IDEA - IRL

INTEGRATED DESIGN OF FLOATING WIND ARRAYS IRELAND

MSP Consultation Report (Year 1)

Document number: WP4 D2A
Author(s): Greg Bohan, Ota Dvorak
Delivery date: 07 February 2024

seai SUSTAINABLE ENERGY AUTHORITY OF IRELAND

This project has been supported with financial contribution from Sustainable Energy Authority of Ireland under the SEAI Research, Development & Demonstration Funding Programme 2022, Grant number 22/RDD/804

Project partners

External links

This project is closely coordinated with the IEA Wind TCP Task 49 – Integrated Design on floating wind Arrays (IDeA)[1]

Disclaimer

Document Information

Project Acronym	IDEA-IRL
Project Title	Integrated Design of Floating Wind Arrays Ireland
Award Number	22/RDD/804
Work Package	WP4
Deliverable Number	D2A
Deliverable Title	MSP Consultation Report (Year 1)
Due Date	31 January 2024
Delivery Date	7 February 2024
Primary Author(s)	Ota Dvorak, Greg Bohan
Co-Author(s)	David Cahill, Aoife Kelly

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

Version Control

Version No.	Date	Description	Prepared by	Checked by
0.1	12/12/2023	First draft circulated for internal review and updates	OD, DC, AK	GB
0.2	31/01/2024	Second internal draft circulated for IDEA-IRL review	OD, GB	GB
1.0	07/02/2024	Report submitted to SEAI	GB, OD	MKD

Executive Summary

This report was prepared by the IDEA-IRL project as the second deliverable for WP4 of the project.

It updates on consultation and research undertaken over the course of 2023 to gain a deeper understanding of key markets for floating offshore wind globally, work done in relation to marine spatial planning, and areas designated for the future development of floating offshore wind internationally.

The markets assessed were; the USA, France, Germany, Ireland, Italy, the Netherlands, Norway, South Korea, the UK, Portugal, Spain and Japan. Interviews were undertaken with representatives from each of these countries, with the end goal of speaking to a floating offshore wind expert and a marine spatial planning expert in each country.

Some key findings from the report were:

- **The Importance of MSP is clear and realised:**

Encouragingly, the importance of MSP seems clear in almost all markets. With the exception of Japan, all other markets assessed have an MSP body in place, and most have or are transitioning to plan-led regimes. While some countries may not have finalised MSP plans, they are at least in the process of this. In contrast to a developer led regime, a plan-led regime places a clear emphasis on the importance of MSP, and makes it easier for states to develop offshore wind in a more coordinated, planned fashion, which should help to minimise conflicts between different users of the marine environment, maximise the efficiencies from offshore wind development, and achieve the benefits of MSP.

- **Opening a new market for offshore wind without a solid MSP framework is difficult:**

Not having an MSP plan in place makes it more difficult for regulators to issue permits for OW projects. OW has an impact on many stakeholder groups and these impacts must be considered when issuing permits. A creation of an MSP policy integrates the requirements of different sea user groups and finds a compromise so that all marine industries can share in the sea resources sustainably while not being detrimental to the ecosystem or each other's operations.

- **FLOW is set to play a key role in the green energy transition, but 2030 targets will be difficult to meet:**

The global predictions for the growth of OW markets are massively favourable with figures of up to 15% annual growth being quoted. FLOW can be a tool for countries with deeper seas to get involved in the OW business, which they otherwise wouldn't be able to do with grounded installations. That said, many countries have set ambitious targets for offshore wind and floating offshore wind (generally not technology specific) for 2030, which experts in the countries generally don't expect will be achieved in the 2030 timeframe and are more likely to slip to 2035. Generally, this should not be seen as a major issue, with 2030 a milestone on the road to 2050 and longer term, but it is a clear trend.

- **Key topics to consider include supply chain integration, port capacity, domestic value retention, and permitting procedures:**

In developed markets, there is a good level of domestic expertise on the topic and the supply chain is generally developed, however capacity is a concern. This is easier for countries with either onshore wind or offshore oil & gas experience, as there are many transferable skills between these industries. Another topic linked to supply chain is domestic value retention. Here a tricky balance must be struck. On one hand, OW projects are not likely to be possible without engagement from multinational OEMs and developers. On the other hand, governments want to support local businesses in coastal areas and industrialisation.

For European markets, port capacity for FLOW may become an issue. Quay-side installation requires deep ports, especially for spar platforms which can require a draft in excess of 50 m, but also for semi-submersibles. Many semi-submersible platforms require more than 10 m of draft. Ports with such deep water are used by large shipping operations and the competition for space and port capacity is often fierce. Furthermore, OW activities require a lot of marshalling space, which is often lacking. Improving the port capacity is one of the keys to unlocking higher OW roll-out in Europe.

Finally, the permitting process is a clear bottleneck for the industry. Some of our interviewees quoted projects taking over a decade to build because of a complicated permitting process. Strong MSP processes can be a way to aid permitting processes, as well as resourcing of the relevant bodies, and mandatory timelines.

- **Co-Existence still needs to be addressed:**

While many MSP plans have identified sites as priority areas for floating wind / offshore wind, in many cases, these activities will need to co-exist with other activities, and how this will be done still needs to be figured out. A key stakeholder here will be fishers, as cited by most experts interviewed.

IDEA-IRL will use the learnings from this consultation and research to refine the future approach to consultation to targets key markets and stakeholders, and address the challenges noted above, and find learnings for Ireland.

Table of Acronyms

AA	Appropriate assessment
ANEV	Associazione nazionale energia del vento - Italian wind energy association
BOEM	Bureau of ocean energy management - USA organisation responsible for managing offshore resources
BSH	Federal maritime and hydrographic agency - German authority which publishes the site development plan
CAGR	Compound annual growth rate
CFD	Contract for difference - a scheme for renewable resource producers hedge energy prices
DECC	Department of environment, climate and communications (Ireland)
DGRM	Directorate General for Natural Resources, Safety and Maritime Services - Portuguese authority for coordinating MSP
DMAP	Designated marine area plan - Irish MSP
DRAM	Regional directorate for sea affairs - Azorean (Portuguese) branch of local government responsible for local MSP activities
DRM	Regional directorate for the sea - Madeiran branch of local government responsible for local MSP activities
DSF	Documents Stratégiques de Façade - French marine spatial plans
EEZ	Exclusive economic zone
FLOW	Floating offshore wind
GDG	Gavin & Doherty Geosolutions
GIS	Geographic information system
HPA	High potential area
IDEA	Integrated design of floating wind arrays - IEA Wind Task 49
IDEA-IRL	Mirror project to IDEA with a focus on the Irish market and additional scope
IEA	International Energy Agency
LCOE	Lifecycle cost of energy
MAC	Maritime area consent - Irish seabed lease term
MAP	Maritime area planning - Irish MSP policy
MARCO	Mid-Atlantic regional council on the ocean - USA regional MSP authority
MITECO	Ministry for the ecological transition and the demographic challenge - Spanish ministry responsible for MSP
MOF	Ministry of ocean and fisheries - South Korean national authority on MSP
MPA	Marine protected area
MSFD	Marine strategy framework directive (EU)
MSP	Marine spatial planning
NMPF	National marine planning framework - Irish marine spatial plan
NOAA	North Atlantic atmospheric administration - USA provider of oceanographic and metocean data
NOP	National ocean policy - USA policy for ocean governance
NROC	Northeast regional ocean council - USA regional MSP authority
NSP	North Sea programme - Dutch MSP policy

NVE	Norwegian water resources and energy directorate - Organisation responsible for MSP in Norway
NWP	National water plan - Dutch policy concerning the use of the nation's water resources
O&G	Oil and gas
O&M	Operations and maintenance
OCAP	Ocean climate action plan - USA policy for future use of the oceans
OEM	Original equipment manufacturer
ORE	Offshore renewable energy
OREC	Offshore renewable energy catapult
OREDP	Offshore renewable energy development plan - Irish plan to build ORE
ORESS	Offshore renewable energy support scheme - Irish ORE subsidy support auction scheme
OW	Offshore wind
OWF	Offshore wind farm
PDA	Project development area
POEM	Planes de Ordenación del Espacio Marítimo - Spanish marine spatial plan
PPE	Pluriannual energy programme - French plan for development of energy projects
PSOEM	Plano de Situacão do Ordenamento do Espaço Maritimo Nacional - Portuguese marine spatial plan
PUZ	Priority use zone
R&D	Research and development
RSE	Ricerca sistema energetico - Italian energy system research organisation
SDP	Site development plan (Germany)
SEA	Strategic environmental assessment
SID	Sistema Informativo del Demanio marittimo - Italian interactive ocean use maps
SNML	National strategy for the sea and coast - French policy governing the creation of MSP
TCE	The Crown Estate - British government organisation for management of land
TCES	The Crown Estate Scotland - Scottish government organisation for management of land
UCC	University College Cork
WEA	Wind energy area (USA)
WEI	Wind Energy Ireland
WFD	Water framework directive (EU)
WP	Work package (of the IDEA project, often followed by a number)

Table of Contents

1 Introduction

This report has been prepared by the IDEA-IRL project as the second deliverable for WP4 of the project.

The IDEA-IRL project commenced in February 2023. The project is being undertaken by a partnership of UCC, WEI, and GDG. Its goal is to accelerate the sustainable development of Floating Offshore Wind Arrays (FOWA) both domestically and internationally. This will be achieved by building upon key background knowledge and by coordinating and leveraging the international FOWA research effort under the framework of the supported IEA TCP Wind Task 49.

Specific objectives across all the work packages include:

1. Deliver a set of fully defined reference sites characteristic of the international global floating wind deployment pipeline including all relevant technical, social, environmental, and economic parameters.
2. Deliver a set of fully open source and customisable floating wind array reference designs including key engineering tool input files, cost and environmental impact models.
3. Deliver a Failure Mode, Effects & Criticality Analysis framework for floating wind arrays including for coupled / cascading failures.
4. Engage with the international groups developing innovations for the floating wind energy industry, categorise in terms of multidisciplinary impact and ensure that functionality for their development is included in the reference sites and/or reference farm definitions.
5. Engage with the international agencies responsible for Marine Spatial Planning (MSP) to collect open research questions and concerns. Provide responses directly where possible and otherwise ensure that the reference sites and reference farms are defined in such a manner that they enable the required research.
6. Apply the work of Task 49 in an Irish context and engage with the local supply chain to provide specific policy recommendations and development pathways.
7. Raise the profile of floating wind energy technology, related research, and expertise in Ireland through the delivery of a multifaceted communications strategy.

This report will primarily serve to update on the consultation that has taken place to date in relation to WP4, which has primarily focused on MSP in relevant countries engaged in IEA Wind Task 49.

This report relates to consultation undertaken in Year 1 of the project (February 2023 – December 2023). Updates to this report will be completed for years 2 and 3. As this report considers the first round of consultation undertaken, it should be viewed as more introductory, with the view to gaining a deeper understanding of the offshore wind markets in the relevant counties, latest developments, work done to date on MSP, and any key findings. This will be used to guide and inform future work areas and consultation for WP4, as well as to inform the other WPs where relevant.

2 Work Package 4 Overview

WP4 of the project is focused on Stakeholder Integration and Research Requirement Classification. It will be used to ensure the project has the required information from stakeholders, providing key input to the other more technically focused WPs (1-3, 5) within the IDEA-IRL project (Figure 2-1)

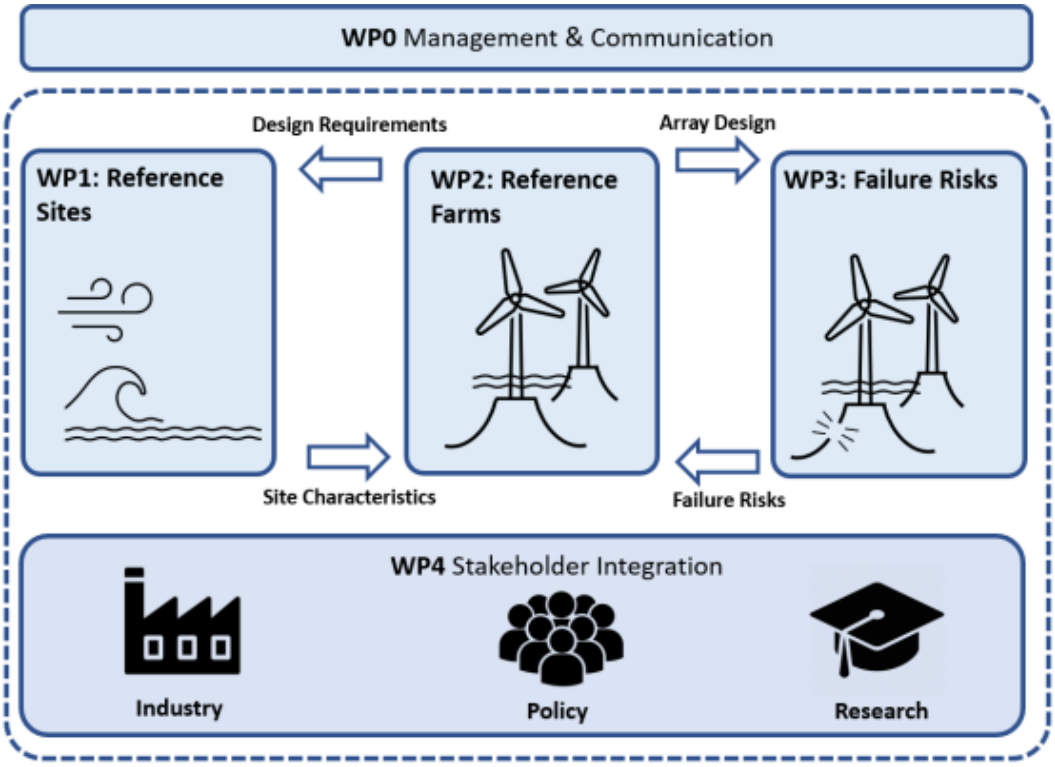


Figure 2-1: Overview of WP0-4, with WP5 - Irish Pathways - also included in this project.

WP4 has a few key objectives, including to:

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

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

- **WP4-D1:** Analytical hierarchy process (AHP) report. A report detailing the AHP methodology to be used to rank and score a list of floating wind innovations, as well as update on work to date for WP4 (Month 6 – see [1])
- **WP4-D2A:** MSP Consultation year 1. Report outlining the consultation undertaken to date, and queries arising from the consultation process, along with recommendations or actions taken for their resolution. (Month 12 – this report)
- **WP4-D2B:** AHP Ranking Report. Report outlining the outcome from the AHP Ranking process of innovations, and assessing potential research topics. (Month 14)
- **WP4-D3:** MSP Consultation year 2. (Month 24)
- **WP4-D4:** MSP Consultation year 3. (Month 36)
- **WP4-D5:** Recommendations for future activities (Month 36)

Milestones for the WP are also listed below:

- **WP4-M1:** Initial definitions and functionality recommendations transferred to WP1,2 &3. (Month 12)
- **WP1-M2:** Final definitions and functionality recommendations transferred to WP1, 2 & 3 (Month 24).

WP4 will ultimately look to identify, characterise, and publish the major research questions faced by the industrial, academic and MSP communities in the development of innovations and the strategic planning for FLOW.

Through the deliverables, a feedback loop will be established with WP1, WP2, WP3 and WP5 to ensure that the reference sites and farms being designed contain a sufficient level of detail; are configured in such a manner to address the identified research needs; and any Irish specific context particularly in relation to MSP is considered where necessary.

A register of innovations will also be developed and scored using an AHP approach, to identify innovations with the potential to make the greatest trans-disciplinary impact. A prioritised list will be used to inform the technical developments in WP1-WP3. At least 2 of these innovations will be selected for impact assessment in WP2. This is discussed in further detail in [1], and the ranking and scoring process will be addressed in WP4 Deliverable 2B, which will be delivered separately to this report.

More relevant to this report, WP4 will engage with relevant international floating wind experts and MSP agencies to understand and categorise the key questions relating to FLOW and MSP. This work will not be related to local planning regulations, but instead focus on cross-cutting topics, for example:

- MSP Policies
- offshore wind targets and development approaches
- designated areas for floating offshore wind development
- viable required port facilities,
- grid capacity requirements,
- viable floating farm project capacities,
- suitable geotechnical / bathymetry, accessibility limits,
- impacts on marine life,
- impact on the fishing industry etc.

This report will focus on the MSP consultation undertaken throughout 2023, giving an overview on the process, of the relevant markets, and some key learnings and conclusions. This process is discussed in detail below.

Innovation and research will be addressed in WP4 deliverable 2B.

3 WP4 Consultation Overview

The primary aims of the first year of work and consultation for WP4 have been to gain a deeper understanding of the relevant markets for floating offshore wind and the work done and documents published in relation to MSP, identify sites that have been designated for the future development of floating offshore wind internationally, gain key contacts, identify preliminary queries, and steer future work for WP4.

All counties identified through their role in the IEA Wind Task 49 have been engaged, and interviews have been conducted with all countries with the exception of China and Denmark, where interviews were arranged but then had to be postponed due to scheduling conflicts. These countries will be engaged and reported on in Year 2.

Follow up interviews have also been undertaken with several country experts with more of a focus on MSP. These countries are the USA, Ireland, Italy, and Norway. Some of these experts worked for the relevant MSP body in that country, while others inputted to the MSP process through the course of their work[2]. Relevant MSP contacts have also been identified for several other countries that will be engaged in Year 2.

Over the course of the Year 2, interviews will be conducted with MSP Experts in each country not yet interviewed as a priority, and follow up interviews will be arranged with key contacts already engaged to monitor developments where useful as well as with new contacts to address key queries identified.

Table 1: List of countries engaged to date as part of WP4

Country	Floating Wind Expert Interviewed?	MSP Expert Interviewed?
USA	✓	✓
France	✓	Contact received to be engaged in Year 2
China	Meeting Postponed - to be undertaken in Year 2	X
Denmark	Meeting Postponed - to be undertaken in Year 2	X
Germany	✓	X
Ireland	✓	✓
Italy	✓	✓
Netherlands	✓	Contact received to be engaged in Year 2
Norway	✓	✓
South Korea	✓	X
UK	✓	X
Portugal	✓	X
Spain	✓	X
Japan	✓	Contact received to be engaged in Year 2

[2] For the purposes of this work, interviewees are kept anonymous. The IDEA-IRL team would like to sincerely thank each interviewee for their time and input to the consultation process, which has been hugely beneficial to the project.

Engagement to date has been undertaken via a survey and interview process, where interviews were generally one-on-one via Microsoft Teams, for one hour. Interviewees were sent a survey/questionnaire in advance of the interview (see [1]) and then this is answered live on the call, to enable discussion on key areas.

As set out in [1], the interviews to data have focused on 5 key areas:

1. **MARKET CONTEXT**: Gain an understanding of each countries' floating wind & MSP context and work to date.
2. **CO-EXISTENCE**: Assess the potential for different activities to co-exist with FLOW in each country
3. **SITE ASSESSMENT CRITERIA**: Discuss what criteria stakeholders see as the most important when assessing a site for FLOW potential
4. **RESEARCH & INNOVATION**: Find what stakeholders see as the key areas in need of research and innovation for FLOW
5. **PIPELINE & FUTURE DEVELOPMENT ZONES**: Identify the areas where floating wind is expected to be developed, capacities and timelines

The same interview structure has been used for all interviews to date. For the Year 2 consultation, the engagement structure will be reviewed and updated, based on the findings from the first round of consultation.

It should be noted that many of the interviews took place early in March / April 2023, and developments have occurred in many jurisdictions between then and the publication of this report. IDEA-IRL has attempted to include any major updates for the relevant markets, and others will be addressed after the next round of consultation.

The majority of the work for this report was also completed before the end of Dec 2023.

A spreadsheet giving an overview of the interview responses is included in Appendix B to this report.

4 Marine Spatial Planning

As discussed, a key focus of this work has been to gain an understanding of the Maritime Spatial Planning activities which have been undertaken to date in relevant countries.

The following section gives an introduction to Marine Spatial Planning, explaining what it is, why it is used, and some general principles to follow when undertaking MSP.

4.1 Background to Marine Spatial Planning

In Europe, MSP is a key part of EU Maritime Policy. The EU Directive on MSP of July 2014 [2] provides for the establishment of MSP at EU Member State level, including with regard to the development of Offshore Renewable Energy (ORE), which must take place according to an ecosystem-based approach and include opportunities for public participation.

This directive defines MSP as:

'a process by which the relevant Member State's authorities analyse and organise human activities in marine areas to achieve ecological, economic and social objectives.'

At an international level, UNESCO, in its Report of the First International Workshop on Marine Spatial Planning from 2006 [3] describes MSP as:

'a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that have been specified through a political process.'

MSP can take many different forms, from high-level strategic plans to comprehensive plans with detailed implementation actions. MSP can be finalised as a policy document or signed into law and be legally enforceable. Plans can have varying scopes, scales, objectives funding streams etc. These are summarised below in Table 2 [4].

For the purpose of this work, the focus has been on MSP practices which have generally been used at a Statewide level, and which have been used to attempt to identify suitable sites for the development of floating offshore wind, or at least offshore wind in general.

Table 2: Overview of MSP Typologies [4]

Criteria	***Categories***	***Definition***
Scale	Local	When a planning area encompasses one or more small (administrative) boundaries (e.g., municipality, district, county).
	Sub-national	When a planning area encompasses an intermediary (administrative) boundary (e.g., province, federal state, autonomous region, island, bioregion, sea-basin, coastal zone).
	National	When a planning area encompasses a whole, or majority of, a nation or territory.
Scope	Coastal Zone	When a planning area covers the coastal zone as it is defined by the country (e.g., up to 1, 3 or 12 NM).
	Coastal and Marine	When a planning area covers all marine waters.
	Marine	When a planning area indicates it does not include a "coastal zone" or coastal waters are not specifically defined or excluded
Purpose	Strategic	When the purpose of the plan is to develop a high-level strategy for the planning area and may include priorities towards the development of a plan in the future.
	Zoning	When the purpose of the plan is to define spatial zones or areas pertaining to the objectives specified by the process. It might include some general goals and identify current and future uses and activities
	Comprehensive	When the purpose of the plan is to define spatial zones or areas, allocate the existing and potential future uses and activities, and develop an implementation plan.
Political commitment	Informal	When there is an informal or verbal announcement to initiate planning (i.e., no official document).
	Executive decision	When an MSP process is initiated through an Executive-level decision (e.g., policy, decree, directive).
	Legal statute	When an MSP process is explicitly established by a legal instrument (e.g., Act, Law, Ordinance).
Implementation framework	Guiding	When a plan is a guiding document for decision makers; a plan informs policy and management decisions, but it is not mandatory to consult the plan.
	Legally binding	When a plan itself is legally enforceable; consulting the plan and implementation is mandatory.

Main objectives	Biodiversity conservation	When the main objectives described in the plan are related to biodiversity conservation (e.g., MPA management plans), without any specific economic, social or cultural objectives (e.g., development of the maritime sectors).
	Economic development	When the main objectives described in the plan are related only to sectoral interests, without any specific ecological or social objectives.
	Multiple objectives	When a plan includes ecologic, economic and social objectives (as per the IOC-UNESCO definition of MSP).
Spatial allocation	Limited	Spatial analysis of current conditions only (e.g., some strategic plans).
	Partial allocation	Spatial analysis of current and future conditions, including scenario development and/or identification of priority areas or zones for one or more objectives but comprehensive spatial allocation not fully developed.
	Detailed allocation	Spatial analysis of current and future conditions, including scenario development and/or identification of priority areas or zones for most or all objectives.
Stakeholders involved	Limited	When a planning process involves only the planning team and governmental authorities
	Key sectors	When a planning process involves the planning team, governmental authorities, and other stakeholders from key sectors.
	Sectors & Public	When a planning process involves a wide range of sectors and categories of stakeholders beyond the planning team and governmental authorities.
Participatory process	Informative	When a planning process is just informed to the public.
	Consultative	When the development of the plan is done using consultations with key stakeholders; public consultation of the draft plan document may occur as is mandatory.
	Collaborative	When the planning process included many opportunities of engagement, aiming collaboration among different stakeholders to develop the plan.
Funding	Government	When a plan is funded by direct allocation from governmental budgets, including users' fees and any national public funds.
	Public-Private	When a plan is funded via public-private partnerships that include government, public and private funding sources.
	Grants	When a plan is funded solely by private and/or public grants not derived from government sources. Includes foundations public entities and private donors.

At its most basic level, MSP involves planning and coordinating the various different activities which need to be undertaken in the relevant maritime area, to minimise conflicts between sectors, maximise co-existence and efficiencies, and ensure environmental protection is paramount. Public engagement is a key part of this.

Given the key role that offshore wind and ORE will play in the future of the global energy system, with up to 380 GW offshore wind capacity anticipated by 2030 and 2,000GW by 2050 [5], MSP becomes even more crucial, to ensures site are chosen in an efficient and coordinated manner to meet targets in a sustainable way. This includes planning between neighbouring counties, as well as within national sea basins.

The MSP Directive establishes a framework for MSP in the EU, and obliged the 22 coastal Member States to develop a national MSP by 31 March 2021, with a minimum review period of 10 years. Countries are at various stages of this process, with further detail available in EU Member States on the EU MSP Platform [6].

For the purposes of MSP in Europe, the region is subdivided into six different sea basins – the Baltic Sea, the North Sea, the Atlantic Ocean, the East Mediterranean, the West Mediterranean, and the Black Sea. Countries within the various sea basins are expected to coordinate MSP plans. The status of the adoption of MSP by EU member states is shown below, taken from the EU MSP Platform in December 2023.

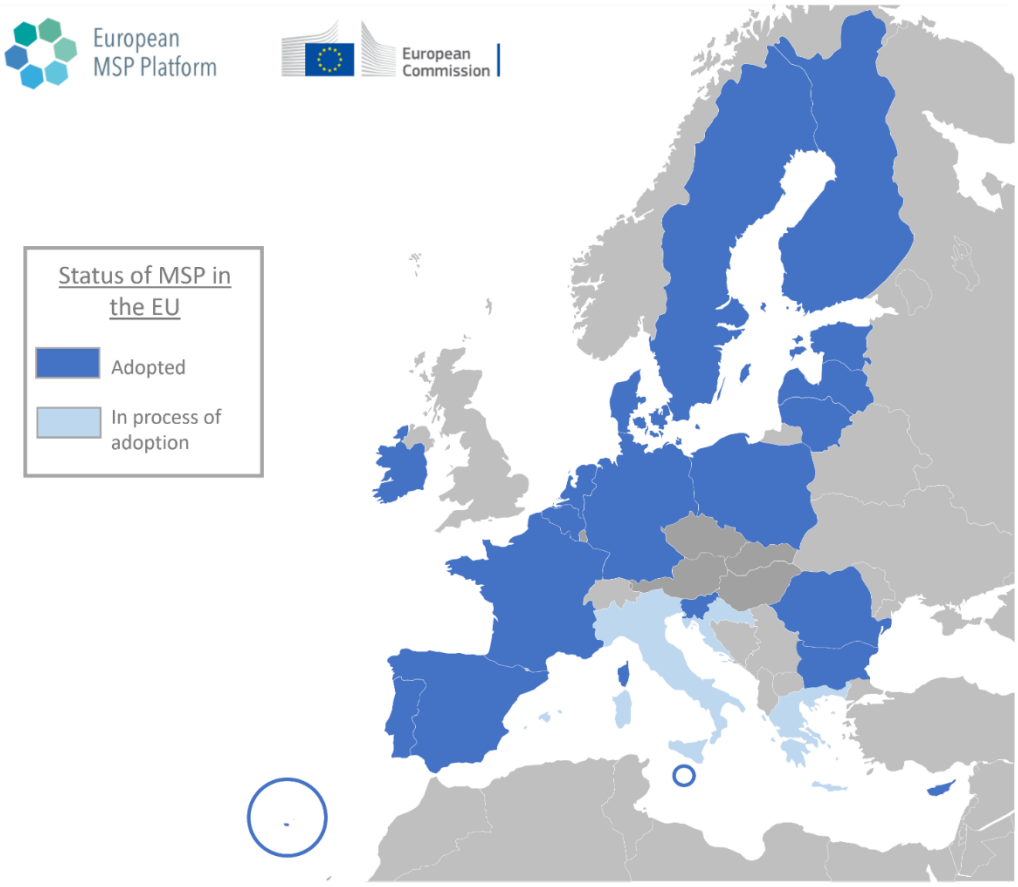


Figure 4-1: Status of MSP in EU Member States [6]

But MSP is by no means just an EU initiative, and it has gained importance across the globe in the last number of years, since the first UNESCO-IOC international workshop in 2006.

In 2022, UNESCO published its State of the Ocean Report 2022 [7], a pilot report developed with the intention of keeping the world up to date on the current state of the ocean. The report notes that MSP will be a key accelerator of the sustainable ocean economy, and states that at the time, approximately 300 MSP initiatives in 102 countries/territories, including government-led processes and pilot exercises, had started and were in different stages of development, with most completed plans being in Europe, but initiatives also underway in Africa, Americas, the Caribbean, Asia and the Oceania regions. These are summarised in [4] and Table 3.

For further information, Appendix A contains a comprehensive list of MSP plans approved internationally as of April 2022, as identified by UNESCO in [4].

Table 3 – Overview of MSP initiatives underway around the world as of April 2022

Region	MSP at early stage		MSP at intermediary stage		Local plan approved		Sub - national plan approved		National plan approved		Countries / Territories engaged in MSP (without repetition)
	Countries / Territories	N	Countries / Territories	N	Countries / Territories	N	Countries / Territories	N	Countries / Territories	N	
AFRICA	Angola, Benin, Cabo Verde, Cameroon, Cote d'Ivoire, Ghana, Kenya, Madagascar, Mauritania , Morocco, Namibia, Tanzania, Togo	13	Guinea, Mauritius, Mozambique, Namibia, Seychelles, South Africa	6	N / A	0	Cabo Verde	1	N / A	0	18
AMERICAS & THE CARIBBEAN	Argentina, Brazil, Bermuda, Colombia, Costa Rica, Curacao, Dominican Republic, Falkland Islands/ Malvinas, Guiana, Jamaica, Mexico, Montserrat, Panama, Peru, Puerto Rico, Suriname, Uruguay, USA , US Virgin Islands	19	Canada, Dominica, Grenada, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Trinidad & Tobago, USA, Venezuela	9	Panama	1	Antigua & Barbuda, Belize, Bonaire, Canada, Ecuador, Mexico, USA	7	Ecuador	1	31
ASIA	Bangladesh, Malaysia, Myanmar, Philippines, Republic of Korea, Thailand, Viet Nam	7	Cambodia, Indonesia, Republic of Korea	3	China, United Arab Emirates, Viet Nam	3	China, Indonesia, Israel, Philippines, Viet Nam	5	Indonesia, Republic of Korea	2	12

EUROPE	Croatia, Greece, Iceland, Italy, Romania, Russia, Isle of Man, Scotland	8	Bulgaria, Cyprus, Estonia, France, Portugal, Spain, Northern Ireland, Scotland	8	Croatia, Estonia, Romania, Sweden	4	Ãland Island, Germany, Norway, Romania, England	5	Belgium, Denmark, Finland, Ireland, Latvia, Lithuania, Malta, Netherlands, Poland, Portugal, Slovenia, Sweden, Scotland, Wales	15	31
OCEANIA	American Samoa, Australia, Fiji, Northern Mariana Islands, Palau, Solomon Islands, Tonga, Vanuatu	8	New Zealand	1	N / A	0	Australia, Kiribati	2	N / A	0	10
Total		55		27		8		20		18	102

UNESCO also released a useful International Guide on Marine/Maritime Spatial Planning in 2021 [8], as well as a step-by-step guide to MSP in 2009 [9]. This sets out 10 key steps to MSP, which are set out below and in Figure 4-2. This gives a very useful overview of the process, and the key steps to developing, implementing and monitoring MSP in a particular area.

- Step 1: Identifying Need and Establishing Authority
- Step 2: Obtaining Financial Support
- Step 3: Organizing the process through pre-planning
- Step 4: Organizing stakeholder participation
- Step 5: Defining and analyzing existing conditions
- Step 6: Defining and analyzing future conditions
- Step 7 Preparing and approving the spatial management plan
- Step 8: Implementing and enforcing the spatial management plan
- Step 9: Monitoring and evaluating performance
- Step 10: Adapting the marine spatial management process

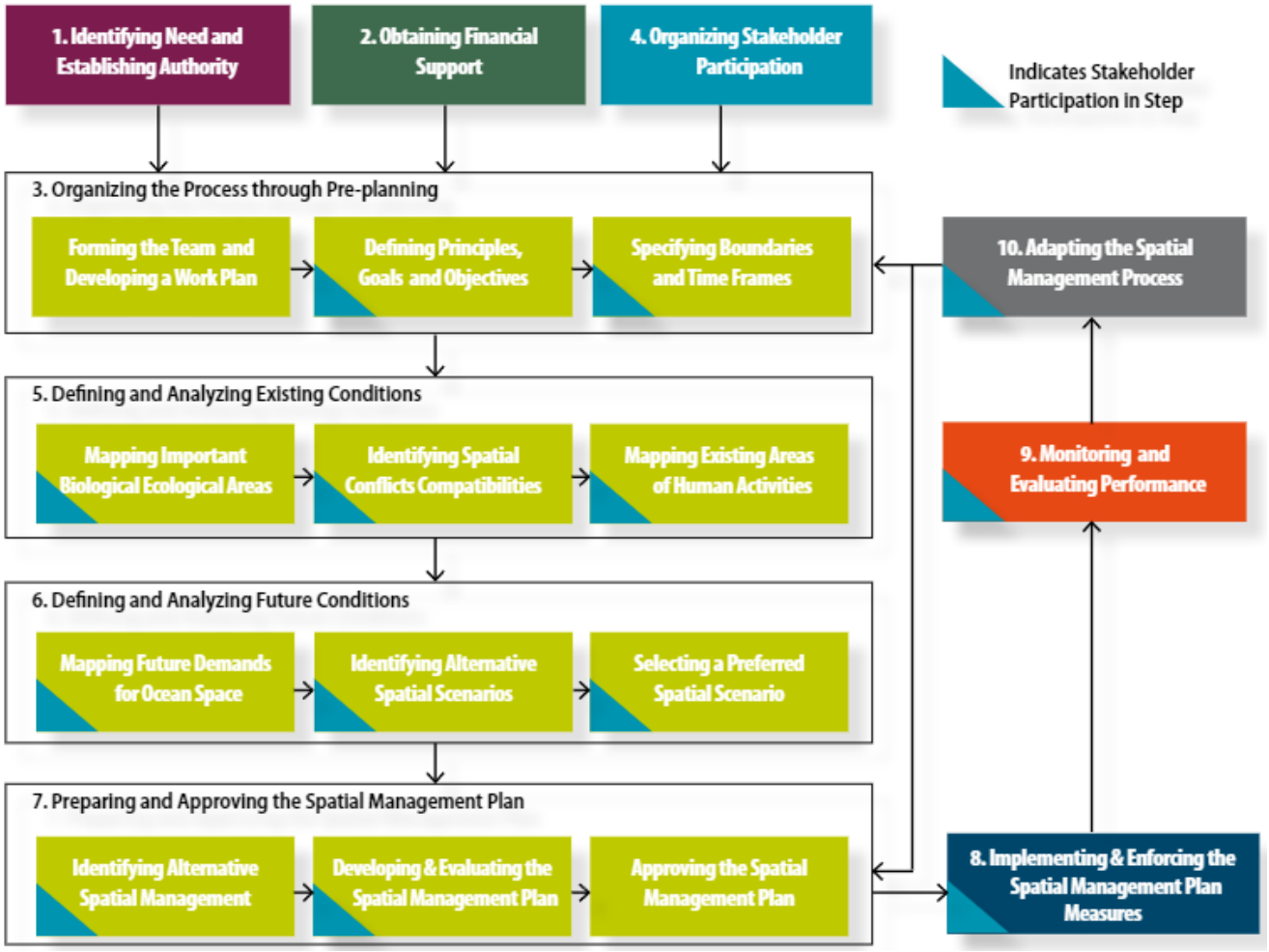


Figure 4-2: Overview of step-by-step approach to MSP [9]

MSP will be key to defining and identifying the future areas for the development of floating offshore wind in Europe and Internationally. The next section gives an overview of the different markets assessed for this round of consultation, and discusses work done in relation to MSP for floating wind where relevant.

These countries, listed below, have been chosen based on their involvement with the IEA Wind Task 49:

- France
- Germany
- Ireland
- Italy
- Netherlands
- Norway
- South Korea
- UK
- Portugal
- Spain
- Japan

Other key findings from consultation and additional research are included in the market overviews.

5 Market Overview

5.1 Pipeline Overview

To inform the market consultation undertaken as part of this work, a floating wind project database was used. This provides a comprehensive list of floating offshore wind projects which are in the public domain – both those that have been installed, and those that are in the pipeline. This data was received from 4C Offshore [10], under a licence / subscription which GDG has with 4C Offshore. This pipeline data was received in February 2023. Table 4 below shows the total floating wind project pipeline (including installed projects) per country, as well as the number of projects/sites.

In addition to this database, we can look to ORE Catapults Floating offshore wind Centre of excellence International Market Opportunities Summary Report [11], to see how they have ranked each market for near term potential. Each market was assessed using weighted criteria spanning technical and policy drivers, commercial investment landscape, and market facilitators. These factors were scored to evaluate the "readiness" of that market for floating offshore wind and the speed of market development. This ranking is included as a column in the table below.

Table 4: Country overview of project pipeline data (from February 2023)

COUNTRY NAME	SUM OF PIPELINE CAPACITY (MW)	NUMBER OF WIND FARMS	OREC MARKET RANKING
ITALY	67,124	71	11
UNITED KINGDOM	56,609	81	1
SWEDEN	47,770	22	16
AUSTRALIA	45,975	20	20
TAIWAN	45,772	42	5
IRELAND	41,170	36	10
CHINA	40,120	23	8
UNITED STATES	29,212	24	7
PHILIPPINES	28,130	34	17
JAPAN	26,891	43	2
SOUTH KOREA	17,752	26	4
BRAZIL	15,507	4	18
SPAIN	15,196	59	12
FRANCE	14,862	26	3
PORTUGAL	10,987	11	9
ICELAND	10,000	1	-
NORWAY	8,774	16	6
FINLAND	7,150	5	-
DENMARK	4,388	5	19
VIETNAM	4,000	1	13
INDIA	3,909	7	22
NEW ZEALAND	3,150	3	-
GREECE	2,600	5	14
LATVIA	1,000	6	-
SOUTH AFRICA	800	1	-

COLOMBIA	500	1	-
SAUDI ARABIA	500	1	-
FAROE IS.	120	1	-
BULGARIA	5	1	-
BARBADOS		1	-
ESTONIA		1	-
GERMANY		1	-
MALTA		1	-
MAURITIUS		1	-
TOTAL	549,972	581	

It should be noted that this project database includes many projects that may have commenced development and since been shelved, others that are highly speculative, and others that will fail at some stage of development for one reason or another. The figures do not represent that potential capacity that will be built in each country, but are useful to gauge the interest and activity of each market for floating offshore wind, nonetheless.

There are also some interesting trends in projects which can be identified from the pipeline.
Figure 5-1 shows the project pipeline as analysed from the 4C Offshore database. The figure includes all floating wind projects currently under consideration known to 4C Offshore in November 2023 (a more recent database that was used for consultation). This data provides a useful high-level market outlook.

The expectation is for developers to be using larger turbines in the future so the trend of increasing machine rating will likely continue. Whether OEMs will be able to deliver 25 MW machines around 2030 remains to be seen, we can however expect FLOW developers to always opt for the larger turbines as they become available.

FLOW projects will soon start to get larger, with the first GW-scale deployments expected to come online in the late 2020s or early 2030s. It is unlikely that projects larger than 2 GW will start appearing any time soon, but the expectation for the 2030s is for 0.5 GW – 1.5 GW developments to be developed.

Future developments will also be possible in deeper water, with some projects planning to be moored in up to 1 km of depth. The typical depth will however be in the region of up to 300 m, unless major breakthroughs in mooring and anchor design change the market.

Notably, it appears that the semi-submersible will be the platform of choice for most future developments. This is likely due to the simplicity of the concept and the inherent stability of a ballast-balanced structure. Semi-submersibles are however typically the largest structures and require the most material, which means that the FLOW industry may become even more dependent on the global raw material prices, unless efforts are made to design structures from readily available materials and manufacture them locally. Either way, the preference for semi-submersibles may signal a start of convergence of the floating platform technology, although there are many semi-submersible designs available and no clear preferred layout yet.

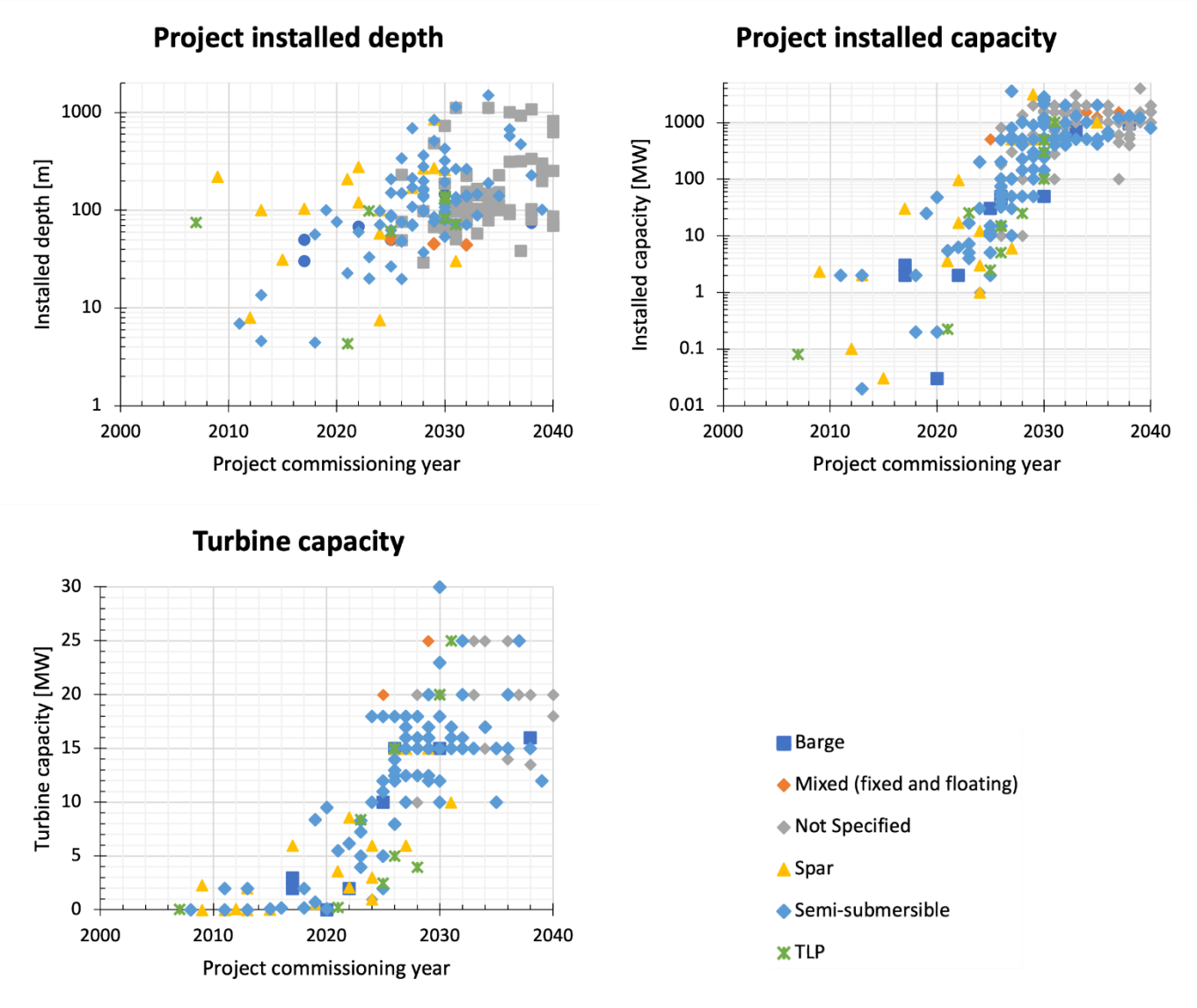


Figure 5-1: The global FLOW project pipeline – trends in project depth, turbine capacity and project size, based on data from the 4C Offshore database, licenced to Gavin & Doherty Geosolutions with a release in November 2023

Given the huge interest in the floating wind market globally, but the still relatively emerging nature of the technology, it will be interesting to monitor how/if the potential trends identified above will materialise in real-time.

5.2 Japan

5.2.1 Market Expectations – Capacity and Targets

Japan's primary energy source is fossil fuels, with 38.70%. 25.84% and 22.34% of Japan's total energy supply coming from oil, coal and natural gas respectively in 2021 [12]. These statistics show that there is vast opportunity for substituting fossil fuels for renewable energy sources in Japan.

By the end of 2022, Japan had an installed wind energy capacity of 4,577 MW, of which, just 136 MW came from offshore sources. Due to the nature of Japan's offshore bathymetry, 80% of Japan's offshore wind potential comes in the form of floating wind technology, based on the assumption that fixed bottom turbines cannot be utilized beyond a water depth of 60 meters. These figures suggest that Japan has the capacity for 500 GW of floating wind, although this should only be seen as a technical potential [13].

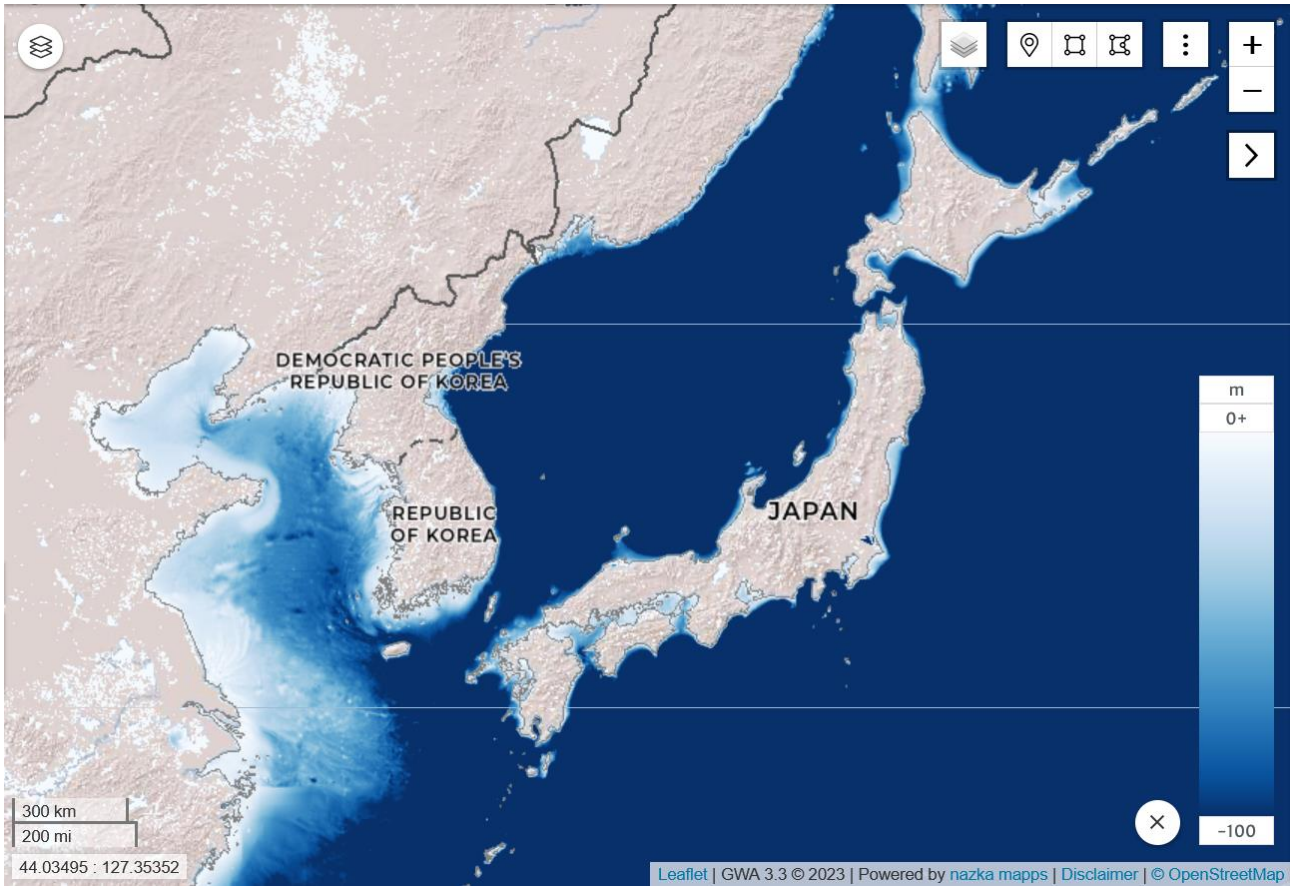


Figure 5-2 Map of Japan's Bathymetry acquired from Global Wind Atlas [14]

As seen above, the water depth which surrounds Japan consists of waters greater than 80 m in depth which is commonly considered to be beyond the range of fixed-bottom wind technologies.

Our floating offshore wind database includes 43 projects/development zones for Japan in total, with a potential capacity of almost 27 GW. This includes 3 commissioned demonstration projects of 3MW or less.

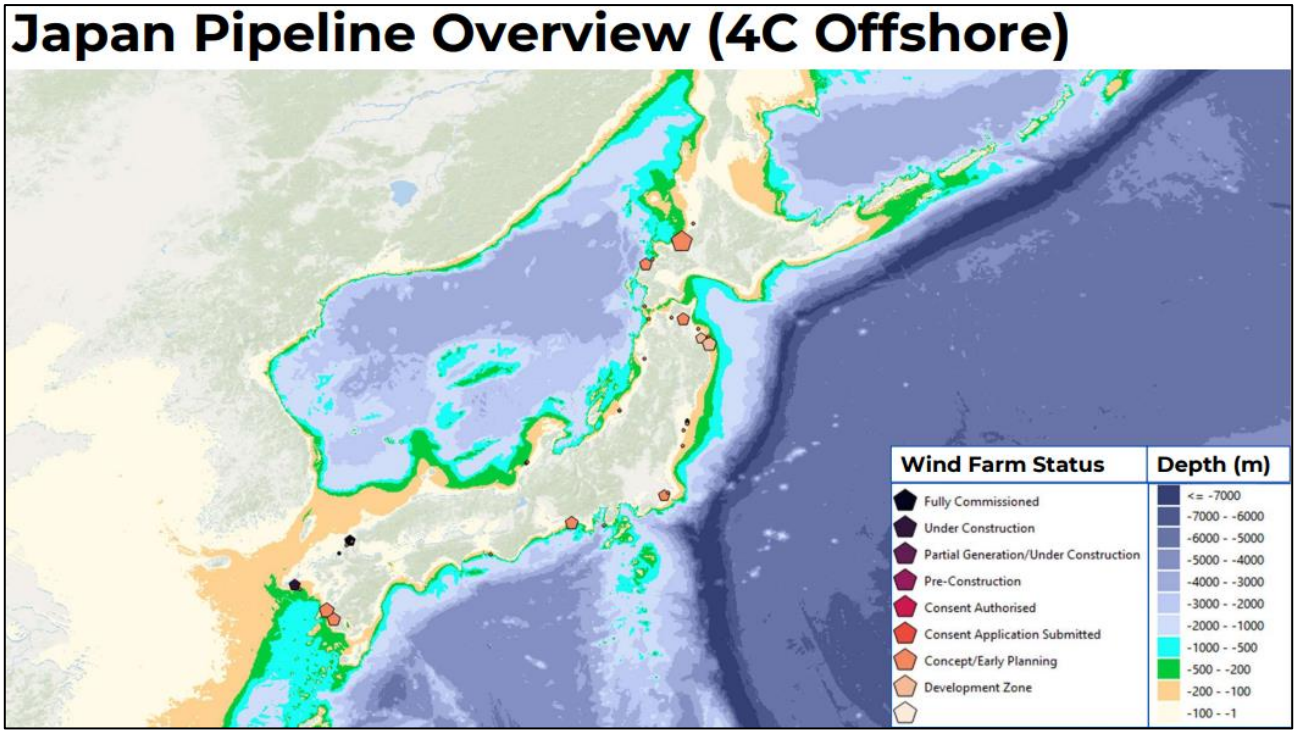


Figure 5-3: Overview of Japanese Floating wind Projects/sites [15]

According to the IEA, at the end of 2021, the ratio of wind power to electricity supply and demand in Japan was 1% [12]. Japan has a target of 10 GW of installed wind energy capacity by the year 2030, with a target of 45 GW to be operational by the year 2040 [16]. Japan's 2030 goals of achieving 10 GW of installed wind energy would boost wind power to 1.7% of the nation's energy mix by 2030, which is much lower than the 3.06% of global electricity which is supplied by wind power as of 2022 [17].

In 2021, the Japanese government selected a consortium of six companies led by Toda Corporation to build the 16.8 MW Goto floating offshore wind farm in Nagasaki prefecture. This was the only bidder in a public auction for the small project. Japan is now working to create a new roadmap for floating offshore wind power by the end of March 2024 – this will be a key milestone for the Japanese market.

Japan's first floating wind farm was due to be commissioned by the Japanese consortium Goto Wind Farm LLC in the southwest of Japan in January 2024, however, this was recently delayed to January 2026 due to the discovery of structural defects [18]. The project is expected to have a generation capacity of 16.8 MW and will consist of eight 2.1 MW Hitachi turbines installed on spar-type, three-point mooring floating foundations.

The largest operational offshore wind farm in Japan is located at Noshiro Port in Akita Prefecture. The OWF (Offshore Wind Farm) was installed in 2022 and consists of 20 Vestas wind turbines with a rotor diameter of 117m and can generate up to 140 MW, enough to power 130,000 Japanese households. This OWF was the first large-scale facility in the country to begin producing electricity commercially.

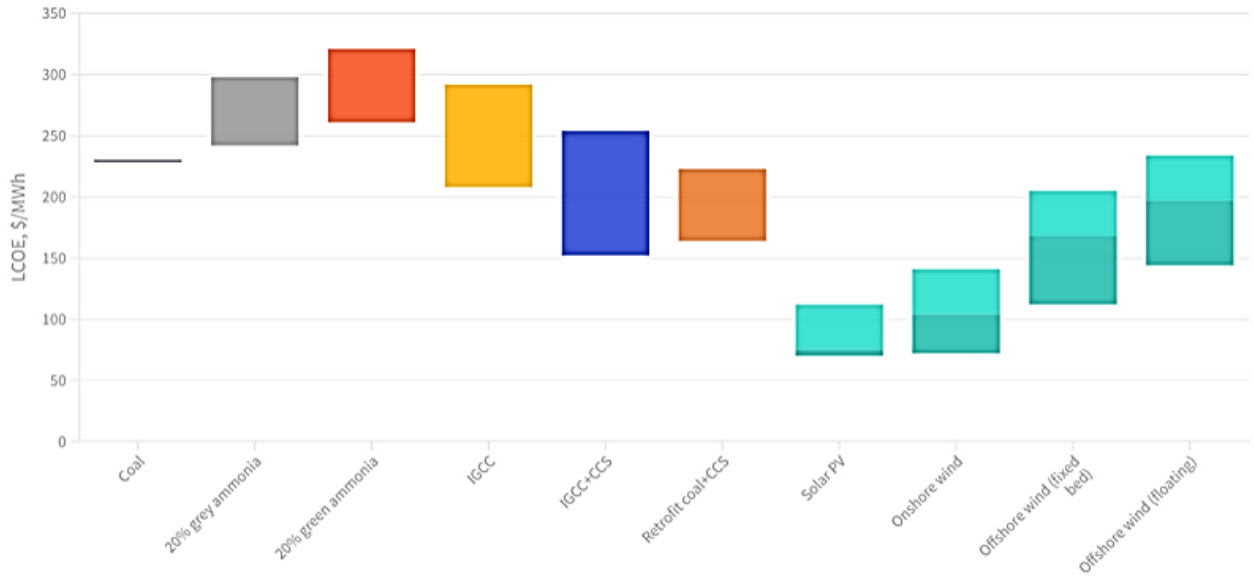


Figure 5-4 LCOE for Different Power Sources in Japan in 2030 [19]

As seen above in Figure 5-4, all forms of wind technology (onshore, offshore fixed-bed and offshore floating) are expected to be cheaper than the LCOE of coal in Japan by the year 2030.

5.2.2 MSP Policy

As of November 2023, there is currently no marine spatial planning in place in Japan, and there is no organisation in-charge of overall MSP. This is an exception to the rule for those countries reviewed in this report.

According to our interviewee, the consensus in Japan was there has been no need for MSP as there were almost no marine industrial uses other than fisheries in Japan. With recent developments in offshore wind in Japan, consensus building with stakeholders has become an issue and the need for marine spatial planning is becoming apparent.

As Japan does not have a history of offshore industries such as oil and gas, coastal areas and activity was governed by the fisheries industry until recently which is presenting issues and further highlights the need for the Japanese government to introduce MSP policies. 'The Basic Plan on Ocean Policy' established by the Japanese government also denotes the requirement for MSP, however, the specific actions are limited.

5.2.3 Overview of Interview

Our interviewee works with a large shipbuilding company in Japan and has responsibilities in policy, R&D, planning & development, MSP, engineering & design, marine environment, O&M and technology. The interview took place in April 2023.

The main takeaways from this interview are the lack of clarity around the future of MSP in Japan. The interview also reveals the vagueness of Japan's wind energy future as the interviewee states that the Japanese government have plans to develop 30-45 GW of offshore wind by 2040, however they have

not given any indication on what the split between fixed and floating technologies will be, and there is no defined pathway to development.

Findings from this interview also suggest that Japan's '2030 Green Innovations Fund Project' is primarily focusing on cost reduction and optimization of O&M for offshore wind, as opposed to investing in getting such developments up and running ASAP.

Japan's approach to offshore wind development is described by the interviewee as a 'complicated market' as the government zones candidate sea areas, which are then bid for by developers. The process is described as very vague and lots of work is required regarding permitting.

They also noted that the Japanese government attempted to expand its exclusive economic zone which resulted in the Korean government setting up floating wind farms near the Japanese EEZ.

Japan has multiple plans for large-scale offshore wind farms as it is one of the biggest substructure suppliers in the world, the first >500 MW floating wind farm is anticipated to be in operation in Japan between 2030-2035 by our interviewee. Out interviewee generally sees the Japanese supply chain as strong, but had some concerns over the port infrastructure suitability to deliver large scale floating wind.

The overall outlook from the interview suggests that the Japan's government, communities and marine users will favour the instalment of floating offshore wind developments compared to fixed bottomed developments. There is a greater wind availability, and the consensus is that floating wind will cause fewer negative impacts on the environment and other marine users such as fisheries.

5.2.4 Summary

Japan does not have a strong history of offshore wind, and no large-scale projects installed as yet.

However, it does have a target of 10GW of offshore wind in place for 2030, and 45GW by 2040, so this is set to change drastically. Our database shows a strong pipeline in place of 27GW, and interest is strong, so it is a market to watch. Given the water depth in Japan, floating wind will be key to its development. ORE Catapult ranked it 2nd globally for near term potential for floating wind.

However, Japan is almost unique in this study in that it has no formal MSP. Consensus is building that MSP will be required to sustainably build out Japan's targets, particularly given the prominence of fishing activities in the Japanese maritime area, so how they put MSP practices in place is something that will be monitored in future work.

5.3 Portugal

5.3.1 Market expectations – capacity and targets

Portugal has one installed offshore wind farm, the 25MW WindFloat Atlantic Project, a floating wind project which was commissioned in 2020 off the coast of Viana do Castelo. The project consists of 3 turbines of 8.4MW each, and it is located 18k from shore, in depths of around 100m. It is the world's first world's first semi-submersible floating offshore wind farm – based on the 'Windfloat' technology, developed by Principle Power [20].

It has no fixed bottom offshore wind deployed.

At the end of 2022, Portugal had installed renewable capacities of 8.2GW hydro, 5.4GW onshore wind, 1.9GW solar, 700MW biomass and 345 MW cogeneration. It also had 4.5GW of natural on the system [21].

Renewable power sources supplied 61% of Portugal's electricity in 2023, up from 49% a year earlier. The country aims to generate 85% of its annual electricity from renewable sources by 2030 [22]. Portugal had set a target of 10 GW of installed offshore wind by 2030, to be allocated via competitive auctions from Q4 2023, however, latest recommendations are for 10 GW of site allocation by 2030 [23], and 2 GW installed capacity [24].

Our floating offshore wind database includes 10 sites/development zones for Portugal (in addition to the commissioned WindFloat Atlantic Project), with a potential capacity of almost 11 GW.

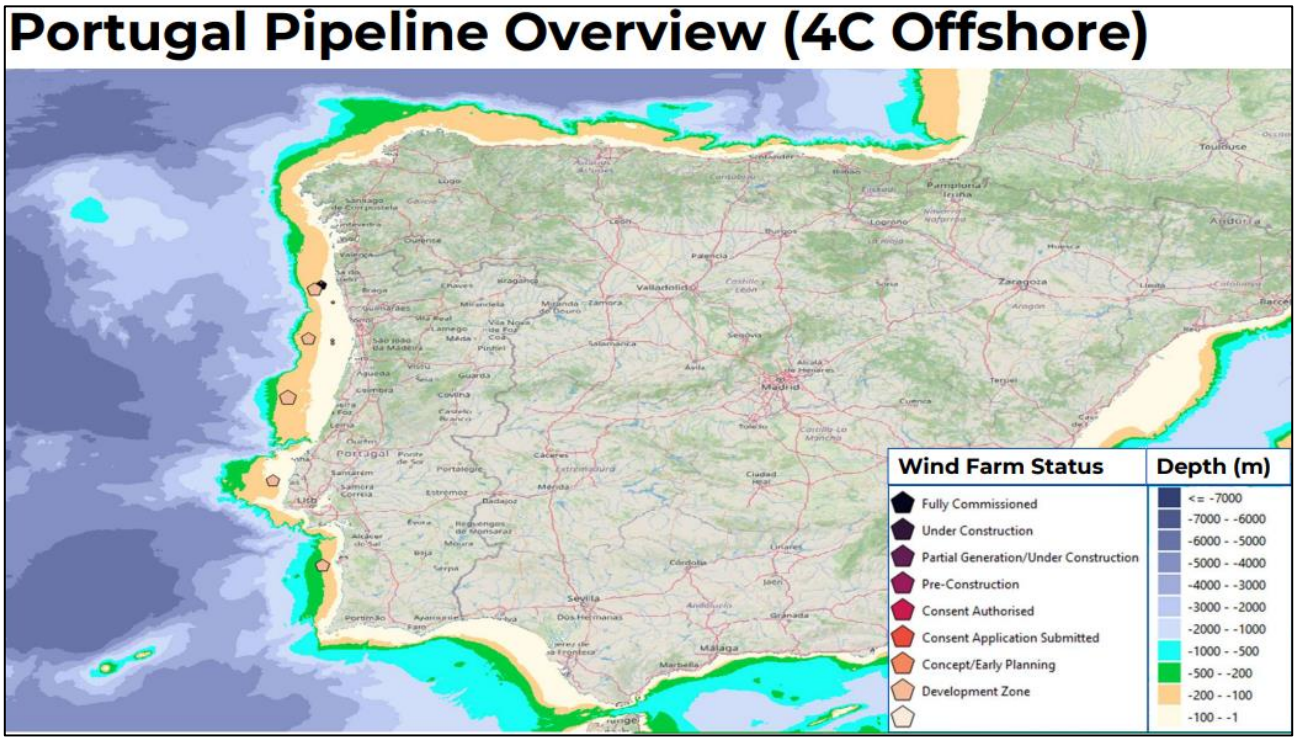


Figure 5-5: Portuguese Floating offshore wind pipeline [15]

5.3.2 MSP Policy

The EU MSP Directive is transposed into national legislation through Law No. 17/2014 on 'marine spatial planning and management', approved for the entire Portuguese maritime space, including the continental shelf beyond 200 nautical miles. Its enabling legislation, Decree-Law No. 38/2015, entered into force on 12 March 2015, and develops the marine spatial planning and management law, defining, among others, the MSP instruments:

I. the Situation Plan with the identification of the protection and preservation areas of the maritime space, and the temporal and spatial distribution of current and potential uses and activities;
II. the Allocation Plans for the private use of some areas or volume of the maritime area not considered in the situation plan [25]

Portugal adopted its Maritime Spatial Plan, the Plano de Situacão do Ordenamento do Espaço Maritimo Nacional (PSOEM), corresponding to the subdivision of the mainland, the subdivision of Madeira and the subdivision of the Extended Continental Shelf in December 2019 by the Council of Ministers (Resolution No. 203-A/2019).

Portugal's MSP hub can be found here: https://www.psoem.pt/

The Directorate-General for Maritime Policy (Ministry of the Sea) is the competent authority regarding the implementation of the Maritime Spatial Planning Directive (MSPD). The Directorate-General for Natural Resources, Safety and Maritime Services (DGRM) is responsible for the coordination of the Portuguese maritime spatial plan, named the Situation Plan, and for the preparation and development of the Plan in the maritime zone between the baseline and the continental shelf beyond 200 nautical miles.

The Regional Directorate for Sea Affairs (DRAM) of the Azores Regional Government is responsible for the preparation and development of the Situation Plan in the maritime space adjacent to the Azores archipelago, named Azores Subdivision. The Regional Directorate for the Sea (DRM) of the Madeira Regional Government is responsible for the preparation and development of the Situation Plan in maritime space adjacent to the Madeira archipelago, named Madeira Subdivision.

In Portugal, the National Ocean Strategy 2021-2030 is the public policy instrument for the sustainable development of the economic sectors related to the ocean. The Strategy points to the importance of maritime spatial planning in the development of a sustainable blue economy and the need to ensure compatibility between different existing and potential future activities taking place there.

Further detail on MSP in Portugal and the relevant Legislation can be found in [26].

In January 2023, Portugal released draft areas for offshore wind development as part of the government's plan to award 10 GW of capacity by 2030. In October - December 2023, areas were consulted on in the Public consultation on Offshore Renewable Energy Allocation Plan.

The consultation paper identifies six potential areas for offshore wind, with a total area of 3,176 km2 - 3,393 km2, in Viana do Castelo Norte, Viana do Castelo Sul, Leixões, Figueira da Foz, Ericeira, and Sines. Site are chosen based on public consultation, the concerns of fishers which were communicated at several meetings with fishing associations and organisations, and input from the advisory committee.

The consultation includes an environmental report, which identities potential impacts on the environment and heritage, and ways to mitigate same [24] [27].

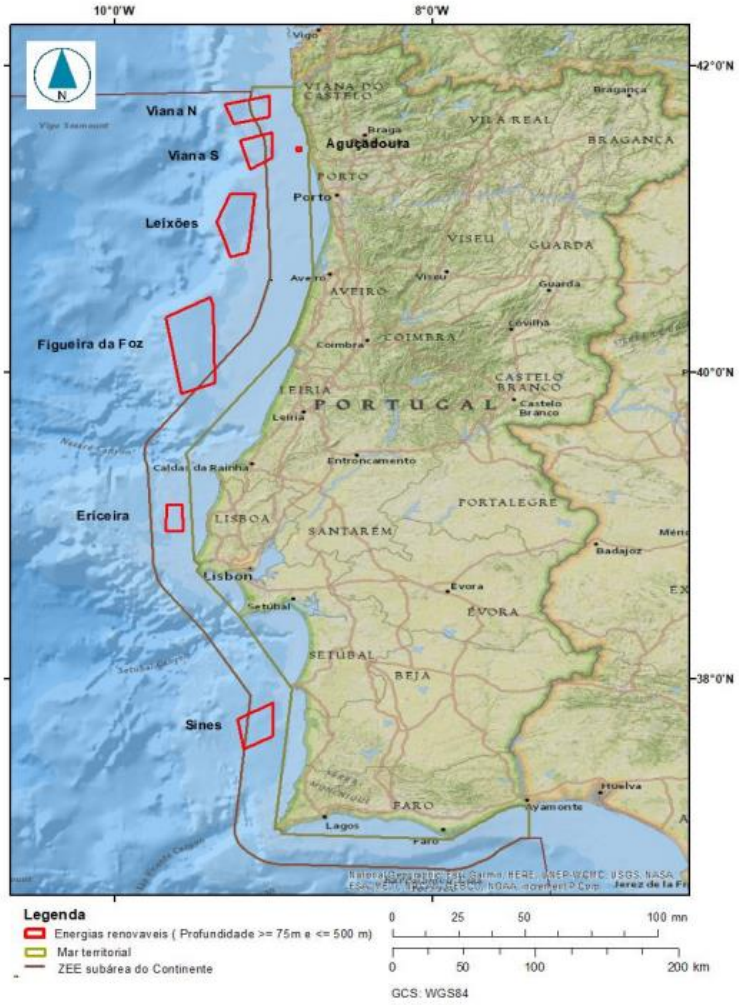


Figure 5-6: Areas planned for the exploration of floating wind and/or wave energy resources in Portugal [27]

In November 2023, Portugal sought expressions of interest from developers to participate in an offshore wind tender. The first tender is set to relate to the identified areas in the regions of Viana do Castelo (1GW), Leixões (500MW), and Figueira da Foz (2GW), reaching up to 3.5GW of total capacity [28]. The areas are defined in the draft Allocation Plan for Offshore Renewable Energies, which was under public consultation from 27 October 2023 to 12 December 2023 [24].

Consultation documents can be viewed here: https://participa.pt/pt/consulta/plano-de-afetacao-para-energias-renovaveis-offshore-paer . Fifty companies or consortia from more than ten countries submitted their expressions of interest for the tender, including developers such as Iberdrola, RWE, Equinor, Ocean Winds, ACCIONA, Corio Generation [29].

A full detailed clarification of the auction process, and the legal framework to govern it, are required. It is not yet clear if the auction will be for a seabed lease only, followed by a separate auction for a CfD-type revenue support mechanism, or if it will be for both, though the latest updates seem to suggest that a two-step approach will be proposed.

5.3.3 Overview of interview and main takeaways

Our interviewee for Portugal works with a national research laboratory in Portugal which supports Government in policy activities including national plans for energy and climate, planning for renewables, solar, wind, biofuels, and biomass. The laboratory has also participated in the development of Portugues MSP.

The interview was conducted in April 2023.

The interviewee noted that Portugal was in the process of increasing its target to 10GW of offshore marine renewables by 2030, with a priority for offshore wind and floating offshore wind, and with floating wind expected to be the dominant technology. This new target was to be an increase from the previous target of 300MW for 2030 set in the Portugal NECP.

At the time of interview, development areas for offshore wind for Portugal had been defined and published, but capacities had not yet been established. These were expected at the end of May. Auction details were also being defined at the time.

The interviewee noted that offshore wind is considered at a plan-level with an offshore working group established by Governmental Dispatch nº 1404/2022 in September 2022 to oversee this, with overall responsibility for MSP resting with the Directorate for Maritime Resources (DGRM – Direcçao Geral de Recursos Maritimos), which coordinates the WG. It was recommended that an interview with the Directorate or Portuguese MSP bodies be sought as part of the next round of MSP consultation when plans are at a more advanced stage.

The interviewee noted there is strong political will to support OW in Portugal, and that the intention is to launch the first concessions in 2023, and have the first large scale floating wind farm in operation before 2030, by around 2027. This was seen as ambitious but not impossible by the interviewee given the narrow window. It was noted that government will support as much as possible to attempt to enable early commissioning, and the project is likely to at least be under construction by 2030, but concerns over supply chain capabilities within Europe were cited as a potential delayer. Ports and Supply Chain were noted as areas in need of attention for Portugal if large scale projects are to be delivered.

The interviewee saw floating wind as a more acceptable technology to existing and future users of the marine environment compared to fixed bottom, that would have less impact on the environment and provide a greater opportunity for local content. It was noted that Portugal already has blade and turbine manufacturing facilities locally, and that the floaters for the WindFloat project were manufactured by a Portuguese company, so this experience, along with Portugal's onshore wind experience, will be beneficial.

It was noted that disruption to fishing activities is a large concern for Portugal, and that large areas have been marked as exclusion zones for offshore wind, due to ongoing fishing activities in these areas.

The interviewee expected floating wind to account for the majority of offshore wind capacity in Portugal in the long term, and noted that no long term targets for offshore wind, outside of the 10GW target for 2030, had been set.
It was noted that our interviewee expected floating wind development in Portugal to begin in the North near Viana, and then move south towards Lisbon, but that this should be assessed versus the MSP areas released.

5.3.4 Summary

The commissioning of the WindFloat Atlantic project was a huge milestone for the industry.

Portugal is a market with strong potential, a solid pipeline and a target of 10 GW of site allocation by 2030, and 2 GW installed capacity, which is ambitious but realistic. Recent indications are there is strong interest in the market from major developers.

Portugal appears to have used well laid our MSP processes to identify sites for floating, which should help it to reduce conflicts going forward. It is now opening up some of its identified sites for tendering in 2024, but the auction process needs to be clarified. This would be generally seen as ideal – putting MSP process in place, identifying sites using same, and then tendering these.

Portugal will be an important market to monitor, to see if the MSP practices it has employed help future projects to be developed in an efficient and sustainable way, with minimum conflicts.

5.4 Spain

5.4.1 Market expectations – capacity and targets

Spain is a global onshore wind energy development hub. It currently has an installed capacity of approximately 30GW of onshore wind, the second highest in Europe, behind Germany (59GW) [30]. At the end of 2022, it also had an installed capacity of approximately 26GW of solar PV, including ground mounted and for self-consumption [31]. In 2023, Spain recorded a 50.4% share of renewable electricity. Wind power accounted for 23.5% of electricity in 2023, and was Spain's leading source of electricity [32].

Spain has no commercial scale offshore wind. 2 demonstration projects are in operation in Spain. The 2MW DemoSATH project, which is a floating demonstration project located in Northern Spain, is in depths of 85m. The project is in operation since September 2023, and uses a concrete twin-hull barge structure, made of modular, pre-fabricated components. The design has a single point of mooring. The project is developed by RWE [33]. The 5MW Elican fixed bottom demonstration project was also commissioned in 2019, developed by Esteyco at the Plocan test site in the Canary Islands.

Our floating wind project database contains 59 projects in development in Spain, with a total capacity of over 15GW. Spain is targeting 1-3GW offshore wind by 2030, set out in the 'Roadmap Offshore Wind and Marine Energy in Spain' from 2022 [34] with a longer-term target of 17GW by 2050.

It is anticipated that the vast majority of this capacity will be floating wind due to the bathymetric conditions in Spanish waters. This is a major reason that Spain has not developed any large-scale offshore wind to date, as well as the existence of strong onshore wind and solar resources. Floating wind now provides an opportunity for Spain to tap into its offshore wind resource potential.

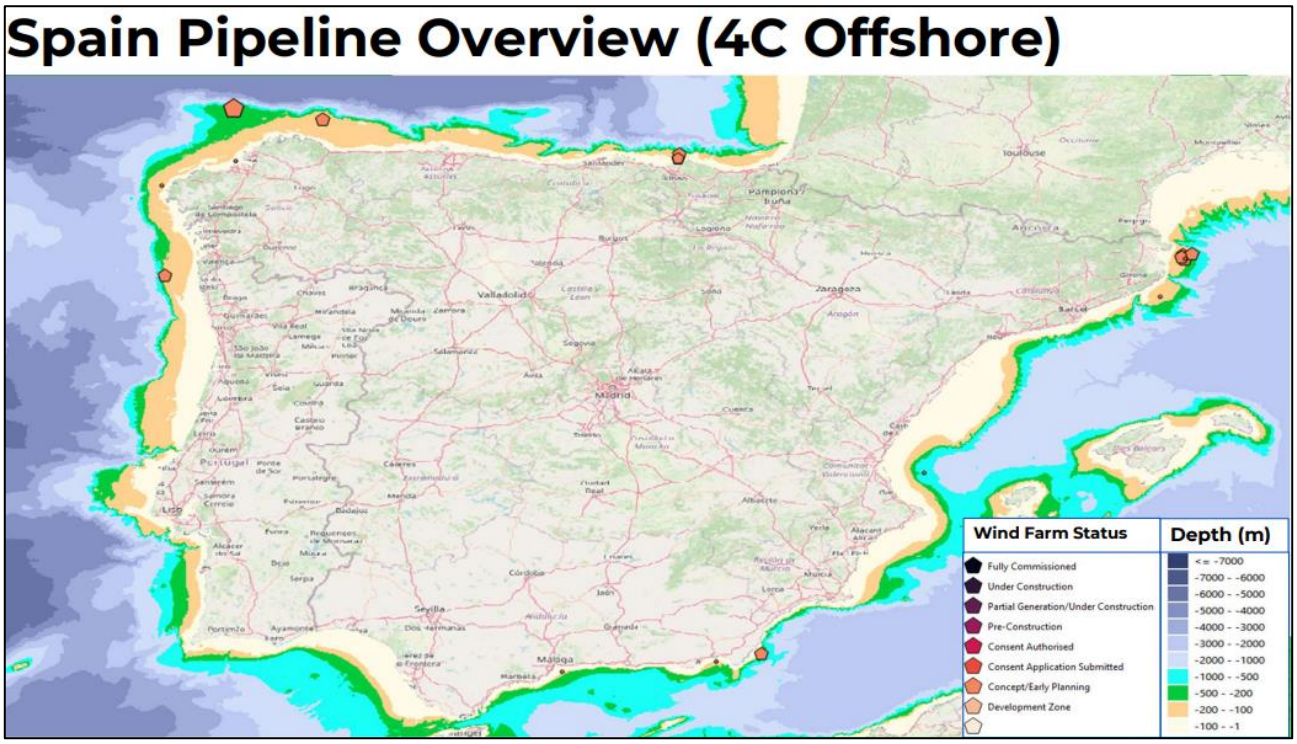


Figure 5-7: Overview of projects in the pipeline for Spain

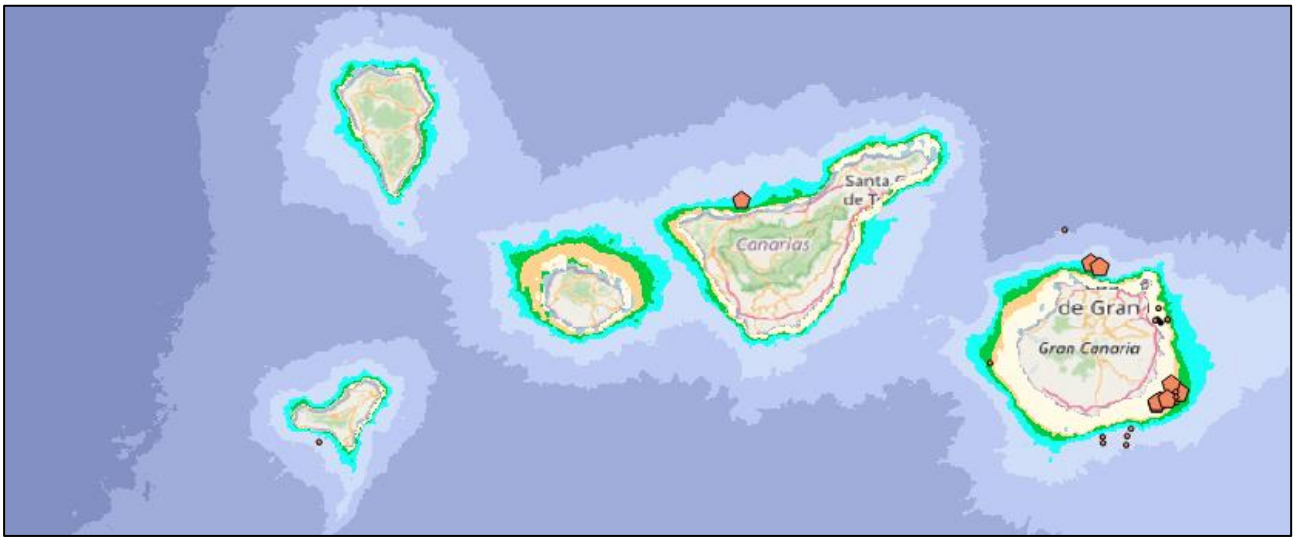


Figure 5-8: Overview of projects in the pipeline for the Canary Islands

5.4.2 MSP Policy

Spain's marine area is separated into separate subdivisions; North Atlantic, Levantine-Balearic, Strait and Alboran, South Atlantic, and the Canary Islands. The different subdivisions are shown below in Figure 5-9.

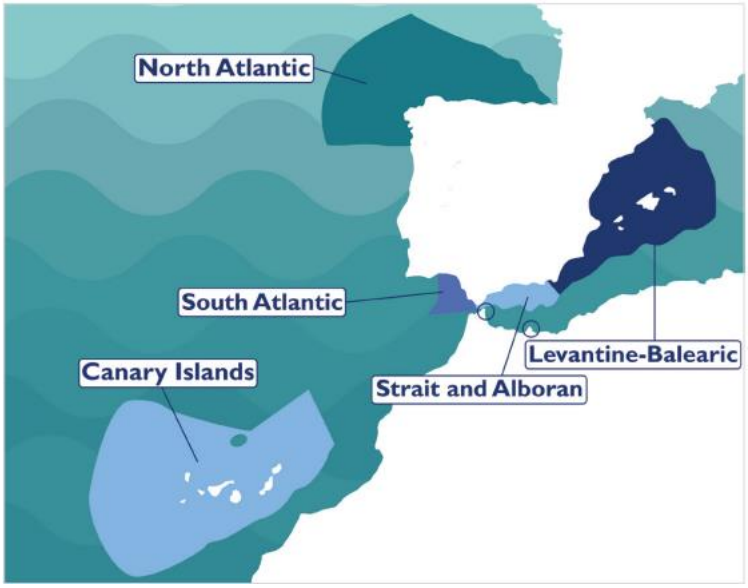


Figure 5-9: Marine Subdivisions in Spain [34]

MSP in Spain is Governed through POEMs (POEM, according to the Spanish acronym of "Planes de Ordenación del Espacio Marítimo") [35]. These are managed by the Ministry for Ecological Transition and the Demographic Challenge.

In February 2023, the council of ministers approved Royal Decree 150/2023, approving the Marine Spatial Plans (POEM) for Spain. It establishes plans for each of the five Spanish marine subdivisions. The establishment of the POEM in Spain has been driven by Directive 2014/89/EU of the European

Parliament and of the Council of 23 July 2014, in the framework of the European Union's Integrated Maritime Policy initiative to promote blue growth through maritime planning. This was then transposed into Spanish law through Royal Decree 363/2017, which establishes the framework for MSP in Spain.

The POEMs (one for each subdivision), define the spatial and temporal planning of what different uses and activities can be carried out in Spanish waters. The drafting of the POEMs was informed by input from many sectors, such as fisheries, tourism, energy, and industry. Further information / data on this can be viewed here: http://www.infomar.miteco.es/visor.html [36].

The POEMs establish Priority Use Zones (PUZs) and High Potential Areas (HPAs).

PUZs are areas where activities of general interest are currently taking place (Biodiversity protection, Environmentally assessed coastal protection aggregate sites, Protection of underwater cultural heritage, R&D&I, National defence, Safety in navigation)

HPAs are areas where the realisation of certain activities is foreseeable, such as offshore wind development, port activity, Aquaculture, biodiversity conservation etc.

The POEMs also identify Offshore wind energy Priority Use Zones (ZAPER by its Spanish acronym): these have been defined to give priority to the possible deployment of infrastructures for the exploitation of commercial offshore wind energy, without prejudice to the fact that such projects may include hybridisation with other offshore renewable technologies.

The roadmap notes that *'Average wind speed and bathymetry are the two most relevant technological elements taken into account in the development of the MSP (POEM by its Spanish acronym) which, together with the analysis of the other uses and activities in the marine environment, the environmental values and protection figures, as well as the compatibility between the different elements, allow the definition of the most suitable areas for the deployment of offshore wind power in our country.'*

In all, The POEM outlines areas with greatest potential for offshore wind, totalling 19 zones and 4948 km2. A total capacity of approximately 15 – 30 GW could be procured from these sites, assuming a power density of 3 – 6 MW/km2. Potential offshore wind areas are identified in all subdivisions except for the South Atlantic subdivision. The Roadmap document suggests a typical range for the average density ratio for offshore wind projects to be between 4 MW/km2 and 6 MW/km2.

All sites identified are within 1000m depth, with a minimum of 50m, and the majority of areas around 500m – showing clearly that the projects will be almost exclusively floating offshore wind. The Roadmap suggests that fixed bottom projects are unfeasible in locations deeper than 50-60m, while floating wind can be developed in depths of 'hundreds of metres', with the depth restriction coming from the laying of underwater power infrastructure. The document expects the costs of floating wind to decrease between 38% and 50% by 2050, and to reach 40-60€/MWh by 2030 for commercial scale projects.

The first auction for offshore wind in Spain was due to take place in 2023, but is now expected by February 2024 [23]. Before projects can be built, Spain first needs to adopt a new legal framework to replace Royal Decree 1028/2997, which establishes the procedure for the processing of offshore wind authorisation applications [37].

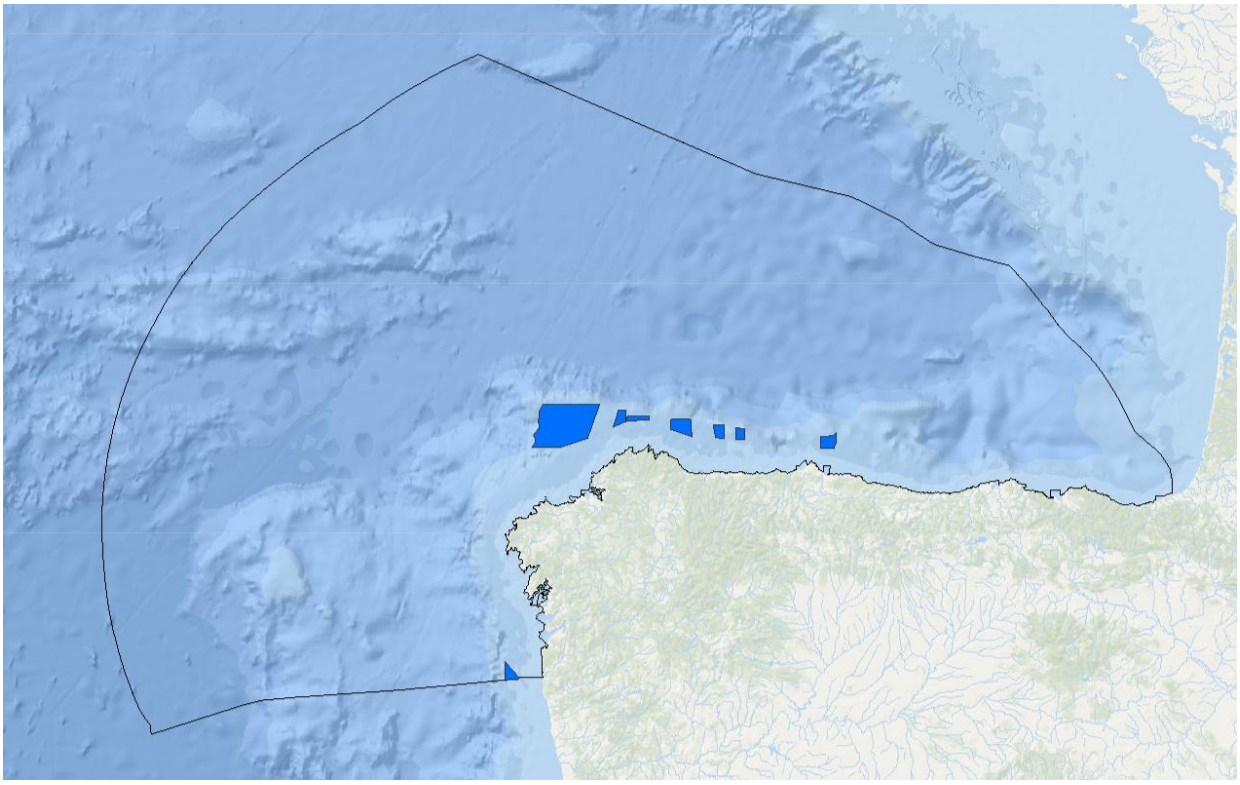


Figure 5-10: North Atlantic Areas identified for offshore wind

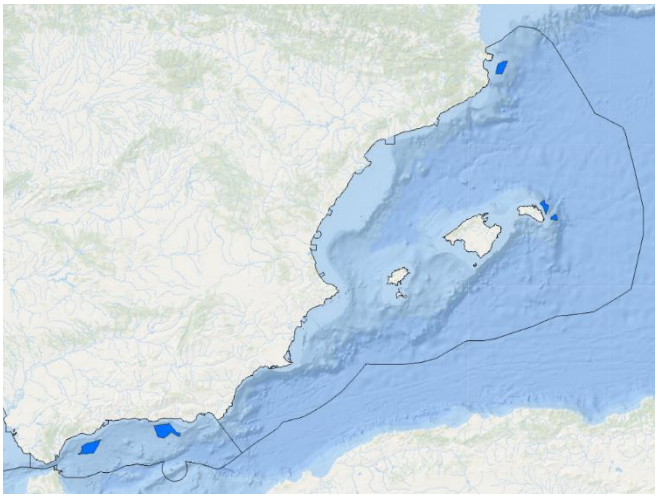


Figure 5-11: Strait and Alboran and Levantine-Belearic areas identified for offshore wind

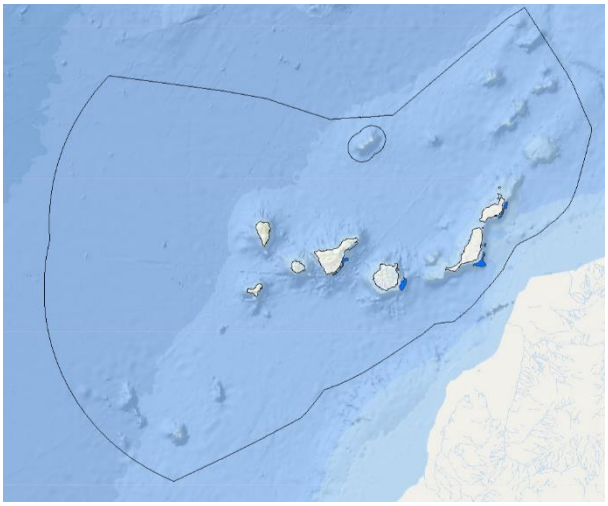


Figure 5-12: Canary Islands areas identified for offshore wind

It is planned that the revision of the MSP will be carried out 6 years after their approval by Royal Decree, Consequently, the current MSP will be reviewed and updated by 31 December 2027 at the latest. The MSP will also be monitored periodically to ensure their effectiveness is evaluated and any revisions / adaptations required are implemented. Each Department affected by the MSP (POEM) will also produce an annual report on the implementation of these plans, which will be sent to the Directorate General for the Coast and the Sea, which will then send an analysis of the same to the Interministerial Commission for Marine Strategies to ensure the coordinated implementation and management of the MSP (POEM) and their updates. Further detail on MSP in Spain can be found on the European MSP Platform [38].

5.4.3 Overview of interview and main takeaways

Our Spanish interviewee works with a renewable energy centre which develops applied research in renewable energies and provides technological support to energy companies and institutions in the areas of wind, solar, thermal, solar PV, biomass, hydrogen, and storage. They work within the centre's offshore wind department, in an R&D role.

The interview took place in April 2023.

Our interviewee noted that the Spanish Roadmap from 2022 [34] sets a target of 3GW of offshore wind by 2030 (noted as 1 – 3 GW in the roadmap), with a longer-term vision of 17GW by 2050 also in place. Due to the water depths and conditions off the Spanish coast, it is anticipated that the majority of this capacity will be floating wind, and that fixed bottom wind development in Spain will be very limited.

Out interviewee noted that offshore wind development in the country is managed by the central Government, with input from regional and local governments. The Spanish Ministry for the Ecological Transition and the Demographic Challenge (MITECO) is responsible for MSP in the State, but it was noted this could change after upcoming elections in 2023.

The interviewee informed us that MSP in Spain is carried out through POEMS (POEM, according to the Spanish acronym of "Planes de Ordenación del Espacio Marítimo") [35], and that these had been proposed by government at the time of interview, and will identify which areas are dedicated to offshore wind energy. Auctions will then take place to determine who will build on these identified sites.

Our interviewee expected the first 500MW commercial scale floating offshore wind project to be developed between 2030 and 2035. They noted that Ocean Winds had recently contracted Navantia Seanergies for the anticipated construction of between eight and twelve floating foundations per year between 2027 and 2031 [39], and that it was hard to see a large-scale project being developed before 2030.

It was noted by the interviewee that while floating wind may be more acceptable to coastal communities due to the lower visual impact, it will not be more acceptable to fishing communities as it takes up more space and the structures including mooring lines are not stationary. Spain has seen protests from fishermen in relation to offshore wind, particular for those POEMs in the north of Spain.

It was thought that aquaculture, hydrogen and other renewables show good potential to co-exists with floating wind, but that commercial fishing, MPAs and tourism / leisure areas did not.

Our interviewee anticipated that the first floating wind projects in Spain would be in the Canary islands, which has milder conditions to facilitate easier deployment, while also cautioning that these milder conditions would also limit energy production. The North Atlantic area was also seen as an area where development would take place, with a large area identified here according to the POEM.

5.4.4 Summary

Spain's strong history in onshore wind should be of benefit as it enters the offshore wind market in the coming years.

Much like Portugal, fixed bottom will be very limited, and its future will be floating.

It also has a target in place that is realistic (1-3GW by 2030), although expectations are that this may slip to 2030-2035.

It has similarly used well laid out MSP practices, and identified 'Offshore wind energy Priority Use Zones', which is very important. Overall, it has identified enough are for 15-30GW to be built, which allows for significant attrition as more detail becomes available on these sites.

It has also seen delays to its first tender, but this should take place in early 2024. This will be monitored closely.

5.5 The UK

The UK is one of the original pioneers of offshore wind globally. The first British offshore wind project, North Hoyle, became operational as early as 2003 with 30 turbines of a combined capacity of 60 MW. Currently, the UK is home to the largest operational offshore wind farm, Hornsea 2 with a capacity of 1.3 GW from its 165 turbines [40] and offshore wind makes up 14 % of UK electricity generation [41].

During the last 20 years, the UK has managed to develop a mature offshore wind market, often with leading technologies and good supply chain interactions, making use of the existing offshore operations expertise from the oil & gas industry as well as of transferable skills from the now-gone shipbuilding industry.

The UK market has been able to grow in part thanks to the *Contracts for Difference* (CfD) scheme, in which owner operators of renewable energy projects get a guaranteed rate at which energy will be purchased from them, thus allowing to remove market uncertainty and provide a higher level of confidence to potential investors in the projects. During the scheme, contracts for the construction of renewable energy projects (including offshore wind) are awarded, along with a pre-determined strike price. The strike price is what the operator of the project will be paid for the energy produced and is generally indicative of the expected Levelized Cost of Energy (LCoE) of the project, though not the same.

At the end of 2022, there were 50 wind farms either in operation or under construction in the UK with record-low strike price of 37.32 £/MWh being reached in 2022 (2012 prices), with a total of almost 7 GW of contracts awarded in the fourth round of the British CfD scheme [42]. This shows the size and maturity of the British offshore wind market and the effectivity of the CfD scheme, however, only one floating wind project won an auction in round 4 of CfD – the TwinHub demonstrator project with 32 MW capacity.

There is a lot of work ahead for the UK offshore wind industry as well as for the policy makers. The fifth round of the CfD allocations failed to attract a single offshore wind development, which should be a clear signal to the regulators that changes are needed. This failure to attract new projects is likely due to supply chain issues throughout the industry with prices of raw commodities, manufacturing, transport, and construction and installation services rising to such levels that projects can no longer run profitably with the low CfD strike prices. The UK is to increase the CFD price cap by 66% for the next CFD round, where the maximum strike price for offshore wind will be GBP 73 (USD 91/EUR 84) per MWh. Floating wind's price ceiling will be set at £176/MWh, up 52% on the £116/MWh in the round 5 tender that also did not result in any bids from eligible developers. [43]

The British market is positioned well, with ample experience, good domestic integration of the supply chain, world-leading research facilities like those at the Offshore Renewable Energy Catapult (OREC) and dedicated training programmes for all types of personnel involved in the industry. There is still a lot of work to be done in terms of policy development and rolling out of floating wind technologies, which would unlock more areas for future projects. The UK will also need to start focusing on some of its older offshore wind farms, which are fast approaching their design lifetime and will either need to be updated to keep operating or decommissioned.

5.5.1 Market expectations – capacity and targets

The UK is currently the second largest offshore wind market globally. Currently, 13.9 GW of offshore wind is fully commissioned in the UK, 78 MW of which is floating wind [44]. For floating offshore wind, the UK is currently the world leader in terms of operational capacity connected to the grid and is home to the second largest floating offshore wind farm in Kincardine (47.5 MW), second only to the Norwegian Hywind Tampen project (88 MW) [45].

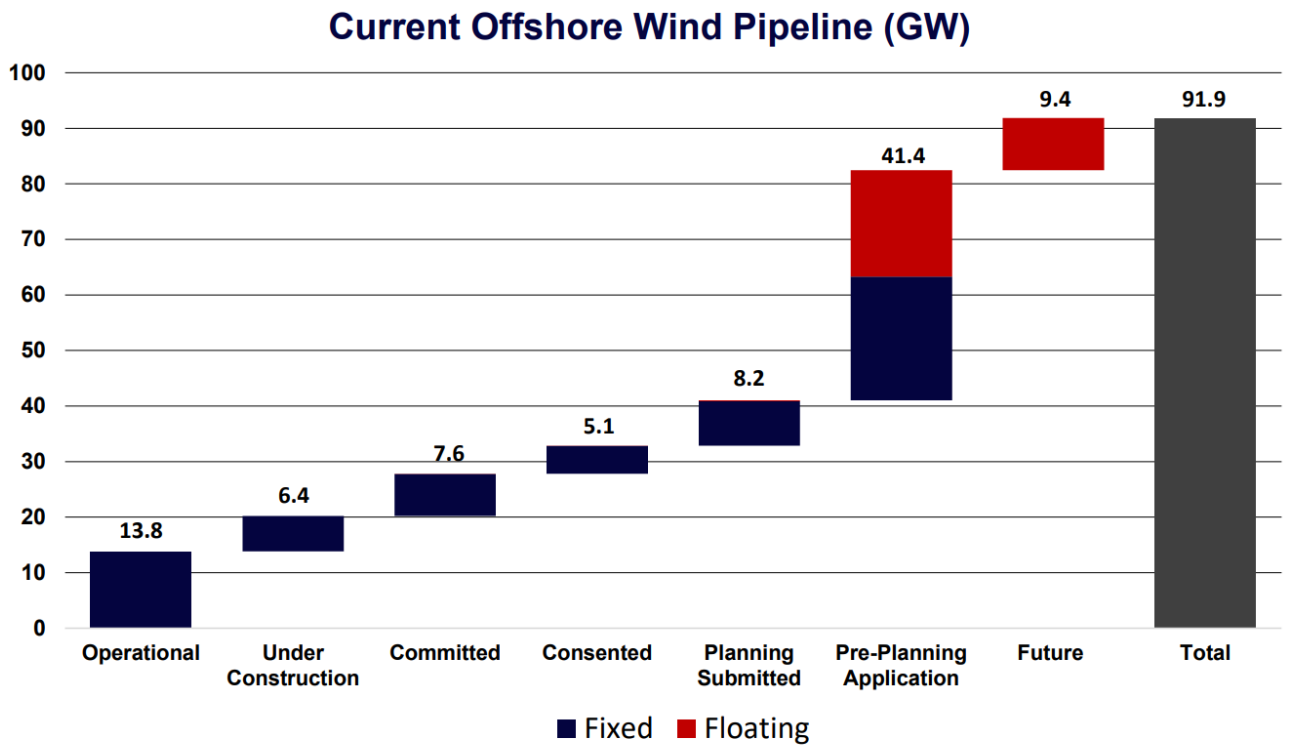
As of 2022, the UK had 2653 operational offshore wind turbines across 44 farms, with a further 545 turbines across six farms under construction [41]. For projects commissioned in 2022, the average turbine size was 9 MW [41]. The British fleet is operating with an average capacity factor of 38% (2022 data), but newer sites achieve about 5-10% more, likely thanks to newer machinery and sometimes a larger distance offshore.

There are two medium-scale floating wind farms operational in the UK: Hywind Scotland (30 MW) and Kincardine. The Hywind project is built on spar-type floating foundations whereas the Kincardine farm uses semi-submersible floaters. Hywind Scotland and Kincardine started producing electricity in 2017 and 2021 respectively and are among the first floating wind projects which have successfully been connected to the grid.

The Hywind Scotland project recently made headlines when it was reporting in January 2024 that after a little over six years of operation, the wind farm's Siemens Gamesa wind turbines are now due for some major maintenance work. This will be the first such maintenance campaign on a floating wind farm. The maintenance campaign is expected to take 3 – 4 months, and the turbines will be towed to a port in Norway to complete the works [46].

Currently in the development pipeline is also the TwinHub demonstrator project, focused on the trials of a new twin-turbine platform in the Celtic Sea. The project has a CfD agreement for 32 MW and is currently in the design phase.

The UK regulators set out a target of 50 GW of offshore wind by 2030, including a 5 GW floating component. In a recently published Offshore Wind Net Zero Investment Roadmap [47], the Department for Energy Security and Net Zero of HM Government makes a strong case for investment into the UK offshore wind sector, showcasing the project pipeline, leasing rounds plan and investment commitments. According to the report, there is currently 78 GW of offshore wind capacity in the UK pipeline, roughly 40% of which is planned to be floating [47]. An overview of the pipeline is presented in Figure 5-13. Note that there is little concrete planning available for 50.8 GW of the 78 GW in the pipeline, so this may not be the most reliable figure, but it does show the UK's commitment to offshore wind deployment, and it shows the British regulators are putting some serious trust in the future of floating wind.



Source: Department for Energy Security & Net Zero Analysis
Footnotes: Operational & under construction up to date as of Q3 2022, committed -> pre-planning application up to date as of Q1 2023, future up to date as of Q3 2023.
Future capacity is based on potential seabed to be leased via The Crown Estate Celtic Sea and INTOG leasing rounds.

Figure 5-13 – Pipeline overview of UK offshore wind projects [47]

Our floating project pipeline shows the UK having the second largest pipeline globally, with 56,609MW across 81 projects/sites.

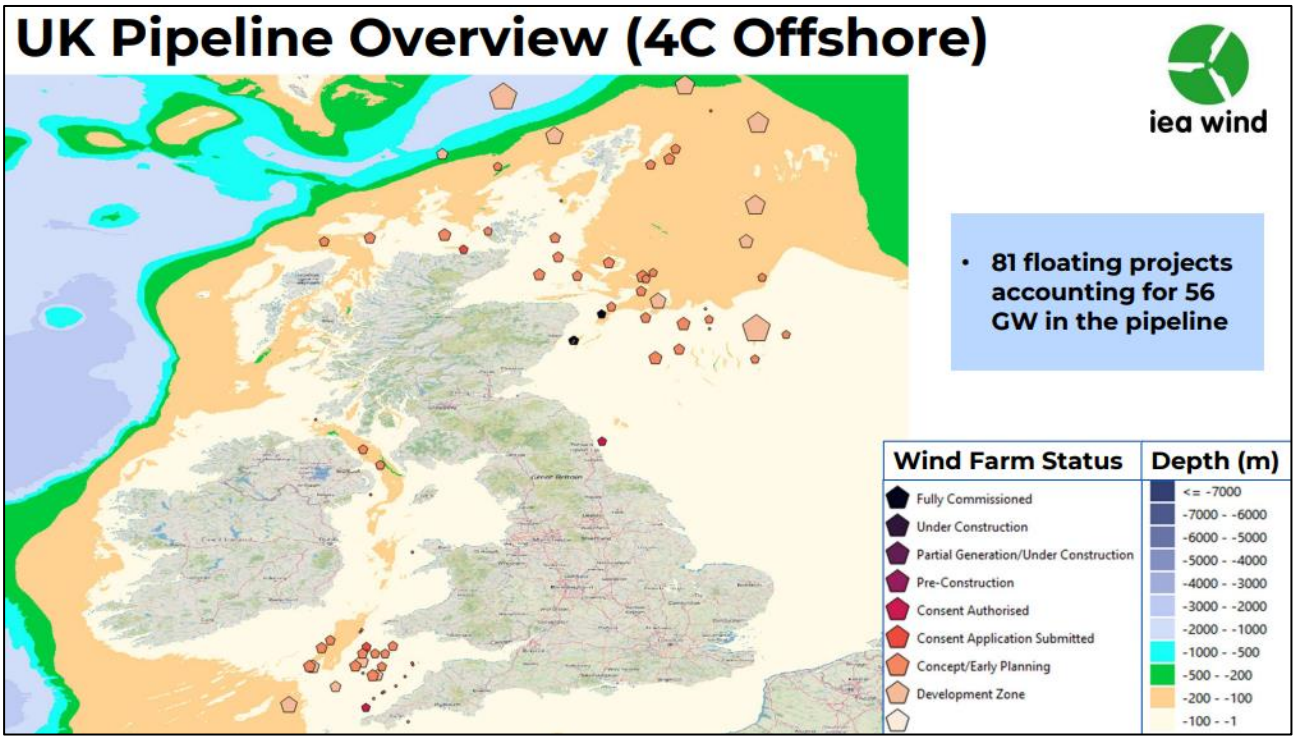


Figure 5-14 – UK Pipeline overview

5.5.2 MSP Policy

The UK four states - England, Scotland, Northern Ireland and Wales - each have a certain degree of autonomy in setting their policies. Since a unified approach to marine spatial planning was required, the Secretary of State, Scottish Ministers, Welsh Ministers and the Department of Environment in Northern Ireland jointly adopted the UK Marine Policy Statement, which sets an overlaying context for the development of marine spatial plans. In this plan, the UK vision for the marine environment is for "clean, healthy, safe, productive and biologically diverse oceans and seas" [48]. This policy statement identifies 11 main areas of concern for marine spatial planning activities in the UK:

1. Marine protected areas
2. Defence and national security
3. Energy production and infrastructure development
4. Ports and shipping
5. Marine aggregates
6. Marine dredging and disposal
7. Telecommunications cabling
8. Fisheries
9. Aquaculture
10. Surface water management and wastewater treatment and disposal
11. Tourism and recreation

The legal basis for all marine planning activities in the UK is the Marine and Coastal Access Act of 2009. This piece of legislature considers marine functions and activities and makes provisions for fish conservation, coastal access routes, works which are detrimental to navigation, or renewable energy installations, among other things. Importantly, the Marine Management Organisation was set up by this act.

Marine spatial planning activities in the UK must always refer to the broad focus of the UK Marine Policy Statement regardless of the jurisdiction in which the MSP activity is being carried out. The policy statement lays out that the authorities responsible for the development of marine plans are the Secretary of State for the English inshore and offshore regions, Scottish Ministers for the Scottish offshore region, Welsh Ministers for the Welsh inshore and offshore regions and the Department of the Environment in Northern Ireland for the Northern Ireland offshore region.

Scotland: The Scottish Crown Estate

In Scotland, the Scottish Crown Estate manages most of the seabed off the Scottish coastline on behalf of Scottish Ministers. This authority awards and manages leases and other agreements and liaises with organisations wanting to build offshore wind projects in Scottish waters. During planning and applications, developers work with the Marine Directorate (previously Marine Scotland), an agency which monitors compliance with existing legislation, and which is responsible for giving out licenses to offshore renewable operators as well as fishing vessels or aquaculture projects. The Marine Directorate also cooperates with NatureScot and the Scottish Environment Protection Agency (SEPA) to carry out any required environmental impact assessments, which form an important part of the lease and license agreement in the UK.

The main document outlining the areas available for offshore wind development in Scotland is the Sectoral marine Plan for Offshore Wind Energy (2020), published by the Marine Directive. A schematic of areas identified by this plan as suitable for offshore wind use is shown in Figure 5-15. This document outlines where offshore wind development is anticipated and desirable and where developers can expect construction bid auctions to go ahead.

Agreements are awarded during leasing rounds, where developers are invited to send out applications. Such two recent leasing rounds were ScotWind and INTOG.

During 2022, 20 projects[3] were awarded seabed option agreements by Crown Estate Scotland via a ScotWind leasing round, 13 of which are for floating turbines. Developers then have ten years to secure the required consent, licenses and financing for being awarded the seabed lease. All the areas under option from the 2022 round of ScotWind have previously been identified as potential areas for offshore wind development in the Scottish Government's Sectoral Marine Plan for Offshore Wind.

The expectation is that the projects will start being built in the late 2020s and onwards. As part of the ScotWind leasing round, developers are not only required to propose projects with reasonable market value, but they are also required to consider local supply chain development and outline how their supply chain is going to be managed and where it will be located. This is a very important part of ScotWind aimed at improving local economic value to the regions where the projects will be built. Successful Scotwind projcets are shown below in Figure 5-16 [49].

[3] The first 17 successful projects were announced in April 2022. These were joined in October 2022 by three further projects, granted agreements through the Clearing process.

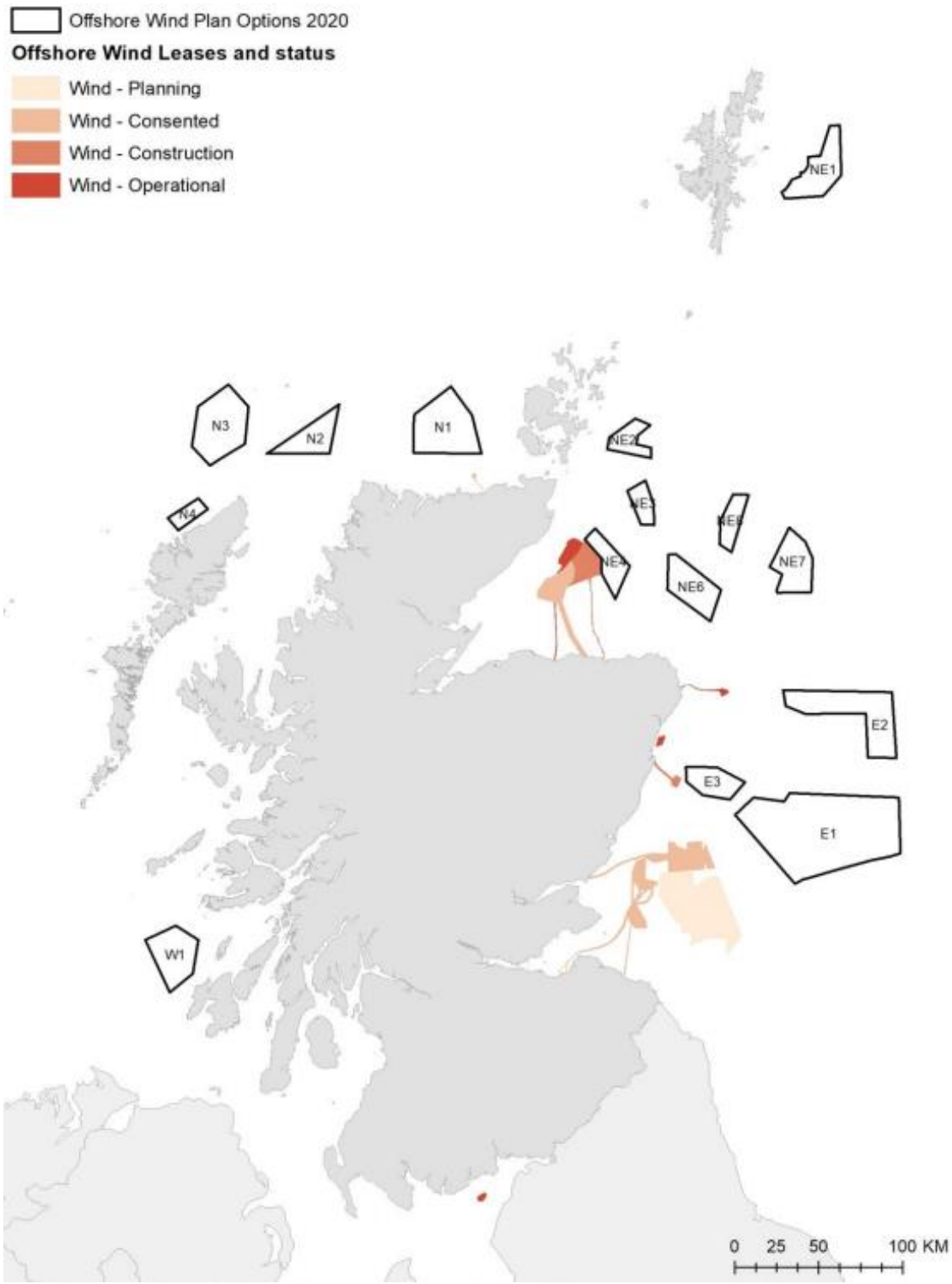
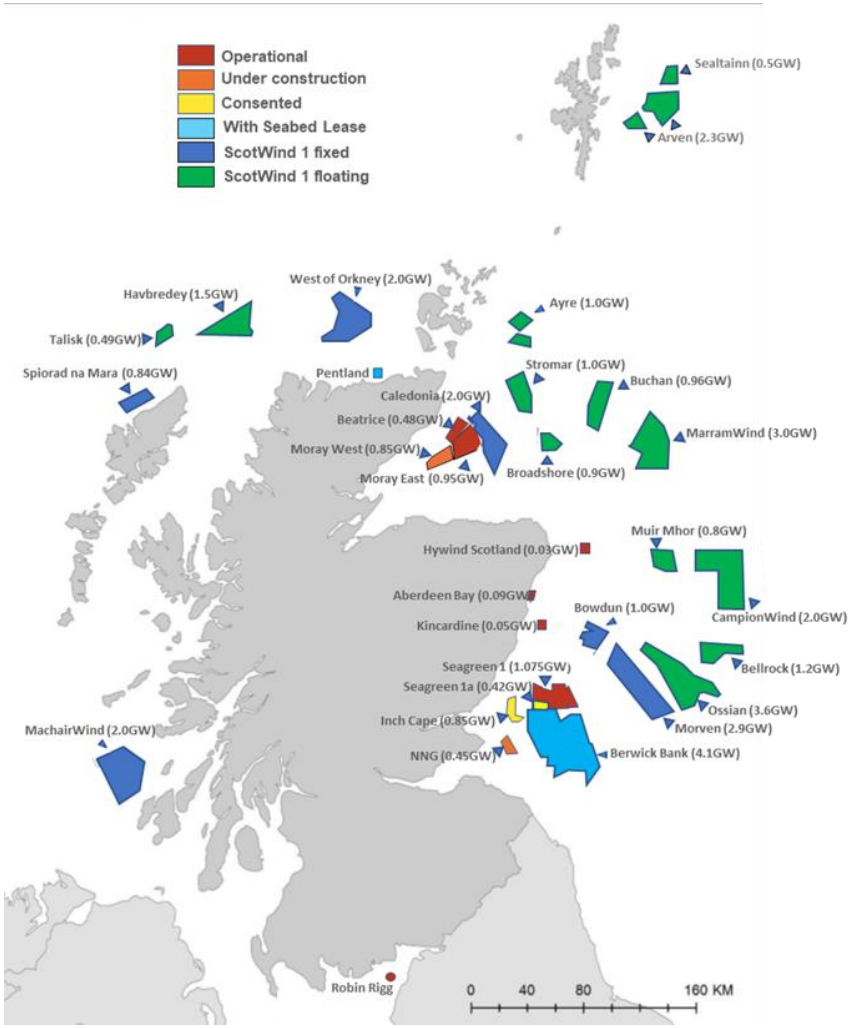


Figure 5-15 – Scottish Sectoral Marine Plan for Offshore Wind Energy [50]



ScotWind Round

SITE	DEVELOPERS	CAPACITY
Morven	BP and EnBW	2,907MW
Ossian	SSE Renewables, CIP and Marubeni	3,610MW
Bellrock	BlueFloat Energy¦ Renantis Partnership	1,200MW
CampionWind	ScottishPower Renewables and Shell	2,000MW
Muir Mhor	Vattenfall and Fred Olsen Renewables	798MW
Bowdun	Thistle Wind Partners	1,008MW
Ayre	Thistle Wind Partners	1,008MW
Stromar	Orsted and BlueFloat Energy¦ Renantis Partnership	1,000MW
Caledonia	Ocean Winds	2,000MW
Broadshore	BlueFloat Energy¦ Renantis Partnership	900MW
MarramWind	ScottishPower Renewables and Shell	3,000MW
Buchan	Floating Energy Allyance	960MW
West of Orkney	RIDG, Corio Generation and TotalEnergies	2,000MW
Havbredey	Northland Power	1,500MW
Talisk	Magnora Offshore Wind	495MW
Spiorad an Mara	Northland Power	840MW
MachairWind	ScottishPower Renewables	2,000MW
Arwen 1a	Mainstream RP and Ocean Winds	500MW
Arwen	Mainstream RP and Ocean Winds	1,800MW
Sealtainn	ESB Asset Management	500MW

Total = 30,026MW
Floating Wind = 19,271MW (64%)

Figure 5-16: ScotWind Projects

England, Wales, and Northern Ireland: The Crown Estate

In waters surrounding England, Northern Ireland, and Wales, the seabed is managed by The Crown Estate. This is an organisation which awards seabed rights to companies, acts as a knowledge exchange centre and plays an active role in leasing sites for offshore wind developments. However, this authority does not create the marine plan in the given areas.

In English waters, MSP activities are carried out by the Marine Management Organisation. This organisation has the authority of the Secretary of State to conduct marine planning activities. One of its main focuses is to design a planning process for the development of future marine plans. The organisation encourages local communities to get involved in MSP lays out several objectives for what a marine plan needs to do, notably putting emphasis on considerations regarding environmental protection as well as on creating industrial growth and job opportunities.

In England and Wales, the leasing follows an auction system as part of the CfD scheme as discussed earlier, where The Crown Estate presents areas identified for future development and invites investors, and operators to submit bids for projects to develop these areas. The Crown Estate then decides whether to provide a seabed lease to future project operators.

The leasing or 'option fee' will be paid annually until companies get the final planning permission, which they need to then bid in the CfD auction. The seabed areas for which bidding will run have been pre-selected by the Marine Management Organisation when creating the marine plan. Currently, round 5 of CfD auctions has finished with no new allocations to offshore wind, likely because of a push for too low purchase prices of electricity. Round 6 applications will likely open sometime in the spring of 2024.

As discussed previously, there are many projects in the British marine planning pipeline. There is a mix between floating and fixed-foundation projects, but all of them seem to be keeping to roughly 150 km from shore or less, however, there are some exceptions. Most of the deployment is focused on the east coast, both for Scotland and England. This is likely due to many factors like the depth, proximity to more densely populated areas, and more development space.

The marine spatial plans for Scotland and England are shown in Figure 5-15 and Figure 5-17. Projects in various stages are shown. In addition to these, there are plans for up to 1.4 GW of floating wind to be developed off the coast of eastern Northern Ireland during the North Channel 1 and 2 projects [51].

In the Celtic Sea, the Crown Estate has also identified three fixed-boundary Project Development Areas (PDAs) of up to 1.5GW each, giving an opportunity to deliver up to 4.5GW of floating offshore wind in the Celtic Sea, as shown in Figure 5-18 [52]. The Round 5 leasing process will begin in early 2024 when pre-qualification questionnaires will be issued to prospective Bidders. Detailed timings will then be confirmed. Offshore Wind Leasing Round 5 seeks to establish a new floating wind sector in the Celtic Sea off the coasts of South Wales and South West England. It is expected to be the first phase of commercial development in the Celtic Sea, with plans to create up to 4.5GW of offshore wind capacity. In its Autumn Statement in November 2023, the UK Government confirmed its intention to unlock space for a further 12GW of capacity in the Celtic Sea, so there is another significant market there.

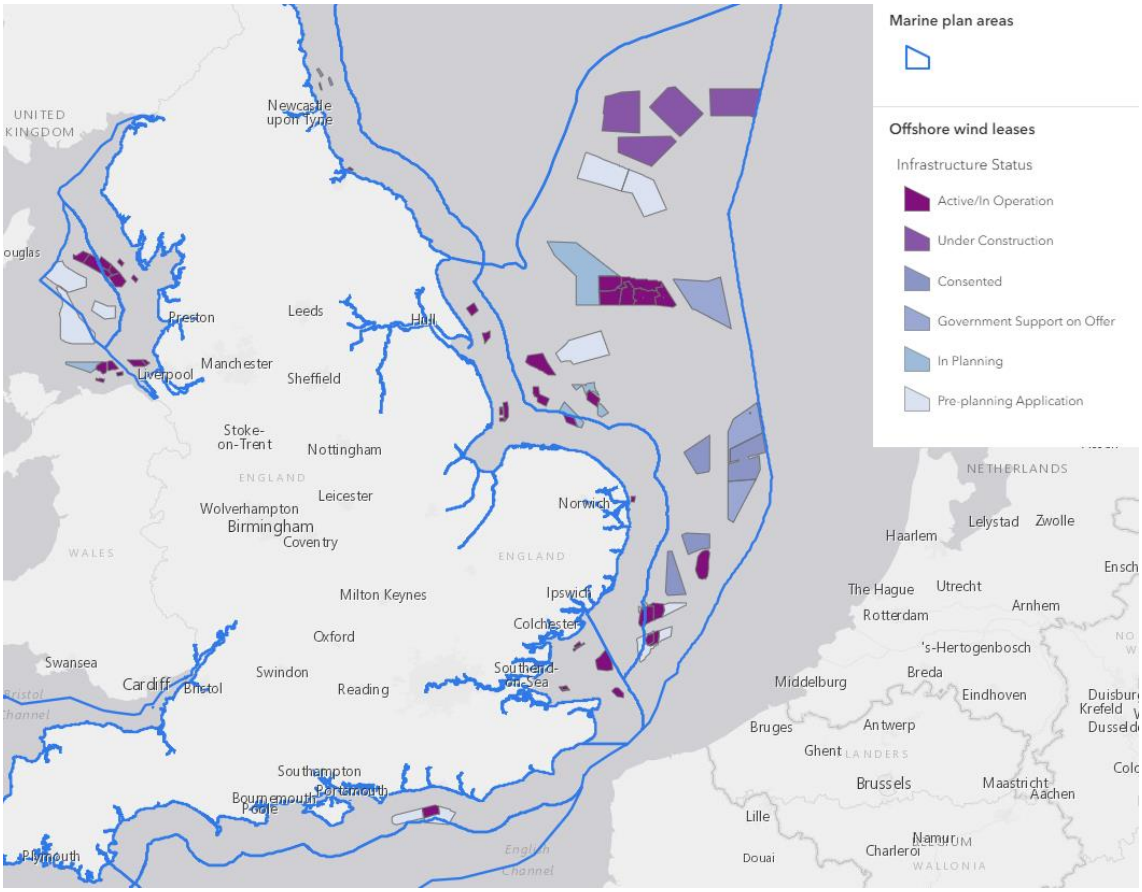


Figure 5-17 – Offshore renewable energy in the marine plan for English waters

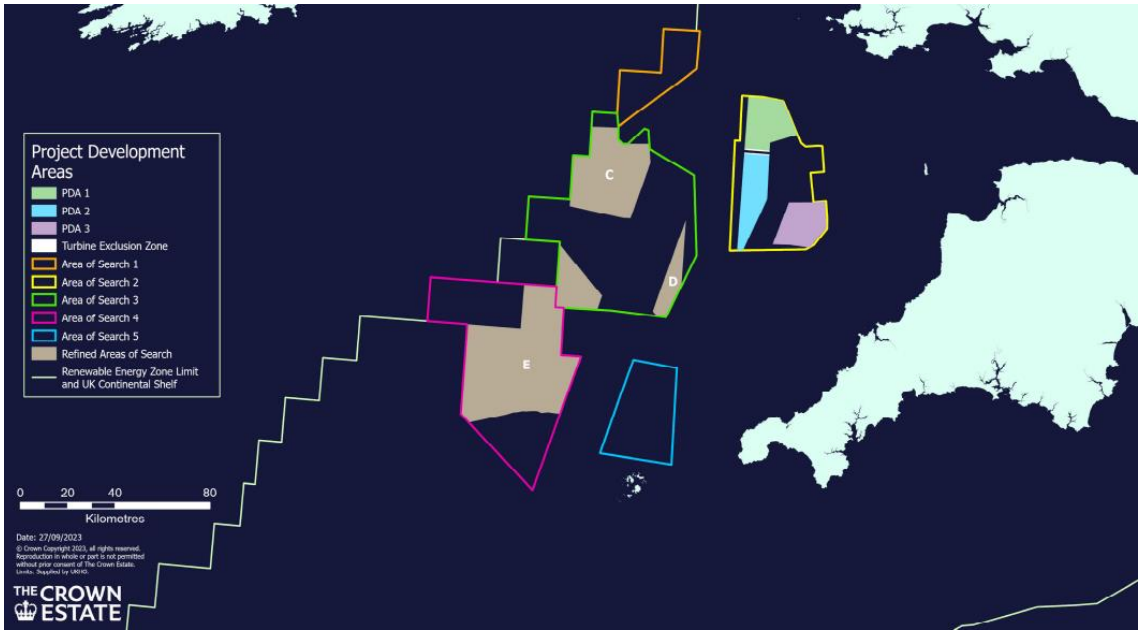


Figure 5-18 – Celtic Sea floating wind project development areas

5.5.3 Overview of interview and main takeaways

The interviewee for the British market has their background in R&D, engineering design, and technologies. The answers from the interview lean more heavily towards the Scottish side of the market.

For this interview, a general discussion was held, and due to time constraints, the usual interview structure was not followed. The discussion took place in May 2023.

The interviewee noted that MSP for offshore wind development in the UK has witnessed significant evolution over the past two decades and there are notable differences between Scotland and the rest of the UK. The UK's approach to offshore wind development is multifaceted, with various agencies and sectors involved in shaping the landscape. Project developments across the UK are plan-led with auction rounds taking information from marine plans.

In England and Wales, the seabed is primarily controlled by The Crown Estate (TCE), while Scotland's seabed is managed by The Crown Estate Scotland (TCES), making the planning process different between the two regions. TCES operates as a government agency, emphasizing a plan-led approach.

The most recent Scottish MSP has been released in 2020, which fed into the ScotWind leasing rounds of project contracts. In theory, this approach aligns well with the holistic management of marine space, but in this case, process has struggled, to fully recognized conflicts between marine industries. While MSP, when carried out well, can minimize conflicts, it may not always be the most efficient way to develop offshore wind quickly. Compensation mechanisms may need to be in place for those who are displaced or impacted by these developments.

A significant area of improvement needed in the MSP process is the provision of guidance on the sustainable deployment of OW projects. For example, how to facilitate successful projects and ensure compatibility with other critical infrastructure like ports and the electricity grid remains an open question. The recent announcement of the results of the ScotWind auction, which awarded rights for up to 25GW of offshore wind projects, has raised concerns about the capacity of the grid and other logistical challenges in implementing such a massive expansion all at once.

In Scotland, the marine plan initially assumed a capacity of 10 GW. However, with ScotWind now at 30 GW, there's a pressing need to reassess the capacity required for sustainable development. TCES should undertake a thorough review of development capacity between now and 2050, considering factors such as grid connections, option agreements, and attrition rates.

Less than a half of the projects have grid connections, and getting these can be time-consuming. Along with the development option agreements having specific end dates, this creates a sense of urgency in the coming years. There's a question of whether the 30GW target is indeed realistic, given the potential for attrition. TCES can either adopt a supportive stance to expedite grid connections and flexibility on option agreements or take a more stringent approach and focus on delivering a smaller number or projects but with higher credibility. Currently, it's unclear which path they will choose, causing uncertainty within the sector. The communication between Scottish government and CES has been criticized for being unclear at times.

On the other hand, TCE which manages the rest of the UK's seabed is not a part of the UK government and thus has a fundamentally different relationship to HM Government. TCE and partner organisations auction lease agreements in CfD funding rounds, with Round 6 starting in the first half of 2024. No new offshore wind projects were agreed during Round 5 in 2023. TCE is also focusing on floating wind projects in the Celtic Sea.

The future of MSP will require better recognition of conflicts, providing guidance on sustainability, and addressing the uncertainty surrounding capacity and targets. A more planned approach, driven by the least cost of energy and minimal societal and environmental impacts, is essential to ensure the UK maximizes the potential of offshore.

5.5.4 Summary

The British offshore wind market is one of the most developed ones in the world and one of the pioneer markets of floating offshore wind. There is a long history of institutional support for project development via government and other agencies which are in charge of offshore wind licensing, permitting, marine planning and development area auctions.

The development auctions are plan-led and there are many projects in the pipeline, which is in line with the UK's ambitious targets of 50 GW of offshore wind by 2030, including 5 GW of floating.

The UK has been known as a developer-led market, but ScotWind and the Celtic Sea Leasing round signal a move to a more plan led model, using spatial planning, which is an important step change and should help with the sustainable development of the large UK pipeline.

How this large pipeline is managed, particularly those projects successful in ScotWind which will be aiming to commission at similar times, will be crucial, and shows that as well as spatial planning, there needs to be temporal consideration given to when projects will be developed – given supply chain, grid and resources in general are limited.

5.6 Germany

Wind power has been expanding steadily as an industry in Germany since the first installation of an onshore wind farm in 1995. The first offshore windfarm was constructed in 2007. At the end of 2015, Germany was the third largest producer of wind power in the world by installations, behind only China and the USA [53]. It has now been eclipsed by other emerging markets such as the UK but remains of the world largest producers of offshore renewable wind energy. The level of ambition of the Federal government for the Energiewende (energy transition) has dramatically increased with the new coalition elected in 2021, the share of renewables to be reached in the power mix by 2030 being set at 80% (against 47% in 2022) [54].

Germany has 187 offshore wind farm projects of which 29 currently operating, 1 where construction has progressed enough to connect the turbines and generate electricity, 3 are in the build phase, and 6 are either consented or have applied for consent [55].

Germany has not shown much interest in floating offshore wind as a technology to date. Our project pipeline shows no floating wind projects in the pipeline for Germany. It is thought their focus will be on large scale fixed-bottom offshore wind for the foreseeable future. Germany is unlikely to be a market of focus for this project in future, but is discussed below nonetheless.

5.6.1 Market Expectations

In Europe, more than 37 GW of offshore wind capacity is expected to be built in 2023–2027, of which 16% is likely to be installed in Germany.

New offshore wind installations in Germany have been low since 2020, primarily due to unfavourable offshore wind policies and a small short-term offshore wind project pipeline [56]. Despite this, in 2022 the total installed capacity increased by more than 300 MW. According to the Site Development Plan (Flächenentwicklungsplan) published by the German Federal Maritime and Hydrographic Agency (BSH) in January 2023, a capacity of 24.7 GW is due for commissioning by 2030. This may increase the installed capacity to up to 36.5 GW until 2030, taking into account that the projects tendered in 2021 and 2022 which are to be commissioned by 2026 and 2027 [57].

The current statutory targets in Germany are for offshore wind to reach a cumulative installed capacity of 30 GW in 2030, 40 GW in 2035 and 70 GW in 2045 as per the reformed Wind Energy at Sea Act 2022.

Figure 5-19 - Overview of Offshore Wind Energy in Germany. Source: BWO Offshore [58]

5.6.2 MSP Policy

Germany adopted its first Maritime Spatial Plan in 2009 for the German Exclusive Economic Zone (EEZ) of the North Sea and the Baltic Sea. The legal basis for the establishment of maritime spatial plans in the German EEZ is the Federal Regional Planning Act, which was extended to the EEZ in 2004, and last amended in 2017 to implement the EU Directive on Maritime Spatial Planning.

In contrast to the territorial sea, the EEZ does not belong to the territory of the Federal Republic of Germany. Maritime spatial planning must therefore respect the freedoms of the UN Convention on the Law of the Sea, such as the freedoms of navigation, overflight and to lay cables and pipelines. It is therefore a matter of "limited spatial planning".

The legal regulations for spatial planning in the German EEZ apply to

- economic and scientific usage,
- ensuring the safety and ease of maritime navigation, and
- the protection of the marine environment [59]

The area designations in the spatial plan for the EEZ in the North Sea and the Baltic Sea are a basis for sectoral planning within the framework of the Site Development Plan (SDP), the revision of which began at the end of 2021. On the basis of the Offshore Wind Energy Act, the Federal Maritime and Hydro- graphic Agency (BSH) performs the task of central development and, on behalf of the Federal Network Agency (FNA), the site investigation of areas for the construction and operation of offshore wind turbines.

Within the framework of a central model, a staged planning and tendering process takes place. In the first step, spatial and temporal provisions for offshore wind energy sites are specified in the SDP. The next step is the site investigation of the sites designated in the SDP. After the site investigation has

been carried out, the sites are auctioned off in a competitive procedure in which the information from the preliminary investigation is made available to the bidders. The successful bidder will be able to install wind turbines on the site after the approval procedure, is entitled to the market premium, and may use the connection capacity. The central model applies to the commissioning of offshore wind turbines from 2026 onwards. In the central model, the SDP is thus the controlling planning instrument for the synchronous development of offshore wind energy and its grid connections at sea.

The Waterways and Shipping Administration additionally issues general rulings with regulations on navigation in wind farm areas. The developers of offshore wind farms are indirectly affected by the SDP because they have to comply with planning requirements, in particular those set out in the SDP, site suitability assessments and the invitation to tender for individual project sites during actual project development (only in the EEZ) and in their application documents. They also have to meet the requirements (ancillary provisions) set out in the planning approval for construction, operation and decommissioning of turbines after the end of use.

Offshore wind energy is not limited to the defined priority areas and reservation areas. In principle, it is also possible on other sites within the EEZ. However, the construction and operation of offshore wind energy generation facilities is unlikely to be compatible with general shipping traffic on the main routes through the North Sea and the Baltic Sea and is thus excluded in the areas concerned. This is also true with regard to certain military uses such as submarine training areas. Whether offshore wind farming is compatible with other uses and whether multiple use of an area is possible can usually be answered only after a case-by-case assessment. In addition to the areas designated for wind energy, the maritime spatial plan contains specifications that aim to balance wind energy with other uses/functions of the EEZ [60].

5.6.3 Overview of interview and Main Takeaways

Our interviewee works for a German research organisation, with a specific focus on floating offshore wind. The interview was conducted in November 2023.

Our interviewee noted that MSP in Germany is overseen by BSH, and that no specific sites have been identified for floating offshore wind, but there has been strong buy in to the need for MSP from the early days. It was recommended that someone from BSH be contacted in the next round of consultation.

The interviewee did not expect large scale floating wind to be in operation in Germany before 2040.

They noted that Germany is quite limited in terms of floating wind energy development. Due to its shallow offshore seabed, bottom fixed turbines are the most suitable for this region. Germany has ambitious offshore wind targets as stated above but there is no floating wind specific aspect to these goals pre-2030.

Innovations in technology related to offshore wind is certainly a priority but research has shown there is not much support for floating wind in Germany as there is no sense in constructing this type of windfarm due to geographical characteristics of Germany’s seabed. To facilitate maximum GW

installation, the consensus seems to favour technology that already exists in favour of emerging technologies.

As stated above, Germany's targets are 30 GW for 2030, 40GW by 2035 and 70GW by 2045. From policy perspective, floating wind is not a focal point, nor is it opposed. From research and learning perspective in universities and energy institutes there is much more interest in floating wind as a technology suitable for exportation.

Central German model for the development of wind energy

The BSH or Federal Maritime and Hydrographic Agency is the government branch with responsibility for marine areas. They consult extensively with research facilities in order to identify marine areas suitable for development. Based on this information the area and size of the sites are selected. No sites have been identified that are suitable to facilitate floating wind specifically but sites have been identified to cater to 'innovative' renewable energy technologies.

Wind Energy Resource, accessibility, Metocean, floating dynamics, seabed and geotechnical conditions, socioecological factors, supply chain and finally grid connections are all important factors for offshore wind energy in Germany. It is Important to emphasize that supply chain is a very relevant topic for floating wind along with qualified personnel.

In terms of the 80GW being realistic, Germany began its offshore wind ambitions under some misconceptions in terms of availability and functionality of the supply chain. All countries now have very high targets and interviewee feels that very few of these targets, if any, are achievable. Ports as an important part of the supply chain, for example, were badly affected by COVID-19. Administration is also very important. Governmental decisions and speed of policy very important. Political will to reach offshore wind targets is high in Germany and as such, development will not be hampered by political opposition.

Development of onshore wind was also hampered by COVID-19 but also due to the strict height and distance limitations imposed that apply to the sector. In South Germany, the consensus is that there should be huge distances between houses and turbines. Each region varies in terms of its policies and support of onshore wind. Our interviewee doesn't think onshore wind is competing with offshore but other could possibly rival other renewable energy sources.

In relation to MSP, our interview called for more collaboration between neighbouring countries. They also noted that supply chain is a big concern in Germany, and across Europe, which puts targets at risk, and is something that needs to be addressed. They also noted that timelines for permitting need to be shortened to increase the chances of reaching the targets.

5.6.4 Summary

Germany has been and will continue to be one of the offshore wind leaders in Europe.

It has strong offshore and onshore markets, and has employed marine spatial planning practices from an early stage, which has helped the market to develop sustainability.

Germany has huge targets for offshore wind of 30 GW in 2030, 40 GW in 2035 and 70 GW in 2045, and a strong delivery framework already in place, however it is not anticipated that floating wind will form a significant part of these targets, if any.

5.7 USA

After taking office in January 2022, the Biden Administration set a goal of deploying 30 GW of offshore wind by 2030, enough to power 10 million homes with clean energy, support 77,000 jobs, and spur private investment up and down the supply chain.

Subsequently, the Biden Administration quickly issued two Executive Orders that directly impact offshore wind. The Executive Orders reveal that:

- Offshore wind power is a critical element of the Administration's climate change policy goals.
- The Administration supports the Jones Act as part of a broader policy that seeks to maximize the use of U.S. goods, products, services and materials.

After the Executive Orders were issued, there was a visible shift in regulatory priorities, which reveals the complex legal and regulatory landscape that stakeholders in the offshore wind arena must understand and navigate. Offshore wind energy projects on the U.S. Outer Continental Shelf (OCS) are the focal point of federal regulation. The 2022 U.S. Department of Energy Offshore Wind Market report stated that as of May 2022, current and planned U.S. offshore wind energy projects have the potential to generate 40,083 MW of power.

The Inflation Reduction Act (IRA) became law on August 16, 2022. The IRA contains investment tax credits and other incentives to encourage offshore wind development, which will only hasten further developments.

5.7.1 Market Expectations

The global offshore wind energy market size was valued at USD 33 billion in 2022 and is expected to hit USD 179.41 billion by 2032, poised to grow at a CAGR of 18.50% during the forecast period 2023 to 2032 [61].

Annual PV growth rose in all major markets last year except the United States, where it shrank almost 15% due to supply chain challenges and rising costs [62].

Our floating offshore wind pipeline includes 29,212 MW for the USA, across 24 projects.

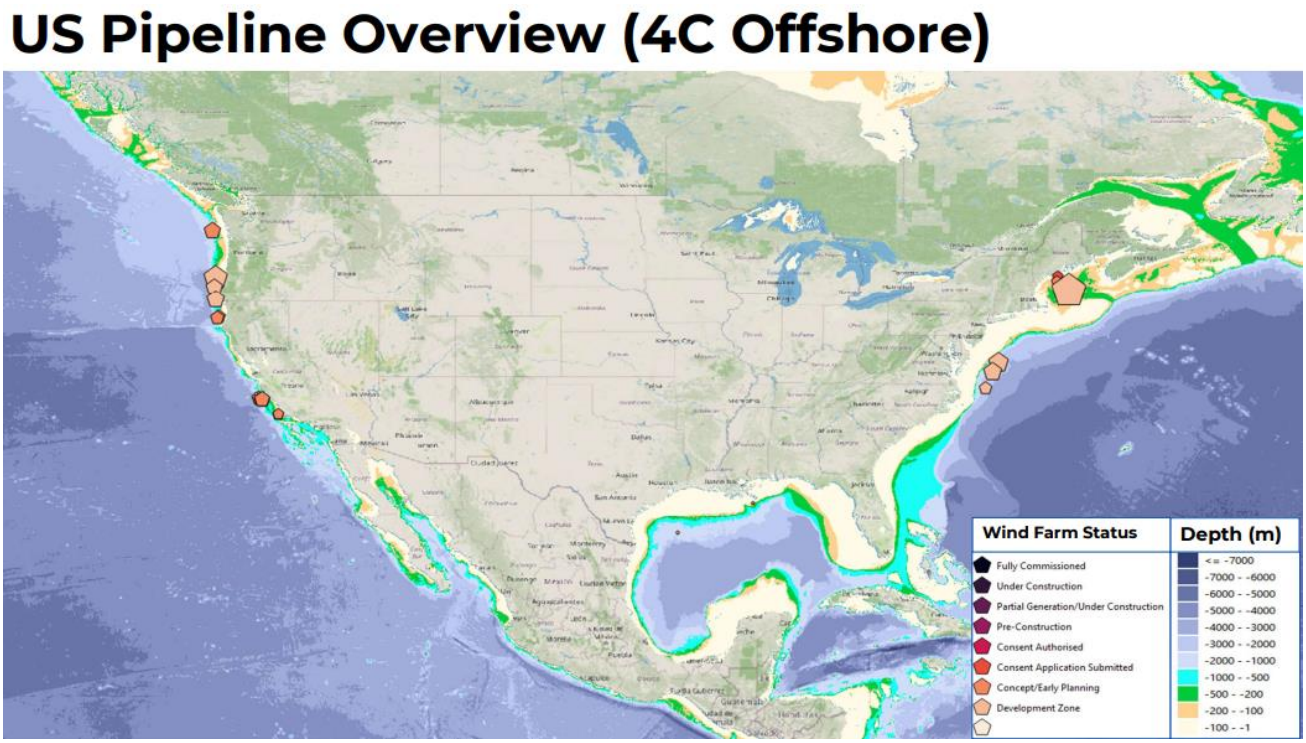


Figure 5-20 – US Pipeline overview

The USA has 3 small scale offshore wind projects commissioned (the fixed bottom Block Island, which is 30MW and was fully commissioned in 2017, the fixed bottom Coastal Virginia Offshore Wind, which is 12MW and was fully commissioned in 2020, and the floating T-Omega Wind 1/16 prototype, which is 0.3MW and was commissioned in 2023.

Vineyard 1 is currently under construction, and will be an 804MW fixed bottom project off the coast of Massachusetts. South Fork is also under construction, and will be a 132 fixed bottom project also off the coast of Massachusetts.

5.7.2 MSP Policy

MSP in the United States can be implemented at multiple spatial scales: national, regional, or state-level.

The spatial scale influences process and implementation, due to the varying regulations that apply, as well as the varying drivers to MSP efforts and thus, stakeholder concerns. To date, MSP in the United States bears little similarity to experiences abroad. In effect, there is no coordinated MSP effort, although President Obama addressed MSP through Executive Order 13547, establishing the National Ocean Policy (NOP) for the oceans, coasts and great lakes.

While the NOP did not mandate MSP at the national level, it did strengthen ocean governance and coordination, establishing guiding principles for ocean management, and adopting a flexible framework for effective MSP to address conservation, economic activity, user conflict, and sustainable use of offshore areas.

Under the NOP, federal agencies in the United States are tasked with forming regional entities to create ocean plans. There were regional ocean planning entities prior to the NOP, such as the Mid-Atlantic Regional Council on the Ocean (MARCO), and the Northeast Regional Ocean Council (NROC).

In the United States, early examples of MSP have been implemented by individual states, including Massachusetts and Rhode Island. Each of these was produced under state mandates and funding and resulted in identification of specific areas, or zones, for certain human use activities. These plans are notable in the approach to MSP absent a federal effort and highlight alternative pathways to MSP in the United States [63].

5.7.3 Overview of current MSP

The latest development in Marine Spatial Planning in the USA comes in the form of the Ocean Climate Action Plan which includes the U.S. Ocean Justice Strategy. For the first time, the federal government is outlining how it will integrate principles of equity and environmental justice in federal ocean activities, including conservation, management of marine resources, and infrastructure projects. The plan outlines the ocean climate actions needed to meet three goals:

1. Create a carbon-neutral future without harmful emissions that cause climate change,
2. Accelerate nature-based solutions to protect and support natural coastal and ocean systems that store greenhouse gases, reduce the climate threat, and protect communities and ecosystems against unavoidable changes, and
3. Enhance community resilience to ocean change by developing ocean-based solutions that help communities adapt and thrive in our changing climate. [64]

Undertaking the actions described in the Ocean Climate Action Plan (OCAP) will provide other benefits, such as new, well-paying and sustainable jobs, a diverse workforce, and equitable access to the ocean and coasts, as well as more resilient global food production and future ocean discovery and innovation.

The organisation responsible for managing the offshore resources of the country is the Bureau of Ocean Energy Management (BOEM). This organisation is managed by the Department of the Interior and ensures offshore resources are utilised in an environmentally and economically beneficial ways. The BOEM deals with planning for the outer continental shelf – waters which are outside of the state coastal waters, but still within US jurisdiction. BOEM is a well-established organisation, which also deals with issuing oil & gas leases.

The BOEM also takes input from the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce. NOAA provides BOEM with baseline oceanographic data, fisheries assessments, assesses potential socio-economic impacts and provides metocean conditions. NOAA also helps developers operate within the requirements of the National Environmental Policy Act.

In 2023, BOEM identified five Wind Energy Areas (WEA) in the Gulf of Mexico off the coast of Texas and Louisiana. The WEAs have a total area of 5300 km^2. The regulator is expected to issue a proposed sale notice for the use of these areas at the start of 2024. A further three WEAs have been identified

in the central Atlantic coastal region off the coast of North Carolina, Virginia, and Delaware. These have a total area of 1400 km^2 and are expected to support up to 8 GW.

A further WEA is being considered off the coast of Maine – a potential 14000 km^2 is being considered, but as this area is still in the draft stage, it is likely it will get significantly reduced before the proposed sale notice is issued. This WEA in the Gulf of Maine is between 20 and 120 nm offshore.

There are also areas under consideration on the west coast. There are two draft WEAs off the coast of Oregon, located 18-30 nm offshore with a total area of 900 km^2, the discussions about these areas have started in 2023. Off the Californian coast, five leases have already been issued to areas which will most likely be developed using FLOW technology. These leases have been allocated in 2022. The five Californian lease areas span 1500 km^2.

5.7.4 Overview of interview and Main Takeaways

2 interviews were held with US representatives as part of this work, one interviewee had a focus on wind technology R&D, and was spoken to in March 2023, and the other worked in an MSP organisation, and was spoken to in April 2023.

They stated that for the US generally, sites are plan led. The Government defines lease areas but developer interests can have an impact on what zones they choose. Once sites areas are leased to developers, it is all down to the developers, and there is no Government support for survey data, offtake etc. Previously the development regime was more developer led.

Developers can reach out to BOEM, the Government planning organisation, to express they are interested in the area, but BOEM takes over specific siting work. Leases for areas are one-off payments. It is not envisaged US projects will receive direct subsidy support, but they can be eligible for a variety of tax credits to help to lower costs.

Floating wind is expected to be operational between 2030-2035, with our MSP interviewee expecting the US to have 1 – 3 GW floating wind by 2030, and our floating wind expert expecting the first 500MW project to be in operation in around 2030.

Our interviewees feel that floating wind will be more agreeable to the general population than fixed bottom wind, generally due to it being further from shore, where less activities are taking place.

There is general confidence in the supply chain, but challenges expected to be faced for floating wind, and there are concerns that floating wind will impact the fishing industry significantly.

It was noted that resource wind speed, site bathymetry, metocean conditions and socio-ecological factors (marine mammals/birds, migratory patterns, fishing zones, protected areas, other users of the environment) are the most important factors when identifying a site as well as the consentability of that site. Consentability may be defined as the ease at which consent for a project in the area could be achieved, which might make it more attractive than a site with higher technical potential. It was noted that noted that buildable depths are evolving all the time, and a limit cannot be put on this – now looking at up to 1300m.

Research questions seen as most important or pressing in relation to floating wind and MSP include the impact of mooring lines / anchors on seabed habitats and marine mammals, co-existence potential, how costs can be lowered and innovations that can be made to avoid any bottlenecks in development e.g. supply chain.

Both interviewees thought that floating wind would account for the majority of installed offshore wind capacity in the US by 2050. Our MSP expert noted that the US is looking at very deep sites relative to other jurisdictions, with the US looking to identify sites in areas up to 1300m in depth at that stage, with the expectation that deeper sites would be found in future.

5.7.5 Summary

The US is a hugely interesting market, which is developing both offshore wind and floating offshore wind markets in parallel.

In BOEM, it has a very coordinated MSP body which has already identified several areas for development, some of which have already been leased. It has shown an interest in much deeper sites than other markets, which may help to drive on the supply chain for floating wind.

While the scale of the market and the state structure will bring challenges to the regulation of offshore wind in the US, the US can be expected to be a key market for floating wind in future, and one that will be keenly monitored as part of this work.

5.8 Ireland

5.8.1 Market Expectations

Ireland has a strong onshore wind industry with ~ 4.5GW installed (40% renewable electricity) as of 2023. Gas accounts for around 50% of electricity in Ireland, and 85.8% of primary energy comes from oil, natural gas, coal, and peat. 13 % of Ireland's primary energy requirement in 2022 came from renewables.

Ireland has very ambitious targets for offshore wind (5GW installed by 2030, 2 GW for non-grid uses to be in development by 2030, 20 GW for 2040, 37 GW for 2050), and targets 80% renewable electricity for 2030.

Ireland has only one offshore wind farm, the 25MW Arklow Bank project, which was built in 2004. Since then, the focus was on the development of onshore wind, but offshore wind will be key to future development.

Initial offshore wind development in Ireland will focus on fixed-bottom, but there is high long-term potential for floating wind. Ireland's Programme for Government noted an intention to take advantage of a potential of at least 30GW of offshore floating wind power in Ireland's deeper waters in the Atlantic.

Ireland is executing a three-phased approach to offshore wind development, and is currently transitioning from a developer-led model for Phase 1, to plan-led for future development, and MSP work ongoing.

Phase 1 – the first batch of projects to be developed in Ireland – will consist of fixed bottom projects only. These are Oriel Windfarm (Parkwind and ESB), North Irish Sea Array (NISA) (Statkraft and Copenhagen Infrastructure Partners), Dublin Array - formerly Kish and Bray Banks (RWE and Saorgus Energy), Codling Windpark 1 and 2 (EDF Renewables and Fred Olsen, now being progressed as one project), Sceirde Rocks (Fuinneamh Sceirde Teoranta (FST), owned by Corio Generation), and Arklow Bank Windfarm Phase 2 (SSE).

These projects are entirely developer-led, and took part in a subsidy support auction – Offshore Renewable Energy Support Scheme (ORESS) 1 – in May 2023. 4 projects were successful in ORESS 1 for a total of 3,074 MW: Sceirde Rocks, Codling Wind Park, NISA, and Dublin Array. These projects now have a seabed lease (known as a Maritime Area Consent (MAC)) and route to market, and will look to submit planning applications in 2024. The bidders secured 20 year-contract for differences (CFDs) at an average price of 86.05 euros/MWh ($93.0/MWh), lower than the 95 to 115 euros/MWh range predicted by industry group Wind Energy Ireland [65] . The unsuccessful projects will need to find another route to market if they are to continue development.

In a significant change in approach from Phase 1 (which was completely developer-led), the Phase 2 Policy Statement confirmed that Phase 2 will be Plan-Led. Phase 2 projects will be within State identified individual Offshore Renewable Energy (ORE) Designated Areas, which will be designated according to legislative provisions for Designated Maritime Area Plans (DMAPs) in the Maritime Area

Planning (MAP) Act 2021. This approach will relate to all Phase Two auctions. Phase 2 projects will also be fixed bottom.

The location of ORE Designated Areas for Phase Two will be geographically aligned with available onshore grid capacity, with the first of these off the south east coast, where EirGrid has identified 900 MW of onshore capacity. EirGrid will proactively develop offshore grid transmission infrastructure for the first Phase 2 auction (ORESS2.1), which will connect offshore projects to onshore nodes on the South coast, including offshore substations and submarine cable connecting offshore substations to the onshore grid. ORESS2.1 participants will compete for supports to develop offshore arrays that connect to offshore substations developed by EirGrid.

Phase 2 will comprise at least two further auctions, intended to secure the remaining capacity for delivering 5 GW by 2030. If all ORESS 1 winners in Phase 1 proceed and none of the losers proceed independently via PPAs, an additional ~2 GW is needed at least [23].

Future offshore wind development in Ireland (post Phase 2) will be led by the Future Framework, which is currently under consultation [66]. Floating wind is expected to play a key part in this phase of development.

The prices in Ireland's first offshore wind auction are much higher than the last auction in the UK in July 2022, but global costs have risen significantly since then and developers in the UK benefit from a mature network of supply chain and port infrastructure. Another key difference is that UK contracts are for 15 years compared with 20 years in Ireland. The first projects in Ireland will rely on imported components, exposing them to global markets at a time of high demand in Europe and the United States. Last April, European leaders pledged to quadruple offshore wind capacity in northern sea areas to 120 GW by 2030. [67]

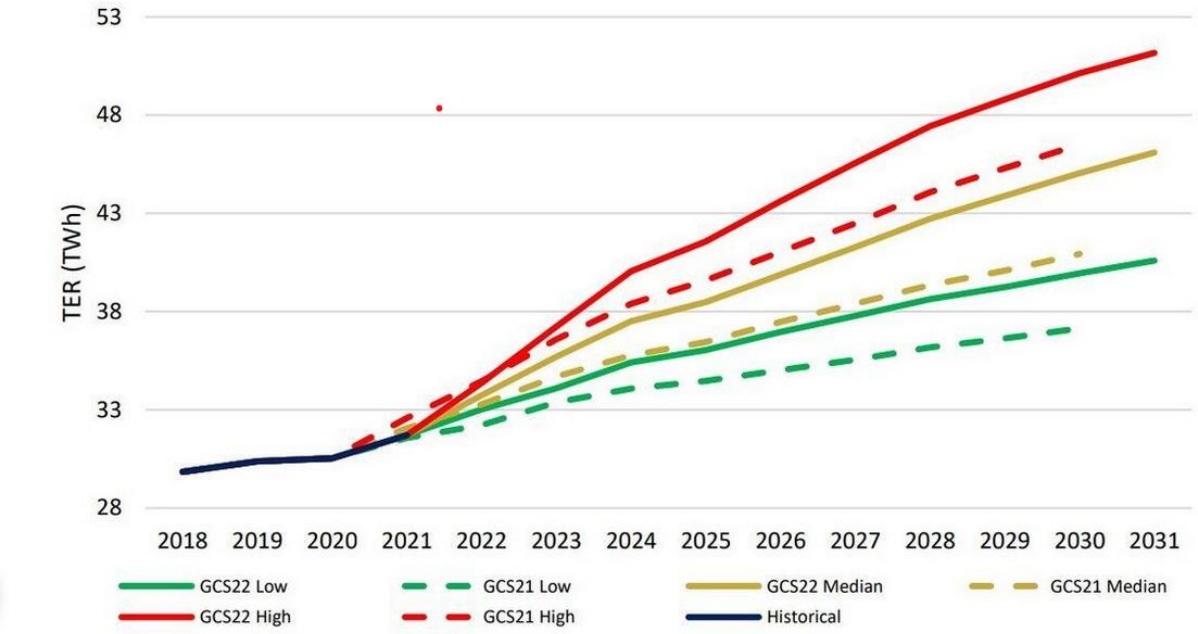


Figure 5-21 - Forecast power demand in Ireland [89]

Our pipeline for Ireland includes 31 floating projects all around the coast – for a total of 41GW. It should be noted that this pipeline was in place before the accelerated move to a plan-led system was put in place.

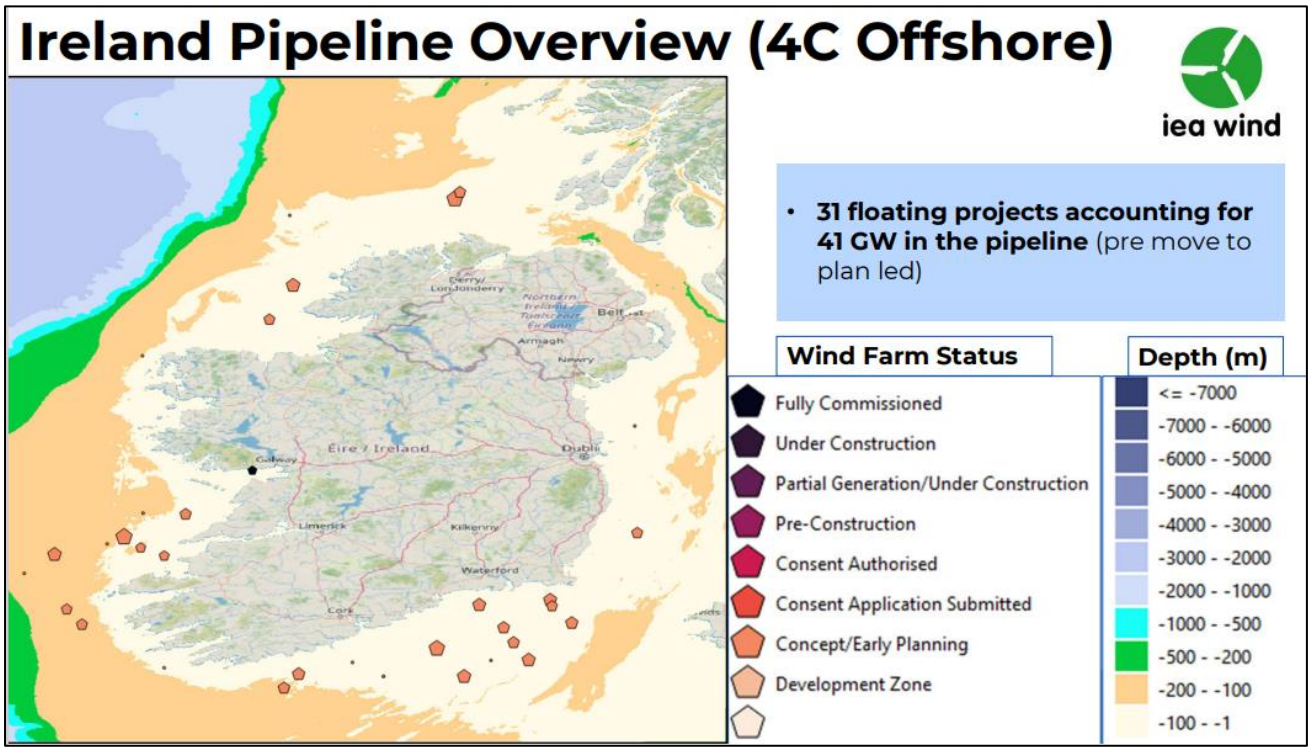


Figure 5-22 – Overview of Irish pipeline

5.8.2 MSP Policy

Ireland adopted its Maritime Spatial Plan, the National Marine Planning Framework (NMPF) in June 2021. The NMPF is the overarching framework for decision-making that is consistent, evidence-based and secures a sustainable future for the marine area. The EU MSP Directive is transposed into national legislation by way of regulations made in 2016 (SI 352 of 2016). Since the regulations were made under the European Communities Act 1972, they were strictly limited to measures required to transpose the Directive.

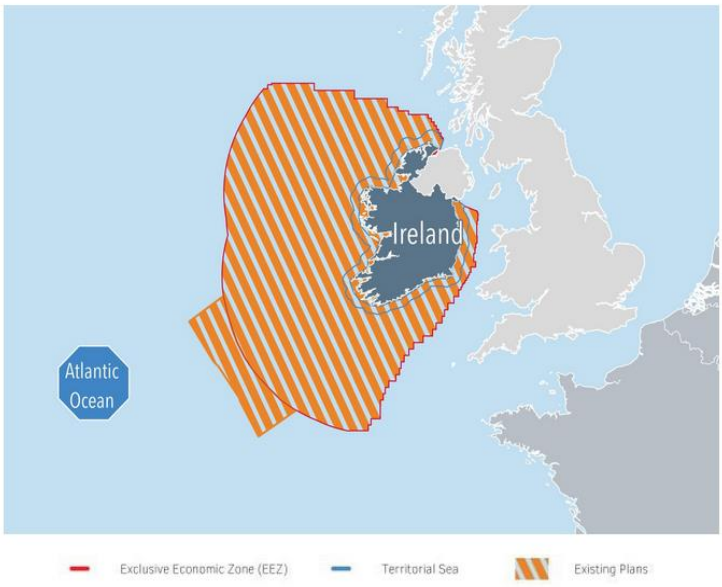


Figure 5-23 Overview of Irish EEZ which is covered by the NMPF [68]

In October 2018, the regulations were repealed and replaced by Part 5 of the Planning and Development (Amendment) Act 2018. The Irish maritime area extends over 490,000km2 (approx. 7 times its terrestrial landmass) and comprise parts of the Irish and Celtic Seas as well as the Atlantic Ocean where Ireland has defined its EEZ and certain areas of the Continental Shelf.

In 2006, Ireland submitted information on the limits of the continental shelf claimed by Ireland and three other coastal States in the area of the Celtic Sea and the Bay of Biscay. In 2010, an extension of the continental shelf was granted. Negotiations to share this area between the four coastal States are still in progress.

The National Marine Planning Framework (NMPF) brings together all marine-based human activities for the first time, outlining the government's vision, objectives and marine planning policies for each marine activity. The NMPF details how these marine activities will interact with each other in an ocean space that is under increasing spatial pressure, ensuring the sustainable use of our marine resources to 2040.

The NMPF is intended as the marine equivalent to the National Planning Framework. This approach will enable the Government to:

- set a clear direction for managing our seas
- clarify objectives and priorities
- direct decision makers, users and stakeholders towards strategic, plan-led, and efficient use of our marine resources

The NMPF has been prepared with an ecosystem-based approach and informed by best available knowledge. As part of the preparation of the NMPF, a Strategic Environmental Assessment (SEA) and Appropriate Assessment (AA) have been carried out. [69]. The NMPF has been scrutinised in detail and certain measures have been suggested such as the following;

- The NMPF should be reviewed, substantially revised and updated once a systematic sensitivity analysis of the marine environment has been conducted and more information is available on the location of the proposed expanded network of marine protected areas. For this purpose, a new SEA should be conducted. This should not wait until MPAs are formally designated.
- Future iterations of the NMPF should include statements and maps outlining the Government's spatial strategy for Ireland's marine territory (or separately for the regional sections thereof (e.g. Irish Sea, Celtic Sea, northwest Atlantic inshore, southwest Atlantic inshore, offshore Atlantic…). This will help to ensure that it follows a plan-led rather than development-led approach to marine spatial planning and that it is perceived as such.
- The NMPF should be complemented by a set of regional-scale marine spatial plans. These plans should include explicit and detailed zoning to allow for the spatial coordination of marine uses. Such plans should be subject to a rigorous high-resolution cumulative impact assessment to ensure that the impacts of proposed developments do not have adverse impacts on marine ecosystems.
- Detailed Designated Maritime Area Plans (DMAPs) should be prepared for nearshore coastal and estuarine waters. Coastal planning authorities should be encouraged to work together to prepare joint plans for transboundary bay and estuary areas. For this purpose, consideration should be given to the extension of the boundary nearshore area to twelve nautical miles from the high-water mark.
- The DMAPs for nearshore coastal and estuarine waters, as described above, should follow an Integrated Coastal Zone Management approach taking explicit account of both land- and sea-based uses and their impacts on marine and coastal ecosystems (e.g. agricultural practices, inshore fishing, aquaculture, seaweed harvesting, dredging). Such DMAPs should explicitly support the achievement and maintenance of Good Environmental Status under the EU MSFD and Good Status (chemical, ecological, physical) under the EU WFD.
- DMAPs located fully or partially within coastal and/or estuarine waters should be formally required to demonstrate full alignment with RBMP objectives. Options for integrating/aligning DMAPs with local authority Development Plans should be investigated.
- Consideration should be given to the preparation of one or more very large-scale marine protected areas covering areas of high biodiversity value within the far offshore sections of Ireland's EEZ. Such marine protected areas should be embedded within an ecosystem-based marine spatial plan and be accompanied by a dedicated programme of research, exploration and environmental education.
- The implementation of the NMPF should be accompanied by a dedicated, funded programme of measures focussed on the achievement and maintenance of the Good Environmental Status as required by the EU MSFD. Such ecosystem restoration measures will require close monitoring to ensure they achieve their objective. [70]

Further to MSP in Ireland - The Draft Second Offshore Renewable Energy Development Plan (OREDP II) is an update to its 2014 predecessor OREDP I. It is currently a draft document, having undergone public consultation from 24 February 2023 to 20 April 2023. It is a high-level guiding framework and national spatial strategy that will be used by the DECC to identify Broad Areas of Interest for ORE in Ireland and aid the transition to the enduring regime.

The purpose of the OREDP II is to provide an evidence base to facilitate the future identification of areas most suited for the development of fixed wind, floating wind, wave and tidal as part of the

enduring plan-led regime for offshore wind development in Ireland (now known as the Future Framework) (post-2030).

It also looks to assess the resource potential for ORE in Ireland's maritime area, and to identify any critical gaps in marine data or knowledge and recommend prioritised actions to close these gaps.

It is important to note that the OREDP II does not identify specific areas for ORE development, but provides a framework based upon the development of criteria which can be used to identify Broad Areas which will be assessed in further detail before the formal designation process is initiated.

The draft OREDPII did identify potential broad areas of interest for floating wind of the south, west and northwest coasts, considering a number of criteria including wind resource, bathymetry, availability of datasets, onshore infrastructure, demand centre proximity etc (Figure 5-24).

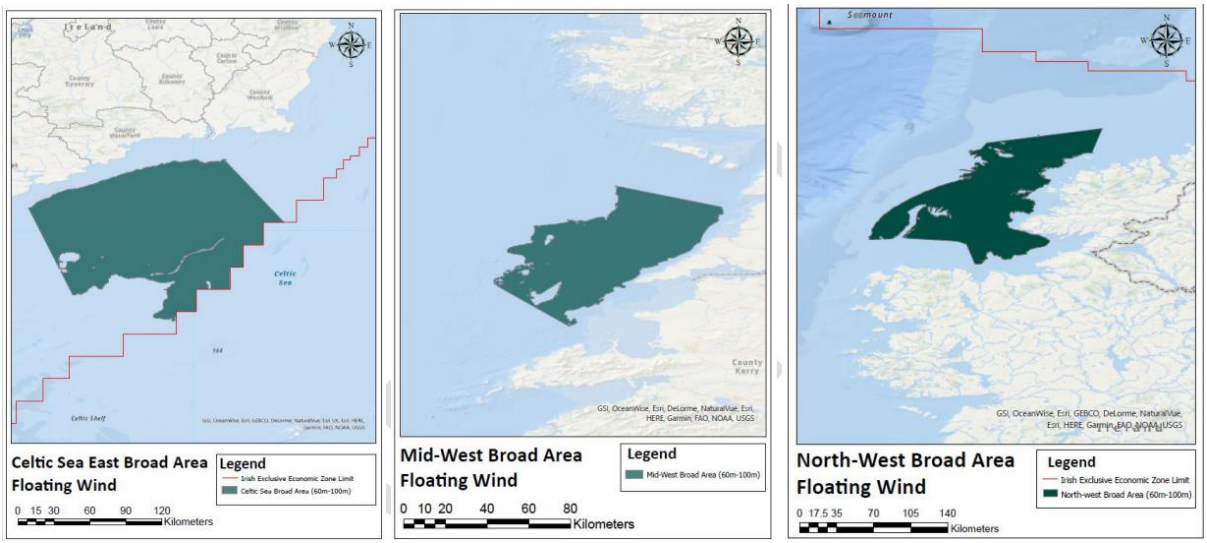


Figure 5-24: Potential Broad Areas of Interest based on the proposed criteria shown in the OREDP II

For fixed wind in Phase 2, details on Ireland's first draft DMAP proposal were published on 14 July 2023. The site of ORESS 2.1 will be chosen from this DMAP.

The geographical area of the South Coast ORE DMAP Proposal extends the marine area stretching from the High-Water Mark on Ireland's south coast to the 80 metre depth contour and/or the edge of the Irish Exclusive Economic Zone (EEZ). The western boundary of the geographical area is based on the location of a military danger and restricted area defined by the Irish Aviation Authority, while the eastern extremity is the demarcation between the Irish Celtic Sea and Irish Sea, classified by the International Hydrographic Office.

The process to establish this DAMP will take place according to an ecosystem based approach following a period of engagement with key stakeholders, most importantly including local and marine communities, and a review of other existing maritime usages. Any refinement of the geographical area of the DMAP Proposal will be further informed by environmental assessments to determine its suitability for development of offshore wind.

Following the publication of the DMAP Proposal, DECC launched a public information and engagement period seeking the views of local South Coast communities to help determine where future offshore wind energy developments may take place. The maritime area of the DMAP proposal will be further refined following the initial eight-week period of public engagement, which will include

expert environmental impact assessments and analysis, to assess its suitability for offshore renewable energy development.

A final draft DMAP is expected to be published by DECC by March / April 2024, with the final DMAP then adopted by September.

The next DMAP for fixed bottom wind is expected to be off the east coast.

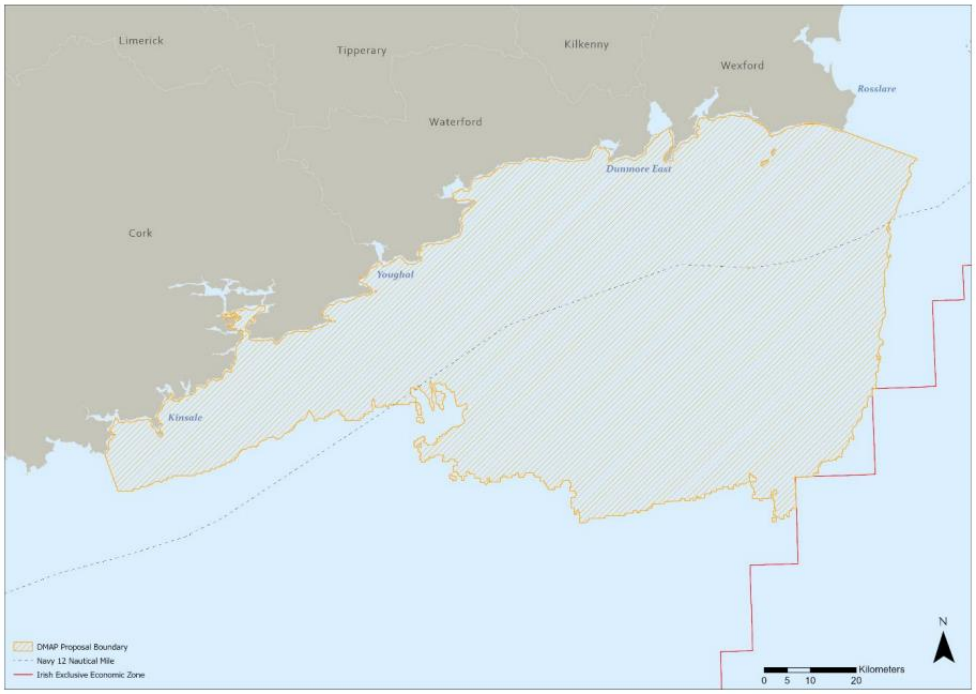


Figure 5-25: Geographical Area of South Coast DMAP Proposal

5.8.3 Overview of interview and Main Takeaways

2 interviews with Irish consultees took place in April 2023.

They noted that Ireland is currently in a transitional period moving from a developer led approach to a plan led approach post 2030. This period of transition reveals some weak areas in policy. For example, OREDPII published a framework for general areas moving to DMAPs. However, these areas of interest were more examples, not identified sites. When examining data availability, it is evident that there is not enough information available to carry out a full identification of areas on a national level.

It was noted by one interviewee that the OREDP II perhaps gave too much focus to FLOW, noting that it assumed that fixed bottom projects could only be developed to a maximum water depth of 60-70m, but that this depth is likely to increase as technology and supply chain evolves.

Interviewees cited 2030-2035 as an optimistic timeframe for the first floating farm to be operational in Ireland.

It was stated that Hydrogen Production and Communications networks are most likely to interact with floating wind farms in Ireland, while commercial fishing and shipping were least likely to interact. Due to the trawling nature of commercial fishing and the footprint of the FOW devices, co-existence is least likely. Aquaculture is normally located close to shore so is unlikely to be adjacent to FLOW farms. Due to the large area of the Irish maritime area relative to other countries (in particular North Seas countries) co-existing with shipping most likely could be avoided.

Mooring speed and how this varies but technology type, floating platform choice, how costs can be lowered, dynamic cables reliability and performance, electricity system benefits, opportunities for co-location of other ORE technologies and the impact of mooring lines are all key research questions in need of investigation.

There was a difficulty in making estimations on expected offshore wind development due to the lack of clarity on targets post 2030 and the split between fixed and floating.

Both interviewees saw the most potential for FLOW in the south coast and thought this was where the majority of floating wind capacity would be concentrated. By this logic, it was assumed a project off the southeast coast near Wexford would be most likely for 2035 timelines.

There was less optimism when speaking about the west coast due to accessibility issues as sufficient access for maintenance would not be possible. Development could occur potentially in the longer term if this constraint could be overcome.

Although not noted by government as a priority area for FLOW, one interviewee noted good potential also exists on the East coast, even though its potential is smaller than the south and west. They believed the east coast would be a good place for an early FLOW project in Ireland.

5.8.4 Summary

The Irish market is an interesting one, which has huge potential given its large sea area and strong wind speeds.

The accelerated move to a plan-led system caused some uncertainty in the market, but served to lower speculation, and should make it easier for MSP practices to be efficiently employed. This is being shown by the current work on the south coast DMAP, as well as work done on the OREDP II and the current consultation on the future Framework. Future floating development should take place in a planned and coordinated fashion, if the framework set out in the OREDP II is followed and refined as needed.

Ireland will focus on fixed bottom wind to reach its 2030 target of 5GW, which should help the industry here develop, and put many of the pieces in place that will be needed to delivery floating wind further down the line. Floating wind can be expected from around 2030 at the earliest. Longer term targets will require some form of export market to be realised.

5.9 France

Having fully commissioned its first commercial offshore wind project, the 480 MW Saint-Nazaire wind farm, in November 2022, France became Europe's second largest offshore wind market in new additions in 2022, followed by the Netherlands (369 MW) and Germany (342 MW) [56].

In December, The European Commission approved a €4.12bn ($4.44bn) scheme to support the rollout of two offshore floating wind farms in France. The scheme was approved under the EU's state aid for temporary crisis and transition framework. It aligns with the Green Deal Industrial Plan, launched in February 2023, which aims to support a swift transition to climate neutrality. France will use the €4.12bn to build and operate two offshore floating wind farms in the Golfe du Lion. Each will have a capacity of 230–280MW capacity and will generate 1.1 terawatt-hours of clean electricity annually. Two beneficiaries will be chosen in 2024 through a non-discriminatory bidding process. [71]

5.9.1 Market Expectations

In 2022, a total of two megawatts of cumulative floating offshore wind energy was installed in France.

In France, floating offshore wind is forecast to reach some 882 megawatts of capacity installed by 2030. France held its first round of tenders for offshore wind back in 2012, but developers have had had to jump a series of administrative and legal hurdles to get projects off the ground. The 480 MW Saint Nazaire offshore wind project, awarded in 2012, only commissioned in 2022.

Both Fécamp and Saint Brieuc were awarded in 2012, along with Courseulles-sur-Mer. The combined capacity of the 2012 awards was 2 GW. In 2014, a second round saw tenders awarded for two further projects, the 496 MW Dieppe-Le Tréport and the 496 MW Ile d'Yeu et de Noirmoutier wind farms.

However, what really grabbed attention was the tender for nearly 600 MW capacity off Dunkerque in June 2019, which was awarded at price of just €44/MWh, less than a third of the renegotiated feed-in tariff set for projects under rounds and two. This low price point marked a jumping off point for offshore wind in France [72]. Offshore wind has become a core part of the government's energy transition plans. In addition to the reduction of greenhouse gas emissions, additional clean renewable energy is needed for two reasons. First, France has been quick to limit electricity generation from coal. In 2019, coal-fired plant provided just 1.6 TWh of power out of total supply of 537.7 TWh, ahead of coal's intended phase out in 2022. Second, the government aims to reduce the share of nuclear power in the generation mix to 50% by 2035. Last year, nuclear power provided 70% of France's electricity.

France is targeting 40GW of offshore wind by 2050, with a 2035 milestone of 18GW. There is no split between fixed and floating in this target. Our pipeline includes 26 floating wind projects in France, for a total capacity of almost 15 GW.

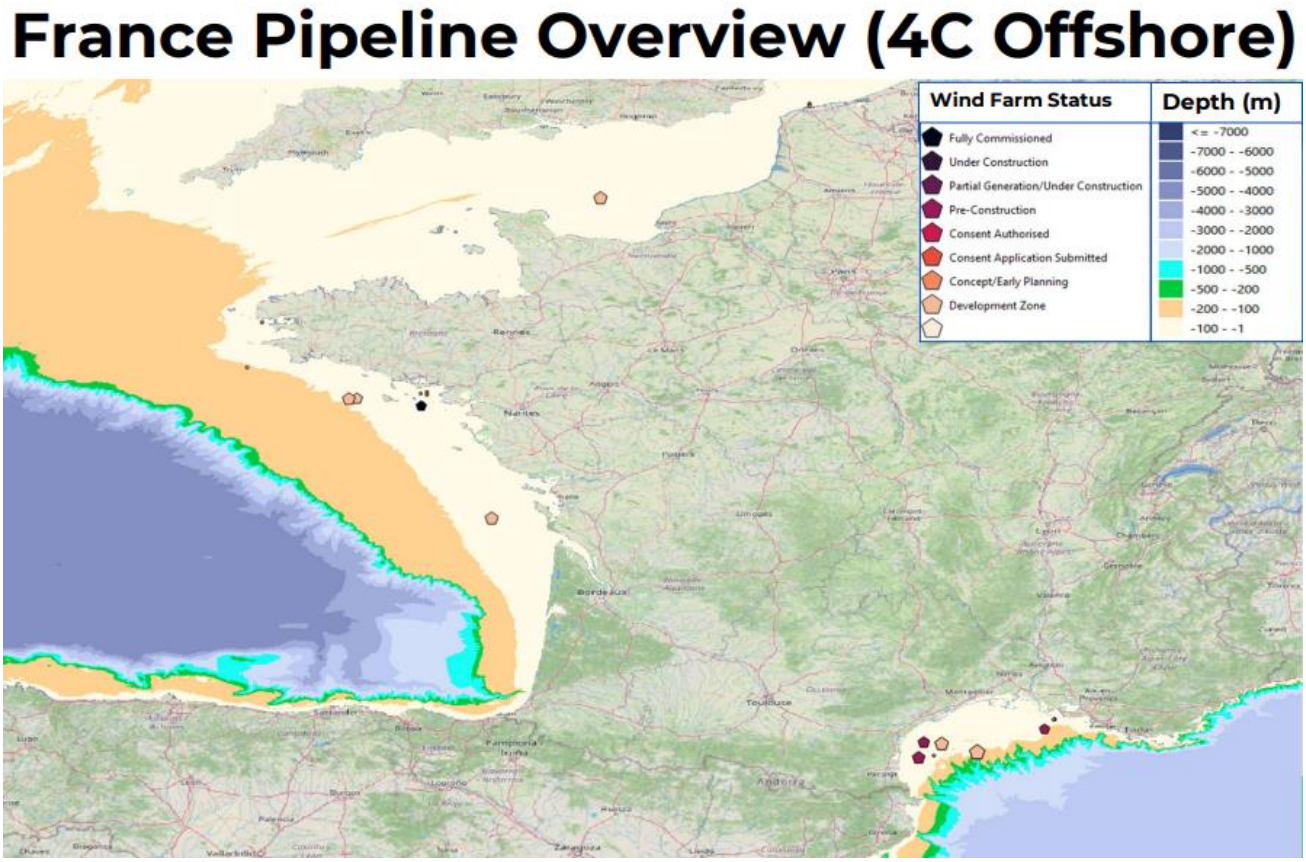


Figure 5-26 – France pipeline overview

5.9.2 MSP Policy

France adopted 4 Maritime Spatial Plans, the Documents Stratégiques de Façade (DSF) in April/May 2022 for the following sea basins: The East Channel-North Sea, North Atlantic-West Channel, South Atlantic and the Mediterrranean. They are the legal mechanism chosen by France to address the requirements of both MSFD and MSP Directive and specify the conditions to implement the National Strategy for the Sea and the Coast (SNML) in accordance with local specificities. The DSF all contain two parts:

- Initial assessment and strategic objectives and MSP - vocational map and fact sheets (finalised in September/October 2019)
- Monitoring mechanism and action plan (finalised in April/May 2022)

The EU MSP Directive was transposed into national legislation through article 123 of law n°2016-1087 for the “reconquest of biodiversity, nature and landscapes” adopted on 8 August 2016. This article modifies the French Environmental code through the introduction of the concept of maritime spatial planning. The approaches for implementing article 123 are further elaborated through the political decree n°2017-724 adopted on 3rd May 2017. [73]

In order to develop a long-term strategy to support sustainable growth in the marine and maritime sectors, France has adopted a National Maritime and Coastline Strategy (Strategies nationale pour la mer et le littoral - SNML) which sets out an ambitious maritime policy for the 21st century. The national strategy is implemented at the level of sea basins by means of sea basin strategy documents

(document stratégique de façade - DSF) in mainland France (Eastern Channel-North Sea, North Atlantic, South Atlantic, Mediterranean).

Sea basin strategy documents are the legal solution chosen by France to address the requirements of the MSFD and the MSP Directive and these documents specify the conditions for implementing the national strategy according to local contexts. It includes MSP in the form of an activities map and it is subject to an environmental assessment. The four strategic documents have been drafted in cooperation with stakeholders and have been assessed by the French Environmental Authority. The documents provide an initial situational analysis, define strategic objectives, establish an evaluation procedure and lastly propose an Action Plan for each basin.

5.9.3 Overview of interview and Main Takeaways

Our French interview took place in March 2023, with a project developer active in France.

They noted that the goals for floating wind and fixed bottom wind are not necessarily differentiated. France follows a planned led system. Once a project starts tendering to the moment it is in the water takes around 10 years. There is political will to reduce this time. The main time constraints arise in the consenting stage of development. Projects need enough data to submit applications for authorization and obtaining this data is often a challenge.

A full environmental assessment environment of the site is provided by the State. It takes some time to process applications. However, once authorisation has been obtained, a period of 18 months is permitted for appeals.

Tenders are free to bid. Projects need to invest in order to participate in the tender, and mandatory guarantees must be provided, but there is no direct participation fee/cost. The tender includes the site exclusivity, an index-linked CFD and grid connection. This process generally sounds efficient and attractive and has a low risk profile, but having the State centralising all this assumes the State has sufficient resources and expertise to carry out its role effectively. Judging by the delays it consenting stage, we know this is not always the case.

In France, development is carried out under PPE – Pluriannual Energy Programme (in French, PPE). For the next 10 years there will be State defined volumes to be awarded per coast. The Current PPE has been in place for the last decade and is finishing in 2023. At the end of this, the State will have awarded tenders for 7.5GW. However, change is needed as PPE system is limited in how much energy it can deliver. Volumes have been small (500MW), and tenders are for only one site at a time. The State is considering something like ScotWind where there are more plots to bid for and more judgement criteria. The new PPE requires revolution not evolution. The State is very receptive and open to discussion with industry. Interviewee feels that offshore wind in France is currently in a transitional period.

Interviewee feels that commercial scale floating wind will be operational in France pre 2040, around 2035, and that France contains to infrastructure to support this. In relation to assessing a site's suitability for offshore wind, the interviewee feels that Resource wind speed, Proximity to demand centres and Socio ecological factors are the most important factors. Also, Developers need to make arbitrations between differences after 1 & 2. The business model is the key output.

Developers map many sites, and what they build is a composite index of heat maps of different criteria. All parameters are important and while above could be seen as key, the others all play a part, and all parameters need to be integrated. Areas that need to be prioritised for research include exploring how to lower costs, co-existence potential and the noise impacts of floating offshore wind. An additional research topic could investigate the recyclability of floating wind projects including floaters.

The north of France is seemingly more suitable to fixed bottom and it is unlikely floating wind will be developed in this zone due to shallow waters. The Atlantic has much greater potential for floating wind development and sites are currently in development. A05 will most likely be the first site developed (Brittany).

Mediterranean site (AO6) will be developed in parallel with AO5 and may be operational around the same time or earlier, depending on a range of factors such as supply chain and infrastructure. Developments will be on the continental shelf – 200m is seen as the cutoff for now, but sites may go deeper in the future. Future zones will be identified in the new PPE once established.

5.9.4 Summary

While France has seen delays to the development of early projects, learnings from these should ensure that future projects are delivered more efficiently. Consenting and supply chain issues have caused delays to date, but projects are now starting to come online.

The Atlantic shows great potential for floating offshore wind, and France is ranked as the market with the 3rd highest near-term potential for floating wind by OREC.

Progress with the A05 and A06 sites should be monitored, with our expert expecting these sites to be commissioned before 2035 as the first large scale floating projects.

France is at a transition stage, with the last PPE running up until the end of 2023. Future plans should be monitored, as our expert notes these need ‘revolution not evolution’, and a ScotWind type approach may be employed.

5.10 Norway

5.10.1 Market expectations – capacity and targets

Norway is one of the global leaders in renewable energy. Most of the electricity in the country is generated from hydro schemes (88%), some onshore wind (10%) and only very little from thermal sources (2%). As of 2021, Norway operated close to 4 GW of onshore wind, 1.4 GW of which got commissioned in previous year [74]. Currently, there is only one operational Norwegian offshore wind farm – the floating Hywind Tampen project of 88 MW. This is not grid-connected, but rather powers offshore oil & gas operations.

The specific feature of the Norwegian power grid is its high storage capacity. Relying on hydropower means the Norwegians can store large amounts of energy in the form of potential energy of water in a dam high up in the mountains. This allows the system to use other sources when possible (like wind and solar) but also provides security when wind and solar production is not possible.

Lately, and mostly with the recent improvements in floating offshore wind, Norway has been making extensive plans to build up offshore wind generation. The country has a long coastline dominated by strong wind from the North Sea, the Arctic Ocean, and the Norwegian Sea. Except for the parts of the North Sea directly south of Norway, the depth is between 100-300 m, which favours floating wind installations.

The nation has ample experience with offshore installations from the oil & gas sector, which has been driving Norwegian economy since the middle of the 20th century but will likely in the future struggle with capacity of ports suitable for offshore wind operations.

Norway already makes almost all its electricity from renewable resources and therefore is under no pressure to reduce its electricity generation carbon footprint. However, the country recognizes that relying on one major source of electricity (hydro) is not good for national security. There have been events when Norway had to import electricity from Swedish nuclear plants, because the reservoirs froze and couldn't get enough power. Hoping to diversify its energy portfolio and to export energy, Norway has set out a goal to include 30 GW of installed offshore wind by 2040 [75] [76].

It is to be expected that not all Norwegian offshore wind will be grid-connected. This has been foreshadowed by the commissioning of the first Norwegian floating wind farm – Hywind Tampen. This installation is not connected to the grid, but rather provides renewable power to the nearby Snorre and Gullfaks oil & gas fields [77]. Traditionally, oil rigs are powered by diesel generators or gas turbines, using around 25 cubic meters of fuel per day [78], which equates to roughly 4 MW of power on average to be supplied by fossil fuels for fossil fuel mining operations. Powering these installations by wind turbines could therefore be helpful to decreasing the carbon footprint of these mining operations and Norway is pioneering the research and activities focused on doing just that.

The current installed capacity is only the single Hywind Tampen installation of 88 MW. This project is on spar platforms in 260 – 300 m of water. At the moment, this is the largest capacity operational floating wind project in the world, and it is installed in the greatest depth of all floating wind projects.

With the recent opening of 20 new areas for offshore wind projects [79], and the high level of offshore operations expertise in the country, a boom in offshore wind projects can be expected in Norway over the next two decades. Furthermore, the country is well-positioned to include a high percentage of domestic supply chain in the projects, as there is experience with all stages from seabed mapping and presurvey activities, through offshore structure installations and vessel construction, to digital twin technologies for innovative O&M [80].

Our pipeline shows a total of 16 floating projects/areas equating to nearly 9GW in Norway.

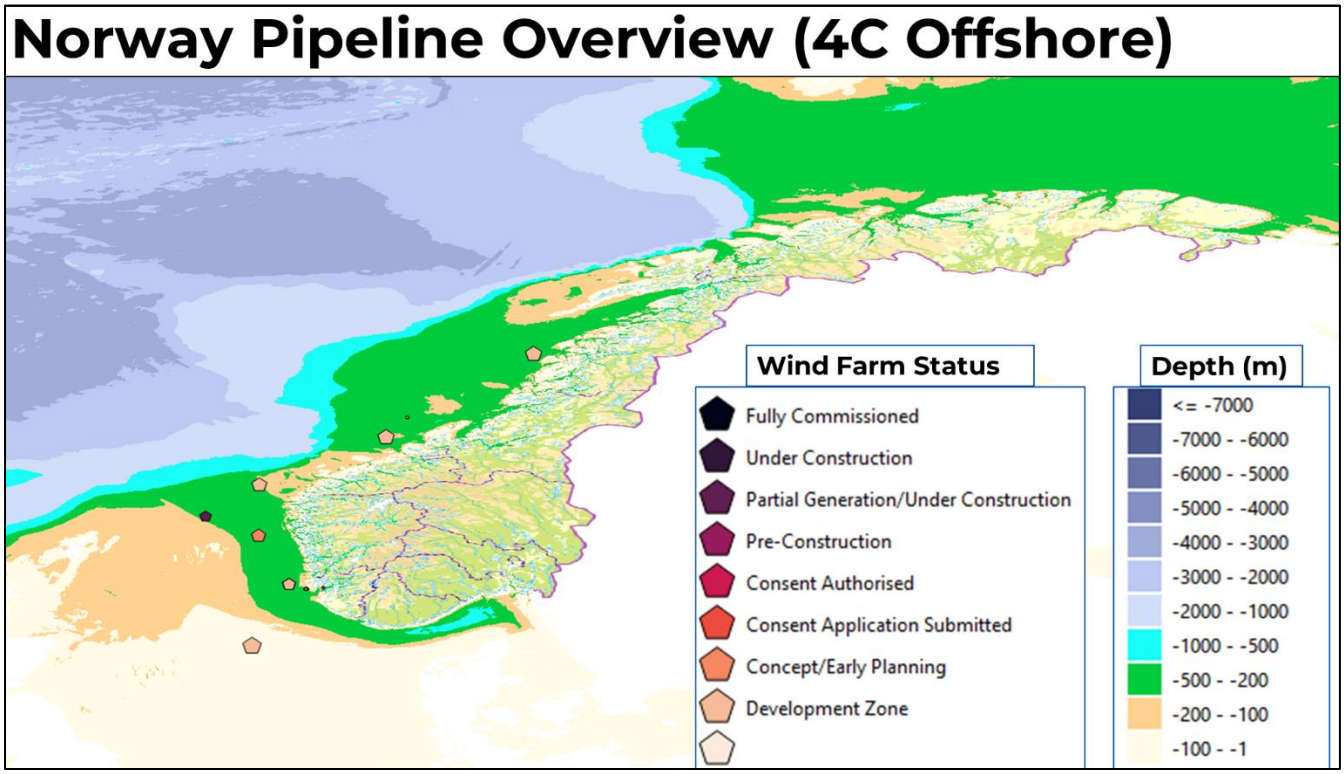


Figure 5-27 – Norway pipeline overview

The first large scale floating project is expected in 2030-2035 in Norway, in the Utsira Nord Area.

Utsira Nord was opened for renewable energy production in 2020. Arrangements are now being made to grant a licence for the development of 1500 MW of offshore capacity at the site. The average depth in the area is 265 metres, so the project will be floating, and also grid connected. A tender using qualitative criteria for site was to take place in early 2023, but in late 2023 it was announced that the tender – due to be Norway's first competitive auction along with Sørlige Nordsjø II - is delayed until at least 2024 due to State Aid issues.

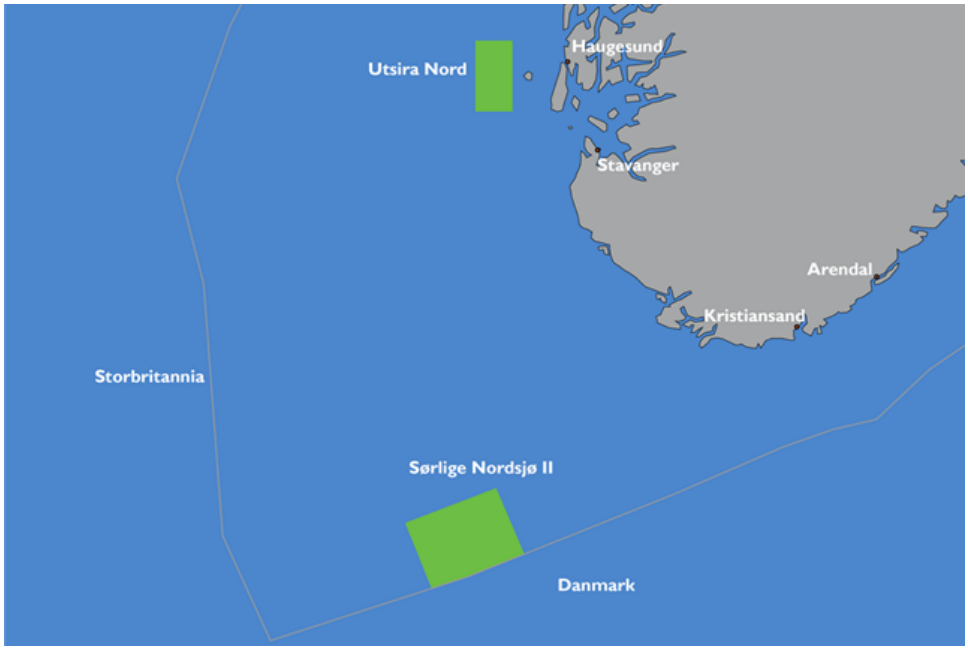


Figure 5-28 – Utsira Nord and Sørlige Nordsjø II areas

5.10.2 MSP Policy

Norway has started producing integrated marine planning documents and legislation in 2008 with the Integrated Management of the Marine Environment of the Norwegian Sea [81]. Work on the marine management plans is coordinated by the Steering Committee which is headed by the Ministry of Climate and Environment and has representatives from other relevant ministries (Petroleum and Energy; Trade, Industry and Fisheries; Local Government and Modernisation; Foreign Affairs; Transport; Labour and Social Affairs; Finance; Justice and Public Security; Defence). The creation of the plans is knowledge-based, and the scientific advisory is provided by two groups: the Advisory Group on Monitoring and the Forum for Integrated Ocean Management. There is significant overlap between the members of these two advisory groups. These two advisory groups are headed by the Institute of Marine Research and the Norwegian Environment Agency respectively. The organisation structure of the Steering Committee is shown in Figure 5-29.

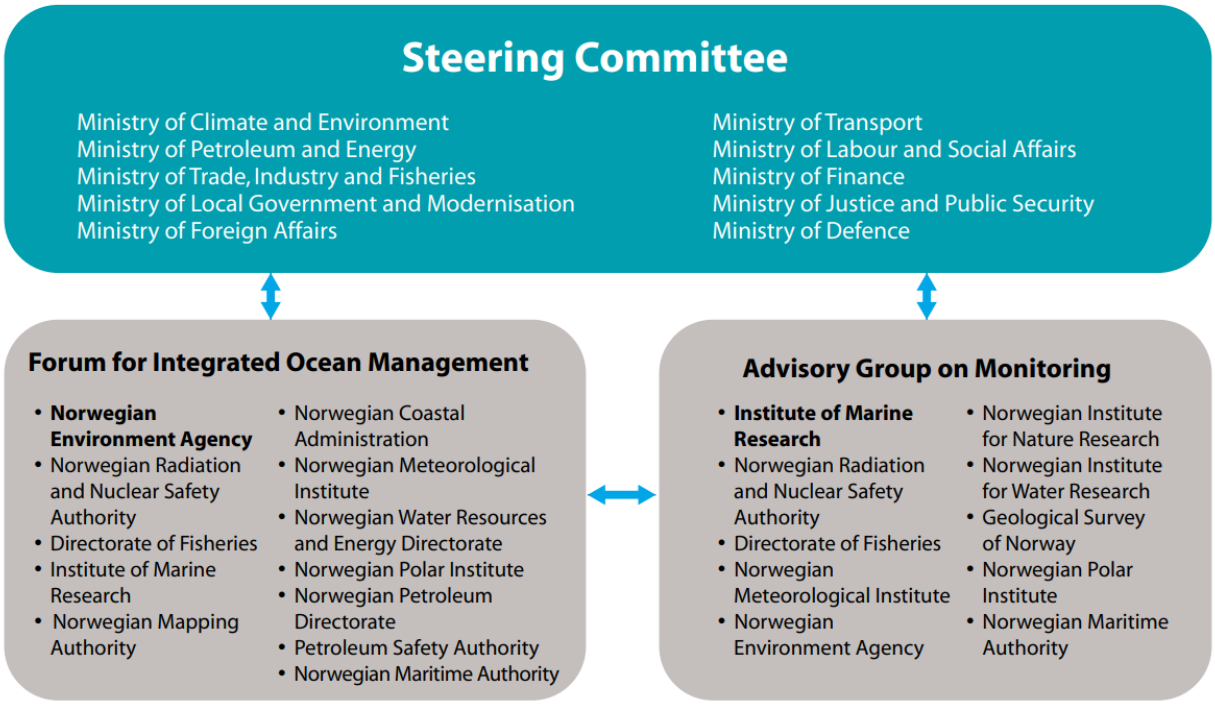


Figure 5-29 – Norwegian Steering Committee which oversees the MSP activities in the country [82]

This system makes sure a wide variety of user groups can be represented both scientifically and politically during the creation of the MSP policies.

The marine plan itself is published by the Ministry of Climate and Environment, and is split into three areas – Barents Sea & Lofoten, Norwegian Sea, and North Sea & Skagerrak.

The Norwegian strategy towards the ocean is presented in the 2019 document Blue Opportunities [83] which is written with the UN 2030 Sustainability Development Goals (SDGs) in mind, especially SDG14 – Life Below Water. Blue Opportunities is based on five main elements:

- Promoting, developing, and defending the law of the sea.
- Promoting conservation and sustainable use of the ecosystem.
- Contributing to knowledge-based management.
- Supporting the implementation of international ocean-related instruments.
- Advocating an integrated approach to marine management that will underpin a sustainable ocean economy.

In some coastal areas in Norway, ocean industries contribute to over 50% of value creation in the region. Norway therefore is keen to keep promoting sustainable growth and job creation in the ocean industries. Currently the largest ocean industry in the country is offshore oil & gas.

In the Blue Opportunities, Norway also acknowledges the importance of international cooperation when formulating marine plans – one full section of the document is focused on international cooperation and ocean diplomacy.

The Norwegian management plans for marine areas are issued by the Ministry of Climate and Environment and were originally split among three areas. The first plans were issued between 2008 and 2013 and have since been revised in 2016-2017 and an integrated plan was created which deals with all three areas at the same time in 2019. This latest integrated plan identifies offshore wind as one of the emerging ocean industries in Norway.

The document outlining this plan presents a review of the current ways the sea is used including valuable information like fishing and shipping density maps, oil & gas production activity maps, or natural parks and protected areas. The areas used by the armed forces for shooting and exercise are also marked out on a special map in the plan. All maps and detailed information about each sector are well-laid out in the document [82].

The Norwegian Water Resources and Energy Directorate – NVE - is a directorate under the Ministry of Petroleum and Energy which is responsible for MSP. It is focused on identifying best sites available (tech agnostic) – and the State decides which sites to open up (plan led model).

When identifying floating wind areas, they use a GIS decision making tool which finds the balance between technical and economic factors for floating wind, and are generally looking for depths of 100 m to 300 m ideally – max 1000 m.

Other key criteria are grid connection proximity, wind resource, wave conditions, O&G, shipping, important fishing areas, birds areas. Once large areas identified then go through SEA, Government ranks areas and decides which to open.

In April 2023, NVE announced a list of 20 potential new offshore wind zones identified using MSP processes. These are areas that are technically suitable for offshore wind , and where conflicts of interest are relatively low. Areas were chosen along the entire coast – Norway wants the whole country to benefit, and wind speeds and direction differ between north and south, so correlation and cannibalisation will be lower.

Development is expected to start at Utsira Nord and gradually move northwards. In total, an area corresponding to 54,000 km2 have been identified - 6 to 13 times more than required for 30 GW, assuming 3.5 - 7.5 MW/km2.

In September, the Norwegian government announced plans to investigate opening three new offshore wind areas, including expansions to Utsira Nord and Sørlige Nordsjø II, from 2025.

Figure 5-30 - Overview of sites identified for offshore wind in Norway

Regarding co-existence and conflicts, The Norwegian Environment Agency and the Norwegian Fisheries Directorate disagree that Sønnavind A should be included for further investigation.

The Norwegian Environment Agency justifies this as a conflict with birds, while the Norwegian Directorate of Fisheries emphasizes that the area is the only one of the identified areas that lies in its entirety in an important area for fisheries.

NVE believes that Sønnavind A is a particularly favourable area from a power system perspective, and that there is a particular need for more knowledge about the effects before it is decided whether the area should be opened to offshore wind or not. For this reason, NVE has chosen to include the area for further investigations.

5.10.3 Overview of interview and main takeaways

2 interviews took place with contacts working in Norway – one with a focus on R&D, and the other with a focus on MSP.

They noted that Norway is including floating wind in their MSP. The target is to include 30 GW of offshore wind by 2040 and judging by the depth of the sea around Norway, a significant portion of this is likely to be floating. Of the current 4.5 GW of opened areas, 1.5 GW are designated for floating projects.

Generally, the development is plan-led, but there are interesting exceptions not found in other markets yet – developer-led projects for powering oil & gas mining operations. Despite acknowledging how ambitious this target is, the Norwegians believe a 500 MW+ floating wind farm could be operational in the country by 2035, likely supported by a domestic supply chain. The ports and grid infrastructure will, however, need to be developed to make that possible and plans for this are already in place.

In terms of industry conflicts, the perceived impact on fishing is the same between floating and fixed developments in that neither technologies will permit fishing within the farm. There are currently some studies going ahead with aquaculture fish farming within the sites. Floating wind is also perceived as potentially more environmentally friendly due to simpler and less invasive installation methods. The synergies with offshore oil & gas might work well in this market, while combining wind and military activity will be likely as challenging as anywhere else.

Developers in Norway are likely to look mainly at the resource wind speed, grid connection availability, proximity to ports and suppliers, socio-economic factors and the likelihood of a site getting consent as factors deciding whether to bid for a project or not.

To make the most of the industrial boom in FLOW, the country representatives believe optimisation of O&M processes and of all project operations to be the key. They also consider studying the impact of mooring systems on benthic habitats and lifecycle carbon assessment studies as priorities for making sure the industry is moving in the right direction.

5.10.4 Summary

Norway already generates most of its electricity from renewable resources, so they are not as pressured into seeking low-carbon energy technologies as other countries might be. However, the lion's share of this energy comes from hydroelectric plants, which can be out of commission in times of extreme cold or draught, therefore the country is looking for ways to diversify the energy portfolio.

Offshore wind will play a role in this – there are ambitions targets in place for offshore wind and likely a majority of these will be fulfilled with floating technology. Norway has a strong supply chain developed during years of oil & gas mining, which can be used to build FLOW and help boost domestic offshore activity with the future decline of North Sea oil & gas.

The areas of focus are mainly in the south and south-west of the country, centred around large population clusters, but development zones have been identified all along the extensive coastline.

FLOW is officially considered in the marine plan, which is detailed and includes cooperation between many government organisations and ministries, thus making sure a large group of stakeholders are involved in the formation of MSP policies. The plan is created by a committee with input from all relevant ministries who in turn seek expert help from scientific advisory groups.

5.11 Italy

5.11.1 Market expectations – capacity and targets

Italy is a new entrant into the offshore wind energy market with the first offshore wind project, the 30 MW Beleolico wind farm close to Taranto harbour being commissioned in April 2022. Despite being new to the offshore wind industry, Italy has ample experience with onshore wind with over 11 GW of installed capacity in 2020 [84].

Like many other countries, Italy is setting goals for domestic renewable energy content. By 2030, the country would like 30% of its total energy (55% of electricity) to be made from renewable sources. The country has access to a lot of coastline and marine space. Some is not suitable for offshore wind use due to large water depth, but there are many areas in Italian waters which would be useful for offshore wind development, especially when considering floating wind installations.

As of autumn 2023, Italy is yet to implement a formal marine spatial plan, however an unofficial version was published last year and is under review. The lack of MSP policy is likely one of the factors holding back offshore wind in Italy. This lack of a centralised plan is creating uncertainty in the market and very long permitting lead times. The first Beleolico project took 14 years to complete from its inception, due to long delays with permitting and environmental impact assessments.

Despite the regulatory issues, there is keenness to build offshore wind in Italy. Currently more than 60 GW of developer-led projects are waiting for planning permission. It will possibly take a bit of time before these projects can be realized, which can be seen from the country's modest plan to include 900 MW of floating wind by 2030 [85].

Our database shows a capacity of 67 GW in the pipeline for Italy – the highest of any country included. This is spread over 71 projects / sites.

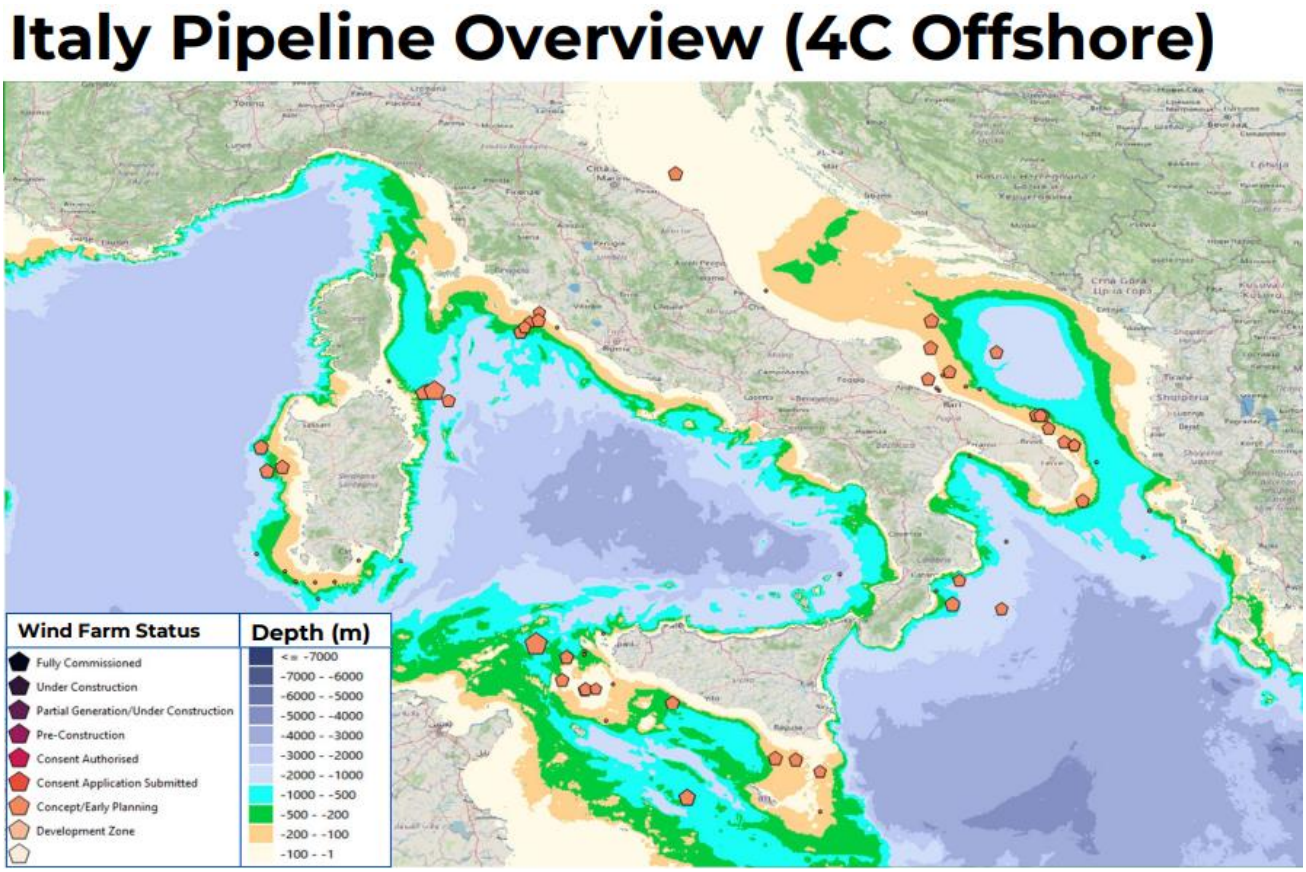


Figure 5-31 – Italian Pipeline overview

Italy has a big task to do: to untangle itself from confusing regulatory frameworks and lack of direction in MSP. Once the permitting hurdles are overcome, the country can start unlocking the great potential of the resource, mainly on the west coast of the mainland and around the islands of Sardinia and Sicily.

The current Italian offshore wind capacity is 30 MW from one project (Beleolico close to Taranto harbour) with ten 3 MW turbines on fixed monopiles. There are no other projects currently under construction or in any other more advanced phases of development, but over 60 GW of offshore wind projects are waiting for response to their project permission applications. This shows a lot of intent to develop offshore wind projects.

The country's energy plan is to have 55% of electricity to be made by renewable resources by 2030, but offshore wind will likely play a marginal role in achieving this scenario in the close future. In 2020, Italy made 39% of its electricity using renewable resources, but wind power contributed only 6.5% of electricity production [86]. The current predictions of offshore wind content in Italy's electricity grid by 2030 are between 900 MW as mentioned in the ANEV reports and 2.1 GW mentioned by interviewed experts. Due to a large number of projects in the pipeline, it is quite likely that once the permitting framework is put into place, the projects will be deployed rapidly and that the sector will see a lot of growth in the second half of the 2030s.

5.11.2 MSP Policy

The authority dealing with marine planning and permitting is the Ministry of Infrastructure and Transport. Attached to the ministry there was a special technical committee tasked with creating the first outline for a marine spatial plan. This plan was submitted for review in autumn 2022 and was expected to be approved by April 2023, but this has not happened yet. The unofficial version of the marine plan is available online (in Italian) on the website of the Ministry of Infrastructure and Transport as part of the SID Portale del Mare [87].

Without a centralized MSP approach, some MSP questions are also addressed by local and regional bureaus.

Another agency with a stake in offshore wind is the Ministry of the Environment and Energy Security. This ministry supports renewable energy projects and research organisations like the Ricerca Sistema Energetico (RSE).

The current provisional, unofficial marine plan considers areas for fishing, defence, tourism, marine protection, shipping transport, generic use, and energy. Offshore wind falls in the energy category, which is designated for the use by energy source providers. Interestingly, this includes all energy sources – offshore oil & gas, offshore photovoltaics, and offshore wind as well. Figure 5-32 shows the preliminary marine spatial plan use areas of the Italian sea, and quite likely in areas designated for marine protection after an extensive environmental impact assessment.

Not shown in Figure 5-32 is the large shipping channel going through the Sicilian channel – between Sicily and Tunisia. This is an extremely busy shipping route as it is a direct connection between the Suez Canal and the strait of Gibraltar. This will likely have to be considered in any planning permissions for offshore wind as there are commonly issues raised about the compatibility of maritime shipping and offshore wind installations, mostly due to reduced navigational visibility, especially during the night, increased collision risk resulting from both the presence of the turbines as well as the increased local traffic due to offshore wind O&M and installation vessels as well as other considerations like radio and radar signal.

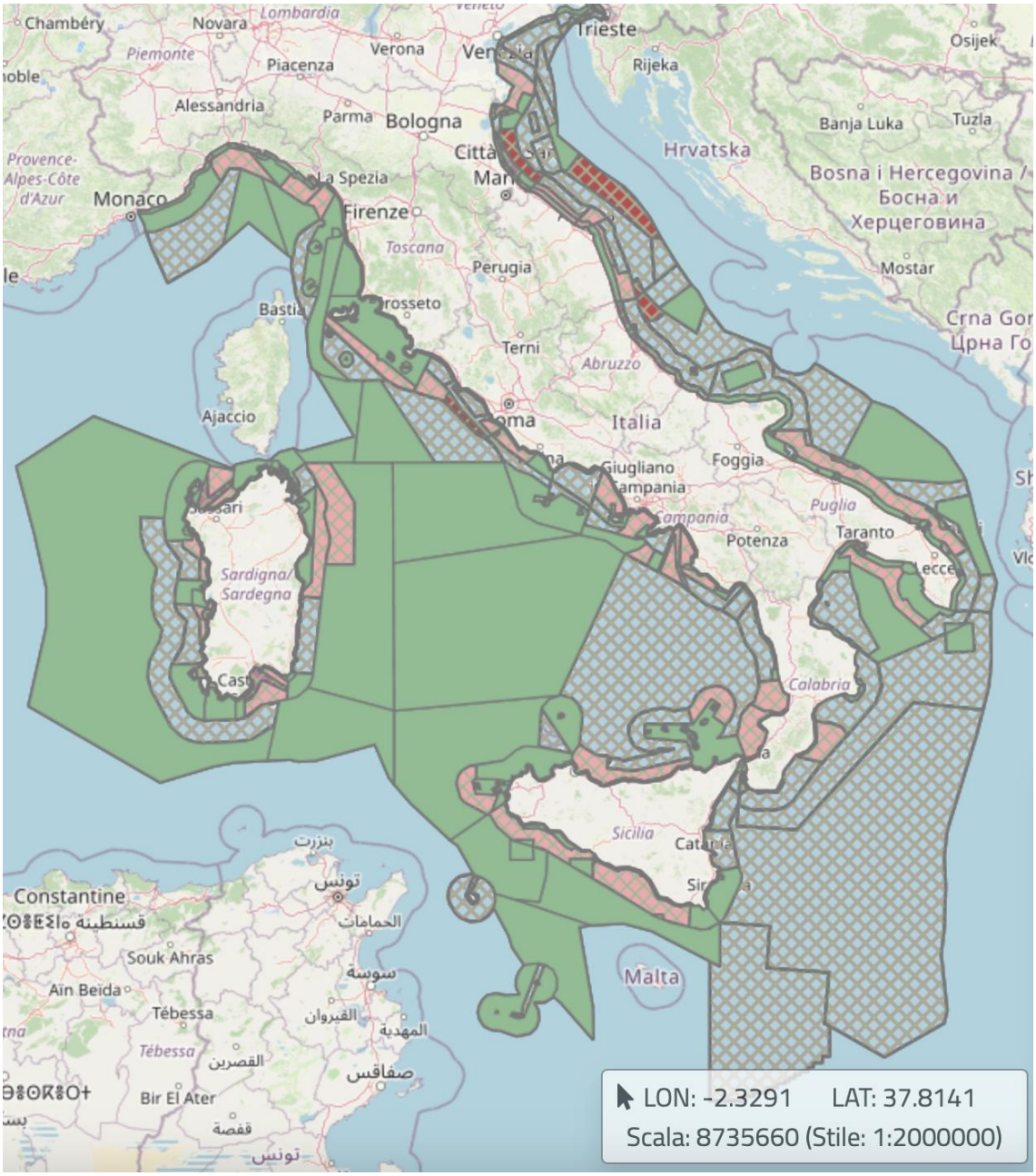


Figure 5-32– Preliminary MSP map of Italy (Marine protected areas in green, fishing areas in pink, areas dedicated to energy use in red, other layers are available, but not shown for clarity) [87]

The marine plan makes considerations for offshore wind in the “energy” and “generic” use categories but doesn’t make any specific provisions for floating installations – these will be considered along the same lines as the fixed bottom ones.

When developing the marine plan, representatives of Italy consulted with their counterparts in neighbouring countries, however it is unclear what the outcome of these negotiations was on the plan.

5.11.3 Overview of interview and main takeaways

The first Italian interview was a R&D GIS specialist from a public agency dealing with renewable energy research. This took place in October 2023.

The second took place in November 2023, with someone that had directly engaged in supporting the national committee in charge of preparing the Italian MSP.

They noted that the offshore wind industry in Italy is set up for quick growth, driven by both national targets and the unique geographic advantages of the country. Italy currently has a national energy climate plan, which includes a 0.9 GW plan for offshore wind, which is currently being revised with potential new goal of 2.1 GW by 2030. At this point, the country doesn't make any distinction between floating and fixed-bottom projects in the energy plan, (unofficial) marine plan or in any other capacity.

Given Italy's mostly deep waters, there is a strong likelihood that a portion of its offshore wind capacity will be built using floating foundations.

Offshore wind projects in Italy are developer-led. The country has more than 60 GW of offshore wind projects in the pipeline, however, they are stuck in the planning phase, leading to confusion and uncertainty in the industry. A notable issue is the absence of a formal marine spatial plan.

The Ministry of Infrastructure and Transport is primarily responsible for MSP in Italy and issues decrees related to this. There has been an effort to create a marine spatial plan, with maps available, but none officially approved. The goal is to set up a "one-stop-shop" system for MSP activities where one organisation would be responsible for creating the marine plan as well as the permitting process for offshore wind. Delays have arisen due to ongoing debates about the plan's finer details.

While the (unofficial) marine spatial plan acknowledges offshore wind, it does not specifically mention floating wind. The plan identifies areas for energy use, which can include oil & gas, floating PV, offshore wind and other technologies.

Offshore wind projects are expected in the Sicilian channel, off the south-western coast of Sardinia and off the west coast of the Italian mainland, especially in the Lazio region, where a large coal powerplant will be de-commissioned soon and the energy demand will have to be met with local generation.

One interviewee disagrees that there will be a 500 MW+ floating wind farm in Italy before 2030 but makes a point that they see it as a realistic target for 2035. There are some perceived differences between floating and fixed-support projects, with floating being viewed as more acceptable for coastal communities due to smaller visual impact because of the possibility to be installed further offshore in deeper water. Floating wind projects are also viewed as potentially less disruptive to marine environments, especially during the construction phase thanks to a smaller noise footprint. On the other hand, there is no perceived difference between floating and fixed platforms in terms of disruption to fishing and other users of the marine environment.

By 2050, the expectation is that floating wind projects will account for the majority of offshore wind installations in Italy, potentially there could be some competition between floating and fixed projects in intermediate depth waters, but this will likely be different project to project based on bathymetry, seabed type and type of turbine. There is a lot of discussion going on about the readiness of the Italian ports and generally the supply chain to support deployment of gigawatt-scale farms in the near future.

Figure 5-33 shows the areas of Italy where developers are planning to build offshore wind projects. These are concentrated around the southern coast of Sicily, southwestern coast of Sardinia, the Lazio region of the eastern coast of the mainland and all along the Adriatic coast. Most of the areas identified are located on banks much shallower than the average depth of the Mediterranean Sea (1500 m), but some in waters potentially too deep for fixed foundations.

Comparing the map of projects in Figure 5-33 with the unofficial MSP map in Figure 5-32 shows some of the projects are proposed in areas designated for environmental protection. It is yet unclear how the permitting process will work in these areas which could potentially cause issues.

During the interview it was pointed out that the projects off the northeast coast of Sardinia might be tricky to execute as it is an area with a huge amount of tourism. Sardinia is already a net exporter of energy to the rest of the country, therefore new cables between the island and the mainland would have to be built to allow exporting the energy. This project is already in planning and it is called the Tyrrhenian link. In addition to these issues, there is very little industry in Sardinia, so local supply chain integration and staging port capacity could be problematic.

There are also some doubts about the projects in the Adriatic as the wind resource there is not always great, however the shallow water might allow lower construction costs.

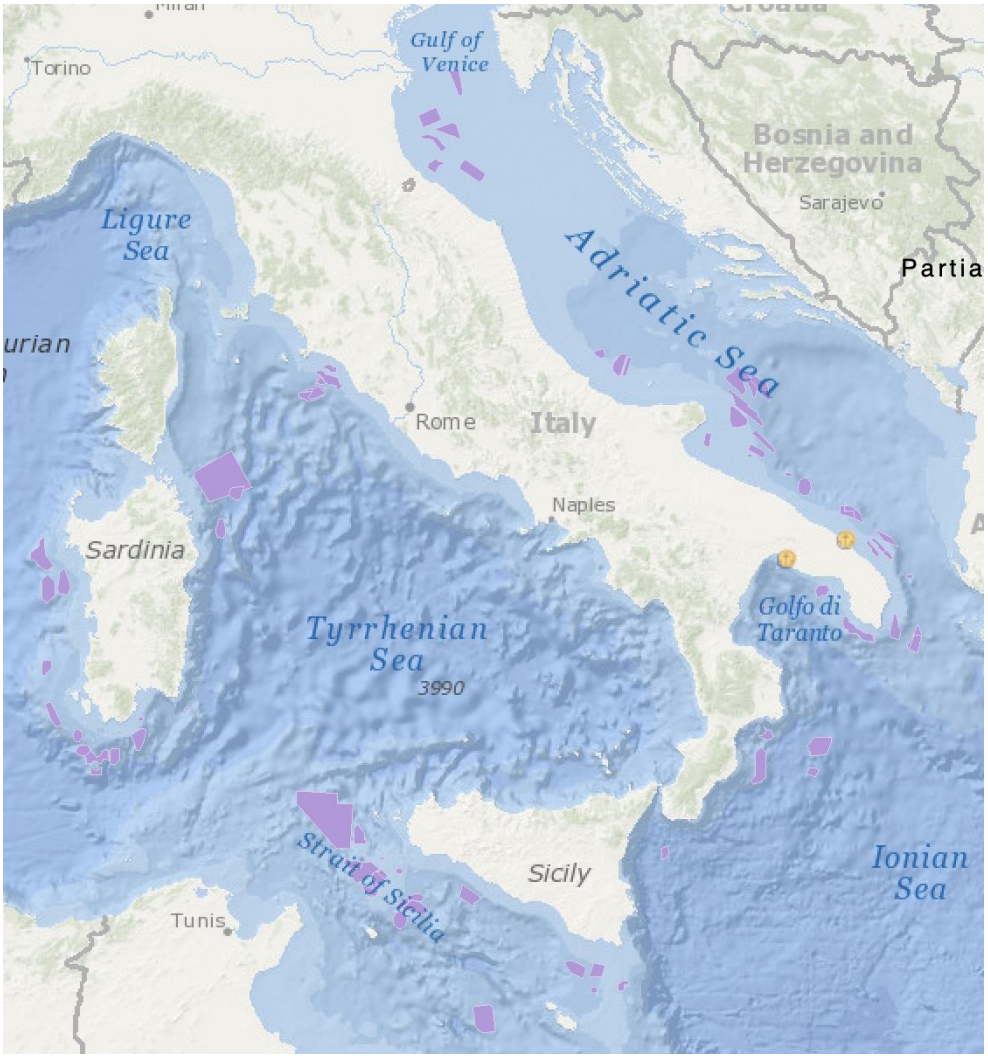


Figure 5-33– Map outlining the offshore wind project pipeline in Italy (4C Offshore)

5.11.4 Summary

The Italian market is in a position where the policy landscape is blocking deployment due to there not being a formal permitting framework in place. The industry is keen to expand and build, which is shown as a large number of projects awaiting permission. The country lacks a formal marine spatial plan which could inform permitting decisions and there is no single regulatory body to which developers could go to get the go-ahead for their proposed project. Once these legal hurdles are overcome, the market will quite likely grow very quickly. A further consideration for Italy is to make sure efficient policies are put into place to integrate the domestic supply chain into the new offshore wind market so that local economic value can be created for communities where the projects will be built. This is a common thing for emerging industrial markets.

5.12 South Korea

South Korea, like much of Asia is still heavily reliant on fossil fuels, in 2022, just 0.25% of primary energy consumption in South Korea came from wind energy sources. 83.21% of South Korea's primary energy came from fossil fuels in 2022, only a slight decrease in dependency compared to 1986, where 87.22% came from fossil fuels [88]. The South Korean government has a target of increasing the country's renewable energy mix to 20% by 2030, this is the primary driver of wind energy development in the region.

5.12.1 Market expectations – capacity and targets

As of 2018 Korea had aims to have an installed capacity of 12 GW of offshore wind by the year 2030, since 2018, this has been increased to 14.3 GW of offshore wind by 2030. In 2021, the South Korean government announced a project to develop an 8.2 GW wind complex offshore of Sinan County, in the South Jeolla Province. The project is anticipated to cost €34B and aims to be completed by 2030, where it would be become the world's largest single offshore development.

The Korean government have also agreed to invest roughly €1B in the first phase of a 6 GW floating wind farm which is planned to be developed off the coast of Ulsan. The project would require close to €30B in a public-private investment to have the project commissioned by the 2030 target. In addition to the above, Korea has a plan to achieve an energy mix of 70% renewables by 2050, approximately 50 GW. Our database shows 17,752MW in the pipeline for South Korea, over 26 projects/sites.

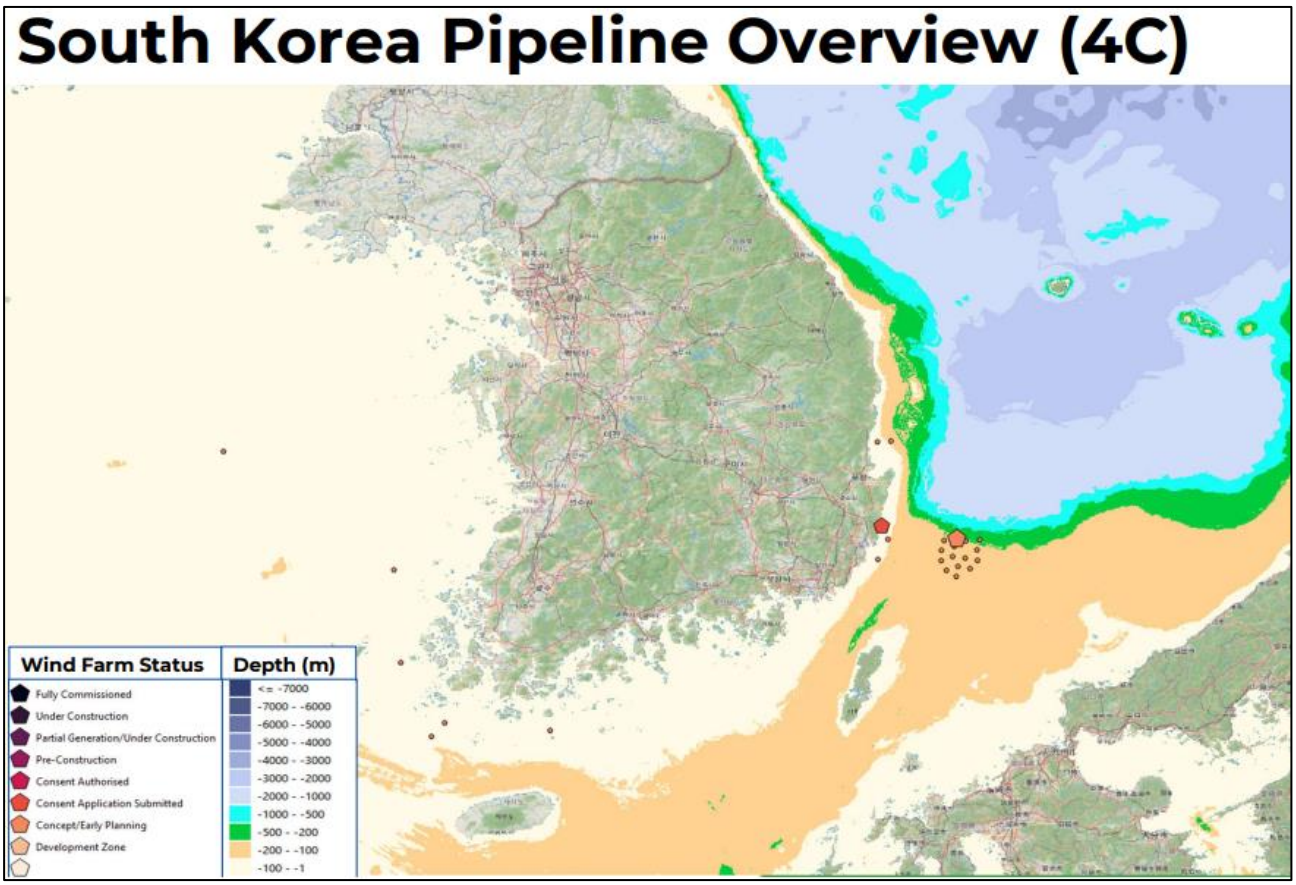


Figure 5-34 – South Korea Pipeline overview

Planned development in Korea can be seen below, with the large-scale floating Ulsan development area to the south east, and large scale fixed bottom areas to the south west.

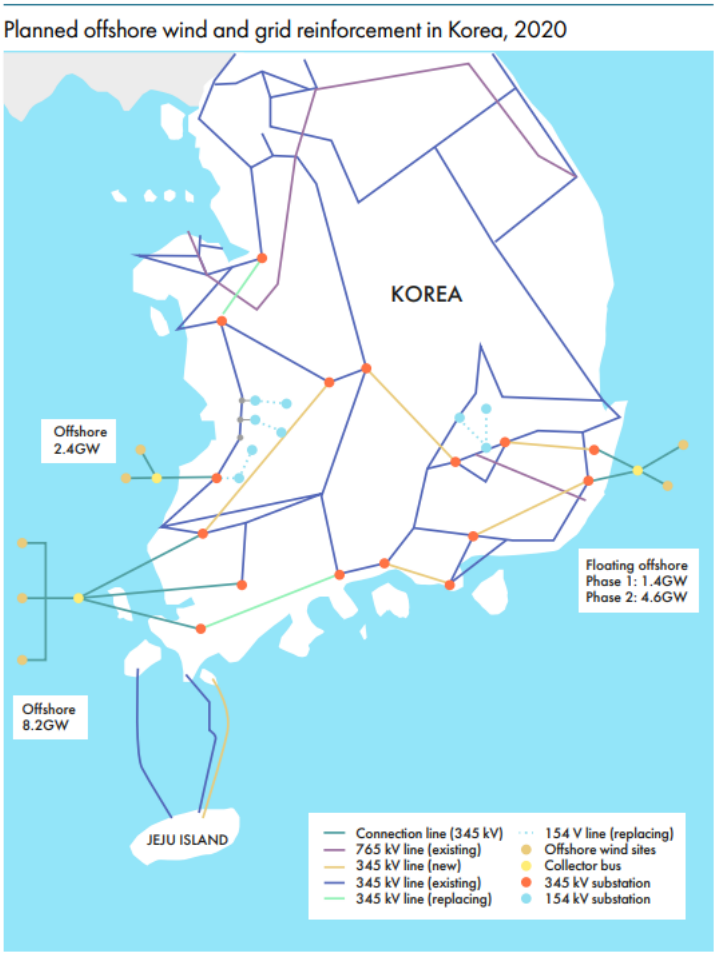


Figure 5-35 – Planned project development in Korea

5.12.2 MSP Policy

The Ministry of Oceans and Fisheries (MOF) are the national authority in charge of MSP in South Korea's 71,000km^2 of territorial sea. South Korea's MSP was introduced for constructing a 'pre-planning' and 'post-use' system based on the characteristics of marine space and values of the ecosystem, preventing reckless uses of marine space. South Korea's aim is to build a system that enables planned use of marine space by determining desirable marine uses for a better management through scientific spatial analysis and participation of interested parties.

The primary laws and policies relevant to MSP in South Korea include:

- The Marine Spatial Planning and Management Act, which entered into force on April 18th, 2019.
- 1st Marine Spatial Framework Plan (2019)
- Marine Spatial Management Plan

Current MSP in South Korea involves each proposed project undergoing a Marine Spatial Assessment and qualified evaluation upon spatial characteristics deriving from relevant legal and institutional settings, demands for marine use, development or conservation. Once assessed under these criteria, each project is placed into one of nine categories:

1. Fishery activity protection zones
2. Aggregate and mineral resource development zones
3. Energy development zones#
4. Marine tourism zones
5. Environmental and Ecosystem management zones
6. Research and education conservation zones
7. Port and navigation zones
8. Military action zones
9. Safety management zones

A Marine Spatial Assessment in South Korea is a five-step process; a basic data survey is carried out, the assessment terms are selected appropriately, computation of input standards and input values for each assessment item takes place (standardization), the assessment items for each core value are combined, and finally, a conflict analysis is carried out (overlay).

5.12.3 Overview of interview and main takeaways

The interviewee for the Korean market is employed in government funded research projects in areas such as climate change mitigation, and climate neutral technologies.

The interview highlights the optimistic goals of Korea and the progress thus far. The interviewee emphasizes the fact that there are many government-led plans in Korea although both plans and government change regularly, resulting in a conflict of interests. Terms for presidency and congress are 5 years and 4 years respectively, and typically when the government changes, so do the overall plans, although there was a change in government in 2022, and despite this, the overall plans have remained the same; reduce carbon by 40% by 2030.

It's clear from the interview that development is heavily dependent on the Korean government who control permits and play the role of negotiator between stakeholders. Such changes and difficulties have changed the expectations for the first 500+ MW floating wind farm, which was initially expected to be commissioned before 2030, but now the interviewee feels 2030-2035 is a more realistic timeframe.

Floating developments are also expected to be less favourable in the public eye due to the necessity for mooring lines which are a hinderance to fisheries, which is a huge industry in Korea.

The future of floating wind is expected to progress slowly, the LCOE of floating wind is expected to take ~10 years to compete with that of fixed-bottom wind developments.

5.12.4 Summary

South Korea has large targets in place which look like they will be difficult to achieve. The 6GW Ulsan project is very ambitious and targeting commissioning before 2030, but our expert believes 2035 is more likely.

The approach in Korea to target multi-GW scale projects may make these large targets easier to reach, but this will need to be monitored.

There is a huge amount of interest in the Korean market, and it has good MSP practices in place.

5.13 The Netherlands

One of the initial pioneers of wind power and offshore wind power, the Netherlands has a strong tradition in harvesting wind energy. Since 1990, the Dutch have been active in building wind projects with the first offshore turbines in the country becoming operational in 2006. So far, all Dutch offshore wind farms are built on fixed foundations, this is due to the depth of the Dutch region of the North Sea seldom exceeding some 70 m. In fact, in most of the area the depth is between 10 – 50 m. The shallow surrounding sea, strong wind resource in the North Sea, proximity to large load centres and port infrastructure have all contributed to the quick growth of the Dutch offshore wind industry.

Currently, most of the Dutch electric energy is being produced from natural gas (40%), with wind (17.4%) and solar (14.6%) being the two other most important sources, along with coal (12%) [49]. With a total of roughly 57% of electricity being generated from fossil fuels, the government is taking steps to become more energy sustainable and setting ambitious offshore wind targets.

Some of Europe's biggest ports are in the Netherlands, which puts the country in a very strong position to be involved in the offshore wind supply chain. The Rotterdam port is the busiest in Europe one of the largest in the world and the port of Amsterdam has experience with OW operations in the North Sea. In January 2024, the Port of Amsterdam announced a project to build a special OW installation section to cater to OW construction going on in the region.

Figure 5-36 - Offshore wind developments around the Netherlands

5.13.1 Market expectations – capacity and targets

As of December 2023, the Dutch have an installed OW capacity of 4.7 GW, none of which is floating. There has been one attempt at commissioning a floating wind demo-scale project, but plans for this were halted.

The national goal is to build 21 GW of offshore wind by 2030, which would be able to supply 16% of the country's energy consumption. This target was confirmed in the North Sea Programme 2022-27. The latest target of 4.5 GW by 2023 has been exceeded last year and the Netherlands appears to be on good track to match the ambitious goals.

However, due to the shallow depth of the local sea, it is unlikely any of the projects will be floating. Unless there is development of floating structures which could be competitive with fixed foundations in shallow applications, it is likely that most of the projects will be built on monopiles or jacket foundations as they have been up to now. Our database includes no floating wind projects in development in the Netherlands.

5.13.2 MSP Policy

More than half of the area of the Netherlands is in the sea and the need for MSP has been recognised early on with the onset of offshore wind projects. Since the stakeholder groups are represented by multiple ministries, the Dutch have set up the Interministerial Consultation Body for North Sea Governance (IDON), which coordinates policy development and develops the long-term strategy. The coordinating manager of the North Sea is the Rijkswaterstaat, who manage licensing.

The policy section concerning the North Sea Programme (NSP) is called the National Water Plan (NWP) and the NSP is an integral part of the NWP. It is expected that once the Environment and Planning Act comes into effect, it will replace The Water Act, which has been an overarching policy for the NWP, but the NWP will remain in place as part of the Environment and Planning Act. The NSP implements the requirements of the European Maritime Spatial Planning Directive.

The first MSP policy document was published in 2009 by the Ministry for Transport and Public Works and has since been called the North Sea Programme. This first plan was for the period between 2009-2015, currently the operational plan is the third edition for the period 2022-2027.

The main policy points of the NSP are:

- **Strengthen the marine ecosystem** by reducing litter and underwater noise as well as setting up protected areas and species protection plans.
- **Transition to a sustainable food supply** mainly by reducing the negative impacts of the fishing industry on the ecosystem.
- **Transition to sustainable energy** by identifying new offshore wind areas and coordinating MSP activities.
- **Maritime transport.** Clearways must be kept within wind farms to not obstruct shipping along the Northern Sea Route as well as any other sea routes.

Because of the massive national and international significance of the shipping industry in and around the Dutch EEZ, maritime transport plays a stronger role in MSP activities in the Netherlands than in countries with less shipping activities.

The Dutch government is very interested in building more offshore wind projects. The latest NSP document outlines a possible scenario where 38 GW of OW could happen by 2050. To make that happen, many new wind energy areas will have to be identified. The NSP also mentions how ecological compatibility will keep playing a critical role when deciding which areas to open.

There are no specific considerations for floating wind in the MSP documents, quite likely this is because FLOW is not expected to be deployed in the Netherlands.

Importantly, the NSP mentions the need to contact neighbouring countries for a potential to set up projects together. This is especially important because all the countries with which the Netherlands share a sea border are active in the OW industry and constructing projects of their own based on their own MSP. Coordinating these plans will ensure better continuity of MPAs, shipping channels and possible it could enable other operational synergies like cooperation on a sub-sea cable network for exporting power from wind farms across the North Sea. Four neighbouring countries have contributed their opinions to the formation of the third edition of the NSP document.

5.13.3 Overview of interview and main takeaways

The person interviewed for the Dutch market works in Engineering and Design for offshore wind. According to them, it is true that there are some ambitious targets for offshore wind deployment, which aim for up to 21 GW by 2030, 50 GW by 2040 and a whopping 70 GW by 2050. Due to the shallow sea, none of these targets include any specific numbers for FLOW and FLOW projects are not expected.

OW development in the Netherlands is plan-led. There are pre-defined sites with available data sets and developers are invited to tender for projects in these sites. This is similar to the British approach, but the auction process is replaced by the tendering rounds.

The tendering process includes considerations for the externalities of OW projects like environmental impact assessments as well as socio-economic impact assessments. This is a good way to integrate consideration for more stakeholder groups into the definition of the project itself and at an early stage. As of 2023, there are no rules on domestic supply chain content in the projects and there is a prevailing global mindset, however this is subject to change with the developing situation.

In addition to the organisations named previously, two more agencies are important in MSP: The Ministry of Economic Affairs and Climate Policy and its Dutch Enterprise Agency (RVO). The RVO is responsible for creating the Offshore Wind Energy plans, the guiding documentation to the roll-out of offshore wind and the government’s strategy.

International cooperation is required for the Dutch market, especially with Germany, Belgium, The UK and Denmark as all these countries run OW projects in close proximity to each other. There are ongoing discussions of building an energy island in the North Sea to serve as a centre for exporting

the energy from the wind farms in the area. There is also potential for joint projects in the Scheldt estuary area.

Generally, the Dutch representative does not believe FLOW has a bright future in the Netherlands, because the technology will not be able to compete with the well-established grounded technology in the shallow water. On the other hand, they are optimistic about the national supply-chain and port infrastructure capabilities, even though they noted a lack of storage space in the ports, which is required for marshalling operations for large OW projects.

A new government will be coming into office soon and this may change the way the Dutch OW market operates, but this remains to be seen. At the moment, the Dutch are considering entering the hydrogen production market as an alternative way to store energy as well as export it from the sea. There is a strong pipeline infrastructure in the area developed by the oil & gas industry and there are ongoing investigations as to how to make use of that network for transporting energy to more inland parts of Europe.

5.13.4 Summary

National targets don’t include FLOW, but the OW market is very well-developed in the Netherlands, with a strong growth prediction, a lot of government support, and a competent and well-established supply chain and port infrastructure to back the growth.

5.14 Key Findings from MSP Consultation

Although each market brings its own specific challenges and features, there are some common issues and trends which become apparent from the interviews and research conducted to produce this report.

5.14.1 The Importance of MSP is clear and realised

Encouragingly, the importance of MSP seems clear in almost all markets.

With the exception of Japan, all other markets assessed have an MSP body in place, and most have or are transitioning to plan-led regimes. While some countries may not have finalised MSP plans, they are at least in the process of this.

In contrast to a developer led regime, a plan-led regime places a clear emphasis on the importance of MSP, and makes it easier for states to develop offshore wind in a more coordinated, planned fashion, which should help to minimise conflicts between different users of the marine environment, maximise the efficiencies from offshore wind development, and achieve the benefits of MSP.

This is becoming more important as markets mature, targets increase, and the efficient use of space becomes paramount. New emerging markets can learn from more mature markets, and use plan-led approaches from the off, as has been seen in Portugal, Spain, Norway etc.

5.14.2 Opening a new market for offshore wind without a solid MSP framework is difficult

Not having an MSP plan in place makes it more difficult for regulators to issue permits for OW projects. OW has an impact on many stakeholder groups and these impacts must be considered when issuing permits. A creation of an MSP policy integrates the requirements of different sea user groups and finds a compromise so that all marine industries can share in the sea resources sustainably while not being detrimental to the ecosystem or each other's operations.

We have seen consenting for project can take over a decade in some cases and slows the development process down to a point where developers might rather pull out and work in other markets. MSP should help to improve these timelines.

Furthermore, the creation of an MSP with clearly designated OW zones sends a message to the industry that the government is ready to support OW projects and help the developers.

It must be said, however, that the creating the first MSP policy document is often a very slow process, due to the number of consultations required with many different groups. But the work pays off in the long run, because the market can then operate in a plan-led mode with designated sites, rather than in a developer-led mode with lengthy individual permission applications.

5.14.3 FLOW is set to play a key role in the green energy transition, but 2030 targets will be difficult to meet

The global predictions for the growth of OW markets are massively favourable with figures of up to 15% annual growth being quoted. FLOW can be a tool for countries with deeper seas to get involved in the OW business, which they otherwise wouldn't be able to do with grounded installations. Countries are including specific FLOW targets in their energy strategies.

Likely the largest markets to watch for FLOW deployment are South Korea, USA, China, UK, Norway, France, Portugal, Spain, and Italy. These countries are already active players on the global wind energy market and are looking to expand their portfolios with floating wind. In a lot of cases, FLOW is the preferred option to grounded OW due to large depth. Globally, 29 countries are planning or considering almost 600 FLOW projects with a combined capacity of almost 500 GW. This is data from the 4C Offshore Database as licensed to GDG in November 2023. Not all these projects will be built, and many will be adjusted and perhaps made more modest, but these values show a strong will of developers to consider FLOW technology to unlock previously untapped markets and sites.

Development of FLOW technology also provides a chance for more companies to get involved in the OW supply chain and carve out a niche for themselves. There are still many technological challenges and solving them could make a new company a global expert. Some of the main technological challenges include the manufacturing of floating platforms, design of dynamic cables, design of mooring and cable connectors, control systems for floating applications, or O&M service strategies and condition monitoring specifically for FLOW.

That said, many countries have set ambitious targets for offshore wind and floating offshore wind (generally not technology specific) for 2030, which experts in the countries generally don't expect will be achieved in the 2030 timeframe and are more likely to slip to 2035.

Generally, this should not be seen as a major issue, with 2030 a milestone on the road to 2050 and longer term, but it is a clear trend.

5.14.4 Key topics include supply chain integration, domestic value retention, and permitting procedures.

One of the interview sections was about the readiness of the local supply chain to cater for the OW and FLOW expansion. In developed markets, the responders usually mentioned that there is a good level of domestic expertise on the topic and the supply chain is ready, however capacity often seems like an issue. To match the targets set by nations worldwide, capacity must be increased both for equipment manufacturing as well as for installation operations, transport, and O&M. Many interviewees mentioned that growing these capacities locally will be important to the sustainability of the OW industry. Increased domestic involvement in the supply chain could also positively influence the public opinion of the projects.

In emerging markets, the question is often how to build large projects with domestic supply chain content when the domestic industry has no experience with OW. This is easier for countries with either onshore wind or offshore oil & gas experience, as there are many transferable skills between these industries.

Another topic linked to supply chain is domestic value retention. In many cases, OW developments are in some form sponsored by public funding. If this funding goes to domestic companies, aside from supporting the green energy transition, the money will also boost the local economy. Here a tricky balance must be struck. On one hand, OW projects are not likely to be possible without engagement from massive multinational OEMs and developers. On the other hand, governments want to support local businesses in coastal areas and industrialisation.

For European markets, port capacity for FLOW may become an issue. Quay-side installation requires deep ports, especially for spar platforms which can require a draft in excess of 50 m, but also for semi-submersibles. Many semi-submersible platforms require more than 10 m of draft. Ports with such deep water are used by large shipping operations and the competition for space and port capacity is often fierce. Furthermore, OW activities require a lot of marshalling space, which is often lacking. Improving the port capacity is one of the keys to unlocking higher OW roll-out in Europe.

Finally, the permitting process is often quoted as a bottleneck of the industry. Some of our interviewees quoted projects taking over a decade to build because of a complicated permitting process. To an extent this ties back to the first point about the need for MSP, but even within countries with an established MSP policy, the permitting can be a bottleneck. On the other hand, it is not just about making it quicker, because the permitting process also includes environmental and socio-economic impact assessments in many cases, which should not be overlooked.

5.14.5 Co-Existence still needs to be addressed

While many MSP plans have identified sites as priority areas for floating wind / offshore wind, in many cases, these activities will need to co-exist with other activities, and how this will be done still needs to be figured out.

A key sector here will be fishers. In almost all counties spoken with, it has been noted that engagement will be needed with fishing organisations to establish how FLOW activities will impact fishing activities, and how impacts could be mitigated.

In many cases this is not year clear, and site-specific considerations will need to be accounted for, but it is clear that further engagement will be needed on this in the future in most markets.

6 Conclusions and Next Steps

This work has proved a very useful exercise to gain a deeper understanding of what are seen as some of the key markets for floating offshore wind globally.

Results will be considered further by IDEA-IRL, and used to refine the approach to future consultation, and focus on key markets, to address some of the queries identified throughout this report.

For WP4, a further report will be prepared to assess floating offshore wind innovations and research topics, which will be delivered in Month 14.

7 References

[1] O. D. Greg Bohan, “Floating Offshore Wind Innovations Analytical Hierarchy Process Report,” 31 July 2023. [Online]. Available: https://www.marei.ie/wp-content/uploads/2023/08/IDEA-IRL_WP4-D1.pdf. [Accessed January 2024].

[2] The European Parliament and the Council of the European Union , “DIRECTIVE 2014/89/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 July 2014 establishing a framework for maritime spatial planning,” July 2014. [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0089. [Accessed January 2024].

[3] UNESCO, “Visions for a Sea Change,” November 2006. [Online]. Available: https://unesdoc.unesco.org/ark:/48223/pf0000153465/PDF/153465eng.pdf.multi. [Accessed January 2024].

[4] UNESCO-IOC, “Pilot State of the Ocean Report (Pilot StOR) - Marine Spatial Planning - Supplementary Material,” June 2022. [Online]. Available: https://www.mspglobal2030.org/wp-content/uploads/2022/05/StOR_MSP_SupplementaryMaterial_2022-1.pdf. [Accessed January 2024].

[5] GWEC, “Global Offshore Wind Report 2023,” 28 August 2023. [Online]. Available: https://gwec.net/wp-content/uploads/2023/08/GWEC-Global-Offshore-Wind-Report-2023.pdf. [Accessed September 2023].

[6] European Commission, “The European Maritime Spatial Planning Platform,” [Online]. Available: https://maritime-spatial-planning.ec.europa.eu/. [Accessed January 2024].

[7] UNESCO, “State of the Ocean Report 2022,” June 2022. [Online]. Available: https://unesdoc.unesco.org/ark:/48223/pf0000381921/PDF/381921eng.pdf.multi. [Accessed January 2024].

[8] UNESCO, “International Guide on Marine/Maritime Spatial Planning,” 2021. [Online]. Available: https://unesdoc.unesco.org/in/documentViewer.xhtml?v=2.1.196&id=p::usmarcdef_0000379196&file=/in/rest/annotationSVC/DownloadWatermarkedAttachment/attach_import_d5018f04-3c69-402e-9546-f94b1ad178f3%3F_%3D379196eng.pdf&updateUrl=updateUrl8141&ark=/ark:/4822. [Accessed January 2024].

[9] UNESCO, “Marine spatial planning A Step-by-Step Approach toward Ecosystem-based Management,” 2009. [Online]. Available: https://unesdoc.unesco.org/ark:/48223/pf0000186559/PDF/186559eng.pdf.multi. [Accessed January 2024].

[10] 4C Offshore , “4C Offshore,” [Online]. Available: https://www.4coffshore.com/. [Accessed 24 January 2024].

[11] ORE Catapult, “INTERNATIONAL MARKET OPPORTUNITIES - Summary Repotr,” June 2022. [Online]. Available: https://ore.catapult.org.uk/wp-content/uploads/2022/06/FOW-PR12-Int-Market-Projections-Report-May-22-AW.pdf. [Accessed January 2024].

[12] Y. Watanabe, “Report 2021 - Japan,” IEA, 2021.

[13] Z. Janipour, “Floating offshore wind energy: Reaching beyond the reachable by fixed-bottom offshore wind energy,” Rabobank, Amsterdam, 2023.

[14] Technical University of Denmark, “Global Wind Atlas,” DTU Wind, 2023. [Online]. Available: https://globalwindatlas.info/en/. [Accessed 20 December 2023].

[15] 4C Offshore, *Market Analysis for GDG (Subscription service, data not publicly available),* 2023.

[16] K. Golubkova and Y. Obayashi, “Japan aims to become major offshore wind energy producer,” Reuters, 30 June 2023. [Online]. Available: https://www.reuters.com/business/energy/japan-aims-become-major-offshore-wind-energy-producer-2023-06-30/. [Accessed 19 December 2023].

[17] H. Ritchie and P. Rosado, “Energy mix,” Our World in Data, 10 July 2020. [Online]. Available: https://ourworldindata.org/energy-mix. [Accessed 19 December 2023].

[18] The Maritime Executive, LLC., “Defects delay startup of Japan's first floating offshore wind farm,” 24 September 2023. [Online]. Available: https://maritime-executive.com/article/defects-delay-startup-of-japan-s-first-floating-offshore-wind-farm. [Accessed 20 December 2023].

[19] TransitionZero, “Coal-de-sac: Advanced coal in Japan,” TransitionZero, 14 February 2022. [Online]. Available: https://www.transitionzero.org/insights/advanced-coal-in-japan. [Accessed 20 December 2023].

[20] Windfloat Atlantic , “Windfloat Atlantic,” [Online]. Available: https://www.windfloat-atlantic.com/. [Accessed January 2024].

[21] REN, “Technical Data 2022,” June 2023. [Online]. Available: https://datahub.ren.pt/media/r5vj2cq4/dados-t%C3%A9cnicos-2022.pdf. [Accessed January 2024].

[22] Reuters, “Portugal's renewable energy production hit new record in 2023,” January 2024. [Online]. Available: https://www.reuters.com/business/energy/portugals-renewable-energy-production-hit-new-record-2023-2024-01-02/. [Accessed January 2024].

[23] 4C Offshore, “Global Market Overview Q3 2023 - Global offshore wind farms subscription,” TGS | 4C Offshore, 2023.

[24] Cuatrecasas, “Public consultation: Offshore Renewable Energy Allocation Plan,” October 2023. [Online]. Available: https://www.cuatrecasas.com/en/global/art/public-consultation-offshore-renewable-energy-allocation-plan#:~:text=It%20is%20a%20key%20procedure,2050%20CNR)%20and%20the%20REPowerEU. [Accessed January 2024].

[25] European MSP Platform , “Portugal - Maritime Spatial Plans,” [Online]. Available: https://maritime-spatial-planning.ec.europa.eu/countries/portugal. [Accessed January 2024].

[26] European MSP Platform , “Maritime Spatial Planning Country Information - Portugal,” February 2022. [Online]. Available: https://maritime-spatial-planning.ec.europa.eu/media/document/12712. [Accessed January 2024].

[27] DGRM, “Proposta de Plano de Afetacao para as Energias Renovaveis Offshore,” October 2023. [Online]. Available: https://participa.pt/contents/consultationdocument/Plano%20de%20Afeta%C3%A7%C3%A3o_PAER_Versao_CP_outubro.pdf. [Accessed Jan 2024].

[28] renews, “Portugal kicks off 3.5GW offshore wind tender,” Nov 2023. [Online]. Available: https://renews.biz/89194/portugal-kicks-off-35gw-offshore-wind-tender/. [Accessed Jan 2024].

[29] A. Durakovic, “50 Developers Express Interest to Build Wind Farms Offshore Portugal,” Nov 2023. [Online]. Available: https://www.offshorewind.biz/2023/11/16/50-developers-express-interest-to-develop-wind-farms-offshore-portugal/. [Accessed Jan 2024].

[30] GWEC, “GLOBAL WIND REPORT 2023,” March 2023. [Online]. Available: https://gwec.net/globalwindreport2023/#:~:text=Globally%2C%2077.6%20GW%20of%20new,China. [Accessed January 2024].

[31] SolarPower Europe, “EU Market Outlook for Solar Power - 2023 - 2027,” Dec 2023. [Online]. Available: https://www.solarpowereurope.org/insights/outlooks/eu-market-outlook-for-solar-power-2023-2027#download. [Accessed January 2024].

[32] S. Djunisic, “Spain records 50.4% renewables share for 2023,” Renewables Now, Jan 2024. [Online]. Available: https://renewablesnow.com/news/spain-records-504-renewables-share-for-2023-844896/. [Accessed Jan 2024].

[33] RWE, “Floating Offshore Wind in Spain - DemoSATH,” 2023. [Online]. Available: https://www.rwe.com/en/our-energy/discover-renewables/floating-offshore-wind/demosath/. [Accessed January 2024].

[34] Ministry for Ecological Transition and the Demographic Challenge, “Roadmap Offshore Wind and Marine Energy in Spain,” September 2022. [Online]. Available: https://www.miteco.gob.es/content/dam/miteco/es/ministerio/planes-estrategias/desarrollo-eolica-marina-energias/enhreolicamarina-pdf_accesible_tcm30-538999.pdf. [Accessed January 2023].

[35] Clyde & Co, “POEM: starting point for offshore wind energy in Spain,” March 2023. [Online]. Available: https://www.clydeco.com/en/insights/2023/03/starting-point-for-offshore-wind-energy-in-spain#:~:text=Areas%20of%20high%20potential%20for%20offshore%20wind%20energy%20development&text=The%20POEMs%20set%20the%20accessible,December%202027%20at%20the%20latest. [Accessed January 2024].

[36] Gobierno De Espana , “Visor de Informacion Geografica Marina,” [Online]. Available: http://www.infomar.miteco.es/visor.html. [Accessed january 2024].

[37] IIDMA, “Offshore wind energy in Spain needs to be urgently regulated to avoid irreversible damage to the marine environment,” 23 November 2023. [Online]. Available: https://iidma.org/en/offshore-wind-energy-in-spain-needs-to-be-urgently-regulated-to-avoid-irreversible-damage-to-the-marine-environment/. [Accessed January 2024].

[38] European MSP Platform , “Spain - Maritime Spatial Plans,” [Online]. Available: https://maritime-spatial-planning.ec.europa.eu/countries/spain. [Accessed Jan 2024].

[39] Ocean Winds , “Ocean Winds will contract Navantia Seanergies floating platforms and other elements for offshore wind farms,” March 2023. [Online]. Available: https://www.oceanwinds.com/news/uncategorized/ocean-winds-will-contract-navantia-seanergies-floating-platforms-and-other-elements-for-offshore-wind-farms/. [Accessed March 2023].

[40] Ørsted, “Our offshore wind farms,” Ørsted, [Online]. Available: https://orsted.co.uk/energy-solutions/offshore-wind/our-wind-

farms?gad=1&gclid=EAIaIQobChMI3aD6mYbagQMV1uLtCh12pgMEEAAYASAAEgI-X_D_BwE. [Accessed 3 October 2023].

[41] The Crown Estate, “Offshore Wind Report 2022,” The Crown Estate, London, 2022.

[42] Department for Energy Security and Net Zero; Department for Business, Energy & Industrial Strategy, “Contracts for Difference (CfD) - Allocation Round 4: Results,” Department for Energy Security and Net Zero, 7 July 2022. [Online]. Available: https://www.gov.uk/government/publications/contracts-for-difference-cfd-allocation-round-4-results. [Accessed 3 October 2023].

[43] P. Tisheva, “UK raises offshore wind price cap by 66% for next CfD round,” Renewables Now, 16 Nov 2023. [Online]. Available: https://renewablesnow.com/news/uk-raises-offshore-wind-price-cap-by-66-for-next-cfd-round-840409/. [Accessed January 2024].

[44] Department for Business and Trade, UK Government, “Offshore wind,” Department for Business and Trade, 20 March 2023. [Online]. Available: https://www.great.gov.uk/international/content/investment/sectors/offshore-wind/#:~:text=The%20UK%20is%20already%20a,FLOWMIS%20on%2030%20March%202023.. [Accessed 10 October 2023].

[45] Equinor, “Hywind Tampen: the world's first renewable power for offshore oil and gas,” Equinor ASA, 2023. [Online]. Available: https://www.equinor.com/energy/hywind-tampen. [Accessed 4 October 2023].

[46] A. Buljan, “Offshorewind.biz - World’s First Floating Wind Farm to Undergo First Major Maintenance Campaign, Turbines to Be Towed to Norwegian Port,” January 2024. [Online]. Available: https://www.offshorewind.biz/2024/01/15/worlds-first-floating-wind-farm-to-undergo-first-major-maintenance-campaign-turbines-to-be-towed-to-norwegian-port/. [Accessed January 2024].

[47] Department for Energy Security and Net Zero (HM Government), “Offshore wind net zero investment roadmap,” HM Government, London, 2023.

[48] HM Government; Norther Ireland Executive; Scottish Government; Welsh Assembly Government, “UK Marine Policy Statement,” HM GOvernment, London, 2011.

[49] Offshore Wind Scotland , “Scotwind Leasing Round,” 2023. [Online]. Available: https://www.offshorewindscotland.org.uk/the-offshore-wind-market-in-scotland/scotwind-leasing-round/. [Accessed January 2024].

[50] Marine Directorate, “Sectoral marine plan for offshore wind energy,” Scottish Government, Edinburgh, 2020.

[51] North Channel Wind Ltd., “North Channel Wind,” [Online]. Available: https://northchannelwind.com/. [Accessed 6 October 2023].

[52] The Crown Estate, “Floating Offshore Wind,” The Crown Estate, 2023. [Online]. Available: https://www.thecrownestate.co.uk/en-gb/what-we-do/on-the-seabed/floating-offshore-wind/. [Accessed 6 October 2023].

[53] Global Wind Energy Council, “Global Wind Report - Annual market update,” GWEC, Brussels, 2015.

[54] G. Lepesant, “Higher Renewable Energy Targets in Germany - How will the industry benefit,” French institute for international relations: Center for Energy and Climate, Paris, 2023.

[55] 4C Offshore, “Offshore Wind Farms in Germany,” TGS - 4C Offshore, 2023. [Online]. Available: https://www.4coffshore.com/windfarms/germany/. [Accessed 19 December 2023].

[56] Global Wind Energy Council, “Global Wind Report,” Glocal Wind Energy Council, 2023.

[57] D. Trautmann, K. Bader and S. Jeschke, “Global offshore wind: Germany,” Norton Rose Fullbright, 31 July 2023. [Online]. Available: https://www.nortonrosefulbright.com/en-gb/knowledge/publications/22341fc4/global-offshore-wind-germany. [Accessed 19 December 2023].

[58] Deutsche Wind Guard, “Status of offshore wind energy development in Germany,” Bundesverband WindEnergie, Varel, 2022.

[59] Bundesamt fur Seeschifffahrt und Hydrographie (BSH), “Maritime Spatial Plans 2009,” BSH, 2009.

[60] Bundesamt fur Seeshifffahrt und Hydrographie (BSH), “Spatial Planning in the German Exclusive Economic Zone - Supporting document to the Maritime Spatial Plan for the EEZ 2021,” BSH, 2023.

[61] Precedence Research, “Offshore Wind Energy Market,” 2022. [Online]. Available: https://www.precedenceresearch.com/offshore-wind-energy-market. [Accessed 20 December 2023].

[62] International Energy Agency (IEA), “Renewable Energy Market Update - Outlook for 2023 and 2024,” IEA, 2023.

[63] A. W. Bates, “Revisiting Approaches to Marine Spatial Planning: Perspectives on and Implications for the United States,” *Agricultural and Economics Review,* vol. 46, no. 2, pp. 206-223, 2017.

[64] O. P. Commitee, “Ocean Climate Action Plan: A report by the ocean policy committee,” The White House , Washington D.C., 2023.

[65] W. E. Ireland, “Revolution- A vision for Irish floating wind energy,” Wind Energy Ireland , Dublin, 2021.

[66] DECC, “Consultation on the offshore renewable energy (ORE) Future Framework Policy Statement,” 22 January 2024. [Online]. Available: https://www.gov.ie/en/consultation/747c7-consultation-on-the-offshore-renewable-energy-ore-future-framework-policy-statement/. [Accessed January 2024].

[67] E. Garcia, “Ireland's offshore wind prices beat forecasts despite supply risks,” *Reuters,* p. 1, 15 June 2023.

[68] “European MSP Platform,” Euorpean Commission, 2021. [Online]. Available: https://maritime-spatial-planning.ec.europa.eu/countries/ireland. [Accessed 2 December 2023].

[69] L. G. a. H. Department of Housing, “National Marine Planning Framework,” Gov.ie, 30 July 2021. [Online]. Available: https://www.gov.ie/en/publication/60e57-national-marine-planning-framework/. [Accessed 5 December 2023].

[70] D. C. Walsh, “An Evaluation of Ireland’s Marine Spatial Plan – The National Marine Planning Framework,” SWAN- Sustainable Water Network , Ireland , 2022.

[71] Power Technology, “EU approves €4.12bn for two French floating wind farms,” Power Technology , 2023.

[72] RWE, “France sets course to exceed its 2028 offshore wind target,” 16 April 2021. [Online]. Available: https://www.en-former.com/en/france-sets-course-to-exceed-its-2028-offshore-wind-target/. [Accessed 18 December 2023].

[73] E. Commission, “European MSP Platform,” 4 June 2022. [Online]. Available: https://maritime-spatial-planning.ec.europa.eu/countries/france. [Accessed 6 November 2023].

[74] Norwegian Ministry of Petroleum and Energy, “Electricity Production,” 11 May 2021. [Online]. Available: https://energifaktanorge.no/en/norsk-energiforsyning/kraftproduksjon/#thermal-power-plants. [Accessed 31 October 2023].

[75] S. Skalstad Ellensen and K. Oftedal, “20 New Offshore Wind Development Areas Identified by NVE in Norway,” *DLA Piper,* pp. https://norway.dlapiper.com/en/news/20-new-offshore-wind-development-areas-identified-nve-norway, 28 April 2023.

[76] Norwegian Ministry of Petroleum and Energy, “Offshore wind,” Norwegian Government, [Online]. Available: https://www.regjeringen.no/no/tema/energi/landingssider/havvind/id2830329/. [Accessed 31 October 2023].

[77] Equinor, “Hywind Tampen,” Equinor ASA, 2023. [Online]. Available: https://www.equinor.com/energy/hywind-tampen. [Accessed 31 October 2023].

[78] Ipieca Ltd., “Offshore Drilling Rigs (2013),” Ipieca Ltd., 10 April 2013. [Online]. Available: https://www.ipieca.org/resources/energy-efficiency-solutions/offshore-drilling-rigs-2013. [Accessed 31 October 2023].

[79] A. Buljan, “Norwegians Identify 20 New Offshore Wind Areas,” *offshoreWIND.biz,* pp. https://www.offshorewind.biz/2023/04/26/norwegians-identify-20-new-offshore-wind-areas/, 26 April 2023.

[80] Business Norway, “Discover Norway's Offshore Wind Industry,” Innovation Norway, 2023. [Online]. Available: https://businessnorway.com/key-industries/offshore-wind. [Accessed 1 November 2023].

[81] Norwegian Ministry of Climate and Environment, “Update of the integrated management plan for the Norwegian Sea,” Solberg Government, Oslo, 2017.

[82] Norwegian Ministry of Climate and Environment, “Norway's integrated ocean management plans,” The Storting, Oslo, 2020.

[83] Norwegian Ministries, “Blue Opportunities: The Norwegian government's updated ocean strategy,” Norwegian Ministries, Oslo, 2019.

[84] Associazione Nazionale Energia del Vento (ANEV), “2002 - 2022 Venti anni di vento,” ANEV, Rome, 2022.

[85] ANEV - Associazione Nazionale Energia del Vento, “ANEV Brochure 2021,” ANEV, 2021.

[86] Gestore Servizi Energetici, “Fonti Rinnovabili in Italia e Nelle Regioni - Rapporto di monitoraggio 2012-2019,” Gestore dei Servizi Energetici S.p.A., Rome, 2022.

[87] Ministero delle infrastrutture e dei transporti, “Spazi Maritimi,” Ministero delle infrastrutture e dei transporti, [Online]. Available: https://www.sid.mit.gov.it/mappa. [Accessed 19 October 2023].

[88] H. Ritchie and M. Roser, “South Korea: Energy Country Profile,” Our World in Data, 2022. [Online]. Available: https://ourworldindata.org/energy/country/south-korea. [Accessed 20 December 2023].

[89] S. Eirgrid, “Ireland Capacity Outlook,” Eirgrid , Dublin, 2022.

Appendix A – List of MSP Plans Approved as of April 2022

Country	Name of MSP Plan approved (English)	Name of MSP Plan approved (original)	Scale
AFRICA			
Cabo Verde	Management Plan for the Coastline and the adjacent Sea of the island of Boa Vista (2020)	Plano de Ordenamento da Orla Costeira e do Mar adjacente da ilha da Boa Vista (2020)	Sub - national
AMERICAS & THE CARIBBEAN			
Antigua & Barbuda	Barbuda Coastal Zoning (2014)	Same	Sub - national
Belize	Belize Integrated Coastal Zone Management Plan (2016)	Same	Sub - national
Bonaire (Netherlands)	Bonaire National Marine Park Management Plan (2006)	Same	Sub - national :
Canada	Integrated Ocean Management Plan for the Beaufort Sea : 2009 and beyond (2009)	Same	Sub - national
Canada	Placentia Bay / Grand Banks Large Ocean Management Area Integrated Management Plan (2012-2017)	Same	Sub - national
Canada .	Gulf of St. Lawrence Integrated Management Plan (2013)	Same	Sub - national
Canada	Pacific North Coast Integrated Management Area Plan (2017)	Same	Sub - national
Canada	Eastern Scotian Shelf Integrated Ocean Mangement Plan : Strategic Plan (2007)	Same	Sub - national
Canada	Marine Planning Partnership (MaPP) for the North Pacific Coast - Haida Gwaii Marine Plan (2015)	Same	Sub - national
Canada	Marine Planning Partnership (MaPP) for the Canadian Pacific North Coast - North Coast Marine Plan (2015)	Same	Sub - national

Canada	Marine Planning Partnership (MaPP) for the Canadian Pacific North Coast - Central Coast Marine Plan (2015)	Same	Sub - national
Canada	Marine Planning Partnership (MaPP) for the Canadian Pacific North Coast - North Vancouver Island Marine Plan (2015)	Same	Sub - national
Ecuador	Coastal and Marine Spatial Plan (2017-2030)	Plan de Ordenamiento del Espacio Marino Costero (2017-2030)	National
Ecuador	Sustainable development and territorial management plan for the Special Regime of Galapagos (2015-2020)	Plan de Desarrollo Sustentable y Ordenamiento Territorial del RÃ©gimen Especial de GalÃ¡pagos (2015-2020)	Sub - national
Mexico	Marine Ecological Planning of the Gulf of California (2006)	Ordenamiento Ecológico Marino del Golfo de California (2006)	Sub - national
Mexico	Marine and Regional Ecological Planning of the Gulf of Mexico and Caribbean Sea (2012)	Ordenamiento Ecológico Marino y Regional del Golfo de México y Mar Caribe (2012)	Sub - national
Mexico	Marine and Regional Ecological Planning of the North Pacific (2018)	Ordenamiento Ecologico Marino y Regional del Pacifico Norte (2018)	Sub - national
Panama	Management Plan of the Ramsar Site Wetland Gulf of Montijo Managed Resources Area (2019)	Plan e Manejo del Sitio Ramsar Ã•rea de Recursos Manejados Humedal Golfo de Montijo (2019)	Local
USA	Northeast Ocean Plan (2016)	Same	Sub - national
USA	Mid - Atlantic Regional Ocean Action Plan (2016)	Same	Sub - national
USA	2021 Massachusetts Ocean Management Plan (2022)	Same	Sub - national
USA	Rhode Island Ocean Special Area Management Plan (2010)	Same	Sub - national
USA	Long Island Sound Blue Plan (2021)	Cam Same	Sub - national
USA	New York Ocean Action Plan (2017-2027)	Same	Sub - national
USA	Oregon Territorial Sea Plan (1994)	Same	Sub - national .

USA	Marine Spatial Plan for Washington's Pacific Coast (2017)	Same	Sub - national
USA	The Hawai'i Ocean Resources Management Plan (2020)	Same	Sub - national
ASIA			
China	National Marine Functional Zoning (2011-2020)		National
China	Liaoning Province Marine Functional Zoning (2011-2020)		Sub - national
China	Hebei Province Marine Functional Zoning (2011-2020)		Sub - national
China	Tianjin Marine Functional Zoning (2011-2020)		Sub - national
China	Shandong Province Marine Functional Zoning (2011-2020)		Sub - national
China	Jiangsu Province Marine Functional Zoning (2011-2020)		Sub - national
China	Shanghai Marine Functional Zoning (2011-2020)		Sub - national
China	Zhejiang Province Marine Functional Zoning (2011-2020)		Sub - national
China	Fujian Province Marine Functional Zoning (2011-2020)		Sub - national
China	Guangdong Province Marine Functional Zoning (2011-2020)		Sub - national
China	Guangxi Zhuang Autonomous Region Marine Functional Zoning (2011-2020)		Sub - national
China	Hainan Province Marine Functional Zoning (2011-2020)		Sub - national
China	About 60 city (county) level Marine Functional Zonings	N / A	Local
Indonesia	National Marine Spatial Plan		National
Indonesia	5 plans covering 7 outermost small islands	N / A	Sub - national

Israel	Maritime Policy for Israel's Mediterranean Waters (2018)		Sub - national
Philippines	Coastal Land- and Sea - Use Zoning Plan of the Province of Bataan (2007)	Same	Sub - national
Republic of Korea	Marine Spatial Framework Plan		National
United Arab Emirates	Plan Maritime 2030 : Abu Dhabi Coastal and Marine Framework Plan (2016)		Local
Viet Nam	National ICM Strategy to 2020 with Vision to 2030		Sub - national
Viet Nam	| ? (Thua Thien - Hue province)		Sub - national
Viet Nam	Da Nang Master Plan Towards 2030		Local
EUROPE			
Belgium	Royal Decree establishing the marine spatial planning for the period 2020 to 2026 in the Belgian sea - areas (2020-2026)	Arrete royal relatif a l'etablissement du plan d'aménagement des espaces marins pour la période de 2020 a 2026 dans les espaces marins belges (2020-2026)	National
Croatia	Zadar County Integrated Sea Use Management Plan (2015)	Prostorni plan Zadarske zupanije (2015)	Local
Croatia	Coastal Plan for Å ibenik - Knin County (2016)		Local
Denmark	Denmark's maritime spatial plan (2021)	Danmarks havplan (2021)	National
Estonia	Hiiu Maritime Spatial Plan (2016)	Hiiu maakonnaga piirneva mereala maakonnaplaneering (2016)	Local
Estonia	PÃ¤rnu Plan / Planning of PÃ¤rnu County sea territories (2017)	PÃ¤rnu maakonnaga piirneva mereala maakonnaplaneering (2017)	Local
Finland	Finnish Maritime Spatial Plan 2030 (2020)	Suomen Merialuesuunnitelma 2030 (2020)	National
Ãland Island	Maritime Spatial Plan for Ãland Island (2021)	Ãlands havplan (2021)	Sub - national :
Germany	MSP for the German EEZ in the Baltic Sea (2021)	Raumordnungsplan fur die deutsche ausschlieBliche Wirtschaftszone in der Ostsee (2021)	Sub - national
Germany	MSP for the German EEZ in the North Sea (2021)	Raumordnungsplan fur die deutsche ausschlieBliche Wirtschaftszone in der Nordsee (2021)	Sub - national

Germany .	State Development Plan Of Schleswig - Holstein (2021)		Sub - national :
Germany	Spatial Development Programme of Mecklenburg - Vorpommern (2016)		Sub - national
Germany .	State Spatial Planning Programme of Lower Saxony (2017)	Landes - Raumordnungsprogramm , LROP (2017)	Sub - national
Ireland	Project Ireland 2040 : National Marine Planning Framework (NMPF) (2021)	Same	National
Latvia	Maritime Spatial Plan for Internal Waters , Territorial Waters and Exclusive Economic Zone of the Republic of Latvia (MSP 2030) (2019)		National
Lithuania	Comprehensive Plan for the Republic of Lithuania (" maritime territories " section, that complements the terrestrial spatial planning) (2021)		National
Malta	Strategic Plan for Environment and Development (2015-2020)	Same	National
Netherlands	North Sea Programme (2022-2027)	Programma Noordzee (2022-2027)	National
Norway	Integrated Ocean Management Plan for Barents Sea and Lofeton Islands (2015)		Sub - national
Norway	Integrated Ocean Management Plan for Norwegian Sea (2017)		Sub - national
Norway	Integrated Ocean Management Plan for North Sea (2013)		Sub - national
Poland	Maritime Spatial Plan for Polish Sea Areas in scale of 1 : 200 000 (2021)	Planu zagospodarowania przestrzennego Polskich Obszarow Morskich w skali 1:200 000 (2021)	National
Portugal	Maritime Spatial Planning Situation Plan (2019)	Plano de Situacao do Ordenamento do Espaco Maritimo (2019)	National
Romania	One regional MSP plan	N / A	Sub - national
Romania .	4 local MSP plans	N / A	Local

Slovenia	Maritime Spatial Plan of Slovenia (2021)	Pomorski prostorski plan Slovenije (2021)	National
Sweden	Marine spatial plans for Gulf of Bothnia , Baltic Sea , and the Skagerrak / Kattegat (2022)	Havsplaner for Bottniska viken, Ostersjon och Vasterhavet (2022)	National
Sweden	45 comprehensive municipality plans	N / A	Local
England (UK)	East Inshore and Offshore Marine Plans (2014)	Same	Sub - national
England (UK)	South Inshore and Offshore Marine Plans (2018)	Same	Sub - national
England (UK)	South East Inshore Marine Plan (2021)	Same	Sub - national
England (UK)	South West Inshore and Offshore Marine Plans (2021)	Same	Sub - national
England (UK)	North West Inshore and Offshore Marine Plans (2021)	Same	Sub - national
England (UK)	North East Inshore and Offshore Marine Plans (2021)	Same	Sub - national
Scotland (UK)	Scotland's National Marine Plan (2014)	Same	National
Wales (UK)	Welsh National Marine Plan (2019)	Same	National
OCEANIA			
Australia	Marine Bioregional Plan for the South - west Marine Region (2012)	Same	Sub - national
Australia	Marine Bioregional Plan for the North - west Marine Region (2012)	Same	Sub - national .
Australia	Marine Bioregional Plan for the North Marine Region (2012)	Same	Sub - national
Australia	Marine Bioregional Plan for the Temperate East Marine Region (2012)	Same	Sub - national
Australia	Great Barrier Reef Marine Park Zoning Plan (2003)	Same	Sub - national
Kiribati	Phoenix Islands Protected Area Management Plan (2010-2014)	Same	Sub - national

Appendix B – Interview Overview Spreadsheet

Country:	France	Ireland		Norway		USA		Japan	South Korea	Spain	Portugal	Germany	Italy		Netherlands	UK
Expert:	**Tech**	**T**	**MSP**	**T**	**MSP**	**T**	**MSP**	**T**	**T**	**T**	**T**	**T**	**T**	**MSP**	**T**	**T**
Interview Date:	**30-Mar-23**	**04-Apr-23**	**11-Apr-23**	**31-Mar-23**	**12-Apr-23**	**24-Mar-23**	**18-Apr-23**	**20-Apr-23**	**19-Apr-23**	**25-Apr-23**	**28-Apr-23**	**13-Nov-23**	**18-Oct-23**	**14-Nov-23**	**05-Dec-23**	**22-May-23**
Targets																
	40GW OW by 2050 18 GW by 2035 Nothing FLOW Specific	5GW fixed for 2030 2GW in Development by 2030 (potentially some FLOW) 20 GW by 2040, 37GW by 2050 Nothing FLOW specific		30GW OW by 2040		30GW by 2030 (OW) Indicative tarzet of 110GW for 2050 (OW)	15GW by 2045 in California (FLOW)	10GW by 2030 (OW) 30 - 45GW OW by 2040	12GW by 2030 (OW) 70% RES-E 2050, about 50GW	1 - 3GW by 2030 17GW by 2050 OW target - but will be mainly FLOW	10GW by 2030 (OW)	30GW OW by 2030 40 GW OW by 2035 70GW OW by 2045	New target of 2.1GW OW for 2030 being set Nothing FLOW specific		21GW OW for 2030 50GW OW for 2040 70GW for 2050	50GW OW by 2030 100GW OW by 2050 5GW FLOW by 2030
Approach																
	Plan-led. State Tenders termed 'AO' - AO 1 - 4 = 7,8 have been fixed, AO 5 -6 FLOW. Tender inculdes site exclusivity, CFD, grid connection.	Fully Developer led for Phase 1, transitioning to Plan-led post 2030 (this transition has since been brought forward and is being implemented now)		Plan - led generally. Sites identified and assessed by the State. State also involved with Grid connection. May be potential for developers to input on site selection.	Plan - led - with no open-door approach. Government chooses sites which are lease out. Developer gets a licence from the Government, sends in detailed project and construction plans, which must be accepted by Government. Government monitors ops to make sure obligations are fulfilled. CFD expected for early rounds.	Plan - led generally. The Government defines lease areas. But developer interests can have an impact on what zones they choose. Once site areas are leased to developers, it is all down to the developers, and there is no Government support for survey data, offtake etc	Plan-led generally. BOEM has a 4 stage authorisation process: 1. Planning and Analysis, 2. Leasing, 3. Site Assessment, 4. Construction and Operations. Iterative process which used to be more developer led, but is now plan led nationally. All of Government approach, with coordination between Federal, State, Tribal and Local government reps.	Framework for FLOW TBC. Generally, the Gov IDs sites and opens these for competitive auctions. Developers pay a fee to MLIT (Ministry for Land, Infrastructure, Transport and Tourism) to be able to temporarily occupy a site to conduct early activities, such as feasibility studies, site investigation, and EIA. Centralised competitive auctions for combined site and subsidy agreement.	Plan - led. There are many Government led plans in Korea, including for 1GW on the west coast. Recent change in Government changed atmosphere but plan maintained. Governemnt controls permits, helps negotiations with stakeholders.	Plan-led. Coasts/Sea space managed by Central Government with input from regional and local governments. Government proposing POEM which says which areas are dedicated to OW, then system of auctions for Governement identified sites will decide who develops sites.	Plan - led. An offshore working group was established by the Governmental Dispatch nº 1404/2022 in September 2022 involving, research organisations, Licensing Directorates of Marine resources and Energy, the Developers' Association, and Ports Association, among other stakeholders. The works of this working group are scheduled to finish by May 2023	Plan-led. Association reponsible for marine areas and they ask institutions to do studies on site planning for offshore areas – offshore sites are split up into different areas, shipping, marine, nature etc. Maps of the areas are devised and studies carried out for tendering phases. Offshore wind areas identified in Marine Spatial Plan (ROP), prepared by BSH.	Developer-led, with more than 60 GW in the pipeline, most of them stuck in pre-planning/planning, some in overlapping areas. Confusion due to the lack of a formal marine spatial plan. No plans in place for subsidy support/auction yet – waiting for decree on subsidy at the end of the year.	Bottom up approach – developer identities an area of interest, and starts the process according to the present legislation, which is not fully clear. A new law from November 2021 means new procedural guidelines have to be prepared to assist permitting process. Things are a bit wild and undefined.	Government/plan-led. Government has sites that are pre-defined, they do all the site investigations, and data made freely available to developers. When you wind the tender, you get the development permit / rights	Significant differences between Scotwind and rest of UK. Seabed in Scotland controlled by the Crown Estate Scotland (CES), a Government agency, and is plan-led. Crown Estate (CE) for Eng/Wales is independent from Government. This jurisdiction has previously been developer-led, but is now becoming more plan-led.
MSP																
Organisation in Charge of MSP	Primarily DGEC (Direction générale de l'énergie et du climat)	DECC, MARA being Est.	DHLGH	NVE	NVE	BOEM (for energy resources) / NOAA (for fisheries MSP)	BOEM	interview. It is thought that there was no need for MSP because there were few marine industrial uses other than fishery in Japan. In the recent development of offshore wind power generation, consensus building with multiple stakeholders has become a problem, and some	Ministry of Ocean and Fisheries.	Ministry of Ecological Transition - may change after elections.	DGRM - Directorate for Maritime Resources	BSH - Federal Maritime and Hydrographic Agency	The Ministry of Infrastructure and Transport	The Ministry for Infrastructure and Transport coordinates a technical committee which is made of other ministries, including Fisheries, Environment, Economic Development, & Culture. 15 maritime regions in Italy represented. The central and regional organizations work together to make a plan. It is a nice architecture, but not easy to carry out the process.	Ministry of Economic Affairs and Climate Policy, and Dutch Enterprise Agency (RVO)	In Scotland, Marine Scotland does Spatial planning process, CES does leasing round. Marine Management Organisation (MMO) the body in England/Wales.
Relevant Doc / Links	French PPE	https://www.gov.ie/en/consultation/73a6f-the-second-offshore-renewable-energy-development-plan-oredp-ii-public-consultation/		https://www.regjeringen.no/no/tema/energi/landingside/h ovvind/id2830329/	https://veilederе.nve.no/havvind/identifisering-av-utredningsområder-for-havvind/nye-områder-for-havvind/	https://www.boem.gov/renewable-energy/state-activities/california	MSP docs on BOEM website	The Basic Plan on Ocean Policy		https://www.miteco.gob.es/content/dam/miteco/es/ministerio/planes-estrategias/desarrollo-eolica-marina-energias/enhreobicamarino	https://www.dgrm.mm.gov.pt/en/web/guest/as-pem-psoem	No links shared as no FLOW site idenified.	https://www.sid.mit.gov.it/mappa	https://www.mit.gov.it/en	https://english.rvo.nl/topics/offshore-wind-energy/plans-2030-2050#new-projects	
	Document stratégique de façade (DSF) used to map differrent uses of the sea and prioritise zones.	https://www.gov.ie/en/publication/60e57-national-marine-planning-framework/		https://publikasjoner.nve.no/rapport/2012/rapport2012_47.pdf		BOEM wesbite in general recommended for review	BOEM/NOAA NCCOS Reports		MSP webpage on Ministry of Ocean and Fisheries, but quite incomplete. Only fixed type.	https://www.cluteco.com/en/insights/2023/03/starting-point-for-offshore-wind-energy-in-spain#:~:text=Areas%20of%20high%20potential%20for%20offshore%20wind%20energy%20developm	https://webgis.dgrm.mm.gov.pt/portal/apps/webappviewer/index.html?id=102537ae49554da99bab0141e27c6065			https://www.sid.mit.gov.it/documenti-piano	https://windopzee.nl/onderwerpen/wind-zee/wanneer-hoeveel/wind-zee-2030-0/	
	https://www.geolittoral.developpement-durable.gouv.fr/eolien-en-mer-a1242.html										https://dre.pt/dre/detalhe/doc/114042022-201394418					
	https://www.geolittoral.developpement-durable.gouv.fr/mediterranee-r564.html										https://en.oceantrans.info/policy-brief					
Areas identified for FLOW?	Yes - PPE and Tender sites, new ones being established. DSF identify marine spatial plans. 10-year PPE sets tender schedule, locations, capacities and target price	Zones identified by the State and zones outside of this identified by developers who have been and are proceeding on early-stage developments. The identified zones by the State are very new.	NO. OREDPII published framework for broad areas moving to DMAPs – broad areas of interest were more examples, not areas identified	15 OW sites identitfied in 2012. New sites being identified.	Yes - new sites to be released in April / May 2023.	Yes - BOEM Docs - specific lease areas on west coast and pacific have been leased, with more to come off North Carolina and in the Gulf.	Yes.	Not through MSP	Not in MSP. Plan started for research project to construct a digital map for MSP to consider which sites would be best for fixed/floating. This was cancelled but is to be restarted.	Yes - in POEM	Yes - see links	No sites specifically designated for FLOW.	The MSP mentions offshore wind but not floating in particular. Energy use allowed in generic use areas and specific energy use areas, but the energy specific areas are limited and include oil & gas. A lot of the offshore wind applications are in areas which the plan identifies as not suitable for energy use or non-priority energy use.	Recent MSP carried out to identify sites for offshore wind. Not enough area has been identified for OW and this will need to be improved. This doesn't mean sites can't be developed outside of identifed areas. The final opinion from the national commission on the SEA was received last week. The SEA was consulted on and now the competent authority must take into accoiunt the recommendation and consultation to approve the final plans. Transboundary consultation took place with France, Spain, Malta, Greece, Slovenia, and others – very useful process.	No.	MSP released in 2020 for Scotland which fed into ScotWind. Sites were identified and leased, but conflicts weren't fully recongnised. There was also nothing on how these projects can be sustainably developed. A huge capacity of 30GW OW / 19GW FLOW can't all be developed at the same time (Supply chain, grid etc.) so decision needs to be made. CE have not had a big spatial plan, more piecemeal, which got them to round 4. Now delivering round 5 and Floating in Celtic sea. Next phase of projects/round should be more planned.
Quickfire (Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D), Strongly Disagree (SD))																
500MW pre-2030	SD	SD	N	D	D	A	A	SD	A	D	N	SD	D	A	SD	
500MW pre-2040	SA	SA	SA	SA	SA	A	SA	A	SA	SA	A	SD	A	SA	D	
Community Acceptance	N	A	A	N	A	A	A	A	D	A	A	N	A	SA	D	
Users of the marine	N	N	N	A	A	D	A	A	D	D	A	A	D	N	D	
Fishers	A	SD	N	D	A	SD	N	N	D	D	A	D	N	N	D	
env impact	SA	D	N	A	A	A	N	SA	D	A	A	SA	A	N	D	
local content	A	A	SA	SA	SA	D	N	SA	A	N	A	A	A	N	A	
Supply chain pre-2030	A	SD	A	A	D	A	A	A	A	D	A	SD	D	A	A	
ports pre-2030	A	SD	A	A	D	A	N	D	A	N	A	SD	D	N	A	
maj. Of cap.	A	N	SA	A	A	A	A	SA	N	SA	A	SD	SA	SA	SD	
compete with fixed	SA	A	SA	D	D	A	N	SA	A	A	A	A	N	N	D	
Coexistence - Most Likely																
Most likely - 1	Shipping	Hydrogen Production	Hydrogen Production	Oil and Gas	Oil and Gas	Small scale / artisanal local fishing	Small scale / artisanal local fishing	Shipping	Special Protection Areas / Marine Protected Areas	Aquaculture	Other renewables	Military zones / operations	Hydrogen Production	Oil and Gas	Oil and Gas	
Likely - 2	Aquaculture	Communications networks	Other renewables	Hydrogen Production	Hydrogen Production	Other renewables	Shipping	Communications networks	Aquaculture	Hydrogen Production	Aquaculture	Hydrogen Production	Small scale / artisanal local fishing	Aquaculture	Hydrogen Production	
Likely - 3	Tourism / Leisure		Communications networks	Aquaculture	Oil and Gas	Other renewables		Special Protection Areas / Marine Protected Areas	Small scale / artisanal local fishing	Other renewables	Hydrogen Production	Small scale / artisanal local fishing	Special Protection Areas / Marine Protected Areas		Other renewables	
Coexistence - Least Likely																
Unlikely - 1	Military zones / operations	Shipping	Commercial fishing	Small scale / artisanal local fishing	Commercial fishing	Commercial fishing	Commercial fishing	Commercial fishing	Commercial fishing	Commercial fishing	Commercial fishing	Tourism / Leisure	Other renewables	Commercial fishing		
Unlikely - 2	Commercial fishing	Commercial fishing	Aquaculture	Military zones / operations	Special Protection Areas / Marine Protected Areas	Special Protection Areas / Marine Protected Areas	Licensed Dumping Areas	Small scale / artisanal local fishing	Military zones / operations	Special Protection Areas / Marine Protected Areas	Military zones / operations	Oil and Gas	Oil and Gas	Shipping		
Unlikely - 3		Special Protection Areas / Marine Protected Areas	Shipping	Shipping	Military zones / operations	Shipping		Hydrogen Production	Oil and Gas	Tourism / Leisure	Tourism / Leisure	Special Protection Areas / Marine Protected Areas	Military zones / operations	Tourism / Leisure		
Site Assessment Criteria																
Rank 1	Resource wind speed	Resource wind speed	Resource wind speed	Resource wind speed	Resource wind speed	Resource wind speed	Resource wind speed	Socio-ecological factors (marine mammals/birds, migratory patterns, fishing zones, protected areas, other users of the environment)	Resource wind speed	Resource wind speed	Resource wind speed	Resource wind speed	Resource wind speed	Resource wind speed	Resource wind speed	
Rank 2	Proximity to demand centres	Metocean conditions (Accessibility)	Metocean conditions (Accessibility)	Availability of grid connections	Distance to shore	Proximity to demand centres	Metocean conditions (Accessibility)	Resource wind speed	Metocean conditions (Accessibility)	Socio-ecological factors (marine mammals/birds, migratory patterns, fishing zones, protected areas, other users of the environment)	Site Bathymetry	Metocean conditions (Accessibility)	Seabed Geotechnical Conditions	Metocean conditions (Accessibility)	Proximity to demand centres	
Rank 3	Socio-ecological factors (marine mammals/birds, migratory patterns, fishing zones, protected areas, other users of the environment)	Distance to shore	Seabed Geotechnical Conditions	Proximity to usable port & local supply chain	Socio-ecological factors (marine mammals/birds, migratory patterns, fishing zones, protected areas, other users of the environment)	Socio-ecological factors (marine mammals/birds, migratory patterns, fishing zones, protected areas, other users of the environment)	Seabed Geotechnical Conditions	Metocean conditions (Accessibility)	Distance to shore	Availability of grid connections	Socio-ecological factors (marine mammals/birds, migratory patterns, fishing zones, protected areas, other users of the environment)	Seabed Geotechnical Conditions	Socio-ecological factors (marine mammals/birds, migratory patterns, fishing zones, protected areas, other users of the environment)	Seabed Geotechnical Conditions	Distance to shore	
Rank 4		Proximity to usable port & local supply chain	Distance to shore	Socio-ecological factors (marine mammals/birds, migratory patterns, fishing zones, protected areas, other users of the environment)	Availability of grid connections	Site Bathymetry	Socio-ecological factors (marine mammals/birds, migratory patterns, fishing zones, protected areas, other users of the environment)	Distance to shore	Availability of grid connections	Metocean conditions (Accessibility)	Availability of grid connections	Socio-ecological factors (marine mammals/birds, migratory patterns, fishing zones, protected areas, other users of the environment)	'Consentability' of the site	Site Bathymetry	Availability of grid connections	
Rank 5		Socio-ecological factors (marine mammals/birds, migratory patterns, fishing zones, protected areas, other users of the environment)	'Consentability' of the site	'Consentability' of the site	Metocean conditions (Accessibility)	'Consentability' of the site		Proximity to usable port & local supply chain	Proximity to demand centres	Proximity to usable port & local supply chain	Proximity to usable port & local supply chain	Proximity to usable port & local supply chain	Site Bathymetry		Seabed Geotechnical Conditions	
Reserch Topics																
Rank 1	How costs can be lowered	How costs can be lowered	Mooring spread and how this varies by technology type	Lifecycle Carbon Assessment	Port requirements for commercial scale projects	The impact of mooring lines / anchors on seabed habitats and marine mammals	The impact of mooring lines / anchors on seabed habitats and marine mammals	How costs can be lowered	Mooring spread and how this varies by technology type	How costs can be lowered	What is the most efficient planting density of a site	Lifecycle Carbon Assessment	What is the most efficient planting density of a site	The impact of mooring lines / anchors on seabed habit	How costs can be lowered	
Rank 2	Co-existence potential	Floating platform choice	Floating platform choice	Floating platform choice	Co-existence potential	Co-existence potential	Hard technological constraints (e.g seismic activity, wave climate, etc.)	Floating platform choice	Hard technological constraints (e.g seismic activity, wave climate, etc.)	Lifecycle Carbon Assessment	Port requirements for commercial scale projects	Hard technological constraints (e.g seismic activity, wave climate, etc.)	Mooring spread and how this varies by technology type	The noise impacts of floating offshore wind	Skills requirements for developing projects	
Rank 3	The noise impacts of floating offshore wind	The impact of mooring lines / anchors on seabed habitats and marine mammals	How costs can be lowered	Co-existence potential	The impact of mooring lines / anchors on seabed habitats and marine mammals	How costs can be lowered	Power offtake requirements	Mooring spread and how this varies by technology type	How costs can be lowered	What is the most efficient planting density of a site	How costs can be lowered	The impact of mooring lines / anchors on seabed habitats and marine mammals	Lifecycle Carbon Assessment		Floating platform choice	
Additional Research Areas																
	Recyclability of floating wind projects including floaters	Risk management - research into increased risk for bankability and insurability for floating.	Dynamic cables reliability and performance	O&M Optimisation	how energy islands will progress, options for connections, areas, who can connect etc.	innovations to avoid bottlenecks e.g. SC		Wind turbine design for future development	Technologies to protect floating wind structures during tropical cyclones, making it strong enough to with stand them.	Manufacturing and Supply Chain efficencies	recyclability of WT - inculding what to do with with foundations? Should they be left in place?	More needed on supply chain as a research topic.	we need to go more in detail on O&M issues – general strategy and costs	Impacts on birds and how to mitigate them	Supply chain investment and developing this.	
			Electricity system benefits (EVOLVE looking at wind and wave. Important considering market changes)	Optimising operations rather than increasing turbine size	hydrogen production – how it will be connected to OW, costs, infrastructure needed etc.			optimisation of marine construtions works	analysis in case of failure in mooring lines – in WP3 – breaking of mooring line hitting other turbines and preventing failure from spreading		uncertainties on the offshore wind resource assessment	Trained / qualified people for floating wind.	Floating platform choice a big issue – need to lower down options to a few main ones, which can then be decided based on site	Cumulative impacts of plans in the long term.	Turbine Optimisation.	
			opportunities for co-location of other ORE technologies						technology to divert paths of migrating birds		Suitable and efficient industrial value chain	Dynamic power cables.		Decommissioning.	O&M Optimisation.	
Areas for Development																
	Advised to look at DSF. North of France more suitable for Fixed. Atlantic will be an important area for FLOW. A05 in Brittany likely to be first to be developed, with A06 in Med similar timeframe ~ 2035.	Most potential is off the south coast - south east near Wexford could be suitable for early FLOW. West cost seen as priority area by State, but may be challenging due to low accessibility. East coast has more potential for FLOW than many think - should be considered.	Expects first projects off coasts of Cork / Clare in depths of ~ 80-150 m.	South Coast the main focus for FLOW and more demand there. Utsira Nord will be first developed site. Projects will also likely develop close to O&G installations.	FLOW will start on the south coast/SW, then move towards the middle of the coast, and then to the north. South more attractive to developers - ports and proximity to Europe - but state wants projects spread out, to lower grid constraints, lower wind correlation/cannibalization.	Noted that west coast/California would be the first area to develop commercial scale floating wind projects as things stand. Expected a site should be developed here for 2030 or slightly later. East coast seen as next location for development, post-2030, by 2035. Gulf of Mexico should be the next area of development, in depths of 500-1000m, followed by Hawaii closer to 2040.	For 500MW utility scale project, we would be looking at the deeper waters on the Atlantic Coast and Gulf of Maine. No deep water leases for FLOW on th east coast. First leases on the west coast issued recently. Could have 1 - 3GW by 2030.	Northern half of Japan most important due to high wind speeds. South also has more typhoons so less desireable.	Ulsan site will be first to be developed.	First project will be in the Canary Islands - mild conditions - but it will mainly be prototypes here. North west of the North Atlantic region expected to be next and has a large site identified in the POEM	Expected floating wind to develop in the North first near Viana, then move south near Lisbon. Noted that this should be assessed versus the MSP areas released.	No large scale flow anticipated for development.	Priority areas seen as Sicily (mainly NW), then Sardinia, then the mainland (Puglia, Lazio). Projects should start to be commissioned from around 2035.	Strait of Sicilly has a number of ongoing initiatives already listed. Other areas of interest include areas in the Southern Adriatic Sea, Puglia, Sardinia (E&W), North Rome.	No zones identified for floating	First floating project expected to be a Scotwind project, with the first of those to be developed pre-2030. Celtic Sea projects expected from the early 2030s.