-way payment mechanism that settles the difference between a market reference price and an agreed strike price. When market prices fall below the strike price, generators receive a payment; when prices exceed it, they return the difference. The CfD scheme incentivises investment in renewable energy by providing developers of renewable energy projects, normally projects with high upfront costs and long lifetimes, protection from volatile wholesale prices. To date, six allocation rounds (AR) had been completed, with a range of renewable energy technologies successfully bid for contracts through competitive auctions. In AR4, AR5, and AR6, tidal stream benefitted from a dedicated minimum budget in the auction, where support was ringfenced for tidal stream in the CfD auction round before the competition opened to other renewable technologies. From these three AR, there is now a total pipeline for 122 MW of tidal stream projects in the UK, all expected to be commissioned by 2029. While wave energy projects have not yet won CfD contracts and the sector remains at an early stage relative to tidal stream, there is ongoing technology development and industry interest in progressing devices toward a level of maturity that could make them competitive for future CfD auctions.

In July 2025, DESNZ published the results of its CfD AR7 consultation, which focussed on making reforms to AR7 and the broader CfD scheme in support of the renewable deployment targets set out in the Government’s 2030 Action Plan. The most significant change outlined that AR7 would be split into two separate allocation rounds—one for offshore wind technologies (AR7) and a second for non-offshore wind technologies (AR7a)—with separate timelines being published for each. Additionally, prices are now reported in 2024 values, while all previous AR were in 2012 prices. AR7a contains two technology pots, with Pot 2 including both tidal stream and wave. Unlike previous years, Pot 2 does not currently have any ringfenced funds for specific technologies. Results from AR7a are expected February 2026.

The UK has also provided a funding boost for the CfD associated Clean Industry Bonus (CIB), increasing the overall budget to £544 million, up from £200 million the previous year. While the CIB is only available to offshore wind developers, its aim of supporting cleaner manufacturers, new and upgraded factories, port infrastructure and more support for UK or cleaner supply chains, is likely to have positive knock-on effects for the UK ocean energy sector.

## Public funding programmes

### UK Research and Innovation

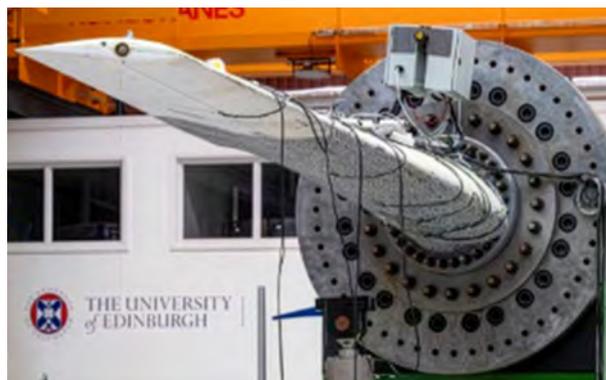
Launched in April 2018, UK Research and Innovation (UKRI) is a non-departmental public body sponsored by the Department for Science, Innovation and Technology. UKRI is the national funding agency investing in science and research in the UK. Operating across the whole of the UK with a combined budget of more than £6 billion, UKRI brings together the seven Research Councils, Innovate UK and Research England.

<https://www.ukri.org/>

### Engineering and Physical Sciences Research Council

The Engineering and Physical Sciences Research Council (EPSRC) is the main funding body for engineering and physical sciences research in the UK. The EPSRC aims to create knowledge and fund innovation with the capability to benefit both society and the economy by supporting research through the provision of fellowships, studentships, research and training grants, competitive funding, and prizes. EPSRC funds and co-invests with industry, at both national and international levels, helping to deliver advanced research facilities and resources for engineering and physical sciences, including wave test facilities and tidal tank testing. EPSRC also provides technology push policy support mechanisms, such as the Industrial CDT in Offshore Renewable Energy (IDCORE), a programme designed to provide sector-specific training to bring forward the next cohort of highly skilled engineers, funding for which was renewed to run until 2032. In addition, IDCORE also provide a number of fellowships, managed activity, standard grants and programme grants and is also responsible for funding the ORE Supergen Impact Hub.

<https://www.ukri.org/councils/epsrc/>



FastBlade tidal turbine blade test facility  
(Credit: University of Edinburgh)

### Innovate UK

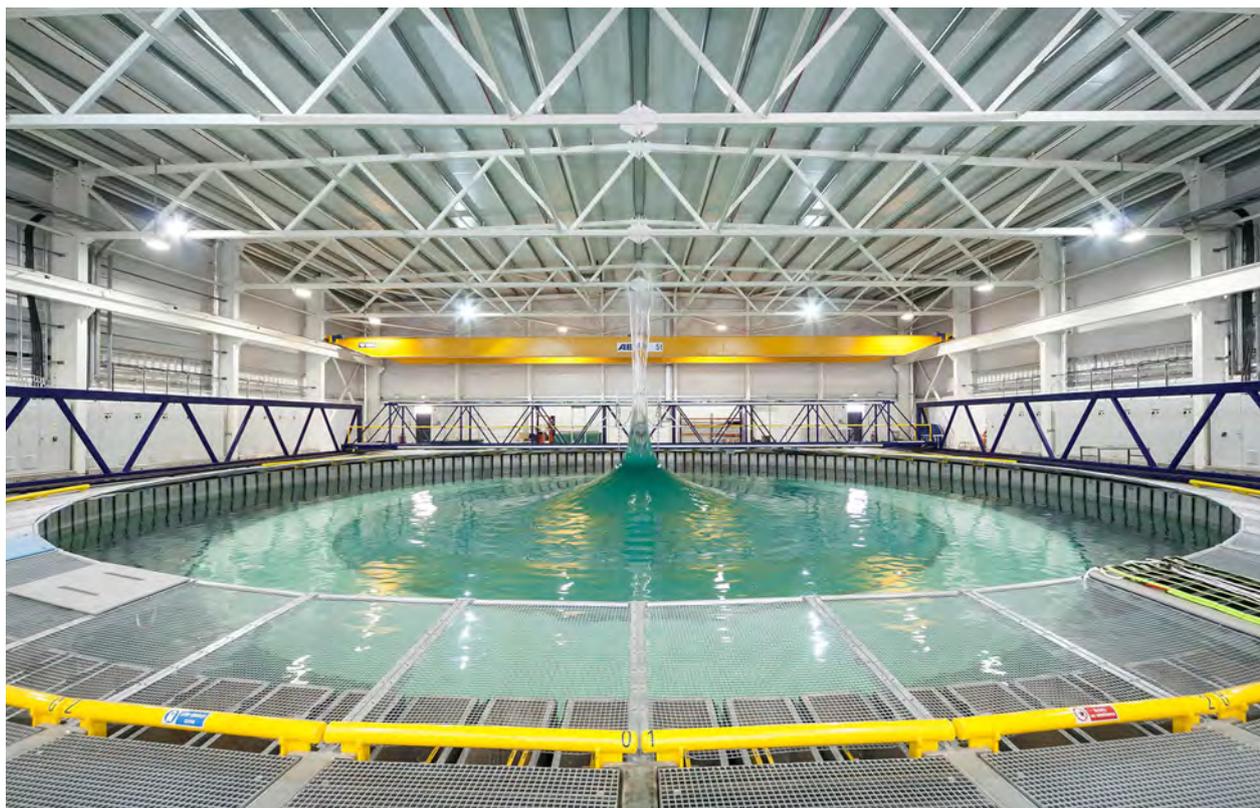
Part of UKRI, Innovate UK inspires, involves, and invests in businesses developing life-changing innovations to create a better future. Providing sectors with expertise, facilities and funding, Innovate UK helps test, demonstrate and evolve ideas, driving UK productivity and economic growth. Innovate UK's network and communities of innovators realise.

<https://www.ukri.org/councils/innovate-uk/>

### Wave Energy Scotland

Since 2014, Wave Energy Scotland (WES) has been using Scottish Government funding, alongside a competitive stage gate process, to tackle the key technical challenges of wave energy conversion, pushing innovative solutions from concept towards commercialisation. Separate funding streams have supported the development of novel wave energy devices, power take-off systems, control systems, quick connection systems and materials. Alongside this, WES is supporting further development of wave devices through the EuropeWave programme, in partnership with the European Commission, Ente Vasco de la Energía (EVE) and Ocean Energy Europe.

During 2025, WES focused on continued innovation support and promoting commercialisation pathways for the emerging technologies, including future opportunities for co-location with the growing floating wind sector. Building on a 2023 study which showed significant cost of energy reduction for wind and wave projects, WES is working to demonstrate the benefits and feasibility of multi-use marine spaces, aiming to maximise the energy generation and economic benefit from available sea areas while helping balance the energy system.



FloWave ocean energy research facility (Credit: University of Edinburgh)

In support of more radical cost-reduction opportunities, WES continued the Direct Generation competition, funding enabling R&D and concept design projects using flexible wave energy devices based on electrostatic power conversion technologies. WES continues to collaborate widely, playing a leading role in the guidance and delivery of the innovation activity required to take wave energy towards commercial readiness and contribution to Net Zero. Echoing the positive message on the economic benefits of tidal energy, WES published a report in February exploring the potential economic benefits of deployment of wave energy technologies, highlighting the opportunities for domestic content, jobs and a strong export market. Through the companies and projects funded by the WES programme, this report further demonstrated the opportunity for emerging marine energy industries to deliver extensive economic value in domestic and export markets, while contributing value to the decarbonisation of the UK energy system.

The qualities of the WES programme have been recognised globally and can be replicated in other low-carbon sectors where the value of focused innovation, detailed evaluation and rigorous project

management can steer emerging technologies towards their potential.

<https://www.waveenergyscotland.co.uk/>

## Key R&D institutions

### Supergen Offshore Renewable Energy (ORE) Hub

Funded by the UKRI's Engineering and Physical Sciences Research Council (EPSRC), the Supergen Offshore Renewable Energy (ORE) Hub was established in July 2018 and continues in its current phase (2023–2027) with £7.5 million of funding. The Supergen ORE Hub provides ambitious research leadership and fosters collaboration between academia, industry and policy stakeholders to accelerate innovation across offshore wind, wave and tidal energy for the clean energy transition. The Hub is a collaboration of 10 leading UK Universities, led by the University of Plymouth, with co-directors from the Universities of Aberdeen, Edinburgh, Exeter, Hull, Manchester, Oxford, Southampton, Strathclyde, and Warwick. Leadership of the ORE Supergen Hub will move to Oxford in February 2026.

### Strategic Research

The Supergen ORE Hub has worked with stakeholders across the sector to establish strategic Research Challenges—priorities within research that have the potential to unlock a step-change in the development of offshore renewable energy. This targeted research addresses a broad range of challenges such as novel anchoring systems and advanced environmental classification, as well as reducing deployment barriers, including planning and consenting processes and supply chain bottlenecks. Their Flex Fund provides research funding as a key mechanism for addressing near-term priorities: £4.6 million has been provided to 46 targeted Flexible Funded projects to date, involving over 100 industry partners and nearly £6 million in matched contributions.

### Research Outputs

Supergen ORE Hub research reaches across industry, policy and standards development. Recent outputs include contributions to new British Standards guidance on undersea cables, and early support for prototype development, such as the semi-commercial M4 wave energy device in Western Australia. The Hub has made a strong contribution to offshore renewables research with over 430 research papers published, leveraging c.£136 million total invested in research. With £228,000 having been awarded to 55 Early Career projects, with the aim of supporting emerging researchers and contributing to the long-term success of the sector.

### Collaboration

The Supergen ORE Hub provides regular events as a platform for a cross-disciplinary, whole sector audience to examine the key challenges limiting progress and explore the opportunities emerging within the rapidly evolving offshore renewables landscape, including an Annual Assembly and Early Career Forum.

<https://supergen-ore.net/>

### Offshore Renewable Energy Catapult

The Offshore Renewable Energy (ORE) Catapult is the UK's flagship technology and innovation research centre for offshore renewable energy, and a key actor in helping to deliver the UK's Net Zero targets. Their aim is to accelerate the creation and growth of UK companies in the ORE sector by providing access to its unique research and develop-

ment capabilities along with its demonstration and testing facilities. ORE Catapult receives core UK Government support as part of the Catapult Network, including ongoing public funding through Innovate UK to underpin its national mission in offshore renewable energy innovation.

In partnership with Renewable Risk Advisers (RRA), ORE Catapult has continued to develop an insurance solution for the marine energy sector, referred to as the Ocean Energy Accelerator (OEA). The OEA seeks to extend the scope of insurance coverage in pre-commercial marine energy projects that do not have sufficient performance track record, by developing an insurance entity with a protected cell company structure and backed financially by a public guarantor. This is expected to significantly reduce capital costs in early-stage projects until such a time when the commercial insurance market is ready to provide greater support. By engaging with the industry to quantify project risks, the team has developed an OEA business case for the first Contracts for Difference (CfD) projects in the UK, which has been presented to potential public guarantors.

<https://ore.catapult.org.uk/>

## Key research, development and demonstration projects

The UK was well represented throughout 2025 in collaborative European projects, which are primarily funded through Horizon 2020 and Horizon Europe:

### EURO-TIDES

EURO-TIDES, funded by the EU and UK Research and Innovation (UKRI), aims to deploy a 9.6 MW tidal energy farm comprising four Orbital Marine Power turbines. The project seeks to de-risk tidal technology development, reduce LCOE, improve availability to over 95%, and strengthen the bankability, insurability and supply chain readiness of Orbital's technology, while improving understanding of environmental impacts.

EURO-TIDES supports the commercialisation of Orbital's technology through manufacturing optimisation, long-term operations and maintenance development, and accelerated performance data collection. It also aims to advance commercial-scale tidal projects in French waters, complementing Orbital's existing UK portfolio. Early results, including

work on drivetrain testing, digital twins and European supply chain competitiveness, were presented at European Wave and Tidal Energy Conference. The project is coordinated by OEE, the consortium comprises the Center for Wind Power Drives, EMEC, Énergie de la lune, ENGIE Laborelec, MaraSoft, Orbital, and the University of Edinburgh.

<https://www.euro-tides.eu/>

## EuropeWave

WES, Ente Vasco de la Energía (EVE) and Ocean Energy Europe (OEE) are currently delivering the EuropeWave wave device development programme, with co-funding from the European Commission. Phase 3 of EuropeWave (aligned with Stage 3 of the IEA-OES Evaluation and Guidance Framework) is supporting three projects to deploy large-scale wave energy converters during 2025-26. CETO Wave Energy Ireland and IDOM Consulting Engineering will deploy their devices at the Basque Country's BiMEP test site, while Mocean Energy will demonstrate the improvements incorporated into its technology off the coast of Orkney in Scotland. Alignment with the IEA-OES recommendations helps the funders guide rigorous, multi-disciplinary engineering activities, and helps the developers to demonstrate their technical qualities as they progress towards realising future commercial opportunities.

<https://www.europewave.eu/>

## FOREST

FOREST (Future Ocean Renewable Energy System Technologies) is a Horizon Europe-funded project that began in November 2025. Led by EMEC, the three-year project brings together eight partners from the UK, Portugal, Spain and Sweden to drive advancements in subsea components and digital technologies that will set new global standards for durability, reliability and efficiency in ocean energy systems.

The oceans offer vast potential for renewable energy, and subsea components are key to unlocking scalable ocean energy deployments. Yet challenges remain around the survivability, reliability, maintenance costs and performance monitoring of ancillary systems. The FOREST project is tackling these barriers with innovations in subsea components and digital technologies, including: a 33 kV dynamic cable and spar connection hub for ocean energy arrays; a quick connector system to streamline deployment and maintenance; and an AI-enhanced optical measurement platform to measure cable and device health. Validated at test sites in Orkney, these innovations will boost the reliability and efficiency of critical ancillary systems, optimising array performance, cutting costs and accelerating global ocean energy deployment.

<https://cordis.europa.eu/project/FOREST>



Orbital O2 nacelle (Credit: SKF)

## FORWARD 2030

FORWARD-2030 will deploy the next iteration of Orbital Marine Power's turbine, the O2-X, incorporating cost-reduction innovations alongside integrated hydrogen production and battery storage. The project will assess large-scale integration of tidal energy within the European energy system and develop smart energy management and operational forecasting tools. The demonstration will be hosted by the European Marine Energy Centre, which will also deliver hydrogen production and a comprehensive environmental monitoring programme. Techno-economic analysis will be led by the University of Edinburgh, with marine spatial planning addressed by the MaREI Centre at University College Cork.

In April 2025, Lloyd's Register awarded Orbital an IECRE Feasibility Statement for the O2-X turbine. During the same year, EMEC conducted drifting acoustic surveys to assess underwater sound impacts and led a world-first demonstration combining tidal power, vanadium flow batteries and hydrogen electrolysis. Results, including technical, safety and socio-economic findings, were presented at European Wave and Tidal Energy Conference.

<https://forward2030.tech/>

## MAXBLADE

MAXBLADE is a €10 million project funded by the EU and UKRI, to investigate the performance and full lifecycle of tidal turbine blades from fabrication to decommissioning, embedding a circular economy element in their design. The project is currently progressing through a range of blade testing activities which will culminate in the full-scale, accelerated life testing of an optimised blade in 2026.

Work is also ongoing to improve the environmental performance of tidal turbines blades. This includes testing the use of more recyclable materials for tidal turbine applications and enhanced health monitoring to extend blade lifetime.

MAXBLADE is led by TechnipFMC and includes Orbital Marine Power, Marasoft, TECNALIA, The University of Edinburgh, EMEC, Laborelec and European Composites Industry Association. It is supported by Edinburgh University's commercialisation service Edinburgh Innovations.

<https://maxblade.tech/>

## MEGAWAVE PTO

MEGAWAVE PTO is a pan-European initiative jointly funded by Horizon Europe and UKRI to design, develop and commercialise a modular, all-electric Power Take-Off (PTO) system for wave energy devices. The drivetrain integrates C-GEN Engineering's modular generator, an axial magnetic gear configuration, and a novel power electronics topology. Its unique value lies in its adaptability, scalability, manufacturability and reliability, enabling reductions in both cost and environmental impact. The modular architecture provides flexibility and inherent redundancy, allowing the same PTO concept to scale from kW to MW capacities depending on site and sea-state requirements, while also maintaining operation in the event of partial PTO failure.

In 2025, the project delivered the design and manufacture of a 1 kW generator and magnetic gear prototype, alongside preparations for experimental testing. Work also progressed on modelling tools, advancement of condition-monitoring and fault diagnostics, maintenance planning, sustainability assessment, LCOE baseline development, and mapping of the European supply chain. Scale-up activities toward the full 100 kW system continued, with project completion planned for 2027.

<https://www.megawave-pto.eu/>

## POWER-Farm EU

The POWER-Farm EU project is a flagship initiative designed to transition wave energy from pilot-scale to commercial bankability. Funded through Horizon Europe, it was launched in December 2025. By validating wave array performance in the rigorous conditions of the Atlantic, the project aims to demonstrate that wave energy is a "clean-firm" renewable source capable of complementing wind and solar.

The project focuses on verifying survivability and reliability at the EMEC Billia Croo test site. It specifically targets the "bankability" gap by providing empirical data on O&M (Operations and Maintenance) costs and yield predictability for large-scale investors. The project will bring the technology from TRL7 to TRL8. Led by CorPower Ocean, the partnership includes EMEC, The University of Edinburgh, Ocean Energy Europe, Renewable Risk Advisers, and Kristinehamn Teknik & Service.

<https://cordis.europa.eu/project/id/POWER-FarmEU>



M100-D tidal turbine “Eunice” before deployment (Credit: Nova Innovation)

## SEASTAR

The Sustainable European Advanced Subsea Tidal Array (SEASTAR) is a 4MW project to deliver 16 tidal stream turbines—the largest number of turbines deployed in a single location globally. Building on the success of Nova’s previous 6-turbine array in Shetland, SEASTAR will utilise Nova’s well-proven turbines to deliver the 16-turbine array at the EMEC Fall of Warness tidal site in Orkney. The project is jointly funded by the EU Horizon Europe programme and UKRI.

<https://www.seastar-tidal.eu/>

## Wave Energy Scotland: Core Innovation Programme and EuropeWave

Since 2014, WES has delivered individual targeted innovation competitions, based on the Pre-Commercial Procurement process that enables up to 100% funding to be provided to emerging technologies. The 5 core programmes and the subsequent EuropeWave project (co-funded by the European Commission, Ente Vasco de la Energía (EVE) and

WES) have delivered a range of technologies to large-scale demonstration, many of them now finding near-term opportunities in offshore industries. The core WES programme has been complemented by a range of collaborative activities, guiding research programmes and targeted innovation support activities.

<https://www.waveenergyscotland.co.uk/>

## Wave Energy Scotland: Direct Generation Programme

Wave Energy Scotland’s Direct Generation Programme supports next-generation wave energy technologies using novel electrostatic approaches based on flexible elastomers and polymers, including Dielectric Elastomer Generators (DEGs) and Dielectric Fluid Generators (DFGs). To advance understanding of these concepts, WES has supported a structured design competition and targeted enabling R&D activities.

**Design Competition:** The second round of the Direct Generation design competition concluded in

summer 2025, completing a two-phase programme launched in late 2023. 4c Engineering and TTI Marine Renewables participated in this round, investigating DFG- and DEG-based wave energy concepts respectively.

**Fundamental Research:** In parallel, WES funded fundamental research in priority areas identified through the design competition. The Universities of Oxford and Plymouth investigated origami-inspired structures for DFGs, the University of Manchester examined nanocomposite electrode solutions for DEGs, and the University of Swansea continues to analyse the electro-mechanical fatigue behaviour of both technologies.

**Programme Outcomes:** Both 4c Engineering and TTI Marine Renewables are exploring intermediate markets, with soft robotics and sensing applications providing potential stepping stones toward future energy harvesting. Wider academic engagement continues through longer-term projects and PhD research, while WES is monitoring progress and plans to publish guidance on the programme's technical conclusions, supporting a phased pathway initially focused on non-generation applications.

<https://www.waveenergyscotland.co.uk/wave-technology/direct-generation/>

### Wave Energy Scotland: Multi Wave Absorber Platform Programme

Wave Energy Scotland's Multi Wave Absorber Platform (MWAP) Programme explores opportunities for wave energy to co-locate with floating offshore wind as developments move into deeper waters and more energetic wave climates. Co-location offers potential benefits for both sectors, including cost reduction, increased energy yield and improved supply consistency. Since 2022, WES has focused on the economic viability, performance impacts and engineering feasibility of these approaches.

An economic study led by OWC Limited found that simple co-location of wave and wind technologies offers the strongest near-term benefits, while also highlighting longer-term potential for versatile platforms capable of hosting either technology. Building on this, WES worked with the FloWave Ocean Energy Research Facility to investigate MWAP behaviour, where multiple wave energy converters are mounted on floating platforms analogous to those

used in floating wind. Numerical modelling comparing MWAP configurations with solo absorbers was presented at EWTEC 2025, alongside PhD research supported by WES and Engineering and Physical Sciences Research Council examining model validation.

In parallel, a 2025 engineering feasibility study led by Blackfish Engineering Design Limited identified clustered wave energy converters on shared host platforms as a more cost-effective alternative to standalone devices. In response, WES has developed a cluster concept design targeting utility-scale, multi-megawatt wave energy deployment.

<https://www.waveenergyscotland.co.uk/research-strategy/strategic-research/multi-wave-absorber-platform/>

### Wave Energy Scotland: Quick Connections System

This programme supports projects aimed at reducing the duration, cost and risk of offshore operations associated with connecting prototype wave energy converters to their moorings and/or electrical systems. Its impact is already extending beyond the wave energy sector. Published in January 2025, the Scottish Offshore Wind Energy Council Innovation Guide highlights impactful innovation taking place in Scotland, and features all three technologies that progressed to Stage 3 of the WES Quick Connection Systems competition, demonstrating the wider value of the programme.

- Quocean are working with CETO Wave Energy Ireland to further develop their connector for use in their EuropeWave deployment at BiMEP and will continue development through the COIN project funded through Horizon Europe.
- Apollo continue towards certification of their connection system and will be testing it in Orkney as part of the FOREST project funded by the same Horizon Europe call.
- Blackfish are working with a manufacturing partner identifying opportunities for extended test to build upon the earlier at sea test campaign. The connection system has achieved Approval in Principle through Bureau Veritas.

<https://www.waveenergyscotland.co.uk/wave-technology/quick-connection-systems/>

## Test Sites and Technology Demonstration

### Existing open sea test and demonstration sites

#### EMEC

EMEC (European Marine Energy Centre) is the world's leading centre for testing and demonstrating wave and tidal stream technologies in the sea. It is the only IECRE-recognised Renewable Energy Testing Laboratory (RETL) for ocean energy. As a plug-and-play facility, EMEC reduces the cost, time and risk of offshore testing by providing pre-consented, grid-connected sites in harsh wave and tidal regimes, alongside sites in less challenging conditions for smaller devices, subsystems and components. EMEC is also an internationally-recognised innovation catalyst, pioneering the transition to a clean energy future through first-of-a-kind and pilot projects spanning ocean energy, offshore wind, renewables integration, hydrogen, e-fuels, and islands decarbonisation.

2025 began with changes to EMEC's leadership team, followed by the creation of an Innovation Team. These changes complement growing engagement with the research community, building on its Independent Research Organisation status, strengthening co-creation with partners and reinforcing EMEC's role in bridging academic research, tank testing, offshore demonstration and real-world data.

EMEC has supported major sector-wide initiatives to help accelerate ocean energy and overcome barriers to deployment. For example, EMEC is leading the 'site development' working group in the Marine Energy Taskforce. Meanwhile, a sector-wide effort to resolve consenting challenges reached a milestone in May with the publication of an evidence-led report setting out recommendations for robust consenting pathways for tidal energy in Scotland while addressing environmental concerns around the potential impact on harbour seals. At EMEC's Fall of Warness tidal energy test



Acoustic monitoring at EMEC Fall of Warness test site (Credit: Colin Keldie/EMEC)

site, preparations continued for upcoming arrays from Orbital Marine Power and Nova Innovation. A major milestone in 2025 was the submission of a Section 36 application to increase consented capacity from 10 MW to 50 MW. EMEC also conducted acoustic surveys around Orbital's O2 as part of the EU-funded FORWARD2030 project. On the wave energy front, OceanEnergy, through the EU-funded WEDUSEA project, has commenced the build programme for its 1 MW OE35 wave energy converter to demonstrate at EMEC's Billia Croo wave test site. CorPower Ocean announced its ambitions to deliver a 5 MW array featuring 14 wave energy converters at the site. EMEC also launched the ambitious €4 million EU-funded FOREST project to advance subsea components and digital technologies for ocean energy arrays.

Beyond ocean energy, EMEC is exploring options for developing a national deepwater and floating offshore wind test site to the west of Orkney. 2025 also marked progress in projects aiming to integrate renewables with complementary energy vectors and offtake industries. Highlights include the completion of two pioneering hydrogen projects: a hydrogen-powered combined heat and power unit at Kirkwall Airport—a UK first; and a world-first three-in-one demonstration integrating the O2 tidal turbine, vanadium flow batteries, and an electrolyser to smooth the cyclical nature of tidal generation and unlock new offtake opportunities.

EMEC reinforced its role as an anchor institution for clean energy innovation globally and locally. Globally, EMEC co-hosted its International WaTERS workshop with OES-IEA, bringing together 18 test sites and organisations from 10 countries. The centre delivered consultancy services across the USA and Asia and strengthened European partnerships through various EU-funded projects, including MaRINERGi.

<https://www.emec.org.uk/>

### Marine Energy Test Area

The Marine Energy Test Area (META), situated in the Milford Haven Waterway, Pembrokeshire, Wales is managed by Marine Energy Wales and offers pre-consented 'Open Water' and 'Quayside' test sites alongside world class port, engineering, and manufacturing facilities. Aiming to bridge the gap between tank testing and the Welsh Demonstration Zones, this series of eight non-grid-connected sites

is suitable for a range of wave and tidal component, sub-assembly, part-scale, and full-scale device tests. META is the only pre-consented, pre-commercial test facility of its kind in Wales and has been funded through the Swansea Bay City Deal as a key partner of the Pembroke Dock Marine Project.

In 2025, META successfully completed three test programmes: Porpoise Power trialed their highly innovative tidal energy convertor which uses an oscillating hydrofoil inspired by a porpoise tail fin; Exo-Engineering completed testing of their eco-engineered scour protection systems known as Exo-reefs; and CGEN Engineering deployed and validated an adaptable modular generator designed for tidal turbines.

<https://www.meta.wales/>

### Morlais

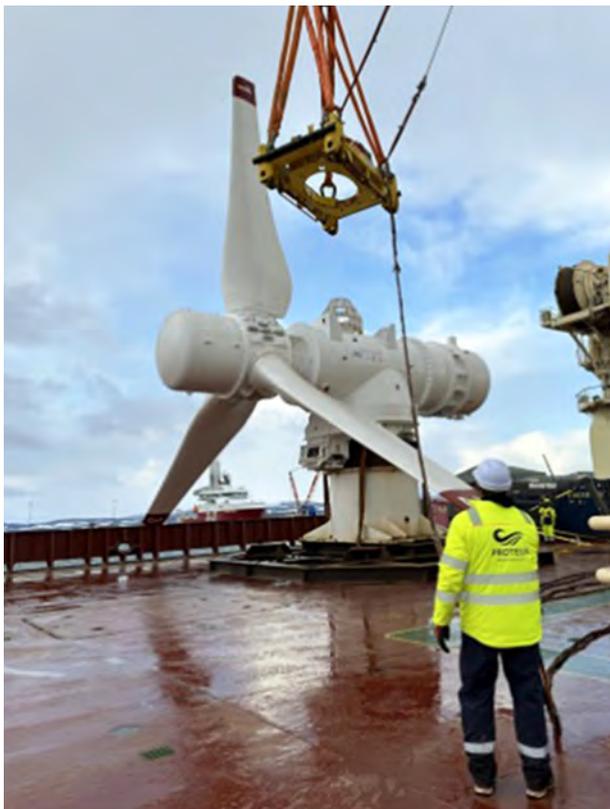
The Morlais scheme, encapsulates 35km<sup>3</sup> of seabed around the promontory of Holy Island being developed by Menter Môn. It boasts powerful tidal current resources and relatively low wave regimes, representing a prime site for future exploitation of tidal energy, and has been leased for 45 years. Infrastructure works to enable the export of electricity generated from tidal stream devices was completed in 2023. The first phase of the project was successfully delivered in February 2024 with the handover of the substation to Menter Môn. Four developers have secured subsidy support under the Contracts for Difference (CfD) scheme in AR4, AR5 and AR6, namely Hydrowing, Magallanes Renovables, Môr Energy, and Verdant Isles.

<https://www.morlaisenergy.com/>

## Research and test facilities

In addition to these large-scale test sites, research institutions across the UK continue to maintain and operate several cutting-edge test facilities, providing invaluable support to early-stage technologies and simulations of real-sea conditions. These include but are not limited to:

- COAST Laboratory – Plymouth University
- Fastblade – University of Edinburgh
- Flowwave – University of Edinburgh
- Kelvin Hydrodynamics Laboratory – University of Strathclyde



MeyGen AR1500 deployment  
(Credit: Proteus Marine Renewables)

## Arrays and demonstration projects in the water

### MeyGen

The MeyGen project, led by Ampeak Energy (previously called SAE Renewables), established in 2010 and situated in the Pentland Firth, is the largest operational tidal stream project in the world. The site has consent awarded for 86 MW, and the option to develop up to 398 MW. The project is being delivered in phases with the 1st phase operational since 2018, with four 1.5 MW turbines. This incorporated two different turbine technologies, Proteus Marine Renewables AR1500 and Andritz Hydro Hammerfest AH1000 MK1.

As a pathfinder, Phase 1 of the MeyGen Project has overcome a range of early technical challenges. Overcoming initial breakdowns, the turbines selected for Phase 1 are now demonstrating their suitability for long-term continuous deployment, with the longest-running turbine exceeding six years of uninterrupted operation. In March 2025, the AR1500 turbine exported a record 372 MWh in a single month,

and by November 2025 the project had delivered a total of 84 GWh to the local grid.

The next phase of MeyGen will deliver an additional 59 MW of capacity utilising 3 MW turbines of up to 24 m rotor diameter. In maintaining its leading position within the tidal industry MeyGen is working to expand its current 86 MW capacity up to 200 MW+ in support of the UK government NET Zero targets and continued support under the CfD.

<https://ampeak.energy/tidal-stream/meygen/>

### Nova Innovation

Nova's Shetland Tidal Array has been generating for more than nine years, accumulating over 86,600 operating hours and counting. The company is currently advancing the design and testing for their next-generation tidal turbine, developed under the UpTEMPO project. Nova is also leading the pan-European SEASTAR project that will see a 4 MW tidal array deployed at the European Marine Energy Centre in Orkney. Nova has won 6 MW of CfD contracts, via AR6, to support the deployment of turbines at EMEC's Fall of Warness site.

<https://novainnovation.com/>

### Orbital Marine Power

In 2025, Orbital Marine Power advanced the development of what could become the world's most powerful tidal turbine, the 2.4 MW O2-X. In April, Lloyd's Register awarded the O2-X an IECRE Feasibility Statement, recognising the maturity of its design, which builds directly on Orbital's proven O2 turbine currently operating at the European Marine Energy Centre in Orkney. Throughout the year, the O2 continued long-term operation at EMEC, providing critical data on component reliability, offshore operations, and environmental performance.

The O2-X incorporates lessons learned from the O2, featuring a larger rotor, improved hydrodynamics, modular construction, and advanced monitoring and control systems. These enhancements are intended to optimise performance, reduce operational risk and support environmentally responsible deployment at scale. Designed to bridge the gap between demonstration and commercial tidal arrays, the O2-X is being delivered through the Horizon 2020 FORWARD-2030 project.

<https://www.orbitalmarine.com/>

## Projects planned for deployment

### CorPower Ocean

Following the successful HiWave-5 demonstrator program in Portugal, CorPower Ocean has signed a berth agreement for Project Valiant. This 5 MW array will consist of 14 Wave Energy Converters and represents the UK's first pre-commercial wave farm at this scale. The array is designed for a 15-year operational life, with deployment scheduled for 2029. It aims to provide a critical data set for grid-connected performance and long-term structural integrity. The Valiant project will demonstrate that the technology is fully commercial and moved beyond TRL9.

<https://corpowersocean.com/>

### Mocean Energy

UK developer Mocean energy has continued to build on the successes of the Renewables for Subsea Power (RSP) project, through which its prototype device, Blue X, achieved over 13 months of reliable offshore operation. Delivered alongside a Tier 1 integrator and several oil and gas operators, this world-first pilot advanced turn-key, off-grid, "always-on" renewable power solutions.

Across 2025 several priority technical areas were addressed through a series of targeted projects:

- EuropeWave is entering its final phase, with offshore trials of the Blue Star 10 OEC scheduled in Orkney from summer 2026. Blue Star 10 represents an evolved, product-ready iteration of Blue X, incorporating expanded solar capacity, onboard batteries and satellite communications, and will also trial a novel direct-drive Vernier Hybrid Machine generator optimised for high-torque, low-speed applications.
- OceanREADI CCS, supported by Innovate UK, will undertake accelerated lifecycle and environmental testing of upgraded powertrain, energy management and power-take-off control systems, focusing on functionality, reliability and resilience.
- OceanPULSE will extend the international reach of Blue Star technology, culminating in a deployment in Australia in 2028. By testing performance under region-specific temperature and biofouling

conditions and integrating a fully electric subsea system, the project will support market readiness and commercial acceptance across CCS, oil and gas, and wider Blue Economy applications.

<https://www.mocean.energy/>

### Ocean Energy

Through the EU-funded WEDUSEA project, OceanEnergy is advancing the development of its 1 MW OE35 floating wave energy converter and is undertaking an ambitious build programme through winter 2025/26 in preparation for deployment at EMEC's Billia Croo wave test site. The deployment phase is scheduled to begin in April 2026 with the installation of mooring components, followed by device hook-up in June 2026, marking a key step towards commercial-scale wave energy demonstration.

<https://oceanenergy.ie/oe-team/>

### Orbital Marine Power

UK developer Orbital Marine Power continued to expand its international activities in 2025, securing 12.5 MW of tidal capacity in Nova Scotia through the province's tidal energy procurement process. Eau-claire Tidal Ltd. and Orbital were awarded two 15-year power purchase agreements, including seabed and grid connection rights at the Fundy Ocean Research Centre for Energy (FORCE) in the Bay of Fundy. The project represents Orbital's largest deployment outside the UK, and positions Nova Scotia to harness one of the world's most energetic tidal resources. The partnership plans to deploy up to six O2-X turbines at FORCE, with an initial staged deployment of up to three units following a Fisheries Act Authorisation issued by Fisheries and Oceans Canada in November 2025. This staged approach enables early operation and environmental monitoring prior to scaling, balancing innovation with ecological protection. Each 2.5 MW O2-X turbine is expected to generate enough electricity to power around 2,000 homes, with the initial 7.5 MW array supplying Nova Scotia's grid.

In December 2025, Orbital also secured £7 million in funding from PXN Ventures, alongside existing shareholders including Scottish Enterprise, to support the delivery of its international commercial projects.

<https://www.orbitalmarine.com/>

## Proteus Marine Renewables

Proteus Marine Renewables brings over 20 years of tidal stream experience, with turbines deployed internationally and more than 22 GWh generated to date. Its AR-Series subsea turbines reflect decades of refinement and are engineered for long-term operation in high-energy environments.

In December 2025, Proteus completed a major off-shore service operation at the MeyGen tidal stream project in Scotland. The campaign involved multiple turbine interventions, subsea cable works and on-deck maintenance, returning two turbines to service and recovering a third for planned upgrades. Proteus' 1.5 MW AR Series 1 turbine has been exporting power at MeyGen since 2017 and a Proteus-led group has been selected to deliver the next 59 MW phase, via the UK Government's CfD scheme.

Internationally, Proteus' 1.1 MW AR1100 turbine became the first grid-certified tidal turbine deployed in Japan in 2025. In France, through its involvement in Normandie Hydroliennes, Proteus is advancing the 12 MW NH1 pilot array at Raz Blanchard, utilising four AR3000 turbines. The project has secured €31 million from the EU Innovation Fund, with deployment planned from 2028. Proteus is also partnering with ORPC on a 2 MW tidal pilot project in Cook Inlet, Alaska, and working with SBS and PLN Indonesia

Power on early-stage tidal energy development in Indonesia, where approvals were granted in 2025.

<https://proteusmr.com/>

## Verdant Power

Verdant Power is developing the Verdant Isles project at Morlais. The first stage of 4.9 MW was awarded a CfD in AR5 and is expected to be commissioned in 2028/29. Resource assessment and front-end-engineering and design for the project is ongoing. Verdant is working with potential tidal stream technology providers to develop the project.

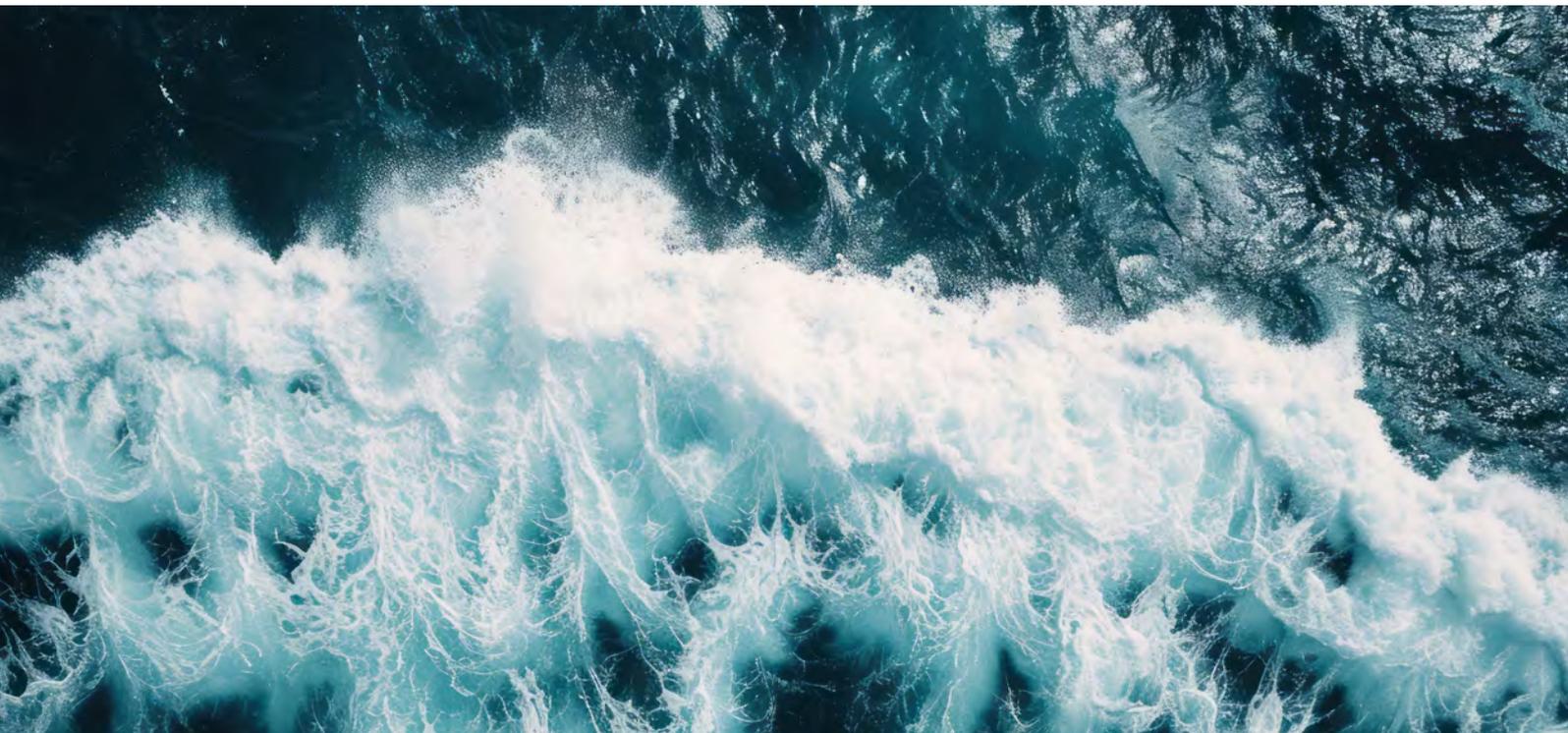
<https://verdantpower.com/>

## Specific Initiatives for international cooperation

This is a non-exhaustive list of examples of different bilateral/regional cooperation initiatives involving the UK:

### Clean Energy Transition Partnership (CETP)

The CETP is a transformative Research, Technological Development and Innovation (RTDI) programme designed to accelerate the clean energy transition through annual joint funding calls. CETP operates



as an international collaboration involving more than 30 countries and over 40 national and regional funding agencies, supported through the Horizon Europe R&I framework, with the aim of aligning priorities, pooling national budgets and delivering co-ordinated calls. In 2025, CETP launched its fourth joint call. Within Scotland, the programme continues to be delivered by Scottish Enterprise on behalf of the Scottish Government, supporting Scottish participation across the CETP modules.

<https://cetpartnership.eu/>

### European Energy Research Alliance (EERA)

The UK continues to chair the European Energy Research Alliance (EERA) Ocean Energy Joint Program (JP), providing the UK the opportunity to continue to guide and assist in the development of the Horizon2020 and now Horizon Europe European funding and work programmes. Comprising of 9 full participants and 4 associate partners, the EERA Ocean Energy JP has identified areas of research, based on

existing research roadmaps, which are considered critical for meeting the necessary requirements for the successful growth of the industry.

<https://www.eera-set.eu/>

### Ocean Energy Systems (IEA-OES)

Ocean Energy Systems (OES) is the abbreviated name for the International Energy Agency (IEA) Technology Collaboration Programme on Ocean Energy Systems. It is an intergovernmental collaboration between countries, founded in 2001, which operates under a framework established by the IEA. The need for technology cooperation was identified in response to increased activity in the development of ocean wave and tidal current energy. The UK was a founding member of the IEA in November 1974 and has maintained a close relationship since then, utilizing its position of leadership to strengthen energy security, spur economic development and advocate for the implementation of cleaner forms of energy.

<https://www.ocean-energy-systems.org> and <https://www.iea.org>

## Relevant National Events

### Relevant events for the ocean energy sector that took place in the UK in 2025 include:

**25<sup>th</sup> – 28<sup>th</sup> February** – Scottish Marine Energy Research (ScotMER) symposium, Stirling/hybrid

**15<sup>th</sup> April** – Supergen ORE Hub Annual Assembly, Manchester

**7<sup>th</sup> – 8<sup>th</sup> May** – Marine Energy Wales Conference, Cardiff

**14<sup>th</sup> – 15<sup>th</sup> May** – All-Energy, Glasgow

**2<sup>nd</sup> October** – Global Underwater Hub Marine Energy Conference, Aberdeen

### Relevant events planned for 2026:

**5<sup>th</sup> March** – Global Underwater Hub Marine Energy Conference, Newcastle

**13<sup>th</sup> – 17<sup>th</sup> April** – Environmental Interactions of Marine Renewables Congress, Oban

**22<sup>nd</sup> April** – Supergen ORE Hub Annual Assembly, Warwick

**28<sup>th</sup> – 29<sup>th</sup> April** – Marine Energy Wales Conference, Llandudno

**13<sup>th</sup> – 14<sup>th</sup> May** – All-Energy, Glasgow

An expanded version of this chapter, with an increased number of entries, has been used in the publication of the 2025 UK Ocean Energy Annual Review, and is available [here](#).

# 05

## Appendices

Image courtesy of Minesto



## Appendix 1

# Membership of the Executive Committee

## Cabinet 2025

### CHAIRMAN

**Dr. Ir. Matthijs SOEDE**

EC DG Research & Innovation

**European Commission**

### VICE-CHAIR

**Mr. Tim Ramsey**

US Department of Energy

**USA**

**Prof. Christophe Gaudin**

The University of Western Australia

**Australia**

**Dr. Purnima Jalihal**

*Until August 2025*

National Institute of Ocean Technology (NIOT)

**India**

**Dr. Srikanth Narasimalu**

*Since October 2025*

NTU

**Singapore**

### SECRETARY

**Dr. Ana Brito e Melo**

WavEC Offshore Renewables

**Portugal**

## Delegates

COUNTRY	DELEGATE	ALTERNATE
<b>Australia</b>	<b>Professor Irene Penesis</b> University of Tasmania	<b>Professor Christophe Gaudin</b> The University of Western Australia
<b>Belgium</b>	<b>Mr. Jan Hensmans</b> Federal Public Service Economy	<b>Dr. Vicky Stratigaki</b> Ghent University
<b>Canada</b>	<b>Dr. Jinxing Huang</b> Natural Resources Canada	<b>Mrs. Elisa Obermann</b> Marine Renewables Canada

<b>China</b>	<b>Mr. Peng Wei</b> National Ocean Technology Center, SOA	<b>Mr. Wang Ji</b> National Ocean Technology Center
<b>Denmark</b>	<b>Mrs. Lærke Baun Skov</b> Danish Energy Agency	<b>Dr. Kim Nielsen</b> Ramboll
<b>European Comission</b>	<b>Dr. Ir. Matthijs Soede</b> EC DG Research & Innovation	<b>Ms Evdokia Tapoglou</b> Joint Research Center
<b>France</b>	<b>Dr. Christophe Maisondieu</b> IFREMER Centre Bretagne	<b>Mr. Benoît Augier</b> IFREMER Centre Bretagne
<b>India</b>	<b>Professor Balaji Ramakishnan</b> National Institute of Ocean Technology	<b>Dr. Purnima Jalihal</b> National Institute of Ocean Technology <b>Dr. G. Vankatesan</b> <i>Since August 2025</i> National Institute of Ocean Technology
<b>Ireland</b>	<b>Dr. Emer Dennehy</b> Sustainable Energy Authority of Ireland	<b>Dr. Brendan Cahill</b> Sustainable Energy Authority of Ireland
<b>Italy</b>	<b>Mr. Luca Benedetti</b> Gestore dei Servizi Energetici (GSE)	
<b>Japan</b>	<b>Dr. Yasuyuki Ikegami</b> Institute of Ocean Energy, Saga University	<b>Dr. Shuichi Nagata</b> Institute of Ocean Energy, Saga University
<b>Korea</b>	<b>Ms. Jae-ok Roh</b> Ministry of Oceans and Fisheries	<b>Dr. Jin-Hak Yi</b> Korea Institute of Ocean Science & Technology
<b>Monaco</b>	<b>HE Bernard Fautrier</b> Government of the Principality of Monaco	<b>Mr. Jérémie Carles</b> Fondation Prince Albert II de Monaco
<b>Netherlands</b>	<b>Mr. Sjoerd van Dijk</b> Netherlands Enterprise Agency	<b>Mr. Fonz Dekkers</b> Ministry of Economic Affairs and Climate
<b>New Zealand</b>	<b>Dr. Alona Bel-Tal</b> AWATEA	<b>Dr. Danielle Bertram</b> AWATEA
<b>Portugal</b>	<b>Prof. Luis Gato</b> Instituto Superior Técnico (IST)	<b>Prof. António Falcão</b> Instituto Superior Técnico (IST) <b>Eng. Ana Alexandra Andrade</b> Directorate General for Energy and Geology
<b>Singapore</b>	<b>Prof. Subodh Mhaisalkar</b> Energy Research Institute	<b>Dr Srikanth Narasimalu</b> Energy Research Institute
<b>Spain</b>	<b>Mr. Yago Torre-Enciso</b> BIMEP - Biscay Marine Energy Platform	<b>Ms. Dorleta Marina</b> Simply Blue Energy Ltd <b>Mr. Endika Aldaiturriaga</b> <i>Since November 2025</i> EVE
<b>Sweden</b>	<b>Mr Robert Fischer</b> Swedish Energy Agency	<b>Mr Jonas Pettersson</b> Swedish Energy Agency
<b>UK</b>	<b>Mr. Tim Warham</b> Department for Business, Energy and Industrial Strategy (BEIS)	<b>Prof. Henry Jeffrey</b> The University of Edinburgh
<b>USA</b>	<b>Mr. Tim Ramsey</b> U.S. Department of Energy	<b>Ms Judith Elaine Buck</b> US Department of Energy <b>Dr Michael Lawson</b> National Laboratory of the Rockies (NLR)

## Appendix 2

# Executive Committee Meetings

MEETING	DATE	LOCAL	COUNTRY
1	19 October 2001	Paris	France
2	21 - 22 March 2002	London	UK
3	31 October 2002	Brighton	UK
4	4 March 2003	Paris	France
5	15 - 16 September 2003	Cork	Ireland
6	26 - 27 February 2004	Lisbon	Portugal
7	4 - 5 November 2004	Copenhagen	Denmark
8	4 March 2005	Paris	France
9	16 - 17 November 2005	Brussels	Belgium
10	1 - 3 May 2006	Vancouver	Canada
11	14 - 15 November 2006	Lisbon	Portugal
12	20 - 21 March 2007	Mexico City	Mexico
13	16 - 17 October 2007	Messina	Italy
14	15 - 16 April 2008	New York city	USA
15	13 - 14 October 2008	Brest	France
16	30 - 31 March 2009	Bilbao	Spain
17	4 - 5 September 2009	Oslo	Norway
18	22 - 23 April 2010	Wellington	New Zealand
19	30 September - 1 October 2010	Dublin	Ireland
20	26 - 27 April 2011	Washington DC	USA
21	13 - 14 September 2011	Madeira	Portugal
22	17 - 18 May 2012	Daejeon	Korea
23	22 - 23 October 2012	Aalborg	Denmark
24	14 - 15 May 2013	Guangzhou	China

<b>25</b>	22 - 23 October 2013	Cape Town	South Africa
<b>26</b>	13 - 14 May 2014	Paris	France
<b>27</b>	10 - 11 November 2014	Halifax	Canada
<b>28</b>	12 - 13 May 2015	Kassel	Germany
<b>29</b>	11 - 12 November 2015	Cancun	Mexico
<b>30</b>	9 - 10 May 2016	Gothenburg	Sweden
<b>31</b>	20 - 21 October 2016	Singapore	Singapore
<b>32</b>	10 - 11 April 2017	Monaco	Monaco
<b>33</b>	14 - 15 November 2017	Chennai	India
<b>34</b>	14 - 15 June 2018	Cherbourg	France
<b>35</b>	29 - 30 November 2018	Las Palmas	Spain
<b>36</b>	26 - 27 March 2019	Riviera Maya	Mexico
<b>37</b>	2 - 3 October 2019	Dublin	Ireland
<b>38</b>	18 - 22 May 2020	Online meeting	
<b>39</b>	4 - 6 November 2020	Online meeting	
<b>40</b>	10 - 11 March 2021	Online meeting	
<b>41</b>	19 - 20 May 2021	Online meeting	
<b>42</b>	15 - 16 September 2021	Online meeting	
<b>43</b>	8 December 2021	Online meeting	
<b>44</b>	10 - 11 March 2022	Online meeting	
<b>45</b>	29 - 30 June 2022	Online meeting	
<b>46</b>	17 October 2022	San Sebastián	Spain
<b>47</b>	22 - 23 March 2023	Online meeting	
<b>48</b>	23 - 24 October 2023	The Hague	Netherlands
<b>49</b>	20-21 March 2024	Online meeting	
<b>49B</b>	18 June 2024	Online meeting	
<b>50</b>	15-16 September 2024	Melbourne	Australia
<b>51</b>	12 - 13 March 2025	Online meeting	
<b>52</b>	20-21 October 2025	Hangzhou	China

# About the International Energy Agency (IEA)

**The IEA works with governments and industry to shape a secure and sustainable energy future for all.**

The IEA is at the heart of global dialogue on energy, providing authoritative analysis, data, policy recommendations, and real-world solutions to help countries provide secure and sustainable energy for all.

The IEA was created in 1974 to help co-ordinate a collective response to major disruptions in the supply of oil. While oil security remains a key aspect of our work, the IEA has evolved and expanded significantly since its foundation.

Taking an all-fuels, all-technology approach, the IEA recommends policies that enhance the reliability, affordability and sustainability of energy. It examines the full spectrum issues including renewables, oil, gas and coal supply and demand, energy efficiency, clean energy technologies, electricity systems and markets, access to energy, demand-side management, and much more.

## **IEA Technology Collaboration Programmes**

The Technology Collaboration Programme (TCP) is a unique global network that drives cutting-edge energy technology research through international cooperation. By bringing together governments, industries, and leading experts, the TCP accelerates energy innovation and helps shape the future of energy solutions to support global energy security and economic growth.

The TCP supports the work of independent, international groups of experts that enable governments and industries from around the world to lead programs and projects on a wide range of energy technologies and related issues. These experts collaborate to advance the research, development, and commercialization of energy technologies.

For nearly five decades, since its establishment in 1975 shortly after the launch of the International Energy Agency (IEA), the program has played a key role in advancing energy technology and fostering international collaboration.

To date, 37 collaborative initiatives have been launched, covering nearly every aspect of energy technology — from renewables and smart grids to hydrogen, carbon capture, and next-generation fuels. These collaborations engage thousands of experts from approximately 300 public and private organisations across more than 55 countries. Many of the original initiatives remain active today, continuously evolving to meet emerging technological breakthroughs and global energy challenges.

[www.ocean-energy-systems.org](http://www.ocean-energy-systems.org)

