SHORE WINNER

Needs and Trends in the Southern European Offshore Wind Energy Sector

Deliverable 2.1 | Report

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v0.5	18/12/2024	Contribution from CoVE Spain submitted
v0.6	24/12/2024	First version of D2.1
v0.7	17/01/2025	Quality Assurance Committee review
v0.8	26/01/2025	Final version of D2.1

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Executive Summary

The offshore renewable energy (ORE) sector in Southern Europe represents a critical component in the global transition to a sustainable, carbon-neutral energy system. Deliverable 2.1 aims to create a comprehensive knowledge base that integrates technical, economic, legal, environmental, and social dimensions to inform future project activities. By examining policies, workforce characteristics, investment levels, and job profiles across Portugal, Spain, Italy, Greece, and Cyprus, this report identifies critical skills gaps and training needs. These findings will help Centres of Vocational Excellence (CoVEs) align educational programs with industry demands while fostering collaboration through a Community of Practice (CoP).

In Section 2, the methodology for this deliverable is presented, combining desk and field research to develop a robust and actionable knowledge base. Desk research involved an extensive review of industry reports, academic publications, policy documents, and statistical data to identify trends, gaps, and opportunities. This was complemented by field research, which included standardized surveys and interviews conducted across all participating countries. These methods provided consistent and comparable data on sectoral needs, workforce dynamics, and vocational education and training (VET) requirements. Additionally, an in-depth analysis of the offshore renewable energy value chain was conducted, emphasizing strategic planning, technological innovation, and workforce development as pivotal factors in the sector's success.

In Section 3, the global and regional context of the offshore renewable energy sector is discussed. The global offshore renewable energy sector has emerged as a cornerstone in addressing climate change and advancing energy sustainability. Among its technologies, offshore wind remains the most developed and widely deployed. Europe has played a pioneering role, hosting 45% of the world's total installed offshore wind capacity, with Southern European countries beginning to align with these advancements. The region's legal frameworks, sectoral priorities, and smart specialization strategies reflect the growing emphasis on offshore renewable energy. Nonetheless, challenges such as workforce readiness, technological costs, and regulatory hurdles remain significant. A comprehensive mapping of 83 occupational profiles revealed diverse workforce needs, spanning engineering, management, ICT, and specialized trades. Aligning VET systems with these needs is essential to support regional development.

In Section 4, the findings of the needs assessment are elaborated, highlighting significant skills and qualification gaps in the offshore renewable energy sector across the participating countries. Portugal, Spain,

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Italy, Greece, and Cyprus each exhibit unique sectoral challenges but share common themes such as the need for upskilling, reskilling, and greater industry-education collaboration. Specific sectoral needs include training in safety protocols, environmental impact assessments, advanced engineering techniques, and digital skills. The gap analysis underscored a mismatch between the existing VET offerings and the skills required for emerging job profiles, necessitating immediate intervention to align educational curricula with industry expectations.

In Section 5, strategic actions and recommendations are presented, tailored to each participating country while consolidating overarching recommendations for the region. Collaboration between educational institutions and industry emerged as a critical success factor. Establishing training centres near ports and offshore sites, integrating internships and apprenticeships into VET curricula, and promoting mobility between educational institutions were identified as key strategies. Additionally, leveraging digital tools such as augmented reality (AR) and virtual reality (VR) can enhance practical training while reducing costs and logistical constraints.

For Portugal, the recommendations include fostering engagement strategies to attract young talent and promoting collaboration between VET providers and industry stakeholders. Spain emphasizes the development of comprehensive training impact evaluations and creating career pathways to bridge the gap between learning and employment. Italy’s focus is on modular training approaches, trainer upskilling, and advanced practical training infrastructure. Greece prioritizes the establishment of local training centres in areas of high offshore project activity, while Cyprus underscores the importance of building industry-academic alliances to support its nascent offshore renewable energy sector.

Across all sections, the consolidated recommendations emphasize strengthening industry-education collaboration through co-designed curricula, work-based learning opportunities, and shared initiatives. Promoting the use of advanced training technologies such as AR/VR to simulate real-world offshore conditions, developing flexible modular training programs, enhancing mobility between VET and higher education systems, and fostering inclusion and diversity are highlighted as critical strategies. These recommendations provide a roadmap for aligning Southern Europe’s VET systems with the offshore renewable energy sector’s evolving demands. By implementing these strategies, policymakers and stakeholders can ensure a skilled workforce capable of driving sustainable energy transitions in the region. Furthermore, the creation of a Community of Practice offers a platform for continuous knowledge exchange and collaborative growth, positioning Southern Europe in a strong position for offshore renewable energy innovation and workforce development.

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List of Acronyms and Abbreviations

Term	Definition
AI	Artificial Intelligence
ANQEP	National Agency for Qualification and Vocational Education and Training
AR	Augmented Reality
ART	Advanced Rescue Training
ATECA	Advanced Technology Classrooms (in Spain)
B.Sc.	Bachelor of Science
BR	Blade Repair
BST	Basic Safety Training
BTT	Basic Technical Training
CAD	Computer-Aided Design

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CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CEDEFOP	European Centre for the Development of Vocational Training
CfDs	Contract for Differences
CH	Crane and Hoist
CITENI	CITENI (Centre for Technological Innovation in Industrial Engineering)
CNQ	National Qualifications Catalogue
CoP	Community of Practice
CoVE	Centre of Vocational Excellence
CPI	Cyprus Pedagogical Institute
CTeSP	Higher Professional Technical Programmes
CTE	Specialised Technology Centres
CVET	Continuous Vocational Education and Training
CVT	Continuing Vocational Training
CYQAA	Cyprus Agency of Quality Assurance and Accreditation in Higher Education
DGEG	Directorate-General for Energy and Geology
DGERT	Directorate-General for Employment and Labour Relation
DGES	Directorate General for Higher Education
DGRM	Directorate-General for Natural Resources, Safety and Maritime Services
EACEA	European Education and Culture Agency
ECVET	European Credit System for Vocational Education and Training
EDP	Entrepreneurial Discovery Process
EECTI	Estrategia Española de Ciencia, Tecnología e Innovación (Spanish Strategy on Science, Technology, and Innovation)
EFA	Enhanced First Aid
EFVET	European Forum of Technical and Vocational Education and Training
EI	Environmental Impact
EI-ERO	Industrial Strategy and Action Plan for Renewable Electric Ocean Energy
EIS	European Innovation Scoreboard
EIT	European Institute of Innovation and Technology
EMFAF	European Maritime, Fisheries and Aquaculture Fund
ENEI	National Strategy for Smart Specialization
EP	Economic Potential

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EQAVET	European Quality Assurance Reference Framework for Vocational Education and Training
EQF	European Qualification Framework
ESCO	European Skills/ Competences, Qualifications and Occupations
ESF+	European Social Fund Plus
ESI	European Skills Index
FLORES	Forward Looking at the Offshore Renewable Energies
FOW	Floating Offshore Wind
FUNDAE	Fundación Estatal para la Formación en el Empleo (State foundation for training in employment)
GDP	Gross Domestic Product
GHG	GreenHouse Ggas
GII	Grupo Integrado de Ingeniería
GIS	Geographic Information System
GWO	Global Wind Organization
HE	Higher Education
HEREMA	Hellenic Hydrocarbons & Energy Resources Management Company SA
HNC	Higher National Certificate
HND	Higher National Diploma
HRDA	Human Resource Development Authority
HVET	Higher Vocational Education and Training
ICT	Information and Communication Technology
IDAE	Instituto para la Diversificación y Ahorro de la Energía (Institute for Energy Diversification and Saving)
IEFP	Institute for Employment and Vocational Training
ILO	International Labour Organization
IOBE	Foundation for Economic and Industrial Research
IoT	Internet of Things
IPTO	Independent Power Transmission Operator
IRENA	International Renewable Energy Agency
ISCO	International Standard Qualification
ISES	Integrated Student Evaluation System
LCOE	Levelized Costs of Electricity
LLL	Lifelong-Learning
LNG	Liquified Natural Gas

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LU	Lift User
M.Sc.	Master of Science
MATES	Maritime Alliance for fostering the European Blue Economy through a Marine Technology Skilling Strategy
MESY	Ministry of Education Sports and Youth
MITECO	Ministerio para la Transición Ecológica y el Reto Demográfico (Ministry for Ecological Transition and Demographic Challenge)
ML	Machine Learning
MOOC	Massive Open Online Course
MPAs	Marine Protected Areas
MSP	Marine Spatial Planning
NDP-OWF	National Offshore Wind Farm Development Programme
NECP	National Energy and Climate Plan
NIP	National Implementation Plan
NOS	National Ocean Strategy
NQF	National Qualifications Framework
O&M	Operation and Maintenance
ODA	Organized Development Areas
ORE	Offshore Renewable Energy
OTEC	Ocean Thermal Energy Conversion
OWE	Offshore wind energy
OWF	Offshore wind farms
OWFODA	Offshore Wind Farms Organized Development Areas
P4S	Pact for Skills
PAER	Allocation Plan for Offshore Renewable Energy
PC	Professional Courses
Ph.D.	Doctor of Philosophy
PNEC	Nacional de Energia e Clima (National Energy and Climate Plan)
PNIEC	Plan Nacional Integrado de Energia y Clima (National Integrated Energy and Climate Plan)
PRR	Recovery and Resilience Plan
PSOEM	Maritime Spatial Planning Situation Plan
RA	Resources Availability
RAEWW	Regulatory Authority for Energy, Waste and Water
RESP	Public Service Electricity Grid

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RRF	Recovery and Resilience Fund
R&D	Research and development
SCC	Specific Curricula Courses
SECTI	Sistema Español de Ciencia, Tecnología e Innovación (Spanish Science, Technology, and Innovation System)
SEIA	Strategic Environmental Impact Assessment
SI	Social Impact
SMEs	Small and Medium-sized Enterprises
SNQ	National System of Qualifications
SSF–RES	Special Spatial Framework for Renewable Energy Sources
STEM	Science, Technology, Engineering and Mathematics
SVQ	System of Vocational Qualifications
SWOT	Strengths, Weaknesses, Opportunities and Threats
S3	Smart Specialisation Strategy
TED	Technology Entertainment Design
TP	Technology Potential
TRL	Technology Readiness Level
TSC	Technological Specialisation Courses
UDC	University of A Coruña
UK	United Kingdom
VET	Vocational Education and Training
VR	Virtual Reality
WP	Work Package
ZAPER	Zonas de Alto Potencial para Energías Renovables (High Potential Areas for Renewable Energies)
ZLT	Zonas Livres Tecnológicas

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1 Introduction

1.1 Scope and Objectives of the Deliverable

Deliverable 2.1 aims to build a shared, comprehensive knowledge base on the Southern European offshore renewable energy sector—encompassing its technical, economic, legal, environmental, and social dimensions—to inform future project activities. By examining relevant national and EU-level policies and strategies, as well as current workforce characteristics, investment levels, and job profiles, this deliverable identifies critical skills gaps and training needs across five participating countries (Portugal, Spain, Italy, Greece, and Cyprus). The findings will help Centres of Vocational Excellence (CoVEs) align their educational programmes with rapidly evolving industry demands and promote best practices within a Community of Practice (CoP).

1.2 Structure of the Deliverable

Under D2.1, a robust data collection and analysis framework has been established to examine the offshore wind sector's workforce needs, training gaps, and skill development priorities. The first step involves defining the scope of the research, specifying both geographical coverage and targeted offshore renewable technologies and developing a standardized protocol that includes templates and data-collection instruments. This approach ensures consistency and comparability across the participating countries.

Data collection then combines desk research (including policy reviews and industry reports) with surveys, interviews, and co-design events. This blend of quantitative and qualitative methods enables an accurate picture of current workforce conditions, such as job types, required skill sets, and investment levels, while illuminating emerging demands in the sector. In the subsequent gap analysis, industry trends and requisite skills are compared to the actual competencies possessed by the existing workforce. This comparison helps identify deficits in both technical and non-technical areas, from advanced engineering knowledge to transversal skills like communication and project management.

Afterwards, the focus shifts to identifying the skills required for key roles and reviewing existing vocational education and training (VET) programmes. Through this examination, the adequacy of current offerings is assessed against rapidly evolving industry needs, especially in digital and green competencies. Based on these findings, initial recommendations are formulated. A proposal is made for new or enhanced training opportunities to address skill shortages, while also emphasizing diversity and best practices that Centres of Vocational Excellence (CoVEs) can adopt collectively.

The field research supporting this work involves administering surveys to teachers, students, and industry professionals, conducting short interviews with a selected subset of respondents for deeper insights, and hosting co-design or design thinking events where the initial findings are refined and validated in collaboration with key stakeholders. All these activities shape the content of the final report, which begins with an overview of the offshore wind sector (its key characteristics, regulatory frameworks, and alignment with national or EU targets) and proceeds to an examination of each country's VET context, including policies, priorities, and best practices.

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A needs assessment then highlights the most urgent workforce requirements—covering both human and material resources—along with trainer development needs. These findings feed into the section on trends and recommendations, which considers future developments in the offshore wind sector, identifies topics on which CoVEs can collaborate, and offers targeted policy or training solutions to remedy existing skill mismatches. By assembling these analyses into one concise document, D2.1 equips educators, trainers, policymakers, and industry stakeholders with evidence-based insights to bolster the offshore renewable energy sector and support the development of a highly competent, adaptable workforce across Southern Europe.

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2 Methodology

2.1 Research Protocol

The main goal of this research protocol is to collect and produce relevant knowledge about the offshore renewable energy sector in its technical, economic, legal, environmental, and social dimensions. This preliminary analysis has allowed the identification of the labour market and skills needs that supported the development of multiple project activities in other WPs.

The offshore renewable energy sector is a complex and multifaceted industry that encompasses several interrelated stages, each of which is critical to the successful development and operation of energy projects. From initial research and planning to decommissioning, each stage requires attention to detail, robust management, and the integration of specialized services (Figure 1). An understanding of this value chain (as explained below) provides insight into the life cycle of offshore renewable energy projects and highlights the importance of strategic planning, technological innovation, and the development of a skilled workforce.

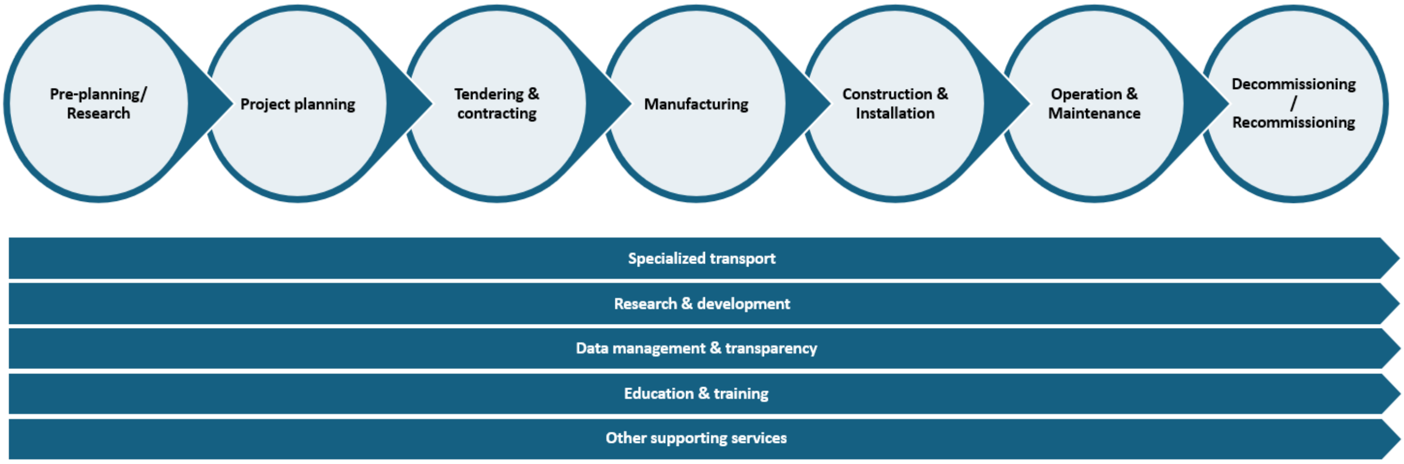

Figure 1. Offshore Renewable Energy value chain (Source: adapted from FLORES project[1])

Pre-planning/Research: This is the initial phase, focusing on conducting comprehensive feasibility studies, selecting appropriate sites, performing environmental impact assessments, and ensuring regulatory compliance. This stage involves identifying optimal locations for offshore installations by considering critical factors such as wind speeds, water depths, and ecological implications. It aims to establish the overall viability and strategic planning of potential projects, ensuring that all necessary groundwork is completed to support informed decision-making and successful project initiation.

[1] "Flores."

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Project planning: The project planning phase involves detailed engineering design, financial modelling, risk assessment, and stakeholder engagement. During this phase, comprehensive blueprints are drafted, financial strategies are developed to secure the necessary funding, and extensive risk analyses are conducted to mitigate potential issues. In addition, obtaining the necessary permits and ensuring regulatory compliance are key components of this phase.

Tendering and contracting: This stage deals with issuing tenders, evaluating bids, and awarding contracts to various suppliers and contractors. The goal is to ensure a competitive selection of services and materials, which is essential for securing the best value and quality for the project. Through this process, project developers can identify and engage with the most capable and cost-effective partners, thereby establishing the necessary agreements and frameworks to proceed with the manufacturing and construction phases.

Manufacturing: A manufacturing company is responsible for designing, producing, testing, and selling one or more of the components that make up an offshore renewable energy power plant. A single manufacturing facility may employ engineers (e.g., aeronautical, civil, design, electrical, environmental, industrial, mechanical, quality, research, structural, production, sub-sea structure design, high voltage electrical), quality managers, control systems specialists, technicians, welders, attorneys, health and safety specialists, back office and administration professionals, assemblers, public relations and marketing professionals, logisticians, and site/plant managers[2].

Construction and installation: This phase is the most labour-intensive of the project. In simple terms, the objectives of this phase are to move the power plant components — turbines, cables, foundations, etc. — to the selected site, conduct any necessary fabrications, install the components according to the site design plan, connect the power plant to the existing electrical grid, and finally test the electrical service from the turbines. For large projects, the construction phase may span several years but typically takes one-half to three years to complete. Many of the jobs of this phase are temporary in nature. Workers may be hired for the duration of this phase or to carry out tasks lasting only a matter of weeks or months. The “construction and installation” phase is the most likely to involve a high concentration of unionised labour. Unionised workers involved in this phase include electricians, painters, pile drivers, labourers, stevedores, millwrights, ironworkers, carpenters, welders, plumbers, and others.

Operation and Maintenance (O&M): The O&M encompasses managing and maintaining offshore renewable energy infrastructure to ensure its efficiency and reliability. This phase includes routine inspections, preventive maintenance, and repairs, with a team of engineers, technicians, and vessel crews performing these tasks Advanced technologies, such as autonomous inspection drones, digital twins, condition monitoring systems, robotic underwater vehicles (ROVs), and AI-powered predictive analytics, play a crucial role in optimizing performance, predicting maintenance needs, and reducing downtime. These innovations

[2] Gould and Cresswell, “A WORKFORCE-FOCUSED RESEARCH REPORT FROM THE WORKFORCE DEVELOPMENT INSTITUTE.”

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enhance safety, extend asset lifespan, and ensure the economic viability of offshore renewable energy systems.

Decommissioning and recommissioning: The decommissioning and recommissioning phase marks the end of an offshore renewable energy project's lifecycle. Decommissioning involves the systematic removal of infrastructure and the remediation of the natural environment, ensuring that the site is restored to a condition that minimises environmental impact. Building trades workers and engineers develop and implement a plan to deconstruct the power plant's components and remove them from the offshore site. Workers such as electricians, utility employees, and riggers disconnect the cables, substations, and transformers from the electrical grid. Barges and their crew handle the deconstruction of the plant's components and their movement to shore. Vessel crew transport employees from ports to the offshore work site, just as they do for the other phases. This process is labour-intensive, requiring specialised crews to dismantle and safely dispose of or recycle components. Conversely, recommissioning focuses on the repowering or upgrading of existing infrastructure to extend its operational life or enhance its efficiency. This phase also demands significant effort and expertise to implement technological improvements and adaptations. Both activities require extensive planning and coordination to manage environmental, safety, and logistical challenges effectively[3].

Horizontal activities in offshore renewable energy projects play a supportive role across the entire lifecycle, enhancing the effectiveness and efficiency of primary processes:

- **Specialised transport:** This includes the logistics of moving large and heavy components from manufacturing sites to construction and installation sites, as well as facilitating the movement of workers for maintenance and other activities. Specialised vessels and transport systems are critical to managing the complex logistics of offshore projects, ensuring the efficient and secure delivery of materials and personnel.
- **Research and Development (R&D):** R&D activities are focused on advancing technology and optimizing systems related to offshore renewable energy. Their efforts drive innovation and help address emerging challenges, contributing to the overall progress and competitiveness of the sector.
- **Data management and transparency:** Effective data management involves the collection, analysis, and dissemination of operational and performance data. Transparency in data reporting supports informed decision-making, regulatory compliance, and stakeholder engagement, ensuring that the project's progress and impacts are accurately communicated.
- **Education and training:** Providing specialised education and training is essential for equipping personnel with the necessary skills and knowledge to operate and maintain offshore renewable energy systems. This includes technical training for engineers and technicians, safety training for all staff, and ongoing professional development to keep up with technological advancements and industry standards.

[3] Gould and Cresswell.

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- **Other supporting services:** This broad category covers various services that facilitate the smooth operation of offshore renewable energy projects, including insurance, IT services, management and administration, financing, policymaking, consulting, and legal support. These services ensure that projects are well-supported from a financial, administrative, and regulatory perspective, contributing to their overall success and sustainability.

To achieve the main goal, the study was divided into four main pillars which are:

- **Sectoral context:** Provides an umbrella view of the offshore renewable energy sector, examining its characteristics, strengths, weaknesses, opportunities, and threats (SWOT). It covers the regulatory framework, strategic alignment with regional development plans, and contributions to societal challenges. This context helps to understand the industry's current landscape, regulatory environment, and future potential and provides the basis for identifying sector-specific needs and trends.
- **VET context:** Focuses on the vocational education and training systems within the offshore renewable energy sector. It explores the policies, priorities, and existing training programmes in participating countries. The context assesses how well the current VET infrastructure supports the sector's workforce needs, highlighting gaps, strengths, and opportunities for improving education and training to meet industry needs.
- **Needs assessment:** Identifies and evaluates the skills, qualifications, and training requirements necessary for the offshore renewable energy sector. It includes an analysis of the current labour market needs, the skills of the workforce, and the expertise of trainers. This assessment helps to identify specific areas where vocational training needs to be developed or improved to ensure that the workforce is equipped with the necessary technical, digital, and environmental skills.
- **Trends and recommendations:** Examines the latest trends in the offshore renewable energy sector and the skills required. It identifies common thematic domains across the participating countries and areas where each country has unique strengths and challenges. The trends and recommendations outline strategies to align vocational training with industry needs, promote upward convergence, and provide actionable insights to improve training programmes and sector collaboration.

Each pillar provided a distinct but interrelated understanding and strategic framework:

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Sectoral context

Characterization of the offshore wind sector

- SWOT analysis for each country
- Identification of challenges, priorities for development, and forecasted evolution

Legal framework and alignment with regional strategies

- Analysis of relevant national and European regulations.
- Assessment of CoVE alignment with regional Research and Innovation Strategies for Smart Specialisation.

Sector indicators, targets, and contribution to social challenges

- Examination of national and international indicators and targets.
- Mapping of sector value chain and associated job profiles.
- Evaluation of potential contributions to addressing social challenges.

VET context

VET systems, policies, and priorities

- Assessment of VET systems, policies, and priorities in each CoVE country (Portugal, Greece, Spain, Cyprus, and Italy).
- Analysis of VET frameworks, regulations, and strategic objectives.

Mapping of the VET offer and inclusion provisions

- Identification and mapping of available VET programs in each country directly or indirectly related to the offshore wind industry.
- Assessment of inclusion and attractiveness provisions within the VET system, particularly in fields related to wind energy.

Assets from the CoVE members

- Evaluation of the experience, knowledge, best practices, and resources contributed by CoVE members.
- Identification of CoVE member contributions to strengthening the community's training offer and enhancing VET programs in the offshore wind sector.

Needs assessment

Identification of skills and qualifications in demand in the job market

- Analysis of current job market trends and requirements.
- Identification of key skills and qualifications needed for employment in the offshore wind sector.

Identification of trainers and their training needs

- Assessment of trainers' backgrounds, qualifications, and areas of expertise.
- Identification of training needs through surveys or interviews with trainers.

Identification of other needs of the industry and education

- Evaluation of additional needs such as equipment, training methodologies, and resources required to support VET programs.
- Analysis of industry and education stakeholders' perspectives on current challenges and areas for improvement.

Skills gap analysis

- Identification of the skills and knowledge required for offshore wind energy.
- Assessment of the current skills and knowledge of the workforce through surveys, interviews, or skill assessments.
- Focus on technical skills, soft skills, digital competencies, and green skills necessary for the sector.

Trends and recommendations

Sector and skills trends

- Analysis of emerging trends in the offshore wind sector and related skills.
- Identification of key areas for skill development and adaptation to industry advancements.

CoVEs' thematic focus

- Assessment of common interests and alignment among the five countries regarding CoVE thematic focus.
- Identification of unique strengths and challenges in each country, serving as the basis for developing the overall thematic focus of the CoVE.

Potential for upwards convergence

- Evaluation of the needs and offerings of each CoVE within the SHOREWINNER Community of Practice context.
- Identification of areas where collaboration and convergence can lead to enhanced outcomes and shared benefits across countries.

Figure 2. Research protocol detailed steps[4]

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2.2 Data Collection Methods

The research approach involved conducting parallel desk and field research across five participating countries: Portugal, Spain, Italy, Greece, and Cyprus. The surveys and other data collection tools were standardised across these countries to ensure consistency and comparability of the data. The initial survey questions were refined based on feedback from project partners to achieve a final standardised set for all participants.

2.2.1 Desk research methodology

Desk research involved the collection and analysis of secondary data from various sources, including industry reports, academic publications, policy documents, and existing statistical data. The following steps were taken:

- **Scope identification**: Definition of the geographic and technological scope of the research.
- **Data collection**: The objective was data acquisition on the current state of the offshore renewable energy sector, including workforce size and growth, job types, and vocational education and training (VET) offerings. The focus was on supply chain development and associated job profiles, aligning with the regional and national smart specialisation strategies of the participating countries. Possible sources for data collection could be internal data (e.g. database information, customer-generated data, previous research results etc.) and/or external data (e.g. government, non-government agencies, trade body statistics, competitor research, public library collections, textbooks and research journals, online journals, and research sites etc.) Useful information could be found in similar projects related to the offshore renewable energy value chain, such as MATES[5] (Maritime Alliance for fostering the European Blue economy through a Marine Technology Skilling Strategy) and FLORES[6] (Offshore Renewable Energies partnership in the Pact for Skills).
- **Stakeholder analysis**: Identification and evaluation of key stakeholders in the offshore renewable energy sector in Southern Europe. This included policymakers, social partners and professional bodies, education and training providers, and employers. The analysis mapped their roles, interests, and influence to ensure the educational training programmes aligned with their needs and expectations, facilitating effective collaboration and targeted vocational training program development.
  Stakeholder engagement plays a crucial role throughout the whole project as it can help minimise unintended consequences by anticipating potential challenges arising from different agendas and values and proactively addressing them. Inclusive stakeholder consultation can serve to define the scope of scenarios, ensure proper communication of results, build trust, increase acceptance of results, and generally build common ground among stakeholders for future applications of the

[4] Voltalia Portugal SA, "SHOREWINNER."
[5] "Maritime Alliance for Fostering the European Blue Economy through a Marine Technology Skilling Strategy."
[6] "Flores."

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scenario or strategy. Moreover, the involvement of stakeholders ensures continuity in long-term planning beyond possible changes in political administrations. Therefore, engaging with stakeholders throughout the whole process is crucial to ensuring its effectiveness and sustainability[7].

To identify stakeholders and engage with all of them constructively and avoid power imbalances, it will be necessary to have a framework to classify them and understand how to engage with them. One option is the two-dimensional Eden and Ackerman matrix[8] which maps stakeholder groups and their interest areas onto a matrix. The grid is divided into four quadrants defining four categories of stakeholders based on influence and interest variables (Figure 3).

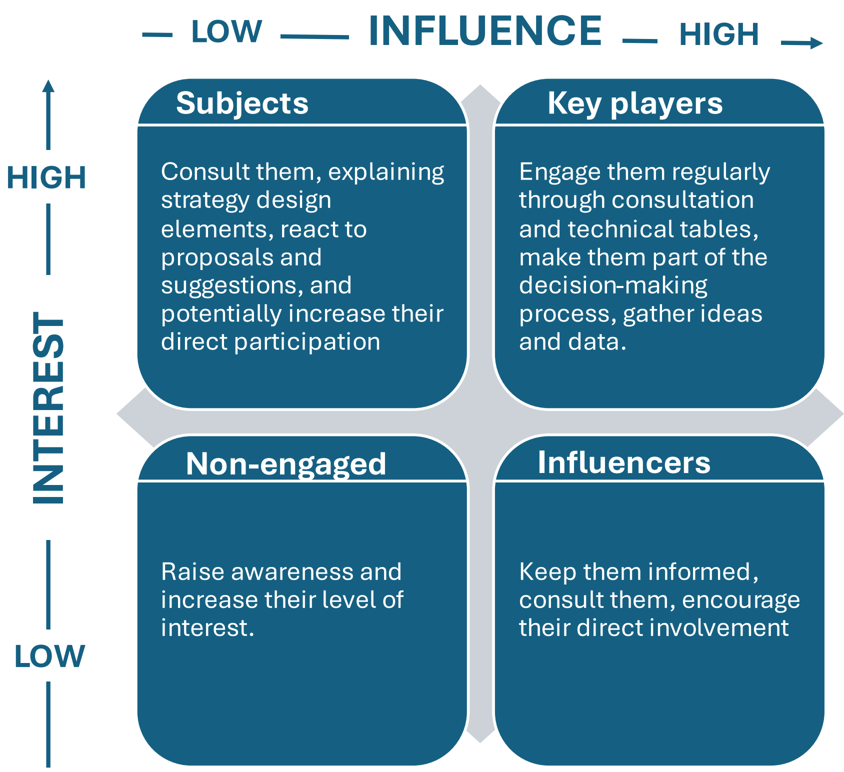

Figure 3. Stakeholder matrix [9]

- **Skills needs identification**: Identification of technical and transverse skills required for various roles in the sector. For the categorisation of skills and definition of job profiles, it was proposed to use the

[7] "Green Hydrogen Strategy: A Guide to Design."
[8] Ackermann and Eden, "Strategic Management of Stakeholders."
[9] "Green Hydrogen Strategy: A Guide to Design."

European Skills/ Competences, Qualifications and Occupations (ESCO)[10] classification along with their ISCO[11] code.

- **Skills supply (VET and HE) analysis**: Identification of relevant VET and HE programmes that met current and projected labour force demands across the European context, based on the skills needs identification conducted in previous steps
- **Gap analysis**: Analysis of industry trends, skills, and qualifications, including comparison with the current state.
- **Preliminary strategies**: Development of strategies to address identified gaps, including new training offers and best practices from other countries.

2.2.2 Field research methodology

Field research involved the collection of primary data through surveys and interviews with key stakeholders, including VET and higher education (HE) teachers, students, and industry professionals. The methodology included:

- **Survey design**: Conducting paper-based or online surveys using online platforms to ensure easy data collection and distribution. Each survey included fields for basic details of the respondents and their institutions to ensure data reliability. Each survey was GDPR compliant following, but not limited to, the bellow guidelines:
    - Presentation of the organisations' privacy policy to respondents before survey commencement.
    - Request for publication consent from respondents.
    - Inclusion of a single checkbox on the first page of the survey, requiring respondents to consent to the privacy policy before proceeding.
    - Assurance that no personally identifiable information be revealed when sharing the results.

  The surveys were designed in a standardised manner to enable a holistic approach to the issue, thereby facilitating the subsequent interpretation of the results.

- **Data collection guidelines**: Collection of data through the designed surveys, focusing on skills needs, gaps, and training requirements. The estimation of survey responses was as follows: 30 from VET and HE teachers per CoVE, 50 from VET and HE students per CoVE, and 20 from industry professionals per CoVE.
- **Data analysis**: Analysis of survey responses to identify trends and needs in the offshore renewable energy sector. Particular attention was given to achieving a balanced representation for both age and gender within the participants.

[10] "CEDEFOP | European Centre for the Development of Vocational Training."
[11] "International Standard Classification of Occupations (ISCO)."

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- **Sharing protocols**: English was the reference language for sharing protocols, guidelines, templates, and final research results, even if the research itself may have been conducted in each country's national language.

2.2.3 Data management

The methodology for data collection involved the distribution of standardised surveys, which partners could choose to conduct online or in paper format, depending on their preferences. These surveys were carefully designed to gather detailed and meaningful insights from participants, ensuring comprehensive data collection. Once completed, all survey responses were recorded and stored in a centralised database to facilitate efficient data management and analysis across the project consortium. This approach aimed to ensure consistency and reliability which would enhance the overall quality and integrity of the research findings. The beneficiaries had to process personal data under the Agreement in compliance with the applicable EU, international and national law on data protection, according to article 15.2 of the GA. The data and results shared on the project website had to respect Article 16 of the GA for Intellectual Property Rights (IPR). All data was securely stored in a centralised digital repository with controlled access. Sensitive data was anonymised to protect respondent confidentiality. Access to collected data was restricted to authorised project partners. Data sharing protocols ensured compliance with relevant data protection regulations, including GDPR. Beneficiaries were required to notify individuals about the transfer of their data to the European Education and Culture Executive Agency (EACEA). Additionally, they were required to provide them with the Portal Privacy Statement[12], which explained the data processing procedures.

2.3 Analysis Techniques

Based on the methodological framework outlined, the following analysis techniques were employed to interpret and synthesize the data collected through desk and field research (Figure 4). These techniques facilitated a comprehensive understanding of the offshore renewable energy sector and its vocational education and training (VET) needs.

[12] "EU Funding & Tenders Portal."

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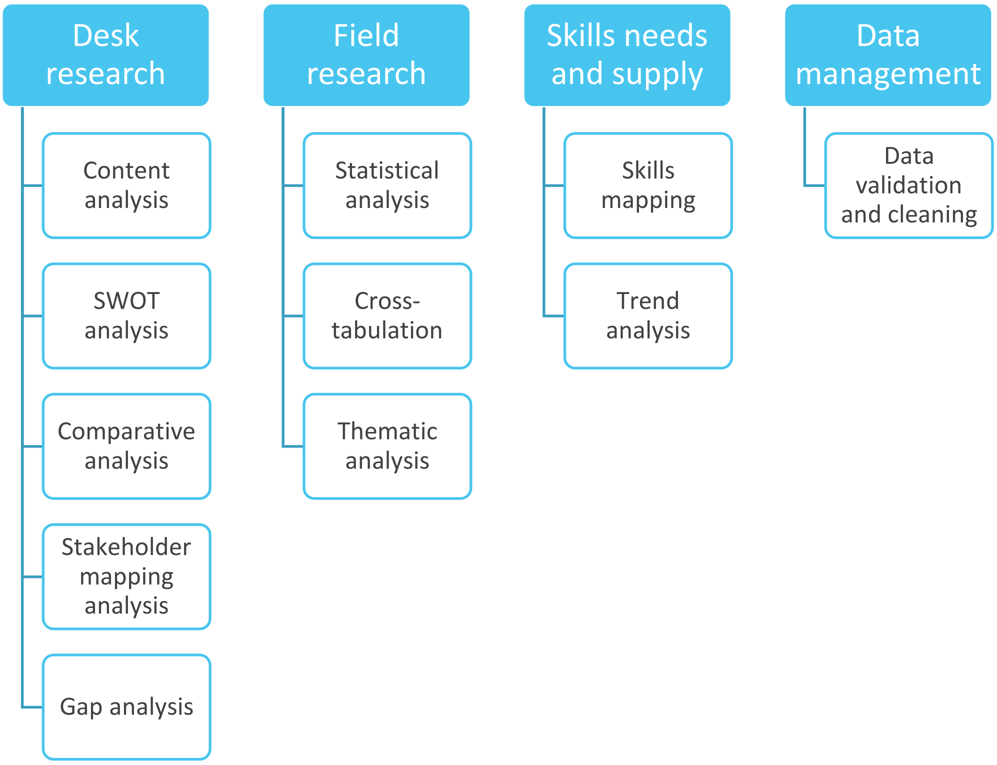

Figure 4. Methodological framework analysis techniques

Desk research

- **Content analysis**: Systematic examination of collected secondary data, including industry reports, policy documents, and academic publications. This involved identifying key themes, patterns, and trends related to the offshore renewable energy sector's technical, economic, legal, environmental, and social dimensions.
- **SWOT analysis**: Evaluation of the sector's strengths, weaknesses, opportunities, and threats. This analysis provided an umbrella view of the industry, informing strategic planning and highlighting areas for improvement and potential growth.
- **Comparative analysis**: Cross-country comparison of the offshore renewable energy sectors and VET systems in Portugal, Spain, Italy, Greece, and Cyprus. This technique identified similarities and differences, enabling the sharing of best practices and lessons learned.
- **Stakeholder mapping analysis**: Identification and assessment of key stakeholders using the Eden and Ackerman matrix. Stakeholders were categorised based on their level of influence and interest, which guided engagement strategies and ensured balanced representation in the research findings.
- **Gap analysis**: Assessment of discrepancies between current VET offerings (skills supply) and the industry's needs (skills demand). This analysis highlighted specific areas where training programmes need development or enhancement to meet labour market requirements.

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Field Research

- **Statistical analysis:** Utilisation of statistical measures such as means, medians, modes, frequencies, and percentages to summarize survey data from VET and HE teachers, students, and industry professionals. This provided an overview of the demographic characteristics and general responses of participants.
- **Cross-tabulation**: Examination of the relationships between different variables (e.g., specific skills needs vs. current training provisions) to identify patterns and correlations within the survey data.
- **Thematic analysis**: Analysis of qualitative data from open-ended survey responses and interviews. This involved coding responses to identify recurring themes, insights, and perceptions about the offshore renewable energy sector and VET requirements.

Skills needs and supply

- **Skills mapping**: Alignment of the identified industry skills needs with existing VET and higher education programmes. This mapping utilised the European Skills, Competences, Qualifications, and Occupations (ESCO) classification to standardize job profiles and competencies.
- **Trend analysis**: Investigation of emerging trends in skills demand and technological advancements within the sector. This analysis informed recommendations for updating or developing new training programmes.

Data management

- **Data validation and cleaning**: Procedures to ensure data accuracy and integrity, including checking for inconsistencies, handling missing values, and verifying responses.

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3 Sectoral and VET Context

3.1 Global and European Overview of the Offshore Renewable Energy Status

3.1.1 Introduction

Offshore renewable energy is a key component in the transition to a sustainable and carbon-neutral energy world (Figure 5). It utilises the natural resources of the ocean to generate clean electricity, making a significant contribution to reducing greenhouse gas emissions. Among the various offshore renewable energy technologies, offshore wind is the most advanced and widely deployed. However, there are other systems that obtain energy from seas and oceans such as wave energy, tidal energy, and thermal energy.

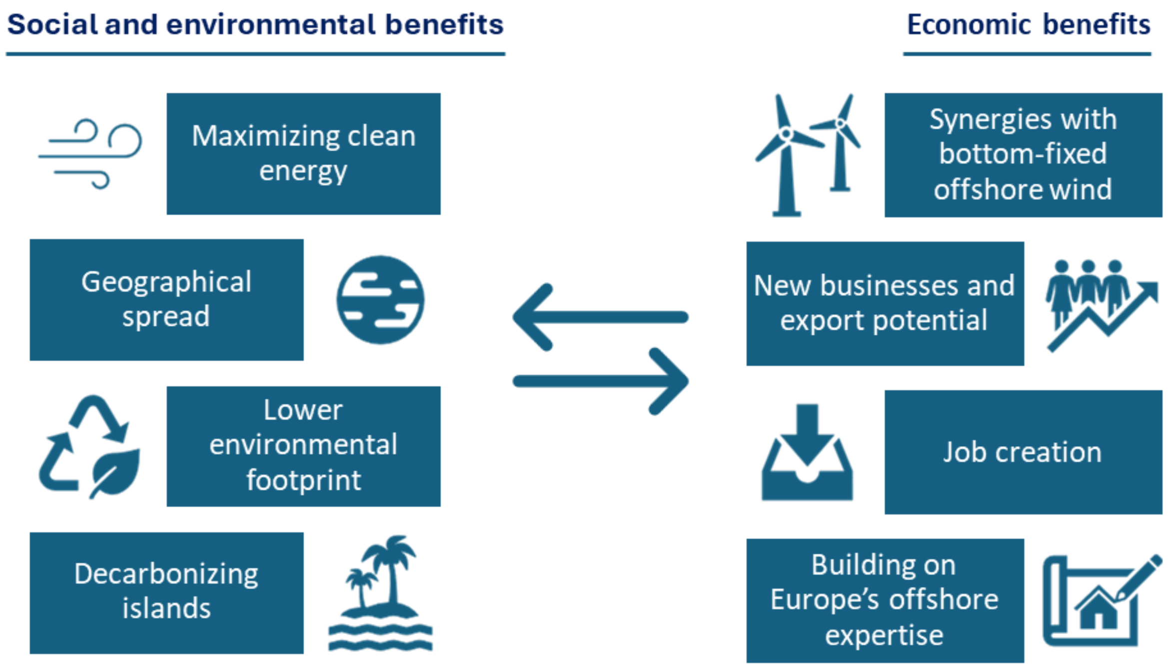

Figure 5. Benefits of offshore renewable energy in Europe (Source: adapted from ETIP Wind Factsheet 2020)

Wind energy utilises large turbines situated in marine environments to capture the kinetic energy from the wind. These turbines are either fixed to the seabed in shallow waters or mounted on floating platforms in deeper waters (Figure 6).

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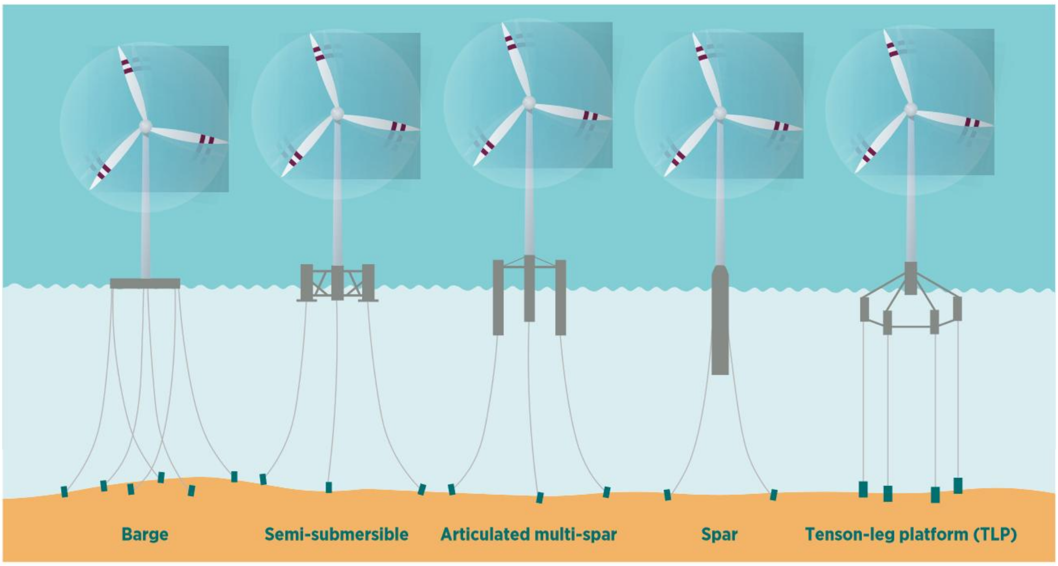

Figure 6. Main categories of floating offshore wind turbine foundations (Source: IRENA 2021a)

The energy capture process begins as the wind turns the turbine blades, which spin a shaft connected to a generator. The generator then converts this mechanical energy into electrical energy, which is transmitted to the shore via underwater cables. Offshore wind turbines installed on floaters have access to the strongest and most stable winds. Installed in more remote maritime areas, they operate whenever the wind blows. They can have average capacity factors of over 50%. Southern Europe, with its expansive coastlines, provides ideal conditions for the deployment of offshore wind farms, contributing significantly to regional renewable energy goals.

Wave energy harnesses the power of ocean surface waves to generate electricity. The energy contained in waves is a form of solar energy, created by the wind as it blows across the surface of the sea. Wave Energy Converters (WECs) capture the kinetic and potential energy of waves and convert it into mechanical energy, which is then transformed into electrical energy. There is a wide range of wave energy technologies (Figure 7).

Each technology uses different solutions to absorb energy from waves and can be applied depending on the water depth and the location. Point absorbers are floating structures that move with the waves, driving a generator to produce electricity. Oscillating water columns capture air movement caused by waves to drive a turbine, while attenuators are long, multi-segmented devices that flex with the wave motion, generating power. Wave energy is reliable and abundant, making it a valuable addition to the renewable energy mixture.

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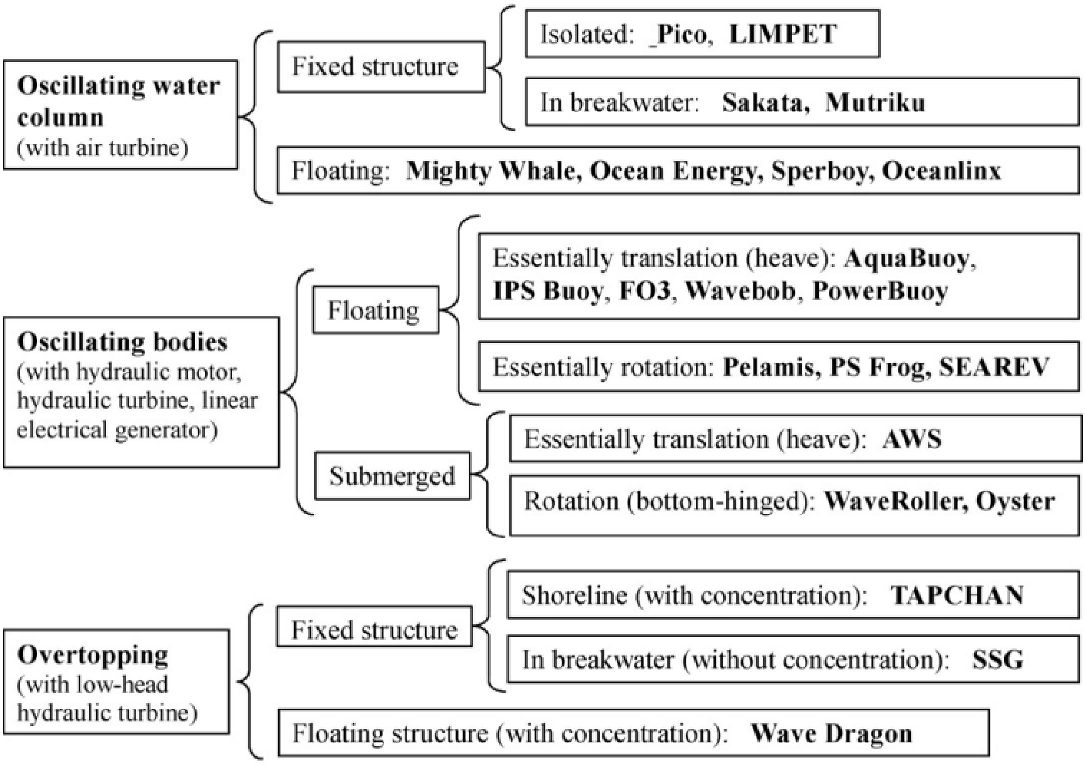

Figure 7. The various wave energy technologies[13]

Tidal energy exploits the predictable and regular movement of tidal currents caused by the gravitational pull of the moon and the sun on the Earth's oceans. This form of energy can be harnessed using tidal stream generators, which operate similarly to underwater wind turbines, or tidal barrages, which use the potential energy in the difference in height (or head) between high and low tides (Figure 8). Tidal stream generators are positioned in areas with strong tidal currents, such as between islands or along coastlines. As the tides flow, they turn the turbine blades, which drive a generator to produce electricity. Tidal barrages work by capturing water at high tide in a reservoir and releasing it through turbines at low tide. The predictability of tides makes tidal energy a consistent and reliable source of renewable power.

[13] Falcão, "Wave Energy Utilization."

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Figure 8. Illustration of tidal energy technologies[14]

Ocean Thermal Energy Conversion (OTEC) utilises the temperature difference between warm surface water and cold deep seawater to generate electricity (Figure 9). This temperature gradient drives a heat engine, typically using a working fluid with a low boiling point, such as ammonia. In a closed-cycle OTEC system, warm seawater heats the working fluid, causing it to vaporize. The vapor expands and drives a turbine connected to a generator, producing electricity. Cold seawater is then used to condense the vapor back into a liquid, and the cycle repeats. OTEC systems can operate continuously, providing a stable base-load power supply. This technology is particularly effective in tropical regions where the temperature difference between surface and deep water is greatest.

[14] https://education.nationalgeographic.org/resource/tidal-energy/

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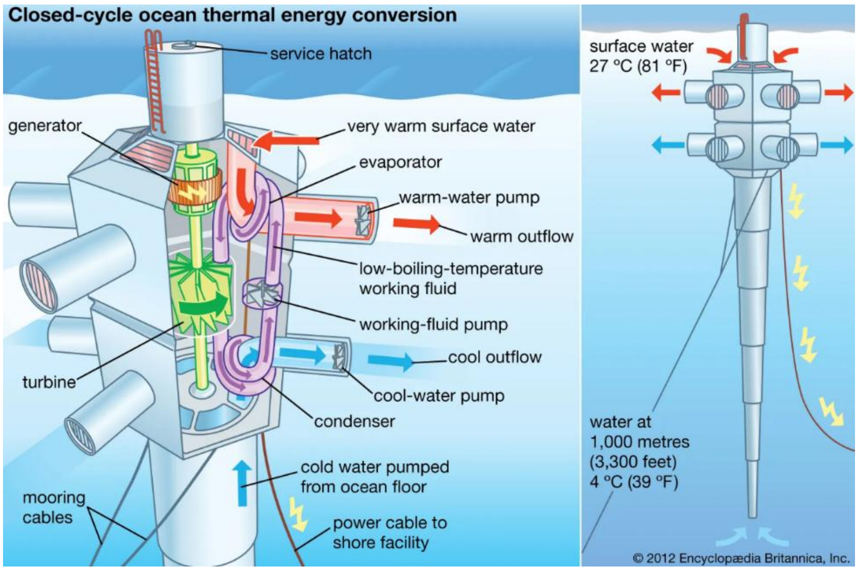

Figure 9. Illustration of OTEC cycle[15]

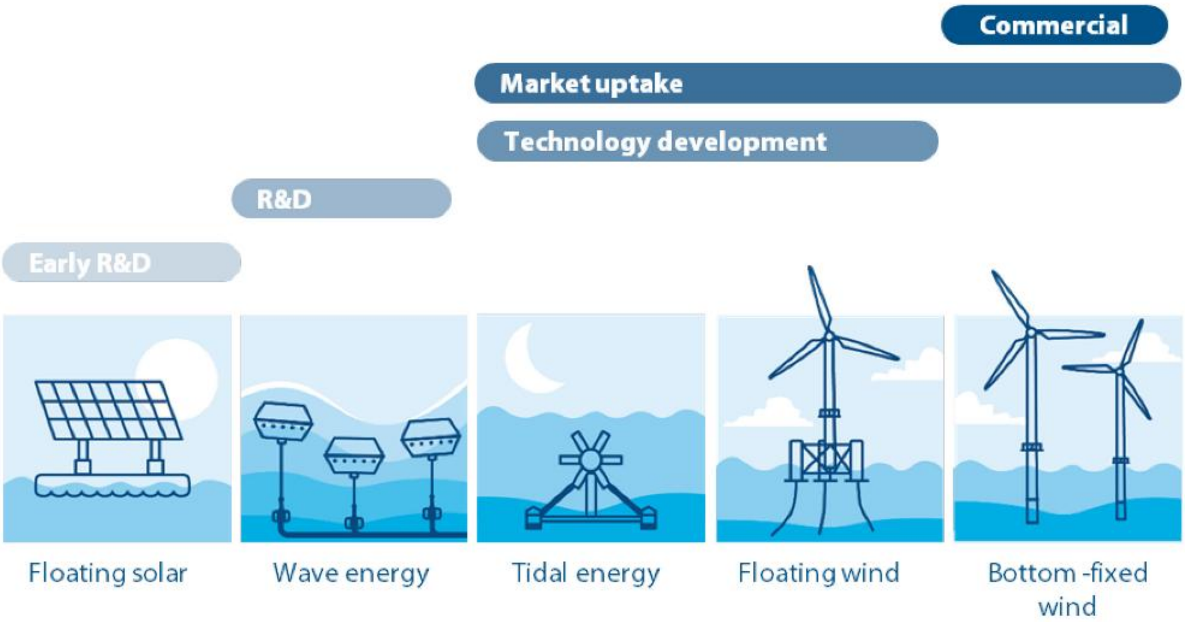

Figure 10. Overview of the ORE technologies[16]

[15] https://www.britannica.com/technology/ocean-thermal-energy-conversion
[16] "Special Report 22/2023: Offshore Renewable Energy in the EU."

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Figure 10 illustrates the developmental status of various offshore renewable energy technologies:

- Floating Solar: Currently in the **Early R&D (Research and Development)** stage, this technology focuses on developing concepts and prototypes for deploying solar panels on water surfaces.
- Wave Energy: Also in the **R&D** stage, wave energy systems are being tested to harness energy from ocean waves. Prototypes are being developed to improve efficiency and durability.
- Tidal Energy: Positioned further along in **Technology Development**, tidal energy systems are transitioning from prototype testing to addressing challenges related to scalability and commercial viability.
- Floating Wind: In the **Market Uptake** phase, floating offshore wind has demonstrated technical feasibility and is gaining traction as costs decline and deployment scales increase.
- Bottom-Fixed Wind: At the **Commercial** stage, this is the most mature technology. Bottom-fixed wind systems are widely deployed and have achieved significant cost reductions, with established supply chains and large-scale installations.

3.1.2 Global overview of offshore renewable energy

Globally, the offshore renewable energy market is growing rapidly. Asia, particularly China and India, are emerging as significant competitors, with substantial investments in offshore wind capacity. In the offshore market, 10.8 GW of new offshore wind was commissioned in 2023, bringing a total global offshore wind capacity to 75.2 GW. Offshore wind additions were 24% higher than in 2022, making 2023 the second-highest year for new offshore wind capacity.

Projections indicate that offshore wind can achieve one-third of the necessary global power sector emissions reductions to reach net zero by 2050. To meet this target, the world will need 380 GW of offshore wind capacity by 2030 and 2,000 GW by 2050, according to IRENA's World Energy Transitions Outlook. The World Bank estimates there is over 71,000 GW of technical potential globally, with significant growth expected outside the traditional markets of Europe and China. [17]

Offshore wind is a key asset in achieving these goals while promoting economic stability. Over the past two decades, it has evolved into a mature, competitive, and scalable energy source. Offshore wind offers large-scale, reliable power and addresses critical issues of energy diversification and security by providing a high-capacity factor and substantial power output. It does so without competing for limited land space and can effectively replace conventional baseload power.

[17] Backwell et al., "Contributors and Editing By."

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For instance, the 3.6 GW Dogger Bank wind farm in the UK, once completed, will supply power to 6 million homes annually. Such projects are well-suited to ensuring national energy security, resilience, and independence.

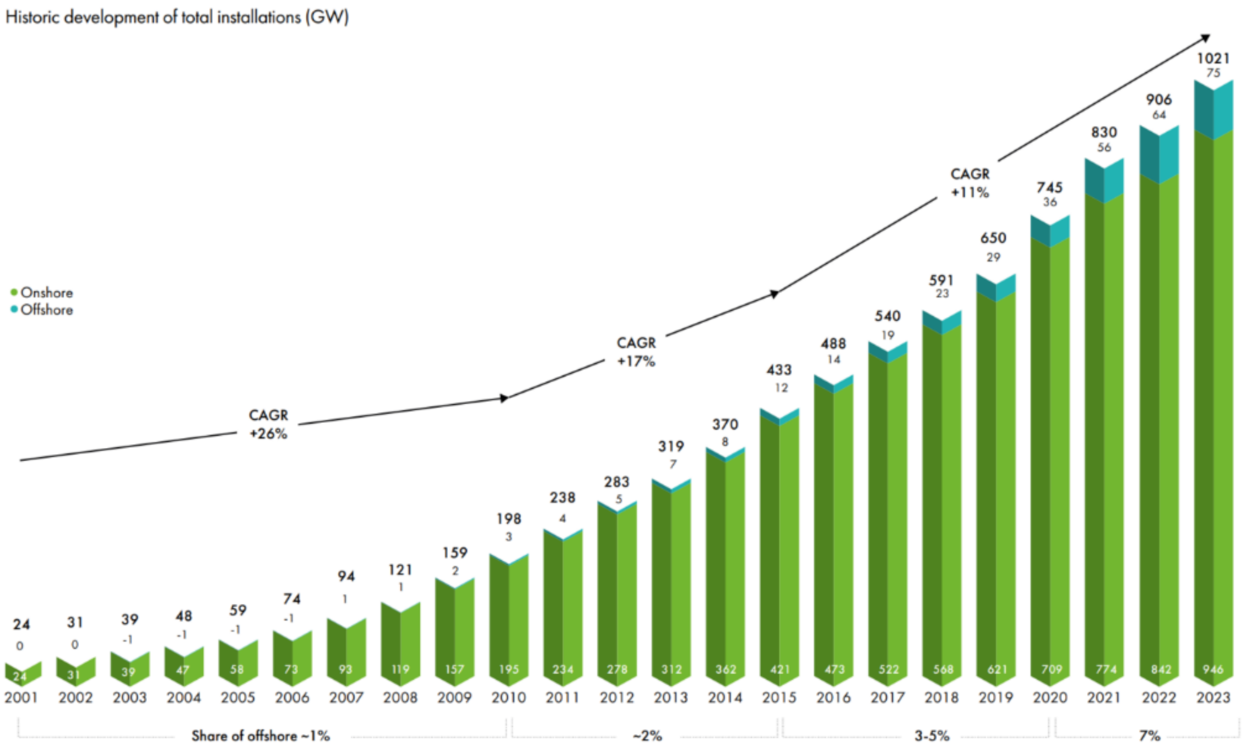

Figure 11. Historic development of onshore and offshore installations in GW (Source: GWEC report 2023)

The diagram in Figure 11 shows the historic growth of wind energy installations from 2001 to 2023, highlighting a continuous upward trend with varying growth rates over different periods. Initially, wind energy installations were primarily onshore, with offshore installations making up a very small portion. Over time, the share of offshore installations has grown significantly, particularly after 2010, due to increased investments and technological advancements. This shift indicates a growing emphasis on offshore wind energy, contributing to the overall substantial increase in wind energy capacity over the past two decades.

Furthermore, offshore wind, along with other offshore renewables, plays a pivotal role in driving a sustainable Blue Economy. Offshore wind contributes positively to sustainable development by ensuring the equitable use of resources through transparent and strategic planning processes. These include comprehensive marine spatial planning and systematic ecological and socioeconomic assessments, guided by social acceptance, cost-benefit analyses, and multi-criteria decision analyses, aiming for optimal outcomes.

Through advanced technology and energy-efficient practices, offshore wind promotes sustainable economic growth. This approach not only sets higher management standards but also enhances environmental quality, balancing economic development with environmental preservation. The benefits extend beyond coastal areas, as supply chains and service providers from various countries support this endeavour.

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The connections between the Blue Economy, sustainable development, and economic growth are clear. However, traditional economic indicators like GDP can be misleading as they often fail to account for natural capital (such as forests, water, and minerals), human capital (education, skills, and health), and social capital (innovation, such as patents).

An analysis of the EU indicates that the offshore wind industry generates approximately €2.5 billion in value for every new gigawatt installed. This means each new offshore turbine contributes about €20.3 million to the EU economy. By 2030, the economic contribution is projected to be 2.5 times greater than in 2022, with wind energy expected to make up 0.81% of the EU's GDP, nearly half of which will come from offshore wind[18].

In the United States, the growth of offshore wind is expected to deliver substantial economic benefits over the next decade. According to the American Clean Power (ACP), under an optimistic scenario of 3,000 MW installed per year and 60% domestic content, these benefits could reach $25 billion annually and support more than 83,000 jobs by 2030. This does not include additional value from tax revenues, emission reductions, health savings, and direct payments supporting workforce development and host communities[19].

Beyond large turbine components, offshore wind presents opportunities for domestic manufacturing, including the production of steel for foundations, substations, and vessels, as well as cables for electricity transport. Additionally, vessels are needed to transport components and workers to and from the project sites[20].

These trends underscore the potential for significant advancements through learning via Research and Development (R&D), leading to technological enhancements. Initially, offshore wind farms were situated closer to shore and at shallow depths (Figure 12). However, thanks to stronger and more consistent wind resources, research, development, and demonstration (RD&D) initiatives have prompted a shift of wind farms to greater distances from the coast and deeper waters[21].

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[18] Dhavle, Boshell, and Roland, "Floating Offshore Wind Outlook."
[19] ACP, "U.S. Offshore Wind Economic Impact Assessment."
[20] Backwell et al., "Contributors and Editing By."
[21] Dhavle, Boshell, and Roland, "Floating Offshore Wind Outlook."

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Figure 12. Offshore wind turbine development trends, 2000-2022 (Source: IRENA, 2023b)

3.1.3 European overview of offshore renewable energy

Europe was the early adopter of offshore wind technology and quickly emerged as the world leader in offshore development. The first offshore wind farm, Vindeby, was installed in Denmark in 1991. Currently (2024), Europe maintains its prominent position, with 45% or 34 GW of total global offshore wind installed capacity in operation, making it the second-largest region in this sector (REF).

EU Strategy for Offshore Renewable Energy Sources

On 19 November 2020, the European Commission published an EU Strategy to harness the potential of offshore renewable energy for a climate-neutral future. This Offshore Renewable Strategy was widely anticipated as part of the European Green Deal and foreseen in the Commission's 2020 Work Programme (infographic in Figure 13). Consultations with stakeholders took place over the course of 2020, including an online public consultation that closed on 24 September 2020.

The Offshore Renewable Strategy aims to dramatically increase the EU's production of electricity from offshore renewable energy sources from 12 gigawatts (GW) at present to over 60GW by 2030 and 300GW by 2050. Whereas wind power is the only offshore renewable technology that currently operates on a commercial basis, the European Commission also sees huge potential in other renewable technologies such as tidal and wave power, floating solar energy, and algae for biofuels. In terms of offshore wind power, the commercial development of floating technologies will allow the exploitation of a much wider range of potential offshore locations.

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The strategy seeks to facilitate the necessary investment of almost €800 billion in offshore renewables between now and 2050, by increasing certainty for investors and smoothing the path for investments, easing bottlenecks, and finding the best combination of public and private finance. Regional cooperation is essential to reaching this goal and ensuring that renewable technologies are developed not only in the North Sea (where most offshore wind projects are currently located) but also in the Baltic Sea, Mediterranean Sea, Black Sea, Atlantic Ocean, and outermost regions and overseas territories. The EU will promote a pan-European supply chain involving multiple regions in coastal and inland areas and look to enhance maritime spatial planning for a successful large-scale deployment of offshore renewable energy. Among the thorny issues to be resolved is the interaction between offshore energy production and other maritime industries such as fishing. The EU should provide a predictable legal framework that promotes innovative and cost-effective projects. It is important to strengthen supply chains and support continuous innovation in the offshore renewables sector, where Europe is the leader in terms of both market size and the development of new technologies. European leadership in offshore renewables helps to support valuable green jobs across the EU (and many more to come as an investment is scaled up), yet the EU faces strong competition from China, the United Kingdom and other countries that are investing heavily in this sector.

In terms of EU financing, the strategy notes the continued importance of mainstream EU programmes such as the Connecting Europe Facility for cross-border infrastructure, the Horizon Europe programme for research and innovation, as well as the new InvestEU programme. It also heavily emphasises the importance of the NextGenerationEU recovery plan, in particular the Recovery and Resilience Facility (RRF), which has a total budget of 672.5 billion Euros of which at least 37 % should be spent on climate-related actions. RRF projects need to be committed by the end of 2023, so it is essential that EU Member States present a pipeline of mature projects that are immediately eligible for funding.

The Commission adopted a legislative proposal on 14 July 2021 to revise the Renewable Energy Directive. This includes a provision that would oblige Member States to cooperate on the amount of offshore renewable generation to be deployed within each sea basin by 2050 and increase their cross-border cooperation on renewable energy, inter alia, through offshore hubs.[22]

The invasion of Ukraine by Russia and its use of gas supplies as a political tool has led to an unprecedented energy security crisis in the EU, resulting in a sharp rise in prices. The EU has taken decisive actions by introducing REPowerEU which aims to eradicate energy dependence on Russia, enhance energy security, increase the share of renewables from 40% (1,067 GW) to 45% (1,236 GW) by 2030, ensure overall resilience through domestically sourced affordable renewables, and reduce prices over time.

[22] Parliament, "EU Strategy for Offshore Renewable Energy Sources | Legislative Train Schedule."

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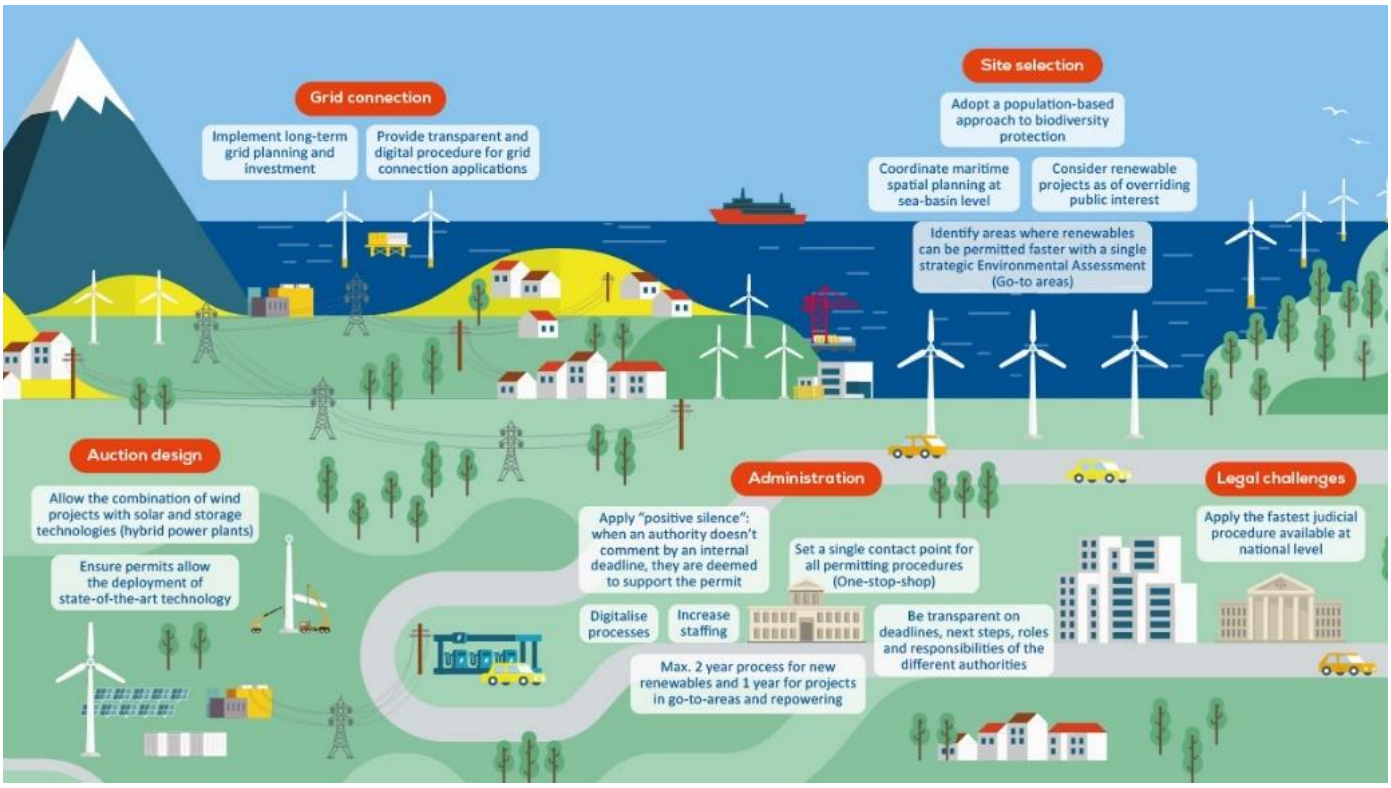

Figure 13. Infographic of guidance to simplify permitting of wind energy projects[23]

The forward-looking strategies introduced in 2023 to enhance energy security through offshore wind include the EU's Offshore Renewable Energy (ORE) generation goals across its five sea basins, aiming for approximately 111 GW by 2030, nearly twice the at least 60 GW set out in the EU Offshore Renewable Energy Strategy [24] in November 2020, and around 317 GW by 2050 [25]. Additionally, there are plans to build 300 GW in the North Seas by 2050 under the Ostend Declaration. The Baltic Sea countries have a target of 19.6 GW by 2030 under 'The Vilnius Declaration'[26].

[23] Tang, "Europe Puts Fast Permitting of Renewables at the Heart of Its Energy Security Plan."
[24] European Commission and Directorate-General for Energy, "An EU Strategy to Harness the Potential of Offshore Renewable Energy for a Climate Neutral Future."
[25] "Member States Agree New Ambition for Expanding Offshore Renewable Energy."
[26] https://windeurope.org/wp-content/uploads/files/newsroom/press-releases/20240410-Vilnius-Declaration-of-Energy-Ministers.pdf

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Moreover, nine countries of the North Seas Energy Cooperation (NSEC) are collectively planning auctions for around 15 GW annually, aiming to award almost 100 GW between 2023 and 2030[27,28].

Southern Europe

In the Mediterranean region, encompassing the five countries involved in this project, the deployment of offshore renewable technologies for electricity generation has progressed relatively slowly. This includes floating offshore wind, wave, and tidal pilot projects. In contrast, onshore wind and solar PV are widely distributed across the Mediterranean islands. Most countries in the region have established specific targets for these technologies over the coming decade, as outlined in their National Energy and Climate Plans (NECPs). The most ambitious targets are set for offshore bottom-fixed wind (notably in France, Italy, and Portugal) and onshore PV. Additionally, countries such as Greece, Malta, and Cyprus are actively conducting analyses of Renewable Energy Sources (RES) potential, which could lead to even more ambitious future policy targets.

Studies indicate that floating offshore wind is the most suitable technology for the region due to the large available areas with favourable wind speeds, appropriate water depths, and relatively high-capacity factors. This results in a technical potential of approximately 4,600 TWh/a by 2030 and 4,700 TWh/a by 2050. Although technology is not yet fully mature, it is promising, with costs expected to decrease over time[29].

The technical potential for bottom-fixed offshore wind in the Mediterranean is limited due to water depth constraints, estimated at 60 TWh/a by 2050. Despite these limitations, bottom-fixed offshore wind is a mature technology and suitable for deployment in specific parts of the Mediterranean region.

Wave energy also shows significant technical potential, estimated at 4,500 TWh/a by 2050, which is comparable to floating offshore wind. However, wave energy technology remains less mature and more expensive than both offshore and onshore wind and solar technologies. Further research, development, and innovation (RDI) investments are necessary to overcome these barriers. Tidal energy, while having a more limited role, is constrained by its lower technical resource potential (22 TWh/a by 2050), technological immaturity, and high-cost levels[30].

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[27] https://energy.ec.europa.eu/system/files/2023-11/231117%20NSEC%20tender%20planning%20-%20November%202023_0.pdf

[28] https://energy.ec.europa.eu/news/north-seas-conference-hague-national-goals-joint-action-offshore-wind-energy-2023-11-20_en#:~:text=The%20tender%20planning%20translates%20NSEC,and%20allow%20for%20better%20collaboration

[29] “WindEurope Studies.”

[30] European Commission. Directorate General for Energy., Guidehouse Netherlands B.V., and SWECO., *Study on the Offshore Grid Potential in the Mediterranean Region*.

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Technology costs

Estimates for the Levelized Cost of Energy (LCoE) for bottom-fixed offshore wind have significantly decreased to current values between EUR 61 and EUR 140 per MWh (refer to the 2019-2022 range in Figure 14). Notably, since 2014, there has been a trend towards larger projects and turbines to leverage economies of scale. According to projections, the future LCoE for bottom-fixed offshore wind is expected to be between EUR 30 and EUR 60 per MWh by 2050. This indicates that the costs of offshore wind installations are approaching those of onshore installations.

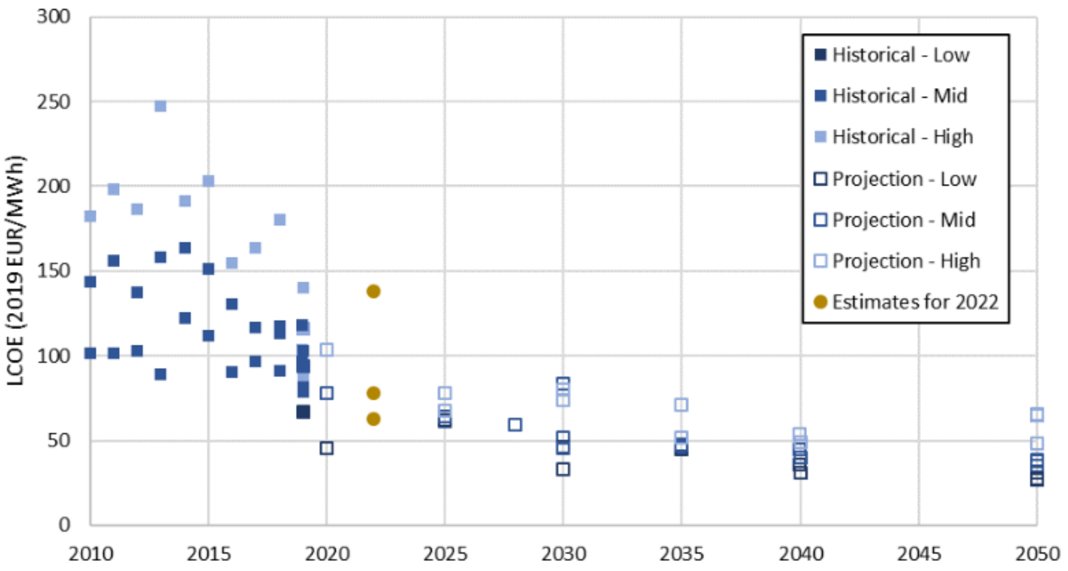

Figure 14. Range of historical, current (European estimates 2022) and projected offshore wind LCoE estimates (Source: JRC, BNEF, Beiter et al, 2021 (chart reproduced from Beiter et al.), 2023.)

Operation and maintenance (O&M) costs are also decreasing. In 2022, the EU's average annual O&M costs for offshore wind ranged from EUR 50 to EUR 80 per kW, with projections indicating a reduction by one-third by 2030, and to EUR 35-40 per kW by 2050 (a 40% decrease compared to 2021)[31]. These reductions are primarily driven by economies of scale, industry synergies, digitalization, and technological advancements, including optimized maintenance strategies[32]. As the number of installations increases, costs are expected to decrease for both onshore and offshore projects. According to the POLES-JRC model, by 2050, overnight investment costs are projected to fall to EUR 753 per kW for onshore wind and EUR 1,628 per kW for offshore wind (Figure 15).

[31] https://assets.bbhub.io/professional/sites/24/BNEF_Climatescope_Report.pdf
[32] https://iea.blob.core.windows.net/assets/86ede39e-4436-42d7-ba2a-edf61467e070/WorldEnergyOutlook2023.pdf

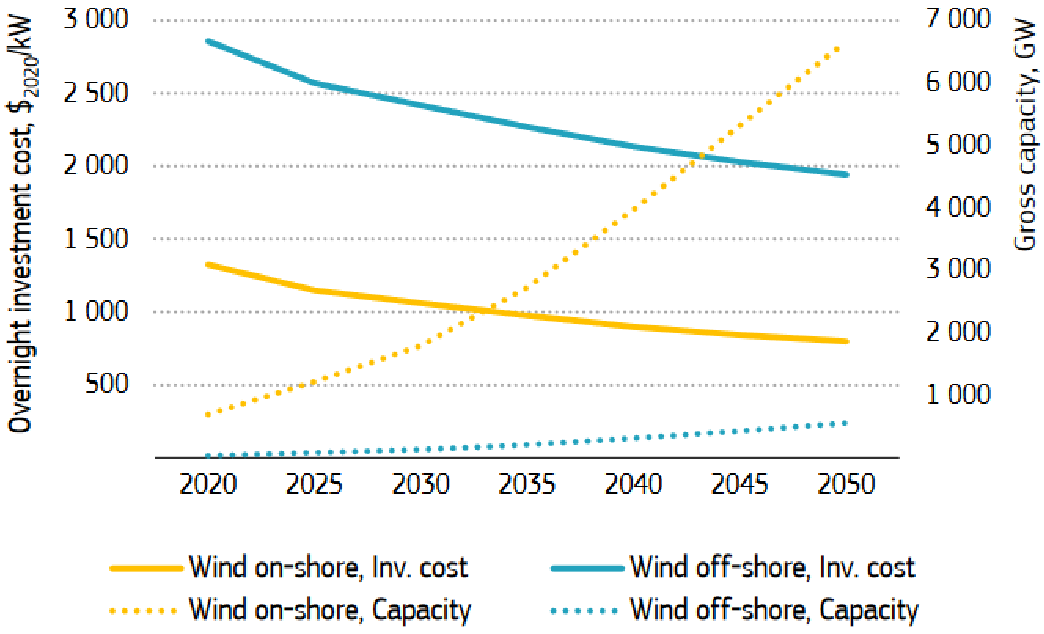

Figure 15. Overnight investment costs (in USD) for onshore and offshore installations according to the POLES-JRC model (Source: JRC, 2023)

3.1.4 Associated job profiles, skills, and knowledge identification

The first step in addressing skill gaps and shortages within the offshore renewable energy (ORE) sector involves mapping the occupational profiles across the ORE value chain. This approach, inspired by the methodology developed in the MATES project[33], focuses on the sector's core activities while incorporating several criteria to refine the selection of relevant profiles. Specifically, the identified profiles are those that:

- Are directly employed in the ORE sector,
- Are critical for the production, implementation, and operation of ORE projects,
- Possess the necessary qualifications to carry out essential tasks,
- Are indispensable due to their broad skillsets, which reduce the need for additional workforce,
- Contribute significantly to the sector's growth.

The mapping process was guided by an extensive literature review and initial expert consultation, using ESCO as the primary reference framework. In total, 83 occupational profiles were identified (see Table 31, ANNEX I).

[33] "Maritime Alliance for Fostering the European Blue Economy through a Marine Technology Skilling Strategy."

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As shown in the Table 31, occupations are divided into the following broader categories:

- Managers (ESCO Group: **1**XXX)
- Engineers (ESCO Group: **21**XX)
- Health professionals (ESCO Group: **22**XX)
- Teaching professionals (ESCO Group: **23**XX)
- Business and administration professionals (ESCO Group: **24**XX)
- ICT professionals (ESCO Group: **25**XX)
- Social professionals (ESCO Group **26**XX)
- Technicians and associate professionals (ESCO Group: **31**XX)
- Material recording and transport clerks (ESCO Group: **432**X)
- Metal, machinery, and related trades workers ((ESCO Group: **72**XX)
- Electrical and electronic trades workers (ESCO Group: **74**XX)
- Underwater divers (ESCO Group: **754**X)

3.2 Offshore Renewable Energy in Southern Europe

The offshore renewable energy sector in Southern European countries has significant potential and is becoming increasingly crucial for the region's sustainable energy transition. With their long coastlines along the Mediterranean and the Atlantic, countries such as Portugal, Spain, Italy, Greece, and Cyprus are well-positioned to utilise offshore wind, wave, tidal, and solar energy. This potential is crucial as these nations aim to diversify their energy sources, decrease reliance on fossil fuels, and achieve ambitious climate goals.

Southern Europe is now tapping into its offshore wind resources, generating clean electricity, fostering economic growth, creating new jobs, and driving technological innovation in coastal and marine industries.

Furthermore, offshore renewable energy advancement aligns with the European Union's goal of achieving carbon neutrality by 2050. This contributes to both regional and global initiatives to address climate change. As technology progresses and the expenses associated with offshore renewable projects decrease, Southern European nations are increasingly well-positioned to utilize their maritime resources. The expansion of this sector offers environmental advantages and enhances the energy independence and economic resilience of the five countries involved.

3.2.1 Portugal

Portugal is in a privileged location to develop its Offshore Renewable Energy sector (ORE). With its long coastline and favourable wind and wave conditions, the country is committed to expanding ORE infrastructures. These efforts align with Portugal's goal of achieving carbon neutrality by 2050 and supporting the ambitious climate targets of the European Union.

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3.2.1.1 Legal framework and policies

The Directorate-General for Energy and Geology[34] is the Portuguese public administration body responsible for developing and implementing Portugal's energy policy.

In 2021, the Council of Ministers[35], dated 1 July, approved the Roadmap for Carbon Neutrality 2050[36]. This important milestone, along with the Roadmap's objectives, led to the development of the PNEC 2030, National Energy and Climate Plan 2030[37]. The PNEC 2030 is the foundation of Portugal energy and climate policy for the next decade, a guide towards a carbon-neutral future. It was approved by the Council of Ministers Resolution No. 53/2020[38], dated 10 July 2020.

The Portuguese Directorate-General for Natural Resources, Safety and Maritime Services[39] (DGRM) is globally accountable for developing Marine Spatial Planning (MSP) instruments and for several aspects regarding the private use of the national maritime space. MSP is a decision-making tool. The Portuguese MSP was adopted in 2019 and includes zones for ocean energy development. The Portuguese law DL 38/2015[40] (amended by the DL 139/2015[41]) lays the basis for the Planning and Management of the National Maritime Space. It defines the legal framework that allows for the implementation of MSPs in the national maritime space, from the baselines to the extended continental shelf. The MSP system consists of a set of instruments developed under strategic instruments of the planning and management policy, from which the National Strategy for the Ocean 2013-2020 stands out.

Portugal approved the 2021–2030 National Ocean Strategy[42] (NOS), aiming to boost the ocean's role in Portugal's economy and ensure a sustainable ocean that benefits the Portuguese population. The associated Action Plan, released in September 2021, outlines over 180 specific measures to be implemented by 2030 across various areas, including significant actions related to Marine Renewable Energies.

Also in 2021, the government established the legal framework for creating Technological Free Zones[43] (ZLT-Zonas Livres Tecnológicas) in Portugal. Through decree-law 67/2021[44], they announced the establishment of a ZLT for marine renewable energy projects in Viana do Castelo, northern Portugal.

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[34] “Energia.”
[35] “Resolução Do Conselho de Ministros n.º 107/2019 | DR.”
[36] “Portugal’s Energy Policies Set a Clear Pathway towards 2050 Carbon Neutrality, According to New IEA Review - News.”
[37] “Portugal’s National Energy and Climate Plan for 2021-2030 - Climate Change Laws of the World.”
[38] “Resolução Do Conselho de Ministros n.º 107/2019 | DR.”
[39] “Maritime Spatial Planning - DGRM.”
[40] “Decreto-Lei n.º 38/2015 | DR.”
[41] “Análise Jurídica - Decreto-Lei n.º 139/2015 | DR.”
[42] “DGPM | NOS 2013-2020.”
[43] “Technological Free Zones | ZLT.”
[44] “Decreto-Lei n.º 67/2021 | DR.”

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In 2022, the Portuguese Government began prioritising offshore wind, announcing a goal of reaching 10 GW of capacity by 2030. This initiative aims to reduce carbon emissions in society and the economy and fulfill the objectives and targets of the Energy Union Strategy and the PNEC 2030. This demonstrates Portugal's dedication to contributing to the goals of REPowerEU[45], the EU initiative to reduce Europe's reliance on Russian fossil fuels and speed up the transition to renewable energy.

3.2.1.2 Sectorial priorities and forecast

The National Energy and Climate Plan 2030 (PNEC 20230) outlines targets for increasing the use of renewable energy sources and improving energy efficiency. It also details the actions and measures needed for decarbonisation and energy transition in Portugal, aligning with the Roadmap for Carbon Neutrality 2050. The PNEC 2030 aims to achieve the following.

- Decarbonising the economy across all sectors, with specific energy, industry, mobility, agriculture, forestry, wastewater, and waste measures.
- Prioritising renewable energies and reducing the country's energy dependence by promoting electrification and diversification of energy sources using local resources.

In July 2024, the PNEC 2030 was updated to include more ambitious goals, aiming for a 55% reduction in greenhouse gas emissions by 2030 compared to 2005 levels, surpassing the previous target range of 45% to 55%. Additionally, the updated plan sets a new target of 51% (Figure 16) for the share of renewable energies in gross final energy consumption by 2030, reflecting a strong and strategic commitment to renewables and their potential for attracting investment.

[45] "REPowerEU."

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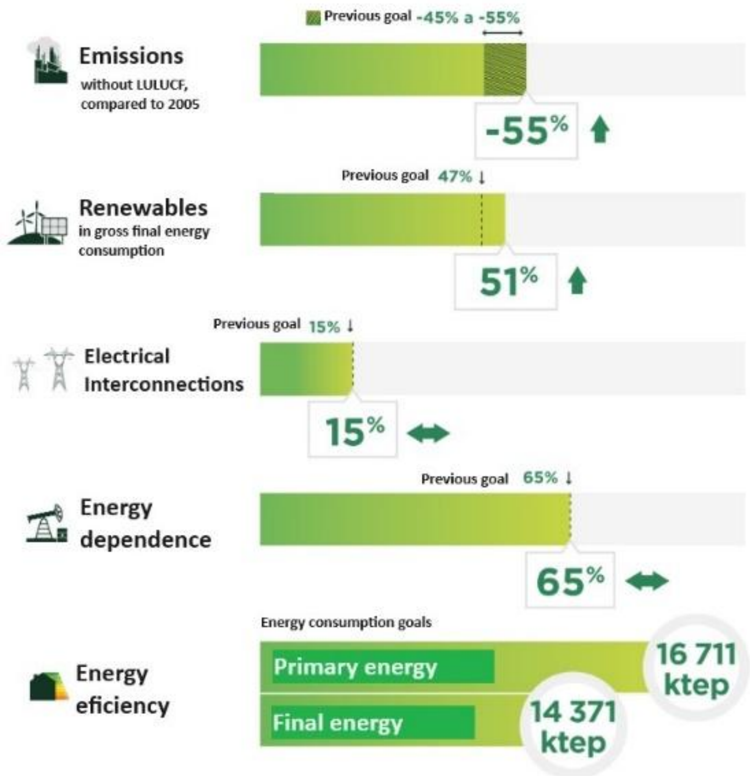

Figure 16. National Plan for Energy and Climate 2023. (Source: adapted from Observatório de Energia e Agência para a Energia)

To reach this goal, the government plans to enhance the utilization of renewable energy sources, specifically by prioritizing solar, onshore wind, and offshore wind technologies from 2025 to 2030. The solar capacity will rise from 8.4 GW to 20.8 GW, onshore wind from 6.3 GW to 10.4 GW, and offshore wind from 0.03 GW to 2 GW. The expected growth is illustrated in Figure 17.

Offshore wind energy is crucial in achieving Portugal's energy independence and meeting its carbon neutrality targets as outlined in legal regulations and policies. It is a key action for expanding Portugal's renewable energy production capacity in the future. Offshore wind farms are anticipated to supply electricity to the Public Service Electricity Grid (RESP) and generate energy for other uses, such as hydrogen production. Small wind turbines could also power activities at sea, such as aquaculture initiatives.

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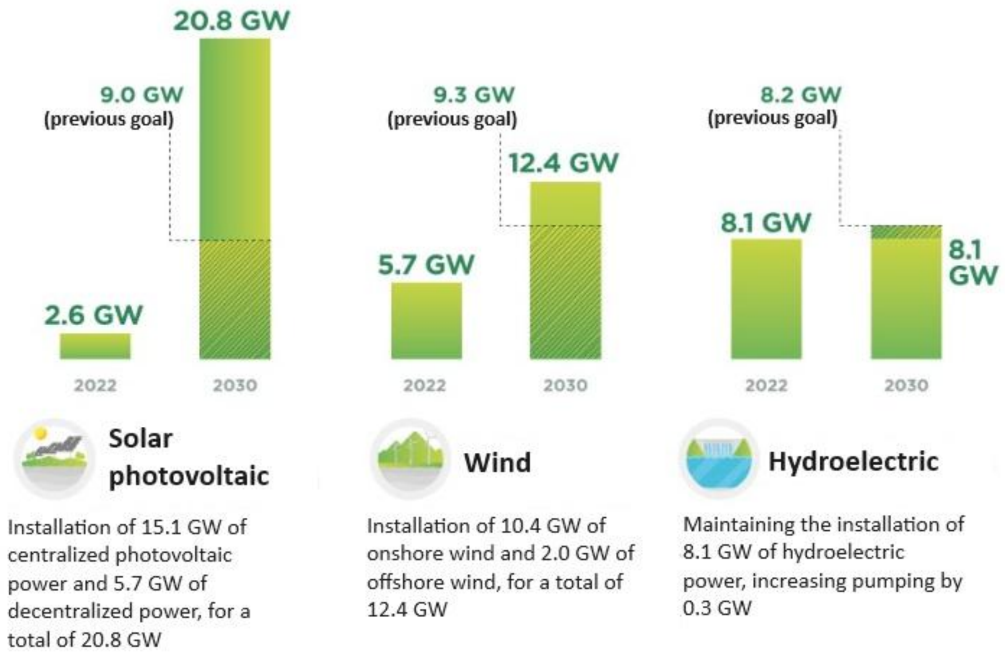

Figure 17. PNEC 2030 expected growth. (Source: adapted from Observatório de Energia e Agência para a Energia)

Portugal's plans for offshore wind energy include not only the installation of power plants, but also, the advancement of technology to enhance the entire value chain. These efforts position offshore renewables as part of the Blue Economy[46] sector and contribute to reducing the energy system's carbon footprint.

The wind resources in the ocean are typically more intense and consistent, with less turbulence than on land, making them ideal for energy production. Offshore energy production takes advantage of vast continuous areas at sea, minimizing visual impact. Wind energy is harnessed in regions with suitable wind resources, away from exclusion zones and conflicts of interest with other activities. Offshore renewable energy production is a promising and environmentally friendly alternative to fossil fuel production.

In Portugal, the regions with the most potent sea winds are concentrated in the north and centre, specifically Viana do Castelo, Peniche, and Ericeira. Another significant area is in the south, along the coast of Sagres, as depicted in Figure 18.

[46] "Portugal - European Commission."

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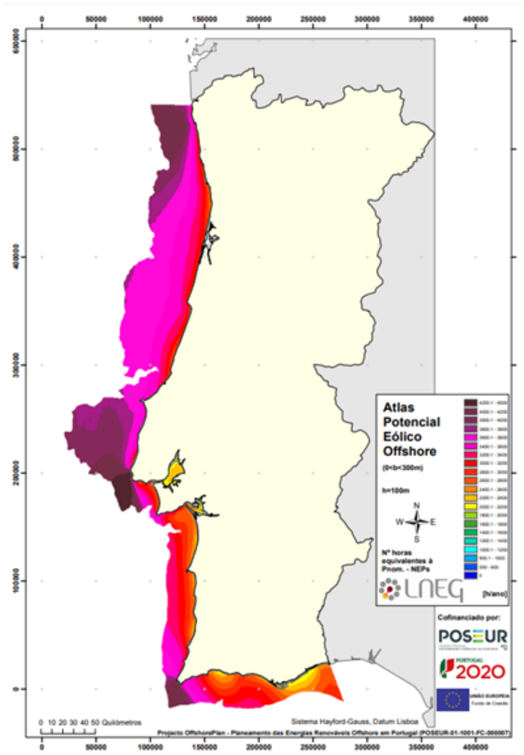

Figure 18. Atlas of Offshore Wind Potential of Continental Portugal[47]

As with wind energy on land, the exploitation of wind energy at sea is dominated by horizontal axis turbine technology. However, turbines at sea are typically larger than those used on land, and a prototype with a 280 m rotation diameter and 15 MW of power was developed in 2022[48]. In terms of installation, there are two types of technology:

- Platform fixed to the seabed, the depth limit for installation of which is between 65m and 70m.
- Floating platform with mooring, the depth of which is more than 70m, with installation possible up to 1000 m.

Although the fixed platform turbine has already reached a level of maturity, being used in wind farms in the shallow waters of the North Sea, it is a technology still under development, particularly in assessing its installation in deeper waters.

While floating platform technology is currently at a less mature stage, significant technological development is expected to reduce the high costs involved, especially in terms of manufacturing and maintenance[49].

[47] Costa, Esteves, and Estanqueiro, *Sustainable Offshore Wind Potential in Continental Portugal*.
[48] "V236-15.0 MW^{TM}."
[49] "Windfloat Atlantic Project."

However, it is anticipated that in the future, this technology will be the most widely used globally, due to its potential to harness vast maritime regions.

Considering the bathymetry of the coast, it is estimated that in Portugal, it is possible to install wind farms with an output of 1.4 to 3.5 GW in locations up to 40m deep. In locations between 40 m and 200m deep, a theoretical installation potential totalling an additional 40 GW is estimated[50] (EI-ERO), Industrial Strategy and Action Plan for Renewable Electric Ocean Energy. Therefore, to exploit the most significant offshore wind potential, floating-based turbines are best suited to these characteristics.

In Portugal, the Windfloat Demo1[51] project has been a significant step forward in the adoption of WindFloat technology. This project, which features a 2 MW wind turbine, was installed in an area of public maritime domain located 6 km off the coast of Aguçadoura, Póvoa de Varzim. The system, which consists of a three-column semi-submersible platform, stabilized dynamically (viscous damping) and statically (water ballast) and anchored to the seabed by gravity and friction using conventional catenary moorings, is designed for offshore wind exploration in deep waters (>40 m) and can be adapted to any type of wind turbine. These platforms are built and assembled on land, close to the sea, thereby reducing installation costs, and then towed to their destination, as seen in Figure 19.

Figure 19. WindFloat Wind Turbine transport to Viana do Castelo[52]

The WindFloat Atlantic project involved installing a wind farm with pre-commercial stage technology in a public maritime area located 20 km off the coast of Viana do Castelo in an area 100 m deep. The wind farm consists of three turbines, each with 8.4 MW of power, based on WindFloat floating platforms. Two

[50] "Apoios Nacionais."
[51] "Windfloat Atlantic Project."
[52] "DOCK90 | Maritime and Offshore Communication Partner."

platforms were constructed in Portugal at the Setúbal shipyards, while the third was built at the port of Ferrol in Spain. Each platform is 30 m high with 50 m between columns. The wind farm was connected to the grid in 2020 and is currently operational (Figure 20).

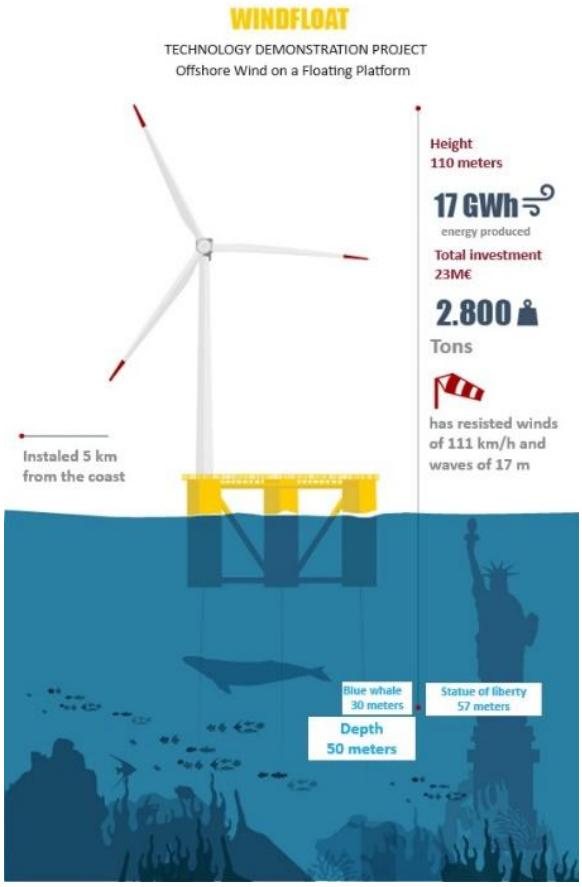

Figure 20. WindFloat technology demonstration and statistics (Source: Noctula)

Portugal has established two test zones for offshore electricity generation devices. These zones have been thoroughly studied, and we can access information regarding bathymetry, soil, and resource characteristics. The first zone is the Aguçadoura Ocean Lab for Future Technologies, located off Aguçadoura beach. It is situated in a 45-meter-deep maritime region covering an area of 3.3 square kilometres. The second zone is the Viana do Castelo Pilot Zone, located off the coast of Viana do Castelo. This zone spans an area of approximately 11 square kilometres and reaches depths ranging between 85 and 100 meters. Additionally, it is equipped with a 40 MW submarine cable that is 17 kilometres long and an onshore substation. This zone holds significant potential for demonstrating and commercialising offshore energy technologies.

In the National Strategy for the Sea 2021-2030, Ocean Renewable Energy is included in AIP7 as a strategic objective (OE3). The following targets are set according to the degree of maturity of floating mooring offshore wind technology appropriate to the bathymetry of the sea off the Portuguese coast and the establishment of pilot zones with support infrastructure:

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- 370 MW of offshore wind and waves by 2030.
- 1.3 GW of offshore wind by 2050.

It's important to note that although Portugal has one of Europe's largest exclusive economic zones, this does not guarantee the production of ocean renewable energy; it is an opportunity with a high differentiating potential that should be studied and invested in. The presence of national companies with experience in manufacturing turbines, platforms, and moorings in the onshore wind sector and international offshore projects is an asset.

In 2022, a national Work Group was created to plan and operate power stations based on renewable energy sources of oceanic origin or location. This Work Group recommends:

- Up to 3.5 GW of capacity in Viana do Castelo, Leixões, and Figueira da Foz should be available in the first phase, subject to one or more competitive procedures. The remaining capacity should be allocated in subsequent phases until 2030, totalizing 10 GW.
- The development of an offshore wind market in Portugal that follows a competitive model, regardless of its degree of centralization and the associated electricity remuneration model.
- The first competitive procedure, which will be open by the end of 2023, begins with a pre-qualification phase lasting at least three months.
- The adoption of a network architecture that makes use of very high voltage substations supported by platforms fixed to the seabed to aggregate the connection of power stations to reduce the number of cables between the spatialized areas and land, with greater or lesser aggregation, allowing for topological solutions that will depend on the degree of resilience desired for the network as a whole to failures in its components. Adopting standardized and non-customized solutions on a case-by-case basis, both for offshore substations and submarine cables, could be a critical decision factor given the scale effects they allow.

A strategy for establishing the offshore wind industry, along with a preliminary analysis of the national and international landscape, has begun. Although the conditions have not yet been defined, the offshore wind auction in Portugal could be launched later in 2024 after defining and spatializing new maritime areas. Each lot put up for auction will have an average of 500 MW, and the spatialization will create the lots needed for the first auction to take place in a balanced way.

Portugal's wind power production reached 5,896 MW in 2024, of which 25 MW were offshore. The National Energy and Climate Plan 2030 sets a target of 6,300 MW by 2025 and 10,400 MW by 2030.

3.2.1.3 National Strategy for Smart Specialisation

The existence of national and European standards outlining priorities and policies that impact various sectors of society and the economy, as targeted by smart specialisation strategies, underscores the critical need to align the analysis of different agendas.

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In June 2022, the National Strategy for Smart Specialization 2030[53] (ENEI 2030) was approved. ENEI 2030 is a strategic framework for prioritizing public interventions in Portugal, focusing on R&D and innovation policies. The strategy outlines seven priorities based on the unique characteristics of Portugal:

1. Digital Transition.
2. Green Transition.
3. Materials, Systems, and Production Technologies.
4. Society, Creativity, and Heritage.
5. Health, Biotechnology and Food.
6. Forests, Ocean, and Space.
7. Financial Instruments for all thematic priorities.

In 2023, the Portuguese Government set a significant goal to increase the contribution of renewable energy to electricity production to 80% by 2026. That is four years ahead of the target previously set by the PNEC 2030. The goal is crucial for accelerating the energy transition and achieving carbon neutrality by 2050. It is also in line with the priorities of the European Green Deal, which aims to make Europe the first climate-neutral continent and reduce net emissions by at least 55% by 2030 compared to 1990 levels. The need for energy transition became even more urgent in the REPowerEU plan, where Europe established a series of measures to address the challenges and disruptions in the global energy market caused by Russia's invasion of Ukraine.

3.2.1.4 Indicators and targets

An inter-ministerial working group has been established to plan and implement the construction of power plants to generate electricity from renewable energy sources in or from the ocean[54]. This initiative was established through dispatch no. 11404/2022 on September 2023[55]. The group comprises representatives from the maritime, energy, and infrastructure sectors, relevant public entities responsible for enforcing regulations in these regions, and key stakeholders. Additionally, there is a representative from the government accountable for the sea area, the energy area, and the infrastructure area. The group is responsible for presenting a final report outlining the initiative's guidelines to the government[56]. The report includes the following recommendations and next steps:

- The development of the offshore wind market in Portugal should adhere to a competitive model, regardless of its level of centralization and the remuneration mechanism.

[53] “R&I Strategy for an Intelligent Specialization.”
[54] “Destaques - DGRM.”
[55] “Despacho n.º 11404/2022 | DR.”
[56] “Relatório do Grupo de Trabalho para o planeamento e operacionalização de centros eletroprodutores renováveis de origem ou localização oceânica.”

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- The network architecture using the National Transport Grid should incorporate substations on platforms fixed to the seabed to connect offshore farms to the onshore grid efficiently.
- A strategy to develop and establish an offshore wind industrial chain should be formulated, considering a preliminary analysis of the national and international scenarios.

Based on the analysis conducted by the interministerial working group, the DGRM has prepared a proposal for the Allocation Plan for Offshore Renewable Energy[57] (PAER). This plan will automatically update the Maritime Spatial Planning Situation Plan (PSOEM) and designate potential areas for the commercial exploitation of offshore renewable energy[58]. The PAER is a crucial contribution to the country's efforts to achieve the goals outlined in the RNC 2050 and to align national objectives with the recommendations in the REPowerEU Plan.

A specific geoportal has been developed to support selecting preferred areas, preparing the plan, and facilitating public discussion for the PAER[59]. This geoportal will continue to evolve as work progresses until the PAER is approved by the Council Resolution of Ministers. It will be an integral part of PAER and will be managed by DGRM.

The preferred regions for installing new proposed areas have been identified by applying various criteria. These criteria include energy resources, conflict with other uses, environmental impacts, bathymetry, slope, pre-existence of synergies, and expressions of interest. The preferred regions are Viana do Castelo (2 lots with a capacity of 1 GW each), Leixões (1 lot with a capacity of 0.5 GW), and Figueira da Foz (4 lots with a capacity of 2 GW each). These regions can accommodate 3.5 MW per km^2, and each lot is assumed to have an installed power of 500 MW.

3.2.1.5 Sector value chain

The ocean renewable energy value chain is composed of several key axes, each of which plays a crucial role and deserves careful consideration:

- Knowledge entities: schools, training centres, universities, and research and technological development centres, particularly those specializing in energy and mechanical and maritime engineering.
- Developers: entities responsible for promoting, owning and building energy facilities, including project development, socio-economic analysis, environmental impact studies, engineering, civil works and logistics.

57 "Public Consultation."
58 "Situation Plan - Maritime Spatial Planning Plan (PSOEM) | The European Maritime Spatial Planning Platform."
59 "Geoportal Do Mar Português."

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- Equipment design and manufacture: companies and entities specializing in the design and manufacture of equipment and systems, including wind turbines (or components), towers, foundations, connection to the electricity grid, offshore substations, remote control and command.
- Maritime equipment and services: design and construction activities for specialized vessels for installing equipment (installation vessels) and other auxiliary vessels for inspection and maintenance services (service vessels), maritime transport and support services (tugs, maritime security, etc.).
- Installation of equipment: installation activities for energy parks or devices, including transportation and installation services for submarine cables, wind turbines and foundations, offshore substations, offshore civil works and related services.
- Operation and maintenance: energy park operation and control activities, meteorological services, electromechanical maintenance and repair, services ancillary to operation and maintenance activities, transportation of materials and people, recycling and dismantling of structures.
- Port facilities: some ports will need to be modernized (upgraded or expanded), given their transversal role in supporting all activities related to maritime renewable energy, adapting to the assembly, manufacture and maintenance of offshore energy equipment and related services.

3.2.1.6 Associated job profiles

The offshore renewable energy (ORE) sector encompasses a diverse range of job profiles across its value chain, reflecting the complexity of activities involved in developing, deploying, and operating offshore wind, wave, and tidal energy projects. Operation and Maintenance (O&M) is a key cost driver in ORE projects, requiring complex logistics and challenging marine operations. The sector's supply chain is multifaceted, involving numerous industries and business areas, which necessitates a diverse and skilled workforce to handle the demands of each stage, showcasing the sector's adaptability and knowledge.

To ensure the success of the ORE sector, advanced technologies, innovative materials, and a well-trained workforce are essential. Investments in vocational education and training are vital for sustaining growth and achieving global offshore renewable energy targets. The International Standard Classification of Occupations (ISCO), a four-level occupation grouping system managed by the International Labour Organization (ILO), categorizes occupations by education level. The European Skills, Competencies, Qualifications, and Occupations (ESCO) classification complements ISCO by providing a standardized framework for mapping skills and competencies, promoting job mobility across Europe, and unlocking opportunities for professionals.

Each ESCO occupation is associated with an ISCO-08 code, forming a hierarchical structure where ISCO covers the top four levels, and ESCO expands into the fifth and lower levels with detailed occupations. These taxonomies facilitate the adaptation of job offers and CVs, aiding in matching skills and driving the growth of the ORE industry. The sector offers career opportunities in research and development, project planning, manufacturing, installation, O&M, management, support services, and education and training.

Mapping ORE sector roles to ESCO occupations highlights the alignment between industry-specific job profiles and the broader European classification of skills and competencies. This approach enhances workforce mobility, clarifies skill requirements, and supports targeted education and training programmes.

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Table 1. provides examples of main ORE sector occupations, aligned with their corresponding ESCO profiles and codes, offering insights into how the ESCO taxonomy supports the industry's development.

Table 1. ORE occupation in ESCO taxonomy

ORE key occupation	ESCO occupation	ESCO code
Research and development (R&D)	Marine engineer Marine electrician ORE engineer Environmental scientist	2144.1.10 7412.8 2149.9.5 2133.7
Project Planning and Development	Project manager Environmental expert Water traffic coordinator	1219.6 2143.2 4323.20
Manufacturing and Supply Chain	Mechanical engineering technician Mechatronics engineering technician Supply chain manager	3115.1 3115.11 1324.8
Installation and Construction	Construction quality manager Product quality inspector Electromechanical engineering technician	3112.1.4 7543.10 3113.1.2
Operations and Maintenance (O&M)	ORE plant operator Wind turbine technician Predictive maintenance expert	3131.1 7412.12 2152.1.13
Grid Integration and Energy Management	Energy manager Energy systems engineer Electrical transmission system operator	1349.12 2149.9.2 3131.3.2
Support Services	Financial analyst Underwater construction supervisor Underwater divers	2413.1 3123.2 7541
Education and training	Education programme coordinator Maritime instructor Vocational teacher	1345.1.3 2320.1.17 2320.1
Community and stakeholders' engagement	Public relations officer Investor relations manager Community social worker	2432.9 2412.6.4 2635.3.6

3.2.1.7 Challenges and contributions

It is crucial that Europe urgently invests in its port infrastructure to align with the ambitions of the REPowerEU and facilitate a more affordable energy transition. The port facilities must be upgraded or new ones built to accommodate large-capacity turbines and a growing market. They will need to support the operation and maintenance (O&M) of a larger fleet, upcoming decommissioning projects, and the establishment of new fixed and floating offshore wind manufacturing centres. This necessitates the expansion of port land, reinforcement of piers, improvement of deep-sea ports, and other civil works. The

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issue of space, both on land and water, is and will continue to be a major concern for ports, which will play a crucial role in the supply chain of offshore wind sector projects. They will serve as hubs for transporting components, materials, and personnel to offshore wind farms, coordinating and synchronizing all movements. Ports will also be necessary for constructing floating platforms near the waterline.

Portugal has already identified national supply chain development opportunities in the mooring systems, power cables, and tower production industries. These developments would enhance existing national experience, capacity, and skills. Since these projects have a medium—to long-term outlook, investment decisions require visibility into the project pipeline.

The Nova School of Business and Economics assessed a study to evaluate the socio-economic impact of the Portuguese offshore wind program[60]. The study considered the impact that a promised 10 GW offshore wind program off the Portuguese coast could have on the Portuguese economy. The analysis focused on estimating and quantifying the macroeconomic impact of deploying 10 GW of offshore wind energy in terms of production, added value, and employment and investigating other associated impacts. The goal is to create conditions for the allocation and installation of 2 gigawatts through capacity auctions by 2030. Following this, depending on the progress of the procedures and projects, auctions can be conducted in stages, and new capacities of up to 10 gigawatts can be allocated.

If followed as planned, the economic impact of the Offshore Wind Energy Project will be very positive in Portugal and strongly driven by investment attraction. The main socioeconomic impacts would be:

- Implementing 10GW in the base scenario will add 8% to the Portuguese GDP in 2022. The indirect and induced effects represent more than 75% of this value.
- The total lifetime output per gigawatt of future work capacity to be installed is 5,417 million euros. The added value is estimated at 1,941 million euros, and the number of jobs to be created is calculated at 41,860.
- The investment phase (CAPEX) accounts for almost half of the total impact in the project phases. The overall effect per gigawatt of capacity on value-added during the investment phase is 903 million euros, and the overall impact on employment is 19,085 jobs.

Upon full implementation, the cumulative 10 GW program is expected to generate an annual value-added impact of 400 million euros and contribute to the employment of 9,000 people, assuming only O&M.

3.2.1.8 SWOT analysis for offshore renewable energy

Economic Potential (EP) of the ORE Sector	
Strengths	**Weaknesses**

[60] Sá et al., *Marine Renewable Energy in Portugal*.

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• Competitive costs for renewable technologies, especially solar PV. • Solar PV in Portugal has one of the lowest projected Levelized Costs of Electricity (LCOE) in Europe. • Attractive location for investment in renewable energy projects. • Robust policy and regulatory framework supporting renewable energy development. • Economic mechanisms such as feed-in tariffs and auctions provide stability and predictability for investors.	• Relatively small domestic market limits the scale of investment and project development compared to larger European markets. • Heavily reliant on foreign investment and European Union funds. • Vulnerability due to dependence on external economic conditions, which could affect funding availability.
Opportunities	**Threats**
• The European Green Deal and related funding mechanisms offer significant opportunities to expand renewable energy infrastructure. • Potential to become a hub for renewable energy technology innovation, particularly in sectors like floating offshore wind and wave energy. • Opportunity to position Portugal as an exporter of renewable technologies and expertise.	• Economic instability and changes in government policies could undermine the financial viability of renewable projects. • Potential for investor confidence to be negatively impacted, slowing project development. • Exposure to global economic conditions, including fluctuations in technology costs, supply chain disruptions, and competition from countries with lower production costs.

Environmental Impact (EI) of the ORE sector	
Strengths	**Weaknesses**
• Portugal has set ambitious targets for 100% renewable energy in electricity generation by 2050. • Strong commitment to reducing carbon footprint and promoting sustainable energy practices.	• Offshore wind, wave, and tidal projects may pose risks to marine ecosystems and bird migration patterns. • Environmental impact assessments indicate potential effects on marine geology and marine life, raising concerns about significant environmental consequences.
Opportunities	**Threats**
• Portugal's creation and expansion of Marine Protected Areas (MPAs) can help mitigate the environmental impact of renewable energy projects.	• Environmental constraints, such as high-priority conservation areas and sensitive ecosystems, could limit available areas for renewable energy development. • Increased project costs may result from the need for careful planning in sensitive areas.

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• MPAs contribute to biodiversity preservation and management of renewable energy installations' effects. • Potential for innovation in advanced monitoring and mitigation techniques to minimize environmental impacts in sensitive areas.	• Challenges in gaining social acceptance and regulatory approval, especially if projects are seen as harmful to the environment or local communities.

Resource Availability (RA) of the ORE sector	
Strengths	**Weaknesses**
• Portugal is a pioneer in developing floating offshore wind projects, with plans for 200 MW of installed capacity in the medium term. • Substantial technical potential for floating wind and wave energy technologies, estimated at 427.3 TWh/year for floating wind and 887.9 TWh/year for wave energy by 2050.	• Wave energy technology is less mature and more expensive, requiring additional investment in research and development. • Lack of clear long-term strategic goals, as Portugal has not fully specified how it will achieve its offshore wind capacity targets.
Opportunities	**Threats**
• Potential for growth in offshore grid infrastructures connecting Portugal with other Mediterranean networks, promoting regional renewable energy integration. • Expected reduction in floating wind technology costs, improving economic viability and competitiveness.	• Competition from regions like the Canary Islands and northern Spain, which are positioning themselves as offshore energy innovation hubs, may impact Portugal's attractiveness for investment. • Legal, social, and economic restrictions could limit the usable area for renewable energy installations, posing significant challenges.

Social Impact (SI) of the ORE sector	
Strengths	**Weaknesses**
• Strong public support for renewable energy initiatives driven by environmental concerns and a commitment to sustainability. • Public awareness facilitates the acceptance and implementation of renewable projects across the country.	• Renewable energy projects, particularly offshore/onshore wind farms and large solar installations, can face opposition due to their visual impact and disruption to natural landscapes. • Concerns are more pronounced in areas reliant on tourism. • Specific groups, such as those in agriculture and fishing industries, may oppose projects competing for land or sea space, leading to potential resource-use conflicts.
Opportunities	**Threats**

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• Development of renewable energy sectors can create new job opportunities and drive educational and training programmes, building a skilled workforce. • Stimulate local economies through renewable energy sector growth. • Integration of renewable projects with other sectors, like aquaculture or eco-tourism, can provide community benefits and reduce opposition by demonstrating shared value.	• Significant resistance may arise in regions reliant on tourism if renewable projects are seen as damaging to natural beauty or the tourist experience, potentially harming local economies. • Ensuring public acceptance is crucial, especially for large or intrusive projects. • Negative perceptions or insufficient engagement with local communities could lead to resistance, delays, or cancellations of projects.

Technology Potential (TP) of the ORE sector	
Strengths	**Weaknesses**
• Portugal is a leader in developing a diverse range of renewable technologies, including floating offshore wind, wave energy, and solar PV. • Ambitious plans to reach 300 MW of floating offshore wind capacity by 2030. • Strong commitment to innovation in renewable technologies, particularly in wave energy research and development	• Limited deployment of certain technologies, such as tidal and bottom-fixed offshore wind, due to technical and economic challenges like deep waters and high costs. • Lack of clear, detailed plans for achieving targets, especially in emerging technologies like tidal and wave energy.
Opportunities	**Threats**
• Significant potential for the expansion of offshore renewable energy technologies, especially in floating wind and wave energy. • Favourable geographic and climatic conditions in Portugal support these technologies. • The European Union’s Green Deal and related funding mechanisms present opportunities for technological advancements and infrastructure development in renewable energy.	• High costs associated with technologies like wave and tidal energy may hinder widespread adoption and economic viability. • Rapid development and decreasing costs of more mature technologies, such as solar PV and wind, may overshadow investment in less mature technologies like wave and tidal energy.

SWOT Analysis for specific ORE technologies	
Wind energy	
Strengths	**Weaknesses**
• Portugal's coastal and mountainous regions provide high wind energy potential, especially for onshore and offshore wind farms.	• Offshore wind energy, especially floating platforms, involves high capital and operational costs compared to onshore alternatives.

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• Portugal is an early adopter of floating offshore wind technology, demonstrated by projects like WindFloat Atlantic.	• Limited offshore transmission capacity and grid integration challenges could slow project deployment.
Opportunities	**Threats**
• Growing interest in offshore wind offers potential for expanding renewable capacity, helping meet EU decarbonization targets. • Advances in floating wind turbines and deeper-water technology will open up new areas for development, increasing efficiency and reducing costs. • Portugal can become an exporter of renewable electricity to neighboring countries, boosting economic growth.	• Solar and other renewable technologies may compete for investment and grid capacity. • Offshore wind farms face potential opposition from environmental groups and fishing communities, concerned about the impact on marine ecosystems and local industries.
Ocean Thermal Energy Conversion (OTEC)	
Strengths	**Weaknesses**
• Portugal has a significant available area for wave energy, with approximately 27,177 km² potentially usable for offshore technologies, including OTEC. • This vast area provides a strong foundation for future offshore renewable development.	• OTEC technology is still in its early stages, lacking maturity and widespread deployment. • The limited technological maturity restricts the immediate potential for large-scale OTEC projects in Portugal.
Opportunities	**Threats**
• Strong potential for research and development in OTEC, supported by Portugal's expertise in offshore renewable technologies like wave and floating wind. • Existing infrastructure and technical know-how can be leveraged to advance OTEC development.	• OTEC faces competition from more mature and economically viable technologies, such as offshore wind and wave energy. • Focus on established technologies may overshadow OTEC, limiting investments and research efforts for its development.
Solar Energy	
Strengths	**Weaknesses**
• Portugal benefits from a sunny climate that supports both utility-scale solar PV and rooftop installations. The country's solar PV technology is highly cost-competitive, with projected levelized costs of energy (LCOE) expected to be among the lowest in the Mediterranean region, ranging between 18-22 €/MWh by 2030 and 10-12 €/MWh by 2050.	• The available rooftop area per capita in Portugal is relatively modest, which could limit the expansion of rooftop solar installations. • Only 0.8% of the country's land area is estimated to be suitable for utility-scale PV installations, potentially constraining large-scale solar projects.
Opportunities	**Threats**

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• Portugal plans to significantly increase its solar capacity in line with its renewable energy goals. This expansion opens doors for investment and technological development in solar PV. • Advancements in solar PV technology, such as higher efficiency modules and improved grid integration, could enhance the attractiveness and viability of solar projects.	• As Portugal continues to develop other renewable energy sources like wind and wave, there could be competition for investment and grid capacity. • Economic and regulatory uncertainties could affect the financial attractiveness of solar investments, potentially slowing down the deployment of solar technologies.
Tidal Energy	
Strengths	**Weaknesses**
• Portugal has identified areas suitable for offshore energy technologies, with potential for future tidal energy projects. • Although specific tidal energy data is currently limited, the potential exists for further exploration.	• No commercial tidal energy projects exist in Portugal, and development in this sector is limited. • Tidal energy is less established compared to other renewable energies like wind or wave.
Opportunities	**Threats**
• Potential to initiate research and pilot projects to explore tidal energy's viability in Portuguese waters. • Portugal's involvement in the Mediterranean and Atlantic offshore energy networks could facilitate the development of tidal energy as part of a diversified renewable energy portfolio.	• Tidal energy faces technological and economic challenges, including high initial costs and limited proven technology, hindering its development. • The focus on more mature renewable technologies, such as wind and solar, might divert resources and attention away from tidal energy development.
Wave Energy	
Strengths	**Weaknesses**
• Portugal has the second-highest wave energy potential among Mediterranean countries, estimated at 888 TWh/year, second only to Greece. • Portuguese waters offer a favourable economic scenario for wave energy, with a projected levelized cost of energy (LCOE) significantly lower than other member states, estimated at 328 €/MWh for 2030 and 149 €/MWh for 2050.	• Limited deployment and development of wave energy technologies, with earlier projects being decommissioned. • Wave energy technologies are still relatively immature and require further advancements and testing to achieve commercial viability.
Opportunities	**Threats**
• Significant potential for growth in research and development of wave energy technologies. • Portugal's National Energy and Climate Plan includes targets for wave energy, aiming for 70	• Competing renewable energy technologies, such as offshore wind, which may offer more immediate returns.

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MW of capacity by 2030, demonstrating a strong commitment.	• Uncertainty in economic feasibility and market demand for wave energy, with financial risks due to high initial costs and long development timelines.

3.2.2 Spain

Spain has a strong tradition in renewable energy and is actively pursuing the development of offshore wind power and other renewable sources. The country has significant potential for offshore wind, given its extensive coastline and favourable wind conditions, and its experience in onshore wind energy provides a solid foundation for the transition to offshore wind. Spain is investing in research and development, building the necessary infrastructure, and attracting international investment. However, challenges such as environmental concerns, grid integration, and technological advancements need to be addressed to ensure the successful development of this sector.

3.2.2.1 Legal framework and policies

The Ministry for Ecological Transition and Demographic Challenge is the Spanish public administration body responsible for developing and implementing Spain's energy policy.

The Spanish legislation that regulates Spain's commitments to climate neutrality is primarily the Law 7/2021, of May 20, on Climate Change and Energy Transition[61]. This law establishes a legal framework for combating climate change and transitioning to a low-carbon economy. Some of its key points are:

- **Climate neutrality objective**: Sets the goal of achieving climate neutrality in Spain by 2050.
- **Emission reduction**: Sets intermediate greenhouse gas emission reduction targets for 2030 and 2040.
- **Development of renewable energy**: Promotes the development of renewable energy and energy efficiency.
- **Adaptation to climate change**: Establishes measures for adaptation to the impacts of climate change.
- **Climate governance**: Creates a framework for climate governance to coordinate climate policies at the state and regional levels.

In addition to this law, other regulations complement and develop Spain's climate commitments, such as the Integrated National Energy and Climate Plan (NECP) 2021-2030[62], a strategic document designed to guide Spain's transition towards a more sustainable and low-carbon economy. Its primary goal is to reduce

[61] "BOE-A-2021-8447 Ley 7/2021, de 20 de Mayo, de Cambio Climático y Transición Energética."
[62] "Plan Nacional Integrado de Energía y Clima (PNIEC 2023-2030)."

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greenhouse gas emissions significantly by 2030, in line with the Paris Agreement. It was published in 2021 and has been updated in September 2024.

Also in 2021, and directly related to offshore renewable energy, the Roadmap for the Development of Offshore Wind and Marine Energy[63] in Spain was published. It outlines a strategic plan for the country's transition towards a renewable energy-based economy. It sets ambitious targets for offshore wind and marine energy capacity, identifies key challenges and opportunities, and proposes measures to promote the development of these sectors. The roadmap aims to position Spain as a leader in offshore renewable energy technologies and contribute to the country's decarbonization goals.

It was followed by the approval in 2023 of the National Marine Spatial Planning[64] by the Royal Decree 150/2023[65], establishing the five maritime spatial plans for Spain's five marine regions: Atlantic Northeast, Atlantic Northwest, Cantabrian Sea, Mediterranean, and Balearic Sea (Figure 21).

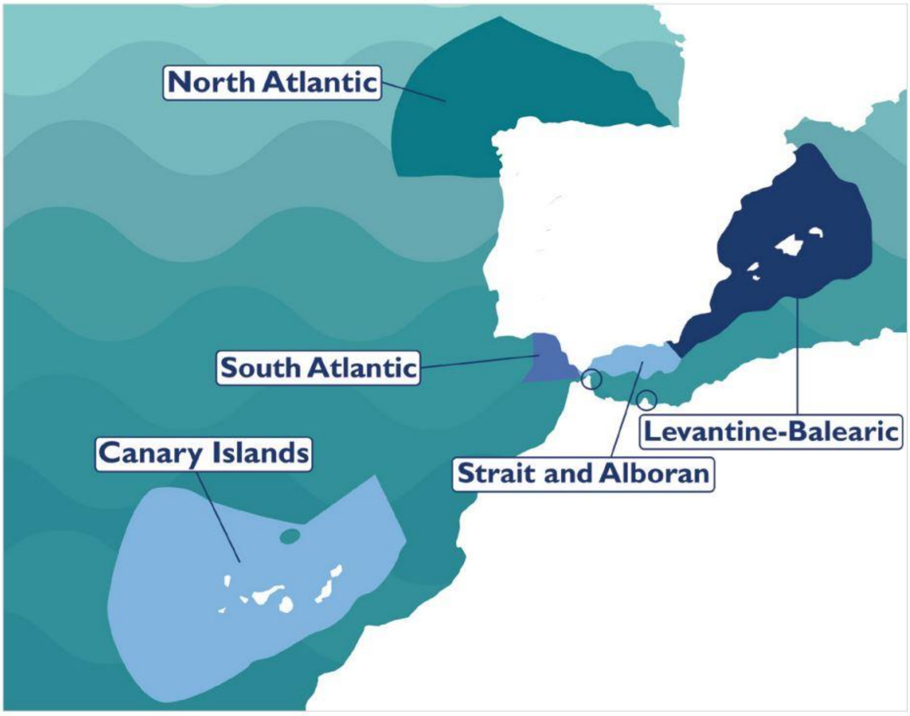

Figure 21. Marine Subdivisions in Spain (Source: MITECO-IDEA)

[63] "Enhreolicamarina-Pdf_accesible_tcm30-538999.Pdf."
[64] "Ordenación del espacio marítimo."
[65] "BOE-A-2023-5704 Royal Decree 150/2023, of 28 February, Approving the Maritime Spatial Planning Plans of the Five Spanish Marine Demarcations."

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These plans outline the sustainable development and use of marine and coastal areas, considering factors such as economic activities, environmental protection, and climate change. They provide a framework for decision-making and resource allocation, ensuring that different sectors and stakeholders work together to achieve common goals for the sustainable management of Spain's marine environment (Figure 22).

The planning includes "ZAPER" zones, or "High Potential Zones" for offshore renewable energy development, defined as areas that are particularly suitable for the installation of offshore wind farms and other renewable energy technologies. These zones are identified based on a variety of factors, including wind resource potential, water depth, distance from shore, environmental and social sensitivity, etc.

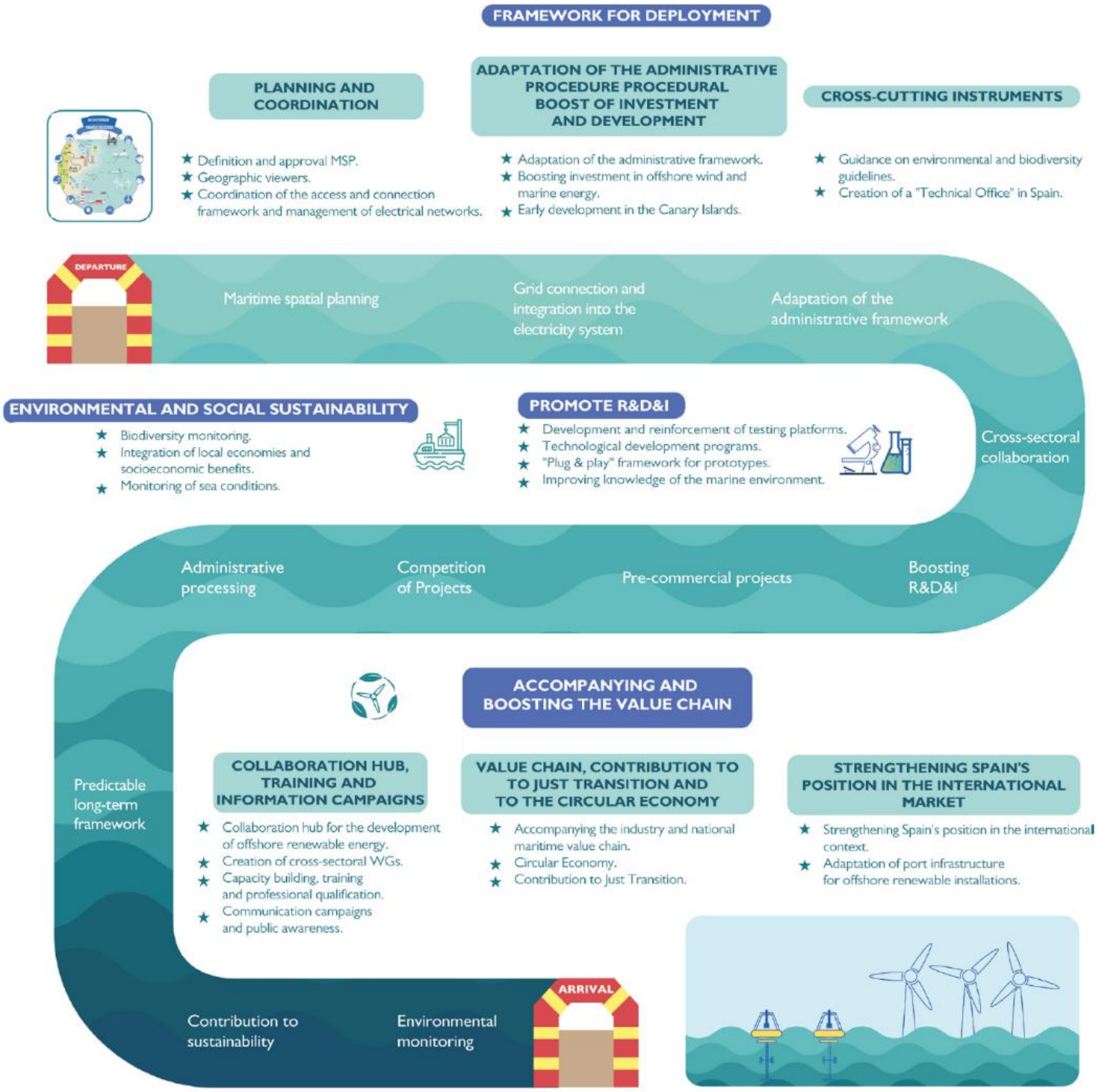

Figure 22. Itinerary of the Roadmap for the development of offshore wind and marine energy in Spain. Period 2021-2030 (Source: MITECO-IDEA)

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The Spanish government has been working on a new Royal Decree (962/2024)[66] that regulates the production of electricity in offshore installations, covering the necessary administrative authorizations, economic framework, and procedures for granting permits. It was published in September 2024 and for the first time, given the high complexity of offshore projects, the regulation establishes a public dialogue phase between developers and affected sectors to increase positive externalities, the industrial development of nearby coastal regions, and the coexistence of generation facilities with other water uses, such as navigation.

Each competitive bidding process will be regulated by a new Ministerial Order that will include elements such as the area of the High Potential Zones (ZAPER) where the facilities will be located and the connection nodes, the power quota, the remuneration parameters, or the concession term. Among other award criteria, the minimisation of environmental impact and space occupied, the generation of local employment, the use of recycled materials, or measures to promote compatibility with other sectors, such as fishing, may be included. Up to 30% of the criteria will not be economic.

3.2.2.2 Sectorial priorities and forecast

The Spanish Roadmap for the Development of Offshore Wind and Marine Energies, released in December 2021 by the Ministry for the Ecological Transition and Demographic Challenge, outlines a comprehensive strategy to position Spain as a European leader in these renewable energy technologies. This roadmap sets ambitious goals for the deployment of offshore wind and other marine energy sources, aiming to stimulate economic growth, create jobs, and reduce greenhouse gas emissions (Table 2). It aligns with the EU's strategy on marine renewable energies and is the result of extensive consultation with various stakeholders.

The roadmap's primary objective is to establish Spain as a European reference point for technological development and environmental innovation in marine renewable energies. To achieve this, it sets out a series of strategic actions focused on:

- Boosting technological development and innovation: Spain aims to become a global leader in R&D for offshore wind and other marine energy technologies. This will be achieved through targeted investments in research, development, and demonstration projects.
- Strengthening the domestic supply chain: The roadmap seeks to foster a robust domestic supply chain for offshore wind and marine energy technologies, supporting the creation of high-quality jobs and enhancing Spain's industrial competitiveness.
- Facilitating permitting and regulatory frameworks: Streamlining administrative procedures and creating a favourable regulatory environment will accelerate the deployment of offshore wind farms and other marine energy projects.

[66] "BOE-A-2024-19172.Pdf."

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- Promoting public acceptance and environmental sustainability: The roadmap emphasises the importance of engaging with local communities and ensuring that the development of marine renewable energy projects is environmentally sustainable.

Through the implementation of these strategies, Spain aims to achieve the following impacts:

- Significant increase in renewable energy capacity: Spain targets installing between 1 and 3 GW of floating offshore wind capacity by 2030 and up to 60 MW of other marine energy technologies in a pre-commercial phase.
- Economic growth and job creation: The development of offshore wind and marine energies is expected to stimulate economic growth, create new jobs in manufacturing, installation, and operation, and attract foreign investment.
- Reduced greenhouse gas emissions: The increased deployment of renewable energy from the sea will contribute to Spain's decarbonisation goals and help to mitigate climate change.
- Enhanced energy security: By diversifying its energy mix, Spain will reduce its dependence on fossil fuels and improve its energy security.

Table 2. Targets by 2030 of the Roadmap for Offshore Wind and Marine Energy in Spain

	2030 Targets	References 2030
Offshore wind energy	1 – 3 GW	5 – 30 GW floating globally 7 GW floating at the European level 60 GW (fixed and floating) at European level
Marine energy	40 – 60 MW	10 GW at a global level 1 GW at European level

3.2.2.3 National Strategy for Smart Specialisation

The Spanish Science, Technology and Innovation Strategy 2021-2027 (EECTI 2021-2027)[67] is the fundamental instrument for consolidating and strengthening the Science, Technology, and Innovation System (SECTI) over the next seven years.

The ECCTI 2021-2027 is specifically designed to facilitate the articulation of the Spanish R&D&I policy with the policies of the European Union, considering the regulations that have been or are being approved, in order to be able to take full advantage of the synergies between the programmes.

In this regard, the strategy adds elements that also aim to promote maximum coordination between State and regional planning and programming.

[67] "Estrategia Española de Ciencia, Tecnología e Innovación 2021-2027."

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The EECTI 2021-2027, together with the State Research, Technical, and Innovation Plans, is configured as the State Smart Specialization Strategy S3, which must include the necessary elements to fulfil the requirements from the European Union. In addition, the EECTI will cover the Regional Smart Specialization Strategies S3 developed in the Autonomous Communities.

To address the strategy, it is essential to emphasize that the promotion of R&D&I must be carried out in a coordinated manner, and that the regions will play a key role in reducing the EU's innovation deficit, something that will be considered an essential task to promote cohesion policies. In this context, the EECTI, as a state S3, will be an indispensable element of the regional S3s and, therefore, has been designed in accordance with the following principles:

- Leveraging the assets and resources available in each of the Autonomous Regions, as well as across the country, to face the challenges and opportunities that will contribute to strengthening growth, maintaining national coordination.
- Limiting investment priorities in RDI to those with critical mass and strong business resources.
- Incorporating a process of identifying priorities and needs in which, in addition to the National Government, the Autonomous Regions or the SECTI itself, attention is paid to the interests of the market and the private sector.
- Broadening the vision of the strategy to support technological and social innovation.
- Establishing a robust monitoring and evaluation system, along with a review mechanism to update the strategic and programmatic options considered necessary in each case.

3.2.2.4 Indicators and targets

The Integrated National Energy and Climate Plan (NECP) 2021-2030, which has been updated in September 2024 states that as a result of the comprehensive analytical and energy modelling process, regulatory framework updates, and technical contributions from various stakeholders, the policies and measures included in the updated National Integrated Energy and Climate Plan (PNIEC) will enable the country to achieve the following results by 2030:

- A 55% reduction in greenhouse gas emissions compared to 2005, which represents a 32% reduction compared to 1990.
- 48% of final energy consumption comes from renewable sources.
- A 43% improvement in energy efficiency in final energy consumption compared to projections in a baseline scenario without measures.
- 81% of electricity is generated from renewable sources.
- 19 GW of self-consumption capacity and 22.5 GW of energy storage.
- Reduction of external energy dependence from 73% in 2019 to 50% in 2030.

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- A 42% reduction in emissions from diffuse sectors and a 70% reduction in sectors under the emissions trading scheme compared to 2005.
- An electrification rate of the Spanish economy of 35%.

The implementation of this Plan aims at transforming the energy system towards greater energy self-sufficiency, essential in the current geopolitical context, based on efficiently harnessing the renewable potential that exists in Spain, particularly solar and wind energy. To achieve this, the deployment of these technologies will be accompanied by the development of flexibility in the energy system, through energy storage and demand management. This transformation will have a positive impact on national energy security by significantly reducing dependence on fossil fuel imports, which represent a high economic cost and are subject to geopolitical factors and high price volatility, as has been the case in recent years.

3.2.2.5 Sector value chain

The Spanish Roadmap for the Development of Offshore Wind and Marine Energies states that offshore wind is an opportunity for Spain to take advantage of its potential for industrial development and innovation. The European Wind Energy Association, WindEurope, estimates that investment in the offshore sector will reach €16.5 billion in 2030 at European level, while the ‘EU Strategy on Offshore Renewable Energy’ recognises that to meet targets and maximise the benefits for the European economy, the offshore renewable energy value chain must be able to increase its production capacities and achieve higher rates of installation.

Spain is in a position to play a leading technological and industrial role in this context, to provide innovative and cost-effective solutions for fixed and floating offshore wind and marine energy in response to this investment potential. In line with the framework for boosting the energy transition and its associated value chain envisaged in the Strategic Energy and Climate Framework, the Sectoral Agenda for the Wind Industry[68] identifies offshore wind as one of the main levers for strengthening the Spanish wind industry. This document, which forms part of Spain’s Industrial Policy Strategy 2030[69], proposes a series of lines of action necessary for the development of the national offshore wind industry.

Offshore wind in Spain also has very important synergies with other strategic sectors, such as the shipbuilding industry (shipyards), the maritime-port sector and civil engineering, for which offshore wind has become a very important potential market in their business diversification and workload stabilisation strategies.

Many of the national companies have been heavily involved in the development of offshore wind farms in Europe and are already playing a leading role in the supply chain of the first floating wind turbine arrays on the continent, with Spain being the main supplier of floating foundations.

[68] Vicent, “Agenda Sectorial de la Industria Eólica.”
[69] “Docu Directrices Generales de La Política Industrial Española.Pdf.”

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In addition, its geographical position, the extension of its coasts and the diversity of maritime regimes to which they are exposed, as well as the technological and research ecosystem, place Spain in an ideal position for the development, testing and demonstration of new prototypes and technological solutions linked to offshore wind, especially floating.

In this context, measures are necessary so that the Spanish industrial and naval ecosystem can maintain and strengthen the competitive positioning of the offshore industry, increasing its contribution to Gross Domestic Product and the generation of qualified employment in our country. In addition to the measures aimed at strengthening capacities, the development of offshore wind in Spain envisaged in this Roadmap also contributes to expanding the national supply chain market, as well as to continuing to develop innovative solutions that allow the sector to continue to compete and provide services at a global level.

3.2.2.6 Associated job profiles

As indicated in the Spanish Roadmap for the Development of Offshore Wind and Marine Energies, measure 2.5 is about training and professional qualification in the marine renewables energy sector. The objectives indicated there are about the availability of qualified professionals for the installation, operation and maintenance of the devices and their infrastructures, with the dual objective of establishing local employment and taking advantage of the opportunity to create local jobs.

It has been detected that in the field of Offshore Wind and Marine Energy there might currently be a lack of professionals in these sectors for the expected deployment, which require specific and qualified training. According to the "EU Strategy on Offshore Renewable Energy", up to 30% of companies identify skills and qualified personnel shortages.

In coordination with the different competent administrations and social agents, the best way to improve the technical skills required in the labour market of the offshore renewable energy sector will be analysed. Special attention will be paid to the introduction of equality and social inclusion criteria in training and vocational training for the occupation of the professional profiles demanded by the sector. The need to reinforce the training programmes offered by existing training centres at national level will be reviewed, so that they are capable of training professionals to carry out the tasks foreseen in offshore wind and renewable energy projects. The need and convenience of supporting the Vocational Training Centres closest to the sea will be assessed, for the development of specific training facilities for offshore wind energy, especially in safety and survival at sea issues in specific specialised training centres and the need to make this training compatible with international standards in the field. The coordination of these activities with Rescue and Combating Pollution Plans, as well as their own contingency plans and means to deal with them, must also be considered, as well as transport and access issues and the GWO-Offshore. This commitment to training could be reinforced through its connection with some of the European initiatives under the European Agenda for Skills, which promote capacity building for the use of offshore renewable energy.

Below is an overview of some key job profiles across various stages of offshore wind farm development and operation:

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1. Engineering & Technical Roles

Wind Turbine Technician (ESCO code 7412.12)

- Role: Responsible for the installation, maintenance, and repair of wind turbines.
- Skills: Mechanical and electrical skills, problem-solving, physical fitness for working at heights.
- Qualifications: Engineering or technical diploma, certifications like GWO (Global Wind Organisation).

Electrical Engineer (ESCO code 2151.1)

- Role: Designs, installs, and maintains electrical systems in the wind farm, including transformers, substations, and grid connections.
- Skills: Electrical system design, power distribution, problem-solving.
- Qualifications: Bachelor's degree in electrical engineering or related field.

Mechanical Engineer (ESCO code 2144.1)

- Role: Focuses on the mechanical systems of the wind turbines, including rotors, gears, and bearings.
- Skills: Mechanical design, CAD software, knowledge of fluid dynamics.
- Qualifications: Bachelor's degree in mechanical engineering.

Structural Engineer (ESCO code 2149.2.1)

- Role: Designs the foundations and support structures for offshore wind turbines, ensuring they withstand harsh marine environments.
- Skills: Structural analysis, experience with marine and offshore standards, use of modelling software.
- Qualifications: Civil or Structural Engineering degree.

SCADA Engineer (Supervisory Control and Data Acquisition) (ESCO code 2152.1.3)

- Role: Develops and manages the control systems that monitor and optimize wind farm operations remotely.
- Skills: Programming, control system design, data analysis.
- Qualifications: Electrical/Control Systems Engineering background.

2. Project Management & Development

Project Manager (ESCO code 1219.6)

- Role: Oversees the planning, development, and execution of wind farm projects from conception to completion.
- Skills: Project management, budgeting, team coordination, risk assessment.

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- Qualifications: Experience in project management (often PMP or PRINCE2 certified), engineering background preferred.

Offshore Construction Manager (ESCO code 1323.1)

- Role: Manages the offshore construction phase, including the installation of turbines and substations.
- Skills: Knowledge of marine operations, logistics, team leadership, health and safety compliance.
- Qualifications: Construction management or engineering background.

Health & Safety Officer (ESCO code 2263.3)

- Role: Ensures compliance with health and safety regulations during the construction and operation of offshore wind farms.
- Skills: Risk assessment, knowledge of offshore safety protocols, attention to detail.
- Qualifications: Certifications in safety management (e.g., NEBOSH, IOSH).

3. Environmental & Regulatory

Environmental Consultant/Scientist (ESCO code 2133.7)

- Role: Assesses the environmental impact of wind farms and ensures compliance with environmental regulations.
- Skills: Knowledge of environmental laws, data analysis, report writing.
- Qualifications: Degree in Environmental Science or related field.

Marine Biologist (ESCO code 2131.4.9)

- Role: Studies the impact of wind farms on marine ecosystems and helps design strategies to minimize harm.
- Skills: Field research, environmental monitoring, knowledge of marine species.
- Qualifications: Marine biology or ecology degree.

4. Operations & Maintenance

Operations Manager (ESCO code 1321.2.3)

- Role: Manages the ongoing operation and maintenance of offshore wind farms to ensure optimal performance.
- Skills: Leadership, technical knowledge of turbines, problem-solving.
- Qualifications: Experience in operations, often in energy or marine sectors.

Asset Manager (ESCO code 3311.1)

- Role: Manages the financial and operational performance of the wind farm over its lifecycle.

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- Skills: Financial analysis, contract management, risk management.
- Qualifications: Business, finance, or engineering background.

5. Logistics & Marine Operations

Logistics Coordinator (ESCO code1324.3)

- Role: Manages the transportation and supply chain logistics of components like turbine blades, towers, and substations.
- Skills: Supply chain management, coordination of marine transport, attention to detail.
- Qualifications: Degree in logistics or supply chain management.

Vessel Manager (ESCO code 4323.19)

- Role: Oversees the operation and maintenance of vessels used in offshore construction and maintenance.
- Skills: Marine operations, vessel maintenance, logistics planning.
- Qualifications: Marine engineering or maritime management background.

6. Data & Analysis

Wind Resource Analyst (ESCO code 2149.7.6)

- Role: Analyses wind data to assess the viability and efficiency of wind farm locations.
- Skills: Data analysis, meteorology, use of wind analysis software (e.g., WindPro, WindSim).
- Qualifications: Background in physics, meteorology, or engineering.

GIS Specialist (Geographic Information Systems) (ESCO code 2165.3)

- Role: Uses spatial data to assist in planning wind farm layouts, environmental assessments, and logistics.
- Skills: GIS software proficiency, data visualization, mapping.
- Qualifications: Degree in geography, environmental science, or a related field.

7. Legal & Compliance

Contracts Manager (ESCO code 2619.1)

- Role: Manages contracts with suppliers, contractors, and service providers involved in the wind farm project.
- Skills: Contract negotiation, legal knowledge, procurement.
- Qualifications: Law or business degree, experience in contract management.

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Regulatory Affairs Specialist (ESCO code 2619.12)

- Role: Ensures that the wind farm complies with all local, national, and international regulations.
- Skills: Understanding of energy and environmental regulations, compliance monitoring.
- Qualifications: Legal or policy background in energy.

8. Finance & Commercial Roles

Investment Analyst (ESCO code 2413.1.2)

- Role: Evaluates the financial viability of wind farm projects, including costs, revenues, and risks.
- Skills: Financial modelling, market analysis, risk assessment.
- Qualifications: Degree in finance, economics, or business.

Procurement Specialist (ESCO code 2422.14)

- Role: Manages the procurement of components, equipment, and services required for the construction and operation of wind farms.
- Skills: Supplier management, negotiation, contract management.
- Qualifications: Degree in business, supply chain management, or engineering.

9. Research & Development

Innovation Engineer (ESCO code 2149.2.8)

- Role: Works on new technologies and techniques to improve the efficiency and cost-effectiveness of wind farms.
- Skills: Research, product development, creative problem-solving.
- Qualifications: Engineering background, often with a focus on renewable energy.

Blade Engineer (ESCO code 2149.2.2)

- Role: Focuses on the design, testing, and optimization of turbine blades for maximum efficiency and durability.
- Skills: Materials science, aerodynamic design, CAD.
- Qualifications: Engineering degree in materials, aerospace, or mechanical engineering.

10. Subsea Engineering

Subsea Cable Engineer (ESCO code 2149.9.5)

- Role: Designs and installs the undersea cables that connect turbines to each other and to the onshore grid.

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- Skills: Knowledge of electrical transmission, marine environments, and cable installation techniques.
- Qualifications: Electrical engineering or marine engineering background.

Diving Technician (ESCO code 7541.1)

- Role: Conducts underwater inspections and repairs of turbines, foundations, and cables.
- Skills: Underwater welding, diving certifications (e.g., commercial diver certification).
- Qualifications: Technical diving certifications, engineering or technical background.

3.2.2.7 Challenges and contributions

The offshore renewable energy sector in Spain faces several challenges and uncertainties:

- Regulatory Framework

The regulatory framework for offshore wind in Spain is still evolving. While progress has been made, the new Royal Decree that aims to regulate the production of electricity in offshore installations, covering the necessary administrative authorizations, economic framework, and procedures for granting permits is still not in place.

- Grid connection

Establishing grid connection infrastructure for offshore wind farms can be complex and costly, requiring coordination between different stakeholders and significant investments.

- Technological Advancements

While floating foundations are becoming more viable for deeper waters, their long-term performance and costs still need to be further demonstrated. Continued technological advancements are crucial for reducing the cost of offshore wind energy to make it more competitive with other renewable sources.

- Supply Chain and Infrastructure

Developing a strong domestic supply chain and infrastructure for offshore wind can create jobs and economic benefits, but it requires significant investments and coordination. At the same time, Spain will need to compete with other countries for access to global supply chains and technologies.

- Environmental Impact

Offshore wind development can potentially impact marine ecosystems, including biodiversity and fisheries. Careful environmental assessments and mitigation measures are necessary to minimize these effects. Also, the visual and acoustic impact of offshore wind farms on coastal communities and marine environments needs to be carefully considered and addressed.

- Public Acceptance

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Addressing concerns from local communities and stakeholders regarding potential impacts on tourism, fishing, and the environment is essential for gaining public acceptance and support. Developing strategies to ensure that local communities benefit from offshore wind projects can help foster positive relationships and support for the sector. These challenges and uncertainties need to be addressed through effective policymaking, technological innovation, and stakeholder engagement to ensure the successful development of the offshore renewable energy sector in Spain.

Potential contribution to addressing social challenges

Spain has identified an industrial opportunity to leverage existing expertise in the onshore wind technology supply chain, which is already strong and well-established within the country, and apply this knowledge to the growing offshore wind sector. In addition, Spain has strong industrial capacities and talent in other important sectors for the development of marine energy, such as the shipbuilding sector, auxiliary industries and electrical systems.

In this sense, the development of marine energy will not only benefit directly related sectors, such as the manufacture of components for offshore operation - turbines, foundations, floating platforms and other auxiliary services- and service companies - potentially extended to operation and maintenance, vessels and other offshore services -, but also other relevant sectors of the Spanish economy could benefit from the development of offshore wind energy, as shown on Figure 23.

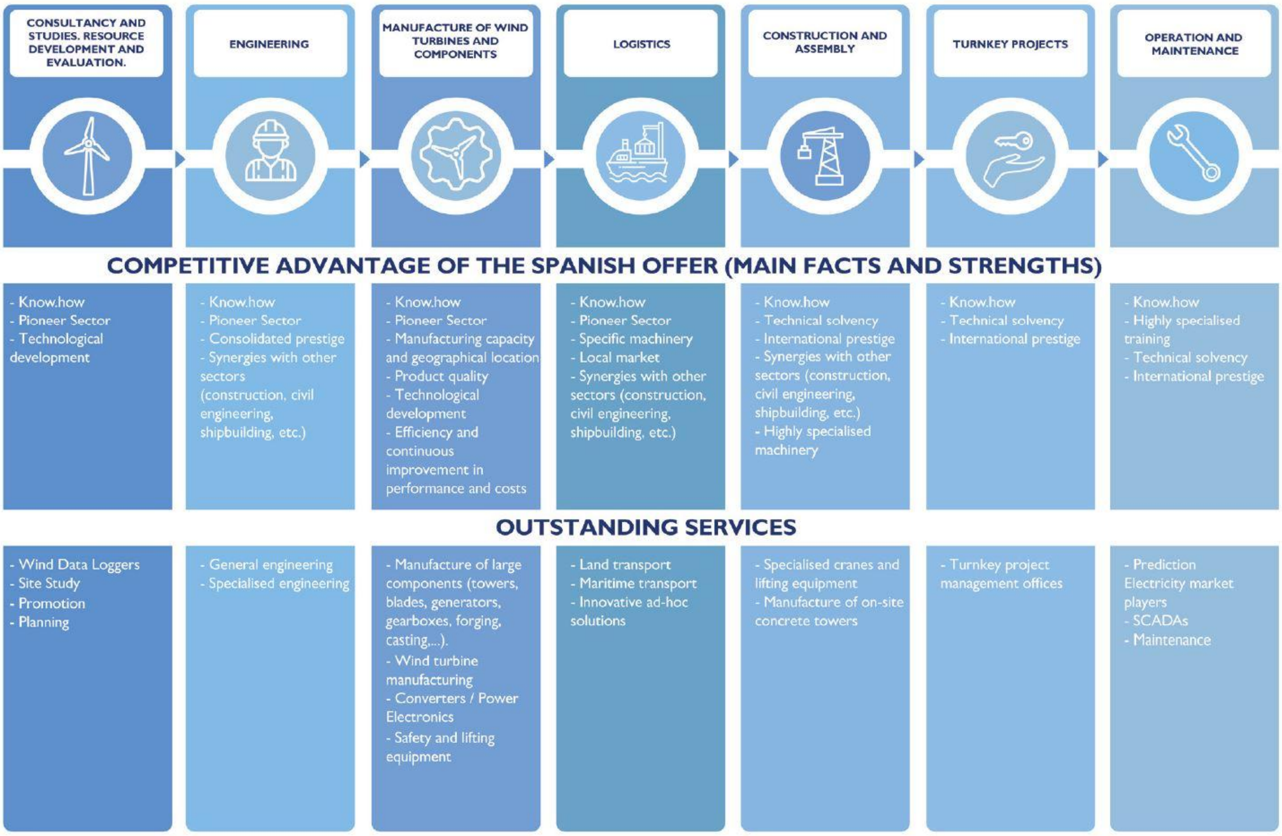

Figure 23. Value chain of the wind industry. Source: Wind Industry Sectoral Agenda (from the Spanish roadmap)

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Those potential opportunities can provide several contributions to addressing social challenges:

Job creation and economic dynamization, specifically (but not only) in coastal regions, attracting investment and boosting local businesses.

A just transition for workers potentially affected by the shift away from traditional energy sources. This could involve skills development programmes and retraining initiatives.

It should be recognized that there is a need for **social acceptance** of offshore projects and engagement with local communities throughout the planning and development process. This could involve measures to mitigate potential negative impacts and ensure equitable distribution of benefits.

Contribution to the fight against climate change and environmental sustainability. Offshore renewable energy should be a key contributor to Spain's climate change goals by reducing greenhouse gas emissions and fostering a more sustainable energy future. The potential environmental impact of these projects should be acknowledged though, emphasising the need for responsible development practices, including environmental impact assessments and mitigation strategies.

3.2.2.8 SWOT analysis for offshore renewable energy

The following SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) of the Offshore Floating Wind Sector in Iberia (carried out by EIT-Innoenergy and Enzen) is presented in the Roadmap for the Development of Offshore Wind and Marine Energy in Spain:

SWOT analysis of the ORE Sector	
Strengths	**Weaknesses**
• Iberia has a significant offshore wind resource and given its water depth conditions; FOW is expected to be the appropriate technology for it. • The Iberian region has strong capabilities across almost the entire FOW value chain, resulting in a relatively advantageous positioning against other competing regions. • Additionally, the Iberian region is very strong in some cross-cutting capabilities which have a low replicability (geographical positioning, supply chain, port infrastructure, manufacturing cost competitiveness, etc.). • There are several FOW technologies being developed in the region, with a precommercial project in operation in Portugal (WindFloat). • Spanish shipyards have constructed the floating structures for some of the most relevant FOW	• Although several developers have expressed their interest in implementing this technology in the Iberia, this has not yet materialized into a particular pipeline of projects. • Currently, National Energy and Climate Plans of Spain and Portugal include very low or no specific targets for offshore energy to 2030. • Investments in the development of new projects, and even more so regarding the supply chain, require a long-term political perspective. • Existing regulations require updating in both countries regarding MSP, streamlining of administrative procedures and the establishment of an appropriate remuneration framework.

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projects and the region has leading players in offshore moorings.	• Public Investment is needed to promote the development of an internal demand for projects (e.g., supporting mechanisms).
Opportunities	**Threats**
• Significant cost reductions are expected in the coming years which will bring down the LCOE by a 66% on average. • The EC estimates 450 GW of offshore wind by 2050; of which 100 and 150 GW are anticipated to be floating. • WindEurope estimates that Iberia could install up to 22 GW of offshore wind by 2050 and this is expected to be mostly floating given water depths. • An internal demand of projects will activate and strengthen the industrial network and value chain, allowing it to move to the outside market. • FOW could have a significant impact on the Iberian economy. • Annual GDP contribution could reach a value between EUR 4,681 and 7,752 million. • The consequent job creation would range between 43,669 and 77,825 jobs.	• Competition with other renewable energy sources. • Current LCOE levels for FOW are not yet competitive against other generation technologies. • Competition with other potential technology and industry hubs. • Other countries/regions are well positioned for FOW development and might threaten Iberia's positioning (e.g., France, Poland, UK, etc.). • Pushback from certain groups, including some environmental organizations and the fisheries sector. Some fishermen's associations have already taken legal action to challenge the maritime spatial plans.

3.2.3 Italy

3.2.3.1 Legal framework and policies

In Italy the Ministry of Environment and Energy Security (MASE) is the public authority responsible for the development and regulation of the national energy policy. Among the energy policies, the offshore wind energy development and regulation is part of the competences of the MASE. In 2019, the National Integrated Energy and Climate Plan 2030 (PNIEC) was approved through the Council of Ministers Resolution No. 100 of 2020 by the Italian government. The PNIEC serves as the foundation of Italy's energy and climate policy for the 2020-2030 decade, according to the pathway toward carbon neutrality by 2050. It sets targets for reducing greenhouse gas emissions, increasing the share of renewable energy, and improving energy efficiency, in line with Italy's commitments within the European Union. The PNIEC was then reviewed in 2024.

The Ministry of Infrastructure and Transport (MIT), through its Directorate-General for the Supervision of Port Authorities, Port Infrastructure, and Maritime Transport, manages both the National Maritime Space and Marine Spatial Planning (MSP). Legislative Decree No. 201 of 17 October 2016 implements the European Directive 2014/89/EU and establishes the legal framework for MSP in Italy, which includes the planning of areas designated for the development of marine renewable energy projects, including offshore wind energy.

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Another important plan is the "Plan for the Sea 2023-2025", which aims at promoting the sustainable development of the ocean and strengthening the role of the sea. The associated action plan includes numerous specific measures to implement, with significant actions in the field of marine renewable energy, with a particular focus on offshore wind power. The government simplified the procedures for the development of innovative projects through the creation of Special Economic Zones (SEZs), which include coastal areas designated for the development of advanced technologies, including marine renewable energy. Decree-Law 76/2020 (Simplification Decree) facilitated the establishment of these zones, with a specific focus on promoting innovation in marine renewable energy technologies.

3.2.3.2 Sectorial priorities and forecast

Nowadays the electricity demand in Italy is supplied by a mix of different energy sources. Figure 24 shows the share of each source updated to 2022, where data are expressed in TWh. It is worth mentioning that the share of wind energy refers almost completely to on-shore installations. With the future plans described in the following sections, the Italian government aims to increase the shares of renewable energy, including offshore wind energy.

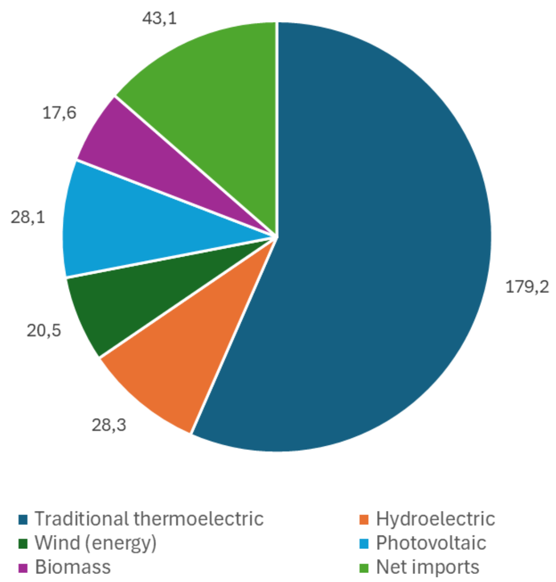

Figure 24. Shares (TWh) of energy demand source (Source: Terna, 2022)

3.2.3.3 National Strategy for Smart Specialisation

National Integrated Energy and Climate Plan 2030 (PNIEC)

The PNIEC is the strategic document adopted by Italy to guide the country's energy transition and climate efforts in line with European Union objectives. The plan aims to reduce greenhouse gas emissions, increase the share of renewable energy in the energy mix, and improve energy efficiency by 2030, with a long-term goal of achieving climate neutrality by 2050. Within the PNIEC, offshore wind energy plays a crucial role.

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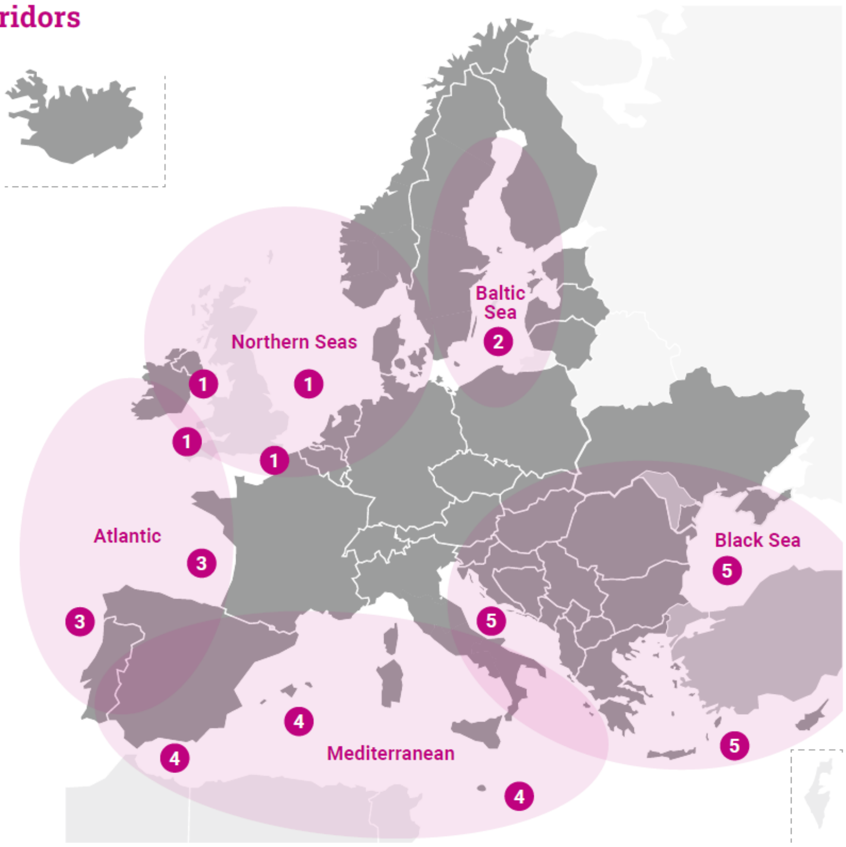
To facilitate offshore renewable energy development, the 2022 TEN-E regulation requires member states to cooperate on cross-border offshore renewable energy targets, within their respective maritime corridors, with intermediate milestones set for 2030 and 2040. Italy, which borders both the eastern and western Mediterranean basins, signed two non-binding agreements in January 2023 with other member states, including Greece, Spain, France, Malta, Croatia, and Slovenia, committing to connect up to 4 GW to the Italian grid by 2030 in the "South and West Offshore Grids" priority corridor, and 4.5 GW in the "South and East Offshore Grids" corridor. The sea basins and involved countries are shown in Figure 25.



TEN-E Priority Offshore Grid Corridors	Countries involved
1. NSOG	BE, DK, FR, DE, IE, LU, NL, SE
2. BEMIP offshore	DK, EE, FI, DE, LT, LV, PL, SE
3. AOG	FR, IE, PT, ES
4. SW offshore	FR, GR, IT, MT, PT, ES
5. SE offshore	BG, CY, HR, GR, IT, RO, SI

Figure 25. TEN-E Priority Offshore Grid Corridors as laid down in Regulation (EU) 2022/869 (Source: EU Commission)

Although offshore wind is still underdeveloped in Italy compared to other European countries, the plan underlines the importance of increasing the installed capacity, with a target of approximately 900 MW by 2030. To achieve this, the government aims to focus on innovative technologies, such as floating turbines, which are particularly suited to the Mediterranean Sea's deep waters, where fixed-bottom turbines are difficult to install. This technological approach will allow the exploitation of offshore areas farther from the coast, minimising visual impact and reducing conflicts with other economic activities, such as fishing and tourism.

The PNIEC also highlights the need to streamline bureaucratic procedures for the development of offshore wind farms. In this regard, the Simplification Decree (DL 76/2020) introduced measures to shorten project

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approval times, simplify administrative processes, and facilitate obtaining the necessary permits. However, significant challenges remain, including the complexity of environmental assessment procedures and local opposition due to concerns over landscape impact.

The PNIEC acknowledges the importance of research and technological development for the success of offshore wind energy in Italy, promoting investments in innovation to reduce the costs of floating technologies and enhance the sector's competitiveness. The expansion of offshore wind will not only help to increase the share of energy from renewable sources, but also create new economic opportunities, generating jobs and stimulating growth in the renewable energy industrial sector.

Plan for the Sea 2023-2025

In the Plan for the Sea document, Italy is described as an ideal candidate to become Southern Europe's energy hub, particularly in the transition towards clean energy. Offshore wind power plays a significant role in this strategy. Offshore wind farms, along with wave energy, are becoming increasingly important in Europe’s renewable energy mix, though Italy’s progress has been somewhat slower.

In addition to offshore wind development, Italy is moving to establish Exclusive Economic Zones (EEZs), as authorised by the 2021 law. An EEZ is useful for offshore wind sector as it gives to Italy the exclusive rights to develop wind farms up to 200 nautical miles from its coast.

This strategy will enhance Italy's sovereignty over the exploration, exploitation, and management of marine resources, including renewable energy such as offshore wind and solar power, as well as tidal and wave energy. Within the EEZs, Italy can exert control over installations and structures at sea, including artificial islands and offshore platforms. The establishment of these zones is expected to improve control over Italy’s offshore fields, while also allowing for more sustainable use of marine resources in line with international norms.

REPowerEU

The REPowerEU plan is a European Commission initiative, and its primary goal is to reduce the European Union's dependence on fossil fuels, and to accelerate the transition towards renewable energy sources. Within this framework, offshore wind energy plays a crucial role.

For Italy, the plan creates opportunities for offshore wind development. Italy’s coastline, specifically in the Mediterranean, can increase the presence of offshore wind farms, contributing to both the country’s energy independence and its climate goals. One of the key aspects of REPowerEU for offshore wind is the choice of ambitious targets. The EU aims to have a total offshore wind capacity of 300 GW by 2050, with an intermediate target of 60 GW by 2030. The development of offshore wind farms slower in Italy than some northern European nations, but REPowerEU is expected to change this, accelerating Italy's contribution.

A major focus of the plan is to streamline and speed up permitting procedures. Historically, Italy, like many other EU countries, has faced bureaucratic hurdles and lengthy approval processes that have delayed the construction of renewable energy projects, including offshore wind farms. REPowerEU seeks to reduce these

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obstacles by simplifying the rules and promoting the establishment of "accelerated development zones" for renewable energy. This would allow Italy to expedite the deployment of offshore wind projects, which is crucial in meeting both EU and national energy targets.

Infrastructure development is another crucial element of the plan. Offshore wind energy requires adequate infrastructure to transmit electricity from offshore platforms to onshore grids. REPowerEU emphasises investment in submarine cables, which would allow Italy to better integrate offshore wind energy into its national grid and contribute to the overall resilience of the European electricity network. Strengthening the grid is key for Italy to fully harness the potential of offshore wind energy.

Financing is also a major component of REPowerEU. The plan makes substantial funds available to support infrastructure development, technological innovation, and research, which will be critical for Italy as it ramps up its offshore wind capacity. Italy is expected to benefit from EU funding programmes, such as NextGenerationEU, as well as private sector investments, which will support the growth of offshore wind and create economic opportunities, including new jobs in coastal regions.

3.2.3.4 Indicators and targets

Within the PNIEC, the policy scenario set by the PNIEC aims to achieve the installation of approximately 131 GW of renewable energy capacity by 2030, including around 28 GW from wind energy. A significant portion of this capacity is expected to be developed in central and southern Italy due to higher wind and solar resource availability. To meet these challenging targets, it will be essential to rely on different renewable technologies, including offshore wind (particularly floating), to exploit additional windy and sunny areas while minimizing land use and landscape impact. At the European level, the strategy for offshore renewable energy aims to reach at least 300 GW of offshore wind energy and 40 GW of ocean energy by 2050 within the EU, considered key target for achieving climate neutrality. Although offshore wind is still underdeveloped in Italy compared to other European countries, the plan underlines the importance of increasing the installed capacity, with a target of approximately 900 MW by 2030. To achieve this, the government aims to focus on innovative technologies, such as floating turbines, which are particularly suited to the Mediterranean Sea's deep waters, where fixed-bottom turbines are difficult to install. This technological approach will allow the exploitation of offshore areas farther from the coast, minimising visual impact and reducing conflicts with other economic activities, such as fishing and tourism.

3.2.3.5 Sector value chain

The offshore wind value chain regards all the activities and stakeholders involved in the development, installation, operation, and maintenance of offshore wind farms, creating value at every stage. It includes research and development, project design, component manufacturing, logistics, installation, and long-term operation and maintenance. In Italy, while the value chain benefits from strong industrial capabilities, skilled labour, and strategic coastal locations, a significant bottleneck exists in the form of under-equipped ports.

Many Italian ports lack the infrastructure necessary to handle the large-scale operations required for offshore wind projects. These facilities need reinforced quays, expansive storage and assembly areas, and deep waters to accommodate the massive components, such as turbine blades exceeding 100 meters and

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floating or fixed foundations, as well as specialized installation vessels. Infrastructure upgrades, such as reinforcing quays, creating assembly zones, and improving transportation links, represent substantial investments that must align with the ports' existing economic activities, such as container shipping or passenger services, which may compete for space and resources. Bureaucratic complexities can further delay these adaptations, potentially slowing the ports' ability to serve the growing offshore wind market. Ports like Taranto, Ravenna, and Brindisi are strategically located near promising offshore wind sites but require significant upgrades to fully support the sector. Without these improvements, logistical inefficiencies can delay projects, increase costs, and limit Italy's potential to become a leader in offshore wind energy. Investments in port modernisation are therefore critical to overcoming this bottleneck and unlocking the full capacity of the Italian offshore wind value chain.

The role of ports in Italy's offshore wind value chain presents both significant advantages and challenges, given the country's extensive coastline and strategic position in the Mediterranean. Ports such as Taranto, Ravenna, Brindisi, and Civitavecchia are well-positioned to serve as logistical hubs for the assembly, transport, and maintenance of offshore wind infrastructure. One major advantage is their proximity to potential offshore wind farm locations in the Adriatic and Tyrrhenian Seas, which reduces transportation costs and time. Additionally, many of these ports have a strong industrial heritage, with existing facilities and expertise in heavy engineering, maritime logistics, and shipbuilding that can be adapted to the needs of the offshore wind sector. Their location in densely populated and industrially active areas also facilitates access to a skilled workforce and supply chains for components such as turbines, cables, and foundations.

3.2.3.6 Associated job profiles

The offshore wind energy sector in Italy requires a diverse range of specialised professionals across various disciplines to support its development and operations. Key roles include R&D specialists, who focus on innovative solutions and sustainable projects. Project planning and development are based on project managers and environmental experts. The manufacturing and supply chain segment demands mechanical and mechatronics engineering technicians alongside supply chain managers to ensure efficient production and logistics. In installation and construction, professionals such as construction quality managers and electromechanical engineering technicians are essential for maintaining high standards. The operations and maintenance (O&M) phase require skilled ORE plant operators, wind turbine technicians, and predictive maintenance experts to ensure optimal performance. Additionally, grid integration and energy management roles like energy managers and transmission system operators are crucial for seamless energy distribution. Support services, including financial analysts and underwater construction supervisors, alongside educators and community engagement officers, complete the multifaceted workforce driving the offshore wind sector in Italy. In addition, to overcome the underdeveloped ports, specific figures are required. Key roles include civil engineers and marine construction experts to design and build large quays and reinforced docking areas capable of handling massive wind turbine components. Logistics managers and supply chain specialists are essential for coordinating the transportation and storage of equipment, ensuring smooth operations. Additionally, construction companies with expertise in heavy infrastructure projects, alongside quality inspectors and project supervisors, play a critical role in ensuring that port facilities meet the technical and

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operational demands of the offshore wind industry. These efforts are vital for creating efficient hubs that facilitate the assembly, deployment, and maintenance of offshore energy systems.

3.2.3.7 Challenges and contributions

Wind conditions are important not only in predicting the amount of future energy production at different time scales but also in defining the loads imposed on all a turbine's structural components. Wind resource strongly influences the layout of turbines within a defined area as a function of the prevailing wind directions.

In Italy, the most appealing sites for offshore wind farm installation in terms of wind resource availability are located nearby the south and in the main islands. Figure 26 highlights the mean wind speed at 100 m above sea level, typical hub height of a multi-megawatt horizontal axis wind turbine. Specifically, the offshore areas of Puglia, Calabria, Sicilia, and Sardegna regions are characterised by a mean wind speed up to 8.5 m/s that is a noteworthy value. Other significant areas are along Lazio and Emilia Romagna coasts. Although the latter has a lower mean wind speed than the former, they are still suitable for wind turbine installation.

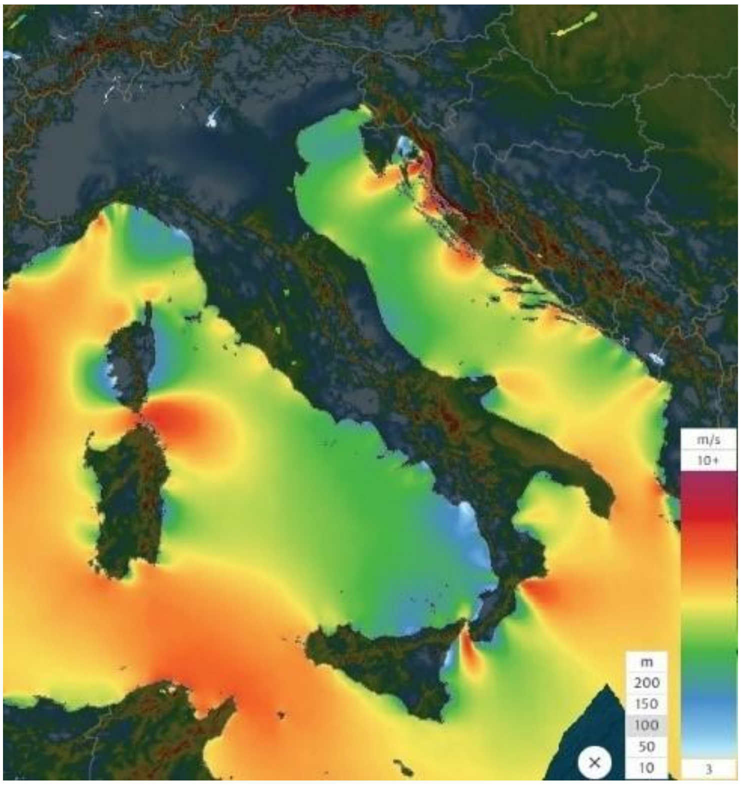


Figure 26. Mean wind speed at 100m above sea level (Source: Global Wind Atlas)

This trend is also confirmed by POWERED project findings (Figure 27). In fact, wind assessment in the Adriatic basin points out that Puglia coast is the most promising in terms of mean wind speed. On the other hand, Emilia Romagna Sea can be considered a good candidate for wind power plants.

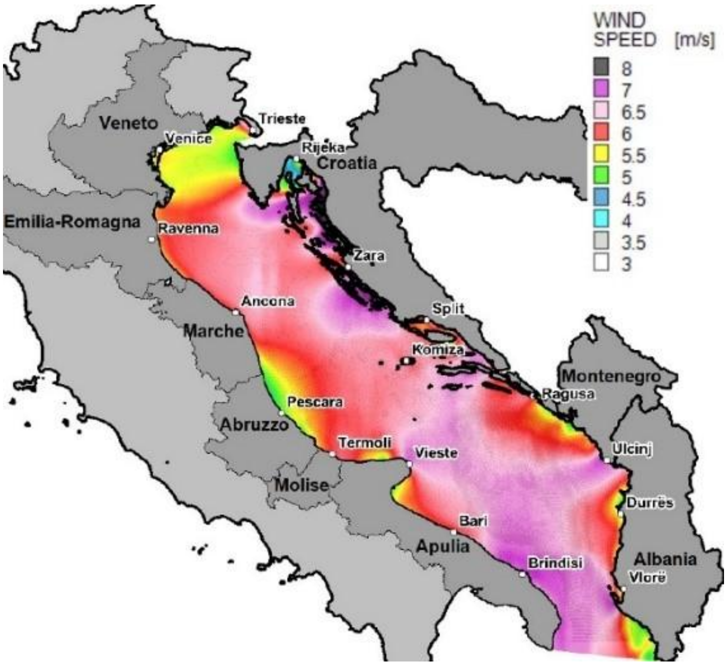
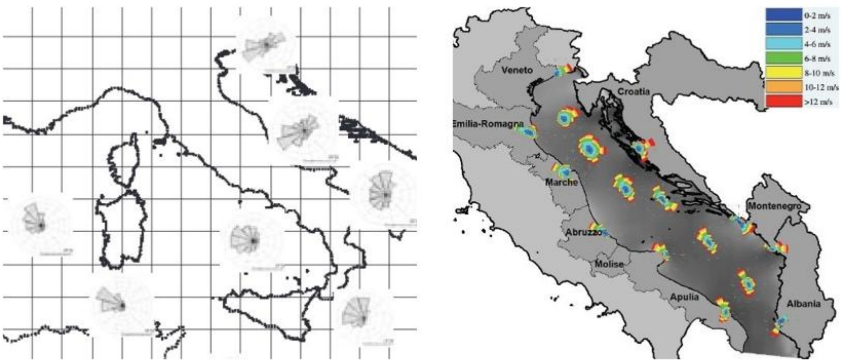


Figure 27. Mean wind speed at 90 m above sea level (Source: POWERED project)

Concerning wind direction, Italian seas experience a peculiar pattern. Specifically, the main wind blows from the northwest on the west coast and around the main islands, as reported in Figure 28 (a). Differently, the east coast, i.e. Adriatic Sea, wind roses in Figure 28 (b) show an NNW-SSE directionality in the south Adriatic Basin while omnidirectional behaviour may be observed at higher latitudes. Wind roses near the coastal line show instead different occurrences due to interactions with the local terrain conformation.



a. Mediterranean area b. Adiabatic basin

Figure 28. Wind frequency distribution (Sources: Lavagnini et. al., 2006, POWERED project)

Offshore wind turbines are typically mounted on tubular towers. Lattice-type towers can also be used. The towers are fixed to the foundation, often employing a transition piece as an interface between the tower and the foundation. These towers allow for the turbine to capture winds at heights far above the water's surface, where the wind resource is generally more energetic and less turbulent. Foundation technology is

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designed according to site conditions. Maximum wind speed, water depth, wave heights, currents, and soil properties are parameters that affect the foundation type and design. While the industry has historically relied primarily on monopile and gravity-based foundations, the increasing number of planned projects in deeper water has motivated research and pilot installations for more complex designs such as jackets, tripods, and floating. The most common structures to support wind turbines are illustrated in the following Table 3.

Table 3. Most common structures to support wind turbines

Type of substructure	Brief Physical description	Suitable water depths	Advantages	Limitations
Monopile steel	One supporting	10–30m	Easy to manufacture, experience gained on previous projects	Piling noise, and competitiveness depending on seabed
Monopile concrete, installed by drilling	One supporting pillar	10–40m	Combination of proven methods, cost-effective, less environmental (noise) impact, industrialization possible	Heavy to transport
Gravity base	Concrete structure	Up to 40m and more	No piling noise, inexpensive	Transportation can be problematic for heavy turbines. Requires preparation of the seabed. Heavy equipment needed to remove it
Suction bucket	Cylinder with sealed top pressed into the ocean floor	n.a.	No piling, relatively easy to install, easy to remove	Very sensitive to seabed conditions
Tripod	3/4-legged structure	Up to 30m and more	High strength. Adequate for heavy large-scale turbines	Complex to manufacture, heavy to transport
Jacket	Lattice structure	>40m	Less noise. Adequate for heavy large-scale turbines	Expensive so far. Subject to wave loading and fatigue failure. Large offshore installation period, sensitive to weather impact
Floating	Not in contact with seabed	>50m	Suitable for deep waters, allowing large energy potentials to be harnessed	Weight and cost, stability, low track record for offshore wind

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In this context, Italian seabed depth is to require floating installations to make the best from wind energy potential. The bathymetry reported in Figure 29 is a clear indication of this. In fact, the scale is chosen to highlight that the regions with a seabed depth lower than 50 m are very limited, especially for the most appealing areas in terms of wind availability. Specifically, most of the sea near Puglia, Calabria, Sicilia, and Sardegna is above 50 m deep at 10 km from the coastline. Therefore, floating wind farms are mandatory to ensure the transition towards renewable energy sources.

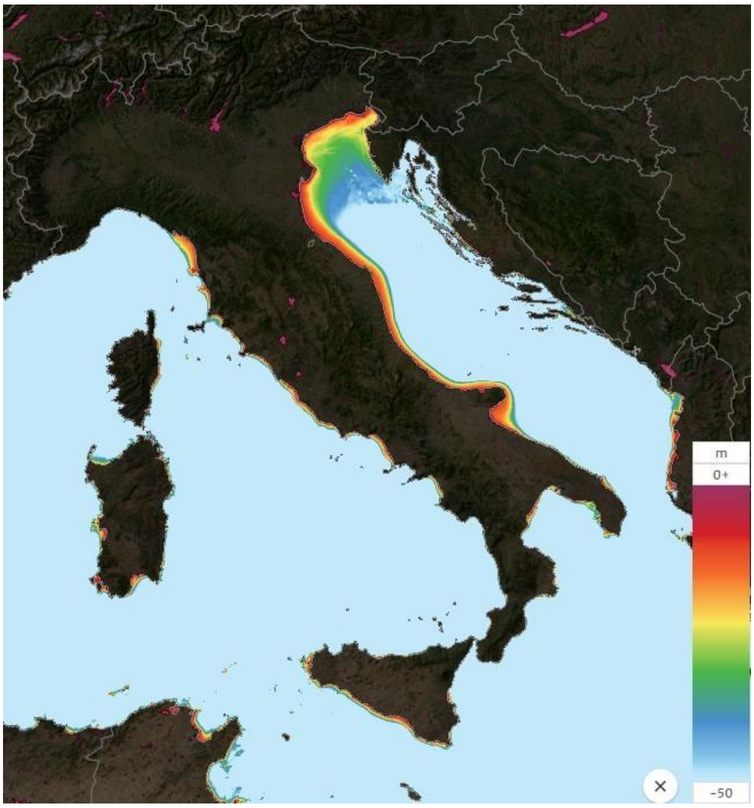

Figure 29. Bathymetry from 0 to –50 m (Source: Global Wind Atlas)

Nowadays, Italy has one operating offshore wind farm (Beleolico) and another project passed the environmental compatibility (7 Seas Med). However, the interest in offshore wind energy is currently growing. Indeed, there are several ongoing projects in the Italian territorial waters mainly in the design phase and some of them has started the authorization process.

Beleolico wind farm

Beleolico wind farm (Figure 30), which is also the first offshore wind farm of the Mediterranean Sea, is located in Puglia, in the outer ring of the Port of Taranto.

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Figure 30. Beleolico wind farm (Source: Renexia)

It consists of ten 3MW wind turbines, resulting in 30 MW of total installed power. The wind farm ensures 62 GWh of annual electricity production, contributing to the annual energetic needs of 60.000 people.

In the context of emissions reduction goal, the prospect is to save 730.000 tons of CO_2 in 25 years thanks to the operations of "Beleolico".

The towers are mounted on fixed monopile structures without transition piece: it is one of the first wind farms using this kind of structure; this allows lower material consumption and less maintenance during time. A highlight of this wind farm is that 90% of materials are recyclable.

7 Seas Med

7 Seas Med is a project aiming to develop the first floating wind farm of the Mediterranean Sea. On March 21st, 2024, the project received the environmental compatibility decree (*VIA* decree). Construction is planned for 2028.

The location is the Strait of Sicily, 35 km off the coast of Marsala, so that the wind farm will not be visible from the coast. Twenty-one floating wind turbines of 12 MW power each will provide a total capacity of 252 MW. The project should ensure 800 GWh of annual electricity production, contributing to the annual energetic needs of 300.000 families. The total amount of avoided CO_2 will be about 350.000 tons.

Ongoing projects

Despite the low amount of installed wind farms, Italy is making a great effort in exploiting offshore wind energy potential. About a hundred offshore wind farm projects, distributed as reported in Figure 31, are in an early design phase, some of them in the authorization phase, for a total capacity of about 80 GW. Most

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of these projects are above 25 km from shore and they are expected to use a floating foundation. Indeed, as explained before, the seabed in Italian waters is too deep for other types of foundations.

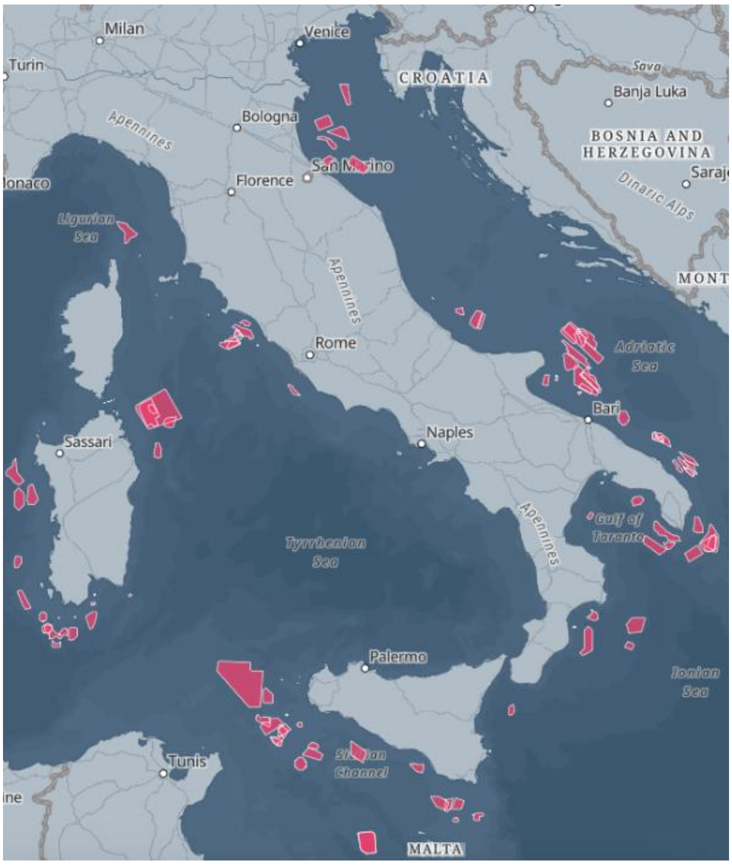

Figure 31. Position of the ongoing offshore wind farm project (Source: 4C Offshore)

The main contributions are from three regions: Puglia, Sardegna and Sicilia, with 37%, 25% and 19% respectively of the total amount. All of them are in the middle of the Mediterranean Sea. The remaining contributions come from Calabria and Lazio, and from Abruzzo, Emilia Romagna, Marche, Molise, Toscana and Veneto with the lowest contributions (Figure 32).

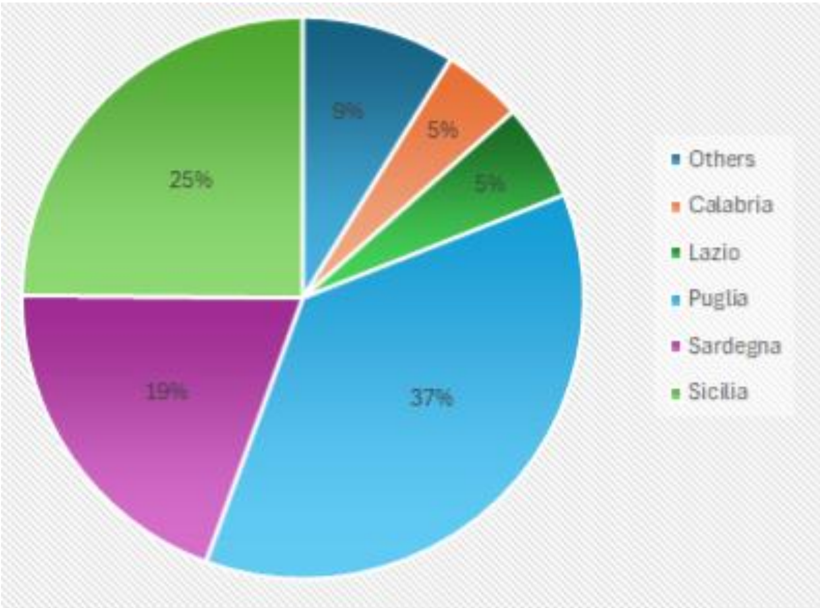

Figure 32. Percentage of the total capacity of ongoing offshore wind farm projects divided per region (Source: 4C Offshore)

3.2.3.8 SWOT analysis for offshore renewable energy

SWOT analysis is a strategic tool as it allows to obtain a complete view of the project, evaluating both internal strengths and weaknesses, as well as external opportunities and threats. This analysis helps to identify the resources and capabilities to be targeted, and the limits to be improved, to build more effective strategies. At the same time, it allows for the anticipation of challenges and the identification of opportunities in a market or environmental context, facilitating more realistic and effective planning. Especially in complex projects such as offshore wind, this methodology guides decision making, supports risk management and improves resource allocation, ensuring that every relevant aspect is considered in the pursuit of objectives.

Overall analysis of the ORE Sector	
Strengths	**Weaknesses**
• Energy potential of the Mediterranean Sea: Wind conditions off the Italian coast, especially in some areas such as the Adriatic and Ionian Seas, offer good opportunities for exploiting wind energy. • Technologies under development: Innovation in floating offshore wind technologies allows the turbines to be placed in deeper areas, thus suitable for the Mediterranean where depths are rapidly increasing away from the coast. • Institutional support and environmental policies: The European Union and Italy are promoting an ecological transition towards renewable sources	• High installation and maintenance costs: Offshore wind infrastructures, especially floating ones, require significant upfront investments and have higher maintenance costs than onshore wind. • Limited infrastructure: Currently there is a lack of ports and suitable facilities for the construction, assembly and transport of large offshore installations, which may slow down development in the sector. • Regulatory complications and bureaucracy: The Italian bureaucratic process can be complex and slow, and authorizations for

with concrete targets for reducing CO emissions, by encouraging offshore wind. • Less visual impact than onshore wind: Being offshore, offshore wind turbines reduce the aesthetic and local opposition problems associated with onshore wind farms.	offshore projects require multi-level approvals that slow down implementation times. • Conflict with other marine uses: Areas suitable for offshore wind can conflict with other local economic activities, such as fishing, tourism or protected marine reserves.
Opportunities	**Threats**
• Italy can leverage the European Green Deal and associated funding mechanisms to expand its renewable energy infrastructure and meet climate objectives. • The Simplification Decree (DL 76/2020) aims to streamline bureaucratic procedures for offshore wind farm development by reducing project approval times, simplifying administrative processes, and facilitating permit acquisition. • The National Integrated Energy and Climate Plan 2030 (PNIEC) underscores the importance of research and technological development in offshore wind energy, advocating for innovation investments to reduce floating technologies costs and enhance sector competitiveness. • The expansion of offshore wind farms is anticipated to increase the renewable energy share, create new economic opportunities, generate employment, and stimulate growth within the renewable energy industrial sector. • According to the Plan for the Sea document, Italy is ideally positioned to become Southern Europe's energy hub, particularly in the transition to clean energy. • Italy is moving toward establishing Exclusive Economic Zones (EEZs), as permitted by the 2021 law, granting exclusive rights to develop wind farms up to 200 nautical miles from its coast. • The necessity to accommodate large wind turbine components drives the development of industries capable of producing specialized transportation and installation vessels.	• The complexity of environmental assessment procedures and potential opposition due to landscape impact may delay or prevent wind farm installations. • Conflicts with other economic activities, such as fishing and tourism, pose risks to the development of offshore wind power plants. • Italian ports lack the infrastructure to handle the large-scale operations required for offshore wind projects. • Limited availability of wind turbines may lead to significant delays in commissioning, impacting project timelines, budgets, and the overall progress toward sustainability and energy transition goals.

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3.2.4 Greece

Apart from the lack of a robust legislative framework, several factors had hindered until now the development of Offshore Wind Farms (OWF) in Greece, despite the significant offshore wind potential. The most important reasons for such delay were the following:

1. the lack of submarine network to support capacity needs.
2. the lack of the necessary infrastructure.
3. the lack of qualified personnel for dealing with offshore projects, etc.

On the other hand, the main technical obstacle was the deep coastal waters that entailed the development of mainly floating OWF projects that only recently became a mature technology.

The Greek Seas are considered as one of the most favourable locations for offshore wind energy development in the Mediterranean basin. Several previous studies indicated that the Aegean Sea in particular is considered one of the windiest areas in the Mediterranean, mainly due to the Etesian wind system that occurs every summer contributing in this way to a steadier energy production throughout a year[70,71,72,73,74].

3.2.4.1 Legal framework and policies

In the context above, in order to resolve important and urgent issues concerning the protection of the natural and urban environment as a whole, and for addressing the energy and climate crisis, the Hellenic Parliament passed on 30.07.2022 a new legislation[75] (L. 4964/2022, GGI A'50) concerning the development of offshore wind energy. Chapter H' of the law, was specifically focused on the advancement of OWFs and the rationalization of the associated licensing procedures. The development of OWFs consists of an important national strategy and is expected to enhance the energy transition plan and contribute to energy security by providing clean and affordable energy to the energy mix of the country.

According to the article 66 of L. 4964/2022, the Greek State has the exclusive responsibility for the research, exploration and identification of the Offshore Wind Farms Organized Development Areas (OWFODA), as well as the authority to grant the corresponding rights to an institution. The Hellenic Hydrocarbons & Energy Resources Management Company SA (HEREMA)[76], has been nominated (article 67 of L. 4964/2022) as the OWF Entity for the management of the above-mentioned rights. A critical milestone for the realization of

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[70] Alpert et al., "A New Seasons Definition Based on Classified Daily Synoptic Systems."
[71] Kardakaris, Boufidi, and Soukissian, "Offshore Wind and Wave Energy Complementarity in the Greek Seas Based on ERA5 Data."
[72] Poupkou et al., "Present Climate Trend Analysis of the Etesian Winds in the Aegean Sea."
[73] Soukissian et al., "Offshore Wind Climate Analysis and Variability in the Mediterranean Sea."
[74] Soukissian and Sotiriou, "Long-Term Variability of Wind Speed and Direction in the Mediterranean Basin."
[75] "N. 4964/2022 (ΦΕΚ 150/Α` 30.7.2022) | ΕΛΙΝΥΑΕ."
[76] "Hellenic Hydrocarbons and Energy Resources Management Company (HEREMA)."

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OWF is the elabouration and development of the National Offshore Wind Farm Development Programme (NDP – OWF). The draft NDP – OWF[77], was officially published on October 31st 2023, and includes inter alia, the main pillars for the design, development, siting, installation and exploitation of OWFs, while also defining the medium and long – term targets regarding the available installed capacity, taking into account the criteria and commitments of article 67 of L. 4964/2022, i.e.:

- The national energy planning and relevant targets, as reflected in the National Energy and Climate Plan (NECP, B' 4893/2019).
- The national planning for the protection of the environment and biodiversity.
- The spatial planning, including the National Spatial Strategy for the land space, the Special Spatial Framework for Renewable Energy Sources (RES), (13A of L. 4269/2014, A' 142)[78], the National Spatial Strategy for the Maritime Space and the Maritime Spatial Frameworks (L. 4546/2018, A' 101)[79], as well as international practices and the findings of the evaluation report of the Special Spatial Framework for RES, of article 5 of L. 4447/2016 (A' 241)[80].
- The requirements of national security.
- Other criteria, such as the existence of monuments and shipwrecks, marine and underwater critical infrastructure, restricted maritime fields, maritime traffic (to ensure the terms and conditions of safe navigation), the existing and the future development of the electricity transmission system.
- Criteria relating to production and development activities.

The draft NDP – OWF also includes the Strategic Environmental Impact Assessment (SEIA), specifically oriented to the protection of the natural, cultural and socio – economic environment, the national security, and to ensure the energy supply to the Greek islands.

Articles 67 – 71 concern the actions to be followed regarding the licensing procedures in the field of OWF research and development, as well as the conditions that should apply to the entities that will undertake these projects in the OWFODA as published by the draft NDP-OWF. Amendments to these articles are given in articles 114, 115 and 116 of L. 5106/2024[81].

Following the completion of the permission applications for research related to the development of OWFs, HEREMA has submitted to public consultation the OWFODA, while according to par. 2 of article 72 of the law, the Regulatory Authority for Energy, Waste and Water (RAEWW)[82] is responsible for launching a

[77] konstantinos, "The Draft National Programme for Offshore Wind Energy, Unlocking a Natural Wealth for Clean Energy and Billions of Euros Investments."
[78] "Νόμος 4269/2014 (Κωδικοποιημένος) - ΦΕΚ Α 142/28.06.2014."
[79] "Νόμος 4546/2018 (Κωδικοποιημένος) - ΦΕΚ Α 101/12.06.2018."
[80] "Νόμος 4447/2016 (Κωδικοποιημένος) - ΦΕΚ Α 241/23.12.2016."
[81] "Νόμος 5106/2024 - ΦΕΚ 63/Α/1-5-2024."
[82] "ΡΑΕ | Official Website."

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competitive bidding process for the granting of operating aid to potential OWF projects. The final investor of each project is the one who will submit the lowest bid.

According to article 72, the above procedure determines the following:

I. The criteria for participation and evaluation.
II. Information on the required letters of guarantee for the participation in the competitive process and the construction and activation of the connection of the OWF projects by the natural or legal person who participated in it.
III. Clauses imposed in case of non-timely implementation of projects.
IV. More specific issues referring to the competitive procedure.
V. A copy of the letter of guarantee for the issuance of the OWF Research Permit referred to in article 70.

For the proper coordination of all stakeholders, in accordance with article 74, an OWF Project Network Connection and Development Coordination Committee is created, consisting of a representative from the Ministry of Environment and Energy, one from HEREMA, one from the Independent Power Transmission Operator (IPTO) and 3 special experts, thus ensuring optimal cooperation and the creation of proposals and suggestions to all stakeholders to develop OWF projects in a technically and cost-optimal manner. IPTO is solely responsible for the development, design, construction and operation of each interconnection project, while RAEWW monitors and evaluates the implementation of their schedules in accordance with articles 108 and 108A of L. 4001/2011 (A' 179)[83].

The remaining articles of Chapter H refer to procedures concerning the financial support of such projects, enabling provisions and actions for electrical space commitments for the installation of OWF projects, with some amendments from article 55 of L. 5069/2023[84].

The 2030 targets set by the EU regarding RES, are the key factor for the immediate development of policies and measures and specific to offshore projects, which can contribute significantly to the achievement of Greece's energy goals. According to this, based on the draft of the revised edition of the National Energy and Climate Plan (NECP)[85]of the Ministry of Environment and Energy issued in October 2023, the measures and policies that are developed aim to cover the following policy priorities:

I. **Reform of the permitting framework and update of the special spatial framework for RES – Acceleration, digitalization and efficiency of permitting:** This policy aims to enhance the mutual trust between investors and the state, reducing licensing times, accelerating investments and thus attracting more future investments related to RES projects. The simplification of licensing procedures, their

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[83] "Νόμος 4001/2011 (Κωδικοποιημένος) - ΦΕΚ Α 179/22.08.2011."
[84] "Ν. 5069/2023 (ΦΕΚ 193/Α` 28.11.2023) | ΕΛΙΝΥΑΕ."
[85] "National Energy and Climate Plans (NECPs) - European Commission."

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digitization, and the definition of clear criteria regarding no-go areas, and environmental and social restrictions, are some of the practices that will be adopted to facilitate investments.

II. **Ensuring implementation of RES and Storage investments – Expansion of operating aid vehicles – Promotion of bilateral contracts:** This policy is oriented to ensure investment interest, initially by extending the aid scheme. In order to provide investment certainty and recover part of the investment, each station will be able to participate in bidding through Contract for Differences (CfDs), but also through the direct participation of RES projects in the electricity markets through bilateral contracts. It will be possible to conclude bilateral contracts with suppliers, consumers and RES aggregators, aiming at a steady revenue stream. Other policies refer to the promotion of short-term storage systems, either from individual energy storage plants or from electricity storage systems integrated in RES stations, the application and extension of the support scheme (SA 64736) for batteries larger than 1,000 MW, as well as the modification of the amplification scheme (SA.60064) for embedded storage systems in RES projects with capacity greater than 200MW.

III. **Promotion of dispersed RES systems, hybrid island systems and strengthening of the participatory role of local communities – consumers:** In order to serve households, farmers and small and medium-sized power stations, policies concerning the financing of RES plants for self-consumption are necessary. The Recovery and Resilience Fund (RRF) has already created programmes specifically oriented to financial support for the installation of such stations by consumers – businesses – communities that are quite energy-intensive. In addition, in order to decarbonize the islands, the already active GR-eco islands program (NSRF 2021 – 2027 and Decarbonization Fund) will be explored on 36 more islands, with hybrid installations on interconnected and non-interconnected islands.

IV. **Ensuring the viability and liquidity of the mechanism for granting operating aid to RES power plants and storage stations:** Each RES project that is active in the electricity market from 2016 onwards is included in a support scheme in the form of operating aid. The aim is to formulate or strengthen legislative and regulatory measures for the proper operation of RES projects, providing special attention to projects of small installed capacity. In addition, according to the regulatory framework of July 2022, environmental markets are going to be created with the Guarantees of Origin in the Greek system.

V. **Development and strengthening of energy networks and optimal integration and operation of RES units – energy storage:** The measures of this policy aim at the modernization and strengthening of high and extra high voltage transmission systems and distribution networks, in order to: i) avoid saturation phenomena, which is one of the main deterrents of the rapid integration of RES into the energy networks, ii) achieve the maximum energy absorption capacity from RES stations and the better utilization of networks. Accordingly, the inclusion of small stations for the reinforcement of existing substations, as well as new regulatory models for the allocation of charges for Network and System development projects is necessary. Projects concerning the development of methodologies for the identification of geographically critical intervention areas, and the strengthening of distribution networks for areas with higher energy requirements have been already launched by the RRF. Other targets are: i) the development of new funding models and simplification - shortening of consultation procedures, ii) the integration of energy storage systems in RES units in order to smooth production fluctuations, and iii) the addition of electrical space to the grid and the limitation of the injected energy during maximum production hours for maximum absorption capacity. With all the above, it is expected to improve the stability of the grid as well as to limit cuts due to inability to absorb the produced energy.

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VI. **Promotion of new technologies and coupling of energy sectors with emphasis on electrification for maximum utilization of domestic potential from RES:**
   a. The development of innovative technologies to achieve the country's medium-term goals is a key priority, based among others, on the development of policies and measures for the development of OWF projects.
   b. The main policy is the formulation of the NDP-OWF, which already includes a first assessment of the potentially exploitable marine areas.
   c. The immediate identification of the first OWFODAs is able to meet the goals set for OWFs by 2030, maintaining continuous upgrading and constantly enriching the list of initial areas.
   d. Measures and policies for the preparation of studies and surveys, in order to identify and meet the needs in port facilities, in the morphologies of the seabed where the projects will be installed and generally in other infrastructure needs.
   e. The creation of tenders for the financial support of OWF projects by the end of 2025 for projects to be completed by 2030.
   f. An application to the European Commission to achieve an OWF pilot project in Alexandroupolis with a total capacity of 600 MW.

3.2.4.2 Sectorial priorities and forecast

Climate change is an urgent threat to both the environment and human well-being. The increased energy needs and greenhouse gas (GHG) emissions were some of the main reasons for the establishment of several targets globally for the decarbonization of the energy mix as a as part of climate change mitigation. Wind energy, mainly onshore, already plays a major role in the required energy transition. On the other hand, offshore energy can be harnessed in various ways and the available space for the potential development of energy technologies is much greater compared to onshore. The EU has set targets and a binding framework for reducing at least 50% GHG emissions, compared to 1990, by 2030.

The draft of the revised edition of the NECP, has been planned based on the international trends, the current status of Greece regarding energy production from RES, and the available resources that are required for the energy mix transition. Due to the rapid pace of development, investment and installation of RES plants during the period 2019 – 2023, the targets set by Greece, according to the previous NECP, increased exponentially.

NECP aims to use the penetration of RES in as many sectors as possible (and especially in electricity generation). Due to the rich and abundant wind (onshore & offshore) and solar resources of the country, the National Plan is oriented towards the electricity production based on RES for the reduction of GHG emissions

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and electricity prices, and the acceleration of the green transition and decarbonization[86], by developing projects that do not require overpriced supports. In respect of that, the main priorities are:

- Cover 80% of the electricity production from solar and wind energy by 2030 or earlier.
- Digitization of the distribution network.
- Connection of non-interconnected islands until 2030.
- Development of new storage systems and the improvement of the existing ones, to achieve sufficient capacity, avoid energy transmission network saturation, and absorb the highest energy from the grid.

According to the NECP 2023, the target for renewables as a share of total gross energy consumption has been increased from the 35% (NECP 2019[87]) to 44% by 2030. Specifically, the goal is for RES power plants to account for 80% of gross electricity consumption by 2030 and nearly 95% by 2035. The above targets are considered realistic and achievable, according to the final offers for connection to the System and the Network (July 2023) for the development of new RES projects (~13.6 GW in the system and 2.6 GW in the network), as well as requests from Operators for new connection offers (~ 42.6 GW).

Due to Greece’s high offshore wind potential, a large percentage of the electricity generation will be based on offshore wind energy. Strong winds with low variability throughout the year, combined with the high energy efficiency of OWF projects, are attractive factors for investors and the development of OWFs in the Greek Seas. Fixed-bottom and floating OWFs with a total installed capacity of 1.9 GW are expected to be developed and installed by 2030. In this framework, the following aspects should be necessarily considered:

- The lack of necessary infrastructure and of specialized human resources for OWF.
- Supply chain disruptions.
- Establishment of strict procedures for the protection of the marine environment.
- Ensuring a balance between consumer, local communities and the state.
- Ensuring safe investments for the country.

On the other hand, the penetration rate of RES in the energy mix depends directly on the power and capacity of storage systems. Storage systems, either as stand-alone storage stations or as integrated units in RES plants, increase system capacity and can restore electricity from conventional fuel plants, as they help maximise energy absorption during peak demand hours. Moreover, these systems alleviate local saturation problems and allow the connection of new RES plants. Greece's goal by 2030 for both individual and embedded storage systems in RES plants is to have a total capacity of up to 3.1 GW.

[86] Taking under consideration the targets set by the EU, the decarbonization of the energy mix requires the constant reduction of electricity production from lignite and its elimination after 2028.
[87] “Εθνικό Σχέδιο για την Ενέργεια και το Κλίμα.”

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3.2.4.2.1 Potential organized development areas of offshore wind farms

The draft NDP – OWF[88], includes an analysis of Greece's maritime areas, and the preliminary delimitation of the potential OWFODA, as well as a first estimation of the potential power of each polygon – area. The potential OWFODA were defined based on the suggestions of the National Energy and Climate Plans, environmental and biodiversity protection planning, the existing Special Spatial Framework for Renewable Energy Sources (SSF – RES), suggestions and opinions from the competent public authorities, public authorities, to prevent conflicts with other maritime uses in the Greek territory, as well as international best practices, approaches and conditions.

Various technical, cultural, social and economic criteria were applied with a view to the initial identification of the medium- (2030 – 2032) and long-term (from 2032 onwards) potential OWFODA. The criteria that have been applied for the prioritization are the water depth and wind speed limits, the grid connection availability/capacity, and the estimated capacity of each area. For the medium- and long-term horizon, 10 and 13 potential OWFODA were identified, respectively, i.e., 23 OWFODA in total[89]. Two additional OWFODA (Pilot 1 & 2[90]) were also defined for the development of fixed-bottom pilot OWF projects, with potential capacity of up to 600 MW and a total area of 353 km^2. The total span of OWFODA is 2.359 km^{2}with a total capacity of up to 11.8 GW, including the pilot projects. Most of the OWFODA are mainly designated for floating wind turbines deployment, with a total estimated capacity of 10.4 GW.

These areas are in the southern Aegean, the eastern coasts of Crete Isl. and the eastern and western Cyclades Complex. For fixed-bottom OWTs, the estimated capacity is 1.4 GW. The locations of the potential floating and bottom-fixed OWFs, are shown in Figure 33. The results of the NDP – OWF, showed that since the total capacity of medium-term potential areas is estimated to 4.9 GW, the goals mentioned in the NECP are not considered impossible.

[88] konstantinos, "The Draft National Programme for Offshore Wind Energy, Unlocking a Natural Wealth for Clean Energy and Billions of Euros Investments."

[89] The 23 OWFODA include 30 potential sites-polygons.

[90] The final boundaries of the pilot projects, will be determined after the approval of the Hellenic National Defense General Staff and Civil Aviation Authority.

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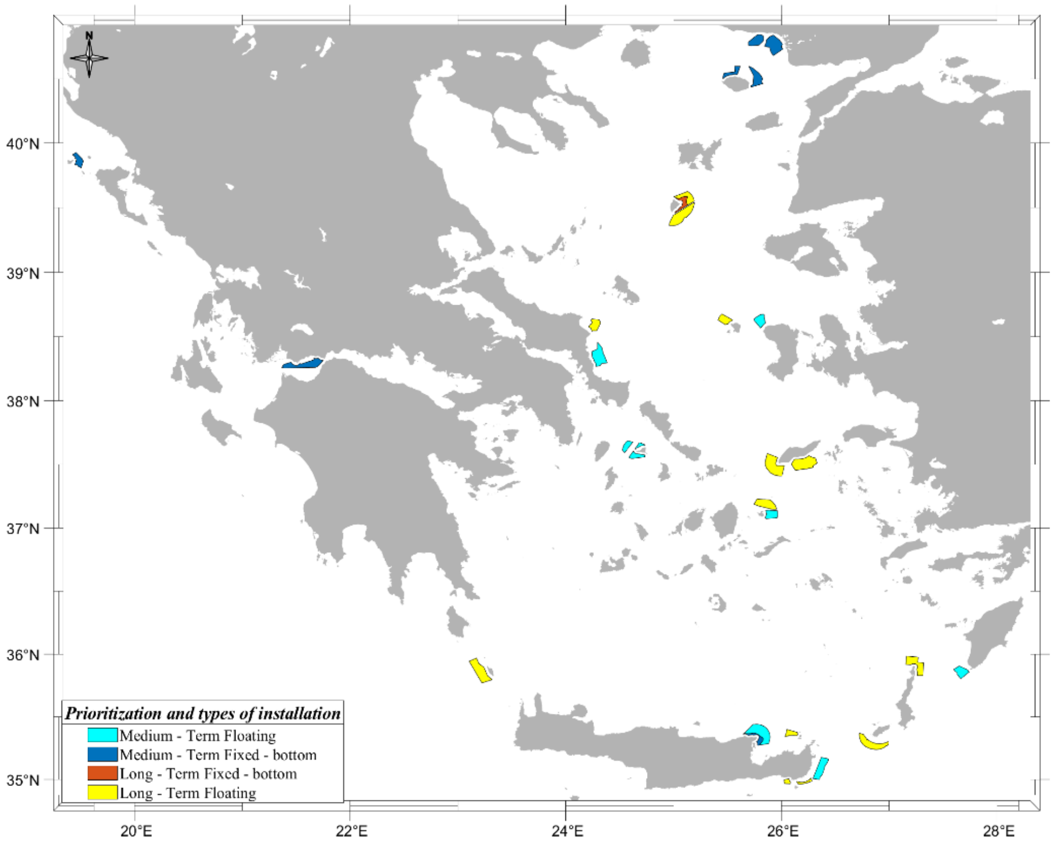

Figure 33. The potential OWFODA in terms of prioritization and installation type in the Greek Seas[91]

3.2.4.2.2 Medium and long-term development perspectives

Among the 23 potential development areas, 10 locations (Figure 33) were identified for development in the medium-term horizon (Table 4, Figure 34), covering a total area of 978 km2, with a total estimated capacity of up to 4.9 GW. Diapontia Islands, Crete-2A, and the Gulf of Patras are designated for fixed-bottom installations, while the rest of them are for floating installations.

Table 4. Information about the medium-term OWFODA in the Greek Seas (Source: NDP – OWF 2023)

Medium-Term Areas			
Polygon Name	**Span (km^2)**	**Type of Foundation**	**Potential Installed Capacity (MW)**
Saint Apostoloi	133.9	Floating	670
Gyaros (includes 3 polygons)	99.52	Floating	500

[91] Stefatos et al., “National Development Program of offshore wind farms.”

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Diapontia Islands	54.34	Fixed – Bottom	270
Donousa 2	65.03	Floating	325
Crete 1	118.0	Floating	590
Crete 2 A	40.06	Floating	200
Crete 2 B	187.26	Floating	935
Gulf of Patras	138.83	Fixed – Bottom	695
Rhodes	74.86	Floating	375
Chios	65.54	Floating	330
Pilot 1 (includes 2 polygons)	219.42	Fixed - Bottom	600
Pilot 2 (includes 2 polygons)	133.98	Fixed - Bottom	

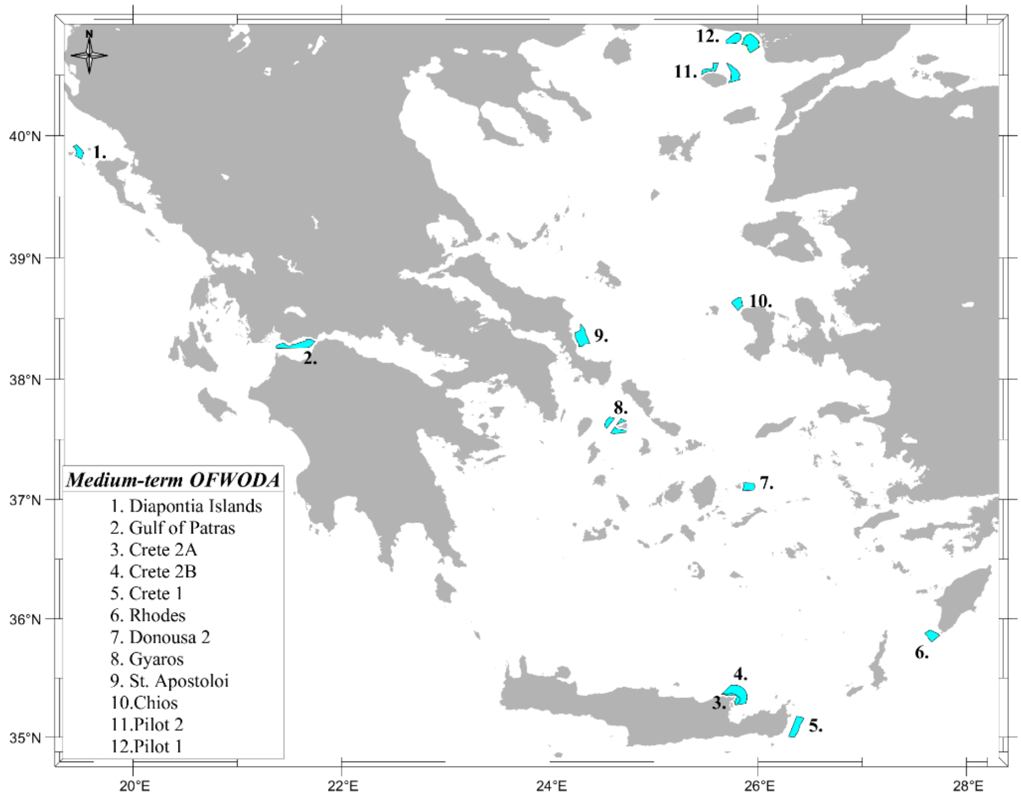

Figure 34. The medium - term potential OWFODA in the Greek Seas[92]

Moreover, 13 areas were identified for long – term exploitation (Figure 35), with an estimated total capacity of approximately 7 GW. St. Efstratios-1A, is designed for long-term fixed-bottom installation, while the

[92] Stefatos et al.

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remaining 12 areas for floating OWFs. More details about the potential available installed capacity are provided in Table 5.

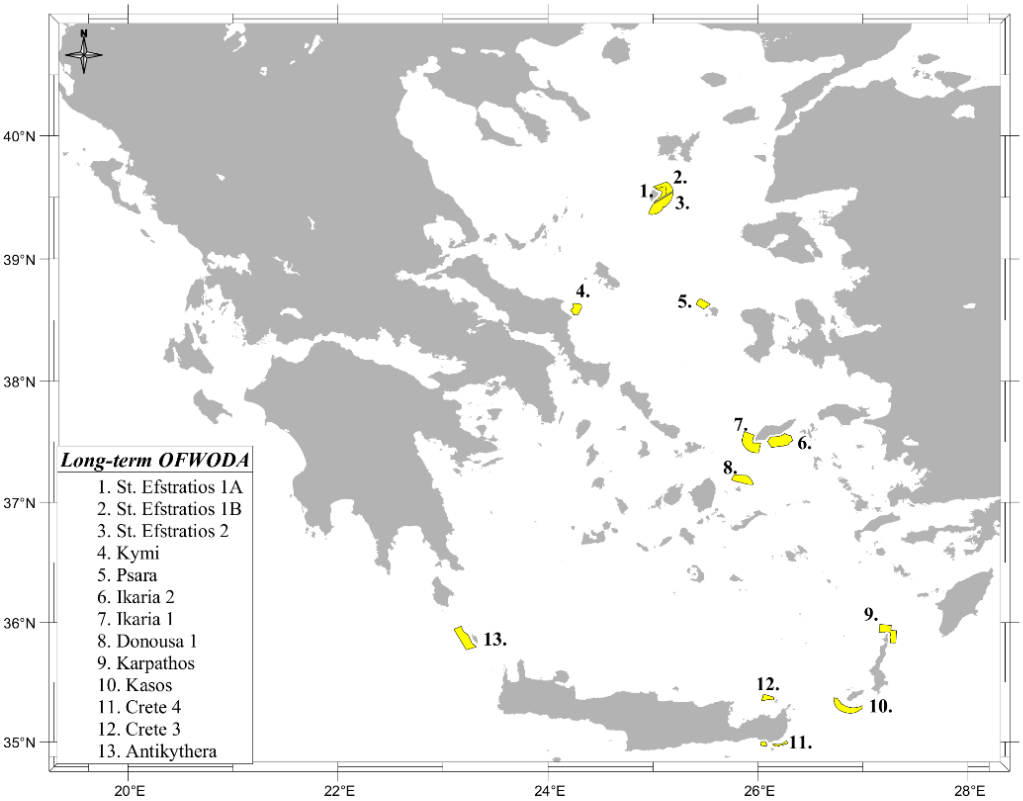

Figure 35. The long - term potential OWFODA in the Greek Seas (Source: NDP – OWF 2023)

Table 5. Information about the long-term OWFODA in the Greek Seas (Source: NDP – OWF 2023)

Long - Term Areas			
Polygon Name	**Span (km^2)**	**Type of foundation**	**Potential Installed Capacity (MW)**
Saint Efstratios 1A	49.91	Fixed – Bottom	250
Saint Efstratios 1B	74.76	Floating	374
Saint Efstratios 2	160.97	Floating	805
Antikythera	165.11	Floating	825
Donousa 1	107.79	Floating	540
Ikaria 2	170.83	Floating	905
Ikaria 1	181.07	Floating	855
Karpathos	124.14	Floating	620
Kasos	141.01	Floating	705
Crete 3	40.63	Floating	205
Crete 4 (includes 2 polygons)	40.78	Floating	205

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Kymi	64.99	Floating	325
Psara	57.77	Floating	290

3.2.4.3 National Strategy for Smart Specialisation

The global economy is affected by three “megatrends”, climate change, digital transformation and automation, and the new structure of global trade. Greece’s economy, society and industry will be directly affected by the green and digital transition of the EU during 2021 – 27. Consequently, the formulation of a new revised strategy, in which new ideas, technologies and innovation will be included, is urgent to address transition risks, exploit development opportunities stemming from climate change mitigation policies, and address the consequences of climate change at a national level.

In the last decade, the orientation of the funds regarding research, technology and innovation was strongly affected by the priority areas formed by the National Smart Specialization Strategy (RIS3 Strategy[93]) for the period 2014 – 2020, applied both at national and regional levels (Figure 36). The main goals of the Strategy 2014-2020[94], based on the Europe 2020 Strategy[95], were specialised on the organisation of smart, sustainable and inclusive development. In this context, the priorities were oriented on i) the development of an economy based on knowledge and innovation; ii) the expansion of innovation and funds for a resource-efficient, low-carbon economy; and iii) the promotion of a high-employment economy that provides economic, social and territorial cohesion.

Over the last 10 years, the orientation of the economy of many regions of Greece has changed, and important specialisations have been defined. The strategy had a significant contribution to the economy, development and research subsidies. More than 530 start–ups with activity directly related to the strategic areas of the programming period 2014 – 2020, were registered in the database of Elevate Greece[96] while 44 of them are related to the sector of Environment and Energy. Nevertheless, delays in evaluations and funding were noticed due to the long-lasting procedures of the Greek State, the complex regulatory framework, as well as the malfunction of the Integrated State Aid Information System. According to the European Innovation Scoreboard – EIS 2023[97] Greece is considered a moderate innovator, with some regions showing interesting performance (Attica and Crete / Eurostat 2021[98]).

To address the above obstacles, the new National Strategy for the period 2021 – 2027 was designed at national level, considering regional specializations and proposals. The aim of the new strategy is to set

[93] “Research & Innovation Strategy for Smart Specialization (RIS3).”
[94] “Εθνική Στρατηγική Έξυπνης Εξειδίκευσης 2014-2020.”
[95] EUROPE 2020 A strategy for smart, sustainable and inclusive growth.
[96] “The Official Platform on the Greek Startup Ecosystem.”
[97] “EIS 2023 - RIS 2023 | Research and Innovation.”
[98] “Home - Eurostat.”

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strategic objectives based on integrating new ideas, promoting innovation and attracting technological investment, shaping the regulatory framework and management capabilities.

The National Smart Specialization Strategy identifies the strategic areas of intervention (priorities), on which investments are focused. Identification of priorities is based on the strengths and the potential of the economy, as well as on the Entrepreneurial Discovery Process (EDP) in which stakeholders are involved. EDP is an extrovert approach that adopts a broad view of innovation and is supported by effective monitoring mechanisms. Effective governance of the EDP aims to: 1) mobilise the innovation ecosystem, and 2) support Greek research to produce high-quality competitive innovations and benefit businesses that systematically and clearly communicate their needs to provide crucial guidance to the research community.

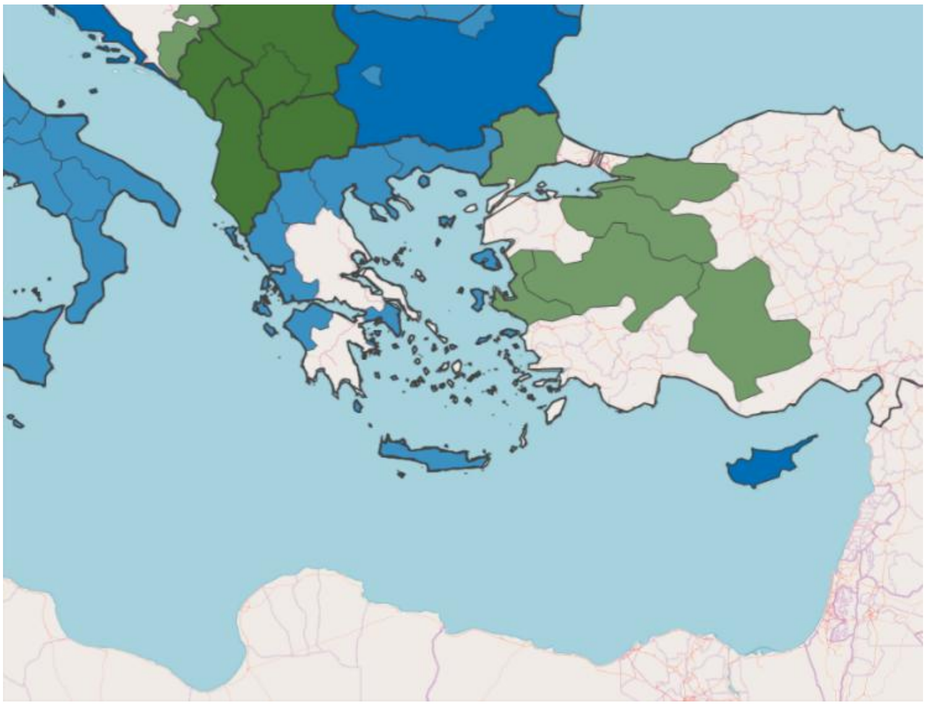

Figure 36. The registered regions of Greece in the Strategy RIS3[99]

The priority areas as formed for the period 2014 – 2020, were raised under further evaluation using selected indicators and criteria, based on Policy Objective 1 and Cohesion Policy 2021 – 2027, as well as the objective of the green and digital transitions set at European level.

These indicators address issues such as the contribution to domestic economic activity, export dynamics, research and development, innovation, digital transformation, circular economy, the contribution to

[99] "Research & Innovation Strategy for Smart Specialization (RIS3)."

domestic Gross Value Added, investments, job creation, export trends, participation in global value chains, index of openness to international markets, educational level of employees and energy consumption.

The analysis led to the identification of 8 priority areas in which Greece has advantages, similar to the initial ones from the strategy of the programming period 2014 - 2020, on which the transition to a new growth model could be based. Each region prioritized and adopted the following areas according to the local needs:

- Agro-food value chain.
- Biosciences, Health and Pharmaceuticals.
- Digital Technologies.
- Sustainable Energy.
- Environment and Circular Economy.
- Transport and Logistics.
- Materials, Construction and Industry.
- Tourism, Culture and Creative Industries.

The offshore wind sector is integrated, as expected, in the priority area of "Sustainable Energy". In Greece, the penetration of RES in energy production is constantly increasing, and therefore the gradual replacement of lignite with cleaner resources for electricity production is underway. Given the strong wind and solar potential that characterises the country, as well as the sufficient water resources, the possibility of further utilising these resources in energy production is particularly attractive. In this context, some opportunities could be created, such as increased interest in technologies directly connected with RES energy production and promising perspectives for industries related to the manufacture of relevant components/technologies. Furthermore, a notable number of researchers participate in European technological platforms, with a high possibility to develop islands of research excellence in the fields of energy production from RES. There is already a significant number of enterprises in the production and supply of products related to energy and energy storage, with the possibility of further increase.

Nevertheless, despite the aforementioned advantages and capabilities in this priority area, Greece is still vulnerable to possible fluctuations in the prices of energy products, as there is poor energy supply security, and it still depends on energy imports. The increase in international competition (cheaper products for energy production and/or saving energy products), affect directly the Greek companies to rapidly integrate international technological developments. The lack of an institutional framework for energy storage constitutes inter alia the reason for the poor infrastructure in this sector. Most of the Greek companies involved in RES do not have a presence in foreign markets, as the interconnection of the domestic energy system with energy-developed countries is incomplete. Moreover, the interconnection between the domestic mainland network and the island network was until recently very insufficient. In general, all the above are obstacles to the decarbonisation of the national energy mix.

Investments, educational level and percentage of R&I employees are indicators in which this priority area performs best, while it is also characterised by significant start-up activity. Activities and individual ecosystems of "Sustainable Energy" are directly connected with many European strategies, such as the

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European Green Deal, the EU Action Plan for the Circular Economy, Horizon Europe, etc., but also the National Energy and Climate Plan (NECP).

In general, most of the existing or new companies remain small, with limited technological expertise and lack of a long-term strategy for growth, and transition towards digitalization. The development of a company also requires the acquisition of specialised employees with upgraded business and digital technology knowledge and skills, which is directly related to the modernisation of the education system. Furthermore, the resources invested in innovation are limited and difficulties arise regarding access to funding.

Another challenge that has a direct impact on the interconnection between R&I is the lack of cooperation between research organisations and the private sector. On top of this, the exploitation of innovative ideas is not funded by National Programmes, but by European ones. On the other hand, the results of publicly funded research are not systemically communicated to the ecosystem, so imported technology is preferred over the development of a domestic technological base.

The vision of the National Smart Specialization Strategy 2021 – 27 is to achieve the transition to a new development model that is financially and environmentally sustainable. This model is based on knowledge and its utilization through the production of high-added-value products and services that can be integrated into International Value Chains. The continuous process of modernization and technological development of the country is based on the following Strategic Objectives [100]:

- Production, effective utilization and diffusion of new knowledge.
- Technological streamlining – Innovation adoption.
- Development, networking and internationalization of Greek enterprises.
- Increase in extroversion – Involvement in Research, Technological and Entrepreneurial Global Value Chains.

To achieve these objectives, several actions have also been identified, which fall under the following intervention areas:

- Human Resources (business and academia).
- R&I infrastructures.
- Innovation support mechanisms, services and facilities.
- Link of research with production.
- Digital transformation.
- Regulatory framework (regulations, administration, taxation).
- Promotion of innovation by the public sector.
- Visibility – Publicity.

[100] Aligned with the directions of the NSRF 2021-27 and the Necessary Enabling Condition 1

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To ensure the effective governance and coordination across national and regional levels and facilitate the successful execution of the National Smart Specialization Strategy, a new Governance System was adopted, consisted of the following three levels: 1) Decisive/strategic level; 2) Steering level and 3) Implementation level and actions/projects management. The primary body of the Strategy's actions, particularly the national component, will be primarily funded by the "Competitiveness" Programme. Each regional specialisation will receive funding from the corresponding Regional Programme. In addition, the National Recovery and Resilience Plan will serve as an extra source of funding for the Strategy.

3.2.4.3.1 Final priorities of the sustainable energy sector

The final priorities set by the RIS3 2021 – 27 regarding the orientation of the investments in the sustainable energy sector are the following[101]:

- **Energy efficiency and saving**: It refers to: i) the development and investment in energy efficiency and energy saving technologies, systems and processes at the level of RES industries and energy storage systems; ii) the adoption of computational techniques to increase energy efficiency, and iii) the development of hybrid systems.
- **Energy from RES**: It refers to the increase of electricity production based on RES technologies, including hybrid RES technologies and projects of offshore/floating RES installations.
- **Energy storage**: It refers to the development and production of energy storage technologies and systems (supercapacitors, superconducting magnetic storage), thermal and electrochemical energy storage technologies (e.g., classic accumulators, flow accumulators), as well as chemical energy storage technologies.
- **Smart grids – demand response – decentralised generation**: It refers to: i) applications regarding smart grid services and technologies, metering, storage, and on-demand response, and ii) increase of RES penetration towards efficient, reliable and safe transmission systems and applications of distributed generation and energy storage units in autonomous networks and micro-networks, iii) creation of a blockchain in energy and especially in distributed generation, storage and consumption, and, iv) clearing and interface platforms with purchases.
- **Low energy consumption and near-zero emission smart communities/cities**: It refers to: i) the development of technologies, systems and methods of interconnection and interaction of final customers for the joint production of energy from RES (RES communities), ii) the inclusion of joint production of electricity (citizen energy communities), smart management, storage, self-consumption and sale thereof and/or on electric vehicle charging services, iii) energy and resource saving technologies and iv) reduce emissions at community and/or city level.
- **Other cross-sectoral interventions**: It refer to: i) the development of pilot projects of RES and energy storage near high tourist areas (e.g., hybrid thermal/cooling coverage solutions and electrical needs), and ii) the adoption of innovative applications in energy management (e.g., internet use, smart grids, blockchain, artificial intelligence, engineering learning).

[101] "Final Priorities of the Sector – November 2021."

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3.2.4.3.2 The case of Crete island

Crete Island is located in the south Aegean Sea, at a distance of about 160 km from the mainland. It has a remarkable coastline of more than 1000 km, with approximately 700.000 permanent residents. Crete has been characterized by the European Commission as a strong innovator with an increased innovation performance by 30.1% in the period 2011 – 2019 (Regional Innovation Scoreboard (2019)-Kriti). The island incorporated RIS3 as a landscape-based development policy approach, to direct public and private investments in selected priority areas. The island agenda was based on 4 general principles:

I. Options and critical mass.
II. Competitive advantage.
III. Connectivity and clusters.
IV. Collaborative leadership.

For the programming period 2014-20, 300 innovative ideas were submitted in Crete related to the following fields of expertise: Agri-food, Tourism, Environment – Energy, and Knowledge. Building on the experience gained from the previous programming period, the transformation of RIS3 for the period 2021-27[102] was based on the smart and sustainable development of specialization areas, with the main goals:

1) To reinforce innovative entrepreneurship by supporting cooperation initiatives for the development of innovative products and services, and take advantage of the dynamics developed from the green and digital transitions
2) To strengthen/upgrade the infrastructure of public research institutions and higher education, to reinforce research in areas of specialization and existing and/or new centers of excellence
3) To support the operation of the Entrepreneurship Observatory of the Region of Crete and the RIS3 governance structure, with particular attention to the post-pandemic business recovery, in the context of the intended transformation of the regional economy.

According to all the above, RIS3 2021-27 strategy for Crete Isl., is oriented on 4 levels:

- Development of innovation with an emphasis on partnerships between research centres and business.
- Strengthening research infrastructures to support areas of expertise of the regional economy.
- Undertake investments to exploit the innovations (as products) that have been developed or integrate them into production processes.
- Support business recovery by investing in new activities.

For the programming period 2021 – 27, some sectors from the previous programming period were proposed to remain (Tourism – Culture and Agri-food), while two new areas of specialization were included related to digital technologies and sustainable use of resources, including the principles of circular economy. In the

[102] "Η Αναθεώρηση της Στρατηγικής Έξυπνης Εξειδίκευσης της Περιφέρειας Κρήτης για τη νέα Προγραμματική Περίοδο 2021-2027."

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field of sustainable use of resources and mitigating climate change and compliance with the green transition goals, the exploration of the possibilities of developing innovations in the field of Blue Growth is included.

Blue growth focuses on technological innovations that consider, inter alia, the harnessing of seabed resources, and of offshore renewable energy sources (such as wave and offshore wind), including recording, mapping, data management, analysis, sensors, platforms, real-time monitoring networks, etc.

The implementation of the new R&I Strategies for Smart Specialization (RIS3) necessitates the enhancement of research infrastructures to achieve a high level of competitiveness and align research efforts with RIS3 objectives. This involves the support of sustainable innovation through improved laboratory equipment, data centres, observatories, and monitoring platforms. Additionally, there is a need to: i) foster flexible cooperation mechanisms to further develop strategic options and create targeted solutions, ii) promote new collaborative initiatives among educational and research institutions, such as clusters, capacity centres, and innovation labs, and iii) upgrade of existing structures.

It is also important to support ongoing innovation initiatives from the current programming period and enhance the successful international presence of these institutions. The strengthened research infrastructures and structures will be directly linked to sectoral specialisations, aiming to build local capacities by providing support to innovators through measurement, technological problem-solving, laboratory experiments, and high-level counselling. Given the significant number of research bodies, better coordination is required for the development and utilisation of research infrastructures to maximise their impact. In this respect, 111 proposals have been already submitted to the consultation with a notable participation from the business community, research and collective bodies, as well as the public sector management.

3.2.4.4 Indicators and targets

HEREMA, as the authority responsible for the management of exploration and identification rights of suitable Offshore Wind Farm Organized Development Areas, announced the draft National Offshore Wind Farms Development Programme at October the 31st, 2023. The presented programme defines the eligible Organized Development Areas (ODA) and estimates the capacity of OWF projects that can be developed, in the mid-term (up to 2030-2032) and long-term (after 2030-2032) horizon. The draft National Programme for the Development of OWF includes 25 areas, covering a total area of 2,712 km^2 and with an estimated minimum capacity of 12,4 GW. Most of the proposed offshore areas are suitable for floating technology. Based on this roadmap, Greece can gain a competitive advantage in fostering new technologies, acquire indigenous know-how and developing the necessary supply chain.

It is noted that the plan, which has already been submitted to the Spatial Planning Directorate of the Ministry of Environment and Energy, qualifies a tank of ten (10) eligible areas for development by 2030-2032 (4.9 GW / 978 km^2), with a total capacity of approximately 4.9 GW, mainly for floating projects. The above areas do not include the marine area between Evros-Samothraki, which is defined as an area for the development of pilot OWF projects (0.6 GW in total), according to Law 4964/2022.

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More precisely, the eligible OWFODA for the medium-term development phase are located in the following areas:

- Eastern Crete, where it is estimated that projects with a total capacity of 800 MW will be developed.
- Southern Rhodes, with a maximum installed capacity of between 300 MW and 550 MW.
- In the central Aegean, with a maximum installed capacity of between 200 MW and 450 MW.
- In the Evia-Chios axis, with a maximum installed capacity of 300 MW.
- In the Ionian Sea, with a maximum installed capacity of 450 MW.

In the long term, the Plan qualifies a tank of thirteen (13) eligible areas for the development of offshore wind farms (6.9 GW / 1,381 km^2, Figure 37 turquoise colour).

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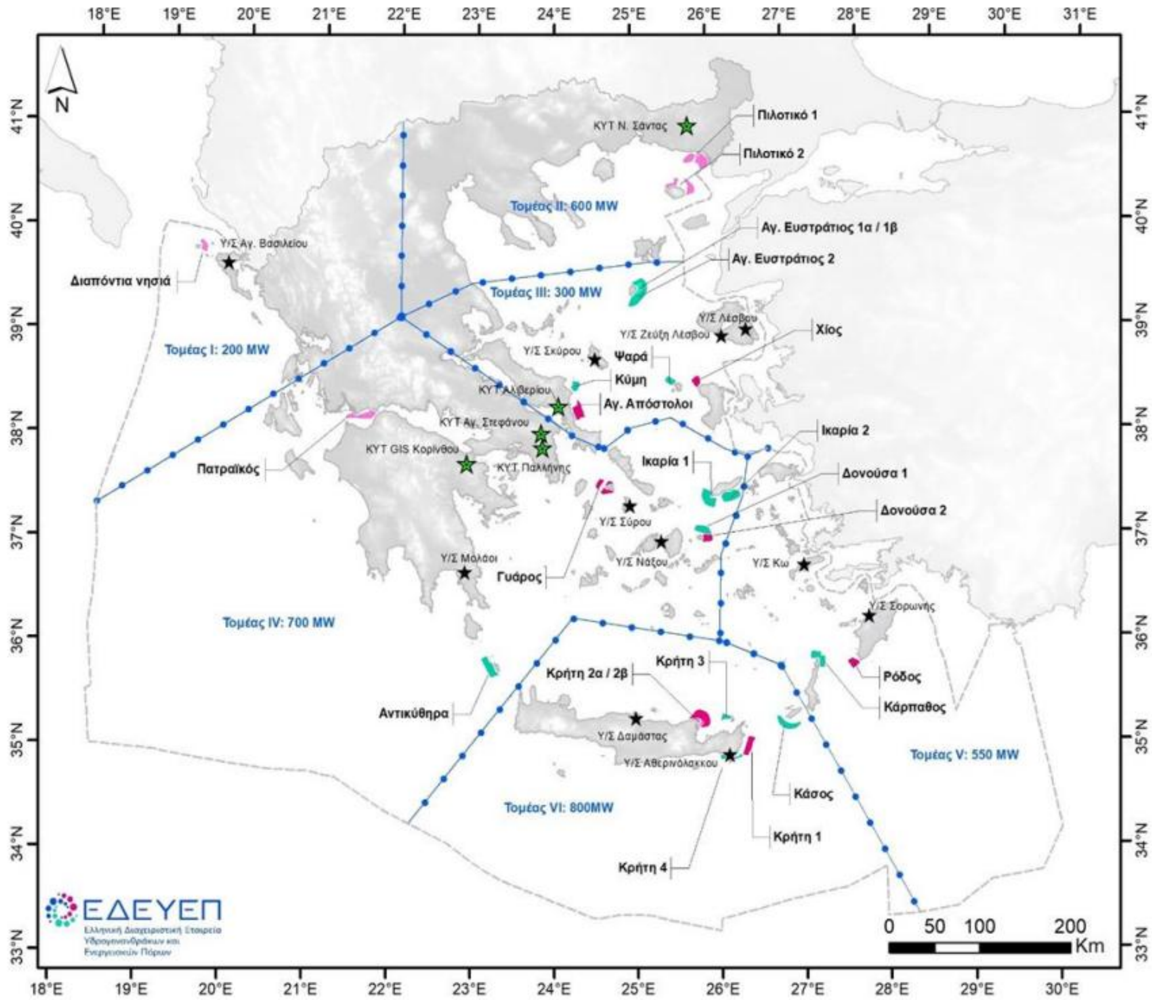

Figure 37. Possible areas of development of Offshore Wind Farms[103]

3.2.4.5 Sector value chain

Today projects that sum up to hundreds of Gigawatts have been announced and planned internationally, with each one of these projects requiring the construction of dozens of Wind Turbine Generators, Towers and Floaters. This has led to the speculation that the emerging supply chain today is unable to support even a fraction of the capacity of the wind farms planned and announced worldwide, according to market factors.

The development of the Greek offshore wind sector requires the development of a domestic offshore wind energy supply chain. It is considered that the only way to ensure the achievement of national targets is to achieve high levels of domestic production development. This way, it could be argued that the domestic

[103] konstantinos, "Announcement of the Publication of the Strategic Environmental Impact Assessment (SEIA) of the Draft of the National Offshore Wind Farm Development Programme (NDP-OWF)."

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OWF supply chain could provide a higher priority in delivering the necessary components to local projects over foreign ones.

Otherwise, the development of the OWF sector in Greece will depend on the production capacity which may be created in other countries of the region, which in turn could provide higher priority to their domestic projects and the needs of the Greek OWF projects will inevitably take second place.

The development of the Greek OWF supply chain will however require significant development of the local manufacturing facilities, the ports infrastructure, the lease or acquisition of specialised vessels and a skilled and trained workforce able to carry out the production, transportation, installation, and maintenance of the major components required for an offshore wind energy project.

To our knowledge, this is one of the very first attempts to capture the entire offshore wind supply chain industry in the country. To identify potential companies within the OWF supply chain in Greece, we started by analysing established supply chains in other countries. This involved researching the industry sectors involved in OWF component manufacturing and assessing whether Greek companies with similar capabilities exist. Therefore, we targeted the country's main ports, shipyards and steel, cable and cement industries as the main parts of the supply chain.

3.2.4.5.1 Ports

The Greek port system consists of approximately 900 ports of different size, administrative organisation, uses, and different importance for the national and local society and economy.

The classification of seaports, which is valid today, was published with Joint Ministerial Decision. During the ranking, the following were considered:

- The peculiarities of the Greek geographical area (division into numerous islands, existence of ferries, intra-island, and interregional connections).
- The statistics of the total annual traffic volume of goods (in tons) and passengers of the ports that meet features A and B of EC decision No. 1346/2001/22.5.2001 of the European Parliament and the Council of the European Union (DDR), combined with the criteria of native geographical the advantages and their effect on the international network and of the country's national transport, as well as the looming perspectives development they show.

This decision groups the Greek ports into four main groups, as follows:

- Ports of International Interest – Group K1 which consists of 16 ports.
- Ports of National Interest – Group K2, which consists of 16 ports.
- Ports of Lesser Interest – Group K3, which consists of 25 ports.
- Ports of Local Interest – Group K4, which consists of all the rest of the ports.

For the purpose of this study, we believe we should focus on ports that belong in Group K1, which are the main Greek ports. From those 16 ports we should exclude ports that are in sites where no OWF are scheduled to be installed, at least in the first phases of the National OWF program. This leaves us with the ports of

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Piraeus, Thessaloniki, Alexandroupolis, Volos, Elefsina, Heraklion, Kavala and Lavrion. Furthermore, due to its location, we should also take into consideration the port of Kymi on the island of Evia.

3.2.4.5.2 Shipyards

The Greek shipyard industry is only recently emerging from a decades-long decline. Previously, state-owned shipyards were heavily in debt and the previous privatisation efforts failed. Luckily this situation has recently changed. Firstly, the Syros Shipyards were acquired by ONEX Shipyards in 2017 and saw a drastic increase in turnover. Later, in 2021 ONEX Shipyards also took over the Elefsis Shipyards, while the "Milina Enterprises Company Limited" owned by shipping magnate George Prokopiou has been in discussions with the Greek Government and finally acquired the Hellenic Shipyards S.A. in Skaramangas. Apart from these three larger Greek Shipyards, there are also smaller shipyards in Chalkis, Perama and Salamina. It is a fortunate circumstance that the Greek shipyard industry appears to be growing again just as the OWF sector calls for a significant demand for floaters and offshore construction.

3.2.4.5.3 Steel & cables industry

Metals manufacturing is by far the biggest heavy manufacturing segment in Greece, with more than 4 billion sales in 2019. The basic metals industry is on the rise, due to increased exports and significant infrastructure projects, while basic metals production comprised 8,4% of total Greek exports, the second largest export category. Large players in this industry are focused on aluminum, iron, steel, and copper. All key players in this industry produce one type of metal, apart from Viohalco group which produces 3 metals and dominates the copper market. Hellenic Cables S.A., which is a company of Viohalco Group has extended expertise in the construction of underwater cables and has already built such cables for OWF in projects abroad. Lykomitros Steel S.A. is already active in the construction of steel structures for bottom fixed OWF such as monopiles and jackets, while EMEK S.A. has been building towers for onshore wind farms for years. The Steel and Cable companies which we believe could be a part of the Greek OWF supply chain, along with their websites are listed in Table 6:

Table 6. Greek companies active in the steel & cables industry which can play a key role in the OWF supply chain

Corporate Name	Segment	website
Cenergy Holdings S.A.	Cables	https://cenergyholdings.com/
Hellenic Cables S.A.	Cables	http://www.hellenic-cables.com/
Corinth Pipeworks (CPW)	Steel pipes	http://www.cpw.gr/
Sidenor S.A.	Steel	https://sidenor.gr/
Sovel S.A.	Steel	https://sidenor.gr/
SIDMA STEEL S.A.	Steel	http://www.hlv.gr/
ELASTRON S.A.	Steel	http://www.elastron.gr/
LYKOMITROS STEEL S.A.	Steel	http://www.lykomitros-steel.gr/
EMEK S.A.	Towers	http://www.emek.gr/

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3.2.4.5.4 Cement industry

Cement production is one of the most important industrial activities in Greece, offering great export opportunities and contributing significantly to the national economy. Limestone, the main raw material for the production of cement and aggregates, is abundant in Greece, which is a strong advantage for the development of the domestic cement industry. At the same time, the intense seismic activity in the country and the requirement for durable construction of private and public projects, result in an increased demand for concrete, as a building material, due to its great durability and strength.

Today, the cement industry in Greece has an annual production capacity of approximately 15 million tons and consists of 3 companies, which are listed in Table 7:

Table 7. Greek companies active in the cement industry which can play a key role in the OWF supply chain

Corporate Name	website
Heracles General Cement Company S.A., a member of the Holcim Group	https://www.lafarge.gr/
TITAN Cement Company S.A.	https://www.titan.gr/
HALYPS Building Materials S.A., a member of the Heidelberg Group	https://www.heidelbergmaterials.gr/el

3.2.4.6 Associated job profiles

As the offshore wind industry matures and the plans to achieve carbon-neutral targets start to become a reality, the EU is poised to witness a surge in projects transitioning into the fabrication, construction, and subsequent operations and maintenance (O&M) phases (Figure 38). However, it becomes increasingly clear that the current supply of skills in the industry falls short of meeting the growing demand. Not enough workers with sufficient experience are available to meet the demands of the offshore wind industry. This is particularly true as other industries, including other renewables, compete for skilled trade workers.

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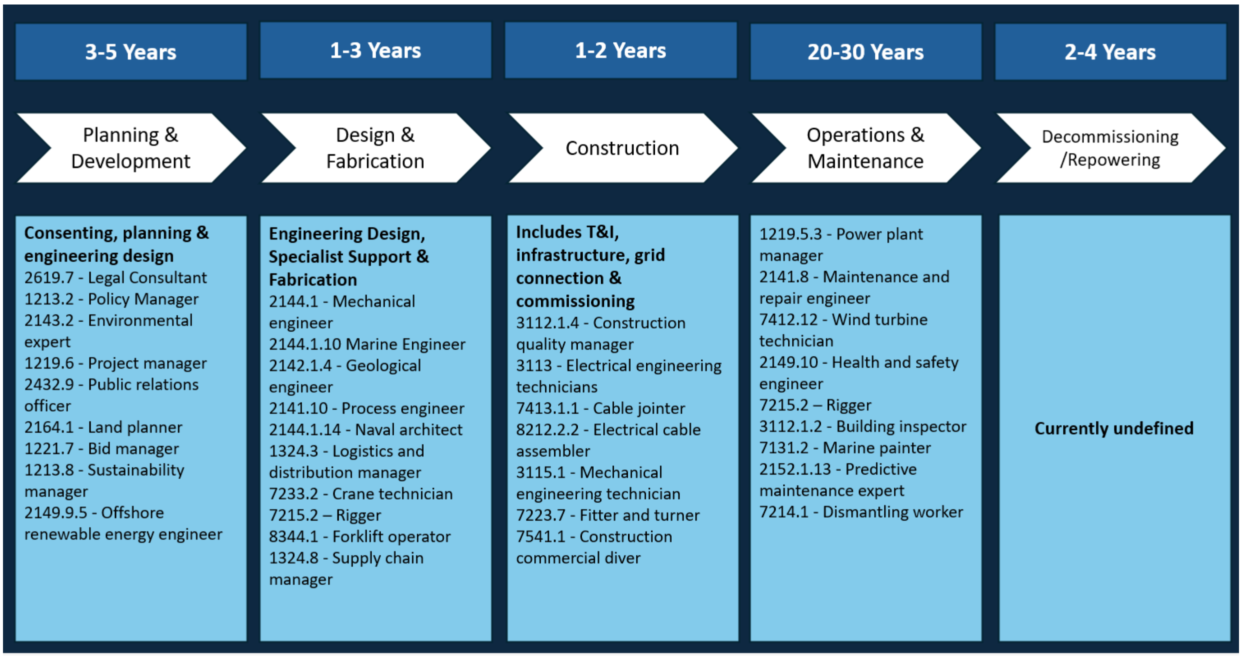

Figure 38. Example of offshore wind project. Timeline and examples of general skills requirements in each project stage[104]

There are numerous types and levels of skills demanded by the offshore wind sector – from environmental surveys through to turbine maintenance – and the exact nature of the skills demanded vary significantly across the project lifecycle. Table 8 is indicative of some of the associated job profiles and skills for the ORE sector[105].

Table 8. Associated job profiles and skills for ORE sector

Sub-Sector	General skills and qualification requirements
Development and project management For consent applications, surveys and studies are needed to analyse environmental impacts and to inform early wind farm design. These include meteorological and oceanographic studies, wildlife surveys, geotechnical and geophysical surveys, port studies, visual studies, economic studies and onshore studies. The services are typically contracted to specialist onshore and offshore survey companies.	Generally, these roles require degree-level qualifications in relevant disciplines such as environmental sciences, marine biology, oceanography, hydrography and geophysics, economics, engineering and project management. Graphic design skills are also required. Indicative related occupational profiles (ESCO Classification): 2619.7 - Legal Consultant, 1213.2 - Policy Manager, 2143.2 - Environmental expert, 1219.6 - Project manager, 2432.9 - Public relations officer, 2164.1 - Land planner, 1221.7 - Bid manager,

[104] "In-Demand Skills in Offshore Wind for the next Decade - Empire Engineering."
[105] "Aura-EU-Skills-UK-Offshore-Wind-Skills-Study-Full-Report-October-2018.Pdf."

	1213.8 - Sustainability manager, 2149.9.5 - Offshore renewable energy engineer
Turbine design and manufacture	Requiring a mix of skill levels. Ranging from degrees in mechanical engineering and physics to mid-range technical skills in welding, platers, electricians, fitters, etc. Apprenticeships, Higher Apprenticeships and HNC / HND (Higher National Certificate/Diploma) being an important route into employment. Vocationally-achieved technical qualification in electrical and design engineering (achieved through an Apprenticeship of Higher Apprenticeship) – welders, platers, pipe fitters, electricians, mechanical fitter and riggers. HNC / HND in electrical engineering. Degree in mechanical engineering and physics. As well as high-level academic qualifications in naval architecture, marine engineering, mechanical engineering, high voltage design engineering. Indicative related occupational profiles: 2144.1 - Mechanical engineer, 2144.1.10 Marine Engineer, 2142.1.4 - Geological engineer, 2141.10 - Process engineer, 2144.1.14 - Naval architect, 1324.3 - Logistics and distribution manager, 7233.2 - Crane technician, 7215.2 – Rigger, 8344.1 - Forklift operator, 1324.8 - Supply chain manager
Balance of plant Including foundations, the turbine tower and array cables that connect the turbines to each other and the offshore substation. Export cables connect the onshore and offshore substations. The onshore substation provides the interface between the wind farm and the onshore transmission grid.	Turbine and foundation installation: Degree in engineering, naval architecture and marine engineering. Vocational qualification in yacht and boatbuilding. Project management. Cable installation: Degree in engineering or mechanical engineering. HNC / HND in technical engineering. Appropriate vocational qualification / experience (e.g. Apprenticeship). Project management. Installation support: Valid dive ticket. Explosive ordnance disposal qualification. Degree in geophysics and environmental science. Vessel (master, mate, deckhand) certifications. Indicative related occupational profiles: 3112.1.4 - Construction quality manager, 3113 - Electrical engineering technicians, 7413.1.1 - Cable jointer, 8212.2.2 - Electrical cable assembler, 3115.1 -

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	Mechanical engineering technician, 7223.7 - Fitter and turner, 7541.1 - Construction commercial diver
Installation and commissioning Foundation installation is undertaken using a jack-up vessel or a floating heavy lift vessel. Cables are installed using specialist cable vessels equipped with cable-handling equipment. The cables may be laid and buried in a single process using a cable plough or in two stages in which a first vessel lays the cable and a second vessel buries the laid cable using a remotely operated vehicle (ROV). Although the large cable manufacturers have their own vessels, the work is typically undertaken by specialist contractors. These contractors also work in oil and gas and telecoms. During the installation, the wind turbine manufacturer and main installation contractors complete the installation activities, while support services include unexploded ordnance surveys and removal, the supply of guard vessels, oil-clean up services, the supply of fuel, waste disposal and insurance.	Turbine and foundation installation: Degree in engineering, naval architecture and marine engineering. Vocational qualification in yacht and boatbuilding. Project management. Cable installation: Degree in engineering or mechanical engineering. HNC / HND in technical engineering. Appropriate vocational qualification / experience (e.g. Apprenticeship). Project management. Installation support: Valid dive ticket. Explosive ordnance disposal qualification. Degree in geophysics and environmental science. Vessel (master, mate, deckhand) certifications. Indicative related occupational profiles: 3112.1.4 - Construction quality manager, 3113 - Electrical engineering technicians, 7413.1.1 - Cable jointer, 8212.2.2 - Electrical cable assembler, 3115.1 - Mechanical engineering technician, 7223.7 - Fitter and turner, 7541.1 - Construction commercial diver
Operations, maintenance and service Operations activities provide support during the lifetime of the wind farm to ensure maximum energy production (typically 20 to 25 years). Operators generally look to use the nearest port that meets its specifications, which may not be the closest port to the wind farm. Operations include day-to-day workflow management and the use of systems to store and analyse data, such as supervisory control and data acquisition (SCADA) and condition monitoring systems (CMS). This allows the owners to respond to failures and, where possible, identify potential failures before they occur. Some owners use specialist contractors to provide this service, while others have developed in-house capability.	Activities are at, primarily, technician level. Relevant Apprenticeship programmes, HNC/ HND and specialist training courses (in high voltage work, working at heights, confined spaces and SCADA, amongst others) are demanded. Turbine maintenance: Technology-specific training; high-voltage equipment handling, certification to undertake lifting, climbing and rope access training. Turbines are becoming much more electronic-based, needing a strong electrical / control and instrumentation skillset. Maintenance of the offshore substation: Largely specialist work with strong demand for technicians with high-voltage experience. HNC / HND in electrical or mechanical engineering. Maintaining the turbine foundation: Specialist equipment skills. Valid diver ticket. Inspections of safety-critical devices including fall arrest systems, davit cranes, boat landing and ladders, external gates and railings and external

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	evacuation equipment: It is likely that most owner / operators will seek to train up their own technicians. Indicative related occupational profiles: 1219.5.3 - Power plant manager, 2141.8 - Maintenance and repair engineer, 7412.12 - Wind turbine technician, 2149.10 - Health and safety engineer, 7215.2 – Rigger, 3112.1.2 - Building inspector, 7131.2 - Marine painter, 2152.1.13 - Predictive maintenance expert, 7214.1 - Dismantling worker

3.2.4.7 Challenges and contributions

In order for the implementation of this plan to be successful, six areas of action are required:

1. The creation of a flexible licensing system, based on the provisions of the European legislation of the REPowerEU, will ensure that interested investors and their projects, when selected, will not face a typhoon of bureaucracy and delays.
2. The rapid promotion of the country's international interconnections, in order for the rich wind potential of the Aegean Sea to become a necessary part of Europe's energy independence. Initiatives such as the Green Aegean Interconnector must be supported at the highest level.
3. The preparation of a focused investment support program for the supply chain. Thus, the country can target to serve not only its own OWPs but also the OWPs of the Eastern Mediterranean region.
4. Exhaustive and continuous dialogue with the society, local administrations and professional associations involved with the marine area, in order to explain the benefits and to address promptly and validly concerns and questions that always arise.
5. The preparation at a high level and the implementation of a road map for the exploitation of the rich wind potential throughout the Aegean Sea, based on international law.
6. The support from the government to HEREMA with more financial and human resources in order to move even faster towards the goal.

In particular, it is emphasised that to maximise the benefits for Greece, the development of OWF must be accompanied by the development of a domestic supply chain that will involve traditional and new sectors of our economy, such as shipyards, ports, cable, cement and electrical equipment industries, metal construction industries, transport, shipping, services, etc.

The development of the offshore wind farm market will have a beneficial impact on the Greek economy, as demonstrated by a study carried out by Foundation for Economic and Industrial Research (IOBE) on behalf of Hellenic Hydrocarbons and Energy Resources Management Company (HEREMA)[106]. In the most ambitious

[106] "Helleniq-Energy_sustainability-Report-En-2022.Pdf."

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scenario, investments for 2030 can reach €7.7 billion and multiply to reach €60 billion by 2050 (Figure 39, Figure 40).

According to the study, there are three different working scenarios, the ambitious scenario, the central scenario and the stressed scenario where the development benefits differ significantly. The ambitious scenario would mean 20% more installed capacity than Greece’s National Energy and Climate Plan (NECP) targets, the central scenario would mean implementation of the National Plan targets and the stressed scenario 20% lower performance. In the ambitious scenario, Greece turns into an exporter of green energy, while in the stressed scenario, it continues to import it to cover its needs. A consequent differentiation also exists in terms of added value in each scenario.

Regarding the economic benefits of offshore wind under the optimistic scenario, the domestic added value will reach 55%, which means that the investment expenditure of €60 billion by 2050 will translate into a €1.9 billion annual contribution to GDP for the period 2024-2050 and in 44 thousand jobs every year.

According to the study (Figure 41), 55% of the domestic added value will come mainly from the construction of offshore wind infrastructure components other than wind turbines (37%), such as the development of platforms for floating wind farms. This is followed by the installation and commissioning of the projects (10%), while a smaller share is in the construction of the wind turbines (5%) and the development and management of the projects (3%).

In the central scenario, investments by 2050 are reduced to €55.2 billion and domestic value added to 45%, which means that the annual contribution to RES will be €1.4 billion and supported jobs will be 32,300 every year.

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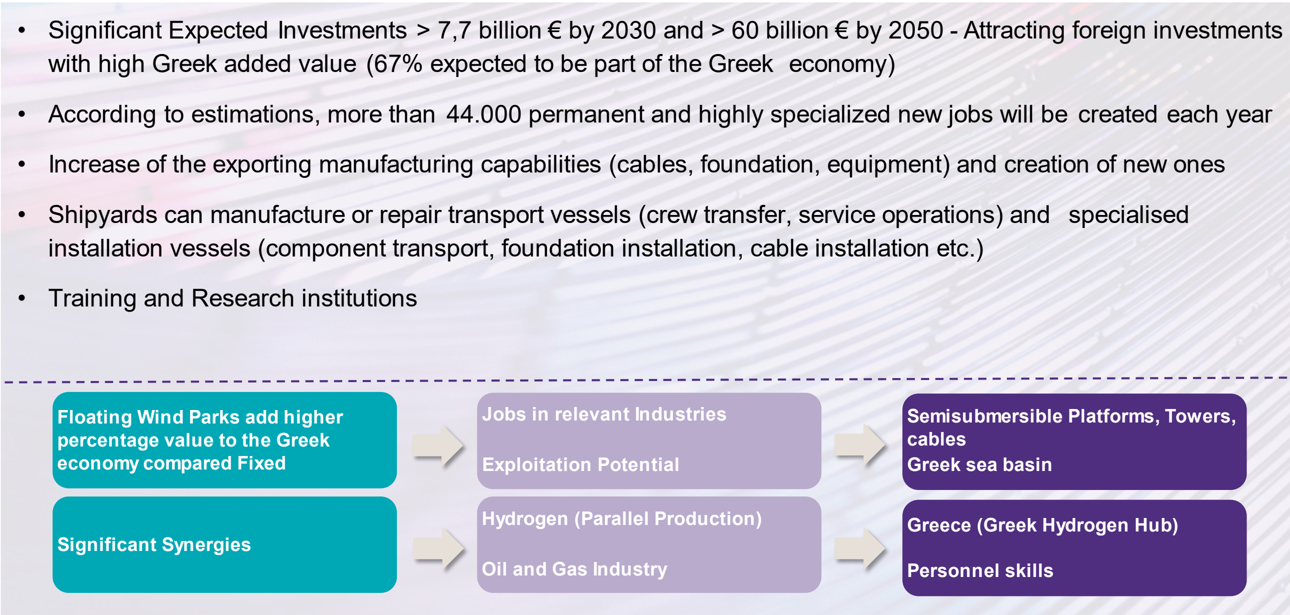

Figure 39. Added value to the Greek economy[107]

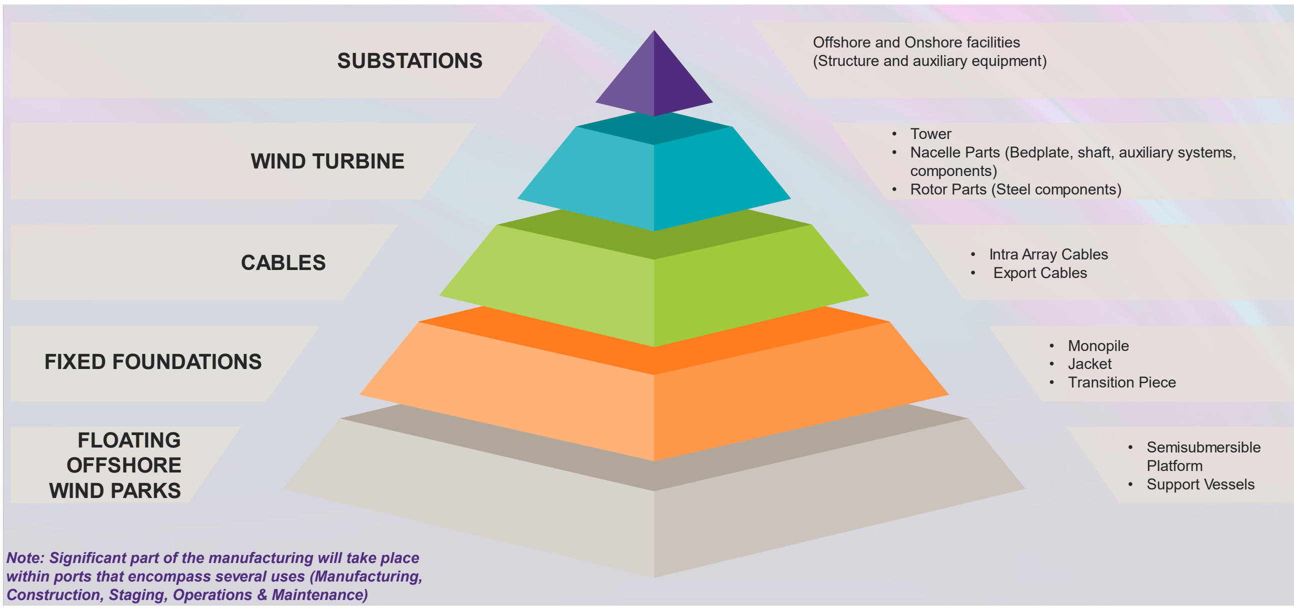

Figure 40. Value to the Greek manufacturing sector[108]

[107] Team, "Presentations of the Workshop."
[108] Team.

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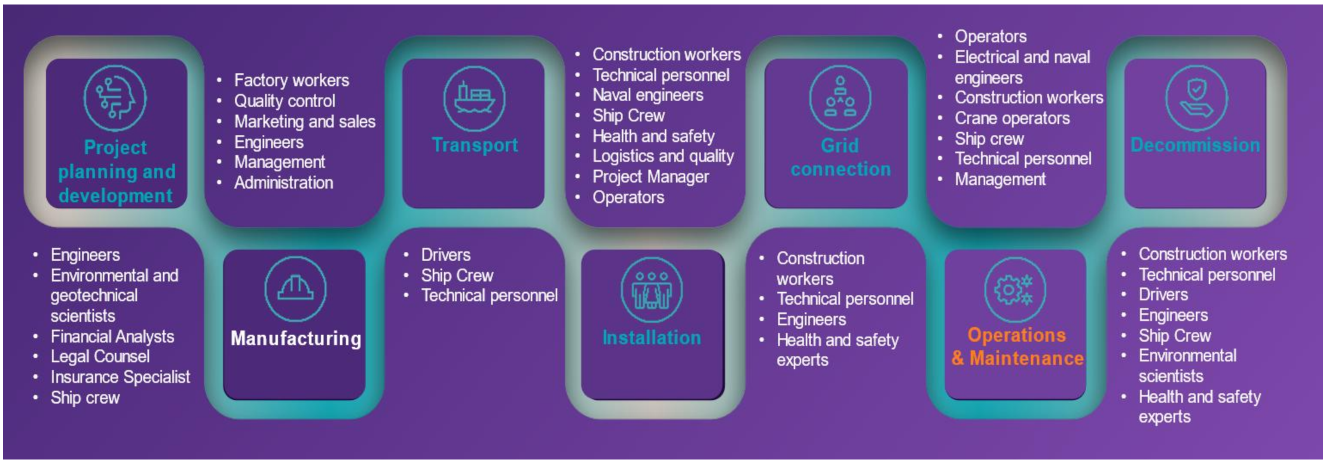

Figure 41. Offshore Wind Farms development stages and equivalent new job creation[109]

3.2.4.8 SWOT analysis for offshore renewable energy

Greece has several comparative advantages for the development of the OWF sector:

I. Strategic location

The country is located in the Southwestern edge of Europe, and is neighboring the Middle East, Eastern Mediterranean and Northern Africa, close to the Suez Canal logistics corridor, and can be risen to be a significant energy hub for the region, by transmitting green electricity produced in Egypt and Israel (or even Saudi Arabia), green Hydrogen produced in the countries of the Persian Gulf, Natural Gas drilled from the Seabed of East Mediterranean, etc.

II. Ideal climatic characteristics

With offshore wind resources in Greece considered among the most attractive for energy production in Europe the potential of the sector cannot be overemphasised. Although onshore wind continues to dominate global wind energy production, the saturation of exploitable sites, a lower comparative energy capacity, and visual and noise disturbances are just a few of reasons behind the current international surge in offshore wind farm (OWF) development.

III. Infrastructure with sea access

Greece is a maritime country, with more than 2.000 islands, more than 200 inhabited islands and more than 70% of its mainland population living seaside. Therefore, there is a large number of existing sea infrastructure, such as dozens of commercial ports, shipyards, etc.

[109] Team.

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IV. Marine and shipbuilding industry with extensive experience

Greece is a maritime nation by tradition, as shipping is arguably the oldest form of occupation of the Greeks and has been a key element of Greek economic activity since ancient times. Today, shipping is the country's most important industry worth $21.9 billion in 2018. If related businesses are added, the figure jumps to $23.7 billion, employs about 392,000 people (14% of the workforce), and shipping receipts are about 1/3 of the nation's trade deficit. In 2018, the Greek Merchant Navy controlled the world's largest merchant fleet, in terms of tonnage, with a total DWT of 834,649,089 tons and a fleet of 5,626 Greek-owned vessels, according to Lloyd's List. Greece is also ranked in the top for all kinds of ships, including first for tankers and bulk carriers.

V. Strong domestic steel, cable, and cement industries

Greek companies that are involved in the steel, cable and cement business are export oriented, internationally competitive and among the biggest companies in the country with a significant contribution in the local GDP.

To identify the strengths and weaknesses in the effort of OWF development in Greece, at the end of 2023 a survey was conducted by a Greek Firm “SAMARAS AND ASSOCIATES S.A.” engaged by ELETAEN, to report on the status and challenges for the supply chain for Offshore Wind in Greece. Most key players of this supply chain were addressed, such as main ports, shipyards, as well as the steel, cement and cables industry.

In summary, potential domestic suppliers for the Greek offshore wind industry identify several key strengths for the sector's development. These include strong wind resources, the country's strategic location, a rich maritime heritage, industry know-how, existing shipyards, well-equipped ports for handling wind farm components, a skilled workforce, and a demonstrated political commitment to project implementation.

They recognise the significant opportunities to be active in the sector, as it concerns an innovative technology that domestic industry can support, with prospects for activity in the next 30 years and the potential for strong locally added value. In addition, there is also the possibility of developing an industry in the maintenance of floating wind turbines.

They also pointed out the weaknesses for engaging in the sector, which mainly concern the insufficient level of infrastructure in terms of equipment and available land in the ports, the lack of construction know-how in the ports, legal, institutional, and regulatory constraints as well as the uncertainty due to the impending privatization of the ports.

While they point out as threats the risk of delays in the implementation of the program, the bureaucracy and local reactions, the increase in the cost and size of the designs, the amount of required investments in infrastructure, and finally the limited capacity of construction throughout Europe.

It should be noted that different industries have a different outlook on the OWF sector prospects. More specifically:

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- Ports still have the lowest knowledge of the sector requirements. They declare that they wish to be involved, however they do not seem to be interested in preserving their limited port space for many years, transforming their facilities for that period and making significant investments. All these are prerequisites for floaters to be put together and offshore wind turbines to be risen on the floaters in ports. Their view on their participation in the sector is to face the floating offshore wind farms equipment as plain cargo, which will be offloaded on the ports, stored for a few days, weeks, or even months on port facilities, and then taken away from the port, for the next cargo to take its place. Subsequently, the prospect of acceleration of the development of the sector does not change their planning, as they prefer to wait for technical specifications to be finalized, and see then, if their infrastructure and availability will allow them to participate.
- On the other hand, shipyards and industries seem to have found more immediate prospects in the development of the OWF sector. While industrial companies are not active in the OWF sector yet, they declare themselves ready to participate. These companies, who are more informed, more prepared, or already active, also set more conditions for their involvement in Greek OWF projects. One main reason is that they identify that currently no industrialization of the production can easily take place. A second reason is that they might already see the challenges in practice.

It should also be noted that these companies, already active in the OWF supply chain for projects that are developed abroad, are not likely to drop existing customers from these OWF project to satisfy the demand that will arise from local projects. This means that the road map for the materialisation of the first projects must take shape, and the developers must approach them so that they can put their orders, while there is still available capacity.

Finally, maritime offshore service companies and crane companies are either already active in the sector (in offshore projects developed in other countries), or are closely monitoring the developments in the sector, as they mostly find that it is fruitful for their involvement. It should be noted that they recognise that they will need adjusting to the special requirements of these projects: crane companies are experienced in transporting, raising and putting together smaller scale wind turbines for onshore projects, they though believe that they can train and prepare for the larger scale and different conditions of offshore projects. They will also need to invest in new crane equipment, which in turn requires a significant time period of 18-24 months for delivery. They believe though that they can cooperate with foreign companies, to be ready sooner. Similarly, offshore vessel companies (e.g. tugboats) do not yet have the required equipment, however they believe that they can obtain the equipment.

Something that developers will have to keep in mind, is that there is cabotage law regarding offshore services in Greece: Vessels under the Greek flag must be employed for offshore services and only if such vessels are unavailable to provide the service can one employ vessels under different flag. This obviously works in the Greek maritime services companies benefit, and because of that they have added incentive to involve in the offshore wind farm sector.

The difficulty to find skilled personnel has been pointed out by several companies. Offshore companies have recently witnessed a tendency for staff fleeing to the Oil & Gas sector. Crane companies have faced difficulties in finding technical personnel in Greece, resulting in often having to find personnel from abroad.

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Even industrial companies mentioned to us that there is a significant difficulty in finding technical workers (such as welders) to employ.

These conclusions are thoroughly presented in a SWOT (Strengths – Weaknesses – Opportunities – Threats) type chart below[110]:

Overall analysis of the ORE Sector	
Strengths	**Weaknesses**
• Significant wind potential. • Strategic location. • Maritime heritage. • Industry and shipyards know-how. • Skilled workforce. • Experience by the management of onshore wind farms. • Political will.	• Insufficient infrastructure in port space and equipment. • Lack of assembly know-how in ports. • Regulatory constraints. • Uncertainty due to port privatisation plans.
Opportunities	**Threats**
• A new innovative technology that may be developed in Greece. • Novel industrial sector with prospects of at least 30 years of activity. • Potential high local added value for Greece. • Side-activities development: a new industry in offshore wind maintenance.	• Risk of delays. • Lack of a clear legal framework. • Bureaucracy. • Limited or lack of social acceptance. • Increasing costs. • Investments required in infrastructure. • Constant design upscaling. • Limited capacity Europewide.

3.2.5 Cyprus

Cyprus is strategically located in the Eastern Mediterranean and is beginning to explore its potential in the offshore renewable energy (ORE) sector, particularly in offshore wind energy. Though its renewable energy sector has so far focused primarily on solar energy, the Cypriot government recognises the significance of diversifying energy sources, especially as the country aligns itself with the European Union's climate and energy targets. With its deep waters and favourable wind conditions off the southern and western coasts, Cyprus presents a unique opportunity for the development of floating offshore wind technology.

While there are currently no operational offshore wind farms, the National Energy and Climate Plan (NECP) has set ambitious targets for increasing the share of renewable energy in Cyprus' overall energy mix by 2030,

[110] "2024-09-02-OW-Supply-Chain-Greece-ELETAEN-Consolidated-Report.Pdf."

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with offshore wind energy expected to play a role beyond that date[111]. Additionally, Cyprus' involvement in key regional energy projects, such as the EuroAsia and EuroAfrica Interconnectors, positions the island as an important player in the Mediterranean energy market, with the potential to export renewable energy to neighbouring regions[112].

The legal and regulatory framework supporting offshore renewable energy development in Cyprus is well-aligned with the broader EU Green Deal and REPowerEU initiatives, which promote energy security and the transition to green energy[113,114]. The government is actively conducting feasibility studies to identify suitable locations for future offshore wind farms and is exploring how floating wind technology can best be integrated into Cyprus' energy strategy. These efforts are crucial as the country moves toward carbon neutrality by 2050, supporting both national energy security and broader European renewable energy goals.

3.2.5.1 Legal framework and policies

The legal framework governing offshore wind energy in Cyprus is built upon the country's broader commitment to the European Union's renewable energy and climate policies, especially the EU Green Deal and Renewable Energy Directive. Cyprus has established a foundation for renewable energy development, including offshore wind, through several key laws and strategic plans to meet its climate goals while promoting economic growth through clean energy.

One of the central pillars of Cyprus' renewable energy legislation is the Law on the Promotion and Encouragement of the Use of Renewable Energy Sources (L.107(I)/2022)[115]. This law defines the scope of renewable energy in Cyprus, covering sources such as wind, solar, and biomass, and provides the legal basis for the promotion and regulation of renewable energy projects. The law also outlines the incentives available for developers, encouraging investments in renewable energy infrastructure, including offshore wind farms. This legislation aligns with Cyprus' EU obligations to increase the share of renewable energy in its energy mix.

In addition to national legislation, Cyprus has laid out its National Energy and Climate Plan (NECP) for 2021-2030, which serves as the country's roadmap for reducing carbon emissions and increasing the use of renewable energy. According to NECP, the share of renewables in total gross energy consumption should increase to 24.3% under the scenario with existing measures and 26.5% in the scenario with additional measures. This percentage will represent the national contribution to the European target of 42.5% in 2030 (NECP Cyprus). While solar energy currently dominates the renewable landscape in Cyprus, offshore wind is

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[111] "Cyprus - Draft Updated NECP 2021-2030 - European Commission."
[112] "Ending Energy Isolation - Project of Common Interest 'EuroAsia Interconnector' - European Commission"; "EuroAfrica Interconnector."
[113] "The European Green Deal - European Commission."
[114] "REPowerEU."
[115] "Ο Περί Προώθησης Και Ενθάρρυνσης Της Χρήσης Των Ανανεώσιμων Πηγών Ενέργειας Νόμος Του 2022 - 107(I)/2022 - 4 - Αντικείμενο Και Πεδίο Εφαρμογής Του Παρόντος Νόμου."

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recognised as a critical future component. The NECP emphasises the need for diversification of energy sources and includes offshore wind as part of the strategy to meet both national and EU climate goals. By contributing to the EU's broader ambition for carbon neutrality by 2050, Cyprus is positioning itself to transition from fossil fuels toward cleaner, more sustainable energy.

All decisions pertaining to the energy sector in Cyprus fall under the jurisdiction of the Ministry of Energy, Commerce, and Industry (MECI)[116]. The MECI is responsible for the formulation and implementation of policies in the fields of energy, trade, industry, and technology, as well as consumer protection, with the aim of the rational utilisation of our energy resources, securing the energy supply of Cyprus, promoting renewable sources and energy saving, the promotion of circular economy, the strengthening of business competitiveness and extroversion, the improvement of the business environment, the stimulation of investments and the effective protection of consumers. New revisions regarding the siting and licensing of renewable energy sources projects include the following:

- Obligation for Member States (MS) to define the land, water, and sea areas required for the installation of RES power plants and associated infrastructure, such as grids and storage systems.
- Obligation for MS to prepare plans designating specific "RES acceleration areas" for one or more types of RES projects.
- Simplified and fast-tracked permitting procedures for RES projects within "RES acceleration areas," including the possibility of conducting only a review or summary check to assess the risk of unforeseen adverse environmental impacts.
- Preparation of plans to designate areas for the development of grid infrastructure and storage systems necessary for integrating RES projects into the electricity network.
- Reduction of maximum timeframes for the completion of the permitting process for RES projects.
- Restrictive timeframes for permitting RES projects within "RES acceleration areas," as stipulated by Law N107(I)/2022, which imposes more stringent timelines.

Another key element in the development of offshore wind energy in Cyprus is the Maritime Spatial Planning (MSP)[117]. MSP is one of the cross-cutting tools of the Integrated Maritime Policy (IMP) and contributes to the sustainable development of marine zones and coastal areas (Figure 42). The Policy Statement on Maritime Spatial Planning (PS MSP) sets the vision, priorities, goals, and strategic guidelines of the State, considering the need for sustainable growth. The MSP for the marine waters of the Republic of Cyprus is set up based on the provisions of the MSP and other Related Matters Laws of 2017 and 2021 (Law 144(I)/2017[118]

[116] "Ministry - Ministry of Energy, Commerce and Industry - Gov.Cy."
[117] "Maritime Spatial Planning - Shipping Deputy Ministry - Gov.Cy."
[118] "Ο Περί Θαλάσσιου Χωρταξικού Σχεδιασμού Και Άλλων Συναφών Θεμάτων Νόμος Του 2017."

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which is harmonised with the Directive 2014/89/EU[119] of the European Union, as amended by Law 34(I)/2021). The laws and provisions of the MSP designate specific zones in Cyprus' Exclusive Economic Zone (EEZ) where activities such as offshore renewable energy projects can be developed. These regulations are designed to protect marine ecosystems while allowing for economic activities, such as energy production, to coexist in harmony with environmental and social considerations. Under this framework, Cyprus is currently exploring areas in the southern and western regions of its EEZ for potential offshore wind projects, where favourable wind conditions and water depth make floating wind technology particularly viable.

Regulatory oversight of the energy sector, including offshore wind, falls under the authority of the Cyprus Energy Regulatory Authority (CERA)[120]. CERA plays a crucial role in the implementation of renewable energy projects by overseeing licensing, grid connection processes, and ensuring compliance with both national and EU regulations. This body works in close collaboration with the Transmission System Operator (TSO) to manage the integration of renewable energy, including potential offshore wind farms, into the national grid[121]. As offshore wind projects develop, CERA will be responsible for ensuring that these projects contribute to a stable and competitive energy market.

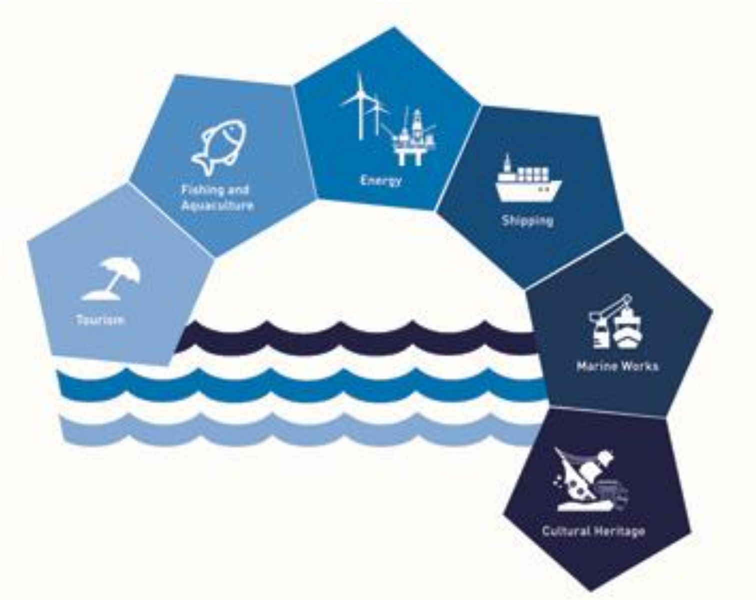

Figure 42. Cyprus Maritime Spatial Planning sectors

Overall, the combination of national laws planned and implemented by MECI, and regulatory oversight by CERA provides a solid foundation for future offshore renewable energy development. With further investment in infrastructure and international cooperation, Cyprus is well-positioned to emerge as a key

[119] "Directive - 2014/89 - EN - EUR-Lex."
[120] "CERA - Home."
[121] "Transmission System."

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player in offshore energy in the Eastern Mediterranean, contributing to both its own energy security and the EU's wider renewable energy goals.

3.2.5.2 Sectorial priorities and forecast

As of 2024, in the marine waters of Cyprus, activities related to energy currently have limited economic significance, due to the early stage of exploitation of potential oil and gas reserves, while other activities for energy production from renewable sources in the marine waters have not yet been conducted.

Taking into consideration the priority given to the energy sector, the MSP includes provisions for the appropriate location of the energy centres, which includes all future plans and energy infrastructure. Additionally, provisions are made for future infrastructures that have been approved within the framework of international energy cooperation (e.g. the "EastMed Pipeline" and "EuroAsia Interconnector" Projects of Common Interest, as well as the Cyprus-Egypt electricity interconnection), and the establishment of protection zones for pipelines and cables is proposed to avoid potential conflicts with other activities in the future. The landing of future pipelines and cables should be within these specific areas. Aiming for future implementation of offshore renewable energy projects, the designation of an area for further investigation for the development of wind energy installations is proposed.

Additionally, the potential utilization of other areas for different forms of renewable energy sources is desirable, although the current MSP does not foresee the designation of such areas due to insufficient scientific data at the present time. The development and operation of offshore renewable energy installations require compliance with environmental conditions provided by current legislation.

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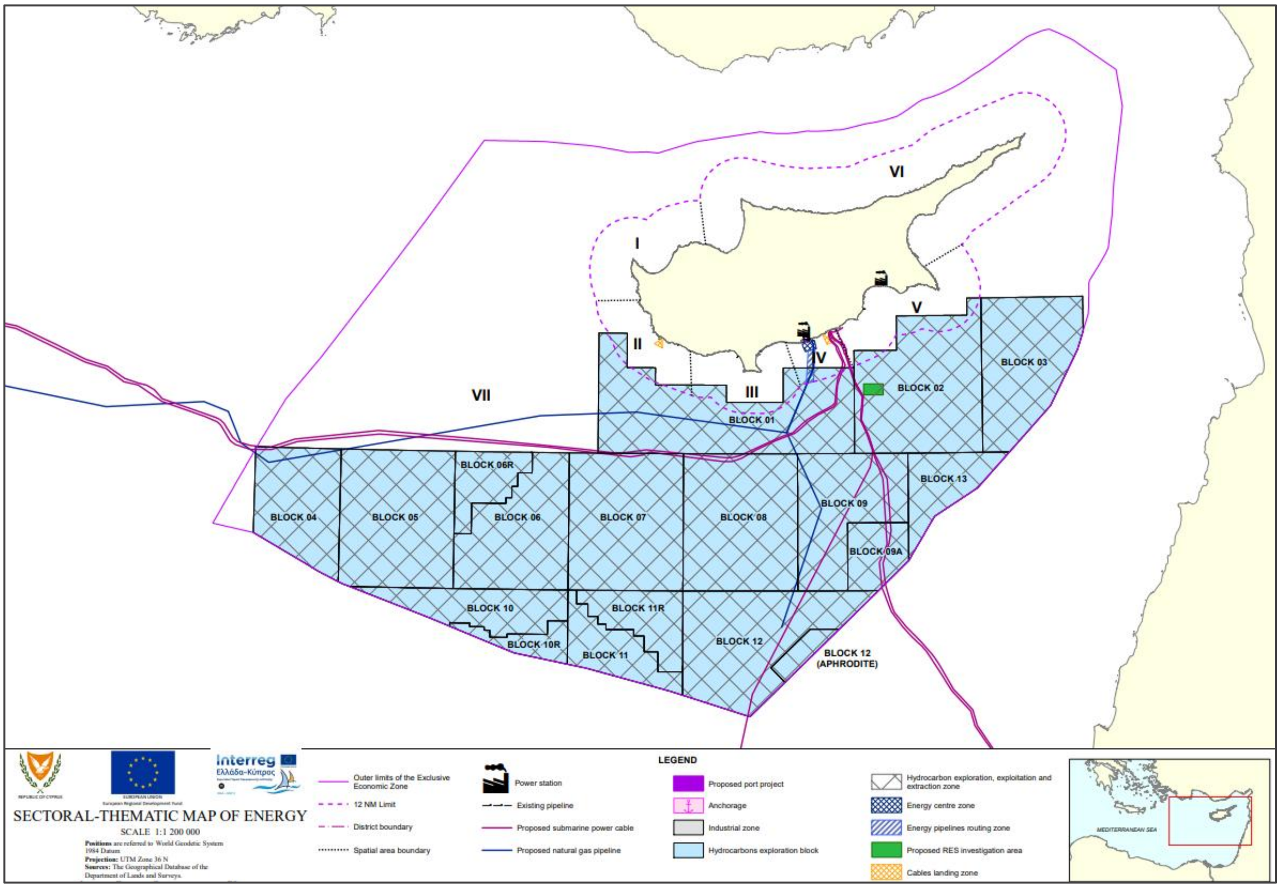

Figure 43. Energy map of the Maritime Spatial Plan[122]

Figure 43 illustrates the key areas where the main activities related to the energy sector can be implemented. The exploitation of marine renewable energy sources is a priority, and a marine area has been identified for further investigation of the development of wind energy installations. The proposed criteria for this area are as follows: minimum distance from land to avoid visual disturbance (beyond 12 nm), maximum depth (no more than 1,000 meters) and minimum average wind speed (8 meters per second in at least one quadrant). Block 2 is highlighted in green to indicate a proposed area for investigation into renewable energy sources.

The development of other forms of renewable energy is encouraged, provided that the environmental conditions set out in current legislation are met. At this stage, no planning can be made for any activities in the marine waters included in this spatial area which are adjacent to occupied areas.

The Cyprus Wind Energy Association (CWEA[123]) has formally proposed the inclusion of blue energy initiatives in the Republic of Cyprus' 2030 renewable energy targets. Specifically, the proposal recommends the

[122] "EN01.Pdf."
[123] CWEA, "Cyprus Wind Energy Association - CWEA."

creation of a floating wind farm with a capacity of 100 MW or more, involving the participation of the Republic of Cyprus, particularly the Ministry of Energy, and an academic institution. This initiative aims to leverage European funding mechanisms such as the Projects of Common Interest (PCI) and aligns with the rapid growth of floating wind energy projects across Europe, particularly in France and the UK.

Cyprus' government has also expressed aspirations for offshore wind to contribute to its long-term goal of carbon neutrality by 2050[124], as part of the broader EU Green Deal. While concrete offshore wind capacity targets have not yet been set for 2050, it is possible that this technology will become a strategic pillar of Cyprus' energy strategy as it seeks to reduce its dependence on imported fossil fuels and increase the resilience of its energy system.

3.2.5.3 National strategy for Smart Specialisation

The Smart Specialization Strategy (S3) of Cyprus (2023–2030) outlines key areas where the country holds a competitive advantage, aiming to enhance economic growth and improve citizens' quality of life through research and innovation (R&I)[125]. S3 is essential for accessing European Structural and Investment Funds (ESIF) in the R&I sector. Its priorities align with critical technological and industrial domains such as renewable energy, digital technologies, and environmental sustainability.

The strategy's objective focus on four major pillars:

1. **Technological priority areas:** Focus on advancing digital technologies, innovative materials, and emerging sectors (e.g., agriculture, environmental monitoring). These areas drive economic growth, productivity, and quality of life.
2. **Economic ecosystems:** Key sectors like agrifood, renewable energy, and maritime are targeted for innovation, enabling Cyprus to diversify and open new market niches.
3. **Emerging ecosystems:** Space technologies, although nascent, will grow by leveraging Cyprus's digital capabilities.
4. **Enablers:** Health and environmental protection are critical, supporting sustainable economic activities and fostering innovations in sectors like tourism, energy, and agriculture.

Cyprus has significant potential for renewable energy production, especially solar and wind energy, due to its favourable climatic conditions. The strategy seeks to enhance the share of renewable energy in the country's energy mix by increasing RES production capacity to meet EU targets. Key research and development priorities in RES include:

- Green hydrogen production and storage solutions.
- Small-scale wind energy systems and innovative solar heating technologies.
- Integration of photovoltaic systems (PVs) in buildings, vehicles, and urban infrastructure.

[124] "Cyprus' Long-Term Low GHG Emission Development Strategy 2022 Update.Pdf."
[125] DITS, "Ερευνα Και Καινοτομία Στην Κύπρο."

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- Smart energy management and monitoring systems for energy distribution and grid optimization.

This focus on RES is aligned with Cyprus's National Energy and Climate Plan (2021-2030), which sets ambitious goals for increasing renewable energy consumption to 24.3% and reducing energy consumption by 2030.

A significant part of Cyprus's S3 is dedicated to addressing the challenges posed by climate change. The strategy emphasizes:

- Adjustment to climate change.
- Environmental protection.
- Circular economy and green production.

The objectives of the CoVE Cyprus are well-aligned with the Smart Specialization Strategy of Cyprus (S3Cy). COVE's focus on workforce development, upskilling, and reskilling supports the strategy's goals of fostering innovation in key sectors such as offshore renewable energy.

In line with S3Cy, CoVE plays a crucial role in developing skills and knowledge in areas like **smart grids**, **digital energy management systems**, and **sustainable energy production**, which are essential for the country's transition to a more sustainable energy future. CoVE's efforts also support the broader European goals of climate neutrality and digital transformation, providing a strong foundation for Cyprus's R&I capabilities in the offshore renewable energy sector.

Through international collaborations and research partnerships, CoVE is expected to contribute to key European programmes like "Clean Energy Transition" and "Sustainable Blue Economy," further aligning Cyprus's innovation ecosystem with European Union priorities.

3.2.5.4 Indicators and targets

Figure 44 shows the renewable energy sources and their locations in Cyprus. Sun energy occupies an important place in the country's energy mix. Solar energy, in particular photovoltaics, is developing quite rapidly, including in the private sector. The country already has a certain number of large and small solar parks, which are located throughout the country, with a higher concentration in the southern and central part. One of them is the 16.8 MW photovoltaic park in Agios Ioannis Malounta, in Nicosia.

Wind Energy accounts for about 32% of renewable electricity generation. One of the largest wind farms in Cyprus is the Orites wind farm with an installed capacity of 82 MW, located in the south-west of the country near Paphos on an area of 16 km². The Orites wind farm covers about 3.5% of Cyprus' electricity needs when fully operational.

Alongside solar and wind, bioenergy is being developed, though on a smaller scale. Biomass and biogas projects are in place, especially in the agricultural sector, where organic waste is converted into energy. While bioenergy currently represents a smaller portion of Cyprus' renewable energy mix, it has potential for growth, particularly in rural areas.

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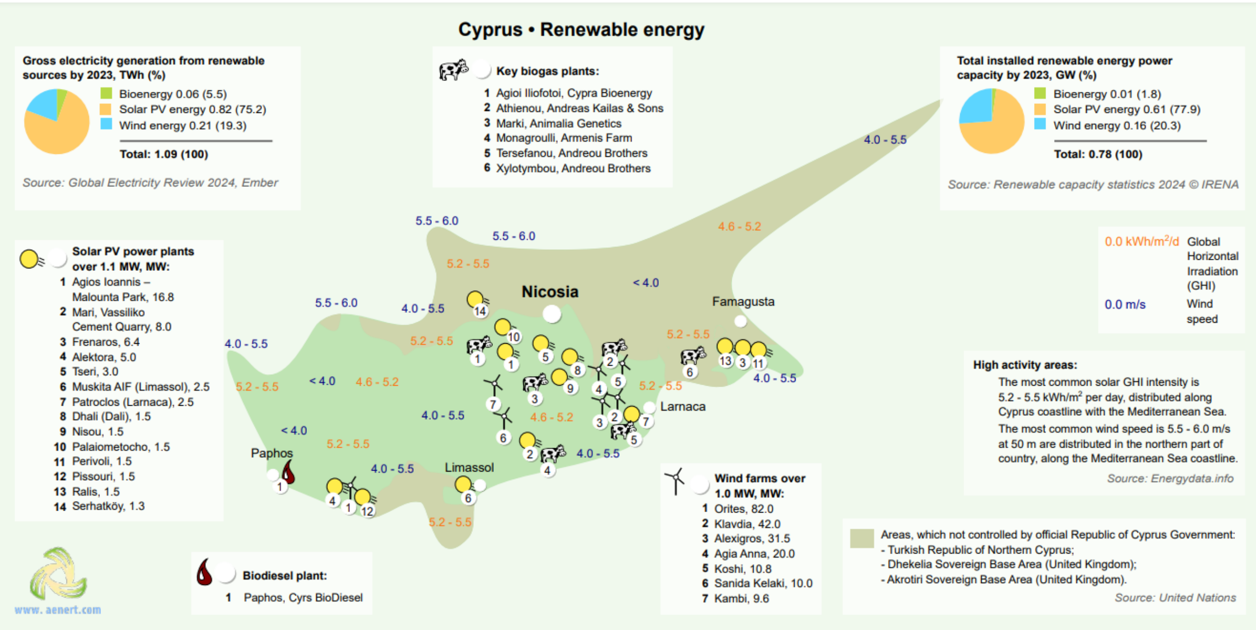

Figure 44. Renewable energy in Cyprus[126]

The statistics of Figure 45 indicate a strong upward trend in renewable energy adoption, driven primarily by solar energy, with wind energy playing a secondary but growing role. Non-renewable energy sources remain stagnant, reflecting a shift toward a more sustainable energy mix. While capacity has increased significantly, especially for solar, capacity utilisation rates suggest that improvements in efficiency or storage might be needed to maximise the benefits of renewable energy. The relatively modest increase in wind energy capacity compared to solar suggests that there may be untapped potential in wind energy, particularly offshore wind projects, which can be explored in the future.

[126] "Energy Industry in Cyprus."

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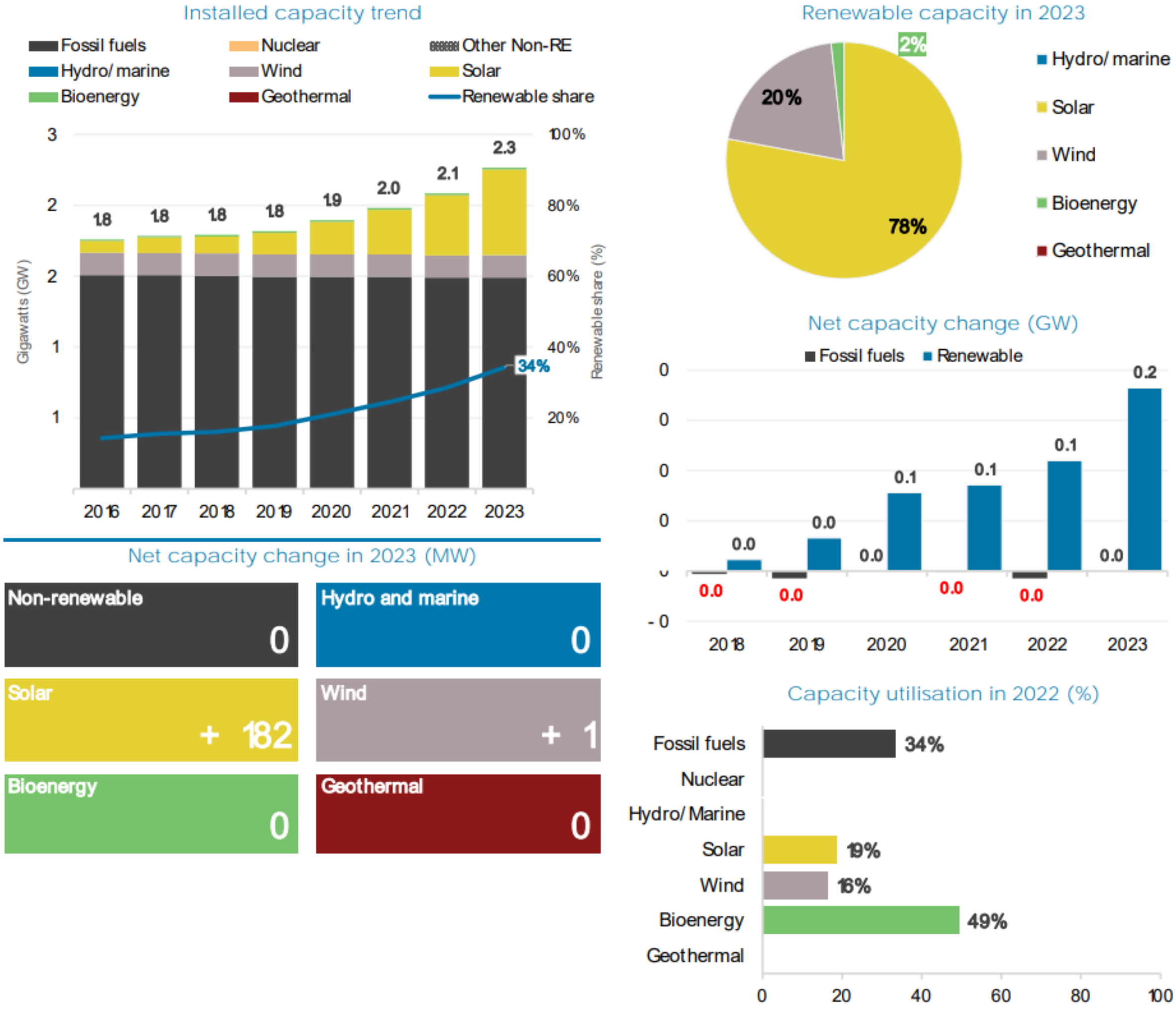

Figure 45. Infographic of electricity capacity in Cyprus (Source: IRENA)

The Republic of Cyprus, heavily reliant on imported oil for power generation, is actively pursuing a transition toward renewable energy sources (RES) to reduce energy costs, greenhouse gas emissions, and its dependence on fossil fuels. According to IRENA's Renewable Energy Roadmap for Cyprus the country aims to achieve between 25% and 40% of its electricity supply from RES by 2030[127]. The roadmap identifies several key indicators and targets for the deployment of solar photovoltaics (PV) and wind energy, including offshore wind projects. IRENA's roadmap outlines six scenarios for Cyprus' energy future, each considering different combinations of gas availability, grid interconnection, and renewable energy deployment:

- **Energy efficiency demand without interim gas solution (SC1)**: This scenario assumes no interim gas solution, resulting in a higher reliance on renewable energy. Natural gas becomes available only in

[127] "Renewable Energy Roadmap for the Republic of Cyprus."

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2023, leading to a significant acceleration in the deployment of solar PV and wind. By 2030, renewable energy is expected to provide 25.6% of the electricity supply.

- **Extra efficiency demand with interim gas solution (SC2)**: In this scenario, electricity demand is lower due to higher energy efficiency, and the interim gas solution is implemented. Gas availability limits the contribution of renewable energy, but the share of RES still reaches 28.3% by 2030, with wind energy playing a significant role.
- **Energy efficiency demand with interim gas solution (SC3)**: Similar to SC1 in terms of demand assumptions, SC3 includes the successful implementation of the interim gas solution. Although natural gas reduces the reliance on renewables, wind and solar still contribute to 25.6% of the electricity supply by 2030.
- **LNG export terminal (SC4)**: This scenario envisions the export of indigenous natural gas via a liquefied natural gas (LNG) terminal. While the reliance on gas increases, renewables still account for 26.4% of the electricity supply by 2030. Investments in storage solutions are required to balance the grid.
- **EuroAsia interconnector (SC5)**: The EuroAsia Interconnector, which links Cyprus' grid with Israel, allows for higher renewable energy penetration. This scenario predicts the highest RES share, with 40.1% of electricity coming from renewable sources by 2030, as the interconnector enables more variable renewable energy, including wind, to be integrated into the grid.
- **LNG export terminal and EuroAsia interconnector (SC6)**: Combining the LNG export terminal with the EuroAsia Interconnector, this scenario balances the benefits of gas exports and grid interconnection, leading to a renewable energy share of 33.2% by 2030.

Table 9 presents the renewable energy shares, generation outputs, and system investment requirements for each scenario in Cyprus' energy transition. These scenarios detail varying levels of renewable energy integration, with a focus on solar PV and wind energy, projecting their contributions to the overall energy mix by 2030.

Table 9. Renewable energy shares, generation cost and system investments per scenario (Source: IRENA)

	SC1	SC2	SC3	SC4	SC5	SC6
Renewable energy share in 2020	27.9%	19.5%	17.8%	17.9%	17.8%	17.9%
Renewable energy share in 2030	25.6%	28.3%	25.6%	26.4%	40.1%	33.2%
of which:						
solar PV	*15.2%*	*17.4%*	*15.2%*	*15.2%*	*26.8%*	*22.0%*
wind	*5.7%*	*5.5%*	*5.7%*	*5.1%*	*8.7%*	*6.6%*
Cumulative generation system investments 2013-2030* (billion EUR)	1.10	0.70	1.06	1.46	1.45	1.55
Average generation cost in 2013-2030 (EUR/MWh)	101.0	91.6	90.4	91.5	88.9	89.1

Table 10 provides estimates of the additional employment opportunities created through the deployment of solar PV and wind energy. The estimates highlight the potential job growth driven by increased investments in renewable infrastructure, with a particular focus on wind and solar energy sectors. These projections underscore the significant socio-economic benefits, including job creation, associated with Cyprus' shift towards a sustainable energy future.

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Table 10. Estimated additional jobs generated by wind and solar PV deployment in Cyprus (Source: IRENA)

	Installed capacity in 2030 (MW)		Estimated additional jobs	
	Wind	PV	Wind	PV
SC1	251	559	2,209	10,621
SC2	175	468	1,540	8,892
SC3	251	559	2,209	10,621
SC4	275	688	2,420	13,072
SC5	372	968	3,274	18,392
SC6	352	998	3,098	18,962

By 2030, wind energy is projected to account for 5% to 9% of Cyprus' total electricity supply, translating to an installed capacity of approximately 175 to 375 MW, depending on the scenario. Alongside solar PV, which is expected to contribute between 15% and 27% of the energy mix, wind energy will play a significant role in Cyprus' renewable energy development.

From an economic perspective, the generation cost of renewable energy is expected to fall significantly. By 2030, the overall cost of electricity from RES, including wind, is projected to range between EUR 83 and 92 per MWh, compared to EUR 130 per MWh in 2013, when power generation primarily relied on oil-fired plants. This decline in cost is driven by advancements in renewable technologies and the gradual shift toward natural gas as a transitional fuel.

To facilitate the expansion of wind energy, Cyprus needs to create market incentives that promote investment in flexible generation and reduce the reliance on oil-fired plants. Policy makers should also focus on simplifying permitting processes and removing regulatory barriers that slow down renewable energy deployment. Ensuring grid flexibility and encouraging the development of storage solutions will be essential to accommodate the variable nature of wind energy and maintain grid stability.

The timeline of Figure 46 presents a four-step strategic plan for advancing offshore renewable energy sources (RES) in Cyprus. It begins with setting national targets for offshore renewables by 2050, followed by creating a roadmap for project development. The third step focuses on aligning marine spatial planning with offshore RES, optimizing infrastructure placement. Finally, the plan establishes a dedicated committee to address offshore RES issues, ensuring informed decision-making. This timeline provided by the Ministry of Energy, Commerce and Industry (MECI) serves as a blueprint for promoting offshore wind and marine renewable energy initiatives in Cyprus.

The roadmap in Figure 47 created by the MECI outlines strategic steps essential for achieving the integration of offshore renewable energy sources (RES) into Cyprus' energy mix. These steps focus on overcoming technical, regulatory, and financial challenges while facilitating the deployment of offshore wind and other marine-based renewable technologies.

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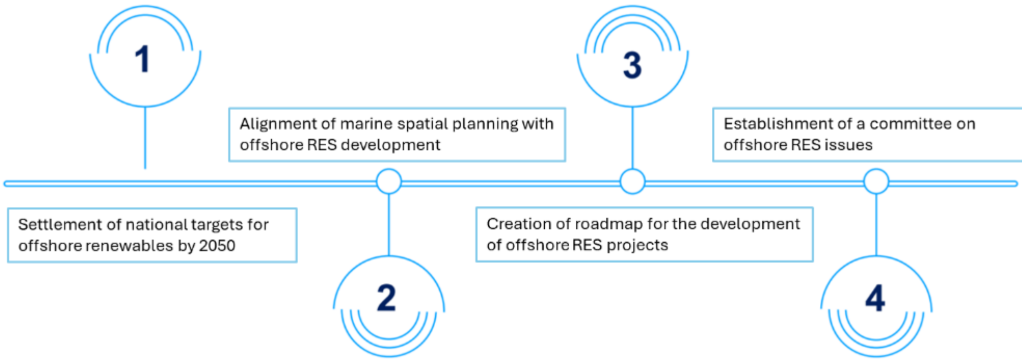

Figure 46. Strategic timeline for ORE development in Cyprus (Provided by: MECI)

Figure 47. Framework for integrating offshore RES in Cyprus (Provided by: MECI)

In summary, while there are no immediate targets specific to offshore wind energy capacity, the NECP includes general renewable energy goals. By 2030, Cyprus aims to generate 23% of its total energy from renewable sources. Offshore wind, though a relatively new consideration, is expected to play a role in helping Cyprus meet this target, particularly in the period beyond 2030, when floating wind technology is anticipated to become more mature and economically viable. This aligns with broader EU objectives under the REPowerEU plan, which calls for increased renewable energy deployment to reduce reliance on fossil fuels, especially in the wake of the energy crisis caused by geopolitical tensions.

In terms of green energy, hydrogen is also emerging as a long-term prospect. As part of the EU's push towards green hydrogen, Cyprus is exploring how surplus renewable energy—particularly from solar and wind—could be used to produce hydrogen. This includes the potential offshore utilization of green hydrogen, where offshore wind farms could generate renewable electricity to power electrolysis processes at sea, converting excess energy into hydrogen. This would provide a clean and flexible energy carrier that can be stored, exported, or integrated into the domestic energy mix. However, Cyprus is still in the early stages of exploring hydrogen's potential, including its offshore applications.

3.2.5.5 Sector value chain

In Cyprus, the principles and axes of this value chain—spanning from research and development to installation, operation, and maintenance—are similarly relevant. The island's offshore wind energy potential, still in the early stages of exploration, will necessitate the development of a value chain that aligns

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with the European models already discussed in the broader report. For Cyprus, knowledge entities such as universities, colleges, research institutes, and vocational training centres will play a crucial role in building the human capital necessary to develop and maintain future offshore wind and other marine renewable energy projects. These entities will be key in addressing the skills gap that exists in the offshore renewable sector, which is critical for Cyprus to fully harness its offshore wind potential.

While the broader supply chain for offshore renewable energy is well-established in larger European markets, Cyprus will need to adapt and develop its local manufacturing and supply chain capabilities. This includes fostering partnerships with international developers and equipment manufacturers, as well as enhancing local infrastructure such as ports to support offshore wind development. Limassol and Larnaca ports will require modernization to accommodate the specialized vessels needed for the installation and maintenance of offshore wind farms, similar to the challenges seen across other Southern European nations.

In the operation and maintenance phase, Cyprus will face similar logistical and technical challenges as with other partner countries. Offshore wind farms require highly skilled teams to manage complex marine operations, including the maintenance of turbines, subsea cables, and offshore substations. Cyprus' emerging offshore renewable energy sector will need to rely on vocational education and training (VET) to ensure that its workforce can meet these demands. Aligning these training programmes with European frameworks like ESCO will ensure that the Cypriot workforce is equipped with the necessary competencies to participate in the European offshore wind industry.

3.2.5.6 Associated job profiles

Cyprus has a small, predominantly service-based economy, with tourism, financial services and shipping being the more relevant sectors. The country has one of the highest shares of people with tertiary education in Europe.

To identify the jobs related to the Offshore Renewable Energy (ORE) sector, it is beneficial to review the current state of professions in Cyprus. The graph in Figure 48 presents a sunburst chart showing the distribution of occupations by sector.

As illustrated in the graph, the primary employment sectors are professionals, service and sales workers, trades workers, associate professionals, clerks, elementary workers, farm and related workers, managers, operators and assemblers.

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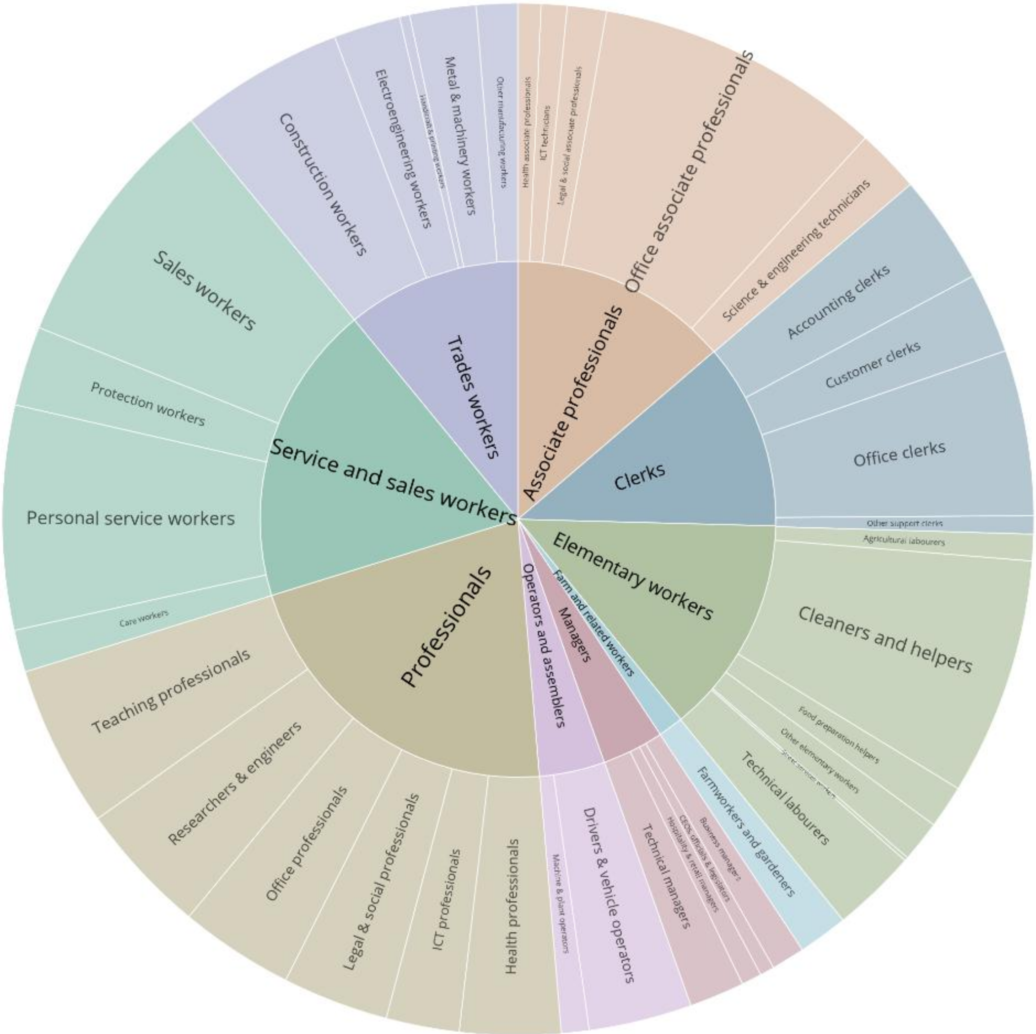

Figure 48. Employment share of occupation (%) in Cyprus in 2022

Among these broad sectors, the occupations most closely associated with the ORE sector can be classified according to the ESCO classification, as outlined in below (Table 11):

Table 11. ORE sector associated job profiles in Cyprus

ESCO Code	Job Profile
1213.2	Policy manager
1219.6	Project manager
1324.3	Logistics and distribution manager
1324.8	Supply chain manager
2141.8	Maintenance and repair engineer
2143.2	Environmental expert
2263.3	Health and safety officer

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2320.1	Vocational teacher
2412.5	Financial risk manager
2421.1	Business analyst
2432.9	Public relations officer
2511.11	Artificial intelligence engineer
2511.3	Data analyst
3113.3	Battery maintenance technician
3115.1	Mechanical engineering technician
7214.1	Dismantling worker
7223.19	Screw machine operator
7233.2	Crane technician
7412.3	Electrical mechanic
8342.2	Dredge operator
8343.4	Production plant crane operator
8343.5	Tower crane operator
1345.1.3	Education program coordinator
2141.4.1	Manufacturing engineer
2141.4.2.1	Automation engineer
2144.1.11	Mechatronics engineer
2149.2.7	Quality engineer
2149.2.8	Research engineer
2149.9.7	Renewable energy engineer
2149.9.8	Solar energy engineer
2149.9.9	Thermal engineer
2151.1.1	Electric power generation engineer
2151.1.3	Electromechanical engineer
2152.1.13	Predictive maintenance expert
2411.1.1	Accounting analyst
3112.1.4	Construction quality manager

3.2.5.7 Challenges and contributions

Cyprus' journey towards integrating offshore renewable energy (ORE) into its energy mix is both promising and complex. While the island has significant potential to harness offshore wind energy, it faces several challenges related to geography, infrastructure and market dynamics. However, with the right investment and regulatory framework, Cyprus has the opportunity to overcome these hurdles and make a meaningful contribution to its energy landscape and regional sustainability goals.

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Challenges:

- **Geographic limitations**: Cyprus's deep waters restrict the development of large-scale fixed wind farms, making floating wind technology the most viable option. This increases the complexity of offshore wind energy projects and necessitates advanced technology.
- **Port infrastructure**: The island's ports in Limassol and Larnaca require modernization to support the construction, maintenance, and transportation needs of floating wind platforms. Ports must accommodate specialised vessels, larger turbine components, and provide expanded storage and pier areas.
- **Economic constraints**: High installation costs, reliance on imported equipment, and limited domestic market size hinder investment. Additionally, slow GDP growth and budgetary deficits further complicate financing for renewable energy projects[128].
- **Regulatory and infrastructure barriers**: Cyprus's regulatory framework for offshore energy projects is underdeveloped. Licensing processes need streamlining, and improvements in energy storage and grid integration are required to fully utilise offshore energy.
- **Market dynamics**: Cyprus's traditional power plants dominate the market, making it difficult for renewables to compete on price. Upcoming changes in the electricity market may reduce renewable energy production, potentially deterring future investments[129].

Contributions:

- **Diversification of energy sources**: Developing offshore wind energy will diversify Cyprus's energy mix, reducing reliance on fossil fuels and improving energy security[130].
- **Alignment with EU goals**: Expanding offshore renewable energy aligns with EU directives to reduce greenhouse gas emissions and transition to sustainable energy, contributing to regional environmental targets.
- **Economic opportunities**: The development of offshore renewable projects can stimulate job creation in construction, operation, and maintenance of wind farms. It can also attract foreign investment and expertise in renewable technologies.
- **Potential as a regional energy hub**: Cyprus has the potential to become a renewable energy hub in the Eastern Mediterranean, facilitating electricity exports and enhancing energy resilience. A key initiative in this regard is the EuroAsia Electricity Interconnector, a 1,208 km link between Crete, Cyprus, and Israel, supported by the Cypriot Recovery and Resilience Plan. This project will not only increase energy security but also create opportunities for Cyprus to export surplus renewable energy, particularly as offshore wind and other projects come online. While the immediate goal is to meet the 2030 renewable energy targets, Cyprus is also planning for the longer term. The country has committed to achieving carbon neutrality by 2050 in line with the EU's broader objectives. This will

[128] "Cyprus Calls for Adjustments in EU State Aid to Tackle Energy Challenges."
[129] Solutions, "Cyprus' Green Energy Struggles as Market Changes Loom."
[130] "Cyprus Accelerating Green Transition amid Energy Sector Challenges, Minister Says."

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require a significant transformation of its energy system, with a continued focus on renewable energy expansion, grid modernisation, and energy efficiency measures[131].

3.2.5.8 SWOT analysis for offshore renewable energy

Economic Potential of the ORE Sector	
Strengths	**Weaknesses**
• Strategic location in the Eastern Mediterranean, offering potential to become a regional hub for offshore renewable energy. • Strong solar energy potential and suitability for floating offshore wind farms in deep waters. • REPowerEU initiative and EuroAsia Interconnector provide export opportunities for renewable energy. • Potential to attract foreign investment into the offshore renewable energy (ORE) sector. • Access to EU funding and initiatives supporting renewable energy development.	• Small domestic energy market limits the scale of potential investment compared to larger European countries. • Lack of an established offshore wind sector and the need for significant infrastructure investments in ports and grid systems. • Reliance on imported fossil fuels for electricity generation, hampering a rapid transition to renewable energy.
Opportunities	**Threats**
• EU funding mechanisms, such as the European Green Deal, provide opportunities to expand renewable energy infrastructure and attract foreign direct investment. • Potential to export renewable energy to Europe and the Middle East via the EuroAsia and EuroAfrica Interconnectors. • Opportunity to capitalise on decreasing costs of floating wind technologies for large-scale offshore wind projects.	• High costs and complexity of floating wind technology due to deep waters. • Modernisation needs in Limassol and Larnaca ports, leading to delays and increased costs. • Installation costs, import reliance, and slow GDP growth as barriers to renewable energy investment. • Regulatory framework and grid integration issues obstructing offshore renewable energy projects. • Market dominance of fossil-fuel power plants reducing renewable energy competitiveness. • Sensitivity of the Cypriot economy to global energy market fluctuations affecting investor confidence. • Policy changes and external conditions as risks to renewable energy development.

[131] “Ending Energy Isolation - Project of Common Interest ‘EuroAsia Interconnector’ - European Commission.”

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	• Competition from Mediterranean countries, such as Greece, threatening investment in Cyprus's renewable energy sector.

Environmental impact of the ORE sector	
Strengths	**Weaknesses**
• Commitment to sustainable development and reducing carbon footprint in line with EU directives. • Ambitious renewable energy goals outlined in the National Energy and Climate Plan (NECP). • Steps taken to ensure that renewable energy projects, including offshore wind, comply with environmental standards.	• Potential risks to marine ecosystems and biodiversity from offshore wind farms. • Need for thorough environmental assessments to minimise impact on marine life and coastal ecosystems. • Public concerns about visual impact and effects on marine habitats may hinder offshore wind projects.
Opportunities	**Threats**
• Establishment of Marine Protected Areas (MPAs) to preserve biodiversity and support responsible marine spatial planning. • Innovation in monitoring and mitigation techniques to protect marine ecosystems while advancing renewable energy.	• Strict environmental regulations and sensitive ecosystems limiting available areas for offshore wind development, increasing costs and delays. • Public opposition, particularly in coastal or tourist-heavy regions, potentially hindering offshore wind farm progress.

Resource Availability of the ORE sector	
Strengths	**Weaknesses**
• Potential for floating offshore wind farms due to the deep waters surrounding the island. • Strong solar energy potential already successfully exploited. • Participation in regional energy interconnectors, like the EuroAsia project, enhancing renewable energy export capabilities.	• Underdeveloped offshore wind resources and lack of infrastructure to support large-scale wind energy projects. • Floating wind technology is less mature and more expensive than traditional fixed-bottom turbines, posing financial and technical challenges.
Opportunities	**Threats**
• Decreasing costs of floating wind turbines as technology advances, increasing financial viability for Cyprus. • Regional energy collaborations offering integration into the wider Mediterranean energy market and shared knowledge.	• Legal and economic constraints potentially limiting Cyprus's ability to rapidly establish itself as a leader in offshore renewable energy.

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Social Impact of the ORE sector	
Strengths	**Weaknesses**
• Growing public awareness in Cyprus of the need to transition to renewable energy sources. • Strong government support for renewable energy initiatives driven by environmental concerns and energy independence. • Expected job creation in engineering, construction, and operations and maintenance (O&M) from offshore wind projects.	• Potential opposition from communities concerned about the visual impact of turbines and interference with fishing or tourism. • Resistance from coastal communities perceiving offshore wind developments as disruptive to their livelihoods.
Opportunities	**Threats**
• Potential for offshore wind projects to boost local economies through new employment opportunities and foreign investment. • Development of vocational training programmes to upskill workers for jobs in the offshore wind sector, addressing the skills gap.	• Significant public resistance to offshore wind farms located near popular coastal areas, which could hinder project progress. • Risks of delays or cancellations of projects due to inadequate community engagement and planning.

Technology Potential (TP) of the ORE sector	
Strengths	**Weaknesses**
• High costs associated with offshore wind technologies in deep waters could slow development in Cyprus. • Rapid growth of more mature renewable technologies, such as solar PV, risks overshadowing investments in emerging sectors like offshore wind.	• Developing technological maturity of floating wind farms, with high initial costs acting as a barrier to widespread adoption. • Lack of infrastructure to support the construction and maintenance of offshore wind farms presents significant challenges.
Opportunities	**Threats**
• Advances in floating wind technology and decreasing costs of renewable energy infrastructure create opportunities to capitalize on offshore wind resources. • EU funding for green energy projects could facilitate the development of new technologies and infrastructure.	• High costs associated with offshore wind technologies in deep waters could slow development in Cyprus. • Rapid growth of more mature renewable technologies, such as solar PV, risks overshadowing investments in emerging sectors like offshore wind.

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3.3 Current Status of VET in Southern Europe

3.3.1 Portugal

3.3.1.1 VET system, policies and priorities

The education and training system in Portugal comprises:

- optional preschool education, covering children from three to six years old,
- basic education (nine years), integrating three cycles (EQF levels 1 and 2),
- secondary education (EQF levels 3 and 4),
- post-secondary non-tertiary education (EQF level 5),
- tertiary (higher) education (EQF levels 6, 7 and 8).

Compulsory education lasts for 12 school years and begins at the age of six. It consists of basic and secondary education. Basic education lasts nine years until age 15, including VET programmes. It is divided into three cycles: the first cycle is four years long, the second cycle is two years long, and both are considered primary education. The third cycle is three years long and corresponds to lower secondary education.

Secondary education[132] includes general and VET programmes from the 10th to the 12th year. Graduates of these three-year programmes can pursue tertiary and post-secondary non-tertiary education, as shown in Figure 49.

In Portugal there are horizontal and vertical permeability, which is essential to the education and training system, ensuring connections among different VET programmes and between general and vocational education[133].

The current Vocational Education and Training (VET) system in Portugal was reformed in 2007, creating a single system known as SNQ[134] (National System of Qualifications). The SNQ, established by Decree-Law no. 396/2007[135] and later amended by Decree-Law no. 14/2017[136], is a comprehensive framework of VET structures, instruments, and modalities aligned with the European Qualifications Framework (EQF). Its main objectives include better alignment of VET qualifications with labour market needs, promotion of enterprise competitiveness, and the recognition, validation, and certification of competencies.

The Government is at the apex of VET governance. The education ministry is responsible for pre-primary, primary, and secondary education and school-based training. The VET system in Portugal (IEFP[137] in

[132] Secondary education corresponds to what internationally is referred to as "upper secondary education".
[133] "VET in Europe Database | Vocational Education and Training in Europe | Portugal."
[134] "National Qualifications Framework."
[135] "Decreto-Lei n.º 396/2007 | DR."
[136] "Decreto-Lei n.º 14/2017 | DR."
[137] Institute for Employment and Vocational Training; www.iefp.pt

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Portuguese, in Figure 50) is supervised by the labour ministry, which implements active labour market policies, carries out apprenticeship programmes, and continuing VET (CVET).

The education and labour ministries jointly supervise ANQEP, the National Agency for Qualification and Vocational Education and Training[138]. It is a public institute integrated in the indirect administration of the State, with administrative, financial and pedagogical autonomy.

IEFP and ANQEP share the responsibility for carrying out VET policies. At the regional and local levels, policies are implemented by regional authorities for VET, supervising regional and local structures: adult qualification centres, basic and secondary education institutions, and vocational and professional training centres.

[138] "ANQEP - ANQEP."

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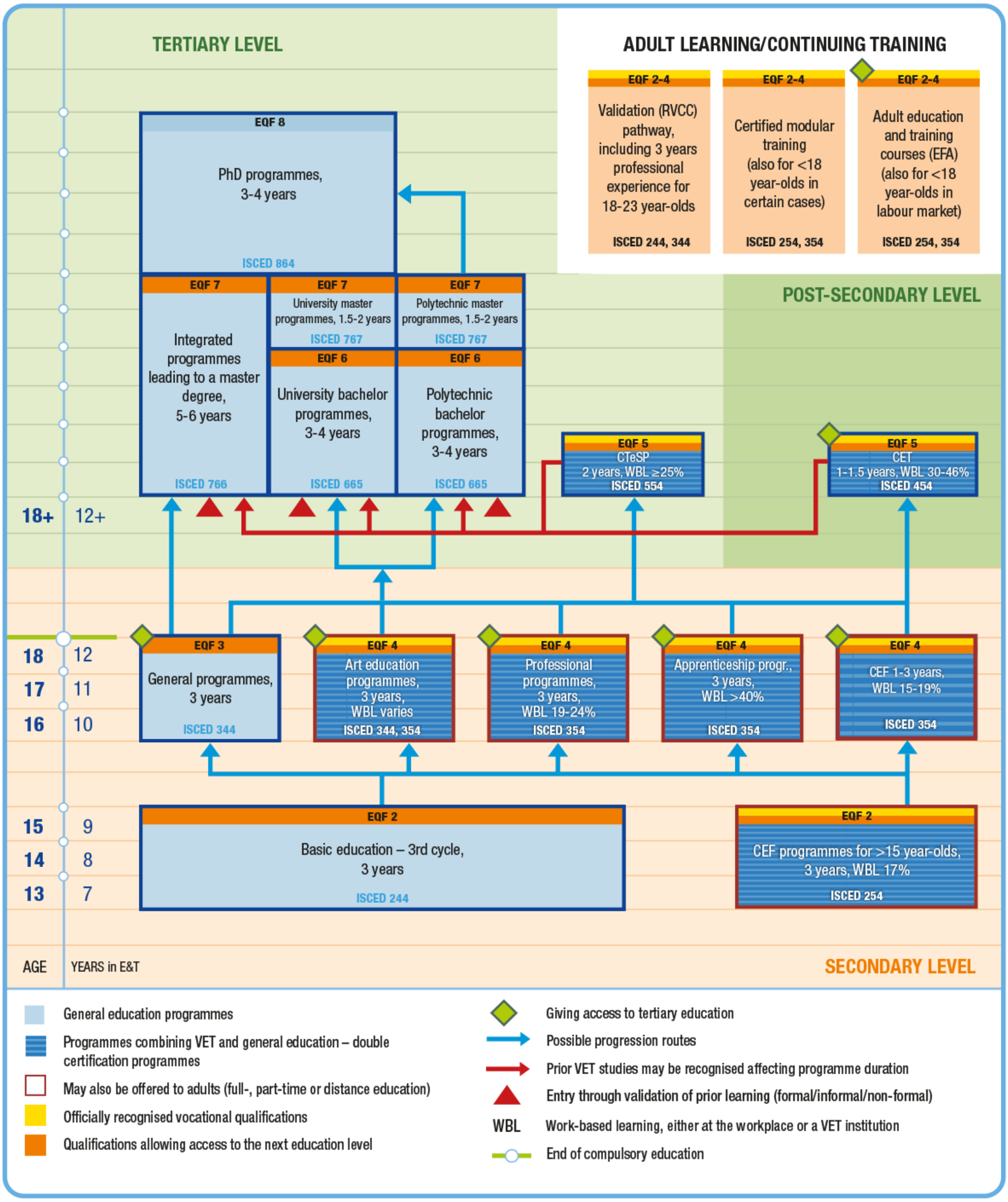

NB: ISCED-P 2011.
Source: Cedefop and ReferNet Portugal, 2019.

Figure 49. VET in Portugal's education and training system (Source: CEDEFOP)

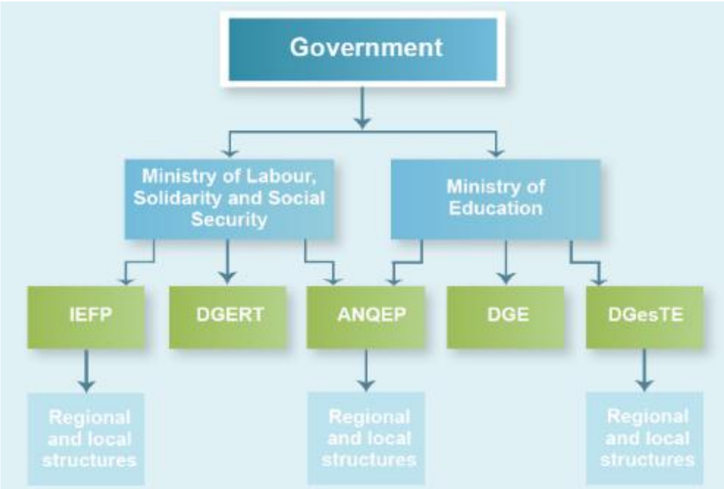

Figure 50. Portuguese VET governance structure

ANQEP is responsible for the specific tools set by the SNQ:

- The QNQ[139] (National Qualifications Framework-NQF) which is referenced to the EQF, includes eight levels of qualification and level descriptors indicating the specific learning outcomes at each qualification level.
- The CNQ (National Qualifications Catalogue[140]) which is a tool linked to QNQ, aiming to manage and regulate non-higher VET programmes leading EQF level 2, 4, and 5 qualifications.
- The national credit system for VET which allocates credits to VET qualifications in the CNQ.
- The Qualifica passport is an online instrument recording qualifications and competencies acquired throughout life. It also offers a guidance service suggesting the most suitable learning path to users based on their background. Individuals' qualifications are also visible to employers[141].

Key challenges and policy responses currently on the high-priority agenda include[142]:

- Increasing participation in lifelong learning.
- Modernizing vocational education and training (VET) provision by introducing new teaching methods and diversified VET programmes.
- Strengthening the alignment of VET with labour market needs.
- Upskilling and reskilling vulnerable groups.

139 "National Qualifications Framework."
140 "Catálogo Nacional de Qualificações."
141 "DGERT – Direção-Geral do Emprego e das Relações de Trabalho."
142 "Spotlight on VET Portugal."

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Although early departure from education and training has been significantly reduced, avoiding it still remains a priority. Additionally, vocational education and training should adapt to the significant changes of digitalization and the shift towards a more environmentally friendly economy and society.

Through the Recovery and Resilience Plan the Government has not only identified areas that future policy interventions will focus on but has also demonstrated its unwavering commitment to the modernization of VET[143]. This plan establishes clear objectives for the education and training system, providing a roadmap for the future.

The plan also aims to expand the network of adult education and training providers in collaboration with qualified centres to attract more adult learners to VET programmes.

In the current economic context, where the socioeconomic effects of the pandemic crisis are significant, VET should be a crucial tool in enhancing employability, promoting social inclusion, and fostering economic development.

This involves increasing participation in lifelong learning, modernizing VET provision by introducing new teaching methods and diversified VET programmes, aligning VET with labour market needs, and upskilling and reskilling vulnerable groups.

The key references regarding the status of VET in Portugal are summarised in Table 12.

Table 12. Status of VET reference in Portugal

Website	Organisation name
www.refernet.pt	ReferNet Portugal
www.dgert.gov.pt	Directorate-General for Employment and Industrial Relations
www.dge.mec.pt	Directorate-General for Education
www.dges.gov.pt	Directorate-General for Higher Education
www.portugal.gov.pt	Government web portal
www.anqep.gov.pt	National Agency for Qualification and Vocational Education and Training
www.iefp.pt	Institute for Employment and Vocational Training
www.catalogo.anqep.gov.pt	National catalogue of qualifications
www.qualifica.gov.pt/	Qualifica programme
www.garantiajovem.pt	Youth guarantee
www.ine.pt	National Institute for Statistics

[143] "Portugal's Recovery and Resilience Plan - European Commission."

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3.3.1.2 Inclusion and attractiveness in VET

SNQ's main objective is to provide education and training to promote equal opportunities and support the integration of vulnerable groups. As a result, all government-regulated VET programmes are accessible to them. Additionally, specific initiatives aim to enable vulnerable groups to access lifelong learning and other education and training opportunities. These initiatives include:

a) Portuguese language courses
b) basic competencies courses
c) special measures for those with disabilities

The Portuguese courses (a) for non-native speakers (PLA) are designed to meet the learning needs of migrant citizens, facilitate their social integration, and assist them in finding employment[144]. These courses are offered by public schools, VET centres, and Qualifica centres in collaboration with the High Commission for Migration and are aimed at migrants who are 18 years old or above.

Basic competencies courses (b) target adults with low-level qualifications, providing literacy, numeracy, and information and communication technology training[145]. They typically last between 150 and 300 hours[146].

Initial and continuing VET courses[147] are created to help people with disabilities (c) gain qualifications that will assist them in finding employment, maintaining their current jobs, and advancing in their careers[148]. These courses are tailored to meet the needs of these learners and are aligned with competency standards and VET expertise.

Inclusive vocational education and training and equal opportunities are essential elements of the Portuguese education and training system. The system aims to remove barriers to participation for learners from vulnerable groups or disadvantaged socioeconomic backgrounds. Since 2010, the country has significantly progressed in combating early dropout rates from education and training. Financial support is available for learners through allowances, grants, and scholarships, targeting inactive or unemployed learners. The operational program for human capital and the operational program for social inclusion and employment include financial support for VET learners, which they receive through VET providers.

3.3.1.3 Assets from the CoVE Portugal

Portugal has made significant strides in its vocational education and training system. It has a strong network of VET centres and emphasises aligning training with market demands. There are general and VET programmes in the upper secondary level of education (years 10 to 12). VET graduates have a special quota

[144] "Portaria n.º 782/2009 | DR."
[145] "Portaria n.º 216-C/2012 | DR."
[146] "DGERT – Direção-Geral do Emprego e das Relações de Trabalho."
[147] "Decreto-Lei n.º 108/2015 | DR."
[148] "Qualificação de pessoas com deficiência e incapacidade - IEFP, I.P."

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for accessing higher education institutions. Additionally, polytechnic institutions offer short-cycle programmes known as higher professional technical programmes (CTeSP), through which graduates obtain a diploma of a higher professional technician, although not a higher education degree[149].

All VET programmes lead to double certification (education and professional certification).

There are also inclusive programmes for adult education and training, designed to support learners who want to complete lower or upper secondary education and/or obtain a professional qualification. With around 300 centres supervised by ANQEP, these programmes are a testament to Portugal's commitment to lifelong learning and career development.

Portugal's VET system focuses on practical experience and theoretical knowledge. Many programmes offer apprenticeships or internships, which allow students to gain hands-on experience, make professional connections, and tackle real-world tasks. This learning approach is not only practical but also engaging for students.

Portugal's VETs are known for their robust infrastructure, close industry connections, and commitment to providing high-quality education that supports individual career development and broader economic goals.

CoVE Portugal can strategically leverage its VET system's experience, know-how, best practices, and resources to develop the SHOREWINNER CoP. The VET system's previous assets ensure that the SHOREWINNER training programmes are not only high-quality and relevant but also adaptive and responsive to the needs of all trainers and trainees.

3.3.1.4 Mapping of VET offerings

In Portugal, we can find several double certification paths (awarding a school and a professional certification) aimed at young people. These pathways enable them to complete basic education (9th year of schooling) and upper-secondary education (12th year) through a more practical learning experience associated with a profession and enable them to continue learning or integrate the labour market. These include Professional Courses (PC) for young people, Technological Specialisation Courses (TSC), and other Specific Curricula Courses (SCC). They can be classified from level 2 to level 5 according to NQF levels information shown in Table 13.

Table 13. NQF in Portugal

Qualification Levels	Qualification
Level 1	2nd cycle of primary education
Level 2	3rd cycle of primary education obtained in primary education or via a dual certification

[149] "Cursos Técnicos Superiores Profissionais (CTeSP) | DGES."

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Level 3	Upper-secondary education geared towards further studies in higher education
Level 4	Upper-secondary education obtained via dual certification or upper-secondary education geared towards further studies in higher education with vocational internship – minimum 6 months
Level 5	Non-higher, post-secondary qualification with credits to continue to higher education-level studies
Level 6	Licentiate Degree (Licenciatura)
Level 7	Master's Degree
Level 8	Doctorate

Offshore wind industry training opportunities are still in the early stages and are developing alongside the sector. The PC and TSC (CET in Portuguese) courses offer training programmes at levels 4 and 5 designed to help professionals gain qualifications in the marine economy, energy, and environmental sectors, as examples in the list, for level 4:

- Photovoltaic solar system installer technician
- Wind turbine installation technician
- Thermal renewable energy systems installer technician
- Aquaculture technician
- Environmental management technician

And for level 5:

- Specialist in Energy Management and Control

At level 5, Higher Professional Technical Courses (CTeSP in Portuguese) are overseen by the Directorate General for Higher Education (DGES). EPATV, our Portuguese partner, is a key member of the Sectoral Council for Qualifications in the Energy and Environment field, bringing their expertise to the forefront.

There are currently 11 CTeSP courses in Renewable Energies across 10 institutions and organic units. Public institutions offer 8 of these courses, and private ones provide 2.

Although there is currently minimal demand for training in offshore renewable energy, there is a tendency for growth. If the SHOREWINNER project evolves to support it, a new CTeSP specific to offshore energy could be established.

The Specific Curricula Courses (SCC) are designed by each school based on the requirements and expectations of the respective integration community. The aim is to contribute to territorial development and cohesion. Each educational establishment publishes SCCs containing the course frameworks and defining their organisation and functioning regime.

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Some courses offer specific certifications not included in the National Qualifications Framework. Specialised VET providers customise them based on specific labour needs. They are related to wind energies and are short-duration courses, as seen in Table 14.

Table 14. Specific certification training available in Portugal

Course	Description	Hours
Rescue at heights	Rescue at Heights training enables the acquisition of the necessary rescue knowledge and skills from professionals responsible for emergency interventions when working at heights.	8h
Working at heights	Working at Heights training enables you to acquire the knowledge and safety skills required for accident-free performance at work at heights.	8h
Power Climber Wind	The Power Climber Wind – Service Lift Operation training is intended to enable the professional operator of this equipment with all methods of use and safety.	4h
Advanced Blade Repair	The Advanced Blade Repair training aims to develop the advanced technical knowledge and skills required to perform complex and structural rotor blade repairs.	80h
Tower Repair	WTG Tower Repair training aims to develop knowledge and skills that enable preventive and corrective maintenance to be performed on the corrosion protection of metal structures in wind turbines.	24h
Blade Inspection and Repair	WTG Blade Inspection and Repair training aims to develop the knowledge and skills that enable the inspection and repair of minor laminate and cosmetic damages on rotor blades.	40h
IRATA Level 1	IRATA – Industrial Rope Access Trade Association introduces the most internationally recognized rope access certification program. This association represents over 70% of the rope access technicians worldwide. IRATA level 1 training enables the development of knowledge and skills that allows the safe execution of rope access and positioning works under the supervision of a level 3 technician.	40h
IRATA Level 2	IRATA – Industrial Rope Access Trade Association introduces the most internationally recognized rope access certification program. This association represents over 70% of the rope access technicians worldwide. IRATA level 2 training allows the development of skills to perform, in maximum safety, complex works of access, positioning and rescue by ropes, under the supervision of a level 3 technician.	40h
IRATA Level 3	IRATA – Industrial Rope Access Trade Association introduces the most internationally recognized rope access certification program. This association represents over 70% of the rope access technicians worldwide.	40h

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	IRATA level 3 training enables the development of the skills of highly experienced rope access technicians and supervisors which will be capable of planning, executing and supervising rope access teams and operations.	
ACCESUS	Accesus training enables the development of technical skills in the installation and operation of Modublade II suspended platforms designed for the transport of persons, in compliance with general rules of use and specific safety standards.	8h
ACTSAFE – End User	ActSafe Training – End User is mandatory for all who operate and/or work with ActSafe powered ascenders, ensuring safety from basic use to rescue.	4h
Power Climb Wind	The Power Climber Wind – Service Lift Operation training is intended to enable the professional operator of this equipment with all methods of use and safety.	4h
SQYFlex TG Blade Access Platform Operator (Category 3)	To equip participants with the knowledge and skills to install and operate the SQYFlex TG Blade Access suspended platform safely and within the manufacturer's recommendations and guidelines.	16h

3.3.1.4.1 Training under GWO requirements and standards

The Global Wind Organization (GWO) is a non-profit industry association with members who are dedicated to promoting safety in the workplace. It sets common international standards for safety training and workforce development, ensuring a safe work environment for all.

GWO training standards describe the requirements for training courses recommended by GWO members. By complying with GWO standards and criteria, certified training providers are considered competent and proficient.

The following courses list compile several courses certified by the Global Wind Organization (GWO) that are available in the catalogue of Portuguese VET centres.

Basic Safety Training – BST

- Working at Heights
- First Aid
- Fire Awareness
- Manual Handling
- Sea Survival

Enhanced First Aid – EFA

- Enhanced First Aid

Advanced Rescue Training - ART

- Hub, Spinner and Inside Blade Rescue

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- Nacelle, Tower and Basement Rescue
- Single Rescuer: Hub, Spinner and Inside Blade Rescue
- Single Rescuer: Nacelle, Tower and Basement Rescue
- Advanced Rescue Training Standard

Crane and Hoist – CH

- Crane and Hoist Basic User
- Crane and Hoist Inspection and Maintenance
- Crane and Hoist Standard

Basic Technical Training – BTT

- Basic Technical Training – Mechanical
- Basic Technical Training – Electrical
- Basic Technical Training – Hydraulics
- Bolt Tightening

Blade Repair – BR

- Blade Repair – BR
- Slinger Signaller/Rigger Signal Person

Lift User – LU

- Lift User

Control of Hazardous Energies Standard

- Pressure Fluid Safety
- Electrical Safety for Qualified Person

Wind Limited Access Standard

- Wind Limited Access Standard Onshore
- Wind Limited Access Standard Offshore

Some of those modules can be combined to form a course or taken separately. Basic Safety Training (BST), for instance, comprises five training modules with a total training duration of 40 hours. In Portugal, 11 GWO-certified companies can offer those courses.

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3.3.2 Spain

3.3.2.1 VET system, policies and priorities

The Spanish VET system is governed by Organic Law 3/2022[150], which organizes VET offerings into modular training pathways, ranging from micro-trainings to full qualifications to enable flexibility and lifelong learning (LLL). The system is a shared responsibility among national, regional and municipal authorities. Work-based learning is a key feature, offered through DUAL VET or traditional school-based programmes including internships. The structure is shown in Figure 51:

[150] Jefatura del Estado, Ley Orgánica 3/2022, de 31 de marzo, de ordenación e integración de la Formación Profesional.

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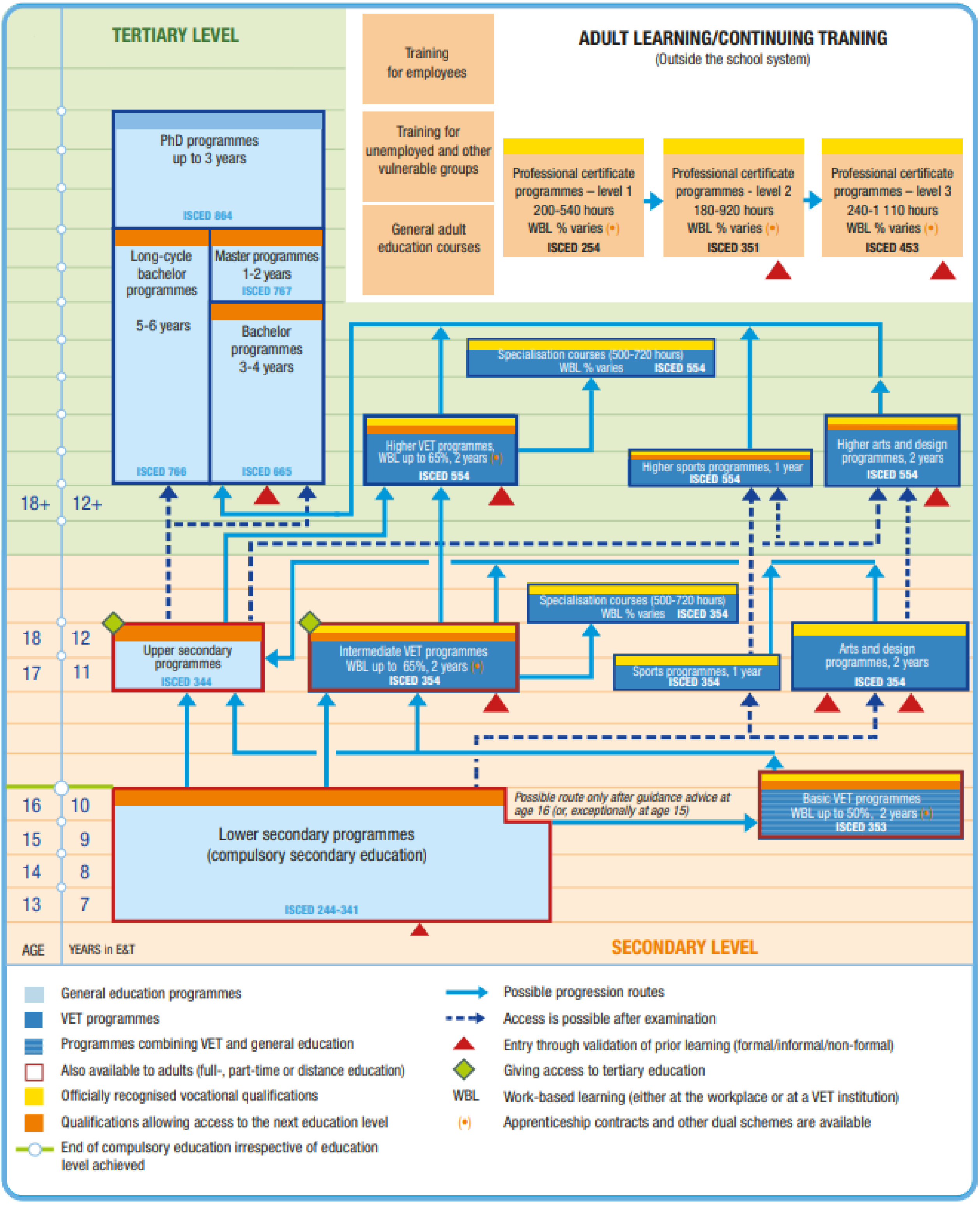

Figure 51. Vocational education and training system in Spain (Source: CEDEFOP)

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The Organic Law 3/2022 on the organisation and integration of Vocational Training aims to transform Spain's vocational training system to address the evolving demands of citizens and the productive sectors throughout their working lives. In response to rapid technological and economic changes, the system aims to enhance human capital through permanent skill development and adaptability, ensuring alignment with labour market needs.

In recent years, the regulatory framework has undergone significant updates to improve the quality of the VET educational system and to align with the standards and objectives set by the European Union. This process has led to the emergence of various new regulations aimed at establishing a legal and institutional framework tailored to the evolving demands of contemporary society and the economy. Their reform seeks to enhance flexibility, promote innovation and ensure the relevance of policies in addressing current and future challenges.

The Royal Decree 659/2023[151] outlines a modern and flexible framework to facilitate continuous qualification and requalification for both youth and the workforce, including employed and unemployed individuals. It emphasises aligning training offerings with labour demand while promoting innovation, entrepreneurship, and sustainability. The decree integrates key transitions such as digitalisation and ecological sustainability across all economic sectors, fostering transversal employability skills alongside technical competencies to produce a well-rounded, high-quality workforce.

This framework also addresses structural challenges like unemployment, early school leaving, skill mismatches, and the lack of formal recognition for work-acquired skills. It prioritises equitable access to training, particularly in rural areas, declining demographic zones, and dense urban regions.

The decree calls for cooperative governance among national and regional administrations to ensure comprehensive training offerings across all levels. It aims to support citizens throughout their educational and professional journeys by promoting lifelong learning pathways, enhancing professional guidance services, and certifying skills gained through diverse experiences. Ultimately, the initiative seeks to modernise vocational training as a tool for economic growth, social equity, and sustainable development, while fostering a culture of continuous learning.

In May 2024, four Royal Decrees were enacted to complete the regulatory framework for the Vocational Training Law of 2022. These decrees finalise the transition to a dual training system for Intermediate and Advanced Vocational Training. Additionally, they introduce modules on topics such as digitalisation, sustainability, entrepreneurship, and technical English. The decrees are structured as follows:

[151] Ministerio de Educación y Formación Profesional, Real Decreto 659/2023, de 18 de julio, por el que se desarrolla la ordenación del Sistema de Formación Profesional.

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- Royal Decree 498/2024[152]: Basic Vocational Training
- Royal Decree 499/2024[153]: Intermediate Vocational Training
- Royal Decree 500/2024[154]: Advanced Vocational Training
- Royal Decree 497/2024[155]: Specialization Courses

Starting September 2024, dual training will become mandatory in the first year of Intermediate and Advanced Vocational Education and in vocational master's programmes that include internships. This dual system integrates learning at both educational institutions and workplaces from the start, phasing out the workplace-specific vocational training module by 2025/26, which previously took place during the second year.

The updated system features two modes of dual training: general and intensive, distinguished by the duration of workplace learning and the expected outcomes. Since early 2024, students have been required to contribute to the Social Security system during their internships, with no financial impact on participating companies.

New modules addressing contemporary economic needs will be introduced in the 2024/25 school year, including Digitalization Applied to Production Systems, Sustainability for Production Systems, Technical English, and Personal Development for Employability I and II. The system also, for the first time, offers elective subjects and incorporates the Intermodule Project, a challenge-based activity designed to simulate real-world scenarios in the relevant production sectors.

Finally, regarding to data, the 2024-2025 academic year marks a significant milestone for Vocational Education and Training (VET) in Spain, with a record enrolment of 1,193,260 students—a 4.2% increase compared to the previous year. This growth underscores the Ministry of Education, Vocational Training, and Sports[156] commitment to modernising and expanding the VET system to align with current labour market

[152] Ministerio de Educación, Formación Profesional y Deportes, Real Decreto 498/2024, de 21 de mayo, por el que se modifican determinados reales decretos por los que se establecen títulos de Formación Profesional de grado básico y se fijan sus enseñanzas mínimas.
[153] Ministerio de Educación, Formación Profesional y Deportes, Real Decreto 499/2024, de 21 de mayo, por el que se modifican determinados reales decretos por los que se establecen títulos de Formación Profesional de grado medio y se fijan sus enseñanzas mínimas.
[154] Ministerio de Educación, Formación Profesional y Deportes, Real Decreto 500/2024, de 21 de mayo, por el que se modifican determinados reales decretos por los que se establecen títulos de Formación Profesional de grado superior y se fijan sus enseñanzas mínimas.
[155] Ministerio de Educación, Formación Profesional y Deportes, Real Decreto 497/2024, de 21 de mayo, por el que se modifican determinados reales decretos por los que se establecen, en el ámbito de la Formación Profesional, cursos de especialización de grado medio y superior y se fijan sus enseñanzas mínimas.
[156] "Bienvenido a la Web del Ministerio de Educación, Formación Profesional y Deportes."

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demands. All this data is collected and published by the Ministry of Education, Vocational Training and Sports in the report “Facts and figures 2024/2025 School Year”[157].

Of the total enrolment, 471,735 students are pursuing Intermediate VET programmes, while 631,717 are enrolled in Advanced VET programmes, highlighting the growing appeal of these educational pathways at all levels. Additionally, Specialisation Courses, which enable graduates to gain in-depth expertise in specific areas, have seen a remarkable 19.7% increase, reaching 7,333 enrolled students.

This expansion goes beyond student numbers, with investments in new training places and the establishment of Advanced Technology Classrooms (ATECA). These facilities, equipped with cutting-edge technology, aim to enhance practical learning and prepare students to meet the challenges of digitalisation and sustainability.

The development of VET aligns with the rising demand for specialised professionals in sectors such as technology, tourism, healthcare, and renewable energy. Key measures, including the creation of additional training places and the introduction of bilingual programmes, are playing a critical role in equipping future graduates with competitive skills for an evolving workforce.

3.3.2.2 Inclusion and attractiveness in VET

Efforts to improve the attractiveness of VET in Spain target challenges such as low prestige, regional disparities, and a mismatch between labour market needs and workforce qualifications. Some initiatives are centered on the future development of bilingual VET programmes to enhance international competitiveness.

Concerning inclusion, in the different national Spanish reforms in VET and adult learning described above, was addressed through the establishment of a Digital Training Centres/Classes Network. This initiative seeks to provide accessible and appealing digital training opportunities, particularly targeting vulnerable populations. The network aims to equip citizens with essential digital skills to navigate an increasingly digitalised society, addressing inequalities caused by age, education level, or socio-economic vulnerability, which often result in significant disadvantages in daily life.

The programmes prioritize individuals over 55 with low qualifications, with particular attention to addressing the pronounced gender gap within this demographic. Training will also be available to other groups outside the formal education system, promoting the acquisition of basic digital skills to enhance quality of life. The centres will offer training regardless of residence or prior education, ensuring widespread access while accommodating personal, work, and social obligations.

[157] “Datos y cifras.”

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Key objectives include empowering citizens to perform online transactions securely (e.g., banking, healthcare appointments, or public administration requests), recognise phishing threats, and engage in digital communication. These foundational skills will not only improve daily functionality but also open pathways to advanced learning opportunities for those who wish to continue their digital education. Through its focus on vulnerable groups, this initiative directly supports gender equity by allocating funds based on the proportion of low-qualified individuals.

3.3.2.3 Assets from the CoVE Spain

The Spanish COVE assembles a set of partners that have been collaborating in the development of skills intelligence activities addressing the Maritime Technologies since 2018, in the framework of the MATES blueprint project[158]. MATES undertook a collaborative approach to develop a skills strategy for maritime technologies, in particular the shipbuilding and the offshore renewable energies. Among its main outcomes, the project contributed to agree a vision document on skills in offshore energy[159], linked to 29 lines of action[160], setting the basis to the creation of the ORESkills large scale partnership in the pact for skills[161]. At present, the ORESkills partnership is building on the FLORES project to increase the number of organisations willing to contribute to the upskilling and reskilling processes in the ORE. All the partners of the Spanish COVE are either participating in this partnership, or in the process of joining it.

3.3.2.3.1 UDC

The University of A Coruña (UDC), through its Campus Industrial de Ferrol (CIF), has established itself as a key player in promoting research, education, and innovation in renewable energy, with a particular emphasis on offshore renewable technologies and their industrial applications. UDC demonstrates a strong commitment to advancing smart industry and human-centered advanced manufacturing, aligning its efforts with regional strategic industrial sectors, including shipbuilding and marine energy.

UDC actively participates in European initiatives such as the MATES and FLORES projects, which focus on the development of skills and training aligned with the demands of the maritime and offshore renewable energy sectors.

The MATES project, supported by the EU, aimed to identify skill gaps and propose strategies for equipping the workforce with competencies in areas like offshore wind and marine energy. UDC contributed its expertise by mapping training needs and developing educational frameworks to ensure alignment with industry requirements.

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[158] "Maritime Alliance for Fostering the European Blue Economy through a Marine Technology Skilling Strategy."
[159] European Centre for the Development of Vocational Training., *EU Jobs at Highest Risk of Covid-19 Social Distancing*.
[160] "P4S_ORE_ActionLines_v6.Pdf."
[161] "Renewables."

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Similarly, the FLORES project focused on fostering skills specific to offshore renewable energy, creating training pathways and frameworks to enhance the employability of students and professionals in this emerging sector[162]. UDC's involvement in these projects underscores its experience in integrating Vocational Education and Training (VET) with cutting-edge research and industry practices in offshore renewable energies.

To support these efforts, UDC benefits from the contributions of key research centres such as the CITENI (Centre for Technological Innovation in Industrial Engineering) and the Grupo Integrado de Ingeniería (GII). CITENI focuses on advancing innovation in industrial and naval engineering, playing a vital role in the development of technologies applicable to renewable energy sectors, including offshore energy systems. Meanwhile, the GII specialises in energy efficiency, optimisation of engineering processes, and Industry 4.0 applications, providing cutting-edge research and fostering innovation in collaboration with industrial partners. Both entities enhance UDC's capacity to offer research-driven and industry-relevant education tailored to the demands of renewable energy.

In terms of academic offerings, UDC provides specialised degree programmes tailored to the needs of the offshore renewable energy sector. These include initiatives like the Sustainable Ship and Shipping 4.0 Erasmus Mundus Joint Master's Degree and MOOCs on Industry 4.0, integrating research and industry-relevant internships to prepare students with advanced technical and practical skills. Collaboration with partners such as Navantia enhances UDC's ability to deliver training aligned with Industry 4.0 innovations, particularly in smart manufacturing and renewable energy systems.

Thanks to its participation in these significant European projects and its strong ties with industry, UDC has developed substantial expertise in VET for the offshore renewable energy sector. The university fosters innovation and workforce development through partnerships with regional and international stakeholders, creating opportunities for students and researchers to engage with cutting-edge technologies and practices in the renewable energy domain. This approach reflects UDC's commitment to addressing current and future challenges in the energy sector while supporting the economic and technological growth of the region.

3.3.2.3.2 CETMAR

CETMAR is a public foundation aimed at promoting the competitiveness of marine sectors by acting as an interim organisation between research, education and training organisations, administrations and industry. Since 2018, CETMAR has been promoting skills intelligence activities addressing the offshore renewable energies value chain. This activity started with the coordination of the MATES Erasmus+ blueprint project, to develop a Skills Strategy for the Offshore Renewable Energy and Shipbuilding industries. Skill gaps have been identified in present and future scenarios, in particular related to digital and data skills, green skills and transversal skills for innovation management. Training materials are being tested to bridge the gaps, and the

[162] "Flores."

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ESCO descriptors for the skills and occupations in the maritime technologies have been updated. MATES contributed to make more visible the career opportunities in the maritime technology industry, highlighting the commitment of the maritime industry to the environment, through innovation and the integration of new technologies. One of the outcomes of this project has been the promotion of an Offshore Renewable Energies (ORE) large scale partnership in the Pact for Skills (ORE Skills). CETMAR is acting as secretariat in this consortium which assembles the most relevant stakeholders for this industrial ecosystem - and leading the working group to build durable skills partnerships in the ORE. To support the activity of this group, most of the ORE Skills partners joined into the FLORES project, also coordinated by CETMAR. This Erasmus+ Forward Looking project is developing tools and activities to strengthen skills in the sector. Namely, it focuses on expanding specialised training opportunities, promoting careers paths within the industry and establishing a Skills Observatory. The ultimate goal is to foster sustainable partnerships within the Pact for Skills, ensuring the long-term success of this initiative.

3.3.2.3.3 CCEFPU

CCEFPU is the department of the Xunta de Galicia (the regional government) which takes care of the competences and functions related to (among others) planning, regulation and administration of formal education in all its extension, levels, grades, modalities and specialities, including the higher education system. The General Directorate of Vocational Education and Training, which is responsible for all VET offers in the region and coordinates more than 230 VET centres throughout Galicia, will be implementing the project.

CCEFPU is responsible for the training of technical personnel directly and indirectly related to the topic of SHOREWINNER project in collaboration with various companies in the wind energy sector, both onshore and offshore. Our VET centres provide training on topics such as Energy and Water Management, Installation and Maintenance, Electricity and Electronics and Mechanical Manufacturing. Therefore, our trainers know many of the needs of this sector and are involved in the continuous improvement of their training to achieve excellence. Among the VET centres in our network, the following ones will collaborate with us as associated partners: CIFP Ferrolterra, CIFP Universidade Laboural, and CIFP Valentín Paz Andrade. All of them have VET programmes directly related to the topic of this project and have a recognised experience in the wind energy sector.

In addition, the CCEFPU has recently created the Galician Centre for VET Innovation Eduardo Barreiros (CGIFP), which in a very short time has become a reference for innovation and entrepreneurship activities in vocational education and training in our region. This centre has several strategic areas, including a space dedicated to the development of innovative projects in the field of sustainability and renewable energies. This centre will be collaborating as an associated partner within the project.

IES Universidade Laboural

The IES Universidade Laboural is a public secondary education and vocational training centrecentre located in Galicia, offering a wide range of educational programmes. Among the different VET programmes offered, they are included:

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- Intermediate VET program in Electromechanical Maintenance
- Advanced VET program in Thermal and Fluid Installations
- Advanced VET program in Industrial Mechatronics in collaboration with the company Rubi

CIFP Valentín Paz Andrade

CIFP Valentín Paz Andrade's Energy and Water department offers a VET in Renewable Energies and a VET in Energy Efficiency. Both training courses have been implemented in the centre for 12 years. Related to that domain, experienced teachers have developed different national and regional innovation projects. Thus, the centre has high quality and modern facilities for practical training. Two of those innovation projects were focused on wind energy, and that is why the centre has a model wind turbine and a real wind turbine (from a repowered wind farm). That wind turbine is a DESA A300 with 300 kW generator, fully functional and being operated and maintained as practical training. Most part of the assembly work was done by students, also as practical training. In that part, all sensors, actuators and PLC were renewed, and an own control program was developed. All these features place the CIFP Valentín Paz Andrade as a reference in Galicia and Spain in wind energy domain, as well as, in other renewable energies as photovoltaic, green hydrogen or aerothermal and geothermal heat pumps.

In terms of collaboration with companies, the centre offers different VETs in intensive dual regime, which are increasing fast in the last years and integrates companies as partners in innovation projects. So, the communication and knowledge of the needs in the partners network is constant and bidirectional.

CIFP Valentín Paz Andrade has also a wide experience with the Erasmus program for the internships of their students and teachers. There is a solid network of both, vocational training centres and companies, including wind energy companies.

CIFP Ferrolterra

CIFP Ferrolterra is an Integrated Vocational Center located in Galicia. It is part of the Xunta de Galicia's network of VET centres and specializes in providing high-quality VET programs aiming at preparing students for employment in technical and industrial sector[163].

- Basic level VET programs:
    - Electricity and Electronics
    - Carpentry and Furniture
- Intermediate level VET programs
    - Electrical Installations and Automation
    - Telecommunications Installations

[163] "CIFP Ferrolterra."

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    - Machining
    - Welding and boiler making
    - Carpentry and Furniture
    - Bodywork/Chassis
    - Vehicle Electromechanics

- Maintenance of Wooden Structures and Furniture for Recreational Boats
    - Advanced level VET programs:
        - Telecommunications and IT Systems
        - Industrial Automation and Robotics
        - Metal Constructions
        - Design in Mechanical Manufacturing
        - Automotive Technology

- Advanced Specialization Courses
    - Collaborative Robotics
    - Additive Manufacturing
    - Maintenance and Safety in Hybrid and Electric Vehicle Systems

Galician Centre for VET Innovation Eduardo Barreiros

The Galician Centre for VET Innovation Eduardo Barreiros (CGIFP) is a space of applied innovation and creativity in the VET in cooperation with different Galician productive sectors, to respond to the current and future challenges of the companies and society[164].

They give support for educational teaching, and they oversee research and applied innovation and transfer the R+D+I project results to all centres that provide vocational training in Galicia.

The goals of CGIFP are:

- Innovation, development and applied research in the field of vocational training.
- The training of teachers at centres that provide professional training in the technologies that are emerging in the productive sectors.
- Advancement in new environments that improve learning processes, promoting internationalization and developing continuous improvement of vocational training.
- The promotion of innovation and entrepreneurship in students, through centres that provide professional training

[164] v3.010, "Portada - Centro Galego da Innovación da Formación Profesional."

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3.3.2.3.4 Aquatera

Aquatera Atlántico is the European branch of the Aquatera group in the Canary Islands (Spain), providing a local perspective on sustainable development, offshore renewable energies and the blue economy, based on the intensive knowledge acquired during 20 years of experience of Aquatera Ltd. in projects and initiatives promoted in these sectors around the world[165]. The team has extensive experience in offshore renewable energy testing and development, from wave energy converters to offshore wind and also offshore floating solar. Aquatera staff has been involved in dozens of blue energy studies and several strategic marine energy planning projects. This wide spectrum of activities has included contributing to the planning and development of test programmes as well as providing wider technical and operational support, permitting services and capacity building.

By leveraging its established network of industry contacts, research institutions, and regulatory bodies, Aquatera Atlántico can streamline project development, foster collaboration among key stakeholders, and navigate the complex regulatory landscape. Its proven track record demonstrates a unique ability to manage the challenges inherent to marine energy projects, from feasibility studies to deployment and monitoring.

With a strong foundation in the Canary Islands and deep ties to the broader international market, the company combines local knowledge with global expertise to deliver tailored solutions in sustainable energy projects. Drawing on the experiences and lessons learned as part of the Aquatera Group, we take a multi-disciplinary approach, supporting our clients at all stages, from planning right through delivery and decommissioning. Similarly to Aquatera Ltd in Orkney, Scotland, we deliver support from an island base in the Canary Islands in Spain, which gives us an unmatched perspective on local and community issues, across Europe and the world. That experience allows us to provide a good insight into the offshore renewable energy sector, together with a broad range of contacts through the industry, both at national and international level. Aquatera Atlántico is working now in two offshore energy related European research projects (Bamboo and Inf4inity), one of them focused on nature inclusive designs for offshore floating wind, and the other on floating offshore solar developments within offshore wind developments.

Aquatera Ltd. was also part of the MATES project, supported by the EU, aimed to identify skill gaps and propose strategies for equipping the workforce with competencies in areas like offshore wind and marine energy. Through the MATES Project, Aquatera delivered multiple stakeholder engagement and consultation activities such as online questionnaires, focus groups, interviews and workshops and developed and piloted the Marine Energy Crash Course; an online short course in the first principles of marine energy including technology, business, environment and policy considerations.

[165] "Aquatera | Specialising in Environmental and Operational Support for Marine, Coastal and Land-Based Activities."

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3.3.2.3.5 Other centres

There are also other VET centres that have already shown interest in joining the SHOREWINNER CoP, aiding in the development and testing of the proposed new curriculum, learning materials and sharing their feedback and experience.

IFGC

The IFP Maritimo Pesquero LPGC (IFGC) is a vocational centre based in Gran Canaria, Canary Islands. It is equipped with the best material means adapted to new technologies for the realization of teaching. The Maritime-Fishing Training Cycles and Installation and Maintenance Cycles can remain at the forefront of modern Vocational Training. The Institute is also certified to teach courses in Multipurpose Coastal Skipper, Local Fishing Skipper, Port Skipper, Automatic Pointing Radar (ARPA), General Operator and Restricted Operator of the Global Maritime Distress and Safety System (GMDSS), Familiarization in Tankers, RoRo and Basic Training Certificate among others. The centre also offers Occupational Training courses, aimed at both recycling and promoting sea professionals and preparing new ones who request it. These monographic courses are in great demand following the recognition that has increased from year to year.

IFL

Instituto Politécnico de Formación Profesional Marítimo Pesquera de Canarias (IFL) is a vocational centre based in Lanzarote, Canary Islands. With 77 years of experience, the CentreCentre is equipped and specialised to teach a total of six modules of Vocational Training, three of Higher Degree (Aquaculture, Machines and Bridge), three of Medium Grade (Diving, Machines and Bridge) and a growing offer of more than 25 Professional Courses approved by the IMO (International Maritime Organization).

IFM

CIFP Felo Monzón Grau-Bassas (IFM) is a vocational centre located in Gran Canaria. The technical VET courses delivered by Felo are multiple, as it is a key centre in the archipelago for vocational training.

3.3.2.4 Mapping of VET offerings

Previous Erasmus+ projects such as MATES and FLORES have been instrumental in mapping and identifying training programmes related to renewable energies, particularly within the offshore wind and marine energy sectors. These initiatives have focused on aligning educational offerings with industry needs to ensure a well-trained workforce capable of supporting the energy transition. Both projects have not only catalogued existing training opportunities but also proposed innovative educational approaches to address the evolving needs of the Offshore Renewable Energy (ORE) sector. Their work informs policy and curriculum development to support Spain’s renewable energy goals, including investments in offshore wind and marine energy technologies.

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The FLORES project has identified 37 training programmes directly related to offshore renewables. Of these, eight are master's programmes (EQF Level 7), while the remainder are short training courses[166, 167]. However, when considering the entire value chain for the sector and the Vocational Education and Training (VET) programmes supporting it, the Galicia region alone offers 38 VET programmes ranging from EQF Levels 3 to 6.

The VET in Renewable energies (2.000h) has two subjects about wind energy: Wind farm assembly management (192 h) and Operation and maintenance of wind farms (193 h)[168]. Both are focused on onshore wind energy. Nevertheless, the first subject contains two learning outcomes, out of eight, related to offshore wind. These learning outcomes are:

- Characterises the assembly processes used in offshore wind farm projects and recognises the differences with onshore wind farms.
- It assesses the risks of offshore wind farms, for which it recognises the specific characteristics of the installation and the environment.

In addition, the VET counts on a transversal subject named Renewable energy systems (160h) with a learning outcome out of nine, related to offshore renewables in general. In that learning outcome is done an introduction about tidal or wave power.

3.3.3 Italy

3.3.3.1 VET system, policies and priorities

Vocational education and training (VET) is characterised by multilevel governance with broad involvement of national, regional and local stakeholders. Ministries of Education and labour lay down general rules and common principles for the system. VET schools oversee upper secondary VET school pathways (EQF 4-ISCED 354). Regions and autonomous provinces oversee VET programmes and most apprenticeship-type schemes. Social partners contribute to defining and creating active employment policies relevant to VET and lifelong learning.

Compulsory education lasts 10 years, up to the age of 16. At the age of 14, learners make a choice between general education, secondary VET school pathways and regional IVET pathways (Istruzione e Formazione Professionale, IeFP). They have the 'right/duty' (*diritto/dovere*) to stay in the education pathway until age 18 to accomplish at least 12 years of education and/or vocational qualification.

At upper secondary level, the following VET programmes are offered:

[166] "D2.2-Report-Map-Training-Offer.Pdf."
[167] "Flores Trainings | Marinetraining."
[168] "Currículos e Perfís Profesionais Dos Ciclos Formativos | Xunta de Galicia."

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- 5-year programmes at technical schools (*istituti tecnici*) or vocational schools *(*Istituti professionali) leading respectively to technical or vocational education diplomas (EQF level 4). Programmes combine general education and VET and can also be delivered in the form of alternative training. Graduates have access to higher education
- 3-year regional IVET programmes (IeFP) leading to a professional operator certificate (attestato di qualifica di operatore professionale, EQF level 3)
- 4-year regional IVET programmes (IeFP) leading to a technician diploma (diploma professionale di tecnico, EQF level 4)

All upper secondary education programmes are school-based but could be also delivered as apprenticeships (Type 1).

There is permeability across VET programmes and also within the general education system. On completion of a 3-year regional IVET path, it is possible to attend 1 additional year leading to an EQF level 4 vocational diploma; this allows enrolling in the fifth year of the State education system and sitting the State exam for an upper secondary technical or vocational education diploma (EQF level 4).

At post-secondary level, graduates of 5-year upper secondary programmes or 4-year IeFP programmes who passed entrance exams may enrol in:

- Higher technical education and training courses (istruzione e formazione tecnica superiore, IFTS): 1-year post-secondary non-academic programmes leading to a high technical specialisation certificate (certificato di specializzazione tecnica superiore, EQF level 4).
- Higher technological institute programmes (istituti tecnologici superiori; ITS academy): 2-year tertiary non-academic programmes which lead to a high-level technical diploma (diploma di specializzazione per le tecnologie applicate - EQF level 5 Implementation of the recently (2022) reformed system of higher technological institutes is ongoing in 2023; it foresees introduction of 3-year programmes leading to an applied technologies qualification (EQF level 6).

VET for adults is offered by a range of different public and private providers. It includes programmes leading to upper secondary VET qualifications to ensure progression opportunities (upskilling) for the low-skilled; these are provided by provincial centres for adult education (centri provinciali per l'istruzione degli adulti, CPIA) under the remit of the education ministry.

Continuing vocational training (CVT) to meet enterprise, sectoral and regional needs is:

- supported by the ESF and is managed by regions and autonomous provinces
- directly funded by the regions and autonomous provinces
- financed by joint inter-professional funds, managed by the social partners.

Moreover, Italian VET is characterised by multiple institutional actors at national and regional levels. Article 117 of the Constitution provides for ownership either by the State, the regions or mechanisms for cooperation between the different institutions, relative to the type of education and training: the State establishes general education standards; regions have exclusive legislative power over VET; and education

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falls within the concurrent legislation, except for the autonomy of education institutions and vocational training.

The Ministries of education and labour and the regions define, with formal agreements, matters of common interest with different responsibility levels.

Apprenticeship is available at all levels and programmes and is defined as an open-ended employment contract. Type 1 apprenticeship is offered in all programmes at upper secondary level and the IFTS. Type 3 apprenticeship (higher training/education apprenticeship) is offered in ITS programmes and all tertiary education leading to university degrees, ITS diplomas, and doctoral degrees. Type 2 apprenticeship does not correspond to any education level but leads to occupational qualifications recognised by the relevant national sectoral collective agreements.

3.3.3.1.1 Main challenges and policy responses

The Italian VET system is characterised by multilevel governance that requires effective coordination and synergies. Learner exposure to work-based learning is low, while the labour market is facing skill shortages and skill gaps at regional level. In this context, new funds are allocated for the expansion of the dual system in regional (IeFP) programmes through quality in company training /virtual business simulations and career guidance schemes (individualised training plans). In turn, the educational value of IeFP programmes is guaranteed through the transversal skills and guidance pathways (PCTO) scheme in place in upper secondary.

Supporting participation of adults in learning is high in the policy agenda. The National Recovery and Resilience Plan (NRRP) includes measures to reform active labour market policies, by implementing essential performance levels and promoting the employability of transitioning and unemployed individuals, particularly those considered vulnerable and distant from the labour market. The plan secures financial incentives and benefits for companies involved in dual training through regional calls for tender. NRRP investments in dual VET aim to facilitate entry of young people into the labour market, including in sectors linked to the digital and green transitions. The plan’s ambitious target is to increase the number of participants in dual training from 39 000 (baseline) to 174 000 by 2025.

To tackle the high number of low-skilled people, education and labour authorities are running multiannual national plans for the upskilling of citizens; respectively, the guaranteeing the skills of the adult population plan for the acquisition of basic and transversal skills in the regions and the 2021-27 Strategic plan for the development of the adult population.

The operational plan for 2023 of the National Digital skills strategy provides digital education in schools and continuous training schemes, with emphasis to inclusion initiatives for disadvantages groups. Focus is given to the digitalisation of SMEs though public-private partnerships. Actions are monitored at both national and regional level to ensure the effectiveness of those initiatives.

The update of the national qualifications framework (QNQ) referenced to the European Qualifications Framework in 2022 and implemented in national legislation in 2023, brings all qualification sub-systems

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together and sets common criteria for levelling national and regional qualifications. This increases the relevance and transparency of qualifications and facilitates European and international mobility of workers. The Ministry of Education, the Ministry of Labour and the Regions work together to ensure that QNQ remains relevant to emerging needs at regional and national levels.

3.3.3.1.2 Policies for aligning VET with labour market demands

In recent years, several policies and initiatives have aimed to improve the alignment between VET programmes and the needs of the labour market. Dual Education System Expansion: Inspired by the German and Swiss models, Italy has been expanding its dual education system, where students split their time between classroom instruction and paid work placements. Known as "alternanza scuola-lavoro" (school-work alternation), this approach is intended to bridge the gap between theoretical learning and practical skills, allowing students to develop on-the-job experience directly relevant to industry requirements. The system is a priority for the Italian government, which sees it as a means to address youth unemployment by making VET graduates more job-ready.

In Italy, surveys have been carried out for more than twenty years to study the phenomenon of the need for occupations and skills from both quantitative (which and how many professional profiles companies expect to have to recruit in the coming months) and qualitative perspectives (which skills, knowledge and competences should be at the centre of the future refresher courses of company employees).

These surveys are conducted by Unioncamere, the Italian Union of Chambers of Commerce, Industry, Crafts and Agriculture (quantitative survey) and by the National Institute for the Analysis of Public Policies, (INAPP) (qualitative survey) at national and regional level.

The results of these surveys are interpreted with the Classification of Occupations (CP 2011) and the Classification of Economic Activities (ATECO 2008). Since 1997, the Excelsior survey, carried out by Unioncamere, has reconstructed an anticipatory picture of labour demand and skills needs expressed by companies. Analytical information is collected on the characteristics of the personnel that the company intends to hire skilled labour, qualifications and levels of training required, difficulties in finding these profiles, need for further training, previous experience, IT and language skills. Inapp began to carry out research in 2006 designed to analyse existing professions and trades, with a view to providing a detailed description of changes in job content in the short-term (next 12 months). Investigation methods were used that made it possible to interview entrepreneurs, corporate human resources managers or industry experts who could outline trends in key sectors of the economy. This information helps to update curricula, develop new programmes, professionally orient students and workers, design retraining interventions and plan the training offer. Furthermore, they support evidence-based employment policies, better-aligning workers' skills with labour market needs.

The audit survey on professional needs, targeting a sample of about 35 000 companies with employees, aimed to collect qualitative information on the needs of companies in terms of the scarcity/lack of specific skills and know-how relating to the skilled workers they employed. Last survey took place in 2021.

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Entrepreneurs were able to reflect and explain in great detail not the training that had been carried out over recent years, but what had to be done in the near future to satisfy specific needs.

The information from these surveys, which explore the vocational and training needs of the labour market, provides guidance to all stakeholders (including VET providers) on a complex educational system that has the task of planning and implementing vocational training and retraining programmes.

3.3.3.2 Inclusion and attractiveness in VET

Tax credits, exemptions and reductions in social security contributions

The 2018 Budget Law established that tax credit for 4.0 training is granted to enterprises for 40% of the expenses relating to the corporate cost of salaried personnel for the time they are occupied in training activities. This can amount to a maximum of EUR 300 000 per year for each enterprise and is granted for stipulated training activities, thanks to corporate or territorial collective contracts. The training activities permissible for requesting tax credits must involve issues connected to the introduction of digital technology innovations: big data and data analysis, cloud and fog computing, cyber security, cyber-physical systems, rapid prototyping, visualisation and augmented reality systems, advanced and collaborative robotics, man-machinery interface, additive manufacturing, the internet of things and machines and the digital integration of corporate processes.

Law 232/2016 introduced financial incentives for companies involved in dual training. To facilitate the recruitment of young people on a permanent contract in the same company where they were on alternance contracts or types 1 or 3 apprenticeship, certain types of enterprise (such as those with fewer than 10 employees) are entitled to total social security exemption for the first 3 years. In the fourth year they will pay 10% of taxable social security contributions.

Companies with more than nine employees pay a contribution for the entire duration of the apprenticeship, equal to 11.61% of the taxable social security contribution.

Wage subsidy and training remunerations

Employers willing to offer apprenticeships can hire an apprentice at an entry grade level up to two levels lower than the final qualification to be obtained and/or pay a salary equal to a percentage of the salary of a qualified worker, according to the provisions of the collective agreement applied.

Other incentives

Several Italian regions (for example, Piedmont and Liguria) also fund standard enterprise training vouchers (for varying amounts, depending on the size of the enterprise). Enterprise vouchers are a simplified management method designed for small enterprises that generally find it difficult to organise structured training courses.

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3.3.3.3 Assets from the CoVE Italy

3.3.3.3.1 UNIVPM

The Polytechnic University of Marche, specifically through its **Department of Industrial Engineering and Mathematical Sciences (DIISM)**, has established a strong background in European projects focused on education, digitalization, research and innovation, as well as resilience and business continuity. These projects have been conducted in **collaboration with both industrial sectors and public institutions**, with a particular interest in the energy sector, especially renewable energy. DIISM has contributed to developing innovative solutions that connect research with industry practices, supporting the development of skills and knowledge that meet current market and institutional demands.

Moreover, UNIVPM offers **degree programmes tailored to the energy industry**, focusing on renewable technologies, which include **training and internship opportunities directly linked to the corporate world**. These programmes provide students with advanced technical skills as well as insights into industry operations, thanks to partnerships with authorities and entities in the field, such as energy consortia and companies specializing in renewable energy.

DIISM is well-positioned to share **advanced training methodologies** developed through various European projects, including approaches based on **simulations and hybrid learning environments**. These practices have proven effective in bridging skill gaps, particularly in technologically advanced sectors such as renewable energy. For instance, the integration of research laboratories with advanced IT infrastructures and the involvement of research groups with homogeneous scientific interests have enabled the refinement of teaching methodologies applicable to corporate contexts as well.

Additionally, DIISM has significant resources in the form of **publications**, **patents**, and **technical know-how**, documented through numerous research collaborations. These resources represent a valuable body of knowledge that can enrich the CoVE's training offer. DIISM's participation in the **Regional Technological Cluster "Marche Manufacturing"**, which serves as a model for stable collaboration, further exemplifies a best practice that promotes ongoing dialogue between academia and industry. This type of cooperation could provide a foundation for developing **joint research and training activities** among CoVE partners, fostering an approach tailored to current and future challenges in the energy sector.

3.3.3.3.2 ForMare

ForMare offers a solid foundation of expertise, experience, and resources focused on **enhancing training offerings within the shipping and Blue Economy sectors**. Their specialization lies in **identifying and bridging skills gaps to meet evolving industry demand**s, particularly in environmental and digital trends crucial to the sector's growth. The marine renewable energy market presents significant opportunities across the Blue Economy. It is a critical asset for sustainable development within shipping and port infrastructure, contributing to reduced GHG emissions, improved energy efficiency, and alignment with national and EU renewable energy targets.

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In response, ForMare has gained substantial experience in **competence gap analysis** and **support in the development of targeted training programmes,** notably through its participation in Erasmus+ projects like SkillSea and MARMED. ForMare employs a proven methodology for skills assessment and recognition, adaptable to meet the emerging needs of the offshore renewable energy sector, thereby supporting a skilled, competitive workforce.

Furthermore, to provide concrete and up-to-date content in line with the industry trends, it is useful to ensure a **strong and close collaboration with technical groups** organized by the industry representative and associations operating in the sector of interest. ForMare has an established partnerships with **networks like the WestMed Maritime Cluster Alliance and Italian Maritime Clusters**. It is also important to foster knowledge exchange and strategic alliances and to link the CoVE with a strong network for knowledge exchange and collaboration. These connections promote the sharing of best practices and resources across regions, empowering the community to develop specialized training pathways aligned with industry innovation and sustainability goals.

ForMare offers valuable practices and resources that could enrich the CoVE's offer. Using **methods developed through projects like Erasmus+ SkillSea and MARMED**, ForMare provides **expertise in identifying skill gaps and support the creation of targeted training programmes** based on different training methodologies according to the diverse target audience.

The training methodology implemented in the MARMED project is highly effective in **enhancing the knowledge of Maritime Cluster Managers** across different EU countries, considering the challenge of providing a comprehensive view of various Blue Economy sectors. This methodology included four key activities.

1. First, the curriculum was developed based on the results of a **skills gap analysis** conducted with key stakeholders in the project.
2. The identified skill gaps were translated into **learning outcomes and objectives**, which guided the creation of the curriculum. The curriculum was modular, divided into units, each aligned with specific EQF criteria and time-bound, with durations specified for each unit. It was also linked to ECVET grades to improve transparency and facilitate transnational recognition of qualifications.
3. Targeting professional learners, the methodology was designed to cater to their needs, incorporating a **mix of engaging methods** such as reading materials (e.g., PowerPoints, PDFs, downloadable documents), practical assignments (e.g., self-reflection activities, case studies), and self-assessment tests to evaluate competencies at the end of each unit. Training materials were made available through an online platform, allowing learners to study at their own pace and participate in live online discussions for deeper engagement and clarification.
4. Finally, a **training evaluation methodology** was developed to assess the overall effectiveness of the course and gather valuable feedback for future improvements.

Besides this specific methodology implemented in the project, there are also other efficient training methodology that could benefit the CoVE.

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The **Train-The-Trainer Training Methodology** is designed to empower experienced professionals to effectively pass on their expertise to new trainers. This approach focuses on building trainers' skills in instructional techniques, curriculum delivery, and assessment methods. Participants are taught how to create an engaging learning environment, adapt content for diverse audiences, and utilize interactive tools to enhance knowledge retention. By training trainers to facilitate hands-on, learner-centred instruction, this methodology ensures the scalable and consistent transfer of specialized knowledge across organizations or educational programmes. This methodology is a powerful tool for organizations aiming to expand knowledge efficiently, build internal capacity, and ensure consistent, high-quality training. By empowering experienced individuals to become trainers, organizations can multiply expertise, reach larger audiences, and standardize training methods across teams, leading to uniform skill development. This approach also enables trainers to tailor content to specific organizational needs, making it relevant and impactful. Additionally, it boosts job satisfaction for trainers by providing professional development, which can enhance retention and foster long-term growth. As these trainers continue to train others, the project sustains a culture of continuous learning, agility, and adaptability.

Also, **Joint-Staff training activities** could represent a valuable training methodology in the context of Offshore Renewable Energy (ORE), involving collaborative training programmes where personnel from different departments, organizations, or sectors work together to develop shared skills and knowledge. These activities can be effective if applied across various industries, e.g. in the offshore wind energy case where several actors from different industries - and with different training backgrounds - operate to achieve a common objective. The goal is to promote teamwork, improve communication, and align strategies among diverse teams, ensuring that everyone involved has a clear understanding of each other's roles and responsibilities. Joint-Staff training helps build interoperability, fosters a sense of unity, and enhances collective problem-solving capabilities. It is especially useful in environments that require coordinated action, such as crisis management or multi-disciplinary projects, where success depends on the seamless collaboration of all involved.

Finally, **peer-to-peer training methodology** involves learning through collaboration and knowledge sharing among individuals at similar levels of experience or expertise. This approach encourages mutual support, where participants can exchange insights, solve problems together, and learn from each other's experiences. Peer-to-peer training fosters a more informal, interactive learning environment, promoting active engagement and reinforcing learning through real-life examples. It also helps build trust and teamwork, as participants develop a deeper understanding of the material by teaching and helping one another. This methodology is particularly effective in promoting continuous learning and skill development within a community or organization.

3.3.3.3.3 IFOA

IFOA is a private, not-for-profit, VET school active for over 50 years, appointed in 1999 as a national training centre by the Italian Ministry of Labour, and a private employment agency, with 14 sites all over Italy.

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Their main assets to the benefit of the CoVE comprise:

- Long-lasting expertise in Higher VET and Continuous VET.
- Extension of operations over the whole national territory.
- Ability to co-design and deliver tailored training on a variety of domains, technical, methodological, financial, organizational, etc.
- Strong connections with companies.
- Huge network of national and international partners.
- Large roster of trainers and experts.
- Belonging to the network of the Italian Chambers of Commerce.

IFOA delivers **traditional and blended learning VET programmes** (mostly EQF4/5) for young unemployed individuals, continuous training for employees and companies, lifelong training, and consultancy and technical assistance to individuals, businesses, and public bodies. The programmes cover a **wide range of domains and sectors**, linked to S3 Strategies of the Italian Regions IFOA is based in, from energy to logistics, from agri-food to large-scale retail trade, from tourism to Industry 4.0, etc. Special attention is also given to soft and cross-skills, especially green and blue (digital).

In 2023 IFOA trained more than 41.000 people in VET, continuous training and LLL programmes, for a global 82.300 training hours administered through around 3.300 training courses and seminars.

Some of the ongoing relevant VET and continuous learning programmes include:

- **Green & Energy Specialist** – Advanced technician for environmental sustainability and quality of industrial processes – EQF 4 post-diploma course with a specific unit dedicated to wind energy and wind plants maintenance.
- **Green Comp** – Emilia Romagna Region FSE+ co-funded project that aims at fostering a positive acceleration of the ecological transition, balancing the quality of work, environmental respect, productivity, added value, economic efficiency, and social justice. It includes 17 training programmes, with durations ranging from 60 to 80 hours.
- **Data Lab** – Emilia Romagna Region FSE+ co-funded project addressed to graduates from all academic disciplines. The goal is to develop knowledge and skills that enable highly educated individuals, from any course of studies, to manage and analyse data, and elabourate pieces of information and high-value-added insights useful for the organizations.
- **Digichamps** - a project funded by Repubblica Digitale, an Italian national initiative, coordinated by the Department for Digital Transformation of the Presidency of the Council of Ministers, focused on bridging the digital divide and promoting education on future technologies. The project aims to provide free training for 390 unemployed young graduates aged 18 to 34 from across Italy, in IT profiles that are in high demand by companies.

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IFOA is **member of many relevant networks**, the main ones being the network of the Italian and EU Chambers of Commerce; the Emilia-Romagna regional clusters supporting the S3 Strategy (GreenTech, Industry 4.0, Innovation, Agri-Food); the Emilia Romagna Regional Strategic Forum for the Blue Economy – S3 Strategy Thematic Area Blue Growth with its productive specializations: Blue Bioeconomy, Marine Manufacturing, Coastal Zones, and Tourism 2.0; the it-ER (International Talents in Emilia-Romagna), the network responsible for implementing the regional strategy of international talents attraction and retention; co-founder of Impact Hub Reggio Emilia, a "knot" in the world-wide network of Impact Hubs for co-working and innovation development; EfVET - European Forum of Technical and Vocational Education and Training; and Chain5, the informal EU network of training centres delivering EQF5 programmes; - European Alliance for Apprenticeships.

IFOA has been **managing international projects funded by the European Union** since 1993 to develop activities related to vocational training, active labour market policies, and international mobility.

In these fields, IFOA has developed a wide experience mainly on curricula development, competences, lifelong learning, work-based learning, active employment policies, social inclusion, and entrepreneurship, in all sectors and domains covered by its training programmes and by the territorial development policies. IFOA is a project promoter, coordinator, or partner and provides technical assistance to public or private entities, covering the entire project lifecycle (from its conception to full implementation). Some of the recent most relevant EU projects:

- **EULEP** - European Union Learning Experience Platform, Erasmus+ Centres of Vocational Excellence (101056320 - ERASMUS-EDU-2021-PEX-COVE) - EULEP project emerged from the need to establish a transnational cooperation platform that helps to foster vocational education and training (VET) excellence while addressing regional/national and EU priorities. EULEP aims to further develop and elabourate the subjects of artificial intelligence, virtual reality and social innovation as means to promote lifelong learning in enterprises. EULEP lies the implementation of the European Learning Experience Platform, which brings together 20 organisations from 8 countries, working together to make continuous VET more attractive for lifelong learning, and offer businesses new and tailor-made training modules that correspond to their skills needs in innovation-oriented subjects.
- **Fit for 4.0** - training trainers and teachers for the 4.0 paradigm, Erasmus+ KA2 - Strategic Partnerships (2019-1-IT01-KA202-007766): the priorities of this project are to open education and innovative practices in a digital era and to support the uptake of innovative approaches and digital technologies for teaching and learning.
- **SCLASS** – Sustainable development in the classroom, Erasmus+ KA2 - Strategic Partnerships (2020-1-DK01-KA201-075165): IFOA is the Italian partner of SCLASS. The project focuses on the concepts of shared classrooms and European cooperation. The ultimate goal is to engage teachers and students in international cooperation to raise awareness among the new generations on the topic of sustainability and to collaboratively find solutions that can help the entire community achieve the 17 goals of the 2030 Agenda (SDGs).

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- **EEP** – Environmental Education Programme, Erasmus+ KA2 - Strategic Partnerships (2021-1-IT02-KA220-SCH-000024160): the project aims to support students in acquiring and developing key skills that will have a fundamental impact on their ability to establish correct relations with the environment and better understand the problems and possible solutions. This will also increase their awareness and ability to dialogue with the environment as responsible citizens.
- **EntreComp4Transition**, Erasmus+ Partnerships for Innovation - Alliances (project n. 101056333): the project targets the empowerment of the SMEs on their journey towards digitalisation and sustainability. EntreComp4Transition aims at developing new, innovative, multidisciplinary approaches for teaching and learning, paving the way for the future “Green Transition Facilitator” by fostering an entrepreneurial mindset, facilitating co-creation, and ensuring recognition of learning outcomes. One of the project results is a sustainable AI-based tool to support companies in identifying skill gaps and raising their competitiveness.

Innovative digital training methodologies and train-the-trainer resources. Among the others, outputs and experience developed by IFOA as lead partner of EU funded “Fit for 4.0: training trainers and teachers for the 4.0 paradigm” project. The project provides a Train-the-trainers program and a MOOC & resource kit for “4.0 teachers and trainers”.

International Mobility and Study Tours. IFOA has been offering for many years new opportunities to open international possibilities for students, trainees, apprentices, entrepreneurs, companies and all people interested in gaining experiences in new contexts throughout Europe and worldwide. IFOA Mobility projects are focused on learning mobility exchanges and quality workplace training. IFOA manages professional internships and training under EU funded programmes (Erasmus+ KA1); tailored-made internships in Italy for EU and non-EU candidates; study tours in Italy.

PratiCARE la Sicurezza. It is a didactic method that educates people about Health and Safety at work, through visual-theatrical representations, staging real risk scenarios specifically designed for each company. Workers are supported by trainers – actors with specific responsibilities and roles in the field of Health and Safety. These workshops aim to raise workers' awareness on various risk situations, making them active participants in identifying safer behaviours to adopt in their workplace.

Corporate Academies. Programmes that combine classroom training with work experience in companies, facilitating the entry of specialized professionals into the workforce through first-level apprenticeship contracts. In 2023, 10 programmes were carried out in three different Italian Regions, covering areas such as IT, administrative-economics, mechanics, and manufacturing. A total of 116 trainees were hired.

3.3.3.3.4 Deep Blue

Deep Blue has extensive experience in the design of tailored-made training courses with both **traditional training methods** and i**nnovative methodologies and techniques** (such as e-learning, web-based training, blended learning, etc.). The flexibility in choosing the delivery methods (synchronous, asynchronous, or hybrid) and a focus on an experiential approach to learning contribute to more effective training sessions.

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Based on innovative **co-design methodologies** and customer/end users' involvement, our approach starts from the **analysis of training needs, skills and technological changes** affecting a specific sector, and the consequent definition of learning objectives, through to the actual **design and delivery of customised training courses**, tailored to the users' environment.

Examples of such activities in EU-funded research projects comprise:

- **Skillful** project[169]: analysis of future trends and changes; updating of existing training courses at European level; designing of new training courses for transport sector workers at all levels.
- **KAAT** project[170]: analysis and mapping of existing professional figures; development of competence framework describing the skills and knowledge needed of different professional figures in the aviation sector.
- **Skill-UP** project[171]: analysis of trends and technological transformations in the air transport sector; definition of future scenarios in four air transport areas (Air Traffic Control, commercial aviation, airport operations, Remotely Piloted Aircraft Systems operations); identification of professional profiles most impacted by the future scenarios, and of new professional profiles needed; definition of training paths defining the key skills and competences that each profile will have to acquire; development of training courses on soft skills (e.g., stress management) for controllers, pilots, drone operators, and airport workers for skills acquisition and upgrading.
- **CYRUS** project[172]: analysis of cybersecurity training needs in the reference sectors (transport and manufacturing); development of a cybersecurity skills framework; development of tailored short-term cybersecurity training courses for the acquisition and upgrade of technical and non-technical profiles; iterative training delivery, validation and recognition of the skills acquired.

Backcasting methodology: traditional Human Factors assessment methodologies, focused on analysing the impact of changes on human performance, such as workload, situational awareness, and social support, do not always ensure **acceptance and adoption of the new working environment**. By utilising a backcasting methodology, i.e. a planning method that starts with defining a desirable future and then works backwards to identify policies and programmes to connect that specified future to the present, **a global socio-technical context of an innovative future can be envisioned**, and a holistic or specific view of the skills, transfer of previous experience, change of values, and responsibilities associated with the change can be derived, contextualising any Human Factors considerations. While forecasting explores what might happen starting

[169] "Skillful – Skills and competences development of future transportation professionals at all levels", funded by H2020 under Grant Agreement n. 723989.

[170] "KAAT – Knowledge Alliance in Air Transport", funded by Erasmus+.

[171] "Skill-UP – skilling, upskilling and reskilling in the future air transport", co-funded by Erasmus+, project n. 408540-EPP-1-2019-1-IT-EPPKA2-SSA.

[172] "CYRUS – enhanced cupersecurity skills", co-funded from the European Union's Digital Europe Programme under Grant Agreement n. 101100733.

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from today, backcasting analyses various paths towards a future dictated by trends, allowing for the embracing of all aspects of innovation, both technological and non-technological, to produce a synergistic effect.

In the Skill-UP project, the backcasting methodology was used to first identify **major trends and future technological transformations** in air transport to draw potential realistic innovative scenarios, based on the judgment of air transport experts, the best available technologies, and expected technological developments. Once the scenarios were defined, **paths were traced back to fill in possible gaps in skills and competence**s in the envisaged future. To develop the future scenarios, in addition to a **top-down** approach focused on a structured review of current official documentation produced at the European level and analysis of past and ongoing EU-funded projects, **bottom-up methods** were employed. By iteratively involving external experts and key stakeholders in the sector in key stages of the project through interviews, surveys, and focus groups, Skill-UP identified future training needs and validated the future scenarios, profiles, and study pathways. The survey and interviews constituted the main input for the development of the future workforce profiles (**personas**). Once the future scenarios were defined, five focus groups were organised in five countries to validate them and collect indications about the main skills and competences required to undertake the essential tasks in the future operational scenarios.

Work-based training framework methodology. We are aware that different personnel in different organisations, sectors and countries have different levels of skills and competences; hence, we aim to customise our training strategy to the user's skills, know-how and needs. Based on the different needs, training include theoretical contents, practical exercises, presentations, gaming and role-plays, case studies for working groups, on-the-job and work-based formats, etc. This encourages the trainees to exercise with co-workers and continuously learn on the job collaboratively.

This methodology is being adopted within the CYRUS project, and is based on a three steps approach:

1. **Analysis of current and future** cybersecurity **skills, competences and training needs** in the TM sectors through a short assessment of the cyber posture of a company (e.g., rapid assessment of either humans, technologies or processes) to define its cybersecurity preparedness, digital skills gaps and improve the impact of the training courses. The main output of this first phase was the development of the cybersecurity Competence Framework mapping the changes in key cybersecurity skills, knowledge and competences needed in the current and future cyber-threat scenarios across the TM sectors.
2. **Design of tailored short term training courses** for the acquisition and upgrade of cybersecurity technical and soft skills, based on the review and selection of training methodologies for VET delivery, the adoption of iterative design, and the implementation of the training modules for different user groups and industrial sectors. The outcome was ready-to-use VET training content including a combination of theoretical and practical learning in cybersecurity, supported by interconnected work activities. The training materials was designed in a way that made them easily adaptable to different user profiles providing both basic cybersecurity knowledge for non-technical profiles and more advanced methodologies and tools for IT and cybersecurity professionals. All the training materials

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will be developed according to the methods and principles of **Andragogy**, the science of the theory, methods, and activities involved in teaching adult learners. These methods were specifically designed to maximise the impact on and retention rate of the adult learners, and include several techniques to enhance the motivation of the trainee, e.g.: inform learners on why they should learn something; build the lessons on their rich working and personal background; explain how the lessons address specific needs relevant to their profession; follow a problem-centred approach applied towards real-life situations; leverage on internal motivators (e.g., anticipated increase in job satisfaction, self-esteem, quality of life) rather than external ones (e.g., a higher salary, a job promotion).

3. **Iterative training delivery, validation and recognition of the skills acquired**. The short-term training courses will be iteratively co-designed and validated with constant involvement of SMEs, professional associations and training providers. A first round of validation of a pilot version of the training will be used to collect feedback from the stakeholders and support the fine-tuning of the training courses. This pilot delivery will enhance the effectiveness of the final version of the training.

3.3.3.4 Mapping of VET offerings

In Italy, the available VET offerings to prepare the current and projected labour force predominantly focuses on **high-level technical roles**, such as engineers and project managers, **rather than operational technicians**.

This is due to various structural, economic and cultural factors:

- Culturally, there is more prestige attached to academic and highly specialized professions in Italy, which results in greater emphasis on training engineers and professionals for the design and supervision of plants.
- Historically, Italy has favoured the development of onshore renewable technologies, such as photovoltaics and onshore wind, with targeted investments in large infrastructures and design expertise. This trend has led to a higher demand for engineers and specialists, while training for operational technicians has been more neglected.
- Economically, compared to countries like Denmark and Germany, Italy started seriously investing in offshore wind energy only later.
- Geographically, the characteristics of the Mediterranean Sea, with its deeper waters near the coast compared to the North Sea, make the installation of offshore turbines more expensive.

When researching information about the available Italian VET offers, we used the following **search strings to identify specific training programmes**:

- Corsi di formazione tecnico eolico Italia (Wind turbine technician training courses Italy)
- Come diventare tecnico eolico offshore (How to become an offshore wind technician)
- Programmi per tecnici eolici offshore Italia (Offshore wind technician programmes Italy)
- Formazione professionale tecnico eolico Italia (Professional training wind energy technician Italy)
- Formazione eolico offshore per tecnici Italia (Offshore wind technician training Italy)

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Table 15. Available VET offers to prepare the current and projected labour force demand in Italy

#	Organization	Course Title	Course Highlights	ORE Sector Specific or Cross-Sector	Soft skills inclusion	Target age / target groups	Delivery method	Internship offer
1	**ELIS**	Talent Academy	Offshore wind, renewable energy, maintenance, soft skills	Cross-Sector	Y (communication, teamwork, problem-solving, adaptability)	Ages 18-35, inclusive	Hybrid	Y
2	**ELIS**	Technical Wind Power Systems Course	Wind systems, maintenance, workplace safety	Sector Specific	No	Ages 18+	In-person	Y
3	**Dinamiche Verticali**	Certified GWO Training	Safety, height operations, first aid	Cross-Sector	No	Ages 18+, industry professionals	In-person	N
4	**Associazione Nazionale Energia del Vento (ANEV)**	Corsi di formazione	Wind power, safety, height operations	Sector Specific	Y (communication, leadership)	Ages 18-45	Hybrid	Y
5	**OTI Group**	Working at Heights + Manual Handling	Height operations, manual load handling	Cross-Sector	No	Ages 18+	In-person	N
6	**ASL**	BTT (Basic Technical Training Standard)	Basic wind tech skills, safety, maintenance	Sector Specific	No	Ages 18+, preferably under 50	In-person	N
7	**Global Wind Organization**	Crane and Hoist Standard	Crane and hoist operation, safety	Cross-Sector	No	Ages 18+, unrestricted	Hybrid	N
8	**Global Wind Organization**	Wind Limited Access Standard	Restricted wind turbine access, safety	Sector Specific	No	Ages 18+	Hybrid	N
9	**BSI**	GWO Certification	GWO certification, workplace	Cross-Sector	No	Ages 18+, unrestricted	In-person	N

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			safety, operations					
10	**Bureau Veritas Italia (certification released by Aliseo Group)**	GWO Training Standard	Safety, maintenance, operations	Cross-Sector	No	Ages 18+	In-person	N
11	**Form UP**	GWO - Sea Survival	Offshore survival, safety in offshore environments	Sector Specific	No	Ages 18+, under 50	In-person	N

Analysing the data, what stands out is that **most courses do not address the development of soft skills**, which are essential for effective communication and teamwork in professional settings. Despite that, the cross-sector nature of the courses seems to be balanced, with programmes offering both sector-specific knowledge and broader, transferable skills. Secondly, many of these programmes **do not automatically provide access to internships**, limiting students' opportunities to apply their theoretical knowledge in real-work situations.
However, it is worth noting that **safety is rightfully emphasized across all courses**, reflecting its critical importance in this sector. From the age data, it's possible to notice a generally inclusive approach, while still prioritizing younger and mid-career participants.

3.3.4 Greece

This chapter examines the current status of Vocational Education and Training (VET) in Southern Europe with a specific focus on offshore wind energy. It provides an overview of the VET system, policies, and priorities shaping the development of this critical sector. Special attention is given to efforts to enhance inclusion and attractiveness within VET, leveraging the strengths of Centres of Vocational Excellence (CoVEs) in Greece, and the alignment of VET offerings with industry demands. Additionally, the chapter explores the contributions of Higher Education Institutions (HEIs) to the sector, mapping their programmes and identifying synergies with VET initiatives to support workforce development in offshore wind energy.

3.3.4.1 VET system, policies and priorities

Vocational Education and Training (VET) is State-regulated, combining school- and work-based learning (WBL). It is offered at upper, post-secondary and tertiary levels. Overall responsibility is with the Ministry of Education in cooperation with other Ministries. VET qualifications at EQF levels 3 and 5 are awarded after certification exams organised by the National Organisation for Certification of Qualifications and Vocational Guidance (EOPPEP). Compulsory schooling lasts until age 15 and completion of lower secondary education *(Gymnasio).* At age 16, learners usually follow one of the two main upper secondary school education programmes, the general path (*Geniko Lykeio, GEL*) and the vocational one (*Epaggelmatiko*

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lykeio, EPAL). Based on CEDEFOP's data (2023), in 2021 33.8% of all upper secondary learners were enrolled in VET. VET permeability is supported as well as its equivalence to general education: at the end of the first year, learners may change direction from VET to general education and vice versa; both types of programmes lead to an equivalent end of upper secondary school leaving certificate at EQF level 4.

VET in Greece is offered through a diverse network of institutions, including Vocational High Schools (EPAL), Public and Private Institutes of Vocational Training (SAEK), and Lifelong Learning and Training Centres. These institutions play a crucial role in equipping individuals with the skills and knowledge required for the evolving labour market. The curriculum combines theoretical and practical components, emphasizing hands-on learning through apprenticeships and internships. A significant priority for VET in Greece is aligning its programmes with current and projected labour market demands, particularly in high-growth sectors. Special attention is given to developing skills related to Renewable Energy Sources (RES), reflecting the national commitment to sustainability and green development. These targeted efforts ensure that VET remains relevant and responsive, fostering a workforce capable of meeting the challenges of modern industries.

Greece has an educational culture that favours general education. The main route at upper secondary level is the EPAL programmes. Reforms in the last decade have endorsed apprenticeship and work-based learning to enable smooth transition from education to work and contribute to reducing youth unemployment. Companies provide apprenticeships in accordance with the training regulations, developed by the education ministry with the contribution of social partners. National standards, training regulations and the quality assurance framework ensure the quality of VET programmes. In order to increase the permeability of VET, recent policies have opened access to higher education for VET graduates.

Changes in VET are closely linked to national priorities set within the EU policy agenda. Greece is developing an overall lifelong learning culture through its reformed national VET and lifelong learning system (law 4763/2020) and its 2022-24 strategic plan for VET and LLL for resilience and excellence through quality, inclusive and flexible VET. The General Secretariat for VET, Lifelong learning and Youth has a central role in the design, coordination and monitoring of national policies (law 4763/2020). In the VET sector, the reform of public employment services (4921/2022) set up a new funding mechanism, a quality assurance system for continuing training programmes and certification of competences for individuals.

The Schools of Higher Vocational Training (SAEK) recently changed their name from Vocational Training Institutes (in Greek IEK) and represent a new era in VET in Greece, emphasizing quality and specialization. This name change reflects not just a formal upgrade but a substantive transformation in the educational and training services these institutions provide. Moving beyond basic vocational education, SAEK now focus on delivering advanced vocational training tailored to the contemporary demands of the labour market, preparing learners for specialized job roles. Their educational practices emphasize the acquisition of specialized knowledge and skills, integrating innovative methodologies such as Augmented and Virtual Reality (AR/VR) technologies into their programmes. These approaches are further enhanced by state-of-the-art labouratories equipped with cutting-edge technology. The philosophy of SAEK revolves around attracting talent by offering practical training opportunities, participation in European programmes, and

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collaborations with universities and industry partners. These strategies not only enhance the qualifications of learners but also position them competitively in both the Greek and international job markets.

3.3.4.1.1 Initial Vocational Education and Training (IVET) schools

The establishment of new initial vocational education and training (IVET) schools, (VTS, in Greek: *Epagelmatikes Sxoles Katartisis – ESK*), awarding qualifications at level 3 of the Hellenic qualifications framework (HQF), was announced by the Ministry of Education. The operation of VTS started in November 2022 at Perama, a suburb of Piraeus and part of the Athens-Piraeus urban area, and at Metsovo, a lively mountain town in Epirus, while the VTS of the island Syros started its operation in February 2023.

Vocational training schools: aims and prospects

The operation of VTS was introduced by Law 4673/2020 National System for Vocational Education and Training and Lifelong Learning, which established the National vocational education and training system at HQF levels 3, 4 and 5 of the Hellenic qualifications framework corresponding to the European qualifications framework (Law 4673/2020).

VTS provide modern initial vocational training aiming to upgrade basic skills in the most demanding specialities. Another goal of VTS is to deal with school dropout and improve the possibility of studying at a higher education level. Above all, VTS aim to ensure students' integration into the labour market and professional life, and particularly to encourage the integration of vulnerable groups into training.

Vocational training schools: structure and programme

Studies in VTS are completed in 2 years following attendance of theoretical and laboratory classes, as well as a paid internship/apprenticeship programme, which is carried out through placements related to students' speciality in companies of the private and public sectors. To register in a VTS, a degree of compulsory education or equivalent is required. VTS graduates earn a Vocational Education and Training degree at HQF level 3, after successful participation in certification exams conducted by the National Organisation for the Certification of Qualifications & Vocational Guidance (EOPPEP)[173].

The specialities that will be provided in VTS prioritise the acquisition of technical vocational skills. More precisely, the VTS of Perama will provide the following specialities: welding and metal cutting technician, rolling mill technician and rolling mill technician for special constructions. The VTS of Metsovo will provide the speciality of textile artisan.

[173] "National Organisation for the Certification of Qualification & Vocational Guidance."

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Additional specialities, with a high demand in the labour market related to the ship-building industry, such as machine tool technicians, applicators, roll workers, pipe workers, electric welders, sandblasters/painters and ship carpenters, have been operating in the VTS of Perama and Syros since the training year 2023/24.

3.3.4.1.2 Transition from IEK to SAEK in Greece

The Greek VET system has undergone significant reforms to enhance its alignment with the demands of the labour market and European standards. One of the most pivotal changes was the transition from **Institutes of Vocational Training (IEK)** to **Schools of Higher Vocational Education and Training (SAEK)**, introduced under **Law 4763/2020**.

Key Aspects of the Reform

1. **Elevating the Status of VET**:
    - The establishment of SAEK marks a shift towards the recognition of vocational education as a cornerstone of economic and social development.
    - SAEK is positioned as an integral part of post-secondary education, providing specialised skills and qualifications at a higher level.
2. **Legal Framework**:
    - Law 4763/2020 regulates the establishment, organization, and operation of SAEK.
    - It aligns the Greek VET system with the European Qualifications Framework (EQF), assigning SAEK programmes to Level 5.
    - The law aims to increase flexibility, quality, and responsiveness to market needs in vocational training.
3. **Distinctive Features of SAEK**:
    - SAEK programmes are designed to provide dual education combining theoretical knowledge with enhanced laboratory practice and at the end of the two years, a semester with workplace training.
    - Close collaboration with industries ensures that graduates are equipped with practical skills relevant to their fields.
4. **Broader Scope**:
    - Unlike IEKs, SAEKs have a broader mandate to develop expertise in emerging sectors such as renewable energy, digital technologies, and sustainable development.

Benefits of the Transition

The vocational training provided by SAEK (Vocational Training Centre) significantly enhances the employability of its graduates. By offering advanced certifications that are widely recognized both nationally and internationally, SAEK ensures that its learners have the qualifications required to thrive in high-demand industries. These programmes are tailored to meet the specific needs of sectors with growing job opportunities, leading to improved job placement rates. In addition, SAEK has established strong ties with

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industry partners. Through direct collaboration, SAEK co-develops curricula with businesses and provides learners with apprenticeships. This ensures that training is not only theoretically sound but also practical, closely aligning with the real-world demands of employers. Moreover, by adhering to European Qualifications Framework (EQF) Level 5 standards, SAEK graduates benefit from enhanced mobility across European labour markets. This alignment with European standards allows for greater recognition of their qualifications, increasing their employability in various European countries.

Overall, SAEK's approach prepares learners not only with the technical skills needed for their chosen industries but also with the certifications and experience that facilitate successful careers in both national and international markets.

Challenges in Implementation

The successful implementation of the new SAEK standards presents several challenges. One of the primary concerns is ensuring a smooth transition for existing IEK (Vocational Training Institute) learners, while aligning all current programmes with the new SAEK curriculum. This requires both curriculum adjustments and a systemic shift in how vocational education is approached across various institutions. Additionally, the development of sufficient infrastructure and the training of educators are critical to delivering the enhanced curriculum effectively. Without the proper resources and qualified instructors, the transition could fail to meet its intended goals.

A significant opportunity in overcoming these challenges lies in the integration of emerging technologies, such as Augmented Reality (AR). AR can revolutionize the way both teachers and learners engage with the curriculum. In vocational education and training (VET), AR provides an immersive experience, allowing learners to interact with learning materials and simulations in ways that traditional methods cannot offer. This approach not only improves the learning process but also better prepares learners for the modern labour market by offering practical, real-world applications in a controlled environment.

The integration of AR in VET training programmes in Greece aims to support teachers and trainers in reskilling and upskilling, enhancing their ability to guide learners through the transition from education and apprenticeships into real professional environments. This research seeks to contribute to this transformation by developing a curriculum that embraces AR technologies and by offering a novel, practical approach to vocational training. By aligning training with the latest technological advancements, it also ensures that VET programmes remain relevant in a rapidly evolving job market, ultimately benefiting both learners and the broader economy.

3.3.4.1.3 VET policies and priorities

Vocational Education and Training (VET) in Greece is increasingly focused on strategic skills development, with particular emphasis on fields such as energy, technology, and green skills. This includes fostering the adoption of tools and technologies that support sustainability, which are critical for meeting both national and international environmental goals. Additionally, Greece's active participation in European programmes such as SHOREWINNER, SECOVE, and STEAM4AG (Erasmus) highlights the importance of international cooperation and the creation of synergies across borders. These initiatives enable learners to gain valuable

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experience, also allowing for the sharing of best practices and the alignment of curricula with global standards.

Internship programmes play a crucial role in bridging the gap between education and the labour market. By implementing apprenticeships and direct connections with businesses, VET institutions ensure that learners receive hands-on training that is relevant to current industry needs. Alongside these educational initiatives, there is a strong push for the modernisation of infrastructure, particularly in labs and the installation of new equipment. This is especially important for supporting training in Renewable Energy Sources, with a focus on energy companies involved in installation and automation, as well as nautical agencies.

Furthermore, there is growing recognition of the importance of investing in automation technologies, such as robotics and marine automation (e.g., ship automation), to ensure that VET learners are well-equipped for the future of work. The Ministry of Education is also prioritising investment in new, experimental specialties that are closely aligned with the needs of the labour market. These emerging fields will help ensure that VET remains adaptable and responsive to changes in technology and industry demands, thus preparing learners for a dynamic and evolving job market.

3.3.4.1.4 Active learners in SAEK across Greece

The table below presents data on all active learners currently enrolled in **Schools of Higher Vocational Education and Training (SAEK)** across Greece. According to the latest figures, there are **145 active SAEK schools** nationwide, with a total of **30,587 learners** (Table 16).

Table 16. Greek SAEK and learners' numbers (DATA from Ministry of Education November 2024)

Greece SAEK	Learners 2024
1 SAEK IRAKLEIOU	318
1 SAEK LARISAS	337
2 SAEK IRAKLEIOU	243
2 SAEK LARISAS	365
THEMATIKI SAEK AIGALEO	797
THEMATIKI SAEK ACHARNON	530
THEMATIKI SAEK THESSALONIKIS	502
PEIRAMATIKI SAEK VEROIAS	320
PEIRAMATIKI SAEK GLYFADAS	357
PEIRAMATIKI SAEK THERMIS	552
PEIRAMATIKI SAEK KARDITSAS	166
PEIRAMATIKI SAEK KOZANIS	336
PEIRAMATIKI SAEK KOMOTINIS	247
PEIRAMATIKI SAEK MYTILINIS	273
PEIRAMATIKI SAEK NIKAIAS	418

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PEIRAMATIKI SAEK PATRAS	632
SAEK AG. ANARGYRON	357
SAEK AG. DIMITRIOU	457
SAEK AG. NIKOLAOU	184
SAEK AGRINIOU	426
SAEK AIGINAS	160
SAEK AIGIOU	240
SAEK AKADEMIAS PLATONOS	211
SAEK ALEXANDROUPOLIS	237
SAEK AMAROYSIOU	377
SAEK AmeA AGIAS PARASKEVIS	63
SAEK AmeA PYLAIAS CHORTIATI	52
SAEK AMPELOKIPON	269
SAEK AMYNTAIOU	119
SAEK AMFISSAS	55
SAEK APOKORONOU	24
SAEK ARGOU	196
SAEK ARIDAIAS	207
SAEK ARTAS	178
SAEK VOLOU	203
SAEK GALATSIOU	398
SAEK GIANNITSON	273
SAEK GREVENON	99
SAEK DAFNIS-YMITTOU	237
SAEK DIDYMOTEICHOU	157
SAEK DRAMAS	165
SAEK EDESSAS	186
SAEK ELLINIKOU-ARGYROYPOLIS	467
SAEK EPANOMIS	413
SAEK EVOSMOU	344
SAEK ZAKYNTHOU	70
SAEK ZITSAS	225
SAEK ZOGRAFOU	364
SAEK IGOYMENITSAS	115
SAEK ILIOYPOLIS	296

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SAEK THIVAS	130
SAEK ISTIAIAS-AIDIPSOU	171
SAEK IOANNINON	423
SAEK KAVALAS	490
SAEK KALAMATAS	417
SAEK KALYMNOU	90
SAEK KARPENISIOY	116
SAEK KASSANDRAS	24
SAEK KASTORIAS	212
SAEK KATERINIS	330
SAEK KERATSINIOU	522
SAEK KERKYRAS	263
SAEK KEFALLINIAS	110
SAEK KIFISIAS	365
SAEK KILKIS	133
SAEK KONITSAS	142
SAEK KORINTHOU	246
SAEK KORYDALLOU	519
2i SAEK KORYDALLOU	95
SAEK KOUFALION	178
SAEK KO	49
SAEK LAGKADA	273
SAEK LEFKADAS	91
SAEK LIMNOU	83
SAEK LIVADIAS	140
SAEK MARKOPOULOU	155
SAEK MEGALOPOLIS	60
SAEK MEGARON	301
SAEK MESOLOGGIOU	168
SAEK METAMORFOSEIS	391
SAEK METAXOURGEIOU	356
SAEK MONASTIRIOU	348
SAEK NAXOU	101
SAEK NAYPAKTOU	139
SAEK NAYPLIOU	208

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SAEK NEAPOLIS	502
SAEK NEAS ZICHNIS	129
SAEK NEAS IONIAS	254
SAEK NEAS SMYRNIS	325
SAEK NEON MOUDANION	263
SAEK XANTHIS	266
SAEK ORESTIADAS	71
SAEK PEIRAIAS	435
SAEK PERISTERIOU	297
SAEK POLYGYROU	62
SAEK PREVEZAS	128
SAEK PTOLEMAIDAS	297
SAEK PYLAIAS CHORTIATI	266
SAEK PYRGOY	207
SAEK RETHYMNOY	457
SAEK RODOY	149
SAEK SALAMINAS	169
SAEK SAMOY	123
SAEK SERON	419
SAEK SITEIAS	106
SAEK SIDIROKASTROU	163
SAEK SINDOU	362
SAEK SPARTIS	105
SAEK STEMNITSAS	30
SAEK SYROU	161
SAEK TRIANDRIAS	502
SAEK TRIKALON	342
SAEK TRIPOLIS	378
SAEK TRIFYLIAS	110
SAEK FLORINAS	197
SAEK CHAIDARIOU	415
SAEK CHALANDRIOU	421
SAEK CHALKIDAS	194
SAEK CHANION	335
SAEK CHIOU	161

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Of these, a significant number are enrolled in **Technical Vocational Specialties**. Based on the available data and the distribution of specialties in SAEK, it is estimated that learners in technical fields constitute approximately **15,000–18,000** of the total population (source: INEDIVIM). This reflects the growing demand for specialized technical education and training in Greece, aligned with the needs of the labour market.

Trainers/ Educators in SAEK

Approximately **10,000+ trainers/ educators** are employed to deliver vocational training in SAEK. These instructors are professionals in their respective fields, bringing practical expertise directly into the classroom. Most of them are employed under fixed-term contracts, with the majority teaching as a secondary occupation, complementing their primary professional careers. This model ensures that learners benefit from up-to-date industry knowledge and real-world insights, making the training highly relevant and practical.

3.3.4.1.5 The role of SAEK Egaleo in Greek VET

The SAEK of Egaleo, as the largest SAEK in Greece, stands out not only for the volume of its learners' body but also for its commitment to innovation and excellence in VET. It leverages cutting-edge labouratory facilities and its robust network of collaborations with local and international industries to provide training that directly aligns with market needs. To stay ahead in a rapidly evolving labour market, SAEK Egaleo actively develops innovative educational scenarios, integrating Augmented Reality (AR) and Virtual Reality (VR) technologies. These tools aim to make the learning process more engaging and transformative, offering learners an immersive experience that bridges theoretical knowledge and practical application.

Furthermore, SAEK Egaleo aligns its efforts with national and European priorities, such as those highlighted in projects like SHOREWINNER, focusing on renewable energy and green skills. This not only enhances learners' technical capabilities but also supports Greece's sustainable development goals.

Despite these advancements, the institution recognizes the need to further expand its reach and impact. Future efforts aim at enhancing the attractiveness of VET schools, particularly by addressing gender imbalances in technical fields and ensuring alignment with global professional standards. Through a combination of advanced teaching methodologies, continuous upskilling of educators, and strengthened collaboration with industries, SAEK Egaleo strives to serve as a benchmark for inclusive and forward-looking vocational education in Greece.

3.3.4.2 Inclusion and attractiveness in VET

VET in Greece has been undergoing reforms to increase its inclusion and appeal to a wider audience. Efforts are aimed at reshaping perceptions of VET as a viable and valuable educational path, bridging the gap between traditional academic routes and practical skills-based education. Enhancing accessibility for learners from diverse socio-economic backgrounds, integrating modern technologies, and aligning programmes with contemporary labour market needs are central to these strategies. Furthermore, emphasis is placed on creating an environment that fosters innovation, gender equality, and inclusivity for individuals

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with disabilities or from marginalized communities, ensuring that no group is left behind in benefiting from the opportunities offered by VET systems.

This foundational shift sets the stage for more targeted measures, such as program-specific enhancements and collaboration with industry, to strengthen VET role in Greece's educational landscape.

3.3.4.2.1 Admission process to SAEK in Greece

The admission process to Schools of Higher Vocational Education and Training (SAEK) in Greece is designed to provide equal opportunities to candidates from diverse educational backgrounds, ensuring that enrolment is based on merit and aligned with national priorities for vocational training.

Admission Through Panhellenic Examinations

A significant number of learners are admitted to SAEK based on their performance in the Panhellenic Examinations, a standardised national testing system. Candidates who graduate from General or Vocational High Schools (Lykeia) are eligible to participate.

The admission process through this route involves the following steps:

1. Candidates sit for the Panhellenic Examinations, which assess their knowledge across various subjects.
2. After receiving their results, they use their scores from the National Graduation Certificate to apply to SAEK.
3. The application is submitted through the parallel admission form, where candidates indicate their preferred SAEK programmes and specialties.

This route ensures that learners are matched with programmes that align with their academic strengths and career aspirations.

Filling Vacant Positions Through Applications

In addition to the primary admission process via the Panhellenic Examinations, SAEK schools also offer a secondary route to fill any vacant positions.

- At the end of August, a direct application process is opened for prospective learners who did not gain admission through the Panhellenic system or are seeking alternative opportunities.
- Candidates apply directly to the SAEK of their choice, provided there are available seats in the program they wish to join.
- Selection is typically based on their academic qualifications and available capacity in each specialty.

This approach ensures that no seats remain unused, maximising the accessibility of vocational training.

A Dual Path to Opportunity

The dual admission system of SAEK—via the Panhellenic Examinations and the supplementary application process—demonstrates the flexibility of the Greek VET system in accommodating various candidate profiles.

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By prioritising merit and addressing market demands, SAEK ensures that learners are equipped with the skills needed for the evolving labour landscape, further enhancing the appeal of vocational education.

The diagram of Figure 52 illustrates the pathways available to learners in Greece's education system, focusing on transitions between Vocational Education and Training (VET) and Higher Education Institutions (HEIs). More specifically:

Upper Secondary Education:

- **General Upper Secondary Schools (GEL):** Students typically pursue academic studies, leading to the national exams for university admission.
- **Vocational Upper Secondary Schools (EPAL):** Students engage in vocational studies, culminating in a diploma at EQF level 4.

Post-Secondary Options:

- **EPAL Graduates:**
  - **Apprenticeship Year:** An optional "post-secondary year – apprenticeship class" combining work-based learning with school-based education, leading to a Level 5 qualification.
  - **Schools of Higher Vocational Education and Training (SAEK):** EPAL graduates can enrol in SAEK programmes to further specialise in their field.
- **GEL Graduates:**
  - **University Admission:** Primarily through national exams.
  - **IEK Enrolment:** GEL graduates may also choose to enrol in SAEK programmes.

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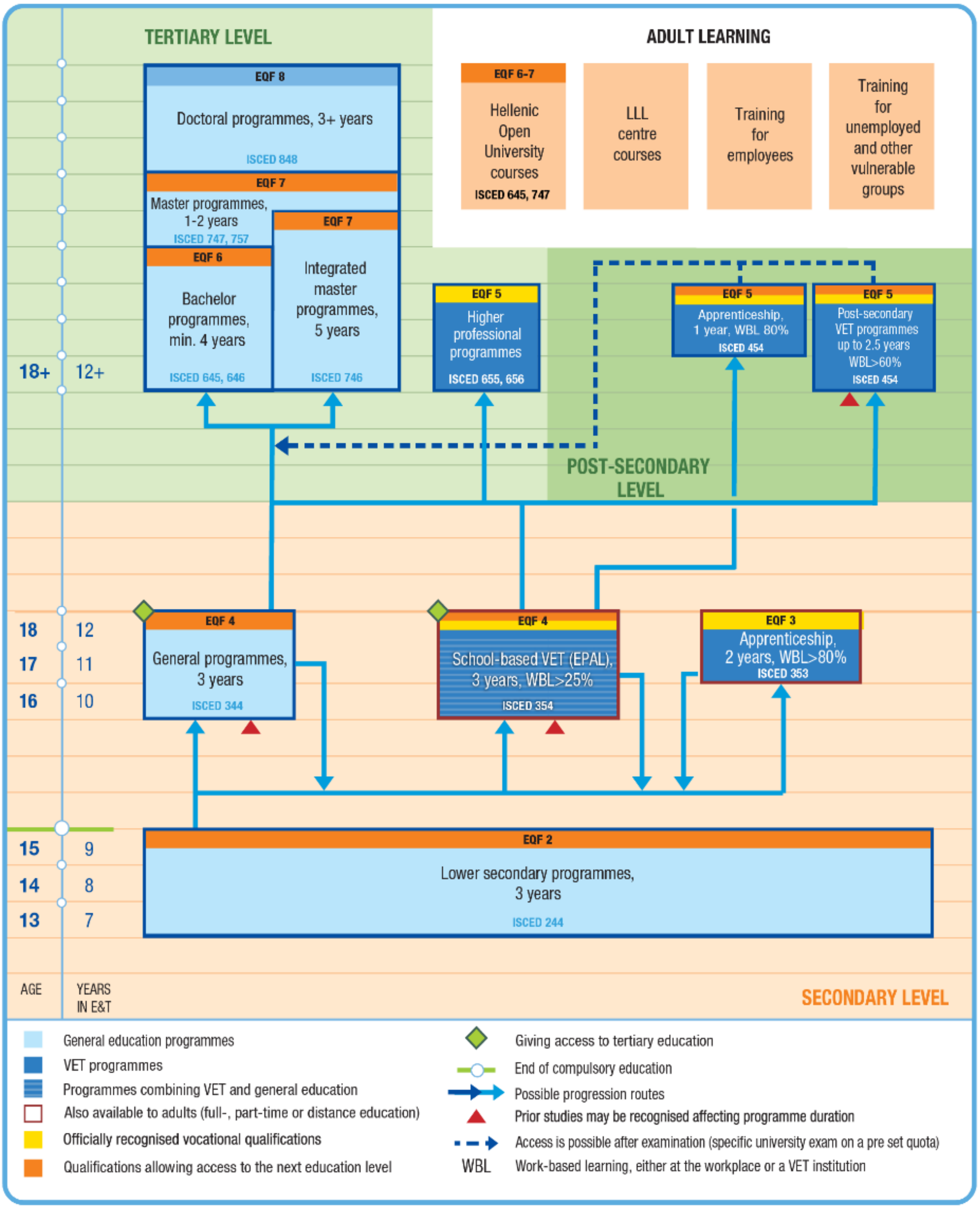

Figure 52. VET system chart in Greece[174]

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Higher Education:

- **Universities:** Offer undergraduate and postgraduate programmes.
- **HEI Graduates:**
    - **Further Studies:** Opportunities for postgraduate education.
    - **Labour Market Entry:** Direct transition into the workforce.

Permeability and Transitions:

- The system allows for mobility between pathways. For instance, VET graduates can access higher education through specific exams, and HEI students may pursue vocational qualifications to enhance practical skills.

3.3.4.2.2 Promoting inclusion and equal opportunities in Greek VET

The Greek VET system is committed to ensuring inclusion and providing equal opportunities for all individuals, regardless of their socio-economic background, disabilities, or immigrant status. Public VET institutions, such as EPAL and Public SAEK, play a pivotal role in this effort by offering free education, making VET an accessible and viable pathway for marginalised groups.

Specialised support measures are in place to address diverse learner needs, including remedial teaching, psychological counselling, and career guidance. Additionally, targeted initiatives encourage women's participation in traditionally male-dominated technical fields, such as renewable energy and engineering, fostering gender equality within the sector. Notably, SAEKs actively provide equal opportunities for both men and women in all specialties, including technical fields like Renewable Energy Sources, which have seen women trainees enrolled over time.

On average, learners in Greece tend to graduate from upper secondary vocational education and training (VET) programmes at a younger age (21 years old) than in EU-27 (22 years old) but the percentage of first-time graduates who obtained a vocational qualification is 22% compared to the 43% of the EU 27 (CEDEFOP, 2023). VET institutions prioritise lifelong learning, supporting adults who wish to reskill or upskill. Flexible learning options, such as evening schools and part-time programmes, help promote social inclusion and ensure education remains accessible at all stages of life. SAEKs exemplify this inclusive approach, combining modern facilities with progressive initiatives that empower all individuals to pursue their vocational aspirations.

[174] "CEDEFOP | European Centre for the Development of Vocational Training."

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3.3.4.2.3 Attractiveness of VET

VET in Greece has adapted to include contemporary fields such as Renewable Energy Sources (RES), increasing its relevance and appeal to younger generations. Strong links with the labour market through apprenticeships and internships enhance the employability of graduates.

Partnerships with companies and participation in projects like SHOREWINNER, SECOVE etc., increase visibility and provide learners with real-world experience. Employer engagement highlights the value of VET graduates, improving its public perception.

National campaigns promote VET as a viable and prestigious alternative to academic education (although need much more focus attractive campaign and a social media campaign). Finally, events such as open days at VET institutions and participation in exhibitions like ENERGIA.TEC showcase opportunities and career paths.

3.3.4.3 Assets from the CoVE Greece

The CentreCentre of Vocational Excellence (CoVE) in Greece consists of the University of the Aegean (lead), the Hellenic Wind Energy Association (HWEA/ELETAEN), the Hellenic Centre for Marine Research (HCMR/ ELKETHE) and SAEK Egaleo. The CoVE demonstrates a holistic approach to VET by fostering collaboration with industry, engaging with the community, and emphasising sustainability and innovation. It is expected to establish a distinguished reputation for expertise in education and training in cutting-edge fields of key sectors such as construction, energy, and technology, particularly Renewable Energy Sources (RES) and sustainable technologies.

Through its strong collaboration with industry experts, the CoVE wishes to ensure that its training programmes will not only be aligned with current market demands but are also forward-looking, preparing learners for future challenges in the energy sector. A cornerstone of its approach lies in its development of modern, modular curricula that seamlessly integrate theoretical knowledge with hands-on practice, adhering to both national and European standards. These curricula will place a significant emphasis on green and digital skills, reflecting the growing importance of sustainability and technological proficiency across industries. Additionally, through these curricula, learners will have the unique opportunity to work alongside professionals of their specialisation during their Practical Training phase. This collaboration bridges the gap between education and employment, equipping learners with the skills and confidence needed for their careers.

Community engagement is another cornerstone of the CoVE's philosophy. By actively involving local communities, the CoVE expects to raise awareness about VET opportunities, promoting inclusivity and accessibility for all learners. Public workshops, open days, and other outreach initiatives not only highlight the value of VET but also cultivate a culture of lifelong learning, encouraging individuals to continuously upgrade their skills in a rapidly evolving job market.

A strong focus on sustainability and innovation also underscores all CoVE’s activities. Through the integration of practices that promote energy efficiency and green technologies, the CoVE will prepare learners to contribute meaningfully to a sustainable future. Participation in European networks further enhances the

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exchange of knowledge and the adoption of innovative instructional methodologies, keeping the CoVE at the forefront of educational and training excellence. To complement theoretical learning, the CoVE will organize educational field visits, where learners will be able to analyse real-world projects under the guidance of expert technicians and scientists. These visits are expected to provide invaluable insights into the practical applications of their training, fostering a deeper understanding of their chosen fields and reinforcing the connection between academic concepts and industry practices.

Furthermore, the CoVE is dedicated to offering tailored learning pathways that cater to a diverse range of learners, including initial VET learners, adult learners seeking professional development, and professionals pursuing upskilling opportunities. This flexibility underscores the CoVE's commitment to inclusivity and its ability to address the evolving educational needs of individuals and industries alike.

Among the resources that will be applied by the Greek CoVE will be:

1. **State-of-the-Art Infrastructure**
    - Fully equipped laboratories and training centres providing students with access to advanced tools and technologies.
    - Specialised facilities available for hands-on learning in renewable energy systems, industrial automation, and other cutting-edge fields.
2. **Qualified Trainers and Mentors**
    - CoVE members will contribute as experienced trainers who are continuously upskilled to stay abreast of technological advancements.
    - Mentorship programmes could bridge the gap between theory and practice, offering personalised support to learners.
3. **Digital Platforms and Tools**
    - Online learning platforms and virtual simulations could enhance accessibility and interactivity in education.
    - Digital tools will be utilised for monitoring of student progress and performance.
4. **Integration of AR and VR Technologies**
    - Augmented Reality (AR) and Virtual Reality (VR) technologies will be utilised in both laboratory exercises and theoretical learning models, providing immersive and interactive educational experiences. These tools enable students to visualise complex systems, simulate real-world scenarios, and practice technical skills in a risk-free virtual environment, bridging the gap between theory and practice.

The CoVE in Greece is expected to leverage its experience, best practices, and robust resources to deliver high-quality, market-relevant training programmes. By fostering collaboration and innovation, the CoVE will significantly enhance the local and national VET ecosystem, equipping learners with the skills needed for a sustainable and dynamic labour market.

3.3.4.4 Mapping of VET offerings

VET plays a crucial role in preparing the current and future workforce for the offshore wind and renewable energy sectors. The rapid expansion of these industries has created a demand for a skilled labour force

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capable of meeting the technical, operational, and maintenance requirements of offshore renewable energy installations. This mapping identifies the VET programmes available in Greece, focusing on their alignment with the current and projected needs of the offshore wind and renewable energy sectors.

Greece, as a country with a limited degree of industrialisation, shapes its VET system to align with its unique geographic characteristics, local community needs, and national priorities. The VET offerings reflect the country's specific socio-economic context, emphasising the development of skills that cater to regional demands and the challenges faced by Greece. This localized approach is further influenced by the national educational policies, which aim to balance the requirements of the labour market with broader social and economic goals, ensuring inclusivity and adaptability.

In Greece, VET programmes are designed to address the distinct needs of a country characterised by its diverse geography, spanning islands, mountainous regions, and urban centres. Many technical specialties focus on sectors that are pivotal to the Greek economy, such as tourism, agriculture, energy, and shipping. Additionally, there is an increasing emphasis on integrating modern technologies and sustainable practices into training, reflecting global trends and the country's aspirations for growth and innovation. The Greek VET system strives to equip learners with practical skills while fostering lifelong learning opportunities, aligning education with the workforce's evolving demands.

At SAEK Egaleo, the specialties offered are specifically tailored to meet these goals, ensuring that students gain expertise in areas critical to the region's and the country's development, such as:

- **Elevator Technician.** The Elevator Technician is responsible for installation, maintenance, repair and the upgrade-modernization of the elevators. The Elevator Technician has knowledge and skills that make it possible to install elevators with responsibility and professional ethics. Maintenance and Repair-Modernization of Elevators are objects of work of the Elevator Technician.
- **Technician of Renewable Energy Sources Installations**. The Technician of Renewable Energy Sources Installations works under the guidance of senior engineers to install, maintain, and manage systems such as photovoltaic panels, wind turbines, geothermal, and solar thermal energy equipment, including storage solutions for future use. Approximately 9,000–10,000 workers are currently employed in this profession, while related industries, including maintenance and installation of renewable energy systems, employed about 100,000 workers in 2012, with 40–50% involved in maintenance and the rest in installation and related products like software and control instruments.
- **Technical Engineer of Thermal Installations and Engineer of Oil and Natural Gas Technology**. The Thermal Engineering Technician & Oil and Gas Technology Engineer specializes in installing, maintaining, and inspecting gas and oil fuel networks, devices, and quality control systems. They can work in industries involving fuel networks, natural gas distribution, DEPA, repair shops, sales companies, or as freelance installers and maintainers, equipped with certified skills to autonomously and responsibly handle tasks like construction, repair, and maintenance of thermal installations.
- **Maritime Automation Technician**. A Maritime Automation Technician designs, installs, maintains, and repairs automation systems used on ships and maritime facilities, including navigation, engine control, energy management, and safety systems. They diagnose malfunctions, optimize operations,

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and contribute to vessel performance, safety, and sustainability by integrating modern, energy-efficient solutions essential for the evolving maritime sector.

Focusing on the specialization of Renewable Energy Sources Technician in Greece, the following public Vocational Education and Training Centres currently offer this program: Egaleo, Piraeus, Chios, Heraklion (Crete), and Aridaia. Additionally, there are schools under the Public Employment Service (DYPA) across Greece offering similar specialties, such as Energy Storage Technician. However, many of these specializations are not currently active due to insufficient student enrolment, which is necessary for the programmes to operate.

These vocational centres aim to provide high-quality technical education aligned with the growing demand for skilled professionals in the renewable energy sector, but the effectiveness of the offerings is constrained by the number of students able to attend. Therefore, while opportunities exist, the actual availability of programmes may vary based on regional demand and resources.

Challenges

The training programmes for renewable energy technicians in Greece, particularly in specialized areas such as offshore wind energy, face significant challenges. There is limited specialized offshore training, as many programmes lack focus on offshore-specific challenges, such as the installation of deep-water turbines and the unique environmental conditions these projects involve. This gap in training is compounded by insufficient digital and automation training, where there is a need for greater emphasis on emerging technologies such as Artificial Intelligence (AI) and the Internet of Things (IoT) for predictive maintenance and operational efficiency in renewable energy systems.

Furthermore, a shortage of certified trainers with real-world experience in offshore environments further limits the quality of education. The demand for qualified instructors who can provide practical, hands-on knowledge in these high-tech and specialized fields is far from being met. Compounding these issues is insufficient funding for vocational education and training programmes, which affects both the quality and availability of these courses. Many schools, especially in rural areas, face challenges due to outdated equipment and a lack of sufficient laboratory facilities, with some not having the necessary infrastructure to provide practical training at all. This makes it even harder for these schools to deliver the advanced training required to meet the growing demands of the renewable energy sector.

These limitations hinder the ability of vocational education to fully support the rapid development of renewable energy industries, particularly offshore wind energy, and contribute to the skills gap that many sectors are currently facing.

According to the existing legislative framework in Greece, there is a significant gap in the collaboration between private and public educational institutions. This lack of effective partnerships has a considerable impact on various aspects of the educational process, particularly in technical and vocational education. The disconnect between the public and private sectors limits the potential for synergies that could enhance the quality of education and training, particularly in high-demand sectors like renewable energy.

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This issue becomes especially evident in technical fields, where practical training and industry engagement are crucial. The absence of strong public-private collaborations means that many students face limited opportunities for hands-on experience and internships, which are vital for bridging the gap between theoretical knowledge and real-world application. Consequently, this results in a reduced opportunity for students to gain experience "on the field", making it both more difficult and less rewarding to enter these sectors after graduation.

The lack of cooperation further exacerbates the challenges faced by vocational education in Greece, particularly in rural or less-developed areas, where limited resources and outdated equipment already hinder the quality of training. As a result, students in technical fields often find themselves underprepared for the workforce, with fewer pathways to gain industry-relevant skills. This creates a substantial barrier to the growth of the renewable energy sector and other emerging industries, which rely on a skilled, well-trained workforce.

3.3.4.5 Mapping of HEI offerings

Many undergraduate and postgraduate study programmes in Greece are related to and active in renewable energy sources, wind energy, offshore wind energy, and environmental education. Moreover, some training programmes are offered by university institutions too.

In detail, Undergraduate (UG), Postgraduate (PG) study programmes and training programmes (TP) are presented in the Table 17.

Table 17. Undergraduate, Postgraduate studies and Training programmes related to renewable energy, offshore wind energy and education

Program type	University / Institution	Department	Program title/ Related courses
UG	University of the Aegean - Mytilene	Department of Environment	• Energy and the Environment • Labouratory course in Transport of Mass and Energy • Renewable Energy Sources • Methods in Environmental Education • Energy Analysis • General Didactics
UG	University of Thessaly - Larissa	Department of Environment	• Environmental Education • Life Cycle Assessment of Environmental Systems • Didactics of Environmental Sciences
UG	Ionian University - Zakynthos	Department of Environment	• Economics and the Environment I • Environmental Fluid Mechanics • Renewable Energy Sources I (Solar PV and Wind Energy Conversion Systems) • Environmental Policy and Legislation

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			• Environmental Education and Communication • Renewable Energy Sources II • Economics and the Environment II • Teaching Methodologies • Teaching Methods for the Physical Sciences
UG	University of Patras - Patra	Department of Physics	• Renewable Energy Sources
UG	Democritus University of Thrace - Komotini	Department of Environmental Engineering	• Technologies of Renewable Energy Sources
UG	Technical University of Crete - Chania	Department of Chemical Engineering and Environmental Engineering	• Energy and Environmental Technologies • Renewable Energy Sources • Design of Energy Systems
UG	Democritus University of Thrace - Xanthi	Environmental Engineering	• Technologies of Renewable Energy Sources
PG	University of the Aegean – Mytilene	Department of Environment	MSc in Global Environmental Change, Management & Technology - Ecological Engineering-Energy & Climate Change • Energy Management and Decision Making
PG	University of Western Macedonia – Kozani	Department of Mechanical Engineering and Electrical and Computer Engineering	MSc in Renewable Energy Sources & Energy Management in Buildings • Energy Economy & Energy Markets • Mechanical Energy Systems • Renewable Energy Technologies • Electrical Energy Systems • Emerging RES & Energy Storage • Wind Energy Systems
PG	University of Piraeus – Piraeus	Department of Digital Systems	MSc in Climate Crisis and Information and Communication • Energy Systems and Climate Crisis
PG	University of West Attica – Athens	Department of Mechanical Engineering	MSc in Energy Systems • Renewable Energy Technologies • Wind Energy Applications

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PG	University of Macedonia - Aristotle University of Thessaloniki – Thessaloniki	Department of Economics – School of Law	MSc in Law & Economics • Environment and Energy: Legal and Economic Aspects • Legal and Economic dimensions of Activities and Transactions in the Energy sector • Policy and Legal framework of the Energy sector in the EU
PG	National & Kapodistrian University of Athens – Athens	Department of Geology & Geoenvironment	MSc in Environmental, Disaster & Crises Management Strategies • Education and Climate Crisis • Earth systems and natural resources • Adaption to Climate Change
PG	Hellenic Mediterranean University – Heraklion of Crete	Department of Electrical Engineering and Mechanical Engineering	MSc in Energy Systems • Wind Energy Systems • Energy Systems Management
PG	University of the Aegean – Rhodes	Department of Preschool Education and Educational Design	MSc in Environmental Education • Theoretical Framework of Environmental Education: Basic Principles and Concepts • Local Societies and Environmental Protection in the Perspective of Sustainable Development • Introduction to Environmental Sciences • Environmental Issues in the perspective of Sustainable Development • Lifelong learning: Active citizenship and Environmental Protection in the Educational Sciences
PG	University of West Attica – Athens	Department of Mechanical Engineering	MSc in Energy and Environmental Investments • Renewable and Conventional Energy Technologies • Economics of Energy and the Environment • Environmental & Energy Legislation and Policy – Social Acceptance of Energy and Environmental Projects

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			• Economic and Technical Evaluation of Energy and Environmental Investments • Planning, Implementati n and Operation of Energy Projects / Environmental Protection Projects • Energy Production, Distribution and Storage Facilities. Smart Grids and Distributed Generation • R&D Applications: Seminars on Contemporary Energy / Environmental Issues
PG	University of Western Macedonia – Kozani	Department of Chemical Engineering & Economic Sciences	MSc in Energy Investments and Environment • Technologies of Renewable Energy Sources
PG	University of Thessaly – Volos	Department of Mechanical Engineering	MSc in Analysis & Management Energy Systems • Analysis of Production Systems – Inventory • Materials for Energy Infrastructures
PG	University of West Attica – Athens	Department of Mechanical Engineering	MSc in Sustainable Energy Systems • Renewable Energy Technologies • Distributed Generation, Energy Storage & Energy Management • Wind/Hydro/Marine Energy Systems
PG	National Technical University of Athens – Athens	School of Naval Architecture and Marine Engineering	MSc in Ship and Marine Technology • Seminars on Topics of Marine and Underwater Technology • Structural Mechanics and Design of Offshore Pipelines • Reliability and Risk Analysis for Offshore Structures • Introduction to Marine Renewable Energy Sources • Steel Structures for Marine Applications
PG	International Hellenic University – Thessaloniki	School of Science & Technology	MSc in Energy Systems • Wind and Hydro Power Systems

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PG	International Hellenic University – Serres	Department of Mechanical Engineering	MSc in Renewable Energy Systems • Energy Conversion Systems • Renewable Energy Sources I • Renewable Energy Sources II
PG	International Hellenic University – Thessaloniki	Department of Agriculture	MSc in Environmental Management and Environmental Education • Environmental Actions in Education • Environmental Education and Awareness • Innovative Environmental Investments • Green Development and Environment
PG	National Technical University of Athens – Athens	School of Electrical and Computer Engineering, Mechanical Engineering, Chemical Engineering, Civil Engineering and Shipbuilding Mechanical Engineering	MSc in Energy Production and Management • Electrical Energy Systems • Wind - Hydroelectric Energy • Environmental Technology and Management
PG	Democritus University of Thrace – Orestiada	Department of Forestry and Management of the Environment and of Natural Resources	MSc in Environmental Planning and Environmental Education • Didactics of Environmental Science
TP - Continuing Education and Lifelong Learning Centre (CE-LLC)	Centre of Continuing Education and Lifelong Learning (C.CE.LL.) – University of Western Macedonia - Florina	-	Renewable Energy Sources • Wind parks • Introduction to energy production • Energy policy – institutional framework – RES licensing
TP - Continuing Education and Lifelong Learning Centre (CE-LLC)	University of Macedonia - Thessaloniki	-	Environment, sustainability and cultural heritage: contemporary educational practices • Environmental Education: Basic principles, theoretical trends and practical application
TP - Continuing Education and	University of the Aegean	-	Environmental Education and Sustainable Development in society

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Lifelong Learning Centre (CE-LLC)			• Introduction to Environmental Education

3.3.5 Cyprus

The education system in Cyprus is structured into several stages that integrate both academic and vocational pathways, providing learners with multiple routes to develop their skills and knowledge from primary through tertiary education. The foundation of the Cypriot education system is compulsory education, which spans from primary school to the completion of upper secondary education at around age 18. The system is designed to be inclusive and adaptable, offering various forms of vocational education at both secondary and post-secondary levels to meet the demands of an evolving labour market.

Cyprus' education system is divided into three primary stages (Figure 53):

- **Primary Education (ages 6-12)**: This foundational stage provides a general education curriculum with no vocational elements.
- **Lower Secondary Education (Gymnasium) (ages 12-15)**: Upon completing primary school, students progress to Gymnasium, which offers general education and the first steps toward vocational training options for interested students.
- **Upper Secondary Education (ages 15-18)**: This stage consists of two main pathways:
    - **Lyceum (General Education)**: A traditional academic route leading to the "Apolyterion" (leaving certificate), which qualifies students for tertiary education (aligned with EQF Level 4).
    - **Technical and Vocational Education and Training (TVET)**: A three-year programme that also leads to the Apolyterion but focuses on technical skills, preparing students either for immediate employment or for higher vocational education. This stream provides qualifications equivalent to EQF Level 4, allowing access to both higher education and the labour market.

3.3.5.1 VET system, policies and priorities

VET in Cyprus is offered at both secondary and tertiary levels, with a strong focus on aligning qualifications with the **European Qualifications Framework (EQF)**. VET programmes start at **EQF Level 2** with the preparatory apprenticeship, progressing through to **EQF Level 5** for higher vocational qualifications (Figure 54)

- **Apprenticeships**: Available to students who have completed lower secondary education, apprenticeships provide both practical and theoretical training in various technical fields. Apprenticeships at the **core level** correspond to **EQF Level 3**, preparing students for entry into the workforce or further studies in evening technical schools, where they can achieve **EQF Level 4** qualifications.

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- **Tertiary VET**: Cyprus also offers **EQF Level 5** VET programmes at the tertiary level, including diplomas in areas such as technical and vocational fields. These programmes are provided by accredited public and private institutions.

In the Technical and Vocational Education and Training (TVET) system, students receive practical and theoretical education geared toward various industries. The system's primary goal is to provide learners with relevant skills that can either lead directly into employment or further study at the post-secondary level.

Post-secondary Education and VET After completing secondary education, students have several options:

- Public Higher Education Institutions offer vocational programmes (1-3 years), focusing on specific trades and professional qualifications.
- Private Higher Education Institutions and universities provide both academic and vocational programmes, many of which are accredited by the Cyprus Agency of Quality Assurance and Accreditation in Higher Education (CYQAA). These programmes may include vocational pathways linked to renewable energy, engineering, and other technical fields.

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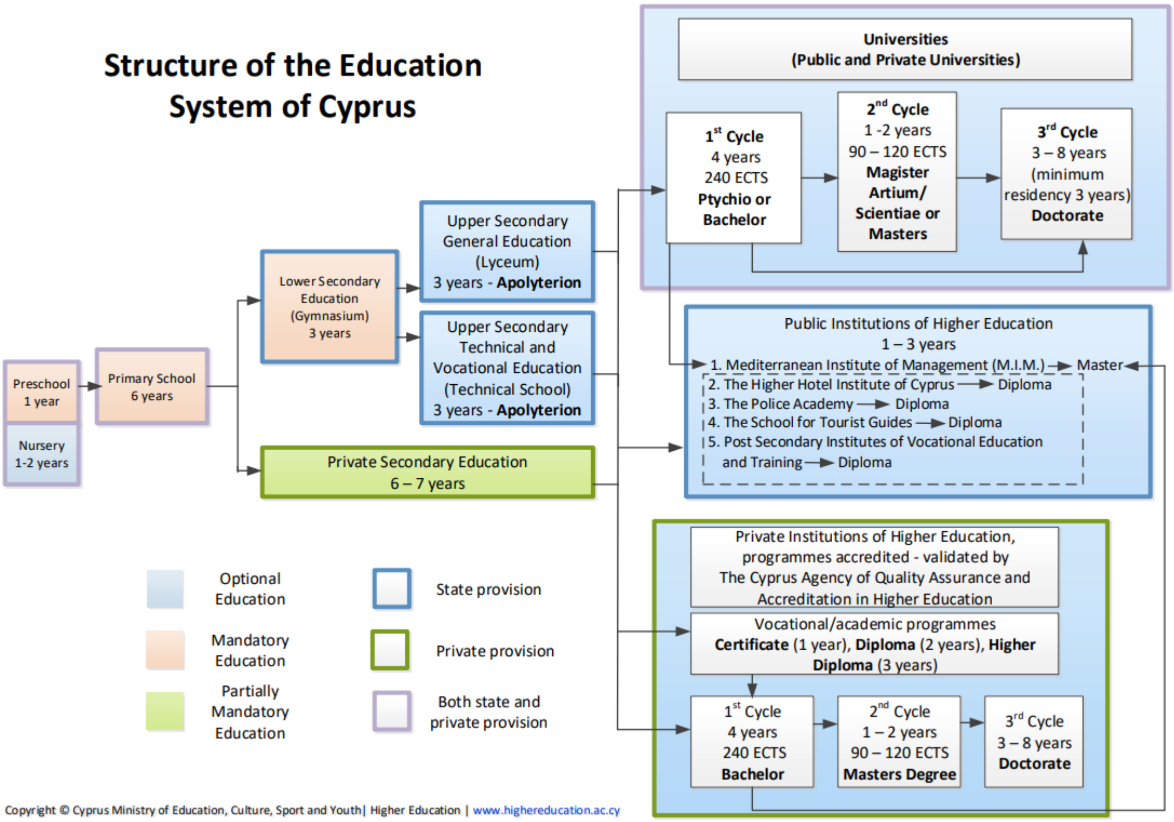
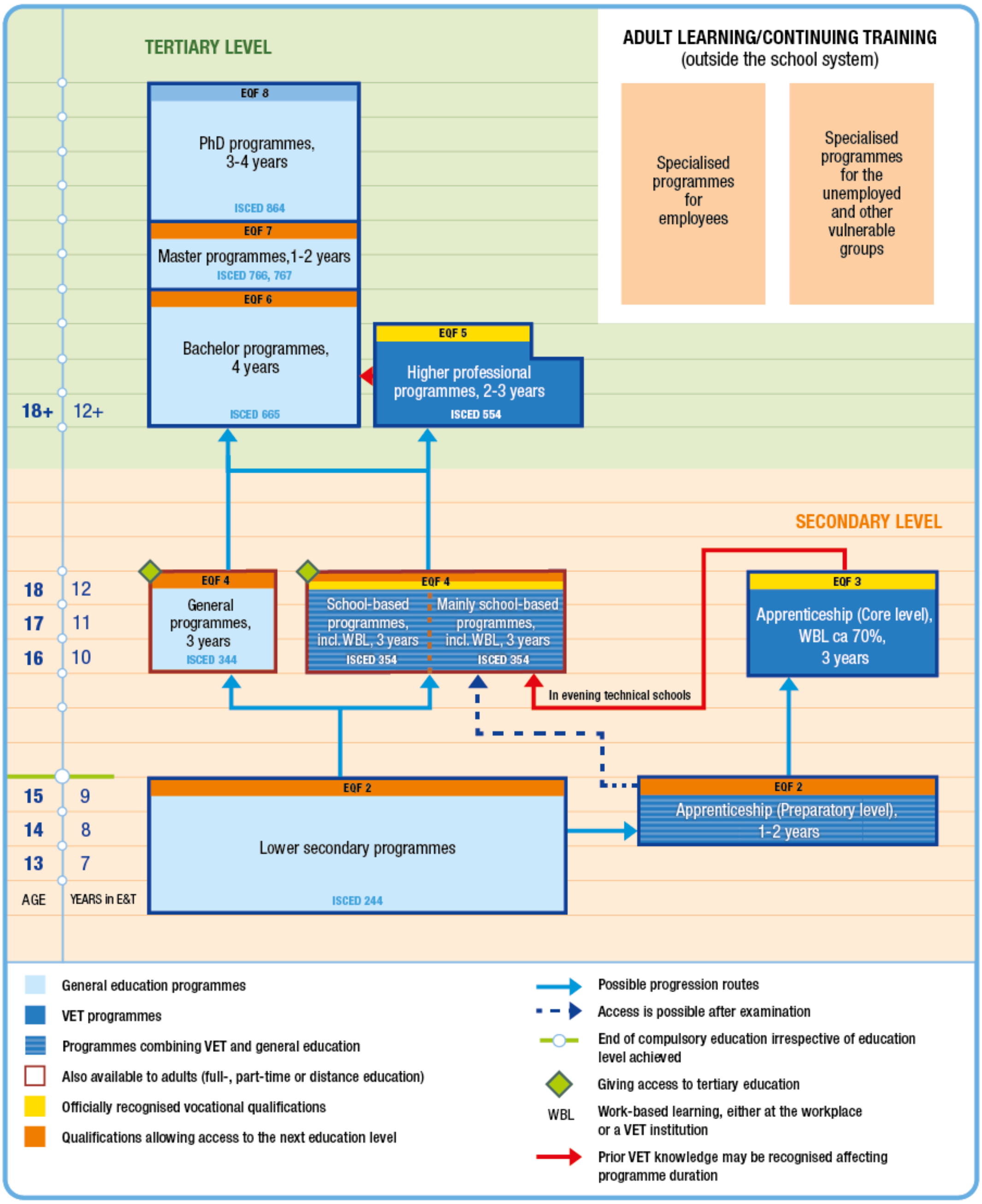


Figure 53. Structure of the education system of Cyprus[175]

The vocational programmes offered at both public and private institutions provide students with qualifications aligned with the European Qualifications Framework (EQF), ranging from EQF Level 4 (Upper secondary level) to EQF Level 5 (Post-secondary non-tertiary qualifications).

[175] "Structure of the Education System of Cyprus."



NB: ISCED-P 2011.
Source: Cedefop and ReferNet Cyprus, 2022.

Figure 54. VET framework in Cyprus[176]

[176] European Centre for the Development of Vocational Training., *Spotlight on VET, 2020 Compilation*.

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Vocational Education and Training (VET) in Cyprus is well-integrated within the broader education system, offering flexibility to learners through permeability between academic and vocational pathways. This means students can switch between general education and vocational routes without losing their progress, ensuring that vocational training remains a viable option for all learners.

For instance, students completing a TVET program at the secondary level can pursue further vocational qualifications at the post-secondary level, either through Public Higher Education Institutions or other accredited private institutions. Additionally, TVET students receive an Apolyterion, which allows them to continue to higher education if they choose, ensuring vertical mobility within the system.

The system is designed to provide lifelong learning opportunities, allowing adult learners to return to vocational education to upskill or reskill. This approach ensures that the VET system in Cyprus remains responsive to changes in the labour market and the evolving demands of industries, including the emerging renewable energy sector. Vocational programmes in Cyprus are also increasingly focused on digital skills and green technologies, as the country aligns its education and training goals with the needs of a sustainable economy.

The VET system in Cyprus is primarily governed by the Ministry of Education, Sports, and Youth[177], with key contributions from other bodies, such as the Human Resource Development Authority (HRDA[178]) and the Cyprus Agency of Quality Assurance and Accreditation in Higher Education (CYQAA[179]). These organizations work together to ensure that vocational programmes are aligned with the country's educational goals, labour market demands, and European standards.

3.3.5.1.1 Ministry of Education, Sports, and Youth (MESY)

The Ministry of Education, Sports, and Youth play a central role in the governance and implementation of VET policies across the country. The Ministry oversees the overall structure of the VET system, from secondary education to post-secondary vocational training programmes, and ensures these are aligned with both national priorities and EU policies, such as the European Qualifications Framework (EQF). Key responsibilities of the Ministry include:

- **Curriculum development**: The Ministry designs the curriculum for vocational education programmes, ensuring that it is relevant to the needs of Cyprus' economy while adhering to European standards.
- **Funding and infrastructure**: It provides funding for vocational schools, develops infrastructure to support VET, and ensures that students and institutions have access to the resources necessary to deliver high-quality vocational training.

[177] "Cyprus Ministry of Education, Sport and Youth."
[178] "HUMAN RESOURCE DEVELOPMENT AUTHORITY OF CYPRUS (HRDA)."
[179] "Home."

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- **Collaboration with European initiatives**: The Ministry works closely with European partners to align VET programmes with broader European Union strategies, such as the Green Deal and the Digital Education Action Plan, ensuring that the Cypriot workforce is prepared for future market demands.

3.3.5.1.2 Human Resource Development Authority (HRDA)

The Human Resource Development Authority (HRDA) plays a crucial role in shaping Cyprus' vocational training landscape by analysing labour market trends and designing VET programmes that correspond to the needs of the economy. The HRDA focuses on ensuring that the workforce is adequately trained and skilled to meet current and future labour market demands, particularly in emerging sectors like renewable energy, tourism, and technology. The HRDA's contributions to the VET system include:

- **Labour market research**: HRDA regularly conducts research on labour market trends to identify skill gaps in key sectors. This research guides the creation of vocational training programmes that are highly relevant to industry needs.
- **Training programmes and grants**: The HRDA provides funding for both public and private training centres to deliver vocational programmes that address identified skill gaps. It offers grants and subsidies to companies and individuals for training and upskilling initiatives, particularly in emerging industries.
- **Continuous Vocational Education and Training (CVET)**: In addition to initial vocational education, HRDA supports continuous vocational education and training (CVET) for individuals already in the workforce, ensuring that they can acquire new skills and adapt to changing market conditions.

3.3.5.1.3 Cyprus Agency of Quality Assurance and Accreditation in Higher Education (CYQAA)

The Cyprus Agency of Quality Assurance and Accreditation in Higher Education (CYQAA) is responsible for accrediting vocational programmes offered at various higher education institutions, ensuring that these programmes meet national and European quality standards. The CYQAA works to:

- **Accredit vocational programmes**: The agency is responsible for the accreditation and quality assurance of both academic and vocational programmes, ensuring that institutions meet rigorous educational standards.
- **Monitoring and evaluation**: CYQAA conducts ongoing assessments of vocational programmes to ensure they continue to meet labour market demands and maintain high educational standards, providing transparency and accountability in vocational education.

These three institutions—the Ministry of Education, Sports, and Youth, the HRDA, and the CYQAA—collaborate to ensure that Cyprus' VET system is dynamic, responsive to the needs of the economy, and aligned with European frameworks, providing pathways for students and workers to gain skills that are in demand in a rapidly evolving labour market.

3.3.5.1.4 Role of higher education institutions

Higher education institutions in Cyprus play a key role in delivering vocational education and fostering lifelong learning opportunities. Both public and private universities, colleges, and specialized training centres offer a wide array of programmes that align with the needs of the Cypriot economy and contribute to workforce development in key industries such as renewable energy, technology, and engineering. Public universities in Cyprus, as well as private higher education institutions, offer a blend of academic and

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vocational programmes aimed at equipping students with both theoretical knowledge and practical skills. These institutions frequently collaborate with industry stakeholders to ensure that their programmes remain relevant to current labour market demands, particularly in emerging fields like renewable energy, marine engineering, and information technology.

One prominent aspect of vocational education in higher education is the integration of hands-on learning with academic study. Many institutions offer programmes that include internships, apprenticeships, or practical training components, allowing students to gain real-world experience while completing their studies. For instance, renewable energy programmes often include practical training in solar energy systems installation, energy management, and sustainable development. Such programmes prepare graduates for direct entry into the workforce, particularly in sectors aligned with Cyprus' goals for renewable energy expansion and sustainability.

Vocational education offerings in Cyprus also include specialized programmes in renewable energy technologies. Institutions provide training in solar energy system installation, wind energy, and energy management, which are increasingly relevant as Cyprus continues to invest in renewable energy infrastructure. Additionally, vocational programmes in engineering and environmental science often integrate modules on sustainability and resource management, helping to prepare a workforce capable of addressing the country’s energy transition goals.

Beyond formal degree programmes, higher education institutions in Cyprus offer numerous short-term vocational courses, certifications, and executive education programmes aimed at professionals seeking to update their skills or transition into new fields. For example, programmes in energy efficiency, smart grid technology, and project management are popular among working professionals looking to advance their careers in rapidly growing industries.

3.3.5.1.5 Recognition of Prior Learning (RPL)

In alignment with European trends, Recognition of Prior Learning (RPL) is an essential component of Cyprus’ approach to lifelong learning. RPL allows individuals to have their informal learning experiences, such as work experience or prior vocational training, recognized and certified. This enables learners to fast-track their education, gaining credits toward formal qualifications without needing to repeat content they have already mastered in the workplace.

The HRDA and Cyprus Agency of Quality Assurance and Accreditation in Higher Education (CYQAA) work closely to ensure that RPL is integrated into the VET system, making it easier for adults to engage in continuous education. This is particularly relevant for sectors like renewable energy and technology, where rapid advancements require workers to continually update their skills. For instance, professionals in the offshore wind or solar energy sectors can apply for RPL to have their existing experience and skills formally recognized, allowing them to pursue further qualifications more efficiently.

3.3.5.2 Inclusion and attractiveness in VET

Given that VET in Cyprus is becoming an increasingly attractive educational option, it has become necessary to improve the capacity of VET schools, in terms of both buildings and specialisations offered. The problem

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of young people being discouraged from attending a VET school due to long distance from their place of residence or due to overcrowding in existing VET schools is addressed through the construction of two new, modern, and larger VET schools in two different cities (in replacement of older buildings with less capacity). The two current schools that will be replaced can no longer serve their educational purposes and they offer minimum flexibility in designing and offering new programmes of study. The two new upgraded schools will provide VET with the means and capacity for improvement and evolution. It is expected that they will serve many enrolled students and other professionals or adults. The schools will feature teaching rooms, labs, multipurpose halls, sports facilities, staff and management rooms.

The construction of the new VET school in Limassol, which is included in the Cyprus RRP, began on 1 March 2023, and an amount of EUR 4 million has already been spent. Regarding the second new VET school in Larnaca, it is noted that the project has been included in the Cohesion Policy Programme 'THALIA 2021-2027'.

Furthermore, several actions and activities have been undertaken by the Cyprus Pedagogical Institute (CPI) to strengthen VET teachers' digital skills: specialised seminars, executive training sessions, conferences and optional seminars. A total of 118 teachers from 14 VET schools participated in these activities. Moreover, through the System of Vocational Qualifications (SVQ) operated by the HRDA, 618 persons were successfully assessed and received the appropriate qualification during 2023. Out of these, 559 persons obtained the 'vocational trainer - level 5' qualification of the Cyprus qualifications framework and the EQF) and 59 persons obtained a qualification concerning the construction industry.

In 2023, Cyprus proceeded to develop a new integrated student evaluation system (ISES)[180], (Regulations of 2023 for the operation of public secondary schools (Amendment No. 2, 2023)[181] which attempts to emphasise the benefits of employing multiple forms of assessment (concurrent assessment) and continuous feedback for teaching and learning. The aim is to address the weaknesses of the educational system in a holistic manner and based on pedagogical criteria. The ISES emphasises formative assessment, differentiating teaching based on the individual needs of each student, and early diagnosis of educational needs.

3.3.5.3 Assets from the CoVE Cyprus

The CentreCentre of Vocational Excellence (CoVE) Cyprus is a strategic partnership that brings together the University of Cyprus (UCY), the Cyprus Chamber of Commerce and Industry (CCCI), the Centre for the Advancement of Research & Development in Educational Technology (CARDET), and INTERCOLLEGE. This consortium combines a wealth of experience, knowledge, best practices, and resources to strengthen the vocational education and training (VET) landscape in Cyprus. By leveraging their collective assets, the

[180] "Integrated Student Evaluation System (ISES) | CEDEFOP."
[181] "National Reforms in School Education."

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partners aim to enhance the quality and relevance of VET programmes, aligning them with both national priorities and European standards.

The CoVE Cyprus partners contribute to the VET sector by integrating academic excellence, industry connections, educational innovation, and practical training. UCY, as the leading research university in Cyprus, offers advanced research and technological advancements, particularly in renewable energy and sustainable solutions. Its Department of Electrical and Computer Engineering and the Photovoltaic Technology Laboratory (PV-Lab) at the FOSS Research Centre provide state-of-the-art facilities and virtual labs. These resources enrich the practical component of VET programmes, offering students hands-on experience with the latest technologies.

CCCI enhances the VET offerings through its extensive network of over 8,000 member enterprises and more than 120 affiliated professional associations. Representing a significant portion of the Cypriot business community, CCCI bridges the gap between vocational training and industry needs. As an accredited VET centre, it organizes training programmes that are tailored to the evolving demands of commerce, industry, and services sectors. CCCI's active participation in national social dialogue and policymaking ensures that VET programmes are aligned with economic strategies and labour market requirements.

CARDET contributes its expertise in educational research and development, focusing on digital skills and capacity building. Affiliated with international institutions like Yale University and the International Council of Educational Media, CARDET brings global best practices to the Cypriot VET sector. Its involvement in developing the Lifelong Learning Strategy 2021-2027 for Cyprus demonstrates its commitment to aligning VET programmes with national educational objectives. Additionally, CARDET's role in global education initiatives enriches VET curricula with international perspectives and competencies.

INTERCOLLEGE complements these efforts by providing a range of academic and vocational programmes that adhere to European standards. Its approach combines theoretical learning with practical training, enhanced by obligatory summer paid internships arranged by the college. This ensures that students gain real-world experience and that their skills are closely aligned with industry needs. INTERCOLLEGE's emphasis on renewable energy and environmentally friendly practices is integrated across its programmes, particularly in the Mechanical Installations Technician diploma, preparing students for careers in emerging sectors.

In conclusion, the CoVE Cyprus partnership places a strong emphasis on digital competencies and sustainable practices, aligning VET offerings with global trends such as digital transformation and renewable energy adoption. By integrating these themes across programmes, the consortium equips students with the skills and knowledge necessary to succeed in a rapidly evolving job market. Furthermore, the active involvement of the partners in policy-making and social dialogue at the national level enables continuous improvement of VET programmes, ensuring they remain aligned with both national priorities and European Union objectives.

3.3.5.4 Mapping of VET offerings

Cyprus' VET system is evolving to meet the demands of a modern economy, with a focus on sectors such as renewable energy, digital technologies, and environmental management. While the offshore wind sector

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remains under development and is not yet a major area of focus, Cyprus has made significant strides in solar energy and environmental technologies, which are central to its National Energy and Climate Plan (NECP).

Solar Energy continues to dominate the renewable energy landscape in Cyprus. VET programmes aligned with the solar industry include Solar Energy Technician courses, which provide hands-on training in photovoltaic system installation and maintenance. These programmes are critical as Cyprus capitalizes on its abundant solar resources to meet national energy targets.

Moreover, Electrical Engineering and Environmental Management programmes are expanding to incorporate renewable energy components. These offerings focus on preparing students to manage, maintain, and innovate in areas such as smart grid technology and energy efficiency, which are essential as the country modernizes its infrastructure to integrate renewable energy more effectively into the grid.

While wind energy programmes are less prominent in Cyprus compared to solar, there is growing recognition of the importance of diversifying the energy mix. The feasibility of offshore wind is being explored, but VET programmes specifically related to wind energy are still in their infancy. Nonetheless, as offshore wind becomes more feasible in the coming years, it is expected that Cyprus' VET system will adapt, particularly in training for wind turbine technicians and marine energy engineers.

The Human Resource Development Authority (HRDA) supports these developments by funding VET initiatives that align with labour market needs, particularly in the renewable energy sector. By fostering partnerships between training centres and industry, the HRDA ensures that VET graduates are equipped with the practical skills necessary for employment in these growing fields.

Overall, while solar energy remains the primary focus of Cyprus' VET system in renewable energy, the country's broader goals in energy transition suggest that other sectors, such as offshore wind and environmental technologies, will gain importance in the future.

Table 18 contains the most relevant certification training programmes along with their respective institutions in Cyprus.

Table 18. Certification training available in Cyprus

Course/Program	Description	Level	Institution
BSc in Electrical Engineering with Specialization on Renewable Energy Sources and Sustainable Energy Systems	This program is designed for students aiming to acquire broad theoretical and technical knowledge in the multidisciplinary field of Electrical Engineering.	EQF Level 6	Frederick University
MSc in Energy Technologies and Sustainable Design	Both programmes offer specialization in the discipline of Energy Technologies within the frame of Sustainable Design.	EQF Level 7	University of Cyprus

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MEng in in Energy Technologies and Sustainable Design			
MSc in Environmental Engineering MEng in Environmental Engineering	Both programmes are designed to equip their graduates with the expertise, the soft and hard skills necessary to address the ongoing and future environmental challenges threatening the security and resilience of the ecosystem, and the societal wellbeing.	EQF Level 7	University of Cyprus
BSc in Electrical Engineering	This program focuses on higher mathematics, physics, electrical circuit analysis, communication systems, digital signal processing, etc. In addition, the program offers capstone design knowledge and experience and a range of elective courses from other disciplines of engineering.	EQF Level 6	Cyprus University of Technology
MSc in Energy Systems	This program aims to provide high-level education in energy engineering and energy materials. The program is designed to meet both the current and future needs of the energy industry and research in energy-related fields.	EQF Level 7	Cyprus University of Technology
Diploma in Mechanical Installations Technician	This program prepares students for careers in various fields such as refrigeration, heating, air conditioning, ventilation, plumbing, and renewable energy sources.	EQF Level 5	Intercollege
PV System Designer and Installer	The course provides the necessary theoretical and practical background for the design and installation of small-scale photovoltaic (PV) systems thereby meeting the great need of businesses for specialized services in the field of grid-connected photovoltaic systems.	HRDA approved course	University of Cyprus – PV Technology
Energy Storage: Diverse Role in the Modern Electricity Network	This course covers theoretical and practical aspects for trainees to develop skills and understanding on Energy Storage and specifically, as regards home systems. It includes the design, installation and operation of Energy Storage Systems integrated in buildings combined with Renewable Energy Systems and specifically, Photovoltaic (PV) systems.	HRDA approved course	University of Cyprus – PV Technology

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Fundamentals of Building Integrated Photovoltaics	Theis program provides the necessary theoretical and practical background for the operation, design and installation of new technologies of Photovoltaic (PV)systems integrated in the building shell, thus covering the great need of companies for specialized services in the field of PV systems installations, so that the skills that will be acquired will be used to attract new customers and lay the foundations for their future work in this rapidly growing field.	HRDA approved course	University of Cyprus – PV Technology
Commissioning tests and inspection according to EN 62446 standard	This course covers theoretical and practical aspects for trainees to develop skills and understanding on the minimum requirements for documentation, commissioning and inspection of grid connected PV systems according to IEC 62446.	HRDA approved course	University of Cyprus – PV Technology
Fundamentals of Nearly Zero Energy Buildings	This course covers theoretical and practical aspects of building integrated photovoltaics (BIPV) in the realm of nearly zero energy buildings (NZEB) The objective of the course is to train participants in NZEB strategies and technologies in order to accelerate the adaptation of the recast EU Energy Performance in Buildings Directive (EPBD)	HRDA approved course	University of Cyprus – PV Technology
Certificate in Training of Small Scale Installers of Photovoltaic Systems	This training program applies the requirements of the law that provides for the promotion and encouragement of the use of renewable energy sources (law 2013_1_112) and specifically the requirement of the law for the certification of installers of small-scale photovoltaic systems.	HRDA approved course (45 hours)	Mesokeleas LTD
Certified Training Program for Photovoltaic (PV) System Installers - PVTRIN	This training program prepares technicians for certification according to internationally recognized standards, promoting efficient and safe installations. Participants will learn about PV systems, installation technologies, and practical skills for organizing installations and troubleshooting issues.	HRDA approved course (58 hours)	Cyprus Productivity Centre

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4 Needs Assessment – Research Findings

4.1 Portugal

4.1.1 Skills and qualifications in demand

Emerging renewable energy production technologies, such as offshore wind energy, have increased the demand for specific skills and qualifications in this field in Portugal and throughout Europe. However, challenges have arisen due to a need for more skills and qualifications among individuals in the labour market. The European Union established the Pact for Skills for Offshore Renewable Energy (P4S-ORE)[182] partnership to address these gaps in 2021. This initiative aims to support the successful implementation of the offshore renewable energy strategy by promoting targeted training programmes to enhance labour skills, offering training pathways that overlap with other sectors, ensuring proper preparation for new employees, implementing measures to attract talent, and contributing to the promotion of strong labour standards.

The European Union designated 2023 as the European Year of Skills[183] to enhance competitiveness, participation, and talent. This initiative aims to address the need for more qualified labour across Europe by promoting investment in training and upskilling. It also seeks to align qualifications with the needs of industries.

A report presented in 2023 in Europe[184] highlights several areas with a shortage of qualified personnel, including construction workers, healthcare staff, metalworkers, mechanics, and electricians, as illustrated in Figure 55.

The skills shortage is also evident in the green transition, where there is a predicted lack of skilled labour to fill job vacancies. It is estimated that an investment of between 1.7 billion euros and 4.1 billion euros is necessary for retraining, reskilling, and upskilling. This investment could lead to the creation of between 198,000 and 468,000 additional jobs across various sectors[185].

Similar to other European countries, Portugal has an increasing shortage of qualified individuals. Unfilled positions rose to 81% in 2023, compared to 46% in 2018. The difficulties in filling these vacancies stem from a need for more qualifications among candidates and a low number of applicants[186].

[182] https://www.marineboard.eu/pact-skills-offshore-renewable-energy
[183] https://year-of-skills.europa.eu/about_en
[184] https://op.europa.eu/webpub/empl/esde-2023/index.html
[185] https://op.europa.eu/webpub/empl/esde-2023/index.html
[186] https://pt.euronews.com/business/2024/04/09/crise-de-emprego-na-ue-candidatos-nao-tem-as-competencias-adequadas

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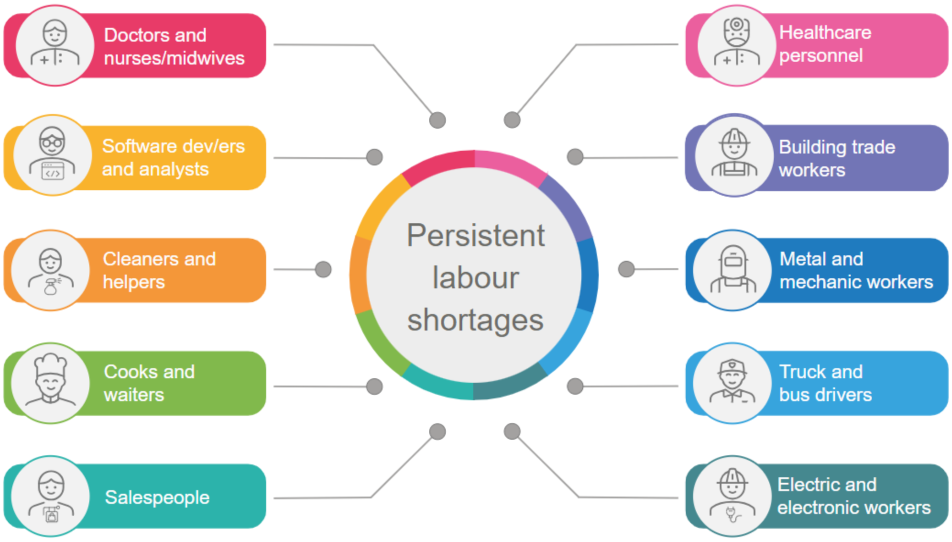

Figure 55. Labour shortages across all skills levels (Source: European Commission)

To address the shortage of skilled labour, Portugal has sought to fill these gaps through the Recovery and Resilience Plan (PRR) under NextGenerationEU. For instance, there has been investment in establishing 365 Specialized Technology Centres (CTEs) in industry, digital technology, IT, and renewable energy. These centres aim to enhance the appeal of secondary-level dual certification training in specialized areas that require a highly qualified workforce, such as the emerging renewable energy production sector[187].

One example of the skilled workforce in renewable energy is the Wind System Installer Technician, who must possess specific skills according to the National Qualifications Catalogue [188], as seen in Table 19.

Table 19. Skills needed in a wind system technician/installer

Skills	Description
Principles	Wind energy; Mathematics; Technical drawing; Chemistry; Physics; Pneumatics and hydraulics; Applied mechanics; Electricity; Automation; Aerodynamics; Health and safety; Environmental protection; Quality (standardisation and certification); IT from the user's point of view.
Knowledge	Organisation, planning and work scheduling; Wind power system installation project; Measuring equipment (characteristics and applications); Wind power system testing and monitoring processes; Operation and regulation of wind power system components; Materials technology (mechanical characteristics, metal alloys, plastic materials and welding technology); Wind power system technology; Communication and interpersonal relations.

[187] https://centrostecnologicos.gov.pt/
[188] https://catalogo.anqep.gov.pt/qualificacoesDetalhe/1761

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In-depth knowledge	Design of small-scale wind power systems; Installation of wind power systems; Repair and maintenance of wind power systems; Standards and procedures applicable to the installation, maintenance and repair of wind power systems.
Expertise	Use techniques for planning and organising work; Use techniques for designing small-scale wind power system projects; Interpret wind power system installation projects; Identify the equipment and accessories to be installed and the physical conditions required for installing wind power systems; Identify the working methods and materials required to carry out installation, maintenance and repair work on wind power systems; Identify the various phases of the work to be carried out and the activities inherent to them; Apply the health and safety standards and procedures relating to the professional activity; Identify the characteristics and operating principles of wind power systems; Identify and use wind power system installation techniques; Identify the different types of materials and their behaviour, as well as the equipment to be used when installing wind power systems; Identify and use the appropriate measuring and control equipment for installing, starting up and diagnosing anomalies in wind power systems; Identify and use wind power system testing techniques; Identify anomalies in wind power systems; Define and use wind power system repair techniques according to the anomaly detected; Identify and use wind power system maintenance techniques; Use technical documentation to record the work carried out.
Behaviour	Interact appropriately with others involved in the installation, maintenance and repair process in order to respond to service requests; Integrate health and safety standards and procedures in the course of their professional activity; Decide on the most appropriate solutions for resolving technical problems; Adapt to new technologies.

Table 19 outlines various technical and non-technical skills and qualifications in high demand within the sector. This includes expertise in engineering fields such as electricity, automation, and wind energy. Additionally, knowledge of health and safety regulations, project organization and planning, and relevant standards and procedures are essential. Regarding skills, workers must be able to collaborate with other wind farm project team members effectively. They should be able to apply their acquired knowledge, solve problems quickly, and adapt to the ongoing changes in the sector, including introducing new technologies.

In addition to the creation of CTEs, Portugal has been making other efforts, as evidenced by the increase in the European Skills Index[189]. The European Skills Index (ESI) from Cedefop - the European Centre for the

[189] https://www.poch.portugal2020.pt/pt-pt/Noticias/Paginas/noticia.aspx?nid=973

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Development of Vocational Training, assesses the performance of European skills systems and the improvements they have achieved over time. The index is based on three skills pillars: development, activation and matching. Skills development includes the country's vocational education and training activities and the results of this system in terms of skills developed and acquired. The skills activation pillar includes education-to-work transition indicators and labour market activity rates for different population groups. Finally, the last pillar of skills matching represents the degree to which skills are successfully used and how effectively they are received in the labour market. Portugal's index for 2022[190], compared to 2020, rose two points from 41 to 43 out of 100. Although there was a drop in the skills activation pillar, obtaining a score of 50 instead of 57 in 2020, there was an increase of 6 points in the skills matching pillar to 44/100 and the score of 35/100 was maintained in the skills development pillar. This year, according to the report, the effects of Covid-19 had not yet been felt in Europe.

In 2024, Portugal's ESI score increased[191] to 45 out of 100. Compared to 2022, there were notable changes in the scores for various pillars. For instance, the activation of competencies improved significantly, rising from a decline of 7 points to an increase of 12 points, resulting in a score of 62 out of 100. Skills development also saw a modest increase, going from 35 to 37. However, there was a slight decline in skills matching, with the score dropping by one point to 43 out of 100.

Compared to other Southern European countries such as Spain, Italy, Greece, and Cyprus, Portugal is better positioned, placing it in the mid-range group, unlike the others. Overall, while all countries have improved their scores, these results indicate that there is still considerable progress to be made in Portugal's development systems and Europe as a whole[192].

4.1.2 Sectoral needs in industry and education

4.1.2.1 Survey of industry professionals

4.1.2.1.1 Survey of respondents

With the aim of CoVE Portugal being able to help develop the blue economy in its country, a questionnaire was developed to obtain relevant knowledge about the offshore renewable energy sector, such as the current reality of the labour market, the industry's need for skills and the challenges organisations face in obtaining these skills. The questionnaire was developed on the Google Forms platform and divided into three different parts depending on the type of respondent. Each part of the questionnaire was associated with questions relating to the type of profile of the respondent, whether they were a professional in the sector, a teacher/instructor at a VET or HEI, or a student. The questionnaires were made available by sending a link by email throughout September and October, with a **total of 197 valid responses**.

[190] https://www.cedefop.europa.eu/en/projects/european-skills-index-esi
[191] https://www.cedefop.europa.eu/en/tools/european-skills-index?y=2024
[192] https://www.cedefop.europa.eu/en/tools/european-skills-index?y=2024

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About professionals from organisations/companies participating in the study, 50 responses were obtained, but due to repeated submissions by some respondents, **46 valid responses from professionals** in the sector were considered.

At the level of **VET and HEI**, various instructors and teachers were contacted, and **25 valid responses** were obtained, one of which was excluded for the same reasons mentioned above.

Finally, a total of **126 responses were received from students** at various vocational and higher education institutions.

Following the distribution of the questionnaires, **10 interviews** were also carried out with selected companies and educational organisations in the offshore renewable energy sector.

Most respondents are professionals between 26 and 35 and those between 36 and 45, comprising 56% of the total respondents, 72% of whom are men. The most common positions held by these professionals are department director and general director. According to the respondents, most organizations operate in the early stages of the offshore renewable energy (ORE) sector's value chain, including pre-planning/research, project management, and operations and maintenance. Another frequently mentioned area is the supply chain in the marine renewable energy value chain.

Figure 56 highlights a notable gap in Portugal, where more companies are needed to operate in the later stages of the value chain, such as recommissioning and decommissioning. An interesting finding from the responses is that a large proportion (65%) of organizations are physically based in Portugal and operate in the national and international markets. Furthermore, approximately 57% of the respondents work for organizations with more than 250 employees.

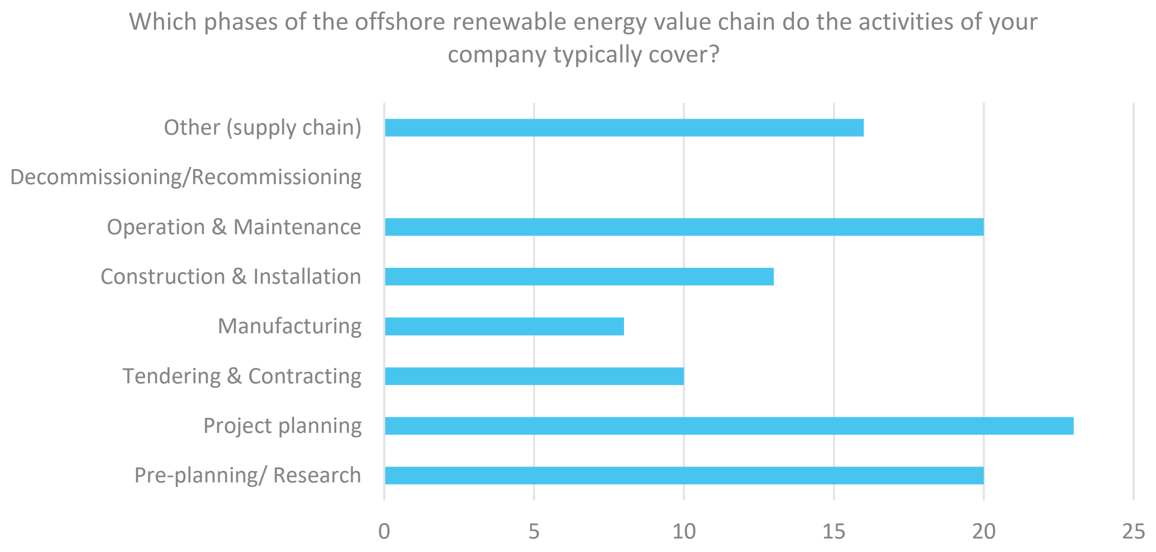

Figure 56. Phases of the offshore renewable energy value chain cover (Source: Portugal CoVE surveys)

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4.1.2.1.2 Competences

Different companies require various levels of education for their professional staff. The differences in education needed levels are reflected in the responses from industry professionals, as shown in Figure 57. Most respondents believe engineers, technicians, designers, and health and safety workers should have higher education qualifications. In contrast, other roles, such as installers and divers, are perceived to require only lower levels of education, such as general secondary or vocational training.

Additionally, 87% of respondents indicated that their companies have or have recently had job vacancies. Furthermore, 57% mentioned experiencing difficulties in filling these positions.

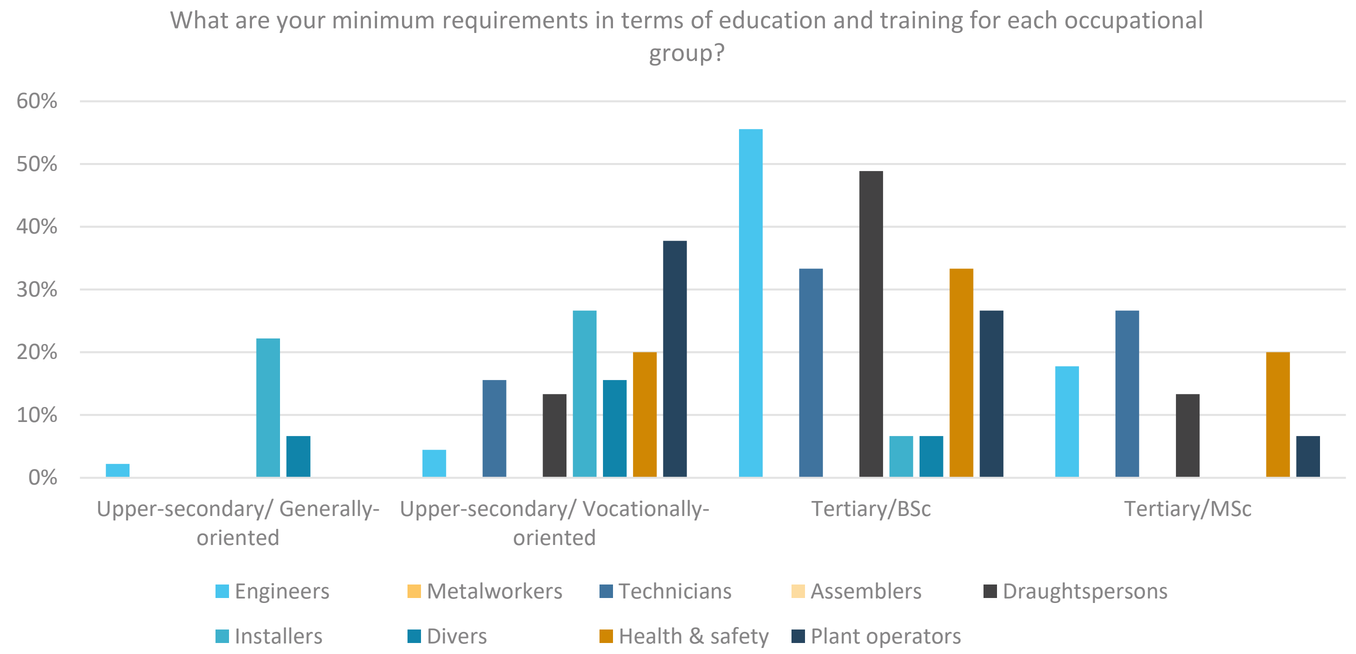

Figure 57. Minimum requirements in terms of education and training (Source: Portugal CoVE surveys)

Most organisations constantly check that their employees are up to date and at maximum productivity, as can be seen in Figure 58. In fact, a significant proportion of the participating companies carry out several reviews throughout the year of their employees' competences and training needs. More than half of the companies (62%) carry out an annual review.

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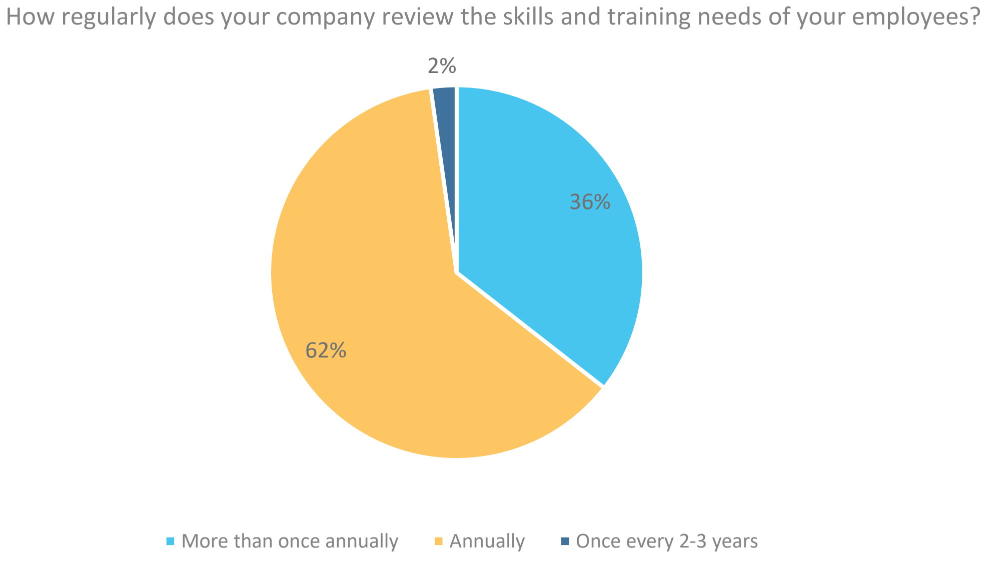

Figure 58. Skills and training review needs (Source: Portugal CoVE surveys)

4.1.2.1.3 Collaboration and engagement

In addition to constantly reviewing employees' skills, most companies (84%) focus on keeping up to date with the rules and regulations in force due to the constant change associated with the ORE sector. Additionally, 49% of the respondents have dedicated teams focused on legal and regulatory compliance. However, it is notable that 9% of respondents indicate that compliance with regulations and standards is not a priority for their company.

Regarding collaboration with professional associations in the sector, 84% of respondents said they participate in association initiatives and 67% in seminars and conferences. Only 7% say they don't liaise with any association in the ORE sector.

When asked about collaboration with technology suppliers, 65% said that the main measure would be developing personalised training solutions, followed by acquiring state-of-the-art training tools and platforms with 56%. As with collaboration with associations, 16% of respondents do not have a relationship with technology suppliers, as seen in Figure 59.

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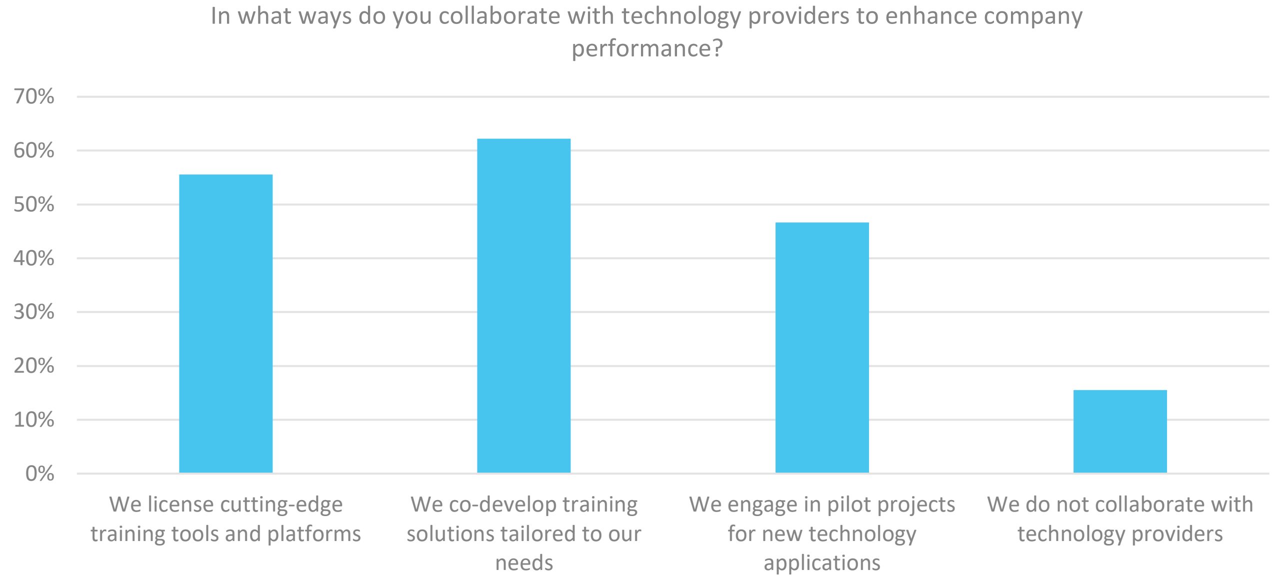

Figure 59. Collaboration ways between industry and technology providers (Source: Portugal CoVE surveys)

4.1.2.2 Survey of VET/HE

4.1.2.2.1 Characterisation of respondents

Most (80%) of VET and HE teachers and trainers are over 45. Similarly to the industry respondents, most (68%) of VET and HE respondents are men. An analysis of the institutions where the respondents teach shows that 48% work in universities and 48% in vocational schools and training centres. It is also important to note that 72% of the respondents are part of the teaching staff of the institutions, and only 28% are in other positions, such as management or pedagogical coordination. The responses show that 48% of the institutions have more than 1,000 students, and of these, 28% are institutions with more than 5,000 students.

An analysis of the responses regarding the levels of education according to the EQF shows that higher education institutions mainly offer programmes at higher levels, from level 6 to level 8 or even from level 5 to level 8. In vocational training centres and vocational schools, trainers and teachers report that their programmes are at levels 3 and 4, corresponding to general secondary education and secondary education with double qualification.

4.1.2.2.2 Study program

According to HE teachers, the career most encouraged by students is engineering at 68%, followed by health and safety at 20%. When looking at the responses from trainers/teachers in training centres and vocational schools, the careers most encouraged are technician, installer, diver, and shipyard operator.

When analysing the group of renewable energies that best fits into the overall value chain of their speciality, the majority of respondents answered that it was onshore solar energy with 40%, followed by offshore wind

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energy with 16%, as seen in Figure 60. Another critical technology is hydropower, which 28% of respondents use. It is also essential to highlight the presence of onshore wind energy.

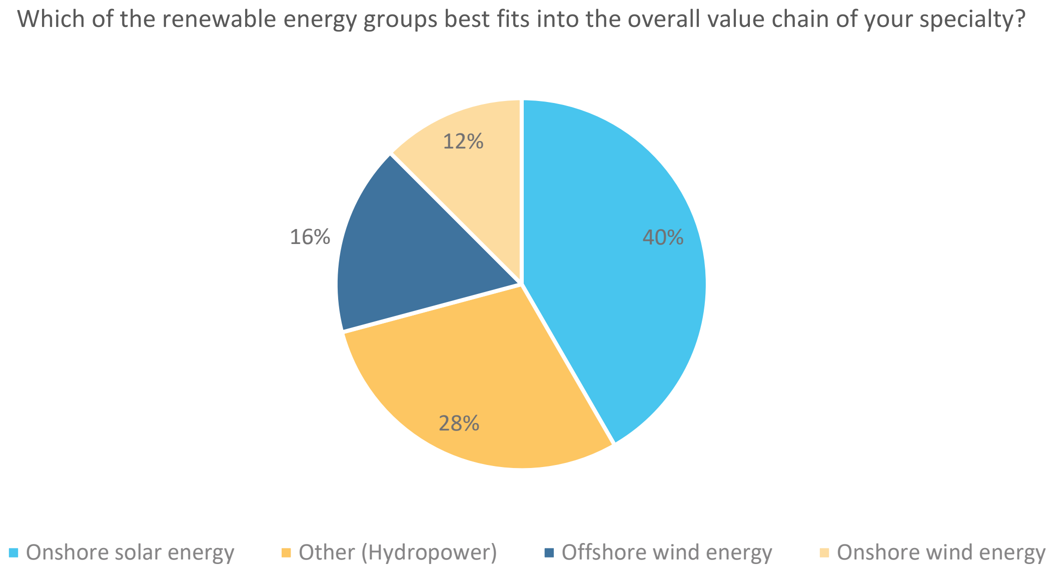

Figure 60. Renewable energy groups that fall within the respondents' speciality (Source: Portugal CoVE surveys)

Upon comparing Figure 60 and Figure 61, we note several similarities, particularly the prominence of technologies associated with onshore solar energy and offshore wind energy. However, institutions have not extensively studied or taught offshore wind energy. Additionally, there is a noticeable absence of tidal and wave energy technologies despite Portugal's extensive coastline.

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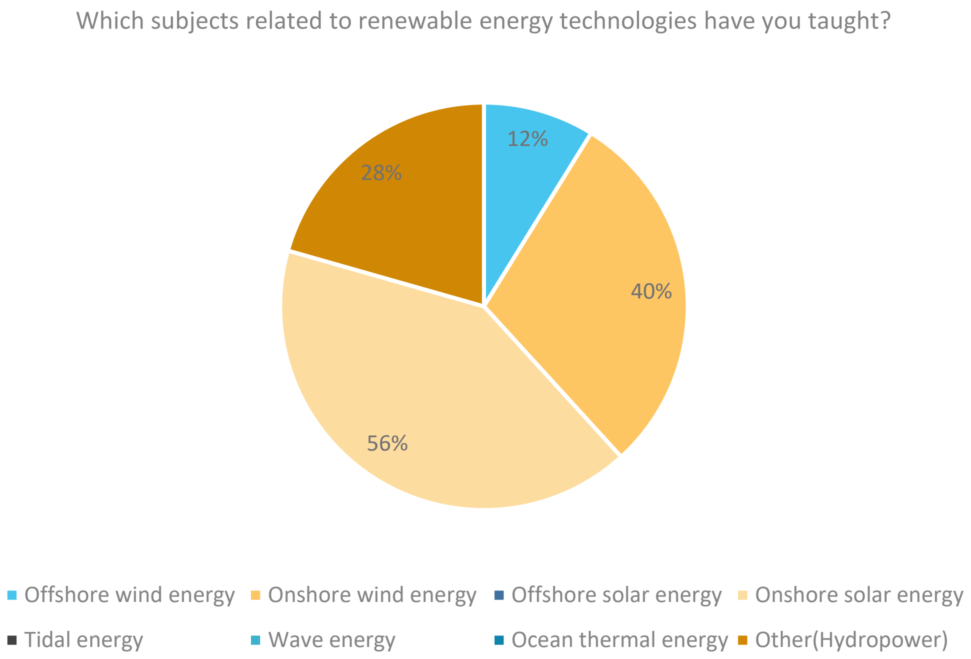

Figure 61. Renewable energy technologies taught (Source: Portugal CoVE surveys)

Figure 62 shows the offshore renewable energy value chain phases covered by the teaching activities. The most covered phase is operation and maintenance, which aligns with some companies participating in the study. However, there is little coverage of the early stages of the value chain, such as pre-planning/research (12%) and project management (4%), in contrast to the responses from companies in the sector.

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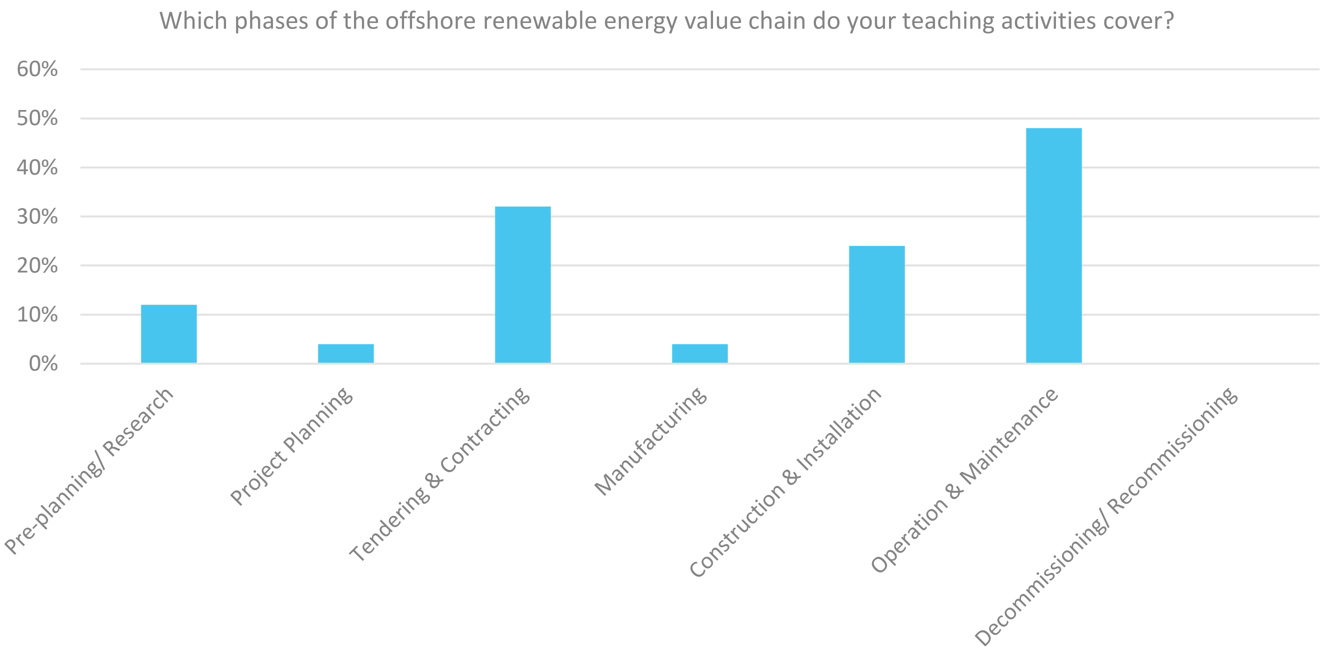

Figure 62. Phases of the offshore renewable energy value chain covered by teaching activities (Source: Portugal CoVE surveys)

Study programmes at respondents' institutions cover a range of technologies, including energy management systems (68%), energy storage (48%), smart technologies (44%) and automation and robotics (36%). Among the technologies, blockchain, materials science, and data analytics stand out in terms of their low level of inclusion in study programmes. In addition to technologies, essential tools such as simulation software (MATLAB), programming languages and CAD software are also covered and stand out for their higher use in educational institutions and training centres.

4.1.2.2.3 Collaboration and challenges

In response to the question about the importance of updating educational content to reflect current realities, 44% of institutions represented by the respondents review their curriculum once a year, while an additional 16% update it more frequently than once a year. However, 12% of respondents indicated that their institutions do not review their curriculum.

Furthermore, most respondents (60%) expressed the need for access to industry experts to enhance their training programs, and 48% noted that they require access to industry workshops, as can be seen in Figure 63.

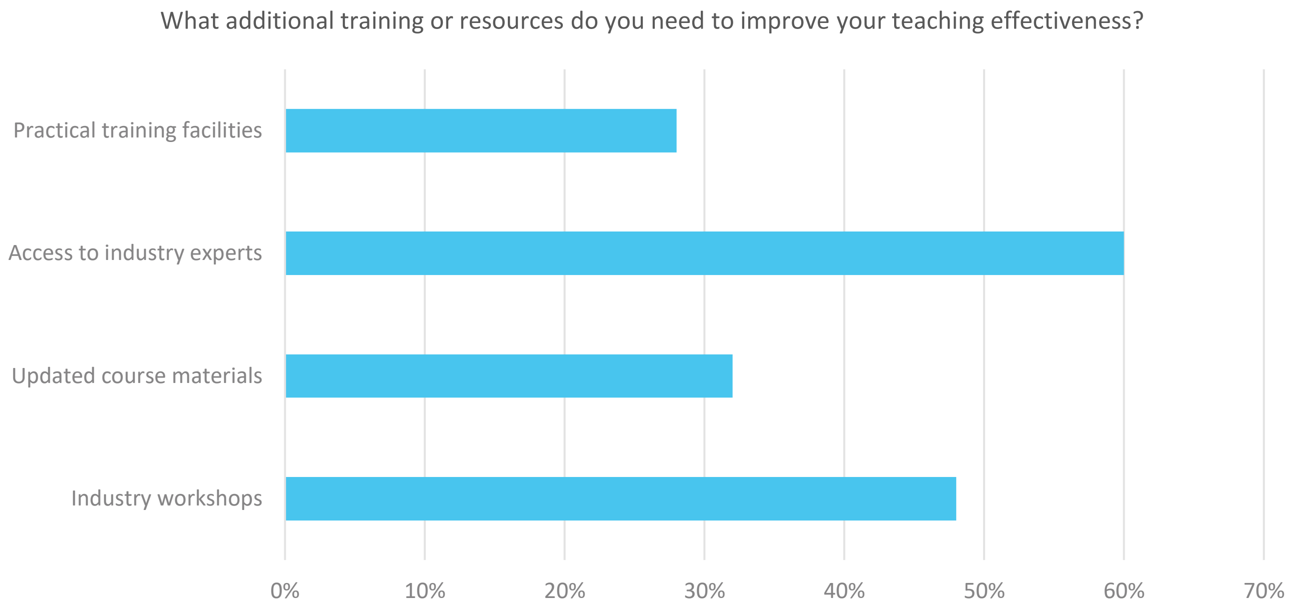

Figure 63. Resources needed to improve teaching effectiveness (Source: Portugal CoVE surveys)

Like other sectors, education faces challenges that limit effective training and teaching promotion. According to respondents, the main challenge is student engagement (56%), followed by other factors such as limited opportunities for practical training and a lack of resources (32%).

Another challenge is aligning programmes with current standards and regulations. As the ORE sector is constantly changing, so is legislation, so a significant proportion of institutions participate in collaborative workshops and adopt industry standards. Around 20% of respondents indicated that their institution needs to engage with policymakers. Within the ORE sector specifically, the challenges respondents face most in preparing students for the industry are listed in order of importance:

- Practical training opportunities.
- Industry-specific skills development.
- Access to real projects.
- Availability of specialised equipment and facilities for training.
- Alignment of academic curricula with current industry technologies.
- Effective partnerships between educational institutions and industry leaders.

This frequent change brings with it other challenges. To address these, 84% of respondents use continuous professional development, 40% use partnerships with technology companies and 20% use access to the latest tools and software.

As mentioned above, one of the challenges is the collaboration between education and industry. This is reflected in the responses shown in Figure 64.

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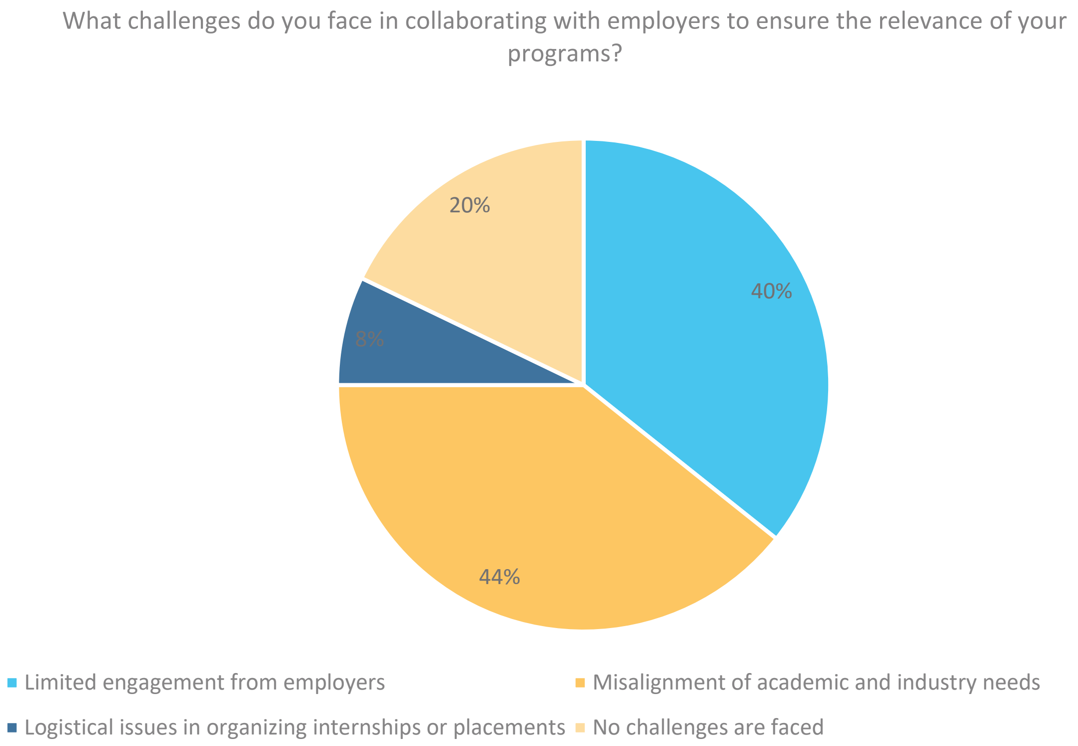

Figure 64. Challenges faced in collaborating with employers (Source: Portugal CoVE surveys)

Finally, in Figure 65, we can see that when asked about the convergence of training programmes with industry standards, the main challenge faced by organisations is updating programmes to comply with standards.

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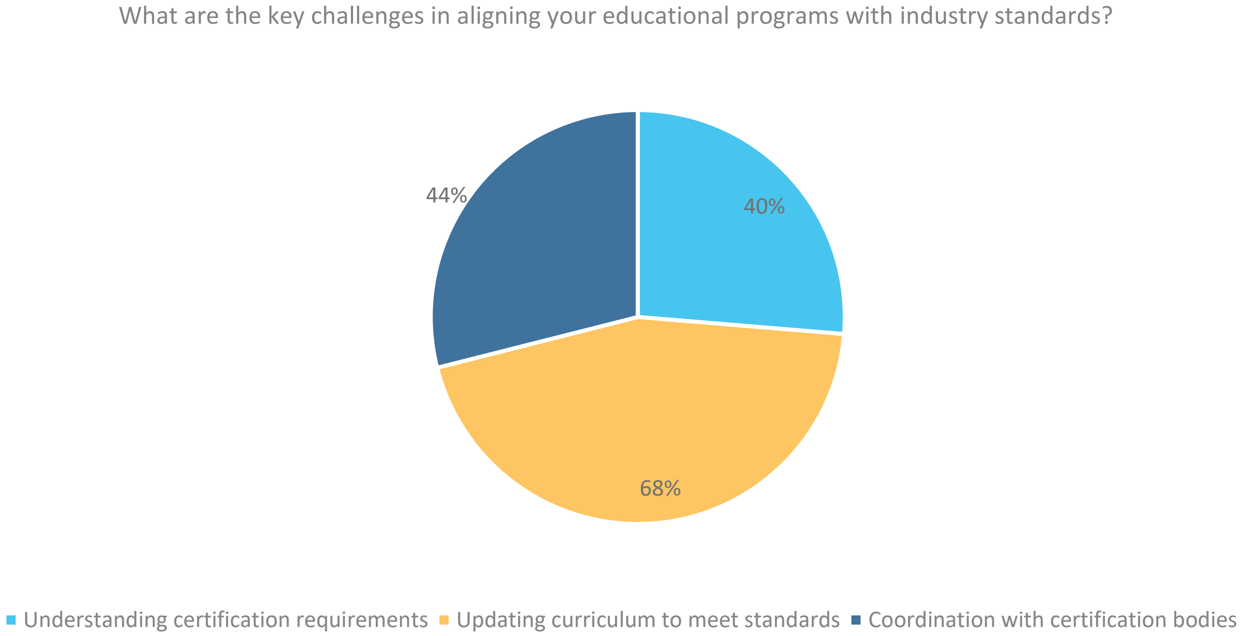

Figure 65. Key challenges in aligning educational programmes with industry standards (Source: Portugal CoVE surveys)

These results show that there is a need for commitment between educators, industry and policy makers to renew programmes that meet the needs and expectations of companies.

4.1.2.3 Survey of students

4.1.2.3.1 Characterisation of respondents

Approximately 87% of the students participating in this survey are 25 years old or younger, with a significant majority being male. Regarding their education, 44% are pursuing a bachelor's degree, 27% are working towards a master's degree, and 29% are enrolled in vocational schools.

Among the careers the institution encourages students to consider, engineering is the most popular, with 77% expressing interest in this field. This is followed by installation-related careers, which attract 28% of the respondents. These results reflect the fact that most respondents are engineering students at the university.

In Figure 66, shows a nearly uniform distribution across the various stages of the value chain, except for the manufacturing and decommissioning/re-commissioning stages, which the students showed little interest in.

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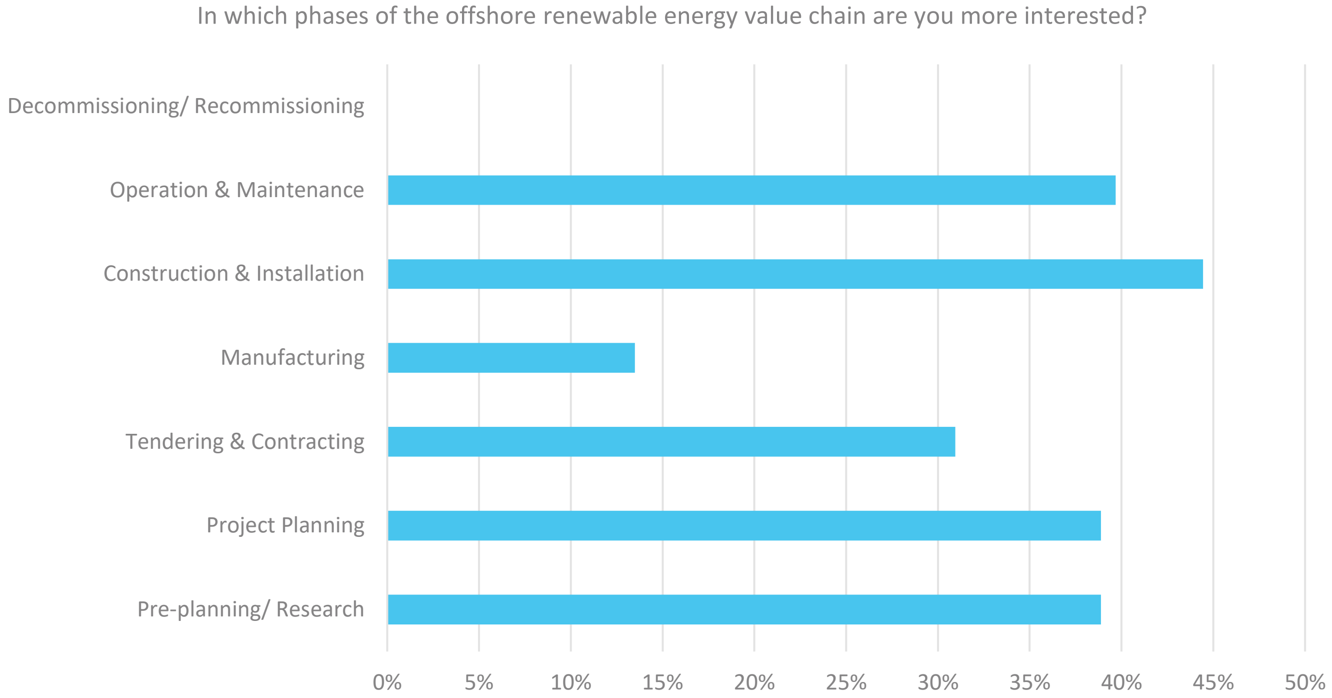

Figure 66. Phases of the offshore renewable energy value chain with the most interest from students (Source: Portugal CoVE surveys)

Figure 67 shows that 30% say they are not very interested in the renewable energy sector and 12% say they are not interested at all. However, the vast majority (58%) are interested or very interested in pursuing a career in renewable energy.

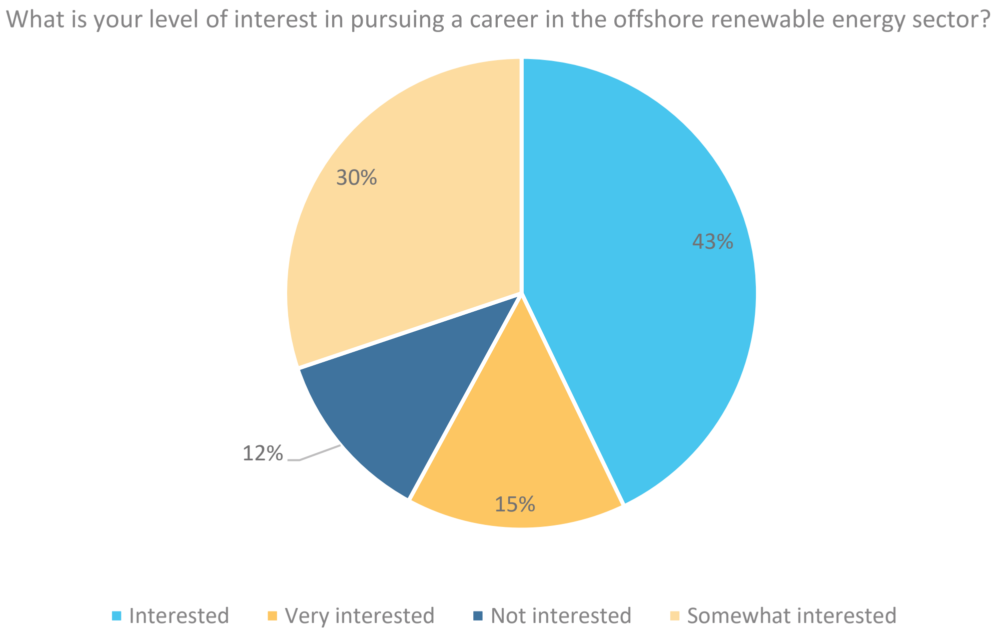

Figure 67. Students' level of interest in pursuing a career in the offshore renewable energy sector (Source: Portugal CoVE surveys)

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4.1.2.3.2 Challenges

Figure 68 shows that a significant proportion of students feel that their current education does not prepare them well for a career in the sector. Only 6% feel well prepared for the offshore renewable energy job market.

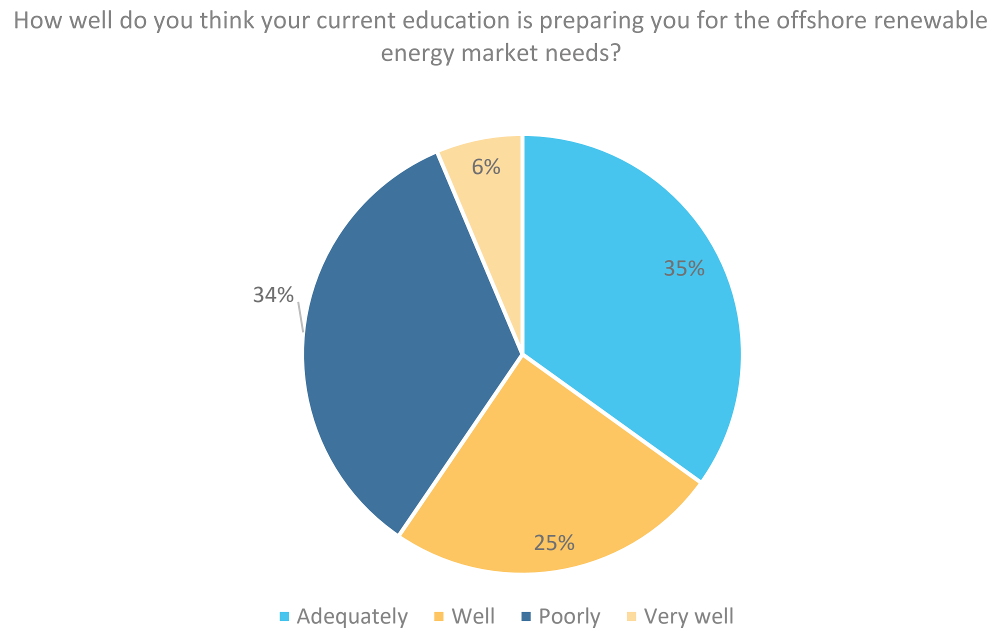

Figure 68. Current preparation of training for the needs of the offshore renewable energy market (Source: Portugal CoVE surveys)

From the results in Figure 69 we can see that the challenge most faced by students is the lack of practical training in the curricula (50%). This challenge is in line with the answers given by teachers and trainers.

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Figure 69. Challenges faced in acquiring practical experience in this field (Source: Portugal CoVE surveys)

In order to overcome these challenges, the support needed from the institutions, according to the students, is listed in order of importance:

- Internship placements.
- Career counselling.
- Industry networking opportunities.
- Scholarships/funding.

4.1.2.4 Interviews

4.1.2.4.1 Characterisation of interviewees

Interviews were conducted with companies with expertise in the field, including the firm responsible for piloting the first offshore wind farm project in Portugal and associations involved in vocational training. A total of 10 interviews were carried out, 4 with education and training providers and 6 with companies active in the renewable energy sector.

The interviewees brought a diverse range of experience. The training institutions mentioned their expertise in GWO BST (Basic Safety Training) and BTT (Technical Training Standard) training and training related to transport, embarking, and staying offshore. They also discussed their involvement in research centres and innovation projects within the sector, alongside the certification of offshore rescue and transport equipment. The companies interviewed included those involved in the early stages of offshore wind project design and those focused on construction, installation, and operation.

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4.1.2.4.2 Developments in the sector and competences

Regarding the ongoing evolution of the sector in Europe and Portugal, the interviewees noted that there may be a reduction in the number of people working on offshore installations. However, they pointed out that onshore assembly, preparation, and transport tasks still have significant growth potential.

Another observation was about the evolution of offshore installation technologies, with bottom-fixed technology currently being the most experienced and established. On the other hand, floating technology is still in the experimental phase but is expected to develop, offering alternatives in locations where traditional fastening methods are not feasible. This technological advancement is expected to create new opportunities for research and development (R&D) and innovation projects in Portugal in the coming years.

One of the interviewees commended Portugal's achievements in experimental offshore wind projects, stating that the country has built a solid foundation to develop structures' manufacturing and assembly phases within the sector's value chain, positioning itself as an industrial hub for Europe.

The survey also discussed the potential emergence of additional technologies that could complement offshore wind and wave energy. One promising short- to medium-term technology is offshore green hydrogen production.

When asked about the readiness of the Portuguese market in terms of training, technical skills, and technological expertise, several qualifications and competencies were identified:

- Welding, blade repair, installation, metal cutting, mechanical forming, navigation.
- Shipbuilding and metalworking.
- Vocational training in technical areas such as electricians and locksmiths.
- More specific content in offshore wind energy installation, operation and maintenance courses.
- Training to work in remote locations (floating platforms).

Other respondents said that although Portugal has a large coastline, it has neither the infrastructure nor the specific skills for offshore and other maritime work, and that the complexity of the sector requires years of experience to acquire the necessary skills and qualifications.

With regard to the functions and technical competences that would require more or better (re-)qualification or improvement of competences, the following functions and competences were mentioned:

- Welders and engineers with skills in electrical systems, automation and control.
- Specialisation in working in a maritime environment is essential, and even deeper specialisation in the offshore wind component.
- Shipbuilding but with a focus on energy, maritime project management, digitalisation and AI with applications in the maritime environment (both in terms of construction and O&M), maritime and oceanic environmental engineering, naval mechanical engineering, electrical engineering of energy systems with a naval and oceanic focus.

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- Professionals: Fitters, welders, machinists and electricians. Higher: Mechanical (mechanical and marine) and electrical engineers.
- Naval engineers, mechanical engineers, civil/structural engineers, materials engineers, electrical/telecommunications/instrumentation engineers and designers.
- Specialisation courses for assets with higher education and specialised vocational training for EQF levels 4 and 5.

4.1.2.4.3 Collaboration and challenges

As seen in the analysis of the questionnaire responses, the need to adapt training and education curricula to the (skills) needs of the industry, and more specifically, the offshore sector, was also mentioned in the interviews. Trainers pointed out that there is a need for more training centres and vocational schools, which makes it a challenge to train competent professionals to work in the offshore sector. Due to the high student/teacher ratio, the lack of practical projects to help students develop and demonstrate different skills was also mentioned, due to the high student/teacher ratio. One interviewee even suggested that changing education and training curricula may not be necessary but rather to acquire skills through small, highly technical, subject-specific training courses. From the point of view of industry professionals, school curricula should integrate business reality and organisational behaviour, including project management and the promotion of critical thinking.

As teachers/trainers mentioned the lack of student engagement, they were asked "What strategies could trainers/teachers use to raise student awareness of the importance of the offshore sector? Would lifelong learning and developing skills to adapt to future changes in the sector be a good strategy?"

Respondents stressed the importance of contact with the sea, either directly or in a simulated environment. Another respondent pointed to the need to strengthen links with business and to the need for basic knowledge to be acquired earlier in the student's career, at secondary school level. Two other points mentioned were that instead of focusing on skills, trainers/teachers should first promote a holistic view of the sector/business and provide information on the remuneration of working at sea, which has more advantages than others.

On the question of "international cooperation in secondary and higher vocational education and training in the offshore renewable energy sector", the participants praised international cooperation as something fundamental that would speed up the process of gaining knowledge and experience. They also stressed the importance of sharing examples, such as those from the UK or the Nordic countries, to gain technical and scientific knowledge from experts who have been working in the sector for many years.

Finally, in response to the question "How do you think educational institutions can adapt their training to the urgent needs of the offshore sector, especially as new technologies emerge?", they mentioned the importance of liaison/dialogue with the industry to adapt teaching programmes to the challenges of the sector.

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4.1.2.4.4 Diversity and awareness

As can be seen in various occupations and sectors, gender inequality does exist. The ORE sector is no different, and this can be seen in education, for example, where engineering tends to be associated with men, as mentioned by the interviewees. One way to overcome this inequality is to promote "inclusive education that encourages the interest of all children in STEM (Science, Technology, Engineering and Mathematics) from an early age, regardless of gender". It is, therefore, necessary to change habits regarding the stimulation and exposure children receive.

A shortage of workers in a sector is often related to communication issues. Communication must be structured and well-planned to attract professionals to the Offshore Renewable Energy (ORE) sector. This can be achieved through training and informational activities, as well as educational initiatives that target a younger audience and expand their knowledge of the industry.

4.1.3 Skills gap analysis

The surveys conducted among industry professionals and VET and HE teachers reveal gaps in the hard skills of their employees and students, as shown in the Table 20.

Table 20. Comparison between the main gaps in hard skills for the ORE sector in Portugal

Order	Professionals	HE and VET teachers
1	Digital skills	Offshore specific skills
2	Engineering skills	Engineering skills
3	Project management	Project design and planning
4	Project design and planning	Foreign languages – reading and writing
5	Foreign languages – reading and writing	Project management
6	Using and understanding numerical or statistical information	Using and understanding numerical or statistical information
7	Offshore specific skills	Digital skills
8	Health and safety skills	Health and safety skills

From the perspective of industry professionals, digital skills are the primary gap that needs to be addressed. Specific offshore skills rank second, indicating that the main issue with employee skills lies not in specialized offshore knowledge but in digital proficiency.

In contrast, teachers and trainers believe that students possess poor knowledge of offshore skills, with engineering skills also being a concern. Unlike the professionals, they think digital skills are already sufficiently developed among students. Both groups agree that health and safety skills are generally well-covered.

Table 21 shows, by order of importance, the gaps in soft skills between staff and students, according to professionals and teachers, respectively.

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Table 21. Comparison between the main gaps in soft skills for the ORE sector in Portugal

Order	Professionals	HE and VET teachers
1	Critical thinking and problem solving	Critical thinking and problem solving
2	Communication and collaboration	Communication and collaboration
3	Flexibility and adaptability	Productivity and accountability
4	Knowledge management and transfer	Initiative and self-direction
5	Productivity and accountability	Flexibility and adaptability
6	Initiative and self-direction	Leadership and responsibility
7	Leadership and responsibility	ICT literacy
8	ICT literacy	Knowledge management and transfer

Table 21 shows that both teachers/trainers and industry professionals consider critical thinking and problem solving to be the biggest gap between staff and students, followed by communication and collaboration. This is no longer the case for the other skills.

Students were asked about their level of confidence in various hard and soft skills on a scale of 1 to 5, where 1 means 'very low confidence' and 5 'very high confidence'.

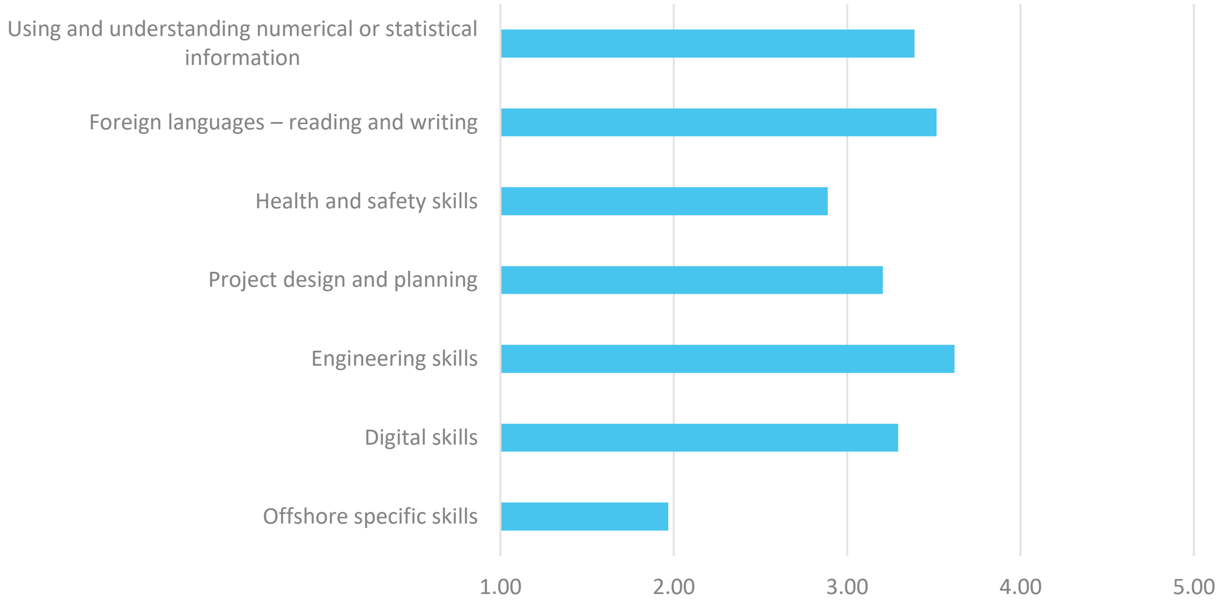

Figure 70. Hard skills confidence levels of students (Source: Portugal CoVE surveys)

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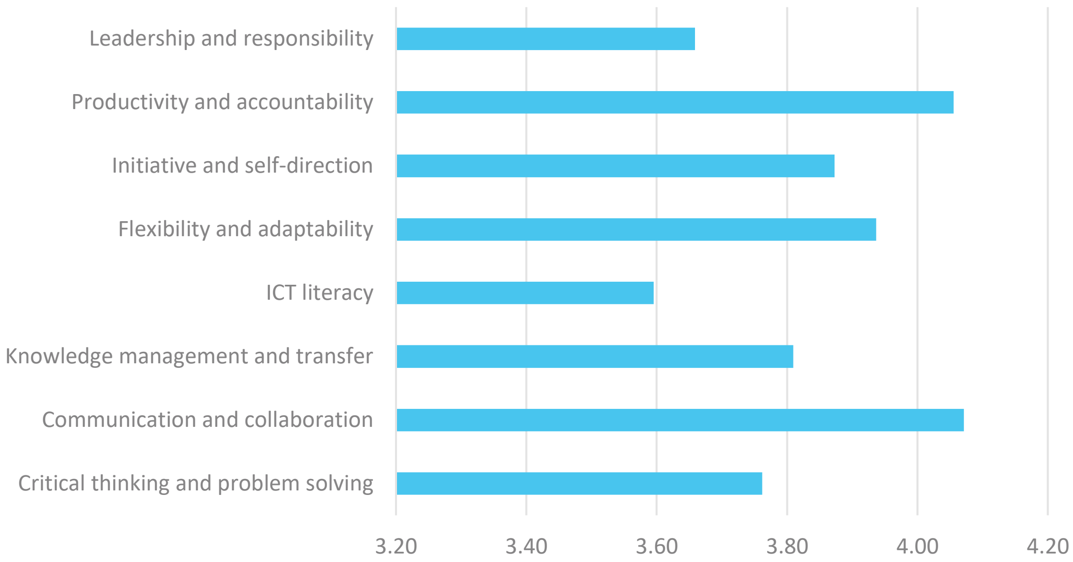

Figure 71. Soft skills confidence levels of students (Source: Portugal CoVE surveys)

The responses, found in Figure 70, show that students feel confident in skills related to engineering, foreign languages, statistical analysis and digital skills. However, confidence is lowest in offshore skills. These results differ from the opinion of teachers, who consider engineering skills one of the most significant gaps.

Soft skills in Figure 71, communication and collaboration skills, productivity, and accountability stand out with high confidence levels, while ICT literacy scored the lowest.

Among interviewees, 90% believe the most significant skills gap is in technical skills, particularly offshore ones. The responses in Figure 72 support this.

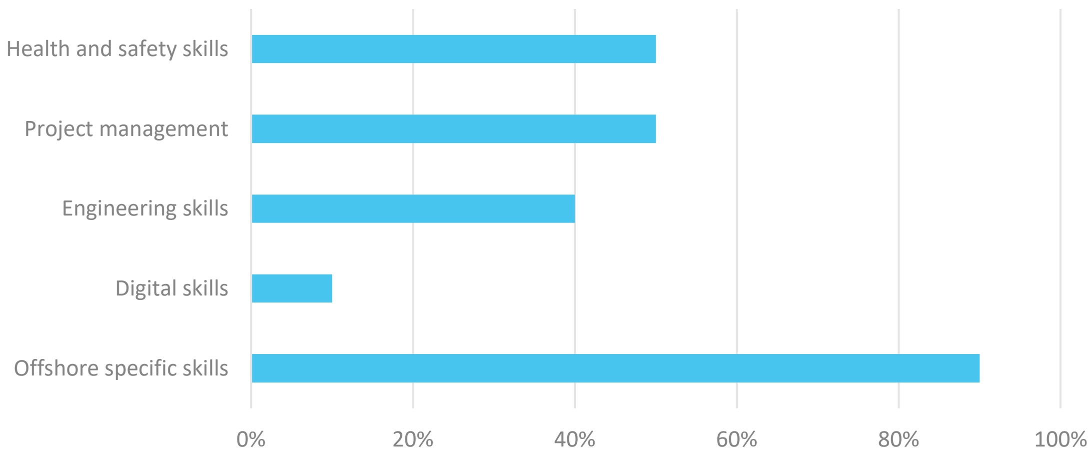

Figure 72. Main gaps in hard skills according to interviewees (Source: Portugal CoVE surveys)

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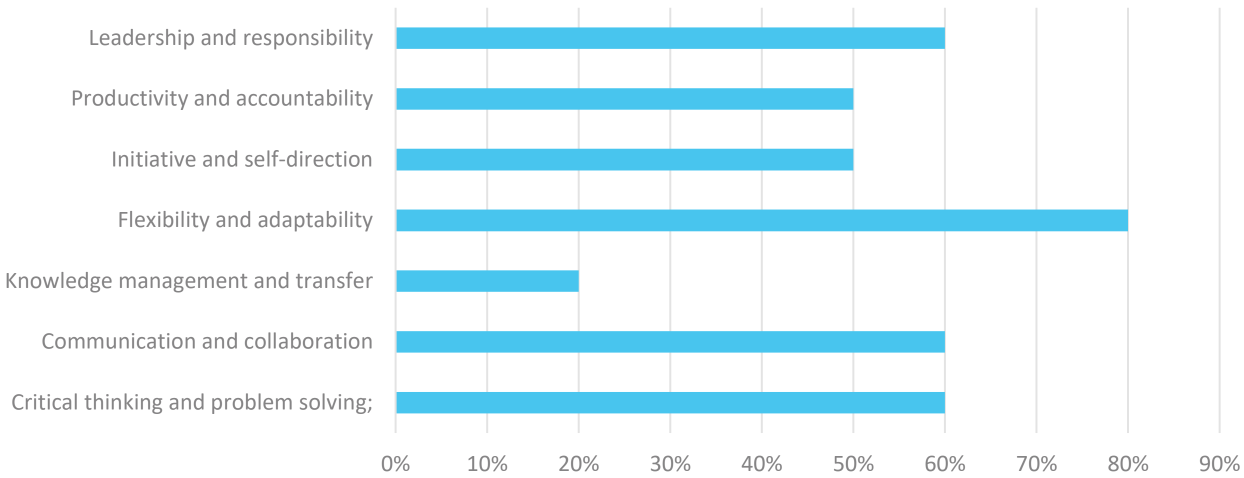

Figure 73. Main gaps in soft skills according to interviewees (Source: Portugal CoVE surveys)

In terms of soft skills (Figure 73), the biggest gap is in flexibility and adaptability, while knowledge management and transfer have the lowest score.

4.2 Spain

4.2.1 Skills and qualifications in demand

The "Report on ORE skills needs", launched in September 2024, from the FLORES project analyses the demand and supply of skills in the offshore renewable energy (ORE) sector in the EU[193]. The report identified 981 job vacancies in the ORE sector across 10 European countries between April and October 2023, with a high demand for technical and engineering profiles, particularly renewable energy engineers and offshore wind energy technicians. Significant gaps were found in the educational offerings, with a notable lack of vocational education and training (VET) programmes and a predominance of higher education programmes, mainly at the master's level. Additionally, there is a strong need for skills in project management and stakeholder relations, as well as competencies in quality assurance (QA/QC) and health, safety, and environment (QHSE). Among these analysed countries, Spain has a big representation of the job vacancies identified, being collected 145 job offers in different sources such as LinkedIn, Siemens Gamesa website, Empléate Foberno, Infojobs, Taylor Hopkinson, ingenierosnavales.com, Robertwalters, PLOCAN and Adecco.

The report emphasizes the importance of collaboration between educational institutions and industry to develop modular and practical training programmes, as well as work-based learning opportunities such as

[193] "FLORES_D2.1.Pdf."

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internships and apprenticeships. It recommends adopting international best practices and fostering collaboration through programmes like Erasmus+ to standardize certifications and expose students to diverse environments and regulatory frameworks. Investment in state-of-the-art simulation tools and offshore specific laboratories, along with industry input into curricula, is crucial to ensure a workforce capable of meeting the evolving demands of the sector and positioning the EU as a leader in the global renewable energy market.

In this report the skills in demand for various roles within the offshore renewable energy (ORE) sector were thoroughly analysed. The report identifies the key technical and soft skills required for different occupational profiles, highlighting the competencies necessary to meet the evolving demands of the industry. Among the hard skills, expertise in emerging technologies, design and project management were essential for the market. In the table below are some of the skills identified for the five most in-demand roles (Table 22):

Table 22. TOP 5 most in-demand professional roles and the skills in-demand (Source: FLORES project)

Occupation	Hard or technical skills	Soft skills
Project manager ESCO-1219.6 (115 job vacancies identified, 11,7%)	Project management Stakeholder management	Communication and collaboration Multi-tasking Being motivational and inspiring
Offshore renewable energy technician ESCO-3119.11 (74 job vacancies identified, 11,7%)	Operation and maintenance Monitoring operations Reporting operational conditions and performance	Effective communication Leadership Organized and structured mindset
Offshore renewable energy engineer ESCO-2149.9.5 (59 job vacancies identified, 6%)	Execution of engineering tasks covering offshore energy systems and structures.	Communication Creativity Being pragmatic
Software developer ESCO-2512.4 (55 job vacancies identified, 5,6%)	Software development and engineering Maintenance and repair QA/QC software	Communication and collaboration Problem solving Motivation
Wind energy engineer ESCO-2149.7.6 (51 job vacancies identified, 5,2%)	Execution of engineering tasks related to wind energy. Offshore and mechanical engineering work	Communication and collaboration Flexibility and forward-thinking Adaptivity

In Spain, the primary industrial activity within the offshore renewable energy sector is focused on construction, particularly in the development of fixed offshore wind farms. As installations across Europe increase, the demand for workers in device construction is also expected to grow. Additionally, there is emerging demand related to the development of floating wind projects in the Spanish territory. However,

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since tenders for these projects have not yet commenced, the current demand remains concentrated in the planning stages of the value chain.

This context explains why, in addition to the top five most in-demand profiles across Europe, Spain shows a significant demand for specialised welders, reflecting its strong emphasis on construction activities.

4.2.2 Sectoral needs in industry and education

Methodology

CoVE Spain have collected information about the offshore renewable energy sector in the country using two different methods:

- **Online questionnaires**: These were designed to gather essential information about the sector and tailored to three distinct target groups: students, educators, and professionals in the field.
- **Personal interviews**: Individuals with significant experience or particularly relevant profiles were selected for in-depth interviews. The questions in these interviews were more open-ended and exploratory, encouraging participants to freely express any thoughts, concerns, or topics of interest related to the sector.

The objective in both cases was to explore several critical areas, including the current state of the labour market, the industry's skill requirements, and not only the obstacles organisations face in acquiring these competences. The surveys and the interviews also aimed to identify gaps perceived by both educators and students during the current teaching-learning process or within the curriculum of their training programmes.

Online questionnaires

Hosted on the Microsoft Forms platform, the online questionnaires were structured in three sections, each tailored to the specific background of the respondents:

- Students from vocational education and training (VET) or higher education institutions (HE)
- Educators from vocational education and training (VET) or higher education institutions (HE)
- Professionals in the sector

The responses were gathered through email distribution of the survey link during September and October 2024, obtaining the following results (Table 23):

Table 23. Number of responses for the online survey

Group of respondents	Expected number of responses	Obtained number of responses
Students	50	58
Educators	30	31
Professionals	20	22
TOTAL:	100	111

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Students represented the largest group of respondents, contributing 58 submissions.

Personal Interviews

Beyond the questionnaires, additional insights were sought through 9 short interviews conducted with selected professionals, teachers and students in the offshore renewable energy field. As explained before, these interviews offered qualitative data to enhance the findings from the survey responses.

These personal interviews were conducted by the various partners of CoVE Spain with the objective of covering companies and educational institutions located in different geographical areas. The areas with the greatest representation, in this case, were the autonomous communities of Galicia and the Canary Islands. Each partner was responsible for carrying out interviews with respondents who were geographically closer to them or, alternatively, with those with whom they shared a closer professional or educational connection.

In this way, the following results were obtained (Table 24):

Table 24. Number of interviews per group

Group of respondents	Number of respondents
VET students	1
HE students	1
VET educators	2
HE educators	1
Professionals	4
TOTAL:	9

4.2.2.1 The sample

Students

The sample consists of 58 Spanish students enrolled in Vocational Education or Training (VET), or in Higher Education (HE) studies.

The typical student profile is a male under the age of 25 who is currently pursuing vocational education or training.

More detailed respondent data is presented below. In terms of gender distribution, the majority of survey participants were male, representing 88% of the sample.

Regarding the studies category (Figure 74), the responses were more varied but highly polarized, with 88% being VET students. There were no responses from secondary education or PhD students.

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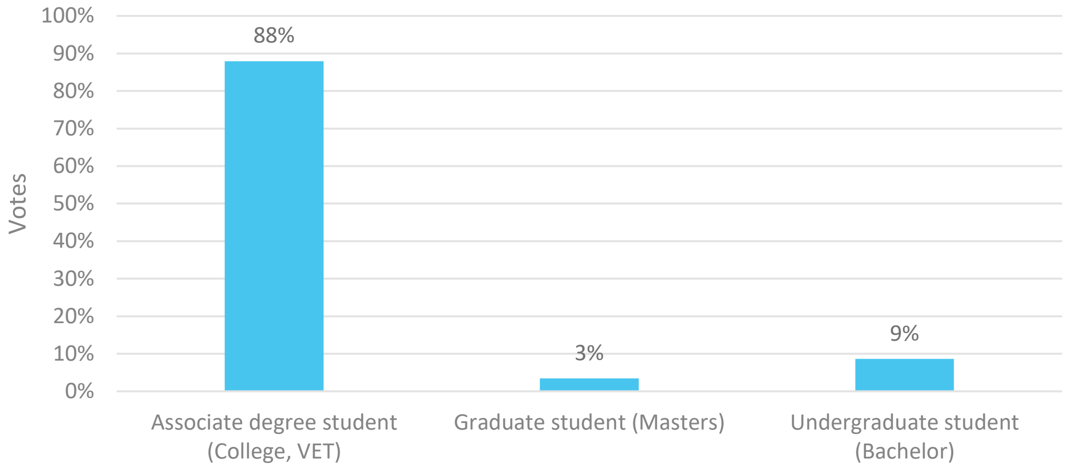

Figure 74. Categories of students (Source: Spain CoVE surveys)

Educators

The sample consists of 31 Spanish students teaching Vocational Education Training (VET), or in Higher Education (HE) studies.

The typical educator profile includes both males and females aged between 26 and 55 years, currently teaching at the university level or in vocational education and training. The sample reflects a heterogeneous demographic profile.

More detailed respondent data is presented below. In terms of gender distribution, the majority of survey participants were male, representing 58% of the sample. Notably, women accounted for 39% of the respondents, a considerably higher proportion compared to the student sample.

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In terms of organizational category, the responses were fairly balanced. The largest group consisted of university professors, representing 54.84% of the sample. This was closely followed by VET teaching staff, who accounted for 41.94% of the respondents, as illustrated in Figure 75.

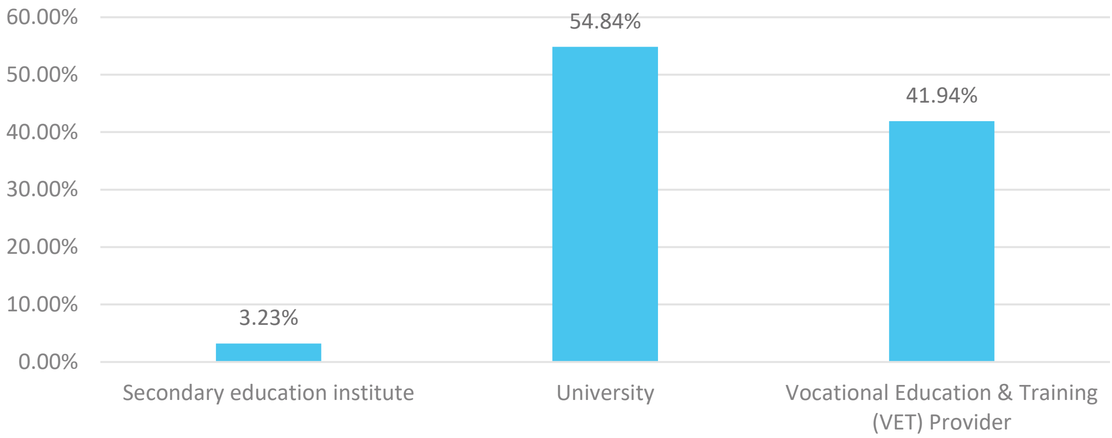

Figure 75. Organization categories (Source: Spain CoVE surveys)

Of the total teaching staff included in the sample, 48.39% hold permanent contracts, while 51.61% are employed on a temporary basis. This suggests that there is a slightly higher prevalence of temporary employment among the teaching staff, which could have implications for job stability, continuity in teaching practices, and long-term commitment to the institution.

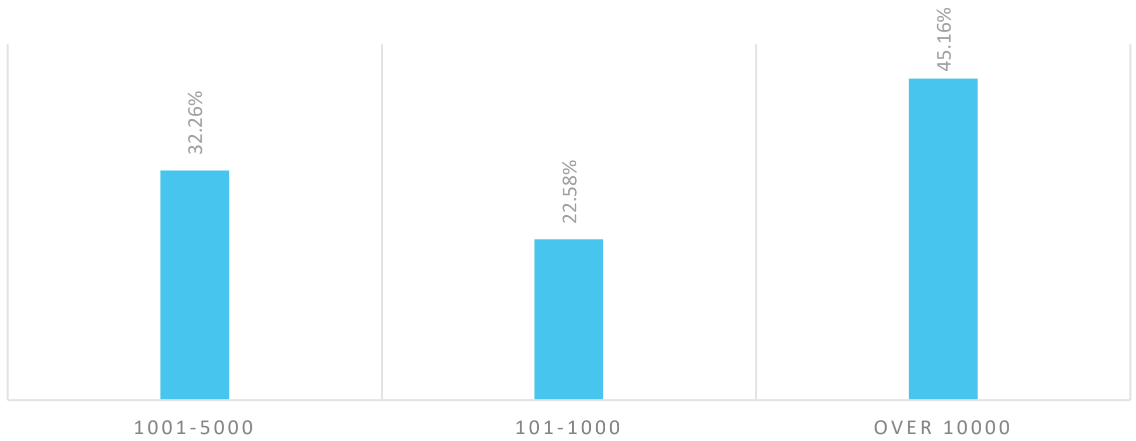

Figure 76. Institutional size (Source: Spain CoVE surveys)

Regarding the total number of students at the institution, there were no responses for the options "0-100 students" and "5001-10000 students." The majority group consisted of institutions with more than 10,000 students (Figure 76).

A question was also posed regarding the percentage of students over 50 years old. The results indicated that this demographic is a minority, with 87% of teaching staff selecting the option that less than 10% of the student body is over 50 years old.

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In terms of the types of degrees awarded by their institution, the responses were evenly distributed among the categories: master's degree (17 responses), bachelor's degree (16 responses), doctorate degree (16 responses), and associate degree (diploma, etc.) (14 responses).

Professionals

The sample consists of 22 Spanish professionals who are experts in the Offshore Renewable Energy (ORE) sector. The typical profile of an ORE professional includes both males and females aged between 26 and 55 years, currently employed at companies with fewer than 50 employees.

In terms of gender distribution, the sample of industry professionals shows an equal representation of male and female individuals, each accounting for 50%. This group demonstrates the highest representation of women compared to the lower representation observed among teaching staff and students.

Regarding company size, based on the number of employees, the largest group consists of professionals from small companies, representing 50% of the total (Figure 77). The next most represented group comprises professionals from companies with more than 1,000 employees. Professionals from mid-sized companies, with between 51 and 1,000 employees, are less represented, accounting for less than 20% of the total.

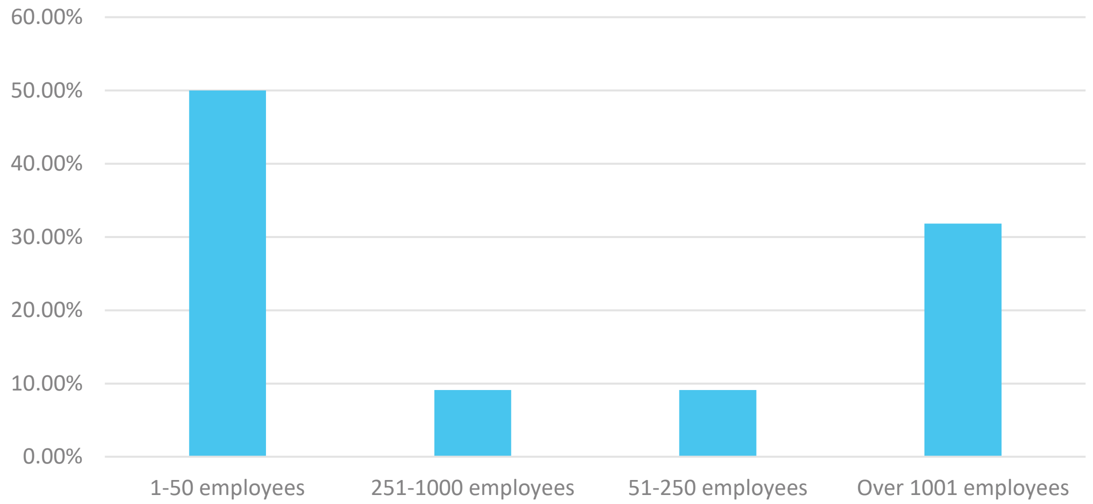

Figure 77. Company size (Source: Spain CoVE surveys)

Sample conclusions

In Table 25 are shown samples from each of the surveyed groups.

Table 25. Sample characterization (Source: Spain CoVE surveys)

Categories	Students	Educators	Professionals
Number of participants	58	31	22
Gender	88% male 12% female	58% male 39% female	50% male 50% female

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		3% others	
Ages	100% < 35 years	The majority age group (42%) is between 46 and 55 years old	The majority age group (41%) is between 46 and 55 years old
Description of the educational organization	93% VET 5% University 2% Highschool or other	42% VET 55% University 3% Highschool	--

4.2.2.2 Students

The results show that the surveyed students are interested in the ORE sector. 57% of the total are very interested or interested in the sector, while 34% are somewhat interested, and 9% have no interest (Figure 78).

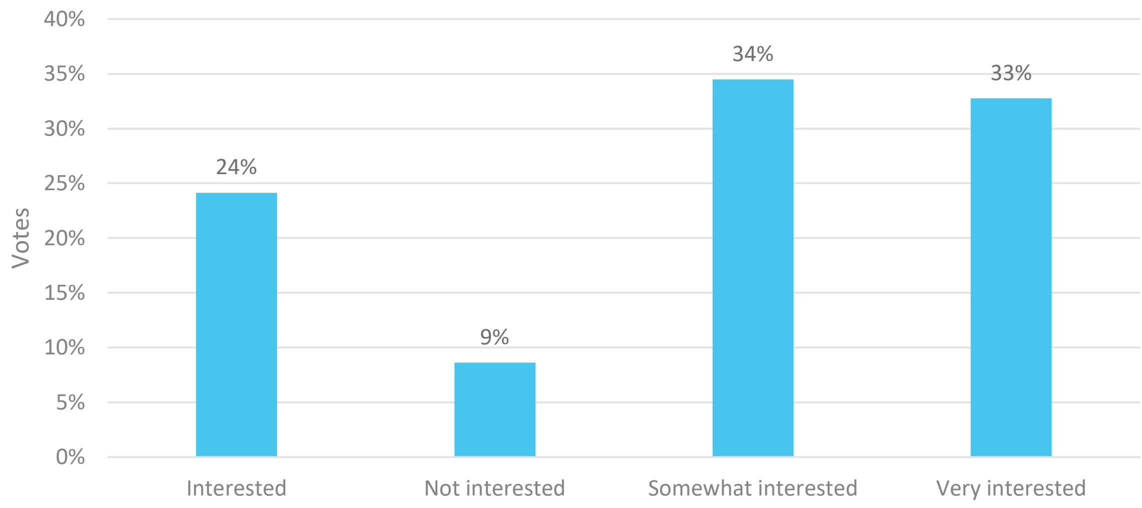

Figure 78. Level of interest in pursuing a career in ORE sector (Source: Spain CoVE surveys)

Based on the responses, a trend can be observed in the career paths that institutions are most actively promoting (Figure 79).

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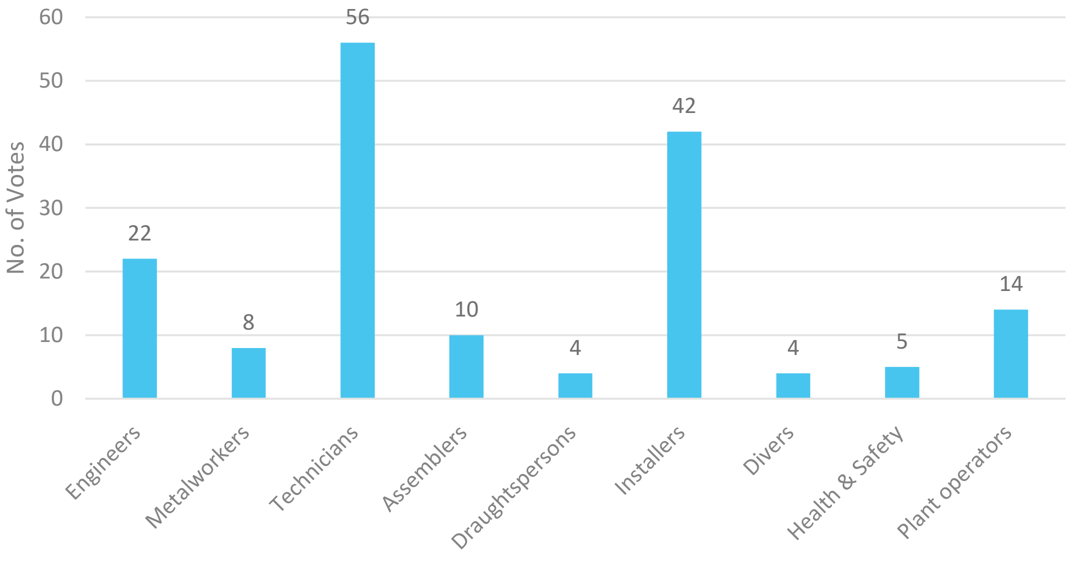

Figure 79. Encouraged career paths for students (Source: Spain CoVE surveys)

The responses indicate a clear preference for certain fields, suggesting that students are being encouraged towards specific career paths more than others. It is important to highlight that this may reflect the current priorities or focus areas of the institution, as well as the growing trends in the job market. Technicians received the most responses, with 56 mentions, indicating that the institution is heavily promoting technical careers. Installers followed closely with 42 responses, suggesting strong encouragement for careers requiring practical skills, particularly in sectors such as construction and maintenance.

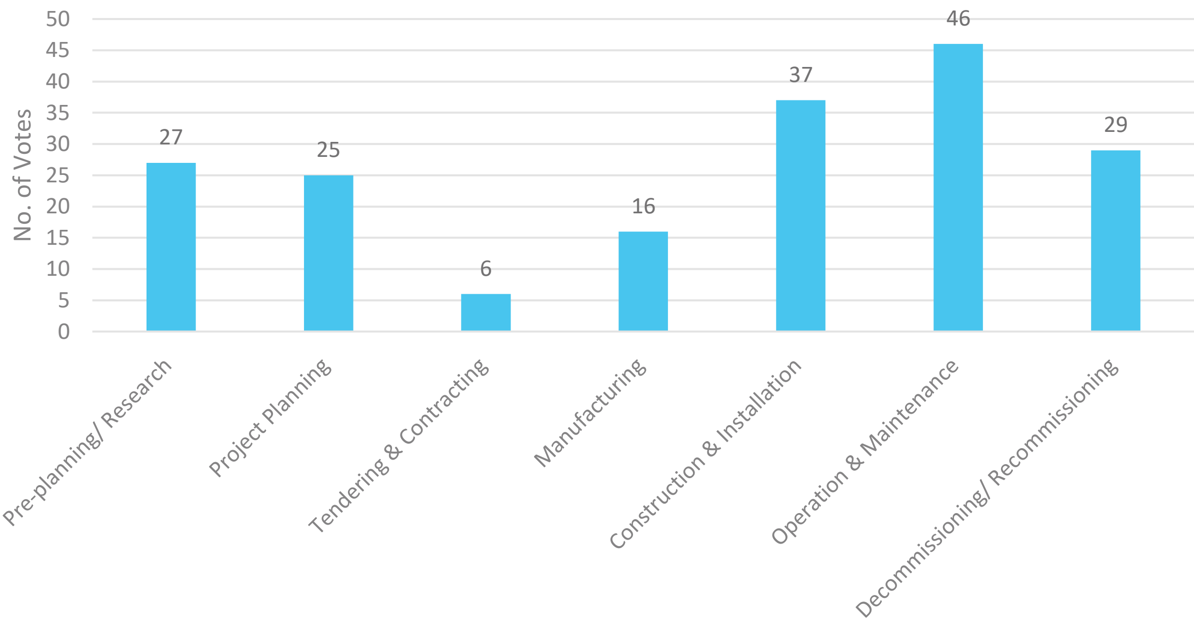

Figure 80. Interest in value chain for students (Source: Spain CoVE surveys)

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When asked about which stages of the value chain, they are most interested in, and given that this was again a multiple-choice question, the majority response was "Operation and Maintenance," followed by "Construction and Installation" (Figure 80)

When participants were asked about the relevance of their current courses to the offshore renewable energy (ORE) sector, the responses were as follows: 33% of respondents considered their courses very relevant to the ORE sector, while 53% found their courses moderately relevant. Consequently, 86% of respondents perceive their courses as at least moderately relevant to the ORE sector, indicating an overall positive alignment with the field. Notably, no students selected the option indicating that their courses were not relevant, suggesting that 100% of respondents perceived some level of relevance in their education to the sector (Figure 81).

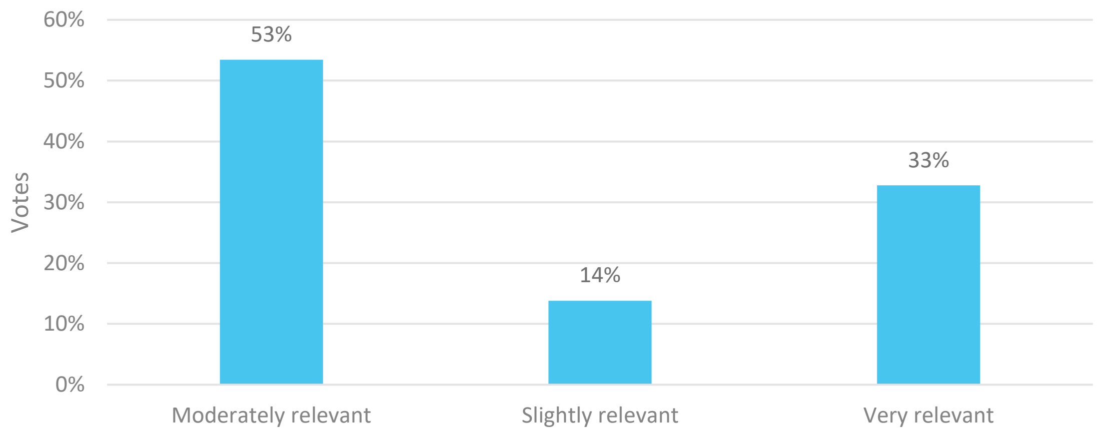

Figure 81. Relevancy of current courses to the ORE sector (Source: Spain CoVE surveys)

In the short interviews, two students—one from a Renewable Energy VET program and the other a naval engineering student—highlighted the lack of hands-on experience and the need for training in working at heights. They also emphasized the lack of knowledge about the ORE sector and the need for greater awareness. One student noted that roles related to the operation and maintenance of offshore wind turbines are particularly demanding in terms of skills and expertise.

Regarding their level of confidence in certain hard skills, rated on a scale of 1 to 5, the highest scores were for Health and Safety Skills (3.5 out of 5), Using and Understanding Numerical or Statistical Information (3.5 out of 5), and Digital Skills (3.4 out of 5). In contrast, Engineering Skills received a relatively low score of 2.2 out of 5, which may suggest that students feel less confident in this area and could indicate a potential gap in the development or emphasis on engineering-related skills within their education. The average rate of confidence in hard skills is a 2.7 out of 5.

Regarding their level of confidence in certain soft skills rated on a scale of 1 to 5, the highest scores were all of them 4.2 out of 5, and in the next following set of skills: Communication and collaboration, Flexibility and Adaptability and Productivity and Accountability. The average rate of confidence in soft skills is a 3.9 out of 5.

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The data reveals a notable difference in student's confidence levels between hard and soft skills. When assessing hard skills, the average confidence standard at 2.7 out of 5. The average confidence in soft skills was notably higher, at 3.9 out of 5.

Furthermore, most of students feel their current education is preparing them well for the ORE market needs. 68% of the sample indicates that they are being well or very well prepared.

The students interviewed with the short interviews methodology they highlighted:

- Hard skills crucial, a much higher influence than soft skills
- Most important hard skill: offshore knowledge and technics
- Soft skills: all of them. Include problem-solving skills
- Most important hard skills: health and safety. A lack of attention to health and safety could make the sector appear riskier, discouraging professionals from entering the field.
- Most important soft skill: flexibility and adaptability, because ORE is a field still in development.

They were also asked if they have participated in any industry-related projects in research, and most of them, 90%, they answered "No". Regarding the practical experience they had, they were specifically asked about those related to the offshore renewable energy sector. Although most did not have experience, some individuals responded that they had participated in workshops, research projects, and internships.

On the other hand, when asked about the challenges they face in gaining practical experience in this field, the main cause was the lack of internship opportunities. However, they also highlighted other factors such as limited access to industry professionals and insufficient practical training in the curriculum.

Both student respondents of the short interviews highlighted the importance of the institutions to be more in contact with companies to know the specific needs of the sector and the necessity of research in the ORE sector through stronger collaborations between academia, industry and government, giving students chances to do internships.

In terms of access to ORE information, the vast majority of students stay informed about marine renewable energies through social media and television.

When students were asked about the support, they need from their institution to pursue a career in the ORE sector, the most frequently mentioned response was "internship placement." This aligns with the challenges they previously highlighted, such as the "lack of internship opportunities."

At the end of the survey, students were asked about any general comments or suggestions for improving the teaching of ORE courses, and some of them gave their impressions:

- "Create specific marine renewable energy modules"
- "Give more emphasis to this marine area, which is very good. Or teach a module for this with internships in the marine sector."

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- "In my career, the topic of renewable energies is quite up to date"
- "Increase the content in vertical jobs and finance the necessary courses by the Ministry of Education"
- "Make working in the offshore wind sector more accessible"
- "Offer more internships and scholarships to future workers and intern students who want to get a future position, as well as complementary orientation courses".

4.2.2.3 Educators

In terms of career paths for students in their institution, educators found the most encouraged ones to be engineers, followed by technicians and installers (Figure 82). There was almost no representation in the fields of health and safety, draughtspersons, assemblers, or divers.

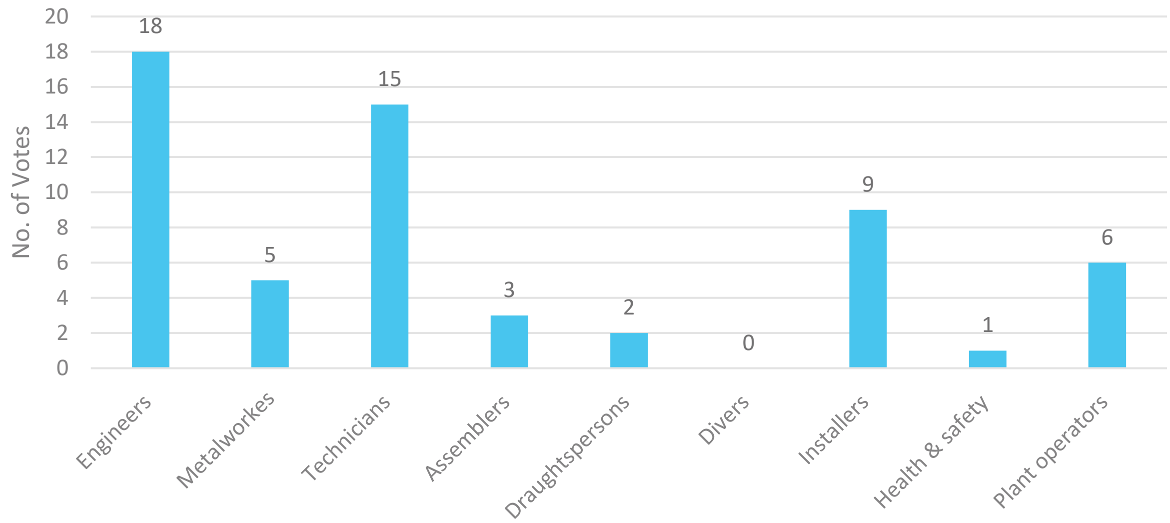

Figure 82. Encouraged career paths according to educators (Source: Spain CoVE surveys)

They were also asked about the renewable energy sector that best fits the value chain of their specialty, with the following results: most respondents selected "Offshore wind energy," accounting for 48% of the responses. The other two sectors represented are "Onshore solar energy" (26%) and "Offshore wind energy" (26%).

Regarding the phases of marine renewable energy covered by the value chain of the teaching process through activities, the most prominent were "Pre-planning and research" and "Operation and Maintenance.

The teaching staff who responded to the survey are generally instructors in offshore wind or onshore wind energy, although there are also some individuals focused on other types of marine energies, such as tidal energy, wave energy, and solar energy.

Regarding the professional experience of the teaching staff in the renewable energy technologies sector, the largest group, with 42%, consists of those with less than 3 years of experience.

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When the same question was repeated but specifying teaching experience in the field of offshore renewable energy technologies, the largest percentage (36%) was no longer those with less than 3 years of experience. Instead, 39% of the total respondents indicated that they had no experience in this specific sector.

Teachers were asked about the most important gaps they believe should be addressed by training programmes. The area where they see the least gaps is in Health and Safety skills, which aligns with students' opinions, as they rated this technical skill with higher confidence levels.

The teaching staff places importance on working on engineering skills, digital skills, and project design and planning. In the case of engineering competencies, this result aligns with the low self-confidence scores shown by students when asked about this specific area. This finding may confirm that there is a potential gap in the development or emphasis on engineering-related skills within education.

Regarding soft skills, teachers identify gaps in several areas, particularly in Critical Thinking and Problem Solving and Initiative and Self-Direction. They also emphasize the importance of Communication and Collaboration skills. In the case of soft skills, the teachers' assessment does not align with the students' perceived confidence in these areas.

The group of teachers was asked about both the technologies and tools they use in their current study programmes. Regarding technologies, Automation and Advanced Robotics and the Internet of Things (IoT) stand out, while there seems to be little or no training in Cybersecurity, Blockchain, and Communication technologies (Figure 83).

With respect to tools, the three most frequently mentioned were Simulation software, Programming languages, and CAD software. Conversely, Blockchain platforms, Cybersecurity tools, and Cloud computing platforms were rarely addressed (Figure 84). In cases where the teaching staff identified tools not included in the provided list, they were asked to name tools relevant to the offshore renewable energy value chain that were not mentioned in the survey. Two respondents highlighted additional tools: “Structural simulation software” and “Naval architecture software.”

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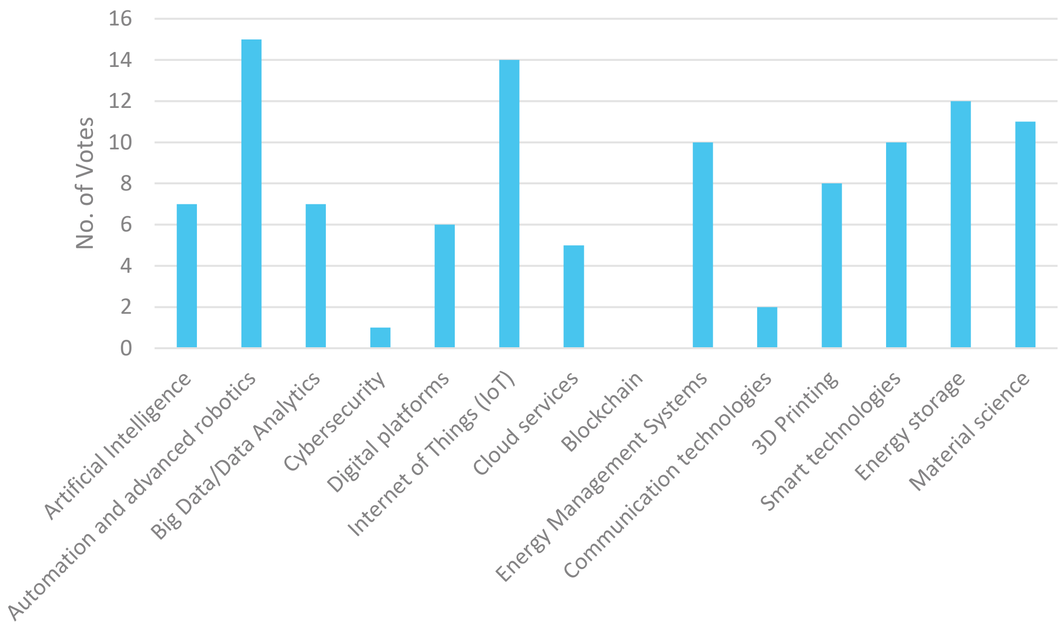

Figure 83. Technologies covered by study programmes (Source: Spain CoVE surveys)

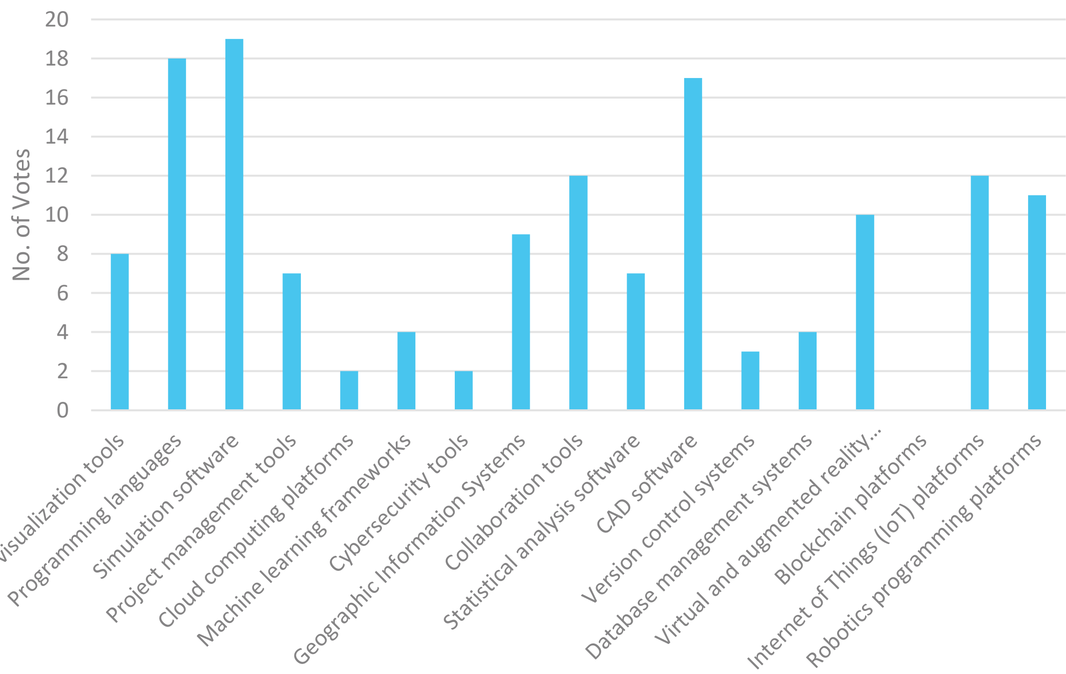

Figure 84. Tools addressed at study programmes (Source: Spain CoVE surveys)

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The teachers were also asked how often they updated their course content to reflect changes in the industry. The majority indicated that they updated their content on an annual basis. To ensure that the curriculum remains aligned with current regulations and standards, compliance reviews were identified as the most frequently used method.

Regarding collaboration, most of the teaching staff reported that they do not work with other education and training providers. This was noted as an area for potential improvement, as such collaboration could enhance teaching effectiveness and the overall quality of education and training.

When asked about resources to improve teaching effectiveness, all the options were deemed important. However, the highest percentage, 29%, went to “Access to industry experts.” Concerning the incorporation of practical experience into the classroom, the most utilized approaches were internships, field trips, and guest lectures from industry experts. Several respondents also mentioned hands-on labs and virtual labs.

Teachers were then asked about the main challenges they face in delivering effective education and training. The primary challenge, cited by 33% of respondents, was limited practical training opportunities, followed by a lack of resources (25%). Student engagement and keeping up with industry changes were also noted as significant concerns.

Furthermore, when asked about the challenges they face in collaborating with employers to ensure program relevance, the most frequent responses included limited engagement from employers, misalignment between academic and industry needs, and logistical difficulties in arranging internships or placements. These areas were identified as having significant room for improvement.

Lastly, teachers were invited to provide comments or suggestions regarding the study program and future collaboration with stakeholders. The remarks they provided are summarized below:

Internships and collaboration between teachers and companies:

- “Collaboration and information exchange between companies and teachers”, “The transfer between companies and teachers should be easier and more common” and “Greater coordination is needed.”
- “Need for adequate internships.”
- “Difficulty accessing real platforms.”

Students’ motivation and engagement:

- “Difficulties in engaging students.”
- “It is important to bring students closer to the real world of work, which is partly being achieved, in order to seek their involvement, responsibility, initiative and interest.”

Resource limitations:

- “Resource limitations, especially the available time to prepare teaching, often hinder its development.”
- “It would be advisable to increase practical teaching in the university's facilities.”

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- “We should even have part of our time dedicated to interacting with companies, we are only counted the hours dedicated to students and internal management.”

ORE specific training:

- “The curriculum is not focused on offshore renewable energies; it is generic to the naval sector, which is why there are no specialised subjects.”
- “Access to teaching materials and specialized workshops is needed.”
- “We would like them to give training talks on SCADA programming.”
- “There is no subject on marine renewables in the Naval Engineering Degree. In the Naval Master's program, there is one subject that covers some marine renewables (along with aquaculture, etc.). In the Industrial Degrees and Master's programmes, there are no subjects on marine renewables.”

Lack of training for trainers:

Regarding the conducted short interviews, some of the most important highlights mentioned by educators are shown in the table below:

Table 26. Highlights from educator’s short interviews (Source: Spain CoVE surveys)

Thematics	Comments
Needs and roles in demand	- *Able to develop operation and maintenance task in wind farms.* - *English language skills.* - *Insufficient workforce to handle certain investments such as the wind farms planned in Galicia, where 62 parks could require 6,000 skilled workers for everything from assembly to commissioning.* - *Professions that may require the most significant skill updates: management and control, including artificial intelligence and energy digitization.* - *Skills most in demand: renewable energies predictive maintenance* - *High demand for specific skills.* - *ORE sector needs people capable of overseeing complex offshore projects. Necessary both, soft and hard skills.*
Hard skills and soft skills	- *Most important hard skills: digital skills critical. Offshore specific skills should be prioritized. Specific ORE skills, like underwater cabling, installation of jackets and piles, activities not present in onshore wind energy.* - *Most important soft skills: initiative and self-direction.* - *Suggestions for better alignment between training and skills needed in the ORE sector: specialized courses and training for trainers in real-world settings.*

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	- *Essential soft skills: communication and collaboration and flexibility and adaptability.*
Gender and diversity representation	- *Women and younger workers remain underrepresented, particularly in technical and leadership roles. We need to create inclusive pathways into the renewable workforce, expand the access to underrepresented groups can enhance workforce capacity and innovation.* - *lack of role models, and the existing ones need to be made more visible.*
Collaboration	- *Need: collaboration between VET and companies. More than 90% of students who do their practices in wind power continue working in wind power companies* - *Wind power industry puts up many obstacles at time to start practices in a wind farm, doing impossible practices agreement.* - *Collaboration: lack of standardisation in training frameworks. Need to harmonize training standards across regions.* - *Collaboration between universities to create shared training facilities such as simulation labs for wind turbine maintenance or maritime safety, towing tanks to do experiment with support structures and so on.*
Interest in ORE careers	- *Offering competitive salaries and compensating time spent away with extended periods at home.* - *Need to focus on training standards and recognized certification to allow people to work in any place and share knowledge through institutions.*

4.2.2.4 Professionals

The most prevalent employee profile across these companies is that of engineers, followed by technicians. Half of the surveyed employers indicated that they currently have vacancies, and 82% stated that they review the skills and training needs of their workforce at least once a year. In terms of the employee groups primarily addressed during these reviews, the focus remains on engineers and technicians, with divers and Health and Safety roles also receiving attention.

When asked about the most important technologies for their companies, respondents overwhelmingly pointed to Artificial Intelligence and Automation and Advanced Robotics. These technologies appear to align with those mentioned by teaching staff, although the industry suggests more emphasis on Artificial Intelligence. Nonetheless, to determine whether study programmes truly address company needs—

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particularly in the practical application of theoretical concepts—a more detailed analysis of the curricula is recommended.

According to professionals in the Offshore Renewable Energy (ORE) sector, the most significant hard-skill gaps requiring attention from educational programmes include digital skills, offshore-specific competencies, engineering skills, and project management. In terms of soft skills, communication and collaboration skills, along with critical thinking and problem-solving, rank as top priorities.

Survey data also shed light on strategies for engaging with professional associations, revealing that the most common approach—cited by the largest number of respondents—is participation in association-led initiatives and panels. This suggests active involvement in industry events and strong engagement with professional groups.

Regarding structures that facilitate continuous learning and professional development, most respondents reported that their companies provide access to continuing education funds. However, some indicated limited support for continuous learning, suggesting an opportunity to enhance this type of training. Given the rapid evolution of the ORE sector, with significant changes occurring in a short time frame, regular updates to worker skills and knowledge are increasingly critical.

Regarding the conducted short interviews, some of the most important highlights mentioned by professionals are shown in the table below:

Table 27. Highlights from professionals' interviews (Source: Spain CoVE surveys)

Thematics	Comments
Needs and roles in demand	- *"The expected demand will be so high that there are not enough trained technicians."* - *Roles in demand: lack of sufficiently qualified welders and crew for offshore vessels.* - Shortage of qualified technical personnel with medium training (maintenance, etc.) - There is a lack of specialized training; The current regulated training does not offer it. - There is a need for training of trainers and improvements in the curricula, making them more practical.
Hard skills and soft skills	- Hard skills: Project management skills and Health and Safety Skills. - Soft skills: Communication and Collaboration, flexibility and adaptability. - Hard skills: Digital skills (Blockchain). - Soft skills: Communication and collaboration. - Hard skills: Offshore specific training.

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	- Soft skills: English language skills (it is still a barrier in Spain).
Gender and diversity representation	- Significant gender gap: shipbuilding around 30% women only.
Collaboration	- *"There should be more direct communication between industry and educational centres. It recommends that Vocational Training Centres, Technology Centres, Consulting Firms... address the industry and ask about their needs."* - *"International cooperation allows lessons learned to be drawn from other regions, and even from sectors with similarities (such as oil and gas)".* - *"Lack of coordination of what schools offer and what companies need. The centres are obsolete in terms of content and practices according to the needs of the industry."* - "Hinge institutions" such as clusters, are necessary to make companies and educational centre collaborate.
Interest in ORE careers	- Need for financial remuneration for dual vocational training tutors. - Need for dissemination of information on marine renewable energies and social awareness of the interest of the sector. - Academy and industry collaboration: increase dual training, and diagnosis of the needs of future occupations.

4.2.3 Skills gap analysis

The results from the surveys of students, educators, and professionals in the Offshore Renewable Energy (ORE) sector reveal significant insights into the current skill gaps in the industry. These gaps are identified across both hard and soft skills, with key differences observed between the needs expressed by students, educators, and professionals.

4.2.3.1 Hard skills

The analysis of hard skills highlights areas where there is room for improvement in aligning educational outcomes with the needs of the offshore renewable energy (ORE) sector. Students expressed the highest confidence in health and safety skills, followed by digital skills. However, engineering skills received a notably lower confidence score (2.2 out of 5), indicating a gap in this area. The average confidence in hard skills overall was 2.7, suggesting that students may feel less prepared in certain technical competencies that are critical for the ORE industry.

Educators share similar concerns, particularly regarding engineering skills, digital skills, and project design and planning. This aligns with students' lower confidence in engineering, indicating that current educational

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programmes might benefit from a greater emphasis on these technical areas. Educators further suggest the importance of incorporating more practical, hands-on training in engineering to better prepare students for the specific demands of the ORE sector.

From the ORE professional perspective, there is a recognition of skill gaps in digital competencies, offshore-specific knowledge, engineering, and project management. These areas are particularly relevant to the ORE sector, and the identified gaps signal the need for more specialized and focused training. The gap in offshore-specific skills suggests that students could benefit from more targeted education to address the unique requirements of this field.

In summary, while there are identifiable gaps in hard skills, particularly in engineering and offshore-specific competencies, the educational and industry sectors are aware of these challenges. Addressing these gaps with a focus on practical training and targeted skill development will be key to aligning educational programmes with the evolving needs of the ORE industry.

4.2.3.2 Soft skills

The analysis of soft skills suggests that while students demonstrate confidence in key areas, there may be potential for further development in certain competencies to better align with the needs of the offshore renewable energy (ORE) sector.

Students generally reported high confidence in soft skills such as communication, collaboration, flexibility, and productivity, with average scores of 4.2 out of 5. These skills are often seen as essential for effective teamwork and operations within the ORE sector, a multicultural sector sometimes in extreme conditions, and the responses suggest that students are reasonably prepared in these areas. However, it is possible that critical thinking and problem-solving could be areas where students feel less confident, as these skills were not as strongly represented in their responses.

Educators noted some potential gaps in critical thinking, problem-solving, initiative, and self-direction, which are often considered important for navigating complex and high-pressure situations. While students feel confident in their soft skills, educators suggested that a greater focus on these areas could help better prepare students for real-world challenges within the ORE sector.

From the industry perspective, professionals acknowledged the importance of communication, collaboration, critical thinking, and problem-solving. These skills are generally seen as necessary for effective collaboration within multidisciplinary teams and for addressing the challenges present in offshore renewable energy projects. Professionals emphasized that these areas should be given more attention during training, indicating that while students show competence in certain soft skills, a more focused development of critical thinking and problem-solving may be beneficial.

In conclusion, while students exhibit confidence in many soft skills that are valuable in the ORE industry, there may be areas such as critical thinking, problem-solving, and initiative that would benefit from further emphasis. Strengthening these competencies could help students align more closely with industry expectations and better equip them for the demands of the offshore renewable energy sector.

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4.2.3.3 Practical experience

The gap in practical experience is another critical area, with students needing more exposure to industry settings through internships and real-world projects. To address these gaps, there is a clear need for better alignment between educational programmes and industry needs, especially concerning emerging technologies like artificial intelligence and automation. Closing these gaps will be essential to ensure that the workforce is adequately prepared for the challenges and opportunities in the rapidly evolving offshore renewable energy sector.

To effectively address the identified gaps in practical experience and better align educational programmes with industry needs, it is crucial that both educational institutions and industry stakeholders—such as companies and training providers—allocate sufficient resources. This alignment requires more than just the development of protocols and proposals; it necessitates a genuine commitment from all involved parties to foster meaningful collaboration.

Educational institutions and training providers should establish dedicated departments or teams specifically tasked with facilitating partnerships with industry players. These departments could be responsible for identifying relevant opportunities for internships, real-world projects, and industry-academia collaboration. In addition, there may be value in incentivizing or rewarding the participation of both educational staff and industry professionals in these collaborative efforts. For example, training providers or educational institutions could consider providing financial support or other incentives to educators or trainers who participate in joint initiatives, such as designing industry-relevant curricula or guiding student internships.

Similarly, companies should recognize the importance of investing time and resources into creating pathways for students to gain hands-on experience. This may involve offering more internship positions, mentorship programmes, or opportunities for students to engage with cutting-edge technologies in real-world contexts. By providing these opportunities, industry players would not only help bridge the gap between theoretical learning and practical application but also ensure that future workers are adequately prepared to meet the evolving demands of the offshore renewable energy sector.

In summary, to close the gaps in practical experience and ensure students are better equipped to meet the challenges of the offshore renewable energy industry, both educational institutions and companies must allocate resources, create collaborative departments, and incentivize involvement from all stakeholders. This mutual commitment will be key in fostering effective partnerships and addressing the critical needs in this rapidly advancing field.

4.3 Italy

4.3.1 Skills and qualifications in demand

The transition toward offshore renewable energy and its related infrastructure highlights a critical need for both technical and non-technical skills in the job market. As emerged from the analysis of short interviews' results, technical expertise is essential in areas such as floating offshore wind technologies, structural and

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naval engineering, turbine performance optimization, and the installation and maintenance of offshore systems. This requires specialized knowledge, including the design of floating platforms, mooring systems, and renewable energy integration. Electrical engineering plays a pivotal role in supporting energy generation infrastructure and ensuring compliance with international offshore standards. Additionally, roles in environmental monitoring, permitting, legal frameworks, and regulatory compliance are increasingly vital to ensure the success of offshore renewable energy projects. However, the complexity of these projects also demands a strong focus on soft skills. Critical thinking, adaptability, communication, and stakeholder management are essential for professionals working in multidisciplinary teams and navigating relationships with diverse stakeholders. Cultural awareness and collaboration are particularly critical in fostering international partnerships and managing global regulatory environments. As the industry evolves, flexibility in reskilling and upskilling is required, especially for workers transitioning from traditional sectors like shipbuilding or oil and gas into renewable energy fields.

In Italy, the workforce shows potential but currently lacks the specialized skills needed for offshore wind construction, maintenance, and operations. Capacity gaps are most evident in offshore engineering, digital modelling, hybrid system integration, and marine-specific health and safety. Bridging these gaps requires a strategic alignment between educational institutions and market needs. Universities and vocational training programmes must expand their offerings to include courses on floating structures, renewable energy systems, environmental impact assessments, and advanced digital tools like GIS and analytics. Collaborative efforts between academia and industry are crucial to developing modular and practical training opportunities, internships, and certifications tailored to offshore renewable energy technologies. Furthermore, adopting international best practices, such as those found in Northern Europe, could provide a model for Italy to follow. Programmes like Erasmus+ and other international collaborations can foster knowledge exchange, standardize certifications, and expose students to varied offshore environments and regulatory frameworks. Investment in state-of-the-art simulation tools and offshore-specific labouratories, coupled with industry input into curricula, will ensure a workforce capable of meeting the sector’s evolving demands. This comprehensive approach to skills development will not only support Italy’s transition to offshore renewable energy but also position it as a competitive player in the global renewable energy market.

4.3.2 Sectoral needs in industry and education

The main goal of the survey conducted was to gain comprehensive and relevant insights into the offshore wind energy sector, and more generally into renewable energy sources, focusing on their technical, economic, legal, environmental, and social dimensions. This preliminary analysis is essential to identify the labour market and skill needs that will support the development of multiple project activities. The analysis was conducted on a sample of teachers, students, and corporate representatives from Italy, Portugal, Spain, Greece, and Cyprus. In this section, there will be described the outcomes from the Italian sample.

Students

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The sample consists of 82 Italian students, predominantly male and under the age of 25. Among them, 83% are actively enrolled in university programmes, with 79% pursuing a bachelor's degree.

When asked about the career paths their institution encourages, 69 students (84.1%) answered "Engineer," followed by "Designer" (24.4%) and "Technician" (22%). In a smaller but still significant percentage, we also have “Plant Operator” (17.1%), “Metalworker” and “Health and Safety Officer/Manager” (both at 15.9%).

It is interesting to notice that only 18.3% of students expressed a strong interest to pursue a career in offshore renewable energy (e.g., offshore wind, offshore solar, tidal energy, wave energy, ocean thermal energy), compared to 50% who were "quite interested" and 26.8% who were "slightly interested", despite 67.1% of the sample feeling that their current educational path was relevant to this sector.

Teachers

With reference to the teachers, the sample is composed of 25 Italian teachers coming from different institutions (e.g. UNIPVM, IFOA, Università Telematica e-Campus, and Universitas Mercatorum).

The age range is distributed between 26 and 55 years old. The most predominant gender is male (76%). Within these institutions, respondents play different role 40% of respondents are permanent teaching staff, 32% are freelance professionals, and 24% hold temporary teaching positions. According to the teachers interviewed, the educational programmes offered by these institutions are generally of a high standard. The majority are classified between levels 6 and 8 of the EQF, indicating that they are academic programmes, including bachelor's, master's, and doctoral courses.

With reference to the respondents’ experience in the Renewable Energy field, the majority of them declared to be mostly qualified in onshore solar energy (64%), while 24% of the declared to be mostly qualified for onshore and offshore wind energy. This trend can be attributed to the significant success of solar energy in Southern European countries.

When asked about the renewable energy technologies related to the subjects they teach/have taught, the respondents confirmed the trend evidenced before: there is a clear majority of respondents who focus their lectures on onshore solar energy (80%), while 36% on wind onshore energy. Only 16% focus also on offshore wind energy.

As evidenced, the teaching activities of the respondents primarily focus on the early stages of the ORE value chain: programmes and activities in which the respondents are involved are mainly focused on the phase of pre-planning/research about the effectiveness of ORE technologies.

Industry representatives

The professionals’ sample is composed of 24 Italian professionals in vast majority male with an age distribution between 26 and 55 years old. The professionals interviewed represent a vast range of companies and organizations of various sizes within the offshore renewable energy sector and related fields, covering different areas of the supply chain. The majority of those interviewed work for Small and Medium Enterprises (SMEs), while others are employed by larger companies with over 1,000 employees, which operate not only

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in Italy but also internationally. In fact, even though most of these companies have a branch exclusively in Italy, over 40% of them provide their products globally. The respondents cover different roles within their respective companies, e.g. positions within the operations department, human resources, chief officers, team leaders or supervisors. Respondents indicate that their companies primarily operate within the upstream phases of the offshore renewable energy value chain, focusing on activities such as pre-planning and project planning (Figure 85).

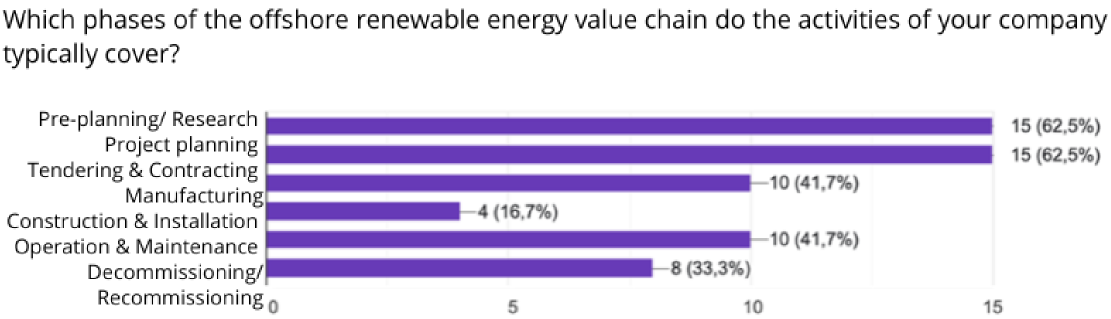

Figure 85. Phases of the ORE value chain covered by companies (Source: Italy CoVE surveys)

Competences

The students interviewed declared to feel less confident in technical-professional fields rather than in cross-functional areas. Most students believed that their current education prepared them well (50%) or even very well (11%) for the renewable energy market's demands, with an additional 35.4% indicating to be receiving "enough" preparation. However, 86.6% of them declared to have not had any practical experience in the field.

Respondents' perceptions of the obstacles to gaining practical experience in this field were fairly uniform, indicating:

- Difficulty in connecting with industry professionals (42.7%).
- Insufficient practical training in their current curriculum (37.8%).
- Geographic constraints (e.g., living in an area with no nearby offshore facilities) and a lack of internship opportunities (both 32.9%).

Teachers

The teachers interviewed highlighted the following skills' gaps among students that educational programmes should addressed:

- engineering skills (electrical, structural, and offshore engineering).
- project design.
- project planning.

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- digital skills.
- project management skills.
- health and safety skills.

With reference to soft skills, the interviewed teacher highlighted mainly critical thinking and problem solving, but also flexibility and adaptability.

Respondents indicated that hard skills are primarily developed through bachelor's and master's degree programmes, as well as vocational training courses. In contrast, soft skills are more effectively developed through internships and on-the-job training, including mentoring and job shadowing. Additionally, they agreed that internal training offered by companies plays a crucial role in developing both hard and soft skills.

The study programmes of the respondents encompass a range of technologies related to renewable energy, e.g. energy storage (48%), energy management systems (44%). A substantial focus is also given to smart technologies, internet telecommunications, IoT, and artificial intelligence. The respondents stated that the tools that they address the most in their study programmes are programming languages, simulation software and collaboration tools, followed by computer-aided (CAD) software and data visualization tools.

Most of the respondents update their training course on annual base (44%) or even more than once a year (32%) to keep up with the latest advancements, highlighting the influence that the rapid evolution of the industry plays on educational programmes. Respondents also agree that the most significant challenge they face in their teaching or training activities is actually keeping up with the constant changes of the industry.

Industry Representatives

The survey results indicate that 75% of companies involved in the survey currently have job vacancies and agree that filling vacancies in the renewable energy sector can be very challenging due to a lack of adequately skilled applicants.

According to the respondents, engineering along with health & safety, are the groups for which the highest levels of education and training are required. For most of the occupational groups considered in this survey, such as metalworkers, technicians, draughtspersons, installers, and plant operators, respondents believe that an upper-secondary or vocationally oriented education is sufficient. Respondents identified additional educational and training requirements, including specialized skills in offshore renewable energy and expertise in the port and maritime sectors, as well as post-degree specialization courses in these fields. They also emphasized the importance of strengthening the collaboration between companies and universities to better prepare students for the workforce, helping them understand the tasks and skills they will need to apply in their daily work.

Most companies are aware that a continuous review of skills and training needs is vital for maintaining a competent and productive workforce, ensuring compliance with industry and legal standards. Nearly half of the respondents reported that their companies review skills and training needs more than once a year. A significant portion also indicated that these reviews are conducted on an annual basis.

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Stakeholder Engagement

ORE is a continuously evolving sector. The changes that can be recorded on the practical side are, most of the time, combined with changes that affect the legislative framework concerning it. Therefore, it is necessary that both students and educators remain informed about changes in legislation and industry practices. To address this challenge, teachers employ various strategies to keep their curricula updated. These strategies include:

- acquiring the current sectorial standards.
- regularly consulting field experts.
- conducting compliance reviews.
- participating in policy forums and collaborative workshops.

Among the main challenges in collaborating with the industry, most respondents highlight the lack of alignment between the needs of universities/training institutions and those of businesses.

Respondents point out several challenges in ensuring students are prepared for the offshore renewable energy sector, revolving around key factors:

- The need to provide practical training opportunities and give students access to real-world projects.
- Development of industry-specific skills.
- Opportunities to create effective partnerships with companies.
- Availability of specialized equipment and facilities.
- Alignment of academic curricula with current industry technologies.

Addressing these challenges requires a joint commitment from educators, industry partners, and policymakers to create a robust framework that supports learning and skill development in the offshore renewable energy sector.

On the other side, when asked about the main challenges to align their educational programmes to the sector standards, the respondents agreed to assert that the main challenge is understanding certification requirements, followed by the need to update their curriculum to meet those standards and to coordinate with certification bodies. These answers point out that, as said before, the ORE is a sector continuously evolving both on practical and legal side.

With reference to stakeholder engagement activities, respondents stated that their companies prefer overall to participate in association-led initiatives and panels and, in second order, to attend and sponsor sector-specific conferences and seminars. Companies also believe that is important to contribute to the development of industry guidelines.

When it comes to collaboration with other technology providers, professionals reported that their companies mostly opt to:

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- co-develop training solutions tailored to their specific needs.
- engage in pilot projects for new technology applications.

It is interesting to notice that some respondents stated that their company never collaborate with technology providers. This may be due to the dimensions of the business and to the chances to create new technologies in-house (Figure 86).

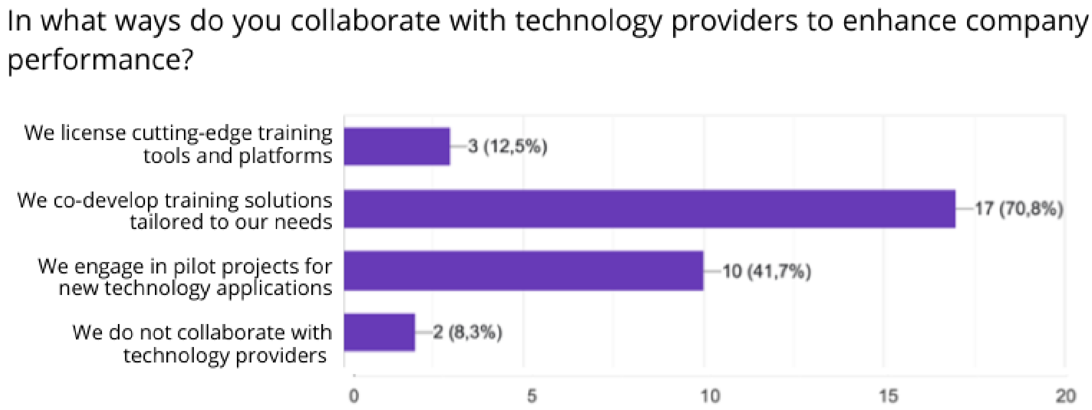

Figure 86. Collaboration of companies with technology providers (Source: Italy CoVE surveys)

Furthermore, companies recognize the importance of continuous learning for their employees.

<u>Transversal Competences and Smart Specialization</u>

With reference to transversal competences, both target groups:

- Emphasise teamwork, problem-solving, and communication.
- Recognise the importance of organizational skills and the ability to learn quickly.

However, teachers place greater focus on teaching-related skills such as systemic/holistic thinking, while professionals emphasise innovation, creativity, and leadership.

With reference to Smart Specialisation, both target groups express uncertainty about alignment with smart specialization goals and the need for new skills within their organizations.

Teachers highlight the need for universities to quickly adapt to changes in learning methods and the specializations required by the job market. Industry representatives are more focused on the practical management and business challenges related to these needs.

4.3.2.1 Sample of interviewees

The sample of 10 interviewees encompasses a broad spectrum of expertise within the offshore renewable energy sector. It includes leaders of industry associations dedicated to developing integrated supply chains and addressing historical challenges in offshore energy development. Additionally, the sample features senior engineers and consultants with extensive experience in the design and implementation of offshore renewable energy projects, including pioneering initiatives such as Italy’s first offshore wind farm and

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advanced floating wind energy projects. The group also includes academics and researchers with specialized expertise in renewable energy technologies, focusing on wave and floating wind energy, numerical modelling, experimental analysis, and scenario development. Moreover, it incorporates seasoned professionals with decades of experience across diverse renewable energy fields, such as photovoltaics, hydrogen, and environmental technologies, who have led innovative solutions and multidisciplinary teams.

Collectively, this diverse representation highlights the critical collaboration between industry, academia, and consultancy in driving advancements in the offshore renewable energy sector and, in particular, in the offshore wind energy sector.

4.3.2.2 Professional background and sector insights

Q1: Can you describe your professional experience in the renewable energy sector? Which specific technologies and areas of the value chain do you specialize in?

The answers reveal diverse perspectives within renewable energy, showcasing varied expertise and approaches. Differences lie in focus areas and roles. Industry professionals tend to prioritize practical applications, such as supply chain development, engineering solutions, and integrating digital tools (e.g., GIS, digital twins). Academics and researchers focus on advancing knowledge, often through modelling, material optimization, or assessing socio-economic impacts. For instance, professors and PhD candidates highlight structural, environmental, and lifecycle aspects, while consultants and associations stress on-the-ground implementation and policy. In summary, while all responses reflect a shared commitment to advancing renewable energy, they vary in their positioning within the value chain. Industry players emphasize execution, academics contribute innovation, and associations foster collaboration. These combined efforts drive the sector's progress, reflecting a multidisciplinary and integrated approach to addressing renewable energy challenges.

Q2: What are your thoughts on the recent growth of ORE technologies in Europe? How do you envision the development of these technologies, especially in Italy?

The responses collectively emphasize Europe's significant progress in offshore renewable energy (ORE), driven by policies like Fit for 55 and the need for clean energy independence. A key theme is Italy's potential to excel in floating wind systems due to its deep coastal waters and abundant wind and solar resources. However, respondents note challenges such as delayed permitting, infrastructure limitations, and grid connectivity issues. Comparisons show shared optimism about Italy's geographic advantages but varied priorities. Industrial experts stress the importance of scaling up manufacturing processes and adapting port infrastructure, while researchers advocate for integrating hybrid solutions and addressing environmental impacts. Some see the Mediterranean as a unique testbed for ORE advancements, with opportunities for global leadership if grid and permitting issues are resolved. In summary, Europe's ORE growth sets a strong foundation, with Italy poised to lead in floating wind and hybrid energy solutions. Success hinges on coordinated efforts to streamline regulations, upgrade grid infrastructure, and innovate technologies, creating a sustainable and competitive energy ecosystem.

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Q3: Besides offshore wind, do you expect significant advancements or investments in other ORE technologies? Which technologies do you think hold the most potential?

The responses highlight a growing interest in offshore renewable energy (ORE) technologies beyond wind, with a focus on tidal energy, wave energy, and floating solar. Common themes include the potential for hybrid systems integrating these technologies to complement offshore wind farms, maximizing energy production and resource utilization. Wave and tidal energy are emphasized for their predictability and consistent output, though respondents acknowledge the need for technological advancements to improve cost-efficiency and scalability. A notable divergence lies in perspectives on adoption timelines. Industry professionals foresee floating solar and wave energy gaining traction soon, while academics emphasize the need for further research and public awareness to overcome opposition and environmental concerns.

4.3.2.3 Workforce readiness and skills needs

Q4. In your opinion, is the current workforce adequately prepared to support the expected growth of the ORE sector in Italy? Where do you see the most significant capacity gaps?

The consensus across responses indicates that Italy's workforce is not yet adequately prepared to meet the demands of the growing offshore renewable energy (ORE) sector. Key gaps exist in offshore-specific skills, including turbine installation, subsea maintenance, and environmental impact assessments tailored to marine settings. While there is existing expertise in solar and traditional energy sectors, the transition to offshore environments requires specialized training in areas like marine engineering, offshore logistics, and dynamic structural analysis.

Several responses highlight the need for interdisciplinary knowledge combining engineering, environmental science, and digital technologies. This is especially critical for integrating hybrid energy systems like floating solar and wind. Theoretical knowledge from universities often falls short of practical applications, signalling a need for educational institutions and industry to align efforts and offer targeted training programmes and certifications. Infrastructure and logistical gaps also pose challenges. Expertise in port restructuring and large-scale logistics for floating structures remains underdeveloped. Respondents emphasize the importance of retraining workers from related industries, such as traditional shipbuilding, and leveraging advanced digital modelling and monitoring tools for offshore projects.

Efforts like offshore wind talent academies and workforce studies suggest potential for improvement. However, without swift and coordinated action to address these gaps, Italy risks missing opportunities to lead in ORE development. A combined effort from industry, government, and academia will be critical to developing a skilled, adaptable workforce capable of meeting the sector's future demands.

Q5. Considering recent trends in ORE, which roles or professions require the most reskilling or upskilling? Which skills do you think will be most in demand?

Marine engineers and technicians emerge as the most critical, particularly for offshore installations, maintenance, and dynamic structural analysis under marine conditions. Environmental analysts must adapt

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to assess marine ecosystems' interactions with ORE projects, while health and safety experts need training aligned with international standards.

Digital skills like GIS, remote monitoring, real-time simulation, and predictive maintenance are increasingly in demand, particularly for energy optimization and hybrid system integration. Project managers and structural engineers also require specialized training to handle the complexities of offshore projects, from load analysis to compliance with international safety protocols.

Multidisciplinary knowledge is emphasized, combining technical expertise with digital tools and environmental science. Upskilling efforts must address practical, application-oriented challenges, necessitating collaboration between academia, industry, and government. For example, retraining workers from traditional industries like oil & gas or metalworking could provide a critical workforce pipeline for ORE projects.

Finally, structural roles tied to hybrid systems, such as integrating wind, solar, and energy storage, are expected to grow. These roles demand advanced design and operational skills, which must be supported through targeted education and training programmes. Overall, reskilling efforts must be proactive and aligned with the evolving technological and regulatory landscape to meet the sector's needs.

4.3.2.4 Skills gaps

Q6. In your view, are the most significant skills gaps in the ORE sector related more to technical (hard) skills or interpersonal (soft) skills? Or do you believe both areas face equal challenges?

The responses emphasize that both technical (hard) and interpersonal (soft) skills gaps are significant in the offshore renewable energy (ORE) sector, with neither outweighing the other. Technical skills gaps include offshore logistics, marine engineering, structural analysis under marine conditions, digital twin modelling, and health and safety compliance. These areas are critical for managing the technical complexity of ORE projects, particularly in challenging marine environments.

Equally important, however, are soft skills such as collaboration, adaptability, critical thinking, and leadership. Given the multidisciplinary and highly regulated nature of ORE projects, professionals must navigate diverse teams, stakeholder engagement, and complex regulatory landscapes. Effective communication is especially vital to align diverse teams and ensure stakeholder involvement.

Some responses highlight the interdependence of these skills, stressing that technical expertise must be complemented by strong interpersonal abilities to manage large-scale, interdisciplinary projects. For example, engaging stakeholders early, addressing social and environmental concerns, and fostering teamwork are essential to the success of ORE initiatives.

In summary, the ORE sector faces equal challenges in both technical and soft skills. Addressing these gaps holistically through targeted training and education programmes is critical to building a competent, versatile workforce capable of driving innovation and managing the complexities of this evolving industry.

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Q7. From the following set of hard skills, which do you believe are the most important for professionals in the ORE sector? Are there any other technical skills that you would consider essential and feel are missing?

- Offshore specific skills (e.g. working at heights etc.)
- Digital skills
- Engineering skills
- Project management skills
- Health and Safety skills

The responses highlight that engineering, health and safety, and digital skills are fundamental for the offshore renewable energy (ORE) sector, with significant emphasis on their integration to address the sector's complex needs. Engineering skills are essential for designing and maintaining offshore systems, while health and safety expertise ensures safe operations in challenging marine environments. Digital skills, including simulation modelling, predictive maintenance, and data analytics, are increasingly critical for optimizing operations and maintenance.

Offshore-specific skills, such as working at heights, subsea monitoring, and navigation, are also crucial, especially for tasks like cable inspections and equipment maintenance. Additionally, expertise in marine geotechnics for seabed quality assessment and environmental compliance is noted as indispensable.

Several respondents stress the importance of advanced and emerging skills, such as integrating hybrid systems (e.g., floating solar and offshore wind), energy storage, and digital twin modelling to improve efficiency. Missing skills include expertise in sustainable material selection, advanced manufacturing for turbine components, and robotics or drone operations for subsea tasks.

A holistic approach combining technical and digital proficiencies with knowledge of regulatory frameworks is key. Collaboration between universities, technical institutes, and industry is crucial to address these gaps. Finally, investments in shipbuilding and specialized vessel design are highlighted as necessary to support the ORE sector’s long-term development, ensuring locally tailored solutions rather than relying on external imports.

Q8. From the following set of soft skills, which do you believe are the most important for professionals in the ORE sector? Are there any other interpersonal skills that you would consider essential and feel are missing?

- Critical thinking
- Communication and collaboration
- Knowledge management and transfer
- Flexibility and adaptability
- Initiative and self-direction
- Productivity and accountability

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- Leadership and responsibility

The responses emphasize that communication and collaboration are vital soft skills for professionals in the offshore renewable energy (ORE) sector, as projects involve multidisciplinary teams, diverse stakeholders, and complex challenges. Critical thinking is highlighted as essential for problem-solving and designing systems capable of withstanding extreme offshore conditions. Flexibility and adaptability are crucial for navigating the sector's rapid technological advancements and evolving regulatory landscapes.

A key skill noted is knowledge management and transfer, which ensures that expertise is shared and not confined to niche areas, thereby fostering the sector's broader development. Leadership skills are deemed critical for guiding teams through large-scale, interdisciplinary projects, while cultural awareness is increasingly important for managing international collaborations and regulatory differences.

Missing skills include the ability to navigate cross-border projects, manage diverse teams, and effectively engage stakeholders like policymakers and the public. Professionals must balance interpersonal and leadership skills with accountability and self-direction to ensure the successful execution of ORE initiatives.

In summary, while all listed soft skills are valuable, the most critical are communication, collaboration, critical thinking, and adaptability. These are essential for fostering innovation, managing multidisciplinary teams, and addressing the dynamic challenges of the ORE sector. By developing these skills alongside cultural awareness and leadership, professionals will be better equipped to support the sector's growth and global collaboration efforts.

4.3.2.5 Training, and industry collaboration

Q9. Do you feel that the current educational and training programmes are aligned with the skills needed in the ORE sector? If not, what strategies would you suggest to bridge this gap and ensure better alignment?

The responses highlight that current educational and training programmes in Italy are not fully aligned with the needs of the offshore renewable energy (ORE) sector. While foundational engineering and environmental science courses exist, specialized offshore training, particularly in areas like digital tools (GIS, digital twins), marine systems, and hybrid energy integration, is limited. Key strategies to bridge this gap include fostering stronger partnerships between academia and industry. These collaborations can facilitate internships, co-op programmes, and real-world problem-solving experiences, providing students with hands-on knowledge. Modular and regularly updated curricula, incorporating certifications in offshore operations, digital technologies, and hybrid systems, are essential to reflect the sector's rapid advancements. Successful models from Northern Europe emphasize collaboration among stakeholders, reducing competition and fostering integration across projects. Italy could replicate this approach to expand sector capabilities. Industry-led initiatives, like the pilot Academy program by AERO, show promise but need scaling. These programmes focus on practical training, such as permitting processes, stakeholder management, and technical documentation.

Institutions should also include marine-specific modules on materials, offshore logistics, and advanced simulation tools. Creating tailored programmes for technical institutes and universities, supported by government funding, could address the industry's skills gap comprehensively.

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In summary, aligning educational programmes with ORE demands requires collaboration, hands-on training, and dynamic curricula. By integrating industry feedback and fostering cooperation, Italy can build a workforce equipped to meet the sector's evolving needs.

Q10. What strategies do you find effective in engaging students with the importance of lifelong learning and skill development for adapting to future changes in the ORE industry?

The responses highlight the importance of real-world engagement to foster lifelong learning and skill development in the offshore renewable energy (ORE) industry. Strategies such as involvement in industry-sponsored projects, case studies, and competitions help students connect theoretical knowledge with practical applications, emphasizing the dynamic and multidisciplinary nature of ORE.

Programmes like the Marine Renewables Academy showcase the value of targeted upskilling initiatives where participants are pre-selected and directly engaged, increasing their commitment to skill development. Similarly, modular and stackable certifications in emerging technologies (e.g., floating wind, hybrid systems) allow professionals to continuously upskill without interrupting their careers.

Highlighting career trajectories and the societal impact of ORE motivates students to adapt and innovate, while gamification of training and exposure to problem-solving in multidisciplinary teams can further enhance their learning experience. Promoting adaptability and innovation as core values prepares students for rapid industry changes.

In summary, effective strategies include integrating real-world projects, industry collaborations, modular certifications, and showcasing the sector’s dynamic nature and societal benefits. These approaches encourage a mindset of continuous learning and adaptability, ensuring students and professionals stay ahead in the evolving ORE industry.

Q11. What role do you see for international collaboration in vocational and higher education training for ORE? How might such collaborations enhance training quality?

The responses emphasize that international collaboration is critical for enhancing training quality in the offshore renewable energy (ORE) sector. Key benefits include sharing best practices, exposing students and professionals to diverse technologies and environments, and creating standardized certifications for global employability.

Programmes like Erasmus+ and international research collaborations are highlighted as effective platforms for fostering exchange and ensuring global relevance in training. These initiatives offer exposure to varied offshore conditions, regulatory frameworks, and advanced technologies, enriching the learning experience. Collaborations with leading institutions, particularly from Northern Europe, can introduce cutting-edge knowledge and innovative practices to Italy.

In summary, international collaboration promotes knowledge exchange, global certification standards, and a holistic educational approach, equipping professionals for the globalized ORE industry.

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Q12. How do you think educational institutions can better align their training with the dynamic needs of the ORE industry, particularly as new technologies emerge?

The responses suggest that educational institutions need to collaborate closely with the offshore renewable energy (ORE) industry to align training programmes with sector demands. Establishing advisory boards and feedback loops with industry leaders will ensure that training programmes keep reflecting emerging technologies like floating wind, hybrid systems, and advanced monitoring tools. By adopting these strategies, institutions can produce a workforce equipped for the dynamic challenges of the ORE sector while fostering innovation and sustainable growth.

4.3.2.6 Diversity, and public awareness

Q13. How would you describe the current level of gender and diversity representation in the ORE sector in Italy? What measures could be taken to improve diversity in the workforce?

The responses indicate that gender and diversity representation in Italy's offshore renewable energy (ORE) sector is limited, mirroring broader trends in STEM fields. While roles such as environmental monitoring and geology show better gender balance, operational and technical positions often have a predominance of male workers. Decision-making roles demonstrate greater gender equality, but challenges persist in other areas. To improve representation, strategies suggested are:

- Promoting STEM Education: Initiatives encouraging young women to pursue STEM fields can build a more diverse talent pipeline.
- Mentorship and Scholarships: Targeted mentorship programmes and financial support for underrepresented groups can increase participation.
- Outreach Programmes: Highlighting achievements of diverse professionals in the ORE sector can inspire broader representation.

By implementing these measures, the sector can create a more inclusive and balanced workforce.

Q14. Do you think there is sufficient public awareness and interest in careers within the ORE sector in Italy? If not, what can be done to improve awareness and attract new talent?

Public awareness of careers in the Offshore Renewable Energy (ORE) sector in Italy remains limited. The lack of engagement is attributed to insufficient outreach and public knowledge about the sector's impact. Strategies to address this include dissemination strategies targeted to highlight ORE's environmental and economic benefits, sharing career achievements through social media and public events can inspire younger generations, or hosting open days at ORE facilities and regional events can connect the sector with the public. These approaches can foster greater interest and attract diverse talent.

4.3.2.7 Closing

Q15. Is there anything else you would like to share that we haven't covered, particularly in terms of workforce development, skills, or the future of the ORE sector in Italy?

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According to the interviewees, the future of Italy's Offshore Renewable Energy (ORE) sector hinges on proactive workforce development and adaptability. Building collaborations between academia, industry, and government is vital to address skills gaps and ensure training aligns with emerging technologies. Emphasizing hybrid systems and integrating advanced mechanical solutions with digital tools will drive innovation. Promoting diversity and inclusiveness in the workforce, alongside public engagement, is crucial to broadening talent pools. By fostering a forward-looking, skilled workforce and leveraging international collaboration, Italy can position itself as a global leader in the renewable energy transition, ensuring sustainability and economic growth for the future.

4.3.3 Skills gap analysis

The analysis of responses highlights a consensus on the importance of addressing both technical and interpersonal skills in the ORE sector. The complex, multidisciplinary nature of ORE projects necessitates professionals who can integrate advanced technical knowledge with strong interpersonal abilities.

Many interviewees emphasized that technical gaps—such as offshore logistics, engineering design, digital tools for monitoring, and health and safety—are more pressing than others. However, the majority of the interviewees call for the indispensable role of communication, adaptability, and collaboration in navigating the evolving challenges of this sector.

On the technical side, engineering skills emerged as foundational, particularly for designing and maintaining offshore systems that must endure extreme marine conditions.

Health and safety expertise remains non-negotiable, given the inherent risks of working at heights, managing underwater infrastructure, and ensuring operational reliability.

Digital skills, such as predictive maintenance, advanced data analytics, and digital twin modelling, were frequently cited as critical to optimizing system performance and ensuring the reliability of offshore plants.

Missing areas, however, also came to light—particularly the need for expertise in integrating hybrid systems like floating solar, environmental regulatory compliance, and advanced manufacturing for turbine components. Some participants underscored the importance of nautical competencies for vessel operation and underwater inspections, hinting at gaps in current training programmes that overlook these specialized roles.

Equally significant, however, is the role of soft skills in ensuring successful project execution. The collaborative and often international scope of ORE projects means that professionals must excel in communication and teamwork, in order to manage stakeholders, both technical and non-technical.

Critical thinking was repeatedly identified as a key factor to addressing the unforeseen complexities inherent to offshore operations, particularly as these systems grow larger and more technologically sophisticated. Flexibility and adaptability are similarly vital; the sector's fast-paced evolution, driven by technological innovation and regulatory updates, requires professionals to remain agile and responsive. Some respondents

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also highlighted the growing need for cultural awareness, especially as international collaborations and cross-border projects become increasingly common. Leadership, too, stood out as a crucial skill for guiding multidisciplinary teams through the complexities of large-scale offshore projects.

A recurring theme across responses is the need for a holistic perspective on the ORE sector. Beyond developing discrete technical or soft skills, professionals must understand the sector as a complete system—one that integrates engineering, environmental, and logistical considerations. This requires not only robust technical training but also an ability to view projects from multiple dimensions, balancing technological advancements with broader societal, institutional, and environmental impacts.

The call to strengthen ties between industry, education, and technical institutes is clear. Many interviewees believe that aligning curricula with sectoral needs—through specialized training, hands-on experiences, and industry-driven modules—will be key to closing the skill gap.

In conclusion, while significant gaps exist in both technical and interpersonal areas, bridging them requires an integrated and forward-looking approach. Training programmes must address technical proficiencies such as advanced digital tools, engineering resilience, and environmental compliance while fostering essential soft skills like collaboration, adaptability, and leadership. By adopting a multidisciplinary perspective and strengthening educational-industry collaboration, it will be possible to equip a workforce capable of driving innovation, ensuring operational reliability, and navigating the complexities of the ORE sector in Italy and beyond.

4.4 Greece

4.4.1 Skills and qualifications in demand

As offshore wind projects expand, particularly with floating wind farms in deeper waters, demand for skilled workers is increasing globally, including in Europe and the US. Countries like the UK, Germany, and Denmark remain leaders, but new markets like Greece, Spain, and East Asia are gaining traction. The ORE sector, particularly offshore wind, is growing at a rapid pace globally, creating a pressing demand for skilled labour. The International Renewable Energy Agency (IRENA) highlighted that global renewable energy employment reached 14 million jobs in 2023, with wind energy jobs accounting for a significant portion. As offshore wind projects continue to scale, workforce development programmes are focusing on both upskilling existing workers and creating new talent pipelines to meet this demand.

Reskilling is especially needed for roles like offshore technicians, engineers familiar with renewable technologies, and project managers. Digitalization skills (data analytics, automation) and environmental assessment skills will be increasingly vital. Engineers from oil and gas industries will also need reskilling to handle renewable technologies, such as wind turbine design and installation. Marine technicians will need upskilling in subsea cabling and maintenance, and high-voltage engineering, while data analysts will be in high demand to optimize energy output using real-time monitoring. As automation increases, there will be demand for IT specialists, particularly in cyber-physical systems and remote operations.

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Greece's workforce has strong foundational skills from maritime and energy sectors; however, significant gaps exist in specialised technical and managerial capacities required for ORE. Addressing these gaps through targeted education, training, and international collaboration will be critical for Greece to successfully scale its offshore renewable energy ambitions. The most critical roles requiring reskilling or upskilling, and the associated high-demand skills, are closely tied to technological advancements and the scale-up of offshore projects. A breakdown might be:

1. High-Demand Roles Requiring Reskilling/Upskilling:

a. Engineers and Technicians

- Marine, structural and Offshore Engineers: Specialization in the design, installation, and maintenance of offshore wind turbines, floating platforms, and underwater cabling.
- Electrical and Grid Engineers: Expertise in high-voltage systems and integrating offshore energy into onshore grids.
- Geophysical and geotechnical Engineers: Expertise in ocean floor engineering – offshore wind turbine foundations.
- Health and safety Engineers: Expertise in developing procedures and measures to protect technicians from hazards, injuries and property damage in the offshore environment.
- Turbine Technicians: Technicians skilled in maintaining large-scale offshore wind turbines are essential as these installations expand.
- Yard professions (welders, pipe fitters, machinery operators and thick metal plates technicians): Technicians skilled in welding and processing of thick metal plates and pipes.

b. Environmental Scientists and Marine Specialists

- Marine Ecologists: To assess and mitigate the environmental impact of ORE installations on marine biodiversity.
- Environmental Planners: For conducting impact assessments and ensuring compliance with environmental regulations.

c. Data Analysts and Technologists

- Data Scientists: Skilled in analysing performance data from offshore installations using IoT and AI technologies and automation.
- IT specialists and Remote Monitoring Specialists: Roles focused on using drones, sensors, and robotics for real-time monitoring of offshore assets and skills in cyber-physical systems.

d. Project Managers, Policy Experts and Analysts

- Project Managers: With expertise in large-scale infrastructure projects, particularly in maritime or renewable sectors.
- Policy and Regulatory Specialists: For navigating complex licensing, permitting, and compliance processes in different jurisdictions

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- Quality managers, insurance specialists, financial and valuation analysts: Existing expertise should be tailored to the requirements of the offshore industry.

2. Most In-Demand Skills

a. Technical Skills

- Offshore Installation and Construction: Proficiency in handling the logistics of offshore operations, including crane operation and seabed preparation.
- Renewable Energy Systems Design: Expertise in designing integrated systems, combining wind, solar, and wave energy.
- Hydrodynamics, Aerodynamics and Structural Analysis: Skills in modeling and assessing the performance of floating structures in dynamic metocean environments.

b. Digital Skills

- Digital Twin Modeling: Creating digital replicas of offshore systems to optimize performance and predict maintenance needs.
- Cybersecurity: Ensuring the safety of connected offshore systems against cyber threats.
- IoT Integration: Deploying interconnected devices to monitor and manage offshore energy systems.

c. Cross-disciplinary Skills

- Marine Spatial Planning: Balancing ORE developments with other maritime activities like fishing and shipping.
- Sustainability Practices: Incorporating circular economy principles in material selection and lifecycle management of offshore systems.

3. Priority Areas for Reskilling

- Transitioning Oil & Gas Workers: Many skills from the oil and gas sector are transferable, such as offshore drilling expertise, but need adaptation for renewable contexts.
- Upskilling Local Communities: Coastal regions can benefit from targeted training in ORE-specific trades to maximise local employment opportunities.
- Academic and Industry Partnerships: Collaborative programmes to fast-track R&D talent for emerging ORE technologies.

By 2030, offshore wind in regions like the US and Europe will require between 15,000 to 58,000 full-time workers annually, depending on the local content requirements of the projects[194]. The demand is not just

[194] Shields and Stefek, "Gearing Up for 2030: Building the Offshore Wind Supply Chain and Workforce Needed to Deploy 30 GW and Beyond."

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limited to engineering roles but also includes data analysts, AI specialists, and environmental impact assessors, who can support the integration of advanced technologies like predictive maintenance and remote monitoring systems.

However, while the number of job openings is growing, there is a challenge in aligning the supply of appropriately skilled professionals. The fast pace of technological change means there's often a mismatch between available workers and evolving industry demands i.e. there is often a misalignment between job openings and skilled professionals due to the rapid pace of technological advancements. While the demand for engineers and project managers is high, the challenge lies in finding professionals with experience specific to ORE technologies (e.g., floating offshore platforms).

The skills and qualifications presented above have been highlighted through the detailed survey conducted, including: (a) the desk research presented in the previous chapter (chapter 3, focusing on the units for Greece), (b) the survey with questionnaires and (c) the survey with interviews, both presented in the following units of this chapter.

4.4.2 Sectoral needs in industry and education

In our effort for identifying the labour market and skills needs that will support the development of the Greek offshore wind energy sector, a survey was conducted by the Greek CoVE aiming to gather comprehensive and relevant knowledge about the offshore renewable energy sector, the industry skill priorities, its current situation, observed skill shortages and ways to tackle these issues. In this context a questionnaire was distributed during September 2024 and answers were received up to the beginning of November 2024 from professionals, trainers/ professors and learners/ students from VET and HEI.

Companies operating in the Greek wind energy industry (utilities, developers, manufacturers, operators and national trade associations) were approached to participate in the questionnaire. Finaly, **twenty-two (22)** completed questionnaires were returned.

Teachers/ Trainers from VET and Professors from HEI, teaching courses in similar fields were approached to participate in the questionnaire. Finaly, **thirty-six (36)** responded to the questionnaires.

Learners from VET and Students from HEI (Undergraduate and Postgraduate students), attending relevant programmes were approached to participate in the questionnaire. Finaly, **eighty-six (86)** responded to the questionnaires.

The results for each respondent category are presented in the units below.

4.4.2.1 Survey of industry professionals – main findings

Survey identity

Survey participants were Greek professionals working in the wind energy sector, most of them were in the age group of "Between 36 and 45", 60% of respondents were men and most of them were highly educated holding important roles in their companies. Most of them, based on the most frequent answers, work in companies operating in the "Pre-planning/ Research" phase of the offshore renewable energy value chain.

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Actually, since the offshore wind industry in Greece is at its very early stages, most of the respondents work in companies active in the Pre-planning/Development phase of onshore projects, but these are the same companies which are expected to be a part of the offshore supply chain offering the same services which they offer today, and which they know best, i.e. Pre-planning/Development services. These companies mostly employ engineers and secondly technicians, as becomes evident from the survey.

The survey is divided into two parts, at the first one the industry skill priorities, its current situation, observed gaps/ skill shortages and ways to address these issues are presented, while at the second part collaboration between companies and associations, continuous learning and development for employees, smart specialisation, compliance with regulations and standards, and other relevant issues are presented.

Skills Supply / Skills Review

In our effort to identify the industry skills priorities and the skill supply, we asked survey participants about the minimum requirements in terms of education and training for specific occupational groups, which are expected to play a significant role in the deployment of the offshore wind industry in Greece. As it was expected, as we move from technical job roles which require mainly practical skills and technical expertise to engineering roles the minimum requirements are increasing to the level of Tertiary/MSc (Figure 87).

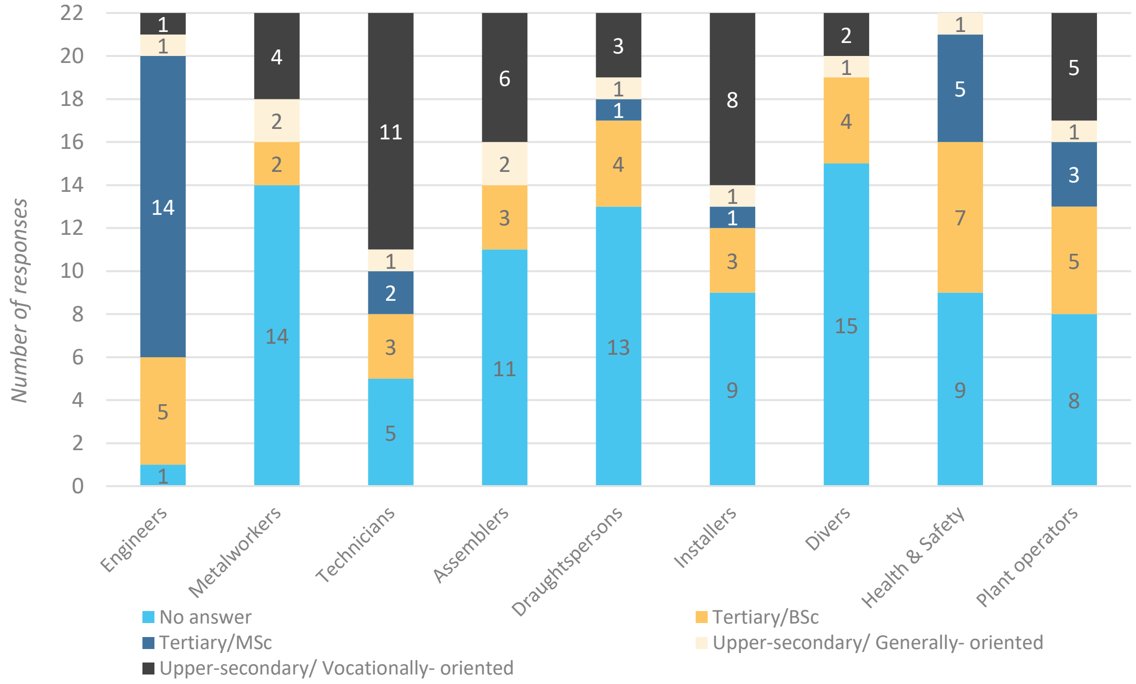

Figure 87. Minimum requirements in terms of education and training for each occupational group (Source: CoVE Greece professionals survey)

As to where organizations offer training, the vast majority is provided in-house or online with distance training. General knowledge training is likely to be provided in-house or online, while when it comes to greater specialization this is more likely to be undertaken not in-house but with external training for staff development, supporting the attendance of workshops and post graduate studies (Figure 88).

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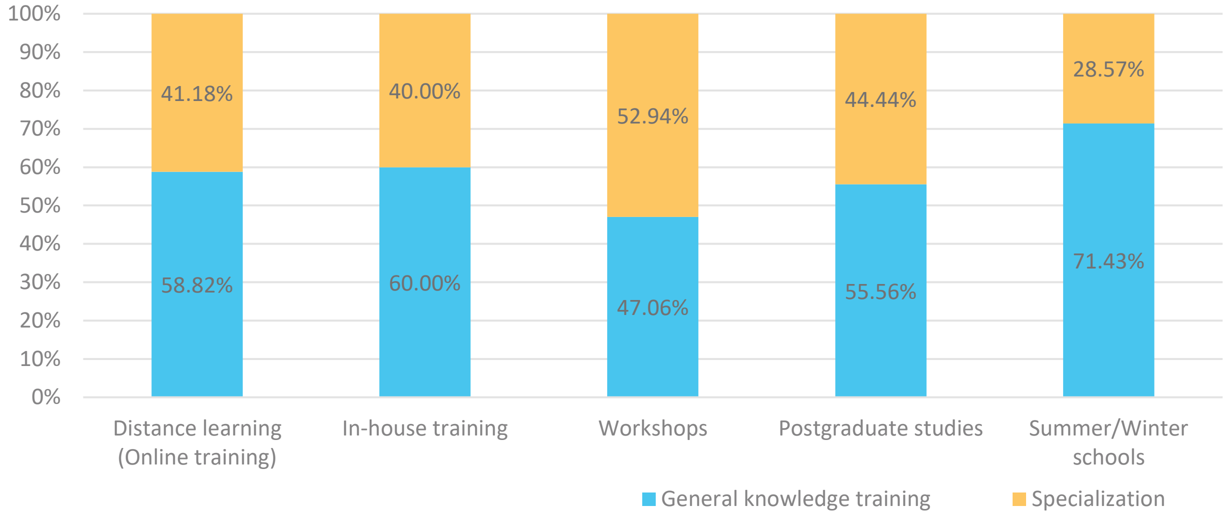

Figure 88. Types of training measures which companies use to upskill their employees (Source: CoVE Greece professionals survey)

However, the first step that companies need to make, before offering training to their employees (either online, or in-house, or via workshops, etc.), is a training needs analysis determining which type of training employees need to thrive in their role, fill a knowledge/skill gap, or develop their learning in order to improve their job performance. Based on the outcomes of our survey, companies tend to review the skills and training needs of their employees on an annual basis (Figure 89). While it seems that companies tend to review the skills and training needs of their engineers and less of their technical staff. This last question and the provided answers reveal the early stage of the offshore wind industry in Greece, as no respondent referred for example to divers indicating that we have not yet absorbed the idea that this new industry will require personnel with different characteristics compared to the one currently employed in the onshore wind energy sector (Figure 90).

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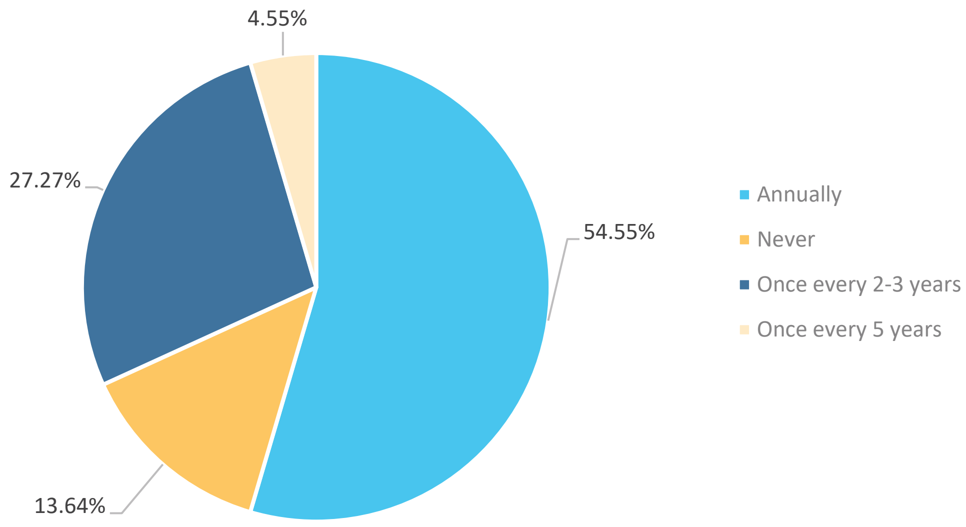

Figure 89. Frequency at which companies review the skills and training needs of their employees (Source: CoVE Greece professionals survey)

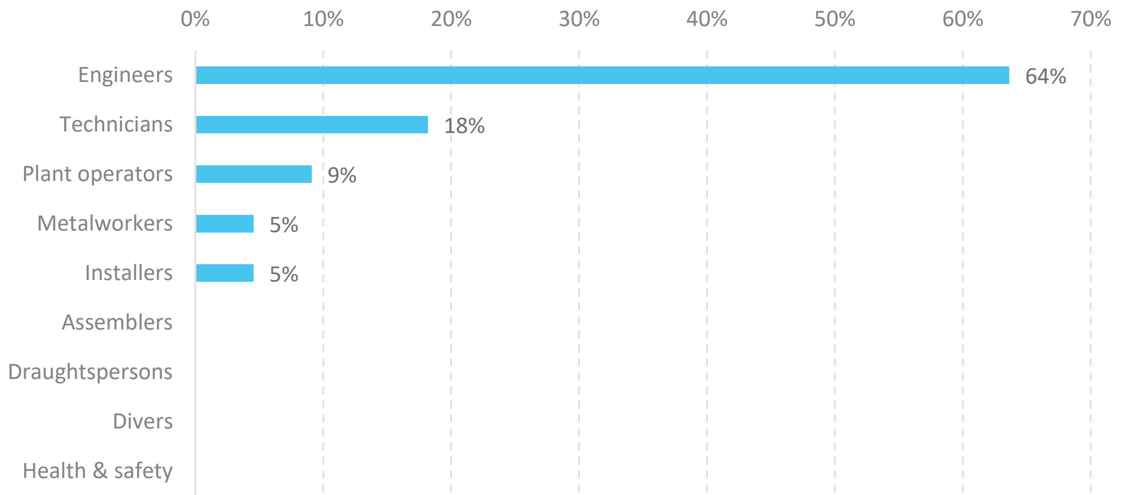

Figure 90. Employee groups which are evaluated as for their skills and training needs (Source: CoVE Greece professionals survey)

A critical outcome of the survey conducted was the identification of possible skill gaps in the current workforce and in what ways these gaps could be addressed.

With regard to hard skills, based on the respondents’ most frequent answers, the most important gaps that should be addressed by educational/training programmes are engineering skills (e.g., electrical, structural, offshore engineering) and offshore specific skills (e.g., working at heights, underwater welding) (see Figure 91).

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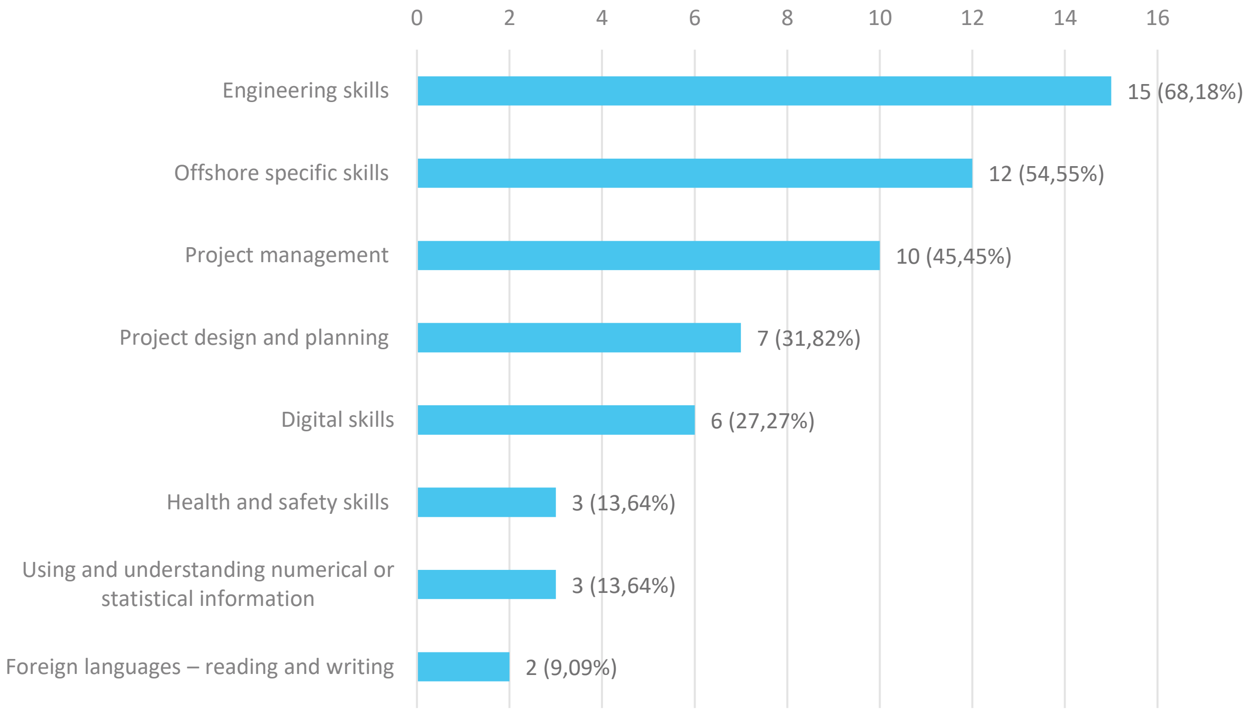

Figure 91. Skill gaps in terms of hard skills which should be addressed by educational/training programmes (Source: CoVE Greece professionals survey)

While when the same question was addressed in relation to soft skills, respondents replied more frequently and identified that the most important gaps had to do with skills such as critical thinking and problem solving (analysing issues and finding effective solutions) and communication and collaboration (exchanging information clearly and working well in teams) (see Figure 92).

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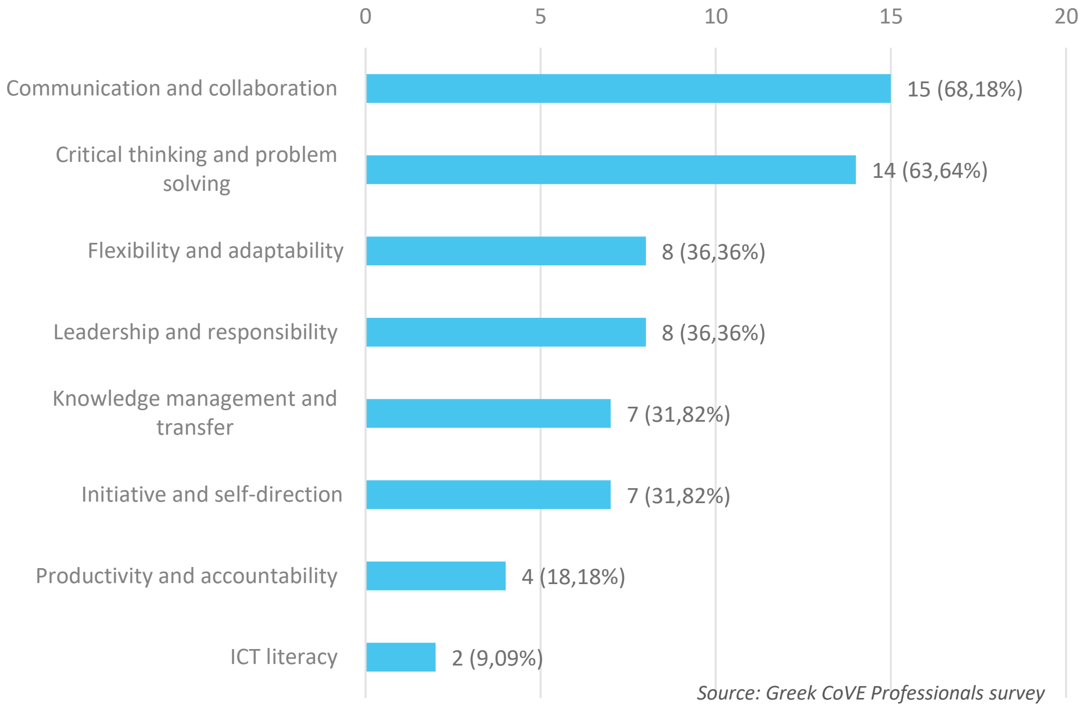

Figure 92. Skill gaps in terms of soft skills which should be addressed by educational/training programmes (Source: CoVE Greece professionals surveys)

Once the above-mentioned gaps in relation to hard skills and soft skills had been identified, respondents were asked to evaluate the most appropriate method which should be used in order employees to acquire these "missing" skills. In-house training, on-the-job training and VET programmes seem more effective for employees to acquire or develop the necessary soft skills, while educational programmes at the level of Master seem ideal to tackle the gaps identified in relation to hard skills (see Figure 93).

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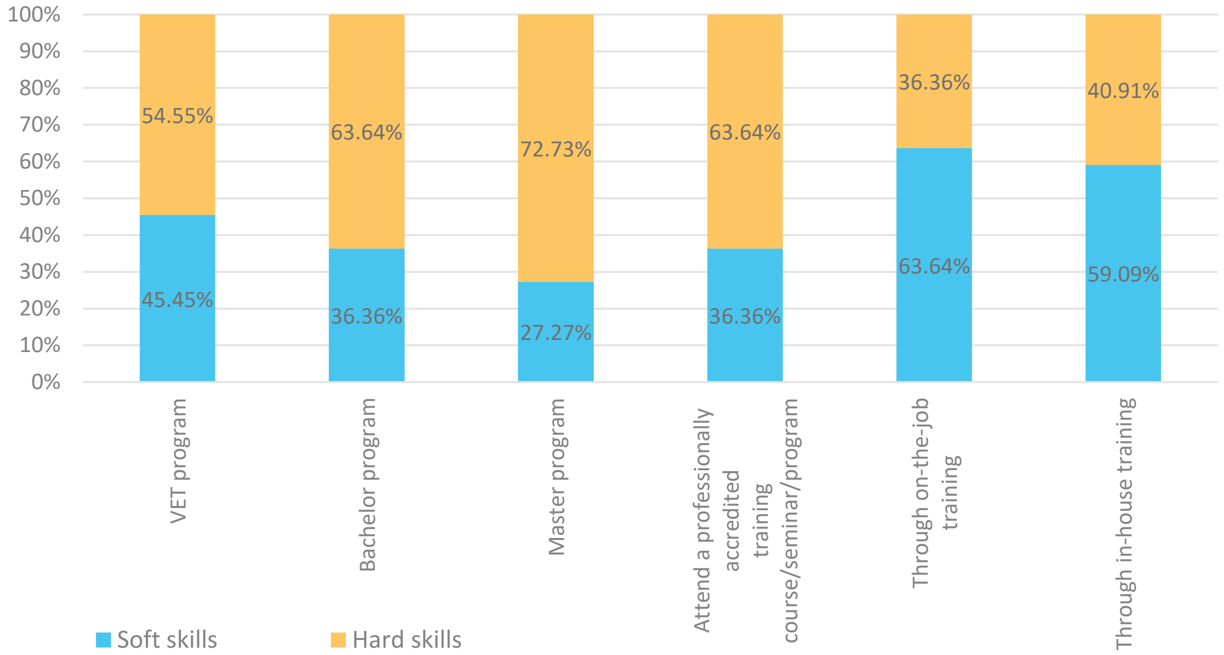

Figure 93. Most effective methods for employees to acquire/develop soft& hard skills (Source: CoVE Greece professionals survey)

Collaboration and Challenges

To ensure regulatory compliance, businesses must stay updated with relevant regulations and implement effective policies and procedures. Staying informed about the ever-changing regulatory landscape is key. Businesses should closely monitor and understand the laws and regulations that govern their industry. Taking into account the importance of this business practice, respondents were asked how their companies ensure their compliance with current regulations and standards. It seems, based on the most frequent answers, that most of the companies have established a dedicated compliance team responsible for monitoring and identifying new regulations that apply to the organization and/or engage external consultants and experts to audit compliance practices. Such teams continuously monitor industry news, regulatory agency websites, and relevant publications to identify any regulatory changes.

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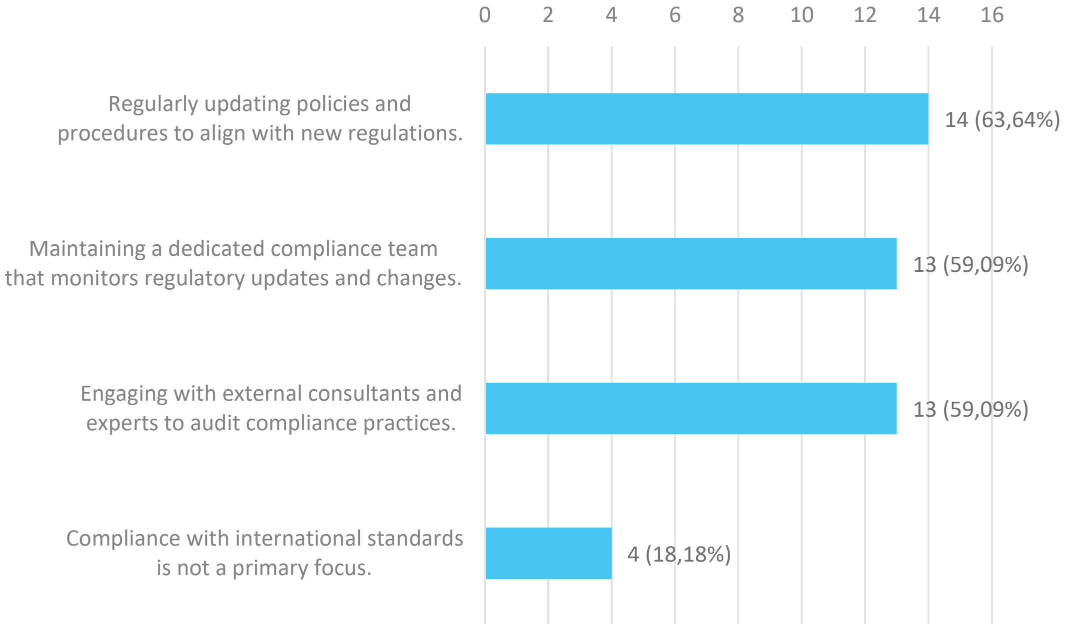

Figure 94. Ways which companies use to ensure their compliance with current regulations and standards (Source: Greece CoVE professionals survey)

By pooling resources, knowledge, and expertise, collaborative networks enable companies to drive innovation, bolster growth, and elevate their competitive edge in the market. The importance of engaging with other companies and associations of the sector in which one company operates was outlined in this research as well. More specifically, respondents were asked about the strategies that they use to engage with professional associations in their sector. Most of them seem to participate in associations and attend conferences or seminars in order to build collaborative networks and enhance the exchange of knowledge and information (see Figure 95).

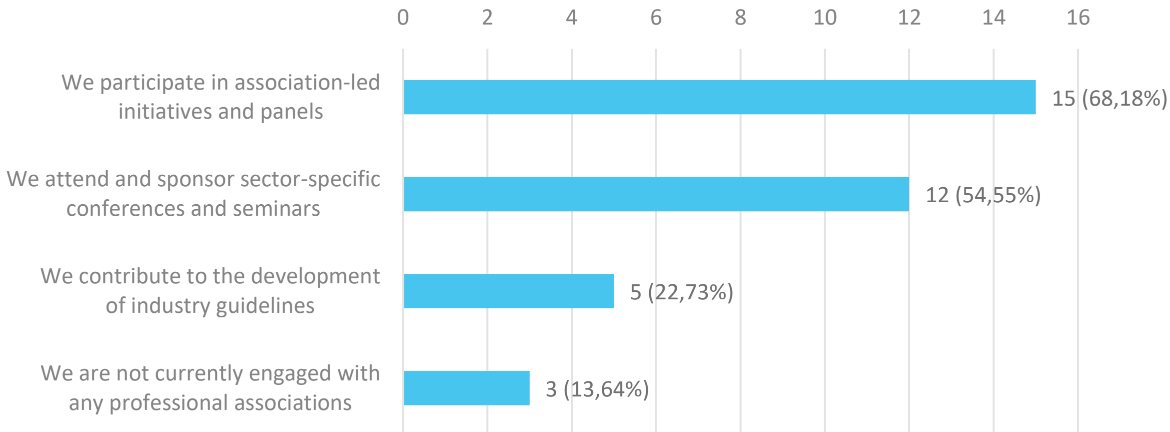

Figure 95. Strategies which companies use to engage with professional associations in their sector (Source: CoVE Greece professionals survey)

In this context of examining collaborations strategies which could enhance the performance of the companies, respondents were asked if and in what way they collaborate with technology providers. As

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Figure 96 shows, the most frequent answer was that companies tend to engage in pilot projects for new technology applications.

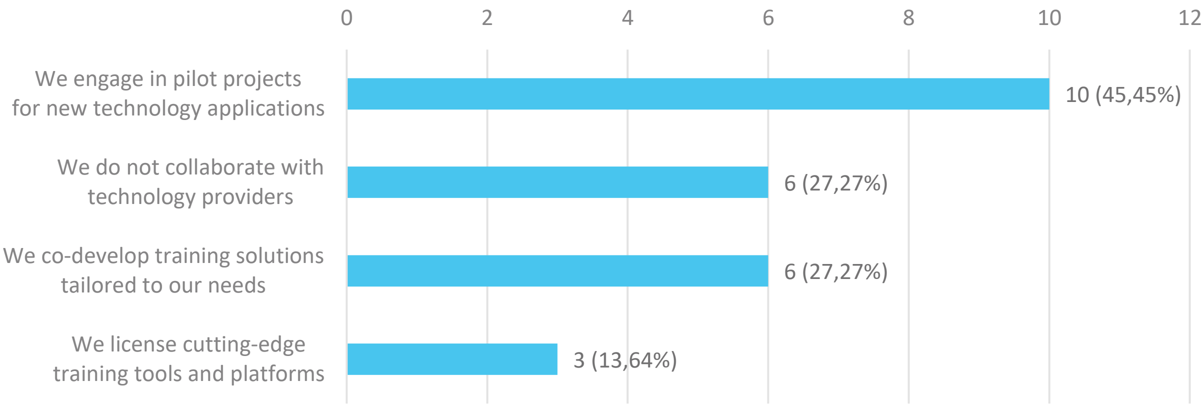

Figure 96. Ways which companies use to collaborate with technology providers in order to enhance their performance (Source: CoVE Greece professionals survey)

Effective employee and team training is a staple of any successful organization. The concept of continuous learning in the workplace transforms the way teams approach professional employee development altogether. Rather than seeing learning and growth as something that happens in isolation or at certain moments in time, the goal is for all team members to constantly be always growing more knowledgeable and competent. Learning and professional development can occur in several different ways within an organization. In this context, we asked respondents about the support structures which are in place in their companies to facilitate continuous learning and development for employees. Most of the companies seem to offer to their employees' subscriptions to online learning platforms, while there is a significant percentage of companies which unfortunately do not promote the concept of continuous learning at all or at a very limited level.

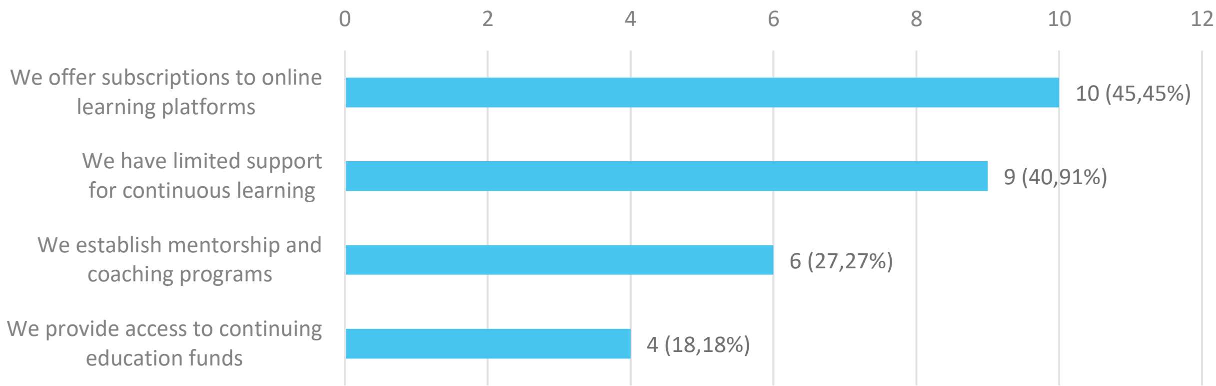

Figure 97. Company structures in place to facilitate continuous learning and development for employees (Source: CoVE Greece professionals survey)

Transversal Skills

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ESCO (European Skills, Competences and Occupations) identifies six main categories of transversal skills and competences: core skills and competences, thinking skills and competences, self-management skills and competences, social and communication skills and competences, physical and manual skills and competences and life skills and competences. In this survey, recognising the importance of transversal skills, respondents were asked to identify the transversal skills which are cultivated at their companies. Teamwork, problem solving and planning and organization have been identified as the ones promoted and cultivated the most, as these were the most frequently provided answers (see Figure 98).

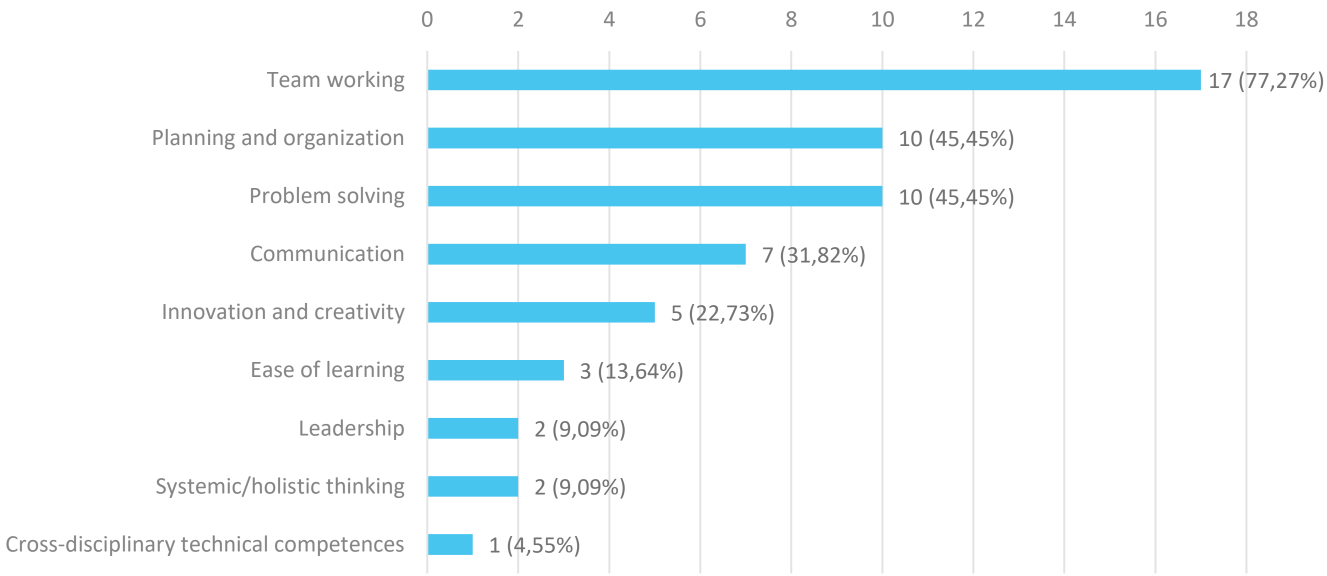

Figure 98. Most frequent transversal skills which are cultivated in companies (Source: CoVE Greece professionals survey)

Smart Specialisation

Smart specialisation is an EU-driven approach that fosters economic growth and job creation by helping regions identify and build on their unique strengths. It emphasizes collaboration among local authorities, academia, businesses, and civil society to implement long-term growth strategies, leveraging EU funding through a bottom-up, partnership-based framework.

The concept was first developed in the context of the high-level expert group on 'Knowledge for Growth' created by the European Commission. It was recast through work by researchers both within and outside the Commission to foster regional economic transformation and incorporated as a key principle of investment in research and innovation in the framework of the EU regional policy. Through its adoption and adaptation towards regional development, the smart specialisation concept has become a powerful instrument for place-based innovation-driven growth. Furthermore, evidence arising from regions and ongoing informal policy discussions signals that the smart specialisation approach may be evolving towards a methodology that goes beyond its application to the EU regional policy. In fact, smart specialisation is gaining interest in both scientific and policy-making communities linked for instance to urban and local development and is also bridging the gap towards more thematic policy approaches such as industrial and energy policies.

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Understanding the importance of the smart specialisation concept, we addressed on this issue two questions to the survey respondents in an effort to understand the challenges their companies might face in adapting their study programmes to smart specialization goals and policies and the necessity or not of adapting new skills for smart specialization that were not needed in the past. Based on the provided answers, it cannot be excluded the possibility that respondents and their companies are not yet very familiar with this concept (see Figure 99, Figure 100).

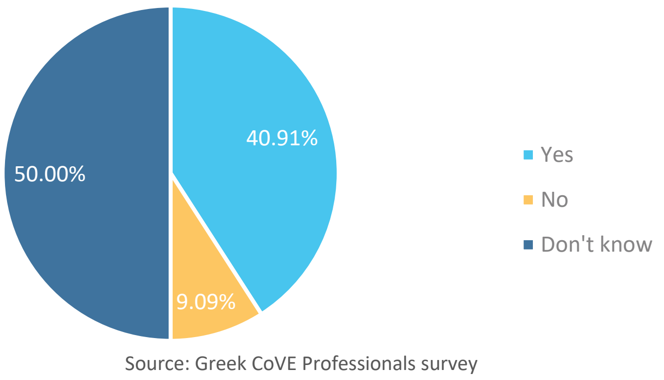

Figure 99. Challenge of adapting study programmes to smart specialization (Source: CoVE Greece professionals survey)

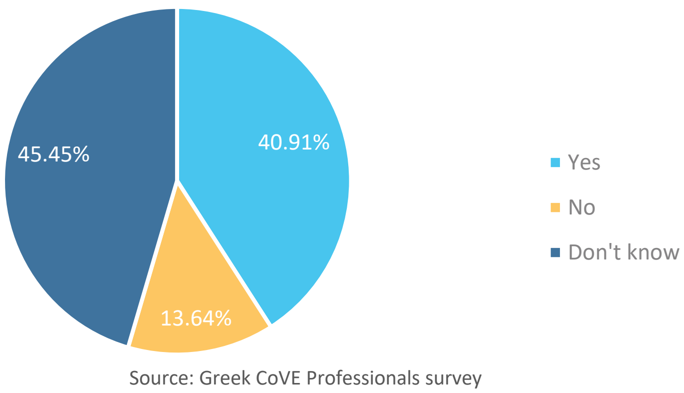

Figure 100. Need for adaptation of new skills for smart specialization (Source: CoVE Greece professionals survey)

4.4.2.2 Survey of VET/HEI Instructors

In total, 36 VET and HEI instructors participated in the survey, with most of them (47.2%) belonging to the age group between 46 and 55 years, highlighting the need for sensitization of the younger groups as well. The vast majority of participants in the survey were men (75%) with only a small percentage of women (25%). It appears that there is still a need to bridge the gap between the two sides around the renewable energy sector in general and offshore wind energy in particular.

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In addition, there was greater participation of instructors in VET, vocational high school education compared to academics and other teaching staff, with percentages ranging from 47.2% of teachers from SAEK Egaleo, 25% of teachers from Vocational high schools of Mytilene and 11% and below Professors from Universities and labouratory centres. The answers to the question "*What is your current position in your institution?*", show that most of the teachers were "Permanent teaching staff" (41.7%) or "Temporary teaching staff" (41.7%) while below 8.3% were the "Administrative staff", "Permanent teaching - Research staff" and "Professor Emeritus" (2.8%). The responses to the question "*How can your organization be best described?*", present that the majority participation was noticed in "Vocational Education and Training (VET)" while 25% were from "Universities" and another 25% from "Secondary Education". The answers to the question "*What type of degrees are attributed by your institution?*", show that from the types of degrees attributed by the institutions, "associate degree" (44.4%) pioneered from technological education followed by "Doctorate Degree" (20%), "Master's Degree" (17.78%) and "Bachelor's Degree" (15.56%). Strengthening the offshore wind energy sector in the academic community and research has critical importance for its development and evolution in the country.

In Figure 101, the answers to the question "*What are the most encouraged career paths for students at your institution?*" show that the most encouraged careers that dominate at the professional level include "Engineers" (22.89%), "Technicians" (22.89%), "Installers" (15.66), "Assemblers" (10.84), and "Health – Safety staff" (10.84%). Professions like "Metalworkers" (1.20%), "Draughtspersons" (3.61%), "Divers" (3.61%), "Plant Operators" (2.41%), and "Others" (6.02%) are not encouraged as much by institutions, but it is important to take actions based on these findings to support these careers and highlight their additional value for the development of the offshore wind energy sector.

The answers to the question "*What Percentage of your students is younger than 30 years old? Personal estimation*" present that most instructors stated that the "majority of students at their educational institutions are under 30 years old" (77.8%) and 14% mentioned that "all of the students are under 30 years old", which is expected, since most students study at a young age. According to these findings, raising awareness among young students about offshore wind energy issues is key to the development of the sector. In contrast with the previous results, the answers to the question "*What Percentage of your students is older than 50 years old? Personal estimation*" followed. "Students over 50 years old" seem to occupy a "percentage of less than 10%" in most institutions (91,7%) while only one instructor noted that the students of their institution are older than 50 years old in a "percentage of 50% and above". These findings reveal that the education of older adults is currently less targeted than the education of younger people.

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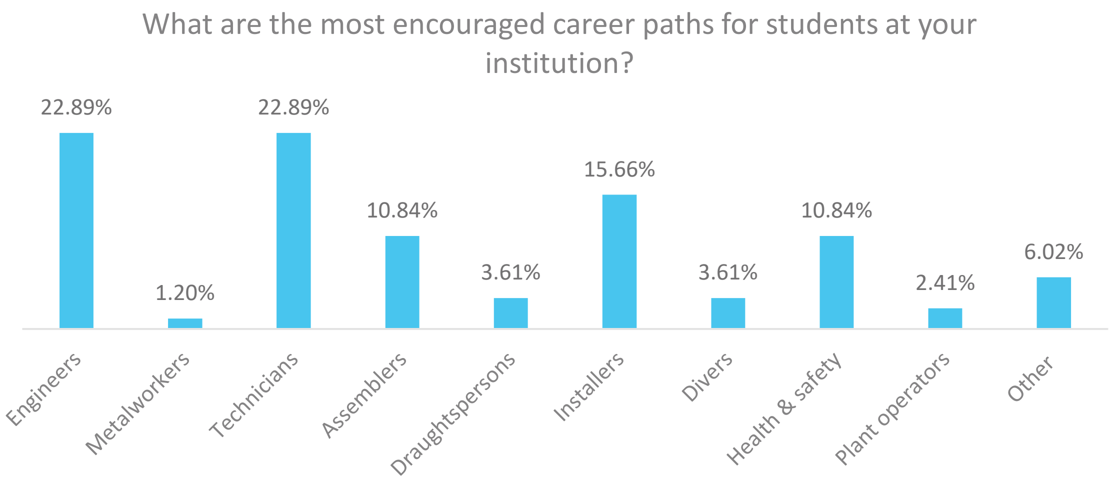

Figure 101. Most encouraged career paths for students (Source: CoVE Greece VET/HEI surveys)

The answers to the question "*Which of the renewable energy groups best fits into the overall value chain of your specialty?*" show that the majority of the instructors are specialized in "Onshore solar energy" (33.3%), "Offshore wind energy" (27.8%) and "Onshore Wind Energy" (11.1%). Only a few noted other renewable energy groups such as "Wave Energy" (5.6%), "Offshore solar energy" (5.6%), "Tidal energy" (2.8%), etc.. These findings present a clear focus on wind and solar energy sectors, which are considered to be developing and sustainable. In Figure 102, the answers to the question "*Which phases of the offshore renewable energy value chain do your teaching activities cover?*" show that the teaching activities most instructors cover are "Pre-planning/ Research" (21.92%), "Operation & Maintenance" (21.92%), followed by "Project planning" (16.44%) and "Construction & Installation" (16.44%). Teaching activities like "Tendering & Contracting" (1.37%), "Manufacturing" (9.59%), and "Decommissioning/ Recommissioning" (5.48%) had a low coverage rate. It was also important that 4 out of 36 respondents stated that they did not cover any of activities in the sector. These results show that there is a gap in education in the field of offshore renewable energy and it needs to be filled.

The answers to the question "*Which subjects related to renewable energy technologies have you taught?*" showed that the majority of the instructors have taught mostly "Onshore solar energy" (23.94%), "Offshore wind energy" (18.31%) and "Onshore wind energy" (16.90%), while "Wave energy" (14.08%), "Offshore solar energy" (12.68%), "Tidal energy" (7.04%), "Ocean thermal energy" (1.41%), and "other subjects" had lower percentages (see Figure 102). This indicates that teaching is mainly based on technologies that are already developed and commercially viable. The answers to the question "*How many years of teaching experience do you have in the sector of renewable energy technologies?*" showed that 52.8% of the instructors have less than 3 years of teaching experience combined in renewable energy technologies, while 27.8% have more than 10 years of experience respectively. This distribution indicates that most instructors in the field do not have extensive experience, which is an important factor not only in the quality of teaching but also in effective student guidance. Therefore, the continuous training of teachers to develop skills in the sector of renewable energy technologies is necessary. Accordingly, the answers to the question "*How many years of*

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teaching experience do you have in the sector of offshore renewable energy technologies?", 22.2% of the instructors have less than 3 years of teaching experience, specifically in offshore renewable energy technologies, while 16.7% stated they have more than 10 years respectively. These findings reveal that offshore renewable energy remains a relatively new sector yet, with space for development in both education and research.

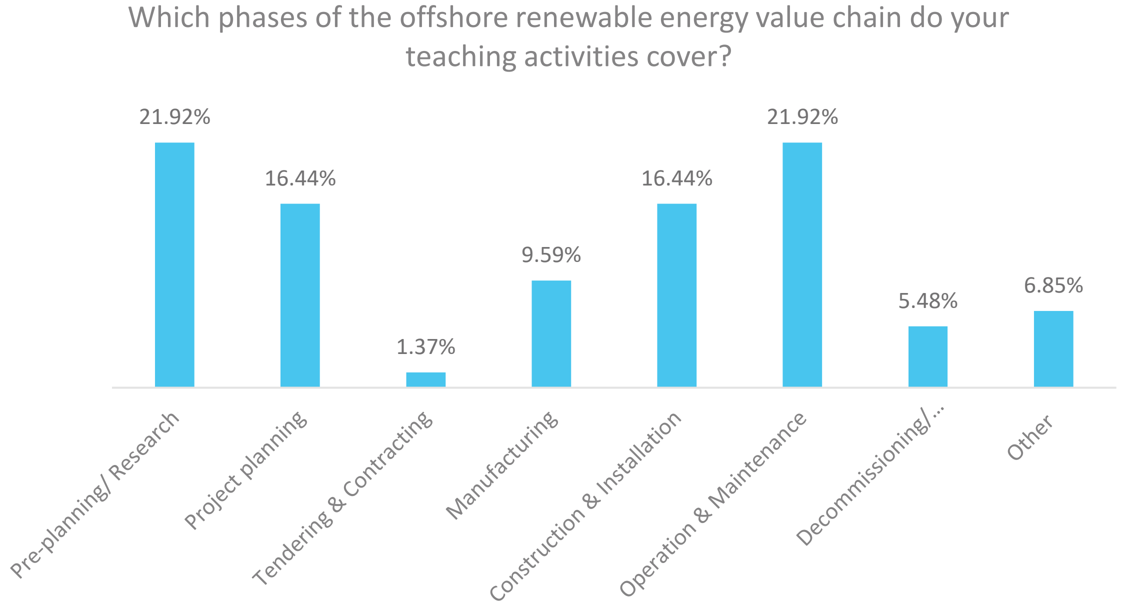

Figure 102. Phases of the offshore renewable energy value chain covered by teaching activities (Source: CoVE Greece VET/HEI surveys)

In the responses to the question "*With regard to hard skills of your students, what in your opinion are currently the most important gaps that should be addressed by educational/training programmes?*", the majority of the instructors reported that the most important gaps that should be addressed by educational or training programmes include "Engineering skills" (21.18%), "Digital skills" (16.47%), and "Offshore specific skills" (15.29%). The adaptation of educational programmes for the strengthening of specialized knowledge plays a vital role in the future of the industry. The answers to the question "*With regard to soft skills of your students, what in your opinion are currently the most important gaps that should be addressed by educational/training programmes?*" highlighted "Critical thinking and problem-solving" skills as the most crucial gaps by 33.33%. Moreover, other significant gaps include "Communication and collaboration" (13.58%) and "Productivity and accountability" skills (12.35%). "Knowledge Management and Transfer Skills" (11.11%) and "Flexibility and Adaptability" (11.11%) had less frequency, together with "Leadership and Responsibility" skills (9.88%), "Initiative and Self-direction" (7.41%), and "ICT literacy" (1.23%), suggesting that these areas are not so critical, but still worthy of attention. These findings show the importance of addressing "Critical thinking and problem-solving" skills, "Communication – collaboration", and "Productivity skills" through targeted educational or training programmes, while also supporting the evolution of other significant abilities like "Knowledge management", "Leadership", "Flexibility/Adaptability", "Initiative and self-direction", and "ICT literacy".

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The answers to the question "*Which methods do you believe are most effective for employees to acquire or develop the following skills?*" show that most instructors believe that "VET programmes" (20.17%) and "on-the-job training" (19.33%) are more effective for employees to acquire or develop Hard skills, followed by "Bachelors" (17.65%), "Masters" (15.13%), "Professionally accredited training course/seminar/programmes" (14.29%) and "in-house training" (13.45%). Respectively for soft skills, the respondents mostly noticed "in-house training" (20.62%), "Professionally accredited training course/seminar/programmes" (19.59%), followed by "Masters" (18.56%), "Bachelors" (15.46%), "on-the-job training" (13.40%) and "VET programmes" (12.37%). According to these findings, it is important to strengthen higher education so that it provides students with the necessary resources to develop Hard skills (see Figure 103).

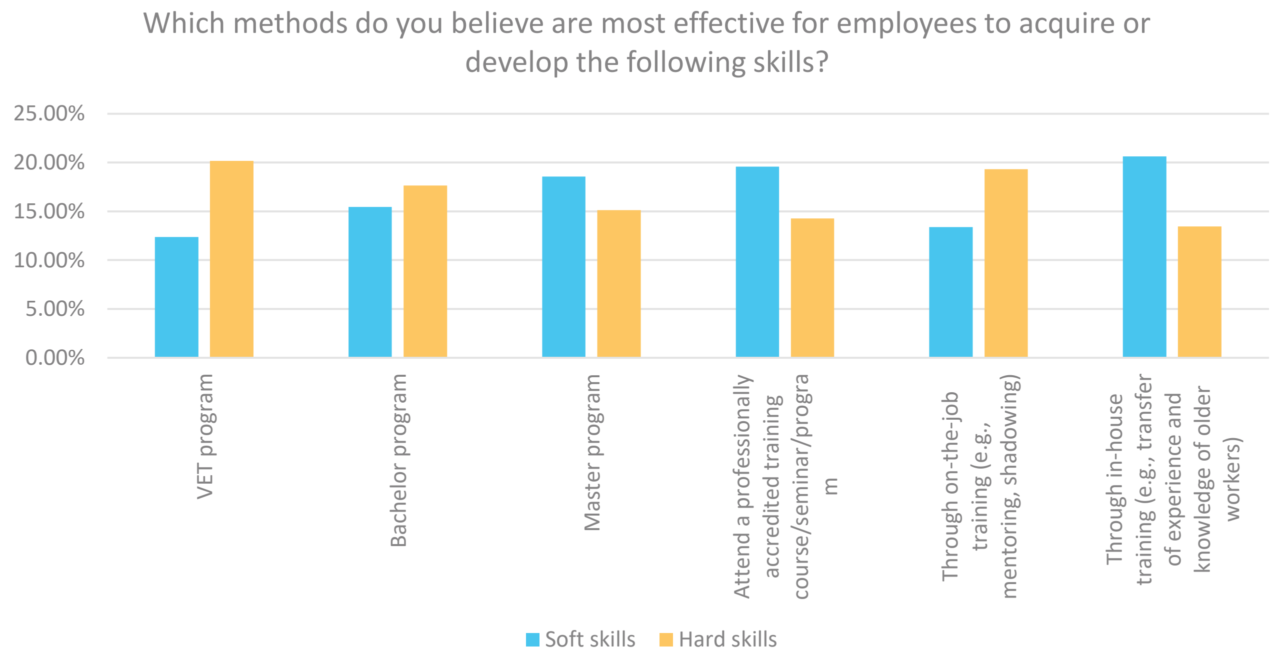

Figure 103. Most effective methods for employees to acquire or develop the following skills (Source: CoVE Greece VET/HEI surveys)

The answers to the question "*Which of the following technologies are covered by your curriculum?*" show that most instructors mentioned technologies such as "Automation and advanced robotics", "Internet of Things", and "Energy storage" at 12.50%, which are covered by their curricula followed by "Energy Management Systems" (11.36%), "3D Printing" (9.09%), "Material Science" (9.09%), "Smart Technologies" (7.95%). To a lower extent, respondents stated "Artificial Intelligence" (6.82%), "Digital Platforms" (6.82%), "Big Data/Data Analytics" (3.41%), "Communication Technologies" (3.41%), "Cloud Services" (2.27%), "Cybersecurity" (1.14%) and "Blockchain" (1.14%). Strengthening education with new technologies is an important pillar for enhancing its effectiveness and efficiency. The answers to the question "*Which of the following tools are addressed (provide training or use) at your study programmes?*" highlight the emphasis on education tools that are used for renewable energy education. "Programming languages and Simulation software" were the most frequently addressed by 14.56% of the instructors. Other tools, such as "Internet

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of Things” (11.65%) “Geographic Information Systems” (9.71%), “Collaboration tools” (9.71%), “CAD software” (9.71%) were also commonly integrated. However, specialized tools like “Database management systems”, “Cybersecurity tools”, “Data visualization tools”, “Cloud computing platforms”, “Virtual and augmented reality tools”, “Blockchain platforms”, “Project management tools” and “Database management systems”, were less frequently mentioned, revealing potential gaps in education coverage. These findings present the crucial role of computational tools in renewable energy education while they emphasize the need for greater integration of specialized technologies.

The answers to the question "*How often do you update your course content to reflect industry changes?*" as presented in Figure 104, show different practices. 44% of the instructors reported that they update their course content “Annually”, while 31% declared content updating “every 2-3 years”. A smaller group which represents 8% of the participants, updates their content “more than once a year”, while 11% are undergoing updates “every 5 years”. Finally, 6% of the instructors do not update their course content, which shows a disconnection with evolving industry needs. With these findings, it seems that despite the efforts of most instructors to align their curricula with the evolving needs of the industry, there is still room for greater consistency in curriculum updates.

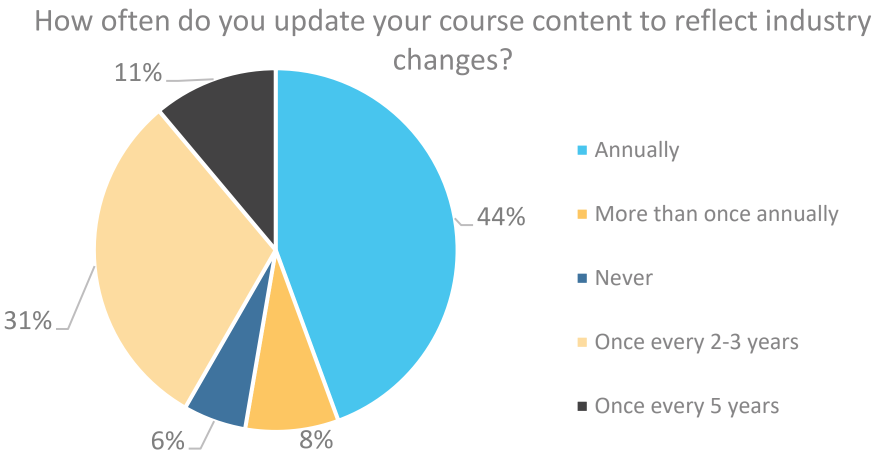

Figure 104. Course content updates for industry change reflections (Source: CoVE Greece VET/HEI surveys)

The answers to the question “*What additional training or resources do you need to improve your teaching effectiveness?*”, present important fields for improvement. In more detail, the results are categorized as follows: Updated course materials (27.4%), Access to industry experts (26.03%), Industry workshops (23.29%), and Practical training facilities (21.92%). According to these findings, instructors recognize the importance of collaboration with industry for the provision of new educational resources, leading to the improvement of their teaching methods. The answers to the question "*How do you incorporate practical experience into your teaching?*" indicate the instructors’ high perception of the importance of connecting their courses with practice experience and the efforts they make to achieve it. The most frequent answers were organizing “Field trips” (22.62%) and “Guest lectures from industry experts” (21.43%) followed by

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organizing “Hands-on labs” (20.24%) and “Internships” (19.05%). Last, in their preferences was the use of “Virtual labs” (16.67%). These findings show that the connection of lessons with practical experience is at a satisfactory level but needs more improvement and encouragement from the instructors to move more in this direction. The answers to the question “*What are the main challenges you face in delivering effective education and training?*” highlighted as the major challenges “Student engagement” (32.31%) and the “Lack of resources” (29.23%). Other crucial challenges constitute “Limited practical training opportunities” (21.54%) and “Keeping up with industry changes” (16.92%). These challenges reflect the need for resource provision, the upgrade of infrastructure, innovative strategies, and greater student involvement in education.

The answers to the question ''*How do you ensure your curriculum aligns with current regulation and standards?*", indicate that there is no preference (or the ability) of instructors to cooperate with policy makers, as most of them address that they don't engage with policy makers (25.49%) and they prefer the use of collaborative workshops (23.53%) and adopting industry standards (19.61%). Last in their choices were following compliance reviews (13.73%), participation in policy forums (9.8%) and participation at regular consultations with policy makers (5.88%). These findings show that there is a collaboration between the educational system and the industry, but not with the policy makers. There is room for action to close this gap so industry, policy makers, and the educational system work together for the improvement of the field. The answers to the question “*How do you collaborate with education and training providers to enhance the quality of teaching and learning?*” show that most educators choose “Shared training facilities” (27.50%) and “Teacher exchange programmes” (27.50%) while in a less percent “Joint curriculum development” (20%). It is worth mentioning that 25% noted that they don't collaborate with other education and training providers. Collaborations with other providers play a significant role in education quality and with these findings, it seems that there's still a gap that needs to be filled. The answers to the question “*What challenges do you face in collaborating with employers to ensure the relevance of your programmes?*” reveal that 30.95% of the respondents reported that they faced no challenges while 28.57% reported obstacles like “Limited engagement from employers” and “Logistical issues in organizing internships or placements” (23.81%). “Misalignment of academic and industry needs” was also noticed at a percentage of 14.29%, while 2.38% noticed “Other”. These findings show that generally, most instructors have effective collaborations with their employers, but in some cases, the partnership, engagement, and alignment remain fields for improvement.

The answers to the question “*What support do you need from social partners to better prepare students for the workforce?*” highlighted the “Mentorship programmes” (32.81%) followed by “Networking opportunities” (31.25%) and “Career counselling services” (31.25%). The 4.69% noted that “No support” is required. These findings focus on the need for the involvement of social partners in bridging the gap between education and employment.

The answers to the question “*How do you address the challenge of keeping up with rapid technological changes in your teaching?*” show that the majority of the instructors mentioned that “Continuous professional development” (46.27%) is the main strategy that they follow for keeping up with rapid technological changes, followed by “Access to the latest tools and software” (32.84%) and “Partnerships with

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technology companies" (19.40%). Only 1.49% of the responders responded that they didn't face any challenges. These findings show that Continuous learning and Partnerships with the industry are essential to align education with rapid technological changes. The answers to the question "*What are the main challenges in ensuring student readiness for the offshore renewable energy sector?*" show that most of the instructors highlighted that "Practical training opportunities" (20.26%), "Access to real-world projects" (16.34%) and "Effective partnerships between educational institutions and industry leaders" (12.42%) are the primary challenges in ensuring student readiness. Other challenges that influence less are "Industry-specific skill development" (9.80%), "Availability of specialized equipment and facilities for training" (9.15%), "Geographic limitations affecting on-site learning experiences" (9.15%), "Alignment of academic curricula with current industry technologies" (7.84%), "Safety training for working in offshore environments" (6.54%), "Financial barriers to accessing advanced training programmes" (5.23%) and "Legal and regulatory compliance training" (3.27%). According to these findings, facing these challenges will lead to targeted investments in professional development and effective collaboration with industry to straighten the effective preparation of students in integration of the offshore renewable energy sector. The answers to the question "*What are the key challenges in aligning your educational programmes with industry standards?*" highlighted most the "Updating curriculum to meet standards" (40.43%) followed by "Understanding certification requirements" (31.91%) and finally, the "Coordination with certification bodies" (27.66%) as key challenges in aligning educational programmes with the industry standards. Summarizing the results, aligning educational programmes with industry standards needs better communication with certification bodies and improved practices for updating curricula.

The answers to the question "*Please specify which of the following transversal skills are cultivated at your organization*" show that most of the instructors specified "Team working" (25.81%), "Problem solving" (20.43%), and "Communication" (19.35%) as transversal skills in their organizations. Less were noted for "Ease of learning" (10.75%), "Innovation and creativity" (6.45%), "Planning and organization" (5.38%), "Systemic/holistic thinking" (4.30%), "Cross-disciplinary technical competencies" (4.30%) while the smallest percentage was observed in "Leadership" (3.23%). With these findings, it is crucial to further strengthen skills such as creative thinking and innovation, while equally important is the cultivation of organizational skills and leadership to ensure a comprehensive education. The answers to the question "*Does your institution face the challenge of adapting its study program to smart specialization goals and policies?*" indicate that the majority of the respondents (55%) replied yes, 31% didn't know, and 14% reported that they didn't face the challenge of adapting their study program to smart specialization goals and policies. The answers to the question "*Does your institution need the adaptation of new skills for smart specialization that were not needed before?*" most instructors (64%) replied yes while 28% didn't know and only 8% reported that their institutions don't need the adaptation of new skills for smart specialization.

The analysis of the questionnaire data presents the current situation in the Offshore Wind Energy sector in both education and training in Greece. Based on the results, key features of the current situation, challenges, and needs are highlighted. Most respondents to the questionnaires consist mainly of men between the ages of 46-55, while there is significantly lower participation of women and younger age groups.

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Most participants come from vocational rather than university education, while the specialties that dominate professionally at the local level include engineers, technicians and other technologically or technically oriented professionals. Teachers active in the field of renewable energy sources have limited experience, with more than 50% having less than 3 years of experience in renewable energy technologies. The lack of educational experience is even more evident in the field of Offshore Wind Energy in particular, with 50% reporting a complete lack of experience, while only 17% have more than 10 years of experience. So far, solar energy and onshore wind energy are the sectors with the greatest specialization of teachers, leaving room for improvement in education, specialization and training in the field of Offshore Wind Energy.

In addition, the analysis identifies significant skills gaps, both in transversal and specialized skills. Engineering skills (e.g. electrical, offshore engineering), digital skills, as well as skills for working offshore are needed. At the same time, students' skills such as critical thinking, adaptability, and problem-solving are essential to prepare students to enter the labour market.

In terms of educational tools, teachers mainly choose to work with programming languages (e.g. Python), IoT platforms, and various simulation software, however, most of them present the need to transition to education with access to renewed and sophisticated educational tools and to create partnerships with industry. It is also noteworthy that based on the data, 44% of teachers proceed to renew their educational materials annually, but there remains a need for more systematic reform with new educational material. In addition, key challenges faced by teachers include the absence of traineeships, access to or lack of limited resources, and the difficulty of aligning their curricula with market needs. To improve the quality and effectiveness of education, the integration of laboratory practice, field visits - facilities, as well as internships are considered key.

In conclusion, there is a strong need to strengthen and develop education and training in the field of Offshore Wind Energy and it is crucial to focus on broadening teachers' skills, simultaneously developing their curricula with developments in technology and creating and supporting partnerships with industry. All these practices will enhance the effectiveness of the training process by better preparing trainees to stand and cope with the demands of the labour market in the sector as well as strengthening and disseminating the Offshore Wind Energy sector in Greece.

4.4.2.3 Survey of VET learners/ HEI students – main Findings

A total of 86 VET and HEI students participated in the survey, of whom 80.2% were men and 19.8% were women. The core target group consisted of individuals up to 35 years of age, with a distribution of 60% VET learners and 40% HEI students. The largest proportion of women was observed in the age group up to 35 years (18.6%), while the majority of men fell into the age category up to 25 years (51.16%). At the same time, we noticed that in the age group up to 25 years, most survey participants were VET learners (48.84%), while the majority of HEI students were found between 26 and 35 age category (25.58%).

Most participants were young, with 57% aged up to 25 years and an additional 29% between 26 and 35 years old. This means that over 85% of the respondents were under 35, leaving little variation across age groups. As a result, further breakdown by age would not provide significant additional insights for the research findings. Similarly, while gender is an important demographic, less than 20% of the respondents were women. This limited representation makes it less practical to conduct detailed gender-based analysis, as the smaller sample size for female respondents could lead to less reliable or representative conclusions. In contrast, the institutional distribution, with approximately 60% of the respondents coming from VET providers and 40% from universities (HEI), offers a much more balanced and meaningful basis for comparison. Exploring differences between these two groups is critical for understanding how educational backgrounds influence perceptions, interests, and course relevance to the offshore renewable energy sector.

Main Survey Findings

For the question "*In your opinion, which career paths does your institution most actively encourage students to pursue?*", it was deemed appropriate to conduct a crosstab analysis with age and the type of organization the student is enrolled in. This approach allows for a deeper understanding of how different institutions (e.g., universities versus vocational training providers) tailor their career guidance based on the demographic characteristics of their students. By incorporating age as a variable, the analysis could reveal whether career encouragement strategies vary between younger and older students, potentially shedding light on how institutions adapt their focus to meet the specific needs and aspirations of diverse student populations.

The results revealed distinct trends in career paths encouraged by institutions across different age groups. In the Above 56 age group, there was an exclusive focus on Engineers (100%), suggesting that older professionals predominantly hold specialized roles. On the other hand, the age groups Between 46 and 55 and Between 36 and 45 demonstrated greater diversity in their career paths. In these groups, Engineers, Technicians, and Health and Safety were the most prominent fields, reflecting the engagement of experienced professionals in a variety of roles. In the Up to 25 age group, Engineers and Technicians clearly dominated, while participation in other sectors remained relatively low. This pattern indicated that institutions actively encourage these career directions for younger individuals, likely due to the demand for such roles in the labour market.

Meanwhile, participation in fields such as "Plant Operations" and "Environmentalists" was minimal across all age groups, potentially pointing to limited interest or representation of these careers within institutions. Additionally, careers like "Drivers" and "Assemblers" were more frequently observed in the middle age groups, likely correlating with practical experience accumulated over time. Overall, the results suggest that institutions prioritize technical and engineering career paths for younger students, while older age groups display broader professional diversification. The dominance of Engineers in the Above 56 age group reflects the tendency for professionals in stable and highly specialized roles to continue working into later years.

Universities predominantly encourage careers in engineering. On the other hand, VET providers prioritize technical and practical careers, with an overwhelming 90.2% of students encouraged to pursue technical roles, while other significant areas include metallurgy (51%) and assemblers (19.5%). Engineering is notably less emphasized by VET providers, with only 2.6% of students directed toward this field.

For the question "*What is your level of interest in pursuing a career in the offshore renewable energy sector?*", the results indicate a strong interest in this field among both groups, with VET learners showing

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slightly higher enthusiasm. Specifically, 46.2% of VET learners reported being “very interested”, compared to 44.1% of HEI students, while 30.8% of VET learners and 29.4% of university students were “interested”. A small proportion of students were “somewhat interested”, with university students at 23.5% and VET learners at 19.2%. Only 3.0% of HEI students and 3.8% of VET learners indicated that they were “not interested”, demonstrating minimal disinterest overall. These results highlight a promising level of engagement in the offshore renewable energy sector across both educational pathways, which can be utilized to design targeted recruitment and training initiatives. The responses at the question “*In which phases of the offshore renewable energy value chain are you more interested?*” reveal notable differences between HEI and VET students in their interests across the offshore renewable energy value chain. University students predominantly showed interest in “Pre-Planning Research” (67.6%) and “Project Planning” (64.7%), reflecting their inclination toward the earlier, analytical phases of project development. Conversely, VET learners displayed the highest interest in Construction & Installation (69.2%), aligning with their practical and hands-on training background. “Operation & Maintenance” was also a significant area of interest for both groups, with 46.2% of VET learners and 38.2% of HEI students selecting this phase. Other areas like “Manufacturing and Tendering” & “Contracting” had moderate interest levels, with VET learners generally showing slightly higher engagement. Interestingly, under “Others”, where students could write their own responses, options like “Environmental Impact” and “In all phases related to ensuring water quality” were mentioned but received very low response rates. This suggests that only a small minority of students were interested in these more specialized or broader aspects of the offshore renewable energy value chain. Overall, the data highlight a clear distinction in preferences, with HEI students favouring research-oriented roles and VET learners leaning towards implementation and maintenance tasks, reflecting the differing focuses of their educational pathways.

The responses to the question “*How relevant do you find your current courses to the offshore renewable energy sector?*” revealed notable differences between HEI and VET students. A higher proportion of VET learners (36.5%) considered their courses to be “very relevant” compared to 23.5% of HEI students, highlighting that VET programmes may have a stronger practical alignment with the offshore renewable energy sector. Similarly, the majority of both groups rated their courses as “moderately relevant”, with 51.9% of VET learners and 52.9% of HEI students selecting this option, suggesting that while their programmes provide some relevant knowledge, there may be gaps in directly addressing sector-specific skills. Interestingly, a greater percentage of HEI students (14.7%) viewed their courses as only “slightly relevant” compared to 7.7% of VET learners, indicating that some university curricula might lack direct applicability to this industry. Additionally, the proportion of respondents who found their courses “not relevant” was minimal for both groups, with 8.8% of HEI students and 3.8% of VET learners, reflecting an overall recognition of some relevance to the sector. These findings suggest that VET programmes could be perceived as more tailored to the practical demands of the offshore renewable energy sector, while university courses might benefit from further integration of industry-specific content to enhance their relevance.

Following, students were asked to assess their confidence levels across a range of skills on a scale from 1 (very low confidence) to 5 (very high confidence). The correlation analysis revealed interesting patterns in

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the relationships between confidence levels across various skills, with distinctions observed between VET learners and HEI students. Among VET learners, strong positive correlations were observed between skills related to "critical thinking", "collaboration", and "project design". For instance, those who reported high confidence in "Critical Thinking", also demonstrated high confidence in "Communication and Collaboration". In contrast, foreign language skills were negatively correlated with more technical skills, such as engineering, suggesting potentially distinct learning priorities among this group.

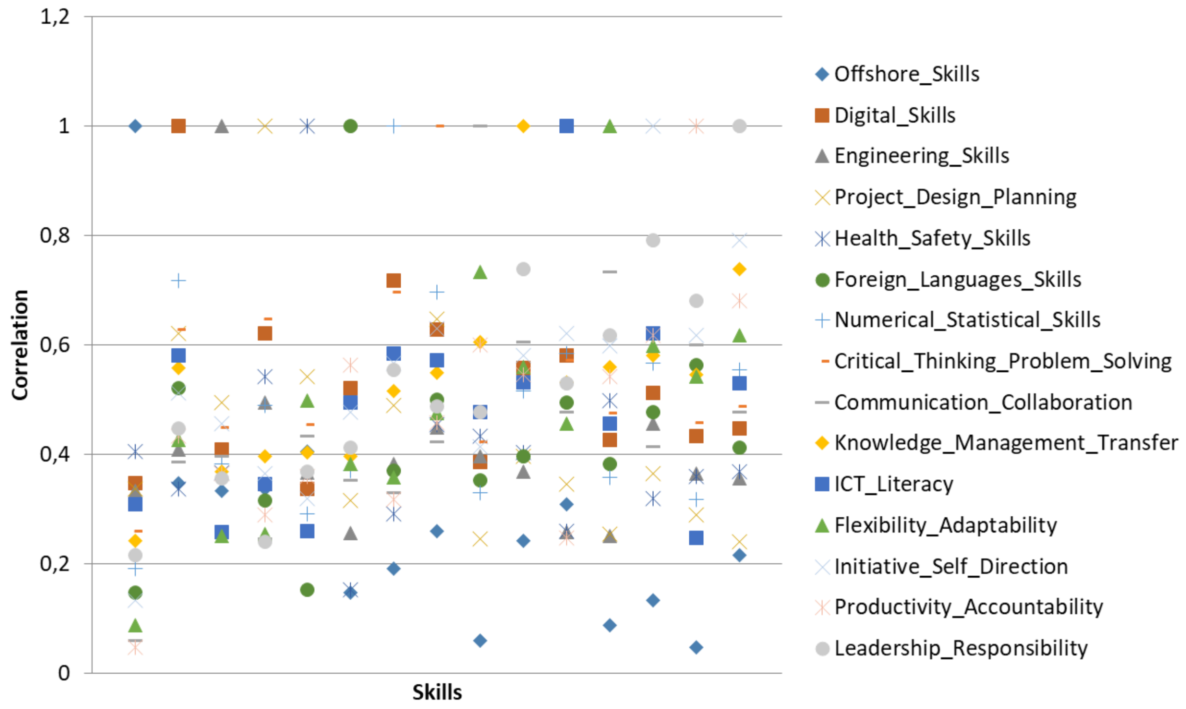

Figure 105. Correlation matrix of skills confidence for VET learners

For HEI students, skills such as "Project Design and Planning" were strongly correlated with "Problem Solving" and "Knowledge Management". This may reflect the emphasis on holistic approaches to addressing complex challenges in higher education. Notably, skills like "Flexibility" and "Leadership" showed stronger correlations in the HEI context compared to the VET setting, potentially indicating a greater focus on strategic and adaptive competencies. Overall, the results highlight differences in skill development priorities between VET learners and HEI students. VET learners appear to focus more on practical and applied skills, while HEI students emphasize competencies related to information management and strategic thinking.

The responses to the question "*How do you stay informed about the latest developments in offshore renewable energy?*" reveal notable differences between HEI and VET students. Social media is the most common source of information for both groups, with 63.8% of HEI students and 66.5% of VET learners relying on it, highlighting its dominant role in modern communication. Academic journals and industry newsletters are more frequently used by HEI students (64.7% and 48.2%, respectively) compared to VET learners (11.5% and 36.5%), reflecting the academic orientation of HEI curricula. In contrast, VET learners appear to rely more on hands-on and direct sources like trainers at VET institutes (17.3%) and professional networks (26.9%), aligning with their practical learning environment. Other sources like TV and LinkedIn show minimal

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relevance, with low percentages for both groups, while online courses hold moderate interest across both (26.9%). The data emphasizes the different information-seeking behaviours of these two groups, with HEI students leaning toward scholarly and formal channels, while VET learners prefer practical and immediate sources of information. This divergence underscores the importance of tailoring communication strategies to their distinct preferences.

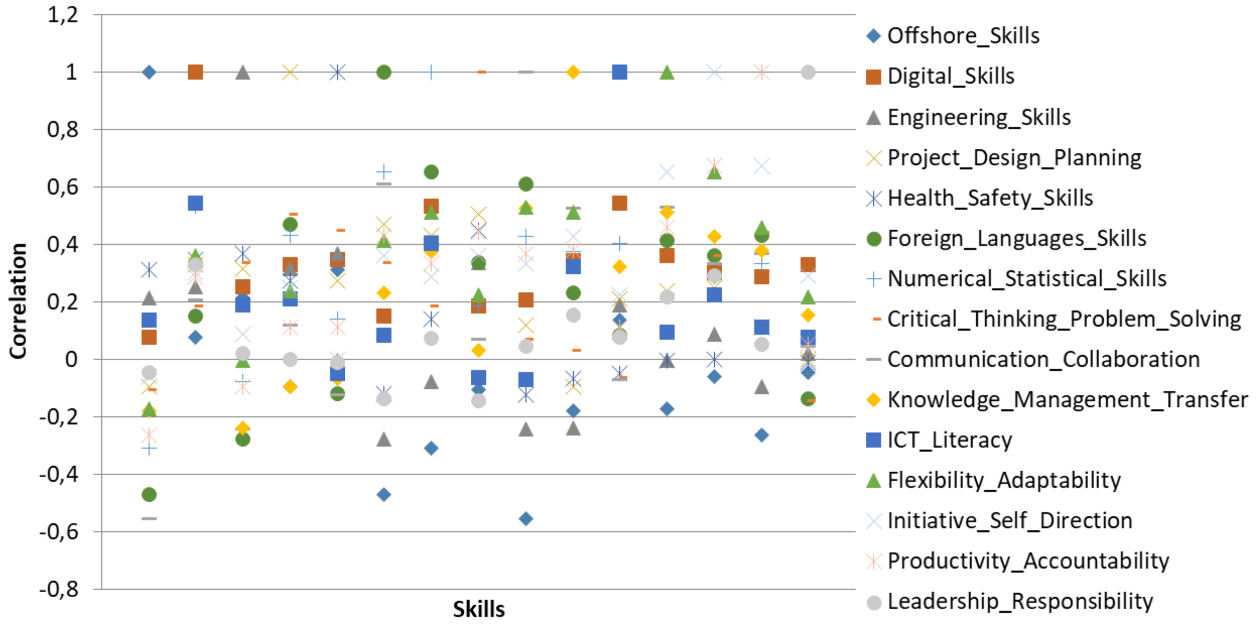

Figure 106. Correlation matrix of skills confidence for HEI students

The responses to the question "*How well do you think your current education is preparing you for the offshore renewable energy market needs?*" reveal significant differences between VET learners and HEI students. Among HEI students, 44.1% feel their education prepares them "well", but only 8.8% rate it as "very well", suggesting moderate confidence in their program's alignment with industry needs. In contrast, VET learners display a stronger positive perception, with 48.1% stating their education prepares them "well" and a notable 23.1% rating it as "very well". Additionally, 38.2% of HEI students view their preparation as "adequate", compared to 21.2% of VET learners. The percentage of those who feel "poorly" prepared is minimal but slightly higher among VET learners (7.7%) than HEI students (8.8%). Overall, the results highlight the practical focus of VET programmes, which appear to better equip students for the offshore renewable energy sector, while university programmes may need to strengthen their connection to industry-specific skills and practices to boost students' confidence.

The responses to the question "*Have you participated in any industry-related projects or research?*" indicate that the majority of both HEI and VET students did not have such experiences, but there are slight differences in participation levels between the two groups. Only 34.6% of HEI students reported participating in industry-related projects or research, compared to 32.7% of VET learners. This shows a marginally higher engagement among HEI students, which may reflect their potential involvement in academic research or internships tied to their studies. However, the majority of students from both groups—65.4% of HEI students and 67.3% of

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VET learners—indicated no participation, highlighting a significant gap in industry exposure across both educational pathways. These findings suggest a need for greater emphasis on integrating industry-relevant projects and research opportunities into both HEI and VET curricula to enhance students' practical experience and readiness for the offshore renewable energy sector.

The responses to the question "*What practical experiences have you had in the sector of offshore renewable energy?*" show notable differences between HEI and VET students. A significant proportion of VET learners (55.8%) reported having no practical experience, slightly lower than HEI students, where 64.7% indicated the same. Internships are the second most reported experience among VET learners (25%), highlighting a relatively stronger focus on hands-on training compared to HEI students, where only 8.8% have participated in internships. Workshops are also more common among VET learners (26.9%) than HEI students (17.6%), reflecting the emphasis of VET programmes on practical learning. Research projects were reported at similar levels by both groups (17.3% for VET and 17.6% for HEI students), indicating that academic-oriented experiences are equally prioritized. Lastly, the category "related to causing changes in water quality" appeared in the "Other" field, representing a very small fraction of responses (2.9%) exclusively among university students. Overall, the data indicates that VET programmes are more effective at offering practical and applied learning experiences, while university students tend to have limited engagements with industry-related practices. This highlights an opportunity for universities to strengthen experiential learning opportunities like internships and workshops.

The responses to the question "*What challenges do you face in gaining practical experience in this field?*" highlight several obstacles that students encounter, with notable differences between HEI and VET students. For HEI students, the most significant challenge is geographic limitations (38.2%), indicating that access to industry facilities is often restricted by location. This is followed by limited access to industry professionals (35.3%) and insufficient practical training in the curriculum (29.4%), reflecting the theoretical nature of university programmes. In contrast, VET learners identified limited access to industry professionals (32.7%) as their main barrier, followed closely by insufficient practical training (26.9%) and geographic limitations (26.9%). Additionally, lack of internship opportunities is a far greater issue for VET learners (25%) compared to HEI students (8.8%), suggesting a stronger need for internship programmes in VET pathways. A small percentage of responses fall under the "Other" category, with HEI students mentioning challenges such as current job position (2.9%) and not facing any difficulty (2.9%). Similarly, a small number of VET learners reported being freshmen and unable to answer (1.9%) or noted that they face no difficulties (1.9%). Overall, these findings highlight that while both groups face overlapping challenges, HEI students struggle more with geographic access and theoretical curricula, whereas VET leaners emphasize the need for industry connections and internships. Addressing these issues through targeted program improvements could support students in gaining practical experience.

The responses to the question "*What support do you need from your institution to pursue a career in this sector?*" reveal differing priorities between HEI and VET students. Among HEI students, the most frequently mentioned needs are industry networking opportunities (70.6%) and internship placements (64.7%), highlighting their desire for stronger industry connections and hands-on experiences. Similarly, scholarships/ funding was also a significant need for HEI students (67.6%), suggesting financial support is a major concern

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for this group. For VET students, the highest priority was internship placements (63.5%), reflecting their focus on practical, real-world training. Industry networking opportunities were also critical (44.2%), though less frequently mentioned than by university students. Scholarships/funding were cited by 30.8% of VET students, indicating a lower demand for financial aid compared to their university counterparts.

The “Other” responses, which included competent management executive, research labouratory visits, and site visits, were minimal, representing only 2.9% of HEI students and 1.9% of VET learners. These responses suggest specific needs that could be addressed through targeted institutional efforts. Overall, the data highlight that while both groups seek stronger industry engagement and internship opportunities, HEI students emphasize financial and networking support, whereas VET learners prioritize practical training. Tailoring support programmes to these differing needs could enhance career readiness across both educational pathways.

Apart from the online survey, interviews were conducted with (a) market leaders, (b) VET/ HEI instructors and (c) VET learners/ HEI students, in the Greek renewable energy sector. The following sections provide insights for each category of interviewees.

4.4.2.4 Interview insights with ORE market leaders in Greece

Four interviews were conducted with market leaders in the Greek renewable energy sector. The interviewees hold key roles in the following companies: TERNA Energy, HellenIQ Energy, PPC Renewables and MORE (Motor Oil Renewable Energy). These companies are expected to play an important role in the development of the Greek Offshore Wind Energy industry.

For more than 20 years, TERNA ENERGY plays a leading role in clean energy production while carrying out innovative projects for the environment, which contribute to sustainable development. With a strong portfolio of projects in Greece and abroad, TERNA ENERGY is the largest investor in the RES sector in Greece and the biggest Greek company in the sector worldwide. TERNA ENERGY continues its dynamic growth with an investment program evolving at an intensive pace and a goal of 6 GW of RES plants until 2029.

HELLENiQ ENERGY, formerly known as Hellenic Petroleum S.A. is one of the largest oil companies in Southeast Europe and with its roots dating to 1958 with the establishment of the first oil refinery in Aspropyrgos, Greece. In the last years, HELLENiQ ENERGY has been transforming from an oil company into an organisation that operates across the entire energy spectrum, including of course renewable energy activities.

PPC Renewables is a 100% subsidiary company of PPC and has been a pioneer, both nationally and at the European level, in Wind and Solar Energy since the 80s. Today, operating 38 wind farms, 18 small hydroelectric plants, 35 photovoltaic plants and 1 hybrid power plant, reaches the total installed capacity of more than 700MW, following an ambitious investment plan, PPC Renewables has a major position in Greek Renewable Energy Sector creating the foundations to lead the country’s energy transformation.

MORE (Motor Oil Renewable Energy), a subsidiary company of the Motor Oil Group is a leading force in the field of RES, one of the largest RES producers in Greece and one of the most important in Southeastern

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Europe. MORE is an important pillar of Motor Oil Group's energy transition plan. Specifically, the company operates a modern portfolio of 839 MW installed capacity, 94% of which is wind-based power generation units. In addition, it manages projects in various stages of development with a total capacity of 2.2 GW. It should be noted that during 2023, more than 450 MW of new projects were licensed with environmental permits, while final grid connection terms were obtained for 287 MW.

The purpose of these interviews was to collect expert opinions and professional insights on the current state and future needs of the offshore renewable energy sector workforce. The information gathered will help to identify skills gaps, training needs, and potential strategies to enhance workforce development in the sector. Interviews were structured on the following thematic sections:

- Workforce readiness and skills needs
- Skills gaps – Hard and Soft Skills
- Training and educational programmes
- Industry collaboration and strategic challenges
- Diversity, inclusion, and public Awareness
- Policy and cross-sector collaboration

4.4.2.5 Interview insights with VET/ HEI instructors in Greece

Six (6) interviews were conducted with two (2) Professors teaching in undergraduate and postgraduate programmes and four (4) teachers/ trainers, teaching in VET schools in Greece. Through the data of their interviews, the current situation on the Offshore Wind Energy sector in the country is presented. Based on instructors' responses, the majority of them have experience in teaching renewable energy in general contexts, even if their expertise was in other areas such as biofuels and photovoltaics. Only one has pure expertise in the field of wind energy. Despite their lack of expertise in the field, all instructors independently support positively the development of offshore renewable energy technologies at both national and European level, highlighting the socio-economic benefits that will arise, since Greece has the advantage of its extensive coastline and its many islands. They support all these under strict controls, always with a view to protecting and respecting the environment and the tourism sector.

Wind energy is the main driver of offshore renewable energy systems and can be combined with other technologies such as photovoltaics and wave energy systems. However, teachers point out serious shortages in specialized knowledge and skills of the workforce (hard skills, communication and soft skills), which will be called upon to support both the design and construction of such systems and their maintenance and monitoring. It is also important to mention that based on the results, gender inequality in the sector is highlighted, as there is a shortage social awareness on issues around Renewable Energy Sources.

Measures to address the above issues included the proposal for international cooperation of teachers with colleagues from countries, where they have already developed in the field of Renewable Energy Sources, with main concern the transfer of the "know-how". In addition, cooperation between educational institutions and businesses for the creation of internships for students was proposed, as well as the creation of flexible curricula with specialized courses that will be constantly renewed and enhanced based on and in

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parallel with technological developments. Other supportive measures that are deemed necessary, however, are the visits of trainees to projects under construction, real case studies, the development of certifications, the participation in conferences, the attendance of seminars with the participation of industry professionals, the development of workshops for practical training, and group work in order to cultivate soft skills.

In practice, with the above actions, students have the opportunity to become familiar early with the technologies and requirements of this industry and will be given the opportunity to network with future colleagues, thus, acquiring the necessary skills for their professional career and development. With these efforts to enhance education, Greece can combine with its extensive coastline to establish itself as a leader in the Offshore Renewable Energy industry.

In conclusion, the findings highlight the need to enhance education and training specialized in the field of offshore Renewable Energy, the cultivation of skills as well as the broadening of social awareness in this field. At the same time, they emphasize Greece's enormous potential to evolve and pioneer in this field when the challenges are addressed.

4.4.2.6 Interview insights with VET learners/ HEI students in Greece

During the interviews, HEI students emphasised the importance of aligning curricula with technological developments and dynamics in the offshore renewable energy (ORE) sector. The need for a modern curriculum that integrates cutting-edge research and emerging technologies was emphasised. These students emphasized the importance of international collaboration and knowledge exchange, which can enhance their academic experience and future career prospects. In addition, they expressed a strong desire for more hands-on learning opportunities, such as internships, research projects and industry fellowships, to bridge the gap between theoretical knowledge and real-world applications and to be flexible in technological change Important.

VET learners focused on the practical aspects of their training and emphasized the importance of a curriculum that incorporates technical skills and hands-on skills. They emphasized the value of collaborating directly with industry professionals to ensure their skills remain relevant and the importance of staying on top of new technologies in the ORE field. Work-based learning, apprenticeships and real-life projects were seen as important in preparing the workforce. These students also emphasized the role of certifications and special qualifications in making them competitive in the ORE industry. VET learners were particularly interested in opportunities for international experience, as they believed it would provide insight into global industry standards and practices, improving their skills and career prospects.

The interviews from both HEI and VET students indicate a shared understanding of the evolving needs in the ORE sector. Both groups agree that education systems must adapt to rapid technological change and industry requirements. HEI students focused on the importance of combining advanced research, international projects and hands-on learning to prepare them for the workforce, while VET learners emphasized putting skills to good use through training work-based, academic and industry certifications. Finally, the results reveal a strong perspective on industry partnerships, specialized requirements, and the need for curriculum innovation to ensure alignment with the rapid growth of the ORE industry.

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4.4.3 Skills gap analysis

There's a well-documented skills gap, particularly in advanced technical roles such as electrical engineering, mechanical engineering, and subsea installations and operations. Recent analysis (*"Energy Transition and Jobs" - a research paper that builds on PwC's Green Jobs Barometer*) shows that a shortfall of approximately 200,000 skilled workers is emerging, which could constrain the energy transition[195]. This is particularly true for specialised roles in floating wind farms, digital technologies, and automation for offshore operations. The shortage is compounded by the aging workforce in traditional energy sectors, such as oil and gas, making reskilling programmes essential.

The most significant gaps are in technical (hard) skills like engineering, data analytics, and installation, but soft skills (teamwork, leadership, problem-solving) are equally important as the sector grows. Technical skills gaps are more pronounced, especially in engineering, data management, and subsea technology. However, as offshore projects require significant coordination and teamwork, soft skills like communication, leadership, management and adaptability are also critical. Both areas need attention, but hard skills often take precedence in technical roles. Additionally, based on the answers of the interviewees project management, digital skills (including ICT and data analytics), and engineering are among the most important technical skills for the Offshore Renewable Energy (ORE) sector. Especially for consortia comprising of 50 to 80 contractors, project management skills hold a most important position. Even though these are rightly emphasized, additional expertise in environmental science, subsea technology, cybersecurity, and energy storage are equally critical for the ORE sector's long-term success.

Regarding soft skills, respondents believe that creative thinking, critical problem-solving, and self-direction are particularly important in an industry defined by innovation, collaboration, and dynamic challenges. However, teamwork, communication, resilience, stakeholder engagement, and leadership are equally vital. These skills collectively enable professionals to innovate, collaborate, and navigate the complex and evolving challenges of offshore renewable energy projects. In a nutshell, in order to succeed in the Offshore Renewable Energy (ORE) sector, professionals must possess a balanced blend of hard (technical) and soft (interpersonal) skills. Training and educational programmes

Regarding the most effective methods for skill acquisition, respondents believe that on-the-job training, in-house training, and accredited professional programmes are well-aligned with the needs of the ORE sector, as they allow professionals to acquire practical, specialized skills while ensuring adherence to industry standards. However, additional methods such as industry-led workshops, cross-sector collaborations, VR/AR training, and mentorship programmes can complement these traditional methods and help address the sector's rapidly evolving demands. Moreover, the respondents also suggested that the young engineers who

[195] PricewaterhouseCoopers, "Green Jobs Barometer."

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left Greece during the financial crisis, would now have 12 years of experience in the offshore wind sector, and so they could be efficiently used in the in-house training.

They also pointed out that the educational and training programmes need to be more flexible, dynamic, and closely aligned with industry requirements. Strengthening industry-academia partnerships, offering specialized short courses, and leveraging virtual training technologies are key strategies to ensure the workforce is adequately prepared for the future of offshore renewables. As the ORE sector embraces automation and digitalization, workforce requirements will shift toward higher-tech, specialized roles, with increased demand for skills in data analytics, AI, robotics, and cybersecurity. The focus will be on digital competence, remote operations, and system optimization, while traditional roles in manual labour and basic maintenance might decrease.

As a final remark, emphasis should be given to training and educational programmes which will facilitate the deliver to the market of well-trained employees who will manage to stand up to the requirements of the new job roles which the ORE sector will need, as this sector continues to grow. An indicative list of these emerging roles might be:

- Floating Wind Farm Specialist
- Marine Energy Technologist
- Offshore Energy Storage Engineer
- Digital Twin Analyst
- Offshore Wind Farm Data Scientist
- Subsea Robotics Engineer

4.4.3.1 Industry collaboration and strategic challenges

Collaboration between industry, academia, and government in workforce development for the ORE sector is still in the early stages but has seen increasing momentum. Universities need to engage more directly with industry to design curricula that align with current and future needs. Industry leaders should be involved in the creation of training programmes and research initiatives to ensure that academic output is aligned with real-world applications in offshore energy technologies. Internships, work placements, and apprenticeship programmes can help bridge the gap between theoretical knowledge and practical experience. Regarding the collaboration between academia and industry, the continuous development of the educational system itself is also important, while a strong connection with industry and live communication are necessary (as e.g., with lectures provided by companies in educational institutions). Overall, it's a bilateral communication need for the educational system and the industry.

Furthermore, collaboration should extend beyond academia, industry, and government to include local communities, environmental organizations, and international research groups. This broader collaboration could ensure that workforce development programmes also address local challenges such as community involvement in offshore projects and environmental sustainability.

At the moment, according to the interviews, companies in Greece struggle with both attracting and retaining skilled professionals due to competition with other sectors and insufficient training. Challenges also include

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brain drain (skilled professionals leaving for better opportunities abroad). Strategies to address this could include competitive salaries, incentives for continuous professional development, and creating long-term career paths with advancement opportunities. Strengthening education and training partnerships, offering incentives for foreign talent, improving working conditions, and building strong professional networks might be as well some strategies that could be deployed to address these challenges. Career pathways could be clarified through mentorship programmes, through the development of standardised qualification frameworks/certification systems and through clear job hierarchies within companies.

Greece must take steps such as establishing structured career frameworks, offering apprenticeships and internships, promoting cross-training, and ensuring that there are strong mentorship networks. To support lifelong learning, a focus on continuing education, certifications, and a culture of innovation will ensure that workers are continuously adapting to new technological advancements and challenges. Both industry and government must collaborate to create an environment where continuous professional development is supported and accessible, ensuring a skilled and adaptable workforce. This lifelong learning can be promoted through online learning platforms, professional certifications, and incentives for attending conferences or workshops on new technologies.

4.4.3.2 Diversity, inclusion, and public awareness

Generally, there is a growing emphasis on improving gender diversity and inclusion in the ORE sector, which has historically been male-dominated. Initiatives to attract women and underrepresented groups are underway, focusing on recruitment and retention.

Measures to improve this could include targeted recruitment, mentorship for underrepresented groups, diversity training within companies, creating an inclusive workplace culture and promoting family-friendly policies in offshore work environments.

Greece makes significant efforts to embrace gender and diversity in the workforce. Further improvement can be achieved by promoting STEM education, developing inclusive recruitment practices, creating supportive workplace cultures, and investing in leadership development.

Another interesting approach to the gender diversity and inclusion issue refers to the establishment of leadership and project management approaches that emphasize taking decisions as a group produces better project planning and technical decisions. In this way, everybody has a voice but also has an impact on ensuring that specialists and project members of different genders or different minorities also get a voice. The percentage gender law seems to not work in practice.

Public awareness is still relatively low, especially compared to more established industries such as tourism, shipping, etc. Educational outreach, public-private collaborations, targeted digital campaigns, and industry partnerships can help raise awareness about the sector and its future career prospects. Information campaigns are under the role of universities, the ministry of Energy and the government.

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4.4.3.3 Policy and cross-sector collaboration

The main conclusion, based on the respondents' answers, is that Government policies and incentives are crucial in ensuring that the workforce in Greece is adequately prepared to meet the challenges of a rapidly growing ORE sector. To boost the sector's growth, we should focus on clear regulatory frameworks, financial incentives for training, and support for career transitions from traditional sectors, such as offshore oil and gas, shipping, etc.

4.5 Cyprus

4.5.1 Skills and qualifications in demand

The analysis of skills and qualifications in demand was conducted using both desk and field research, as outlined in the methodology section. Primary desk research sources included CEDEFOP and HRDA databases, while surveys targeted three distinct groups: Vocational Education and Training (VET) and Higher Education (HE) educators, industry professionals, and students.

The associated job profiles detailed in Section 3.2.5.6 provide a comprehensive overview of the skills and qualifications needed to meet current and future labour market demands. The findings are summarized in Table 28, which categorizes the required skills and qualifications per group according to the ESCO classification framework.

Table 28. Skills and qualifications in demand according to occupational category in Cyprus

Occupational category	Skills and qualifications
Managers (ESCO Group: 1XXX)	• Adherence to company standards • Effective management of budgets • Strong leadership and collaboration skills through liaising with managers • Analysing and developing supply chain strategies and trends • Ensuring policy and legal compliance • Overseeing project and logistics management • Building and maintaining business relationships • Ensuring equipment readiness and maintenance • Controlling expenses for operational success • Competence in strategic planning • Proficiency in inventory management • Continuous process improvement • Educational development, including curriculum monitoring • Cooperation with education professionals for organizational growth and efficiency
Engineers (ESCO Group 21XX)	• Approving engineering design • Performing scientific research

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	• Defining technical requirements • Effective project management • Data analysis • Quality control • Prototype design • Gathering and managing technical information • Demonstrating expertise • Monitoring manufacturing standards for operational success • Skills in sustainable energy promotion • Environmental impact assessment • Proficiency in CAD and technical drawing • Equipment maintenance and safety compliance • Troubleshooting • Developing test procedures and environmental policies • Advising on efficiency and pollution reduction • Designing energy systems • Ensuring health and safety compliance
Health and Safety (ESCO Group 22XX)	• Advising on conflict and risk management • Communicating health and safety measures • Conducting risk assessments • Educating employees on occupational hazards • Ensuring compliance with environmental legislation • Adhering to machinery safety standards • Monitoring employees' health • Monitoring legislative developments • Presenting comprehensive reports
Teaching professionals (ESCO 23XX)	• Adapting teaching methods to students' capabilities • Aligning training with labour market needs • Applying intercultural and general teaching strategies • Assessing students • Assisting students in their learning process • Providing constructive feedback • Ensuring students' safety • Working effectively within a vocational school environment
Business and administration professionals (ESCO Group 24XX)	• Analysing company factors and making strategic decisions • Integrating strategies and aligning business development • Interpreting financials and estimating profitability • Advising on financials, risk, and tax policy • Collecting data and conducting business analysis • Creating financial plans and managing risk

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	• Applying change management and building relationships • Conducting qualitative and quantitative research • Developing PR strategies and managing media • Preparing communication materials • Using communication channels effectively
Technicians and associate professionals (ESCO Group 31XX)	• Conducting audits and maintaining equipment • Demonstrating computer literacy and using documentation • Identifying improvements and troubleshooting • Performing product testing and defect removal • Adjusting engineering designs and defining part requirements • Designing components and liaising with engineers and managers • Interpreting engineering drawings • Advising on construction materials and checking compatibility • Ensuring specifications compliance and inspecting supplies • Following safety procedures and using safety equipment • Keeping records and writing specifications • Working ergonomically and communicating with labs
Metal, machinery, and related trades workers (ESCO Group: 72XX)	• Applying health and safety standards and following construction procedures • Constructing and preparing building sites and working platforms • Operating heavy machinery and tools safely and without supervision • Inspecting and maintaining construction and crane equipment • Disposing of hazardous and non-hazardous waste and managing workpieces • Performing machinery checks and ensuring equipment availability • Troubleshooting and securing working areas and equipment • Interpreting 2D/3D plans and reading blueprints • Installing and repairing crane and electronic equipment • Using safety equipment and reacting in time-critical environments • Working safely in teams and with machines
Electrical and electronic trades workers (ESCO Group: 74XX)	• Applying safety management and complying with electrical safety regulations • Assembling, calibrating, and maintaining electromechanical and electrical equipment • Installing electrical and electronic equipment • Inspecting electrical supplies and fitting mechanised equipment • Resolving equipment malfunctions and solving technical problems • Splicing cables and testing electromechanical systems and electronic units • Using measurement instruments and precision tools

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	• Wearing protective gear and working ergonomically

In terms of transversal skills, Figure 107 illustrates the top skills identified in online job advertisements collected from Cyprus in 2023. The data highlights "Willingness to Learn" as the most frequently cited skill, appearing in 6.5% of all job postings analysed, while "Maintaining a Positive Attitude" is the least mentioned, with a representation of 0.7%. These percentages reflect the proportion of advertisements emphasizing each skill relative to the total sample analysed.

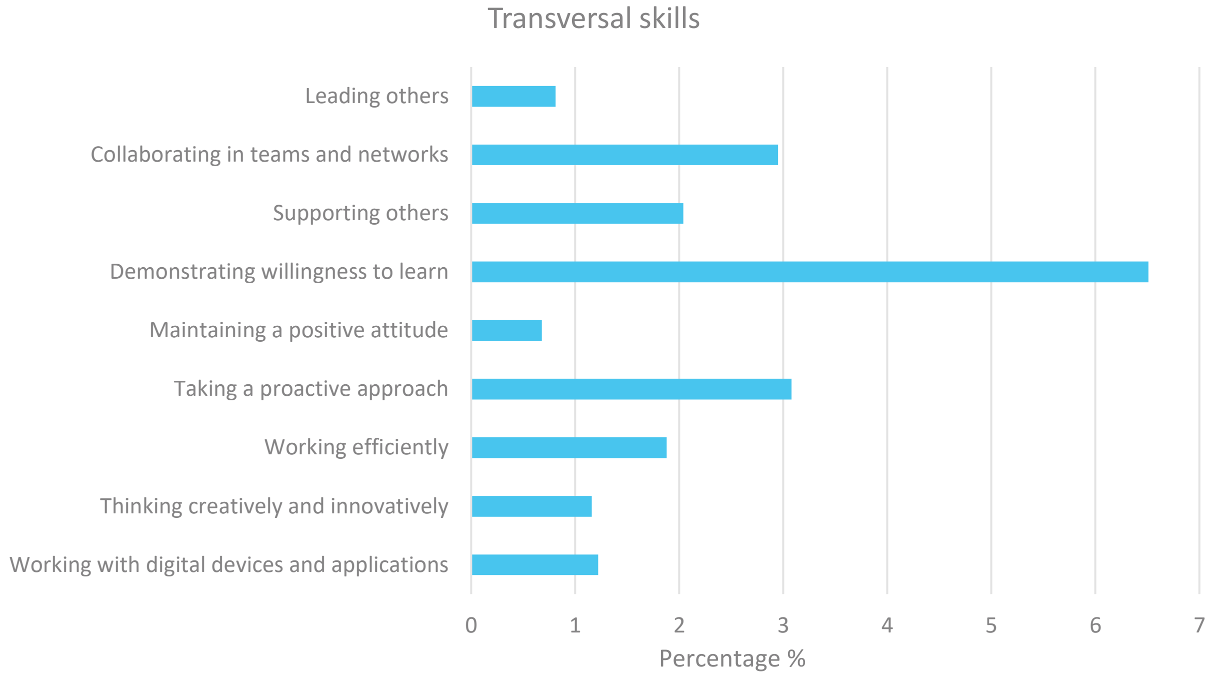

Figure 107. Top skills in online job advertisements for transversal skills and competences collected from Cyprus in 2023 (Source: CEDEFOP)

4.5.2 Sectoral needs in industry and education

To identify the sectoral needs in industry and education, online job advertisements were categorized and examined, along with surveys conducted for VET and HE teachers, professionals, and students. The analysis focused on occupational groups pertinent to the offshore renewable energy (ORE) sector.

1) **Professionals:** Professionals typically perform specialized roles requiring advanced skills and tertiary education. Their activities include scientific research, medical and health services, teaching, business and legal services, social services, and artistic creation.
2) **Associate professionals**: Associate professionals handle technical tasks in research and applied science, arts, business regulations, and social services, often requiring higher education (1-3 years post-secondary) or extensive work experience.
3) **Clerks**: Clerks manage, record, and retrieve information, perform clerical tasks, handle finances, and coordinate appointments. Duties include typing, data entry, secretarial work, and record-keeping.

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4) **Managers**: Managers oversee and evaluate organizational activities across sectors, including enterprises and governments. Their tasks involve policy formulation, budget control, resource allocation, and performance evaluation.
5) **Operators and assemblers**: Operators and assemblers run and monitor machinery, drive vehicles, and assemble products per specifications. This work requires experience with machinery and adapting to technological changes. Most roles need basic secondary education, with some requiring advanced education.
6) **Trades workers**: Trades workers use specialized skills to construct, maintain, and repair buildings, machinery, and various products. They operate hand and power tools, often requiring secondary education with vocational training or significant on-the-job experience.
7) **Elementary workers**: Elementary workers involve the performance of simple and routine tasks which may require the use of hand-held tools and considerable physical effort. For competent performance in many elementary occupations, completion of primary education or the first stage of basic education are required. A short period of on-the-job training may be required.

The 2023 analysis of online job advertisements in Cyprus (see Figure 108) reveals a job market predominantly oriented toward expertise and leadership roles. Professionals were the most sought-after category, with 17,085 postings, followed by associate professionals at 11,039 and managers at 7,306. Moderate demand was observed for service and sales workers, as well as clerks. In contrast, lower-skilled roles such as elementary workers, machine operators, and particularly farm workers—with only 58 postings—showed minimal opportunities. These findings suggest that higher education and specialized training significantly enhance job prospects, with limited openings for lower-skilled positions.

Additionally, a study conducted by CEDEFOP on the same dataset highlights the prioritization of various competencies by employers. The analysis indicates that transversal skills and competences were the most emphasized, comprising 7.5% of job postings, followed by specific skills at 7.2%, and foundational knowledge at 6.3%. This underscores the importance employers place on adaptable and transferable skills alongside general abilities and domain-specific expertise when recruiting in 2023.

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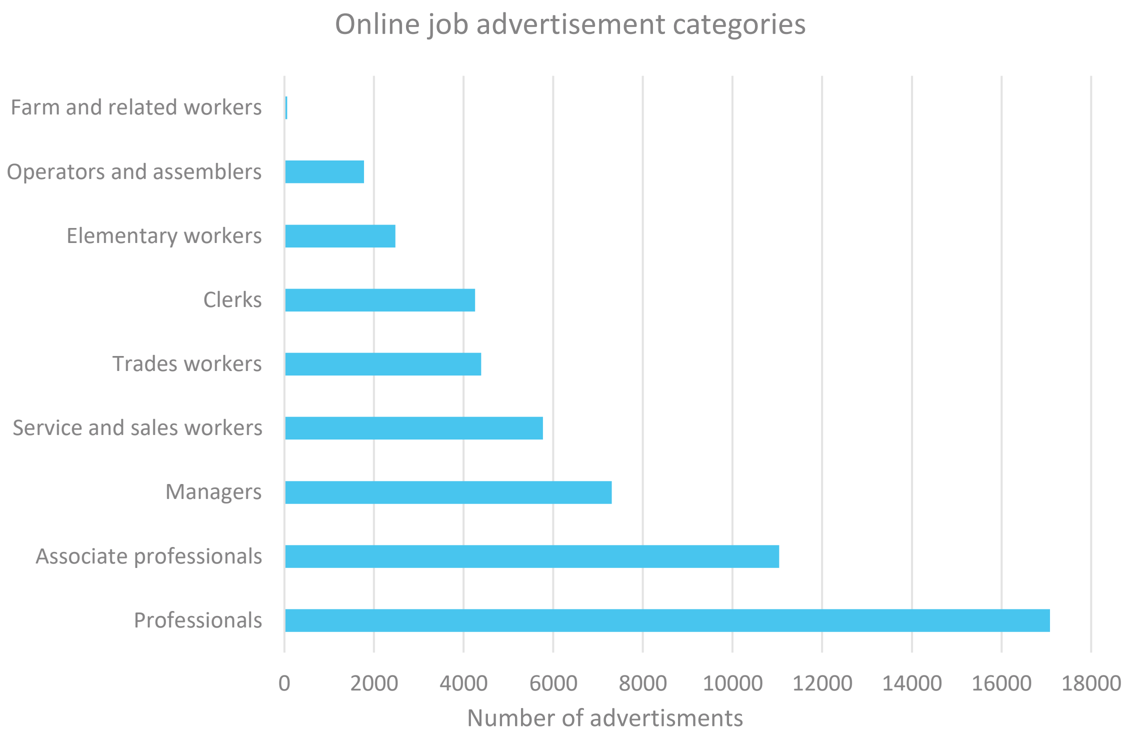

Figure 108. Number of job advertisements per occupational profile collected in Cyprus in 2023 (Source: CEDEFOP)

The data presented in Figure 109 provides insights into the distribution of occupational needs across various sectors and highlights several key observations relevant to the offshore renewable energy sector in Cyprus.

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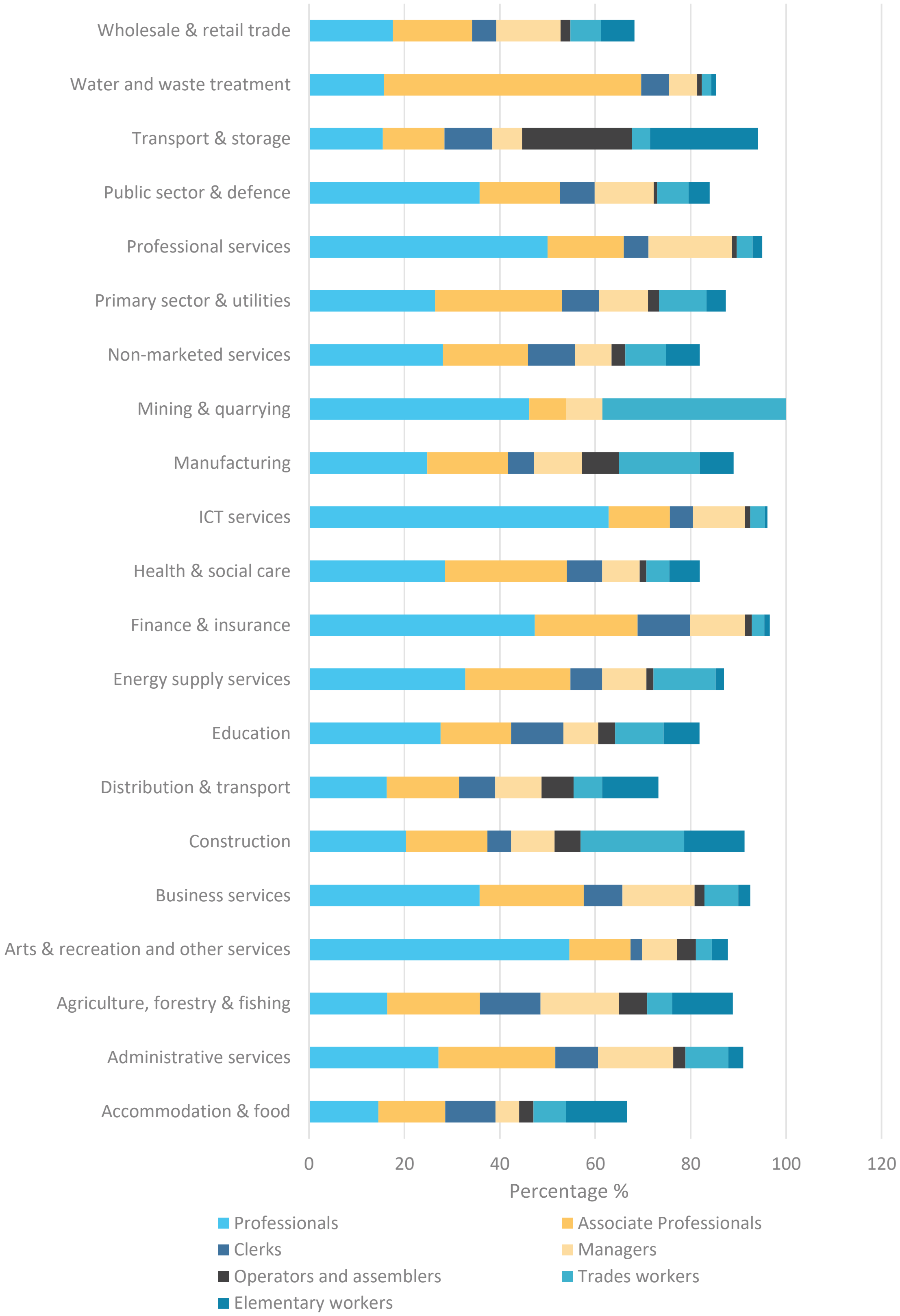

Figure 109. Distribution of occupational needs across sectors in Cyprus in 2023 (Source: CEDEFOP)

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The following sections outline the high-demand occupational categories and their implications for the skills and expertise needed in the sector.

1) **High demand for professionals:** Sectors such as ICT Services (62.8%), Professional Services (49.99%), Finance & Insurance (47.34%), and Mining & Quarrying (46.15%) show a significant demand for highly skilled Professionals. This trend suggests that the offshore renewable energy sector, which relies on advanced technological, engineering, and financial expertise, will require a strong pool of professionals, including engineers, project managers, and financial analysts.
2) **Trades workers and technical skills:** Trades Workers are highly sought after in Mining & Quarrying (38.46%), Construction (21.72%), and Manufacturing (16.91%). These findings indicate that the offshore renewable energy sector will face challenges in securing sufficient skilled tradespeople for construction, assembly, and maintenance of infrastructure. The need for trades workers reflects the importance of technical and hands-on skills essential for building and maintaining energy facilities.
3) **Operators and assemblers:** The Transport & Storage sector (23.06%) shows a strong demand for Operators and Assemblers, indicating that the offshore energy sector will need skilled workers capable of operating heavy machinery and managing logistics operations efficiently.
4) **Associate Professionals:** The highest demand for Associate Professionals is seen in Water and Waste Treatment (53.92%) and Health & Social Care (25.49%). This suggests a requirement for mid-level technical expertise, which could translate to roles in energy efficiency management, environmental monitoring, and support roles in offshore renewable projects.
5) **Clerks and administrative support:** Administrative Services (24.53%) and Finance & Insurance (11.02%) indicate a need for clerical and administrative support. For the renewable energy sector, this implies the importance of strong administrative teams to manage documentation, compliance, and coordination of projects.
6) **Elementary workers:** Significant demand for Elementary Workers is found in Transport & Storage (22.55%) and Accommodation & Food (12.78%). This suggests a need for basic support roles in logistics and site management, essential for offshore energy operations.

Recent surveys and short interviews conducted with 35 industry professionals, 10 VET and HE teachers, 34 students, and 13 additional individuals provided insights into the educational and workforce demands in the renewable energy sector in Cyprus. The findings indicate that educational requirements vary by role (see Figure 110), with engineers typically requiring a BSc or MSc degree, while hands-on roles often demand vocationally oriented educational backgrounds. In HE institutions, students and teachers identified engineering professions as the most encouraged career paths, whereas VET schools emphasized technicians and installers.

Professionals highlighted that continued learning is primarily facilitated through access to education and funding, though a need for improved online learning platforms was also identified. In terms of transversal skills, communication and teamwork were ranked as the most important, while leadership was rated the lowest. Additionally, nearly one-third of company representatives reported challenges in adapting to smart specialization goals, citing difficulties in upskilling staff in line with the current rate of progression.

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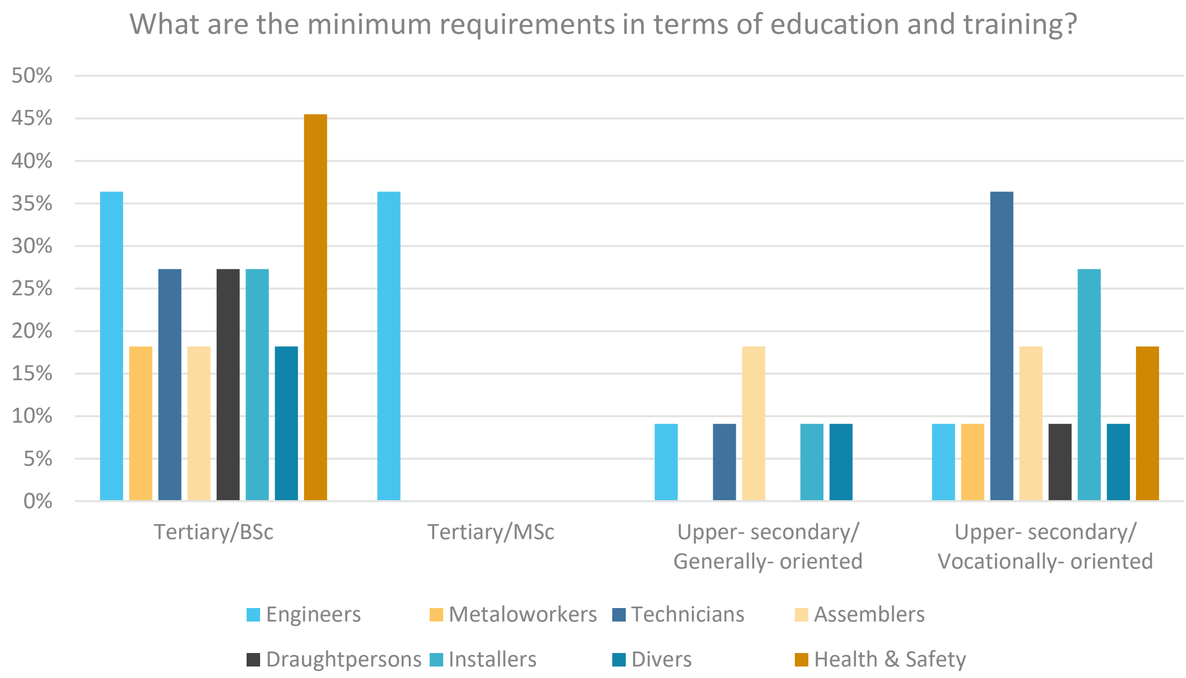

Figure 110. Minimum requirements in terms of education and training (Source: Cyprus CoVE professionals survey)

Surveys conducted among VET and HE students across various academic levels (associate degree, undergraduate, and graduate students) revealed that most students are “somewhat interested” in pursuing a career in the offshore renewable energy (ORE) sector. The most demanded phases of the ORE value chain were identified as pre-planning/research, project planning, and operation and maintenance. Regarding course relevance, students reported that courses were moderately relevant to the ORE sector. Practical experience in the ORE sector was largely lacking, though some students had participated in research projects. Most students identified significant challenges in securing internship opportunities and practical training, particularly those from higher education institutions. Support needs were primarily centered around industry networking opportunities, followed by internship placements and career counselling.

From the perspective of VET and HE teachers in Cyprus, educational activities and programmes were predominantly aligned with the onshore renewable energy sector, emphasizing the demand for integrating offshore renewable energy topics into curricula. Pre-planning/research was identified as the most covered phase of the value chain. Their courses primarily addressed energy storage, energy management systems, and automation/advanced robotics, with virtual and augmented reality tools and project management tools being the most in-demand resources for course delivery. To enhance teaching effectiveness, teachers highlighted the need for industry workshops and access to industry experts. The main challenges reported were student engagement, limited practical training opportunities, lack of resources, and difficulties in keeping up with industry changes. Most teachers expressed interest in increasing collaboration with other providers, as collaboration is currently limited.

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Regarding collaboration with industry, the primary challenges faced by teachers included a misalignment between academic and industry needs and limited employer engagement. Teachers indicated that support from social partners in the form of networking opportunities, mentorship programmes, and career counselling services is equally necessary for better workforce preparation. To address the challenge of keeping up with rapid technological advancements, teachers predominantly relied on access to the latest tools and continuous professional development, with very few leveraging partnerships with technology companies. Additionally, most teachers reported institutional challenges in adapting programmes to smart specialization goals and indicated the need to incorporate new skills not previously required.

4.5.3 Skills gap analysis

The following tables (Table 29, and Table 30) were prepared to group and summarise as succinctly as possible all the necessary information regarding the gaps reported in hard and soft skills.

Table 29. Main gaps in hard skills for the ORES sector in Cyprus

Skills category	Examples of skills gaps
Engineering	• Automation and control engineering • Digital design and 3D modelling • Offshore energy engineering and technology
Project management	• Legal and Commercial Agreement Management • Technical writing and record keeping • Project planning • Financial monitoring • Risk management • Logistics coordination
Digital	• Data science and advanced analytics • Computational modelling and simulation • Full-stack development and code optimization • Information and communication technologies • Robotics and remote controlling
Offshore specific	• Marine transfer and access technologies • Adaptability to challenging offshore environments • Knowledge in vessel operations • Sustainable practices in offshore development

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	• Management of floating exchange platforms • Standardized protocols for installation and servicing
Health and safety	• Development of Health and Safety guidelines • Operational awareness of ocean conditions • Risk management and mitigation in marine environments • Experience in safe machinery operation at sea
Project design and planning	• Technical design • Digital design and 3D modelling • Good knowledge of metocean conditions
Using and understanding numerical or statistical information	• Advanced statistical methods • Data quality assessment • Decision-making based on statistical insights
Foreign languages	• Reading, writing and communicating in English • Understanding of international technical aspects / guidelines

From our recent surveys, teachers from HE and VET institutions identified the most critical hard skills gaps among their students, ranking them in the following order:

1) Digital skills
2) Offshore specific skills
3) Health and safety skills
4) Engineering skills
5) Project design and planning
6) Project management, foreign languages, using and understanding numerical or statistical information

On the other side, industry professionals in Cyprus reported the most significant hard skill gaps among their employees, ranked as follows:

1) Health and safety skills
2) Engineering skills
3) Project management
4) Digital skills
5) Offshore-specific skills, project design and planning, using and understanding numerical or statistical information

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6) Foreign languages

Table 30. Main gaps in soft skills for the ORE sector in Cyprus

Skills category	Examples of skills gaps
Knowledge management and transfer	• Developing and maintaining accessible knowledge repositories. • Facilitating training sessions and workshops for skills sharing. • Encouraging team collaboration and information exchange.
Critical thinking and problem solving	• Analysing root causes of problems and proposing effective solutions. • Evaluating options using data and logical reasoning. • Generating innovative solutions to complex challenges.
Communication and collaboration	• Writing clear reports and delivering effective presentations. • Actively listening and providing constructive feedback. • Building strong, cooperative relationships with team members.
Flexibility and adaptability	• Adjusting quickly to shifting priorities or challenges. • Learning new tools or skills to meet evolving demands. • Adapting approaches to fit diverse environments.
Leadership and responsibility	• Guiding teams toward shared goals and resolving conflicts. • Taking ownership of decisions and their outcomes. • Leading by example with ethical and professional behaviour.
Initiative and self-direction	• Proactively identifying and addressing improvement areas. • Taking steps to complete tasks independently. • Setting and pursuing personal development goals.
Productivity and accountability	• Managing time effectively to meet deadlines. • Tracking progress and delivering high-quality results. • Accepting feedback to enhance performance.
ICT literacy	• Effective digital communication • Adaptability to new technologies • Data presentation and storytelling

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From our recent surveys, teachers from HE and VET institutions identified the most critical soft skills gaps among their students, ranking them in the following order:

1) Critical thinking and problem-solving
2) Communication and collaboration
3) Initiative and self-direction
4) ICT literacy
5) Productivity and accountability
6) Leadership and responsibility
7) Knowledge management and transfer
8) Flexibility and adaptability

On the other sided, industry professionals in Cyprus reported the most significant soft skill gaps among their employees, ranked as follows:

1) Knowledge management and transfer
2) Critical thinking and problem-solving, communication and collaboration
3) Flexibility and adaptability, leadership and responsibility
4) Initiative and self-direction, productivity and accountability

From the students' perspective Figure 111 and Figure 112, illustrate their confidence levels, measured on a scale from 1 to 5, where 1 represents "very low confidence" and 5 represents "very high confidence", across various hard and soft skills.

The data revealed that students exhibit the highest confidence levels in hard skills related to foreign languages (primarily English), while offshore-specific skills ranked the lowest. For soft skills, students reported the highest confidence in productivity and accountability, as well as communication and collaboration, whereas ICT literacy ranked the lowest.

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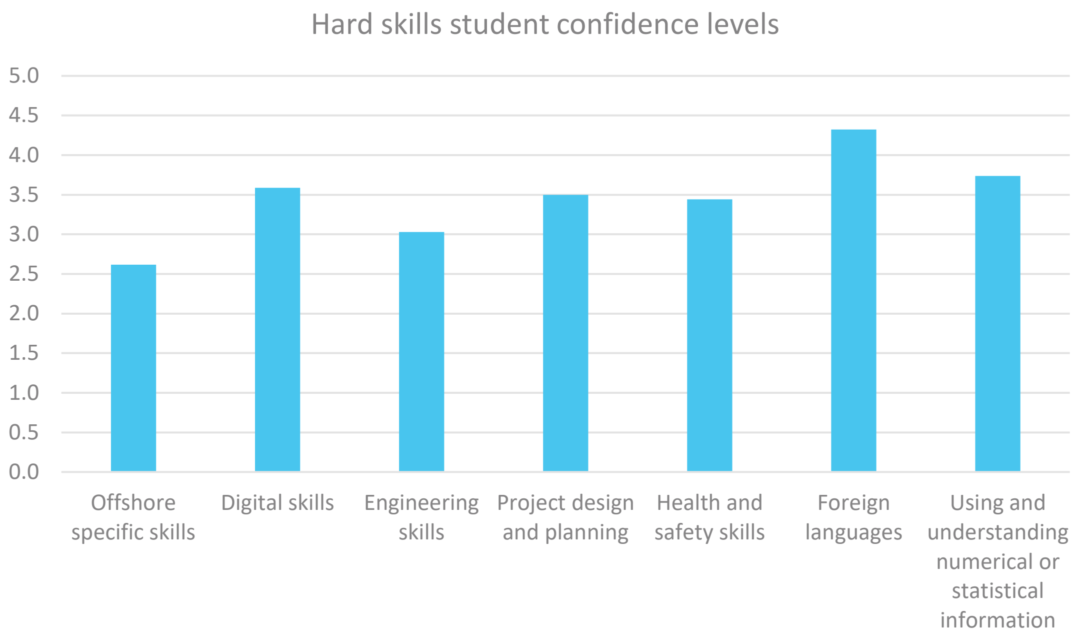

Figure 111. Hard skills confidence levels of students (Source: Cyprus CoVE surveys)

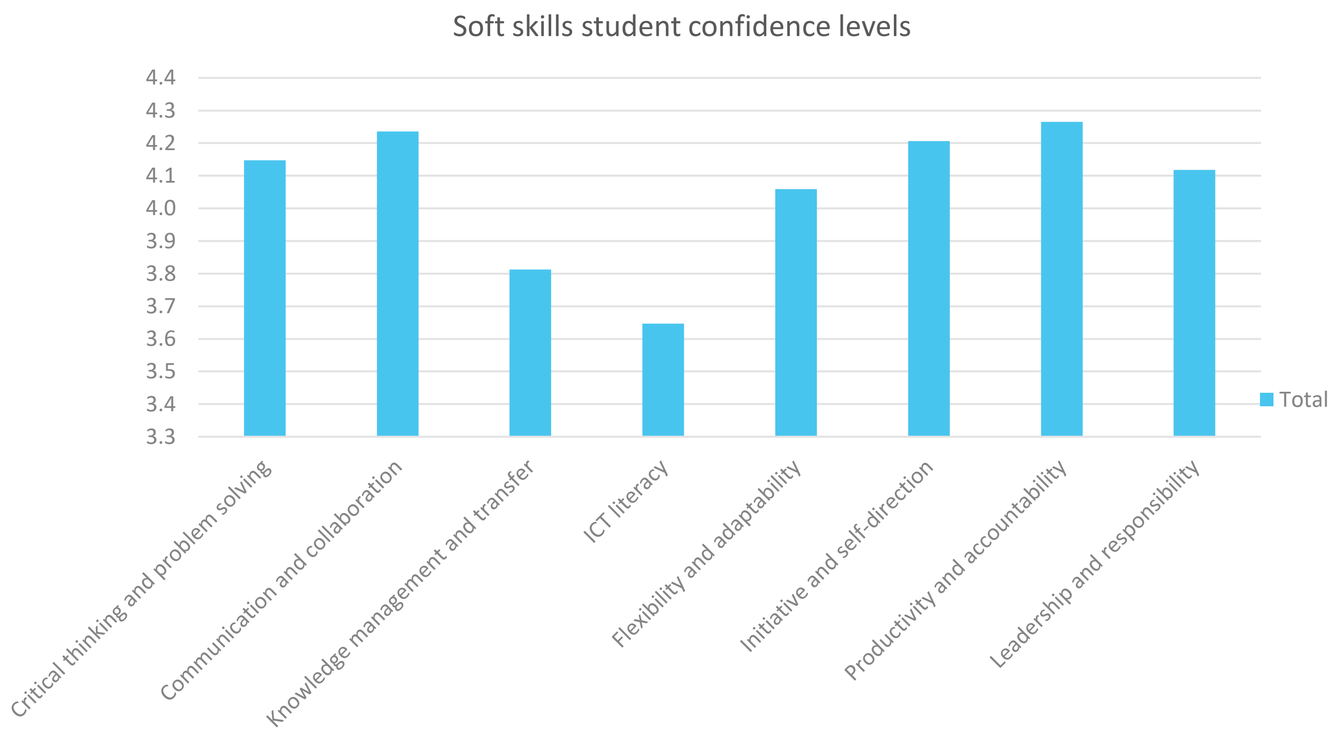

Figure 112. Soft skills confidence levels of students (Source: Cyprus CoVE surveys)

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5 Strategic Actions and Recommendations

5.1 Portugal

5.1.1 CoVE thematic focus

With its extensive coastline along the Atlantic Ocean, Portugal is strategically positioned to emerge as a leader in the growing offshore renewable energy market. The WindFloat Atlantic project has positioned Portugal as a pioneer by establishing a semi-submersible floating offshore wind farm. This project marks a significant milestone for the future of offshore renewable energy in both Portugal and Europe, providing added value and serving as a foundation for the ongoing development of this technology.

Portugal faces several challenges that must be addressed, as highlighted by analysing questionnaires and interviews. These challenges include improving collaboration between industry and education, addressing the lack of qualifications and soft skills among young people, and incorporating more practical training into student curricula.

Given its geographical location and potential for implementing renewable energy, mainly offshore, Portugal is well-positioned to become a reference point in Europe and globally in the offshore renewable energy sector.

Considering the strengths and challenges inherent to the sector in Portugal, the Portuguese CoVE will endeavour to concentrate its efforts on areas such as:

- **Offshore wind farms:** Portugal's extensive maritime border and the experience gained from a pilot project off its coast equip the country with the necessary conditions and expertise to install floating wind farms. To successfully implement this type of infrastructure, specialized training will be required, including engineering knowledge and maritime skills specifically designed for offshore operations.
- **Specific offshore programmes:** A curriculum that emphasizes the acquisition of specialized competencies in offshore operations, such as platform fabrication, turbine technology, the engineering of platform electrical systems, cable management, onshore infrastructure development, and port logistics.
- **Collaboration between stakeholders:** Collaboration among stakeholders is crucial. Promoting cooperation between key players in the sector, including policymakers, industry representatives, and education and training providers, is essential. This collaboration helps align policy objectives, business needs, and worker expectations.
- **Engaging the population:** Promoting the maritime sector to young people is crucial for attracting a skilled workforce and informing the general population to address existing questions and opinions.
- **Soft skills in critical thinking and problem-solving:** Due to its maritime nature, the sector requires initiative from professionals when it comes to critical thinking and problem-solving in order to address any potential issues that may arise in the operating environment.

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The Portuguese CoVE is dedicated to meeting the needs and expectations of all stakeholders in the offshore renewable energy (ORE) sector by focusing on several key areas. This includes revising education and training curricula to better align with the actual requirements of the industry and promoting the sector to young people. By doing so, we can ensure that the labour market has the necessary skills and play a crucial role in shaping the future of the ORE sector.

By developing these initiatives, we can help companies benefit significantly from Portugal's natural resources, thereby establishing the country as a leading reference point for floating offshore renewable energy in Europe.

5.1.2 Potential for upwards convergence

Through possible useful and significant initiatives, the Portuguese CoVE could significantly and practically contribute to the SHOREWINNER Community of Practice (CoP):

- **Skills analysis:** Assessing the qualifications and skills required in the field as well as activities of interest hosted by outside parties.
- **Dissemination and networking events:** Organizing events, including webinars and workshops, with the aim of sharing information about the sector with various target groups. These events will also encourage community engagement and help foster connections among different stakeholders.
- **Organisation of thematic events in schools:** Organizing events in educational institutions enables direct interaction between students and offshore renewable energy professionals. This provides students with practical experience using the technology and equipment in this industry.
- **Company's involvement:** Organising study visits to platform construction sites and industry companies, creating internship programmes with ORE sector firms, encouraging students to engage in practical aspects of the field, and providing them with firsthand experience in real-world operational scenarios.
- **Reskilling and upskilling:** Establish programmes aimed at improving the employability of professionals working in the industry through further education and training. The curriculum will focus on acquiring practical skills relevant to the ORE sector, including safety protocols, electrical installation techniques, and environmental impact assessments.
- **Curricula and regulation update:** Launch initiatives involving businesses and academic institutions to keep them informed about updates to laws and regulations and to revise curricula to reflect current realities.

In consideration of the ORE sector in Portugal, these activities concentrate on the implementation of measures that are indispensable for the advancement of the sector, thereby facilitating its progress, innovation and growth.

5.1.3 Recommendations

To address the identified gaps, we recommend promoting collaboration among stakeholders and fulfilling other needs based on the results obtained from the questionnaire and interviews:

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- **Annual/bi-annual review of companies' needs and expectations**: Evaluating the needs of companies will help identify essential gaps in professional qualifications and skills. This assessment will allow for developing a plan to address these gaps and adjust training curricula. Ultimately, this will encourage collaboration between VET providers and the industry.
- **Dissemination and communication strategy:** The creation of communication strategies will facilitate the addition of partners to the CoP, enabling the exchange of information and resources.
- **Engagement strategy:** Creating strategies to engage young people and professionals in renewable energy sectors by promoting actions through social media and organising events, webinars, and workshops.
- **Approaching HE/VET students:** Creating internship opportunities for students at companies in the sector, organizing study visits (either in person or through virtual platforms), and providing access to industry professionals can all be effective strategies to encourage greater involvement.
- **Mobility between educational institutions:** Encourage the proposal of policies that will facilitate the transfer of students between institutions of higher learning and vocational training facilities.
- **Establishment of training centres:** The creation of training centres near places where services are provided, such as ports. Invest in training courses and centres specific to the ORE sector in conjunction with policymakers so that they can access the most up-to-date technologies and trainers with the most extensive knowledge.
- **HE/VET industry collaboration:** The promotion of collaboration between the two parties will facilitate enhanced success and progress within the sector.
- **Reskilling and upskilling:** Creating tailored offshore programmes allows individuals from various renewable energy sectors and those without prior experience to acquire the necessary skills for a career in offshore renewable energy.
- **Investment in AR/VR:** Investment in augmented reality (AR) and virtual reality (VR) technologies enhances authentic interactions between students and professionals training in offshore renewable energy.

5.2 Spain

5.2.1 CoVE thematic focus

The thematic focus of the Spanish CoVE addresses the situation of the offshore renewable energy (ORE) sector in the area, with the key areas being:

- **Floating offshore wind farms:** Spain has significant potential for offshore wind, given its extensive coastline, favourable wind conditions and its previous experience in onshore wind energy. This technology is particularly well-suited for the country's coastline due to the significant depth of its waters, which makes it difficult to install traditional wind turbines fixed to the seabed. This potential, however, requires specialized training in the design, installation, operation, and maintenance of

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floating offshore wind turbines. This includes subsea technology, structural engineering, and safety protocols for deep-water environments.

- **Maritime logistics and infrastructure:** Logistics are an essential part of the ORE puzzle. To deploy a complete and functional offshore wind farm requires specific logistics and infrastructure. Training programmes that emphasize skills for offshore support vessels, cable laying, and port operations could ensure that the requirements to support these ORE projects are fulfilled.
- **Environmental monitoring and community engagement:** A great concern with ORE projects is their effect on the environment. Other potentially impacted activities are tourism and fishing, which are particularly important in the coastal areas all over Spain. To balance offshore development with marine biodiversity protection, the CoVE will also focus on environmental impact assessment training. The other negative impacts need to be addressed for gaining public acceptance and support. Additionally, community engagement programmes can prepare professionals with skills to foster local acceptance and participation in the ORE projects.
- **Digitalization and data analytics:** Workforce development needs to include training in data management, predictive maintenance, and digital twin technologies to support efficient and data-driven ORE operations. This completely aligns with the already existing big effort in Spain to the digitalization and the development of the Shipyard 4.0.
- **Soft skills for leadership and collaboration:** One of the aspects that were encountered during most of the conversations with the ORE industry representatives was the soft skills requirements. Offshore projects require significant teamwork and coordination, often from people from different countries and/or with different backgrounds. The CoVE will prioritize developing leadership, communication, adaptability, and problem-solving skills. Programmes should target both entry-level professionals and team leaders so they can face the problems that they may encounter during their work.
- **Collaboration and stakeholder engagement:** The CoVE will foster skills in building partnerships with industry, academia, local communities, and government entities to ensure alignment with real-world applications and policy objectives.

5.2.2 Potential for upwards convergence

This vision aligns with the broader SHOREWINNER priorities in areas such as environmental impact assessment, digital skills, and offshore wind energy.

One of the unique characteristics that Spain could offer to the SHOREWINNER community overall is their experience with the production and the logistics of onshore wind energy components. Spain is one of the countries in Europe with more wind energy components manufacturing facilities, and one of the few with the full value chain (Figure 113). In fact, many of the offshore wind components being installed in Europe come from Spanish production facilities (monopiles, jackets, towers, floating platforms, etc) from companies such as Navantia, Windar, Haizea, etc.

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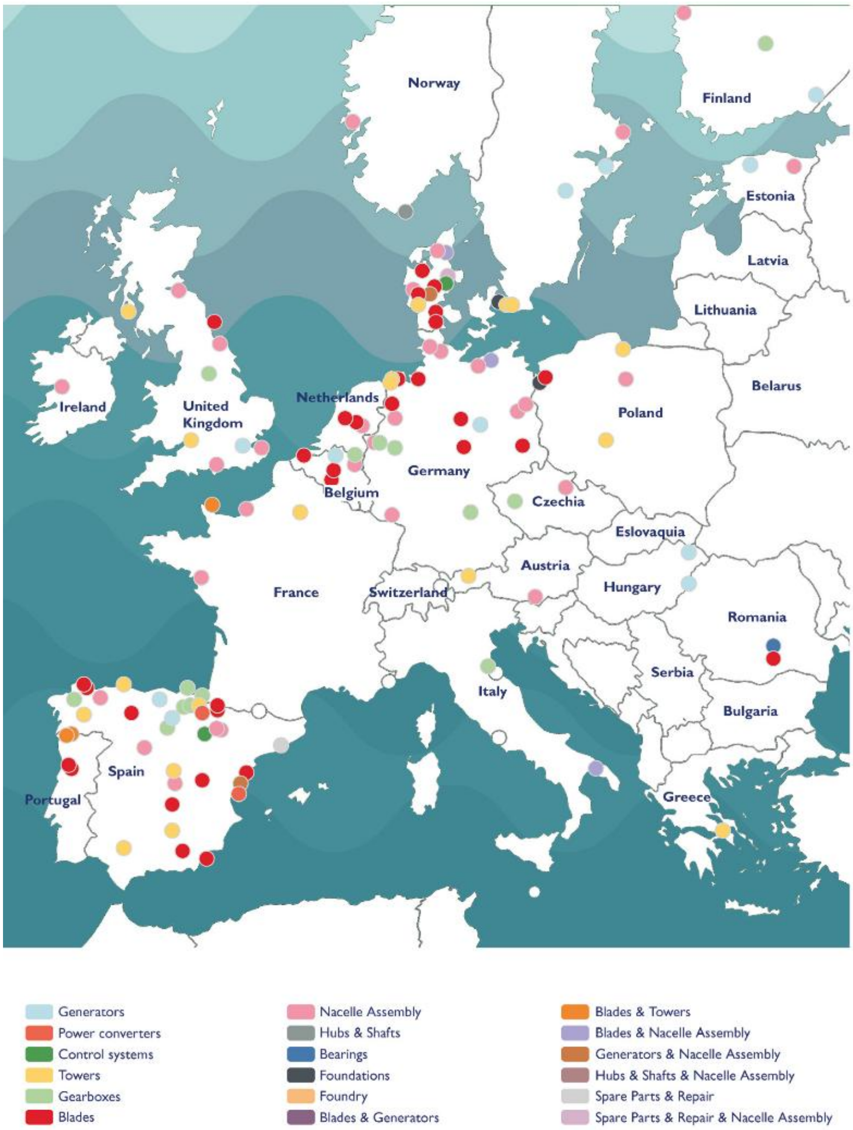

Figure 113. Wind energy components manufacturing facilities in Europe. Source: MITECO-IDAE

Spain has also great capacity for R&D&I in offshore wind in general and floating wind in particular, with important marine-maritime research centres, unique offshore wind projects, wave and current energy prototypes and cutting-edge research groups, as well as several top-level testing platforms for marine energy generation technologies (Figure 114).

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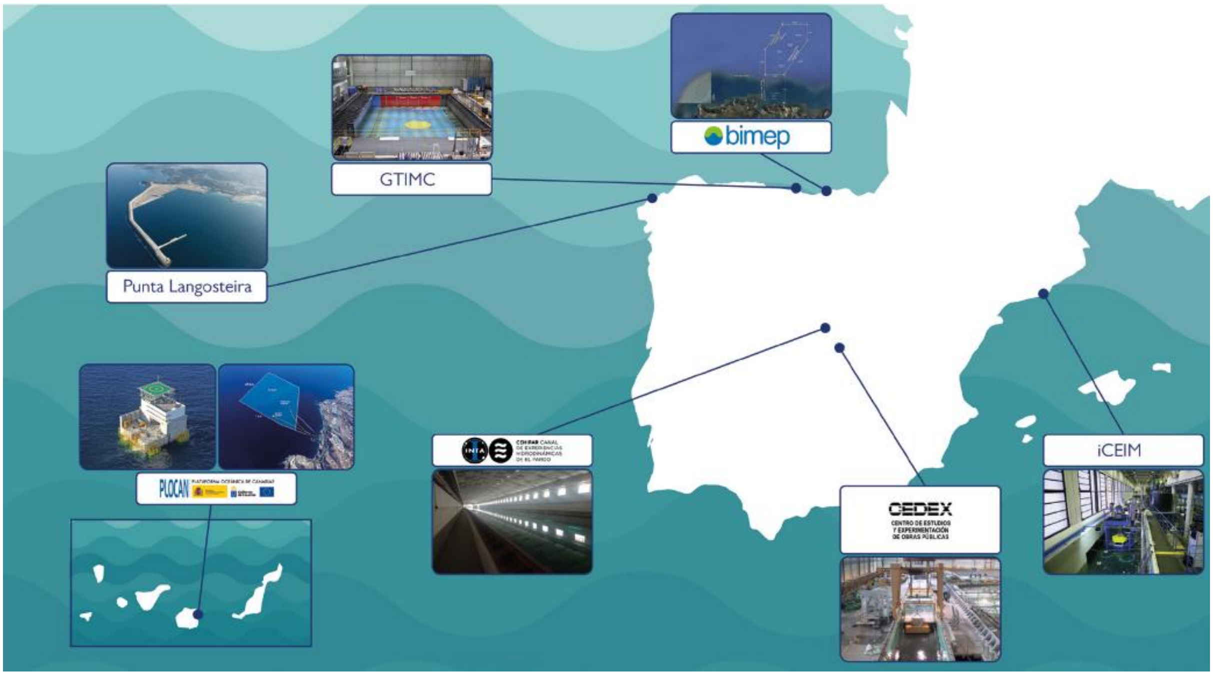

Figure 114. Spanish research centres related to ORE industry. Source: MITECO-IDAE

The development of specific educational programmes, combined with the upskilling of the actual workforce could have a big and positive impact in the country. A skilled workforce that could design, deploy and maintain the new offshore wind farms that are projected is essential to build a solid future for the ORE field in Spain.

5.2.3 Recommendations

During this process of gathering information from the ORE industry and the VET providers two main topics came out very frequently: the incorporation of practice and soft skills in the formations and the urge to keep the curriculum updated.

The first one is an essential point from the industry, that nowadays demands people that are prepared technically to do their job but more importantly to collaborate with other professionals and that can solve unexpected situations.

The second one comes from both the industry and the VET providers, that are aware of the gap that sometimes appears between the classroom and the real world being bigger than it should.

To solve these two main topics, the CoVE proposes a series of measures that hopefully could address or improve this situation:

- Mobility between educational institutions: Encourage the proposal of policies that will facilitate the transfer of students and teachers between institutions of higher learning and vocational training facilities. VET providers need to share their experience and knowledge with others to collaborate more effectively.

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- Industry collaboration: To keep the curriculum updated, it is essential for VET providers and institutions to listen to the industry's needs. It is also very important to establish practice programmes or similar so that part of the formation can be performed in the field.
- Reskilling and upskilling: There is a need for professionals with experience to reach the proposed goals in ORE in the next years. Professionals from diverse renewable energy sectors, or with no prior experience could gain the knowledge to pursue a career in offshore renewable energy with the appropriate formation programmes.
- Dissemination and communication: Probably not only for adults, talks or events on primary and secondary schools could have a tremendous impact. The efforts and opportunities need to reach the appropriate audience.

5.3 Italy

5.3.1 CoVE thematic focus

As described in the previous paragraphs, although offshore wind is still underdeveloped in Italy compared to other European countries, national plans are under development to increase the installed capacity, with a target of approximately 900 MW by 2030, especially relying on innovative technologies, such as floating turbines, which are particularly suited to the Mediterranean Sea's deep waters. At the moment, only one wind farm (Beleolico) is operating in Italy, and a second project passed the environmental compatibility assessment (Seas Med). At the same time, about one hundred offshore wind farm projects are under design and/or authorization, and EU and national funding is available. Indeed, the regulatory issue is key at the moment; two main decrees, expected for a long time, have been recently approved:

- A first one -the so called “Decreto Energia” (energy decree, Legislative Decree n. 181/2023)- to fund the identification of two harbours in Southern Italy, which will host *“suitable infrastructures to ensure the development of investments in the shipbuilding sector for the production, assembly and launching of floating platforms and electrical infrastructures functional to the development of shipbuilding for the production of offshore wind energy”*;
- A second one – the so called “Decreto FER2” (Legislative Decree 19/06/2024), for the "Incentivization of innovative renewable energy plants or those with high generation costs that present characteristics of innovation and reduced impact on the environment and the territory".

Those decrees are there, but the corresponding implementing provisions are still missing, which will allow their effective application, as well as the advancement of the above-mentioned about 100 projects, which are now at a standstill. The situation should be resolved by the end of the year for the first decree, thus allowing the realisation of the necessary structures and infrastructures, while it is still undecided for the second one, as of today.

In the meantime, the industry sector claims to be ready (or almost ready) to take the challenge. Not only technology providers and manufacturers are there, but also elements of their supply chains. Besides design and manufacturing, several other domains are involved, like logistics, safety, transportation, installation,

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operation, maintenance, etc.. All these stakeholders on the one hand declare to possess the required know-how and to be ready to run for bidding the available funds; on the other hand, they claim some need for skilled resources, either to be employed and to be upskilled/reskilled. All in all, a strong need emerges both for information and for training.

For ***information***, as the ORE sector is still underdeveloped, and stakeholders at all levels (from students/trainees to companies) could benefit from a deeper understanding of the broadness, complexity and richness of its potential, and of the links it has with so many disciplines and domains.

For ***training***, because, possibly also as a consequence of the previous point, the current offer for young people is mostly general purpose, and the employed are not sufficiently prepared. It is worthwhile reminding that 75% of companies involved in our survey declared to have job vacancies and agreed that filling them can be very challenging due to a lack of adequately skilled applicants.

Moreover, respondents highlighted the need for:

- Better focus on cross-skills together with technical ones.
- More specific, specialized training opportunities, job- and practice-oriented; in that sense, internship and learning mobility were indicated as possible keys to success.
- Careful and continuous updating of learning programmes, to be preferably achieved by a stricter co-operation in all phases between businesses and learning providers.
- Skilled resources at all levels, from engineers to technicians (in other words, at EQF 4, 5, 6, 7 and 8).
- Regarding continuous training (CVET), mentors, coaches and tutors, to ensure in-company learning.
- Regarding CVET, not only in-company upskilling is welcome, but also the chance to reskill people employed by firms of different sectors (mechanics, metallurgy, oil & gas, etc.) currently facing difficulties, who might conveniently be reallocated in the ORE supply chain.

One further remark regards the existence of several sectoral associations and networks, gathering companies and other stakeholders. These also are in need for training, and in parallel could provide a very good ground for cooperation. In this streamline, the role of Italian CoVE could also be acting as “glue” and as a “loudspeaker” for the existing associations, favouring the circulation of information and the chances for networking, at the same time offering training opportunities, services, international links, and possibly access to EU funding.

Based on the above, the Italian CoVE envisages to focus on:

- providing information and carrying out market and skills analyses.
- providing training to students, teachers and the employed.
- supporting companies in research.
- favouring networking and the pooling of resources.
- planning and organizing internships and learning mobilities.

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- supporting the participation of businesses in EU and national projects.

5.3.2 Potential for upwards convergence

5.3.2.1 Focus and goals

The Italian CoVE is composed by one University (Università Politecnica delle Marche), one training provider expression of the trade association of the Italian shipping industry (ForMare), one training and employment agency belonging to the network of the Italian Chambers of Commerce (I.F.O.A.), and a research, consulting and training company in the air, railway and maritime transportation fields (Deep Blue).

Our goal is standing as an Italian point of reference in training, networking and R&D in the areas of offshore wind technology, logistics and operations, in order to address a large part of the value chain behind construction and commissioning of offshore wind turbines. We aim at building an information, consultancy and training network offering consultancy and training, to set up synergies to the benefit of industrial, academic and VET stakeholders, possibly going beyond the project lifespan.

5.3.2.2 Structure, organization, resources

To be fully active, the Italian CoVE will need some internal functioning structure, initially relying upon the partners' resources, both human and material. Partners will investigate and find out along the project lifespan the possibility to make this structure further sustainable.

In line of principle, our CoVE could be organized as a collaborative network among the Italian partners, each with a well-defined role to maximise expertise and resources. It could be structured in two main levels:

Strategic level: a steering committee composed of partners' representatives to define guidelines, monitor progress and facilitate key decisions. The committee could meet e.g. twice a year, plus when necessary.

Operational level: thematic working groups dedicated to research, training, technology development and dissemination, coordinated by one member of the steering committee.

Our CoVE could adopt a shared governance model, with a main coordinator (e.g. the Italian partnership coordinator) and specific contacts for each area of activity, in order to define clear responsibilities for each partner. The CoVE could draft a yearly work programme, consisting for example of the following phases:

- **Phase 1***:* periodical mapping of skills and training needs in the ORE sector (already done in part in preparation to this very document) and of events organized by third parties in the sector. Furthermore, the existing mapping could be integrated with focus groups or interviews with sector experts to collect qualitative input.
- **Phase 2:** planning an agenda of initiatives (informative events/webinars, training opportunities, possible services, etc.) and creating a dissemination mailing list, as well as sharing via social media and newsletters.
- **Phase 3:** communicating the agenda to the national stakeholders and to the SHOREWINNER partners, for possible broader cooperation.

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- **Phase 4:** delivering the planned activities.
- **Phase 5:** collecting feedback on the quality of the activities organized and the centrality of the topics addressed for the sector through dedicated questionnaires. This feedback will help us to orient subsequent activities.

As said, the CoVE will start exploiting the partner resources. In addition, each partner could involve experts in the field, researchers, and industry representatives interested in the sector and joining the SHOREWINNER CoP. This network could be extended and updated during the project. With reference to material resources, an online sharing space could be created, where useful information can be collected and where the events agenda can be updated. This space could be for example a blog, a shared folder, or a page hosted on the SHOREWINNER official website.

5.3.2.3 Services offered

The Italian CoVE can offer services in the following domains:

Information

- Seminars/webinars; the sector is at present still underknown and underdeveloped in Italy: promoting knowledge sharing represents a strategic opportunity to favour its growth and spreading.
- News on events, regulations, opportunities, job vacancies, matching labour demand/offer, skills, networks, etc.
- Career kits.
- Career days/company visits for students.
- Production of peer-reviewed scientific papers.
- Yearly market and skills analyses.
- Delivery of information events (matchmaking, TED-like, etc.).

N.B.: Some webinars and events could be organised in coordination with other CoVEs and/or in English language, in order to ensure the involvement of international participants. This would broaden the impact and could involve also European Member States not involved in the project but potentially interested in the sector (e.g. Malta).

Training

- Planning/delivery of tailored and/or institutional courses for: young unemployed (EQF levels 4 to 8), employed (reskilling and upskilling), aimed at developing/improving either transversal skills and technical skills;
- Planning/delivery of train-the-trainers courses for teachers/trainers, mentors, tutors, etc.
- Reference to existing courses offered by other provides, inside and outside the EU CoVE.
- Delivery of training events.
- Internships abroad for VET/HVET students.

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- Short mobilities for company representatives.

Networking

- Suppliers/client/partner search at the national and at the EU CoVE level.
- Focus groups on specific topics.
- Delivery of networking events.
- Sharing ideas and opportunities for applying to national and EU funding.

In line of principle, all services/activities can be made available to the whole SHOREWINNER CoP.

5.3.3 Recommendations

5.3.3.1 Strategies to address skills gaps and enhance VET offerings

The main strategies on which Italian CoVE is focusing for developing an effective VET offer at national level can be summed up in the following points:

- Analysis and mapping.
- Supporting transition from learning to work.
- Training of trainers.
- Communication and dissemination.
- Training impact evaluation and assessment.

More in detail, in order to address skill gaps and enhance VET offerings, one of the most important and strategic actions that will be undertaken by the Italian CoVE is the mapping of job market needs, both in terms of professionals and competencies. This activity will include a periodic (every two years) ***blueprint of sector trends and needs***, providing an updated and comprehensive view of the training offer, which will, in turn, help structure the CoVE's training programmes. This is essential to fill the gaps in the VET offering, avoid overlap, and, in collaboration with VET providers, associations, and corporate academies, provide an efficient and effective training offer at the national level.

Considering the characteristics of the Italian labour market and the novelty of the OWE industry in Italy, another crucial aspect that needs to be addressed is ***supporting trainees in the transition from learning to work***. As envisaged in the project, the Italian CoVE will focus on the following activities to facilitate the matching of supply and demand in the job market:

- The development of an Employment Analysis Document, updated annually, which will include job roles, requirements, and recommendations.
- Career kits.
- Career days and visits.
- Creating and promoting opportunities for company internships and short-term mobilities abroad for SME workers.

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- Skills competitions to promote the industry and attract new talent.

Training of trainers is another need identified and emphasized by many stakeholders. The Italian CoVE will develop the necessary training programmes and tools, working in partnership with other operators to address the gaps that will be identified in different phases. Knowledge exchange and sharing at the international level, along with advanced digital resources, are two key assets that the Italian CoVE can offer to the OWE industry and VET trainers.

A well-structured ***communication and dissemination strategy*** is another crucial element that will determine the effectiveness of the VET offering in developing the necessary competencies and professionals in the industry over time. The Italian CoVE will focus on expanding the network of stakeholders, creating opportunities for knowledge and resource exchange, and promoting existing or newly developed training opportunities.

The Italian CoVE will carry out continuous monitoring and evaluation actions through the establishment of feedback systems to ***assess the impact*** of training activities and continuously update the training offerings based on the results.

5.3.3.2 Initiatives for trainer upskilling and reskilling

In regard to the initiatives for trainers upskilling and reskilling, the main contributions that the CoVE has detected are:

- The bi-annual blueprint of sector trends and needs will serve as the foundation for the evolution of the training curricula offered by the CoVE. This will provide an optimal course of action to ensure that trainers involved in CoVE activities stay up to date with both industry and educational trends.
- Co-design and organization of training programmes and material will be another effective way to share the knowledge and the competences.
- Training of trainers on-line and in presence sessions will be developed to support the acquisition of new needed technical and soft skills, according to the already detected training needs and the emerging ones.
- Practical training infrastructures, such as simulations and teaching facilities that replicate real offshore wind conditions. These tools will support the trainers in structure effective programmes, allowing the students and the workers to practice in realistic situations.
- Promotion and diffusion of training the trainers initiatives, co-design focus groups, and other opportunities will be undertaken by the Italian CoVE which aims to become a reference point for information and knowledge sharing among the trainers, professionals and operators of the OWE industry. The newsletter and the project digital platform will be the main channels that will be used for information and collaboration activities.
- The above-mentioned initiatives will be supported by the constant monitoring of training opportunities for trainers, both at national and European level.

5.3.3.3 Recommendations for industry-education collaboration

The main actions for fostering and supporting the industry-education collaboration can be summarized as follows:

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- Co-Design of curricula and learning modules: the process of updating training and educational curricula will involve active participation from industry experts. By ensuring that the curriculum incorporates modern industry practices, technologies, and skills, the trainees will be more employable and sensitive to market demands.
- Implement Work-Based Learning Opportunities: Internship programmes, apprenticeships, cooperative education programmes, and job shadowing opportunities will be included in the new and/or updated training paths. Integrating these opportunities into the educational curriculum equips students with practical skills, while companies gain access to a pool of adequately prepared prospective employees.
- Mapping of good practice of collaboration. As envisaged by the project, a framework for collaboration and partnerships will be delivered.
- Promoting and supporting the definition and submission of EU projects on shared-interest goals and themes.
- Promoting funding opportunities for the training of new resources and the continuing training, such as FSE+, Italian Interprofessional Funds for enterprises. Support the access to those opportunities through consulting services.
- Provision of information, networking and consultancy services for entrepreneurs who wish to start a business in the sector or further develop their business will be provided.
- Creation of stable and multi – stakeholders working groups, in collaboration with already existing platforms and forums at local, national and European level.

5.3.3.4 Inclusion and diversity initiatives

The CoVE has already detected some actions and initiatives for supporting the inclusion and the diversity management in the OWE industry. All the partners have extensive experience in D&I in different fields and projects that will be selected, opportunely adapted and applied to this industry, according to the specific characteristics and needs.

The main methods, tools and initiatives that will be implemented are:

- Organization of public events with a focus on gender gap in the energy industry, with a particular focus on offshore wind.
- Monitoring of the gender distribution in the participation to training programmes, in order to undertake actions and initiatives for supporting the equal access, diversity and inclusion.
- Application of "distance learning" methodologies and know-how, to allow students to study at their own pace and schedule, making it ideal for individuals balancing education with work, family commitments, or other responsibilities.
- The Italian CoVE partners' facilities are designed in order to accommodate all students, with accessible spaces and learning tools that ensure physical inclusivity, such as ramps, sign language interpreters, and adaptive technology.
- The collaboration with other existing initiatives and projects at national and international level is envisaged among Italian CoVE actions for diversity and inclusion. We can mention, as an already

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existing opportunity, that ForMare supports the Federation of the Sea in the EMFAF WinBig project - Empowering Women in the Blue Economy[196]. This project aims to promote the role of women in the emerging sectors of the Blue Economy. The project develops tailored training tools to foster greater gender equality and make the European Blue Economy more inclusive and sustainable. In this context, synergies could be created with the SHOREWINNER project, particularly with our CoVE, strengthening the shared commitment to promoting initiatives focused on inclusion and gender equality in the maritime sector.

5.4 Greece

At the moment, companies in Greece struggle with both attracting and retaining skilled professionals due to competition with other sectors and insufficient training. Challenges also include brain drain (skilled professionals leaving for better opportunities abroad). Strategies to address this could include competitive salaries, incentives for continuous professional development, and creating long-term career paths with advancement opportunities. Career pathways could be clarified through mentorship programmes, through the development of standardized qualification frameworks/certification systems and through clear job hierarchies within companies.

Collaboration between industry, academia, and government in workforce development for the ORE sector is still in the early stages but has seen increasing momentum. Universities need to engage more directly with industry to design curricula that align with current and future needs. Industry leaders should be involved in the creation of training programmes and research initiatives to ensure that academic output is aligned with real-world applications in offshore energy technologies. Internships, work placements, and apprenticeship programmes can help bridge the gap between theoretical knowledge and practical experience. Furthermore, collaboration should extend beyond academia, industry, and government to include local communities, environmental organizations, and international research groups. This broader collaboration could ensure that workforce development programmes also address local challenges such as community involvement in offshore projects and environmental sustainability.

The most significant gaps identified are in technical (hard) skills like engineering, data analytics, and installation, but soft skills (teamwork, leadership, problem-solving) are equally important as the sector grows. Technical skills gaps are more pronounced, especially in engineering, data management, and subsea technology. However, as offshore projects require significant coordination and teamwork, soft skills like communication, leadership, and adaptability are also critical. Both areas need attention, but hard skills often take precedence in technical roles.

[196] "WOMEN IN BLUE ECONOMY | WIN_BIG."

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Once the above-mentioned gaps in relation to hard skills and soft skills have been identified, the next step is to identify the most appropriate methods which should be used in order for employees to acquire these "missing" skills. Based on the respondents' answers, in-house training, on-the-job training and VET programmes seem more effective for employees to acquire or develop the necessary soft skills, while educational programmes at the level of Master seem ideal to tackle the gaps identified in relation to hard skills.

5.4.1 CoVE thematic focus

The thematic focus of the Greek CoVE addresses both the unique strengths and challenges of the Greek offshore renewable energy (ORE) sector while aligning with broader goals within the SHOREWINNER framework. Key areas of focus for the Greek CoVE are expected to include:

- **Floating offshore wind farms:** Greece's deep coastal waters and favourable wind conditions mean that the industry would necessitate specialized training in the design, installation, operation, and maintenance of floating offshore wind turbines. This includes subsea technology, structural engineering, and safety protocols for deep-water environments.
- **Maritime logistics and infrastructure:** Training programmes will emphasize skills for offshore support vessels, cable laying, and port operations, ensuring that Greece's logistical infrastructure can effectively support ORE projects.
- **Environmental monitoring and community engagement:** To balance offshore development with marine biodiversity protection, the CoVE will focus on environmental impact assessment training. Additionally, community engagement programmes will equip professionals with skills to foster local acceptance and participation in ORE projects.
- **Digitalization and data analytics:** Workforce development will include training in data management, predictive maintenance, and digital twin technologies to support efficient and data-driven ORE operations.
- **Soft skills for leadership and collaboration:** As offshore projects require significant teamwork and coordination, the CoVE will prioritize developing leadership, communication, adaptability, and problem-solving skills. Programmes will target both entry-level professionals and team leaders.
- **Collaboration and stakeholder engagement:** The CoVE will foster skills in building partnerships with industry, academia, local communities, and government entities to ensure alignment with real-world applications and policy objectives.

Greece's thematic focus aligns with the broader SHOREWINNER priorities in areas such as environmental impact assessment, digital skills, and offshore wind energy. The Greek CoVE can act as a regional hub for floating wind energy expertise, sharing best practices and collaborating on modular training with other CoVEs. Capacity building goals are expected to be achieved through (a) enhancing collaboration with HEIs, research institutions, and industry to co-design curriculum and ensure relevance to market needs, as well as (b) developing sector-specific qualifications that integrate technical, environmental, and digital skills.

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Through this thematic focus, the Greek CoVE aims to address critical skills gaps, enhance workforce readiness, and position Greece as a regional leader in the offshore wind energy sector.

5.4.2 Potential for upwards convergence

The Greek CoVE, while still building expertise in floating offshore wind technology, has the potential to make substantial and achievable contributions to the SHOREWINNER Community of Practice (CoP) through potential practical and impactful activities:

- **Training and upskilling for existing workforce:** Design and deliver targeted reskilling and upskilling programmes for current professionals in related sectors (e.g., maritime, energy, and engineering). These programmes can focus on transferable skills for offshore wind energy, such as safety protocols, equipment maintenance, and environmental impact management.
- **Education for future workforce:** Offer tailored training programmes for aspiring professionals, equipping them with foundational knowledge and practical skills to enter the offshore wind industry. These programmes will align with industry standards and include key areas such as marine logistics, renewable energy systems, and grid integration.
- **Organization of thematic summer schools:** Host summer schools to introduce students and young professionals to the offshore wind energy sector. These schools can include hands-on workshops, lectures by industry experts, and field visits to related sites, fostering early interest and building foundational knowledge.
- **Dissemination and networking events:** Organize dissemination and networking events to raise awareness about offshore wind energy opportunities and challenges. These events can serve as platforms for knowledge exchange, partnership building, and community engagement, connecting stakeholders across academia, industry, and local communities.
- **Preparation for competitions:** Develop initiatives to prepare participants for competitions such as hackathons, focusing on renewable energy challenges. These activities can encourage innovation, problem-solving, and collaboration among students and early-career professionals.
- **Knowledge sharing and collaboration:** Provide regional expertise on integrating offshore wind projects with Greece's unique coastal and island environments, emphasizing practical approaches to local economic development and environmental sustainability. Moreover, the CoVE could act as a facilitator for cross-sector collaboration by hosting workshops and events that bring together key stakeholders, including local governments, educational institutions, and industry representatives.
- **Focus on feasible areas of expertise:** Develop specialized programmes in onshore preparatory work for offshore wind, such as assembly, logistics, and onshore maintenance, which are critical for the early stages of Greece's offshore wind industry. Moreover, the CoVE could enhance training on energy storage systems and grid integration, areas where Greece can leverage its growing renewable energy capacity.
- **Capacity building for regulatory and environmental roles:** Organize capacity-building sessions for professionals working in permitting, environmental impact assessment, and regulatory frameworks, ensuring alignment with national and EU guidelines.

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- **Localized training to support regional development:** Establish training programmes in coastal and island regions, ensuring local communities have access to employment opportunities generated by offshore wind projects.

Given Greece's current status in offshore wind development, these activities focus on realistic and immediately actionable initiatives. The Greek CoVE's strengths lie in facilitating education, fostering innovation, and building foundational expertise, which will play a critical role in supporting the national and regional transition to offshore wind energy. By addressing workforce readiness, community engagement, and collaboration, these offerings will ensure Greece's meaningful contribution to the SHOREWINNER CoP.

5.4.3 Recommendations

- **Build a Comprehensive National Skills Development Framework** Collaborate with industry stakeholders to create standardized certifications for offshore wind energy skills, ensuring consistency and portability across employers.
  - Develop clear progression pathways from entry-level positions to advanced roles, highlighting opportunities for career growth within the offshore wind industry.
- **Ensure a strong and swift response to skills needs/gaps**
  - Promote a modular approach to vocational training where appropriate, to bridge the skills gap. A modular approach is about structuring training around key modules that may be common to multiple technologies. For relevant professions, this can make it easier and quicker to train new workers and reskill existing ones.
  - Incentivise apprenticeships in the renewable energy industry to get more qualified technicians into the job market.
  - Invest more in infrastructure and trainers for vocational and lifelong learning, with the support of public authorities, ensuring attractive courses that are at the forefront of new technologies, with adequately paid teachers and up-to-date equipment. Companies should be supported to increase their training capacity.
  - Support training programmes development in the fields of permitting, impact assessment and technical regulations, to support capacity-building in national and local administrations, and to reduce disparities in length, and complexity of authorisation procedures amongst member states.
  - Organise innovation competitions where students and researchers collaborate with industry professionals to tackle real-world problems.
- **Boost the visibility and attractiveness of technical, scientific, and engineering renewable careers**

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  - Organise nation-wide awareness-raising campaigns to attract more workers among students and jobseekers alike, through networks of public employment agencies, secondary schools and universities.
  - Promote perspectives for youth and those not in employment, education or training in the field of technical education and vocational training, emphasising the equal value to academic paths, and the crucial role of technical jobs for the energy transition.
  - Foster early exposure to the diversity of technical careers across different renewable energies, by including adequate learning content in primary and secondary schools.
  - Keep career advisors, teachers and trainers across educational levels updated with market, technological and job opportunities trends, through easily accessible lifelong learning opportunities.
  - Promote inclusivity by raising awareness about the diversity of career possibilities.
  - Partner with schools to create hands-on renewable energy projects and competitions that spark interest in technical and engineering careers from a young age.
- **Foster recognition and mobility in educational pathways and the job market**
  - Promote a multi-technology approach in vocational training, where appropriate, to allow trainees to be acquainted with different types of renewable energy systems, thus facilitating mobility across different sectors.
  - Facilitate movement between higher education, and vocational education and training centres, by creating recognised bridges and transferable credentials.
  - Support the recognition of informal acquired skills and experience from related professions, to allow the move of career changers into the renewable energy sector, while being supported by an efficient reskilling and upskilling over time.
- **Consider ways of supporting the workforce in gaining valuable on-the-job / practical experience before going offshore – maximising the exposure to “real world” situations and assets prior to going offshore**
  - Gaining on-the-job experience without actually going offshore is an issue that many employers must deal with. This is very important especially for Greece where at the moment ORE is at its early stages of development and offshore projects have not been installed yet. But this will be an issue even when such projects will have been constructed as with teams working offshore typically being very small and the allowable down-time of a turbine being kept to a minimum for commercial reasons, undertaken training and development on-site is a challenge.
  - It should be considered how the industry can tackle this issue through the provision of training via realistic assets onshore.

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  - This would aid apprentices in completing their programmes as well as supporting upskilling and refresher training without the time and expense of going offshore.

- **Investigate the potential for on-line, distance learning upskilling / refresher modules**
  - We should consider engaging with industry to identify specific skills areas where upskilling / refresher training development could benefit from the creation of targeted modular provision. Such provision might be accessible on-line 24/7 and focus on such areas as leadership skills - upskilling the leaders of the future.
  - To address regional disparities in access to training we could introduce mobile training units equipped with simulators and virtual reality tools to provide practical training in remote areas.
  - Encourage modular, part-time, and online learning options to enable professionals to upskill without interrupting their careers.
  - Offer micro credential and badge programmes that allow learners to acquire specific, in-demand skills quickly.

- **Consider the creation of a talent network for the offshore wind industry**
  - Many of the larger, and more well-known, organisations in the offshore wind industry may not struggle to find appropriate applicants for many of their job vacancies and trainee programmes. However, this may not be the case down in the supply chain, where the “employer brand” may not be so strong. Thus, we should consider whether an initiative such as a talent source network might be beneficial to the offshore wind industry. This network will seek to bring together employers and those looking for employment – whether they’re looking for apprenticeship or graduate opportunities, or career changers or those looking to return to work. The network will also look to link unsuccessful applicants with other employers who are looking for similar skills.

- **Industry-education collaboration. Facilitate the engagement between employers and schools and other education institutions in a way that maximises the impact for the whole sector / regional supply chain**
  - Employer engagement with schools and other education institutions is valuable in terms of turning pupils / students on to specific career paths.
  - Training centres should be established not at the large city centres, but close to the local supply chain, to the local workforce, i.e. at the Aegean islands where a significant part of the offshore wind projects will be deployed. This way there will be benefit both for the companies and the local communities.

- **Leverage Emerging Technologies for Training and Simulation** - Invest in augmented and virtual reality (AR/VR) systems for offshore wind training. These tools can simulate real-world offshore environments, enabling trainees to practice maintenance, troubleshooting, and safety protocols in a risk-free setting.

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- Use digital twins of turbines and wind farms to train technicians and engineers in diagnostics, repair, and optimization of systems.

5.5 Cyprus

5.5.1 CoVE thematic focus

The thematic focus of the Cypriot CoVE addresses the island's unique energy challenges and emerging opportunities while aligning with broader SHOREWINNER objectives. Despite the current lack of offshore renewable energy (ORE) infrastructure, Cyprus's participation in regional energy projects and its strategic Mediterranean location provide potential for future development in the offshore renewable energy sector. The CoVE will emphasize areas that support the research, skills development, and readiness required for offshore energy projects.

A possible area of focus could be the exploration of floating offshore wind (FOW) and green hydrogen systems. Through initiatives like the TETHYS project, a collaborative effort involving the University of Cyprus (UCY) and international partners, the CoVE can offer potential training in the design, operation, and integration of FOW and hydrogen technologies. This collaboration will enable the CoVE to align educational efforts with cutting-edge research and prepare a skilled workforce for future offshore energy projects, even if large-scale deployment has not yet begun in Cyprus.

Given the absence of a developed ORE industry, the CoVE will prioritize digital competencies and the use of advanced simulation tools. Potential training programmes may incorporate digital technologies such as augmented reality (AR), virtual reality (VR), and digital twins to simulate offshore environments. These tools can provide hands-on experience in a virtual setting, helping to bridge the gap caused by the lack of operational offshore facilities in Cyprus. Skills in data analytics, predictive maintenance, and cybersecurity will also support workforce readiness for future ORE projects.

The CoVE will also focus on environmental monitoring and regulatory compliance to ensure that potential ORE development aligns with sustainable practices. The CoVE could also benefit from the outcomes of the SPOWIND project, such as the marine spatial planning WebGIS tool, to support and enhance its own decision-making and planning processes. Collaborating with partners engaged in similar initiatives can provide valuable insights and contribute to achieving the CoVE's objectives.

Lastly, collaboration and stakeholder engagement are integral to the Cypriot CoVE's approach. By partnering with UCY, INTERCOLLEGE, CCCI, and CARDET, the CoVE will leverage research excellence, industry connections, and educational innovation to align vocational education and training (VET) with market needs and global trends. Joint research, internships, and modular training programmes will support skill development and ensure that VET offerings remain relevant to the evolving offshore renewable energy landscape. The international collaboration within the SHOREWINNER framework will further enhance the CoVE's ability to adopt innovative approaches, promote workforce upskilling, and contribute to the EU's sustainability goals.

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5.5.2 Potential for upwards convergence

Due to the lack of an established industry, Cyprus confronts difficulties in the offshore renewable energy (ORE) sector. This limits the incentives for sectoral development as well as the demand for specialized skills. Since the country's technological expertise is impacted by its lack of industry, upward convergence is necessary for Cyprus to catch up to more developed areas. Nonetheless, Cyprus has a number of resources that offer a solid basis for convergence, such as its research facilities, academic establishments, and involvement in important regional initiatives.

Cyprus has a great chance to expand its research capabilities and technical proficiency in ORE through ongoing programmes like TETHYS and SPOWIND. With an emphasis on floating offshore wind and green hydrogen systems, TETHYS collaborates with top universities in Greece, Italy, and Denmark to provide Cypriot researchers and students with access to cutting-edge technology and best practices. In a similar vein, SPOWIND's results, especially the maritime spatial planning WebGIS application, can offer crucial information and techniques to aid in strategic planning and decision-making for possible ORE development.

Another important avenue for convergence is the tight ties between Cyprus and Greece. Cyprus may gain from Greece's experience, research findings, and training models as it develops its floating offshore wind capabilities and associated infrastructure. Knowledge and skill transfer can be facilitated through cooperative programmes, joint summer schools, and modular training efforts with Greek universities. This relationship is further strengthened by initiatives like the EuroAsia Interconnector, which links Cyprus's research and educational initiatives with Greece's effective ORE tactics.

The CoVE can concentrate on reskilling and upskilling initiatives for professionals in relevant fields including engineering, energy, and maritime in order to further promote convergence. Transferable skills like environmental impact management, equipment maintenance, and safety procedures might be emphasized in these programmes. Additionally, in line with industry requirements, customized training programmes for ambitious professionals can offer fundamental knowledge in fields like grid integration, renewable energy systems, and marine logistics.

In order to expose students and young professionals to the ORE industry through practical workshops, expert talks, and field trips, the CoVE can also conduct themed summer schools. Events for networking and dissemination will increase awareness of ORE opportunities, promoting knowledge sharing and establishing collaborations between local communities, business, and academics. Getting participants ready for contests such as hackathons that highlight problems in renewable energy can promote creativity and teamwork even more.

Cyprus can improve its readiness for upcoming ORE opportunities by expanding its research capacity, bringing training into compliance with EU requirements, and encouraging cooperation with more developed areas. These initiatives will close current technological gaps, develop a trained labour force, and establish Cyprus as a possible player in the Mediterranean's offshore renewable energy market. By means of consistent interaction with SHOREWINNER partners and a dedication to global best practices, Cyprus can contribute significantly to the advancement of the sustainable energy transition in the region.

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5.5.3 Recommendations

For Cyprus to be ready for future advancements and to close the skills gap in the offshore renewable energy (ORE) sector, industry-education cooperation must be strengthened. Since there isn't a well-established ORE industry, building solid alliances between academic institutions, research facilities, and industrial players—both domestic and foreign—will improve workforce preparedness and help the nation achieve its energy transition objectives. The following suggestions list essential tactics for productive teamwork:

- **Mutual understanding and trust:** Trust and shared goals are fundamental to successful collaborations. Educational institutions and industry partners must work towards a common understanding of their objectives, timelines, and expectations. Building long-term relationships through regular communication, collaborative initiatives, and mutual participation in advisory boards can enhance the outcomes. Establishing dedicated liaison roles or teams within both sectors can streamline communication and maintain engagement.
- **Develop targeted reskilling and upskilling programmes:** Design reskilling and upskilling initiatives for professionals in related sectors, such as maritime, energy, and engineering. These programmes should focus on transferable skills like safety protocols, environmental impact assessments, and equipment maintenance. Engaging industry experts in program design ensures that training remains relevant to emerging industry needs and technological advancements.
- **Collaborative curriculum development:** Involve industry partners in the design and review of vocational education and training (VET) curricula to ensure alignment with current and future workforce demands. Industry participation in curriculum development can enhance the practical relevance of training programmes and prepare students for real-world challenges. Incorporating industry insights helps address the disparity between academic instruction and the skills required in the workplace.
- **Enhance practical training opportunities:** Facilitate internships, apprenticeships, and joint research projects to provide students with hands-on experience. In the absence of domestic ORE facilities, international partners can offer practical exposure to operational offshore projects. Thematic workshops, and field visits can also introduce students to ORE concepts and practices, fostering early interest and foundational skills.
- **Promote knowledge exchange and dissemination**: Organise dissemination and networking events to create platforms for knowledge exchange between industry, academia, and policymakers. Events such as conferences, seminars, and hackathons can promote awareness of ORE opportunities, share best practices, and facilitate the formation of strategic partnerships. These activities help bridge the gap between theoretical learning and industry application.
- **Encourage staff professional development:** Support continuous professional development by enabling industry experts to deliver guest lectures, mentor students, and participate in academic advisory boards. Conversely, offer opportunities for academic staff to engage in short-term industry placements or consulting roles. This cross-sector experience helps align educational practices with industry needs and enhances the practical knowledge of both educators and professionals.

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- **Leverage existing strengths and collaborations:** Capitalise on ongoing research initiatives to enhance research capacity and knowledge transfer. Collaboration with more advanced regions, particularly those with established offshore renewable energy sectors, can provide valuable insights and effective training models for developing Cyprus's capabilities. Shared initiatives, such as joint summer schools and modular training programmes, can accelerate the alignment of Cyprus's workforce development efforts with European standards and best practices.

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7 ANNEXES

7.1 ANNEX I: Occupational Profiles: Offshore Renewable Energy

Table 31. Occupational profiles, essential skills and competencies, and essential knowledge, following ESCO classification

OCCUPATIONAL PROFILES			
Occupation	**ESCO code**	**Essential skills and competencies**	**Essential knowledge**
Marine engineer	2144.1.10	Adjust engineering designs, approve engineering design, ensure vessel compliance with regulations, execute analytical mathematical calculations, perform scientific research, use maritime English, and use technical drawing software.	Engineering principles, engineering processes, maritime electric drives, maritime law, mathematics, mechanics, mechanics of vessels, naval architecture, technical drawings.
Mechatronics engineer	2144.1.11	Adjust engineering designs, analyse test data, approve engineering design, conduct literature research, conduct quality control analysis, define technical requirements, demonstrate disciplinary expertise, design automation components, design prototypes, develop electronic test procedures, develop mechatronic test procedures, follow standards for machinery safety, gather technical information, interact professionally in research and professional environments, manage personal professional development, manage research data, monitor manufacturing quality standards, operate open source software, perform data analysis, perform project management, prepare production prototypes, report analysis results, simulate mechatronic design concepts, synthesise information, test mechatronic units, think abstractly, and use technical drawing software.	Automation technology, computer engineering, control engineering, design drawings, electrical engineering, electronics, engineering principles, engineering processes, mathematics, mechanical engineering, mechanics, mechatronics, physics, robotics, technical drawings.

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Fluid power engineer	2144.1.7	Adjust engineering designs, approve engineering design, execute feasibility studies, perform scientific research, read engineering drawings, troubleshoot, use CAD software, use computer-aided engineering systems, use technical drawing software.	CAD software, engineering principles, engineering processes, fluid mechanics, hydraulic fluid, hydraulics, mathematics, mechanical engineering mechanics, principles of mechanical engineering, technical drawings.
Installation engineer	2149.2.5	Ensure compliance with construction project deadlines, follow health and safety procedures in construction, oversee construction projects, perform project management, perform risk analysis, perform scientific research, record test data, troubleshoot, work in a construction team.	Construction industry, construction methods, construction product regulation, cost management, engineering principles, engineering processes, project management, project management principles, quality standards.
Logistics engineer	2149.2.6	Define technical requirements, direct logistical functions, execute analytical mathematical calculations, interpret technical requirements, manage engineering projects, manage logistics, perform scientific research, and use technical drawing software.	Engineering principles, engineering processes, logistics, mathematics, project management, supply chain management, and technical drawings.
Quality engineer	2149.2.7	Analyse test data, define quality standards, identify process improvements, inspect quality of products, perform risk analysis, recommend product improvements, record test data, report test findings, set quality assurance objectives, support implementation of quality management systems, undertake inspections, and write inspection reports.	Quality assurance methodologies, quality assurance procedures, quality standards, and test procedures.

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Research engineer	2149.2.8	Collect samples for analysis, define technical requirements, execute feasibility studies, gather experimental data, interpret technical requirements, manage engineering projects, perform scientific research, and use technical drawing software.	Engineering principles, engineering processes, industrial research and development, project management, scientific research methodology, and technical drawings.
Commissioning engineer	2149.60	Analyse test data, check system parameters against reference values, collaborate with engineers, conduct quality control analysis, ensure conformity to specifications, ensure fulfilment of legal requirements, ensure public safety and security, liaise with quality assurance, present reports, read standard blueprints, record test data, test performance of power plants, troubleshoot, use measurement instruments, use testing equipment, and write work-related reports	Project commissioning, quality assurance procedures, quality standards, and safety engineering.
Dismantling engineer	2149.80	Advise on machinery malfunctions, develop design plans, develop project schedules, disassemble equipment, disassemble machines, dismantle broken appliances, draw blueprints, follow health and safety procedures in construction, identify construction materials from blueprints, instruct on safety measures, lead a team, manage the schedule of tasks, perform risk analysis, perform safety data analysis, review construction plans, authorisations, and write stress-strain analysis reports.	Blueprints, design principles, safety engineering

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Offshore renewable energy engineer	2149.9.5	Address problems critically, adjust engineering designs, adjust voltage, approve engineering design, conduct engineering site audits, coordinate communication within a team, design automation components, design offshore energy systems, develop test procedures, ensure compliance with environmental legislation in food production, ensure compliance with safety legislation, inspect offshore constructions, manage engineering projects, perform data analysis, perform project management, perform scientific research, prevent marine pollution, read engineering drawings, report test findings, research locations for offshore farms, research ocean energy projects, use remote control equipment, use technical drawing software, utilize decision support systems.	Automation technology, data storage, electrical engineering, electrical power, safety regulations, energy, energy market, engineering principles, engineering processes, information extraction, innovation processes, marine energy, marine engineering, marine technology, oceanography, offshore constructions and facilities, offshore renewable energy technologies, renewable energy, sensors, statistical analysis, system software, technical drawings, types of photovoltaic panels, types of tidal stream generators, types of wave energy converters, types of wind turbines, wind energy.
Renewable energy engineer	2149.9.7	Adapt energy distribution schedules, adjust engineering designs, approve engineering design, carry out energy management of facilities, design wind turbines, ensure compliance with safety legislation, inform on government funding, make electrical calculations, manage engineering project, perform project management, perform scientific research, promote sustainable energy, provide information on geothermal heat pumps, provide information on solar panels, provide information on wind turbines, research locations for wind farms, use CAD software, use technical drawing software, use thermal management.	Bioeconomy, biogas energy, civil engineering, electrical engineering, energy conservation, energy micro-generation technologies, engineering processes, environmental engineering, fluid mechanics, geothermal energy, green automotive technologies, industrial heating systems, marine energy, mechanical engineering, mining, construction and civil engineering machinery products, photovoltaic systems, power engineering, renewable energy, resource-efficient technologies, solar energy, state estimation, technical drawings, wind energy.
Solar energy engineer	2149.9.8	Adjust engineering designs, adjust voltage, approve engineering design, conduct engineering site audits, create CAD drawings, design a solar heating system, design solar energy systems, examine engineering principles, maintain concentrated solar power systems, maintain solar energy systems, manage engineering projects, operate solar thermal energy systems for hot water and heating, perform a feasibility study on solar heating, perform scientific research, promote sustainable energy, provide information on solar panels, use technical drawing software, use thermal analysis.	Alternative energy, electrical engineering, energy, energy market, energy micro-generation technologies, engineering principles, engineering processes, photovoltaic systems, power engineering, solar energy, solar products, sustainable technologies, technical drawings, thermodynamics, types of photovoltaic panels.

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Thermal engineer	2149.9.9	Adjust engineering designs, approve engineering designs, design an electric heating system, design engineering components, design passive energy measures, design thermal equipment, design thermal requirements, interpret 2D plans, interpret 3D plans, manage engineering projects, operate solar thermal energy systems for hot water and heating, perform a feasibility study on electric heating, perform a feasibility study on heat pumps, perform scientific research, provide information on geothermal heat pumps, troubleshoot, use technical drawing software, use thermal analysis, use thermal management.	Engineering principles, engineering processes, fluid mechanics, heat transfer processes, mechanical engineering mechanics, sustainable technologies, technical drawings, thermal materials, thermodynamics.
Aerodynamics engineer	2144.1.1.1	Adjust engineering designs, approve engineering design, evaluate engine performance, examine engineering principles, execute analytical mathematical calculations, liaise with engineers, perform scientific research, read engineering drawings, use technical documentation, and use technical drawing software.	CAE software, ICT software, specifications, aerodynamics, computer simulation, engine components, engineering principles, engineering processes, mathematics, mechanical engineering, mechanics, multimedia systems, operation of different engines, physics, scientific research methodology, technical drawings.
Waste treatment engineer	2143.1.4	Adjust engineering designs, advise on waste management procedures, approve engineering design, assess environmental impact, develop hazardous waste management strategies, develop non-hazardous waste management strategies, develop waste management processes, maintain waste collection records, monitor legislation developments, perform scientific research, and use technical drawing software.	Characteristics of waste, circular economy, energy, energy market, engineering principles, engineering processes, environmental legislation, technical drawings, waste and scrap products.
Hydropower engineer	2142.1.5	Approve engineering design, design electric power systems, draw blueprints, examine engineering principles, manage engineering projects, operate scientific measuring equipment, perform project management, perform risk analysis, perform scientific research, promote innovative infrastructure design, troubleshoot, use CAD software, use CAM software, and use technical drawing software.	CAD software, CAM software, electrical power, safety regulations, electricity, electronics, principles, energy efficiency, energy micro-generation technologies, energy transformation, engineering principles, hydroelectricity, marine energy, project management, renewable energy, resource-efficient technologies, technical drawings.

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Manufacturing engineer	2141.4.1	Adjust engineering designs, advise on manufacturing problems, approve engineering design, assess financial viability, ensure health and safety in manufacturing, ensure material compliance, perform scientific research, and use technical drawing software.	Consumer protection, engineering principles, engineering processes, industrial engineering, manufacturing processes, production engineering, production processes, technical drawings.
Automation engineer	2141.4.2.1	Adjust engineering designs, analyse test data, approve engineering design, conduct literature research, conduct quality control analysis, define technical requirements, demonstrate disciplinary expertise, design automation components, design prototypes, develop electronic test procedures, develop mechatronic test procedures, gather technical information, interact professionally in research and professional environments, manage personal professional development, manage research data, monitor manufacturing quality standards, operate open source software, perform project management, prepare production prototypes, record test data, report analysis results, simulate mechatronic design concepts, synthesise information, think abstractly, and use technical drawing software.	Automatic control systems, automation technology, computer engineering, control engineering, design drawings, electrical engineering, electronics, engineering principles, engineering processes, industrial engineering, manufacturing processes, mathematics, mechanical engineering, mechatronics, physics, production processes, robotic components, robotics, sensors, technical drawings.
Maintenance and repair engineer	2141.8	Advise on efficiency improvements, conduct quality control analysis, conduct routine machinery checks, create solutions to problems, inspect industrial equipment, inspect machinery, maintain equipment, maintain machinery, manage budgets, perform machine maintenance, perform test runs, resolve equipment malfunctions, troubleshoot, use testing equipment, work safely with machines, and write technical reports.	Engineering principles, engineering processes, maintenance operations, mechanics, quality assurance procedures.

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Electric power generation engineer	2151.1.1	Adjust engineering designs, approve engineering design, design electric power systems, develop strategies for electricity contingencies, ensure compliance with electricity distribution schedules, ensure safety in electrical power operations, perform scientific research, promote sustainable energy, respond to electrical power contingencies, shift energy demands, and use technical drawing software.	Electric current, electric generators, electrical engineering, electrical power safety regulations, electricity, energy, energy micro-generation technologies, engineering principles, engineering processes, renewable energy, technical drawings.
Electromechanical engineer	2151.1.3	Abide by regulations on banned materials, adjust engineering designs, analyse test data, approve engineering design, conduct literature research, define technical requirements, demonstrate disciplinary expertise, design electromechanical systems, design prototypes, gather technical information, interact professionally in research and professional environments, manage personal professional development, manage research data, model electromechanical systems, monitor manufacturing quality standards, operate open source software, perform data analysis, perform project management, prepare production prototypes, record test data, report analysis results, synthesise information, test electromechanical systems, think abstractly, and use technical drawing software.	Design drawings, electric drives, electric generators, electric motors, electrical engineering, electrical machines, electrical wiring diagrams, electricity, electricity principles, electromechanics, engineering principles, environmental legislation, environmental threats, mathematics, mechanical engineering, physics.
Battery system engineer	2151.4	Analyse test data, conform with production requirements, define integration strategy, develop new products, develop predictive models, identify process improvements, perform product testing, and troubleshoot.	Battery chemistry, battery design, battery management systems, computer programming, computer science, control systems, electrical engineering, embedded systems, engineering principles, mechanical engineering, project management, project management principles, safety engineering, vehicle electrical systems.

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Sensor engineer	2152.1.15	Abide by regulations on banned materials, adjust engineering designs, analyse test data, approve engineering design, conduct literature research, conduct quality control analysis, demonstrate disciplinary expertise, design prototypes, design sensors, develop electronic test procedures, interact professionally in research and professional environments, manage personal professional development, manage research data, model sensors, operate open source software, operate scientific measuring equipment, perform data analysis, perform project management, prepare production prototypes, read engineering drawings, record test data, report analysis results, synthesise information, test sensors, think abstractly, and use technical drawing software.	Computer simulation, control engineering, design drawings, digital twin technology, electricity, electricity principles, electronic equipment standards, electronic test procedures, electronics, engineering principles, environmental legislation, environmental threats, mathematics, microsensors, physics, sensors.
Predictive maintenance engineer	2152.1.13	Advise on equipment maintenance, analyse big data, apply information security policies, apply statistical analysis techniques, design sensors, develop data processing applications, ensure equipment maintenance, gather data, manage data, model sensors, perform data analysis, and test sensors.	ICT networking, hardware, computer programming, electrical engineering, electricity, electronics, mathematics, predictive maintenance, statistics.
Health and safety officer	2263.3	Advise on conflict management, advise on risk management, communicate health and safety measures, draw up risk assessments, educate employees on occupational hazards, ensure compliance with environmental legislation, follow standards for machinery safety, monitor employees' health, monitor legislation developments, and present reports.	Assessment of risks and threats, environmental legislation, health, safety and hygiene legislation, personal protective equipment, quality standards, technical drawings.

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Accounting analyst	2411.1.1	Analyse business processes, analyse financial performance of a company, analyse financial risk, check accounting records, create a financial report, draft accounting procedures, explain accounting records, identify process improvements, interpret financial statements, monitor financial accounts, supervise accounting operations.	Accounting department processes, accounting entries, accounting techniques, financial department processes, financial statements, International Financial Reporting Standards, national Generally Accepted Accounting Principles.
Financial risk manager	2412.50	Advise on financial matters, advise on risk management, advise on tax policy, analyse external factors of companies, analyse financial risk, analyse internal factors of companies, analyse market financial trends, apply credit risk policy, assess risk factors, collect financial data, create a financial plan, create risk maps, create risk reports, enforce financial policies, estimate profitability, follow company standards, integrate strategic foundation in daily performance, interpret financial statements, liaise with managers, make strategic business decisions, manage financial risk, strive for company growth.	Monte Carlo simulation, accounting department processes, banking activities, financial department processes, financial products, International Financial Reporting Standards, risk financing techniques, treasury management system.
Business analyst	2421.1	Advise on efficiency improvements, align efforts towards business development, analyse business plans, analyse external factors of companies, analyse financial performance of a company, analyse internal factors of companies, apply change management, build business relationships, conduct qualitative research, conduct quantitative research, identify undetected organisational needs, interpret financial statements, liaise with managers, make strategic business decisions, perform business analysis, use business simulation tools.	Business analysis, business analytics, business communication, data visualisation software, digital data processing, management consulting, management systems standards, market research, risk management, scientific research methodology.

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Data analyst	2511.3	Analyse big data, apply statistical analysis techniques, collect ICT data, define data quality criteria, establish data processes, execute analytical mathematical calculations, handle data samples, implement data quality processes, integrate ICT data, interpret current data, manage data, normalize data, perform data cleansing, perform data mining, use data processing techniques, use databases.	Business analytics, business intelligence, data engineering, data ethics, data mining, data models, data quality assessment, data science, data visualisation software, digital data processing, documentation types, information categorisation, information confidentiality, information extraction, information structure, query languages, Resource Description Framework query language, statistics, unstructured data, visual presentation techniques.
Artificial intelligence engineer	2511.11	Analyse big data, analyse business requirements, apply ICT systems theory, create data sets, creatively use digital technologies, define technical requirements, deliver visual presentation of data, design processes, develop creative ideas, develop statistical software, use data processing techniques.	Python (computer programming), algorithms, artificial neural networks, business process modelling, computer programming, computer simulation, data mining, data models, data science, digital data processing, information architecture, information categorisation, information extraction, information structure, principles of artificial intelligence, Resource Description Framework query language, systems development life-cycle, task algorithmisation, unstructured data, visual presentation techniques.
Data engineer	2511.2	Create data sets, design databases in the cloud, develop data processing applications, establish data processes, implement data warehousing techniques, manage ICT data architecture, manage data, manage quantitative data, manage research data, perform dimensionality reduction, process data, store digital data and systems, use data processing techniques, use databases.	Cloud technologies, computer science, data analytics, data models, data storage, data warehouse, database management systems, digital data processing, unstructured data.
Policy manager	1213.2	Advise on efficiency improvements, advise on sustainable management policies, develop company strategies, ensure compliance with policies, integrate strategic foundation in daily performance, monitor company policy, monitor legislation developments, set organisational policies.	Business analysis, corporate social responsibility, management systems standards, organisational policies, policy analysis, strategic planning.

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Sustainability manager	1213.8	Advise on carbon emissions reduction, advise on corporate social responsibility, advise on sustainability solutions, advise on sustainable management policies, analyse business requirements, analyse supply chain strategies, assess environmental impact, assess the life cycle of resources, carry out training in environmental matters, conduct qualitative research, conduct quantitative research, coordinate environmental efforts, ensure compliance with environmental legislation, environmental design, evaluate company needs, forecast organisational risks, lead the sustainability reporting process, manage environmental management system, manage recycling program budget, measure company's sustainability performance, mitigate waste of resources, monitor social impact, perform risk analysis, produce sustainable products, promote environmental awareness, use sustainable materials and components.	Alternative energy, circular economy, climate change impact, corporate social responsibility, corporate sustainability, emission standards, energy conservation, energy efficiency, environmental legislation, environmental management, monitors, environmental management standards, environmental policy, global standards for sustainability reporting, green building standards, green computing, hazardous waste types, resource-efficient technologies, risk management, sustainability consulting, sustainable finance, sustainable technologies, waste management.
Health safety and environmental manager	1213.7	Abide by business ethical code of conduct, advise on government policy compliance, advise on sustainability solutions, communicate health and safety measures, coordinate environmental efforts, develop contingency plans for emergencies, develop training programmes, educate employees on occupational hazards, evaluate company needs, evaluate employees' work, implement strategic planning, liaise with government officials, liaise with industry experts, liaise with managers, make health, safety, and environment assessments, manage environmental impact of operations, manage health and safety standards, monitor contractor performance, monitor employees' health, monitor legislation developments, perform risk analysis, plan health and safety procedures, promote health and safety, promote sustainability, shape corporate culture.	Assessment of risks and threats, audit techniques, business analysis, energy conservation, environmental legislation, framework for a safety management system, health and safety in the workplace, health and safety regulations, health, safety, and hygiene legislation, organisational resilience, pollution legislation, pollution prevention, production processes, risk management, strategic planning.

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Project manager	1219.6	Apply conflict management, build business relationships, control of expenses, create project specifications, customise project methodologies, draft project documentation, ensure compliance with legal requirements, ensure equipment availability, ensure equipment maintenance, establish daily priorities, estimate duration of work, follow company standards, identify legal requirements, liaise with managers, manage budgets, manage logistics, manage project changes, manage project information, manage project metrics, manage staff, manage supplies, negotiate with stakeholders, organise project meetings, perform PESTEL analysis, perform project management, perform resource planning, perform risk analysis, provide cost-benefit analysis reports, supervise daily information operations, train employees, write work-related reports.	Communication principles, internal risk management policy, project management, project management methodology (PM^2), project management principles.
Power plant manager	1219.5.3	Adapt energy distribution schedules, adhere to organisational guidelines, analyse energy market trends, coordinate electricity generation, create manufacturing guidelines, define manufacturing quality criteria, develop manufacturing policies, ensure compliance with environmental legislation, ensure equipment availability, ensure equipment maintenance, follow company standards, forecast energy prices, liaise with managers, manage budgets, manage emergency evacuation plans, manage staff, manage supplies, meet deadlines, oversee power equipment operation, strive for company growth.	Business management principles, electrical power safety regulations, energy conservation, energy market, manufacturing processes, nuclear energy.
Manufacturing manager	1321.2	Adhere to organisational guidelines, create manufacturing guidelines, define manufacturing quality criteria, develop manufacturing policies, follow company standards, manage budgets, manage staff, manage supplies, meet deadlines, strive for company growth.	Manufacturing processes, sustainable manufacturing.

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Logistics and distribution manager	1324.3	Analyse business plans, analyse relation between supply chain improvement and profit, analyse supply chain strategies, analyse supply chain trends, anticipate the overhaul of the fleet, attend to detail in preparation for audits, communicate with shipment forwarders, comply with checklists, conduct full-scale emergency plan exercises, consider economic criteria in decision making, control reorder points, coordinate dock operations, create a work atmosphere of continuous improvement, develop efficiency plans for logistics operations, direct logistical functions, give instructions to staff, handle stressful situations in the workplace, liaise with colleagues, liaise with transportation companies, manage dispatch software systems, manage staff, manage the fleet according to planned operations, manage transport of goods from warehouse facilities, perform cost accounting activities, provide operational efficiency training to employees, solve operational transport problems, work in a logistics team.	E-commerce systems, freight transport methods, regulations for international transportation, safety regulations for warehouses, supply chain management, types of packaging used in industrial shipments, warehouse operations.
Supply chain manager	1324.8	Analyse business plans, analyse logistic changes, analyse supply chain strategies, analyse supply chain trends, assess supplier risks, estimate costs of required supplies, follow company standards, identify key processes of traceability systems, identify software for warehouse management, implement a management system, liaise with managers, maintain relationship with customers, maintain relationship with suppliers, manage inventory, manage supplies, order supplies, strive for company growth.	Corporate social responsibility, product data management, product life-cycle, supplier management, supply chain management, supply chain principles.
Electromechanical engineering technician	3113.1.2	Adjust engineering designs, align components, apply soldering techniques, assemble electromechanical systems, assist scientific research, fasten components, inspect quality of products, liaise with engineers, operate soldering equipment, perform test runs, prepare pieces for joining, prepare production prototypes, read assembly drawings, read engineering drawings, read standard blueprints, record test data, test electromechanical systems, wear appropriate protective gear.	Design drawings, electric drives, electric motors, electrical equipment regulations, electrical machines, electrical wiring diagrams, electricity, electromechanics.

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Hydropower technician	3113.2	Adjust engineering designs, apply health and safety standards, design electric power systems, maintain electrical equipment, manage engineering projects, monitor electric generators, operate scientific measuring equipment, perform risk analysis, promote innovative infrastructure design, troubleshoot.	Alternative energy, electric generators, electrical power safety regulations, electricity, energy, energy efficiency, energy micro-generation technologies, energy performance of buildings, energy transformation, engineering processes, environmental engineering, hydroelectricity, marine energy, oceanography, renewable energy, technical drawings.
Battery maintenance technician	3113.3	Conduct workplace audits, ensure equipment maintenance, have computer literacy, identify process improvements, perform product testing, remove defective products, troubleshoot, use technical documentation.	Electrical engineering, mechanical engineering, predictive maintenance, production processes, quality assurance methodologies, safety engineering.
Electronics engineering technician	3114.1	Adjust engineering designs, align components, apply soldering techniques, assemble electronic units, assist scientific research, conduct performance tests, configure electronic equipment, ensure finished products meet requirements, fasten components, inspect quality of products, interpret circuit diagrams, interpret electronic design specifications, liaise with engineers, meet deadlines, prepare production prototypes, read assembly drawings, read engineering drawings, record test data, solder electronics, test electronic units, use testing equipment.	Battery formation, design drawings, electronic components, electronic equipment standards, electronic test procedures, electronics, integrated circuits, printed circuit boards, types of electronics.
Pneumatic engineering technician	3115.1.15	Adjust engineering designs, conduct routine machinery checks, create solutions to problems, liaise with engineers, perform maintenance on installed equipment, read engineering drawings, record test data, troubleshoot.	CAE software, engineering principles, engineering processes, pneumatics.

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Welding inspector	3115.1.24	Adhere to organisational guidelines, analyse test data, ensure finished products meet requirements, ensure fulfilment of legal requirements, evaluate employees' work, follow company standards, identify hazards in the workplace, inspect quality of products, liaise with quality assurance, operate welding equipment, perform sample testing, perform welding inspection, prepare samples for testing, recognise signs of corrosion, record production data for quality control, record survey data, record test data, report defective manufacturing materials, revise quality control systems documentation, set quality assurance objectives, spot metal imperfections, write records for repairs, write work-related reports.	Database quality standards, metal joining technologies, quality assurance methodologies, quality standards, types of metal, types of metal manufacturing processes, welding techniques.
Electrical drafter	3118.3.6	Abide by regulations on banned materials, create technical plans, customise drafts, design electrical systems, design prototypes, draw blueprints, ensure material compliance, interpret electrical diagrams, liaise with engineers, model electrical systems, process customer requests based on the REACh Regulation 1907/2006, use CAD software, use technical drawing software.	CAD software, design drawings, electrical engineering, electrical equipment components, electrical equipment regulations, electrical wiring diagrams, electricity, electricity principles, manual draughting techniques, mathematics, technical drawings.
Electromechanical drafter	3118.3.7	Create technical plans, customise drafts, design electromechanical systems, design prototypes, interpret electrical diagrams, liaise with engineers, model electromechanical systems, use CAD software, use technical drawing software.	CAD software, design drawings, electrical engineering, electrical equipment regulations, electrical machines, electrical wiring diagrams, electricity, electromechanics, manual draughting techniques, mathematics, mechanical engineering, technical drawings.

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Mechanical engineering drafter	3118.3.11	Create technical plans, customise drafts, design electromechanical systems, design prototypes, interpret electrical diagrams, liaise with engineers, model electromechanical systems, use CAD software, use technical drawing software.	CAD software, design drawings, electrical engineering, electrical equipment regulations, electrical machines, electrical wiring diagrams, electricity, electromechanics, manual draughting techniques, mathematics, mechanical engineering, technical drawings.
Robotics engineering technician	3119.2.1	Adjust engineering designs, align components, assemble robots, assist scientific research, develop computer vision systems, fasten components, follow standards for machinery safety, inspect quality of products, liaise with engineers, monitor machine operations, perform test runs, prepare production prototypes, read assembly drawings, read engineering drawings, record test data, set up automotive robots, set up machine controls, test mechatronic units.	Automatic control system, automation technology, control engineering, design drawings, electrical engineering, electronics, mathematics, mechatronics, physics, robotic components, robotics.
Metal additive manufacturing operator	3119.1	Apply health and safety standards, ensure compliance with environmental legislation, follow work schedule, liaise with engineers, liaise with managers, maintain additive manufacturing systems, manufacture metal additive manufacturing parts, monitor machine operations, operate precision measuring equipment, perform machine maintenance, prepare parts for post-processing, remove processed workpieces, set up additive manufacturing systems, troubleshoot, use personal protection equipment, work safely with machines, write production reports.	Functionalities of machinery, machine tools, maintenance operations, quality assurance procedures, waste management.

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Offshore renewable energy technician	3119.11	Analyse test data, apply health and safety standards, arrange equipment repairs, ensure equipment maintenance, follow safety procedures when working at heights, gather data, inspect offshore constructions, inspect tidal stream generators, inspect wave energy converters, inspect wind turbines, install electrical and electronic equipment, install offshore renewable energy systems, maintain electrical equipment, maintain electronic equipment, maintain hydraulic systems, maintain records of maintenance interventions, maintain sensor equipment, maintain wind turbines, manage emergency procedures, monitor electric generators, prevent marine pollution, provide first aid, respond to electrical power contingencies, survive at sea in the event of ship abandonment, test sensors, use remote control equipment.	Electric generators, electrical discharge, electrical power safety regulations, electricity, electronics, marine energy, marine engineering, marine technology, maritime meteorology, mechanics, offshore constructions and facilities, offshore renewable energy technologies, renewable energy, types of wind turbines, wind energy.
Process engineering technician	3119.14	Adjust engineering designs, advise on manufacturing problems, analyse test data, collaborate with engineers, conduct routine machinery checks, create solutions to problems, identify process improvements, perform maintenance on installed equipment, read engineering drawings, record test data, resolve equipment malfunctions, troubleshoot.	CAE software, engineering principles, engineering processes, manufacturing processes.
Machine operator supervisor	3122.4.8	Check material resources, communicate problems to senior colleagues, consult technical resources, create solutions to problems, ensure finished products meet requirements, evaluate employees' work, follow production schedule, monitor machine operations, monitor manufacturing quality standards, oversee production requirements, plan shifts of employees, record production data for quality control, report on production results, schedule regular machine maintenance, set up the controller of a machine.	Functionalities of machinery, production processes, quality standards.

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Offshore renewable energy plant operator	3131.10	Address problems critically, apply health and safety standards, arrange equipment repairs, conduct routine machinery checks, ensure compliance with maintenance legislation, ensure equipment maintenance, follow safety procedures when working at heights, gather data, inspect wind turbines, install electrical and electronic equipment, maintain electrical equipment, maintain electronic equipment, maintain hydraulic systems, maintain records of maintenance interventions, maintain sensor equipment, monitor electric generators, prevent marine pollution, respond to electrical power contingencies, survive at sea in the event of ship abandonment, use remote control equipment, work in inclement conditions.	Electric generators, electrical discharge, electrical power safety regulations, electricity, electronics, marine energy, marine engineering, marine technology, maritime meteorology, mechanics, offshore constructions and facilities, offshore renewable energy technologies, wind energy.
Power production plant operator	3131.3	Conduct routine machinery checks, ensure equipment maintenance, maintain electrical equipment, maintain power plant machinery, monitor automated machines, monitor electric generators, oversee power equipment operation, resolve equipment malfunctions, respond to electrical power contingencies, use remote control equipment, wear appropriate protective gear.	Automation technology, electric current, electric generators, electrical power safety regulations, electricity, mechanics.
Electrical mechanic	7412.3	Apply safety management, assemble electromechanical systems, calibrate electromechanical systems, comply with electrical safety regulations, fit mechanised equipment, inspect electrical supplies, install electrical and electronic equipment, maintain electrical equipment, maintain electromechanical equipment, resolve equipment malfunctions, solve technical problems, splice cable, test electromechanical systems, test electronic units, use measurement instruments, use precision tools, wear appropriate protective gear, work ergonomically.	Electrical safety regulations, electricity, electromechanics, electronics, energy storage systems, mechanics.

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Laser beam welder	7212.3.2	Apply precision metalworking techniques, ensure correct metal temperature, ensure equipment availability, ensure necessary ventilation in machining, monitor gauge, operate welding equipment, perform machine maintenance, perform test runs, prepare pieces for joining, program a CNC controller, read standard blueprints, remove inadequate workpieces, remove processed workpieces, set up the controller of a machine, supply machine, tend laser beam welding machine, troubleshoot, use CAM software, use automatic programming, verify laser beam measurement, wear appropriate protective gear.	Laser types, manufacturing processes, quality and cycle time optimisation, quality standards, statistical process control, types of metal.
Pipe welder	7212.3.3	Apply health and safety standards, assemble manufactured pipeline parts, clear pipelines, consider the impact of material characteristics on pipeline flows, cooperate with colleagues, detect flaws in pipeline infrastructure, ensure regulatory compliance in pipeline infrastructures, follow up on pipeline integrity management priorities, guide drill pipes, inspect pipelines, install metal gas piping, lay pipe installation, measure parts of manufactured products, operate soldering equipment, operate welding equipment, perform follow-up on pipeline route services, prevent pipeline deterioration, test pipeline infrastructure operations, use measurement instruments, use metal bending techniques, use rigging equipment, use wrenches, work with blacksmithing hand tools.	Hydraulics, isometric perspective, pipeline coating properties, technical drawings, types of pipelines.
Spot welder	7212.3.4	Apply precision metalworking techniques, apply spot welding techniques, ensure correct metal temperature, ensure equipment availability, monitor gauge, operate welding equipment, perform test runs, prepare pieces for joining, remove inadequate workpieces, remove processed workpieces, set up the controller of a machine, spot metal imperfections, supply machine, troubleshoot, wear appropriate protective gear.	Electric current, quality standards, spot welding, machine parts, types of metal.

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Dismantling worker	7214.1	Apply health and safety standards, construct working platforms, dispose of hazardous waste, dispose of non-hazardous waste, drive mobile heavy construction equipment, follow health and safety procedures in construction, inspect heavy underground mining machinery, keep heavy construction equipment in good condition, operate heavy construction machinery without supervision, operate jackhammers, prepare building sites, prevent damage to utility infrastructure, protect surfaces during construction work, react to events in time-critical environments, recognise the hazards of dangerous goods, secure heavy construction equipment, secure working areas, transport dangerous goods, use power tools, use safety equipment in construction, use tools for construction and repair work in a construction team, work safely with machines.	Mechanical tools.
Boring machine operator	7223.1	Dispose of cutting waste material, ensure equipment availability, monitor automated machines, operate precision measuring equipment, perform test runs, remove inadequate workpieces, remove processed workpieces, set up the controller of a machine, supply machine, supply machine with appropriate tools, tend boring machine, troubleshoot.	Quality standards, types of boring heads, types of drill bits, types of metal.
Computer numerical control machine operator	7223.40	Consult technical resources, ensure equipment availability, monitor automated machines, operate precision measuring equipment, perform machine maintenance, perform test runs, program a CNC controller, read standard blueprints, remove inadequate workpieces, remove processed workpieces, set up the controller of a machine, supply machine, supply machine with appropriate tools, troubleshoot, use CAM software, use automatic programming.	Manufacturing processes, quality standards, statistical process control.

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Stamping press operator	7223.21	Consult technical resources, ensure equipment availability, monitor automated machines, monitor gauge, perform test runs, remove inadequate workpieces, remove processed workpieces, set up the controller of a machine, supply machine, tend stamping press, troubleshoot, wear appropriate protective gear.	Metal forming technologies, quality standards, stamping press parts, types of metal.
Router operator	7223.17	Check quality of raw materials, dispose of cutting waste material, ensure conformity to specifications, ensure public safety and security, maintain router machinery, monitor automated machines, operate router machinery, perform test runs, read standard blueprints, remove processed workpieces, supply machine, supply machine with appropriate tools.	Quality standards.
Screw machine operator	7223.19	Dispose of cutting waste material, ensure equipment availability, monitor automated machines, monitor moving workpieces in a machine, perform test runs, remove inadequate workpieces, remove processed workpieces, set up the controller of a machine, supply machine, supply machine with appropriate tools, tend screw machine, troubleshoot.	Quality and cycle time optimisation, quality standards, screw machine parts, screw manufacturing processes, screw types, types of metal.
Straightening machine operator	7223.22	Consult technical resources, ensure equipment availability, measure flatness of a surface, monitor automated machines, perform test runs, position straightening rolls, remove inadequate workpieces, remove processed workpieces, set up the controller of a machine, supply machine, tend straightening press.	Metal forming technologies, quality standards, types of metal.

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Metal polisher	7224.1	Apply polishing lubricants, ensure equipment availability, monitor moving workpiece in a machine, remove inadequate workpieces, remove processed workpieces, set up the controller of a machine, spot metal imperfections, supply machine, troubleshoot.	Buffing motions, quality and cycle time optimisation, quality standards, types of lubricants, types of metal.
Tool grinder	7224.2	Apply precision metalworking techniques, consult technical resources, dispose of cutting waste material, ensure equipment availability, ensure equipment maintenance, inspect quality of products, maintain equipment, manipulate metal, operate precision measuring equipment, operate surface grinder, remove inadequate workpieces, remove processed workpieces, use metalworking tools.	Cutting technologies, quality standards.
Crane technician	7233.2	Conduct routine machinery checks, follow safety procedures when working at heights, inspect crane equipment, install crane equipment, install electrical and electronic equipment, interpret 2D plans, interpret 3D plans, maintain crane equipment, read standard blueprints, repair crane equipment, secure crane, set up crane.	Blueprints, mechanics.
Fluid power technician	7233.4	Consult technical resources, install hydraulic systems, operate soldering equipment, perform test runs, read standard blueprints, record test data, resolve equipment malfunctions, secure working area, use testing equipment.	Fluid mechanics, hydraulic fluid, hydraulics, mechanics.

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Rotating equipment mechanic	7233.14	Align components, apply health and safety standards, assemble machines, conduct routine machinery checks, fasten components, inspect quality of products, maintain rotating equipment, operate soldering equipment, operate welding equipment, read engineering drawings, read standard blueprints, repair rotating equipment, resolve equipment malfunctions, troubleshoot, use technical documentation.	Mechanics, types of rotating equipment.
Pneumatic systems technician	7233.13	Consult technical resources, install electrical and electronic equipment, install pneumatic systems, operate soldering equipment, perform test runs, read standard blueprints, record test data, resolve equipment malfunctions, secure working area, use testing equipment.	Mechanics, pneumatics.
Construction commercial diver	7541.1	Check diving equipment, comply with legal requirements for diving operations, comply with the planned time for the depth of the dive, cope with decompression, follow health and safety procedures in construction, implement dive plans, inspect construction supplies, interrupt diving operations when necessary, keep records of work progress, maintain diving equipment, use lift bags, use rigging equipment, use safety equipment in construction, weld in hyperbaric conditions, weld underwater, work ergonomically.	Diving equipment, diving operation requirements.

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Rescue diver	7541.3	Apply crisis management, assist in maritime rescue operations, check diving equipment, comply with legal requirements for diving operations, comply with the planned time for the depth of the dive, coordinate rescue missions, deal with pressure from unexpected circumstances, display warnings around the dive site, dive with scuba equipment, ensure diving operations conform with the plan, ensure health and safety of dive teams, handle stressful situations in the workplace, implement dive plans, interrupt diving operations when necessary, maintain diving equipment, perform diving interventions, perform search and rescue missions, provide first aid, react calmly in stressful situations, tolerate stress.	Crisis intervention, diving equipment, diving operation requirements, diving vessels systems, first aid.
Mechatronics assembler	8211.3	Align components, apply assembly techniques, apply soldering techniques, assemble mechatronic units, clean components during assembly, ensure conformity to specifications, follow standards for machinery safety, install mechatronic equipment, maintain mechatronic equipment, meet deadlines, monitor machine operations, perform metal work, read assembly drawings, read standard blueprints, remove defective products, troubleshoot.	Computer equipment, electronics, mechatronics, quality standards, safety engineering.
Electrical equipment assembler	8212.2	Align components, apply soldering techniques, assemble electrical components, attach power cords to electric modules, connect armature windings, ensure conformity to specifications, fasten components, inspect quality of products, interpret electrical diagrams, measure parts of manufactured products, meet deadlines, monitor manufacturing quality standards, operate soldering equipment, read assembly drawings, remove defective products, report defective manufacturing materials, troubleshoot, wear appropriate protective gear.	Electrical discharge, electrical equipment regulations, electrical wiring diagrams, electricity, electricity principles.

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Electronic equipment assembler	8212.3	Align components, apply assembly techniques, apply health and safety standards, apply soldering techniques, assemble electronic units, ensure conformity to specifications, fasten components, interpret circuit diagrams, measure parts of manufactured products, meet deadlines, monitor manufacturing quality standards, read assembly drawings, remove defective products, report defective manufacturing materials, solder electronics.	Electrical equipment regulations, electronic equipment standards, electronics, integrated circuits, printed circuit boards, quality standards, types of electronics.
Metal products assembler	8219.8	Assemble metal parts, ensure equipment availability, ensure public safety and security, fasten components, fix knife blades, inspect quality of products, join metals, manipulate metal, perform pre-assembly quality checks, troubleshoot, use metalworking tools, use technical documentation.	Metal joining technologies, types of metal.
Automated cable vehicle controller	8343.1	Adhere to transportation work schedule, communicate verbal instructions, follow signalling instructions, inspect cables, inspect crane equipment, manage on-board hazards, operate bottom-supported cable-propelled vehicles, operate top-supported cable-propelled vehicles, stay alert.	Cable-propelled transit, health and safety measures in transportation.
Production plant crane operator	8343.4	Apply various lifting techniques, determine crane load, determine the load's centre of gravity, follow safety procedures when working at heights, handle cargo, liaise with the transported goods' workers, operate cranes, operate lifting equipment, operate railway lever frames.	Automation technology, crane load charts, ferrous metal processing, mechatronics, non-ferrous metal processing, robotics.

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Tower crane operator	8343.5	Follow health and safety procedures in construction, follow safety procedures when working at heights, inspect construction sites, interpret 2D plans, interpret 3D plans, keep heavy construction equipment in good condition, operate tower crane, react to events in time-critical environments, secure heavy construction equipment, use safety equipment in construction, work ergonomically, work in a construction team.	Crane load charts, mechanical systems, mechanical tools.
Dredge operator	8342.2	Collect samples, follow health and safety procedures in construction, maintain dredging equipment, measure water depth, position dredger, prevent damage to utility infrastructure, use rigging tools, use safety equipment in construction, work ergonomically.	Dredging consoles, mechanical systems.
Education programme coordinator	1345.1.3	Advise on curriculum development, analyse the training market, cooperate with education professionals, develop a pedagogical concept, ensure curriculum adherence, establish educational network, identify education needs, inspect education institutions, manage budgets, monitor curriculum implementation, monitor educational developments.	Budgetary principles, curriculum standards, pedagogy.
Predictive maintenance expert	2152.1.13	Advise on equipment maintenance, analyse big data, apply information security policies, apply statistical analysis techniques, design sensors, develop data processing applications, ensure equipment maintenance, gather data, manage data, model sensor, perform data analysis, test sensors.	ICT networking hardware, computer programming, electrical engineering, electricity, electronics, mathematics, predictive maintenance, statistics.

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Product quality inspector	7543.1	Create solutions to problems, develop calibration procedures, develop methodologies for supplier evaluation, identify preventive actions, identify process improvements, manage corrective actions, manage health and safety standards, monitor manufacturing quality standards, negotiate with stakeholders, oversee quality control, perform quality audits, report defective manufacturing materials, revise quality control systems documentation, support implementation of quality management systems, track key performance indicators, write inspection reports.	Continuous improvement philosophies, quality assurance procedures, quality control systems, quality standards.
Water traffic coordinator	4323.20	Anticipate shipment handling requirements, apply procedures to ensure cargo complies with customs regulations, coordinate dock operations, coordinate the itineraries of vessels, develop efficiency plans for maritime shipping, ensure compliance with port regulations, ensure vessel compliance with regulations, implement cost-effective cargo handling strategies on ships, implement efficiency plans for logistics operations, liaise with port users, load cargo onto ships, manage dispatch software systems, manage port operations improvement procedures, match vessels to shipping routes, operate port communications systems, prepare transportation routes, verify qualifications of water transport crew.	Commodities in maritime transportation, customs regulations for passengers, freight transport methods, maritime telecommunications, port regulation, principles of cargo stowage, types of maritime vessels, vessel stability principles, vessel traffic services, warehouse operations.

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Community social worker	2635.3.6	Accept own accountability, address problems critically, adhere to organisational guidelines, advocate for social service users, apply anti-oppressive practices, apply case management, apply crisis intervention, apply decision making within social work, apply holistic approach within social services, apply organisational techniques, apply person-centred care, apply problem solving in social service, apply quality standards in social services, apply socially just working principles, assess social service users' situation, build community relations, build helping relationship with social service users, communicate professionally with colleagues in other fields, communicate with social service users, conduct interview in social service, consider social impact of actions on service users, contribute to protecting individuals from harm, cooperate at inter-professional level, deliver social services in diverse cultural communities, demonstrate leadership in social service cases, develop professional identity in social work, develop professional network, empower social service users, evaluate older adults' ability to take care of themselves, follow health and safety precautions in social care practices, have computer literacy, involve service users and carers in care planning, listen actively, maintain records of work with service users, make legislation transparent for users of social services, manage ethical issues within social services, manage social crisis, manage stress in the workplace, meet standards of practice in social services, negotiate with social service stakeholders, negotiate with social service users, organise social work packages, perform fundraising activities, perform street interventions in social work, plan social service process, prevent social problems, promote inclusion, promote service users' rights, promote social change, protect vulnerable social service users, provide community development services, provide social counselling, provide support to social services users, raise awareness on local community's priorities, refer social service users, relate empathetically, report on social development, review social service plan, tolerate stress, undertake continuous professional development in social work, work in a multicultural environment in health care, work within communities.	Company policies, counselling methods, legal requirements in the social sector, social justice, social sciences, social work theory.

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Investor relations manager	2412.6.4	Advise on financial matters, analyse business plans, analyse financial performance of a company, analyse market financial trends, build business relationships, create a financial plan, enforce financial policies, ensure information transparency, follow company standards, liaise with managers, liaise with shareholders, perform public relations, strive for company growth.	Business communication, corporate social responsibility, financial analysis, financial forecasting, financial management, financial markets, financial statements, funding methods, investment analysis, modern portfolio theory, public relations, securities, stock market.
Public relations officer	2432.9	Advise on public image, advise on public relations, analyse external factors of companies, build trust, conduct public presentations, develop communications strategies, develop digital content, develop public relations strategies, draft press releases, establish relationship with the media, give interviews to media, integrate strategic foundation in daily performance, organise press conferences, perform public relations, prepare presentation material, protect client interests, use different communication channels.	Business communication, communication principles, corporate social responsibility, corporate sustainability, digital communication and collaboration, diplomatic principles, forming of public opinion, market research, reputation management, rhetoric, strategic planning.
Maritime instructor	2320.1.17	Adapt teaching to student's capabilities, analyse weather forecast, apply intercultural teaching strategies, apply teaching strategies, assess students, assist students in their learning, distinguish various types of ships, give constructive feedback, guarantee students' safety, monitor developments in field of expertise, operate marine communication systems, prepare lesson content, recognise abnormalities on board, stay up-to-date with maritime transportation technology, teach boating principles.	Global Maritime Distress and Safety System, assessment processes, curriculum objectives, geographic areas, health and safety measures in transportation, international regulations for preventing collisions at sea, vessel safety equipment.
Energy manager	1349.12	Adhere to organisational guidelines, advise on heating systems energy efficiency, advise on sustainable management policies, advise on utility consumption, analyse energy consumption, carry out energy management of facilities, conduct energy audit, create manufacturing guidelines, define energy profiles, define manufacturing quality criteria, develop business case, develop energy policy, develop manufacturing policies, develop staff, establish daily priorities, follow company standards, identify energy needs, liaise with managers, manage budgets, manage logistics, manage staff, manage supplies, meet deadlines, prepare energy performance contracts,	Alternative energy, corporate social responsibility, corporate sustainability, electrical power safety regulations, electricity consumption, energy conservation, energy efficiency, energy performance of buildings, manufacturing processes, resource-efficient technologies, sustainable technologies.

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		promote environmental awareness, promote innovative infrastructure design, promote sustainable energy, strive for company growth, supervise daily information operations.	
Environmental expert	2143.2	Advise on carbon emissions reduction, advise on chemical use reduction, advise on environmental remediation, advise on pollution prevention, analyse environmental data, assess environmental impact, carry out environmental audits, collect samples for analysis, conduct environmental surveys, create solutions to problems, develop environmental policy, develop environmental remediation strategies, investigate pollution, measure pollution, perform environmental investigations, provide training in sustainable tourism development and management, report on environmental issues, report pollution incidents.	Alternative energy, alternative fuels, ecosystem management, environmental legislation, environmental management standards, environmental policy, environmental threats, green building standards, pollution legislation, pollution prevention, resource-efficient technologies, scientific research methodology.
Mechanical engineering technician	3115.1	Adjust engineering designs, analyse test data, define part requirements, design engineering components, liaise with engineers, read engineering drawings, troubleshoot.	CAE software, engineering principles, engineering processes, mathematics, mechanical engineering, mechanics, principles of mechanical engineering.
Construction quality manager	3112.1.4	Adjust engineering designs, advise on construction materials, check compatibility of materials, communicate with external labouratories, ensure conformity to specifications, follow health and safety procedures in construction, inspect construction supplies, keep records of work progress, liaise with managers, use safety equipment in construction, work ergonomically, write specifications.	Building materials, industry construction product regulation, design principles, energy conservation, statistical quality control, total quality control.

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7.2 ANNEX II: Survey for VET and HE teachers

Survey for VET and HE teachers

Thank you for participating in our survey. Your feedback is invaluable and will contribute significantly to our research efforts. Please note that the survey will last approximately **10 minutes**.

Purpose of the Survey

The primary purpose of this survey is to gather comprehensive and relevant knowledge about the offshore renewable energy sector, focusing on its technical, economic, legal, environmental, and social dimensions. This preliminary analysis is crucial for identifying the labour market and skills needs that will support the development of multiple project activities.

Confidentiality

We assure you that your responses will be kept confidential. All data collected will be anonymized and aggregated, ensuring that no individual respondent can be identified in published data. The information you provide will be used solely for research purposes. Please note that the provision of your email is required for potential future communication, verification of a natural user, and to ensure that only one response is submitted per user.

Data Protection and Privacy

Collection of personal data is the sole responsibility of the members of the SHOREWINNER project partnership, who guarantee its full protection in compliance with the General Data Protection Regulation (Regulation (EU) 2016/679), and which arises within the scope of the project and activity to which this form relates.

* Indicates required question

1. Email *

2. By clicking "I Agree" below, you acknowledge that you have read and understood the above information, and you consent to participate in this survey. *

   Mark only one oval.

   ◯ I agree

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SHOREWINNER Project

The **Southern European Community for Offshore Wind Energy** (SHOREWINNER) project aims to set up and develop a Community of Practice (CoP) based on the cooperation among five Centres of Vocational Excellence (CoVEs) committed to the development of skills, upskilling and reskilling of the workforce, sharing of resources, and achievement of major European goals and priorities. The CoVEs will be created in southern European countries with a promising offshore energy sector. Each CoVE will engage national stakeholders to collaboratively provide vocational training aligned with the needs of the local industry. SHOREWINNER will establish a Community of Practice (CoP) to foster collaboration and partnerships among vocational education and training (VET) institutions, higher education institutions, enterprises, research groups, and industry representatives.

Relevant information can also be found here: Southern European Community for Offshore Wind Energy

Personal information

3. Respondent's name *

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4. Please, specify your age *

Mark only one oval.

- Up to 25
- Between 26 and 35
- Between 36 and 45
- Between 46 and 55
- Above 56

5. Please specify your gender *

Mark only one oval.

- Male
- Female
- Other

6. Institution/affiliation *

7. Country of employment *

Mark only one oval.

- Portugal
- Spain
- Italy
- Greece
- Cyprus

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8. What is your current position in your institution? *

Mark only one oval.

- Permanent teaching staff
- Temporary teaching staff
- Administrative staff
- Other: ____________

Institution/ affiliation information

9. How can your organization be best described? *

Mark only one oval.

- University
- College
- Vocational Education & Training (VET) Provider
- Secondary education institute
- Other: ____________

10. How many students does your institution have in total? *

Mark only one oval.

- 0-100
- 101-1000
- 1001-5000
- 5001-10000
- Over 10001

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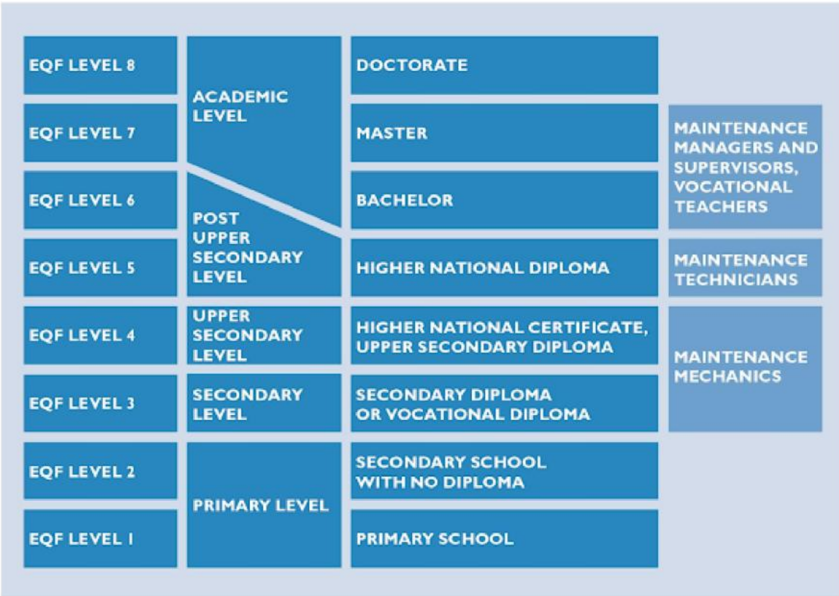
11. What are the European Qualifications Framework (EQF) level(s) of the educational programs at your institution? *



Check all that apply.

- [ ] Level 1
- [ ] Level 2
- [ ] Level 3
- [ ] Level 4
- [ ] Level 5
- [ ] Level 6
- [ ] Level 7
- [ ] Level 8

12. What type of degrees are attributed by your institution? *

Check all that apply.

- [ ] Associate Degree (falls between high school diploma and university degree)
- [ ] Bachelor's Degree
- [ ] Master's Degree
- [ ] Doctorate Degree
- [ ] Other: ______________________

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13. In your opinion, what are the most encouraged career paths for students at your institution? *

Check all that apply.

- [ ] Engineers
- [ ] Metalworkers
- [ ] Technicians
- [ ] Assemblers
- [ ] Draughtspersons
- [ ] Installers
- [ ] Divers
- [ ] Health & Safety
- [ ] Plant operators
- [ ] Other: ____________________

14. What percentage of your students are younger than 30 years old? *

Please provide a personal estimation.

Mark only one oval.

- ◯ Less than 10%
- ◯ Between 10-25%
- ◯ Between 25-50%
- ◯ Over 50%
- ◯ All

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15. What percentage of your students are older than 50 years old? *

Please provide a personal estimation.

Mark only one oval.

- Less than 10%
- Between 10-25%
- Between 25-50%
- Over 50%
- All

Expertise

16. Which of the renewable energy groups best fits into the overall value chain of your specialty? *

Mark only one oval.

- Offshore wind energy
- Onshore wind energy
- Offshore solar energy
- Onshore solar energy
- Tidal energy
- Wave energy
- Ocean thermal energy
- Other: ______________________

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17. Which phases of the offshore renewable energy value chain do your teaching activities cover? *

Check all that apply.

- [ ] Pre-planning/ Research
- [ ] Project Planning
- [ ] Tendering & Contracting
- [ ] Manufacturing
- [ ] Construction & Installation
- [ ] Operation & Maintenance
- [ ] Decommissioning/ Recommissioning
- [ ] Other: ____________________

18. Which subjects related to renewable energy technologies have you taught? *

Check all that apply.

- [ ] Offshore wind energy
- [ ] Onshore wind energy
- [ ] Offshore solar energy
- [ ] Onshore solar energy
- [ ] Tidal energy
- [ ] Wave energy
- [ ] Ocean thermal energy
- [ ] Other: ____________________

19. How many years of teaching experience do you have in the sector of renewable energy technologies? *

Mark only one oval.

- ( ) Less than 3 years
- ( ) Between 3-5 years
- ( ) Between 6-10 years
- ( ) More than 10 years

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20. *

How many years of teaching experience do you have in the sector of offshore renewable energy technologies?

Mark only one oval.

- No experience
- Less than 3 years
- Between 3-5 years
- Between 6-10 years
- More than 10 years

Skills review

21. With regard to hard skills of your students, what in your opinion are currently the most important gaps that should be addressed by educational/training programs? *

Check all that apply.

- Offshore specific skills (e.g., working at heights, underwater welding)
- Digital skills (e.g., CT skills, remote-controlling, data analytics, smart device handling)
- Engineering skills (e.g., electrical, structural, offshore engineering)
- Project management (e.g., planning, executing, and closing projects)
- Project design and planning (e.g., conceptualizing and organizing project components)
- Health and safety skills (e.g., risk assessment, emergency response)
- Foreign languages – reading and writing (especially English)
- Using and understanding numerical or statistical information (e.g., data interpretation, statistical analysis)
- Other: ____________________

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22. Based on the previous question on skills gaps please indicate, if needed, specific skills or activities

23. With regard to soft skills of your students, what in your opinion are currently the * most important gaps that should be addressed by educational/training programs?

Check all that apply.

- [ ] Critical thinking and problem solving (Analyzing issues and finding effective solutions)
- [ ] Communication and collaboration (Exchanging information clearly and working well in teams)
- [ ] Knowledge management and transfer (Efficiently handling and sharing information and expertise)
- [ ] ICT literacy (Proficiency with information and communication technologies)
- [ ] Flexibility and adaptability (Adjusting to new conditions and challenges)
- [ ] Initiative and self-direction (Proactively taking charge and managing one's own work)
- [ ] Productivity and accountability (Effectively completing tasks and taking responsibility for outcomes)
- [ ] Leadership and responsibility (Guiding others and being accountable for actions)
- [ ] Other: ____________

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24. Which methods do you believe are most effective for employees to acquire or develop the following skills? *

Mark only one oval per row.

	Hard skills	Soft skills
VET program	◯	◯
Bachelor program	◯	◯
Master program	◯	◯
Attend a professionally accredited training course/seminar/program	◯	◯
Through on-the-job training (e.g., mentoring, shadowing)	◯	◯
Through in-house training (e.g., transfer of experience and knowledge of older workers)	◯	◯

25. Do you have any general comments or suggestions in the context of skills review?

Study program

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26. Which of the following technologies are covered by your study program? *

Check all that apply.

- [ ] Artificial Intelligence (e.g., neural networks, natural language processing)
- [ ] Automation and advanced robotics (e.g., remotely operated vehicles, drones, etc.)
- [ ] Big Data/Data Analytics (e.g., Hadoop, Spark)
- [ ] Cybersecurity (e.g., encryption, intrusion detection systems)
- [ ] Digital platforms (e.g., e-commerce platforms, social media platforms)
- [ ] Internet of Things (IoT) (e.g., smart home devices, industrial IoT sensors)
- [ ] Cloud services (e.g., AWS, Google Cloud Platform)
- [ ] Blockchain (e.g., Ethereum, Bitcoin)
- [ ] Energy Management Systems (EMS) (e.g., SCADA, BEMS)
- [ ] Communication technologies (e.g., 5G, VoIP)
- [ ] 3D Printing (e.g., FDM printers, SLA printers)
- [ ] Smart technologies (e.g., smart grid, smart meters)
- [ ] Energy storage (e.g., lithium-ion batteries, supercapacitors)
- [ ] Material science (e.g., nanomaterials, composite materials)

27. Please list technologies, related to offshore renewable energy entire value chain, that are not mentioned above.

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28. Which of the following tools are addressed (provide training or use) at your study programs? *

Check all that apply.

- [ ] Data visualization tools (e.g., Tableau, Power BI)
- [ ] Programming languages (e.g., Python, R)
- [ ] Simulation software (e.g., MATLAB, Simulink)
- [ ] Project management tools (e.g., Asana, Trello)
- [ ] Cloud computing platforms (e.g., AWS, Azure)
- [ ] Machine learning frameworks (e.g., TensorFlow, PyTorch)
- [ ] Cybersecurity tools (e.g., Firewalls, Anti-virus software)
- [ ] Geographic Information Systems (GIS)
- [ ] Collaboration tools (e.g., Slack, Microsoft Teams)
- [ ] Statistical analysis software (e.g., SPSS, SAS)
- [ ] CAD software (e.g., AutoCAD, SolidWorks)
- [ ] Version control systems (e.g., Git, SVN)
- [ ] Database management systems (e.g., SQL, NoSQL databases)
- [ ] Virtual and augmented reality tools (e.g., Oculus, HoloLens)
- [ ] Blockchain platforms (e.g., Ethereum, Hyperledger)
- [ ] Internet of Things (IoT) platforms (e.g., Arduino, Raspberry Pi)
- [ ] Robotics programming platforms (e.g., ROS, LabVIEW)

29. Please list tools, related to offshore renewable energy entire value chain, that are not mentioned above.

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30. How often do you update your course content to reflect industry changes? *

Mark only one oval.

- More than once annually
- Annually
- Once every 2-3 years
- Once every 5 years
- Never

31. What additional training or resources do you need to improve your teaching effectiveness? *

Check all that apply.

- [ ] Industry workshops
- [ ] Updated course materials
- [ ] Access to industry experts
- [ ] Practical training facilities
- [ ] Other: ____________________

32. How do you incorporate practical experience into your teaching? *

Check all that apply.

- [ ] Internships
- [ ] Guest lectures from industry experts
- [ ] Field trips
- [ ] Hands-on labs
- [ ] Virtual labs
- [ ] Other: ____________________

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33. What are the main challenges you face in delivering effective education and training? *

Check all that apply.

- [ ] Lack of resources
- [ ] Keeping up with industry changes
- [ ] Limited practical training opportunities
- [ ] Student engagement
- [ ] Other: ____________________

34. Do you have any general comments or suggestions in the context of study program?

____
____
____
____
____

Collaboration and challenges

35. How do you ensure your curriculum aligns with current regulations and standards? *

Check all that apply.

- [ ] Regular consultations with policy makers
- [ ] Participation in policy forums
- [ ] Compliance reviews
- [ ] Adopting industry standards
- [ ] Collaborative workshops
- [ ] I don't engage with policy makers
- [ ] Other: ____________________

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36. How do you collaborate with education and training providers to enhance the quality of teaching and learning? *

Check all that apply.

- [ ] Joint curriculum development
- [ ] Shared training facilities
- [ ] Teacher exchange programs
- [ ] I don't collaborate with other education and training providers
- [ ] Other: ______________________

37. Please list any additional educational collaboration partners your institution engages with

____
____
____
____
____

38. What challenges do you face in collaborating with employers to ensure the relevance of your programs? *

Check all that apply.

- [ ] Limited engagement from employers
- [ ] Misalignment of academic and industry needs
- [ ] Logistical issues in organizing internships or placements
- [ ] No challenges are faced
- [ ] Other: ______________________

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39. What support do you need from social partners to better prepare students for the workforce? *

Check all that apply.

- [ ] Networking opportunities
- [ ] Mentorship programs
- [ ] Career counselling services
- [ ] No support is required
- [ ] Other: ____________________

40. How do you address the challenge of keeping up with rapid technological changes in your teaching? *

Check all that apply.

- [ ] Continuous professional development
- [ ] Partnerships with technology companies
- [ ] Access to latest tools and software
- [ ] No challenges are faced
- [ ] Other: ____________________

41. In your opinion, what are the main challenges in ensuring student readiness for the offshore renewable energy sector? *

Check all that apply.

- [ ] Practical training opportunities
- [ ] Access to real-world projects
- [ ] Industry-specific skill development
- [ ] Alignment of academic curricula with current industry technologies
- [ ] Availability of specialized equipment and facilities for training
- [ ] Effective partnerships between educational institutions and industry leaders
- [ ] Financial barriers to accessing advanced training programs
- [ ] Geographic limitations affecting on-site learning experiences
- [ ] Safety training for working in offshore environments
- [ ] Legal and regulatory compliance training
- [ ] Other: ____________________

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42. What are the key challenges in aligning your educational programs with industry standards? *

Check all that apply.

- [ ] Understanding certification requirements
- [ ] Updating curriculum to meet standards
- [ ] Coordination with certification bodies
- [ ] Other: ____________________

43. Do you have any general comments or suggestions in the context of collaboration and stakeholder engagement?

____
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Transversal Skills

44. Please specify which of the following transversal skills are cultivated at your organization. *

Check all that apply.

- [ ] Communication
- [ ] Team working
- [ ] Ease of learning
- [ ] Planning and organization
- [ ] Problem solving
- [ ] Innovation and creativity
- [ ] Leadership
- [ ] Systemic/holistic thinking
- [ ] Cross-disciplinary technical competences

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45. Please list relevant transversal skills that you feel are important and not mentioned above

Smart specialization

Smart specialisation is an innovative approach that aims to boost growth and jobs in Europe, by enabling each region to identify and develop its own competitive advantages. Through its partnership and bottom-up approach, smart specialisation brings together local authorities, academia, business spheres and the civil society, working for the implementation of long-term growth strategies supported by EU funds.

46. Does your institution face the challenge of adapting its study program to smart specialization goals and policies? *

Mark only one oval.

- Yes
- No
- Don't know

47. Does your institution need the adaptation of new skills for smart specialization that were not needed before? *

Mark only one oval.

- Yes
- No
- Don't know

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48. Please elaborate

Communication

49. Would you like to receive news regarding the results of the questionnaire? *

Mark only one oval.

- Yes
- No

50. Would you like to receive news and updates regarding the SHOREWINNER project? *

Mark only one oval.

- Yes
- No

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7.3 ANNEX III: Survey for Professionals

Survey for Professionals

Thank you for participating in our survey.
Your feedback is invaluable and will contribute significantly to our research efforts. Please note that the survey will last approximately **10 minutes**.

Purpose of the Survey

The primary purpose of this survey is to gather comprehensive and relevant knowledge about the offshore renewable energy sector, focusing on its technical, economic, legal, environmental, and social dimensions. This preliminary analysis is crucial for identifying the labour market and skills needs that will support the development of multiple project activities.

Confidentiality

We assure you that your responses will be kept confidential. All data collected will be anonymized and aggregated, ensuring that no individual respondent can be identified in published data. The information you provide will be used solely for research purposes. Please note that the provision of your email is required for potential future communication, verification of a natural user, and to ensure that only one response is submitted per user.

Data Protection and Privacy

Collection of personal data is the sole responsibility of the members of the SHOREWINNER project partnership, who guarantee its full protection in compliance with the General Data Protection Regulation (Regulation (EU) 2016/679), and which arises within the scope of the project and activity to which this form relates.

* Indicates required question

1. Email *

   ____

2. By clicking “I Agree” below, you acknowledge that you have read and understood the above information, and you consent to participate in this survey. *

   Mark only one oval.

   ◯ I agree

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SHOREWINNER Project

The **Southern European Community for Offshore Wind Energy** (SHOREWINNER) project aims to set up and develop a Community of Practice (CoP) based on the cooperation among five Centres of Vocational Excellence (CoVEs) committed to the development of skills, upskilling and reskilling of the workforce, sharing of resources, and achievement of major European goals and priorities. The CoVEs will be created in southern European countries with a promising offshore energy sector. Each CoVE will engage national stakeholders to collaboratively provide vocational training aligned with the needs of the local industry. SHOREWINNER will establish a Community of Practice (CoP) to foster collaboration and partnerships among vocational education and training (VET) institutions, higher education institutions, enterprises, research groups, and industry representatives.

Relevant information can also be found here: [Southern European Community for Offshore Wind Energy]

Personal information

3. Respondent's name *

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4. Please, specify your age *

Mark only one oval.

- Up to 25
- Between 26 and 35
- Between 36 and 45
- Between 46 and 55
- Above 56

5. Please specify your gender *

Mark only one oval.

- Male
- Female
- Other

6. Company name *

____

7. Country of employment *

Mark only one oval.

- Portugal
- Spain
- Italy
- Greece
- Cyprus

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8. If your company is present in different countries, please indicate which one you are providing information for.

____

9. What is your current position in your company? *

Mark only one oval.

- ◯ Chief Officer (e.g. Executive, Financial, Operating)
- ◯ Director
- ◯ Manager
- ◯ Team Leader/ Supervisor
- ◯ Sales & Marketing Department
- ◯ Finance & Accounting Department
- ◯ Human Resources
- ◯ Operations
- ◯ Other: _______________________________________

Company information

10. How many employees does your company employ in total? *

Mark only one oval.

- ◯ 1-50 employees
- ◯ 51-250 employees
- ◯ 251-1000 employees
- ◯ Over 1001 employees

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11. Which phases of the offshore renewable energy value chain do the activities of your company typically cover? *

Check all that apply.

- [ ] Pre-planning/ Research
- [ ] Project Planning
- [ ] Tendering & Contracting
- [ ] Manufacturing
- [ ] Construction & Installation
- [ ] Operation & Maintenance
- [ ] Decommissioning/ Recommissioning
- [ ] Other: ____________________

12. To which geographic market does your company typically provide services? *

Mark only one oval.

- ( ) National
- ( ) Regional
- ( ) European
- ( ) Global

13. Which of the following occupational groups are the most representative among your company's employees? *

Check all that apply.

- [ ] Engineers
- [ ] Metalworkers
- [ ] Technicians
- [ ] Assemblers
- [ ] Draughtspersons
- [ ] Installers
- [ ] Divers
- [ ] Health & Safety
- [ ] Plant operators
- [ ] Other: ____________________

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14. What percentage of your company's employees are younger than 30 years old? *

Please provide a personal estimation.

Mark only one oval.

- Less than 10%
- Between 10-25%
- Between 25-50%
- Over 50%
- All

15. What percentage of your company's employees are older than 50 years old? *

Please provide a personal estimation.

Mark only one oval.

- Less than 10%
- Between 10-25%
- Between 25-50%
- Over 50%
- All

Skills supply

16. Are there currently any vacancies in your company? *

Mark only one oval.

- Yes
- No

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17. Has it been difficult to fill these vacancies (or the most recent ones), due to the lack of adequate skills of applicants? *

Mark only one oval.

- No, it's very easy
- No, it's quite easy
- Neither difficult nor easy
- Yes, it's quite difficult
- Yes, it's very difficult

18. What are your minimum requirements in terms of education and training for each occupational group? *

Mark only one oval per row.

	Tertiary/BSc	Tertiary/MSc	Upper-secondary/ Vocationally-oriented	Upper-secondary/ Generally-oriented	No answer
Engineers					
Metalworkers					
Technicians					
Assemblers					
Draughtspersons					
Installers					
Divers					
Health & Safety					
Plant operators					

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19. Do you have any general comments or suggestions in the context of skills supply?

____
____
____
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20. Does your company support training measures? If yes, which is/are the type(s) of training preferred in your company? If no, skip the question.

Mark only one oval per row.

	General knowledge training	Specialization
Distance learning (Online training)	⬭	⬭
In-house training	⬭	⬭
Workshops	⬭	⬭
Postgraduate studies	⬭	⬭
Summer/Winter schools	⬭	⬭

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21. Which subjects related to renewable energy technologies have you taught? *

Check all that apply.

- [ ] Offshore wind energy
- [ ] Onshore wind energy
- [ ] Offshore solar energy
- [ ] Onshore solar energy
- [ ] Tidal energy
- [ ] Wave energy
- [ ] Ocean thermal energy
- [ ] Other: ____________________

Skills review

22. How regularly does your company review the skills and training needs of your employees? *

Mark only one oval.

- ( ) More than once annually
- ( ) Annually
- ( ) Once every 2-3 years
- ( ) Once every 5 years
- ( ) Never

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23. Which employee groups are mainly addressed? *

Mark only one oval.

- Engineers
- Metalworkers
- Technicians
- Assemblers
- Draughtspersons
- Installers
- Divers
- Health & Safety
- Plant operators

24. Which of the following technologies do you consider most important for your company? *

Check all that apply.

- Artificial Intelligence (e.g., neural networks, natural language processing)
- Automation and advanced robotics (e.g., remotely operated vehicles, drones, etc.)
- Big Data/Data Analytics (e.g., Hadoop, Spark)
- Cybersecurity (e.g., encryption, intrusion detection systems)
- Digital platforms (e.g., e-commerce platforms, social media platforms)
- Internet of Things (IoT) (e.g., smart home devices, industrial IoT sensors)
- Cloud services (e.g., AWS, Google Cloud Platform)
- Blockchain (e.g., Ethereum, Bitcoin)
- Energy Management Systems (EMS) (e.g., SCADA, BEMS)
- Communication technologies (e.g., 5G, VoIP)
- 3D Printing (e.g., FDM printers, SLA printers)
- Smart technologies (e.g., smart grid, smart meters)
- Energy storage (e.g., lithium-ion batteries, supercapacitors)
- Material science (e.g., nanomaterials, composite materials)

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25. With regard to hard skills of your employees, what in your opinion are currently the most important gaps that should be addressed by educational/training programs? *

Check all that apply.

- [ ] Offshore specific skills (e.g., working at heights, underwater welding)
- [ ] Digital skills (e.g., CT skills, remote-controlling, data analytics, smart device handling)
- [ ] Engineering skills (e.g., electrical, structural, offshore engineering)
- [ ] Project management (e.g., planning, executing, and closing projects)
- [ ] Project design and planning (e.g., conceptualizing and organizing project components)
- [ ] Health and safety skills (e.g., risk assessment, emergency response)
- [ ] Foreign languages – reading and writing (especially English)
- [ ] Using and understanding numerical or statistical information (e.g., data interpretation, statistical analysis)
- [ ] Other: ______________________

26. Based on the previous question on skills gaps please indicate, if needed, specific skills or activities

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27. With regard to soft skills of your employees, what in your opinion are currently the most important gaps that should be addressed by educational/training programs? *

Check all that apply.

- [ ] Critical thinking and problem solving (Analyzing issues and finding effective solutions)
- [ ] Communication and collaboration (Exchanging information clearly and working well in teams)
- [ ] Knowledge management and transfer (Efficiently handling and sharing information and expertise)
- [ ] ICT literacy (Proficiency with information and communication technologies)
- [ ] Flexibility and adaptability (Adjusting to new conditions and challenges)
- [ ] Initiative and self-direction (Proactively taking charge and managing one's own work)
- [ ] Productivity and accountability (Effectively completing tasks and taking responsibility for outcomes)
- [ ] Leadership and responsibility (Guiding others and being accountable for actions)
- [ ] Other: ______________________

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28. Which methods do you believe are most effective for employees to acquire or develop the following skills? *

Mark only one oval per row.

	Hard skills	Soft skills
VET program	⬭	⬭
Bachelor program	⬭	⬭
Master program	⬭	⬭
Attend a professionally accredited training course/seminar/program	⬭	⬭
Through on-the-job training (e.g., mentoring, shadowing)	⬭	⬭
Through in-house training (e.g., transfer of experience and knowledge of older workers)	⬭	⬭

29. Do you have any general comments or suggestions in the context of skills review?

____

____

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____

Collaboration and challenges

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30. How does your company ensure its compliance with current regulations and standards? *

Check all that apply.

- [ ] Regularly updating policies and procedures to align with new regulations.
- [ ] Maintaining a dedicated compliance team that monitors regulatory updates and changes.
- [ ] Engaging with external consultants and experts to audit compliance practices.
- [ ] Compliance with international standards is not a primary focus.
- [ ] Other: ______________________

31. What strategies do you use to engage with professional associations in your sector? *

Check all that apply.

- [ ] We participate in association-led initiatives and panels
- [ ] We contribute to the development of industry guidelines
- [ ] We attend and sponsor sector-specific conferences and seminars
- [ ] We are not currently engaged with any professional associations
- [ ] Other: ______________________

32. In what ways do you collaborate with technology providers to enhance company performance? *

Check all that apply.

- [ ] We license cutting-edge training tools and platforms
- [ ] We co-develop training solutions tailored to our needs
- [ ] We engage in pilot projects for new technology applications
- [ ] We do not collaborate with technology providers
- [ ] Other: ______________________

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33. What support structures are in place to facilitate continuous learning and development for employees? *

Check all that apply.

- [ ] We offer subscriptions to online learning platforms
- [ ] We provide access to continuing education funds
- [ ] We establish mentorship and coaching programs
- [ ] We have limited support for continuous learning
- [ ] Other: ____________________

34. Do you have any general comments or suggestions in the context of collaboration and stakeholder engagement?

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35. What are the key challenges in aligning your educational programs with industry standards? *

Check all that apply.

- [ ] Understanding certification requirements
- [ ] Updating curriculum to meet standards
- [ ] Coordination with certification bodies
- [ ] Other: ____________________

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36. Do you have any general comments or suggestions in the context of collaboration and stakeholder engagement?

____
____
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____

Transversal Skills

37. Please specify which of the following transversal skills are cultivated at your company. *

Check all that apply.

- [ ] Communication
- [ ] Team working
- [ ] Ease of learning
- [ ] Planning and organization
- [ ] Problem solving
- [ ] Innovation and creativity
- [ ] Leadership
- [ ] Systemic/holistic thinking
- [ ] Cross-disciplinary technical competences

38. Please list relevant transversal skills that you feel are important and not mentioned above

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Smart specialization

Smart
specialisation is an innovative approach that aims to boost growth and jobs in Europe, by enabling each region to identify and develop its own competitive advantages. Through its partnership and bottom-up approach, smart specialisation brings together local authorities, academia, business spheres and the civil society, working for the implementation of long-term growth strategies supported by EU funds.

39. Does your company face the challenge of adapting its study program to smart specialization goals and policies? *

Mark only one oval.

- Yes
- No
- Don't know

40. Does your company need the adaptation of new skills for smart specialization that were not needed before? *

Mark only one oval.

- Yes
- No
- Don't know

41. Please elaborate

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Communication

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42. Would you like to receive news regarding the results of the questionnaire? *

Mark only one oval.

- Yes
- No

43. Would you like to receive news and updates regarding the SHOREWINNER project? *

Mark only one oval.

- Yes
- No

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7.4 ANNEX IV: Survey for Students

Survey for Students

Thank you for participating in our survey.
Your feedback is invaluable and will contribute significantly to our research efforts. Please note that the survey will last approximately **5 minutes**.

Purpose of the Survey

The primary purpose of this survey is to gather comprehensive and relevant knowledge about the offshore renewable energy sector, focusing on its technical, economic, legal, environmental, and social dimensions. This preliminary analysis is crucial for identifying the labour market and skills needs that will support the development of multiple project activities.

Confidentiality

We assure you that your responses will be kept confidential. All data collected will be anonymized and aggregated, ensuring that no individual respondent can be identified in published data. The information you provide will be used solely for research purposes. Please note that the provision of your email is required for potential future communication, verification of a natural user, and to ensure that only one response is submitted per user.

Data Protection and Privacy

Collection of personal data is the sole responsibility of the members of the SHOREWINNER project partnership, who guarantee its full protection in compliance with the General Data Protection Regulation (Regulation (EU) 2016/679), and which arises within the scope of the project and activity to which this form relates.

* Indicates required question

1. Email *

2. By clicking "I Agree" below, you acknowledge that you have read and understood the above information, and you consent to participate in this survey. *

   Mark only one oval.

   ◯ I agree

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SHOREWINNER Project

The **Southern European Community for Offshore Wind Energy** (SHOREWINNER) project aims to set up and develop a Community of Practice (CoP) based on the cooperation among five Centres of Vocational Excellence (CoVEs) committed to the development of skills, upskilling and reskilling of the workforce, sharing of resources, and achievement of major European goals and priorities. The CoVEs will be created in southern European countries with a promising offshore energy sector. Each CoVE will engage national stakeholders to collaboratively provide vocational training aligned with the needs of the local industry. SHOREWINNER will establish a Community of Practice (CoP) to foster collaboration and partnerships among vocational education and training (VET) institutions, higher education institutions, enterprises, research groups, and industry representatives.

Relevant information can also be found here: [Southern European Community for Offshore Wind Energy]

Personal information

3. Respondent's name *

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4. Please, specify your age *

Mark only one oval.

- Up to 25
- Between 26 and 35
- Between 36 and 45
- Between 46 and 55
- Above 56

5. Please specify your gender *

Mark only one oval.

- Male
- Female
- Other

6. Institution/affiliation *

____

7. Country *

Mark only one oval.

- Portugal
- Spain
- Italy
- Greece
- Cyprus

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8. Please specify the category of student you belong to within your institution *

Mark only one oval.

- Secondary education student
- Associate degree student (College, VET)
- Undergraduate student (Bachelor)
- Graduate student (Masters)
- Graduate student (PhD)
- Post-doctoral researcher

Institution/ affiliation information

9. How can your organization be best described? *

Mark only one oval.

- University
- College
- Vocational Education & Training (VET) Provider
- Secondary education institute
- Other: ____________________

10. What type of degrees are attributed by your institution? *

Check all that apply.

- [ ] Associate Degree (falls between high school diploma and university degree)
- [ ] Bachelor's Degree
- [ ] Master's Degree
- [ ] Doctorate Degree
- [ ] Other: ____________________

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11. In your opinion, which career paths does your institution most actively encourage students to pursue? *

Check all that apply.

- [ ] Engineers
- [ ] Metalworkers
- [ ] Technicians
- [ ] Assemblers
- [ ] Draughtspersons
- [ ] Installers
- [ ] Divers
- [ ] Health & Safety
- [ ] Plant operators
- [ ] Other: ____________________

Study program

12. What is your level of interest in pursuing a career in the offshore renewable energy sector
(e.g. Offshore wind energy, offshore solar energy, tidal energy, wave energy, ocean thermal energy)? *

Mark only one oval.

- ( ) Very interested
- ( ) Interested
- ( ) Somewhat interested
- ( ) Not interested

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13. In which phases of the offshore renewable energy value chain are you more interested? *

Check all that apply.

- [ ] Pre-planning/ Research
- [ ] Project Planning
- [ ] Tendering & Contracting
- [ ] Manufacturing
- [ ] Construction & Installation
- [ ] Operation & Maintenance
- [ ] Decommissioning/ Recommissioning
- [ ] Other: ____________________

14. How relevant do you find your current courses to the offshore renewable energy sector? *

Mark only one oval.

- ( ) Very relevant
- ( ) Moderately relevant
- ( ) Slightly relevant
- ( ) Not relevant

Skills review

From
a scale of confidence from 1 to 5, with 1 meaning 'very low confidence' and 5 meaning 'very high confidence', how confident do you feel in each of the following sets
of skills?

15. Offshore specific skills (e.g., working at heights, underwater welding) *

Mark only one oval.

	1	2	3	4	5	
Very	( )	( )	( )	( )	( )	Very high confidence

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16. Digital skills (e.g., CT skills, remote-controlling, data analytics, smart device handling) *

Mark only one oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very high confidence

17. Engineering skills (e.g., electrical, structural, offshore engineering) *

Mark only one oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very high confidence

18. Project design and planning (e.g., conceptualizing and organizing project components) *

Mark only one oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very high confidence

19. Health and safety skills (e.g., risk assessment, emergency response) *

Mark only one oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very high confidence

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20. Foreign languages – reading and writing (especially English) *

Mark only one oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very high confidence

21. Using and understanding numerical or statistical information (e.g., data interpretation, statistical analysis) *

Mark only one oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very high confidence

22. Critical thinking and problem solving (Analyzing issues and finding effective solutions) *

Mark only one oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very high confidence

23. Communication and collaboration (Exchanging information clearly and working well in teams) *

Mark only one oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very high confidence

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24. Knowledge management and transfer (Efficiently handling and sharing information and expertise) *

Mark only one oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very high confidence

25. ICT literacy (Proficiency with information and communication technologies) *

Mark only one oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very high confidence

26. Flexibility and adaptability (Adjusting to new conditions and challenges) *

Mark only one oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very high confidence

27. Initiative and self-direction (Proactively taking charge and managing one's own work) *

Mark only one oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very high confidence

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28. Productivity and accountability (Effectively completing tasks and taking responsibility for outcomes) *

Mark only one oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very high confidence

29. Leadership and responsibility (Guiding others and being accountable for actions) *

Mark only one oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very high confidence

30. How do you stay informed about the latest developments in offshore renewable energy? *

Check all that apply.

- [ ] Industry newsletters
- [ ] Academic journals
- [ ] Online courses
- [ ] Professional networks
- [ ] TV
- [ ] Social media
- [ ] Not interested
- [ ] Other: ______________________

Collaboration and challenges

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31. How well do you think your current education is preparing you for the offshore renewable energy market needs? *

Mark only one oval.

- Very well
- Well
- Adequately
- Poorly

32. Have you participated in any industry-related projects or research? *

Mark only one oval.

- Yes
- No

33. What practical experiences have you had in the sector of offshore renewable energy this field? *

Check all that apply.

- [ ] Internships
- [ ] Workshops
- [ ] Research Projects
- [ ] None
- [ ] Other: ____________________

34. What challenges do you face in gaining practical experience in this field? *

Check all that apply.

- [ ] Lack of internship opportunities
- [ ] Limited access to industry professionals
- [ ] Insufficient practical training in curriculum
- [ ] Geographic limitations (e.g. living in area with no nearby industry facilities)
- [ ] Other: ____________________

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35. What support do you need from your institution to pursue a career in this sector? *

Check all that apply.

- [ ] Career counselling
- [ ] Internship placements
- [ ] Industry networking opportunities
- [ ] Scholarships/funding
- [ ] Other: ____________________

36. Do you have any general comments or suggestions for improving the teaching of offshore renewable energy courses?

____
____
____
____
____

Communication

37. Would you like to receive news regarding the results of the questionnaire? *

Mark only one oval.

- ( ) Yes
- ( ) No

38. Would you like to receive news and updates regarding the SHOREWINNER project? *

Mark only one oval.

- ( ) Yes
- ( ) No

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