



jrlore

Joint Research Laboratory on
Offshore Renewable Energy



LEADERSHIP
ON OFFSHORE
RENEWABLE
RESEARCH

**from the
Basque Country**

www.jrl-ore.com



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About Us ———

The JRL-ORE created in 2017 is a stable collaboration formula between the University of the Basque Country, Tecnalia and BCAM that fortifies the implementation of actions aimed at reinforcing research, training and transfer in the field of Offshore Renewable Energy.

After years of collaboration, the launch of the JRL-ORE supposed the normalization of a continuous teamwork, because none of research groups would have arrived to where it is, or had created such promising advances on their own. We need each other.

The JRL-ORE has allowed us to go one step further in sharing knowledge, with the commitment to work together.

JRL-ORE in numbers

(2022-2023)



64
Researchers



83
Indexed publications
(27 in Q1, 29 JRL-ORE
co-publications)



+60
Trained students
(TFG/TFM/ master REM+)



6
PhD thesis
(+9 ongoing)

Technologies & Products

The activity of the Joint Research Laboratory on Offshore Renewable Energy covers **EIGHT TECHNOLOGIES, or AREAS OF KNOWLEDGE.**

Each of these offshore renewable technologies, has a specialized researcher in charge.

Transversally to the technologies, we have developed **SIX PRODUCT or SERVICE CATEGORIES** on which we focus our research efforts and which we make available to the industry.

This catalogue has been designed to **COVER ALL STAGES OF THE OFFSHORE RENEWABLE ENERGIES PROCESS.** From the initial phases, with the generation of innovative concepts, research and selection of innovative materials and mathematical models designed to optimize the useful life and reduce costs, through the implementation of floating structures and offshore renewable systems, test campaigns in laboratory and open sea and finally the grid integration of offshore renewable energies.



Power & Energy Systems



Applied Mathematics/Data Analytics



Power Electronics



Control Engineering



Materials



Marine Geology



Fluid Dynamics



Mechanics

INNOVATIVE CONCEPTS



— Generation, modeling and evaluation of **innovative concepts** [TRL1-4] to reduce costs and increase the useful life of offshore renewables



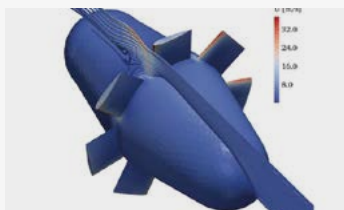
INNOVATIVE MATERIALS



— **Innovative materials** and components in the marine environment [TRL6-9]



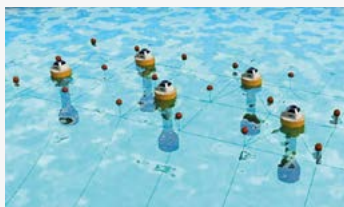
MATHEMATICAL MODELS



— Intelligent **mathematical models** based on data for offshore renewable structures and their interaction with the marine environment



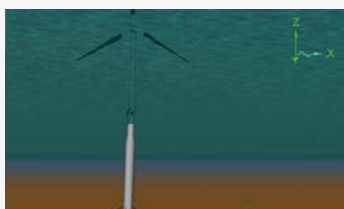
FLOATING STRUCTURES



— Design, optimization and control of **floating structures** and offshore systems, including anchoring, umbilical cable, operations at sea, layout and floating solar



TEST CAMPAIGNS



— Planning, monitoring and support of **test campaigns** in laboratory and open sea [TRL3-6]: wave, tidal, offshore wind and cross-cutting



GRID INTEGRATION



— Conversion, transmission and **grid integration** of Offshore Renewable Energy

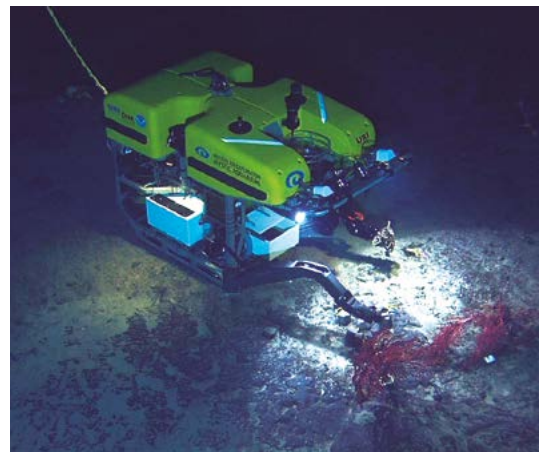


ROVing the last frontier

Although the Oceans present a huge potential for generating renewable energy, they still remain as the last frontier for exploration, and ROVing in their depths still presents huge technological challenges. ROVs (Remote Operated Vehicles) and AUVs (Autonomous Underwater Vehicles) are one of the most important tools for underwater work and exploration. ROVs and AUVs are used in a wide spectrum of applications: laying communications and power cables in the seabed, seafloor geological survey, marine life research, cleaning of biofouling on ship hulls, monitoring of fishing nets or visual inspection of underwater infrastructure are tasks performed by ROVs. ROVs already undertake a wide variety of work in the offshore industry and can work in competition or collaboration with divers, improving the safety of their missions in many cases. In the specific case of offshore wind power, seabed characterization for GW-scale developments presents significant challenges in terms of cost, time, and availability of assets (vessels and equipment). This information is generally required well before financial commitments are established. Today, full characterisation at each foundation location is considered prohibitive, and seabed characterisation efforts are commonly subject to significant de-scoping to reduce cost. The challenge is



The submersible vehicle MARUM-QUEST is lowered into the water from the stern of the RV METEOR © MARUM - Zentrum für Marine Umweltwissenschaften, Universität Bremen; V. Diekamp (<https://www.marum.de/Entdecken/Technologien.html>). CC-BY-4.0



ROV Hercules © Mountains in the Sea Research Team; IFE Crew; and NOAA/OAR/OER (<https://www.flickr.com/photos/noaaphotolib/5424616529/in/photostream/>). CC BY 2.0 DEED.

"Mountains in the Sea Expedition 2004. The ROV Hercules recovers the basalt recruitment block experiment that was deployed by the DSV Alvin submersible in 2003. New England Seamount Chain"

in finding the optimum balance of cost, schedule and risk in both the selection of foundation types and the characterisation of the seabed geotechnics, but new developments in design, operation and sensing in ROVs can bring considerable cost reductions for future floating offshore wind developments.

In the last years, many heavy and light work class ROVs, and micro ROVs can be found in the market. Heavy Work class and ultra heavy duty commercial ROVs service primarily oil and gas operations. Their power range is 150-250 kW and their weight can exceed several Tons. They can operate usually down to 3000 m, with some able to handle depths of 6000 m. Conventional work class ROVs, with power range up to 100 kW weight around one Ton and they can carry payloads, including robot manipulators of approximately 50-700 kg. in the last year, a great variety of compact small electric ROVs with power range below 15 kW, with a depth rating below 900 m and payload capability less than 200 kg have widened the scope of applications available in the market. Small ROVs with no manipulators and a cost in the range of 10-100 k€ can still perform many visual inspection and sensing applications.

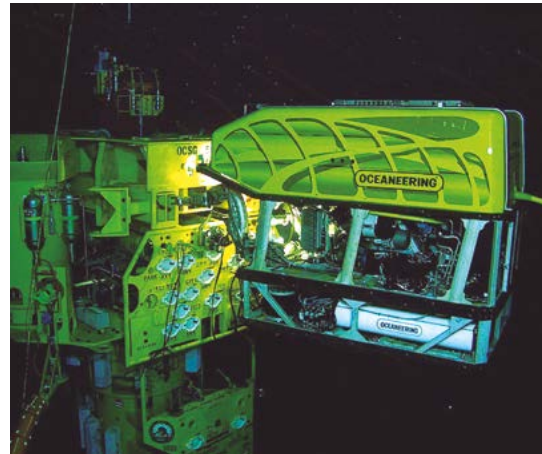
Power and communication underwater are very challenging tasks and most unmanned underwater vehicles require a tether to provide power and communications with the human

operator on the deck or onshore. To tackle this challenge, **the JRL-ORE is developing a PhD. thesis on underwater contactless power transfer for charging batteries underwater. The development of this type of technology can open the gate to resident ROVs.**

A ROV always requires additional systems such as a control room, in most cases housed in some form of shipping container located on the support vessel, on a dock or platform or onshore. The system also needs some sort of launch and recovery system (LARS). For small ROVs the operator can do this manually by pulling the tether, but work class ROVs require cranes, with drums and slip rings to power data and power. The ROV also requires a deck cable, an umbilical and a tether. The deck cable connects the control room with the LARS. The umbilical cable is a very long heavy-duty, armoured cable, stored in the LARS' winch drum. This umbilical serves as the power and communication cable, but it must also operate as the lift wire able to support the weight of the ROV. Work class ROVs are usually lowered using the crane and the umbilical inside a garage. The tether is a shorter and flexible cable that allows the ROV to roam around the garage. The tether requires a tether management system (TMS) to avoid excessive drag, tangling with objects and other problems.

Designing, building, servicing and operating ROVs are demanding tasks that require a highly skilled workforce, and they can offer value added careers. However, there is a lack of trained personnel for the marine industry, and this can become a bottleneck in the development of future offshore renewable power plants. The **JRL-ORE has experience in operating ROVs** and is currently immersed in a project for the promotion of STEAM careers oriented to marine engineering and science with a program of ROV building workshops and a ROV competition, the URPEKARI Hackathon. Kids and teenagers build their own low cost ROVs from material available in their nearby hardware store and try to perform several tasks in a swimming pool emulating offshore operations such as laying a cable, removing plastics from the ocean or following a track in order to reach a specified destination. With this project, the JRL-ORE hopes that the enrolment in engineering and marine careers in the next years improves somehow.

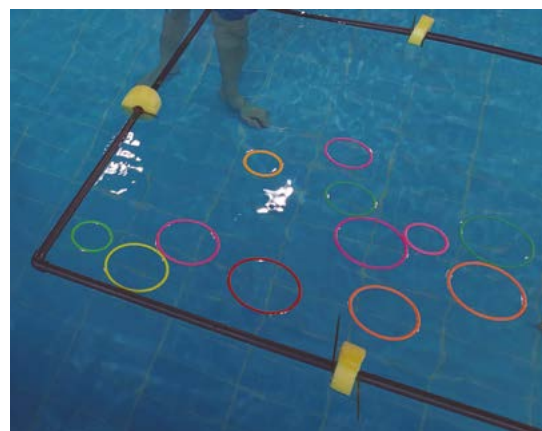
In cooperation with JRL-ORE, a group of students in the Engineering School of the University of the Basque Country in Bilbao has created URPEKARI, a student association for the promotion of extracurricular and multidisciplinary activity among UPV/EHU students with special interest in the development of underwater robotics.



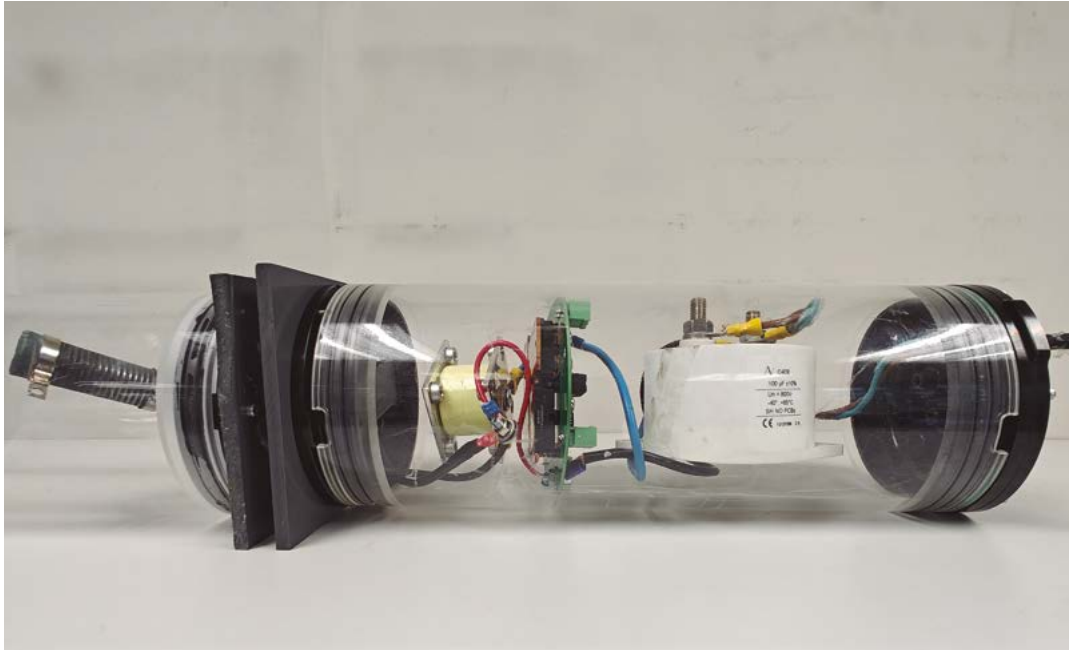
Donated to the public domain by the Vice President of Oceaneering Mr. Duncan McLean https://es.m.wikipedia.org/wiki/Archivo:ROV_working_on_a_subsea_structure.jpg



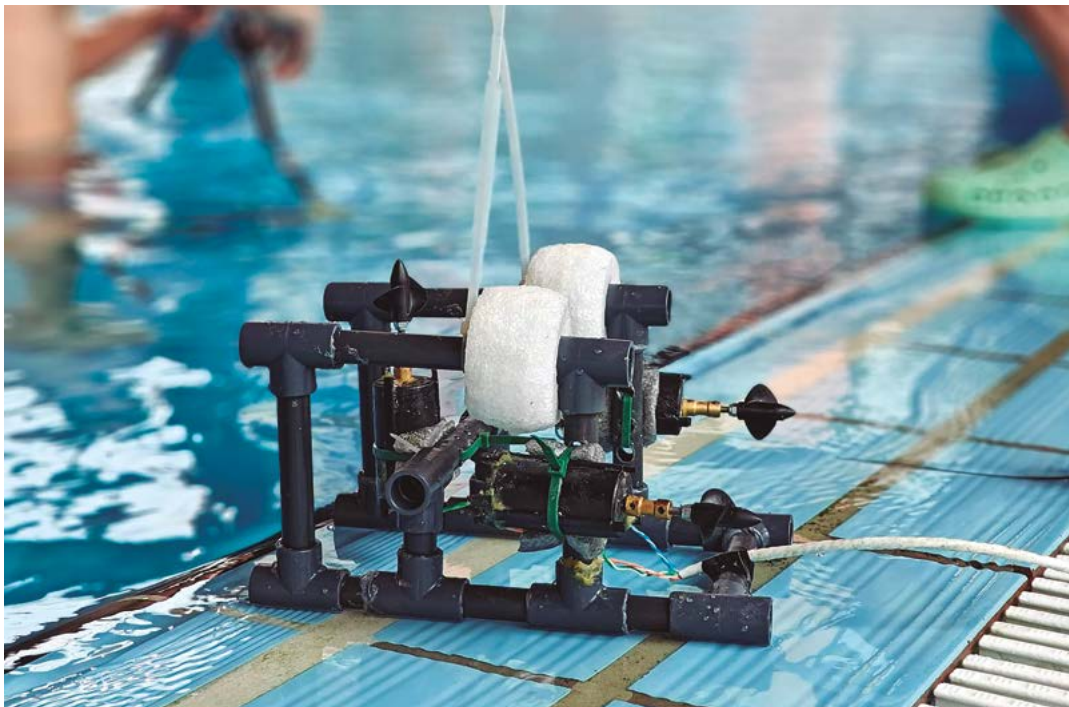
Lett brønnintervensjon – RLWI © Leverandør FMC Technologies <https://ndla.no/image/26?> CC BY-SA 4.0 DEED "Light well intervention – RLWI"



ROV competition URPEKARI Hackathon 2024.



Underwater contactless power transfer prototype developed by the JRL-ORE.



ROV competition URPEKARI Hackathon 2024.

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*UPV/EHU Electronic
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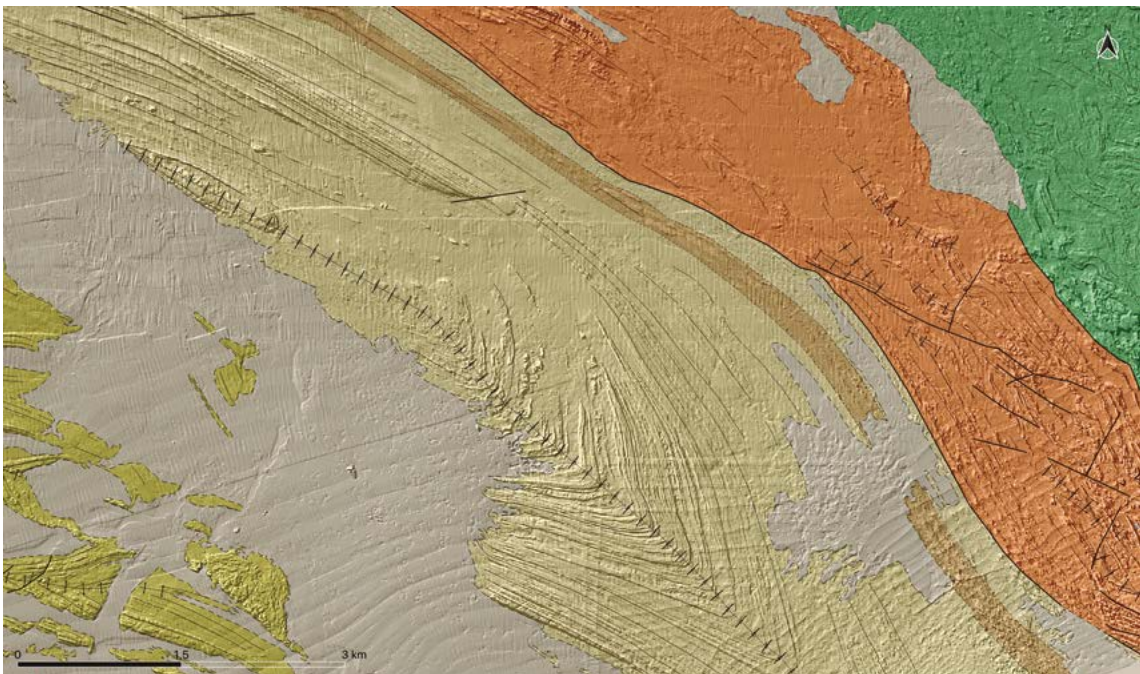
The role of geology in offshore renewable energies _____

Marine geology is an important factor that conditions the uses that humans make of the earth's seas. Issues such as the extraction of energy resources, the underwater mining or even the establishment of the maritime borders of states, are some examples of activities that depend to a large extent on marine geology and that serve as drivers for the advancement of knowledge in this discipline.

The impact of geology on offshore renewable energies can be considered to affect in two ways. On the one hand, geohazards determine which areas are suitable for the location of marine renewable energy farms. These geohazards may be due to earthquakes,

tsunamis, volcanoes, submarine landslides, fluid activity or sediment migration. On the other hand, once the offshore sites have been chosen, the type of seabed will constrain issues such as the distribution of the energy extraction devices and the type of foundation, as well as the routing of the cables and the location of the infrastructures necessary for energy export.

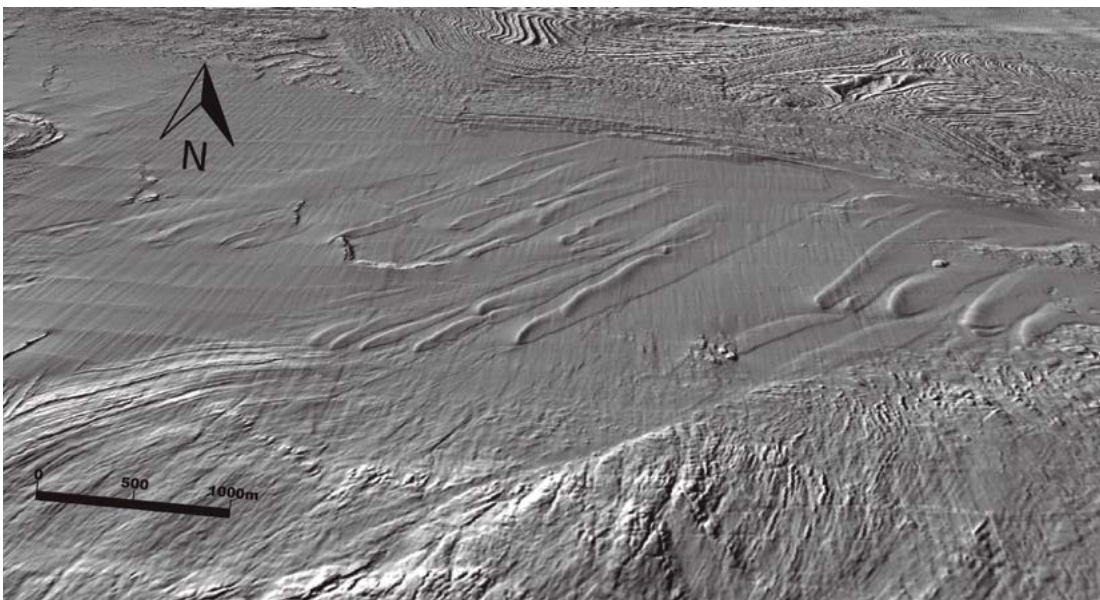
One of the first steps in planning an offshore renewable energy farm is the preparation of a desktop geological study, in which all available seafloor and sub-surface information will be integrated. Geological and geomorphological maps of the site are an important part of this study. Once



the general geological features are known it is time to develop a detailed geophysical and geotechnical survey, with a methodology appropriate to the conditions of the site and the needs of the developer. Proper planning of this part of the project can lead to considerable savings in the initial design and installation phases of offshore renewable energy farms.

The geophysical and geotechnical surveys will combine several remote sensing techniques and on-site field works. For example, it should include a high-resolution bathymetry of the entire site, to generate a digital terrain model from which to draw up an initial characterization of the type of seabed,

distinguishing between rocky sectors and those covered by unconsolidated sediments. Furthermore, sonar acoustic backscatter data can be used to classify bottom sediments. The backscatter sediment classification must be validated with direct observations of sediment type. This will require bottom sampling, either by divers or by drilling and coring systems. The next step will be to carry out seismic profiling to understand the distribution and structure of rocks and sediments under the seabed. There are different seismic reflection systems that can be used depending on the information to be obtained. Seismic profiles can be used to determine the thickness of unconsolidated sediments, locate areas of alteration in the rocky



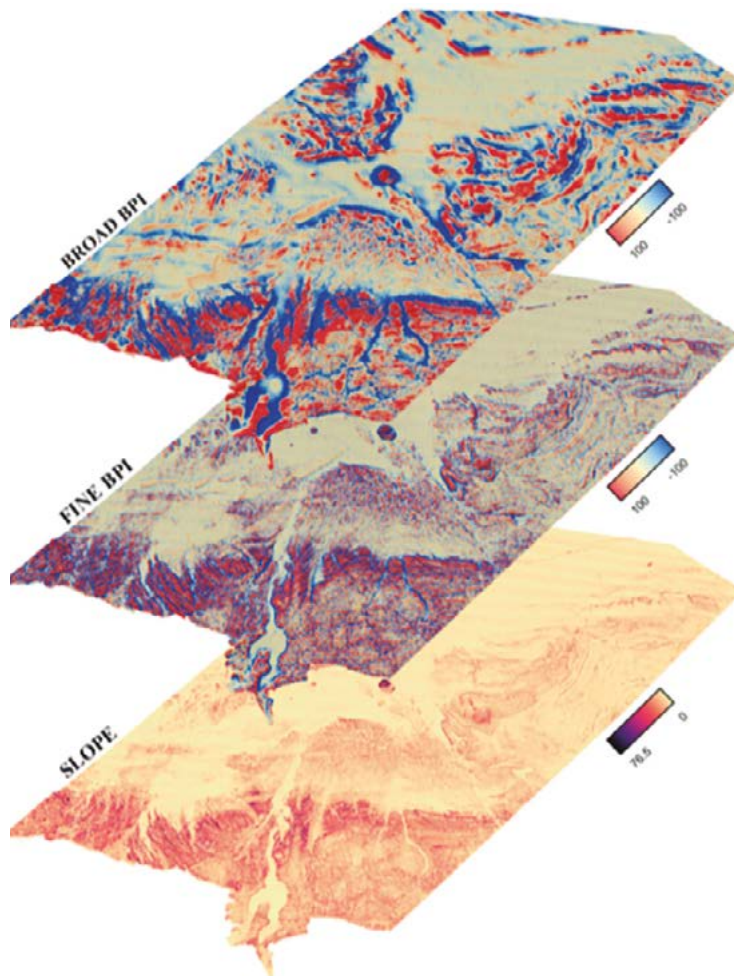
Underwater sand dunes off the shores of Bizkaia

substrate or identify seismic anisotropies in rocks and sediments. Properly interpreted, these anisotropies can reveal the presence of structures such as folds and faults or provide information on sediment mobility.

One of the main challenges of marine geology, which also affects the development of marine renewable energy farms, is to have time series of data and to be able to obtain as much data as possible, of the best quality, at the lowest cost and as quickly as possible. The time series of data are particularly important for assessing the environmental impact of anchorages, moorings and cables on the seabed and for assessing the mobility of sediment around the submerged infrastructures of the farm. Related to this issue, *during the project REDISH, funded by Euskampus Fundazioa and devoted to studying the relationship between sedimentary dynamics and hydrodynamics on the continental shelf of the Basque Country, researchers from the geology group of the JRL-ORE developed geological and geomorphological maps of the BiMEP test site, to create a tool to study the mobility of sediment in the area.*

Finally, it should be noted that the continuous improvement in technologies for obtaining bathymetric and seismic data, in bathymetric LiDAR, in image processing and especially the

development of autonomous platforms such as ROVs, AUVs and USVs, with which data collection can be automated, open up a promising future for the study of the seabed and its application in offshore renewable energies.



Bathi-morphological maps used for geomorphological mapping and sediment mobility analysis in BiMEP

MARINE GEOHAZARDS:

Earthquakes. Caused by a rapid release of energy due to the rupture of faults in the Earth's crust and upper mantle. The propagation of seismic waves can affect structures attached to the seafloor, and can also trigger destructive tsunamis.

Volcanoes. Due to magma rising through the earth's crust to reach the surface. The risk associated to volcanic eruptions in the sea includes lava flows that will modify the seabed surface, ash clouds and pyroclasts and may also cause tsunamis.

Tsunamis. A tsunami is formed by a sudden displacement of a large volume of water which generates a succession of extremely long wavelength waves that increase their height when they reach shallow waters. Tsunamis may be triggered by earthquakes, volcanic eruptions, submarine or onshore landslides, and even by meteorite impacts.

Submarine mass movements. The failure of large areas of the seafloor can create large mass movements, several orders of magnitude larger than any onshore mass movements. Rapid sediment migration, fluid remobilization, earthquakes, big storms, volcanic eruptions or even anthropogenic activity can trigger submarine mass movements.

Fluid activity. The migration of fluids -Water released from underlying sediments, gasses generated by biogeochemical processes or hydrothermal activity- can reach the surface escaping along faults and fractures or create overpressure in certain sectors of the sediment column that eventually could cause failure of the seafloor.

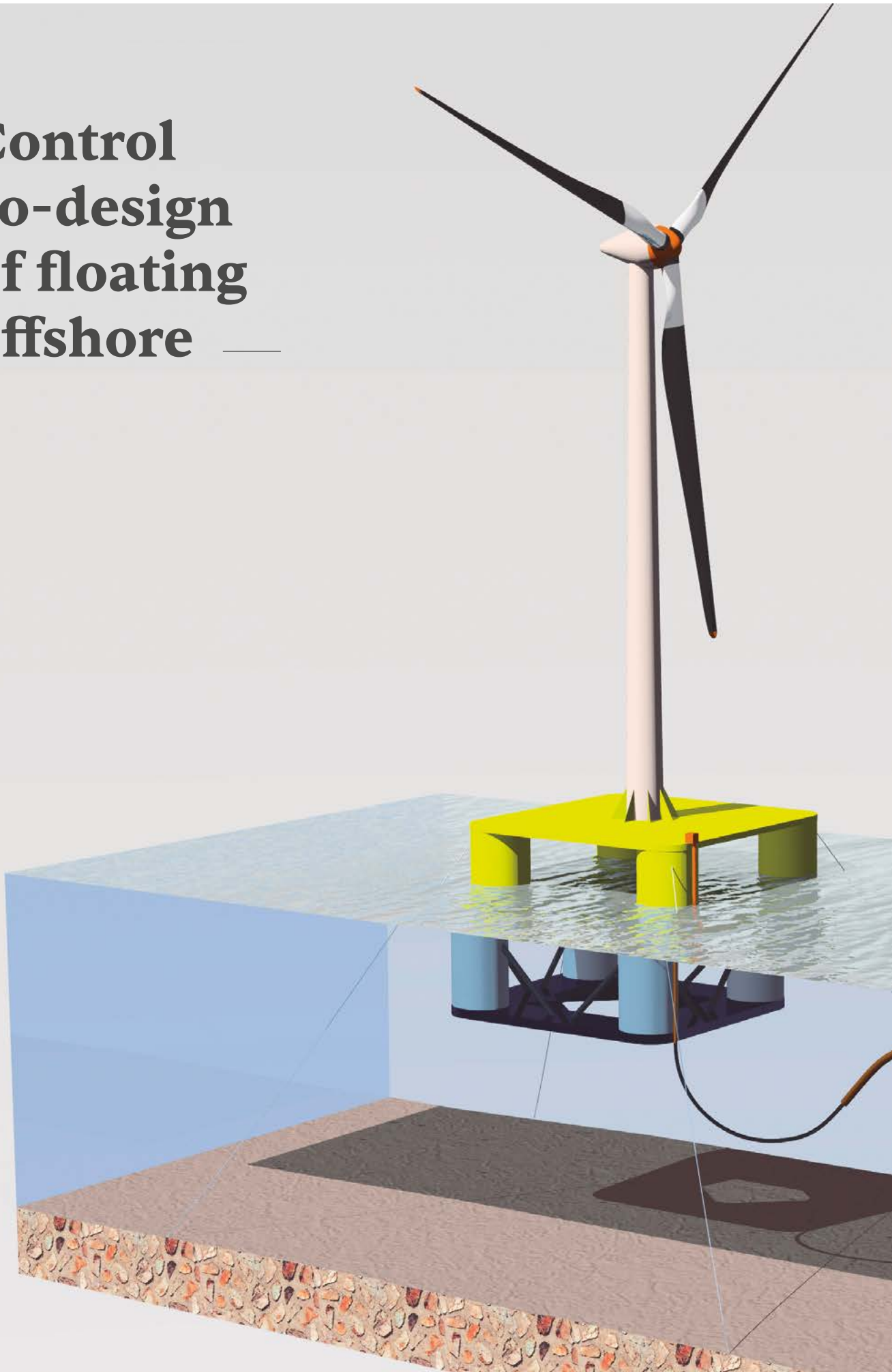
Migrating bedforms. The mobility of sediments by bottom currents over the seafloor produces migrating bedforms similar to dunes in a desert. The movement of these bedforms may affect the submerged infrastructures, such as submarine cables and pipelines.

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NÉSTOR VEGAS

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Control co-design of floating offshore



The offshore wind market has grown significantly in recent years, with the total installed capacity reaching over 57.6 GW by the end of 2022. GWEC expects 130 GW of offshore wind capacity to be added globally between 2023 and 2027.

With 80% of the world's offshore wind resource potential in areas with a water depth of more than 60 metres, GWEC market intelligence forecasts the floating offshore wind market to reach 16.5 GW by 2030.

Wave energy had a global installed capacity of 25 MW in 2022. Although far from offshore wind numbers, a huge research effort and investment will allow the final technology deployment.

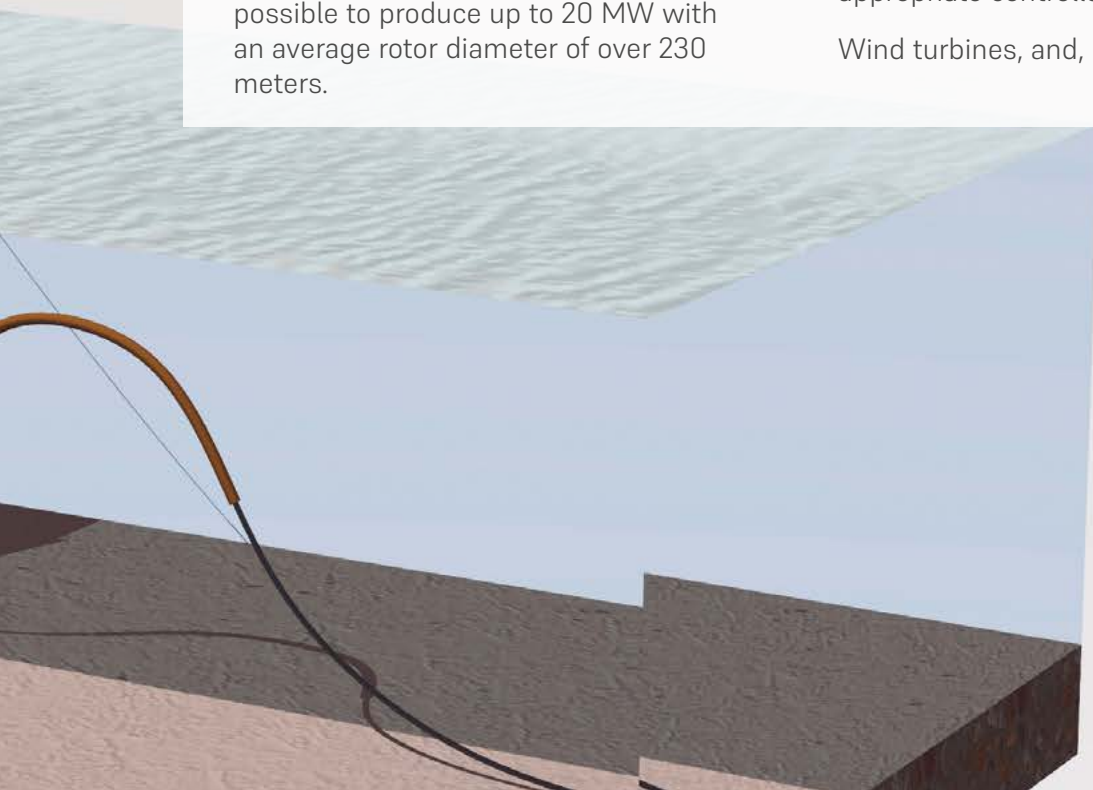
In the case of offshore wind, to reach these numbers implies increasingly larger turbines. Hub height, rotor diameter and power rating continue to grow. Offshore wind turbines have passed from an average rotor diameter of approximately 148 meters and a power rating of 5.5 MW in 2018 to 15 MW in 2023. It is expected that between 2025 and 2030, new designs of these turbines will make possible to produce up to 20 MW with an average rotor diameter of over 230 meters.

For both technologies to play a leading role, it is necessary to accelerate their commercial deployment through the development of innovations that lead to cost reduction. One way is the optimisation of designs; the other, supply chain development.

Traditionally, the design of floating wind turbines and wave energy converters has been carried out sequentially, starting from a structural design and considering control only in the last phases of the design. Thus, each design stage is restricted by the previous stage and the controllers developed in the last stage (wind turbine, energy extraction system, active ballast...) have a limited impact on the optimisation of the complete system.

Although sometimes control systems are considered the "hidden technology", those are a key part in any modern industry, going hand by hand with electronics and Information Technology advances. Quality of products and services, longer life of the machines and improved performance are some of the benefits obtained by the use of appropriate controllers.

Wind turbines, and, in particular, offshore



wind turbines are not an exception, and several control systems are used to maintain the stability and productivity of wind farms. Therefore, the development of advanced control technology applied to Floating Offshore Wind Turbine (FOWT) industry is one of the ways of improvement necessary for getting suitable and profitable FOWT farm deployments.

In parallel with this development, a new design concept is gaining attraction recently: Control Co-Design (CCD). Since the impact on the performance of control strategies can be significant, to consider the effect of control in the early stages of the overall design can lead to innovative results, enhancing the construction and lowering costs, while increasing the machine's lifetime and productivity, in a holistic way.

This idea is being boosted by ARPA-E programs in USA, and powered by NREL in several projects, such as the Wind Energy with Integrated Servo-Control (WEIS) project based on the use of a system level optimiser, which aims to obtain promising plant topologies by introducing a control optimisation loop in the design cycle.

Control co-design is the central idea of the **Elkartek project KONFLOT**. The objective is the generation of knowledge and integral design techniques for floating renewable energy devices, including floating wind and wave energy converters. **The main goal of**

this project is to establish a design methodology that considers the different subsystems, their dynamics and interactions, and the performance of the available controls, from the first phases of the design. This concurrent design process will give rise to groundbreaking alternatives that could not be achieved in sequential design processes, replacing the concept of mass with control and reducing costs. The performance of the controls is the design driver to obtain breakthrough design alternatives that allow the reduction of loads and LCOE.

In the floating wind energy case study, several traditional control strategies, as PID structures, and advanced ones, as Non Linear Model Predictive Control, are implemented within an optimisation problem for adjusting structural variables in FOWT. This allows to reduce the overall cost while maintaining the performance and fatigue limits. The main result of the project is the validation of the proposed CCD strategy, given a valid procedure for the design of innovative FOWT devices.

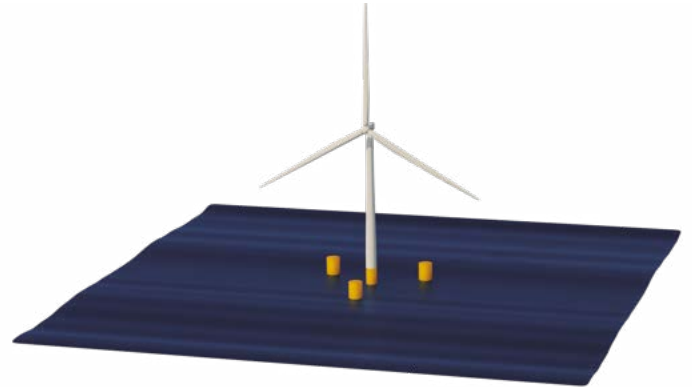
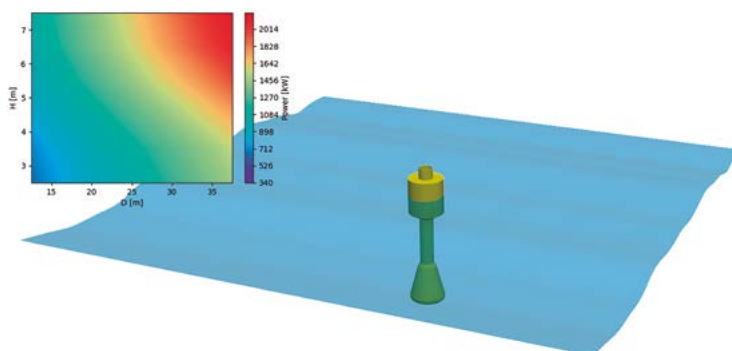
For validation purposes, a software tool and a framework have been developed, allowing the initial test of the optimisation process, with the CCD strategy.

Future advances in this Elkartek project will be focused on the improvement of the CCD process with innovative and computationally better optimisation techniques, extending the search range of

the optimisation to more machine design parameters and advanced configuration control techniques, applied in different levels, which will allow to maximise the benefits.

In the case of wave energy, the technology is still in an early stage of development. Thus, the CCD will allow the leap from small, individually validated devices, to pre-commercial farms of a few units, which will lead to the necessary cost reduction to demonstrate their economic viability.

Such leap is achieved by the use of advanced spectral controllers that enable maximising the energy generation from a wave energy converter (WEC). In addition, the spectral method is particularly interesting due to its low computational cost. Hence, the controller can be incorporated into the CCD loop in order to optimise the different geometrical characteristics of the floater, the power take-off system or mooring lines. Such a novel design methodology has been implemented within the KONFLOT project, providing an effective tool for the design of the next generation of innovative WECs.



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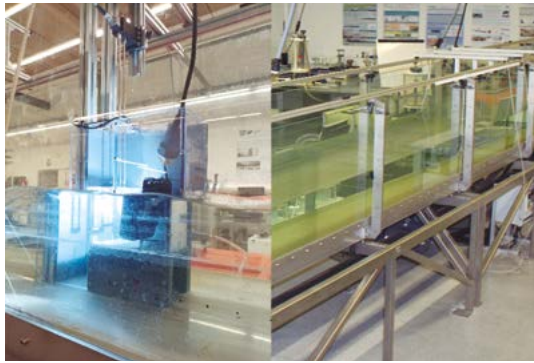
UPV/EHU Automatic Control and Systems engineering department

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MARKEL PEÑALBA

Mondragon University full lecturer & Ikerbasque Research Fellow

Test Facilities

UPV/EHU FLUME



Physical scaled model of OWC Mutriku Wave Energy Converter in the UPV/EHU flume.

The multipurpose upgraded wave flume (2D wave flume 25 m long, 0.60 m wide and 0.7 m high) of the Department of Energy Engineering – UPV/EHU allows to perform experimental tests on wave interaction with physical scaled models at low TRL design state, in diverse marine engineering fields (e. g. Offshore Renewable Energy – ORE). The facility has been updated with the capacity of producing irregular wave spectra (with AwaSys7 software) and tracking motion of floating structures by Qualisys optical system. Apart from the description of the phenomenon, the wave flume enables the validation of numerical models (CFD) with the potential capacity of describing the phenomenology in real scale prototypes. Some typical devices and phenomena under test are: overtopping in ORE structures, performance of different types of Wave Energy Converters (WEC) and the characterization of the wave dissipation and reflection in different marine structures. In addition, Tecnalia is developing in collaboration with UPV/EHU an innovative concept known as “wave-box” where wave-structure interaction is studied by inducing the relative motion with a controlled moving tank.

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GUSTAVO ESTEBAN

*UPV/EHU Energy
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ELECTRICAL PTO LAB



A turbine emulator to reproduce the mechanical output of a wave, tidal or wind energy device. It is aimed at validating the electrical configuration and **research on control strategies. At the moment, research on predictive maintenance of electrical generators subjected to variable and high loads as in wave energy is being carried out within the VALID project.** The stator winding insulation failure is the most relevant fault cause of electrical generators. An intense test campaign including variable input with peaks up to 2 times the nominal power of a completely sensorised generator allows to understand the degradation process of the insulation and research on methodologies to estimate the remaining useful life as well as increase the life expectancy through adaptative controls.

This knowledge also allows the proper sizing of the generator as a high rated power in order to allow high peaks would imply the generator working at low efficiency for most of the time; while a too low rated power aimed at working in a higher efficiency area would lead to a fast degradation of the insulation.

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JOSEBA LOPEZ-MENDIA

*TECNALIA Offshore
 Renewables Researcher*

HARSHLAB



The laboratory for testing materials and components in offshore environments (HarshLab) has successfully completed its first year of operation in the hostile environment of the Bimep renewable energy experimentation area, 1,5 miles off the coast of Bizkaia, in the Bay of Biscay. During this time, activity in the HarshLab has been frenetic, with tests being carried out not only on new coating systems that are more resistant to corrosion and fouling (eg. NEMMO, NEWSKIN projects), but also with tests that go beyond the field of materials. Thus, during this time it has been possible to carry out unique tests, such as those of two turbines at the scale of a wave energy generator (Arrecife Systems), different systems of sensorised gauges (Inalia, Lumiker), a novel corrosion monitoring system (Vicinay) or an echo sounder for measuring biomass under floating structures (Fundación Azti, at SAFEWAVE project), among others. All of them concluded offering valuable results on the viability of the different technologies tested, and demonstrating once again that the possibility of carrying out tests in a real offshore environment is a competitive advantage for our clients.

In addition to customer trials, this first year at Bimep has been a real test of its survival for the HarshLab, which has successfully withstood the heavy swells that hit the Bay of Biscay during the winter. Thus, it is of vital importance to control the behaviour of the mooring lines that anchor the laboratory to the seabed, 65 metres underwater. To this end, we have monitored the state of the mooring lines with a small ROV that allows us to descend safely to the seabed, as well as the design and execution of tests on mooring line components and umbilicals.



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TECNALIA Materials for Extreme Conditions researcher

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JOSEBA LOPEZ-MENDIA
TECNALIA Offshore Renewables Researcher

Data management

The Basque Country Government has recently made a significant investment in the Atlantic Data Infrastructure (ADI), marking the establishment of the largest, cutting-edge data center for the Atlantic region. Situated at the Ezkerraldea-Meatzaldea Campus of the Science and Technology Park of Bizkaia in Abanto-Zierbena, ADI is more than just a data center – it represents a zero kilometre system with state-of-the-art digital technology deeply rooted in the Basque Country. Born out of a fruitful collaboration between the public and private sectors, ADI aims to provide a ‘close, reliable, and cost-effective’ alternative for the industrial landscape of the Basque Country.

In harmony with the strategic vision of the Basque Government, TECNALIA is leading the development of a TECNALIA DIGITAL PLATFORM TDP Big Data Lab. This innovation hub is dedicated to crafting sophisticated artificial intelligence models tailored to tackle real-world challenges. Whether it's optimising day-to-day decision-making, maintaining robust systems and services, or refining planning strategies, TECNALIA DIGITAL PLATFORM is committed to delivering practical solutions. By embracing cutting-edge practices like Big Data, DevOps, and cloud technologies,

TECNALIA empowers businesses to thrive, always guided by a dedication to excellence and innovation. Within THE TECNALIA DIGITAL PLATFORM, TECNALIA is currently implementing Tecnalía Data Lab TDL , a shared high-quality data platform to train and validate data-based models; in the next few months, TDL will be coupled with Tecnalía Compute Platform TCP, a HPC platform for training the models and later Tecnalía Research Cloud TRC will be implemented as a platform where to host and develop algorithms based on Generative Artificial Intelligence.

The digital transformation in the offshore renewable energy sector mirrors the strides made in the development of these data infrastructures. For instance, TECNALIA's HarshLab stands as a unique facility designed for testing components in offshore renewable energy assets. It not only collects and analyses data but also employs post-processing techniques to construct digital twins, demonstrating a forward-thinking approach to the digitalization of the sector. The HarshLab will be fully integrated with TDL, TCP and TRC in order to increase the meaningfulness and data robustness of the experimental campaigns in the

RESOURCES OF SUPERCOMPUTATION AT UPV/EHU:

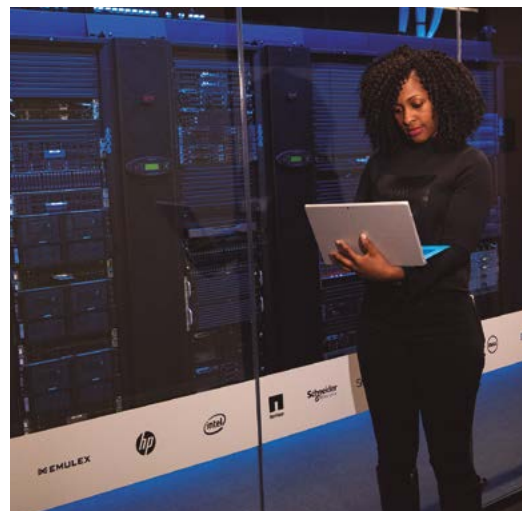
JRL-ORE has complete access to the super computation resources of the UPV/EHU Scientific Computing Service (IZO-SGI), mainly used for CFD calculations (STAR-CCM+ available). The service applies new tendencies in HPC (High Performance Computing) with the cluster “**Arina**” featuring 147 nodes, which provide 196 multicore processors (CPUs) containing a total amount of 4396 cores, and a total net storage capacity of 120 TB. The nodes are connected to each other via Infiniband network characterized by high bandwidth and low latency or internode communications (100 Gb/s EDR). The regular node characteristics are Xeon type of 192 MB RAM and processor base frequency of 2.10 GHz (20 cores per processor and 2 processors per node). The system contains 4 GPU Nvidia Tesla K40m featuring 2880GPU cores and 12 GB of integrated GPU RAM each. In addition, JRL-ORE owns at UPV/EHU, available for its particular use 3 Workstations with the following particular characteristics: Processor Xeon with 28 nodes with base frequency of 4.8 GHz and GPU Nvidia RTX featuring 48 GB of integrated RAM for GPU acceleration of CFD simulations.

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GUSTAVO ESTEBAN

UPV/EHU Energy Engineering department

Resources of supercomputation at BCAM:

BCAM has recently updated its own HPC cluster, named **Hipatia**. It consists of 18 nodes, with one provided with GPU Nvidia Tesla K40, and 2 storage nodes and 4 terabytes for RAM Connection Infiniband. BCAM also can count with 21 specific nodes in the Donostia International Physics Centre (DIPC) and one GPU NVIDIA QUADRO EDU RTX8000. It is expected that in the following months the number of dedicated nodes in DIPC cluster, named **Hyperion**, will be increased.



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VINCENZO NAVA

*TECNALIA Offshore Renewables Researcher / Energy, Climate and Urban Transition
 BCAM Researcher*

Dissemination activities

MARINE ENERGY CONFERENCE

The first Marine Energy Conference was celebrated in 2014, before the creation of the JRL-ORE. By that time, researchers of the three institutions had started the collaboration in the field of Offshore Renewable Energy and have regular contact within the Euskampus pole of knowledge “Renewable Energies in the Marine Environment”.

We decided to get together researchers from the different groups to share our projects, the latest advances of our PhD students and have fruitful discussions about further collaborations.

We called it **Dissemination conference of projects in marine renewable energies**, and even if it was open to public, only researchers from TECNALIA, University of the Basque Country and BCAM participated in it, and there were very few attendees from outside these 3 entities.

And as the collaboration between the groups increased, we went a step further and created the JRL in 2017.

At the same time, we started collaborating in the training of new Offshore Renewable professionals through the REM master.

We then decided to open the conference to new researchers and companies, and the IX. edition was held in June 2023 with more than 80 attendees of around 20 institutions.



EWTEC 2023

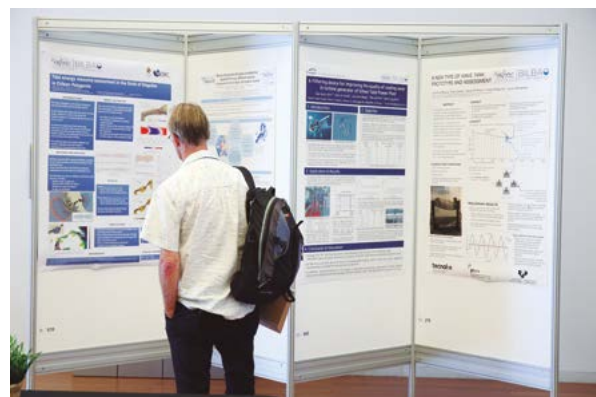
The University of the Basque Country (UPV/EHU) through the ‘Bilbao School of Engineering’, the first modern faculty of engineering in Spain, was delighted to be hosting the 15th European Wave and Tidal Energy Conference on 3rd to 7th September 2023.

With a record of 382 attendees and 382 submitted abstracts the programme counted on the following activities:

- Oral sessions with a total amount of 236 presentations
- 18 Posters
- 2 Keynote speaker sessions one with a scientific-oriented profile (Prof. Iñigo Losada, from IH Cantabria) and the other one representing the industry sector (Dr. Andrew Smith, Orbital Power).



- A presentation of the JRL-ORE by its Scientific Director Dr. Eider Robles.
- Technical meetings, such as the Executive Board and Technical Committee meetings.
- Technical visits, with 62 attendees to the Mutriku Wave Power Plant and 95 attendees to the testing area of BIMEP
- A total of 9 side events from the following institutions: Alliance for Sustainable Energy LLC (NREL and Wave Energy Scotland), University of Edinburgh, EVE (Basque Energy Agency), Alliance for Sustainable Energy LLC (NREL, SANDIA LAB – TPL TEAM), Ocean Energy Europe, AZTI and WavEC, Alliance for Sustainable Energy LLC (SANDIA LAB – WEC-SIM TEAM), Ocean Energy Systems and Coastal Science Division-PNNL, SUPERGEN-ORE HUB - University of Plymouth.
- 5 exhibitors: “SafeWAVE project” by AZTI and WavEC, “Supergen ORE Hub Wave and Tidal Energy research and opportunities” by SUPERGEN-ORE HUB - University of Plymouth, “INTERTEKWATER AND ENERGY” by INTERTEK, TADEK OCEAN ENGINEERING and SPRINGER
- Social events, such as the Regatta, the Welcome reception at the Olatua, Pintxos route, Track Directors dinner, Gala dinner at the Guggenheim Museum with a special tribute to Prof. António Falcão, Executive Board dinner, and Sailing through the river of Bilbao.



Tecnalia 20 years in offshore

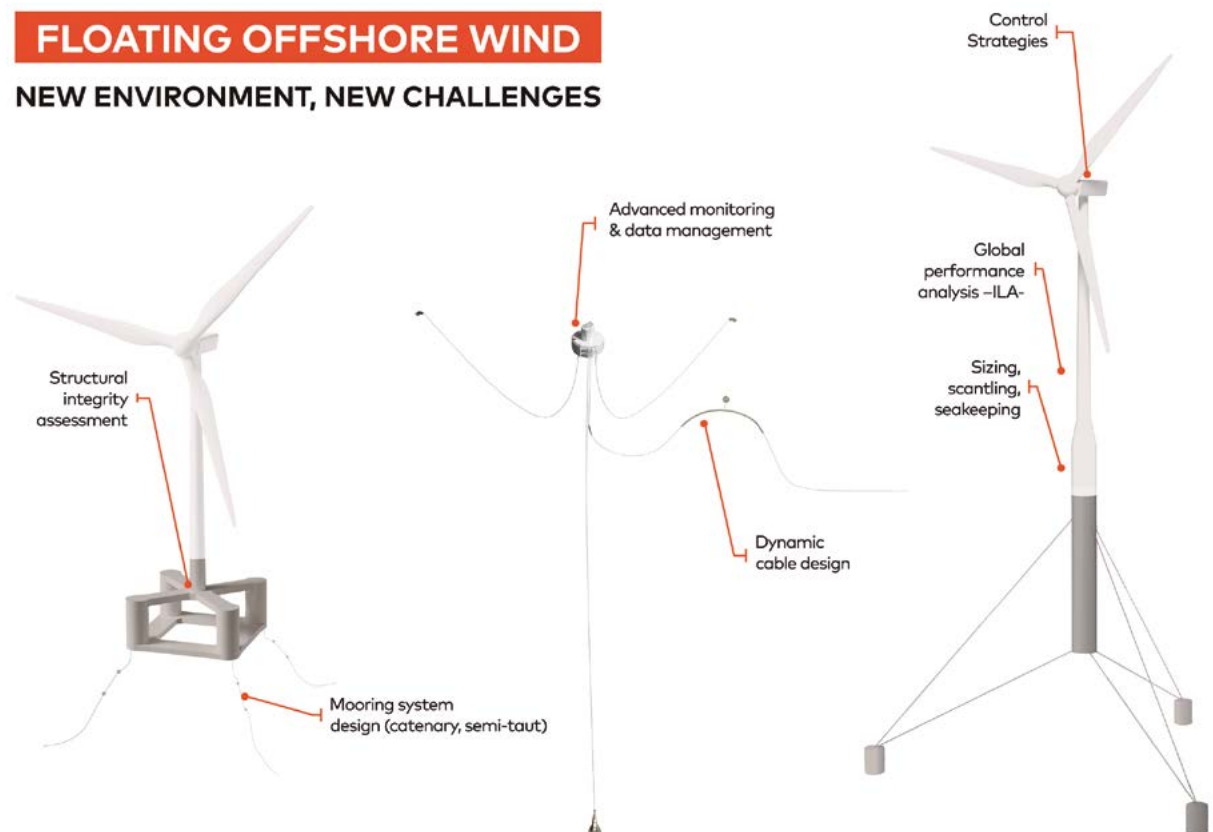
Offshore Renewable Energies are key to achieve the ambitious goal of a climate-neutral Europe by 2050. However, its economic viability depends on reducing manufacturing, installation, operation and maintenance costs.

TECNALIA celebrates 20 years of research activity in the offshore renewable energy sector.

Design and optimisation of technological solutions for offshore renewables (floaters, mooring systems, control algorithms, power cables).

- **Advance calculation techniques** in hydrodynamics, aerodynamics, integrated load analysis and structural integrity.
- **Physical testing in controlled environment** (reduced scale) and real operating conditions, with calibration/ correlation of numerical models.
- **O&M based on assets digitalization** from smart monitoring and data acquisition systems, to AI algorithms.

FLOATING OFFSHORE WIND NEW ENVIRONMENT, NEW CHALLENGES



European Researchers' Night and Schools' programme 2024-2025

JRL-ORE is a scientific community composed of researchers with a passion for science and a determination to improve society's knowledge on climate change effects and offshore renewables. **ORE4citizens** is an EU funded project with the aim to:

1. Bridge the gap between ORE science and perception of citizens and students.
2. Increase social awareness, citizen commitment and acceptance of scientific activity within the area of Offshore Renewable Energies (contributes to the EU missions).
3. Promote STEAM vocations among young people. Particularly towards disciplines necessary for ORE, to contribute to the value chain of the Basque Country and Europe.
4. Empower female figures in science. Promote the scientific careers of young women and attract talent.
5. Show the value of scientific activities funded by the European Union and how they contribute to society. Special emphasis on the Green Deal.
6. Showcase the scientific and academic capabilities of the Basque Country in ORE (R&I and training) and its contribution on a European scale.



SPECIAL ACTIVITIES

OREGAUA

Every September, European cities celebrate RESEARCHERS' NIGHT, an event to bring science closer to citizens. This year we will be launching the **27th of September OREGAUA in Nautika Itsasgunea, Portugalete**. A free to access program for children and adults which includes music, experiments, talks, exhibition, games and many more surprises regarding Offshore Renewable Energy.

ORESKOLAK

Our researchers will visit schools to educate young students on the societal challenges tackled by ORE and the goals achieved to this day.

Motivational talks, hands-on ORE experiments and workshops will be carried out with primary and secondary school students.

We want students to understand the big challenges ahead and how STEM disciplines and ORE technologies are part of the solution.

OREGUNAK

World Ocean Day 8th of June: photo exhibition of Basque Projects in ORE will be showcased in FICOBA. This exhibition will tour the Basque country in the following months.

Offshore Wind Energy Day 14th of September: We will celebrate a family day on the beach, showcasing how to build fixed and floating offshore wind mock-ups. Other initiatives will include visits to Bilbao Port, BiMEP, Mutriku Wave Power Plant, etc.

Saitec's DemoSATH project marks Spain's first floating wind installation providing clean energy to households

Offshore wind energy holds a crucial position in the ongoing global energy transition. Emerging prominently in current discussions, it plays a central role in shaping the future energy landscape, where the significance of renewable energy production becomes essential, thanks to the abundant resource harnessed from the wind.

Several examples around the world underscore its clear potential and capacity to revolutionize the landscape by providing a sustainable and effective alternative. One such example is DemoSATH, located on the Basque coast of Spain, marking the first-ever connection of a floating offshore wind turbine to the electrical grid in the country.

Drawing on Saitec's extensive experience with over 30 years in civil engineering and its commitment to innovation and sustainable solutions, Saitec Offshore Technologies emerged less than a decade ago. This spin-off is dedicated to designing technology for floating offshore wind turbines, already playing a prominent role in the global floating offshore wind sector, thanks to the pioneering DemoSATH project.

In collaboration with two energy giants, Germany's RWE and Japan's The Kansai Electric Power Co. Inc. (known as KEPCO), the Basque engineering has undertaken the initiative from its foundations to connection and subsequent operation. This project involves a 2MW demonstrator installed on the Basque coast, specifically in Armintza, within the testing area of BiMEP, one of Spain's two zones for testing such devices.





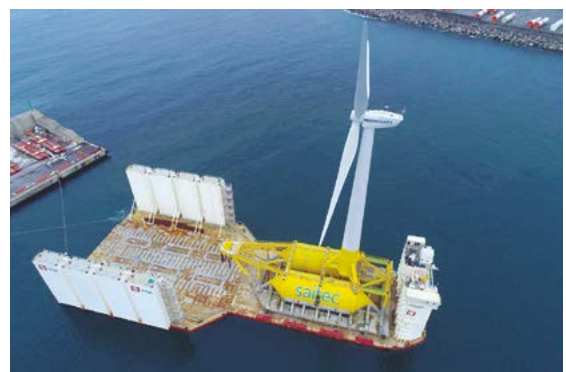
The project's objectives can be summarized in three aspects: first, to test the disruptive technology patented by the Basque company, known as SATH (Swinging Around Twin Hull); second, to acquire knowledge about all phases of the process needed for the successful installation and operation of this nearly 70-meter tall platform; and finally, to contribute to Spain's energy mix by providing electricity to around 2,500 households.

The construction of the floating offshore wind platform has been entirely carried out onshore at the Port of Bilbao. The process began with preparing this port area to erect the colossal structure. Subsequently, efforts were directed towards manufacturing the concrete elements that form part of the assembly, imitating an industrialized construction model. This showcases the replicability of the SATH technology on a mass production scale, a crucial aspect for future larger-scale developments.

A key aspect of this phase has been the involvement of the local supply chain, with 75% of the construction budget allocated to companies located within 25 km of this location. This emphasis on leveraging the knowledge, experience, and capabilities of local businesses is a priority for upcoming larger wind farms. This not only has a positive impact in terms of employment and increased business opportunities but

also contributes to the competitiveness and cost reduction of floating offshore wind farms, a highly valued aspect for promoters.

The next step involved positioning all elements to form the base of the device. Subsequently, the transition piece, tower, and turbine were placed, completing the entire assembly before its floating, a decisive moment to validate the proper execution of all previous work. After successfully completing this operation, final checks and validations were carried out before towing and installation in the selected area. This last stage concluded in



the summer of 2023, and shortly thereafter, the platform began operating.

Since DemoSATH's installation, its outstanding performance in the demanding Cantabrian Sea has been evident, navigating through major storms and waves. Simultaneously, a key milestone of generating 1GWh has been achieved, affirming that the platform's behavior aligns well with the numerical models developed during the structure's design period.

During the remaining installation period, the goal is to continue collecting data on its performance in various meteoceanic scenarios while exploring paths for collaboration with other sea users, including fishing and aquaculture. DemoSATH serves as a testing ground where all initiatives aiming for a positive impact and commitment to biodiversity conservation and promotion find a place.

This project forms the foundation on which Saitec Offshore Technologies builds its global ambition and aspirations. The company has already envisioned other pre-commercial initiatives (up to 50MW) in Bizkaia with the GEROA Project and in Catalonia with Medfloat. Both will serve, once again, as testbeds to validate the SATH technology while analyzing other factors related to the social, economic, and environmental context and coexistence with other activities at sea. Simultaneously, the engineering team is engaged in bids and projects on an international scale, with a special focus on France, the UK, the US, and Japan.



The Supergen Offshore Renewable Energy Hub: Driving Innovation and Impact in UK Offshore Renewables

The Supergen Offshore Renewable Energy (ORE) Hub was established to accelerate the impact of current and future ORE technologies and drive the UK towards its net zero greenhouse gas commitments. Rapid expansion in ORE is essential to the UK for Net Zero, climate change mitigation, energy security and green growth and jobs.

- **Climate change mitigation:** requires ORE to be deployed 10 times faster than the current rate to meet Net Zero targets as set out in the 6th Carbon budget. To meet UK plans for Net Zero, Energy Security and just transition, a significant ramp up in underpinning research and in skills and training is required – it cannot be business as usual.
- **Energy security:** ORE growth will mitigate the effects of the cost-of-living crisis and geopolitical instability. ORE can minimise consumer energy costs, but research and engineering challenges need addressing to realise the scale and rate of deployment required, taking a whole system approach with interdisciplinary collaboration underpinned by integrated research and innovation.
- **Green growth and jobs:** UK ORE industry growth underpins new high-skilled jobs, often in areas in most need of investment, to support the levelling up agenda. With local and abundant resource, rapid expansion of ORE for Net Zero could help achieve a Just Transition with economic and social benefits.

CHAMPIONING THE UK'S ORE EXPERTISE

In 2018 the Supergen ORE Hub was awarded £5 million of funding from the Engineering and Physical Sciences Research Council (EPSRC) with a further £4 million awarded in June 2019.

In 2023 the Hub secured a further £7.5 million of EPSRC funding to continue to champion and maintain the UK's offshore wind, wave, tidal energy expertise, provide research leadership to connect stakeholders, inspire innovation and maximise societal value in offshore renewable energy. The Supergen ORE Hub is led by Professor Deborah Greaves at the University of Plymouth, with Co-Directors from the Universities of Aberdeen, Edinburgh, Exeter, Hull, Manchester, Oxford, Southampton, Strathclyde, and Warwick. The high-level objectives of the Supergen ORE Hub are to:

Provide 'Visible Research Leadership' in ORE research.

Execute, publish and inspire distinctive and ambitious world class research through the core programme.

Facilitate a programme of co-ordinated UK led research through a flexible fund.

Be a respected voice for policy makers and a trusted partner for industry.

FUNDING AND SUPPORTING VITAL RESEARCH SKILLS DEVELOPMENT

Have strong international collaboration.

Ake a whole systems approach to ORE.

Become a 'beacon for equality, diversity and inclusion' (EDI).

Support the development of early career researchers (ECR).

The Hub is supported by an Advisory Board of leading ORE industry and Government stakeholders, in addition to a Research Alignment Group consisting of the Principal Investigators of other significant UK led research programmes.

The Advisory Board brings together leading experts with essential insight and dialogue beyond the academic sector. The Board comprises of representatives from UK Government, ORE Catapult, Carbon Trust, RenewableUK, Original Equipment Manufacturers, utilities, developers and other sector leaders, covering all ORE sectors and disciplines.

The Research Alignment Group provides independent, objective, impartial advice and strategic guidance on the direction of Hub research. They are a panel of expert academics who are well placed to help the Hub focus on research relevant to the ORE sector, especially in areas of emerging ORE research.



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DEBORAH GREAVES

*Supergen ORE Hub
 Scientific Director*

A core part of the Supergen ORE Hub is the Flexible Funding Awards. The Awards are designed to support ambitious research in offshore renewable energy across Offshore Wind (Fixed and Floating), Wave and the Tidal Energy sectors in the UK. Total investment made by the Supergen ORE Hub into ORE research between 2018 and 2023 is £3,760,000 to 40 projects, with c£4,425,000 of industry matched support.

The Supergen ORE Hub also supports a 200 strong Early Career Researcher network, supporting ECRs as the research leaders of the future through development training and collaboration. The Hub also supports an ECR Research Fund, which develops existing research activities or ECR career skills. The total investment into ECRs through this fund between 2018 and 2023 is c£204,000 to 46 projects.

The Supergen ORE Hub Research Landscape is informed by the Advisory Board and Research Alignment Group and shared in an interactive web-based tool which brings together and communicates UK offshore wind, wave and tidal energy research. The Research Landscape enables industry, government, and researchers to share ORE projects, opportunities and challenges.

Further collaboration between academia, industry, government and the public is supported through various outreach initiatives, research events and stakeholder workshops - most notably the Hub's Annual Assembly and ECR Forum. The Assembly and Forum bring together the ORE community to share, explore and debate cutting-edge ORE research. Past Assembly discussion topics have included the latest ORE research, international collaborations, championing equality, diversity and inclusion and ORE policy.

Further information about the Supergen ORE Hub, including funded projects, news and events, and access to the Research Landscape, can be found at www.supergen-ore.net.

REM+ _____

The Master in Renewable Energy in the Marine Environment (REM PLUS) is an Erasmus Mundus Joint Master Degree (EMJMD) offered by four universities: the University of the Basque Country, the University College Cork, the Norwegian University of Science and Technology and École Centrale de Nantes.

www.master-remplus.eu



PRESENTATION AND GOALS

The aim of the REM PLUS master is to form specialists with the required skills to accomplish this technological challenge.

The Master provides the student with skills in assessment, analysis, simulation, development and exploitation of all available energy in the marine environment and in project development of safe, efficient and reliable marine energy generation plants, including operation and maintenance design and study of the integration of the plants in the electric system.

PROFESSIONAL OUTINGS

The completion of the master will prepare the student for a leadership role in various renewable energy and marine sectors. Students will be able to carry out high-level technical jobs in engineering companies, equipment manufacturers and other marine industries.

Likewise, students will also be able to pursue research positions in Universities, Research and Development in technological poles, and other institutes.

Moreover, this programme has a network of associated centers formed by several world-renowned research institutions and companies entailing a great career opportunity for students.

MODULES AND SUBJECTS

MODULE 1. Resource and marine environment

MODULE 2. Theoretical foundations: early marine energy conversion

MODULE 3. Conversion technologies

MODULE 4. Connection and integration into the electricity grid

MODULE 5. Engineering, development and management of offshore parks

MODULE 6. Environmental, economic and legal aspects of marine renewable energy

MODULE 7. Local culture

APPLICATION PROCEDURE

Applicants are required to complete the online application, providing documents and forms available through the REM PLUS website:

<https://application.master-remplus.eu/>

The Master has just accredited the recognition of excellence by the European Education Agency with a 90/100 score, highlighting its professional adaptation to the needs of the field, the value of his international degree, and the quality of the services offered to the students. It finally takes note of the well-thought-out promotion strategy with the impressive results of the second call for applications.

SUPPORTED BY



WITH THE SUPPORT OF EUSKAMPUS FUNDAZIOA

2024 is a year of celebration, for it has been **13 years** of international excellence and cooperation for the COMMON GOOD and **10 years** of cross-border university collaboration between UPV/EHU and the University of Bordeaux.

UPV/EHU, DIPC and TECNALIA, along with the University of Bordeaux, and its trustees and partners as a whole, seamlessly continue the path to contribute towards fostering a more prosperous, sustainable and equitable society.

Euskampus Fundazioa, confirmed as the joining force and catalyst of the Alliance which also fosters the cooperation of all its trustees with numerous stakeholders on both sides of the Basque-French border and in Europe, through several lines of action deploys its activities in pursuit of cooperative research and innovation.

The framework of this alliance holds space for a significant number of initiatives of collaboration, such as the **LTCs, Laboratories for Transborder Cooperation**, a formula for collaboration developed since 2015. The LTCs were created to provide an institutional framework for research teams from the Basque country and from Bordeaux working together. This framework supports trans-border research communities, which involve young and senior researchers, students, and technicians that can move from one lab to the other without boundaries and share a common vision and action agendas.

Another example of collaboration are **Euskampus Missions**, a collective response led by the Euskampus trustees, ad coordinated with other institutions and actors, to achieve predefined goals that address a huge scientific, technological, environmental, cultural or economic challenge, or a mixture of them, through a

coordinated agenda of education, research, knowledge transfer and dissemination actions where we may find a consolidated and enlarging web of cooperative research and innovation.

These are some examples of international collaboration, but there are many more promoted by the Euskampus alliance, across frontiers, disciplines, and cultures.

Moreover, the Joint Research Laboratories JRLs, which illustrate the support for institutional collaboration instruments among the trustee's entities. The **Joint Research Laboratory on Offshore Renewable Energy**, is one of the five JRLs based in the Basque Country, and composed of researchers from TECNALIA, BCAM and UPV/EHU.

Artificial Intelligence, cement technology, antibiotic resistance, and bio-printing in three dimensional structures of organs and tissues are the other areas of research where JRLs develop their activities.



The launch of the JRL-ORE seeks to **strengthen the research links between the parties** in order to take advantage of synergies between them and to reach critical masses in the agreed scientific and technological areas. It aims to increase the level of the research results in terms of their impact in the business world and society in general. Its goal is to become an ally to the industry, providing technological solutions and creating value in the process. The objective of this JRL is to facilitate interaction among different groups involved in marine energy in the Basque Country. They focus their activities on wave energy, applied mathematics for offshore wind energy, and the design of tools for ocean

energy technologies. Along with the scientific and innovation action lines, the JRL ORE promotes and launches new higher education programs contributing to the development of new specialized professional profiles in the renewable energy sector.

With the support of international instruments such as the JRL-ORE, we are looking towards the future, satisfied with the path traveled and eager to continue contributing towards turning a better world into a reality: connecting institutions, disciplines and people, co-creating knowledge and solutions for the COMMON GOOD.

JRL-ORE Members



UPV/EHU GROUPS



"YOU CANNOT GET THROUGH A SINGLE DAY WITHOUT HAVING AN IMPACT ON THE WORLD AROUND YOU. WHAT YOU DO MAKES A DIFFERENCE, AND YOU HAVE TO DECIDE WHAT KIND OF DIFFERENCE YOU WANT TO MAKE."

.....

Jane Goodall



jrlore

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