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BEYOND - Blue Economy sYnergies fOr sustainable Development

D.3.2.1 Cross-Sectorial Educational Program Curriculum

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Standard Call for Proposals

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1. Introduction and background

There is immense potential to transform offshore wind farm (OWF) energy into catalysts for sustainable development in various sectors of the blue economy, going beyond their traditional role as simple energy producers across the Mediterranean (e.g., Lambert et al., 2019).

Nevertheless, although several OWF are planned in the Mediterranean Sea, there are no active real offshore wind infrastructures (see <https://map.tgs4c.com/>). Therefore, there is great potential for future planning, study, monitor, analyze and develop OWF in the Mediterranean and Adriatic Sea in particular. These future activities require consolidated knowledge and capacities to support activities than span from planning to full environmental impact assessment for an optimal placeman. Future OWF experts need to have expertise that span from the technical/technological aspects and ecological and environmental issues.

Therefore the “Cross Sectoral Education Program” considered in BEYOND aims at developing the first of a series of capacity building events, introducing an innovative approach that integrates the development of sustainable energy production, the conservation of marine ecosystems and the advancement of multiple sectors of the blue economy. The BEYOND Summer Schools will bridge technical and environmental knowledge for discussing solutions, evaluating scenarios, and presenting best practices. Hands-on computer work, international experts, case-study analyses and on-site visits to energy facilities are key elements of the programme.

The Summer School is unique, because it is among the first of its kind to facilitate cross-border collaboration as part of the drive towards a green transition in the Adriatic. The curriculum also provides the basis for unique opportunities to contribute to the transfer of knowledge and best practice, through the inclusion of international experts from outside the region, while fostering collaboration among joint researchers and students. By focusing on marine ecosystems and the technology behind potential OWF sites, the Summer School curriculum is in line with the EU’s



priorities of basic science, good governance and finally, innovation through novel ways of using green energy in combination with marine science, transferred via a transdisciplinary approach.

2. Aims and Outline

The OWF Summer School curriculum is set to define the standards and materials required and is intended to be carried out annually in successive years. This pilot edition was split into two parts – technical and ecological - across two locations in order to be effective with the multisectoral technical facilities of the main organisers (OGS – PP2 and RITEH – PP3). The curriculum also reflects the specialisations of the two partners. These courses aim to integrate students and researchers from both countries, focusing on combining OWF technical aspects with biological and environmental considerations. The curriculum focuses on the integration of OWF within the marine environment and other blue economy sectors, through a multidisciplinary approach that takes into consideration the importance of developing both hard and soft skills. In particular, the curriculum features interactive lectures, including highly qualified expert talks, case studies and real-world pilot studies, as well as working group activities and field visits. The courses are organized also in part as exchanges of experience among experts and project partners in order to update course participants with new knowledge and developments from the project, ensuring ongoing learning and adaptation to new technologies and methodologies. To optimise the engagement and interest of students, the methodologies used will remain largely practical, interactive with the use of case studies and action research through collaborative problem solving. SMEs and other enterprises will collaborate with students and researchers to gain practical insights into real-world challenges and solutions. While the pilot edition is divided into technical and ecological tracks—reflecting the distinct expertise of the lead partners (RITEH and OGS)—the two tracks are designed to foster increasing cross-pollination of themes and knowledge.



2a. Technical

Part A of the curriculum is designed by the Faculty of Engineering, University of Rijeka (RITEH) in Rijeka, Croatia, the aim of which is to provide target participants with an understanding of the technical background and functioning of OWFs.

Part A is based on the following outlined activities:

- brief general introduction to OWF, from a technical and environmental/biological perspective;
- multi-use strategies and OWF: combining OWF with aquaculture, fisheries (fixed gears), tourism;
- hands on use of 3D printed models of different wind turbines and foundations, and access to a pool where target students will be guided how to install them;
- demonstration of different mooring systems and how they swing or move due to waves and other disturbances in the sea (pool), with the simulation of wind by using fans;
- utilisation of a wind tunnel facility, including the placement of a (scaled) turbine in a wind tunnel followed by an analysis of its aerodynamic function

2b. Ecological

Part B of the curriculum is designed by the Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS) in Trieste, Italy, the aim of which is to provide target participants with an overview of the present ecological context and an understanding of the potential ecological implications of OWFs.

Part B is based on the following outlined activities:

- introduction to the need for green energy production and marine renewable energy (technical and ecological perspectives);



- maritime spatial planning (MSP) and OWF development, that will include analysis of policy coherence, analysis of conflicts, allocation of space for OWF, spatial-based management measures;
- exploration of ecological effects of offshore wind farms: artificial hard substrate effects, underwater noise, barrier/mortality effects, attracting/dislocating effects, fishing regulations;
- ecosystem modelling for representing cumulative effects of OWF (practical exercise with the use of simplified model);
- sustainable solutions, including nature inclusive design (NID), ecosystem-based management, sustainability assessment;
- governance, policies and best practices, including existing working examples (from other EU seas).

Overall, the BEYOND Summer School curriculum is constructed to implement an interdisciplinary learning model, and to facilitate the adoption of a cross-sectoral point of view regarding the development of technical and environmental projects, thus helping to foster and optimise the uptake of new blue technologies. Field trips are also included in the curriculum to consolidate class learning and account for differing learning styles among students. Moreover, experts will also address the importance of themes such as the nexus between ecology, technology, energy, spatial planning, governance and best practice, and the relevance to the blue sector.

3. Target Participants

The educational program is designed to target participants scientists, young researchers, technicians, MSc and PhD students, employees of local, regional, national and international authorities, employees of SMEs and enterprises that are or will be involved in coastal zone management, marine spatial planning, energy security planning, OWF development and impact assessment. Case studies and examples will be mainly from cross-border region of Croatia and



Italy, and thus participants from the Italy-Croatia programme area will be a primary target, yet the courses will be open to participants from all EU countries and countries from the Mediterranean Sea. In fact, BEYOND aims to be a landmark initiative that transcends traditional programme area boundaries.

Participants should fulfil the following requirements:

- Knowledge of English (level B2 or higher).
- A demonstrated interest in the theme of sustainable energy security and marine resources.

Preferred, but not mandatory, fields of expertise: oceanography (physics, chemistry and biology), marine biology, geology, geophysics, geochemistry, (environmental) engineering, ecological modelling, climate study, coastal zone maritime spatial planning. The course is tailored for 20 - 40 participants for each part (technical and ecological) in order to ensure good interaction between teachers and students and foster active participation of students in all activities and discussions.

4. Expected Learning Outcomes and Impacts

4a. Learning Outcomes

The students will be introduced to and deepen their knowledge of the technical and environmental aspects of OWF, with an emphasis on the Adriatic Sea. Each year, the initiative expects to train at least 40 participants across a wide range of multidisciplinary offshore wind farm (OWF) topics. These include energy requirements, legal and regulatory frameworks, technological solutions and optimizations, environmental impacts, cumulative impact modeling, mitigation strategies, and multipurpose integration. Delivered by 4 to 6 diverse lecturers per module (technical and ecological), the program fosters cross-skilling, strengthens expert-student networks, and builds strategic partnerships to support future OWF developments.



Expected outcomes of the curriculum once implemented will include:

- a. A repository of learning materials serving as the basis for the development of a more sophisticated course syllabus;
- b. A more sophisticated, detailed course syllabus, including learning objectives, modules, descriptions, assessment methods, and resource lists;
- c. A long-term cross-sectoral and cross-border educational programme that combines theoretical knowledge from engineering and environmental sciences to address development challenges and opportunities in the OWF sector.

4b. Learning Impacts

The curriculum will contribute to the transfer of knowledge and advanced practices regarding a sustainable energy security approach using marine resources, thus facilitating the up-skilling of students and researchers alike, as well as enhancing the competences of technical and administrative employees of SMEs, authorities and enterprises connected to the OWF and other blue sectors.

- a. Target participants will be exposed to necessary skill sets, considering the challenges and the opportunities of the green transition in relation to the OWF sector with possible long term impacts on the future choices and impacts in the speed of adopting green technologies;
- b. The curriculum will act as an essential point of reference in educational terms and will be the first of its kind in the cross-border region; moreover, being it innovative, the educational programme is expected to impact beyond the programme area and attract the attention at the level of the Mediterranean basin.
- c. Increase adoption of quantitative approaches both for technical and ecological analyses of OWF will assure long-term sustainability and reduced impact of future OWF projects, through a transdisciplinary approach and innovative tools that will be presented during the courses;



- d. Regional collaboration will be strengthened through the exchange of best practice and cooperation with the presence of international experts thanks to the creation, with the cross-border program of a network of experts and practitioners in the field of OWF.

5. Long-Term Prospects

To provide an excellent basis for the long-term continuation of the BEYOND Summer School curriculum, both PP2 – OGS and PP3 – RITEH are taking steps to incorporate modules into existing or forthcoming educational programs at the respective institutes.

PP2 – OGS runs the [Advanced Master in Sustainable Blue Economy | Blue Skills](https://blueskills.ogs.it/advanced-master/about) (<https://blueskills.ogs.it/advanced-master/about>), jointly organized with the University of Trieste, the aim of which is to bring scientific excellence and technological innovation at the centre of several Blue Economy initiatives. The Master is intended to support the creation of stable and attractive blue career pathways throughout strengthening professional skills and enhancing competencies in fields related to sustainable blue economy. The summer session of the 9th edition this year featured a lecture by Marta Alvir from RITEH on "Technical Aspects of Offshore Wind Farms in the Adriatic Sea," which was extremely well received. Consequently, OGS will propose the incorporation of lectures on renewable energies in the Mediterranean to the collegiate this year to ensure the Master syllabus remains up to date and aligned with current developments in the blue economy. This will include a lecture by Marta Alvir on "Offshore Wind Development in the Adriatic Sea" under Session 2 of the three sessions that run within the Master, entitled SESSION 2: "Tools for assessing and developing strategies." The main focus of the lecture is on offshore wind development, using the Adriatic Sea as a case study. Starting from an overview of offshore renewable energy, the lecture will expand towards exploration of offshore wind potential, key wind turbine and foundation technologies, site selection criteria, and the main engineering and environmental challenges associated with offshore wind projects. The lecture also discusses future technological developments and the



role of offshore wind in supporting a sustainable blue economy. Furthermore, this lecture shows how offshore wind can contribute to the sustainable use of marine resources while supporting the transition to renewable energy with the creation of opportunities for economic development in coastal regions. This lecture aligns with Session 2, because it focuses on the criteria needed to assess the feasibility of offshore wind projects.

PP3 – RITEH is currently developing the new undergraduate study programme [Artificial Intelligence in Engineering](https://riteh.uniri.hr/en/novosti/rijeka-introduces-croatias-first-ai-in-engineering-study-programmes-in-croatian-and-english/) (<https://riteh.uniri.hr/en/novosti/rijeka-introduces-croatias-first-ai-in-engineering-study-programmes-in-croatian-and-english/>), which is undergoing the accreditation process and is expected to be launched in the 2027/28 academic year. The programme combines computing, data science, artificial intelligence and engineering of physical systems, to equip students with interdisciplinary knowledge and practical competencies for modelling, simulation, analysis and digital control of real technical systems. As part of the programme, one of the optional courses within the Computational Environmental Engineering specialization will be Offshore & Coastal Engineering, building on the knowledge, results and stakeholder input generated through the BEYOND project. The course is intended to provide students with both theoretical knowledge and practical skills in offshore and coastal engineering, covering the design and analysis of offshore structures and marine infrastructure, together with environmental considerations related to offshore developments. Through lectures, independent study and laboratory practical work, students will gain knowledge on the technical and environmental aspects of offshore wind farms, incorporating expertise and research outcomes developed by RITEH and OGS within the BEYOND project. In this way, RITEH will ensure that the study programme reflects the latest developments in offshore renewable energy and contributes to preparing future professionals for the sustainable blue economy. The course is planned to include lectures delivered by an OGS expert on the environmental aspects to continue collaboration between RITEH and OGS.



It is foreseen that the inclusion of elements of the BEYOND Summer School curriculum into existing institutional programs will therefore help to establish a separate long-term curriculum on OWFs in its own right within the region.

6. Risks and solutions

The BEYOND Summer School curriculum would like to represent a long term, self-standing, multidisciplinary and cross-country effort. The risks envisaged for this activity are:

Risk	Solution
Lack of participation: in spite of the great developments foreseen for OWF in the Mediterranean Sea, a dedicated program might be of interest for a handful of people per country with poor cascading effects and participation.	Joint organization of the BEYOND cross-sector curriculum programme side-by-side to other local activities (i.e., University Courses at RITEH, Summer School Blue Growth at OGS) should facilitate participation.
Long term sustainability of the Cross-Sectorial Educational Program Curriculum difficult to achieve	Embedding the BEYOND cross-sector curriculum programme in long term/institutional activities of RITEH and OGS should assure no costs and long-term sustainability; moreover, a formal agreement between RITEH and OGS guarantee the future implementation of the course after the project.
Lack of interest of OWF subject: the current boost of OWF interest is connected to EU	The cross-sectorial program has the intent to consider very different sectors and disciplines



regulations and Mediterranean lack of OWF, but political local changes might undermine the interest for these technologies	across technological and ecological aspects as well as exploring synergies with other blue sectors. These are all aspects that make the programme broadly valid beyond OWF application and can thus serve many other issues (marine spatial planning; conservation planning, management of traffic, etc.).
Different learner backgrounds: Participants may enter with very different knowledge, professional experience, and digital skills.	Assess entry competencies; provide bridging modules, flexible learning paths and learning materials.
Outdated learning materials: learning materials based on the outcomes of the BEYOND project may become outdated over the coming years of the cross-sectoral program, since the project itself has already been completed and will not be updated further.	Lecturers will have to put effort into updating the learning materials or into emphasizing and explaining their relevance within the current context.



7. Conclusions

A cross-border educational program has been broadly designed to bridge technical and environmental expertise, with a specific focus on integrating offshore wind farms (OWF) into marine ecosystems and the broader blue economy. The activity features two pilot testing courses held in Trieste (Italy) and Rijeka (Croatia) to bring together students and researchers from both countries and also from the Mediterranean basin. The set of lecturers, SME and key industry stakeholders will directly engage with participants creating a network of experts for future advancements on OWF field, ensuring continuous upskilling and alignment with emerging technologies and methodologies.

Both partner institutions will jointly formalize and adopt the educational program during the project lifecycle. Upon completion, attendees will receive a Certificate of Participation. The interdisciplinary learning framework will equip participants with a holistic, cross-sectoral vision for sustainable marine resource management and technical project development, driving the uptake of innovative blue technologies.

