Wind Energy Ireland Position Paper
Port Requirements for Floating Offshore Wind in Ireland

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Executive Summary

Ireland's *Future Framework for Offshore Renewable Energy* sets out plans for Ireland to deliver 20GW of offshore wind by 2040 and at least 37GW by 2050. This includes both fixed bottom and floating wind, with a significant volume of floating wind required to meet both targets. Delivering on these ambitions will require coordinated action across the entire offshore wind supply chain — with port infrastructure forming one of the most **urgent priorities**. Port infrastructure is critical for the practical delivery, ongoing maintenance, and decommissioning of offshore wind and is widely recognised as an area requiring investment in Ireland. Ports infrastructure needs to be **accelerated** and supported to secure the necessary licences and move through the planning system as quickly as possible, given the long development lead times for ports, to enable them to begin construction and expand in time to support project delivery.

Serving as the link between marine and landside activities, ports often become focal points for supply chain activity and development. Unlike other aspects of the supply chain, port development requires significant planning and longer lead times and consequently must be facilitated **now** to ensure the required infrastructure is in place to support the deployment and lifecycle of floating wind (through to final decommissioning) in Ireland. In this context, this document has been prepared in response to a series of queries specific to port requirements for floating offshore wind, raised by the Department of Transport.

The queries raised are noted below for reference:

1. To what extent will the requirements for port infrastructure differ based on the type of floating turbine design? For instance, if a port builds infrastructure that is adapted to a spar platform, will it be able to meet the specifications to handle the semi-submersible or tension-leg platform base designs?

2. Follow on question: For areas that are designated for wet storage, will these be tailored to a specific base design i.e. in terms of moorings etc?

3. It is understood that floating wind farms will require multiple ports for marshalling and assembly. However, which specific elements of construction are expected to take place in a single port? For instance, how many ports will be required for the foundations, array and export cables, tower sections, blades, nacelles and mooring chains?

4. What is the minimum requirement in terms of port infrastructure to reach operational viability for the construction of a floating wind farm?

5. What are the minimum port requirements for Operations and Maintenance of floating wind farms?

6. Which ports outside of Ireland do developers deem feasible to construct Irish floating wind farms from? From how far will developers tow to Ireland?

7. Do industry players have views of what roles specific Irish ports will play in floating wind farm development? For example, what specific role do developers see Shannon Foynes playing as opposed to ESB Moneypoint?

8. Port Esbjerg is being used to construct jacket foundations for an offshore wind farm off the coast of Virginia, US. What features does Port Esbjerg have/ American ports lack that required Esbjerg to partake in the process?

To best address the queries posed by the Department of Transport (DoT), the Wind Energy Ireland Floating Offshore Wind Committee initiated a Working Group (the FLOW Port Requirements Working Group), to respond to the queries. The Working Group has included members across industry, including developers actively developing floating projects, consultants with experience in the sector and the wider supply chain.

The responses in this document have been structured to address each question individually, with the aim of enhancing the Department's understanding of the subject and highlighting key concerns from an industry perspective.

Summary & Conclusions

The following summarises the key conclusions outlined in each of the responses:

Query	Theme	Summary & Conclusions
1	Influence of substructure type on port requirements	• Port requirements vary by platform design, mainly due to substructure draft and under-keel clearance. Spar platforms are unlikely to be feasible for Irish waters due to deep draft needs in proximity to suitable port infrastructure. Semi-submersibles and TLPs are more suitable for Irish conditions. • Ports seeking to develop infrastructure should consider the likely platforms being deployed in Irish waters. • Other port infrastructure requirements such as quay length, load-bearing capacity, laydown area, and craneage are relatively consistent across platform types, but channel access requirements, quay water depths and wet storage requirements may vary. • Depth limitations may, in some cases, be mitigated through dredging or optimised operational strategies; however, these solutions could be constrained by cost, environmental impact, or site-specific conditions. • The ability to deliver the projected 30GW (including up to 2,000 turbines by 2050) of floating offshore wind will depend heavily on infrastructure readiness,

		with an average of one turbine installation every 1.5 days during the installation window (2035–2050). This places significant pressure on port capacity and suitability.
2	Nature of wet storage	• Wet storage of floating substructures, both pre and post turbine integration, is expected to become a necessary element of *commercial* scale floating wind projects, offering flexibility in logistics and project sequencing. Storage of foundations for fixed-bottom turbines is also required (on land), but the specific challenge for floating substructures is their significant size (and therefore the significant area of storage required) along with the potential duration of storage required (months to years). • Post-integration units require greater shelter, larger footprints, and more complex mooring systems due to their size, weight, and sensitivity to environmental conditions. Safety, maintenance access, and visual impact are key concerns. • Wet storage may not always be required depending on factors such as project scale, weather windows for installation, substructure manufacturing location and loadout, available port infrastructure, adjacent land for staging, and access to sheltered waters. However, for commercial-scale deployment in Irish waters, this is expected to be a key requirement. • Wet storage facilities can be designed to support multiple floating platform types, provided they share similar draft and mooring requirements. • Two wet storage models: generic areas with no moorings or pre-laid moorings tailored to likely platform types. Pre-laid moorings require early investment, close coordination with developers, and regulatory clarity. • Ports may be best positioned to manage wet storage consenting, particularly where it occurs within port statutory limits. However, this places financial and risk burdens on ports unless there is cost-sharing or revenue certainty. • Collaboration among developers (as seen in Scotland's NEEOG group) could help aggregate demand and justify shared wet storage infrastructure.
3	Activity expected at ports and number of ports required	• Floating wind deployment at commercial scale in Ireland will require a multi-location port strategy due to the scale and complexity of components, physical constraints at individual ports, and geographic spread of DMAPs. • A distributed port approach allows for reduced tow distances, parallel deployment on different coasts, and regional economic benefits. • However, a multi-location strategy introduces increased logistical complexity and coordination risk for transport and installation campaigns. • To mitigate the logistical risk, at least one anchor port/terminal on both the west and south coasts should be capable of supporting both substructure manufacture/assembly and turbine integration, or alternatively, a single port on each coast that can accommodate both functions if feasible. • Co-locating all construction activities at a single port would demand extensive quay space, heavy-lift capability, and a large, high-strength landbank. Although there may be opportunities to support both where sufficient water depths and space is available. • Failing to support domestic substructure manufacturing or assembly would represent a significant missed opportunity to develop the Irish supply chain. Central planning of DMAPs should consider proximity to ports and potential scheduling overlaps with fixed-bottom projects to avoid port congestion and bottlenecks.
4	Minimum port requirements for construction	• Port requirements for floating offshore wind are highly project-specific, influenced by delivery strategy, foundation type, turbine size, and site location. • The most critical factor is throughput — the infrastructure must support the rate of component handling needed to meet the construction schedule. • Minimum viable infrastructure must enable safe and efficient assembly, integration, and tow-out of large floating wind components.

		• A floating wind delivery strategy usually involves multiple port types, each with distinct roles and infrastructure requirements: o Assembly ports – heavy-lift capacity, large laydown areas, launch infrastructure. o Integration ports – deepwater berths, high-capacity cranes or alternatives, unobstructed access. o Support marshalling ports – sufficient quay length and landside area to support marshalling of moorings, anchors, and other ancillaries. In practice, no single port terminal is likely to meet all project requirements. Developers often adopt a multi-port strategy (common for fixed-bottom) assigning different roles to separate locations. • In addition to throughput and logistical considerations, several local factors further influence port requirements and suitability, including, tow to site distance, local environmental and access constraints and transports and handling requirements. • Demonstration-scale projects may utilise existing infrastructure with adaptations, while commercial-scale projects (>500 MW/year) will likely require purpose-built or significantly upgraded facilities with multiple berths, high throughput, and robust logistics planning.
5	Minimum port requirements for O&M	• There are two main repair and maintenance strategies for floating wind: routine maintenance, typically conducted offshore, and major component replacement (MCR), which may involve more complex interventions. • Routine maintenance ports must have sufficient quay length, water depth, and landside infrastructure to support standard O&M operations using SOVs or CTVs. These requirements are considerably less demanding than those for turbine integration or construction-phase activities. • Service Operation Vessels (SOVs) are expected to play a central role in routine maintenance of floating wind farms, with port requirements broadly similar to those for fixed-bottom offshore wind O&M. • MCR can be carried out either in-situ or via tow-to-port. In-situ MCR is becoming more viable and may become standard practice by the time Ireland deploys commercial-scale floating wind. However, adoption timelines will depend on technology readiness, safety requirements, and weather conditions. • Tow-to-port remains an important fallback strategy when in-situ repairs are not feasible due to safety, equipment, or environmental constraints. Ports supporting tow-to-port MCR require infrastructure similar to turbine integration ports, including heavy-lift capability. • Ports involved in the initial deployment of floating wind may also need to support future decommissioning and repowering, reinforcing the long-term importance of port investment.
6	Feasibility of non-Irish ports and maximum tow distances	• Recent research conducted within the SIMREI project suggests towing distances of up to 300 km (approximately 161nm) are technically feasible though towage and weather complexities will add significantly to the cost of such options. Building Irish FLOW ports is crucial to building competitive FLOW projects. • Ports in South Wales, Southwest England, or France are potentially viable, although at the limit of what is deemed feasible for South Coast Irish projects. Conversely, Irish ports may also serve as attractive options for projects located in adjacent British or French waters, particularly where closer alternatives are constrained or unavailable. • Whilst the max. feasible distance may be in the region of 300km, for commercial-scale developments, minimising tow distance is essential to ensure efficiency, safety, and economic viability.

		• Foreign ports are likely not feasible for West Coast projects due to longer distances and greater exposure. Irish ports must emerge to serve these projects. • The absence of early visibility on floating project timelines presents a barrier to investment. A clearly defined pipeline of projects, alongside an updated National Ports Policy that removes the prohibition on State funding, is essential to unlock investment, reduce deployment risks, and prevent delays to Ireland's offshore wind ambitions. • Floating wind infrastructure requires substantial upfront investment in the region of hundreds of millions. Due to development timescales for port infrastructure, this is required prior to an individual project's FID, meaning it is not practicable to fund this via specific FLOW projects. To make this viable, ports must be able to diversify revenue streams and avoid reliance on FLOW projects alone. • A multi-modal approach, where ports are designed to accommodate other sectors (e.g. RoRo, bulk, containers, cruise, defence), can significantly reduce investment risk and improve utilisation between offshore wind campaigns. • While a multi-modal approach can reduce investment risk and enhance port utilisation between offshore wind campaigns, it may also introduce operational complexity. Floating wind projects often require dedicated, high-specification infrastructure and predictable access windows. Careful planning is therefore essential to balance the needs of offshore wind with those of other port users, particularly in high-demand or space-constrained ports • State support for early-stage investment, as seen in Scotland through the FLOWMIS scheme and investment from state investment vehicles is a key enabler of port infrastructure development and Ireland is encouraged to adopt a similar approach.
7	Industry view on roles of specific ports	• The Shannon Estuary, comprising ESB Moneypoint, existing SFPC facilities, and the proposed development at Foynes Island, is recognised as one of the few Irish locations with natural characteristics (deep water, wide channels, Atlantic access) suitable for commercial-scale floating wind. Collectively, these sites could accommodate multiple aspects of deployment within a single geographical region, though their final specifications remain subject to consent, investment decisions and project needs. • Bantry Bay, while not yet equipped with the necessary infrastructure, is the focus of a significant private development proposal by the Leahill Port Company, which is advancing plans for a 150-acre ORE port on the bay's north side. The bay's strategic location means it could serve both southern and western floating projects, and there are opportunities for a joint role with the Port of Cork or Cork Dockyard e.g., substructure manufacture in one and turbine integration or wet storage in the other. • The Port of Cork may be suitable for demonstration-scale floating wind projects, depending on scale and location. With further expansion and investment, it may be able to accommodate projects of commercial scale, however this would be subject to feasibility assessment, project specifics, and the port capacity to deliver FLOW alongside fixed offshore wind projects. While demonstration projects can play an important role in testing and de-risking technology, it is essential that they do not delay Ireland's readiness for full commercial-scale deployment. • Other ports, such as Galway, Killybegs, Rosslare and Waterford could play supporting roles — for example, in marshalling of ancillary components, operations and maintenance (O&M), especially if located near project sites. • Northern Ireland ports also have potential roles in supporting floating offshore wind. Belfast Harbour already hosts a dedicated offshore wind terminal and is advancing plans for additional capacity, while ports such as Warrenpoint, Larne, and Foyle could contribute to project delivery depending on demand and the geographic spread of DMAPs.

		• Realising Ireland's floating offshore wind (FLOW) potential will require timely government intervention and support for ports with development plans - particularly through a revised National Ports Policy that prioritises offshore wind infrastructure and facilitates access to State funding for ORE ports from concept through to construction. • A clear policy relating to the timeline for the delivery of the National DMAP is essential, along with timelines for the running of auctions for fixed and floating project development areas within the DMAP.
8	Port of Esbjerg	• Port Esbjerg was likely selected for offshore wind construction due to its advanced infrastructure and supply chain, highlighting key gaps in U.S. port readiness and potential impacts of regulatory constraints like the Jones Act. • Esbjerg's involvement in a U.S. project illustrates how leading port infrastructure enables global participation. • Jacket fabrication was likely chosen based on capability, cost, and availability, not proximity. • Highlights Ireland's export potential if it develops high-capacity fabrication and port infrastructure. • Without similar investment, Ireland risks being bypassed for major international supply chain opportunities.

Follow-up Actions

Should the Department have any queries on the content of the response document, the Working Group is open to further engagement and discussion as required.

Introduction

Wind Energy Ireland (WEI) would like to thank the Department of Transport for the opportunity to respond to their questions on the port requirements for floating offshore wind (FLOW) in Ireland.

WEI is Ireland's largest renewable energy organisation with over 200 members who have come together to plan, build, operate and support the development of Ireland's onshore and offshore wind generation. We work to promote wind energy as an essential, social, economic, and environmentally friendly part of the country's low-carbon energy future. As a leader in Ireland's fight against climate change, wind energy creates and maintains jobs, invests in communities, and reduces CO_2 emissions and contributes to our security of energy supply.

Context

Ireland's *Future Framework for Offshore Renewable Energy* outlines plans to deliver 20 GW of offshore wind capacity by 2040 (equivalent to 1,200–2,000 turbines, depending on turbine size, 15–25 MW) and at least 37 GW by 2050. This will require a mix of fixed-bottom and floating wind, with floating wind playing a critical role in meeting both targets. In early May 2025, the Minister for Climate, Environment and Energy, Darragh O'Brien, announced the

commencement of work on a National Offshore Renewable Energy Designated Maritime Area Plan (DMAP). The single National DMAP is intended to accelerate the site designation process for offshore renewable energy development. WEI welcomes this plan which is expected to be completed by the end of 2027 and represents a crucial first step in enabling the development of floating offshore wind in Ireland.

Due to the limited global deployment of floating wind at commercial scale, port requirements for FLOW are less well defined than those for fixed-bottom wind. However, it is widely understood that the infrastructure needs differ significantly because of the floating nature of the substructures.

This document has been prepared in response to queries posed by the Department of Transport concerning port infrastructure for FLOW. To address these queries, the Wind Energy Ireland Floating Offshore Wind Committee established the FLOW Port Requirements Working Group. This document summarises the group's responses.

Port Infrastructure for Floating Offshore Wind

Port infrastructure is critical to the delivery, ongoing maintenance, and decommissioning of offshore wind and is widely recognised as an area requiring investment in Ireland. The National Planning Framework (April 2025) highlights this in National Policy Objective 51:

"Support the sustainable delivery of port and harbour infrastructure to facilitate the development, maintenance and operation of offshore renewable electricity generating developments."

Similarly, National Policy Objective 55 commits to:

"Enabling port infrastructure for the marshalling and assembly of wind turbine components and for the operation and maintenance of offshore renewable energy projects."

Ports and suitable port infrastructure are **essential** for the success of offshore wind projects. As the interface between marine and land-based operations, ports become focal points for supply chain activity and investment. Unlike many other parts of the supply chain, port development requires significant planning and development lead times. As such, action is needed **now** to ensure that the necessary infrastructure is in place to support the entire lifecycle of floating wind projects, from deployment to decommissioning. The *Wind Energy Ireland* ***National Ports Study*** commissioned in 2022 sought to understand the extent of existing port infrastructure in Ireland. The study highlighted that currently there is limited port infrastructure to support fixed-bottom construction, and with no existing infrastructure suitable to support the deployment of floating wind. Considering the current infrastructure

deficit to serve the Offshore Renewable Energy (ORE) sector, the upcoming revision to Ireland's National Ports Policy must be cognisant of the criticality of suitable port infrastructure, with ability to deploy floating wind at scale the backbone of achieving 37GW by 2050. Port infrastructure must be fast-tracked through licensing and planning to begin construction in time to support project delivery, given long development lead times.

A European Challenge

Ireland is not alone in facing a port infrastructure deficit, as ports across Europe are expected to become a major bottleneck for offshore wind deployment by 2029. The Wind Energy in Europe Report 2024 highlights the following:

"The most acute hurdle is likely to be port capacity. As things stand, we believe there is sufficient port capacity in Europe to service build-out up to 2028. But by 2029 we expect the planned rate of installations to outstrip port capacity, even when new expansions are taken into account. We therefore expect offshore project delays to become a major bottleneck across Europe from 2029. Port capacity is also our main priority for offshore wind build-out, as it has the longest development lead times within the value chain. Expanding ports typically takes 6–10 years from permitting to commissioning. This makes it essential for investments to be made as soon as possible to minimise potential delays."

Due to the long lead times involved in port development, including design and consenting, ports must begin work **immediately** to ensure readiness for floating wind deployment. While several development plans are progressing, the success of these proposals will depend heavily on the **efficiency of planning and consenting processes**. In many cases, the consenting timeline will represent the critical path for redevelopment. The enactment of the Planning and Development Act 2024 is seen as a positive step and it is hoped the legislation will improve consistency, efficiency, and transparency in the planning regime, and support the accelerated rollout of renewable energy and associated projects across Ireland. Similarly, the Government's approval of the revised *National Planning Framework,* particularly National Policy Objectives 51 and 55, is a timely and positive development.

Planning and Consenting Considerations

In the context of consenting more generally, developers will likely pursue a multi-port approach to serve projects. It would be proposed that a degree of **flexibility** is allowed for within the consents granted to port locations as the exact nature of the staging activity may vary. Similarly, as the ports may serve other sectors when not in use for ORE construction staging, consents granted to ports should be afforded a degree of flexibility to ensure consenting conditions do not preclude the use of the facility for **differing purposes**. Additionally, given the significant investment required for ports aiming to serve the sector, a phased approach to development may be necessary. In such cases, it is crucial that planning

permissions account for the maximum development envelope and allow for some flexibility in validity periods. This ensures that essential infrastructure expansion can proceed without requiring additional planning submissions, preventing delays in critical upscaling. Coordination will be critical between marine spatial and planning policy. The upcoming National DMAP Roadmap must be cognisant of the available infrastructure and planned developments to support floating wind, additionally the update to the National Ports Policy must align with wider ORE policy and ensure ports with development plans can be adequately supported.

The Investment Challenge

Meeting Ireland's floating offshore wind ambitions will require **urgent and large-scale investment** in port infrastructure. However, under the current National Ports Policy, commercial ports are **prohibited** from accessing State funding, creating a fundamental barrier to the development of critical infrastructure. The upcoming review of the Ports Policy presents a vital opportunity to reassess this position and to explore how Irish ports can be more effectively supported. By enabling targeted public investment and providing visibility on a **clear pipeline of projects**, Ireland can unlock private capital, accelerate infrastructure delivery, and position its ports at the centre of a thriving offshore wind supply chain.

DoT Questions

1. To what extent will the requirements for port infrastructure differ based on the type of floating turbine design? For instance, if a port builds infrastructure that is adapted to a spar platform, will it be able to meet the specifications to handle the semi-submersible or tension-leg platform base designs?

In considering the question it's useful to consider the role of the port. The activities that the port is required to host will ultimately dictate the required specification for port infrastructure. The activities vary for instance if considering substructure manufacture (or assembly) vs solely turbine integration, and consequently the port specifications will differ. Further details on the range of port activities and touchpoints relevant to floating wind deployment are provided in the Appendices to Questions 4 and 5.

Infrastructure requirements also vary depending on the type of floating platform, due to differences in draft, dimensions, and deployment methods. Although the question references spar platforms, these are *generally* considered less suitable for Irish waters given their substantial draft and the need for deep, sheltered areas for ballasting and upending. Spar platforms are particularly suited to regions with deep fjords and an established offshore oil and gas industry, such as Norway and the Gulf of Mexico. In contrast, the Irish market is currently focused on semi-submersible and tension-leg platform (TLP) technologies, which are better aligned with the characteristics of Irish ports and seabed conditions.

As mentioned, substructure draft and associated under-keel clearance are key differentiators between platform types, directly influencing required channel depths, wet storage depths, and quayside water depth/draft requirements. In contrast, factors such as quayside length, load capacity, channel width, landside area, and craneage tend to be relatively consistent across platform types, whether TLPs or semi-submersibles. However, it's worth noting that TLPs are typically smaller and can be integrated either portside or offshore, which influences vessel type and therefore berthing requirements. Deployment rates are the primary driver for quay length and the extent of both wet and dry storage requirements. Meanwhile, craneage and channel width requirements remain broadly consistent regardless of platform type.

Due to the variation in dimensions and draft within platform types and sub-types, early engagement between ports, developers, and supply chain stakeholders is critical to ensure infrastructure specifications are appropriate and future proofed. For ports targeting substructure fabrication, landside space and launch methods will be particularly sensitive to platform size and geometry. **Proactive and ongoing coordination with developers will be essential to ensure infrastructure is aligned with project needs**.

Table 1 presents indicative draft ranges for different floating hull types (post-turbine integration) at the 15MW scale. These drafts exclude under-keel clearance, which is required in addition to the noted draft. As per DNV-ST-N001 and Marine Warranty Surveyor (MWS) guidance, the under-keel clearance should be the greater of 1m or 10% of the draft, up to 3m. In benign and sheltered areas, this requirement may be reduced subject to MWS approval. Drafts are expected to increase for larger turbines above 15MW, depending on platform design.

Table 1 High Level Draft for 15MW Supporting Hull Types

FLOW Substructure Type	Critical Draft Requirement*	Material
Barge	6m-8m	Steel
Barge	10m -12m	Concrete
Semi Sub	10m -16m	Steel
Semi Sub	12m -18m	Concrete
Spar	70m	Steel
Spar	80m	Concrete

**Quayside water depth requirement with turbine integrated, but excluding underkeel clearance*

While water depth is an important factor, it should not be seen as a fixed constraint. Platform designers can optimise draft to a degree within technical limits. Operational strategies such as tide-dependent movements, the use of temporary buoyancy aids, utilising semi-submersible vessels or grounding foundations for integration can also mitigate depth limitations to some extent in certain circumstances. Dredging of quayside pockets and access channels may provide a longer-term solution and where required should be considered early due to licensing lead times. However, dredging may not always be viable due to local geotechnical constraints, the potential presence of hard rock or significant excavation volumes affecting cost, and the risk of adverse effects on port hydrodynamics.

In the context of the required characteristics to support floating deployment, only a limited number of locations offer the required combination of deep, sheltered waters and proximity to suitable port infrastructure. The 2022 Wind Energy Ireland National Ports Study highlighted a lack of viable ports to support floating wind deployment, a situation that remains unchanged as of 2025.

In the context of Ireland ambitions and commitment to deploy 37GW of offshore wind, and Programme for Government's 30GW of floating wind, this will require the deployment of 1200-2000 turbines (depending upon turbine size assumed, number assume 15MW to 25MW) in the 25-year period up to 2050 with sufficient port capability to support this. Assuming the earliest feasible delivery year is 2035, this equates to an average installation rate of approximately 80-133 units per year through to 2050. With an assumed installation season spanning seven months each year, this translates to nearly one unit being installed every 1.5 days between April and October for 15 consecutive years. It is important to note that these figures do not account for any gradual ramp-up period required to build supply chain and installation capability.

Given the intensity and cadence of deployment, port infrastructure will be a critical enabler, not only for assembly and integration, but also for wet storage to support pre-deployment staging and post-installation maintenance. In particular, wet storage may be required at relatively short notice to respond to installation delays or scheduling constraints, reinforcing the need for flexible and well-positioned facilities. The strategic proximity and layout of ports will therefore have a material impact on the efficiency and resilience of Ireland's floating wind deployment ambitions. Consequently, the design of floating wind deployment for Ireland must be cognisant of the criticality of ports to floating wind deployment and understand the sensitivity of port proximity. Enabling infrastructure must be a critical driver in the holistic design of a DMAP roadmap for floating wind.

2. Follow on question: For areas that are designated for wet storage, will these be tailored to a specific base design i.e. in terms of moorings etc?

Summary

Designated wet storage areas will **not** typically be tailored to a single floating base design but rather must be capable of **accommodating a variety of platform types**, (excluding spars in an Irish context), due to the expected diversity of floating technologies. Mooring systems will need to be designed based on local site conditions (e.g. water depth, seabed type, exposure) and the likely range of substructure types. Two approaches are under consideration: flexible designated zones with no pre-laid moorings, and zones with pre-installed moorings designed to suit a broad envelope of expected platforms. The preferred approach will depend on the local context, project pipeline certainty, and collaboration between ports, developers, and the supply chain. Further operational, commercial and consenting considerations are discussed below.

Wet Storage Definition

Before addressing the requirements for accommodating wet storage, it is helpful to clarify the term. In the context of floating wind installation, "wet storage" often refers to the temporary offshore storage of pre-installed moorings within the wind farm area prior to final hook-up. However, in this instance, it is assumed that the term relates to the temporary storage of floating substructures, both pre and post turbine integration. These two stages of wet storage are distinct operations, with post-integration storage being significantly more challenging to accommodate due to factors such as safety, space, and mooring complexity.

It is worth noting that wet storage may not always be required for deployment, depending on the scale of the project, the availability of suitable weather windows for installation, existing port infrastructure, adjacent land for staging, and access to sheltered waters. Nevertheless, given the nature of the question and the anticipated requirement for commercial scale deployment and maintenance, this response focuses specifically on wet storage and mooring considerations.

Additionally, the need for component storage during construction is **not exclusive to floating wind**. Storage of foundations for fixed-bottom turbines is also required (on land). However, floating substructures present a more complex challenge due to their significant size, the large water area required for secure storage, and the potential duration of storage, which may range from months to years.

Wet Storage – Pre-Turbine Integration: For commercial-scale projects, pre-integration wet storage of floating substructures is increasingly being viewed as a necessary operational

feature, particularly when onshore assembly or delivery schedules create gaps before turbine integration. This form of wet storage provides flexibility in sequencing fabrication, towing, and integration operations, helping to reduce bottlenecks at the quayside. As projects scale up, developers will likely place greater emphasis on identifying ports that can manage high volumes of wet-stored substructures while ensuring sufficient manoeuvring space and environmental protection.

Wet Storage – Post-Turbine Integration: Although generally seen as more complex, post-integration wet storage, where fully assembled turbine units are mooring prior to offshore deployment, is likely to become an unavoidable element of large-scale commercial projects. Constraints related to offshore weather windows, installation vessel availability, and turbine delivery schedules can all necessitate temporary storage of completed units. This form of storage presents greater operational and safety challenges, particularly in terms of mooring requirements, water depth, and proximity to heavily trafficked port areas. Nonetheless, its role is expected to grow, especially in cases where just-in-time tow-out is unfeasible.

Distinct Requirements and Risks of Wet Storage Post-Turbine Integration:

As noted, wet storage of the fully integrated unit is distinct and more challenging for several reasons, including the following:

- When stored with the turbine integrated units need regular maintenance and would likely require a diesel generator installed on board to facilitate maintenance and periodic rotation of blades as required.
- The draft and area requirements for integrated substructures in wet storage are greater than for substructures alone because the additional weight of the turbine increases the overall displacement and draft, while also expanding the spatial footprint needed for safe mooring, maneuvering, and maintenance access; furthermore, if catenary mooring is used, the required mooring radius increases with water depth, further enlarging the area required.
- Fully integrated units are also more sensitive to wave and wind conditions due to their increased windage and structural exposure. They require more sheltered conditions than bare substructures to minimise motion, reduce risk of damage, and preserve turbine integrity during storage periods.
- Given the different hydrodynamic behaviour of fully integrated floating turbines compared to substructures alone, particularly due to their higher centre of gravity and increased peak loading, mooring requirements will differ significantly. Depending on port layout and operational needs, it may be necessary to designate two or more separate wet storage zones to safely accommodate both substructure only and fully integrated units.

- Hook-up to moorings will be more intensive for several reasons including;
    - Increased system complexity (the presence of the turbine and all topside equipment which must be safety connected).
    - Larger and heavier structures making handling, positioning and securing the units more challenging.
    - Requirement for specialist personnel, including electrical, mechanical and controls technicians due to the topside equipment.
    - Weather sensitivity and stability issues due to the top-heavy nature of the fully integrated units, narrowing the available weather window for operations.
- Consenting is more challenging due to the increased environmental, navigational, and operational risks associated with storing fully integrated, quasi-operational units, which require greater regulatory scrutiny than bare substructures. Given their close proximity to the port, the visual impact of fully integrated wet storage units warrants careful consideration and should not be understated from a consenting point of view.
- They could be stored in sub-optimal temporary storage for prolonged periods of time (even over winter in harsh conditions) depending on weather window availability, the impact of which should not be underestimated with respect to potential damage and/or issues with warranties.

Due to the reasoning noted, wet storage pre and post turbine integration are distinct operations and require different port characteristics, including draft, available area, shelter and access.

Wet Storage – Designated Mooring Zones vs Pre-laid Moorings

In response to the question, wet storage areas (for both pre and post integration) will be capable of accommodating various technology types with spar as the exception (due to the reasons specified in Response 1), with moorings tailored to local conditions and the specific platform types being hosted. Two key approaches to anchoring have been identified in this context. The first involves designating a specific zone for wet storage, ensuring adequate area, depth, and safety clearance, but without pre-installed moorings. The second option includes a wet storage area equipped with pre-laid moorings designed to accommodate a range of platform types suited to local conditions. There is no consensus on the most suitable approach, as both options have distinct advantages and implications. They differ in terms of upfront investment, operational complexity, flexibility, and how they interface with installation logistics. The choice between them will influence how ports and project developers plan for storage, access, vessel operations, and platform compatibility.

A key consideration is determining responsibility for consenting, managing, and operating the wet storage area, particularly in cases where pre-laid moorings are provided. In the instance that pre-laid moorings and anchors are proposed, these would need to be designed within an envelope that accounts for likely variations in substructures proposed to be deployed within

that jurisdiction. There is a requirement for collaboration with developers and their supply chain, as ports cannot progress designs for moorings without sufficient understanding of the likely range of platforms and their associated mooring systems. A collaborative approach between developers for wet storage could assist in collating this type of developer/supply chain data and could help map out demand for the ports, similar instances are proposed in Scotland for example. However, this can only work where the pipeline is known and there is relative certainty of timescales and locations of projects.

In Scotland, regions like the Cromarty Firth, which have extensive experience accommodating large semi-submersible Floating Production Storage and Offloading units (FPSOs), will likely consider the use of pre-laid mooring fields, like the buoyed-off moorings employed in oil and gas operations. It should be noted that multiple ScotWind projects are collaborating within the Northeast and East Ornithology Group (NEEOG[1]). This cooperative approach will help establish a need for port-led mooring fields where there is a steady demand and multiple users.

Establishing a pre-consented area with pre-laid moorings would enable faster deployment and could create potential new revenue streams for ports. It is noted that this approach requires significant upfront investment and would only be viable if there is sufficient revenue certainty to ensure a reasonable payback period, supported by a viable pipeline of projects. If ports do not provide pre-laid moorings, the responsibility for temporary mooring design would fall to developers. In this case, ports would designate and manage anchoring zones rather than installing fixed infrastructure. However, this approach would likely be less efficient in terms of deployment and ultimately less cost-effective.

Key Requirements for Wet Storage

- Located in relative proximity to the integration port to optimise transport cycle times. And preferably in an area under the jurisdiction of a Port Authority.
- Sites should be relatively sheltered with limited sea states to prevent damage and to facilitate mooring, unmooring, and crew transfers for commissioning and/or repair work. In cases where wet storage is required post-integration, greater shelter will be needed for the reasons outlined previously.
- Potential to consider provision of pre-laid generic mooring to accommodate semi-subs, barges and TLP.
- Sufficient space to accommodate temporary mooring footprints without impacting navigation and existing port operations.

[1] In 2022, the NEEOG was established by ScotWind developers in the north east and east regions, primarily to respond to the strategic ornithological requirements set out in the Scottish Government's Sectoral Marine Plan for Offshore Wind Energy (SMP-OWE, 2020), Ornithology Roadmap (2022) and wider consenting barriers. This was to ensure timely roll-out of the large scale Scottish offshore wind pipeline through developer and stakeholder collaboration.

Wet Storage and Consenting Considerations

The Working Group's engagement with port authorities in other jurisdictions, such as Associated British Ports (ABP) and the Cromarty Firth Port Authority, on the topic of has highlighted evolving approaches to the management and consenting of wet storage. Key challenges identified include the allocation of responsibility for obtaining consents, legal uncertainties around Environmental Impact Assessments, and the need for viable commercial models that balance port risk and developer requirements. These insights offer useful comparisons for Ireland as it develops its own frameworks. Further detail is provided in *Appendix Question 2: Port Engagement and Wet Storage Consenting Models*.

3. It is understood that floating wind farms will require multiple ports for marshalling and assembly. However, which specific elements of construction are expected to take place in a single port? For instance, how many ports will be required for the foundations, array and export cables, tower sections, blades, nacelles and mooring chains?

Summary

Floating wind deployment at commercial scale in Ireland will require a multi-port strategy, with **different ports fulfilling specific roles** such as substructure manufacture/assembly, turbine integration, and the marshalling of ancillary components. As it stands at present **no single Irish port can support all elements at commercial scale**. To manage risk and improve efficiency, there should be at least one anchor port on both the west and south coasts, one to support substructure manufacture/assembly and one to support turbine integration. Or, where feasible, a single port on each coast that can accommodate both functions. This approach helps reduce the logistical complexity and risk associated with a distributed, multi-port strategy, while also supporting regional economic development.

Key Terminology

In the context of the question, it is assumed that "marshalling" refers to ports used for receiving and storing components, while "assembly" refers to ports used for assembling substructures, turbine sub-assemblies, and related integration activities (terminology used in the response is clarified below). Ports designated for substructure manufacture or assembly and turbine integration will therefore need to accommodate both marshalling and assembly functions. Additionally, smaller ports may be used exclusively for the marshalling of ancillary equipment such as chains, anchors, and mooring lines.

To ensure clarity and avoid misunderstanding, the following terms will be defined in the context of floating wind deployment:

- **Fabrication**: Producing components to be used in the manufacturing process.
- **Manufacture**: Using fabricated components to produce substructures.
- **Assembly**: Assembling prefabricated components to produce substructures.
- **Integration**: Installation of the turbine onto the substructure, typically occurring quayside.

Furthermore, an overview of the key port touch points which drive port requirements has been included in Appendix Question 3: Key Port Touch Points and Activity Overview for further detail and reference.

Multi-Port Solution

A multi-port solution is likely to be necessary for floating offshore wind (FLOW) deployment in Ireland due to several interrelated factors:

- The anticipated geographic spread of future DMAPs (Designated Maritime Area Plans)
- Physical limitations at individual ports (e.g. quayside length, laydown area, water depth)
- The scale and complexity of floating wind infrastructure, which involves multiple large components such as substructures, turbines, moorings, and anchors.

A key point to emphasise is that all offshore wind farms, whether using fixed or floating foundations, typically require multiple ports to support their delivery, and this is not a requirement unique to floating offshore wind (FLOW).

It is also important to note that a single port may comprise multiple terminals, each with different capabilities, ownership structures, or development plans. References to a "multi-port solution" may therefore include distinct terminals within one port/port jurisdictional area as well as coordination between geographically separate ports.

Currently, no single Irish port has the capacity to handle all elements of FLOW delivery at commercial scale. A distributed port approach in this context can enhance feasibility by reducing tow distances and enabling parallel deployment on opposite coasts. In addition to increasing resilience by avoiding single points of failure and spreading economic benefits across regions. In this context it is assumed that deployment would be supported by various ports specialising in manufacture/assembly, turbine integration or supporting the marshalling of ancillaries. With some ports potentially providing both manufacture/assembly and turbine integration.

However, in this context a multi-port strategy may introduce additional complexity and risk in terms of transport and installation (T&I) logistics. With components coming from multiple locations for dovetailed campaigns, coordination demands increase, potentially raising transport costs and creating risks of bottlenecks and knock-on delays. To manage these risks effectively, it would be preferable to have at least one major port on each coast (e.g., west and south) capable of supporting manufacturing or assembly and one for turbine integration, to enable co-location of key deployment activities. A single site could potentially accommodate both substructure assembly and turbine integration, although this would ultimately depend on the availability of adequate landside space, quay length, and suitable marine conditions for hull launching and manoeuvring.

Several Irish ports, including those in Northern Ireland, have strong potential to support floating wind, benefiting from deep waters, sheltered conditions, and in some cases existing high specification infrastructure. Development plans are advancing in multiple locations, but further investment will be essential for facilities to meet industry needs. Comparable facilities

are also being planned on the south coast of the UK, which could support projects off Ireland's south coast. **Failing to enable substructure manufacture or assembly in Ireland would represent a major missed opportunity to build and strengthen the domestic supply chain.**

Regarding ancillary components, it is anticipated that regional ports will be able to support the marshalling of mooring equipment and other required elements without the need for significant upgrades. These functions are expected to be served by the regional ports closest to the floating wind projects. Commercial-scale floating wind projects will require a high volume of anchors, placing significant demands on landside storage capacity. While a single port may accommodate this in some cases, larger projects are likely to require a multi-port strategy for anchor handling and ancillary components to mitigate logistical bottlenecks. Ports are not typically required for cable-related activities, as subsea cables are generally manufactured in continuous lengths, loaded directly onto installation vessels, and transported straight to site. This minimises handling, reducing the risk of damage and maintaining warranty conditions. Port involvement may only be necessary if cables are delivered in sections or if installation is staged over a prolonged period, requiring temporary storage. Further additional detail regarding the anticipated port activities in an Irish context is included in Appendix Question 3: Key Port Touch Points and Activity Overview.

Central Planning

The number and role of ports required for floating wind in Ireland will be heavily influenced by the identification of sites through the development of the National DMAP (Designated Maritime Area Plan). If the National DMAP establishes a sequential timeline for releasing sites around the coast, overlapping construction phases for floating projects are likely, necessitating more than one port with floating capabilities. The DMAP process should therefore take into account the availability of port infrastructure, ensuring that **ports in close proximity to designated areas are adequately supported through targeted development.**

Furthermore, depending on the scheduling set by central government, floating wind projects may compete with fixed-bottom projects for limited port capacity. While the infrastructure requirements for fixed-bottom staging and marshalling are generally less demanding than those for floating wind, some ports may be capable of supporting both. It is worth noting that ports gaining experience through involvement in the fixed-bottom industry are expected to benefit future floating wind deployment, as they will develop greater familiarity with offshore operations and the marshalling requirements common to both sectors. However, if ports operate on a first-come, first-served basis, this could hinder the timely deployment of floating wind in Ireland. **There must be a sufficient number of ports located around the coast to support both fixed and floating deployment and avoid causing bottlenecks.**

4. What is the minimum requirement in terms of port infrastructure to reach operational viability for the construction of a floating wind farm?

At a minimum, operational viability for constructing a floating wind farm requires access to port infrastructure that can safely and efficiently support the assembly, integration, and deployment of large-scale floating wind components. While specific needs vary by project, the infrastructure must enable sufficient throughput to meet the construction schedule, accommodate the physical and logistical demands of floating structures, and ensure safe tow-out to the offshore site.

1. Delivery Strategy and Throughput Requirements

The scale and pace of a floating wind project's delivery will determine port requirements. A key consideration is the targeted delivery rate (MW/year), which defines the number of foundations, turbines, and associated components that must be handled within a given timeframe. This, in turn, drives the required number of berths, quay length, and available laydown area. To maintain schedule and avoid delays, developers typically aim to install as much capacity as possible per season. This reduces programme risk and supports commercial milestones such as Contracts for Difference (CfD) obligations or power purchase agreement (PPA) triggers. Ports must therefore facilitate efficient and reliable throughput operations.

2. Core Port Types and Functions

A floating wind delivery strategy usually involves multiple port types, each with distinct roles and infrastructure requirements:

Assembly Ports: Used for fabricating, manufacturing, or assembling substructures and the subsequent float out. These ports require heavy lift capacity, extensive laydown areas, and suitable launch infrastructure (e.g., slipways, dry docks, semi-submersible barges). For concrete structures, casting and curing areas are needed.

Integration Ports: Where turbines are mounted onto floating foundations. These ports require high-capacity cranes (or alternatives such as jack-up vessels), deepwater berths, and adequate space for pre- and post-integration storage. Considerations include air-draft constraints (e.g., bridges or overhead lines), seabed conditions (for grounding or jacking, if required), and sufficient clearance for manoeuvring integrated units.

Support Marshalling Ports: Used for the marshalling and staging of ancillaries such as mooring systems, anchors and chains. These ports typically have lower infrastructure requirements and may be smaller, secondary facilities with appropriate handling capabilities.

An indicative breakdown of port activities and infrastructure specifications is provided in *Appendix Question 4 – Port Activities and High-Level Port Specifications*. This is informed by the Wind Energy Ireland National Port Study and industry input from the Floating Wind Working

Group. These specifications are illustrative and are provided to demonstrate the likely port requirements for a proposed throughput.

3. Logistics Considerations and Multi-Location Approaches

In practice, no single port is likely to meet all project requirements. Developers often adopt a multi-port strategy, assigning different roles such as manufacturing, integration, and support to separate locations. This approach enables optimal use of existing facilities, though it requires careful planning and coordination as a multi-port strategy introduces additional logistical complexity.

Where feasible, co-locating assembly and integration functions can streamline logistics and reduce handling risks. However, this may not always be possible as the infrastructure demands are significant.

4. Local Considerations

In addition to throughput and logistical considerations, several local factors further influence port requirements and suitability:

Tow Distance to Site: Longer tow distances increase risk of weather delays and require more capable vessels, potentially extending berth or storage occupancy requirements.

Environmental Conditions: Port exposure, tidal range, and navigational constraints affect operational reliability and timing.

Transport and Handling: Moving heavy components (e.g., via SPMTs) requires reinforced surfaces, wide turning radii, and reliable transport access (road, rail, or barge).

Access Constraints: Factors such as shallow channels, air-draft restrictions, or port congestion may limit suitability or constrain deployment schedules.

5. Infrastructure Requirements by Scale

For demonstration-scale projects (<200 MW), it may be feasible to adapt existing infrastructure with limited upgrades. Workarounds such as phased turbine integration, dredging, or use of restricted tidal windows can offer cost-effective solutions, especially for standalone deployments near suitable facilities.

In contrast, commercial-scale projects (e.g., ≥500 MW/year) place significantly higher demands on infrastructure. These projects typically require multiple berths for concurrent operations, large marshalling areas, dedicated storage zones, and robust logistics planning to enable continuous deployment and minimise bottlenecks.

Summary

In summary, the minimum infrastructure required to achieve operational viability for floating wind construction will vary by project. However, it must consistently enable the efficient

handling of large components, support safe integration and tow-out operations, and align with the intended construction schedule. Early engagement with port authorities and flexibility in logistics planning are essential to mitigate risks and secure infrastructure that meets project needs.

5.What are the minimum port requirements for Operations and Maintenance of floating wind farms

There are two main repair and maintenance strategies for floating offshore wind: Routine maintenance, typically conducted offshore, and major component replacement (MCR), which may require more complex interventions either offshore or at port.

Routine Maintenance

Routine maintenance is anticipated to be primarily offshore, with Service Operation Vessels (SOVs) playing a central role. SOVs are specifically designed to support offshore wind operations by providing technician accommodation, spare parts storage, and equipment for safe personnel and cargo transfer to and from turbines. Their ability to operate in higher sea states than Crew Transfer Vessels (CTVs) makes them especially suited to the deep-water, dynamic conditions of floating offshore wind.

Table 3 Range of Vessel Particulars CTV vs SOV

Vessel	LOA (m)	Beam (m)	Draft (m)*	Assumed Travel Speed (knots)	Nr of Passengers
CTV (twin hull catamaran type)	20-30	8-10	2.0-3.5	20	12-24
SOV	80-100	16-25	5.0-7.0	12	60-90
*Includes 0.5m underkeel clearance.					

While more expensive than CTVs, the higher safe operational weather limits of SOVs reduce downtime and increase time-on-turbine, resulting in greater operational efficiency. SOVs are expected to work alongside CTVs and, where necessary, Walk-to-Work (W2W) gangways to facilitate safe technician access.

<u>Port Infrastructure Requirements for Routine Maintenance:</u>

Although routine maintenance ports do not require the same infrastructure as construction-phase or turbine integration ports, they must meet the following criteria:

- Sufficient quay length and water depth to accommodate SOVs and/or CTVs
- Tidally unrestricted access for 24/7 vessel operations, particularly important for CTVs
- Landside area within approximately 50 metres of the quayside (although longer distances may be feasible depending on project specifics)

Typical landside infrastructure includes:

- Office space (~2,500 m² over 2–3 levels)
- Workshop with 6 m vertical clearance
- Parking for 30–50 vehicles
- Space for a 40 ft container and HGV turning
- Storage for oil waste (5,000 L) and fuel tanks (100,000 L)
- Forklift access and 2t jib crane for CTV loading.

Estimated minimum landside area: 3,500–5,000 m²

Importantly, the infrastructure requirements for SOV-based O&M ports for floating wind are not materially different from those for conventional fixed-bottom offshore wind farms.

Major Component Replacement (MCR)

In the early stages of floating offshore wind, major maintenance was performed using tow-to-port strategies, as demonstrated at Kincardine in Scotland. While technically feasible, this approach has proven logistically challenging and costly, given the extended turbine downtime and dependence on port infrastructure. Technological advancements have enabled in-situ major component replacement (MCR), with milestone operations such as the world's first in-situ generator replacement at Kincardine using an up-tower crane system. This approach avoids the logistical burden of towing turbines to shore. Further details of insitu MCR methods have been included in *Appendix Question 5: Insitu MCR Methods.*

However, views differ on how widespread in-situ MCR will become in the near term. Some stakeholders expect tow-to-port to remain a critical strategy, particularly while in-situ methods mature. It may also be necessary in cases where offshore repairs are not feasible due to equipment limitations, safety concerns, or weather conditions. As such, maintaining robust tow-to-port capabilities remains essential in floating wind maintenance planning.

Port Infrastructure Requirements for Tow-to-Port MCR:

The infrastructure requirements for hosting major maintenance are similar to those needed for turbine integration, with the requirement for lesser landside storage. Ports must be capable of facilitating the tow-in and tow-out of fully integrated units, potentially providing wet storage for multiple units (less than for commercial scale deployment, potentially with capability to accommodate 3-5 nr during a maintenance campaign), offering quayside facilities for heavy lifts, and accommodating at least one unit moored at the quayside.

Decommissioning and/or Repowering

While tow-to-port may not remain the preferred approach for major maintenance or component replacement in the long term, ports must nonetheless retain the capability to support such operations at short notice if required. Additionally, ports will play a critical role in end-of-life activities, including decommissioning or potential life extension of floating wind

assets. These future requirements should be considered when assessing infrastructure needs. As such, port planning should extend beyond short-term or "minimum" deployment requirements for commercial scale projects and adopt a long-term perspective that accommodates not only installation and operations, but also unplanned maintenance and eventual project decommissioning.

6. Which ports outside of Ireland do developers deem feasible to construct Irish floating wind farms from? From how far will developers tow to Ireland?

In the context of feasibility, research conducted within the SIMREI project (Support Infrastructure for Marine Renewable Energy in Ireland, led by Rockall Research in partnership with Ocean Wave Venture and MMCC Port Marine), along with findings from the ongoing DIFOWT project, has determined that a reasonable maximum distance from port to floating offshore wind (FLOW) farms is approximately **135 to 160 nautical miles (250 to 300 km).** This estimate is subject to various factors, and in more sheltered areas, longer towing distances may be feasible. These conclusions align with the 2021 "FLOW Marshalling and Assembly in Restricted Ports" by ORE Catapult, led by Arup, which classified ports located more than 150 nautical miles from deployment sites as "restricted" due to increased operational and logistical challenges.

While the maximum preferred towage distance is generally considered to be up to 300 km/161nm, effectively ruling out the use of foreign ports for West Coast projects, the final determination will ultimately depend on what is available in the market at the time**. If the market cannot deliver suitable port infrastructure, Irish FLOW projects will be built from UK, French or Spanish ports, to the detriment of an indigenous supply chain and the Irish economy**. The potential for foreign ports to service Irish projects depends on their availability at the time of deployment. Ireland may face competition from UK and French projects both fixed-bottom and floating, raising the risk of bottlenecks in suitable port infrastructure. This could delay or even derail Ireland's floating wind deployment. It is noted that for South Coast projects, UK or French ports may be feasible, particularly where towing distances may be extended due to greater shelter. Port Talbot and Milford Haven/Pembroke Dock in South Wales could contribute to the deployment of South Coast projects, alongside Avonmouth in Southwest England, with Brest in France also potentially playing a role, depending on the project location.

Increased tow distances are recognised as a key constraint in the selection of suitable ports for floating offshore wind. While recent studies, suggest that towing distances of up 250–300 km are technically feasible and potentially longer in favourable conditions, proximity remains a critical factor. Longer tow distances introduce greater operational complexity, increase exposure to weather-related delays, and raise overall project costs. For commercial-scale developments, **minimising tow distance is therefore still seen as essential to ensure efficiency, safety, and economic viability.**

The availability and readiness of port infrastructure will be a decisive factor in Ireland's ability to capitalise on the floating offshore wind (FLOW) opportunity. **Without timely investment in port upgrades, the associated socio-economic benefits risk being realised abroad, as seen in**

early UK projects serviced from continental Europe. A well-defined project pipeline is crucial to support the business case for investment, but existing funding constraints stemming from policy, commercial viability requirements, and long lead times pose significant barriers. Other jurisdictions, such as the UK and Scotland, have responded with targeted state support mechanisms to bridge these investment gaps and de-risk early-stage development. Ireland may need to consider a similar strategic investment approach to enable its ports to play a central role in the FLOW supply chain. Further detail on these challenges and potential solutions is provided in *Appendix Question 6: Port Infrastructure and Investment for Floating Offshore Wind in Ireland.*

7. Do industry players have views of what roles specific Irish ports will play in floating wind farm development? For example, what specific role do developers see Shannon Foynes playing as opposed to ESB Moneypoint?

There is generally a good understanding within the industry of the potential roles specific Irish ports could play in enabling floating offshore wind development. While firm plans are still emerging, several locations are known to be progressing with plans to support the floating industry. The final specification of these ports, particularly ESB Moneypoint and Shannon Foynes (Foynes Island), has yet to be fully defined and is likely to evolve in response to the pace, scale and geographic distribution of Ireland's floating wind pipeline.

The Shannon Estuary comprises multiple terminals with complementary potential, including ESB Moneypoint, existing SFPC facilities, and the proposed development at Foynes Island (proposed by SFPC). Collectively, these sites could accommodate several aspects of floating wind deployment within one geographical area.

On the **Shannon Estuary, ESB Moneypoint** is considered a **strategically significant site** with the potential to accommodate both substructure manufacture or assembly and turbine integration. However, the detailed specification of the facility is still being developed, and what ultimately emerges will depend on further investment decisions and project needs.

Since the launch of the Green Atlantic at Moneypoint Programme in 2021, policy shifts and delays in Ireland's offshore wind programme have impacted the availability of land at the site. Significant portions have since been allocated to power generation projects expected to submit planning applications within the next 12 months. **There is a risk that further delays to a clear pipeline of floating wind projects in Ireland will result in additional lands at Moneypoint transferred to other power generation projects, and as a result, the opportunity to develop an ORE enabling deep water port at Moneypoint will be lost.**

Similarly, Shannon Foynes, particularly Foynes Island, is understood to have the potential to support either of these activities, though again, its final role will depend on how the infrastructure is configured as plans progress. Both sites are actively being explored for development to meet offshore wind requirements.

Generally, the **Shannon Estuary** as a whole is recognised for its unique natural characteristics, including **deep water** and **wide channels**, which make it one of the few locations in Ireland suitable for commercial-scale floating wind deployment. These features have been highlighted in Wind Energy Ireland's ***National Ports Study (2022)*** and the SFI-funded Wet Storage project led by UCC.

On the south and southwest coasts, the **Port of Cork and Bantry Bay** have potential to serve the floating industry. The Port of Cork is already positioned to support fixed-bottom offshore wind and is well placed geographically to serve both Irish and UK markets. It also benefits from **short tow-out distances and existing infrastructure** that could potentially be scaled up, if backed by a sustained pipeline of floating projects. It is noted that this would be subject to feasibility assessment and investment and would depend upon project specifics and the ability of commercial scale floating activity to coexist with existing port business streams.

Bantry Bay, while not yet equipped with the necessary infrastructure, is the focus of a significant private development proposal by the Leahill Port Company, which is advancing plans for a 150-acre ORE port on the bay's north side. Bantry Bay also has the natural characteristics required for floating offshore wind. The bay's strategic location means it **could serve both southern and western floating projects**, and there are opportunities for a joint role with the Port of Cork or Cork Dockyard e.g., substructure manufacture in one and turbine integration or wet storage in the other.

Given the ambitious targets for floating wind deployment in Ireland, it is expected that a **network of ports** will be needed, with **Cork, Bantry Bay, Moneypoint, and Shannon Foynes positioned as key facilities**, with regional ports such as **Galway, Killybegs, Rosslare and Waterford (and others) supporting** specific phases of project delivery.

In addition to ports in the Republic of Ireland, Northern Ireland ports also have potential roles to play. **Belfast Harbour** already hosts a dedicated offshore wind terminal and is advancing plans for additional capacity at the adjacent D3 site, while ports such as **Warrenpoint, Larne, and Foyle Port** could contribute to project delivery depending on future demand and the geographic spread of DMAPs. Together, ports across the island of Ireland will be essential to ensuring a resilient and competitive supply chain for floating offshore wind.

While industry can provide commentary on the viability of certain ports to support floating deployment, ultimately the roles played by Irish ports will be dictated by what is available to the market at the time. **There is a desire for developers to utilise Irish ports as it can drive down construction risk and reduce CAPEX and OPEX**, in addition to supporting the growth of an indigenous supply chain. However, **if suitable infrastructure is not available in Ireland, developers will build from outside of Ireland.**

Without a clear pipeline of floating offshore wind projects in Ireland to support the business case, it is difficult to see how Irish ports can undertake the required capital upgrades and the **ports must be supported by Government Policy**. There are several Irish ports with development plans at varying stages of maturity, it is essential that these ports are supported by the incoming **National Ports Policy**. Port infrastructure that can assist Ireland in meeting its climate goals should be a matter of **national significance**. Ireland's ports are critical for ensuring the continuing flow of trade in/out of the country and are essential in supporting the climate ambitions of the Climate Action Plan and Programme for Government. It is noted that

government funding for port infrastructure is not unusual across EU Member States, where it is recognised that ports are critical infrastructure with high societal value.

In addition to investment in port infrastructure, the development of local content will be critical to the successful deployment of floating offshore wind (FLOW) in Ireland. Strengthening domestic supply chains can reduce reliance on scarce, highly specialised, and often costly installation vessels, while also shielding projects from global risks such as currency fluctuations, tariffs, and import taxes. Local manufacturing can help overcome logistical hurdles, lower transport costs, and create high-value employment in coastal regions, contributing to the social licence necessary for FLOW development. A long-term strategy to support local content will not only make deployment more efficient and cost-effective but will also position Ireland as a more self-reliant participant in a globally competitive market. Further detail on this topic is provided in *Appendix Question 7: Local Content and Supply Chain Development for Floating Offshore Wind*.

8. Port Esbjerg is being used to construct jacket foundations for an offshore wind farm off the coast of Virginia, US. What features does Port Esbjerg have/ American ports lack that required Esbjerg to partake in the process?

Port Esbjerg has several key features that make it uniquely capable of supporting large-scale offshore wind construction: Extensive quayside space, deep-water berths, heavy-lift cranes, and a mature offshore wind supply chain. Esbjerg is also a major jacket manufacturing port in Europe. There are only few ports in the world equipped with the necessary infrastructure and capacity, including specialised heavy-lift cranes, to facilitate the production of foundations of this scale.

In contrast, many US ports currently lack this scale of infrastructure, particularly for handling and assembling large offshore components like substation jackets. Additionally, the US maritime regulatory environment, such as the Jones Act, complicate domestic transport logistics. These gaps likely contributed to Esbjerg's selection despite the transatlantic distance.

It is noted that the jackets fabricated and transported from Esbjerg were for the substations and not for WTG and comprised of three jacket foundations. This is not the same type of serial installation which is highly sensitive to port proximity. It would be quite typical for substation jackets and topsides to be fabricated at a location a significant distance from the installation site and transported directly to the array location for installation.

The selection of a fabrication facility for provision of jackets will be dependent upon number of factors including but not limited to;

- Cost
- Available yard space and orderbook
- Programme
- Capability
- Transport and logistics.

Without detailed confidential project information it is difficult to identify why this was selected over other US alternatives. But it will have been driven by project economics, capability and availability.

The selection of Esbjerg to service offshore wind projects globally highlights the export opportunity that can emerge from an initial investment in manufacturing and quayside facilities. Additionally, large-scale components (such as jackets or floating platforms) are too large for road transport and consequently require suitable port infrastructure to facilitate deployment and onward transport. The example of Esbjerg demonstrates that large-scale manufacturing of components of this nature is not feasible without class leading port infrastructure.

Appendix Question 2: Port Engagement and Wet Storage Consenting Models.

ABP Engagement

As part of the Working Group's response, Associated British Ports (ABP) were consulted regarding their development plans at Port Talbot. The engagement aimed to understand how ports in jurisdictions more advanced than Ireland are approaching the management of wet storage.

ABP indicated they have extended the Statutory Harbour Authorities (SRA) limits into Cardiff Bay. From a navigational safety perspective, this extension enables a more structured and coordinated management of operations within the area, replacing the previous short, direct approach. This adjustment enhances overall safety for vessel movements within the bay. Additionally, the extension permits anchoring within the SRA, accommodating up to 100 vessels using drag anchors, without the need for a marine licence. However, should semi-permanent anchoring solutions be required, ABP will need to obtain a Marine Licence for such installations.

ABP has indicated its intent to take the lead on the consenting process and has expressed interest in providing fixing points, buoys, and other infrastructure as a managed service within the port. This approach is seen as beneficial, as it presents an additional revenue stream for the port. However, challenges remain due to uncertainties surrounding mooring configurations, revenue models, and cost structures. Further discussions are required to determine an appropriate pricing mechanism, considering factors such as residence time in the mooring zone and cost per vessel movement.

Responsibility for Seeking Consents

In addition to the debate around the provision of pre-laid moorings, there is uncertainty regarding **who should be responsible for obtaining the necessary consents and licenses for wet storage in Ireland**. It remains unclear whether the responsibility should lie with **ports or developers.** Additionally, there is a lack of clarity about the specific requirements and whether wet storage would trigger an **Environmental Impact Assessment (EIA).** From engagement with Cromarty Firth Port Authority on the topic of wet storage, there is ongoing legal disagreement between the ports and the Scottish Government on the requirements around consenting requirements for wet storage. Given the precedence of mooring semi-submersible oil rigs in Scotland, there is a desire that floating platforms are treated with parity.

If an EIA is required, developers are reluctant to include wet storage within their project-wide EIA due to uncertainties in the early project stages, particularly regarding the final selection of manufacturing/assembly locations and WTG integration ports. Including wet storage at this stage could also result in multiple overlapping consents across various ports for each development, creating significant administrative challenges for MARA.

Ports may be best positioned to manage the responsibility of obtaining consents (similar approach to be taken by ABP), particularly as the operations will fall within their statutory boundaries. However, this would place a financial burden on ports, requiring them to secure consents in advance without guaranteed contracts for such a facility. Developers are open to collaborating with ports and exploring shared cost arrangements, especially when wet storage facilities could be used by multiple parties. To establish a viable commercial model for obtaining licenses, developers, ports, and the Government must work together to ensure that the time and resources invested in license applications and enabling works are recoverable. A clear pipeline of floating projects will be crucial to managing this process effectively and preventing scenarios where the first developer shoulders the majority of the costs or where ports invest in securing consents for activities that ultimately do not materialize.

In considering how wet storage is being developed in other jurisdictions, in April 2025, Offshore Solutions Group (OSG) signed a two-year seabed Exclusivity Agreement with Crown Estate Scotland for areas in the Moray Firth to develop its pioneering FLOW-Park. The project will create a temporary anchorage site for floating offshore wind (FLOW) foundation units. The project is backed by Scottish Enterprise, which provided grant support, highlighting the role of state agencies in other jurisdictions in ensuring commercial viability in the floating sector.

Appendix Question 3: Key Port Touch Points and Activity Overview

Key Port Touch Points and Activities: The following table outlines the key port touch points and activities which drive port requirements.

Table 4 Key Port Touch Points, Activities and Requirements

Activity	Role of Port	Requirement
Substructure Manufacture (Concrete)		
Fabrication and manufacture of substructures	Accommodating fabrication of concrete components on the quayside and deploying full units from the port.	Concrete fabrication capabilities with skilled workforce specialised (concrete specialists – slip forming, pre-stressing, curing, reinforcement work), large landbank with heavy load bearing capacity (30te/m2 min). Launching facilities (slipway or float off basin most useful in context of concrete units), sufficient water depth at quayside and in access channel. Supporting equipment such as ring crane or crawler, in addition to SPMTs and other ancillary equipment. A means to store a number of fully fabricated units, either wet stored or dry stored. Robust fendering and bollards for mooring large vessels and/or platforms.
Substructure Assembly (Steel)		
Assembly of prefabricated substructure components	Assembly of prefabricated substructure components and deployment of fully assembled units	Sufficient quay length and landbank with load capacity (high, but likely less than what is required for concrete fabrication) to accommodate receipt and storage of prefabricated components. Skilled workforce specialising in steel fabrication (steel fitters, welders, riggers, QA/QC inspectors for structural connections), with sufficient workshop areas (welding/bolting stations, painting sheds, or fit-out zones). Launching facilities, sufficient water depth at quayside and in access channel. Supporting equipment such as ring crane or crawler, in addition to SPMTs and other ancillary equipment. A means to store a number of fully fabricated units, either wet stored or dry stored. Robust fendering and bollards for mooring large vessels or platforms.

Installation Campaign		
1. Mooring spread installation at the FLOW site.	Components delivered to a marshalling port where anchor and mooring spread installation campaign is staged from.	Sufficient quayside length and water depth to accommodate delivery vessel and AHTS, CSVs required for installation. Available laydown area to accommodate interim storage of mooring components during installation campaign. Lesser landbank and draft required than for turbine integration.
2. Array and export cable installation at FOW site	Cable likely delivered via cable installation vessel directly to site, may not be necessary to accommodate at staging port.	Cables typically manufactured in continues length and loaded directly onto cable laying vessel and transported directly to site. Manufacturers and installation contractors aim to minimize handling to avoid unnecessary unspooling/spooling as can cause warranty issues. May be a required to accommodate some degree of cable at a port if cables are delivered in sections or if installation is staged over months requiring temporary storage.
3. Turbine integration at the quayside	WTG components delivered to port. Fully assembled hulls delivered to port, likely towed into storage before integration. Turbine integration occurring quayside, with heavy cranage required, likely ring crane* or large crawler. Possible requirement to provide wet storage for floating units pre and post turbine integration in relative proximity to quayside. Accommodation of post-integration commissioning at the quayside.	Significant water depths at the quayside and in the access channel to allow for fully laden units to be towed out post integration, quay length sufficient to support at least 1nr unit during turbine integration, significant quayside and hinterland bearing capacity and access to wet storage with adequate shelter and draft. Supporting equipment such as ring crane or crawler, in addition to SPMTs and other ancillary equipment.
4. Tow out and hookup of fully assembled turbines.	Fully integrated units towed out to site for hook-up or temporarily stored in wet storage area while waiting for weather window.	Sufficient water depth and access channel width to allow for tow out.

Activity Overview

It remains to be seen if substructures will be fabricated or assembled in Ireland, however there are ports with ambitions to support this activity. For example, ESB Moneypoint are planning to upgrade the existing site to accommodate assembly of prefabricated components, and/or fabrication of concrete units. As it currently stands there are no other Irish ports proposing to host substructure manufacture or assembly, beyond Bantry Bay and Moneypoint. However, it is noted that facilities located on the West Coast of the UK could service South Coast Irish projects with relative ease in this context. The Moneypoint site is ideally situated to support this type of activity and could serve as a major hub for platform assembly, utilising the significant land bank and deepwater access. It is noted that while the site has obvious natural advantages, significant redevelopment and upgrades would be required to accommodate activity of this nature. A strong pipeline of floating projects in Ireland must materialise for investment in this type of facility to make sense. Note, capital expenditure estimates for ports pursuing floating specific port infrastructure are anticipated to be in the region of hundreds of millions, highlighting the scale of the investment required.

It would be expected that the ability to compete on cost for a manufacturing facility would rely on the existence of skilled labour in proximity and favourable energy costs, or with some mechanisms to support local manufacture. Additionally, to host fabrication/or assembly of substructure will require establishment of high skill labour force and supply chain at the port location, if not already existing. This may be a barrier to fabrication or assembly in Irish ports. Locating manufacturing facilities near existing educational institution or establishing new training centres nearby could support hands-on workforce training as industry demand grows. A good example of this approach is the Nigg Skills Academy, which was established close to the port to provide apprenticeships and training for the offshore sector.

In the case of steel substructures, these are not expected to be fabricated in Ireland due to the absence of large-scale domestic steel manufacturing and fabrication facilities, as well as strong international competition from more established supply chains in Europe and Asia.

In instances that steel substructures are fabricated outside of Ireland, they will be transported via semisubmersible heavy lift vessel and floated off adjacent to the turbine integration port, in sufficiently deep water to cater for such activity, c. 19m LAT depending on the vessel specification. An access channel with sufficiently wide dredged depth must also be available for tow in and out of the floating units from the quayside. While this scenario has been included for reference, not championing the manufacturing or assembly of substructures in Ireland would represent a significant missed opportunity from a supply chain development perspective. Relying solely on the import of fully fabricated substructures could limit local economic benefits and reduce industry resilience. For steel substructures, and increasingly for concrete designs, designers are adopting modular, transport-efficient solutions that enable

rapid local assembly. Facilitating local manufacturing or, at a minimum, local assembly offers the potential to build domestic capability, create skilled jobs, and establish a more robust and competitive supply chain to support future offshore projects.

Mooring spread installation will occur prior to tow-out and hook-up of fully integrated units (with mooring spread 'wet-stored' until hook-up occurs). So, the integration port could also host the mooring spread marshalling depending on project scheduling. However, given the lesser port requirements for accommodation of the mooring spread, i.e. anchors, mooring lines/chains, some of the tier 2 and 3 Irish ports could possibly become involved supporting this type of activity (providing the port is in proximity to the project site and would make sense from a logistics perspective). For large scale projects (1GW+ with 50-67 nr platforms could have up to 201 anchors and moorings requiring pre-lay), a multi-port solution may be preferred for moorings to avoid bottlenecks during the installation phase depending upon the phasing of the pre-lay campaign.

Cables and substation will likely be transported directly to site from manufacturing location, i.e. no need to accommodate these at a marshalling port, although there may be requirements to store spare export cabling, this wouldn't necessarily have to be at an integration port.

Appendix Question 4: Port Activities and High-Level Port Specifications

Port Activity Specifics

The following sections outline the processes and activities a port would need to accommodate for hull fabrication and assembly, mooring component staging, and turbine integration. A *range of high-level* port specifications is proposed to illustrate the likely requirements associated with these activities.

In practice, actual port requirements will be project-specific, influenced by the planned delivery and deployment rates in addition to substructure specifics. As such, the figures provided should be viewed as indicative ranges intended to support early-stage planning and benchmarking.

It is noted that the tables provided relate to commercial scale deployment suitable for delivering 500 MW (25-33 substructures) per year and assumes 15 MW turbines.

Port Requirement for Assembly of Prefabricated Steel Components

A steel substructure assembly port must be capable of accommodating the following:

- Arrival and offloading of raw materials or prefabricated components (steel plate, prefabricated hollow sections and other secondary steel)
- Storage of prefabricated components
- Movement of SPMT, and large mobile and crawler cranes across site (note, rail-based systems can also be used within manufacturing yards for component transfer and can improve site efficiency and operational safety).
- Assembly activity for pre-assembled steel components:
    - Movement of prefabricated components across the site (SPMT or crane)
    - Welding and structural assembly of sections.
    - Painting or coating of units.
    - Installation of secondary steel and equipment.
    - Storage of partially and fully complete hulls (either awaiting final surface coating or outfitting or awaiting launch).
    - Final inspections and certifications for regulatory approvals for assembled hulls.
- Launching of fully assembled hulls, either via dry dock (only one dry dock potentially large enough to accommodate this located in Ireland – Belfast, Harland & Wolff, but note added for completeness), semi-sub barge or novel means.
- Ballast and stability for floating out readiness.
- Mooring and tow-out preparations.
- Tow out assistance.

Port Requirement for Fabrication and Manufacture of Concrete Substructures

A concrete substructure fabrication and manufacture port must be capable of accommodating the following:

- Arrival and offloading of raw materials and components (rebar, aggregate and cement)
- Storage of raw materials and components
- Movement of SPMT, and large mobile and crawler cranes across site (note, rail-based systems can also be used within manufacturing yards for component transfer and can improve site efficiency and operational safety).
- Fabrication activity for concrete substructures as follows:
    - Erection of moulds or formwork for casting
    - Placement of steel reinforcement cages
    - Concrete batching and pouring
    - Curing of concrete and strength testing
    - Surface treatment and outfitting of units.
    - Storage of partially and fully complete hulls (either awaiting final surface treatment or outfitting or awaiting launch).
    - Final inspections and certifications for regulatory approvals for assembled hulls.
- Launching of fully assembled hulls, either via dry dock (there is only one dry dock potentially large enough to accommodate this located in Ireland – Belfast, Harland & Wolff, but note added for completeness), semi-sub barge or novel means.
- Ballast and stability for floating out readiness.
- Mooring and tow-out preparations.
- Tow out assistance.

Table 5 High Level Range of Indicative Port Infrastructure Requirements for Manufacture or Assembly Port

PARAMETER	UNIT	Lower Range	Upper Range
Access Channel Width	m	270	400
Access Channel Depth Requirement	m LAT	12	20
Berthing Pocket Water Depth	m LAT	12	20
Berthing Pocket Width	m	100	150
Quay Berth Length	m	200	600
Quayside Loadout Width (on the quayside)	m	120	160
Quayside Bearing Capacity	Te/m^2	25	50
Wet Storage Area (phasing assumes 5 substructures in wet storage at one time)	ha	25	50
Wet Storage Draft	m	12	20
Laydown Area Steel (total area for component storage and assembly)	ha	30	40
Laydown Area Concrete (total area for component storage and fabrication/manufacture)	ha	25	30
Laydown Bearing Capacity	Te/m^2	25	50

Notes:

The *estimated* wet storage areas are based upon an assumed mooring spread diameter commensurate with the anticipated water depths, with the range reflecting variation on how they are positioned (i.e. linearly or in 2 rows of 2 and 3 nr units). The areas noted have also been informed by the ongoing work being completed by University College Cork (UCC) focusing on layout and mooring optimisation for wet storage.

The required size of laydown area (for fabrication or assembly and storage) required for a floating wind fabrication facility depends on factors such as the type of substructure, material, the number of units being produced simultaneously, and logistics for storage, assembly, and transport.

There will be differences in requirements between concrete fabrication/manufacturing and steel assembly. Particularly in terms of laydown area, due to the nature of the materials, fabrication processes, and handling constraints. Consequently, an indicative laydown area range has been noted for each to illustrate the likely differences in area required.

Port Requirements for Mooring Component Campaign

A port accommodating staging of mooring equipment must be capable of accommodating the following:

- Arrival and offloading of mooring components (anchors, chains, synthetic ropes, connectors, and tensioning systems)
- Temporary storage of mooring components on quayside prior installation
- Inspection and quality control of components (Non-destructive testing (NDT) methods might be used to check for defects in chains, connectors, and anchor points)
- Accommodating any required pre-assembly activity, or pre-tensioning

Load-out of components to be installed at the FLOW site.

Table 6 High Level Range of Indicative Port Infrastructure Requirements for Mooring Campaign Port

PARAMETER	UNIT	Lower Range	Upper Range
Access Channel Width	m	60	100
Access Channel Depth Requirement	m LAT	6	8
Berthing Pocket Water Depth	m LAT	6	8
Quay Berth Length	m	100	150
Quayside Bearing Capacity	Te/m^2	5	10
Laydown Area (marshalling and storage)	ha	4	8
Laydown Bearing Capacity	Te/m^2	2.5	5

Port Requirements for Turbine Integration

The turbine integration port must be capable of accommodating the following:

- Arrival and offloading of hull units (assuming these are fully assembled elsewhere and transported to a standalone turbine integration port).
- Arrival and offloading of WTG components (tower, nacelle, blades)
- Erecting of turbine towers
- Towing of hull from wet storage, or movement of assembled units from dry storage for launch to integration berthing pocket
- Wet docking of hull (if required), or grounding of hull if this is the proposed integration methodology
- Installation/integration of WTG onto the hull
- Ballasting of full assembled FLOW units.
- Quayside testing and commissioning
- Installation of temporary equipment for offshore installation
- Intermediate storage (moored floating units inshore at wet storage area)
- Tow out assistance.

Where substructures are fully assembled elsewhere, they would be towed to the integration port if in relative proximity. Where fabrication is located an impracticable tow distance the

substructures would be transported via submersible vessel and subsequently floated off in a deep sheltered area in proximity to the port and then towed to and moored in the integration berth. Turbine components being delivered will require a loading berth large enough to accommodate the transport vessel which will likely be longer than the integration berth. Meaning sufficient lengths of quay will be required to accommodate both activities, particularly if they are scheduled to occur concurrently. The quay length ranges included in Table 7 and 8 assume a discrete berth for component delivery, substructure launch (for Table 8), turbine integration and commissioning.

Depending on the available infrastructure, turbine integration and pre-commissioning of a fully integrated unit could be completed onshore. In the event of issues during commissioning, the unit can be taken offline before launch, eliminating the need to wait for wet storage or quay space to inspect the unit. Systems available in the market, such as the Bardex Omnilift, are capable of supporting onshore activities and can directly lower the floater for wet tow, as well as retrieve floaters back to dry land when necessary.

Table 7 High Level Range of Indicative Port Infrastructure Requirements for Turbine Integration/Assembly Campaign Port *(Integration Only)*

PARAMETER	UNIT	Lower Range	Upper Range
Access Channel Width*	m	270	400
Access Channel Depth Requirement	m LAT	12	20
Berthing Pocket Depth Requirement	m LAT	15	25
Air Draft Constrained	m	No air draft constraints ideally, however this would be determined on a case-by-case basis	
Quay Berth Length (integration only)	*m*	*400*	*500*
Quay Berth Width (integration only)	*m*	*40*	*60*
Quayside Bearing Capacity	te/m^2	25	50
Laydown Area (integration only)	*ha*	*10*	*20*
Laydown Bearing Capacity	te/m^2	25	50
Wet Storage Area Pre-Integration (phasing assumes 10 substructures in wet storage at one time)	ha	50	100
Wet Storage Area Post-Integration (phasing assumes 5 substructures in wet storage at one time)	ha	50	75
Wet Storage Draft Pre-Integration	m	12	20
Wet Storage Draft Post-Integration	m	15	25

Table 8 High Level Range of Indicative Port Infrastructure Requirements for Turbine Integration/Assembly Campaign Port *(Manufacture or assembly plus Integration)*

PARAMETER	UNIT	Lower Range	Upper Range
Access Channel Width*	m	270	400
Access Channel Depth Requirement	m LAT	12	20
Berthing Pocket Depth Requirement	m LAT	15	25
Air Draft Constrained	m	No air draft constraints ideally, however this would be determined on a case-by-case basis	
Quay Berth Length (substructure activity plus integration)	m	550	800
Quay Berth Width (substructure activity plus integration only)	m	100	150
Quayside Bearing Capacity	te/m^2	15	25
Laydown Area (substructure activity plus integration only)	ha	35	50
Laydown Bearing Capacity	te/m^2	15	25
Wet Storage Area Pre-Integration (phasing assumes 10 substructures in wet storage at one time)	ha	50	100
Wet Storage Area Post-Integration (phasing assumes 5 substructures in wet storage at one time)	ha	50	75
Wet Storage Draft Pre-Integration	m	12	20
Wet Storage Draft Post-Integration	m	15	25

DNV-ST-N001 Channel Width Requirements

* Channel access widths for towing operations are guided by the Marine Operations Standards published by DNV (DNV-ST-N001), which specify a minimum width of three times the maximum beam of the towed item (e.g., substructure), with additional allowances for yaw and sway. In exposed areas, further channel width may be required to account for significant crosscurrents and to provide space for tugs assisting with manoeuvring on either side. While narrower channels may be accepted under ideal conditions, such as short, straight channels with minimal time constraints. This is assessed on a case-by-case basis and remains subject to the Marine Warranty Surveyor's discretion.

It is acknowledged that, depending on project specifics, wet storage before and after integration may not always be required. However, requirements for both have been included, as this is expected to be necessary for commercial-scale projects planned for deployment off the Irish coast.

Appendix Question 5 – In-situ MCR Method

The successful implementation of in-situ MCR at Kincardine demonstrates the potential for these methods to become standard practice in the industry, offering cost savings and reduced downtime. As the floating wind sector continues to mature, it is anticipated that substantial research and development efforts will focus on refining and standardizing in-situ MCR techniques, including:

- Motion-Compensated Access and Lifting Systems: Walk-to-Work (W2W) gangways and motion-compensated cranes mounted on dynamically positioned vessels enable safe technician access and precision lifting of medium-to-large components in challenging sea conditions.
- Modular Turbine Design: Original Equipment Manufacturers (OEMs) are developing modular nacelles and drivetrain components to allow targeted subcomponent replacement offshore, minimising the need for full generator or gearbox swaps.
- Robotics and Drone Technologies: Emerging tools such as blade repair drones and nacelle-inspection crawlers support minor repair tasks remotely and reduce technician time on site.
- Floating-to-Floating Transfer Systems: Vessels with motion compensation enable safe transfer of personnel and equipment directly to the floating platform without fixed infrastructure.
- Advanced Service Operation Vessels (SOVs): New-generation SOVs with DP2/DP3 capabilities and integrated lifting systems are being developed specifically to support floating wind O&M at scale.

Appendix Question 6 - Port Infrastructure and Investment for Floating Offshore Wind in Ireland.

Port Investment Challenge

Ports are key facilitators of supply chain development; Irish floating offshore wind projects built from Ireland will serve to promote the development of an indigenous supply chain. The positive impact of dedicated ORE Ports on growing the supply-chain has been seen in many mature offshore wind markets (e.g. Esbjerg in Denmark and the Port of Nigg in Scotland). There is a real risk of the socio-economic opportunities associated with offshore wind development being realised unnecessarily outside of Ireland if sufficient port infrastructure is not available. Early UK FLOW projects were largely serviced from Norwegian and Dutch ports, and the UK has moved significantly to ensure that the next round of FLOW deployments are captured by the UK supply chain. The supply chain opportunity assumes those ports exist and have the capacity required at the point in time it is needed, however the greater risk is that offshore wind cannot be delivered due to the absence of port infrastructure and Ireland's climate goals cannot be met.

The scale of investment needed to prepare Irish port infrastructure is substantial, with planned upgrades requiring hundreds of millions in funding. **For ports to justify these significant developments, their business cases must be supported by a strong pipeline of floating projects, providing clear visibility on scale, location, and delivery timelines**. Delivering a well-defined pipeline in a timely manner will not only reinforce the investment case for ports but also send strong market signals to stimulate broader supply chain development beyond port infrastructure. This will help ensure that the supply chain is mobilised in time to meet growing demand and support the successful deployment of floating offshore wind in Ireland. While the investment burden is high, there are opportunities to improve cost efficiency and adaptability through the use of modular and scalable port side systems. For example, technologies such as those used in load out and tensioning operations, including market agnostic solutions developed by companies like Bardex, can offer greater operational flexibility and reduce the extent of bespoke infrastructure required. This kind of adaptability can help future proof ports against uncertainty in project timelines and turbine configurations.

At present there is a **lack of demand certainty** early in the development process for ports seeking to undertake significant development works, this is a fundamental barrier to investment. Without a mechanism to overcome this barrier by providing greater revenue certainty early in the development process, the industry will rely on those investors that are able to invest on an anticipatory basis. This is a limited pool, and it is likely that Ireland will not develop the scale of infrastructure required. While the role of developers in helping fund port infrastructure has been considered, the long lead times required for planning, consenting, and

construction mean that **upgrades must begin well before a project's Final Investment Decision (FID)**, making project-specific financing unviable in most cases.

The large ports in Ireland underwent corporatisation beginning in 1997, with ports encouraged to compete commercially and fund themselves through revenue producing activities. The current Ports Policy, which is due to be revised in Autumn 2025, followed on from the previous 2005 Policy which prohibited Exchequer funding for infrastructure development of commercial ports as defined in the Harbours Acts (1996-2015). Whilst corporatisation may have been relevant in the early 2000s, ports are now facing an evolving landscape where the infrastructure must keep up which includes renewable energy. It is hoped that the updated Ports Policy will be cognisant of the challenges facing Irish ports and **remove prohibition of Exchequer funding for commercial ports.**

To date the Government's Port Policy has cited the CEF funding scheme as the preferred method to support ports seeking to develop ORE infrastructure. Whilst the policy also considers the potential involvement of the ISIF and EIB in providing future finance, there is an acknowledgement that both ISIF and EIB require projects to be supported by an underlying commercial/business case. Meaning the fund can only support projects with a positive business case where the anticipated revenue generated by the facility is sufficient to make the project investable, or those projects where grant funding has been used to reduce the funding gap. **While ISIF and or the EIB could play a role in funding port infrastructure in Ireland, this will be predicated on the ports being able to demonstrate commercial viability.**

State Support for Ports in other Jurisdictions

Governments in other countries have recognised the significant financial burden associated with developing port infrastructure for floating offshore wind. In the UK, the government has allocated £160 million through the Floating Offshore Wind Manufacturing Investment Scheme (FLOWMIS) grant scheme to support floating-specific development plans. Similarly, Scotland has proposed a Strategic Investment Model to facilitate ScotWind deployments, ensuring that port infrastructure and the broader supply chain are fit for purpose. This Investment Model is expected to explore joint funding options, with contributions from both the Scottish Government and the private sector, helping to de-risk infrastructure investment and accelerate the development of critical port facilities.

The redevelopment of Ardersier Port exemplifies the critical role of state support in advancing nationally significant infrastructure projects. Haventus, the company spearheading this transformation, secured a £100 million joint credit facility in May 2024, with £50 million each from the Scottish National Investment Bank (SNIB) and the UK Infrastructure Bank (UKIB). This funding complements a prior £300 million investment from Quantum Capital Group in 2023.Both SNIB and UKIB operate with mandates to support infrastructure projects that align with public policy objectives, such as the transition to net-zero emissions. While they seek returns on their investments, their terms are often more favourable than those offered by private lenders, reflecting their broader economic and environmental goals. SNIB, for instance,

can invest up to £50 million independently and up to £100 million with additional support from Westminster.

The Ardersier Port project underscores the effectiveness of these mechanisms. By providing substantial financial backing, SNIB and UKIB have facilitated the creation of a major offshore wind hub, poised to play a pivotal role in the UK's renewable energy ambitions. This initiative not only supports the nation's net-zero targets but also revitalizes a region historically linked to the oil and gas industry, demonstrating the multifaceted benefits of strategic state investment in infrastructure.

Due to ISIF's obligation to invest on commercial terms, and the current difficulty ports face in securing firm commercial commitments, grant funding alone is unlikely to be sufficient to bridge the funding gap. A level of strategic or targeted state investment—similar to the Scottish model—will likely be required. Such investment can play a crucial role in de-risking early-stage development, sending positive signals to the market, and unlocking further private capital. The 2023 Wind Energy Ireland report, *"We Can Build Them,"* outlined a proposal for a strategic investment model in Ireland that mirrors the Scottish approach, with early-stage equity provided to ports during the high-risk phases when future demand is uncertain, which could be utilised to support Irish ports and the FLOW sector. The industry notes that under the Clean Industrial Deal, the European Commission is currently updating state aid rules relating to clean tech manufacturing. This aims to make it easier for Member States to invest directly into manufacturing facilities such as ports for renewable energy via grants, tax incentives, subsidised loans and other mechanisms.

Multi-model Ports

Whilst port infrastructure improvements will require significant investment to meet the demanding specifications, the infrastructure will have the capability to serve other markets should there be delays to offshore wind construction or should the market decline in the future. The port specifications for floating offshore wind typically include heavy-duty quaysides and large landside areas far beyond what would be required for traditional port business streams such as RoRo, containers, or bulk cargo handling. Consequently, **port infrastructure developed specifically for the ORE sector will have broad suitability across a number of sectors, with suitability to market themselves as multi-modal facilities.**

This has been observed in Belfast at the D1 terminal where the site has not been used for fixed-bottom staging and marshalling since 2018 but has accommodated cruise vessels and blade repair over the past number of years.

In addition to the example at Belfast Harbour's D1, across Europe a number of ORE facilities have been used to cater for other sectors. For example, Cuxhaven Port in Germany has two main quays which accommodate offshore staging. Whilst this is the primary usage, both quays frequently accommodate fishing vessels when not in use for ORE activities. Similarly, Great Yarmouth in the UK offers itself as a multi-modal port. The facility hosted marshalling for the

Galloper Wind Farm in 2017 and more recently the East Anglia One project (2019). Whilst the facility has demonstrable ORE capabilities, several alternative business streams have made use of the infrastructure in the time between staging projects, including handling timber cargoes, bulk, agri bulk, aggregates, and steel. The suitability of ORE infrastructure to serve additional sectors should serve to reduce investment risk and cost and allow for increased utilisation of the facilities.

Notwithstanding Ireland's neutrality, an important consideration in the context of port infrastructure is the increase in defence spending across Europe due to the evolving geopolitical landscape. Existing fabrication and shipbuilding facilities are likely to be heavily engaged in fulfilling defence contracts for the foreseeable future, with the renewables sector competing for raw materials and yard space. However, rather than framing defence and renewables as competing interests, there is an opportunity for synergy. Defence investment could help catalyse growth in renewable energy infrastructure if both are integrated into long-term planning for port development and fabrication capacity.

Furthermore, the defence of marine assets, particularly those critical to energy resilience will become an increasingly significant focus of defence strategy in the coming decades. Ensuring sufficient port infrastructure to accommodate naval vessels tasked with protecting these assets will be essential, and this should be considered in the context of multi-modal ports. While a multi-modal approach can reduce investment risk and enhance port utilisation between offshore wind campaigns, it may also introduce operational complexity. Floating wind projects often require dedicated, high-specification infrastructure and predictable access windows. Careful planning is therefore essential to balance the needs of offshore wind with those of other port users, particularly in high-demand or space-constrained ports.

Appendix Question 7 - Local Content and Supply Chain Development for Floating Offshore Wind.

In addition to investing in port infrastructure, actively encouraging the development of local content is critical to supporting the floating offshore wind sector in Ireland. Strengthening local supply chains can significantly aid the deployment of floating wind by **reducing reliance on expensive and highly specialised vessels**, which are often booked years in advance. It also offers additional advantages as projects become **less exposed to currency fluctuations, tariffs, and import taxes**, which are increasingly prevalent globally (e.g., recent tariffs imposed by the Trump administration).

Local manufacturing of components can mitigate logistical challenges, lowers transportation costs, and create a substantial number of skilled, high-paying jobs in coastal communities. Ensuring the FLOW industry can provide tangible jobs for local people will be an important step in achieving the required social licence for the deployment of commercial scale floating wind. In this context, the proposed Net-Zero Industry Act (NZIA) offers a timely opportunity to support indigenous industrial development through the use of non-price criteria in renewable energy auctions. These may include job creation, supply chain resilience, and environmental performance—allowing Ireland to legally incentivise local content within EU internal market rules. As floating wind progresses toward commercialisation, such mechanisms will be vital to ensure Ireland builds a competitive, homegrown supply chain capable of supporting long-term sectoral growth. By implementing a long-term strategy for local content, Ireland can enable more efficient, cost-effective deployment and become self-reliant to some extent, which is an essential step as global demand for offshore wind supply chains and skillsets continue to grow.

If a local supply chain is to emerge in Ireland, support from central government will be essential. In terms of examples from other jurisdictions, the UK has taken a proactive approach to building supply chain capacity and boosting local content through several key initiatives, including:

- **Offshore Wind Sector Deal (2019):** Committed to increasing UK content to 60% by 2030 and developing regional clusters as focal points for innovation, skills development, and supply chain coordination.
- **Offshore Wind Manufacturing Investment Scheme** (OWMIS, 2021): Provided £160 million in funding to upgrade port infrastructure and attract OEMs. Beneficiaries included ports such as Grimsby, Hull, Teesworks, and Able Marine Energy Park.
- **Floating Offshore Wind Manufacturing Investment Scheme** (FLOWMIS, 2023): Currently allocating £160 million in grant funding to enhance port infrastructure critical for scaling up floating offshore wind.

- **Freeport Designation**: The UK has supported clustering around ports through Freeports, offering tax and customs incentives and streamlined planning within designated zones.
- **Offshore Renewable Energy (ORE) Catapult**: A government-supported innovation centre (part-funded by Innovate UK) that has supported UK SMEs since 2013, fostering R&D and advancing the offshore wind sector.

The Contracts for Difference (CfD) subsidy mechanism in the UK has played a key role in supporting the development of local supply chains for offshore wind, particularly through the Supply Chain Plan (SCP) process. For projects over 300 MW, developers are required to submit a Supply Chain Plan that demonstrates how their project will enhance the competitiveness, capability, and productivity of the UK supply chain. Approval of this plan by the Department for Energy Security and Net Zero (DESNZ) is a prerequisite for CfD eligibility. While the SCP mechanism has encouraged investment in UK-based manufacturing, infrastructure, and skills development, its success has also depended on the maturity of the domestic supply chain and a pragmatic approach to implementation.

If similar local content requirements are introduced in Ireland for example, through a future floating Offshore Renewable Electricity Support Scheme (ORESS), policymakers must take into account the current state of the Irish supply chain. Any local content stipulations should be realistic, proportionate, and aligned with market capacity to avoid unintended consequences. Local content is undoubtedly important for long-term economic development, energy security, and political support for offshore wind. However, it must be balanced carefully against the need to maintain cost competitiveness. Excessively stringent requirements could drive up the Levelised Cost of Energy (LCOE) and risk deterring investment at a time when attracting capital for emerging floating wind technology is already challenging. A phased approach, supported by targeted investment in infrastructure and workforce development, may be the most effective way to increase local content without compromising affordability or project delivery timelines.