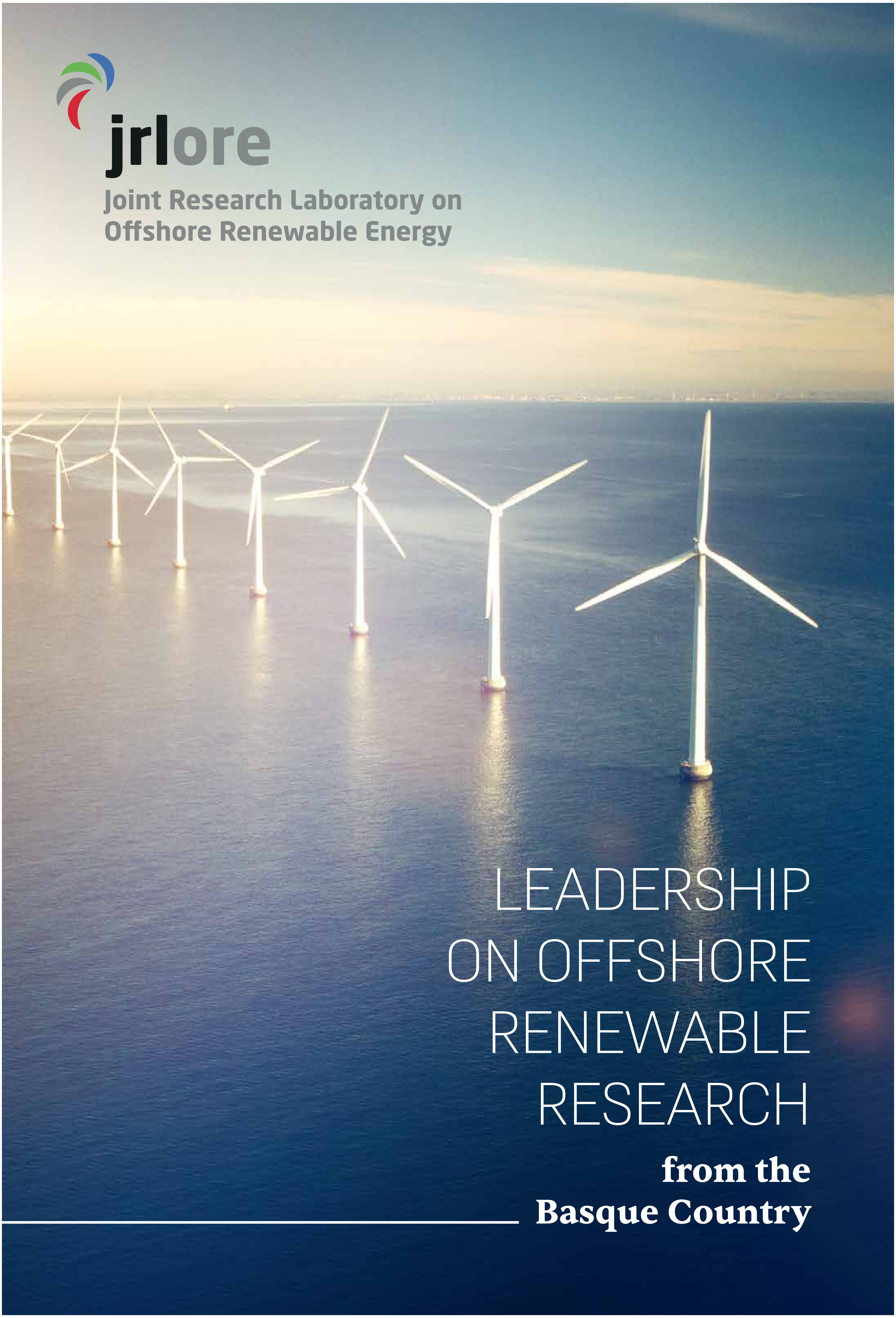


jrlore

Joint Research Laboratory on Offshore Renewable Energy

# LEADERSHIP ON OFFSHORE RENEWABLE RESEARCH

**from the Basque Country**


www.jrl-ore.com
Visit our YouTube channel

# About Us

Offshore renewable energy sources (offshore wind, wave and tidal energy) are expected to play a very important role in a future carbon free energy system, contributing also to economic growth and job creation.

In fact, floating wind appears as the first key energy transition technology in the review performed by DNV of 10 technologies setting the pace of the energy transition over the next five years [1].

Offshore wind is growing very fast with 22 GW of cumulative power and more than 5,000 turbines installed in Europe by the end of 2019 [2] concentrated in areas with continental shelf, such as the North Sea. An emerging technology based on floating solutions will enable offshore wind deployments in many sites around the world with deeper waters. Other marine renewable technologies such as tidal stream or wave power are still in their infancy with a number of projects in the range of MW but the possibility of contributing with hundreds of GW of installed power by 2050 around de world [3].

The JRL-ORE is a **scientific community** with the main motivation to **strengthen the research links between the parties** in order to take advantage of existing synergies and to reach critical masses in scientific and technological areas related to Offshore Renewable Energy. It aims to increase the level of the **research results** in terms of their impact in the business world and society in general.




[1] DNV, TECHNOLOGY PROGRESS REPORT, Energy Transition Outlook 2021.
[2] WindEurope, "Offshore wind in Europe. Key trends and statistics 2019," February 2020.
[3] Ocean Energy Systems vision for international deployments of ocean energy 2017.

# JRL-ORE in numbers

(2018-2021)

**59**
**Researchers**

**94**
**Indexed publications**
(30 in Q1, 40 co-publications)

**115**
**Trained students**
(TFG/TFM/ master REM)

**7**
**PhD thesis**
(+8 ongoing)



# Technologies & Products

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

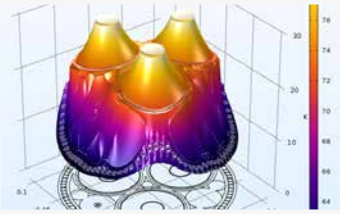
Each of these offshore renewable technologies, has a specialized researcher in charge.

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

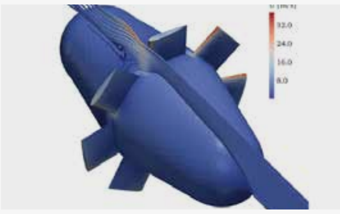


___ Generation, modeling and evaluation of **innovative concepts** [TRL1-4] to reduce costs and increase the useful life of offshore renewables

## INNOVATIVE MATERIALS

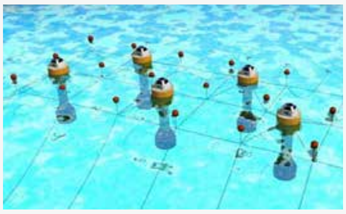
___ **Innovative materials** and components in the marine environment [TRL6-9]

## MATHEMATICAL MODELS



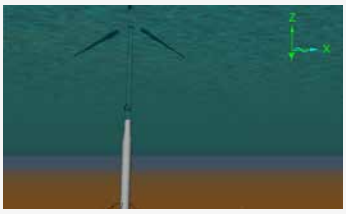
___ Intelligent **mathematical models** based on data for offshore renewable structures and their interaction with the marine environment

## FLOATING STRUCTURES



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

## 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

# The energy crunch in Europe and marine renewable energy

**GREGORIO IGLESIAS**
*Professor of Marine Renewable Energy*
*University College Cork, Ireland*



Europe uses vast amounts of natural gas and coal for generating electricity. The price of natural gas has been rising for some time. Massively. It more than tripled relative to the pre-2021 period. The price of coal has increased drastically too. As a result, the cost of electricity has skyrocketed. In Spain, for instance, it rose from 70 €/MWh to around 230 €/MWh in just three years. As a result, European homes are cold this winter, and inflation is rising, undermining the economies of citizens and families.

Unfortunately, this situation is not expected to improve any time soon. On the contrary, it is poised to worsen. 40% of Europe's natural gas is supplied by Russia (over 50%, in the case of Germany). The supply of Russian gas had decreased significantly even before the invasion of Ukraine – perhaps out of a desire to strengthen the case for the new Nord Stream 2 pipeline. The current war may lead to further decreases or downright stoppage of supply, which would cause the price to rise further. The prospect of blackouts in Europe cannot be ruled out.

Irrespective of the current geopolitical situation, there is a structural problem. And there is no need to stress here the repercussions for the climate of our excessive dependence on fossil fuels. This situation must be addressed. In the short term, alternative gas suppliers are being

sought (e.g., Qatar); however, liquified natural gas is more expensive, and the infrastructure is not there yet – for a start, Germany does not have an LNG terminal of its own (one is in planning). The real solution, which can only be implemented, alas, in the medium-to-long term, would be for Europe to reduce its dependence on fossil fuels.

Renewable energies are essential to this end. Marine renewable energies, not least offshore wind, have a role to play. A significant amount of offshore wind power is already installed and operational in the North Sea. These are bottom-fixed turbines, thanks to the low water depths in the region. For offshore wind to expand to other regions (European Atlantic, Mediterranean), floating turbines must be used given the scarcity of areas with water depths below 50 m (the practical threshold for bottom-fixed turbines). Indeed, floating offshore wind is the new frontier.

We have investigated the cost of energy from floating offshore wind in the European Atlantic and Mediterranean. There are promising areas, especially in the Atlantic, e.g., Ireland, Scotland, Galicia and Brittany, with vast resources and values of the Levelized Cost of Energy (LCOE) around 100 €/MWh. These values will naturally decrease as the industry develops and economies of scale kick in. The details can be found in Martinez and Iglesias (2021, 2022); the take-home message is that floating offshore wind has enormous potential to contribute to the energy mix in Europe. Such contribution would help alleviate the energy crunch and reduce carbon emissions. It would also make Europe less dependent on external countries for its crucial energy supply.

Green hydrogen can be advantageously combined with offshore wind. It may be produced with the excess electricity in periods of low demand, avoiding curtailment. It is also possible, in principle, to imagine a floating wind farm located far offshore and dedicated entirely to producing green hydrogen, without a submarine cable for exporting electricity, but its economic viability is not obvious at present due to efficiency issues.

Finally, the connectivity of the European grid must be strengthened for many reasons, not least for balancing out the variability of renewable energy generation. The wind does not blow all the time in all regions. Combining offshore wind energy with onshore wind, solar, wave, tidal, etcetera from different regions throughout Europe, north and south, west and east, will go a long way towards mitigating their variability – but requires a level of interconnectivity that is currently lacking.

# The Basque Country - Marine Renewable energy

Located in the North of Spain, the Basque Country is one of the largest industrial concentrations in Europe and holds the highest R&D intensity in Spain. In fact, the region has become a worldwide reference in marine renewable energy.



Regarding **offshore wind**, the Basque wind sector is a well-recognised global supplier, building on its experience in onshore wind and a tradition in the shipbuilding industry and marine activities. Basque companies are present in all major key international markets, with more than 250 delegations all over the world. Together with technology centres and universities, these companies cooperate in R&D projects in all major technological challenges for the wind sector, with a special focus on digitalization, to optimize components design and reduce the costs of Operations & Maintenance, one of the European wind industry's main priorities. It is also significant the relevance of floating wind stakeholders in the Basque Country, which  boasts five floating wind platform developers, a unique test site and strategic R&D initiatives for the development of key elements of a floating wind farm such as substations or the optimization of O&M activities.

The Basque Country has also become a key region in driving ocean energy. Its industrial and technological positioning, its strong value chain, and its unique set of R&D infrastructures for testing and vali-

dation of marine energy components and systems have led the region to become one of the few regions in the world with key stakeholders in every segment of the value chain.

With its excellent marine resource and this diversity of stakeholders, the Basque coast holds a unique position to profit from wave energy and to develop and test wave power generating devices.  In fact, the region counts with two world reference infrastructures in the field of wave energy. Both boosted by EVE, Mutriku OWC plant, and the open sea test site BiMEP, bring a distinct scientific-technological offer and have managed to position the Basque Country as an international benchmark in wave energy.

Mutriku OWC is the first grid-connected wave energy plant in Europe and an up-and-running test site for new concepts in air turbines, generators, control strategies, and auxiliary equipment. On the other hand, the Biscay Marine Energy Platform (BiMEP) is a singular open infrastructure for real-scale testing and validation of marine energy components and systems. The platform's main goal is to provide technology developers with a site with suitable wave and wind resources for testing the technical and economic viability of different concept designs.

**MARCOS SUÁREZ**

*"Basque Energy Cluster"*

# A “digitalised” approach for sustainable offshore renewable energy

Words like **Artificial Intelligence** and **Big Data** have become part of common language in recent years. Nowadays, everybody is familiarised with “Google” and other search engines, able to navigate through very large datasets in a few seconds and to offer a set of ad-hoc solutions to the user based on his/her interests and needs. More generally, the algorithms for images recognition, “chat-bot” and natural language recognition are well-known and well-spread examples of Artificial Intelligence in everyday life; and more and more often the development of autonomous vehicles, robots and so on are making extensive use of digital technologies.

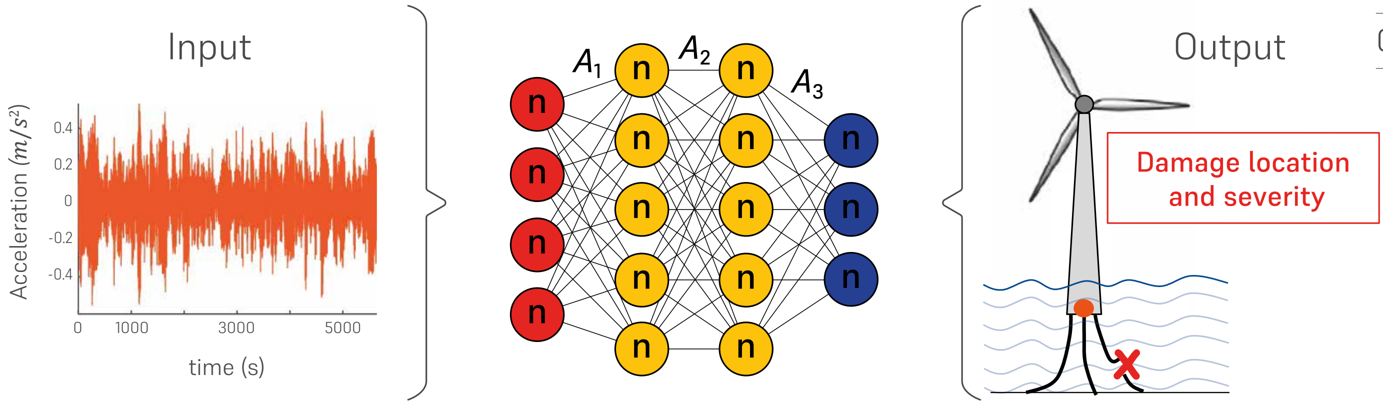


On a more technical perspective, Data Analytics and Data Science are already popular approaches for the solution of many engineering problems being able to investigate wider solution spaces than the traditional approaches, generally working in real or near-to-real time. For example, the concept of “digital twin”, i.e. a virtual replica of a physical asset, is nowadays a reality in both the advanced manufacturing and building industry sectors.

The offshore renewable sector could largely benefit from this “digitalisation surge” with the objective of reducing the uncertainties, cutting down costs and increasing the reliability and the sustainability of offshore renewable projects. For example, during the operation of a floating offshore wind farm, the implementation of “smart” control strategies would improve the efficiency of turbines; operations in the sea could be reduced in time by predicting the failures and anticipating correction measures; the same operations could become safer, through aerial and submarine drone inspections; the impact of the farm on the wildlife could be assessed via indirect measurements. One of the major limitations to the current implementation of digital approaches in the offshore renewable sector is that such industry is still in its infancy and the datasets are limited. However, the institutions at JRL-ORE have developed several conceptual frameworks, oriented at improving future designs and increasing reliability and performance of the offshore wind platforms, with a specific focus on the mooring system.

The problem of monitoring the status **Structural Health Monitoring (SHM) for the mooring system of a Floating Offshore Wind Turbine** via indirect measurements has been tackled in several projects. During the project **MATHEO**, funded by the Basque Government within the framework of the ELKARTEK 2019 programme, researchers from JRL-ORE in collaboration with other departments at TECNALIA and the JRL-IA, designed a Deep Neural Network architecture for the real-time detection of a damaged condition of the mooring system for a floating offshore wind platform. An unsupervised network has been designed by using an encoder/decoder approach; the network was purposely trained and it was able to detect in real time the occurrence of any malfunction of the mooring system. The network worked very efficiently. The results of the project were disseminated

to solve the inverse problem. By doing so, the health status of the platform could be assessed at each sea state; moreover, the solution could be more easily extended to real problems; finally, being based on statistical properties, the solution is less sensitive to failures of measurement systems. In the project **ExpertIA**, currently ongoing and funded by the Basque Government within the framework of the ELKARTEK 2021 programme, the expert domain knowledge in the field of the






in a webinar, available in the JRL-ORE YouTube channel. Also during the project **VIVIR**, funded by Iberdrola Foundation, researchers at BCAM tackled the problem of identifying failures for floating offshore wind platforms via the design of a Deep Neural Network. The novelty of the approach proposed in VIVIR with respect to the current literature consists in analysing some statistical and modal properties (instead of long time series) of the displacement of the platform in order

monitoring of mooring systems is going to be imbricated with the most breakthrough advances in terms of neural networks.

In the same project ExpertIA, the application of AI techniques is also oriented to the **mooring system design**. In this case, a subrogated model will be trained for the optimisation of the design of mooring systems, accounting for constraints and other rules of thumb that are generally adopted in mooring system design.

Recently, the national project **IA4TES** (in Spanish, Inteligencia artificial para la transición energetica sostenible) has started. It is funded by the European Union, via the NextGenerationEU fundings and within the National Plan of Recuperation, Transformation and Resilience. It is led by Iberdrola and it involves 18 companies, universities and research centres all over Spain, including Tecnalia and BCAM. Two case studies in the field of offshore renewables will be developed among the activities of the project. Algorithms based on artificial intelligence techniques will be developed in order to develop datasets and degradation models from few samples and data of components and subassemblies of offshore wind platforms. The final aim of the activities is to reduce uncertainty in the assessment of the structural health of structural components and the estimation of their remaining useful life (RUL).

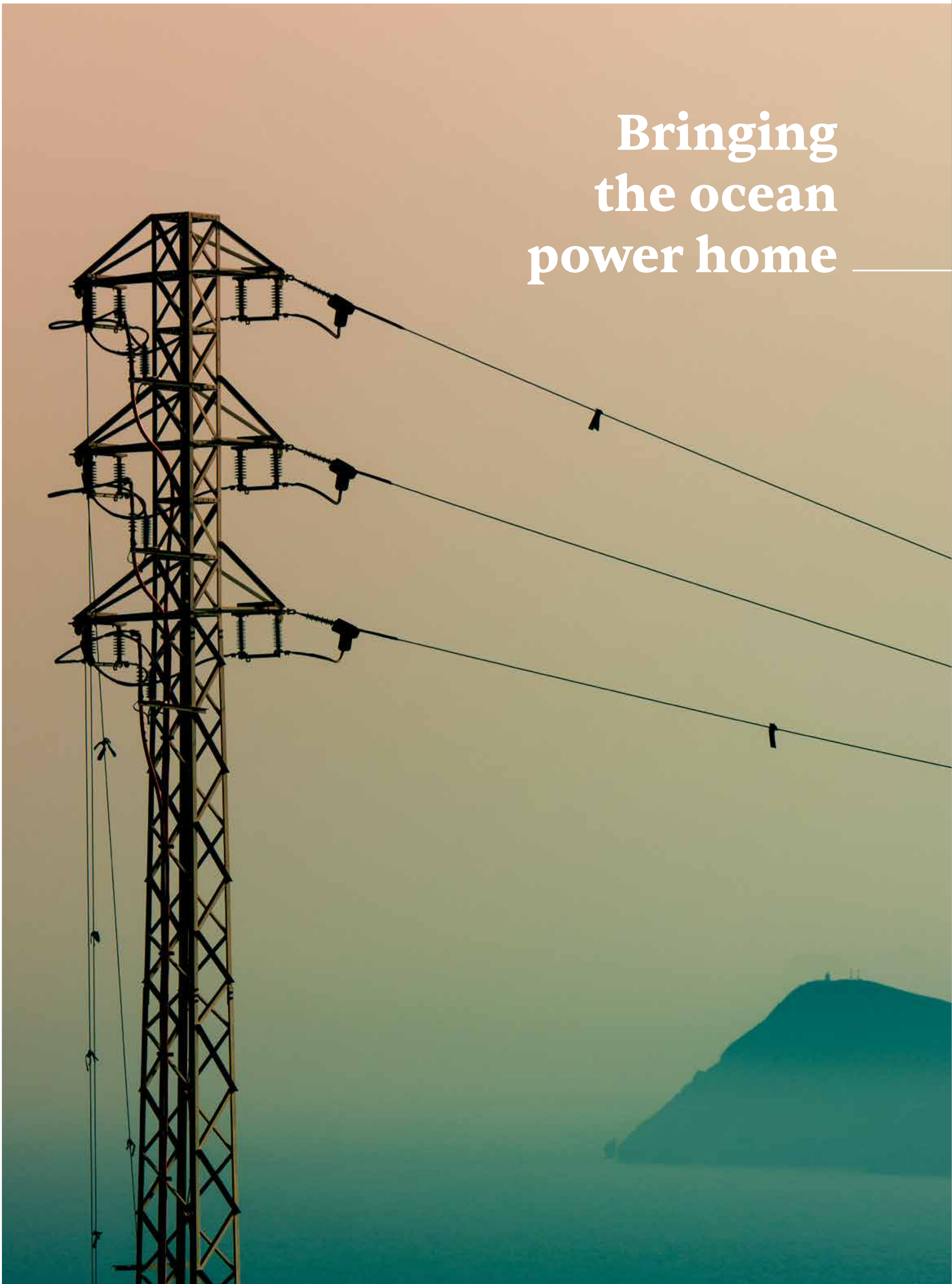


**Reliable data flow and storage** is crucial when managing computationally burdensome numerical simulations. **MARIA**-Monitoring floating platforms in offshore wind through artificIAl intelligence- is the acronym of the project led by the department of Energy Engineering at UPV/EHU. The team received a sponsored Microsoft Azure account to be utilized within one year. The objective of the project is to develop a coupled numerical model of floating offshore wind platform. This type of model would typically have a prohibitive computational cost. With the aim of reducing the computational burden, it is proposed that the coupled model should be assisted with an AI component. A time-dependent study was performed with the selected time-step. Finally, two examples of decay tests in heave of the sub-platform without and with moorings were presented, accompanied by a damping factor study, with the aim of providing a better understanding of the hydrodynamic damping of the whole platform. The coupling study adding a mooring system in the decay tests and the regular wave tests has shown good agreement between the computational results and experimental measurements from the tests run in the LIR/NOTF Laboratory, MaREI (Marine and Renewable Energy Ireland) Centre, corresponding to the SATH prototype developed at SAITEC OFSHORE TECH. After the first six months of activity, the team has already sent to Microsoft the first positive results of these simulations. Among the outcome of the project, the response of the platform has been analysed. In the following months the platform will be subjected to more tests and the ultimate objective is to test a prototype in real conditions, in the Biscay Marine Energy Platform test area, which is located off the coast of Armintza, hosting a 2 MW wind turbine.

**VINCENZO NAVA**

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

The offshore renewable sector could largely benefit from this "digitalisation surge" with the objective of reducing the uncertainties, cutting down costs and increasing the reliability and the sustainability of offshore renewable projects



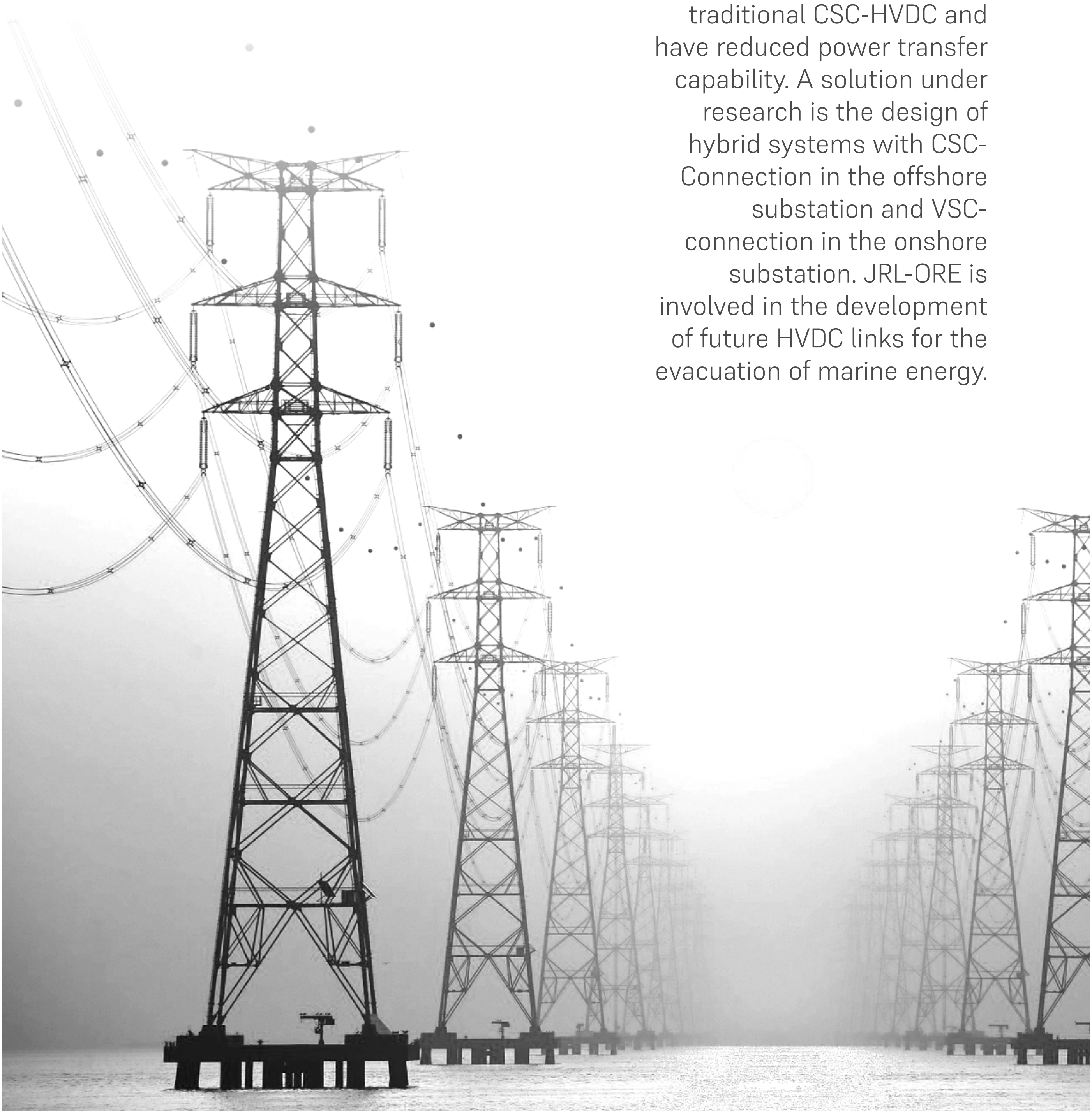
# Bringing the ocean power home

Offshore Renewable Energy is one of the main alternatives for decarbonizing our planet. Large offshore wind and wave farms require a strong and efficient connection to the onshore grid, involving very long distance and very high-power cables from the farm to the onshore location and for connecting all wind or wave generators to a collector hub or substation. This involves developing technology to solve the following specific issues:

- Offshore to onshore type of connection. Depending on the distance to shore and the power of the plant, the connection can be either AC, similar to most onshore plants, or DC.

The capacitive reactive power production of a long AC submarine cable affects active power carrying capability and voltage profile along the cable length. Inductive reactive compensation at both ends and at the cable mid-point of an AC cable connection can increase the cable capacity for the transfer of active power. JRL-ORE has capabilities for commissioning tests of high voltage underground and submarine cables. When the distance from the offshore farm to the onshore connection point is short, HVAC -High Voltage AC- connection is the most conventional solution, but each connection system is specific of each project. JRL-ORE is developing a PhD thesis with a researcher from Iberdrola Renewables about “Methodologies and Technical Criteria for the Electrical Design of Offshore Wind Farms with HVAC Technology”. The objective of the work is to develop standardized solutions that consider a complete methodology to design the connection system from basic project stage to commissioning. However, AC cable transmission links have a maximum distance of 50 to 100 km.  Often the best offshore farm location and the best onshore connection point are at a distance beyond the break-even cost distance and DC transmission is the only viable option. DOlwin2, Helwin2 and DolWIn3 Offshore windfarms, with a distance to the shore of 40 to 45 km and an onshore cable of 85 km use HVDC -High Voltage DC- transmission.

There are different solutions for the HVDC transmission systems depending on the converter topology used onshore and offshore. HVDC-VSC systems have more flexibility to comply with Grid Code requirements but are more expensive than traditional CSC-HVDC and have reduced power transfer capability. A solution under research is the design of hybrid systems with CSC-Connection in the offshore substation and VSC-connection in the onshore substation. JRL-ORE is involved in the development of future HVDC links for the evacuation of marine energy.



## 01 HVDC Grids

Nowadays, offshore windfarms that use HVDC transmission for grid connection are designed using point to point connections. This makes economic sense for individual wind farms, but planning several wind-farms in large marine areas requires the deployment of offshore transmission grids, similar to the existing onshore AC transmission grid. This will allow wind farms to share the HVDC transmission lines and, in case of a failure in one of the links, the wind farms may still remain connected, resulting in a more robust and tolerant system in the event of problems in a submarine cable.  HVDC grids are not a reality today due to technical limitations related to the protection of the grid. The technology required for HVDC breakers and protection systems is actually under development. JRL-ORE is working in a PhD Thesis about "New Protection Algorithms for HVDC Grids". This work is analyzing in detail how future HVDC grids can be protected and it is proposing innovative protection algorithms to detect and clear faults in an optimum way to limit the affection to the entire grid.

## 02 Interconnection of wind and wave generators and the substation within the wind farms.

The connection of the wind turbines to the main collector hub, or substation, requires very careful planning, as hundreds of kilometers of cable are required. TECNALIA, in collaboration with IDOM, is working in the development of a tool based on genetic algorithms for the optimization of offshore wind farm layouts, reducing the inter-array cable length and the electrical losses. The work is funded by the Basque Government HAZITEK 2019 program in SEAPOWER project. In addition to the layout optimization, a transition from AC output wind turbines to DC output wind turbines and a DC distribution system within the wind farm introduces a very big potential for cost reduction in the wind turbine and the wind farm cable system.

## 03 Grid Stability

Connection of renewable energy generation to the grid is based on power electronics, general called Inverter Based Resources (IBR). As IBRs replace traditional power plants based on synchronous generators, the dynamic of the grid changes and the frequency response when an event occurs is affected. This issue is related to a decrease of the mechanical inertia of the system. One possible solution under study within JRL-ORE, is the design of IBRs that can mimic the behavior of traditional synchronous machines.



**PABLO EGUÍA**
*UPV/EHU Electric Engineering department*

**IÑIGO MTNEZ. DE ALEGRÍA**
*UPV/EHU Electronic Technology department*

# Why testing offshore renewable technologies before going to sea is a must



Renewable energies are moving to the open sea because the higher resource allows to achieve a better performance. However, the marine environment is also very aggressive and presents a number of additional challenges to ensure the reliability and survivability of technologies. This results in more expensive solutions. In order to exploit its full potential, innovations need to be developed to accelerate cost reduction to a competitive level.

The validation of such innovative solutions usually requires testing in real sea conditions before they can be incorporated in final products. However, testing in real sea conditions is hard and costly, and failures might be detected too late in the design process. This situation can be solved by including testing campaigns at different stages of the design process. Testing methods should be implemented with the aim of reducing uncertainties, increasing confidence in results, supporting and guiding the design and assisting in the decision-making process.

An effective collaboration of the supply chain early in the process may leverage further costs reductions, as the final product will require the integration of different components and sub-systems, existing or new to develop. Technology transfer from other sectors can accelerate the development of new products. However, even if commercial solutions are used, these will need to be tested under new conditions and requirements. This validation cannot wait till the final product is integrated and tested in real sea conditions; on the contrary, components and sub-systems should be tested in laboratory-controlled conditions before they are integrated in the final system. In fact, each testing phase is an opportunity to improve the design.

JRL-ORE is working on different R&D projects for the development of offshore renewable technologies, which include testing campaigns using its own laboratories or collaborating with other universities and research centres.

## UPV/EHU FLUME

**The multipurpose wave flume** (2D wave flume 12.5 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).

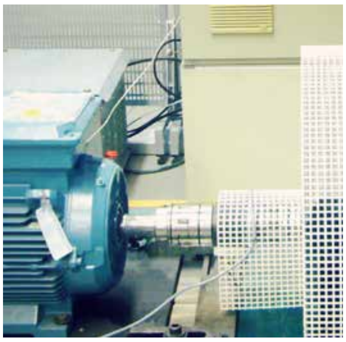
Apart from the description of the phenomenon, the wave flume enables the validation of numerical models (CFD) with the potential capacity of describing the phenomenology in real scale prototypes.

Some typical devices and phenomena under testing 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.

## HARSHLAB

**HarshLab** is the largest floating test laboratory for the validation and experimentation of materials and components in real offshore environment. This laboratory will enable materials, components, and equipment to be assessed when they are submerged, in the atmospheric area (above the water), in what is known as the splash area (where the waves break) and on the seabed. To date, this information was obtained from laboratory testing, but the results were not always extrapolated to what actually happens at sea. In this way, companies will be able to reliably predict how the different systems to be used in the marine environment for the research and development of new technological solutions for the *offshore* industry are going to perform, which will affect their safety and extend their life cycle.

## THE ELECTRICAL PTO LAB



**The Electrical PTO Lab** has been one of the test infrastructures included in the MARINET2 network. It is a turbine emulator to reproduce mechanical output of a wave, tidal or wind energy device. It is aimed at validating the electrical configuration and research on control strategies. It will be connected in real time to Mutriku OWC power plant to test the reliability of electrical generators with the new hybrid testing methodology proposed in VALID project

**JOSE LUIS VILLATE**

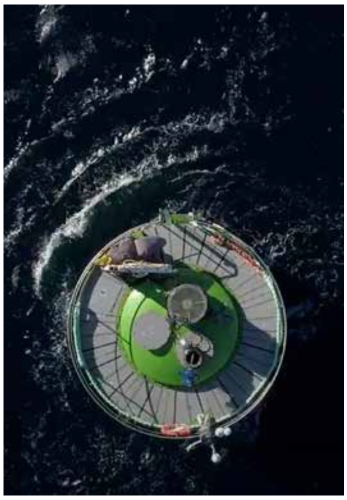
*TECNALIA, Renewable Energy, Energy Efficiency and Circularity Director*

# Some Offshore Renewable Projects Including Testing



## H2020 LIFES50+

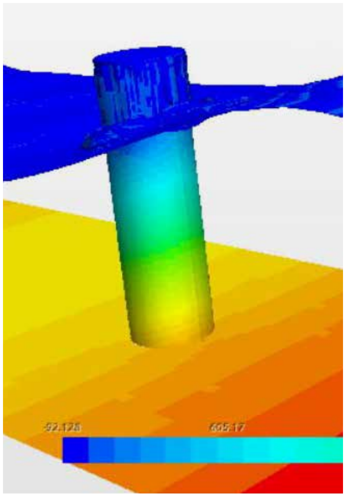
Proving cost effective technology for floating substructures for 10MW wind turbines at water depths greater than 50 m. Delivered two optimized, innovative substructure designs that have been qualified to TRL of 5 through experimental validation in relevant environment.



## OPERA

collected, analysed and shared open-sea operating data and experience to validate and de-risk several industrial innovations for wave energy, taking them from a laboratory environment (TRL 3) to a marine environment (TRL 5), opening the way to long term cost-reduction of over 50%.

Testing is an essential part of many JRL-ORE projects, at different stages of the technology development and with different purposes such as technology validation, research on new components, design and control methods, reliability improvement, standardization of testing procedures, etc. We use our own laboratories, and provide assessment in external labs and sea trials.

## VALID

will develop a Hybrid Testing Platform for accelerated testing with methodologies by combining the virtual and physical environment reducing cost in the product developing process, tackle scaling challenges and lower uncertainties once fully demonstrated in the ocean.

## MATHEO

Webinar 1 Computational and experimental analysis of the overtopping on structures for offshore renewables.

Webinar 2 Modelling and simulation of sediment material for offshore wind energy applications.

Webinar 3 Challenges of applying deep neural networks to the offshore wind energy sector.

1 2 3

## MARINET & MARINET 2

MaRINET2 is working towards its vision of unlocking the energy potential of our oceans by ensuring the integration and enhancement of leading European research infrastructures specialising in research, development and testing of Offshore Renewable Energy (ORE) systems.

# REM+

MASTER IN RENEWABLE ENERGY IN THE MARINE ENVIRONMENT
REM PLUS

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

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# ICOE-OEE 2022

## The Basque Country welcomes ICOE - OEE 2022. The joint event on ocean energy will be held in Donostia / San Sebastián.

This year, the Basque Energy Cluster and Ocean Energy Europe have teamed up to deliver the leading global ocean energy event. The International Conference on Ocean Energy and Ocean Energy Europe 2022 (ICOE-OEE 2022) will take place on the 18, 19 and 20 of October in Donostia-San Sebastián in the Kursaal Congress Center.

The relevance of the Basque Country as one of the most relevant hotspots in Europe for the development of ocean energy has led Donostia / San Sebastián to become the chosen venue for the ICOE-OEE 2022, that will gather ocean energy professionals and decision-makers from all corners of the globe.

ICOE-OEE 2022 will provide numerous forums for all attendees to share advancements in research and technology breakthroughs. It will be an unparallel opportunity to spur commercialization, attract investment, market your organization, and raise brand exposure and visibility to high profile professionals and new audiences.

The registration for the event is already open. Take advantage of the special early bird rate, and benefit from a substantial discount on your participation. Additionally, along with access to the conference and exhibition space, you can also reserve a spot for one or more of the different activities planned.



# EWTEC23

## And also the Basque Country will host in Bilbao from 3 to 7 September 2023, the 15th edition of the prestigious European Wave and Tidal Energy Conference (EWTEC).

As announced by Jesús María Blanco, associate professor at the School of Engineering of Bilbao, University of the Basque Country and coordinator of the Erasmus Mundus Master in Renewable Energies in the Marine Environment (REM PLUS), the conference will take place in the UPV/EHU Paraninfo (Bizkaia Aretoa).

This initiative has been carried out under the supervision of the Joint Research Laboratory on Offshore Renewable Energy, (JRL-ORE), and promoted by the University of the Basque Country (UPV/EHU), Tecnalia and the Basque Center for Applied Mathematics (BCAM).

EWTEC is well established among renewable energy conferences showing considerable growth since its launch in 1993. It has provided global focus for all activities in wave and tidal energy conversion technologies, research, development and demonstration.

Jesús María Blanco and the head of the offshore division of Tecnalia Corporation, José Luis Villate, will be the president and vice president of the conference, respectively. The candidacy had the support of numerous institutions from the beginning, such as public administrations highlighting the Spanish Ministry of Science and Innovation and the Basque Government through the EVE, singular facilities BIMEP, PLOCAN, research centers, EUSKAMPUS, private companies (VICINAY MARINE, IDOM, SENER) and other relevant associations (Basque Energy cluster and SEA EUROPE).



# JRL-ORE Members

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After celebrating 10+ years of international excellence and cooperation for the COMMON GOOD, the vision of Euskampus for 2030 has been renewed in order to enable the UPV/EHU, DIPC and TECNALIA, along with the University of Bordeaux, and its trustees and partners as a whole, to contribute towards fostering a more prosperous, sustainable and equitable society.

Euskampus Fundazioa has been 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, as the support for institutional collaboration instruments among the trustee's entities such as the Joint Research Laboratories (JRL) .

The Joint Research Laboratory on Offshore Renewable Energy, is one of the JRLs based in the **Basque Country**, and composed of researchers from **TECNALIA**, **BCAM** and **UPV/EHU**. The launch of the JRL-ORE strengthens the collaboration in research focusing on identifying dynamics that favour the implication of scientific and technological agents in the territory. The results will definitely have a direct impact both economically and socially.

Its goal is to become an **ally to the industry**, providing technological solutions and creating value in the process. 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 travelled 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.

THE
FUTURE
DEPENDS
ON WHAT
WE DO
TODAY

**Mahatma Ghandi**

jrlore

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