FLORES

Offshore Renewable Energies partnership in the Pact for Skills

Report on ORE skills needs

September 2024

Co-funded by the European Union

About this Report

Forward Looking at the Offshore Renewables will promote the core activity of the Large-scale partnership launching the Pact for Skills in the Offshore Renewable Energies (ORE) sector. FLORES will support the most committed stakeholders in the ORE, underpinning the success of the offshore renewable energy strategy with the stimulation of dedicated training offers. The partnership will promote the skilling process for the new jobs expected in the sector, estimated to account for between 20,000 and 54,000 new workers in the following five years and contribute to improve upskilling opportunities in the field of the actual ORE workforce.

Project duration: January 2023 – March 2025 (27 months)
www.oreskills.eu

Document information	
Short description	This report undertakes a skills demand and supply analysis, covering all key occupational profiles engaged in the ORE value chain. The objective is to identify where there are considerable mismatches, and also to point to important gaps that need to be addressed. Building upon the findings of the Erasmus+ MATES Blueprint project, desk-research and stakeholder consultation activities were deployed, and data from both established and emerging ORE markets across the EU were collected and processed. This enabled to identify current skills needs vis-à-vis the qualifications and competences that existing educational programs and training courses are now offering. Important conclusions as to the relevant priorities that should be set-up and the actions that subsequently need to be undertaken in order to reconcile differences between skills supply and demand, were thus drawn. Their successful implementation will allow to effectively address the existing gaps, and thus equip the sector with a more skilled workforce driving fast growth and development.
Next steps	This report will inform the analysis of future trends in ORE occupations (D2.3), and will serve as a solid reference in all other project activities (WP3-WP5)
Work Package	WP2 Observatory skills needs & offer
Task	T2.1 Analysis of present skills needs in EU
Deliverable	D2.1 Report on ORE skills needs
Dissemination level	PU
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Contents

1. Introduction

1.1. ORE technologies break-down

Offshore renewable energy consists of the following forms / technologies:

Offshore Wind Energy

Offshore wind energy is a renewable energy technology that involves the installation of large wind turbines in bodies of water, typically in coastal areas or the open sea. These turbines, which are typically arranged in farms, harness the kinetic energy of the wind to generate electricity. Offshore winds tend to be stronger and more consistent than onshore winds, leading to higher energy yields.

Ocean Energy

Ocean energy encompasses various technologies that capture the energy from ocean waves, tides and currents to generate electricity. More specifically:

- *Wave energy* converts the up-and-down motion of waves into electricity.
- *Tidal energy* harnesses the energy from the movement of tides.
- *Ocean current energy* captures energy from the movement of ocean currents.

Ocean energy accounts for a predictable and consistent energy generation, with the potential for baseload power production.

Offshore solar energy

Offshore solar energy involves the placing of photovoltaic panels on floating structures on bodies of water, such as lakes, reservoirs, or the open sea. Offshore solar farms present a promising potential for large-scale solar energy generation, especially in regions with high solar irradiance, while the water's cooling effect can enhance the efficiency of the solar panels.

Geothermal energy
Salinity gradient energy
Ocean Thermal Energy Conversion (OTEC)

In certain locations, deep geothermal resources can be tapped beneath the seafloor for electricity generation. This involves drilling into hot rock formations to access geothermal heat. Geothermal energy can serve as a continuous and reliable source of baseload power.

Salinity gradient power, also known as blue energy, captures energy from the difference in salt concentration between sea- and fresh-water. It can provide a constant and predictable source of power, especially in estuaries or areas where fresh water meets sea water.

Ocean Thermal Energy Conversion (OTEC) is a method of harnessing the temperature difference between the warmer surface water of the ocean and the colder deep water to generate electricity.

The concept relies on the fact that the ocean surface absorbs and retains heat from the sun more effectively than deep water. OTEC has the potential to provide a continuous and renewable source of energy, but it is currently not widely implemented due to high upfront costs, technical challenges, and the need for specific geographic conditions. However, ongoing research and development aim to address these challenges and make OTEC more feasible in the future.

Some projects also integrate multiple renewable energy technologies in a *hybrid approach*. For example, a facility might combine offshore wind with wave or tidal energy to maximize energy output and reliability. By combining the strengths of different offshore renewable energy sources, energy efficiency and reliability can increase.

1.2. Market updates

Among the aforementioned ORE technologies, *offshore wind energy* and specifically its bottom-fixed applications is the most mature technology currently commercially available. The remaining technologies are still considered as emerging sub-sectors since, as depicted In Figure 1, they have not yet reached commercialization. They are currently at different stages of technology development and market uptake.

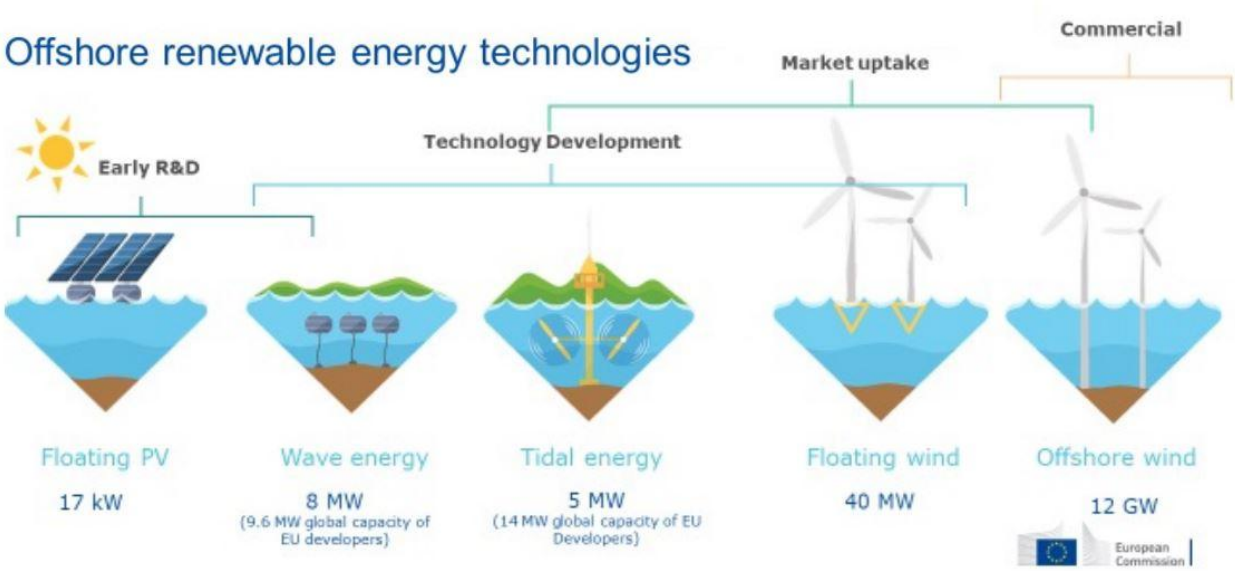

Figure 1: *State of play of offshore renewable energy technologies in the EU (Source: JRC, 2020)*

In 2021, about 65% of the globally installed ORE capacity was concentrated In the five EU Sea Basins. This capacity, which amounts to 16.3GW, is mainly located in the North (84%) and Baltic Seas (15%), spreading across 10 EU countries in total.

Installed capacities of offshore wind energy, that accounts as mentioned above almost for the entirety of the ORE capacity, are mainly concentrated in Germany (47%), the Netherlands (27%), Denmark (14%) and Belgium (14%), while significantly smaller (2% in total) are the capacities in Sweden, France, Spain, Ireland and Portugal (Figure 2). The UK also accounts for a considerable amount (i.e., 10.3GW) but is treated separately since, due to Brexit, it is not incorporated in EU reported statistics.

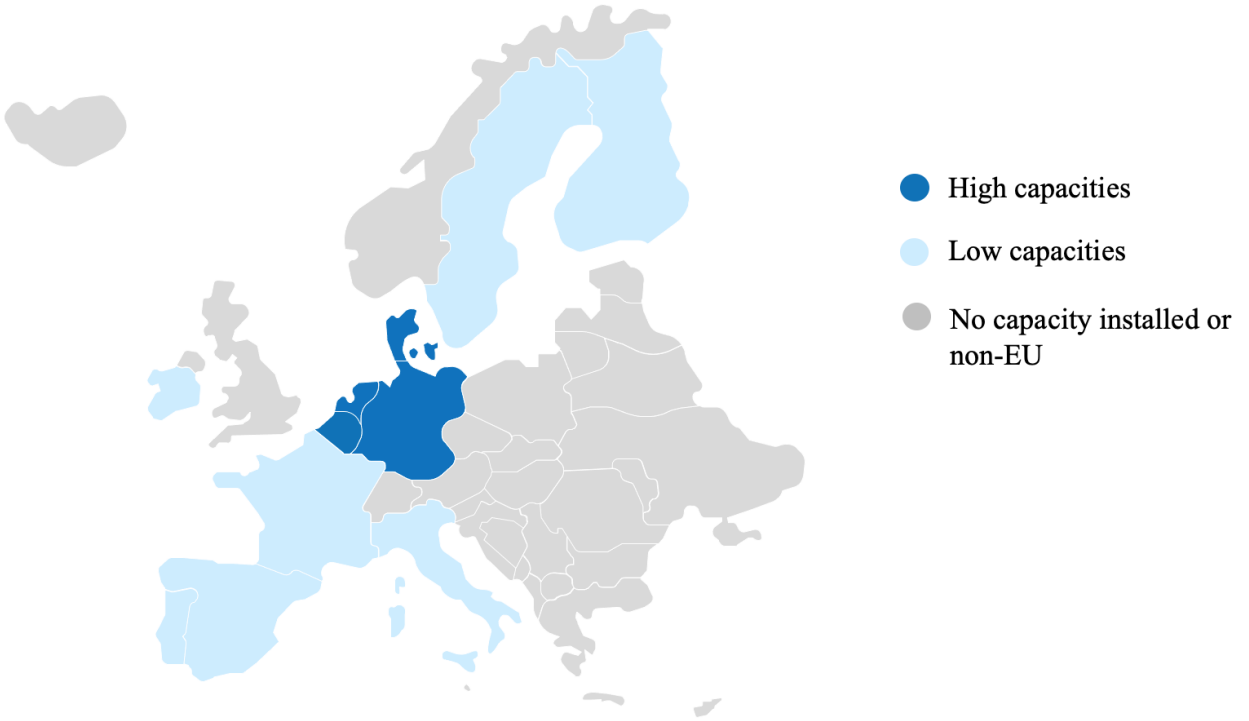

Figure 2: *Schematic concentration of installed capacities of offshore wind energy across the EU (Source: authors' own elaboration based on data from Blue Economy Report 2022)*

Offshore wind energy capacities are rapidly increasing due to several technological developments that have been realized over the past years (i.e. cost reductions, better wind turbine reliability, larger sites, etc.). The sector has therefore been actively driving economic growth, job creation and competitiveness across Europe. More specifically, in 2019, offshore wind energy accounted for 0.2% of all EU jobs, 1% of the EU GVA and 1.7% of the total EU Blue Economy.

1.3. Policy drivers and outlook

With the aim of ensuring that the ORE sector actively contributes towards the EU reaching its ambitious energy and climate targets for 2030 and 2050, in 2020 the EC published an EU Strategy on ORE[1] . The Strategy sets out the appropriate pathways for supporting the long-term sustainable development of the sector, and includes the following targets in terms of installed capacity: i) have at least 60 GW of offshore wind and 1 GW of ocean energy by 2030; and ii) have at least 300 GW of offshore wind and 40 GW of ocean energy by 2050 (Figure 3).

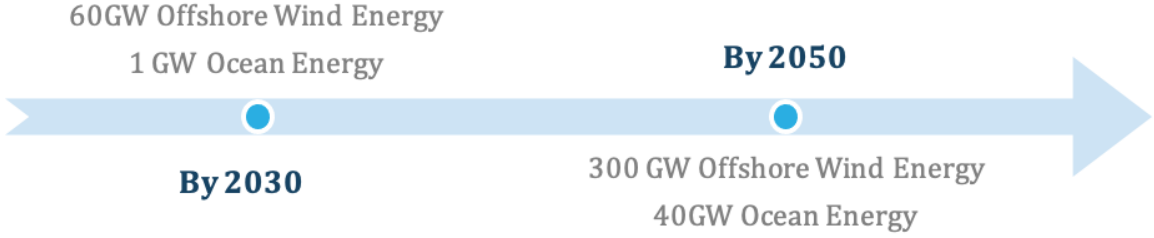

Figure 3: *Targets set in the EU Strategy on ORE in terms of offshore wind and ocean energy capacities in 2030 and 2050 (Source: EC, 2020)*

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2020:741:FIN&qid=1605792629666

For maximizing the resulting impact, the Strategy went beyond the narrow definition of energy production related factors, and addressed broader issues such as (i) access to the sea-space; (ii) fostering of regional and international cooperation; (iii) industrial and employment dimensions; and (iv) the transfer of technological research projects from labs to practical applications. Implementation of the Strategy is still ongoing, discussing during the offshore conference (a key milestone) that was organized in 2021 for ministries and public authorities, investments, public acceptance and permissions, as well as offshore infrastructure and grid planning issues. A dedicated working group on ORE was established the same year under the Clean Energy Industrial Forum. This group was tasked with identifying and defining the challenges that the sector faces, including any potential implementation bottlenecks for reaching the 2030 and 2050 goals. Additionally, it was responsible for developing targeted recommendations to successfully address these challenges and bottlenecks.

The revised Regulation on Trans-European Energy Networks (TEN-E)[2] (entered into force in June 2022) puts the EU ORE Strategy ambitions into operation by including new infrastructure categories for hybrid offshore grids and radial lines, as well as permitting provisions intended to accelerate the scale-up of offshore grids. TEN-E also supports regional cooperation for defining non-binding regional goals for offshore renewable generation to be deployed within each sea basin (see for example the North Sea Energy Cooperation or the Baltic Energy Market Interconnection Plan). This can feed into the development of strategic integrated offshore network development plans.

In addition to the above, in October 2023, the EC presented two key wind power initiatives whose purpose was to accelerate wind energy manufacturing and deployment in Europe. These were:

- the European Wind Power Action Plan[3], structured in six main pillars of concerted action by the EC, Member States and the Industry (Figure 4). One pillar concerns skills, acknowledging the availability of skilled workers as crucial for increasing production capacity in Europe;
- Communication on achieving the EU's offshore wind ambitions[4], which identifies six areas where progress would help to speed up the roll-out of offshore capacity: (i) strengthening grid infrastructure and regional cooperation; (ii) accelerating permitting, (iii) ensuring integrated maritime spatial planning; (iv) strengthening the resilience of infrastructures; (v) sustaining research and innovation measures to supporting offshore renewable energy;, and (vi) developing supply chain and skills. With regard to the latter, the need for a combined approach accelerating efforts to (a) support the development of new skills both for people working in or entering the industry (especially in digitalization, ICT, robotics, health and safety), and (b) improve the diversity and inclusiveness of the sector, is highlighted.

[2] https://energy.ec.europa.eu/topics/infrastructure/trans-european-networks-energy_en
[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023DC0669&qid=1702455143415
[4] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52023DC0668

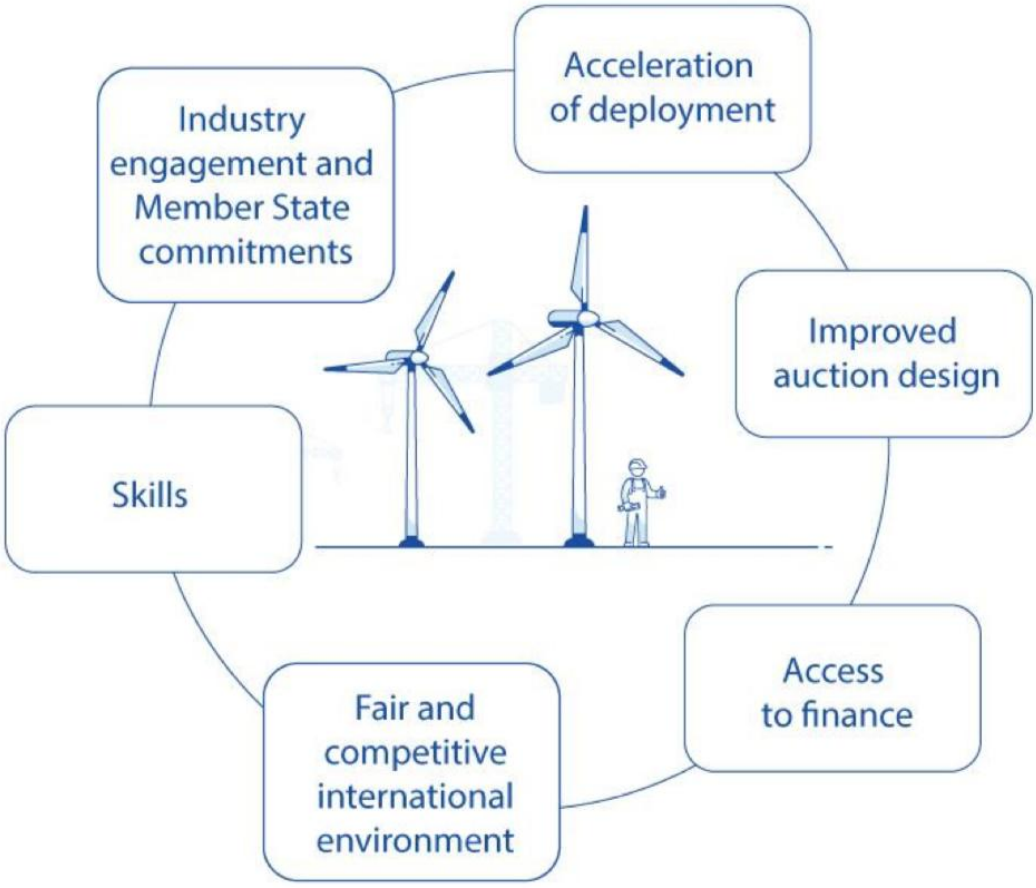

Figure 4: *The six main pillars of the European Wind Power Action Plan (Source: EC, 2023)*

In addition to offshore wind energy, ocean energy technologies are also emerging rapidly. These can provide a steady and predictable power output. In the last decade, EU countries and the private sector have invested over 4€ billion in relevant research and pilot projects, while through the relevant Strategic Energy Technology (SET) Plan[5], the EU has set clear cost reduction targets on ocean technologies for the next ten years. More specifically, for tidal stream technologies, costs are expected to be reduced to 0.15€ per kWh by 2025 and 0.10€ per kWh by 2030. For wave energy, a cost reduction to 0.20€ per kWh by 2025 and 0.15€ per kWh by 2030 is estimated. Offshore installations as well as islands where electricity costs are currently very high will be the first to benefit from the commercialization of ocean technologies.

1.4. Aim and structure of the report

Taking into consideration the current status of the ORE sector, its future outlook and corresponding policy drivers, the present report addresses the issue of skills development in the sector, a high priority in the EU political agenda, as clearly reflected in the recently published European Wind Power Action Plan and the Communication on achieving the EU's offshore wind ambitions. More specifically, the present report performs a skills intelligence analysis, assessing the current skills demand and supply, and comparing the two in order to identify and highlight existing gaps and shortages that need to be addressed.

[5] https://setis.ec.europa.eu/system/files/2022-05/SET%20Plan%20OCEAN%20ENERGY%20Implementation%20plan.pdf

To this end, the rest of the report is structured as follows: Section 2 presents the overall methodological framework devised to performing the skills intelligence analysis, describing in detail the steps that were followed in order to assess skills demand and supply. The ORE value chain and the corresponding occupational profiles, as defined and classified in the European Skills, Competences, Qualifications and Occupations (ESCO) database, served as the main reference layers. Using the latter, a solid knowledge basis was built in Section 3, identifying and listing all key relevant information sources and outlining the contribution that each of them makes to the current knowledge on skills development in the ORE sector. Sections 4 and 5 present the results of the skills demand and supply analysis respectively, the combined assessment of which enabled to draw some valuable conclusions in Section 6. These relate to existing key mismatches and gaps that need to be addressed so that the ORE sector can be supported with more qualified personnel, and thus achieve faster growth.

2. Methodological framework

As depicted in Figure 5, a skills demand and supply analysis was performed herein covering all key occupational profiles engaged in the ORE value chain, with the aim of identifying considerable mismatches that currently exist between supply and demand, and thus point to important gaps that ought to be addressed. Building upon the findings of the Erasmus+ MATES Blueprint project, desk-research activities were deployed and data from both established and emerging ORE markets across the EU were collected and processed for assessing (a) what are currently the main skills needs in the sector, and (b) what qualifications and competences are now being offered by key educational and training institutes. Close-comparison of those results enabled to draw some important conclusions concerning the relevant priorities that should be set and the actions that need to be performed for reconciling existing differences and better aligning skills supply and demand. To this end, existing gaps can be addressed leading to the sector being equipped with a more skilled workforce that can drive faster development and growth.

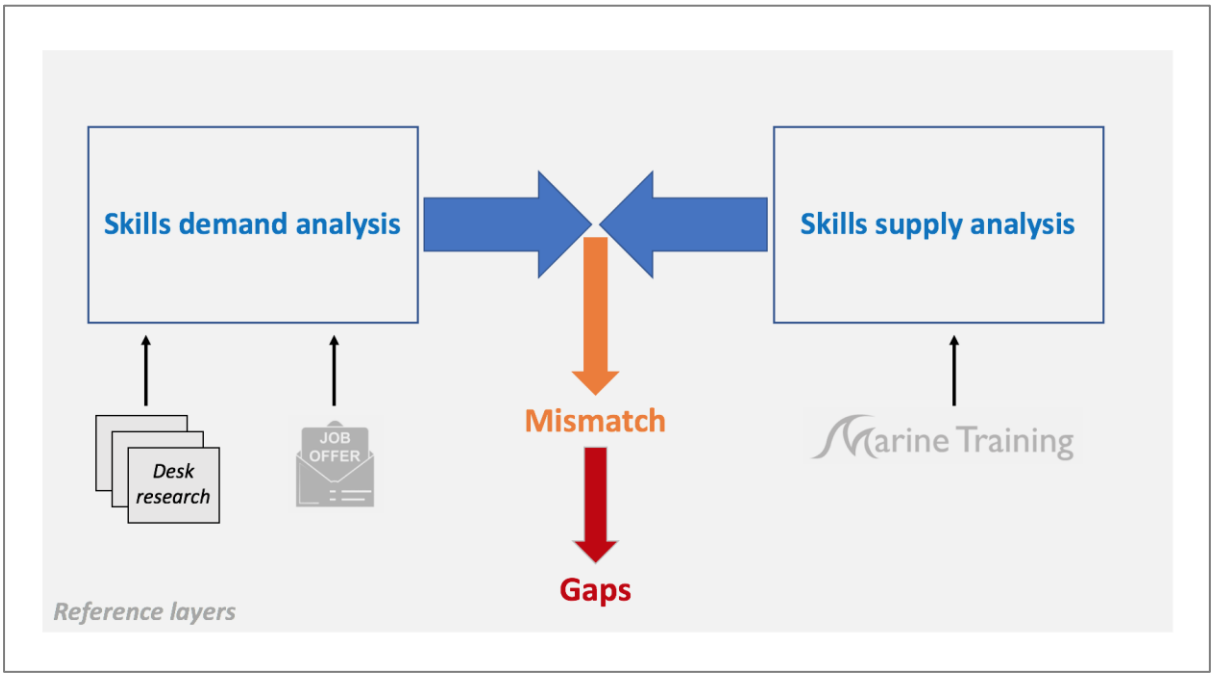

***Figure 5**: Skills intelligence analysis methodological framework (Source: authors' own elaboration)*

2.1. Reference layers

Before starting to collect data on skills demand and supply in the ORE sector, the first step was to set-up proper reference layers to guide the data collection process. This also allows to report results in a more structured way, thus facilitates their direct comparison or consideration with similar or complementary results from past (e.g. the MATES project) or ongoing relevant projects and initiatives.

The first layer to set up was the ORE value chain, which presents all the different phases an ORE project undergoes throughout its lifetime, with multiple activities being undertaken at each phase. Those activities are executed by professionals belonging to a wide variety of occupational profiles, presenting diverse but complementary skills and competences. Identifying all occupational profiles engaged in the ORE value chain was the next reference layer to be set up.

2.1.1. ORE Value chain

The ORE value chain included in the "Baseline report on present skills gaps in shipbuilding and offshore renewables value chains" of the MATES project[6] was taken as our starting point. However, it was updated and enriched, utilizing not only the results of an extended literature review but also industry insights collected via a targeted workshop held on 27th April 2023 in Copenhagen, Denmark within the framework of the WindEurope Annual Event 2023.

The ORE sector is characterized by increased complexity, incorporating various activities taking place both offshore and onshore. A generalized structure that applies to all ORE technologies was adopted herein (Figure 6), with a number of cross-cutting activities providing support to all the different phases of the ORE value chain.

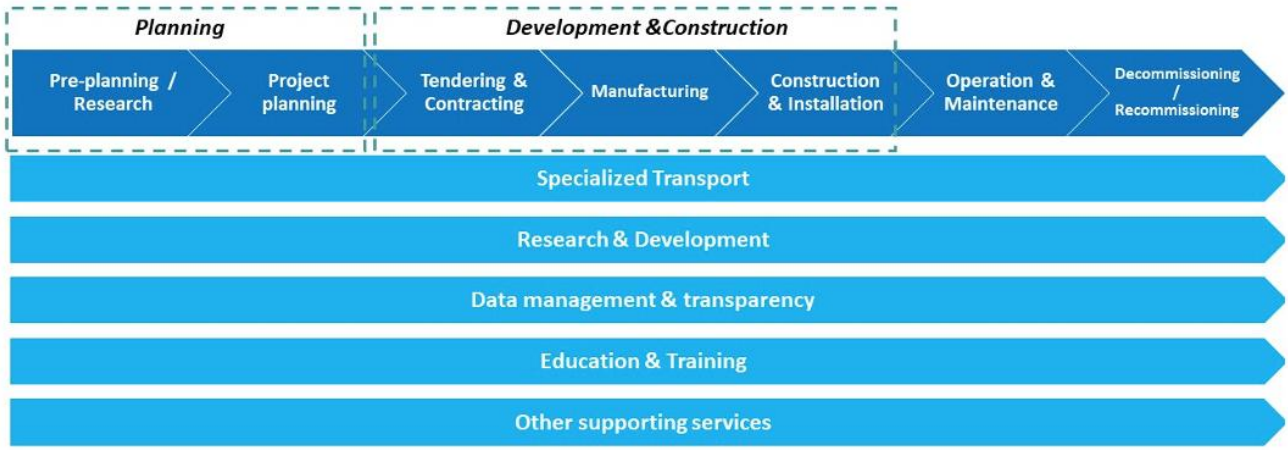

Figure 6: *ORE value chain (Source: authors' own elaboration based on data from Hørman et al., 2022; IRENA & ILO, 2022; Sdoukopoulos et al., 2020; BVG Associates, 2019b; JRC, 2017; Steen, 2016; Hannon et al., 2016; Piirainen, 2015; Roslyng Olesen, 2015; IRENA., 2014)*

Phases of the ORE value chain

As depicted in Figure 6, the ORE value chain comprises four key phases: (i) Planning; (ii) Development & construction; (iii) Operation & maintenance; and (iv) Decommissioning / Recommissioning. Each phase is briefly described below, with an explanation of all key activities incorporated.

Planning

The planning phase consists of *pre-planning / research* activities and of the actual *project planning*.

Pre-planning / research activities collect and provide all the background data and information necessary for the proper planning and development of an ORE project. More specifically, they include all the different surveys and studies that need to be undertaken for identifying: (a) whether the existing environmental conditions are appropriate for developing an ORE project (i.e., resources assessment, metocean analysis, hydrographic surveys, geotechnical surveys, etc.); (b) what would be the impact imposed on the environment (i.e., environmental impact assessment, etc.); and (c) whether the project is feasible and what capacity can be reached (i.e., feasibility studies, pre-FEED studies, etc.) (Public – Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power Generation, 2020; BVG Associates, 2019a; Steen, 2016; IRENA, 2014; Ayee et al., 2009;

[6] https://www.projectmates.eu/wp-content/uploads/2020/10/MATES_D2.1_Final_Oct-2020.pdf

IMAREST, n.d.). Specialized vessels and equipment are used in the aforementioned activities ensuring that all surveys are undertaken in safety, while consulting services, usually provided by external actors, complement the work undertaken. This collective process leads to the acquisition of all consents and permits needed to start the planning and development of the foreseen project (BVG Associates, 2019a; IMAREST, n.d.).

Based on the results of the aforementioned activities, a viable ORE project system / plant can be developed. Within *project planning* activities, the technical characteristics of the project are specified (i.e., FEED study, farm design and layout, etc.) and the respective financial resources needed are determined. This is a key milestone in the ORE value chain, since it informs all subsequent phases and activities (BVG Associates, 2019a; Steen, 2016; Ayee et al., 2009; IMAREST, n.d.).

Development & Construction

This phase includes all activities required for the sourcing, manufacturing, construction, assembly and installation of all materials, components and equipment of an ORE project, ensuring that the available resources are efficiently utilized.

The first group of activities in this phase relates to the handling and execution of all necessary Tendering & Contracting procedures, so that all relevant contracts are correctly prepared and signed. Increased complexity is entailed, since multi-contracting is often necessary as different services that have to be carried out simultaneously, need to be combined.

Manufacturing is a key part of the ORE value chain, as in the value chain of many other sectors; thus many opportunities for creating synergies with complementary sectors and exploiting transferrable skills exist. Activities can range from the sourcing of raw materials to the manufacturing and assembly of all different components of an ORE project, including also the ones that are necessary for the project's connection to the onshore grid (Public – Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power Generation, 2020; IRENA, 2014; Ayee et al., 2009).

Construction & Installation (C&I) activities comprise all activities undertaken on site for the construction of the ORE project and the successful installation of all of its components including its connection to the onshore grid (Wallasch et al., 2014; Ayee et al., 2009). *Engineering, procurement* and *construction* works are entailed (i.e., civil works, laying submarine cables, installation of turbines, base, substations, grid connection, etc.), with several of them being labour-intensive, requiring the delivery of multiple products, components and equipment (Public – Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power Generation, 2020; Steen, 2016; IRENA, 2014; Ayee et al., 2009).

Operation & Maintenance

This phase covers the operation and management of the ORE project, ensuring the efficient performance and reliability of the relevant infrastructure (e.g. cables, substations, etc.) so that energy generation and delivery is constant and unobstructed. To this end, regular monitoring, inspection and repair (when needed) of the all components and equipment is undertaken within the whole operational life of the project estimated to be approximately 20-25 years (IRENA & ILO, 2022; Public – Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power Generation, 2020; BVG Associates, 2019a; Steen, 2016; IRENA, 2014; Ayee et al., 2009; IMAREST, n.d.)

More specifically, activities related to the Operation of the ORE project aim to ensure that all operations are executed safely, the integrity of all assets is well-maintained and electricity generation is optimized (BVG Associates, 2019a). For example, asset management entails the proper scheduling of site personnel, the supervision of marine and vessel operations, the remote monitoring and control of the site and its operations, repair of equipment failures, environmental monitoring, electricity sales, administration and office tasks, etc. all ensuring the proper functioning of the project according to all applicable health and safety standards (BVG Associates, 2019a; Ayee et al., 2009).

Maintenance includes routine services for ensuring the integrity, balance and achievement of the maximum lifespan of the ORE project. Relevant activities include preventive maintenance (i.e., oil and filter change, calibration of electronic sensors, blade cleaning, etc.), periodic equipment inspections, warehousing / storage of spare parts, unplanned repair, etc.. Maintenance can be carried out either by the plant operator or by a subcontractor (BVG Associates, 2019a; Piirainen, 2015; Ayee et al., 2009).

Decommissioning / Recommissioning

The last phase in the lifecycle of an ORE project is its Decommissioning / Recommissioning, with the relevant activities taking place both offshore and onshore. In the case of Decommissioning, the project is shut down and the facility is dismantled. The relevant infrastructure should be safely removed from the marine environment minimizing any potential risk to the environment. Current practices and institutional frameworks require extracting value from decommissioned parts (Natural England, 2022; Public – Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power Generation, 2020; BVG Associates, 2019a; IRENA, 2014). In the case of Recommissioning, a previously decommissioned or inactive facility is brought back to its operational capability. There are several scenarios in which recommissioning may be necessary (e.g. temporary decommissioning, upgrades and modifications, change of ownership or management, extended downtime, etc.).

Cross-cutting activities

A number of cross-cutting activities provide targeted support in all phases of the ORE value chain. These are briefly outlined below.

Specialized Transport

Though to differing extents, all phases of the ORE value chain require Specialized Transport, involving all three modes of transport and multiple relevant stakeholders (i.e., manufacturers, logistics companies, transport operators, shipping companies, port authorities, terminal operators, etc.). Efficient coordination and collaboration among those actors is therefore key so that all value chain activities can be effectively supported avoiding potential delays (IRENA,, 2014; Ayee et al., 2009). Some unique challenges are involved in these operations since components of unusual weight, length and shape have to be transported to deep waters where weather conditions are often harsh. Those conditions have to be tackled every time workers are transported to the ORE facility (Ayee et al., 2009).

Research & Development (R&D)

Research & Development (R&D) activities aim to further improve ORE technologies both environmentally and economically, in an attempt to drive the commercialization of all technological

advancements integrating innovation in the sector (Steen, 2016; IRENA, 2014; Ayee et al., 2009). For technologies already commercially available, R&D seeks to improve or optimize the cost-effectiveness and performance of the relevant systems, address equipment fatigue, ensure reliability, support grid integration, and expand energy production capacity. (Ayee et al., 2009). R&D activities cover all different phases of the ORE value chain, addressing a wide range of systems, components, and operations. For example, R&D activities in manufacturing aim to drive down manufacturing costs, develop advanced fabrication techniques and automate manufacturing processes. R&D activities in alternative materials focus on reducing the structure's weight (e.g. weight of blades in wind turbines) and increase its strength and flexibility (Ayee et al., 2009).

Data Management & Transparency

As in all business sectors nowadays, data management is key. This applies to all the different phases of the ORE value chain, with several operations / processes being now digitalized. The effective management and analysis, but also the security, of the large amount of data being generated, are crucial for enhancing the efficiency of operations and thus driving forward the sector's further growth and development. More specifically, digitalization largely contributes to reducing associated costs and minimizing possible risks, enhancing at the same time performance and increasing revenues. According to estimates, digitalizing an offshore wind farm can reduce maintenance costs by 10% and increase revenues by 3% (Mohamadi, 2021; IMAREST, n.d.). Digitalization and effective data management can affect the design of energy systems (e.g. layout optimization, improvement of blade aerodynamics, WTG control and yield, etc.), their manufacturing, installation, service and operation, as well as energy trading during the operational phase of the plant (Mohamadi, 2021; IMAREST, n.d.).

Education & Training

The existence of appropriate Educational programs & training courses is of the utmost importance for ensuring that the sector is equipped with well qualified employees who can effectively and timely drive further efficiency improvements whilst at the same time ensuring that all risks are minimized and any potential problems are effectively addressed. The proper identification of skills demand is important for aligning existing programs / courses with current needs, and thus providing graduates with all skills, competences and qualifications required by the industry. Those activities are crucial for all sectors and especially fast-growing ones like the ORE sector, since it is very important to have the necessary capacity in terms of skills, competences and knowledge in place at all times (IRENA & ILO, 2022; Steen, 2016; IRENA, 2014).

Other supporting services

A series of other services support the ORE value chain. These include financing services that manage and ensure the commercial viability of ORE projects by exploiting all available funding opportunities, as well as administrative, legal and consulting services, sales, etc. (Shields et al., 2023; IRENA & ILO, 2022; IRENA, 2018; Steen, 2016; IRENA, 2014).

2.1.2. Corresponding occupational profiles

As described above, the ORE value chain encompasses several different processes and operations of varying complexity undertaken by a multitude of occupational profiles, with each one filling a different but complementary role, creating different type and size of impacts. The list of those occupational profiles was compiled building upon the one devised within the framework of the MATES research project. The latter was properly updated, drawing insights from: (a) the results of

the literature review that was conducted; (b) consultations undertaken with industry stakeholders organized within the framework of targeted events; and (c) job vacancies-related data collected over an 8-month period (see sub-section 2.2.2). The occupational profiles identified, which amounted to 174 in total (Table 1), are reported following the ESCO classification and its corresponding levels of hierarchy, apart from two occupational profiles (highlighted in green). These are not currently listed in ESCO, so they were placed within the most relevant ESCO group. Overall, 42 groups of occupational profiles were distinguished (Hierarchy Level 3).

Table 1: *Occupational profiles engaged in the ORE value chain*

A/A	Occupational Group of profiles (ESCO Hierarchy Level 3)		Occupational profiles (ESCO Hierarchy Level 4)	
Managers				
1	ESCO-112	Managing directors and chief executives	ESCO-1120.2	Business manager
2	ESCO-121	Business services and administration managers	ESCO-1211.1 ESCO-1213.2 ESCO-1213.3 ESCO-1213.4 ESCO-1213.7 ESCO-1219.6 ESCO-1219.7	Financial manager Policy manager Procurement department manager Programme manager Health safety and environmental manager Project manager Quality services manager
3	ESCO-122	Sales, marketing and development managers	ESCO-1221.1.1 ESCO-1221.3 ESCO-1221.3.2 ESCO-1221.3.2.1 ESCO-1221.4 ESCO-1222.1.2 ESCO-1223.1	Advertising manager Chief marketing officer Marketing manager Sales manager Commercial director Public relations manager Product manager
4	ESCO-132	Manufacturing, mining, construction, and distribution managers	ESCO-1321.2 ESCO-1321.2.3 ESCO-1323.1 ESCO-1324.8	Manufacturing manager Operations manager Construction manager Supply chain manager
5	ESCO-133	Information and communications technology service managers	ESCO-1330.1.1	ICT information and knowledge manager
6	ESCO-134	Professional services managers	ESCO-1349.11	Document management officer
7	ESCO-142	Retail and wholesale trade managers	ESCO-1420.6	Trade regional manager
Professionals				
8	ESCO-211	Physical and earth science professionals	ESCO-2114.1.8 ESCO-2114.2	Oceanographer Geophysicist
9	ESCO-213	Life science professionals	ESCO-2131.4.9 ESCO-2133.7 ESCO-213X.X	Marine biologist Environmental scientist Metocean analyst
10	ESCO-214	Engineering professionals (excluding electrotechnology)	ESCO-2141.4 ESCO-2141.4.1 ESCO-2141.4.2 ESCO-2141.4.2.1 ESCO-2141.8 ESCO-2142.1.4	Industrial engineer Manufacturing engineer Production engineer Automation engineer Maintenance and repair engineer Geological engineer

A/A	Occupational Group of profiles (ESCO Hierarchy Level 3)		Occupational profiles (ESCO Hierarchy Level 4)	
			ESCO-2142.1.9	Transport engineer
			ESCO-2143.1	Environmental engineer
			ESCO-2143.1.3	Recycling specialist
			ESCO-2143.2	Environmental expert
			ESCO-2144.1	Mechanical engineer
			ESCO-2144.1.1.1	Aerodynamics engineer
			ESCO-2144.1.9	Industrial tool design engineer
			ESCO-2144.1.10	Marine engineer
			ESCO-2144.1.11	Mechatronics engineer
			ESCO-2144.1.14	Naval architect
			ESCO-2144.1.23	Welding engineer
			ESCO-2146.2	Drilling engineer
			ESCO-2149.10	Health and safety engineer
			ESCO-2149.10.1	Fire prevention and protection engineer
				Application engineer
			ESCO-2149.2	Calculation engineer
			ESCO-2149.2.1	Component engineer
			ESCO-2149.2.2	Contract engineer
			ESCO-2149.2.3	Design engineer
			ESCO-2149.2.4	Installation engineer
			ESCO-2149.2.5	Logistics engineer
			ESCO-2149.2.6	Quality engineer
			ESCO-2149.2.7	Research engineer
			ESCO-2149.2.8	Commissioning engineer
			ESCO-2149.6	Dependability engineer
			ESCO-2149.7	Energy engineer
			ESCO-2149.9	Energy systems engineer
			ESCO-2149.9.2	Offshore renewable energy engineer
			ESCO-2149.9.5	Onshore wind energy engineer
			ESCO-2149.9.6	Renewable energy engineer
			ESCO-2149.9.7	Solar energy engineer
			ESCO-2149.9.8	Materials engineer
			ESCO-2149.11	Robotics engineer
			ESCO-2149.15	Test engineer
			ESCO-2149.16	
11	ESCO-215	Electrotechnology engineers	ESCO-2151.1	Electrical engineer
			ESCO-2151.1.1	Electric power generation engineer
			ESCO-2151.1.3	Electromechanical engineer
			ESCO-2151.1.5	Power distribution engineer
			ESCO-2153.1	Telecommunications engineer
12	ESCO-216	Architects, planners, surveyors and designers	ESCO-2163.1	Industrial designer
			ESCO-2165.4.1	Hydrographic surveyor
			ESCO-2166.10	Illustrator
			ESCO-216X.X	Marine spatial planner
13	ESCO-226	Other health professionals	ESCO-2263.3	Health and safety officer
14	ESCO-241	Finance professionals	ESCO-2411.1	Accountant
			ESCO-2411.1.5	Cost analyst
			ESCO-2411.1.7	Financial auditor
			ESCO-2411.1.8	Financial controller
			ESCO-2413.1	Financial analyst
			ESCO-2413.1.2	Investment analyst
			ESCO-2413.1.3	Merger and acquisitions analyst

A/A	Occupational Group of profiles (ESCO Hierarchy Level 3)		Occupational profiles (ESCO Hierarchy Level 4)	
15	ESCO-242	Administration professionals	ESCO-2421.1 ESCO-2421.3 ESCO-2422.14 ESCO-2423.3	Business analyst Business intelligence manager Procurement category specialist Human resources officer
16	ESCO-243	Sales, marketing and public relations professionals	ESCO-2431.14 ESCO-2431.5 ESCO-2431.6 ESCO-2433.3 ESCO-2433.5	Pricing specialist Business developer Client relations manager Renewable energy consultant Solar energy sales consultant
17	ESCO-251	Software and applications developers and analysts	ESCO-2511.3 ESCO-2511.4 ESCO-2511.11 ESCO-2511.14 ESCO-2512.3 ESCO-2512.4	Data analyst Data scientist ICT intelligent systems designer ICT system architect Software architect Software developer
18	ESCO-252	Database and network professionals	ESCO-2521.1 ESCO-2529.3 ESCO-2529.5	Database administrator Embedded systems security engineer ICT resilience manager
19	ESCO-261	Legal professionals	ESCO-2619.1 ESCO-2619.5 ESCO-2619.12	Contract manager Legal consultant Regulatory affairs manager
Technicians and associate professionals				
20	ESCO-311	Physical and engineering science technicians	ESCO-3112.1.4 ESCO-3112.3 ESCO-3112.5 ESCO-3113.1 ESCO-3113.1.2 ESCO-3113.2 ESCO-3114.1.4 ESCO-3115.1 ESCO-3115.1.6 ESCO-3115.1.7 ESCO-3115.1.9 ESCO-3115.1.11 ESCO-3115.1.15 ESCO-3115.1.24 ESCO-3118.3.6 ESCO-3118.3.7 ESCO-3119.2 ESCO-3119.8 ESCO-3119.11	Construction quality manager Construction safety manager Energy analyst Electrical engineering technician Electromechanical engineering technician Hydropower technician Instrumentation engineering technician Mechanical engineering technician Industrial maintenance supervisor Marine engineering technician Marine surveyor Mechatronics engineering technician Pneumatic engineering technician Welding inspector Electrical drafter Electromechanical drafter Automation engineering technician Industrial engineering technician Offshore renewable energy technician
21	ESCO-312	Mining, manufacturing and construction supervisors	ESCO-3122.5 ESCO-3123 ESCO-3123.1.8	Waste management supervisor Construction supervisor Demolition supervisor
22	ESCO-313	Process control technicians	ESCO-3131.1 ESCO-3131.3	Offshore renewable energy plant operator Power production plant operator Electrical transmission system operator

A/A	Occupational Group of profiles (ESCO Hierarchy Level 3)		Occupational profiles (ESCO Hierarchy Level 4)	
			ESCO-3131.3.2 ESCO-3131.3.7 ESCO-3139.2	Power plant control room operator Solar power plant operator Industrial robot controller
23	ESCO-315	Ship and aircraft controllers and technicians	ESCO-3153.4	Drone pilot
24	ESCO-325	Other health associate professionals	ESCO-3257.5	Occupational health and safety inspector
25	ESCO-331	Financial and mathematical associate professionals	ESCO-3311.1 ESCO-3311.3.1	Asset manager Energy trader
26	ESCO-332	Sales and purchasing agents and brokers	ESCO-3322.1.2 ESCO-3323.2 ESCO-3324.1	Renewable energy sales representative Purchaser Commodity broker
27	ESCO-333	Business services agents	ESCO-3339.2	Auctioneer
Clerical support workers				
28	ESCO-422	Client information workers	ESCO-4225.1	Customer service representative
29	ESCO-431	Numerical clerks	ESCO-4311.2	Sales support assistant
30	ESCO-432	Material-recording and transport clerks	ESCO-4323.11 ESCO-4323.20	Port coordinator Water traffic coordinator
Craft and related trades workers				
31	ESCO-711	Building frame and related trades workers	ESCO-7119.1	Construction scaffolder
32	ESCO-712	Building finishers and related trades workers	ESCO-7126.8	Plumber
33	ESCO-713	Painters, building structure cleaners and related trades workers	ESCO-7131.1	Construction painter
34	ESCO-721	Sheet and structural metal workers, moulders and welders, and related workers	ESCO-7212.3 ESCO-7215.2 ESCO-7215.3	Welder Rigger Rigging supervisor
35	ESCO-722	Blacksmiths, toolmakers and related trades workers	ESCO-7223.5 ESCO-7223.7	Drilling machine operator Fitter and turner
36	ESCO-723	Machinery mechanics and repairers	ESCO-7233.5 ESCO-7233.13	Greaser Pneumatic systems technician
37	ESCO-741	Electrical equipment installers and repairers	ESCO-7411.1 ESCO-7411.1.4 ESCO-7412.10 ESCO-7412.12 ESCO-7413.1 ESCO-7413.1.1	Electrician Solar energy technician Power tool repair technician Wind turbine technician Electricity distribution worker Cable jointer
38	ESCO-742	Electronics and telecommunications installers and repairers	ESCO-7422.1 ESCO-7422.6	Communication infrastructure maintainer Telecommunications equipment maintainer Telecommunications technician

A/A	Occupational Group of profiles (ESCO Hierarchy Level 3)		Occupational profiles (ESCO Hierarchy Level 4)	
			ESCO-7422.7	
39	ESCO-754	Other craft and related workers	ESCO-7541.1	Construction commercial diver
Plant and machine operators and assemblers				
40	ESCO-821	Assemblers	ESCO-8211.3 ESCO-8212.2.2 ESCO-8212.3 ESCO-8212.3.2 ESCO-8212.3.5 ESCO-8219.7 ESCO-8219.8	Mechatronics assembler Electrical cable assembler Electronic equipment assembler Electromechanical equipment assembler Printed circuit board assembler Metal furniture machine operator Metal products assembler
41	ESCO-834	Mobile plant operators	ESCO-8343.3 ESCO-8343.4	Mobile crane operator Production plant crane operator
Elementary occupations				
42	ESCO-933	Transport and storage labourers	ESCO-9333.8	Warehouse worker

2.2. Steps in analysing skills demand

Taking into consideration the two reference layers described above, data collection activities for analysing skills demand in the ORE sector were initiated (Figure 7). These comprised: (a) a desk research activity collecting and analyzing all pertinent (scientific and grey) literature published to date, and (b) a job vacancies analysis collecting relevant job offers published online over an 8-month period (April-November 2023). Collected data were effectively processed for extracting valuable conclusions on:

a) the occupational profiles that are in high demand;
b) the skills (hard and soft) that are mostly requested by the industry;
c) the knowledge and experiences that a candidate should possess for being considered for the job offer;
d) the level of education and type of training that employers are looking for;
e) whether knowledge of additional languages (i.e. other than the native one) is often placed as a mandatory precondition or as a preference

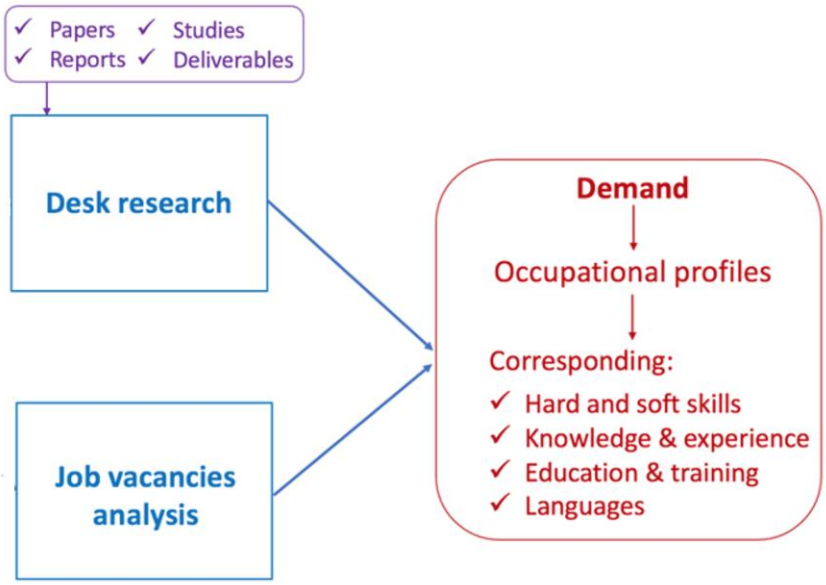

***Figure 7**: Breakdown of activities for analysing skills demand (Source: authors' own elaboration)*

2.2.1. Desk research

With the ORE sector continuously and rapidly growing, pertinent literature has in turn expanded, with the topic of skills attracting increased attention. In order to identify, collect and analyse all relevant contributions, the Systematic Literature Review (SLR) approach was in principle followed. Different search engines were utilized to identify relevant contributions, with the results obtained ranging from scientific papers to project reports, industry publications, studies, etc. An initial screening process of identified contributions was undertaken based on abstract / executive summary review, enabling removal of all non-relevant contributions. The content of those retained was then analyzed, and valuable information on skill needs and developments in the sector were extracted. Once synthesized, we were able to draw valuable insights (see Section 3) which properly informed and were effectively combined with the results of the job vacancies analysis.

2.2.2. Job vacancies analysis

Job posting and search are now mostly undertaken via relevant online portals and platforms, providing access to a wealth of information which can be collected and processed in order to analyse skills demand. Following the steps outlined in Cedefop's 'Online job vacancies and skills analysis' booklet[7] (Figure 8), 981 job vacancies in the ORE sector were identified across Europe over an 8-month period (April – October 2023) (Table 2).

An online survey tool (i.e. ArcGIS Survey123) was used to simplify and expedite the data collection process that addressed required hard and soft skills, qualifications, knowledge and experience, etc. Key relevant platforms (e.g. LinkedIn, EURES, Indeed, etc.) were scrutinized to this end, using a number of relevant keywords either separately or in combination (e.g. offshore renewable energy, marine renewable energy, offshore marine energy, offshore wind energy, floating renewable energy, ocean energy, wave energy, tidal energy, thermal offshore, thermal energy, maritime renewable, marine / maritime spatial planning, marine environment, etc.).

[7] https://www.cedefop.europa.eu/en/publications/4172#group-downloads

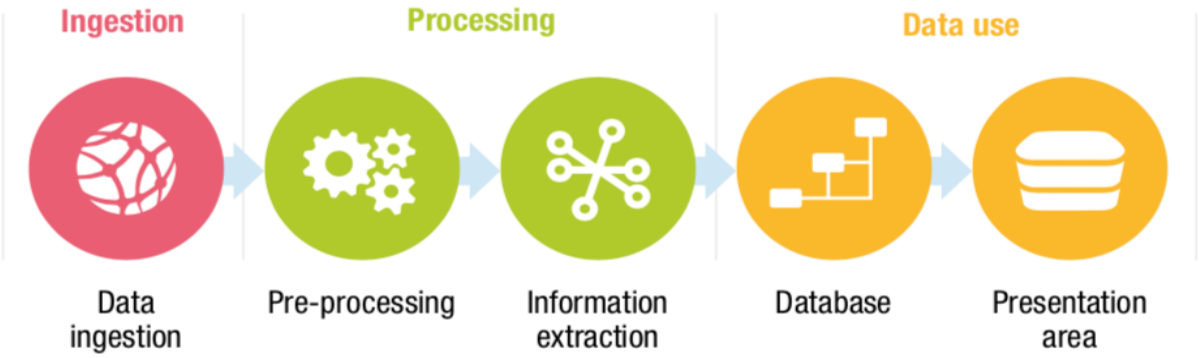

Figure 8: *Online job vacancies data collection and production process (Source: Cedefop, 2019)*

Table 2: *Distribution of collected job vacancies per European country*

A/A	Country	Number of collected job offers[8]	Key sources
1	Germany	76	Vattenfall • LinkedIn • Green Recruitment Company • Vinci • Indeed
2	Denmark	100	beBee • Indeed • Energy Job Online • Global Wind Service • GrabJobs • Vattenfall • Trabajo • Job Leads • EuroJobs
3	Netherlands	129	LinkedIn • Werkenaaenergie.nl • Siemens Gamesa • Hetuitzendbureau.nl • Eures • BP • SeaQurrent
4	Belgium	51	LinkedIn • Indeed
5	France	95	Vestas Vacancies • EURES
6	Spain	145	LinkedIn • Siemens Gamesa • Empleate Gobierno • Infojobs • Taylor Hopkinson • Ingenierosnavales.com • Robertwalters • PLOCAN • Adecco
7	Italy	65	LinkedIn • Aventa.fr
8	Portugal	351	Vestas Vacancies • LinkedIn • EURES
9	Finland	9	Simply Blue Group • Hitachi Energy • LinkedIn • Enersense • Ntice • beBee
10	Sweden	27	Navitas • LinkedIn • Hexicon Group • Flux Partners • Energy Job Online • Talent
11	Ireland	24	Vestas Vacancies • EURES

Data collection efforts were shared among consortium partners involved in Task 2.1 of WP2, taking into account the country in which they are located and their language capabilities, as many job offers were posted in national languages. For facilitating the process and ensuring consistency of reported data, a relevant guidebook was developed by CERTH-HIT and was presented to and shared with the project partners.

2.3. Steps in analysing skills supply

[8] Total number of job offers in the table is not equal to 981, since some job offers involved multiple countries

Analysing skills supply consists of collecting information on ORE-related educational programs and training courses currently on offer by different institutions and bodies across the EU. The fast development and growth of the sector naturally drove such programmes and courses to rise in number and/or become more targeted, as very often in the past they had been part of programmes & courses addressing renewable energy as a whole.

The process of identifying such programmes and courses and collecting all relevant data, started in March 2023 and ended in early September 2023. The MarineTraining Platform[9], a service platform dedicated to marine education and training developed and operated by the University of Ghent, served as the tool for consolidating this information and presenting it to any interested web user[10]. More specifically, a set of relevant guidelines were prepared by the University of Ghent, followed by a hands-on experience workshop where the process of directly inserting programme / course information into the platform was explained to project partners and any questions / difficulties were cleared up.

Project partners were each assigned a different set of EU countries in which to search for relevant educational programmes and training courses. For this assignment, the location of each partner was taken into consideration in an effort to overcome any potential language barrier as details of some programmes and courses are provided only in the national language. Besides desk research, recommendations provided by academics and industry experts during a focus group meeting (April 2023) were also taken into account for the identification of those programmes and courses.

After retrieving all data uploaded in the MarineTraining platform, a screening and cleaning process removed any duplicates as well as any irrelevant input (e.g. 'events' are not considered as training, etc.). In addition, all programme / course links were double-checked so as to ensure that all data fields were filled out and no programme / course information was missing.

The aforementioned process resulted in 398 educational programmes and training courses being retained in the MarineTraining platform. The information presented for each one of them is displayed in the following Table (Table 3).

Table 3: *Programme / course information presented in the MarineTraining platform*

✓ Title	*Title of the programme / course in English or in the national language of the country where the programme / course is offered*
✓ Type	*Short-cycle tertiary education, Bachelor, Master, PhD, etc.* *The ISCED 2011 Level is also indicated*
✓ Format	*Onsite, online or blended*
✓ Description	*Short description of what the programme / course entails and what exact knowledge students / attendees will be gaining*
✓ Start date	*Date that the programme / course starts*
✓ Duration	*In hours, days, months or semesters*
✓ Cost	*In Euros (€) or national currency either for the whole programme / course or per year. Cost is often differentiated for EU and international students*
✓ Entry level	*Level of education required for entering the programme / course (e.g. Bachelor, Master, etc.)*
✓ Application procedure	*Link to online application platform / system*

[9] https://www.marinetraining.eu/home
[10] https://www.marinetraining.org/flores

✓ Grant opportunities	*Available opportunities that can be exploited for covering part of the cost of the programme / course*
✓ Learning outcomes	*List of competences and qualifications that students will gain upon completion of the programme / course*
✓ Prerequisites	*Degrees (or grades) that applicants should have for getting selected to attend the programme / course, or entrance exams*
✓ Language	*Language of the programme / course*
✓ Provider	*Institution / body offering the programme / course*
✓ Contact	*Contact e-mail to reach out for more information*
✓ Relevant ISCED categories	*Thematic ISCED category(ies) that the programme / course is relevant to*

These information fields are predefined in the MarineTraining platform. However, in addition to this information, the occupational profiles that each identified programme and course addresses were also specified, along with the skills (hard and soft) that the programme / course provides. Of course, as mentioned before, the ESCO classification of occupational profiles was used to this end.

The distribution of the identified programmes and courses per country is depicted in Figure 9 below. Portugal and Germany account for the largest shares (27,14% and 18,09% respectively), while quite similar in number are the programs & courses offered in Ireland, the Netherlands, Spain and Belgium. As expected, most programmes and courses are offered in North European countries where the largest shares of installed capacity are located, while Mediterranean countries also account for a considerable share for meeting the relevant needs of the market that is rapidly growing there.

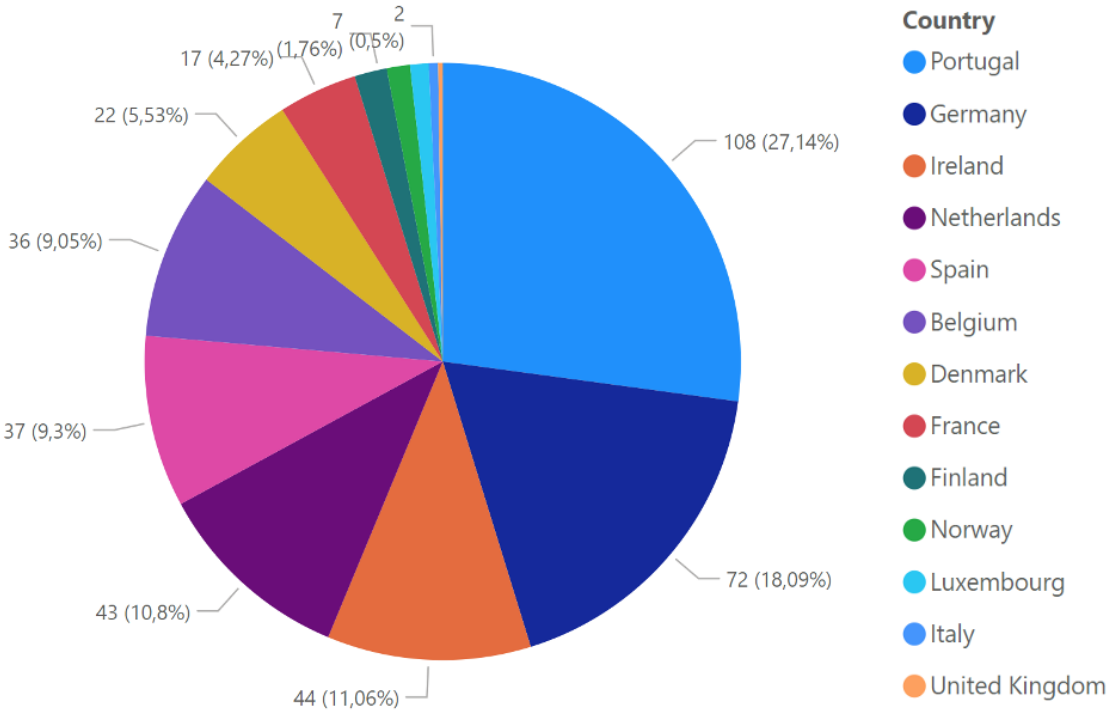

Figure 9: *Distribution of identified programs & courses per country (Source: Own elaboration)*

3. Building a solid knowledge basis

After setting the proper reference layers and before starting the data collection activities planned for assessing both skills demand and supply, the next step was to review all relevant information published to-date in order to set up a solid knowledge basis that will properly inform both analyses. In addition to this desk research activity, structured interactions with key stakeholders facilitated through a number of key events that took place were effectively utilized for extracting valuable insights that further reinforced the knowledge basis to be established.

3.1. Desk research

The sector's rapid growth naturally led to the introduction of several supporting initiatives covering, among other topics, skills analysis and development in the sector. As outlined in the methodological framework of the present report (Section 2) and with the aim to build, as mentioned above, a solid knowledge basis which can stand alone as a key reference for future actions, a desk research activity was performed following, in principle, the Systematic Literature Review (SLR) approach. All information sources identified are listed below in Table 4, along with the issuing initiative / organization(s) and a brief outline of the contribution they make to the knowledge basis.

Table 4: *Relevant information sources identified[11] addressing skills analysis and development in the ORE sector*

Information source	Issuing initiative / organization(s)	Input to the knowledge basis
Web portals		
Skills Online Vacancy Analysis Tool for Europe (Skills OVATE)	Cedefop	Online job advertisements big data
MarineTraining Platform	Ghent University	Up-to-date list of relevant educational programs and training courses collected within the framework of different projects / initiatives
Studies & Reports		
Researching Skills and Training Needs of the Industry	T-SHORE project	(a) Skills demand in ORE, focusing on starting technicians, operators and coordinators with VET degree (EQF3-5), (b) Current training courses and infrastructure for workforce upskilling and reskilling in the sector
Baseline report on present skills gaps in the shipbuilding and offshore renewables value chains	MATES project	(a) Skills demand and supply analysis in the ORE sector (2018-2019) (all EQF levels), (b) Assessment of supply-demand mismatch, and (c) Identification of skill gaps and shortages
Building our potential: Ireland's Offshore Wind Skills and Talent Needs	BVG Associates for Green Tech Skillnet and Wind Energy Ireland	(a) Offshore wind deployment project till 2050 and analysis of implications on the supply chain and skills, (b) Identification of skills challenges and shortages, (c) Provision of targeted recommendations for skills development in the short, medium and long-term

[11] Pertinent literature related to the ORE sector in the UK has not been included

Global Offshore Wind Report 2023	Global Wind Energy Council	Actions the industry can take to support building the offshore wind workforce of the future
Global Wind Workforce Outlook 2022-2026	Global Wind Organization & Global Wind Energy Council	Wind workforce forecasts and dynamics
The Socio-economic Benefits of Solar and Wind Energy	IRENA	(a) Policies to promote skills development to enable value creation, and (b) strategic planning for skill needs, education and training
Compétences et métiers des énergies décarbonées	EVOLEN	(a) Identification of carbon free energy skills and professions in France, (b) skills foresight (2030), and (c) pathways to improve the mismatch between skills supply and demand
Articles		
How can offshore wind benefit from transferable skills within oil and gas	Airswift	Transition from oil and gas to offshore wind (transferable skills, reskilling process, companies' business refocus)
Initiatives		
Energy Skills Alliance	OPITO	(a) Energy skills demand foresight (short-term and 2050), (b) People and Skills plan facilitating the fluidity of people across the energy sector, (c) Integrated STEM programme and energy apprenticeship scheme

3.2. Stakeholder consultation

The 2023 Annual Event of WindEurope in Copenhagen provided a first-hand opportunity to engage with sectoral experts and collect valuable feedback that properly informed all different segments of the present report. To this end, a targeted workshop entitled *'Informing the ORE sector skills observatory'* was organized within the framework of this event on Thursday 27th of April 2023, and relevant experts were invited to attend and share their views. For better structuring and facilitating the discussion, invited experts received a set of questions in advance aiming to:

a) validate the ORE value chain (all phases and activities) and the list of occupational profiles engaged in all different operations (i.e. our reference layers);
b) highlight the occupational profiles that, in their opinion, are currently in high demand as well as those that presently exhibit the most significant skill gaps and lack of qualifications;
c) suggest proper ways to better align skills supply with demand.

The workshop participants confirmed that the ORE value chain presented to them[12] is valid, but made a couple of recommendations which were well received and then integrated into the final version of the ORE value chain presented in sub-section 2.1.1. More specifically, the experts recommended:

[12] This is the one previously developed by the lead authors and reported in Deliverable 2.1 of the MATES project

- In the Planning phase, to include pre-planning activities (usually carried out by external organizations) which are critical to the entire value chain;
- To include Tending and Contracting as the first group of activities in the development and construction phase, since these activities are carried out before any manufacturing process can start;
- To include data management and transparency as cross-cutting activity, given the increased importance that is now given to such activities.

With regard to the list of occupational profiles engaged in the ORE value chain, though the experts found it more or less complete, they recommended 15 additional profiles to be included[13]. After carefully checking each of these, 13 were found to be alternative labels of occupational profiles already included (Table 1), while the remaining two (i.e. Marine Spatial Planner and Metocean Analyst) were not found in the ESCO database and will therefore be recommended for consideration in the database's next update. In Table 1, both profiles are highlighted in green, and have been included in the group of occupational profiles identified as most relevant.

Additional insights were provided by the workshop participants for occupational profiles engaged in selected parts of the ORE value chain. More specifically, they highlighted the importance of the Tendering and Contracting group of activities within the ORE value chain, stressing the intrinsic complexity involved. The latter necessitates the engagement and efficient cooperation of a large and diverse set of occupational profiles covering procurement, legal, commercial and technical aspects, ensuring that the appropriate policy and business environment is in place and thus the setting up and upscaling of ORE projects is smooth and in line with environmental conservation.

With regard to occupational profiles being currently in high demand, they noted that:

- Divers are much needed, but industry actors do not find it very challenging to recruit well-qualified professionals;
- Competent technical workers with the appropriate vocational education and training (VET) are also heavily requested by the industry, given that they represent the majority of the human resources employed in the sector (e.g. they account for 40% of the employees engaged in the Development & Construction phase of the ORE value chain);
- Engineers are currently in the highest demand, especially for carrying out activities related to sea-bed analysis and the installation of floating wind farms. In almost all cases, a higher education degree is a prerequisite;
- There is also strong demand for service technicians as well as well-qualified welders, although demand for the latter has started to decrease gradually.

Insights on skills and competences mostly requested by the industry were also shared by the workshop participants. As a general comment, the experts emphasized the increased complexity characterizing the sector which is also reflected in the required skills, competences and knowledge. While stressing that identifying and listing those requirements does add real value, they acknowledged that such a process is highly complicated. Taking the ORE value chain as reference, they noted that pre-planning activities involve to a large extent skills, competences and knowledge related to relevant policy frameworks and legal procedures aiming to ensure that an ORE project complies with existing regulations (e.g. environmental impact, materials used, manufacturing processes deployed, etc.) and that its upscale can be smooth. As mentioned before, tendering and contracting activities require competences that cover both commercial and technical aspects, the identification and listing of which would also add real value. For example, procuring the foundation of an ORE system requires to effectively combine knowledge of commercial and legal aspects, so

[13] Geophysical engineer, Hydrodynamicist, Metocean analyst, Geotechnical engineer, Marine scientist, Marine spatial planner, HV electrical designer, Marine engineer / Naval architect, Document controller, Supply chain specialist, Water traffic coordinator, Transport expert, Port expert, Drone operator

as to ensure that all activities are performed in accordance with the specificities set in relevant legislation. The case is the same for manufacturing activities.

Skills, competences and knowledge related to commercial aspects (e.g. negotiate contracts with the manufacturing parties, contract management, procurement management, etc.) as well as to marketing, are the ones mostly missing from the sector today. Workshop participants have observed that there is a significant lack of working experience in the sector especially with regard to *planning activities*, which is an important barrier for ensuring smooth ORE operations. Good knowledge of English is also an important requirement for ensuring good communication among different occupational profiles engaged in various activities of the ORE value chain. However, in some countries, it is not easy to recruit blue-collar workers who speak English well. Finally, workshop participants pointed out the *synergies* that the ORE sector presents with other sectors (mostly Oil & Gas) and the great opportunities that exist for exploiting transferable skills (mainly related to engineering, project management and risk management).

4. Skills demand analysis

As described in the methodological framework devised for meeting the needs of this report (Section 2), and building on the results of the desk research and stakeholder consultation activities, a process

to collect data on employers' skill requirements from job vacancies posted online in key relevant platforms (e.g. LinkedIn, EURES, Indeed, etc.) was established and communicated to project partners sharing the effort of collecting data, with the aim of ensuring consistency in the final dataset. More specifically, a guidebook was prepared by the partner in charge (CERTH-HIT), clarifying the steps to be followed: (i) identify platforms / websites listing relevant job vacancies in the countries allocated to each project partner; (ii) use the same set of keywords (i.e. offshore renewable energy, marine renewable energy, offshore marine energy, offshore wind energy, floating renewable energy, ocean energy, wave energy, tidal energy, thermal offshore, thermal energy, maritime renewable, marine / maritime spatial planning and marine environment) and save all relevant results in pdf format; (iii) fill out all details of each job advertisement in the online data collection form that had been prepared in the ArcGIC Survey123 tool. The latter included the following information fields:

- Job title
- Job level (e.g. senior, mid-senior, etc.)
- Company / organization / institution posting the vacancy
- Work model (e.g. on-site, hybrid)
- Working hours (e.g. full-time, part-time)
- Job location (e.g. country, region)
- ORE sub-sector addressed
- Time stamp (i.e. date that the job advertisement was posted)
- Contract duration (e.g. in years, permanent, etc.)
- Link to the online job advertisement
- Technical skills and competences required for the position
- Soft skills required for the position
- Education and/or training required or desired for the position
- Experience required or desired for the position
- Knowledge of other languages required or desired for the position.

The data collection process lasted for 8 months, from April to October 2023, resulting in the identification of 981 job vacancies, with all their information completing the final dataset. As depicted in Figure 10 below[14], these vacancies were located in 10 EU countries, with Portugal accounting for the largest share followed by Spain and the Netherlands.

[14] Exact numbers are presented in Table 2

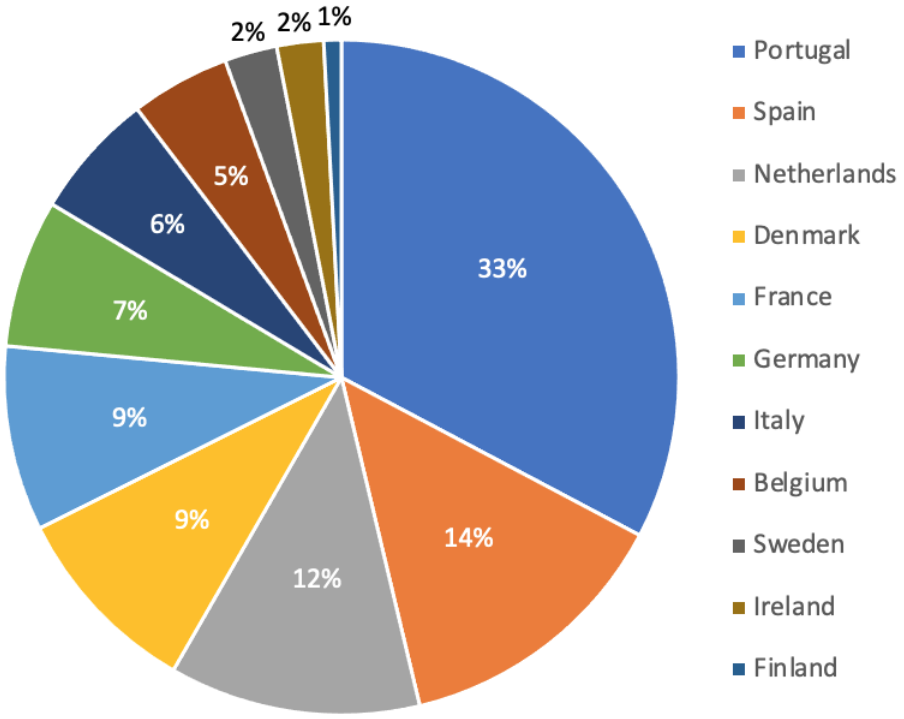

Figure 10: *Share of collected job vacancies per European country (Source: Own elaboration)*

The broad groups of occupational profiles (i.e. ESCO Hierarchy Levels 1 & 2) mostly requested by the industry, according to the analysis of the job vacancies that were collected, are presented in Table 5 below. Professionals currently account for the highest demand, followed by Managers and Technicians and Associate Professionals the demand for whom is quite balanced. Much less is the need for occupational profiles belonging to the other 4 broad groups of ESCO (i.e. ESCO-4, 7, 8 & 9).

Focusing on the ESCO Hierarchy Level 2 group of occupational profiles, it is evident that the industry currently has a greater need for science and engineering professionals, as well as associate professionals, while there is also significant demand for administrative and commercial managers. These results fully validate the views expressed by sectoral experts during the targeted workshop held within the framework of the WindEurope Annual Event 2023 (see pages 28-29).

Table 5: *Break-down of demand per broad groups of occupational profiles (ESCO Hierarchy Levels 1 & 2)*

A/A	Broad groups of occupational profiles (ESCO Hierarchy Levels 1 & 2)		Job vacancies	
			Number[15]	Share
1	**ESCO-1**	**Managers**	**198**	**20,2%**
	ESCO-11	Chief executives, senior officials and legislators	7	0,7%
	ESCO-12	Administrative and commercial managers	171	17,5%
	ESCO-13	Production and specialized services managers	19	1,9%
	ESCO-14	Hospitality, retail and other services managers	1	0,1%
2	**ESCO-2**	**Professionals**	**542**	**55,3%**
	ESCO-21	Science and engineering professionals	394	40,2%
	ESCO-24	Business and administration professionals	52	5,3%
	ESCO-25	Information and communications technology professionals	85	8,7%
	ESCO-26	Legal, social and cultural professionals	11	1,1%

[15] The number of job vacancies per ESCO Hierarchy Level 1, do not add up to a total of 981 since some job vacancies addressed more than one broad group of occupational profiles

A/A	Broad groups of occupational profiles (ESCO Hierarchy Levels 1 & 2)		Job vacancies	
			Number[15]	Share
3	**ESCO-3**	**Technicians and associate professionals**	**189**	**19,3%**
	ESCO-31	Science and engineering associate professionals	126	12,9%
	ESCO-32	Health associate professionals	1	0,1%
	ESCO-33	Business and administration associate professionals	62	6,3%
4	**ESCO-4**	**Clerical support workers**	**5**	**0,5%**
	ESCO-42	Customer services clerks	2	0,2%
	ESCO-43	Numerical and material recording clerks	3	0,3%
5	**ESCO-7**	**Craft and related trades workers**	**20**	**2%**
	ESCO-71	Building and related trades workers, excluding electricians	2	0,2%
	ESCO-72	Metal, machinery and related trades workers	4	0,4%
	ESCO-74	Electrical and electronic trades workers	13	1,3%
	ESCO-75	Food processing, wood working, garment and other craft and related trades workers	1	0,1%
6	**ESCO-8**	**Plant and machine operators and assemblers**	**6**	**0,6%**
	ESCO-82	Assemblers	6	0,6%
7	**ESCO-9**	**Elementary occupations**	**5**	**0,5%**
	ESCO-93	Labourers in mining, construction, manufacturing and transport	5	0,5%

Narrowing the focus towards individual occupational profiles (i.e. ESCO Hierarchy Level >4), Table 6 below lists the 39 profiles that are currently in higher demand, out of the 174 profiles that were identified in total (Table 1). Project managers rank highest. This highlights that the efficient and effective planning and execution of new ORE projects, successfully tackling all related aspects, minimizing any possible risk and meeting the targets that have been set in terms of productivity, etc. are key priorities for the industry. Among the top 10, in demand, occupational profiles, half of them are engineers, marking the important role they are playing in the ORE value chain and the great impact their skills and competences impose on performance, reliability etc. ORE technicians, often reported as hard to find, form the second most in-demand occupational profile. The top 10 profiles are completed by (a) software developers, who play an increasingly important role due to the rapid introduction today of new systems and technologies; (b) purchasers, who are key for ensuring that ORE projects are supplied with the necessary materials, equipment and services on time and at the desired quality; and (c) ORE plant operators, who are essential for ensuring the smooth and safe operation of ORE projects, meeting energy production targets and securing energy supply.

Table 6: *List of occupational profiles (ESCO Hierarchy Level >4) in higher demand*

A/A	List of occupational profiles (ESCO Hierarchy Level >4) in higher demand		Job vacancies	
			Number	Share
1	ESCO-1219.6	Project manager	115	11,7%
2	ESCO-3119.11	Offshore renewable energy technician	74	7,5%
3	ESCO-2149.9.5	Offshore renewable energy engineer	59	6%
4	ESCO-2512.4	Software developer	55	5,6%
5	ESCO-2149.7.6	Wind energy engineer	51	5,2%
6	ESCO-3323.2	Purchaser	36	3,7%
7	ESCO-2149.2.5	Installation engineer	36	3,7%
8	ESCO-3131.1	Offshore renewable energy plant operator	32	3,3%
9	ESCO-2141.8	Maintenance and repair engineer	32	3,3%
10	ESCO-2149.9.2	Energy systems engineer	31	3,2%

A/A	List of occupational profiles (ESCO Hierarchy Level >4) in higher demand		Job vacancies	
			Number	Share
11	ESCO-2151.1	Electrical engineer	30	3,1%
12	ESCO-2149.2.7	Quality engineer	27	2,7%
13	ESCO-1213.7	Health, safety and environmental manager	18	1,8%
14	ESCO-2433.3	Renewable energy consultant	17	1,7%
15	ESCO-2144.1	Mechanical engineer	15	1,5%
16	ESCO-1223.1	Product manager	14	1,4%
17	ESCO-3322.1.2	Renewable energy sales representative	12	1,2%
18	ESCO-2423.3	Human resources officer	11	1,1%
19	ESCO-2142.1.4	Geological engineer	11	1,1%
20	ESCO-2529.3	Embedded systems security engineer	11	1,1%
21	ESCO-2511.4	Data scientist	9	0,9%
22	ESCO-1221.4	Commercial director	9	0,9%
23	ESCO-1324.8	Supply chain manager	9	0,9%
24	ESCO-2149.2.1	Calculation engineer	8	0,8%
25	ESCO-1120.2	Business manager	7	0,7%
26	ESCO-1323.1	Construction manager	7	0,7%
27	ESCO-2619.1	Contract manager	7	0,7%
28	ESCO-1221.3.2.1	Sales manager	7	0,7%
29	ESCO-7412.12	Wind turbine technician	7	0,7%
30	ESCO-2151.1.5	Power distribution engineer	7	0,7%
31	ESCO-2144.1.14	Naval architect	6	0,6%
32	ESCO-2149.2.6	Logistics engineer	6	0,6%
33	ESCO-2149.16	Test engineer	6	0,6%
34	ESCO-2149.2.2	Component engineer	6	0,6%
35	ESCO-2431.5	Business developer	6	0,6%
36	ESCO-3339.2	Auctioneer	5	0,5%
37	ESCO-2411.1.8	Financial controller	5	0,5%
38	ESCO-7411.1.4	Solar energy technician	5	0,5%
39	ESCO-9333.8	Warehouse worker	5	0,5%

Organized according to their ESCO Hierarchy Level 3 group, for each of the 39 occupational profiles listed above, the following information, as requested by the industry, is reported in subsequent sub-sections (4.1-4.18): (a) Technical skills and competences; (b) Soft skills; (c) Knowledge; (d) Experience; (e) Education and training (Qualifications); and (f) Languages.

4.1. Business services and administration managers (ESCO-121)

This ESCO Hierarchy Level 3 group includes 2 of the 39 occupational profiles that are currently in high demand, namely the Project manager, currently the industry's top priority, and the Health, safety and environmental manager, an occupational profile ranked among the top 15, given the greater attention now placed on those three dimensions (i.e. health, safety, environment) in a combined approach.

Project manager (ESCO-1219.6)

Technical Skills and Competences

Technical skills and competences requested mainly include: (a) Project management, incorporating effective time management as well as financial management, etc.; and (b) Stakeholder management, which covers creating and exploiting networking opportunities,

effectively engaging with key stakeholders and establishing strong working relationships, liaising with clients, etc. In addition, the industry places emphasis on skills related to the management of : (i) contracts, bids and tenders; (ii) potential risks; and (iii) multi-disciplinary teams. Where needed, project managers should also be in a position to provide technical expertise and support, across all phases of the ORE value chain (with particular focus on pre-planning activities that are very critical), while ensuring compliance with QHSE standards. The actual execution of some technical tasks (e.g. engineering design, R&D, etc.) is rarely required.

Soft skills

The soft skills commonly requested include: communication; collaboration; multi-tasking; being motivational (including self-motivation) and inspiring; well-organized; creative; adaptive; versatile; detail-oriented; team-player; open to learning; able to travel internationally and work across different cultures; able to explain work tasks clearly and patiently; as well as having a structured mindset and a positive and proactive attitude.

Knowledge

Knowledge requirements differentiated according to the characteristics of the projects for which the relevant job vacancy was issued. However, general knowledge of ORE technologies, key principles of the circular economy, project and financial management planning tools, relevant IT systems, applicable regulations and standards, and key technical issues were commonly requested in the majority of the relevant job vacancies. Both broad (i.e. ORE projects) and more targeted projects (i.e. QHSE, engineering projects) were addressed. For ORE projects, a deep understanding of the energy market and the characteristics of its key players was requested, along with know-how on offshore installations, component transportation and logistics. For QHSE-related projects, knowledge on QHSE planning frameworks was sought, while engineering projects addressed different fields of specialization (i.e. civil, mechanical, electrical, marine and naval) requesting knowledge of ORE structures and components, hydrodynamics, electrical connections and cables, energy systems integration, etc.

Experience

Experience in leadership and team management, stakeholder and risk management, tendering processes, and working in multidisciplinary and international environments was the most general one commonly requested in almost all relevant job vacancies. On top of that, working experience in using PM methodologies (e.g. PRINCE2) and software (e.g. MS Project) was also found to be an important prerequisite, with 3 years most often indicated as the minimum threshold. More specialized software (e.g. AutoCAD) was requested for more specialized projects (e.g. engineering projects). However, the aforementioned experiences had to be combined with ORE-related project management working experience on market developments and infrastructure (e.g. floating structures, offshore grid and cable connections, etc.)

Education and Training (Qualifications)

In 82% of the relevant job vacancies, academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were requested. These mainly addressed different fields of engineering (e.g. marine, civil, structural, industrial, electrical), while PM certification (e.g. from the Project Management Institute or the International Project Management Association) was desired in several cases. Besides engineering, academic qualifications in business administration or economics were also requested, but only to a small extent (6% of relevant job vacancies).

Languages

English proficiency (both oral and written) was a prerequisite in all relevant job vacancies, along with the national language of the country where the job vacancy was located. For positions in multilingual countries, knowledge of the additional language(s) was also desirable.

Health, safety and environmental manager (ESCO-1213.7)

Technical Skills and Competences

Key technical skills and competences requested include the successful execution of all QHSE-related tasks, such as establishing the relevant methodological framework, managing hazardous materials and ensuring compliance with applicable standards. Team management is also regarded as essential, covering staff training, mentoring and providing support where needed. On-site inspections also fall under the responsibilities of this profile, overseeing the deployment of necessary equipment and supervising relevant operations. Results must be accurately reported and communicated to key stakeholders.

Soft skills

The soft skills commonly requested include: communication and collaboration; leadership; flexibility; adaptivity; problem-solving; being open-minded and a team player.

Knowledge

A HSE or HSEQ orientation is essential, while sound knowledge of relevant standards and regulations (including ISO, ISM Code, IEC) is a prerequisite, as these guide the operations and protocols of ORE activities. Risk management and awareness of ORE market dynamics are also crucial for informed decision-making at the management level. Additionally, in some cases, chemical knowledge may also be needed.

Experience

Experience in handling HSE issues in the offshore (preferably) or onshore renewable energy sector is sought. Candidates with similar experience in other sectors may also be considered, with a minimum of three years typically required.

Education and Training (Qualifications)

A B.Sc. degree (EQF 6) predominately in HSE or, alternatively, in environmental science or engineering was requested almost in all relevant job vacancies. In several cases, this also had to be accompanied by some relevant certification (e.g. NEBOSH[16] or MVK[17] and HVK[18] in the Netherlands).

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies.

[16] National Examination Board in Occupational Safety and Health
[17] Middelbare Veiligheidskundige
[18] Hogere Veiligheidskundige

4.2. Physical and engineering science technicians (ESCO-311)

This ESCO Hierarchy Level 3 group includes 1 of the 39 occupational profiles that are currently in high demand, namely the Offshore renewable energy technician. This profile is the second most in-demand, after the Project Manager.

Offshore renewable energy technician (ESCO-3119.11)

Technical Skills and Competences

The primary skill and competence required is the operation and maintenance, both preventive and corrective, of key infrastructure components (e.g. wind turbines). Other highly sought skills and competences include: (a) monitoring operations (e.g. performance of wind turbine generator, etc.) using remote systems, and ensuring compliance with QHSE standards; (b) reporting operational conditions and performance (e.g. technical, safety, etc.); (c) undertaking repair works (e.g. replacing turbine components, performing fault diagnosis, troubleshooting, etc.; (d) communicating, collaborating and building relationships with key stakeholders; (e) collecting, managing and processing operational data (e.g. turbine data); and (f) addressing and fulfilling customer requests.

Soft skills

The soft skills commonly requested include: effective communication; leadership; having an organized and structured mindset; motivating others and him/herself; being results and safety-oriented; being proactive and innovative; being enthusiastic and a team player, as well as having the ability to work independently.

Knowledge

ORE technicians should know how to work safely at heights and in challenging weather conditions, have a deep understanding of high voltage systems, and be able to effectively use appropriate equipment and software for the collection, processing and reporting of relevant data. More advanced mechanical and IT knowledge was requested only in a small number of vacancies.

Experience

Experience requested was mainly related to electrical and industrial maintenance, hydraulics and servicing relevant equipment. Key for industry actors was also to find candidates that have already worked in offshore marine environments, and are well aware of the working conditions there.

Education and Training (Qualifications)

Two-thirds (2/3) of the relevant job vacancies requested candidates with post-secondary education (EQF 5), primarily in electrical or mechanical engineering. The remainder targeted candidates in the same field, but with a B.Sc. and/or M.Sc. degree (i.e. EQF 6 or 7).

Languages

Native speakers in the respective country involved, with a good understanding of English (both oral and written) were requested in the vast majority of relevant job vacancies. Knowledge of technical terms in English was also found to be a prerequisite in several of them.

4.3. Engineering professionals (excluding electrotechnology) (ESCO-214)

This ESCO Hierarchy Level 3 group includes a significant share (i.e. 33,3%) of the 39 occupational profiles that are currently in high demand:

- Offshore renewable energy engineer
- Wind energy engineer
- Installation engineer
- Energy systems engineer
- Quality engineer
- Calculation engineer
- Component engineer
- Logistics engineer
- Test engineer
- Maintenance and repair engineer
- Mechanical engineer
- Naval architect
- Geological engineer

Engineering professionals not elsewhere classified

Industrial and production engineers

Mechanical engineers

Civil engineers

As previously noted, engineers (of various specializations) play a crucial role in the ORE value chain, and their skills and competences make a noticeable impact on the ORE systems' performance, reliability, etc.

4.3.1 Engineering professionals not elsewhere classified (ESCO- 2149)

Offshore renewable energy engineer (ESCO-2149.9.5)

Technical Skills and Competences

The main technical skills and competences requested involve the successful execution of various engineering tasks (e.g. define/review technical specifications, perform technical analysis, etc.) covering offshore energy systems and structures (e.g. foundations), layout setting of farms, as well as mechanical and cable engineering work (e.g. analysis of subsea cables). Particularly critical is the role of ORE engineers in pre-planning activities, carrying out site screening studies, energy yield assessments, (pre)feasibility studies, etc. Other skills and competences in demand include project management, contract / tender / bid management, stakeholder management, risk management, QHSE and data reporting and documentation.

Soft skills

The soft skills commonly requested include: communication; creativity; being pragmatic, well-organized, open-minded, team player, quick learner, self-motivated, able to work against deadlines and willing to take an initiative; having an investigative, critical as well as problem-solving attitude;

Knowledge

Besides general knowledge commonly requested for engineering profiles (e.g. programming, standards and regulations, systems' design, etc.), the following more specific knowledge was requested for ORE engineers: ORE market and business characteristics, key structures and substructures (including foundation and monopile design), key equipment used, 2D and 3D CAD modelling, digital twins development, coupled models operation, cost structuring and analysis

(CAPEX, OPEX, DEVEX), associated logistics processes and warehousing. Candidates who were zero-emission oriented were also found to be important for the industry.

Experience

Previous working experience in the ORE sector was requested (minimum 2-3 years), while long experience (5-10 years) in other power / energy sectors (e.g. Oil & Gas) would also be considered of value. In some cases, candidates were expected to have experience of specialized software relevant to performing certain tasks.

Education and Training (Qualifications)

In all relevant job vacancies, academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were requested, mainly in the field of mechanical, electrical, electromechanical, industrial, marine or civil engineering, or naval architecture. Targeted training was required only in two cases, both from the Global Wind Organization (GWO).

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies.

Wind energy engineer (ESCO-2149.7.6)

Technical Skills and Competences

As is the case with all engineering profiles, the successful execution of engineering tasks related to wind energy is the main skill and competence requested. This includes offshore and mechanical engineering work, coupled with QA/QC and QHSE, while management skills (project, stakeholders, resources, risk management) are also very important.

Soft skills

The soft skills commonly requested include: communication; collaboration; flexibility and forward-thinking; adaptivity; data-driven decision-making; problem-solving; being open-minded, self-motivated, action-oriented, proactive, quality-conscious, team-player and enthusiastic; being able to guide and mentor, work with limited supervision and under pressure; having a customer and results-orientation, a structured mindset, and a systematic and positive attitude.

Knowledge

Interestingly enough, a large number of relevant job vacancies required knowledge on business administration and/or analysis. This mainly stems from the fact that such professionals may serve as managers of operations of a relevant company or project. Candidates must also demonstrate knowledge in various other areas, including maintenance, manufacturing, mechanical systems and market trends, programming, and project administration and management. Additional expertise in technical standards, supplier management, wind turbine transport and installation is also essential. More specifically, in-depth experience with wind turbine generators was also required covering their design, installation, control, engineering, operation and maintenance.

Experience

Candidates are required to have experience in the transport, construction and maintenance of wind farm components, as well as proficiency in 2D drawing and/or 3D modelling tools (e.g. Ansys, Agile

and/or Scrum methodologies, Atlassian suites, CATIA design, etc.). Additionally, experience with concurrent engineering, the design and development of accumulator and cylinder systems, as well as with the coordination of different engineering processes is essential.

Education and Training (Qualifications)

In all relevant job vacancies, academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were requested, mainly in the field of mechanical, structural, aerodynamics, civil or ocean engineering, or naval architecture.

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies.

Installation engineer (ESCO-2149.2.5)

Technical Skills and Competences

The successful execution of relevant engineering tasks (i.e. related to cable, marine and offshore engineering work) accounted for the main technical skills and competences requested. Additionally, expertise in project and logistics management, the coordination of installation activities, stakeholder management, QA/QC, QHSE and documentation management and reporting is also essential.

Soft skills

The soft skills commonly requested include: communication; leadership; time management, self-awareness; being systematic, organized, solutions-oriented, independent, service-minded, motivated, willing to learn, a team-player, able to work in a multicultural group, enthusiastic;

Knowledge

In common with other engineering profiles, a strong technical background and programming knowledge is seen as a prerequisite. In addition, installation engineers need to present a deep understanding of the characteristics and attributes of components and cables, the design and operation of electrical systems, appropriate tools that can be used for effectively performing different tasks (e.g. finite element analysis, systems engineering, quality development, etc.), relevant electrical and connectivity standards and regulations, as well as of the ORE market dynamics and sectoral developments.

Experience

Experience in systems engineering, design and assessment of floating and bottom fixed structures, installation analysis and dynamic cables, with a focus on the wind industry, was requested.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were mainly requested in the field of structural, civil, mechanical or marine engineering, or naval architecture. In a few cases, higher academic qualifications were requested (i.e. Ph.D. – EQF 8) in mechanical engineering with a focus on hydrodynamics.

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies.

Energy systems engineer (ESCO-2149.9.2)

Technical Skills and Competences

The main technical skills and competences required include QA/QC processes, such as the design of control functionalities, ensuring the certification of electrical simulation models, and verifying functionalities and system components through software and/or field testing. Additionally, the demand for successfully executing electrical, system and control engineering tasks, was also high with the use, where needed, of specialized software.

Soft skills

The soft skills commonly requested include: communication; collaboration; leadership; professionalism; self-motivation; problem-solving; being pragmatic, proactive, innovative, process and results-oriented, a team-player (in international teams) and able to embrace changes; having strong interpersonal skills, a structured mindset, a can-do personality, solid sense of quality and responsibility and the ability to embrace changes

Knowledge

Sound knowledge in programming languages and algorithms is required, as well as in power system design, testing, control and modelling. Familiarity with power systems simulation tools (e.g. DigSilent, PowerFactory, TSAT) is essential. Proficiency in Atlassian suites and other computational methods, aerodynamics / aeroelasticity, controller design and operation, electrical plant integration and EMT-type models is also highly rated.

Experience

Experience in the following areas was requested: Atlassian suites, contingency analysis, control development (including software and engineering) for wind turbine applications; large power system dynamics, real-time embedded systems and short-circuit analysis.

Education and Training (Qualifications)

Academic qualifications at the M.Sc. level (i.e. EQF 7) were primarily requested in the field of electrical, power systems or control engineering. Additionally, a considerable number of job vacancies also asked for Ph.D. holders (i.e. EQF 8) in the same fields.

Languages

Fluency in English was requested in all relevant job vacancies.

Quality engineer (ESCO-2149.2.7)

Technical Skills and Competences

The main technical skills and competences required include QA/QC and QHSE. However, many job vacancies emphasized the importance of resource management (i.e. assessing, selecting and managing suppliers, and controlling procurement activities), operational monitoring, inspections,

stakeholder management and data processing, and reporting. Key engineering tasks taken up mainly relate to system, control and welding engineering work.

Soft skills

The soft skills commonly requested include: communication; collaboration; leadership; critical thinking; problem-solving; work organization; accountability; ability to trust and learn quickly and independently; being innovative, self-motivated, open-minded, proactive, detail-oriented, service-minded, team-player; having a can-do attitude; and being able to work in a busy and versatile business environment.

Knowledge

Key knowledge required includes proficiency in Atlassian suites, having a deep understanding of all quality management and continuous improvement methodologies, be well aware of all applicable standards (including auditing) and regulations.

Experience

Experience in quality assurance and management (including control plans and tools), Agile and/or Scrum methodologies, Advanced Product Quality Planning (APQP) framework in the (offshore) energy sector was mainly requested.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were primarily requested in the field of mechanical, process, industrial or metallurgical engineering, or material science. In a handful of job vacancies, certification on inspections and welded constructions was also requested.

Languages

Fluency in English was requested in all relevant job vacancies.

Calculation engineer (ESCO-2149.2.1)

Technical Skills and Competences

The main technical skills and competences required include the successful execution of engineering tasks related to electrical and marine engineering work, as well as design activities such as defining design requirements, designing infrastructure components and functionalities, and optimizing existing designs. Competences in QHSE are also needed, though to a lesser extent.

Soft skills

The soft skills commonly requested include: communication; creativity; motivation; being innovative, detail and results-oriented, team player; and having good sense of responsibility.

Knowledge

Proficiency in programming languages, using Atlassian suites, and performing Finite Element Analysis (FEA) were requested, along with sound knowledge of product and/or technology development, as well as of the dynamic behaviour of mechanical structures.

Experience

Experience was primarily requested in systems engineering, as well as in the design and analysis of dynamic mechanical systems and of wind turbines.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were requested in the field of mechanical, structural, civil or computational engineering.

Languages

Fluency in English was requested in all relevant job vacancies.

Component engineer (ESCO-2149.2.2)

Technical Skills and Competences

The main technical skills and competences required include: (a) product and component development i.e. concept formation, development of technical specifications according to commercial requirements, etc., (b) monitoring, (c) evaluation of performance (i.e. cost assessment and other performance metric) and (d) reporting.

Soft skills

The soft skills commonly requested include: communication; collaboration; creativity; innovation; being proactive, solution-, result- and customer-oriented, pragmatic, practical, enthusiastic and emphatic.

Knowledge

Solid knowledge on commercial activities and management was requested, with emphasis on wind turbines (i.e. technology, structure, foundation, components, acoustics). Service and maintenance awareness was also acknowledged as essential.

Experience

Experience was requested primarily in wind energy product and/or technology development (e.g. turbine towers or other load-carrying components) and in providing relevant technical support services.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were requested in the field of mechanical or marine engineering.

Languages

Fluency in English was requested in all relevant job vacancies.

Logistics engineer (ESCO-2149.2.6)

Technical Skills and Competences

The main technical skill and competence requested was logistics management (i.e. planning and optimization of all logistics processes for meeting the needs of ORE projects, identifying potential logistics bottlenecks, etc.). Project (i.e. manage day-to-day tasks, align logistics planning with other

planning systems, etc.), financial (i.e. plan the budget for logistics, control the costs for logistics, etc.) and stakeholder management capabilities (i.e. build relationships, collaborate, make presentations, etc.) were also identified as essential, followed by competences relating to pre-planning activities (i.e., develop project proposals, etc.)

Soft skills

The soft skills commonly requested include: communication; flexibility; adaptability; having an entrepreneurial attitude; being a team-player and knowing how to deal with cultural differences and sensitivities.

Knowledge

Solid knowledge in logistics-related programming (i.e. logistics planning, infrastructure and management) was requested. Additionally, some job vacancies emphasized the importance of knowledge in robotics and automation, reflecting the technological advancements currently transforming the logistics sector.

Experience

Experience was primarily requested in managing all logistics processes related to the installation, operation and maintenance of ORE projects, particularly wind farms.

Education and Training (Qualifications)

Academic qualifications at the M.Sc. or Ph.D. level (i.e. EQF 7 or 8) were requested in the field of logistics management and planning, as well as in mechanical or industrial engineering, energy technology and computer science.

Languages

Fluency in English was requested in all relevant job vacancies.

Test engineer (ESCO-2149.16)

Technical Skills and Competences

The main technical skills and competences required include: (a) QA/QC (i.e. design and maintain test environments, supervise quality, plan internal tests, etc.); (b) inspection (i.e. develop inspection procedures and plans, ensure compliance with inspection plans, etc.); (c) monitoring and evaluation of performance (i.e. review power performance test results, etc.); and (d) reporting and documentation (i.e. prepare reports, report quality on-site, prepare documents for audits, document internal processes, etc.).

Soft skills

The soft skills commonly requested include: communication; well-organized, detail-oriented and enthusiastic; having an international oriented mindset; and ability to handle tasks or make decisions under time constraints.

Knowledge

Solid knowledge in programming is requested, along with proficiency in using Atlassian suites, performing defect analysis, managing databases, conducting inspections, analysing KPIs and

automating systems. In addition, knowledge of the MEASNET standard, as well as turbine technology, structure, foundations, components and acoustics is also essential.

Experience

Experience was requested primarily in test engineering for the wind industry (i.e. wind sensors and measurements) as well as in automation engineering.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were requested in the field of mechanical or software engineering, as well as in computer science.

Languages

Fluency in English was requested in all relevant job vacancies.

4.3.2 Industrial and production engineers (ESCO-2141)

Maintenance and repair engineer (ESCO-2141.8)

Technical Skills and Competences

The main technical skills and competences required include the execution and management of maintenance activities (i.e., develop, improve and maintain routine maintenance procedures, perform corrective maintenance, and ensure periodic repairs). Stakeholder management was also in high demand, as was the monitoring of the operational performance of key components (e.g. wind turbines) and the management of manufacturing-related aspects such as CIM service orders and costs. The execution of operational activities as well as the handling of QA/QC processes was also requested in some job vacancies.

Soft skills

The soft skills commonly requested include: communication; commitment to safety; team spirit; being autonomous, dynamic, competitive, and results-oriented; and being able to travel frequently in a regional area.

Knowledge

Solid knowledge of the maintenance needs and processes of high voltage systems and wind energy components was requested, combined with proficiency in the use of relevant tools / software. Risk assessment and analysis was also identified as essential.

Experience

Experience was requested in: (a) the commissioning and electrical and/or industrial maintenance of key infrastructure (e.g. wind turbines and PVs); (b) monitoring relevant improvement projects (i.e. overseeing and tracking relevant projects to ensure improvements are achieved); (c) failure rate modeling and investigation (i.e. investigating and analysing failure rates to enhance reliability and performance); and (d) fault detection techniques and troubleshooting in electronic and automation systems.

Education and Training (Qualifications)

Post upper secondary (i.e. EQF 5) and secondary level education (EQF 3) was mainly requested in the field of industrial and electrical maintenance.

Languages

Fluency in English was requested in all relevant job vacancies, but with emphasis on knowledge of technical terms.

4.3.3 Mechanical engineers (ESCO-2144)

Mechanical engineer (ESCO-2144.1)

Technical Skills and Competences

The main technical skills and competences required include the successful execution of engineering tasks related to mechanical, system and offshore engineering work (e.g. 3D design, identification of component requirements and specifications, systems' integration, etc.). Skills related to QA/QC as well as project and risk management were also in high demand, while there were fewer requests for effective financial and stakeholder management.

Soft skills

The soft skills commonly requested include: communication; collaboration; leadership; problem-solving; being well-organized, open-minded, process- and value chain-oriented, self-motivated, able to embrace changes and willing to learn and be able to travel frequently.

Knowledge

Solid knowledge was requested on: (a) relevant mechanical and hydraulics systems and their components, including applicable regulations; (b) design for manufacturing; (c) use of Atlassian suites, as well as quality development and control tools; (d) performing extreme and fatigue analysis, ILAD analysis and application, FEM analysis and calculations, etc.; and (d) automating systems and databases. In general, knowledge of renewable energy systems components (e.g. wind turbine, tower, yaw systems) as well as of technical standards knowledge are regarded as giving added value.

Experience

Experience was primarily sought in mechanical and structural component design and development, with emphasis on the wind industry, as well as in systems engineering and the coordination and management of relevant projects.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were requested in the field of mechanical engineering, structural engineering, or mechatronics.

Languages

Fluency in English was requested in all relevant job vacancies.

Naval architect (ESCO-2144.1.14)

Technical Skills and Competences

The main technical skills and competences required include the successful execution of engineering tasks related to marine and offshore engineering work, such as carrying out anchoring calculations for floating wind turbines, hydrodynamic calculations, modelling construction

strategies, etc. Interface management was also found to be in demand, along with stakeholder management and the provision of support to contract / tender / bid management and R&D activities.

Soft skills

The soft skills commonly requested include: working in a dynamic business environment; being proactive, independent, and able to take initiatives.

Knowledge

Solid knowledge was required in hydrodynamic simulations, floating structure analysis, computational fluid dynamics, hull sizing, anchoring technology, marine and mooring systems, and tank and wind tunnel testing.

Experience

Experience was requested in hydrodynamics and naval engineering, with emphasis on offshore wind energy or oil and gas projects.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were requested in the field of naval architecture or marine engineering.

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies.

4.3.4 Civil engineers (ESCO-2142)

Geological engineer (ESCO-2142.1.4)

Technical Skills and Competences

The main technical skills and competences required include the successful execution of engineering tasks related to offshore and geotechnical / geological engineering work. Data collection, management and analysis capabilities were also mentioned as highly important.

Soft skills

The soft skills commonly requested include: communication; collaboration; interpersonal skills; being open-minded, goal-oriented, a team-player, enthusiastic and willing to learn and travel abroad; and having a respectful, positive and proactive attitude.

Knowledge

Solid knowledge was requested in offshore geotechnical design, numerical analysis, soil investigation and analysis, as well as mechanics.

Experience

Experience was requested in wind offshore geotechnics, geotechnical / structural design and analysis, and integration of geophysical with other data.

Education and Training (Qualifications)

Academic qualifications at the M.Sc. or Ph.D. level (i.e. EQF 7 or 8) were requested in the field of geological, geotechnical or civil engineering.

Languages

Fluency in English was requested in all relevant job vacancies, while fluency in the national language where the vacancy was located was indicated as desirable.

4.4. Administration professionals (ESCO-242)

This ESCO Hierarchy Level 3 group includes 1 of the 39 occupational profiles that are currently in high demand, namely the Human resources officer.

Human resources officer (ESCO-2423.3)

Technical Skills and Competences

The main technical skill and competence required is people management, which includes responsibilities such as managing recruitment, mentoring, identifying staffing needs, assessing capabilities and training needs, and conducting interviews. Stakeholder management is the second most important skill and competence for this role.

Soft skills

The soft skills commonly requested include: communication; collaboration; flexibility; adaptability; problem-solving; interpersonal, organizational and perceptive skills; integrity and discretion; resilience; being self-driven, customer-oriented, team-player, enthusiastic, and able to build trusted relationships but also to work independently; having a strategic, hands-on approach and understanding, as well as a good sense of quality.

Knowledge

Good knowledge of HR policies, systems and practices is required, along with proficiency in widely used professional suites (e.g. MS Office). HR officers should also be well aware of the characteristics of the ORE sector as well as of relevant clean energy and zero emission applications.

Experience

Experience in relevant industrial sectors (e.g. energy, construction, maintenance) was required in the following areas: (a) recruitment and employee relations, (b) HR management, policies and practices, and (c) quality management and continuous improvement.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. level (i.e. EQF 6) were requested in the field of human resources, labour relations, business, law, political / social sciences or psychology.

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies.

4.5. Business service agents (ESCO-333)

This ESCO Hierarchy Level 3 group includes 1 of the 39 occupational profiles that are currently in high demand, namely the Auctioneer.

Auctioneer (ESCO-3339.2)

Technical Skills and Competences

The main technical skill and competence required is contract, tender, and bid management, including tasks such as analysing and reviewing tender requirements, optimizing the tender process, and preparing bid proposals. Additionally, expertise in various other areas of management were required including project management, stakeholder and people management, risk management, and data management.

Soft skills

The soft skills commonly requested include: communication; collaboration; multi-tasking; flexibility; being responsible, detail- and customer-oriented, a team player, and able to understand and synthetize large volumes of information in a relatively short time.

Knowledge

In addition to the required awareness of bid planning, processing and evaluation, as well as of business administration tasks and analysis, it was deemed important to also have a good understanding of the ORE sector and relevant engineering work. Generally, candidates should be familiar with the operational framework of the ORE market and the concepts of green energy and asset management.

Experience

Experience was primarily required in commercial and (offshore) project management, including proficiency with relevant tools (e.g. CMR systems), along with experience in related engineering work.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. level (i.e. EQF 6) were requested in the field of business administration, business communication, engineering or law.

Languages

Fluency in English was requested in all relevant job vacancies.

4.6. Software and applications developers and analysts (ESCO-251)

This ESCO Hierarchy Level 3 group includes 2 of the 39 occupational profiles that are currently in high demand, namely the Data scientist and the Software developer.

Data scientist (ESCO-2511.4)

Technical Skills and Competences

The main technical skill and competence required is data management and analysis, while there is also demand for supporting the execution of certain engineering tasks, QA/QC as well as developing dedicated software solutions.

Soft skills

The soft skills commonly requested include: communication; collaboration; problem solving; time management; being open-minded, proactive, independent, results and detail-oriented, a team player, curious and passionate; as well as having a holistic point of view.

Knowledge

Solid knowledge on data analysis and visualization was required, along with strong communication skills to effectively explain obtained results. Deep understanding of programming languages, algorithms, and DevOps practices was also essential.

Experience

Experience was requested in: (a) programming languages and algorithms; (b) data management, governance and engineering; (c) data mining and maintaining data infrastructures in cloud environments (e.g. MS Azure); and (d) simulations and statistical modelling.

Education and Training (Qualifications)

Academic qualifications at the M.Sc. or Ph.D. level (i.e. EQF 7 or 8) were requested in the field of computer science, statistics or mathematics.

Languages

Fluency in English was requested in all relevant job vacancies.

Software developer (ESCO-2512.4)

Technical Skills and Competences

The main technical skills and competences required include software development and engineering, covering maintenance, repair and QA/QC of software. There is also high demand for IT tasks such as programming, code review, script improvement, and API development. Additionally, expertise in relevant documentation preparation and management, stakeholder management, and various engineering tasks (e.g. control, system, and offshore engineering) is also essential.

Soft skills

The soft skills commonly requested include: communication; collaboration; problem-solving; motivation; creativity; being inspirational, open-minded, goals- and results-oriented, enthusiastic, willing to improve, able to embrace changes, meet deadlines and work in an international team; having an agile way of thinking, good sense of responsibility and a creative approach to new opportunities.

Knowledge

Proficiency in using Atlassian suites and MS Azure cloud services was mainly required. In addition, software development and IT expertise was requested in electrical systems design, operation and engineering and hydraulics.

Experience

Experience was requested in the following areas: (a) using Agile and/or Scrum methodologies and Atlassian suites; (b) DevOps practices; (c) hardware / platform abstraction layers; (d) inter-process communication (IPC) mechanisms; (e) safety-critical software development and engineering; (f) socket programming, network concepts, and design; (g) time sensitive networking, time-triggered Ethernet, or similar network technologies; and (h) stakeholder management.

Education and Training (Qualifications)

Academic qualifications at the B.Sc., M.Sc. or Ph.D. level (i.e. EQF 6, 7 or 8) were requested in the field of computer science or software, control or electronics engineering.

Languages

Fluency in English was requested in all relevant job vacancies.

4.7. Database and network professionals (ESCO-252)

This ESCO Hierarchy Level 3 group includes 1 of the 39 occupational profiles that are currently in high demand, namely the Embedded systems security engineer.

Embedded systems security engineer (ESCO-2529.3)

Technical Skills and Competences

The main technical skill required is software development and engineering, including tasks such as defining and developing software architecture. There is also strong demand for expertise in cybersecurity, including the design of cybersecurity architecture, and adhering to cybersecurity standards.

Soft skills

The soft skills commonly requested include: communication; collaboration; leadership; motivation; creativity; innovation; flexibility; problem-solving; accountability; being safety- and detail-oriented, enthusiastic, a team player, and able to work independently without supervision; and also having a pragmatical mindset.

Knowledge

Sound knowledge was required of relevant security standards and regulations, cybersecurity, IT / ICS security, and computer-related techniques including analysis, ethical hacking, data collection, and reporting. Change and risk management skills are essential for recruitment in this field, and proficiency in technical documentation and writing is important for effectively disseminating results.

Experience

Experience was required in: (a) programming languages and algorithms; (b) software development frameworks (e.g. .NET); c) cybersecurity principles, systems and models; (d) cloud services (e.g. MS Azure); (e) relevant international and national legislation; and (f) change and stakeholder management.

Education and Training (Qualifications)

Academic qualifications at the M.Sc. level (i.e. EQF 7) were requested in the field of computer science or information technology. In a few cases, CISSP[19] and/or GISSP[20] certifications were also sought.

Languages

Fluency in English was requested in all relevant job vacancies.

4.8. Electrical equipment installers and repairers (ESCO-741)

This ESCO Hierarchy Level 3 group includes 2 of the 39 occupational profiles that are currently in high demand, namely the Solar energy technician and the Wind turbine technician.

Solar energy technician (ESCO-7411.1.4)

Technical Skills and Competences

The main technical skills and competences required include the execution of: (a) maintenance tasks such as maintaining photovoltaic (PV) systems and associated electrical components; (b) repair tasks, such as conducting fault diagnosis and troubleshooting; (c) electromechanical tasks, such as connecting PV panels, verifying the installation of PV systems, etc.); and (d) electrotechnical tasks, such as interpreting electrical drawings and diagrams.

Soft skills

The soft skills commonly requested include: leadership; professionalism; organization; responsibility; and commitment.

Knowledge

Knowledge of energy regulation and management was mainly requested.

Experience

Experience was primarily required in the assembly, connection, and installation of solar PV systems.

Education and Training (Qualifications)

Primary level education (i.e. EQF 2) was requested in the relevant job vacancies, with a driving license (Category B) as a prerequisite.

Languages

Fluency in the national language of the country where the job vacancy was located was requested.

Wind turbine technician (ESCO-7412.12)

Technical Skills and Competences

The main technical skills and competences required include the execution of: (a) relevant operational and maintenance tasks, such as controlling and assessing operations (e.g. of blades), performing preventive and corrective maintenance, maintaining safety gear, etc.; (b) logistics

[19] Certified Information Systems Security Professional
[20] Global Industrial Cyber Security Professional

processes, such as developing, monitoring and improving logistics toolkits; and (c) repair tasks, including on-site repairs, troubleshooting, etc..

Soft skills

The soft skills commonly requested include: communication; organizational skills; problem-solving; flexibility; being open-minded, independent, a team-player and in good physical condition; as well as having a structured and positive mindset.

Knowledge

Wind turbine technicians need a comprehensive skill set that includes: (a) knowledge of composites (i.e. understanding composite materials used in blades); (b) proficiency in hydraulic systems and components; (c) familiarity with relevant IT systems; (d) market and mechanical knowledge (i.e. insights into the wind energy market and relevant mechanical systems); (e) expertise in both mechanical and electrical engineering principles; (f) understanding of turbine commissioning processes and technical specifications; and (g) awareness of relevant safety and security protocols.

Experience

Experience in the commissioning, assembly, service and maintenance of wind turbines, and other heavy mechanical components, was requested. Candidates should also have experience working at heights and in challenging weather conditions. In some cases, experience in IT systems and data reporting was also needed.

Education and Training (Qualifications)

Secondary level (i.e. EQF 3) and upper secondary education (i.e. EQF 4) was mainly requested in the field of electrical or mechanical engineering. Certification from key bodies was also requested in several cases (e.g. VESTA, Siemens Gamesa, etc.).

Languages

Basic knowledge of English (both oral and written) was requested, including sufficient knowledge of technical terms.

4.9. Electrotechnology engineers (ESCO-215)

This ESCO Hierarchy Level 3 group includes 2 of the 39 occupational profiles that are currently in high demand, namely the Electrical engineer and the Power distribution engineer.

Electrical engineer (ESCO-2151.1)

Technical Skills and Competences

The main technical skills and competences required included the execution of electrical, electromechanical, cable, control, system, marine and offshore engineering tasks, ensuring that high quality standards are met throughout. The demand for performing certain technical tasks such as interpreting technical specifications, conducting technical reviews of design, preparing deliverables, etc. was also high, while project, stakeholder and documentation management skills were also acknowledged as essential.

Soft skills

The soft skills commonly requested include: communication; leadership; interpersonal and organizational skills; creativity; problem-solving; being focused and systematic, pragmatic and proactive, process- and detail-oriented, independent, self-motivated, team-player, willing to learn, able to work in an agile, multicultural global environment; and having a structured way of working.

Knowledge

Programming languages were identified as a core knowledge requirement, while the most important areas of expertise include: (a) software and tools, i.e. proficiency in relevant software and tools such as Atlassian suites, CAD software, design and process tools (e.g. DFMEA, DFA, DFM, etc.); (b) electrical engineering, i.e. preparing electrical designs, designing, testing and verifying low, medium or high voltage components (e.g. power converters), understanding electrical standards and regulations, etc.; (c) power systems design and application of power electronics; (d) grid connection processes; as well as (e) thermal design and simulation techniques.

Experience

Experience was requested in the following areas, all with a focus on offshore environments: (a) electrical and electromechanical design, calculations and installations; (b) high voltage systems engineering and installations; (c) use of relevant planning software (e.g. CAD, EPLAN, etc.) and simulation and modelling tools (e.g. OrcaFlex, etc.); and (d) product data and documentation management (e.g. PDM link and BOM creation, source code management, software continuous integration process, etc.).

Education and Training (Qualifications)

Academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were mainly requested in the field of electrical, electromechanical or mechatronics engineering.

Languages

Fluency in English was requested in all relevant job vacancies, while knowledge of the national language where the job vacancy was located was considered an advantage.

Power distribution engineer (ESCO-2151.1.5)

Technical Skills and Competences

The main technical skills and competences required relate to grid connection processes. This includes assessing various grid integration options and preparing digital models of grid connections to ensure effective integration and performance. Stakeholder management was also acknowledged as crucial, involving coordination and communication with regulatory bodies, utility companies, and project teams. Additionally, there is high demand for providing technical expertise and consultancy, offering specialized guidance to optimize grid connection strategies and address technical challenges. Furthermore, adherence to QHSE standards is essential, ensuring that all processes comply with relevant regulations and best practices for managing risks and maintaining high standards.

Soft skills

The soft skills commonly requested include: communication; commitment; interpersonal skills; creativity; adaptability; responsibility; continuous improvement orientation; being self-motivated, open-minded, proactive and being able to work in a global environment.

Knowledge

A comprehensive knowledge base is essential, including a solid understanding of electrical engineering principles and the renewable energy market. Specific expertise in offshore wind farms was requested covering aspects such as development, integration, operations, and projects management. Additionally, power distribution engineers need to be well-versed in technical sales basics and strategic planning, as they may also assume project management responsibilities in some cases.

Experience

Experience was required in: (a) offshore wind or other renewable energy development projects, showcasing the understanding of the relevant associated challenges and processes; (b) technical performance analysis of electrical power systems, particularly those involving power electronic sources or loads – this includes assessing system efficiency, reliability and overall performance; (c) electrical systems development, from design through to implementation and optimization; (d) extra high voltage systems, including their design, engineering and integration into larger power distribution networks; and (e) grid engineering, which involves the design and management of electrical grid systems to ensure stability and efficiency.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were requested in the field of electrical or electrical power engineering.

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies.

4.10. Finance professionals (ESCO-241)

This ESCO Hierarchy Level 3 group includes 1 of the 39 occupational profiles that are currently in high demand, namely the Financial controller.

Financial controller (ESCO-2411.1.8)

Technical Skills and Competences

The main technical skills and competences required are in the financial management and analysis area. This includes managing and analyzing financial aspects, conducting financial and analytical accounting, performing financial control, and supervising or reviewing financial performance. Stakeholder management, as well as data management and analysis were also found to be in high demand.

Soft skills

The soft skills commonly requested include: communication; creativity; being accurate, proactive, detail-oriented, a team-players and willing to learn and improve.

Knowledge

Sound knowledge of accounting and finance is required, including expertise in end-to-end financial processes and auditing. Additionally, proficiency in documentation management software is essential, enabling to visualize results effective. Solid skills in budget management and business administration are also required, alongside the ability to generate data-driven insights.

Experience

Experience was primarily requested in project control and auditing, with a key role in finance departments. This experience highlights the importance of overseeing financial activities, ensuring compliance, and contributing to the financial health and transparency of the company.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. level (i.e. EQF 6) were requested in the field of finance, accounting or business administration.

Languages

Fluency in English was requested in all relevant job vacancies, while knowledge of the national language where the job vacancy was located was considered an advantage.

4.11. Legal professionals (ESCO-261)

This ESCO Hierarchy Level 3 group includes 1 of the 39 occupational profiles that are currently in high demand, namely the Contract manager.

Contract manager (ESCO-2619.1)

Technical Skills and Competences

The main technical skills and competences required focus on contract, tender and bid preparation and management. Following closely in demand is stakeholder management, while monitoring the relevant processes and effectively managing resources was also acknowledged as essential.

Soft skills

The soft skills commonly requested include: communication; organizational skills; being detail-oriented, a team player, willing to listen and learn, and able to build solid relationships; and having a structured mindset, positive attitude, and a genuine interest in process improvements.

Knowledge

Sound knowledge of contract management and negotiations is essential for this role, including expertise in FIDIC[21] yellow book contracts, and other relevant contract types. Additionally, solid command of ORE technologies is mandatory to ensure a comprehensive understanding of the market.

[21] International Federation of Consulting Engineers

Experience

Experience was requested primarily in commercial and contract administration, as well as claims management. Candidates were expected to have experience in authorizing contracts with original equipment manufacturers (OEMs) (e.g. of wind turbine generators), and effectively managing all contracting and procurement processes. Having strong commercial and business insights, project management experiences in the energy sector, as well as working in multi-national and multi-cultural teams were also important assets.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were requested in the legal, commercial or technical fields.

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies, particularly within legal and business environments.

4.12. Managing directors and chief executives (ESCO-112)

This ESCO Hierarchy Level 3 group includes 1 of the 39 occupational profiles that are currently in high demand, namely the Business manager.

Business manager (ESCO-1120.2)

Technical Skills and Competences

The key technical skills and competences required include stakeholder management, as well as business development and management, with emphasis on sale management skills. High demand was also identified for financial management and analysis.

Soft skills

The soft skills commonly requested include: communication; commercial awareness; conceptual thinking; adaptability; being solution-oriented, passionate and willing to travel.

Knowledge

Sound know-how was required in business administration, the operation of business transmission systems, applicable standards and regulations, market challenges, drivers and foresight, as well as project management practices.

Experience

Experience was requested mainly in client management and development, and the integration of renewable energy systems into the transmission network.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. level (i.e. EQF 6) were requested, preferably in the field of electrical engineering.

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies.

4.13. Manufacturing, mining, construction and distribution managers (ESCO-132)

This ESCO Hierarchy Level 3 group includes 2 of the 39 occupational profiles that are currently in high demand, namely the Construction manager and the Supply chain manager.

Construction manager (ESCO-1323.1)

Technical Skills and Competences

The technical skills and competences required mainly include QA/QC and QHSE, while there was a high demand for the successful execution of engineering tasks related to mechanical, marine and offshore engineering work. Project management skills were also identified as of added value.

Soft skills

The soft skills commonly requested include: communication; collaboration; leadership; interpersonal skills; decision-making; problem-solving; flexibility; knowledge-sharing; being independent, open-minded, results-oriented, self-motivated, proactive, persistent, responsible, calm, a team-player, able to coach, and willing to travel.

Knowledge

Solid knowledge of enterprise resource planning (ERP) software was mainly requested, along with proficiency in general documentation management software and ISO standards. Technical expertise in ORE infrastructure commissioning and installation was also essential, while holding an ADR license would be an advantage.

Experience

Experience was mainly requested in: (a) construction management in offshore or onshore energy projects (particularly wind farms); (b) vibration analysis of rotating machines; and (c) customer management and relationships.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were requested in the fields of civil or industrial engineering, project management or business administration.

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies.

Supply chain manager (ESCO-1324.8)

Technical Skills and Competences

The main technical skills and competences required include resource and stakeholder management, while there was also high demand for project management skills.

Soft skills

The soft skills commonly requested include: interpersonal skills; leadership; curiosity; being independent, process-, results- and customer-oriented, open-minded, a team-player, passionate; having sense of urgency and a positive mindset.

Knowledge

Solid knowledge of enterprise resource planning (ERP) and documentation management software was requested, along with competences in engaging with key stakeholders and effectively managing the relationships with them. Deep understanding of the characteristics of the ORE market was also essential, while LEAN inventory planning was requested in some of the relevant job vacancies that were identified.

Experience

Experience was primarily requested in: (a) supply chain management for organizations with a global focus; (b) building account management for suppliers; (c) strategic purchasing; (d) operational procurement; and (e) using ERP software (mainly SAP).

Education and Training (Qualifications)

Academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were requested in the fields of supply chain management, manufacturing engineering (or engineering in general), sales / marketing or business administration.

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies.

4.14. Process control technicians (ESCO-313)

This ESCO Hierarchy Level 3 group includes 1 of the 39 occupational profiles that are currently in high demand, namely the Offshore renewable energy plant operator.

Offshore renewable energy plant operator (ESCO-3131.1)

Technical Skills and Competences

The main technical skills and competences required relate to ensuring adherence of ORE operations to QHSE and other relevant standards and institutional frameworks. Key tasks in-demand falling under the responsibility of this occupational profile include: operations monitoring (including inspections), reporting and management, stakeholder management, financial analysis and management, maintenance and repair management, and staff coordination.

Soft skills

The soft skills commonly requested include: communication; interpersonal and intercultural skills; leadership; responsibility; proactivity; problem-solving; being independent, self-motivated, safety-

and results-oriented, pragmatic, a team-player, enthusiastic and willing to travel; having a positive and can-do attitude.

Knowledge

Solid knowledge and deep understanding of the characteristics of the ORE sector (i.e. structures, technologies, business insights, etc.), particularly of offshore wind, was a prerequisite. Proficiency in industrial control systems (e.g. SCADA) and documentation management software was also essential, along with project management expertise.

Experience

Experience was requested in: (a) offshore remote (i.e. control room) operations and maintenance management; (b) technical field work related to maintenance and electrical engineering tasks, mechanics, etc.; and (c) documentation management and reporting.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were mainly requested in the field of engineering (industrial, energy, electrical, mechanical or naval), business administration or project management. Secondary level education (i.e. EQF 3) was however also requested in some job vacancies, mainly in the field of business and technology.

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies.

4.15. Sales and purchasing agents and brokers (ESCO-332)

This ESCO Hierarchy Level 3 group incorporates 2 of the 39 occupational profiles that are currently in high demand, namely the Purchaser and the Renewable energy sales representative.

Purchaser (ESCO-3323.2)

Technical Skills and Competences

The main technical skills and competences required relate to stakeholder management, while strong demand was also documented for resource management, the preparation and management of relevant contacts, tenders and bids, as well as for project management, staff coordination and business development.

Soft skills

The soft skills commonly requested include: communication; collaboration; leadership; curiosity; adaptability; being systematic, open-minded, dynamic, self-motivated, action-, result- and change-oriented, persistent, proactive and a team-player; having a holistic and positive mindset; and adopting a fact-based approach.

Knowledge

Sound knowledge of stakeholder management, business administration and finance and accounting principles and practices was required, along with proficiency in the use of documentation management software.

Experience

Experience was requested primarily in: (a) contracts negotiation; (b) strategic purchasing and procurement; and (c) stakeholder engagement and management.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. level (i.e. EQF 6) were mainly requested in the fields of engineering, economics or business administration.

Languages

Fluency in English was requested in all relevant job vacancies.

Renewable energy sales representative (ESCO-3322.1.2)

Technical Skills and Competences

The main technical skill and competence required is sales management, which includes activities such as developing and codifying sales workflows, creating and executing sales plans, and achieving high sales performance. Reporting performance and engaging and managing relationships with key stakeholders were also found to be in demand.

Soft skills

The soft skills commonly requested include: communication; judgement skills; being resilient, independent, self-motivated, driven by consistent results; having a positive, competitive and can-do mindset, and adopting a proactive and responsible approach to addressing and resolving issues or problems.

Knowledge

Solid knowledge in setting and executing strong communication plans was required, utilizing various tools and practices tailored to the characteristics of the target audience.

Experience

Experience was required in B2B sales planning and execution.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. level (i.e. EQF 6) were requested in the field of engineering (naval or other).

Languages

Fluency in English was requested in all relevant job vacancies.

4.16. Sales, marketing and development managers (ESCO-122)

This ESCO Hierarchy Level 3 group includes 3 of the 39 occupational profiles that are currently in high demand, namely the Commercial director, the Product manager and the Sales manager.

Commercial director (ESCO-1221.4)

Technical Skills and Competences

The main technical skill and competence required was commercial management, which included identifying commercial requirements, ensuring that commercial milestones and KPIs are met, etc.. Stakeholder and risk management were also found to be in demand.

Soft skills

The soft skills commonly requested include: communication; adaptability; being confident, proactive, customer-oriented, quality-driven, a team-player, able to influence and build networks, as well as work independently and under pressure.

Knowledge

Sound knowledge of the ORE market, business and relevant projects is required, in combination with the effective management principles of commercial activities.

Experience

Experience was requested in: (a) ORE projects development and management (particularly wind); (b) business and commercial development, including bids and partnerships; and (c) procurement and finance.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were requested in the fields of business administration, economics, law or engineering (mainly electrical engineering).

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies.

Product manager (ESCO-1223.1)

Technical Skills and Competences

The main technical skill and competence required is business development and management, while the demand was also high for stakeholder management and documentation preparation and management.

Soft skills

The soft skills commonly requested include: communication; collaboration; commitment; strategic thinking; problem-solving; networking; being proactive, open-minded, self-driven, decisive, a team-player, able to inspire, able to work independently, and willing to learn; having a multi-disciplinary orientation, a structured mindset, and a positive attitude.

Knowledge

Sound knowledge in a variety of fields is required for this role, including accounting and finance, business administration, commercial activities development and management, economics and engineering, preferably in the ORE sector. Deep understanding of key technical issues as well as of applicable standards and regulations is also essential.

Experience

Experience was primarily requested in: (a) product management, technical sales or commercial evaluation of ORE infrastructure / projects (e.g. wind turbines); (b) project management and coordination; and (c) business data analytics.

Education and Training (Qualifications)

Academic qualifications at the M.Sc. level (i.e. EQF 7) were mainly requested in the fields of engineering (mechanical, electrical or renewable), bioengineering, or environmental or marine science.

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies.

Sales manager (ESCO-1221.3.2.1)

Technical Skills and Competences

The technical skills and competences required mainly relate to effective stakeholder management and meeting customer requests. Strong demand was also identified in developing and managing platforms and/or databases facilitating sales.

Soft skills

The soft skills commonly requested include: communication; relationship-building; problem-solving; commitment; accountability; being methodical, self-motivated, detail-, solution- and results-oriented, able to balance responsibilities and prioritize work, work in a global environment and travel frequently; and having a structured mindset.

Knowledge

Sound knowledge of the ORE market was required (including forecasts), along with expertise in sales strategies, and the development and management of commercial activities.

Experience

Experience was requested mainly in: (a) long-term sales processing and coordination; (b) brokering; (c) business development and administration; (d) ORE project management; and (e) effectively handling associated financial and legal issues.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. level (i.e. EQF 6) were requested in the fields of business administration, engineering, economics or law.

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies.

4.17. Sales, marketing and public relations professionals (ESCO-243)

This ESCO Hierarchy Level 3 group incorporates 2 of the 39 occupational profiles that are currently in high demand, namely the Business developer and the Renewable energy consultant.

Business developer (ESCO-2431.5)

Technical Skills and Competences

The main technical skills and competences required included business development and management, stakeholder management and providing technical expertise or consultancy.

Soft skills

The soft skills commonly requested include: communication; networking; autonomy; being able to inspire and coach people and a team-player; and having an enterprising and proactive attitude.

Knowledge

Deep understanding and knowledge of the ORE sector is a prerequisite, along with gaining insights into technology developments and innovations contributing to energy transition pathways and the successful realization of zero-emission strategies.

Experience

Experience was requested in: (a) technical and commercial management within the renewables industry; and (b) offshore hydrogen production business development.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were requested in an engineering or business field.

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies.

Renewable energy consultant (ESCO-2433.3)

Technical Skills and Competences

The main technical skills and competences required include providing technical expertise or consultancy, managing stakeholders as well as preparing and managing relevant contracts, tenders and bids. The demand for project and business management was high, as it was also for staff coordination.

Soft skills

The soft skills commonly requested include: communication; organizational skills; strategic and critical thinking; business vision; flexibility; independent decision-making; and ability to be part of large multidisciplinary teams.

Knowledge

Sound knowledge of the ORE market was required, along with proficiency in tools for: (a) planning, designing and optimizing ORE projects (e.g. WAsP engineering, WindPro, Windfarmer, OpenWind for offshore wind, etc.); (b) weather conditions forecasts (e.g. FUGA model); and (c) energy yield assessments. Knowledge of documentation management software is also essential.

Experience

Experience was primarily requested in: (a) wind resource and yield assessments; (b) extreme wind and turbulence analysis; (c) IEC[22] site classification; and (d) contract management.

Education and Training (Qualifications)

Academic qualifications at the B.Sc. or M.Sc. level (i.e. EQF 6 or 7) were requested in the fields of engineering (civil, electrical, energy or industrial) or economics.

Languages

Fluency in both the national language of the country where the vacancy was located as well as in English was requested in all relevant job vacancies.

4.18. Transport and storage labourers (ESCO-933)

This ESCO Hierarchy Level 3 group includes 1 of the 39 occupational profiles that are currently in high demand, namely the Warehouse worker.

Warehouse worker (ESCO-9333.8)

Technical Skills and Competences

The main technical skills and competences required include: (a) warehouse and stock management (e.g. maintaining stock control and ensuring security); (b) execution of warehouse activities (e.g. unpacking, packing goods, and preparing orders); and (c) handling warehouse equipment and machinery (e.g. operating manual and electric lift trucks, using forklifts, etc.).

Soft skills

The soft skills commonly requested include: communication; analytical thinking; creativity; being social, enthusiastic, solution- and result-oriented, and able to work independently.

Knowledge

Sound knowledge of inventory management and stock control, warehousing operations, logistics processes, and transport infrastructures and operations was required. In some cases, basic knowledge of administrative management and airports warehousing was also requested.

Experience

Experience in distribution centres and general warehouses was required, along with proficiency in using warehouse management systems.

[22] International Electrotechnical Commission

Education and Training (Qualifications)

Upper secondary level education (i.e. EQF 4) was requested.

Languages

Good knowledge of English (both oral and written) was requested.

5. Skills supply analysis

As mentioned in Section 2.3, after data screening and cleaning, 398 educational programmes and training courses were retained in the MarineTraining platform. These were chiefly spread along 13 countries (see Figure 9), with Portugal and Germany hosting the largest number of available programmes and courses, followed by Ireland, the Netherlands, Spain and Belgium which also accounted for a considerable share (9-10% each). As expected, most of the available programmes and courses are offered in North European countries where the majority of the ORE installed capacity is located. However, with the ORE market emerging in the Mediterranean region, there is also a considerable number of programmes and courses already available in these countries. This is expected to increase substantially in the coming years.

Slightly larger was the share of educational programmes identified (56%) than that of training courses (44%). Most of the identified programmes and courses were in higher education, primarily at the M.Sc. level (46%), followed by programmes and courses at the B.Sc. (23%) and Ph.D. levels (13%). Short-cycle tertiary educational programmes and courses also represented a significant share (17%), while very few post-secondary non-tertiary educational programmes and courses were identified (1%).

Most programmes and courses are offered in English (59%), with the remainder being available only in the national language of the country where the host institution / body is located. On-site teaching is the most common format adopted (49% of all programmes and courses), while important was also the share of online programmes and courses (29%), reflecting the impact of digitalization in education. Additionally, a considerable number of programmes and courses (22%) opted for a blended format, combining the benefits of both in-person and online learning.

The majority of the identified programmes and courses offer competences and capacities that are applicable across all different ORE technologies. However, some of them are more targeted emphasizing a particular technology. This is mostly the case for offshore wind, with 14% of the programmes and courses addressing it, which is very logical given that it represents the large majority of the installed capacity in Europe.

Overall, 43 occupational profiles were addressed by the identified programmes and courses. Over 90% of the latter, however, target technical occupational profiles. More specifically, science and engineering professionals (ESCO-21) was the occupational group mostly addressed (i.e. by over 75% of the identified programmes and courses), with renewable energy engineers (ESCO-2149.9.7) being the main focus. Energy engineers and offshore renewable energy engineers were also heavily targeted, by 14% and 10% of the identified programmes and courses respectively, while interestingly enough, many programmes, particularly those related to safety, provide qualifications and competences for emergency response workers (ESCO-5419.6), an occupational profile not initially included in the list of occupational profiles corresponding to the ORE value chain (see Table 1). Other occupational profiles adequately covered by the identified programmes and courses, in descending order, include (see Figure 11): (a) environmental engineers (ESCO-2143.1); (b) mechanical engineers (ESCO-2144.1); (c) offshore renewable energy technicians (ESCO-3119.11); (d) electrical engineers (ESCO-2151.1); (e) onshore wind energy engineers (ESCO-2149.9.6); and (f) solar energy technicians (ESCO-7411.1.4).

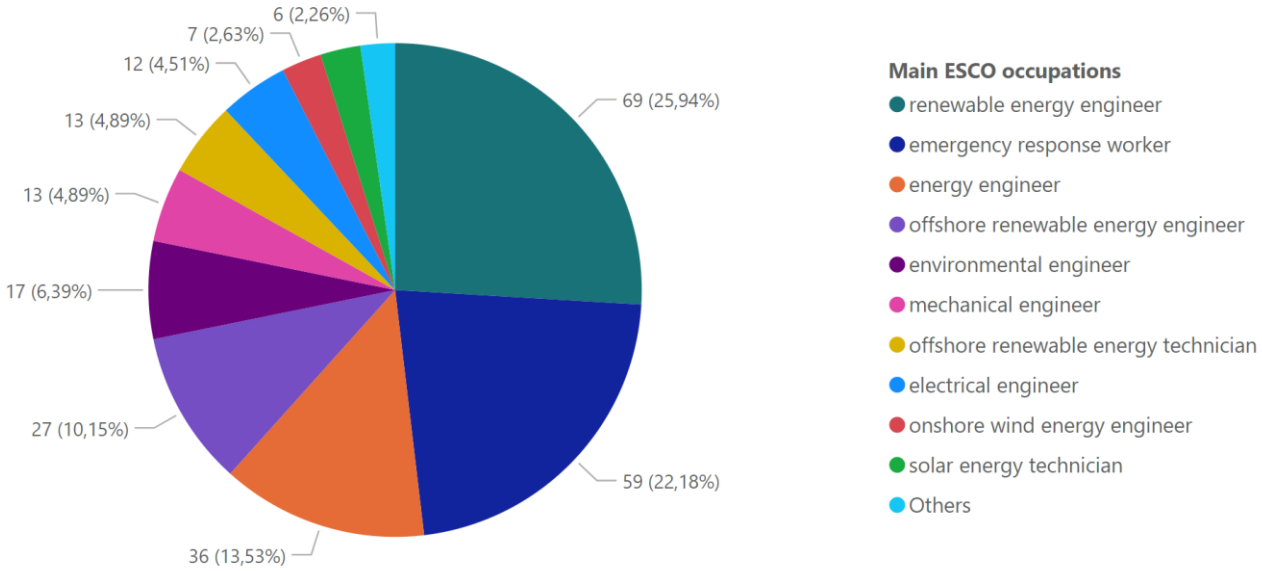

Figure 11: *ESCO occupational profiles mostly addressed by the identified educational programmes and training courses (Source: Own elaboration)*

Typical was the duration of higher educational programmes (i.e., 3 years for B.Sc., 1-2 years for M.Sc. and 3 years for Ph.D.), while the duration of training courses varied per format, thematic focus and expected learning outcomes, ranging from a few hours to days or week(s). Fee per programme / course also varied to a significant extent, ranging from free-to-attend programmes / courses to tuition costs of thousands of euros. It is worth noting that many programmes / courses differentiated their fees per national and international (or EU and non-EU) students. Hosting institutions also varied in type including universities, academies, VET providers, research institutions, consulting companies, service providers, and key industrial actors and their associations.

Key skills provided per occupational profile are listed below in Table 7.

Table 7: *Key skills and competences provided by the identified educational programmes & training courses per occupational profile addressed*

A/A	List of occupational profiles (ESCO Hierarchy Level >4) in higher demand		Key skills and competences provided
1	ESCO-1213.8	Sustainability manager	Apply system design thinking ~ Monitor manufacturing impact ~ Design indicators for waste reduction ~ Apply procedures and regulations for eco-labelling ~ Implement environmental action plans ~ Promote sustainable packaging
2	ESCO-1349.12	Energy manager	Develop energy saving concepts ~ Analyse energy market trends ~ Monitor utility equipment ~ Identify faults in utility meters ~ Write research proposals ~ Promote innovative infrastructure design
3	ESCO-2112.1	Meteorologist	Analyse environmental data ~ Review meteorological forecast data ~ Conduct research on climate processes ~ Design scientific equipment and graphics ~ Operate remote sensing equipment ~ Use geographic information systems ~ Apply blended learning
4	ESCO-2133.6	Environmental programme coordinator	Conduct environmental surveys ~ Conduct environmental site assessments ~ Analyse big data ~ Promote environmental awareness ~ Carry out training

A/A	List of occupational profiles (ESCO Hierarchy Level >4) in higher demand		Key skills and competences provided
			in environmental matters ~ Implement environmental action plans
5	ESCO-2133.7	Environmental scientist	Have computer literacy ~ Advise on chemical use reduction ~ Implement environmental protection measures ~ Environmental design ~ Prepare visual data
6	ESCO-2133.15	Environmental technician	Implement environmental action plans ~ Implement environmental protection measures ~ Apply statistical analysis techniques ~ Advise on pollution prevention and chemical use reduction ~ Environmental design
7	ESCO-2141.4	Industrial engineer	Analyse stress resistance of materials ~ Develop mechatronic test procedures ~ Conduct performance tests ~ Monitor plant production ~ Recommend product improvements ~ Apply technical communication skills
8	ESCO-2142.1.11	Water engineer	Design drainage well systems ~ Compute irrigation pressure ~ Supervise waste-water treatments ~ Supervise waste disposal ~ Measure water quality parameters ~ Maintain irrigation controllers
9	ESCO-2143.1	Environmental engineer	Resolve conflicts ~ Assess the life cycle of resources ~ Advise on pollution prevention and on mining environmental issues ~ Design strategies for environmental emergencies ~ Conduct quality control analysis
10	ESCO-2143.1.3	Recycling specialist	Update licenses ~ Develop recycling programs ~ Develop waste reduction strategies ~ Conduct research on waste prevention ~ Manage contracts ~ Analyse environmental data
11	ESCO-2144.1	Mechanical engineer	Use technical documentation ~ Perform relevant feasibility studies ~ Program firmware ~ Perform project management ~ Define part requirements ~ Inspect industrial equipment ~ Use CAD software ~ Use testing equipment and analyse test data ~ Analyse production processes for improvement
12	ESCO-2144.1.6	Equipment engineer	Inspect industrial equipment ~ Use CAD software ~ Analyse test data ~ Ensure equipment availability ~ Use testing equipment ~ Analyse production processes for improvement ~ Install mechatronic equipment ~ Perform data mining ~ Analyse energy consumption
13	ESCO-2144.1.10	Marine engineer	Install mechatronic equipment ~ Perform data mining ~ Manage engine room resources ~ Analyse energy consumption
14	ESCO-2144.1.11	Mechatronics engineer	Define manufacturing quality criteria ~ Create technical plans ~ Perform test runs ~ Manage IPR ~ Increase the impact of science on policy and society
15	ESCO-2149.9	Energy engineer	Analyse experimental laboratory data ~ Coordinate electricity generation ~ Design energy systems ~ Design automation components ~ Mitigate environmental impact of projects ~ Perform feasibility studies ~ Examine engineering principles ~ Assess energy management of facilities ~ Adapt energy distribution schedules ~ Develop material testing procedures ~ Perform project management

A/A	List of occupational profiles (ESCO Hierarchy Level >4) in higher demand		Key skills and competences provided
16	ESCO-2149.9.5	Offshore renewable energy engineer	Oversee pre-assembly operations ~ Analyse big data ~ Promote sustainable energy ~ Respond to electrical power contingencies ~ Advise on ORE subjects ~ Review meteorological forecast data
17	ESCO-2149.9.6	Onshore wind energy engineer	Ensure compliance with noise standards ~ Oversee pre-assembly operations ~ Test procedures in electricity transmission ~ Record test data ~ Perform data analysis ~ Ensure compliance with safety legislation ~ Respond to electrical power contingencies ~ Promote sustainable energy ~ Advise on ORE subjects ~ Review meteorological forecast data
18	ESCO-2149.9.7	Renewable energy engineer	Examine engineering principles ~ Design wind turbines ~ Assess energy management of facilities ~ Adapt energy distribution schedules ~ Develop material testing procedures ~ Perform project management
19	ESCO-2149.9.8	Solar energy engineer	Draw blueprints ~ Use CAD software ~ Read engineering drawings ~ Run simulations ~ Utilise machine learning ~ Troubleshoot
20	ESCO-2151.1	Electrical engineer	Perform test runs ~ Monitor manufacturing quality standards ~ Conduct quality control analysis ~ Model electromagnetic products ~ Test electromechanical systems ~ Test hardware
21	ESCO-2165.2	Cartographer	Create thematic maps ~ Apply digital mapping ~ Improve user-friendliness ~ Use traditional illustration techniques ~ Use spreadsheets software ~ Create GIS reports ~
22	ESCO-2422.12.5	Environmental policy officer	Plan measures to safeguard cultural heritage ~ Liaise with government officials ~ Ensure compliance with environmental legislation ~ Perform environmental investigations ~ Manage land resources permits ~ Advise on legislative acts
23	ESCO-2433.3	Renewable energy consultant	Provide information on wind turbines and solar panels ~ Inform customers on energy consumption fees ~ Advise on energy efficiency of systems ~ Promote environmental awareness ~ Negotiate improvements with clients
24	ESCO-2511.7	Green ICT consultant	Provide ICT consulting advice ~ Create project specifications ~ Ensure compliance with environmental legislation ~ Apply business acumen ~ Track KPIs ~ Identify processes for re-engineering
25	ESCO-3112.8	Engineering assistant	Plan engineering activities ~ Assist scientific research ~ Perform data analysis ~ Recruit employees ~ Apply statistical analysis techniques ~ Perform clerical duties
26	ESCO-3113.1	Electrical engineering technician	Monitor machine operations ~ Resolve equipment malfunctions ~ Inspect electrical supplies ~ Read assembly drawings ~ Prepare production prototypes ~ Operate soldering equipment
27	ESCO-3113.1.2	Electromechanical engineering technician	Manage and analyse big data ~ Calibrate electromechanical systems ~ Write technical reports ~ Operate printing machinery ~ Integrate new products in manufacturing ~ Monitor machine operations ~ Resolve equipment malfunctions ~ Inspect electrical

A/A	List of occupational profiles (ESCO Hierarchy Level >4) in higher demand		Key skills and competences provided
			supplies ~ Read assembly drawings ~ Operate soldering equipment
28	ESCO-3115.1.9	Marine surveyor	Recognize signs of corrosion ~ Monitor cargo discharge ~ Assess vessels' structural integrity, capabilities and operations ~ Read engineering drawings
29	ESCO-3115.1.24	Welding inspector	Revise quality control systems documentation ~ Ensure conformity of products with design requirements ~ Use non-destructive testing equipment ~ Write work-related reports ~ Evaluate employees work ~ Analyse test data
30	ESCO-3119.11	Offshore renewable energy technician	Monitor electric generators ~ Test sensors ~ Replace large components ~ Set-up machine controls ~ Ensure safety in electrical power operations
31	ESCO-3119.19	Utilities inspector	Review construction projects ~ Undertake inspections ~ Manage health and safety standards ~ Identify faults in utility meters
32	ESCO-3123.1.11	Electrical supervisor	Maintain electrical equipment ~ Conduct quality control analysis ~ Assemble electrical components ~ Install electrical and electronic equipment ~ Assemble electronic units ~ Maintain robotic equipment ~ Test sensors ~ Use specific data analysis software ~ Assemble mechatronic units
33	ESCO-3151.2	Marine chief engineer	Maintain voyage logs ~ Maintain vessel engine room ~ Analyse work-related written reports ~ Operate mechanical equipment of ships ~ Operate control systems ~ Communicate verbal instructions
34	ESCO-3151.4	Ship duty engineer	Manage vessel engines and systems ~ Inspect engine rooms ~ Moor vessels ~ Operate maritime communication equipment ~ Write work-related reports
35	ESCO-3257.7	Health and safety inspector	Maintain relationships with government agencies ~ Inspect government policy compliance ~ Monitor organization climate ~ Conduct workplace audits ~ Monitor employees' health ~ Present reports
36	ESCO-5411.1	Firefighter	Avoid contamination ~ Prevent marine pollution ~ Operate marine communication systems ~ Use GIS – Organize fire drills
37	ESCO-5419.6	Emergency response worker	Ensure compliance with environmental legislation ~ Provide emergency supplies ~ Coordinate with other emergency services ~ Estimate damage ~ Clean-up spills
38	ESCO-7119.1	Construction scaffolder	Position outriggers ~ Position sole plates ~ Build scaffolding ~ Transport construction supplies ~ Interpret 3D plans
39	ESCO-7212.3	Welder	Follow health and safety procedures in construction ~ Apply precision metalworking techniques ~ Perform tungsten inert gas welding ~ Shape sheet metal objects ~ Perform metal active gas welding
40	ESCO-7411.1	Electrician	Test and maintain electrical equipment ~ Repair wiring ~ Cut wall chases ~ Splice cable ~ Work in a construction team

A/A	List of occupational profiles (ESCO Hierarchy Level >4) in higher demand		Key skills and competences provided
41	ESCO-7411.1.4	Solar energy technician	Install photovoltaic systems ~ Maintain robotic equipment ~ Test sensors ~ Use specific data analysis software ~ Assemble mechatronic units
42	ESCO-7413.1	Electricity distribution technician	Maintain electrical equipment ~ Read electricity meter ~ Follow and enforce safety procedures when working at heights ~ Assess areas for power line installation ~
43	ESCO-7421.4	Marine electronics technician	Check system parameters against reference values ~ Interpret circuit diagrams ~ Apply soldering techniques ~ Test electronic units ~ Manage quantitative data

6. Key mismatches and gaps

By carefully comparing the skills demand and supply analysis presented in the two previous sections, valuable conclusions can be drawn with regard to existing mismatches and resulting gaps that need to be addressed. These are the following:

1) Despite now being a top priority for the industry, project managers with competences in ORE are not being sufficiently targeted by available educational programmes and training courses. The same also applies to ORE technicians, the second most in-demand occupational profile;
2) Elaborating further on the latter point, a significant lack of VET programmes and courses was observed, with most of the identified programmes and courses being in higher education;
3) Most of the identified programmes and courses were at the M.Sc. level, indicating that ORE-related qualifications and competences are being provided as a specialization;
4) Compared to the past, when ORE-related qualifications and competences were integrated within broader programmes and courses addressing renewables in general, there is now a greater number of programmes and courses dedicated to ORE;
5) The alignment of skills demand and supply for engineers is more balanced, with the same tasks however, often carried out by different types of engineers. This relates very considerably to conclusion no. 3, with undergraduate backgrounds shaping, to some extent, employment decisions, given the set of interrelated functions that the selected candidate will have to complete in his/her new role;
6) Occupational profiles that are currently in high demand are those that are key to the ORE value chain, while many of the identified educational programmes and training courses addressing occupational profiles with a more supporting role in the ORE value chain. Notable is the case of qualifications on emergency response, which are provided in several programmes and courses, although they are not heavily requested by the industry till now (possibly because of the scarcity of such events);
7) Project and stakeholder management skills were found to be transversely requested for technical occupational profiles, highlighting the importance of organizing and executing tasks according to the defined time schedule and action plan, effectively cooperating with key stakeholders where this is needed;
8) Educational and training providers should place greater emphasis on equipping their graduates with QA/QC and QHSE-related skills. The same also goes for soft skills, which are equally important to the industry. There is consensus by the industry on the latter. Communication and collaboration (internal and external) skills were required in all job vacancies, while the demand was great for adaptivity, problem-solving, and candidates being open-minded, detail- and results-oriented, and self-motivated;
9) IT skills (at least basic) are needed for the large majority of occupational profiles (e.g. for managing documentation, monitoring performance, reporting results, etc.), and educational and training providers (e.g. VET) should take care to equip their graduates with them. Proficiency in using specialized software was requested in several cases and educational and training providers can facilitate learning through the acquisition for example of educational licenses;
10) More work-based learning opportunities such as internships and apprenticeships) are needed for improving employment opportunities for graduates (in the same company or responding to another job vacancy where basic working experience is needed – this is usually the case);

11) It would be of great added value if additional industrial associations were to invest in providing targeted training, either via their own resources or by teaming up with key institutions. Such programmes / courses are often well respected and widely recognized.

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