IDEA - IRL

INTEGRATED DESIGN OF FLOATING WIND ARRAYS IRELAND

Supply Chain Capability Consultation Report

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Reporting is based primarily on interviews and supplementary research undertaken between November 2024 and February 2025, to give a snapshot of the markets of interest at that time. While efforts have been made to capture significant updates in these markets in the time between the interviews taking place and publication of the final report, some more recent developments may not be accounted for. Furthermore, the information about individual markets covered in this report should not be considered the complete view of market updates, challenges, or supply chain development. For a more detailed view, the authors suggest the reader consults individual supply chain reports from relevant national authorities, some of which are referenced in this report.

[1] Project home page: https://iea-wind.org/task49/

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Executive Summary

The Integrated Design of Floating Wind Arrays - Ireland (IDEA-IRL) project aims to help accelerate the commercial deployment of floating offshore wind arrays by providing reference metocean conditions, reference array-level designs, a better understanding of risk, and by studying non-technological challenges to the development of floating offshore wind. This report was prepared by the IDEA-IRL project as the third deliverable for Work Package 4 – Stakeholder Integration. It builds on previous reports on marine spatial planning and innovation management, which included interviews and consultation with several offshore wind stakeholders from various countries.

During the interviews it became apparent that along with marine spatial planning and permitting frameworks, another non-technological source of challenges is the complex global supply chain of offshore wind. Previous work has shown how reliant the supply chain is on China's manufacturing and mining operations. Here we present the data collected by the Global Wind Energy Council as a reminder of the situation and to put it into perspective with national goals of managing the energy trilemma – secure, cheap, and sustainable production. With China holding many of the cards and geopolitical tensions rising, many governments are looking to become more self-sufficient and promote domestic manufacturing and bigger engagement of local companies in industrial activity. This push for onshoring comes with debates about the effect on local greenhouse gas emissions and the prices of energy.

We have selected four different offshore wind markets as case studies of different levels of domestic supply chain development: Norway, The United Kingdom, Italy, and Ireland. We have identified the parts of an offshore wind project which contribute most to its cost, along with other critical constraints like port, vessel and transmission availability, skill development, and access to raw materials. We have then conducted in-depth interviews with representatives of the offshore wind industry from the four countries to find out the situation in their domestic market concerning these challenges.

This report outlines the motivation for the exploration as well as the findings from the interviews and links to critical pieces of recent policy from the researched markets.

Norway only has a very small amount of offshore wind capacity deployed, yet there is a lot of domestic expertise – Norwegian companies provide a full suite of installation, development, deployment, operations & maintenance solutions, and Norway also has over 5 GW of onshore wind. Norwegian-based shipyards build a large array of small to medium sized offshore wind vessels. The country is home to one of the largest submarine cable manufacturers in the world and there is domestic experience in offshore substation outfitting. The workforce in Norway is making use of extensive offshore oil & gas experience and the transferability of skills. They also benefit from a range of dedicated university courses and vocational training available. Norway is almost entirely reliant on imports for all parts of the wind turbines, with some domestic manufacturing capacity for balance of plant components. Norway will have to rely on floating technology due to large depth everywhere except for the southern parts of the Norwegian North Sea. A characteristic of the Norwegian market is that one of the drivers of offshore wind deployment has been the decarbonisation of oil & gas drilling operations in the North Sea, in addition to supply of electricity into the national grid.

The United Kingdom has one of the most well-developed offshore wind supply chains in the world, being one of the original markets and pioneers of the technology with over two decades of experience. UK companies offer specialised manufacturing services for most balance of plant components as well as wind turbine blades, monopile foundations and transition pieces. The real strengths of the UK supply chain lie in operations & maintenance, engineering services and consulting, and policy development. The already large scale of deployment brings other issues – UK ports are not able to support the rate of growth and will have to be modernised at great expense, along with the national electricity transmission grid, which currently presents a bottleneck for transporting the power from the wind farms in the north to the load centres in the south.

Italy has the second largest steel industry in Europe and one of the largest ship-building industries with a long tradition. This, combined with a strong onshore wind industry should position the country such that offshore wind development could build on a well vertically integrated supply chain by attracting foreign companies to set up business as well as by encouraging domestic firms to join the industry. However, due to a vague policy framework and so-far-slow permitting process, development of offshore wind is only starting now with the first round of projects. Italy, similarly to the UK and Ireland also needs to invest in port and electricity transmission infrastructure to really create an environment in which offshore wind could flourish into the future.

Ireland finds itself with some of the best wind resources in the world and some of the most complicated metocean conditions for constructing wind farms. The offshore wind industry in Ireland is nascent, but with great potential and the government appreciates this. Ireland is currently rolling out new industrial strategies and policy pieces which are aimed to help the country make the most of the renewable energy revolution. This is a long-term investment in international cooperations, workforce training, transmission grid infrastructure and ports. Currently, there is almost no domestic manufacturing capability in terms of offshore wind projects, but Irish companies have been involved in engineering and consultancy services as well as operations & maintenance in other markets. The first batch of Irish offshore wind projects is being developed right now, with future rounds imminently forthcoming. Due to the bathymetric conditions in most of Ireland's marine territory, these future developments will likely include the use of floating technology. Ireland is thus positioned to create unique domestic business opportunities in the floating offshore wind industry

Table of Acronyms

AHP	Analytical Hierarchy Process
APAC	Asia and Pacific
BCG	Boston Consulting Group
BoP	Balance of Plant
CAPEX	Capital Expenditure
CBAM	Carbon Border Adjustment Mechanism (Act)
CfD	Contract for Difference
CRM	Critical Raw Materials (Act)
DETE	Department of Enterprise, Trade and Employment (Ireland)
DEVEX	Development Expenditure
DMAP	Designated Maritime Area Plan (Ireland)
EEA	European Economic Area
EFTA	European Free Trade Association
EU	European Union
FLOW	Floating Offshore Wind
GDG	Gavin & Doherty Geosolutions Limited
GWEC	Global Wind Energy Council
HVDC	High Voltage Direct Current
IDEA	Integrated Design of Floating Wind Arrays
IDEA-IRL	Integrated Design of Floating Wind Arrays - Ireland
IEA	International Energy Agency
INTOG	Innovation and Targeted Oil and Gas Leasing Round
LATAM	Latin America
LCoE	Levelized Cost of Energy
MAC	Maritime Area Consent
MSP	Marine Spatial Planning
NESO	National Energy System Operator
NREL	National Renewable Energy Laboratory
NZI	Net Zero Industry (Act)
O&G	Oil & Gas
O&M	Operations & Maintenance
OEM	Original Equipment Manufacturer
OPEX	Operational Expenditure
ORE	Offshore Renewable Energy
OREC	Offshore Renewable Energy Catapult
ORESS	Offshore Renewable Electricity Support Scheme (Ireland)
OW	Offshore Wind
OWDT	Offshore Wind Delivery Taskforce (Ireland)
RCG	Renewables Consulting Group
TCP	Technology Collaboration Programme
TIGGOR	Technology Innovation for Green Growth of Offshore Renewables
UCC	University College Cork
UKRI	UK Research & Innovation
WEI	Wind Energy Ireland
WP	Work Package (of the IDEA project)
WTG	Wind Turbine Generator

Table of Contents

1 Integrated Design of Floating Wind Arrays (IDEA) 1
2 IDEA-IRL Work Package 4 Overview 2
2.1 Findings from the first year of Work Package 4 3
2.2 Work Package 4 in its second year 3
2.3 The format of the supply chain consultations 4
3 The supply chain challenge 5
3.1 The offshore wind supply chain 5
3.1.1 The people 7
3.1.2 The materials 7
4 Global market performance overview 8
5 Market research methodology 10
6 Results of market research and interview analysis 10
6.1 Norway 10
6.1.1 Updates from the market 11
6.1.2 Current state of the supply chain 11
6.1.3 Raw materials, workforce and skills 12
6.1.4 Ports, vessels & infrastructure for OW 13
6.1.5 Future steps 14
6.2 United Kingdom 14
6.2.1 Updates from the market 14
6.2.2 Current state of the supply chain 15
6.2.3 Raw materials, workforce and skills 16
6.2.4 Ports, vessels & infrastructure for OW 16
6.2.5 Future steps 17
6.3 Italy 18
6.3.1 Updates from the market 18
6.3.2 Current state of the supply chain 18
6.3.3 Raw materials and workforce 19
6.3.4 Ports, vessels & infrastructure for OW 20
6.3.5 Future steps 20
6.4 Ireland 21
6.4.1 Updates from the market 21
6.4.2 Current state of the supply chain 21
6.4.3 Raw materials and workforce 22

6.4.4 Ports, vessels & infrastructure for OW 23
6.4.5 Future steps 23
7 Conclusions 24
7.1 Conclusions for the Irish context 25
8 References 26
Appendix A: Guiding questionnaire for the supply chain interviews 31

1 Integrated Design of Floating Wind Arrays (IDEA)[3]

This report has been prepared by the IDEA-IRL project team as the third deliverable for work package (WP) 4 of the project. The IDEA-IRL project commenced in February 2023. The project is being undertaken by a partnership of University College Cork (UCC), Wind Energy Ireland (WEI), and Gavin & Doherty Geosolutions Limited (GDG). Its goal is to accelerate the sustainable development of Floating Offshore Wind (FLOW) both domestically and internationally. This will be achieved by building upon key background knowledge and by coordinating and leveraging the international FLOW research effort under the framework of the supported International Energy Agency (IEA) Wind Technology Collaboration Programme (TCP) Task 49.

Specific objectives across all the work packages include:

1. Deliver a set of fully defined reference sites characteristic of the international global floating wind deployment pipeline including all relevant technical, social, environmental, and economic parameters.

2. Deliver a set of fully open source and customisable floating wind array reference designs including key engineering tool input files, cost and environmental impact models.

3. Deliver a Failure Mode, Effects & Criticality Analysis framework for floating wind arrays including for coupled / cascading failures.

4. Engage with the international groups developing innovations for the floating wind energy industry, categorise in terms of multidisciplinary impact and ensure that functionality for their development is included in the reference sites and/or reference farm definitions.

5. Engage with the international agencies responsible for Marine Spatial Planning (MSP) to collect open research questions and concerns. Provide responses directly where possible and otherwise ensure that the reference sites and reference farms are defined in such a manner that they enable the required research.

6. Apply the work of Task 49 in an Irish context and engage with the local supply chain to provide specific policy recommendations and development pathways.

7. Raise the profile of floating wind energy technology, related research, and expertise in Ireland through the delivery of a multifaceted communications strategy.

This report will primarily serve to update on the consultation that has taken place during the second year of WP4 activities – consultation interviews assessing the readiness and ability of partner countries' supply chains to support the construction of floating wind projects in the required volume.

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[3] More information on the task and previously published deliverables can be found at https://iea-wind.org/task49/ and https://www.marei.ie/project/idea-irl-integrated-design-floating-wind/

2 IDEA-IRL Work Package 4 Overview

WP4 of the project is focused on Stakeholder Integration and Research Requirement Classification. It will be used to ensure the project has the required information from stakeholders, providing key input to the other more technically focused WPs (1-3, 5) within the IDEA-IRL project (Figure 1)

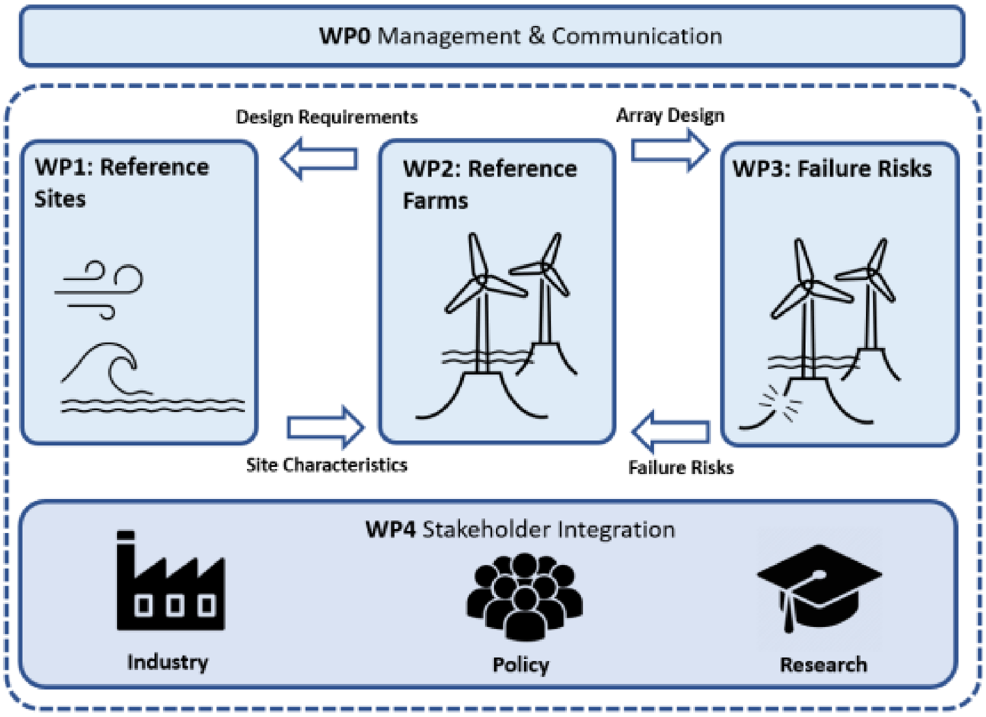

Figure 1: Overview of WP0-4, with WP5 - Irish Pathways - also included in this project.

WP4 has a few key objectives, including to:

- Assess & facilitate international MSP collaboration for FLOW zoning and identify future development zones for FLOW internationally.
- Align Task work to real world research questions and analysis methods.
- Curate a floating wind innovation register and score for social, economic and environmental benefit.

The six planned deliverables for this WP, to address these key objectives are:

- **WP4-D1:** Analytical hierarchy process (AHP) report detailing the AHP methodology to be used to rank and score a list of floating wind innovations (Month 6 – see) - COMPLETED
- **WP4-D2A[4]:** MSP consultation report publishing the results of the first interview round and arising queries and recommendations for their resolution. (Month 12) - COMPLETED
- **WP4-D2B:** AHP Ranking Report. Report outlining the outcome of the of innovation ranking and assessing potential research topics. (Month 14) - COMPLETED
- **WP4-D3:** Supply chain capability consultation report (this report) (Month 24)
- **WP4-D4:** To be confirmed at future task meetings (Month 36)
- **WP4-D5:** Recommendations for future activities (Month 36)

[4] Supported by a publication in EERA DeepWind 2024 proceedings [64] - Floating offshore wind – an overview of marine spatial planning and the needs of the industry (Dvorak et. al., 2024)

2.1 Findings from the first year of Work Package 4

The detailed findings of the first year of WP4 are available in the previous deliverables, however, to state the motivation for this report, a summary is provided below.

During the first year of interviews, the focus was on MSP and floating wind innovations. During the consultations we spoke to the interviewees about other potential non-technological challenges to the development of floating wind which we could analyse in future WP4 work. Two such areas were identified:

1. **Supply chain constraints** – Is there enough capacity and capability within the global and national supply chains to fulfil the ambitious deployment targets which have been set by governments? What effects may local supply chain content requirements have on the price of offshore wind (OW) projects? What policies and measures are being taken by relevant floating wind markets to encourage the development of supply chain and skills?

2. **Coexistence** – How can we better work with other industries to manage coexistence and using the same maritime space for more industrial purposes? This mainly relates to fishing and how it interacts with FLOW, but not exclusively. Are these interactions any different than with fixed-bottom projects?

The initial plan for WP4 was to continue the MSP interviews for another two years and thus create a view of how MSP develops throughout the duration of the task. However, since in the first year we have found that the importance of MSP is clear and realised by all member countries, the vast majority of which already have an MSP policy in place or are in the process of developing one, it was proposed to explore the supply chain constraints related to FLOW across key Task 49 partner countries.

2.2 Work Package 4 in its second year

The proposed format for consultation mirrors the approach taken during the first year of WP4 – with interviews undertaken with national representatives with experience in either industrial policy or within the supply chain for FLOW in the given country, and a report prepared on the findings. The desired outcomes of this consultation are as follows:

1. **An overview of what different markets are doing to develop the OW industry domestically** which could serve as inspiration for emerging markets on policies to employ

2. **A better understanding of member countries' supply chain capacities and competencies** and therefore, when comparing against the relevant national targets, a better idea of whether these targets are realistic

3. **Learnings on how the supply chain is planning to source the required raw materials**, which are often cost drivers and can be subject to political pressure and tariffs

4. **An assessment of the situation in skills development** and whether there will be enough people to support the large scale of deployment required to meet the ambitious targets

This report will focus on the supply chain capacity and capability consultation undertaken throughout 2024 and 2025, giving an overview of the process, of the relevant markets, and some key learnings and conclusions.

2.3 The format of the supply chain consultations

The interviews use a guiding structure to help make the most of the time which the participants volunteer for these consultations:

1. **Background questions** – Starting with a few background questions about the interviewee and the country they are representing. This includes any updates on MSP in the country over the past year.

2. **The current state of your country's domestic OW and FLOW supply chain** – This includes questions about the supply chain as it is now; How much of the supply chain is domestic? What parts of the project are supplied domestically? Is domestic involvement different throughout the different stages of the project? What is the policy landscape?

3. **Ports, vessels, and infrastructure** – Are the domestic ports ready for FLOW development as staging ports/installation bases/Operations and Maintenance (O&M) bases? Are ports being developed as part of the nation's industrial strategy? Is there local shipbuilding, which is relevant for OW? Is the national electricity grid ready to transmit and distribute the energy from future OW projects?

4. **Skills, education, and networking** – Some of the most important considerations for developing any market is the availability of a high-quality workforce. Is the nation taking steps to train people for the OW industry and facilitate cooperative research?

5. **Future expansion** – What are the national plans, on an industrial policy level as well as on the level of individual companies, to expand the involvement in the OW supply chain, attract foreign investment and ensure maximisation of economic value capture?

We have designed this structure to find out as much information as possible about the country's supply chain so that we can answer the four objectives laid out in section 2.2 as efficiently as possible.

The full questionnaire which was used to guide the interviews is available in Appendix A: Guiding questionnaire for the supply chain interviews.

3 The supply chain challenge

Wind energy will contribute to the tripling of the global renewable energy capacity to achieve the delivery of 1.5°C scenarios [1]. Under the 1.5°C scenario, the global OW capacity would have to reach around 500 GW globally by 2030 [2]. However, the current deployment rate of wind energy is insufficient to meet these expectations, due to a combination of technological and non-technological issues. In WP4, we explore key non-technological barriers to OW development; supply chain pressures and policy and permitting frameworks. The Global Wind Energy Council (GWEC) presents four possible reasons why the global supply chain is facing difficulties [1]:

1. **Inflation and rising cost of capital** propagate through the supply chain and make the projects more expensive, which has resulted in failed auctions and project cancellations. This is especially important in terms of any projects using a Contract for Difference (CfD) scheme, which sets the strike price and the long-term revenue which the project will generate.

2. **Supply chain companies have not scaled down production** capacities in a period of economic downturn because of optimistic policies and market predictions. Companies have been upkeeping large scale production facilities, without utilising them to the maximum because of temporarily lower demand. This, combined with the next point, has put a strain on company balance sheets and potentially impacted investor/shareholder confidence.

3. **The improvement of wind turbine generators (WTGs) and other equipment has been expensive** and original equipment manufacturers (OEMs) have not been able to recover the costs. The generation of new 15MW+ WTGs is not suitable for all markets, is often held back by vessel and port availability and capacity and can result in untested technology being fielded. It can also stand in the way of standardisation.

4. **Political forces** are emphasizing resilience and job creation in the supply chain which is pushing for more localisation. It is no longer the case that policies support maximum roll-out but rather take a more holistic approach to the energy transition, thinking more about the externalities. This can result in difficulties for an industry which relies on a globalised supply chain, as it tries to navigate the new set of industrial strategies.

Countries can try to make the energy transition more manageable by increasing the efficiency of the renewable energy industrial chain, supply chain, and value chain using industrial strategies [3]. Such strategies are typically implemented on a national level as part of achieving broader national and international goals, an example would be the UK Offshore Wind Sector Deal, or Powering Prosperity – Ireland's Offshore Wind Industrial Strategy.

3.1 The offshore wind supply chain

To better understand which parts of the supply chain to focus on, it is useful to show an overview of the contributions to the Levelized Cost of Energy (LCoE) of individual components to the project. A 2023 study by the National Renewable Energy Laboratory (NREL) shows a breakdown of the cost of OW for both floating and fixed-bottom projects. The data from this study is shown in Table 1 [4] and it clearly shows some important points to consider.

Table 1: Breakdown of the costs of fixed-bottom OW and FLOW projects [4].

	Fixed bottom		Floating	
	$/MWh	% of LCoE	$/MWh	% of LCoE
Capital Expenditure (CAPEX)	70.0	73.7%	119.0	82.1%
Turbine	25.7	27.0%	32.9	22.7%
Balance of system	30.4	31.9%	66.0	45.4%
• *Development*	1.5	1.6%	1.9	1.3%
• *Substructure & foundation*	9.2	9.7%	33.1	22.8%
• *Electrical infrastructure*	15.5	16.3%	22.4	15.4%
• *Installation*	3.5	3.7%	5.4	3.7%
• *Lease price*	0.7	0.7%	3.2	2.2%
Financial CAPEX	14.0	14.8%	20.5	14.1%
• *Construction insurance*	0.7	0.7%	1.1	0.8%
• *Decommissioning bond*	1.7	1.8%	2.9	2.0%
• *Construction financing*	2.9	3.1%	4.9	3.4%
• *Contingency*	6.2	6.5%	10.5	7.2%
• *Commissioning*	2.5	2.6%	1.1	0.8%
Operational Expenditure (OPEX)	25.1	26.4%	25.9	17.8%
Operations	4.0	4.2%	9.0	6.2%
Maintenance	21.1	22.2%	16.9	11.7%
LCoE	95		145	

1. The energy from FLOW projects is still about 50% more expensive than from fixed bottom. However, the prices shown are from 2022.

2. Capital expenditure (CAPEX) dominates the LCoE in both cases, but especially so in FLOW projects (on a percentage basis, and in terms of absolute costs). This means FLOW projects are even more subject to the issues associated with a high degree of front-loaded spending.

3. The main contributors to LCoE are the capital costs of the WTG, substructure and foundation, electrical infrastructure and the total cost of project maintenance, which is the main contributor to operational expenditure (OPEX). The parts of the supply chain related to these aspects should be analysed in more detail.

4. Floating technology still requires a larger amount of contingency, more expensive insurance and higher decommissioning bonds. This hints at a lower degree of confidence amongst investors, governments and insurance companies and is most likely linked to the technology being still quite new compared to fixed bottom OW.

3.1.1 The people

Transitioning towards clean energy already requires a significant amount of manpower. In the UK alone, it is expected that the OW industry will employ over 100,000 people by 2030 [5]. This future workforce must be trained and educated and includes engineers, surveyors, researchers, installation technicians, rope access workers, vessel operators and more. It is expected that a lot of workers will be coming from the offshore oil & gas (O&G) sector, due to a large degree of skill transferability [6], but this is unlikely to be sufficient and opportunities must be given to people to complete vocational training, specialisation courses and degrees.

Skills development also includes setting up of any organisations fostering research-academia-industry collaborations, organisation of networking events and conferences and participating in international research projects or setting up local and national centres of excellence. All these activities accelerate development through idea sharing and connect people.

3.1.2 The materials

Recent fluctuations in the price of OW and the slowing down of the decrease of LCoE can in part be attributed to the cost of raw materials used in the industry. The large machines required to make the transition possible require mainly the following [7], [8]:

- Steel (towers, foundations, hub castings, nacelles, transition pieces, moorings…)
- Concrete (mostly foundations, but also plays into port modernisation)
- Rare earth metals (among other things for permanent magnets in generators)
- Carbon/glass fibre (blades)
- Polymers (blades, moorings)
- Copper (generator windings, cables)
- Aluminium (Cables, oxidation electrodes…)

In many cases, the markets which deploy OW don’t have direct access to the mining and/or production of these materials and must import them. In some cases, like rare earth metals, only a handful of countries across the world control the production and thus political pressures can be introduced as an extra layer of difficulty in securing a supply chain.

Circular economy principles and recycling are being explored as ways to secure raw material supplies, but in many cases the technology required to recycle and enable a circular economy is still being developed, as is the case with blades which use thermosetting polymers as matrix in their composite construction. Future work might make this possible at a much larger scale, but these considerations have to be brought into the design process first.

4 Global market performance overview

In this report we summarise the findings from interviews with people knowledgeable about the OW supply chain in their country of operation. The industrial, value and supply chains for OW are very complex and it is useful to talk about the localisation of these globalised chains. Table 1 shows the parts of projects which require the largest investment. The localisation of manufacturing capacity for these parts has previously been studied by Boston Consulting Group (BCG) on behalf of GWEC. The 2023 BCG report goes into detail about localisation. Figure 2 and Figure 3 present some of the data from this report, namely manufacturing capacity localisation for some of the key parts of the supply chain (Figure 2) and the expected year in which this capacity will become insufficient and unable to meet the demand for OW projects (Figure 3). In this case, Europe is treated as a single market and includes the geographic area of the continent.

In 2021, 80% of the installed OW capacity globally was built and deployed in China. China has since held its position as the largest OW market in the world and given the country's high level of industrialisation, it comes as no surprise that most of the OW supply chain is Chinese. The second largest region for manufacturing OW components is Europe. Other regions of the world contribute to the supply chain a lot less than these two and often in quite specific areas; for example, there are many large cable-manufacturing facilities in Japan and South Korea [1].

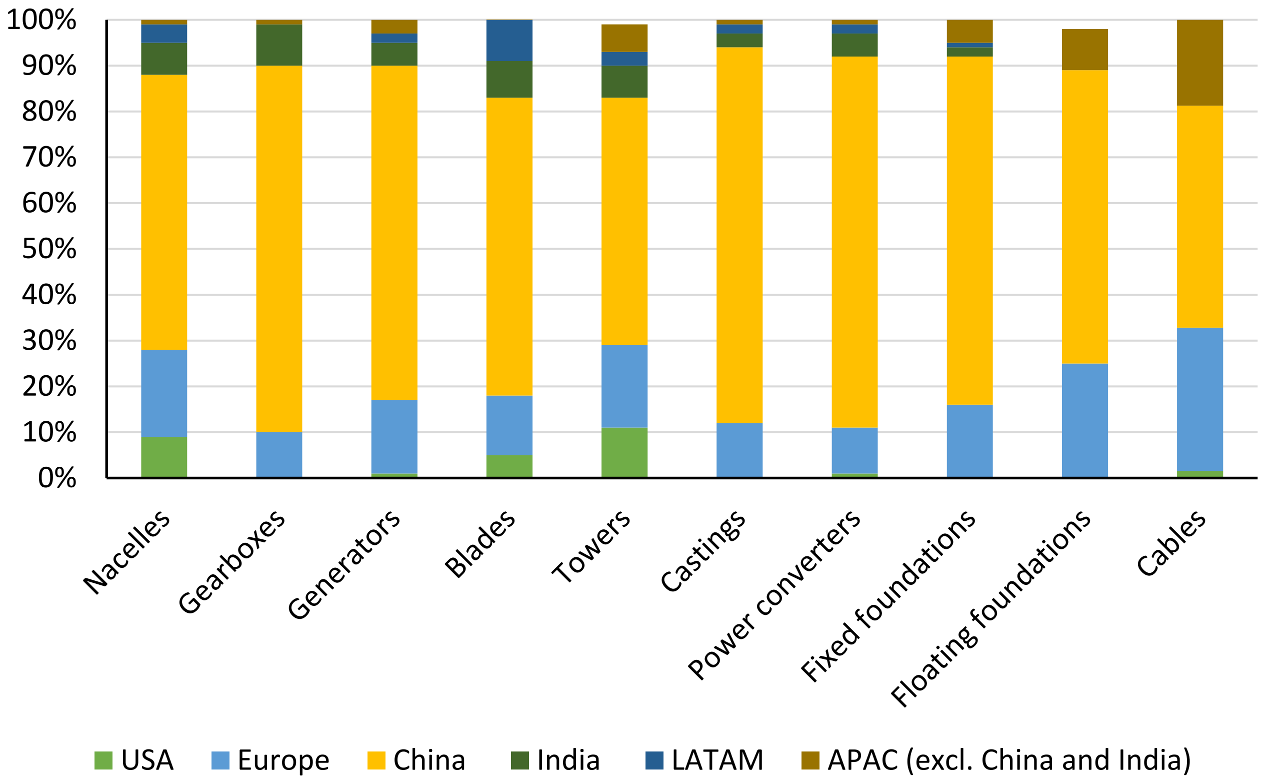

Figure 2: Regional manufacturing capacity of key WTG and balance of plant (BoP) components expressed as percentage of global manufacturing capacity[5]. Data based on [1]

[5] For most components, the global supply chain, as of 2023, was ready to support the manufacturing for roughly 160 GW of wind power per year. This includes offshore as well as onshore. More data is available in the GWEC report [1].

Manufacturing capacity of these regions is also important to consider, because it is being quoted as one of the likely future inhibitors to deployment rates of renewable technology. Due to the global events of the past years and the technological push towards bigger WTGs, many supply chain actors have not been able to adequately scale production and adapt to changes. This has led to a few years of negative impact on balance sheets and increased uncertainty.

Figure 3 shows a timeline of when manufacturing bottlenecks could start inhibiting deployment rates for OW in various regions. The data is based on the BCG report for GWEC [1] and is now likely out of date, having been published in 2022, but it can still serve as an indication of the greater issue at hand.

Based on Figure 3, manufacturing bottlenecks already have an impact on the potential of regions to supply their own demand. In Latin America (LATAM) and the Asia and Pacific (APAC) region excluding China and India, there is already a lack of regional capacity to manufacture critical components at a sufficient rate. This leads to increased imports from other parts of the world. Globally, the only market where predictions show that local supply can meet demand is China[6].

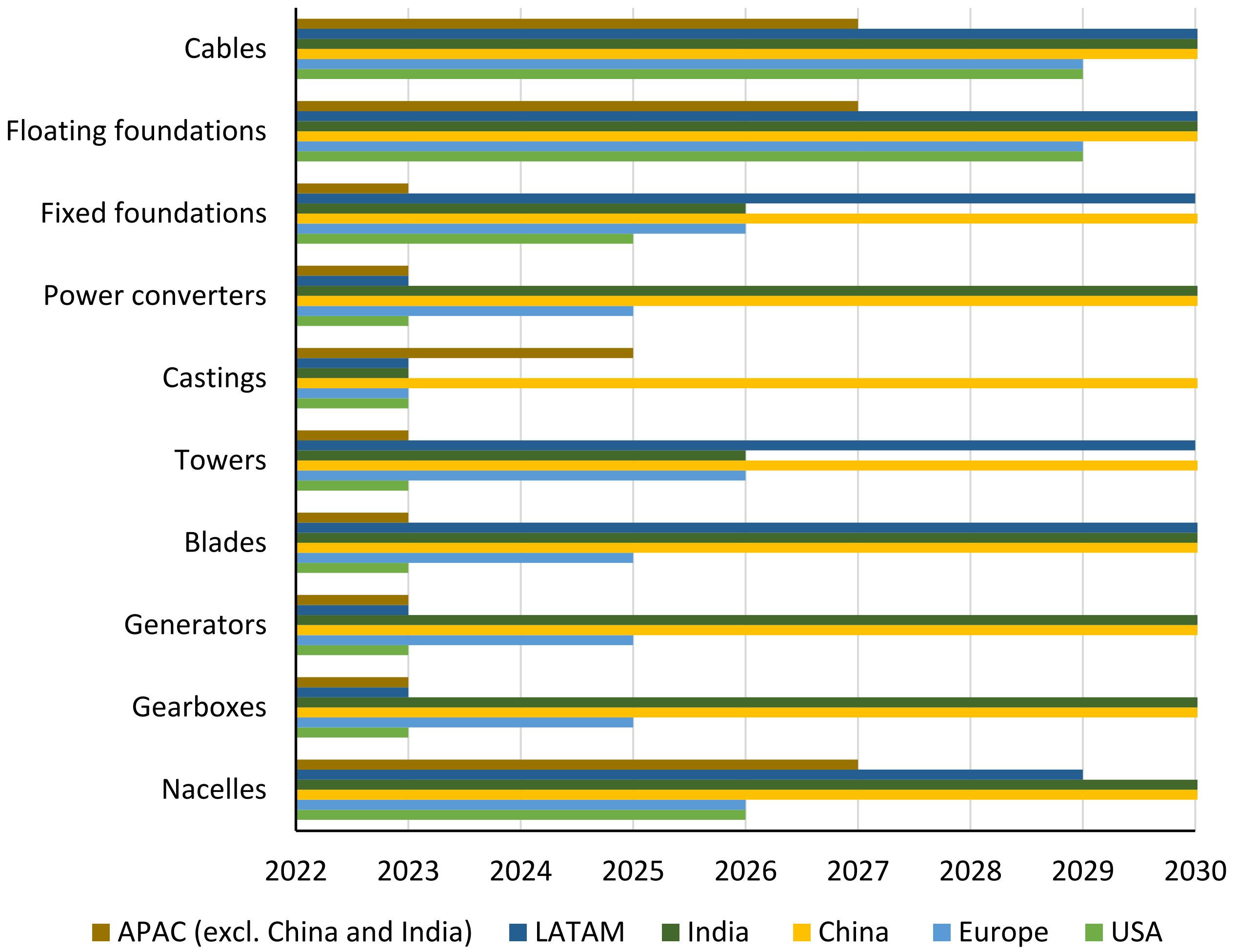

Figure 3: Timeline of expected supply chain bottleneck issues for different WTG components and regions. Data based on [1]

[6] Using the data from the BCG GWEC study until 2030 [1].

5 Market research methodology

Four markets were considered for analysis in this report: Italy, Norway, United Kingdom, and Ireland. These were selected due to being markets with different, specific characteristics, different levels of maturity and unique supply chain development features. Interview participants were invited to participate through the IDEA contact network. Four participants responded, one from each country. These were representatives with experience working in the offshore wind industry in upper management roles in academia, private sector industry and research organisations. Their identities will remain undisclosed as per the interview participation agreement. Interviewees were sent the interview questionnaire ahead of the interview, this questionnaire is available in Appendix A: Guiding questionnaire for the supply chain interviews. Each interview lasted roughly an hour and followed structure of the questionnaire, sometimes adapting it to the given market.

Notes were taken during the interview, and these were analysed and re-written into structured text. Where applicable, information provided by the interviewees was fact-checked and references provided.

6 Results of market research and interview analysis

The following markets were explored: Norway, United Kingdom, Italy and Ireland. These countries were selected as markets with a varied level of market development, supply chain capacity and capability and industrial history. All of them have representatives within the Task 49 framework.

The UK is one of the original OW markets with a 20-year legacy, and 14.7 GW of installed capacity, it is the second largest market globally. Norway has ample experience in offshore O&G and is planning to use wind power to electrify O&G operations and diversify its energy portfolio. Norway is currently home to the World's largest FLOW deployment, Hywind Tampen. Ireland and Italy have nascent OW industries but are in completely different situations. While Italy is facing a difficult policy and permitting situation, it has a developed heavy industry supply chain including shipbuilding and steel production. Ireland on the other hand is making a lot of progress in policy development but almost entirely lacks heavy industry. An exploration of these four markets should provide a good overview of the range of concerns and challenges countries face when trying to develop a domestic OW supply chain.

6.1 Norway

Norway has a well-established OW industry, much of which is Norwegian-based rather than Norwegian-owned. Our interviewee noted that in 2023, approximately 6,000 man-years were linked to OW activities in Norway, including vessel building and operations, engineering, cable manufacturing, and maintenance. The majority of the activity is directed internationally, contributing to the global OW supply chain. Norway benefits from good transferability of skills between offshore O&G and OW.

Originally, OW in Norway was meant as a means for the electrification and decarbonisation of offshore O&G operations [9] like the existing Hywind Tampen project, the largest operational FLOW deployment to date (88 MW). As of now, OW is also considered part of the strategy for diversifying the sources electricity in the national grid.

6.1.1 Updates from the market

Sørlige Nordsjø II Offshore Wind Farm (1.5 GW) has been awarded to a consortium run by the Belgian company ParkWind, backed by Ingka (majority owner of IKEA) and the Japanese energy group JERA. There is no Norwegian ownership, although O&G logistics company NorSea Group is involved as a strategic partner.

Utsira Nord floating offshore wind development (500 MW) has been delayed as it involves state aid and therefore needs approval from the European Free Trade Agency (EFTA) Surveillance Authority. Negotiations with EFTA are ongoing to find a legal way to promote local technology development in floating wind projects. Attempts to actively promote local content in fixed-bottom projects have for now been paused.

Electrification of O&G platforms continues to play key role in Norway's OW, with a debate on whether to use cables from shore or OW turbines linked directly to the installations. In the future, electrification of O&G is expected to continue playing a role in the deployment of OW in Norway. Norwegian companies are also involved in electrification of UK O&G installations through the Innovation and Targeted Oil & Gas [10] (INTOG) scheme.

Cost Concerns & Subsidy Debate has started on the back of the CfD for the Green Volt floating project being higher than expected, shifting public opinion negatively. The CfD for the floating Green Volt was £139.93/MWh [11] (£197/MWh in 2025 prices [12]). Subsidies for floating wind are now a big topic, and it remains to be seen whether O&G electrification will receive more support than grid connected OW. Debate over subsidies is intensifying, with some suggesting a resource rent tax with annual refunding of cash value of deficits as an option.

Norwegian OW activity has evolved since its origins as a means of reducing O&G emissions in the early 00s. The Russian invasion of Ukraine shifted focus to include resource security and diversification among O&G electrification. The government abandoned local content requirements for fixed-bottom wind but is pushing for local supply chains in floating wind, potentially seeking EFTA exceptions.

6.1.2 Current state of the supply chain

Norway's strengths in terms of OW supply chain involvement lie in shipbuilding and operations, manufacturing of BoP components (cables and substations), and O&M and engineering services. A thorough analysis of the Norwegian OW supply chain was completed in 2023 by Renewables Consulting Group (RCG) Nordic [13]. Presented here is the supply chain analysis based on the interview carried out for the IDEA-IRL project.

Project Development & Operations are a big part of the Norwegian contribution with Equinor being the largest Norwegian company in OW, leveraging its expertise in offshore O&G to lead OW projects both in Norway and globally. Other notable developers are ENI and HitecVision owned VårGrønn and the state utility Statkraft.

Cables & Electrical Infrastructure are another part of Norway's domestic manufacturing capability. Norwegian companies manufacture subsea cables, including export and inter-array cabling. These are some of the most critical BoP components and a lot of research is being done with dynamic cables for FLOW.

High-Voltage Direct Current (HVDC) Platforms are engineered and provided by Aibel and Aker Solutions, particularly the external structures. The companies have a track record from O&G and successfully contributed to FLOW projects in the past.
Vessels & Engineering are provided domestically by Subsea 7 and other firms are involved in shipbuilding and vessel services for OW. Subsea 7 is one of the largest OW services operators. The Italian company Fincantieri, one of the largest shipbuilding companies globally, also build ships in Norway at several locations, mostly small to mid-size O&M vessels. Shipyards based in Norway build most of the specialist vessels for OW used on the European market.

O&M expertise has been developed in Norway with the O&G industry and now extends into OW. Norwegian firms are involved in subsea inspections, repairs, and logistics for OW farms, with the IKM Group and NorSea being among the biggest.

6.1.3 Raw materials, workforce and skills

Norway imports most of its steel and there are no clear government initiatives to secure sustainable steel supplies or manage price fluctuations. There is ample domestic supply of concrete and Norway is one of the countries pioneering sustainable, low-carbon concrete and the use of carbon dioxide capture and sequestration techniques in the production of concrete.

Norway's OW sector has extensive use of itinerant labour**,** particularly workers from Eastern Europe, which provides a unique challenge. With improving economic conditions in Eastern Europe and a 20-25% drop in the value of the Norwegian Kroner compared to other currencies fewer foreign workers are willing to work in Norway, leading to potential labour shortages. This is a major concern for the expansion of Norway's OW industry, as it requires a large skilled workforce to build and maintain projects. However, many universities in Norway as well as vocational schools and colleges offer courses in offshore renewable energy (ORE). This, in combination with a large offshore O&G sector means that Norway is in a good position for developing talent for the industry[7] as well as re-skilling people with experience from O&G.

[7] More information on the Norwegian workforce for offshore wind can be found in a (Norwegian) report by VindKOMP: https://www.regjeringen.no/contentassets/432d1df8c0fe4f00871b62401287550f/final-report_vindkomp-fase-1.pdf

6.1.4 Ports, vessels & infrastructure for OW

Grid infrastructure in Norway is in a different situation compared to most markets, due to the nature of and motivation for developing the FLOW industry in the country. Most of the deployed capacity will be used to decarbonise O&G mining operations in the North Sea, therefore grid connection is not an issue for most projects, since they are not planned to be grid connected.

However, in cases where projects will be connected to the grid, there is potential for FLOW projects to use at least some of the existing cabling which currently powers O&G operations in some locations. Power transportability from the north of the country towards the load centres in the south remains a potential bottleneck.

Norway has strong port infrastructure, but investment in OW support facilities has been slow due to a lack of secure demand. Ports need investment to expand, but companies need assurance of projects before investing. Investment is mostly required for land acquisition to enable staging activities. Some Norwegian ports are in a unique position of being able to provide very deep berths, which enable manufacturing of floating spar foundations at quayside.

This advantage is being demonstrated with the tow-to-port maintenance strategy for Hywind Scotland, with the Scottish project using a Norwegian port (Wergeland Base in Gulen [14]) for maintenance, due to a lack of suitable port capacity locally. Norwegian ports are mostly not in major cities and require additional investment in logistics and transport infrastructure and size increases to enable OW marshalling activities.

Some key ports include Gulen, which is being developed by Equinor to support OW activities and Windport Mandal, which is being considered as an option for OW foundation production and staging. Norwegian ports could play a significant role in servicing OW farms in other North Sea markets, including the UK, due to their proximity and high level of local expertise. This suggests a potential future business model for Norwegian ports.

Norway is one of Europe's most important shipbuilding hubs for OW vessels. Shipyards in Norway (some domestically owned, some with foreign ownership) specialize in building construction, support, and crew transfer vessels rather than jack-up vessels used for installing bottom-fixed turbines. Among the more notable Norwegian companies in OW vessel operations are:

- **Subsea/Seaway 7**: Norwegian-based, specialising in OW installation vessels, to be merged with Italian Saipem [15].
- **DOF**: Norwegian company providing OW vessel services.
- **Solstad:** Norwegian offshore shipping company with a fleet of subsea work vessels and dedicated ORE vessels.
- **Olympic**: Norwegian operator of vessels for subsea work and OW activities.
- **Fincantieri/Vard**: An Italian-owned company, operates Norwegian shipyards designing and outfitting OW related vessels under the brand name Vard
- **Ulstein:** Family-owned shipyard/ship designer with long history in O&G now designing and outfitting vessels for OW.

Given Norway's strong shipbuilding industry, port infrastructure and OW vessels, their services are already being exported to other European countries. Many European OW projects require high-tech support vessels, Norwegian shipyards, ports, and vessel operators could meet this demand. Norway's position next to the North Sea, one of the largest OW markets globally, also plays into this.

6.1.5 Future steps

It is expected that OW development will be interlinked with O&G in the future, utilising synergies in skills but also sharing infrastructure. Many oil fields have cables to which wind farms might be able to connect with necessary update works done. It is expected that most of the OW development in Norway will be floating [16]. Norway is expected to follow the EU regulations and policy regarding OW, mostly due to being part of EFTA and within the European Economic Area (EEA). Overall, the country is in a good position to benefit from and contribute to the European regional OW supply chain and make use of the extensive domestic maritime industry experience.

6.2 United Kingdom

The UK is currently the second largest OW market globally and is also one of the original pioneering markets. Due to two decades of development, the UK supply chain is well developed and capable of supplying around 50% of project components based on value. The government has goals to increase this number to over 60% in the next auction rounds, as described in the Offshore Wind Industrial Sector Deal [17].

OW has had support in the UK for a long time and the current government is expected to continue to support the industry. Government deployment goals keep rising and after the failed CfD auction round 5, where no OW projects bid due to low offered strike prices, the confidence in the industry is being restored[8].

6.2.1 Updates from the market

The Industrial Growth Plan, published by RenewableUK, Offshore Wind Industry Council, The Crown Estate and The Crown Estate Scotland, has been developed to support growth in the sector [18]. The ambitious plan claims the industry could create up to 10,000 jobs, triple the manufacturing capacity, double research and development investment and output and provide £25bn gross value added to the economy. The plan makes use of UK experience with this industry as well as with other industries. The plan identifies which parts of the supply chain the country is likely to focus on providing domestically and which are more likely to get imported.

GB Energy has been established as a publicly owned organisation tasked to drive the UK transition towards clean energy and help energy security by investing in renewables [19]. It aims to reduce reliance on fossil fuels, decrease energy costs and provide green jobs in the UK. GB Energy may help de-risk investments into floating wind and other disruptive technologies.

[8] More information on the supply chain in the UK can be found in the OREC *Offshore Wind Supply Chain Confidence Survey Report* from 2024 [68] and other OREC publications.

The Clean Power 2030 Action plan has been published to outline an approach to three energy-related challenges; maintaining secure and affordable supply, creating new industries and investments, and protecting the environment [20]. Among other things, the plan puts emphasis on grid development, which is important as an enabler of transporting electricity from Scotland and more remote locations to load centres in England.

The Offshore Wind Industry Partnership, managed by the Offshore Wind Industry Council, is an initiative supporting local supply chain development, using funds which CfD holders contribute [21]. Developers are expected to contribute around £1m per GW installed into the fund to be invested in local supply chain, business scale-up and innovation. Alongside this, the Clean Industry Bonus lets CfD applicants gain more revenue if they decide to invest in more sustainable supply chains.

A change of government has created some uncertainty about the future support to the market, but key processes remain unchanged. There is some controversy about the (maybe unrealistic) deployment targets for the industry. The CfD system, which has enabled the past decade of growth remains similar, while including considerations from the Offshore Wind Sector Deal to increase domestic content to over 60% [22]. Developers are required to submit a Supply Chain Development Plan for this, outlining among other things the level of domestic content, but this is not a legally binding document, and it will be difficult to enforce its fulfilment.

6.2.2 Current state of the supply chain

The UK supply chain is among the most developed in Europe and able to provide 48% of value of contracts towards OW projects [23]. Most of this contribution lies in development expenditure (DEVEX), where 83% is supplied domestically and OPEX with an 81% domestic contribution [23]. Comparably, the CAPEX part of the supply chain is under-represented in the country with only about 12% domestic content. This hints at the UK’s position as a market with a lot of expertise in the technology but low manufacturing capacity.

Manufacturing in the UK focuses on specialist industries. There is potential for the UK to become a net exporter of cables for FLOW applications, with ongoing research into dynamic cables. There is also potential for FLOW platform manufacturing, but this depends on port infrastructure investment, as currently the capacity to build platforms is limited. On the other hand, monopiles will be manufactured in a new factory in the Teesside region [24] (SeAH Wind – subsidiary of the Korean SeAH Steel Holdings). Vestas operates blade manufacturing facilities on the Isle of Wight and plans to open another factory in Leith to increase capacity [25].

O&M practices have been developed in the UK over the last two decades. This means UK companies are well suited to provide these services for the domestic market as well as to export them abroad. Currently a lot of effort is going into condition monitoring, life extension programmes and incorporating artificial intelligence in these processes because they often rely on pattern recognition from collected data.

A challenge lies in the supply of raw materials for the industry, especially steel and metals required for generator production. Because of this, it is unlikely that nacelles will ever be built in the UK and will continue to be imported from abroad. There is also not a lot of vertical integration of the supply chain, unlike in the Chinese market, so the UK is at risk of facing production bottlenecks in the short and mid-term ranges. This is a common issue in multiple markets in Europe [7].

Sustainable approaches play a big role in formulating the future of the UK supply chain development. The recent Offshore Wind Industrial Growth Plan as well as the Clean Industry Bonus are incentivising companies to consider things like circular economy practices or increased local manufacturing emissions because of onshoring production. This further underlines the government's continued effort to build the industry with ethical considerations in mind.

6.2.3 Raw materials, workforce and skills

Domestic production of raw materials required for OW in the UK is not economically feasible, except for concrete and materials obtained using recycling and circular economy principles. Otherwise, raw materials will have to be imported, or production outsourced.

One major initiative is the introduction of a skills passport [26], recently announced by RenewableUK which aims to make it easier for workers to transfer between O&G and OW. The passport would create a register of transferable skills. Additionally, the Offshore Renewable Energy Catapult (OREC) is conducting a skills foresight exercise to assess workforce requirements and ensure training aligns with future industry needs. This goes hand in hand with programmes like TIGGOR (Technology Innovation for Green Growth of Offshore Renewables), which is a regional cooperation in the Tyne region, where small companies can get investment and Newcastle University provides post-graduate training [27].

There is a number of such industry/academia cooperations across the UK, including several industrial doctorate training centres. Across the UK, Innovate UK and UK Research & Innovation (UKRI) have set up nine technology Catapults, one of them being the OREC. This is a centre focused on accelerating the development of ORE technologies by providing testing facilities, education, networking events, facilitating industrial and academic partnerships and producing open access reports and market reviews.

If the UK's ambition to build over 50GW of OW by 2030 is to be realised, it will require around 100,000 people to work in the industry [28]. Currently, it is about 32,000 [28], compared to the roughly 220,000 who are supported by O&G [29]. The skills development is driven mostly by academia and government.

6.2.4 Ports, vessels & infrastructure for OW

Despite a long tradition of shipbuilding in the past, shipbuilding for OW is unlikely to restart domestically, except perhaps for specialist shipbuilding in Belfast. This means the UK will likely have to rely on existing fleets or import more ships. There is potential to repurpose vessels from the declining O&G sector, particularly those used for anchors, mooring lines, and cables. The challenge with doing that is that vessels working in O&G can often command higher rates than when working for OW.

Port infrastructure development is another critical issue; the UK currently lacks the domestic port capacity to build OW at scale, with only the Port of Nigg in the north offering significant potential, though it still requires further expansion. Mostly there is little space for marshalling activities and a lack of deep berths for quay-side construction and maintenance of floating projects. The Scottish government is investing to develop the port of Ardersier as a dedicated OW construction port [30] to support the combined circa 35 GW of ScotWind and INTOG projects expected to be developed. This lies in the Cromarty Firth Freeport zone and thus can offer tax incentives to OW development activities. The port is scheduled to open in 2025. Freeports are expected to play more of a role in OW development in other areas as well, including the Celtic Sea, Teesside, Thames, and other regions. Until the freeports are developed for OW use, the UK will have to lean on receiving help with vessel and port operations from other players in the North Sea market.

The National Grid, in charge of electricity transmission in the UK, has released ambitious plans [31] to increase north-south transmission capacity to be able to accommodate OW projects in Scotland and enable power transmission to load centres in the Midlands and other parts of England. This investment will make it possible to connect more OW, but comes at a significant cost, which will likely propagate in connection charges charged to developers, thus increasing LCoE. The investment plan, as published by the Electricity Systems Operator proposes £58bn is spent on grid modernisation to accommodate renewable energy capacity. The modernisation would also create and sustain around 20,000 jobs.

6.2.5 Future steps

The UK's Industrial Growth Plan is focused on expanding domestic OW manufacturing, a committed strategy aimed at boosting local content. The Clean Industry Bonus is expected to help balance the trade-off between increasing local content and managing costs.

Government support for the industry remains strong, though the pace of policy advancements may slow. The political landscape, including the UK's new government, foreign election outcomes, and the EU Green Deal Industrial Plan [32], will influence future developments. A potential trade war between the US and EU driven by policies such as the Inflation Reduction Act [33] and any import tariffs imposed by either side could negatively impact the UK economy and supply chains. It will depend on how much the UK will align with EU policy on these matters. Media narratives, such as reports of the UK running low on gas reserves, could create a volatile support environment and even fuel anti-green sentiment if OW costs rise sharply. This raises critical questions about how much of the cost taxpayers will bear.

While the UK has set ambitious OW deployment targets, industry estimates suggest these are unlikely to be met. The National Energy System Operator (NESO) report projects 43-50 GW by 2030 [34], but OREC forecasts a lower figure of 37-38 GW. Overall, while OW remains a priority, cost pressures, political uncertainty, and evolving trade dynamics will play a significant role in shaping the industry's trajectory over the coming years.

The country is in a very good position to develop the industry thanks to the long tradition and strong ongoing support from academia, government and the industry.

6.3 Italy

Italy's OW sector remains in its early stages, with the 30MW Taranto wind farm (also known as Beleolico) remaining the only operational project. The industry and supply chain are still developing, using experience from an extensive onshore wind industry, and interest in going offshore is high. Around 85 GW worth of connection requests have been made for offshore wind projects [35] (fixed and floating), however many of these are speculative.

6.3.1 Updates from the market

The government has introduced policies to support OW, including an incentive for innovative technology and OW, allocating the first 3.8 GW (mostly floating, as only two fixed-bottom projects are at an advanced stage). The FER2 decree [36] also mentions port infrastructure, aiming to fund two southern ports for OW construction and assembly, with funding expected by the end of the 2024 and port selection in early 2025.

The country's first marine spatial plan was published two months ago, covering the Adriatic, Ionian, and Tyrrhenian Seas [37]. While a positive step, it doesn't make enough OW specific dedications of areas, but rather specifies areas for energy use, thus combining different use cases together. Most areas are classified for general use. OW can be developed in general use areas if compatible with other uses. More specific planning considerations would improve the confidence in the industry and possibly simplify the planning and permitting processes.

The government plans an OW specific analysis within the next year to identify priority development zones and introduce fast-track permitting by 2026. Developers are actively engaged in discussions with the state, and early-stage agreements are being explored. This is an effort to speed up the project delivery; the government would like timelines of 60 months or less. Smaller projects may be needed initially to build investor confidence before scaling up to GW-scale developments.

6.3.2 Current state of the supply chain

Italy faces similar difficulties as other European countries in that the manufacturing capacity is severely limited. There are no domestic incentives to include local content in projects and therefore strategic supply chain development is also limited. Selecting suppliers is mainly driven by price.

Nadara is one of Europe's largest renewable energy companies and it is headquartered in Milan. They operate 4.2 GW of renewable energy projects including onshore and OW in markets around Europe and the US. They have recently signed a partnership with BlueFloat [38] and are looking to gain more experience in the FLOW industry. They are also developing OW in Italy, two of their projects are expected to pass their environmental impact assessments later in 2025.

Prysmian is a large cable manufacturing company with over 35,000 employees, operations in over 50 countries and headquartered in Milan. They supply transmission cables and are developing new high voltage products.

Saipem deliver OW foundations with experience from large projects like Dogger Bank, Seagreen and Hywind Scotland providing various services. They are currently branching out to secure more of the expanding FLOW market. Saipem have signed a new partnership with the Danish Divento to work together on Saipem STAR1 foundations for projects in Sicily and Sardinia [39]. Saipem are expected to merge with Subsea/Seaway 7 soon [15].

Fincantieri, one of the largest shipbuilding companies in the region, is headquartered in Italy, however a lot of their vessel production for OW is based in Norway using the brand name Vard.

WTG OEMs have some production facilities in Italy also. Vestas has a blade facility in Taranto and Renexia is trying to set up a partnership with MingYang for a WTG manufacturing plant [40]. This may prove challenging due to EU concerns about Chinese entrants to the market.

The steel industry in Italy is strong, in Europe second only to Germany, however the largest company, Acciaierie d'Italia is currently struggling financially [41]. Italian steelmakers have not yet invested into expanding their capacity to include manufacturing for OW, but this can change with increased market confidence.

6.3.3 Raw materials and workforce

Italy is Europe's second largest producer of steel (11th globally) with 21m tons produced in 2023 [42]. Thanks to the utilisation of circular economy principles, using a high proportion of recycled scrap, Italy's steel industry also has one of the lowest emission intensities of steel production globally [42]. The industry is recognised as one of the critical inputs and enablers of other Italian industries and is rightly considered crucial in the strategic supply chain. The sector is pressured by rising energy costs, difficulties with finding raw materials and scrap and global oversaturation of the market mainly due to pressures from China.

Domestic availability of other important materials is low, as is the case across the region. The EU is trying to address the region's dependence on China for raw materials in the Critical Raw Materials Act (CRM) Act [43], which is part of the Green Deal Industrial Plan and plays into the Net Zero Industry (NZI) Act [44]. The CRM Act acknowledges the importance of raw materials in the context of the EU's ability to develop strategic sectors like renewable energy, digital services, aerospace and defence. The Act sets a target of at least 10% of materials to be domestically extracted, 40% domestically processed and 25% recycled, with no more than 65% of imports of any material coming from a single non-EU country by 2030.

Skills development in Italy's OW industry is progressing, though still in its early stages. Enel has launched a training academy for those interested in working in OW [45]. Additionally, partnerships are forming with universities, such as the University of Cagliari in Sardinia, which now offers an OW course [46]. These initiatives are partly driven by compensation measures to offset project impacts like visual pollution and effects on fishing and tourism. More universities will likely get involved and new vocational training programs may emerge as OW development expands. The focus is on ensuring local communities benefit through skills training and employment opportunities so they can participate in the industry being developed in their region.

6.3.4 Ports, vessels & infrastructure for OW

Ports in Italy are not currently fully suitable for supporting OW projects, particularly FLOW. Upgrades are necessary, and the FER2 decree is expected to help with this by selecting at least two southern ports for assembly and integration (not manufacturing). Likely candidates include:

- Augusta (Sicily): for foundation assembly and integration.
- Brindisi and/or Taranto (Apulia): close to major projects, useful for integration.

For O&M, additional ports, including Coriano, could be viable. However, these ports are not included in FER2 planning and will require private investment from developers or third parties to make them more compatible and increase any staging capacities as required. OW developers will not be responsible for developing the ports but will act as clients to port management entities.

Vessel availability planning will be a critical focus point for the OW industry in Italy. FLOW projects don't require large installation vessels, as most installation work is done at the port, reducing reliance on heavy-lift jack-up vessels which have been a bottleneck in other OW markets. In Italy, the main vessel challenge will be cable-laying vessels, but Italy has an advantage here. Prysmian, a global leader in cable installation, operates domestically. However, their vessels are booked years in advance, so early planning is essential. Vessel construction is a possibility as well with many large shipyards present in Italy. Importantly, Fincantieri, an Italian company already builds OW vessels in their Norwegian yards. It may be possible to expand domestic capacity to building OW vessels in Italy as well.

Power transmission between load centres and OW locations may end up being a challenge. 50% of Italy's electricity consumption is in the industrial northern parts, while OW projects will be concentrated in the south. A recently published plan [47] aims to reinforce the south-north grid connection, with OW projects integrated into this strategy. The transmission system operator Terna has been proactive in this to minimise the risk of grid availability becoming a bottleneck. Getting a connection quote from Terna is relatively easy but time-consuming, operating on a first-come, first-served basis. This has contributed to Italy's large OW pipeline as developers rush to secure connection agreements.

6.3.5 Future steps

Italy's OW development potential is strong, especially in the south. With load centres in the north, grid capability is still questionable. Terna is addressing this with their €21bn grid modernisation plan, but the timing of this as well as the outcome will depend on how the plan is executed. Near-term projects are expected to proceed without major grid issues due to planned upgrades. However, post-2030, as more OW projects develop in the south, further grid expansion will be necessary. Terna might help OW development by taking on more of the risk associated with power transmission.

The OW supply chain remains nascent, and local suppliers need significant growth to capture more value within the country. This development can be supported by clear regulations and long-term policies to give certainty to developers and encourage investment. A simplified permitting procedure and a more detailed marine spatial plan along with a revised calculation of the CfD strike price with increased transparency would increase developer confidence and take away some investment risk.

Finally, Italy should develop a stronger long-term growth plan for the OW industry that aligns supply chain growth, regulation, and infrastructure investment with national deployment targets and marine spatial planning. It seems like this is already happening to a certain extent.

6.4 Ireland

The metocean conditions in Ireland, especially on the west coast, are some of the most severe in the world. This results in the country potentially having access to some of the best OW generation conditions with regular north Atlantic wind, but challenging conditions will need to be overcome to deploy projects in these locations.

This opportunity is currently underutilised, but steps are being taken towards achieving the 5 GW by 2030 deployment target in Ireland, with longer term targets of 20GW by 2040, and 37GW by 2050 also set.

6.4.1 Updates from the market

Powering Prosperity – Ireland's Offshore Wind Industrial Strategy is a plan published in 2024 and includes action points to be implemented during 2024 and 2025 aimed at building a resilient OW supply chain [48]. The strategy considers opportunities for Irish business, regional opportunities, and routes to market for OW deployment. It is a collaboration between the Department of Enterprise, Trade and Employment (DETE) and the Offshore Wind Delivery Taskforce (OWDT).

The South Coast Designated Marine Area Plan (SC-DMAP) was approved in October 2024 and it identifies four sites for future fixed-bottom wind farms off the south coast of Ireland [49]. The first site, Tonn Nua (900 MW) will be auctioned in 2025. Further programmes of deployment will take place within Maritime Areas B, C and D through an orderly, strategic and managed process of development, with a further indicative capacity of 3 – 4.2 GW potentially available from these sites. This regional MSP policy is important in setting the procedures for future projects.

Six Phase 1 projects received a Maritime Area Consent (MAC) in December 2022 [50], and the projects have all since submitted planning applications. Four of the projects have successfully secured a CfD for a combined capacity of slightly over 3 GW within the Offshore Renewable Electricity Support Scheme (ORESS) 1 auction. The two projects unsuccessful in ORESS 1 are continuing their development. The second round of auctions within the ORESS programme is expected in 2025 and will build on the south coast DMAP. The first area to be auctioned will be the 900 MW Tonn Nua. Recently one of the ORESS1 projects – Sceirde Rocks was cancelled by the developer [51].

6.4.2 Current state of the supply chain

The Irish OW supply chain has been explored in more detail in the second deliverable of WP5 of the IDEA-IRL task [52]. Here information found during the interview process is included.

In ORESS 1 projects, supply chain constraints are not a major concern, as all projects are fixed bottom and present a learning opportunity for existing and potential Irish suppliers, as it is accepted that most of the supply chain will be provided by international suppliers, and no strict domestic content provisions have been set. Long-term deployment targets will likely rely on FLOW, which requires further supply chain development and a slightly different supply chain.

Surveys, engineering and O&M are some of the strengths of Irish supply chain. There are experienced and innovative companies working in the early stages of OW development. Surveying, consultancy and innovative O&M were quoted as the areas in which key opportunities may lie for Irish companies within OW development [53]. Some companies are engaged in delivering Tier 2 and Tier 3 (subassemblies and subcomponents) elements of OW. However, there is a lack of capacity in installation and manufacturing, meaning international supply chains and partnerships will be essential. The DETE is working on integrating supply chain strategies into industrial policy as is happening with the Offshore Wind Industrial Strategy.

Floating foundations could possibly be built in Ireland, especially if they are made from concrete. The demand for these is likely to be high in upcoming auction rounds and Irish companies could find their niche there. This will only be possible with some port modernisation, making sure there is enough deep berths for quay-side installation.
Future auctions will play a crucial role, with a competitive MAC process expected, possibly including non-price criteria. The government is assessing how to structure these auctions while ensuring compliance with EU regulations, particularly the NZI Act, the CRM Act and the Carbon Border Adjustment Mechanism [54] (CBAM), which is linked mainly to steel and concrete imports from non-EU countries, but also to energy imports from outside the EU. A minimum domestic supply chain requirement is under discussion but remains uncertain due to concerns about it being detrimental to the development of the projects.

6.4.3 Raw materials and workforce

There is little scope for Ireland to produce its own materials, except for recycling and the production of concrete. Most materials as well as manufactured products will have to be imported, at least in the mid-term future.

Ireland is actively identifying ways to make transferability of skills easier between O&G and OW (and other industries). OWDT has a dedicated skills and workforce team, with input from WEI. A study commissioned by Green Tech Skillnet in partnership with WEI [55] identified key skill and talent needs. Green Tech Skillnet also set up a specialised Offshore Wind Academy, which provides courses for existing and new workers in the industry [56].

The Offshore Wind Skills Action Plan, was launched in October 2024 with suggested goals and tasks and an advisory group to oversee implementation [57]. The plan outlines how to attract experienced staff, promote long-term workforce growth, and adapt skills to match new needs.

International partnerships are being well-used in the Irish market. Key initiatives include the T-SHORE project, a partnership between organisations from 5 EU countries [58]. The plan is to launch regional Centres of Vocational Excellence, and centres for research excellence. A national OW cluster is being explored, potentially acting as a central hub to connect training, research, and career opportunities. Ireland is making good use of available EU funding to help finance these.

Raising awareness of OW careers, starting in schools, to build a long-term talent pipeline will serve as a long-term investment in the workforce. While many skills are transferable from other industries, transitioning workers may leave gaps in those industries.

6.4.4 Ports, vessels & infrastructure for OW

The National Ports Policy, which has been in place since 2013 [59], is due an update soon [60]. A consultation took place last year, but progress has been slow due to environmental assessments, delaying the next consultation round until at least Q2 2025. The policy generally outlines a plan to allow Irish ports to exist in a competitive and effective market, including consideration of OW development.

While Ireland has several ports with potential or plans to support OW development (including Rosslare, Port of Cork, Shannon Foynes, Port of Waterford, Bremore etc.), a national ports study completed by GDG for WEI in 2022 [61] found that only Belfast Port is currently capable of supporting OW construction and marshalling. Another study outlined what can be done to make Irish ports more suitable for supporting the industry [62]. Investment is now beginning to flow into ports. The European Investment Bank is working with ports on funding models, and a pathfinder floating demo project is being considered as part of the Offshore Renewable Energy Roadmap, expected in Q2 2025.

Ireland does not currently build OW vessels, though domestic vessels support survey work, and act as crew transfer vessels, and support O&M activities.

Grid capacity is a major concern, with ORESS 1 developers required to secure MACs and grid connection agreements while also funding their own grid upgrades. EirGrid will develop infrastructure to support the 900 MW Tonn Nua project off the south coast as part of the Powering Up Offshore South Coast plan [63], developed based on the SC-DMAP, but beyond this, grid availability is extremely limited.

Future solutions to the grid issues may include alternative routes to market, such as hydrogen production, private wires, and international interconnection. Ireland has a memorandum of understanding with the UK on future interconnectors and ongoing discussions with France, Spain, and Germany about co-developing electricity and hydrogen infrastructure

6.4.5 Future steps

Ireland is an emerging market, where recent policy developments are enabling projects to develop. In ORESS 1 projects, which are all fixed-bottom, international companies will likely do most of the work with Irish suppliers determining how they can best enter the industry – there will be many opportunities for entry.

A lot of investment is going into training the workforce for future projects. The next challenge will be to make sure these people have work to do. If there is not enough OW project work in Ireland, there can be a risk of Irish-trained personnel leaving the country to go work in another market. This needs to be carefully managed to make sure the long-term investment in the workforce can be maximally utilised.

Future Irish projects will likely involve heavy use of floating technology. This presents an option for Irish companies to gain domestic market experience which they will then be able to export to other FLOW markets, as they emerge. It is expected that pathfinder projects will help with this.

More policy changes will likely happen. Government departments are taking an iterative approach to the legislative landscape surrounding OW and will be reviewing the effectiveness of the current policies. Input from organisations like Enterprise Ireland, WEI, and the Industrial Development Authority will be considered when making updates. As in other markets, EU policy will also play a role – it is not yet clear how CBAM will affect imports for the OW industry in Ireland.

7 Conclusions

This report has shown many of the complexities associated with the offshore wind supply chain. It is a globalised network, which currently clearly relies on the manufacturing capacity of China. In many markets, there are government plans to change this situation, increase the share of locally sourced offshore wind components and become less dependent on the import of strategic resources and technologies from abroad. The European region has the second highest manufacturing capacity after China. Increasing this capacity and carving out specialised niches for domestic industries is starting to appear on many countries' industrial development plans. Alongside this, non-price decision criteria are starting to appear in seabed leasing and CfD auction rounds, especially in developed markets. These two strategic decisions aim to address the dependence on imports by increasing domestic capacity and capability.

The main tools for incentivising industrial growth in the offshore wind sector quoted in these plans are; facilitating collaborative partnerships (both international and between industry and academia), tax incentives for sustainable and renewable technologies, government-backed education programmes, simplified permitting, leasing and CfD mechanisms and strategic investment into national electricity transmission systems.

Change is unlikely to come overnight. The loss of manufacturing capacity due to offshoring is a deep-rooted issue and affects not only the OW industry, but the entire vertical supply chain and adjacent industries. To be effective, national industrial plans will require ongoing political and public support to provide investors with confidence to finance OW developments. This may prove challenging to do with a tense geopolitical situation, recently fluctuating prices of energy, and still relatively high strike prices in auctions for FLOW projects. Managing public support closely will be critical.

Many OEMs are slowly reaching the stage where they will not be pushing for bigger turbines, no matter the cost. They may instead start focusing on other factors like machine cost, implementing circular economy principles, standardisation, increasing longevity, developing re-powering strategies and so on. This pause in the development race should enable the rest of the supply chain to catch up and get involved.

While the support for OW across the explored markets is high and the predictions are optimistic, the developments and potential impacts of international policy should be closely watched – this includes the EU NZI, CBAM, and CRM Acts, but also any newly imposed tariffs between the EU, China, and the US.

7.1 Conclusions for the Irish context

For Ireland, development of the Phase 1 projects will be a key driver for the development of the industry here. While expectations for supply chain contribution from Irish suppliers is not high at this stage, particularly in relation to the major components, there are areas where the domestic supply chain can and will contribute, such as surveys, engineering, O&M, permitting and consenting etc. Longer term, floating wind provides an opportunity for the domestic content contribution to grow, and measures such as those discussed in this report are being put in place to ensure the necessary skills and infrastructure are in place to facilitate this. Ireland can benefit from being a fast follower in this regard, and look to other regions such as the UK for learnings.

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Appendix A: Guiding questionnaire for the supply chain interviews

The following questionnaire has been made available to consultation participants prior to the interview so they know what to expect and are ready to answer questions.

IEA WIND TASK 49 WP4 WORKSHOP ROUND 2: Q&A TEMPLATE

Date:

Time:

Attendees:

Country:

Round 1 of the interviews focused on marine spatial planning, geographical areas of possible future offshore wind development and national deployment targets. The results of the Round 1 interviews can be found online on the IEA website:

https://iea-wind.org/wp-content/uploads/2024/08/IEA-Wind-Task-49-WP4-Report-2-MSP-and-Market-Consultation.pdf

Round 2 focuses on domestic supply chain integration and the nation's readiness to support a growing offshore wind and floating offshore wind industry.

Part A: Background questions

Starting with a few background questions about yourself and the country you are representing:

1. What type of organisation are you representing and what is your role within the organisation?

Organisation:

A. Government authority
B. Private company engaged in the offshore wind supply chain
C. Offshore wind developer
D. Research institution
E. University/academic institution
F. Other

Your role within the organisation:

2. What has been the biggest development[9] in your national offshore wind market in the past year?

Answer:

[9] Any new government policies, large projects, changes in infrastructure, new production facilities, new plans/goals?

Part B: The current state of your country's domestic offshore wind and floating offshore wind supply chain

In this section we explore the domestic parts of the offshore wind supply chain in your country, focusing on floating offshore wind. Please describe the current state of the domestic parts of the (floating) offshore wind supply chain. This can include the following topics, but please feel free to share any interesting factors:

- What percentage (if any) of your domestic offshore wind sector's business activity is served by domestic companies?
- What parts of the project are supplied by domestic suppliers?[10] Do you know (roughly) the capacity of these suppliers?
- Have any large original equipment manufacturers set up production facilities, regional headquarters, or operations & maintenance bases in your country?
- Do developers have to submit a supply chain development statement or plan?
- Do authorities require a minimal domestic supply chain content to issue a permit/seabed lease?
- What is your domestic supply chain's strategy in terms of acquiring raw materials?[11]
- …anything else about the domestic supply chain in its current state?

Answer:

Part C: Ports, vessels, and infrastructure

Ports and vessel capacities are often an issue when growing the offshore wind market and are subjects of much discussion around O&M methods for floating wind developments. In this section, please tell us how ready your country is for future offshore wind growth in this aspect. Your answer can also include commentary on the current state of the transmission network. Your answer can be structured around the following topics:

- Are there enough specialist vessels to support offshore wind growth in your market?[12] Are these owned and operated domestically?
- Are there any new vessels for offshore wind work being built in your country?
- Are your domestic ports ready to support of offshore wind projects?[13] What about floating wind projects? How many such ports are there? Are they deep enough for floating wind projects?
- How are the local ports being developed? Which industry is shaping this development?
- Is the transmission grid in your country ready for the future growth of the offshore wind industry[14]?
- …anything else related to ports, vessels, or infrastructure?

Answer:

[10] Engineering services, pre-construction surveys, turbine manufacturing, blade manufacturing, foundation design and construction, floater manufacturing and design, mooring system design and manufacturing, cable manufacturing, O&M services…

[11] This can include use of circular economy principles, recycling, own raw material mining…

[12] This includes jack-ups, heavy lift vessels (HLV), crew transfer vessels (CTV), cable laying vessels (CLV), tugs for towing floating turbines, and others.

[13] This can include fabrication, construction, installation, operation & maintenance, quay-side maintenance and commissioning for floating projects, and decommissioning activities.

[14] Are there any planned updates? Are alternative power offtake methods considered, e.g.: green hydrogen?

Part D: Skills, education and networking

In this section, we'd like to discuss the approach your country is taking to developing local skills in the offshore industry. Please describe how skills are being developed, you can follow the topics below:

- What schools / colleges / universities offer specialist courses and vocational training for future professionals in the offshore wind sector? What kind of course are these?
- Are there industries from which workers can easily transit into the offshore wind industry?
- Is your country hosting a conference / trade show about offshore wind this year or is it planning to do so soon?
- Is there a research centre/organisation/industrial cluster etc. focusing on offshore renewables in your country?
- Are there plans to develop the skills of future industry workers?[15] Think about roughly the next decade.
- …anything else?

Answer:

Part E: Expanding your country's offshore wind domestic supply chain in the future

Offshore wind is a strategic resource but also offers new economic activities and potential for employment and growth in a sustainable way. Please describe what steps are being taken by your country's government to help offshore wind grow.

- Do you think the involvement of domestic industry in the offshore wind sector is going to grow in the future? Will floating wind technology help it grow? In which part of the supply chain[16] is there potential for growth?
- What steps (if any) is the government taking to boost the involvement of the local supply chain in the offshore wind industry?[17]
- What steps, in your opinion, should the government be taking?
- How is the government planning to attract large OEMs to set up business centres or manufacturing plants?
- …is there anything else being done to help the sector grow?

Answer:

[15] For example, will the government be setting up training centres/research organisations/supporting conferences or is it leaving it up to the industry?

[16] Engineering services, pre-construction surveys, turbine manufacturing, blade manufacturing, foundation design and construction, floater manufacturing and design, mooring system design and manufacturing, cable manufacturing, O&M services…

[17] If relevant, include examples from your country from other industries as well. Is the government offering any level of subsidy?