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Maritime Alliance for fostering the European Blue Economy through a Marine Technology Skilling Strategy

Co-funded by the Erasmus+ Programme of the European Union

Baseline Executive Report on Present Skills Gaps in Shipbuilding and Offshore Renewables Value Chains

January 2021

About this Report

This document is a short version of the Baseline Report on Present Skills Gaps in Shipbuilding and Offshore Renewables Value Chains which was developed within the framework of the **'MATES – Maritime Alliance for Fostering the European Blue Economy through a Marine Technology Skilling Strategy'** project. Its main objective is to present in a systematic way the key outcomes of the Baseline Report, providing interested readers with a clear overview of the information they will find in the extended report. More specifically, for the two sectors addressed i.e. *Shipbuilding and Offshore Renewable Energy*, a detailed skills supply and demand analysis was performed enabling the identification of the main mismatches, gaps and key shortages that currently exist, thus providing a set of targeted recommendations for addressing them.

After a brief outline of the methodological framework devised for guiding the preparation of the report, the aforementioned key outcomes are presented for each of the two sectors.

All references are available in the full report.

Credits

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Deliverable: 2.1. Baseline report on present skills gaps in shipbuilding and offshore renewables value chains

Please cite this publication as: Sdoukopoulos, E. et al. (2021). Baseline Executive Report on Present Skills Needs in Shipbuilding and Offshore Renewables Value Chains. Results of the MATES project (www.projectmates.eu)

or

Hellenic Institute of Transport (CERTH-HIT), (2021). Baseline Executive Report on Present Skills Needs in Shipbuilding and Offshore Renewables Value Chains. Results of the MATES project (www.projectmates.eu)

Methodological Framework

Figure 1 shows the steps followed for assessing the skills supply and demand mismatch and identifying the main gaps and shortages that exist today.

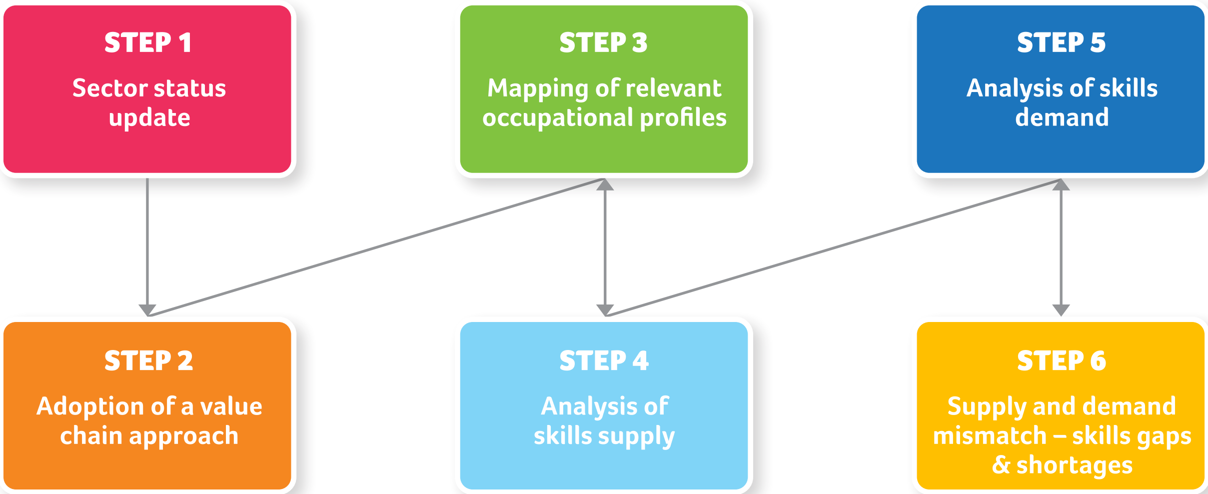

Figure 1. Steps followed for identifying existing skill needs

The first three steps contributed towards building the appropriate background for the report and setting the key reference layers upon which the skills supply and demand analysis was performed. More specifically, in ***step 1***, the status quo of each sector was described, highlighting key characteristics and its evolution over time, thus putting forward the key challenges that are currently being confronted. In ***step 2***, the value chain of each sector was set, providing the basis for identifying in ***step 3*** all the relevant occupational profiles and assessing the ones that impose a greater impact on the value chain. For the latter, relevant educational & training programs that are available in different EU countries were identified and analyzed in ***step 4***. Mainly as an expert-driven process, skills demand was addressed in ***step 5***. More specifically, following a round of workshops, surveys (i.e. job vacancies and questionnaire survey), personal interviews and Focus Group meetings with experts, the key priorities in terms of both hard and soft skills were defined. The latter enabled the evaluation in ***step 6*** of the skills supply and demand mismatch and put forward the main gaps and shortages that exist today, thus proposing a set of actions to be taken for addressing them.

The Shipbuilding Sector in Europe

STEP 1 Current status – key facts

Table 1: Key facts shaping the shipbuilding sector in Europe today

Industry specialization	More sophisticated vessels characterized by high-end equipment and technological components (e.g. cruise vessels, yachts, specialized vessels such as dredgers, etc.).
Economic activity	€41 billion of production value annually from 2010 to 2014 following closely the performance of global competitors (e.g. South Korea, China).
Market size	300 companies actively involved in shipbuilding, maintenance, repair and retrofitting activities & 22,000 marine equipment manufacturers and suppliers of different size and sales volume.
Allocation of industry productivity	Romania, Germany and Italy currently hold the largest productivity shares across the European context.
Employment	Over 200,000 people directly employed & over 350,000 jobs generated by the economic activity of marine equipment manufacturers and suppliers.

STEP 2 Value chain

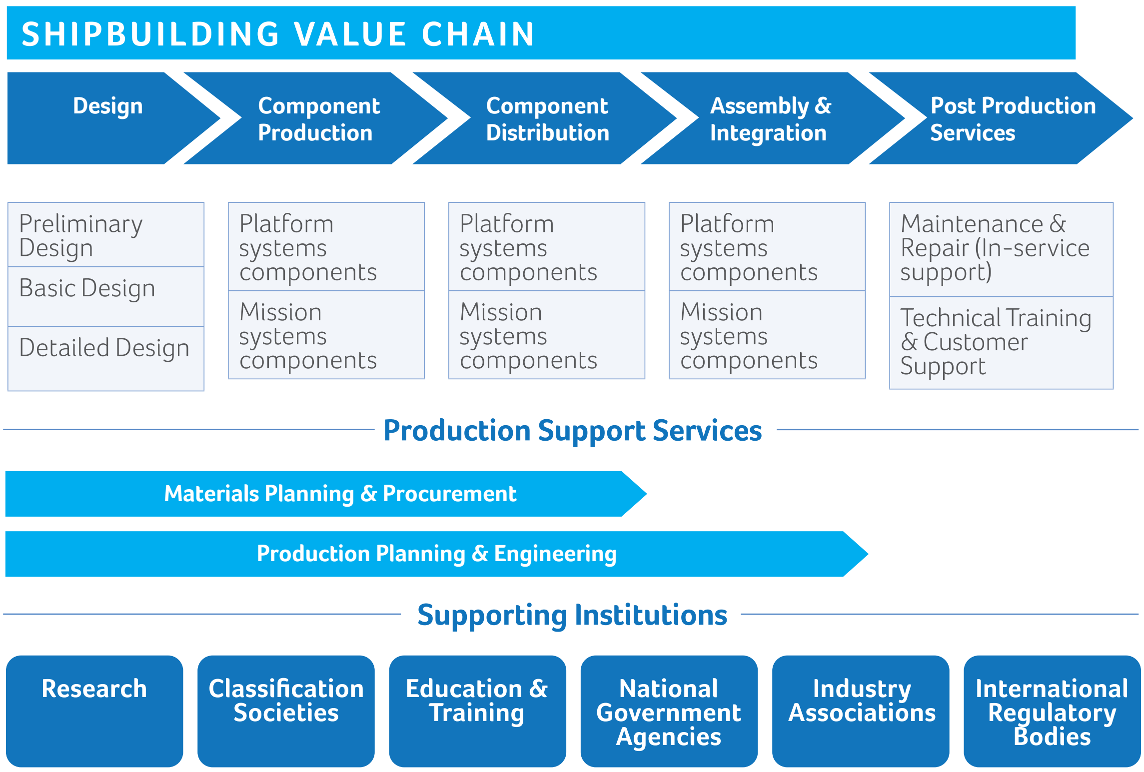

Figure 2. The shipbuilding value chain – key phases and processes

STEP 3 Relevant occupational profiles

Taking ESCO[1] as the main reference point, 60 relevant occupational profiles were identified and clustered into occupational groups. From these, 35 were categorized as primary considering their impact on the value chain (Figure 3). For each of these, the essential skills and competences are listed, while the minimum level of education required is also indicated along with the value chain segment(s) to which they contribute.

Table 2: Primary occupational groups and profiles

Occupational group	Occupational profile
Engineers	Naval architect, Marine engineer, Electro-mechanical engineer
Engineering technicians	Marine engineering technician, Electro-mechanical engineering technician, Electronics engineering technician
Draughtpersons	Marine engineering drafter, Electro-mechanical drafter
Metalworkers	Welding inspector, Welder, Shipwright, Boilermaker, Pipe welder (pipefitter), Sheet metal worker
Electricians & Electronics Technicians	Marine electrician, Marine electronics technician, Electro-mechanical equipment assembler, Electronic equipment assembler
Mechanics	Vessel engine assembler
Surface Treatment	Surface treatment operator, Transport equipment painter, Abrasive blasting operator (sandblasting)
Boat artisans	Marine upholsterer, Boat rigger, Fiberglass laminator, Made-up textile articles manufacturer (sail maker)
Machinists	Computer numerical control (CNC) machine operator
Carpenters	Marine Carpenter
Other	Vessel assembly inspector, Marine surveyor, Construction scaffolder, Construction scaffolding supervisor, Mobile crane operator, Production plant crane operator

[1]The European Skills/Competences, qualifications and Occupations [https://ec.europa.eu/esco/portal/home]

STEP 4 Skills supply

In total, 482 relevant educational and training (E&T) programs offered, for the academic year 2018-2019, in 17 EU countries were identified (Figure 3) and their curricula were assessed. The large majority (48%) consisted of Vocational Education and Training (VET) programs addressing mainly technical occupational profiles specializing in **metalworking** (e.g. welders, shipwrights). Under- and post-graduate programs also accounted for a considerable share (37%) oriented mainly towards **engineering fields** (i.e. naval architecture, marine engineering). Most of these programs however do not provide direct specializations applicable to the shipbuilding sector, but more general qualifications that can be applied to several different sectors. As a result, on-the-job training is regarded as a prerequisite, while there is a need for a certain 'transition' period before new employees can start providing added value to their company.

Some other, mostly **technical**, occupational profiles are not addressed by a considerable number of the available programs (e.g. electro-mechanical drafters, assemblers) and thus there is a need to introduce new programs, preferably accredited by an appropriate awarding professional body and/or society. As expected, given their distribution per type and European Qualifications Framework (EQF) level, most of the identified E&T programs are offered only in the national language of each respective country. Just 17% of all programs are offered in English or are bilingual, and these are mostly under- and post-graduate programs. To this end, international participation opportunities are scarce, and may also not be attractive enough because of the lack, in several cases, of Europe-wide accreditation and recognition.

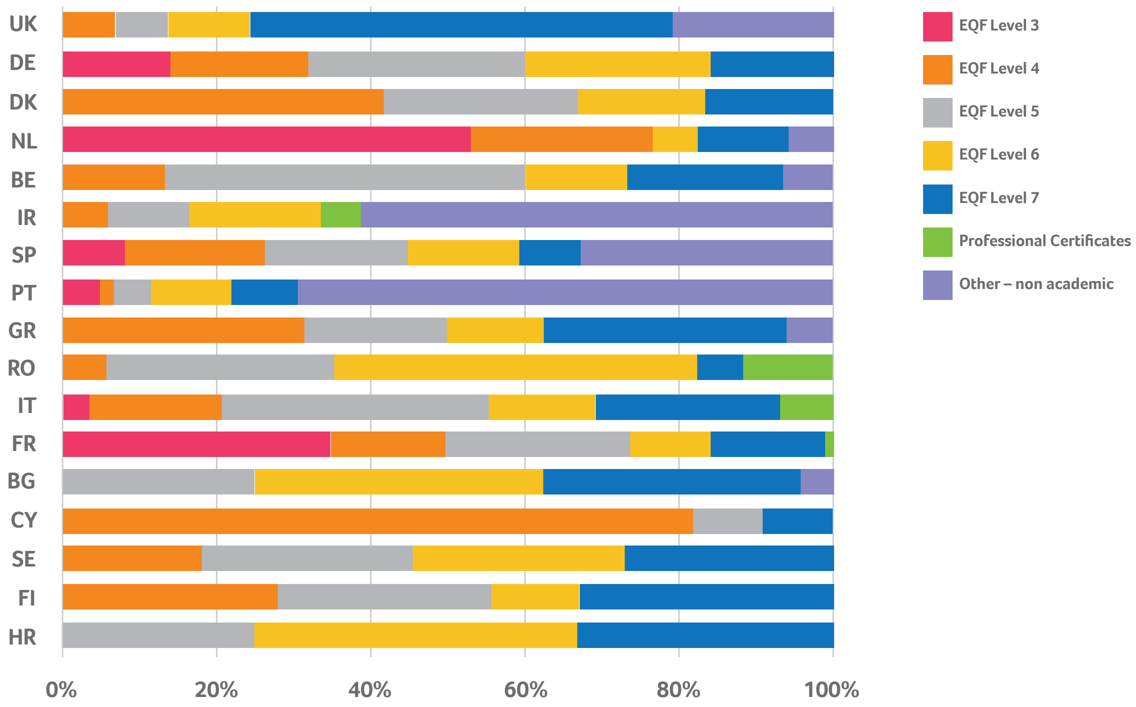

Figure 3. Distribution of identified programs per EU country and EQF[2] level

[2]European Qualifications Framework [https://europa.eu/europass/en/description-eight-eqf-levels]

STEP 5 Skills demand

The key outcomes of the various expert-driven (i.e. workshops, personal interviews, focus groups), participatory (i.e. questionnaire survey) and desk-research (i.e. analysis of available job vacancies) activities that were undertaken for assessing skills demand are summarized in Table 3 below.

Table 3: Key outcomes of the skills demand analysis

Key challenges the sector faces	(i) Aging workforce, (ii) Transfer of employees to other sectors, (iii) Early implementation stage with regard to new technologies compared to other sectors, (iv) Substantial outsourcing of various activities, (v) Non-standardization of several key activities.
Age distribution of employees	Young (below 30 years old) and older (above 50 years old) constitute 10-25% of the companies' personnel. The sector does manage to attract new talents but should establish proper mechanisms to transfer knowledge to next generation.
Skills assessment	50% of the companies that participated in the questionnaire survey assess the skills and training needs of their employees every year while 27% carry out such a process more than once a year. Engineers and engineering technicians are mostly targeted by this process.
Upskilling and reskilling needs	These were found to relate mostly to the relevant implications of electrification and the use of alternative fuels in shipping, as well as of additive manufacturing.
Employment needs and requirements	Engineers, managers and technicians are currently in greatest demand. For engineers and managers, higher education degrees are set as a minimum educational requirement, while upper secondary education degrees are set for technicians.
Difficulties in finding well-qualified personnel	The companies that participated in the questionnaire survey highlighted that they experience some difficulties in finding well-qualified personnel. Most candidates prove to be lacking the necessary practical experience.
Hard skills	The following three hard skills were identified by the industry as most important: (i) *Specific technical skills* (i.e. welding, sandblasting, etc.), (ii) *Project management skills* (i.e. lean management, etc.), and (iii) *Foreign languages* (i.e. reading, writing and communicating in English).
Soft skills	The following three soft skills were identified by the industry as most important: (i) *Critical thinking and problem-solving,* (ii) *Communication and collaboration* and (iii) *Creative thinking and innovation.*
Additional insights	(i) Hard and soft skills should be of *equal importance* when devising suitable strategies and plans for addressing them, (ii) *Professionalism* is an important cross-cutting quality and a basic requirement for the efficient development of both hard and soft skills, (iii) The *multi-disciplinarity of work teams* and the current *multi-cultural business environment* should be carefully considered.

STEP 6 Supply and demand mismatch & recommendations

The skills supply proved not to be well aligned with the requirements of the industry in most of the EU countries covered in the analysis, although a few exceptions do exist mostly referring to post-graduate programs. Companies are therefore obliged to address this problem themselves, usually at their own expense.

The relevant educational and training programs that were identified to be offered across Europe also present considerable differences which increases the efforts required by workers to efficiently adapt to different working environments, and obviously limits to a certain extent their mobility potential.

In several cases, it was stressed by the experts that a number of educators are not closely engaged with the industry and practical knowledge is not efficiently transferred to students. It is important to strike a good balance between the necessary theoretical knowledge and practical experience provided so that students can successfully advance professionally in the career path they choose to follow.

Several recommendations were also provided for addressing the aforementioned mismatch:

- National professional bodies should provide accreditation to certain educational and training programs, while a centralized system supported by a European professional body can ensure that existing differences across Europe at present are minimized.
- New educational and training programs should integrate on-the-job training within their approach, so that theoretical knowledge is efficiently combined with practical experiences. In that way, the labour market can be supplied with 'ready-to-work' young professionals, which removes the burden from companies.
- Regular detailed analysis of the market and its dynamics would provide added value to educators allowing them to better inform the programs they are offering.
- Industry actors should pay attention to reforming their human resource policies and mechanisms for the replacement of retired employees, so that available knowledge and experiences are successfully transferred to future generations.

Key skills gaps and shortages & recommendations

Table 4 below summarizes and groups the key gaps and shortages that were identified for both hard and soft skills.

Table 4: Key outcomes of the skills demand analysis

Skills group	Gaps and shortages
Hard skills	
Engineering	Electronic & electrical engineering skills; Skills in automation; Engineering design skills; Skills in marine engineering.
Business management	Knowledge of business management tools; Lean and quality management; Knowledge to efficiently coordinate different projects / works and take informed decisions; Team building and management techniques; Skills for communicating technical knowledge and work guidelines (especially for inter-disciplinary teams); Holistic perspective of shipbuilding projects.
Project management	Knowledge of the life cycle of shipbuilding projects; Project planning and organization; Resources planning and monitoring; Knowledge and efficient exploitation of available financial instruments; Design and optimization of production processes; Logistics and supply chain organization.

Design	Knowledge of design software (e.g. CAD); 3D design; Data-based modelling; Knowledge of different production processes; Knowledge of all safety and regulatory parameters; Knowledge of any changes in relevant regulations and possible implications in workflows and conditions.
Technical	Welding techniques; Composite materials manufacturing, application and surface finishing; Assembly and installation of engines of new type; Knowledge of cryogenic and overpressure technology (such as hydrogen); Electrical and electronic systems assembly and installation. Handling of cranes, CNC machines and robots.
Digital	Digitalization and optimization processes for improving operations; (Big) data analytics; Handling of ERP and MRP systems; Programming and handling of CNC machines and robots.
Foreign languages	Ability to fluently communicate in the English language; Reading and understanding of engineering drawings, technical specifications and user manuals; Knowledge of other languages (e.g. Italian, Spanish, Chinese) for supporting international collaboration.
Soft skills	
Communication & collaboration	Ability to communicate in different languages (mostly English) and in inter-disciplinary teams; Ability to establish and manage horizontal and vertical relationships.
Leadership & responsibility	Ability to take informed and evidence-based decisions; Ability to lead inter-disciplinary teams and effectively distribute roles and responsibilities.
Critical thinking & problem-solving	Knowledge of problem-solving techniques; Quick and efficient solution finding; Quick decision-making capability.
Creative thinking and innovation	Monitoring of technical and technological advancements and quick adaptation to workflows and conditions.
Knowledge management & transfer	Ability to efficiently manage and use new knowledge acquired through different means (E&T programs, practical experiences, etc.); Ability to transfer acquired knowledge to others (e.g. new employees).

For addressing the aforementioned gaps and shortages, a number of recommendations were also provided:

- *On-the-job training* was regarded as the most appropriate solution for developing the required hard skills, along with *participation in targeted, professionally accredited courses and programs.*
- The setting-up of proper *knowledge-transfer mechanisms* was also acknowledged to be of increased importance so that new professionals get a good grasp of all the different experiences and lessons that older employees have acquired and learnt over the years, which they may efficiently exploit during their professional life.
- Less attention was given to VET programs and programs of higher education since, according to the companies, they fail to provide the practical experience that the industry urgently needs.

The offshore renewable energy sector in Europe

STEP 1 Current status – key facts

Table 5 below summarizes the key facts currently shaping the offshore renewable energy (ORE) sector in Europe.

Table 5: Key facts shaping the offshore renewable energy sector in Europe today

Industry specialization	The sector includes several technologies that present different levels of market and technology readiness (TRL). The better established one is offshore wind energy, though ocean energy also presents considerable growth.
Installed capacities	The installed capacity of offshore wind energy in Europe amounted to 18.5GW in 2018, produced by 4,543 grid-connected wind turbines organized in 105 offshore wind farms. Ocean energy capacity, during the same year, was approximately 250 MW, with tidal energy being the biggest player.
Market potential	The ORE sector in Europe presents a significant potential for further development in the upcoming years. Offshore wind energy is expected to reach 60GW of installed capacity until 2030, and 300GW until 2050. Floating wind energy is also growing, but in common with ocean energy, the pace is much lower. According to the European Technology and Innovation Platform for Ocean Energy, ocean energy (i.e. wave and tidal energy technologies) is expected to cover at least 10% of the energy demand in Europe by 2050.
Allocation of industry productivity	70% of the installed capacity of ORE is concentrated in the North Sea. The UK holds the largest share (43%) followed by Germany, Denmark, Belgium and the Netherlands. Regarding ocean energy, about 90% of its total capacity is installed in France, while 8% is located in the UK.
Employment	In 2018, offshore wind energy accounted for approximately 210,000 jobs, which represents a 14.7% increase compared to the previous year. Ocean energy generated a much smaller number of jobs, estimated at 2,250 in 2016. However, employment rates for both offshore wind and ocean energy are expected to significantly rise in the near future, considering planned investments and the consequential increase in the number of installations and capacities.

STEP 2 Value chain

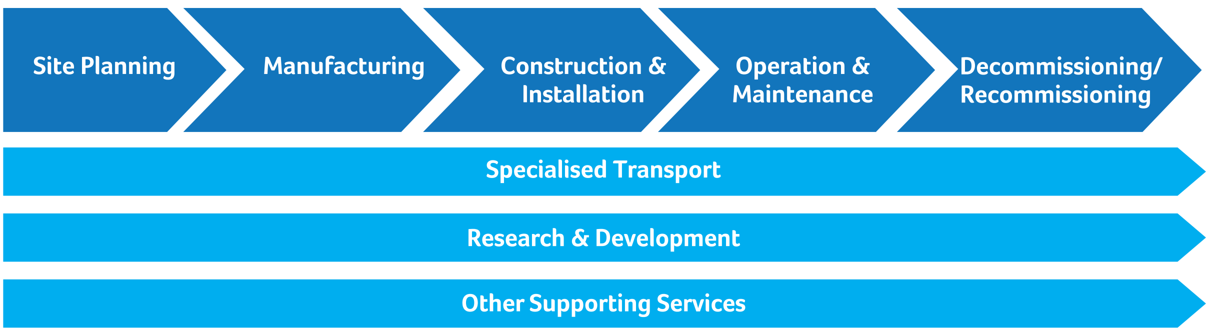

Figure 4. The offshore renewable energies value chain – key phases

STEP 3 Relevant occupational profiles

Taking the classification of the European Skills, Competences, Qualifications and Occupations (ESCO) as the main reference point, 66 relevant occupational profiles were identified and clustered into occupational groups. Among them, 23 were categorized as primary (Table 6) considering their impact on the value chain (Figure 4). For each of these, the essential skills and competences are listed, while the minimum level of education required is also indicated along with the value chain segment(s) to which they contribute (within the main report). It is worth noting that 11 additional occupational profiles not currently included in ESCO were also identified and considered (Table 6).

Table 6: Primary occupational groups and profiles

Occupational group	Occupational profile
Engineers	Renewable energy engineer, Energy systems engineer, Wind energy engineer, Solar energy engineer, Power distribution engineer, Electric power generation engineer, Maintenance and repair engineer *Not included in ESCO:* Offshore engineer, Offshore wind energy engineer, Wave energy engineer, Tidal energy engineer
Metalworkers	Welder
Technicians	Wind turbine technician, Solar energy technician, Hydropower technician, Tidal power technician, Wave power technician, Electro-mechanical engineering technician *Not included in ESCO:* Offshore wind energy engineering technician, Wave energy engineering technician, Tidal energy engineering technician
Assemblers	Electro-mechanical equipment assembler, Electronic equipment assembler, Printed circuit board assembler,
Draughtspersons	Electro-mechanical drafter
Installers	Cable installer *Not included in ESCO:* Marine renewable energy (MRE) installer
Divers	Construction commercial diver
Health & safety	Health and safety officer
Plant operators	Power production plant operator, Solar power plant operator *Not included in ESCO:* Offshore wind farm operator, Wave farm operator, Tidal farm operator

STEP 4 Skills supply

In total, 551 education and training programs were identified to be provided in 12 European countries for the academic year 2018-2019 (Figure 5). They cover all EQF levels, with the majority of them consisting of M.Sc. (43%) and B.Sc. (24%) programs. Specialization in ORE is therefore mostly provided at **post-graduate level.**

However, only a **few of the identified programs** were found to **address the sector directly**, with most doing so only indirectly, i.e. within the broader framework of renewable energy specialization (Figure 6). Nevertheless, despite the scarcity of such programs, in their curricula, all critical aspects of the ORE value chain are covered.

Engineers and **technicians** with specializations mainly in wind energy and to a lesser extent in the other forms of renewable energy, prove to be the occupational groups mostly addressed by the available E&T programs. The greatest gaps and shortages mainly concern **technical-related occupations** (i.e. electro-mechanics, assemblers, welders, construction divers, etc.), bearing in mind the low number of VET programs that were identified (10%). The construction & installation phase as well as the operation & maintenance phase of the ORE value chain are most impacted by existing gaps and shortages. The need for skills related to the decommissioning/recommissioning phase of existing projects is expected to increase in the near future, since many offshore wind energy projects are now entering the final phase of their lifecycle. Given that the majority of the identified programs were M.Sc. degree programs and with the relevant projects taking place mostly in the North Sea, it is not surprising that a large number (45%) are provided in English. This can encourage international participation, which could in turn support relevant developments either to kick-start or progress in other EU countries.

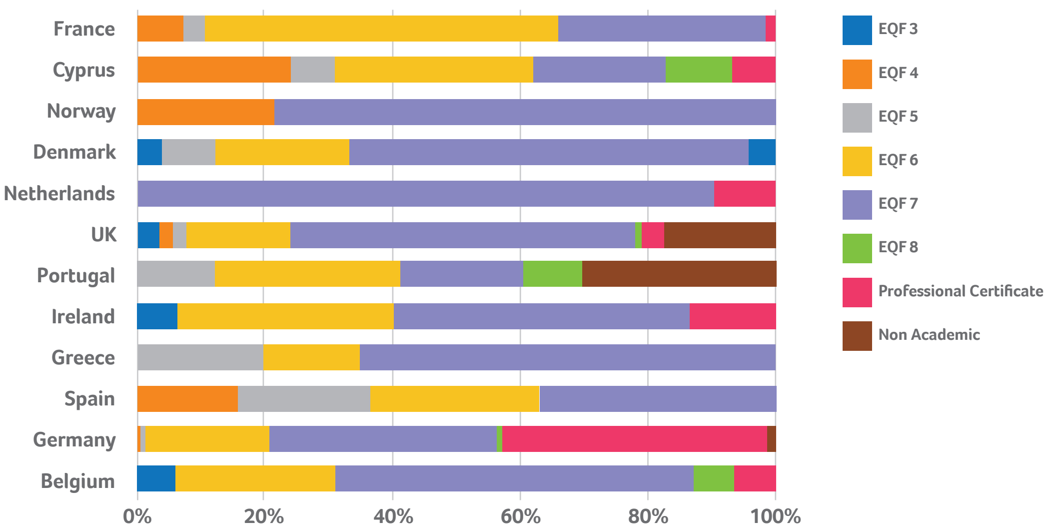

Figure 5. Distribution of identified programs per EU country and EQF level

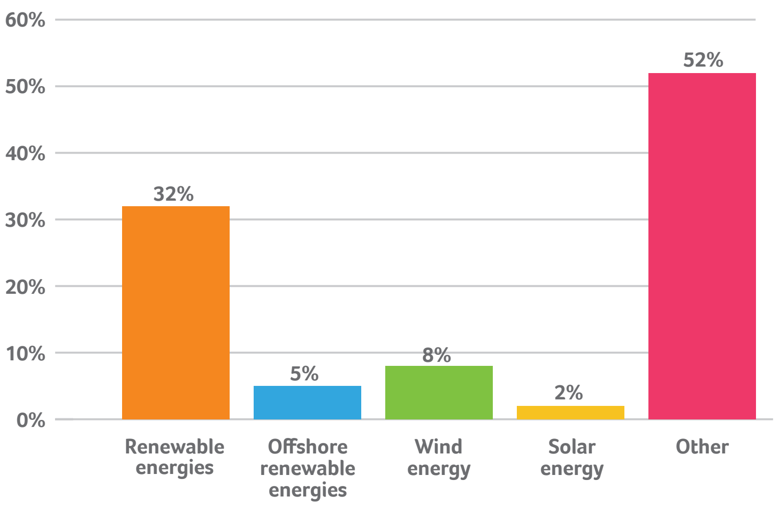

Figure 6. Distribution of education and training programs per specialization

STEP 5 Skills demand

The key outcomes of the various expert-driven (i.e. workshops, personal interviews, focus groups), participatory (i.e. questionnaire survey) and desk-research (i.e. analysis of available job vacancies) activities that were undertaken for assessing skills demand are summarized in Table 7 below.

Table 7: Key outcomes of the skills demand analysis

Key challenges the sector faces	(i) High dependence on technological evolution, (ii) Temporary work relationships (i.e. increased subcontracting of several activities), (iii) Need for multi-disciplinary approaches (and teams) given the high complexity of ORE projects, (iv) Increased employment needs for managers, engineers and technicians, (v) High demand for skills related to project management, offshore engineering, digital skills, robotics and remote controlling, (vi) Need to place greater emphasis on the transferability and diversification of skills, as well as on the development of soft skills, and (vii) Need to establish targeted methods and specific criteria that are consistent across the European context for assessing relevant skills and competences.
Age distribution of employees	Young (below 30 years old) and older (above 50 years old) constitute 10-25% of the companies' personnel. The sector does manage to attract new talents but should establish proper mechanisms to transfer knowledge to future generations.
Skills assessment	82% of the companies that participated in the questionnaire survey assess the skills and training needs of their employees once a year or at least once a year. *Engineers, technicians* and *health & safety professionals* are mostly targeted by this process.
Upskilling and reskilling needs	The activities related to *construction and installation* and *operation and maintenance* as well as to *health and safety* present needs for upskilling and/or reskilling. These needs also refer to coping with the increasing size of offshore renewables infrastructures, working in the harsh marine environment and digitalization of the sector. Engineers, managers, technicians and health and safety professionals are mostly affected by these needs.
Employment needs and requirements	*Managers, engineers* and *technicians* are currently in highest demand, while vacant job positions tend to be quite difficult to fill with competent professionals. For engineers, health and safety officers and consultants, higher education degrees are the minimum education requirement, while for the rest of the occupations (i.e. metalworkers, technicians, assemblers, etc.) upper secondary education degrees are desired.
Difficulties in finding well-qualified personnel	The companies that participated in the questionnaire survey highlighted that they tend to face difficulties in finding well-qualified personnel, which however does not restrict the sector's growth and development for now.
Hard skills	The following three hard skills were identified by the industry as most important: (i) *project management skills*, (ii) *engineering skills* (i.e. 3D design, offshore renewable energies systems etc.), and (iii) *digital skills* (i.e. data analytics, non-invasive monitoring, automation, robotics etc.).
Soft skills	The following three soft skills were identified by the industry as most important: (i) *creative thinking and innovation*, (ii) *critical thinking and problem-solving* and (iii) *initiative and self-direction* and *communication and collaboration*.
Additional insights	(i) Hard and soft skills should be of *equal importance* and their balance depends on the occupation, the needs of the company and the age of the employee, (ii) hard skills ensure *practical experience*, while the soft skills identified included *knowledge transfer, skills transferability* and successful *teamwork* and *collaboration* and (iii) *knowledge on environmental-related issues*, such as climate change and its implications, is of high value to the industry.

STEP 6 Supply and demand mismatch & recommendations

The alignment of skills supply and demand varies across Europe. For example, in the UK, there is an acceptable degree of alignment between skills supply and demand. Several formal education programs are combined with apprenticeships, traineeships in different companies, summer schools, etc. all of which aim to provide students with the practical experiences that industry is in great need of. However, this is not the case in other EU countries, and thus this mismatch should be carefully addressed for supporting the sector's future growth. To this end, a number of targeted recommendations were provided by the experts:

- The development of an ORE competency framework which may function as a sectorally consistent set of industry-required skills detailing, for all relevant occupational profiles, the essential competences and qualifications, desired knowledge, etc.
- Funding of targeted projects for facilitating the establishment of collaborations between key industry players and education and training providers to significantly contribute towards addressing the current skills supply and demand mismatch.
- Changes in secondary education, further raising student awareness of climate change impacts and the potential of the ORE sector towards addressing them. In that way, the interest of students can be triggered and they may look for opportunities offered in the sector and decide to follow relevant education and career paths.
- Carefully consider the dynamics of each ORE sub-sector so that education and training providers are well prepared to accommodate the expected growth.
- Create or reinforce synergies with other sectors (e.g. offshore oil and gas, onshore renewables, etc.) facilitating knowledge transfer as well as the mobility of professionals.
- Utilize test sites for the collection of practical experiences and the transfer of practical knowledge to young professionals. To this end, the relatively high costs need to be addressed by allocating available financial resources or providing some form of subsidy.

Key skills gaps and shortages & recommendations

Table 8 below summarizes and groups the key gaps and shortages that were identified for both hard and soft skills.

Table 8: Key outcomes of the skills demand analysis

Skills group	Gaps and shortages
Hard skills	
Project management	Contract management; Documentation and reporting; Adhering to timetables and successfully meeting milestones; Financial monitoring; Risk management; Logistics coordination.
Engineering	Instrumentation & control systems; 3D design; Good knowledge of the main principles of ORE technologies (especially of wind turbines including their foundations).
Digital	(Big) data management and analytics; Database design and management; Algorithm development and numerical modelling; Software programming and development; Information and Communication Technologies (ICT); Automation capabilities (e.g. used for offshore foundations, submarine cables installation, surveying and condition monitoring activities, etc.); Robotics and remote controlling (e.g. drones).
Offshore-specific	Good knowledge of the main principles of ORE technologies; Standardization of installation and maintenance procedures; Non-invasive methods for condition monitoring (e.g. use of drones); Offshore access systems; Ability to work in harsh conditions, that the marine environment is often characterized by, as well as under water and at great depth (e.g. near the sea bottom); Knowledge of metocean conditions; Basic knowledge of vessel operations; Environmental awareness (i.e. knowledge of the impact of ORE projects on the marine environment and ecosystem); Floating component exchange platform operations.

Health and safety	Set-up and updating of relevant protocols; Standardization of installation and maintenance procedures; Good knowledge of metocean conditions; Good knowledge of marine risks; Handling of heavy machinery (e.g. cranes).
Project design and planning	Engineering design; 3D design and visualization; Good knowledge of metocean conditions; Efficient coordination of logistics activities; Good knowledge of all relevant policy frameworks (and the specifications and limitations these set); Proper preparation of all relevant documentation for both internal and external purposes.
Using and understanding numerical or statistical information	Efficient use and presentation of statistical information; Numerical modelling; Algorithm development.
Foreign languages	Reading, writing and communicating in English; Understanding of international technical aspects / guidelines.
Environmental	Good knowledge of the impacts of ORE projects on the marine environment.
Soft skills	
Creative thinking & innovation	Monitoring of technical and technological advancements and quick adaptation into workflows and conditions.
Critical thinking & problem-solving	Knowledge of problem-solving techniques; Quick and efficient solution finding; Quick decision-making capability.
Initiative & self-direction	Ability to undertaken initiatives for introducing further efficiencies into operations and other processes; Self-directed learning.
Communication & collaboration	Ability to efficiently transmit and explain work responsibilities and coordinate parallel or interdependent activities (especially in multi-disciplinary teams).
Knowledge management & transfer	Ability to efficiently manage and use new knowledge acquired through different means (E&T programs, practical experiences, etc.); Ability to transfer acquired knowledge to others (e.g. new employees).
Leadership & responsibility	Ability to take informed and evidence-based decisions; Ability to lead inter-disciplinary teams and effectively distribute roles and responsibilities.
Flexibility & adaptability	Easily understand and adapt to the conditions of the respective working environment (i.e. reduce adaptation time); Have an agile mind-set able to cope with different situations and circumstances.
Productivity & accountability	Enhance personal efficiency rate; Develop a high level of personal accountability (i.e. be resilient, resourceful and honest).

For addressing the aforementioned gaps and shortages, a number of recommendations were also provided:

- *On-the-job training* was regarded as the most appropriate solution for developing the required hard skills, exploiting test sites, which however require confidentiality issues and funding subsidies to be addressed.
- *In-house training* is also of high preference since it facilitates knowledge and experience transfer from older employees to younger ones as well as from invited external leading experts.
- Similar to the shipbuilding sector, less attention was given to higher education and VET programs, which although they remain necessary since they provide important theoretical knowledge, nevertheless present limitations in acquiring practical skills, knowledge and experience.

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