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Business model development in Swedish ports - Adjustment to new volumes from offshore wind industry




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HÅLLBAR SJÖFART

Business model development in Swedish ports - Adjustment to new volumes from offshore wind industry

Business model innovation and sustainable shipping

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Summary

Sweden aims to achieve a full fossil-free energy system by 2045, and electricity demand is expected to rise substantially by then. As a renewable energy source, offshore wind can contribute largely to meet the future electricity demand, as Sweden has excellent offshore wind site conditions, a strong maritime industry, and some of the largest ports in Scandinavia. Swedish ports may play a crucial role in the green energy transition while enabling large-scale offshore wind deployment. However, ports face multiple challenges when preparing for offshore wind, especially an uncertain business case and low market readiness.

To address some of these challenges, this project investigated how ports may integrate offshore wind as a new business area into their business model. The study identified four main categories of business models that ports can pursue based on their primary function: Construction, Installation & Decommissioning (CID); Service; Combined and Auxiliary port models. It also provided recommendations on how to improve the sustainability of maritime operations between ports and wind farms by using alternative fuels, optimized vessel design, and enhanced port services. To increase visibility and promote the operational potential of the eleven Swedish ports that participated in the study, the project produced a Port Brochure mapping their infrastructure capacity for offshore wind.

Overall, the study emphasized importance of involving ports, wind developers and shipping agencies in collaborative platforms that are crucial for de-risking and implementing offshore wind projects. The report is intended to serve the port authorities as a general guidance in understanding needs of the industry and as a support tool when evaluating decisions about expanding their business into offshore wind. Both the report and the brochure provide valuable sector-specific insights that may assist policymakers and industry stakeholders in fostering dialogue and engagement toward the green energy transition.

Sammanfattning

Sverige ämnar att helt eliminera fossila energikällor från sitt energisystem till 2045, och fram till dess förväntas även efterfrågan på el att öka avsevärt. Som en förnybar energikälla kan havsbaserad vindkraft i stor utsträckning bidra till att möta det framtida behovet av fossilfri el. Detta då Sverige har utmärkta förutsättningar för att etablera vindkraft till havs och har en stark maritim industri, samt några av de största hamnarna i Skandinavien. Genom att möjliggöra en storskalig utbyggnad av havsbaserad vindkraft kan svenska hamnar spela en avgörande roll i den gröna energiomställningen. Svenska hamnar står dock inför flera utmaningar när de förbereder sig för etablering av havsbaserad vindkraft. Affärsunderlaget är osäkert och marknadsmognaden är låg.

För att hantera några av dessa utmaningar undersökte detta projekt hur svenska hamnar kan introducera havsbaserad vindkraft som ett nytt affärsområde. Studien identifierade fyra huvudsakliga kategorier av affärsmodeller som hamnar kan välja baserat på deras primära funktion: hamnar för konstruktion, installation och avveckling (CID-hamnar); servicehamnar; kombinerade hamnar; samt stödhamnar. Studien genererade även rekommendationer för hur hållbarheten i de maritima operationerna mellan hamnar och vindparker kan förbättras genom användning av alternativa bränslen, förbättrad fartygsdesign och utvecklade hamntjänster. För att öka synligheten och lyfta fram den operativa potentialen hos de elva svenska hamnar som deltog i studien tog projektet även fram en hamnbroschyr som sammanställer hamnarnas nuvarande infrastrukturella kapacitet för havsbaserad vindkraft.

Studien understryker behovet av samarbetsplattformar där hamnar, utvecklare, rederier och fartygsägare samarbetar för att reducera risker och framgångsrikt genomföra havsbaserade vindkraftsprojekt. Rapporten är avsedd att användas som en generell vägledning för hamnmyndigheter att förstå industrins krav och fungerar som stöd vid utvärdering av hamns beslut om att utöka verksamheten till att omfatta havsbaserad vindkraft. Både rapporten och broschyren ger dessutom värdefulla sektorspecifika insikter som kan hjälpa beslutsfattare och branschaktörer att upprätthålla dialog och engagemang i den gröna energiomställningen.

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1 Introduction

1.1 Background

Sweden has committed to achieve net zero greenhouse gas emissions by 2045 with future national energy system based on 100% fossil-free electricity production and expected 300 TWh of electricity demand per year. Offshore wind is one of the renewable sources with high potential to contribute to this goal as Sweden has a long coast with constantly strong winds. Unlike other European countries, Sweden has no offshore wind targets, but instead, has an "open door market policy" which means that developers are individually responsible for permits, grid connection and choosing offshore wind zones – which makes the project development rather lengthy and uncertain. However, industry has a huge interest to develop offshore wind in Sweden which resulted in more than 100 GW of permit applications back in 2022. Despite market disruptions and defence reasons which led to rejection of the 13 offshore wind projects in 2024, there are currently 4 permitted projects with planned installed capacity of 3,4 GW. Furthermore, there are 35 GW of submitted permit applications (Green Power Sweden, 2025), which, if granted and built over the next 10-15 years, could supply Sweden´s additional electricity demand by 2045.

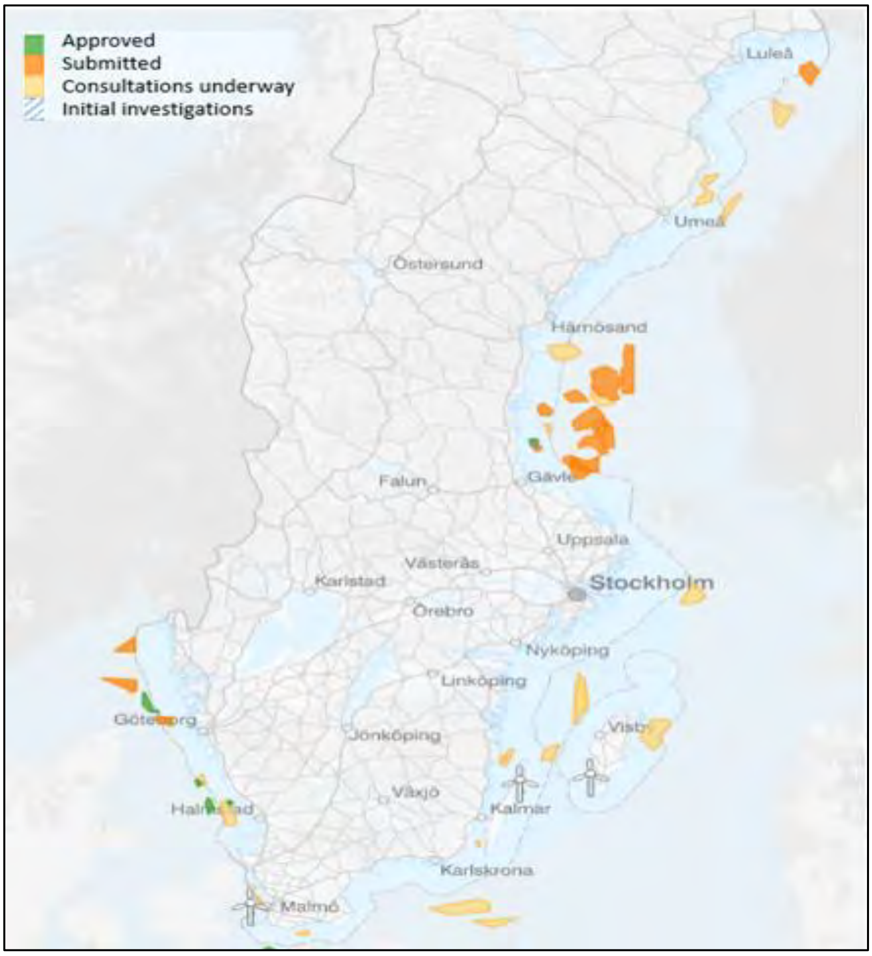

Figure 1: Swedish offshore wind development areas (Vindbrukskollen, 2026)

Furthermore, the offshore wind targets in neighbouring countries Denmark and Norway (as well as other Baltic states) indicate development trends that may become business opportunity in 5-10 years for Swedish ports and industry. The North Sea and Baltic Sea countries have committed in 2022 (Esbjerg) and 2023 (Ostend) to develop nearly 300 GW of offshore wind capacity by 2050. This pledge was reaffirmed by Hamburg declaration (January 2026) to work towards 100 GW in cross-border projects in North Seas by 2050.

Apart from 4 permitted projects, most of the Swedish developers are still awaiting the permit decision for 35 GW of submitted applications but the outcome is uncertain. This creates significant risk for ports that view offshore wind as a promising new business area but lack sufficient assurances that developers will ultimately obtain the permits needed to build these projects. Even if the permits are awarded, the project´s economic viability is questionable as Sweden does not have any green support scheme currently in place; direct off-takers of electricity are hard to land and electricity prices vary on day-do day basis, which makes it highly volatile for offshore wind developers to have a guaranteed income over the next 20-25 years.

The earliest construction of permitted offshore wind projects in Sweden is set to 2030-2032, and evidence shows that port adaptation takes at least 5-7 years before the expected start of the construction. This means that Swedish ports and developers shall already start to engage in a dialogue with industry and investigate how to best prepare to ensure the conditions are in place ahead of the first works on wind farm development.

In this sense, some early work with ports capacity assessment in Sweden has been done during NOW PORTS project in 2021-2023. NOW PORTS developed the Nordic Port Alliance as the basis for future Nordic collaboration and networking. The project showed a need for further improvement of port capacities to meet expected offshore wind power demand, and investigated challenges associated with uncertainty risks and unclear profitability (Nordic Innovation, 2024).

In Sweden, it has become clear that there is a gap in understanding how to develop a cost-effective and sustainable port business model for offshore wind. In general, ports lack a methodology to help them make decisions if and how the offshore wind shall be integrated as a new innovative business. There is also insufficient knowledge about the offshore wind power industry requirements for ports logistics and infrastructure that can fit new generation turbines (15+MW) as well as growing size of installation vessels, cranes and other equipment. Furthermore, there is a need to investigate how shipping companies can carry out logistic operations using ports for installation and maintenance work on offshore wind farms in a sustainable way, decreasing fossil emissions, and using renewable and green fuelling. These are some of the most prominent challenges ports are facing when considering offshore wind as a new business case.

1.2 Purpose and expected impact

This project aims to address some of the gaps regarding uncertainties of integrating offshore wind as a new innovative area in ports' business models. The purpose of the project is to investigate how Swedish ports can best assess and decide on integrating new volumes and business opportunities and act as a value-creating logistics node in offshore wind supply chain. Since requirements for the port physical infrastructure upgrade are investment-intensive, ultimately, the port needs to be able to monetarize the physical space for other purposes and other industries when these are not used by offshore wind. The goal is therefore to identify an approach that can be used by port management to evaluate decisions on scale and volume of the investment, profitability, flexibility, and how to cope with the associated risks. In that sense, the project will provide guidelines as a decision-making tool that can support port authorities throughout this process.

The project is also expected to contribute to the sustainability of shipping operations, partly by creating knowledge about how the maritime logistics system can enable the efficient expansion of green energy in the form of offshore wind power, but also by understanding how the port can meet customer needs in a completely new supply chain. It takes a holistic approach to business, which includes both economic, social and environmental aspects, through efficient and possible fossil-free operations achieving wider societal impact in the region.

2 Role of ports in offshore wind development

2.1 Different scope and requirements for offshore wind ports

The ports' capacities are crucial for effective construction, installation, and operation of offshore wind farms. Ports serve as an interface between land and sea, and their facilities are used to store the wind turbine components and equipment, handle the loads onto vessels, support installation of wind turbines at offshore sites, sail towards the site and back with crew, etc. In terms of offshore wind technology, we differentiate between different types of bottom fixed and floating foundations (Figure 2). Bottom fixed offshore wind represents mature technology, which is installed in shallow waters usually up to 50 m, using monopile, gravity based and jacket foundations. On the other hand, floating offshore wind is an emerging technology that is harnessing stronger winds further from the shore and in deeper waters (over 60 m) with spar, semi-sub, barge and tension leg platform (TLP) foundations. Floating wind is more massive in volumes and size and would typically require deeper quayside draft, larger sheltered storage area, wet storage and bigger bearing capacity at ports compared to bottom-fixed (Arup, 2020).

After final investment decision is taken, the development of an offshore wind farm is usually sequenced in several phases, involving different operational work packages or scopes.

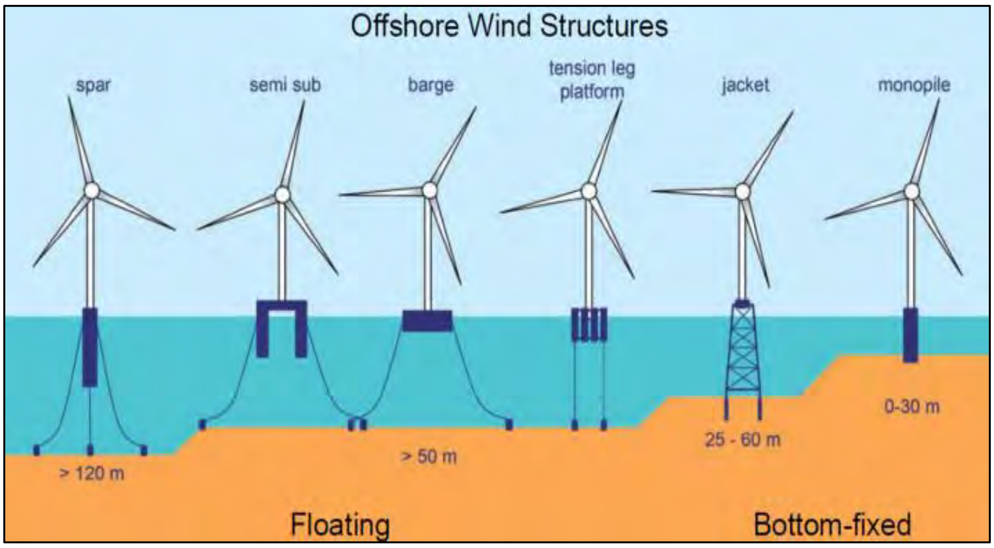

Figure 2: Mainstream offshore wind foundations (Gallardo, et al., 2024)

In general, ports can be classified according to the type of services or work packages they provide. A general categorization involves 4 types of ports:

1. ***Manufacturing or fabrication port:*** *provides services to activities related to manufacturing of wind components, such as towers or foundations.*
2. ***Construction and Installation (C&I) port:*** *host activities for components delivery and temporary storage, pre-assembly and assembly of units/components, cable installation, loading of components onto installation vessels. It also supports installation of foundations and entire wind turbine units, and other complementary services needed for logistic flows and commissioning.*
3. ***Operations and Maintenance (O&M) port:*** *used for activities including regular and unforeseen maintenance and service works on offshore wind farms.*
4. ***Decommissioning port:*** *used for activities that support removal and decommissioning operations after the end of life of offshore wind farm. Need to have similar facilities to C&I port, but larger space and preferably processing unit nearby for recycling components.*

Ports are involved to some extent during all phases of development of offshore wind farm, but most intensive use is during Construction and Installation (C&I) phase and Operation and Maintenance (O&M) phase. C&I phase of the offshore wind farm is the one with the most intensive use of the ports´ facilities, which usually lasts 1-3 years, depending on the size of the project. The O&M phase lasts longer and covers the entire operational lifetime of a wind farm (20-30 years). However, not all ports need to provide services for all the operation packages. Ports will decide which services they can offer based on their business strategy and investment volumes. The highest requirements are for C&I packages, where most of the ports would need to invest significant assets in physical upgrade of their infrastructure. On the other hand, requirements for O&M or cable packages do not usually require major investments and ports can easily adapt to them.

2.2 Port and shipping activities in offshore-wind value chain

In the offshore-wind value chain there are several shipping and port activities that take place. This project focuses primarily on the C&I and the O&M phase because the most intensive activities involving port are taking place in these 2 phases. A general overview of port-to-wind farm shipping activities is given in Figure 3 below.

As noted earlier, activities in the C&I phase in the port typically include manufacturing, assembly, storing, staging, marshalling and installing. Wind turbine and wind farm components and sub-assembled components are shipped to the port via different transport modes, barges, rail or road. Several different vessel types are involved in the C&I phase, depending on the purpose: wind turbine installation vessels, foundation installation vessels, cable laying vessels, offshore support vessels (OSVs), heavy lift vessels, jack-up barges, crew transfer vessels (CTVs) and service operation vessels (SOVs). Transport of equipment is necessary not only to, but also inside wind farms, as well as transport of personnel within different support functions, such as diving support.

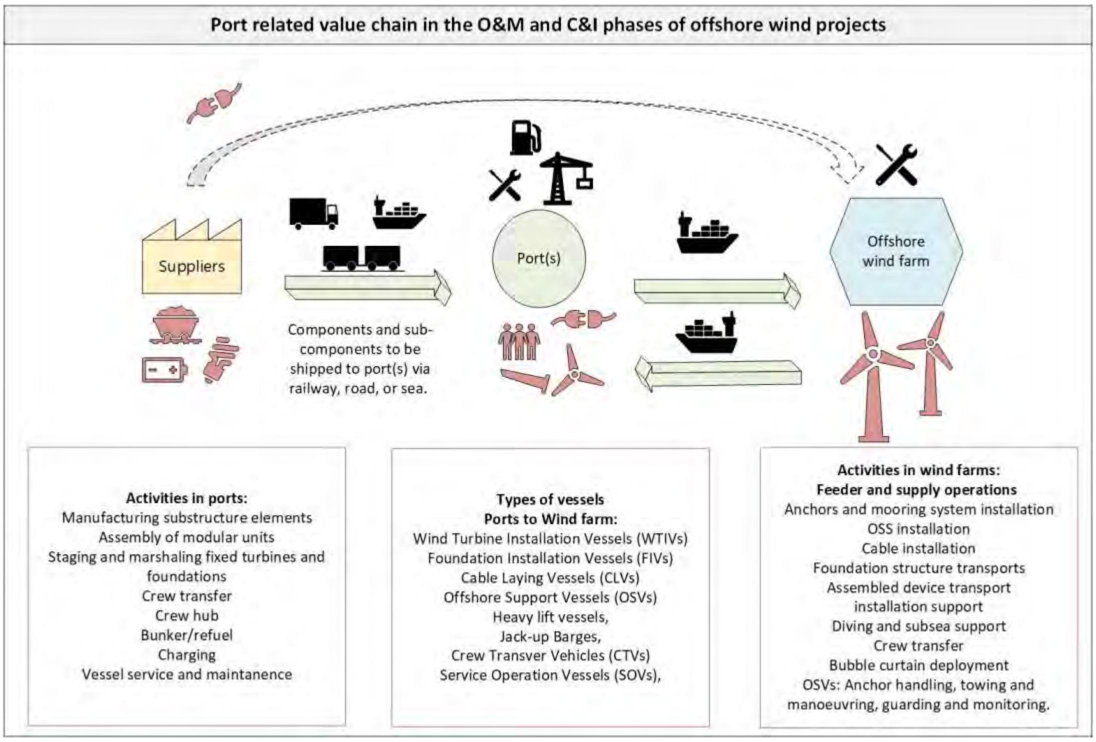

Figure 3: Port, wind farm and shipping activities

For the O&M phase, main purpose is to support activities related to maintenance and servicing life-long operation of the offshore wind farm (20-30 years). In this phase fewer vessels are involved such as OSVs, CTVs and SOVs. Service and supply operations are performed at the wind farm, which includes both scheduled and preventive maintenance as well as unscheduled maintenance. However, in case of unscheduled maintenance, replacement of the major component such as blade would require larger installation vessel so bigger vessels may be sporadically involved in this phase.

For both phases, the vessel crews need to pass through the port that will serve as a crew hub, where ports need to provide infrastructure for the shipping operations e.g. bunkering/re-fuelling, charging and having service and maintenance of the vessels.

2.3 Impact of offshore wind on port business models

For Swedish ports the introduction of offshore wind represents a new and innovative business area. For a port to introduce a new product or service in a financially sustainable manner it is necessary to design and implement a viable business model that leverages existing resources and stakeholder relationships. A business model describes the commercial logic that the business rests upon and business model design should be guided by the strategic direction of the company (Teece, 2010). The potential impact of engaging with the offshore wind industry therefore depends on the port's strategic objectives and its existing business model.

When a company needs to refine or develop a new business model, the task is typically carried out by top managers in close communication with the firm's owners (Chesbrough, 2010). In the case of an established company with a long history, any change to the business model will affect relationships with existing stakeholders. Since ports function as transfer points in often large logistics networks, they become focal nodes for numerous local and international stakeholders whose wants and needs may conflict (Langenus & Dooms, 2018; Magginas et al., 2018). As a result of this high degree of interconnectedness, ports need to consider that their business models are part of a larger business ecosystem of interconnected companies and organizations which put pressure on the organization to adapt context-specific practices (Golzarjannat et al., 2021). Beyond demands from stakeholders such as customers and suppliers, ports also face pressure from authorities and competitors to develop and implement business models that leverage new technologies and offer differentiated, hard-to-imitate customer value (Kringelum, 2019). As an example, ports use digitalization to improve productivity and to create new business models that attract new customer segments by leveraging data and analytics (Henríquez et al., 2022; Wide et al., 2025).

Alongside the external pressures for change originating from the sources described, there are also conservative institutional forces that work to maintain the organizational status quo and resist changes that threaten the existing business model (Chesbrough & Rosenbloom, 2002). Managers may wish to escape the port's specific organizational heritage when developing new business models, but their choices remain shaped by the organization's history. Consequently, both managers and owners innovate within the constraints of an organizational path dependence that is unique to the company (Chesbrough & Rosenbloom, 2002).

3 Methodology

3.1 Multimethod approach and framework selection

The framework for methodology used in this study combines a theoretical approach for innovative business model development and practical work with project participants and case studies. The project involved multiple industry stakeholders to understand different perspectives relevant to development of offshore wind business opportunities at ports.

Ports ongoing business cases were assessed to understand if and how the new innovative business area (such as offshore wind) can be integrated into the existing model. Evaluation of port technical capacities for offshore wind was primarily based on benchmark industry requirements for the most demanding phase in development of offshore wind farm that is, Construction & Installation. Minimum functional requirements were identified for this phase assuming latest 15MW generation of wind turbines for both bottom fixed and floating wind turbine foundations. The benchmark requirements were evaluated based on the relevant reports and interviews with the industry participants. Ports infrastructure capacities were mapped and presented as brochure in annex of this report.

Secondly, to examine and illustrate the potential commercial implications of engaging with the offshore wind industry, business model concept was used as analytical lens, treating it as a framework for identifying the core activities, resources, and relationships that enable a port to create revenue and maintain its operations over time (Osterwalder & Pigneur, 2013). The report therefore outlines the main types of value that ports can offer stakeholders in the offshore wind sector and explains how these forms of value can be generated through both existing capabilities and newly developed processes and assets.

When working with business modelling, it is necessary to recognize that there are multiple types of business model definitions and frameworks that can be used to operationalize the business model concept. In this report, the Business Model Canvas (BMC) is used, which describes the business model as consisting of nine distinct but interconnected building blocks (Osterwalder & Pigneur, 2013). The building blocks explain revenue generation and costs as well as associated incoming and outgoing cash flows. These building blocks are: the value proposition that the company aims for, the customer segments included in the business model, the customer relationship, the channels used to deliver value to customers, the key resources and key activities necessary to produce the value, the key relationships that the business model builds on, and the costs and revenues that the business model generates.

Lastly, the model included assessment of sustainability aspects in view of growing demand for green, fossil-free vessel fuelling infrastructure at ports to be used during offshore wind C&I and O&M phases as to understand how the shipping operations impact the environment. The decommissioning phase's environmental impact at the end of an offshore wind project was not considered. The study focused primarily on shipping activities related to bottom fixed wind farm as most of the Swedish ports are suitable to this type of technology which will most likely also be firstly installed. The approach involved mapping of shipping and port operations that were linked to different environmental impacts and identification of factors influencing the sustainability of port-related operations in offshore wind park. Data was collected through interviews and sustainability reports of participating shipping companies involved in C&I phase and O&M phase.

In practical terms, the project used a multi-method approach combining data gathering, different sources and case studies:

Data gathering: Primary sources (semi-structured interviews, email surveys, site visits, and workshops) were combined with secondary sources (public information, internal documents, annual reports, and news articles). Comprehensive desktop research was conducted to gather latest data relevant to the business development of the ports towards offshore wind industry as well as to understand needs from the wind industry towards ports, including risk assessment and uncertainty. 18 interviews were conducted with port authorities, wind developers, installation contractors and shipping agencies to obtain data and situational assessment. Two online workshops were organized where the wind industry presented the latest technical requirements for ports infrastructure capacities. These workshops provided both input to the model and capacity building to ports. Networking meetings were organized at Wind Europe 2025 in Copenhagen and Energy Summit in Poland, Gdansk, 2025.

Case studies. Following the initial ports analysis which provided insights into their infrastructure capacities and ongoing businesses, the project selected 3 major ports (Trelleborg, Gävle and Wallhamn) as examples for detailed assessment. Additionally, Kålvik port was evaluated as a special case of evolving future floating offshore wind port as well as Kattegat port alliance as example of ports collaboration.

Study visit. A study visit to Ronne Port and Offshore Centre Bornholm (Danmark) was organized in October 2025. It both increased knowledge of port and showcased development of offshore wind port as well as provided networking and collaboration opportunity with Danish offshore wind stakeholders. Lessons learned were used as input for the model.

Due to strategic sensitivity of business model innovation, notes were anonymized and analysed collectively to protect participants and sensitive information.

3.2 Project participants

The project recruited some of the major actors in supply chain for offshore wind farm installation & operation in Sweden and Northern Europe as to gather latest and most relevant information. The following groups of stakeholders were part of the project:

1. Ports (target group). Ports are strategic anchoring point due to their location, facilities and proximity to supply chain. Ports involved in this project ensured good geographical coverage including some of the major logistic hubs in Sweden: Trelleborgs hamn, Göteborgs Hamn, Gävle Hamn, Wallhamn, Ystads Hamn, Smålandshamnar, Söderhamns Stuveri & Hamn, Falkenbergs Terminal och Hamn, Stockholms hamnar, Hallands Hamnar and Kålviks Hamn.

2. Wind developers and Wind Turbine Generator (WTG) manufacturers. Both are crucial for port capacity building, industry knowledge transfer and dialogue about future business opportunities and project derisking. Developers cover all phases of the wind farm life cycle (design, installation, operation decommissioning), and they are responsible for screening and selection of ports to be used for wind farm construction and operation. In this project participated some of the major developers in Swedish market: Vattenfall, OX2, RWE, Zephyr, Eolus Vind, Freja Offshore. WTG manufacturers work hand-in-hand with developers during installation and operation phases and are involved in port selection. WTG in this project was represented by Siemens Gamesa Renewable Energy.

3. Shipping agencies. EPCI (Engineering, Procurement, Construction & Installation) contractors are responsible for implementing sea (offshore) operations related to the C&I phase of the wind farm project. They own specialized vessels and equipment carrying out construction and installation operations from the port. EPCI was represented in this project by Jan de Nul. Service vessel owners, such as Northern Offshore Services (N-O-S) are supporting O&M operations with CTV and SOV fleet. The collaboration with N-O-S and Jan de Nul provided input regarding port requirements, sustainability and maritime shipping operations between port to wind farm.

Additionally, project reference group involved **Nordic cluster organisations** (Norwegian Offshore Wind cluster, Energy Cluster Danmark), as a backbone for networking and information sharing and best practices from Nordic region. The main Swedish port association, Sveriges hamnar (Transportföretagen), was included in the reference group for synergies and alignment with the port sector.

4 Results

The study investigated a method for integrating offshore wind in business model of Swedish ports and was based on 3 interlinked segments: technical assessment of port infrastructure capacities, business model analysis and assessment of environmental impact of shipping and port operations for offshore wind parks.

4.1 Swedish ports infrastructure capacities

Gap assessment of current capacities of Swedish ports participating in this project against requirements for C&I phase was done in view of the latest offshore wind industry benchmarks. Ports should fulfil minimum infrastructure requirements regarding the navigation channel dimensions, air draft, seabed conditions, ground bearing capacity and storage area, quayside dimensions and draft, heavy duty bearing capacity at quay to accommodate installation vessels, as well as storage, loading and assembly of wind turbine components (GDG, 2022). In this project, the minimum functional requirements for port infrastructure during C&I phase for both bottom fixed and floating offshore wind were identified (Table 1)[1] as a baseline for gap assessment of the Swedish ports´ capacities

[1] Parameters are derived from interviews with industry representatives involved in the project and literature review listed in the reference section of this report. Minimum benchmark requirements are generalized to simplify overview, but assessment for any specific project would require a separate analysis.

involved in the project. The wind farm of 750-1000 MW with the individual WTG of 15 MW is used here as reference size.

REQUIREMENT	BOTTOM-FIXED	FLOATING
Air draft	Installation vessels: 125m (sailing), 202m (operations)	No air limitation should be set due to growing size of floating structures to be transported by installation vessels
Navigation channel width	120m	150m
Navigation channel depth	9-12m	Depends on the type of foundation: Spar: 90m Semi-sub and TLP: 12-15m
Draft at quay	12.5 m	Depends on the type of foundation: Spar: 90-100m Semi-sub and TLP: 12-15m
Seabed	Stiff clay or sand also suitable to jack up operations	n/a
Storage area and pre-assembly	18-20 ha	34-50ha (covering manufacturing, assembly and installation needs)
Quay berth dimensions (heavy duty) with exclusivity access for vessels	250m length and 60-80m width	600-900m length and 40-80m width
Swell and tide	10-12 m/LAT	10-12 m/LAT
Bearing capacity	15t/m2–40t/m2 of ground pressure depending on scope (nacelles, blades, tower, etc); 10-12 t/m2 uniform load; 30-40 t/m2 concentrated load	Storage capacity : 7.5t/m2–≥20t/m2; Quay side capacity: 15-50t/m2
Office space	700- 1000 m2	700- 1000 m2
Other important facilities	Heavy duty Ro-Ro preferred	Wet storage area: Min 80 ha Wet storage draft: 13-23m

Table 1: Minimum infrastructure requirements for bottom-fixed and floating offshore wind ports (C&I phase)

The analysis of ports capacities showed that their infrastructure is currently insufficient to serve industry needs for full construction, assembly and installation service packages. Some of the ports have partially suitable infrastructure, for example, minimum storage area may exist, but there is no sufficient heavy bearing quay, or draft at quayside may be too low or there is no jack up possibility, etc. Today, most of the ports can offer storage for certain wind components, or partial pre-assembly or installations works, as well as infrastructure for maintenance and operation of the wind farm and connection point for incoming energy

& electricity. Detailed presentation of the infrastructure facilities of Swedish ports involved in this project is given in Annex 1 (Ports Brochure: Offshore Wind Ports in Sweden).

However, despite limited capacities, the ports are willing to commit to additional investments to upgrade their infrastructure should there be a viable business case and customer that can guarantee investment return. Most of the adaptation work would involve upgrade of port basins (dredging, extension/deepening/reinforcement of quays, etc.), reinforcement of ground to ensure load-bearing capacity and access to roads and handling equipment, reconstruction of certain quay sections to be able to handle longer ships and extension of land area for storage. Early engagement of ports in the offshore wind development plans is crucial to allow them enough time to plan permits, budget, resources, etc.

For the Swedish ports involved in this project, infrastructure upgrade and investment needs may vary from port to port, with some ports having to conduct minor to medium adjustments, while others will have to invest highly to adapt their facilities to use of wind industry. When it comes to manufacturing port, there are no production sites of major wind components currently in Sweden. Some ports on the west coast have considered plans for developing their facilities as manufacturing port for floating foundations, as to accommodate floating offshore wind projects on west coast of Sweden and North Sea basin. On the other hand, most ports already have adequate facilities that might require minor upgrades for service (O&M) port and some other packages to support logistic flows, which can be easily integrated into their business model.

Ports have several options for financing that sometimes also involve innovative management models. Financing is done via private and public funding, but primarily through loans from commercial banks. As a derisking strategy, in some cases there is a joint venture with another company that invests in the port facilities and runs part of the offshore wind business. On European level, ports have been flagged as strategically important for future of European marine industry. In March 2026, the European Commission adopted EU Ports strategy with aim to strengthen their competitiveness and enable acceleration of green energy projects (including offshore wind) as well as ensure safety and defence functions. In this regard, ports can co-finance their infrastructure via Connecting Europe Facility (CEF), Cohesion funds and Invest EU as well as get support via advisory services and de-risking tools (European Commission, 2026).

4.2 Port business models for offshore wind

To clarify how business models may evolve for ports engaged in the offshore wind sector, we propose a categorization comprising four key port business models for serving the industry (Table 2). This categorization focuses specifically on business models and, although similar in some respects, differs from the categories presented in Chapter 2, which are based on a broader set of criteria.

Each business model has distinguishing traits that are grouped and linked to the key components of the Business Model Canvas (Canvas described in Methodology Chapter).

Port Category	Description
Construction, installation and decommissioning (CID)	Construction, installation and decommissioning (CID) ports handle and support large-scale manufacturing, pre-assembly, assembly, installation, and end-of-life removal of offshore wind farms. This category also includes manufacturing or fabrication ports.
Service (O&M)	Service ports provide long-term operational support, including maintenance facilities, vessel berthing, and logistics for ongoing wind-farm operations. The business model thus contains the Operation & Maintenance port.
Combined	Combined ports integrate both construction and service functions, enabling them to support installation campaigns while hosting O&M activities.
Auxiliary	Auxiliary ports offer complementary capacity for specialized tasks, overflow needs, or niche services within the offshore wind value chain.

Table 2: Categories of port business models for offshore wind

4.2.1 Construction, installation and decommissioning port

The construction, installation and decommissioning (CID) business model covers ports that provide the space, infrastructure, and logistics needed to manufacture, assemble, and eventually dismantle offshore wind farms. During the construction phase, the port handles large components such as turbines, monopiles, blades, and cables, supports heavy-lift operations, and coordinates frequent vessel movements. In the decommissioning phase, the port serves as a base for bringing components back to shore, sorting materials, and preparing them for recycling or disposal. In both phases, the port functions as a central hub and must ensure that activities comply with environmental and safety regulations while maintaining efficient operations for all users.

CASE STUDY 1

PORT OF TRELLEBORG

LOCATION:

South coast (Skåne Region)

OWNERSHIP:

Municipality-owned

CORE BUSINESS:

Largest RoRo port in Scandinavia

FOUNDATION SCOPE:

Bottom-fixed offshore wind

Port of Trelleborg provides an example of how a port can integrate offshore wind–related activities within an existing and capacity-intensive operational environment. During the construction of the German section of the Kriegers Flak offshore wind project (2016), the German company Hochtief AG used the Port of Trelleborg for the transshipment of concrete jackets during C&I phase. For Port of Trelleborg, the project began in 2013 with the arrival of the construction elements, which had been manufactured on Funen in Denmark and transported to Trelleborg by barge. In Trelleborg, the jackets were lifted on board for transport to the installation site. The transshipment required a seaborne crane capable of lifting the 600-ton and 60-meter-tall concrete structures. Transport to the site required calm seas which thus meant potential disruptions in operations due to poor weather. Despite the port's extensive commitments to RORO-traffic and intermodal freight flows, these activities were accommodated without significant disruption to core operations, illustrating a high degree of operational flexibility and organizational adaptability. The port's short navigational channels and well-developed support functions enabled efficient vessel movements, while the ability to host engineering teams and manage time-sensitive offshore logistics contributed to reliable project execution.

The value proposition of the construction and decommissioning port focuses on providing the physical assets and services required for actors to carry out manufacturing, construction, assembly, and decommissioning of foundations, monopiles, blades, and related components. This requires a deep basin suitable for activities such as assembling floating pylon foundations, extensive storage areas for components, access to raw materials sourced locally or transported to the site, and facilities appropriate for tasks such as mounting wind turbine blades. The construction and maintenance of quays, basins and storage areas with sufficient carrying capacity are therefore essential, but they also constitute major cost drivers.

Important customer segments include wind farm developers, construction companies, operators, and technology developers. Each of these segments may be involved in different phases of wind farm development, and they require tailored value propositions. This, in turn, means that the port must shift its focus between key assets and activities depending on the phase of development the wind farm project is in and the customer segment that is in focus. To understand customers' needs and establish a suitable sequence of activities, it is important that the port engages in relationship building through direct and frequent contact.

Key assets include the location of the port, ideally close to the wind farm, but additional factors such as basin depth, high load bearing capacity, and natural harbour conditions that remain accessible even at low tide further strengthen the business case. Given the long-term strategic implications, it is also necessary to have a plan for the future use of the area dedicated to construction. Since environmental impact assessment is a key concern for regulators, the port must also determine what role it will play in the restoration of the area where the wind park is located during decommissioning phase. The port must also accommodate the storage and servicing of large construction equipment and cranes, and either host or source skilled labour specializing in concrete and steel construction.

Turning to the key activities it appears as if the core management concerns of the construction and decommissioning business model involve defining an attractive value proposition that aligns with the port's strategy, securing long term customer relationships, obtaining the necessary permits and managing resulting changes in and around the port, building relationships with key suppliers of hardware and services, and arranging the resources and activities required for the port organization to meet the operational demands associated with the value it aims to deliver. The duration of construction and decommissioning phases in offshore wind projects varies with project scale and port capacity. To support these phases, ports form partnerships with property owners, municipalities, regulatory authorities, developers, and other ports that supply materials or receive redirected flows. Such collaborations streamline permitting processes and help ensure alignment with broader regional development and sustainability objectives. Additionally, because construction, assembly, and decommissioning activities often extend over several months and in some cases even multiple years, there is a significant risk that existing customer relationships may be affected. Since freight flows that shift to other ports can be difficult to regain, it is widely considered essential that the port implement its offshore wind business model in a way that preserves its existing customer portfolio and service levels during intensive periods of these works. To avoid commercial cannibalization of existing business models, the management team needs to identify the potential impact that a construction and decommissioning business model may have on current operations.

Regarding key relationships, it is important for the port to maintain strong ties with local authorities, as this strengthens its ability to navigate regulatory requirements and improves its understanding of how local stakeholder groups are affected by port activities and how their intentions may influence future plans. The port also needs to establish and maintain long-term relationships with key suppliers such as construction firms, and support these actors with clear information throughout all phases of the project. By proactively working with key actors the port can ease permitting processes and improve customer retention.

The cost structure of the construction and decommissioning business model is dominated by high fixed costs which arise from the high utilization of fixed port infrastructure. Revenue is generated through leasing space and facilities to one or more customer groups, charging fees for various port activities and services, and renting out machinery. Long-term contracts with guarantees from customers are particularly valuable for ensuring financial stability and mutual commitment.

4.2.2 Service port

Offshore wind farm sites are expected to operate for 20 to 30 years. To keep wind turbines functioning in the harsh offshore environment, it is necessary to continuously monitor the machinery and carry out both regular maintenance and occasional repairs. These and other associated services create a long-term demand for port services such as providing accommodation for service technicians, offering tools and machinery for repairs or manufacturing of parts, as well as renting out storage and workshop space to wind farm operators. The operational phase therefore offers a stable source of business for a port. Focusing on services targeting actors operating the offshore wind farm, this is a service-centred port business model similar to what is often referred to as an Operations and Management (O&M) port. A service port thus requires a business model that emphasizes long-term planning, operational efficiency, and strong partnerships.

The value proposition of a service port business model focuses on offering a range of port-related services tailored to actors involved in the operation of the offshore wind farm. It is therefore necessary to work closely with key customer segments involved in different operational tasks, such as offshore service providers, and understand the types of value that enable them to succeed in their work. This may include providing quayside support for service vessels, facilitating efficient crew changes, offering provisioning, or supplying different types of storage space for materials and parts needed for maintenance and repairs. Ideally, customer relationships are long-term, although short-term engagements may be appropriate for certain segments. Engagement is maintained through close business relationships. Because external staff are present on site on a continuous basis, it is necessary to support them through physical meetings, integrated business systems, and other digital communication channels to ensure that they remain up to date on operational, security, and safety issues.

Key resources include service-minded and skilled staff, technical competence, cranes, quays, and appropriate storage facilities. It is also crucial for the port to have strong connections to other transport infrastructure, such as airports and ports that supply materials and components. The key activities of service ports involve planning and managing capacity and utilization to ensure smooth and efficient operations. Key partners typically include operators and logistics companies specializing in sea-based freight. A service port may have proportionally higher operating expenditure due to staff-related costs. However, if new or specialized inventories are required, this can also lead to increased depreciation, fuel consumption, and maintenance costs. Desirable contracts are those that align with depreciation schedules and offer attractive terms for all parties involved.

4.2.3 Combined port

Ports that consider engaging with offshore wind power must evaluate not only the construction- and service-oriented business models individually, but also the possibility of combining them. The combined port model represents an attempt to integrate these two approaches, offering both strategic opportunities and notable risks.

CASE STUDY 2

WALLHAMN

LOCATION:
West coast (Västra Götalandsregion)
OWNERSHIP:
Privately-owned
CORE BUSINESS:
Major port hub for export/import of the vehicles in the Nordics
FOUNDATION SCOPE:
Bottom-fixed and floating offshore wind

Wallhamn illustrates how a port with a diversified operational profile can identify strategic opportunities in relation to the offshore wind sector. The port's geographical location and industrial context provide conditions that could support activities such as the production or assembly of floating foundations, drawing on existing material flows and logistics capabilities. Wallhamn's available land areas, combined with its established handling of specialised cargo and access to relevant industrial inputs, creates a foundation for potential synergies between offshore wind activities and current port operations. These synergies include the possibility of integrating new manufacturing or pre-assembly processes with ongoing logistics, thereby enhancing the port's long-term industrial relevance.

The combined business model increases the strategic exposure of the port to changes in the offshore wind sector. The combined business model also means that the port will need to build up and maintain skills and resources that allow it to excel in two distinct areas. Yet, by capturing both dimensions, the port's engagement with the offshore wind sector will be longer, thus giving rise to opportunities for increased specialization and economies of scale. This makes the combined port an attractive business model for ports that wish to engage with offshore wind power over an extended time horizon.

However, the diverse requirements of construction and service activities mean that synergies between the two areas may be few while investment needs remain high. Moreover, because the service model requires lower levels of investment, more ports are likely to pursue it, which increases competition. The combined port business model is thus a potentially risky choice if there are ports in the vicinity, or located closer to the offshore wind site, that have the potential to develop into dedicated service ports for the offshore wind sector.

CASE STUDY 3

PORT OF GÄVLE

LOCATION:

East coast (Region Gävleborg)

OWNERSHIP:

Municipality-owned

CORE BUSINESS:

Full-service port that handles a variety of goods, including containers

FOUNDATION SCOPE:

Bottom-fixed offshore wind

Port of Gävle illustrates the challenges inherent in operating a combined-port model. The ports' main mission is to serve the regional industrial companies with infrastructure for logistics. Hence, the ports customer relationships is built on long term commitments with regional business and industry. The port handles substantial container, bulk, and energy flows that cannot be displaced without disrupting established industrial supply chains, yet it also has land areas, suitable draft, and heavy-lift capacity that make it relevant for selected offshore wind activities. This combination requires the port to rely on adaptable and reconfigurable areas rather than fixed, single-purpose zones. Major investments in bearing capacity or new quay structures only become viable if multiple projects can be sequenced over time, ensuring long-term utilisation. As a result, the port depends on modular and flexible land use, integrating construction-related opportunities with ongoing O&M-compatible activities while continuously reallocating space to balance risk, capacity, and long-term industrial relevance.

4.2.4 Auxiliary port

Auxiliary ports help the main offshore wind ports with different tasks but are not the primary actor involved in the construction or services targeting the offshore wind sector. The growing complexity of offshore wind development places increasing demands not only on primary offshore ports but also on the wider regional port system that supports them. Providing services to the offshore wind power sector entails operational challenges and may require the port to renegotiate relationships with existing customers.

Moreover, as offshore wind power projects continue to scale up, the task of serving the offshore sector becomes increasingly demanding, even for relatively large ports. Because of these business-related and operational risks, as well as the potential need for temporary expansions in equipment or storage capacity, it is essential for ports targeting the offshore industry to collaborate with neighbouring ports and identify those willing to act as auxiliary ports. The structure and aim of the collaboration will then decide how the existing business model is impacted.

EXAMPLE OF PORT COLLABORATION

KATTEGAT PORT ALLIANCE

Swedish Ports of Halland and Danish Port of Grenaa

In 2025, Swedish Ports of Halland (Port of Halmstad & Port of Varberg) and Danish Port of Grenaa joined in a partnership *Kattegat Port Alliance* to collaborate around cargo mobility, energy and offshore wind. Due to their geographical proximity and long history of ferry service, they identified joint business opportunity to provide services for offshore wind projects to be developed in Kattegat Sea basin.

Position of Ports of Halland within the Kattegat Port Alliance presents it as an auxiliary port that strengthens the regional capacity for offshore wind logistics. Through the partnership with Port of Grenaa, the port contributes additional land, storage options, and logistics capability that complement Grenaa's established offshore wind expertise. The collaboration helps the two ports combine resources, optimise goods flows, and handle complex project logistics more efficiently, particularly within offshore wind, the energy sector, and existing cargo segments. Ports of Halland support smoother transport chains and more cost-effective handling of wind-power components, while also helping the broader logistics system that surrounds major offshore wind developments. The auxiliary role allows the port to remain focused on its established cargo operations while contributing flexible capacity and operational support to the offshore wind sector as part of a coordinated regional effort.

The expansion of offshore wind power is likely to have positive impacts on ports located close to, or well connected with, those directly serving the offshore wind industry. The auxiliary ports may not be directly involved in the construction or servicing of offshore wind farms but instead contribute to the industry's growth by enabling primary ports to allocate more of their resources to offshore wind operations. In practice, this support can include providing temporary storage capacity, handling overflow traffic, or offering logistical flexibility during peak construction periods. In a scenario where the port only scales up its existing operations the business model may not be affected at all, while in other scenarios the impact may be considerable. Taken together, an expansion into the offshore wind sector by one port may thus reshape regional port networks, creating new interdependencies and opportunities across a broader geographical area.

4.3 Business model development and implementation

Each business model described above requires careful evaluation and the development of a context specific design prior to implementation. Nevertheless, there are general characteristics of the business models that should be compared and explored. Therefore, the market potential, revenue characteristics, infrastructure needs and comparative investment scale of each of the business models is presented in the following table.

Business model	Market potential	Revenue characteristics	Infrastructure needs	Investment scale
CID port	High revenue per project; dependent on large-scale installation campaigns	Large but episodic revenue; long term prospect requires securing multiple projects	Deep draft, heavy-lift quays, large storage, high bearing capacity	Medium to very high
Service port	Long-term, stable demand over 20–30 years	Predictable and recurring revenue	Quay access, workshops, smaller warehouses, crew facilities	Low to medium
Combined port	Access to both revenue streams	High potential but also high exposure and competition	Must meet both sets of requirements	Very high
Auxiliary port	Indirect revenue from overflow, storage, logistics services	Lower revenue but lower investment and risk	Flexible storage, overflow capacity, logistics support	Low

Table 3: Key characteristics of the four business models

Moreover, the implementation process itself involves several critical steps that will ultimately determine the viability of the model. Given the substantial values at stake and the associated business risks, decision makers will encounter significant uncertainty throughout the process. To structure this journey and to give stakeholders insight into the complexity of developing and implementing a port business model that serves the offshore wind power industry, we present a brief overview of key decision pathways. It is necessary to note that while these steps are presented as being sequential, they may occur simultaneously or in a different order.

4.3.1 From Conceptualization to Realization Across All Models

The four business models share an initial sequence of decisions. The key steps from initial conceptualization to finished decision proposal of ports flow chart are presented in Figure (4) below.

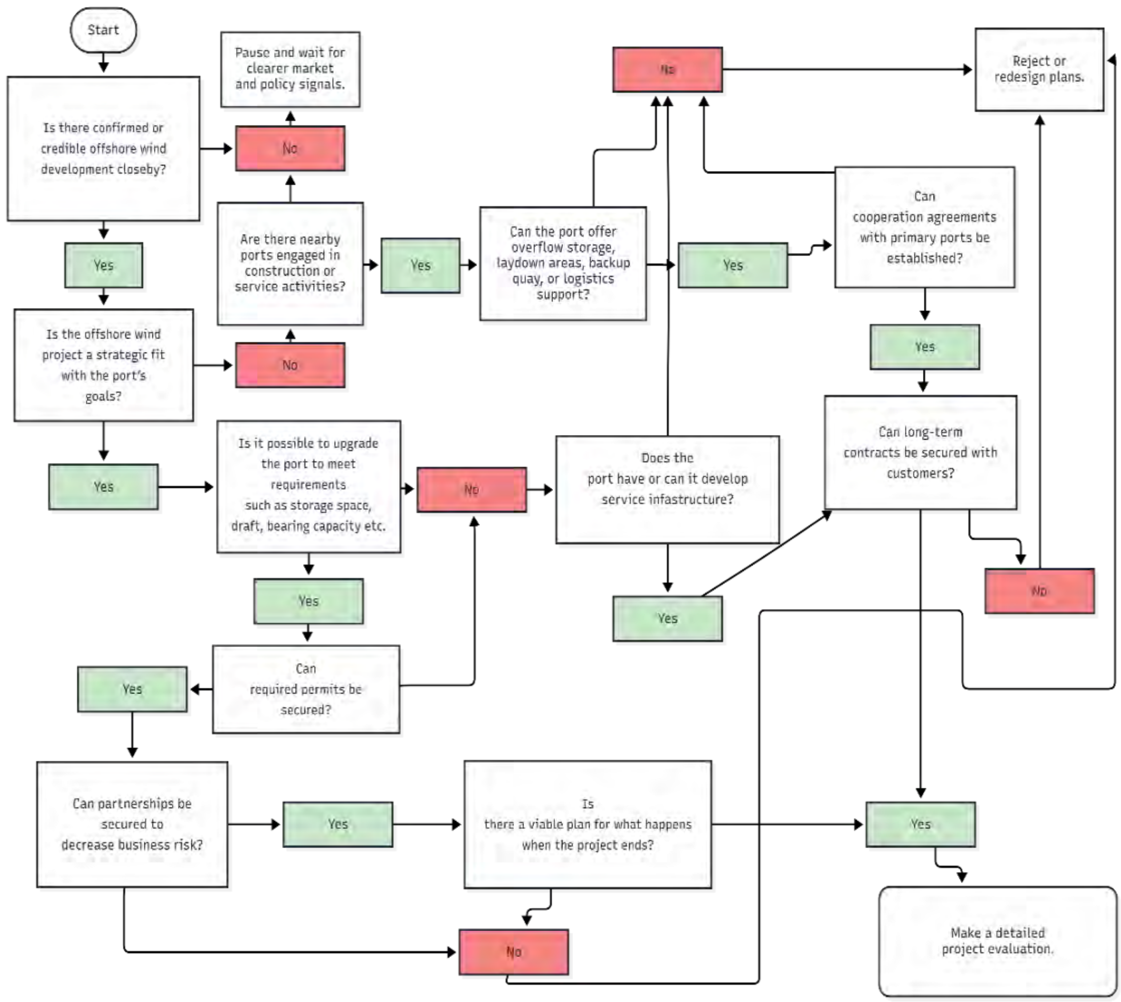

Figure 4: Decision-making flow chart about offshore wind business for ports

Ports must first determine whether there are confirmed plans for offshore wind activity in the region or if it is reasonable to expect that such plans will be realized. If not, the process should be halted and the plans kept until clearer policy or market signals are identified. If activities or credible plans are present, the port needs to assess its strategic intent to enter the offshore wind market. Once a strategic fit between the port's existing goals and an expansion into offshore wind power is confirmed, the port must decide which customer it intends to serve and through which business model this should be done.

A detailed description of the decision-making process for each business model category is provided in the subsequent sections. These serve as guidelines to support port authorities in evaluating business models for offshore wind.

Decision Process for CID ports

For ports pursuing a Construction and Decommissioning model, the first step is to assess whether their physical characteristics allow for handling large structures, including deep basins and quays with high load bearing capacity. If the port cannot accommodate these requirements, it must evaluate whether upgrades are feasible at a reasonable cost. If upgrades are not feasible, the model should be rejected. If the port already has the necessary infrastructure, or if upgrades are possible at an affordable cost, the next step is to secure permits, including those related to environmental, land use, and operational aspects. Failure to secure permits means that the model will need to be rejected or that work will need to pause while the model is further developed.

CASE STUDY 4

PORT OFKÅLVIK

LOCATION

Northern-west coast (Västra Götalands Region)

OWNERSHIP:

Privately-owned

CORE BUSINESS:

Development of new floating offshore wind port under way

FOUNDATION SCOPE:

Floating an**d** Bottom-fixed offshore wind

Port of Kålvik illustrates how permitting processes can constitute a constraint for ports seeking to position themselves within the offshore wind value chain. The port possesses several advantageous physical characteristics, including significant natural depth close to shore and stable geological conditions, which together provide favourable conditions for activities such as the construction or assembly of floating wind foundations. Despite these favourable conditions, the port's development has been so far impeded by a complex regulatory landscape and lack of policy support. Nevertheless, Kålvik remains strongly committed to develop as a future offshore wind port and continues its efforts to overcome permitting constraints.

Once permits are secured, the port must rely on existing or establish new partnerships with stakeholders that are necessary for the project. If these partnerships cannot be secured, project specific risk may increase beyond what is tolerable, and the process should in that case be paused. If partnerships are possible, the port must ensure it can protect existing customer flows during peak construction and operation periods. If this cannot be achieved, the project poses considerable risk to the current operating model. To move forward either the offshore business model or the current operational model must be redesigned or else the offshore business model should be rejected. Next, the port must confirm that forecasted revenues, such as space leasing and fees for equipment and services, justify the investments required. If not, the port should reject or redefine its approach, potentially shifting to a service or auxiliary model. Lastly, the port must have a viable plan for decommissioning support and site restoration; if not, further redesign is necessary. If all these steps are satisfied, the port can proceed with detailed investment planning and contracting.

Decision Process for Service Port

For ports seeking to provide services, the first step is to identify a clear value proposition and a suitable customer base that can offer reliable demand over time. Demand may come from actors operating existing wind parks or from confirmed future parks that are under development. Although the service model carries lower risk and offers greater operational flexibility compared to the previous model, the current policy climate makes it necessary to confirm demand before moving forward. If a viable market exists, the port must either have or be able to develop service quays, crew transfer capabilities, storage for spare parts, and access to airports or major transport hubs. If any of these elements cannot be upgraded at a reasonable cost, the model may perform worse than it would in other ports.

Next, the port must ensure that it has a workforce capable of supporting its customers. If this is not possible, the port should pause its plans or seek partnerships with specialized contractors. If workforce development is feasible, securing long-term service agreements reduces business risk. Local stakeholders such as municipalities and educational institutions may find a long-term customer presence attractive and may therefore be open to collaboration. Without such agreements, financial stability remains uncertain and the port should delay its plans until conditions improve.

Finally, operational expenditure must be manageable, including costs related to staff, vessel handling, and maintenance. If these expenses cannot be kept at sustainable levels, the port must redesign its cost structure or abandon the model. Once these criteria are met, the port can develop the necessary infrastructure and proceed by contacting potential customers.

Decision Process for Combined Port Model

The combined port model requires medium to long term demand for both the C&I phase and the O&M phase. If only one phase shows strong demand, the port should select the corresponding single-phase model. If demand exists for both phases, the port must be able to separate construction flows from service flows both physically and operationally. If this cannot be achieved, the risk of operational disruption increases, and the port should either reject the model or redesign its layout.

The port must also assess whether synergies such as shared equipment, shared workforce, or shared logistics are realistically achievable. If they are not, the port should proceed only if the business model is expected to remain viable on its own. Investment needs must be sustainable, meaning that medium-to-high investment levels are acceptable if they can be distributed across both phases. If investment requirements become too large, the port should defer its plans, reduce the scope, or shift to a service only model.

Finally, securing both long-term and short-term contracts is essential for reducing revenue uncertainty. If such contracts cannot be secured, the port should pause its plans. When all conditions are met, the port can move forward with phased investments and dual service operations.

Decision Process for Auxiliary Port Model

For auxiliary ports, the first step is to confirm the presence of nearby ports engaged in construction or service activities. If no such ports exist, there is no role for auxiliary support, and the port should either wait for future developments or broaden the search to include ports located farther away. If suitable ports are identified, the auxiliary port must determine which types of services it can realistically offer. For example, it may provide overflow storage, temporary laydown areas, backup quay capacity, or general logistics support. If none of these services can be delivered or are requested by primary ports, the model should be rejected.

Next, because cooperation between ports is central to this model, it is necessary to define and formalize appropriate cooperation agreements with primary ports. The structure of these agreements will influence the overall business risk. Yet, if a suitable legal and strategic fit cannot be achieved, the port should pause further work on this business model.

Investments should be reasonable in relation to the expected business risk, and where possible, a flexible investment plan will allow the port to maintain a low risk profile. If this is not achievable, the port should reassess its approach. If the above conditions are met, the port can move forward by investing in the relationship with the primary port and work on potential project-related investments such as flexible storage and logistics capacity.

4.3.2 Bottlenecks and opportunities for ports targeting offshore wind

For this study port representatives have presented several factors that either blocked or facilitated the development and implementation of a business model focusing on the offshore wind power industry. When examining the factors it was possible to categorize them into eight key clusters. First, the ports' physical infrastructure is a decisive factor for offshore wind readiness. Many facilities face limits such as low load-bearing capacity, aging quays, and insufficient basin depth, which restrict handling of heavy components and large installation vessels. At the same time, some ports already have deep-water sections or heavy-lift areas used for other cargo, offering a foundation to build on. Overall readiness varies widely, but targeted upgrades to infrastructure could enable significant business opportunities.

Second, land access and spatial constraints are a persistent challenge since ports often lack large areas suitable for laydown, preassembly, or long-term storage, due to existing flows already occupying most usable land. Displacing these activities may not be feasible given commercial obligations. At the same time, ports may hold substantial raw or adjacent land that could be developed. Immediate availability is limited, but long-term strategic development could turn this constraint into a future advantage. Third, there are issues with ports' operational capabilities. Suitable heavy-lift cranes are rare, and ports are dependent on existing flows that they cannot pause or displace without commercial loss. At the same time, ports have strong logistics ecosystems, experienced operators, and in some cases extensive experience with land-based wind logistics. Such capabilities lower learning curves and provide a solid base for storage, marshalling, or O&M activities even if full installation capacity is not yet in place.

Fourth, one of the most concerning barriers is the permitting and regulatory environment. It poses one of the most significant bottlenecks, and is characterized by long, uncertain, and obscure processes involving multiple agencies and, in some cases, government-level decisions. In a worst-case scenario a port may enter a regulatory limbo or catch-22 where ports need developer commitments to secure permits, while developers need ports that already have permits. Nevertheless, some ports benefit from transparent governance and proactive planning, but overall, clearer national guidance and better coordination are needed to accelerate development. Fifth, energy and grid capacity are limiting factors that constrain the port's ability to offer shore power, support electrified construction equipment, or host energy-intensive operations. If a port already has maxed out the local capacity, it will be forced to decline new initiatives. Yet, some ports have invested in energy optimization programs and existing land-power infrastructure, positioning them well for future electrification demands. The tension between constrained regional grids and proactive local initiatives underscores the need for coordinated energy planning if ports are to function as hubs for offshore wind and broader green industrial development.

Sixth, financial and investment conditions pose a challenge since these projects are characterized by high upfront costs and significant uncertainty. Reinforcing quays to offshore wind standards may cost millions per quay meter, making speculative investment untenable. Long-term commitments from developers or industry actors are therefore essential to justify capital expenditure. On the opportunity side, offshore wind offers long-term contracts and aligns with industrial demand for electricity, creating potential for stable revenue streams over decades. The challenge is bridging the gap between high initial risk and long-term value. This gap could be narrowed through coordinated procurement, shared risk models, or national designation of strategic ports. Seventh, the Swedish market is fragmented, with no national strategy designating which ports should specialize in offshore wind. This creates risks of overinvestment, duplication, and inefficient competition among municipal ports. Yet the same fragmentation also opens opportunities for multi-port collaboration, shared infrastructure, and coordinated regional solutions. Developer's interest has historically been strong, and ports recognize the need for joint approaches that distribute risk and align capacity with project pipelines. A coordinated market approach could transform today's uncertainty into a platform for specialization and collective competitiveness.

Eight, the strategic positioning of ports is challenging since they operate within local, regional, national and international contexts that shape their ability to engage in offshore wind. Conflicts with national and local vetoes, or political hesitation stalls development, even if other conditions are favourable. However, early movers may become strategic national nodes in a future offshore wind system. Ports with supportive governance and clear strategic direction can thus position themselves as key actors in an emerging offshore wind landscape.

Considering above mentioned, several barriers that are linked to port characteristics can be addressed with sufficient funding and collaboration, while others related to policy, regulation, and market conditions are far more difficult for ports to address on their own. These matters require attention from policymakers at the national level or even at the EU level.

4.4 Sustainability of port & maritime operations

Sustainability is an important aspect in the offshore wind project. In particular, the different offshore wind project phases require a number of services in the port as well as maritime operations to transport equipment and personnel, which may impact the surrounding environment, both in terms of emissions to air, land, and sea. EPCIs and shipping operators in offshore wind projects do have requirements on ports to make sure their operations in the supply chain of offshore wind are running, not only smooth and effective, but also in a more sustainable way. There is a demand, not only from society, but also from offshore wind developers to reduce emissions as much as possible. In this study, factors in the value chain of offshore wind projects that impact the environment in the surrounding of the ports have been identified alongside operators' current and potential requirements on the port. In addition, actions that can be taken to operate as sustainably as possible in the logistics chain between ports and wind farms illustrate the improvement potential as well as the role of the port to facilitate such sustainable development.

4.4.1. Overall sustainability factors and requirements

In Figure 5, operational factors that impact the sustainability of the maritime operations between the port and offshore wind park are summarized in combination with requirements on the port to reduce the overall environmental impact. This summary is based on insights from maritime operations in both the C&I and O&M phase for bottom fixed offshore wind technology. The insights collectively highlight a set of recurring sustainability requirements related to port infrastructure, vessel technologies, operational planning, and supporting services. The figure organizes insights into port-related requirements, transit-related operational factors, offshore service considerations, and vessel design and retrofit measures, illustrating how different parts of the logistics chain contribute to the overall environmental performance of offshore wind operations.

In the port, requirements relate to shore power service, bunkering possibilities, waste sorting facilities as well as distance to sleeping arrangements, public transportation and airport. On the transit to the wind farm, i.e. the shipping operations, speed, time allowed for transport and efficiency are important factors impacting the environment. At the wind park, such factors involve use of hybrid propulsion vessels and an efficient service to reduce fuel consumption, emissions and noise levels. Vessel technology adjustment factors relate, for example, to battery power, fuel choice, solar energy, hull paint and anti-fouling as well as capacity. A detailed list of all activities is presented in the next chapter.

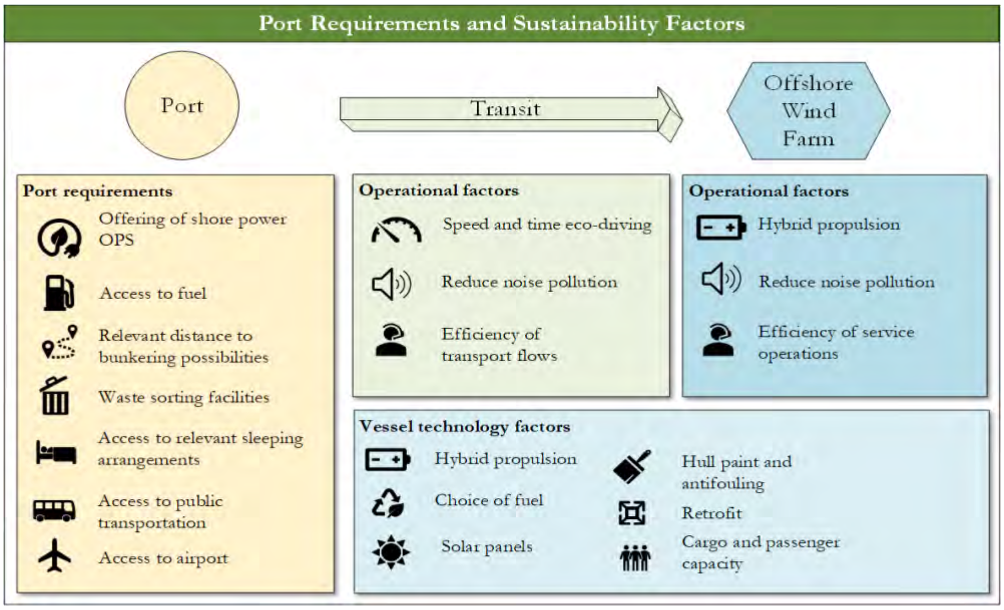

Figure 5: Sustainability factors and requirements in ports during shipping operations

4.4.2 Scenario assessment of sustainable O&M operations

To enable a systematic assessment of how different sustainability measures influence offshore wind O&M operations, a structure for assessing different scenarios was developed. Scenarios were designed to reflect conditions relevant for Swedish ports and to align with the sustainability factors previously identified including port requirements, operational conditions during transit, vessel-related technological choices, and indirect accessibility factors.

A base-case operational profile was defined around case study ports, including Trelleborg, Gävle, Wallhamn, and Kålvik, and taking into consideration the offshore wind farms that these ports are most likely to serve. Typical Swedish distances between port and offshore wind farms were therefore used as starting point, generally ranging between 30–50 km, but with the possibility of extending up to 70–100 km for future projects. In addition, the size and layout of modern offshore wind farms were considered. Current operational farms typically consist of 50–100 turbines of 8–10 MW, while next-generation developments may use +15 MW turbines. These variations defined scenario parameters tied to farm size, number of required technicians, and vessel utilization.

To ensure comparability, the project group defined a baseline case operational profile that reflects a typical O&M setup:

- Day-based 12-hour operations with port as the daily base;
- 30 nautical miles transit distance (approx. 60 km);
- Diesel as the baseline fuel;
- Average transit speed of ~20 knots;
- 12–24 passenger capacity, consistent with common CTV configurations.

This baseline case is a relevant reference point to be compared with more sustainable alternatives. The proposed scenarios include 1) Alternative fuel use, i.e. HVO100 (Hydrotreated vegetable oil or renewable diesel) or methanol, 2) reduced vessel speed, 3) increased passenger capacity, 4) extending the distance between port and wind farm, and 5) increased number of wind turbines to serve. These scenarios represent realistic operational alternatives that ports and service operators may encounter as offshore wind expands in Sweden.

Sustainability impact from the case with alternative fuel use

Based on real operational data, a comparison of a baseline case was made with one of the scenarios to operate with HVO100. In the baseline case, operations used diesel fuel with a 22 nm transit distance serving a wind farm of 94 turbines, with bunkering every 7–8 days at a quay-based station. In the HVO100 case, the transit distance was 30 nm to the same number of turbines, with bunkering via truck or land-based facilities. Both setups involved fuel volumes of 8–10 m^3 per bunkering cycle, transit speeds of roughly 18–20 knots, and CTVs configured for 24 technicians with shore power needs in the 63–64 A range. The data shown in Table 4 is based on operational data and emission calculations from N-O-S.

A first key finding is the significant reduction in carbon emissions achieved by switching from diesel to HVO100, despite the fact that the HVO100 case involved a longer distance between port and wind farm. The data shows that using HVO100 reduced emissions by approximately 85% per nautical mile, corresponding to a reduction of nearly 1,600 kg CO_2 per day for the vessel in question (Table 4).

KPI	Unit	Baseline case	Case with HVO100
Fuel consumption transit (back and forth park)	l/h	500	500
Fuel consumption operations in offshore wind park	l/h	200	200
Fuel consumption in port (12h)	0	Onshore power	Onshore Power
Total fuel consumption per day	l/day	1400 l (average)	1400 l (average)
Total fuel consumption per distance (NM)	l/NM	31,9	31,9
Carbon emissions transit	kg	1340	~200kg
Carbon emissions park operations	kg	536	~80kg
Total carbon emission/day and ship	kg/day	1876	280kg
Total CO2 per distance (NM)	kg/NM	85 kg/NM	~12kg/NM

Table 4: Data of major KPIs comparing baseline case and the scenario using HVO100

The comparison also highlights practical differences in bunkering logistics. While the baseline case used a fixed bunkering station, the HVO100 operation relied on a bunker truck, indicating that ports may need to offer flexible bunkering solutions when supporting alternative fuels. This is particularly relevant for ports considering future adoption of low-carbon fuels such as methanol or biofuels. Another important insight concerns shore-power requirements. Both cases operated with relatively modest shore-power needs, but the fact that the HVO100 vessel also used onshore power during port stays highlights the potential for further emission reductions if ports can supply higher-capacity OPS (onshore power supply) in the future, particularly as hybrid and battery-supported vessels become more common.

Finally, the results underline the economic dimension of sustainability choices. Although HVO100 offers substantial emission reductions, this type of renewable fuel is currently more expensive than diesel, and the additional cost is typically borne by the customer. This highlights the need for clear communication between ports, operators, and developers regarding cost implications, environmental benefits, and possible incentives to support sustainable O&M operations.

Together, these findings show that even a single real-world case can provide valuable insights into the environmental and operational impacts of different fuel and infrastructure choices. They also confirm that ports play a crucial enabling role in the transition toward more sustainable offshore wind logistics, both through bunkering options and the availability of onshore power and other supporting services.

4.4.3. Activities to reduce environmental impact in the C&I and O&M phase

Analysis and baseline scenario results conducted in this study showed that there are three main groups of activities (Table 5) that can be taken to reduce environmental impact in C&I and O&M phases:

a. *Vessel technology*
b. *Operations*
c. *Port service*

Vessel technology. There are several examples of installation vessels equipped with battery systems designed for future connection to OPS, enabling reduced fuel use and emissions during port stays (Jan De Nul Group, 2025). For CTVs, connecting to OPS while in berth is common. There are also examples of newbuild vessels designed to operate on methanol, although current methanol bunkering availability differs between ports, making fuel access a determining factor when selecting suitable construction hubs in the C&I. For the case of the methanol CTV, the supporting logistics chain is also designed to be as low-emission as possible, with tank trucks running on HVO-100 during bunkering. Further, in the O&M phase it is possible to bunker HVO-100 in all vessels upon customer request, enabling emission reduction whilst maintaining operational performance.

In addition to fuel and energy developments, another example is the implementation of ULEv (Ultra-Low Emission vessel) technology, capable of filtering up to 99% of nanoparticles from exhaust gases (Jan De Nul Group, 2025). This reduces local air-quality impacts in and around ports where construction vessels berth. Together, these initiatives highlight a shift towards offshore construction fleets that require ports to provide high-capacity OPS, potential methanol bunkering solutions, and quay infrastructure compatible with hybrid and low-emission vessels.

Where in value chain	Area of application	Specific activity	Reduced impact on environment
C&I, O&M	Vessel	Connection to OPS while in berth.	In port emissions
C&I, O&M	Vessel	Hybrid and full battery technology.	Efficiency - fuel consumption/nm & potential non fossil energy
C&I, O&M	Vessel	Building vessels powered by methanol	CO2 emissions/ton fuel
C&I	Vessel	ULEv (Ultra-Low Emission vessel) technology, capable of filtering up to 99% of nanoparticles from exhaust gases	Local emissions
C&I, O&M	Vessel	Vessel efficiency by improved features and design: propeller, hull coating, bow fender, drivetrain, solar panels etc.	Efficiency - fuel consumption/nm
O&M	Vessel	Offer HVO-100 to vessels upon customer request	CO2 emissions/ton fuel
O&M	Vessel	Upgrading older vessels to extend their lifespan by increasing passenger capacity. One vessel can take more people - instead of two vessels - one vessel can do the same job.	More passengers per vessel, emissions/fuel consumption per person and trip
C&I, O&M	Vessel	Hull design optimized for minimal water resistance.	Efficiency - fuel consumption/nm
C&I, O&M	Vessel	Regular cleaning programs, bottom cleaning and hull coating are increasingly discussed, as well as the impact on water resistance if hull cleaning is not performed regularly	Efficiency - fuel consumption/nm
C&I, O&M	Operations	Planning of efficient operations at sea - smart route planning and scheduling of maintenance/work in relation to movement of the vessel between wind turbines.	Distance operated. Total fuel consumption.

O&M	Operations	Reduced speed favours less fuel consumption. The customer decides on the operational schedule. Distances to the wind farms are one factor influencing the requirements on speed to allow personnel to have sufficient time at wind farms.	Fuel consumption/nm
C&I, O&M	Operations	Reduced speed in port and coastal sensitive areas to limit noise levels.	Noise level
C&I, O&M	Port service	Location of ports in relation to wind farm sets conditions for operations, i.e. distance.	Total distance to wind farm
C&I, O&M	Port service	Shore power options for charging and hotel load at berth, 64 A for CTVs.	In port emissions
C&I, O&M	Port service	Future shore power possibilities for charging batteries for electric propulsion.	Non fossil energy for the operations
C&I, O&M	Port service	Alternative fuels bunkering solutions , e.g. methanol and HVO100	CO2 emissions/ton fuel
O&M	Port service	Proximity to public transport and airports to minimize travel distance between port and accommodation, airport etc.	Personnel travel distance
C&I, O&M	Port service	Waste management and sorting in ports; rarely an issue in Sweden, may be in countries with fewer regulations.	Recycling level

Table 5: Examples of activities to reduce environmental impact from C&I and O&M phase

Operations. Energy-efficiency improvements are another component of offshore wind service provider's sustainability strategy. Optimized hull design, upgraded drivetrains, solar panels on several vessels are examples of efficiency measures taken. Furthermore, emission outcome depends on project planning, such as the speed of vessel, number of trips, distance to the wind farm, time at sea, total distance operated during a day etc. Planning often lies in the hands of the customers and their negotiated contracts, and an in-depth discussion around efficiency improvements in the operating schedule can favour reduced impact from the operations.

Port service. The role of port service and supporting infrastructure is highly important in reducing environmental impact. Shore-power availability, future OPS-ready charging capacity, reliable waste-management systems, and proximity to essential services like public transport links all to reducing indirect emissions and improving the overall sustainability of O&M operations.

Sustainability of offshore wind operations and use of renewable fuels for vessels installing and servicing wind farms are becoming important segment for ports business model. Requirements increase related to onshore power supply and bunkering alternatives, which may also increase the costs in terms of need for upgrading the onshore power supply as well as fuel bunkering infrastructure. Such requirements come from vessel operating companies when choosing or selecting the port to run their offshore wind related activities. As shown in the previous section, there is a significant potential for reducing greenhouse gas-emissions by introducing sustainability measures and thereby a potential in contributing to Swedish 2045 target on net zero greenhouse gas emissions.

5 Conclusions

The Swedish offshore wind sector currently plays a relatively marginal role in the Swedish energy landscape but offers considerable potential for further development. With land-based wind power facing hurdles such as restrictive permitting, the offshore wind power is one of the few remaining areas in which the Swedish energy production still can expand using renewable sources. Ports are central to the development of an offshore wind power sector, however there are only few Swedish ports that have limited experience from this sector. Against this backdrop, this project examined how new business opportunities linked to offshore wind can be integrated into port operations in a sustainable way. This was a first of its kind study in Sweden, conducted using a qualitative approach, interviews and workshops with project participants and selected industry actors. The business opportunities were assessed using three interlocking perspectives: technical assessment of port infrastructure capacities, ports business analysis through business models, and an assessment of environmental impact of shipping operations from ports to offshore wind parks. Ports infrastructure facilities were mapped in a Port Brochure to present existing potential and opportunities to be explored in future by offshore wind industry.

By applying the Business Model Canvas methodology and analysing the potential for port-based value creation within the offshore wind sector, four distinct business model categories were identified: Construction, Installation & Decommissioning (CID); Service (O&M); Combined; and Auxiliary port. Each business model is characterized by a unique investment profile, risk level, and revenue structure. Additionally, the project analysed the decision-making process linked to the development and implementation of offshore wind port business models. The results indicate that, although each business model has its own characteristics, there is a universal set of decisions that ports must consider when evaluating a role they should take in the offshore wind value chain. These decisions form a decision tree, guiding the ports in their initial assessments and helping them make more informed choices.

The analysis of the sustainability aspects of offshore wind projects shows substantial potential for emissions reduction through the use of appropriate vessel technologies, improved operational planning, and well-designed port services. The results indicate that switching to renewable fuels such as HVO100 can reduce emissions by up to 85% per nautical mile for vessels involved in installation and service activities. In general, ports that can offer onshore power supply, alternative bunkering options, competitive logistics services, and strong connections to transport networks will be better positioned to meet the expectations of developers and operators. In this way, the project results help ports authorities to better understand the growing needs of the offshore wind industry and evaluate potential business models.

Looking ahead, the integration of offshore wind into Swedish port business models will depend not only on local strategic choices but also on national policy clarity, coordinated permitting processes, and long-term market signals. Ports cannot resolve these systemic uncertainties alone. Future research is needed to deepen understanding of multi-port collaboration models, investment risk-sharing mechanisms, and the role of ports in regional energy and industrial ecosystems.

For port authorities and practitioners, the next step is to apply the decision frameworks developed here to concrete investment planning and stakeholder dialogues. For policymakers, there is an urgent need to streamline permitting, articulate a national port strategy for offshore wind, and align grid, energy, and maritime policies to support port readiness. If these elements come together, Swedish ports can become pivotal nodes in the green energy transition, strengthening regional economies while enabling large-scale offshore wind deployment.

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Annex 1 (Port Brochure)

Offshore Wind Ports in Sweden - Mapping ports´ capacity and potential

Offshore Wind Ports in Sweden

Mapping ports´ capacity and potential

LIGHTHOUSE
SWEDISH MARITIME COMPETENCE CENTRE

Potential for development of offshore wind ports in Sweden

A Lighthouse project supporting ports in preparing for offshore wind

Swedish ports are facing a remarkable opportunity. The expansion of offshore wind is creating a growing demand for robust infrastructure, efficient logistics, and business models that meet the sector's technical and operational requirements. Ports play crucial role in value chain for sustainable energy transition. For wind developers, energy companies, and actors in the shipping industry, this represents a chance to build long term partnerships with ports that want to play an active role in the energy transition.

In this project we have worked together with eleven Swedish ports to explore how their capacity can be developed to meet future needs. Through case studies, dialogue with a broad reference group, and analysis of existing business models, we have identified the investments, processes, and strategic choices required to integrate offshore wind business model into port operations.

This brochure provides an overview of the potential – and shows how Swedish ports can become a central part of the value chain for tomorrow's sustainable energy systems.

PROJECT:

Business model development for offshore wind in Swedish ports - Adjustment to new volumes from offshore wind industry

IMPLEMENTED BY:

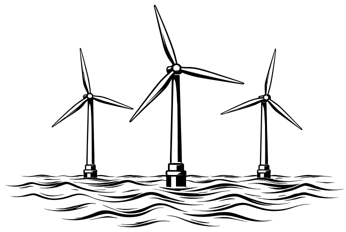
RISE Research Institutes of Sweden and Göteborgs Universitet

PROJECT FUNDERS:

Trafikverket
Lighthouse Hållbar Sjöfart

Partner ports

- Port of Gothenburg
- Port of Trelleborg
- Port of Gävle
- Wallhamn
- Söderhamns Stuveri & Hamn
- Smålandshamnar
- Ports of Stockholm
- Ports of Halland
- Port of Ystad
- Falkenberg Terminal & Port
- Port of Kålvik



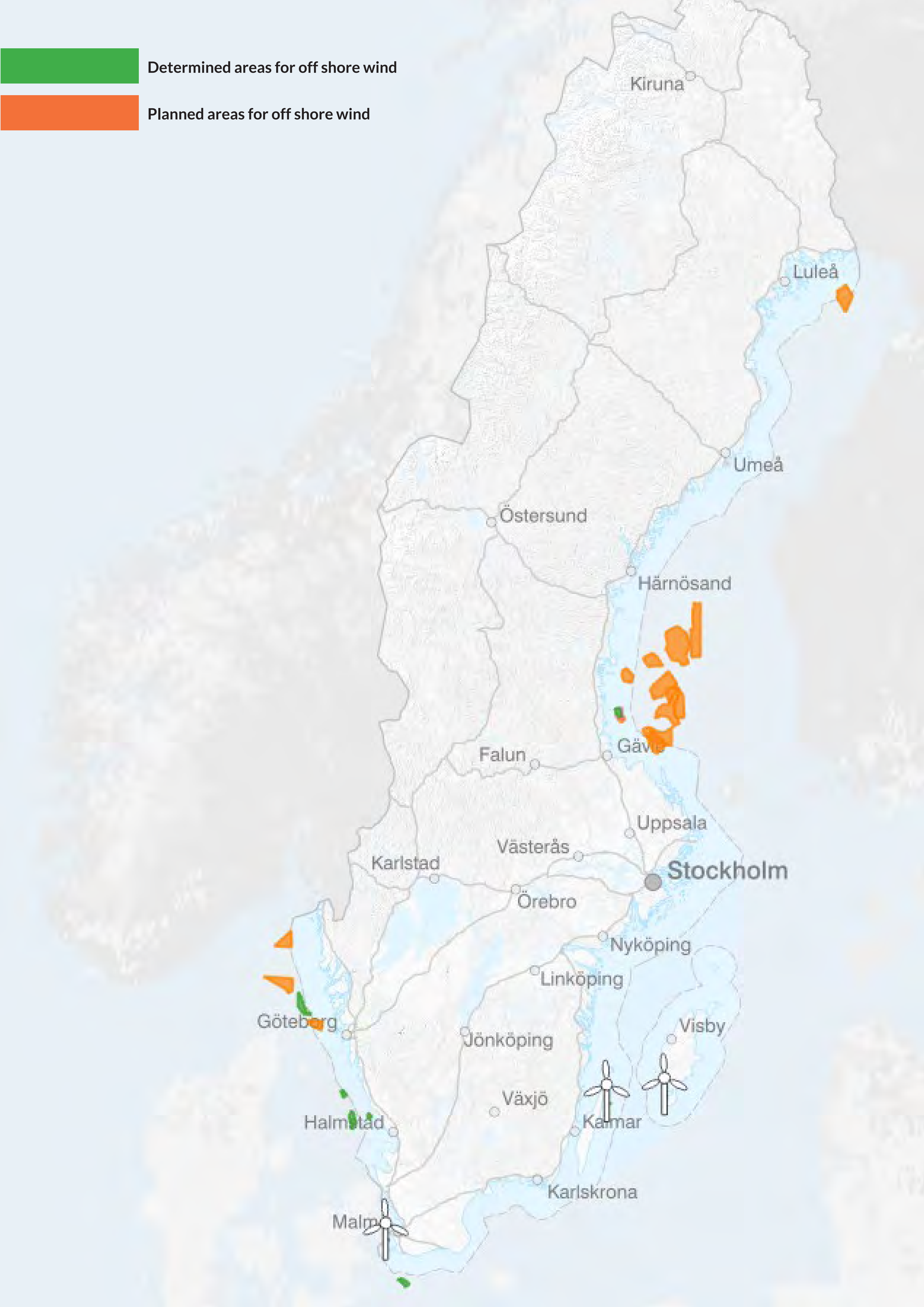
Swedish Ports and Emerging Offshore Wind Opportunities

Sweden's coastline hosts a network of strategically positioned ports that play a central role in the country's maritime logistics, industrial activity, and energy transition. As Europe accelerates its shift toward renewable power, these ports are becoming increasingly important as hubs for offshore wind development — not only for installation and maintenance, but also for manufacturing, storage, and long term operational support.

With several areas already planned for offshore wind and additional zones under evaluation, Sweden is preparing to scale up its capacity and strengthen its position in the Nordic energy landscape. By the time of publishing this brochure there were 3,4 GW of approved offshore wind projects and 35 GW of submitted applications in planning pipeline, that, if built, can supply around 150 Twh of electricity per year securing half of expected el. demand in Sweden by 2045.

This presentation highlights Swedish ports and their capacities for planned offshore wind areas that will shape the nation's future energy system.

Disclaimer:
This overview is limited to ports that participated in the Lighthouse project (Hållbar Sjöfart 2025 Program). Further work is required to include comprehensive assessment of all other ports in Sweden that aim to work with offshore wind industry.


Determined areas for off shore wind
Planned areas for off shore wind
Kiruna
Luleå
Umeå
Östersund
Härnösand
Falun
Uppsala
Västerås
Karlstad
Stockholm
Örebro
Nyköping
Linköping
Visby
Jönköping
Växjö
Karlskrona

Port overview

A presentation of key infrastructure capacities of 11 Swedish ports

NORWAY
Gulf of Bothnia
Söderhamns Stuveri & Hamn
Port of Gävle
Ports of Stockholm
Port of Kålvik
Skagetrak
Wallhamn
Port of Gothenburg
Smålandshamnar
Port of Varberg
Falkenbergs Terminal & Port
Kattegat
Ports of Halland
Gotland
Oland
Baltic Sea
DENMARK
Port of Trelleborg
Port of Ystad

#01

Port of Gothenburg

Location: Göteborg
Coordinates: 57.70° N, 11.93° E

PORT OF GOTHENBURG is the largest port in Scandinavia and handles around 20% of Sweden's total foreign trade measured in tons. About 55% of Sweden's container traffic passes through the port, making it the country's main gateway for international container shipping. With the Nordic region's largest range of shipping services and rail-connected inland terminals linking Sweden with global markets, the port functions as a key logistics hub. The port is also Sweden's only port able to accommodate the world's largest oceangoing vessels and it serves as the Nordic region's largest energy hub.

PORT OF GOTHENBURG

TAKING YOU FURTHER

Port overview

Location	Göteborg
Coordinates	57.70° N, 11.93° E
Main usage	Container, vehicle export, RoRo, energy, cruises
Total area (m^2)	2milj m^2 storage area
Quay berth length (m)	2000m, 8 RoRo ramps
Quay berth width (m)	-
Quay draft (m LAT)	max 14,2 m
Quayside bearing capacity (t/m^2)	2,5 tons/m^2
Ground bearing capacity (t/m^2)	-
Craneage capabilities	Container cranes, mobile cranes, gantry cranes, etc.
Type of seabed	Clay and some part bedrock
Navigational channel capacity	The vessels can be 400 m long, draft up to13,5
Ro/Ro capabilities	Yes
Jack up capabilities	Not investigated
Track record in wind industry	Co-invested in offshore wind project Västvind
Proximity to offshore wind sites	Västvind, 40 km, Poseidon 60 km
Possible role as offshore wind port	☐ Manufacturing ☑ Assembly, construction and installation ☑ O&M (service) ☐ Decommissioning

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#02

Port of Trelleborg

Location: Trelleborg
Coordinates: 55.38° N, 13.16° E

PORT OF TRELLEBORG is the largest RoRo port in Scandinavia. It handles a significant share of the Swedish foreign export/import volumes. Today 16 RoPax ferries operate regularly in the four transport corridors between Trelleborg and the Continent. The geographic location of Trelleborg as Sweden's most southern port, only 85 km from the German border, creates excellent conditions for timetables with high frequencies. It is shortest route from Scandinavia to the continent. Largest railway port in the Baltic sea with rail ferries that operate from the port. The new All-round commercial pier opens for projects/or longer establishments. This pier is not used for any regular traffic.

Trelleborgs Hamn

Port overview

Location	Trelleborg
Coordinates	55.38° N, 13.16° E
Main usage	Mainly a RoRo port
Total area (m^2)	1 150 000 m^2 30 000 m^2 logistic center
Quay berth length (m)	5 400 m 13 berths including 8 ferry berths for regular traffic including 7 with double RoRo ramps and 2 directly rail-linked. 2 commercial quays.
Quay berth width (m)	Commercial quay 1 : 162m long and 100m wide. Commercial quay 2: 500m long and 200m wide
Quay draft (m LAT)	7,4 – 8,5 m
Quayside bearing capacity (t/m^2)	2tons/m^2
Ground bearing capacity (t/m^2)	10t/m^2 (2 Partially gravel and partially paved, sheltered, 8m from quay)
Craneage capabilities	Mobile cranes, fork lifts
Type of seabed	Limestone seabed
Navigational channel capacity	Depth 6,5-9 m, 150 m wide
Ro/Ro capabilities	Yes, with unrestricted headroom
Jack up capabilities	Yes
Track record in wind industry	Implements own wind trubine on port area (2024). Base port for Kriegers Flak assembly 2013-2016.
Proximity to offshore wind sites	Kriegers flak 30 km, Kustvind 30 km
Possible role as offshore wind port	☐ Manufacturing ☑ Assembly, construction and installation ☑ O&M (service) ☐ Decommissioning

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#03

Port of Gävle

Location: Gävle
Coordinates: 60.68° N, 17.18° E

PORT OF GÄVLE is the largest container port on Sweden's east coast and the third largest container terminal in the country. The port handles a wide range of cargo including containers, forestry products, steel, energy products, fuel and bulk goods, serving industries and international trade. The port's strategic location and direct connections to national rail and road networks create efficient conditions for intermodal freight transport. Gävle hamn is also one of Sweden´s largest energy ports.

Port of Gävle

Port overview

Location	Gävle
Coordinates	60.68° N, 17.18° E
Main usage	Steel, wood, paper, chemicals and fuels
Total area (m^2)	3 800 000 m^2 incl 1 000 000 m^2 storage area
Quay berth length (m)	2 800 m
Quay berth width (m)	28-42 m
Quay draft (m LAT)	6 - 12,2 m
Quayside bearing capacity (t/m^2)	24 t/m^2 in general, 150 t/m^2 in designated heavy lift area.
Ground bearing capacity (t/m^2)	24 t/m^2
Craneage capabilities	186 t
Type of seabed	Sand and clay
Navigational channel capacity	Vessels can be 42 m wide and 245 m long and have a draught of 12,2 m.
Ro/Ro capabilities	No
Jack up capabilities	Yes
Track record in wind industry	Handling, storage and transport of land-based wind components
Proximity to offshore wind sites	Storgrundet, Najaderna, Olof Skötkonung, Fyrskeppet, Gävle East, Gävle West, Utposten 2, Sylen, Gretas Klackar, Lambda North, Lambda South, Mimer, Eystrasalt. All are within 200 km from Gävle hamn.
Possible role as offshore wind port	☑ Manufacturing ☑ Assembly, construction and installation ☑ O&M (service) ☑ Decommissioning

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#04

Wallhamn

Location: Tjörn
Coordinates: 58.00° N, 11.69° E

WALLHAMN is one of Sweden's leading vehicle ports and a major hub for the import and export of vehicles in the Nordic region. Located on the Swedish west coast, the port specialises in RoRo cargo and regularly handles cars, trucks, buses and other rolling cargo. Today ocean-going vessels call weekly at Wallhamn, connecting Sweden with global automotive logistics networks. The port area includes warehouses and open storage areas totaling 570,000 m², including 17,500 parking spaces, providing extensive capacity for indoor and outdoor cargo storage and logistics services.

Wallhamn AB

Port overview

Location	Tjörn
Coordinates	58.00° N, 11.69° E
Main usage	RoRo cargo; Export and import of vehicles, container, timber, steel, general cargo
Total area (m^2)	570 000 m^2
Quay berth length (m)	800 m
Quay berth width (m)	15m
Quay draft (m LAT)	10,6m
Quayside bearing capacity (t/m^2)	10 tons/m^2 Depends on location quay
Ground bearing capacity (t/m^2)	Depending on location
Craneage capabilities	Mobile cranes
Type of seabed	Sand and clay
Navigational channel capacity	Vessel max 265m LOA, width channel 140m, Max draft vessel 9,5m
Ro/Ro capabilities	Yes
Jack up capabilities	Not investigated yet
Track record in wind industry	n/a
Proximity to offshore wind sites	Poseidon, 50 km
Possible role as offshore wind port	☐ Manufacturing ☑ Assembly, construction and installation ☑ O&M (service) ☐ Decommissioning

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#05

Söderhamns Stuveri & Hamn

Location: Orrskär, Långrör, Stugsund
Coordinates: 61.21° N, 17.16° E

SÖDERHAMNS STUVERI & HAMN AB operates several ports in the Söderhamn region on Sweden's east coast, including Orrskär, Stugsund and Långrör. The ports handle a wide range of cargo, with the Port of Orrskär being one of Sweden's leading transshipment ports for sawn timber. In addition to forest products, the ports handle bulk and general cargo including cement, oil and chemical products. The company also provides logistics services for several industry-owned port facilities, and plans are currently being explored to expand the Port of Orrskär with an additional two hectares of storage area and a new quay.

Söderhamns Stuveri & Hamn AB

Port overview

Location	Orrskär, Långrör, Stugsund
Coordinates	61.21° N, 17.16° E
Main usage	Cargo: sawn timber, cement, oil, chemical products
Total area (m^2)	100 000 m^2 + 20 000 m^2 with new expansion in Orrskär. Orrskär is main port in consideration for offshore. Stage two in Orrskär port expansion will include investigation of creating additional storage. Långrör and Stugsund can be utilized for various work after discussions.
Quay berth length (m)	200 m total (100 + 100 m) + 100 meter with port expansion in Orrskär.
Quay berth width (m)	130m including terminal area in Orrskär.
Quay draft (m LAT)	9,2 + 10,9 + 11,5 in Orrskär.
Quayside bearing capacity (t/m^2)	New quay will have 5t/m2 uniformly distributed, with higher point loads possible after project-specific engineering assessment.
Ground bearing capacity (t/m^2)	Terminal area in perimeter to new quay will have 5t/m^2 uniformly distributed, with potential for higher localized loads following case-by-case evaluation.
Craneage capabilities	Usage of rented mobile cranes is an option, project for acquiring shore crane with is currently undergoing as part of port expansion.
Type of seabed	Bedrock
Navigational channel capacity	35 m width and 12 m depth
Ro/Ro capabilities	No
Jack up capabilities	Currently under investigation
Track record in wind industry	Have unloaded and stored land-based wind turbine components. Components up to 91 ton each in weight.
Proximity to offshore wind sites	Storgrundet, 20 km
Possible role as offshore wind port	☑ Manufacturing ☑ Assembly, construction and installation ☑ O&M (service) ☑ Decommissioning

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#06

Smålandshamnar

Location: Oskarshamn and Västervik
Coordinates: 57.26° N, 16.45° E

SMÅLANDSHAMNAR operates the ports of Oskarshamn and Västervik on Sweden's east coast. The ports serve as important links in the regional transport system, handling a wide range of cargo including forest products, bulk cargo, energy products and project cargo. Over the years, Smålandshamnar has developed both the expertise and equipment required to handle most common cargo types and cargo handling techniques in the industry. While maintaining this broad capability, the ports have developed a particular specialization in Lo/Lo and Ro/Ro cargo handling.

Smålands-
hamnar AB

Port overview

Location	Oskarshamn and Västervik
Coordinates	57.26° N, 16.45° E
Main usage	Bulk and general cargo, Ferry services to Gotland
Total area (m^2)	Oskarshamn: 390 000 m^2+ 51 000 m^2 44 000 m^2 cold storage
Quay berth length (m)	430
Quay berth width (m)	-
Quay draft (m LAT)	10 m -10,3 m
Quayside bearing capacity (t/m^2)	Oskarshamn: 5 tons/m^2
Ground bearing capacity (t/m^2)	-
Craneage capabilities	Oskarshamn: Cable cranes 63-125 tons, folding cranes 14-25 tons
Type of seabed	Morain/bedrock
Navigational channel capacity	Oskarshamn: Width 96 m, depth 11-13 m
Ro/Ro capabilities	Yes
Jack up capabilities	To be investigated
Track record in wind industry	Established infrastructure for handling land based wind turbines
Proximity to offshore wind sites	Simpevarp Havsvindpark (ej beviljat tillstånd) 15 km
Possible role as offshore wind port	☐ Manufacturing ☐ Assembly, construction and installation ☑ O&M (service) ☐ Decommissioning

CONTACT US

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#07

Ports of Stockholm

Kapellskärs hamn

Location: Stockholm, Kapellskär
Coordinates: N 59.43´ E 19.04´

PORTS OF STOCKHOLM is one of the world's largest passenger ports and one of Sweden's largest ports for RoRo and ferry cargo traffic. It operates several ports in the Stockholm region, including Stockholm, Kapellskär, Nynäshamn and the modern freight port Stockholm Norvik. Today regular ferry services connect Stockholm with major destinations around the Baltic Sea, supporting both passenger and freight transport. With modern container and RoRo terminals and efficient transport connections, the ports ensure the supply of goods to Sweden's largest consumption region.

Here are presented ports of Kapellskär and Norvik as most relevant ones for wind industry.

STOCKHOLMS HAMNAR

Port overview

Location	Stockholm, Kapellskär
Coordinates	N 59.43´ E 19.04´
Main usage	Freight and passenger traffic
Total area (m^2)	210.000
Quay berth length (m)	245+245+130+200+200 (all roro)
Quay berth width (m)	20,10,10
Quay draft (m LAT)	6,7-8,8
Quayside bearing capacity (t/m^2)	2,5t/m2 BK1
Ground bearing capacity (t/m^2)	2,5t/m^2 BK1
Craneage capabilities	n/a
Type of seabed	Clay
Navigational channel capacity	Loa 240, beam 32,31, draft 8,4
Ro/Ro capabilities	Yes
Jack up capabilities	To consider
Track record in wind industry	n/a
Proximity to offshore wind sites	Baltic Offshore Delta South and Baltic Delta Epsilon
Possible role as offshore wind port	☐ Manufacturing ☐ Assembly, construction and installation ☑ O&M (service) ☐ Decommissioning

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Ports of Stockholm

Norviks hamn

Location: Stockholm, Norvik
Coordinates: 59.3483° N, 18.1073° E

Port overview

Location	Stockholm, Norvik
Coordinates	59.3483° N, 18.1073° E
Main usage	Container and RoRo
Total area (m²)	44 hektar
Quay berth length (m)	450m container quay and 280+240m RoRo-quays 200 m multipurpose
Quay berth width (m)	>100 m
Quay draft (m LAT)	9,8 m(RoRo quay) - 16,5 m (container quay) 12,5 (multipurpose)
Quayside bearing capacity (t/m²)	>2,5t/m² BK1
Ground bearing capacity (t/m²)	>2,5t/m² BK1
Craneage capabilities	Container cranes, mobile cranes
Type of seabed	Gravel and rock
Navigational channel capacity	Max draft 15,3 Wind restriction >200 m max 13 m/s Vis restriction >200m not less 0,5M
Ro/Ro capabilities	Yes
Jack up capabilities	To consider
Track record in wind industry	n/a
Proximity to offshore wind sites	Baltic Offshore Delta South and Baltic Delta Epsilon
Possible role as offshore wind port	☐ Manufacturing ☑ Assembly, construction and installation ☑ O&M (service) ☐ Decommissioning

#08

Ports of Halland

Halmstads hamn

Location: Halmstad
Coordinates: 56.65050° N, 12.85278° E

Hallands hamnar represents a joint venture of 2 ports on west coats of Sweden: Ports of Halmstad and Port of Varberg.

PORT OF HALMSTAD is the largest port in the Halland region and Sweden's foremost port for handling scrap fractions of sheet metal, steel, metals and plastics. It is also one of the country's leading container ports. In addition to recycling materials and containers, the port handles bulk cargo, vehicles and steel products. The port operates four specialised terminals handling around three million tonnes of cargo annually, and its location close to major European highways and the national rail network creates excellent conditions for efficient transport and logistics.

HALLANDS HAMNAR
Ports of Halland

Port overview

Location	Halmstad, Halland County, SW Sweden
Coordinates	56.65050° N, 12.85278° E
Main usage	Commercial logistics hub incl. ferry to Denmark
Total area (m^2)	830 000 m^2
Quay berth length (m)	2400 m
Quay berth width (m)	32 m
Quay draft (m LAT)	6.5–11
Quayside bearing capacity(t/m^2)	≥4
Ground bearing capacity (t/m^2)	High load-bearing quays (~4 t/m^2)
Craneage capabilities	8–160 t harbor cranes(Twin)
Type of seabed	Soft (mud/sand)
Navigational channel capacity	200 m LOA / 32 m beam Depth 11 m
Ro/Ro capabilities	4 RoRo berths
Jack up capabilities	No permit today (soft seabed)
Track record in wind industry	Yes, handled wind turbine components. Participates in Kattegatt Port Alliance (Hallands Hamnar and Port of Grenaa)
Proximity to offshore wind sites	Kattegatt Syd~30 km Galene ~25 km
Possible role as offshore wind port	☐ Manufacturing ☐ Assembly, construction and installation ☑ O&M (service) ☐ Decommissioning

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Ports of Halland

Varbergs hamn

Port overview

Location	Varberg , Halland County, SW Sweden
Coordinates	57.117009° N, 12.243205° E
Main usage	Major forestry port industry hub in the Nordics
Total area (m^2)	315 000 m^2
Quay berth length (m)	1370 m
Quay berth width (m)	32 m
Quay draft (m LAT)	6.5–11
Quayside bearing capacity (t/m^2)	≥4
Ground bearing capacity (t/m^2)	Partial (small heavy duty area)
Craneage capabilities	Up to 80t harbor cranes
Type of seabed	Soft (pile supported)
Navigational channel capacity	215 m width LOA / 33 m beam Depth 11 m
Ro/Ro capabilities	N/A
Jack up capabilities	No (pile supported quay)
Track record in wind industry	Yes, handled wind turbine components. Participates in Kattegatt Port Alliance (Hallands Hamnar and Port of Grenaa)
Proximity to offshore wind sites	Galene ~25 km
Possible role as offshore wind port	☐ Manufacturing ☐ Assembly, construction and installation ☑ O&M (service) ☐ Decommissioning

#09

Port of Ystad

Location: Ystad
Coordinates: 55.43° N, 13.82° E

PORT OF YSTAD is one of Sweden's largest ferry ports and an important gateway between Sweden and the Baltic Sea region with daily traffic to Denmark and Poland. Rail ferries also operate daily to Poland. Port of Ystad handles significant volumes of RoRo freight traffic together with dry bulk and general cargo such as timber, grain and other bulk commodities. The port also provides cargo handling, storage and logistics services supporting regional and international trade. Its strategic location on Sweden's south coast creates efficient maritime connections between Scandinavia and ports around the Baltic Sea.

Port of Ystad

Port overview

Location	Ystad
Coordinates	55.43° N, 13.82° E
Main usage	Ferry port
Total area (m^2)	Total usable area appr. 415.000m2, further 140 000m^2 to be developed
Quay berth length (m)	8 berths between 105 - 250 m depending on quay, 1 directly rail linked
Quay berth width (m)	Depending on quay: 20-40m, and to be futher developed
Quay draft (m LAT)	7 m inner port (bulk/general cargo), 9 - 9,5 m outer port (ferry)
Quayside bearing capacity (t/m^2)	3 ton/m^2 on existing quay, other arrangements may be made when building a new quay
Ground bearing capacity (t/m^2)	3 ton/m2
Craneage capabilities	Mobile port crane, 30 tons
Type of seabed	Sand over morain
Navigational channel capacity	7,2 m -9,5 m deep, 150 m wide
Ro/Ro capabilities	Yes
Jack up capabilities	Yes
Track record in wind industry	Rotor blades and generators on RoRo
Proximity to offshore wind sites	Kustvind 20 km, Kriegers flak 60 km
Possible role as offshore wind port	☐ Manufacturing ☑ Assembly, construction and installation ☑ O&M (service) ☐ Decommissioning

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#10

Falkenberg Terminal & Port

Location: Falkenberg
Coordinates: 56.90° N, 12.50° E

FALKENBERG TERMINAL & PORT operates the commercial port in Falkenberg on Sweden's west coast. It functions as a complete logistics centre where sea, rail and road transport are integrated, providing efficient cargo handling and forwarding services. The terminal handles conventional cargo and offers a wide range of logistics services including storage, repacking and distribution. With warehouse and storage facilities of around 50,000 m² Falkenbergs Terminal provides flexible logistics solutions for regional and international supply chains.

Falkenbergs Terminal
Port of Falkenberg

Port overview

Location	Falkenberg
Coordinates	56.90° N, 12.50° E
Main usage	Dry bulk - loading/unloading, storage and packaging.
Total area (m^2)	50 000 m^2 storage area
Quay berth length (m)	300 meters
Quay berth width (m)	About 70 meters
Quay draft (m LAT)	6,5 m
Quayside bearing capacity (t/m^2)	5 tons/m^2
Ground bearing capacity (t/m^2)	5 tons/m^2
Craneage capabilities	Mobile cranes
Type of seabed	Sand
Navigational channel capacity	7 m deep channel, channel 2 km long, 24 m wide 5-10 m depth
Ro/Ro capabilities	Yes
Jack up capabilities	No
Track record in wind industry	Handling land based wind turbine components.
Proximity to offshore wind sites	Vindpark Falkenberg, 10 km
Possible role as offshore wind port	☐ Manufacturing ☑ Assembly, construction and installation ☑ O&M (service) ☐ Decommissioning

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#11

Port of Kålvik

At Kålvik, on the northest part of the Swedish west coast, we are creating a port with perfect conditions for the efficient and large-scale deployment of offshore wind power. The port is adapted for both bottom-fixed and floating foundations. A facility is planned here that will be able to become a hub in the expansion of offshore wind. With great depth near land (+70m), surfaces on land with high capacity for heavy loads, sheltered location and the possibility of creating large flat areas, the site is ideal. Work on the permit process is ongoing and there is great political agreement in local municipality about the initiative.

Port of Kålvik has in April 2026 been granted Net-Zero Strategic Project status by the Swedish Agency for Economic and Regional Growth under the EU Net-Zero Industry Act (NZIA).

KÅLVIK
VINDKRAFTSHAMN
STRÖMSTAD

Port overview

Location	Strömstad
Coordinates	59.07° N, 11.19° E
Main usage	No activities today, area is under development with foreseen use as future offshore wind port.
Total area (m^2)	45 Ha
Quay berth length (m)	900 m
Quay berth width (m)	25-100 m
Quay draft (m LAT)	>15 m
Quayside bearing capacity (t/m^2)	20-50 t/m^2
Ground bearing capacity (t/m^2)	>50 t/m2 (bedrock base granite)
Craneage capabilities	Planned ring crane hook height 225 m, lift capacity 3000 ton
Type of seabed	Bedrock
Navigational channel capacity	>70 m depth, >700 m width
Ro/Ro capabilities	Yes
Jack up capabilities	No (to steep seabed)
Track record in wind industry	N/A
Proximity to offshore wind sites	Vidar, Mareld, Poseidon
Possible role as offshore wind port	☑ Manufacturing ☑ Assembly, construction and installation ☑ O&M (service) ☑ Decommissioning

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