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RENEWABLE ENERGY INSTITUTE

Recommendations for Accelerating the Commercialization of Floating Offshore Wind Power

December 2023

Acknowledgements

In creating our recommendations, we received many suggestions from experts in related fields, including ministry officials and those involved in offshore wind projects. We would like to express our sincere gratitude for their assistance.

December 2023

Authors

The Offshore Wind team at Renewable Energy Institute

Cover Photo

About Renewable Energy Institute

Renewable Energy Institute is a non-profit think tank which aims to build a sustainable, rich society based on renewable energy. It was established in August 2011, in the aftermath of the Fukushima Daiichi Nuclear Power Plant accident, by its founder Mr. Son Masayoshi, Chairman & CEO of SoftBank Corp., with his own resources.

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The websites cited in this document were last viewed on 10 November 2023.

Introduction

In 2022, newly installed renewable energy globally reached more than 330 GW, the largest in history. Of this total, solar accounted for two-thirds. Wind power accounted for 75 GW, but in 2023, it is estimated that more than 100 GW has already been installed. The global energy transition triggered by the fossil fuel crisis caused by Russia's invasion of Ukraine is expected to accelerate further. More than 440 GW is projected to be installed in 2023, even more than in 2022, with a possible further increase to 550 GW in 2024.

On the other hand, Japan's movement toward introducing renewable energy appears to be slowing down. The cumulative installation amount at the end of 2022 was approximately 80 GW of solar power and about 4.6 GW of wind power, and the installed amount in 2022 alone was about 4.6 GW of solar power and about 0.1 GW of wind power. In particular, wind power is limited. Against this backdrop, offshore wind power development is beginning to advance little by little. In January 2023, the 140 MW Akita-Noshiro port area projects began entire commercial operation. Under the Renewable Energy Sea Area Utilization Act, the 1.7 GW in Round I, for which tender results were announced at the end of 2021, is underway, and together with the 1.8 GW in Round II, which is currently under review, 3.5 GW is expected to be operational by FY2030. Round III will also soon be open for applications. The country's "ambitious goal of 5.7 GW installation by 2030" (the "Sixth Basic Energy Plan") is likely to be reached. However, this speed and volume need to be increased.

On the other hand, the situation in neighbouring countries is different. China has already licensed over 80 GW of offshore wind projects, of which 31GW have started operations. A new bill to introduce floating offshore wind (FOW) power is about to be passed, and we will soon see proposals for several GW. Taiwan aims to start operating more than 20 GW of fixed-bottom offshore wind (FBOW) by 2035 and has been preparing to develop its GW level for FOW for some time. In South Korea, business development is progressing for over 20 GW of fFBOW and FOW projects, and in particular, the scale of its FOW development is one of the largest in the world, and the European offshore wind industry is making large-scale investments.

Japan is said to have offshore wind power potential equivalent to about nine times the current electricity demand. Approximately 90% of this vast reserve exists at depths of 50 m or more, where FOW technology is expected to be used. Of course, it is essential to expand the FBOW that is already in practical use. Still, the extent to which Japan can draw out the vast potential of offshore wind power will depend on its ability to make full-scale use of FOW technologies.

To date, Renewable Energy Institute has been involved in a wide range of projects related to offshore wind power, including visualization mapping of its business development with grid system status, organizing regional coexistence study groups and regular roundtable discussions with offshore wind business developers. Regarding FOW, we interviewed multiple operators and stakeholders and heard voices that a 3 GW/y-class market is needed for the industry to become fully operational. The suggestions for rapidity and scale expansion also apply to the fixed-bottom type.

Specifically, this report calculates the potential of FOW power for the first time in Japan and recommends a "fast track" approach. Other topics covered include formulating a roadmap, creating a predictable market that provides for grid system and port development, formulating a Maritime Spatial Planning for consensus building, and strengthening the national government’s efforts. We hope these recommendations will stimulate interest and participation in introducing FOW and help further discussions.

I. Measures to accelerate the introduction of FOW

Recommendation 1. The need for an ambitious roadmap aligned with climate goals

In March 2023, the United Nations Intergovernmental Panel on Climate Change, IPCC, released the Sixth Assessment Report Synthesis Report, stating that actions to limit temperature rise to 1.5°C would require 60% reduction of greenhouse gas (GHG) emissions (65% reduction in carbon dioxide) by 2035 relative to that in 2019, indicating the need for significant enhancement of reductions.[1]

The "Net Zero Roadmap, 2023 Update," which was published by the International Energy Agency, IEA, in September 2023, states that to achieve "net zero (emissions)" to limit temperature increase to 1.5°C, GHG emissions in 2035 must be 80% lower than in 2022 for developed countries and 60% lower for emerging and developing countries. In particular, developed countries are required to reduce emissions in the power sector to almost zero.[2] The net-zero scenario (NZE) is driven by the deployment of solar PV and wind power, with annual PV deployment of about 820 GW/year in 2030, four times the single-year deployment in 2022, and annual wind power deployment of 320 GW/year, one-third of which will be offshore wind power.

Japan is the world's fifth-largest carbon dioxide emitter and the second largest among developed countries after the United States. It has a significant responsibility as the world aims for the 1.5°C goal. However, with the level of the current measures, it will be difficult for Japan to decarbonize the power sector by 2035, as set out in the NZE. As soon as possible, there is a need to establish a roadmap with a sense of urgency that aligns with Japan's climate goals for decarbonization.

As in other countries, expanding solar power and introducing onshore and offshore wind power are crucial to decarbonizing Japan. In December 2020, the government, together with industry, compiled the "Vision for Offshore Wind Power Industry (1st)" (Vision for OW Industry)[3], which set the goal of "forming offshore wind power projects of 10 GW by 2030 and 30-45 GW by 2040." The targets for project formation, which were considered ambitious at the time, have become more modest as countries accelerate their energy transitions and reassess their targets for offshore wind power.[4] In particular, although there is a possibility that the sea area under its jurisdiction, which is said to be the sixth largest in the world and more than ten times the area of Japan, can be utilized by making full-scale use of FOW technology, there is no explicit target value for the floating type.

To achieve climate goals, at least 20 GW or more of FBOW and 10 GW or more of FOW must be in commercial operation by 2035. This goal is also the numerical value necessary to foster industry in Japan.

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[1] IPCC, AR6 Synthesis Report: Climate Change 2023, March 2023

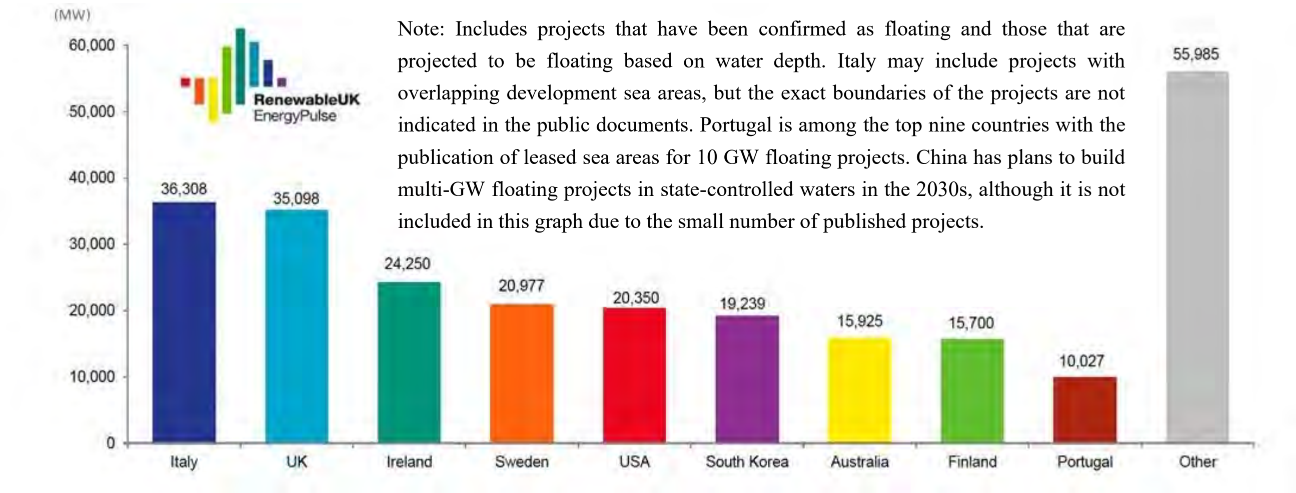
[2] IEA, Net Zero Roadmap: A Global Pathway to Keep the 1.5°C Goal in Reach 2023 Update, September 2023

[3] Public-Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power Generation, "Vision for Offshore Wind Power Industry (1st)" (in Japanese), December 2020

[4] Japan's restrained target value stems from the low number for 2050 carbon neutrality that it references. While other developed countries are trying to decarbonize their electricity sectors by 2035 with renewables as the core, Japan's target is to supply 50-60% of its electricity from renewable energy sources by 2050. Cabinet Secretariat, Ministry of Economy, Trade and Industry, et al., "Green Growth Strategy Accompanying Carbon Neutrality in 2050" (in Japanese) (June 2021).

Since major offshore wind power developers are limited to overseas countries and the industry supply chain has yet to grow in Japan, measures are needed to attract such developers to Japan. First, we need to attract investment from overseas and, simultaneously, create the soil for Japanese developers to conduct projects together with overseas developers to learn business know-how and foster domestic industry. As countries and regions worldwide accelerate their energy transition, it takes work to formulate projects that will attract foreign businesses to Japan. As for FOW, even though they are still in the early stages of use, countries have set targets for the gigawatt level for 2030-35, and developers are beginning to concentrate there (Figure 1). Even without an institutional framework, the targets and roadmaps set by governments are a major signal.

Figure 1. Global Toal Announced FOW Portfolio (MW)



Source: RenewableUK, EnergyPulse Insights: Offshore Wind June 2023 Global Edition June 2023

The world's largest FOW farm is Norway's Hywind Tampen, which began operation in August 2023 and has 8.6 MW of 11 wind turbines. Considering that it is not unusual for fixed-bottom wind power farms to exceed 1 GW per site, the scale of FOW is still tiny, and there is plenty of room for Japan to participate.

An ambitious roadmap must be created as soon as possible to bring FOW to commercial use in Japan quickly. This is not a numerical target but a year-by-year roadmap for at least 10 GW of FOW to begin commercial operation between 2030 and 2035, laying the foundation for industry. First, designate ocean areas sufficient to encourage large-scale projects and clarify the schedule for bidding and other activities in advance. By showing the scale of the project, it will become possible to attract market development outside of Japan.

At the same time, as has been pointed out in the development of other renewables, it is essential to revise Japan's unique licensing system to international standards, centralize environmental impact assessments and marine area studies to increase efficiency and speed up the process, improve rationality in the use of infrastructure such as ports, grids, and ships, and create a market where developers can engage in healthy competition.

Renewable Energy Institute has been proposing a “Fast Track to Accelerate Floating Offshore Wind Development" at a government committee and other meetings. This “fast track” should be made to function as a way to attract investments in Japan toward the industrialization of FOW.

Early start-up of commercial-scale FOW - Fast Track

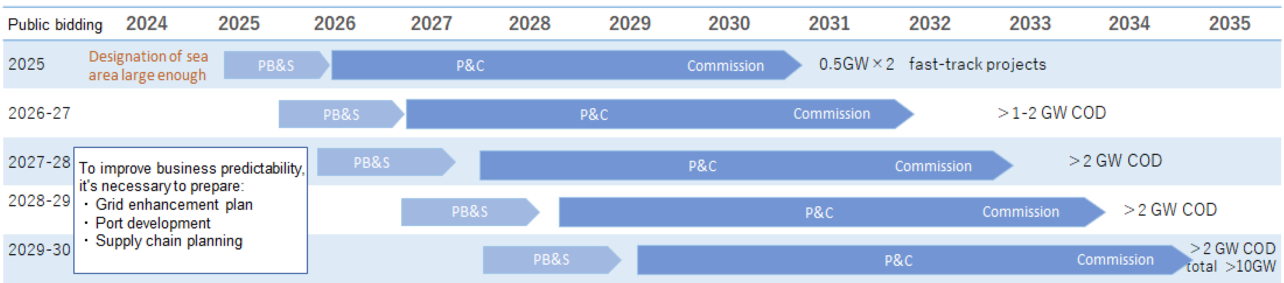
The Japanese government uses the Green Innovation Fund (GI Fund) to support the development of FOW technology, and in October 2023 announced four candidate areas for demonstration projects (Phase 2) [5] with approximately 30 MW per location. However, bidding for projects ranging from several hundred MW to over 1 GW is already being conducted one after another around the world.

In order to accelerate the introduction of FOW in Japan, it is necessary to advance procedural and regulatory reforms aimed at speeding up project formation. "Fast Track" is a proposal that aims to quickly start operations of several hundred MW projects through the application of flexible procedures and regulations, rather than technology demonstration.

Definition of Fast Track: Two 500MW FOW projects with a commercial operation date (COD) of 2030-2031 should be established within territorial waters, totaling 1GW. Once the legal system for Exclusive Economic Zone (EEZ) is in place, it is envisaged that the project would be deployed in connected EEZ sea areas and quickly expanded to 1-2 GW class projects in each area.

Japan's potential for FOW is 470 GW within its territorial waters and 952 GW if the EEZ is taken into account, assuming an annual average wind speed of at least 8.0 m/s at 140 m above the sea level and a water depth of 50-300 m. Of these, the sea area for FOW will be selected in consideration of the capacity that can be connected to the local grid and access to large ports (see Chapter 2 for details).[6] Figure 2 shows the process from the selection of the sea areas to the start of operation.

Figure 2 Fast Track (500 MW x2 projects, total 1 GW) 2030-2031COD and the further full-scale utilization by 2035



Note: PB&S: Public bidding and selection; P&C: Permitting and Construction

Source: Created by Renewable Energy Institute

[5] Ministry of Economy, Trade and Industry News Release, "Designation of promotion areas under the Renewable Energy Sea Area Utilization Act, areas subject to surveys under the centralized system and candidate areas for GI Fund (Floating Demonstration)" (in Japanese), October 3, 2023

[6] It should be noted that the agreement of the local government and fishermen operating in the area was not taken into account when identifying candidate sites.

Fast track has many advantages over small-scale projects. First, it is consistent with the developers' corporate strategy of expanding their GW-class business domestically and internationally. Wind turbine manufacturers have no choice but to place a low priority on small-number and small-scale projects. They prefer a 500MW-scale project with about 33 units of 15MW-class wind turbines, which is enough for a minimum order volume.

Implementation of fast-track is possible to flexibly operate the certification and licensing procedures necessary for the development of the FOW industry through relatively large-scale project implementation. Much of the knowledge and experience gained thus can be utilized in the system design for GW-class wind farm projects.

Furthermore, the implementation of fast-track can provide an immediate realistic response and solution to the challenge faced by the industry of developing a mass production system for the floating body portion of the project. The infrastructure and logistics development and expansion required for the installation of larger wind turbines on floating structures in fast-track projects can be effectively utilized in GW-class large-scale projects following Fast Track. The overwhelming increase in the number of data acquisition points to monitor the operational status after the start of commercial operation will enable the acquisition of a large amount of technical information, which will also contribute to future design optimization through the implementation of appropriate coupled analysis of the integrated wind turbine and floater system.

Since the fast-track projects are to be implemented within territorial waters, flexible operation of the current scheme with a view to future development of the FOW industry is key to reaping the benefits of the 500 MW class projects. Potential areas for implementation include those selected in consideration of wind conditions, systems, and ports (see Chapter 2), as well as the areas that were the subject of public solicitation in GI Fund Phase 2. In the latter case, it will be necessary to increase the size of the project to 500 MW and confirm that the grid capacity in the region is sufficient.

An important element is to design a system for fast-track that benefits first movers, and to have a large number of businesses show interest leading to successful bidding. In the current environment where the prices of major equipment and goods are rising significantly and internationally, it is also necessary to give businesses options regarding power purchase conditions. Specifically, it is possible to clearly specify the choice of FIT/FIP (possible until FY2025) and consider applying Open Book + minimum profit guarantee prior agreement. [7] Other support measures include actively utilizing the investment[8] and loan functions of Japan Organization for Metals and Energy Security, JOGMEC, and actively injecting GX funds.

Building local consensus is essential for project implementation. Constructive stakeholder coordination must begin promptly. Further cooperation from prefectural governors is essential for dialogue with fishermen who operate governor-licensed fishing operations within their territorial waters. In order to normalize this process, it

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[7] A concept in which a guaranteed profit is agreed upon in advance in exchange for the disclosure of cost information necessary for the project implementation by the project operator. One could assume that if the government can obtain information on project implementation costs in a transparent manner at the initial stage of establishing a large-scale renewable energy industry, it will contribute to the design of a fair and appropriate purchase price system through fair comparison with the cost of electricity generated from nuclear and coal-fired power plants.

[8] See Article 11, Paragraph 1 of Act on the Japan Organization for Metals and Energy Security (in Japanese) (amendment required)

would be a good idea to consider introducing part of the sea area occupancy fee and subsidies for regional power supply locations to offshore wind power as incentives, and giving them to prefectures.

Given that the government has already begun soliciting applications for participation in the demonstration project, it may be possible to give priority to developers participating in the demonstration project to allow them to transition to fast-track status. In addition, it may be possible to pre-grant the right to automatically acquire the right to occupy the EEZ sea area to be connected once the law covering the EEZ is in place. This would enable the project participants to plan the expansion and development of the project as early as possible, leading to a shorter construction period for the GW-class wind farm project.

Recommendation 2. The need for a predictable investment environment and a flexible competition mechanism

(1) Reducing business risks by dividing bidding procedures for maritime occupation rights and business support measures

Under the Renewable Energy Sea Area Utilization Act, developers are publicly invited for each promotion zone, and participating businesses submit their exclusive occupancy and use plans over public bidding that include details of the power generation project, implementation timing, electricity supply price, etc., and undergo assessment. Therefore, the successful bidder will carry out the project at the proposed supply price. After winning a bid, procedures such as various permits and environmental assessments are required, so currently it takes several years or more for a concrete plan to be finalized and an investment decision to be made. On the other hand, advances in technology related to offshore wind and changes in the market are significant, such as wind turbines becoming larger and supply chain prices changing, and the longer the lead time from determining the supply price to construction, the greater the risk of future environmental changes. This situation could reduce predictability of FOW market, leading to investment disincentives and increased costs. To reduce such risks, it is necessary to reform various procedures to shorten the period from award of bid to construction. [9] In addition, it is also possible to introduce a two-stage system that separates the selection of maritime rights holders and the determination of supply prices, deferring the latter and reducing the period from determination of supply prices to construction (Figure 3).

In the UK, the Crown Estate,[10] which manages maritime areas, designates development areas and conducts bidding for maritime occupation rights (lease rights). [11] The successful bidder for the lease right will coordinate with interested parties, identify the sea area where the business will actually be carried out from among the available sea areas, and flesh out the business plan. Applications for the business support measures by the government (Contract for Difference, CfD) are held once a year, [12] separate from bidding for maritime lease rights, and a variety of projects in multiple ocean areas apply according to the maturity of their business plans. Under such a system, developers can proceed with business development according to the characteristics of the sea area in question, shorten the period from determining supply prices to construction, and take time to engage in dialogue with the local community from an early stage. Developers operating both in Europe and in Japan have pointed out the advantages of the British system.[13]

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[9] There is also a move by the government to shorten the procedures by selected operators by implementing some of the procedures before the selection of operators. Ministry of the Environment, Study Group on the Optimal Environmental Impact Assessment System for Offshore Wind Power Generation, A New Environmental Assessment System for Offshore Wind Power Generation, (in Japanese) (August 2023).

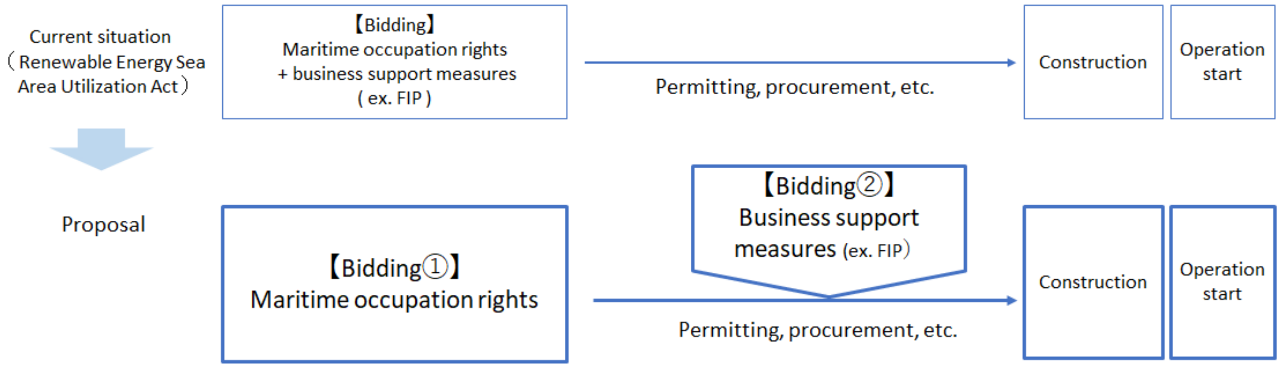
[10] The sea in Scotland is managed by Crown Estate Scotland, which also has a separate bidding process for sea area occupancy rights. Crown Estate Scotland, ScotWind leasing round.

[11] Developers that meet certain requirements, such as experience in project implementation and financial size, are eligible to participate in the bidding process. In the bidding process, after receiving confirmation of the eligibility of the project plan, bidders compete for an option price to acquire the right to occupy the sea area for 60 years after the start of construction. The developer can prepare for the project by exclusive use of the sea area for up to 10 years while paying the option fee at the winning bid price, and the option must be exercised within the same period. For an overview of other bidding procedures, see the following: The Crown Estate, Information Memorandum, Introducing Offshore Wind Leasing Round 4, September 2019.

[12] For an overview of the CfD mechanism, see: Department for Energy Security and Net Zero, Contract for Difference,

[13] Some developers recommend the "centralized system" in Denmark and the Netherlands (different from the "Japanese version of the centralized system"), in which the central government collects information necessary for development, including the conditions of wind, seabed and

Figure 3: Image of two-stage bidding system
(separation of auction for the right to occupy sea area and project support mechanism)



Source: Created by Renewable Energy Institute

Concerns that the higher bid prices that would arise if price competition were introduced into bidding for maritime rights would push up costs[14] can be addressed by setting upper limit bid prices and introducing evaluation criteria other than price.[15] Furthermore, in order to encourage operators who have won the bid for the right to occupy the sea area to start operation at an earlier date, a system in which an occupancy fee is paid according to the number of years until the start of construction or operation could be introduced, referring to the example of the UK. It is also possible to introduce a system whereby developers who fail to start operation within a certain period of time lose the right to occupy the area after the period has elapsed.

(2) Ensuring grid system enhancement for FOW – grid expantion planning and cost sharing method

The UK has plan for transmission line reinforcement within the island of Great Britain. [16] The plan contemplates the construction of high-voltage direct current (HVDC) or high-voltage alternating current (HVAC) transmission lines, or a combination of both, to the vicinity waters where offshore wind farms will be located, as well as the installation of offshore substations (Figure 4). Such studies are being carried out for candidate areas selected by the Crown Estate for offshore wind installations, with specific consideration being given to the enhancement of local transmission lines to deliver the generated electricity to the demand areas, in anticipation of potential offshore wind installation areas that may be developed in the future.

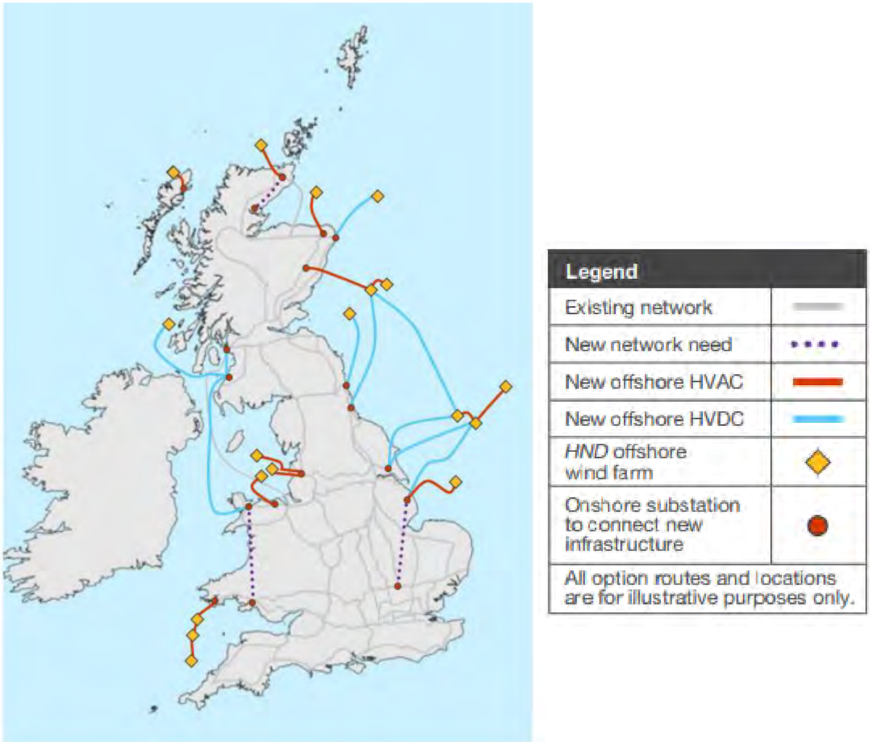
environment, as well as infrastructure development status in the sea area, and conducts tender after completing grid-connection, licensing, and other procedures.

[14] WindEurope, the European wind industry association, expressed concern over the cost increase in response to the results of the bidding process for lease rights in the UK that was opened in February 2021. In addition, the German bidding process for sea-use rights opened in July 2023 resulted in a total payment of 12.6 billion EUR for 7 GW, and the organization is calling for improvements to the system. Of the amount paid in Germany, 90% will be used to lower grid connection costs, 5% for marine nature conservation, and 5% for environmentally-friendly fishing. See: WindEurope, Latest UK seabed leasing risks raising costs of offshore wind, February 2, 2021 : German offshore auctions award 7 GW of new wind; future auctions must avoid negative bidding, July 12, 2023.

[15] The Scottish lease rights tender, whose results were announced in January 2022, set a maximum option price per ㎢. Project description, developer's experience, costs, and supply chain formation were also evaluated. See: Crown Estate Scotland, ScotWind Leasing, Seabed leasing for new offshore wind farms Offer Document April 2021 : Seabed leasing for new offshore wind farms Guidance Notes April 2021.

[16] NationalgridESO, Pathway to 2030, *A holistic network design to support offshore wind deployment for net zero*, July 2022

Figure 4. UK: Onshore grid expansion plans to support offshore wind deployment



Source: NationalgridESO, Pathway to 2030, A holistic network design to support offshore wind deployment for net zero, July 2022

In contrast, Hokkaido, which has large offshore wind potential, has an overwhelmingly lack of local transmission lines to accelerate the deployment of several GW-class offshore wind power (Figure 5). [17] The Pacific side of Tohoku, with its deep water and is compatibility with FOW, also lacks transmission lines to send several GW-level electricity to demand areas. Transmission line expansion plan needs to be developed based on the future offshore wind deployment plans. One of the reasons why onshore wind power has not expanded in Japan is that it cannot be connected to the grid due to a lack of transmission capacity. It is hoped that this situation will be solved with the development of offshore wind power and grid system. In addition, the expansion of solar power generation is currently causing widespread output curtailment in certain power areas, which is damaging investment predictability. In order to improve this situation, the reinforcement of inter-regional grid lines to send power across areas after offshore wind connection should also be expanded and accelerated.

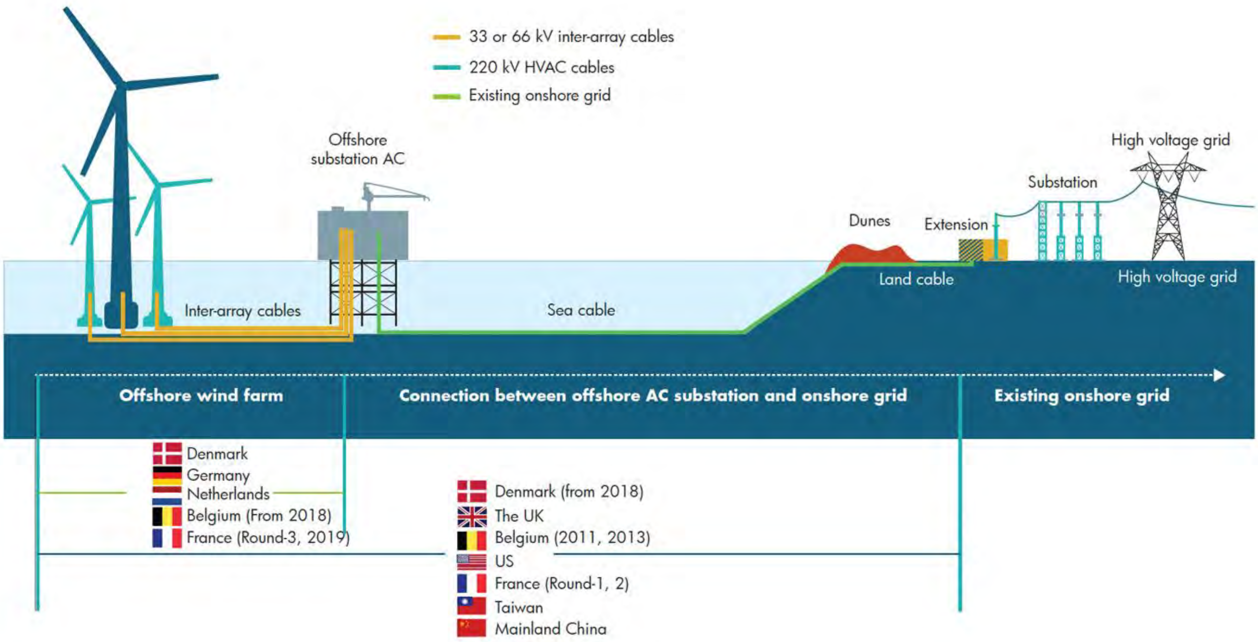
[17] Renewable Energy Institute's website, OSW Project Areas & Transmission Lines (beta version)

Figure 5. Transmission lines over 220kV in Hokkaido and Tohoku areas

Source: From Renewable Energy Institute's website "OSW Project Areas & Transmission Lines (beta version)"

Offshore wind power, not just floating, may have take-off distances ranging from a dozen km to several tens of km, or several farms may be built in a single sea area. It is therefore more reasonable for each power producer to lay submarine cables collectively, rather than individually, and for the power producers to specialize in the construction of power lines from offshore substations to offshore wind farms. Figure 6 shows the concept of responsibility sharing from offshore wind farms to onshore substations in each country. In several countries, the transmission operator installs the equipment up to the offshore substation, and the responsibility of the power producer is from the offshore substation to the power plant.

Figure 6. Grid connection responsibility in different offshore wind markets

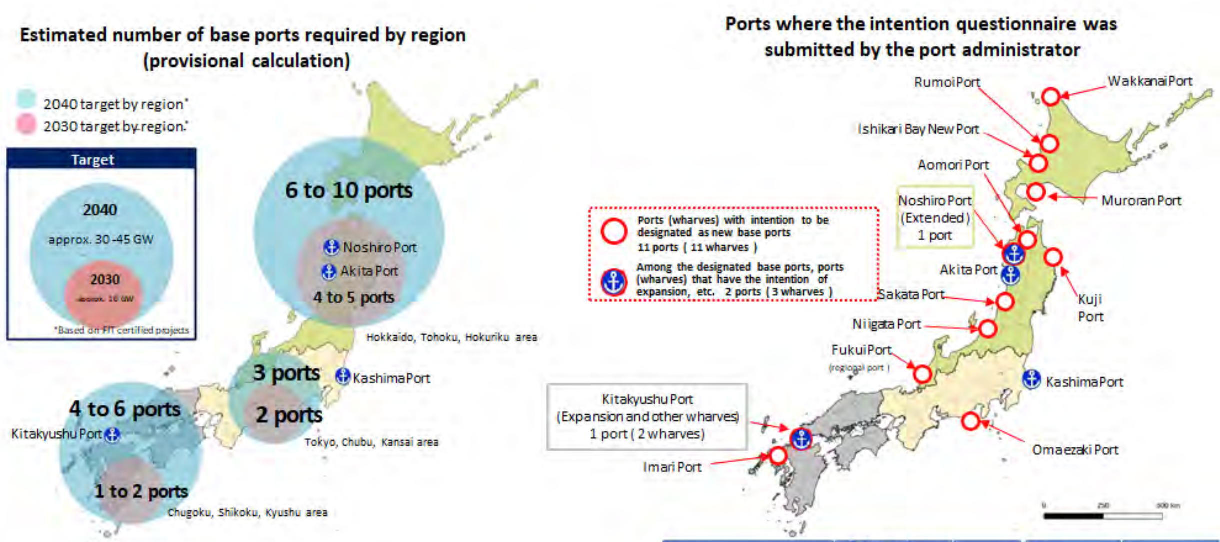


Source: Global Wind Energy Council (GWEC), Global Offshore Wind Report 2020, August 2020

(3) Transparency and clarification of port development and usage rules

Regarding the development of ports, which are essential for the introduction of offshore wind power, the Ministry of Land, Infrastructure, Transport and Tourism, MLIT, compiled a guideline for the required number of base ports in February 2022 in accordance with the targets of the "Vision for OW Industry." [18] In September of the same year, the Ministry surveyed ports (wharves) with intentions to be designated as base ports and published the results (Figure 7). [19] The ministry is also investigating the scale of supporting facilities for FOW and the number of base ports required (Figure 8). [20]

Figure 7: Survey results of ports (wharves) that intend to be designated as base ports for offshore wind



Area	Estimated number of base ports necessary	total	Designated base ports	Ports with newly expressed intentions
Hokkaido, Tohoku, Hokuriku	About 6 to 10 ports	11 ports	2 ports	9 ports
Tokyo, Chubu, Kansai	About 3 ports	2 ports	1 port	1 port
Chugoku, Shikoku, Kyushu	About 4 to 6 ports	2 ports	1 port	1 port

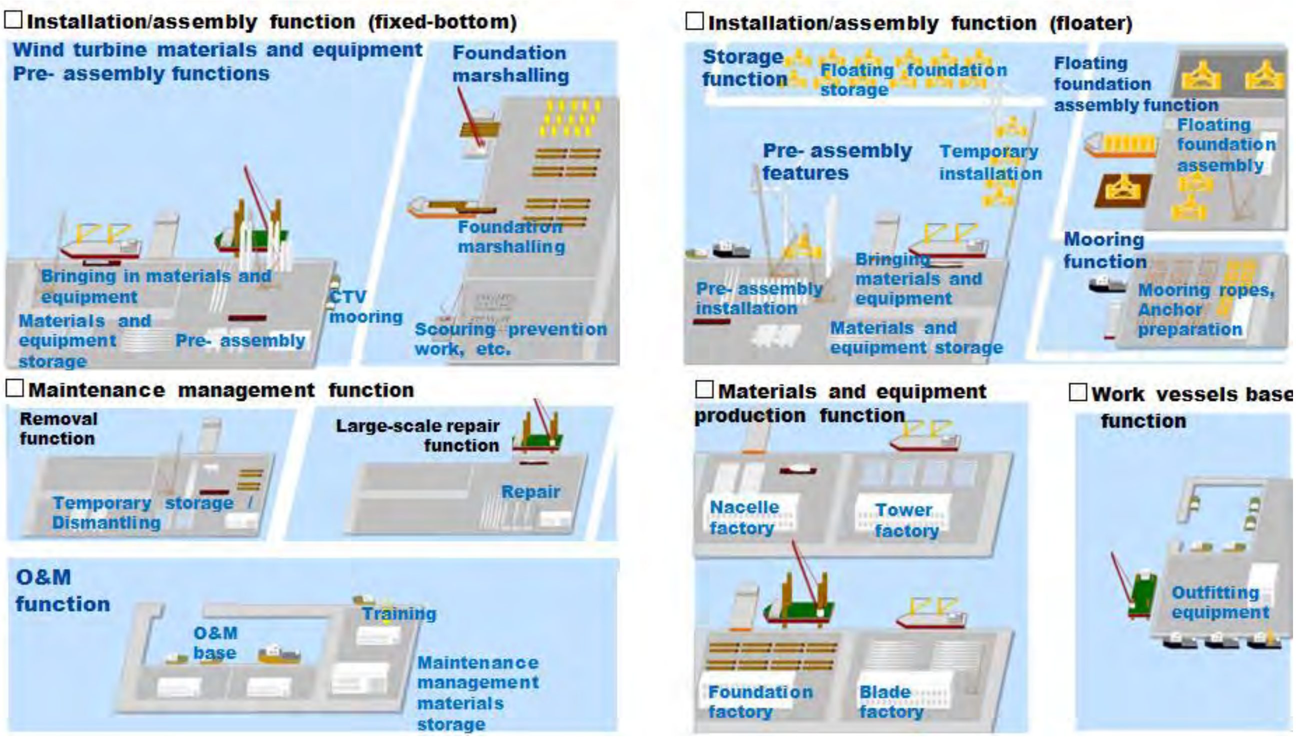
Source: MLIT, Port and Harbor Bureau, "Concerning ports (wharves) with intention to be designated as offshore wind power base ports, etc." (in Japanese), September 2022. Translated into English by Renewable Energy Institute.

[18] MLIT, Study Group on Base Ports and Harbors for Achieving Carbon Neutrality in 2050: Base Port Layout and Scale (in Japanese), February 2022

[19] Ports and Harbors Bureau, MLIT, Regarding ports (wharves) with intention to be designated as base ports (in Japanese), September 2022

[20] Ports and Harbors Bureau, MLIT, Study Group on Ports and Harbors to Promote the Introduction of Offshore Wind Power Generation (1st meeting) (in Japanese), May 31, 2023

Figure 8. Image of port functions required for offshore wind



Source: Ports and Harbors Bureau, MLIT, Study Group on Ports and Harbors to Promote the Introduction of Offshore Wind Power Generation (1st meeting) (in Japanese), May 31, 2023. Translated into English by Renewable Energy Institute.

On the other hand, as noted above, the targets in the "Vision for OW Industry," initially considered ambitious, have become more modest than those of other countries. Furthermore, there is no explicit target value for the floating type to be included in the 2040 project formation. The figures in the "Vision for OW Industry" and the "Master Plan" for the development of the backbone power grid are based on the statement that "renewable energy will account for only 50% to 60% of electricity in 2050." [21] This is the goal outlined in the country's "Green Growth Strategy for Carbon Neutrality in 2050. Therefore, there are natural limits to the infrastructure planning required for the growth of renewable energy.

The MLIT should proceed with plans and implementation for the development of base ports that will enable the operation of at least 20 GW of FBOW and 10 GW of FOW by 2035 at the very least. When formulating specific plans, priority should be given to developing ports in areas where new wind farms can be constructed at regular intervals, considering the potential of offshore wind power and plans to strengthen transmission lines.

[21] supra note 4: Cabinet Secretariat, Ministry of Economy, Trade and Industry, et al. "Green Growth Strategy Accompanying Carbon Neutrality in 2050.

Usage rules (lease contracts) also need improvement. MLIT has published a draft lease agreement for base ports. [22] According to this, the rent is calculated by dividing the total amount invested in the development of the rental property by the output of the businesses that plan to use the base port. Therefore, the total amount of loan fees ultimately borne by businesses is not fixed at the time of contract but depends on the number and output of potential businesses. In particular, if no successor operator emerges, the original contracted operator alone will be responsible for the entire amount[23] invested in the base port. The risk of such increases in business costs must be reduced as much as possible.

The cost-sharing system in which the first user of a base port bears the risk of taking the entire development cost and then coordinating with subsequent users should be abolished. From the perspective of long-term use of base ports, the system should be improved to create a fair and predictable burden among operators.[24] Furthermore, in the current situation where there are not enough base ports, construction delays for earlier users significantly impact the construction schedules for later users. To optimize the start of operations and accelerate the offshore wind introduction, the government (MLIT) should take an active role in coordinating the use of ports rather than leaving it up to developers.

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[22] MLIT, "___ Port Offshore Renewable Energy Generation Facilities Handling Wharf Lease Agreement (Draft)" (in Japanese).

[23] Examples of project costs for base port designation include 3.5 billion JPY for Noshiro Port, 9.4 billion JPY for Kashima Port, and 9.1 billion JPY for Niigata Port, which was designated as a base port in April 2023. For Noshiro Port, see the minutes of the 13th Project Evaluation Subcommittee, Port and Harbor Subcommittee, Council for Transport Policy, MLIT (in Japanese), January 23, 2020; for Kashima Port, see Kashima City, Kashima City Offshore Wind Power Project Promotion Vision [Final Draft] (in Japanese), November 2021: for the Port of Niigata, see Port and Harbor Bureau, MLIT, Designation as a Base Port for Offshore Renewable Energy Power Generation Facilities (Base Port) (in Japanese), April 6, 2022.

[24] For example, the rent could be per day and per unit area.

Considerations and recommendations: for the healthy growth of offshore wind from GWEC "Global Offshore Wind Report 2023"

The offshore wind industry market has been rapidly expanding, but it has faced difficulties in recent years. On the supply chain side, profitability has deteriorated due to soaring product prices and logistics costs, as well as rising interest rates as a measure against inflation, leading to price hikes. As a result, companies are holding off on entering smaller or slower-moving markets. There is a decision to invest in less mature markets, with a high likelihood of inadequate returns. On the development side, some companies are withdrawing from certain countries and projects, as well as unprofitable markets and auctions.

Although this situation is not desirable, it could be seen as a sign that the offshore wind industry, which is currently expanding rapidly, is experiencing "growing pains" as it progresses to its next development stage. To prepare for further expansion in the future, it is necessary to introduce policies and create a market environment that considers the development of supply chains and infrastructure.

Global Wind Energy Council, GWEC, has considered what is needed to develop the offshore wind industry going forward.[25] GWEC mentions the visualization of pipelines, the transparency and speeding up of the licensing process, and the rationalization and speeding up of grid connections, which are also mentioned in this report. This also applies to Japan, which is still in the process of market development. The following is an excerpt from the GWEC report.

> Major infrastructure sectors with high capital costs, such as energy, petrochemicals, mining, and ports, are over 100 years old and relatively mature, making them highly attractive to politicians, policy makers, regulators, and industry stakeholders. They have a clear understanding of the needs of the industry. Those sectors have also lived through significant volatility in the past. For example, West Texas crude oil prices have ranged between $17 and $120 per barrel over the last eight years—some insights into how they have coped with such an unstable price structure.
>
> - They expect volatility and build those expectations into everything they do across their value chain through hedging, risk sharing in offtake contracts, supply chain resilience and diversification, sophisticated commodities market monitoring and hedging, and so forth.
> - Contracts with buyers are often negotiated to allow for payment of higher prices to reduce price volatility. Price caps and price floors may be established to protect buyers and sellers, respectively. Contract terms vary widely depending on market conditions ('buyer's market' vs. 'seller's market'), but in most cases risk is shared between buyers and sellers.
>
> So, what is required to expand the offshore wind industry? There are several conditions for large-scale industries with high capital costs to flourish. The key to this is the role of the government. It is necessary to determine where government support is needed and could be productive, and when it is best to leave decisions and investments to the private sector.
>
> Predictability and visibility are crucial for any industry, as businesses will invest in the supply chains and develop projects when they know there is going to be a relatively constant flow of projects.

[25] GWEC, Global Offshore Wind Report 2023, August 2023

Reasonable returns are an important factor in any industry. Businesses want to make a reasonable return for their shareholders. The higher the risk, the higher the return expected, hence a balanced approach to risk sharing is essential to ensure affordability. There is always a tension between investors, who seek reasonable returns, and governments who desire low prices - through approaches such as reverse auctions - and energy security (it is uncertain whether auctions will achieve this). Therefore, a compromise is required.

The project's route to market needs to be secured. Which permits are required and who will provide them in order to obtain a business license in a reasonable amount of time? Are there options for monetization through auctions, business-to-business PPAs, or other means clear? Is grid planning sufficiently advanced to provide clarity on when the grid will be ready to connect to a project? Consideration of these questions can help create a clear route to market.

Infrastructure and labor availability are also essential. Offshore wind needs grids, ports, transport corridors and supply chain facilities, as well as a skilled and trained workforce to build, operate and maintain wind farms. If these are not available, a plan of implementation with reasonable government support and planning is an alternative. It is also necessary to ensure that the plan includes an option for private investors to provide the capital.

A bankable offtake mechanism is needed. It is important to be able to provide a viable offtake mechanism/contract/PPA that allows projects, whether they are of utilities, companies, or others, to access international financing without undue risk of default, counterparty risk, curtailment, or other risks.

If governments want to encourage wind and other renewables and storage technologies to meet net zero and other commitments, they may need to provide tangible incentives to attract investment. The U.S. Inflation Reduction Act, other incentive mechanisms, and the role of REPowerEU could be considered. On the other hand, what happens if every country unrolls an industrial policy package on the scale of an IRA? The incentive for the public and private sectors to cooperate, rather than compete, for investment in resources and supply chains could be lost.

Given the "public good" nature of wind energy and its crucial contributions to a just energy transition, governments of various countries should cooperate and focus on incentive-based approaches that promote market growth rather than promoting policies that may discourage cooperation, such as prescriptive policies and strict local procurement requirements.

Collaboration across the board - between industry and government, OEMs and developers, governments across and within regions, within supply chains - will increase common understanding, build trust, encourage technology transfer and the efficient flow of resources. It will also harmonize approaches to market development, risk sharing in the value chain and investment protocol. All of these outcomes will help to advance the growth of offshore wind at the pace and scale required to meet net-zero commitments and deliver the global energy transition.

Recommendation 3. Strengthening of national efforts for consensus building and regulatory reform

(1) Establishing a framework for building consensus with stakeholders - Formulation of Marine Spatial Plan

To accelerate the identification of development sea areas, it is essential to build consensus among interested parties including prior users of the sea area. The use of the sea includes industrial uses such as fishing, shipping, tourism, communications, and other energy development, as well as for national security and defense. At the same time, the protection of the marine natural environment is an urgent issue from the perspective of ensuring biodiversity.[26] As the importance of each use increases, it is necessary to decide which ocean areas should be used and how, while protecting the marine environment and considering the cumulative effects of multiple uses across the board. This is the role of the national government, which can oversee and decide policies in an integrated manner.

The role of the national government will become increasingly important in the development of FOW, which is expected to be developed on a large scale offshore and in EEZs, and where the fishery operators involved are spread across a wide range of fisheries operating under governor's and minister's permissions. It is difficult for prefectures alone to identify a wide range of stakeholders and coordinate the use of sea areas across prefectural borders, not to mention EEZs that are beyond the authority of prefectures.

More than 100 countries and regions around the world are already working on Marine Spatial Planning, MSP,[27] which is a management and utilization plan[28] which aims for comprehensive ocean management and sustainable use of diverse resources. The EU has required each country to develop their MSP since 2014, and the benefits of developing such a plan are said to include reducing conflicts of interest, improving the predictability of investments, and protecting the environment. Spain has identified potential offshore wind development areas through MSP in order to realize its offshore wind roadmap, which was decided in December 2021. [29] In the US, many states have also developed their own MSPs. [30]

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[26] At the G7 Summit in 2021, Japan pledged to conserve at least 30% of its terrestrial and marine areas by 2030 ("30 by 30"), together with other major countries, in order to halt biodiversity loss. As of 2021, the conservation area of the sea in Japan is 13.3%. Ministry of the Environment, Secretariat of the 30 by 30 Alliance for Biodiversity, Natural Environment Planning Division, Nature Conservation Bureau, "30 by 30" (in Japanese).

[27] Intergovernmental Oceanographic Commission, UNESCO, State of the ocean report 2022: pilot edition, 2022, p.28

[28] Third Basic Plan on Ocean Policy, May 2018, p.104

[29] supra note 25: GWEC, Global Offshore Wind Report 2023, p.19

[30] In the US, there are plans for waters across several states, in addition to the plans in individual states of Hawaii, Massachusetts, New York, Rhode Island, Washington, and Oregon.

The methods and contents of MSP vary from country to country, [31] but one of the most important aspects is the participation of stakeholders in each procedure. Information on ocean use should be aggregated and made easily accessible to stakeholders. Information is to be shared widely from the early stages of the planning process to make procedures transparent and provide opportunities for participation.

Policies related to the use of the sea are diverse, both in terms of related ministries and stakeholders, and it is anticipated that a certain amount of time will be required to coordinate these policies. However, by sharing the future vision toward 2050 among the parties concerned, future coordination will be facilitated, and efficiency and cost reduction in achieving each policy goal will be expected. For the private sector, it will improve the credibility and predictability of policies, leading to more future investment. The Japan's MDA Situational Indication Linkages, so called MSIL, have already provided a variety of information on the oceans online, serving the basis for discussion. The national government (Cabinet Office), together with relevant ministries and agencies, should initiate specific discussions toward the formulation of a MSP and begin its development.[32]

With the current demand for accelerated offshore wind power development, it is not appropriate to wait until the completion of the national MSP to develop offshore wind power. The Cabinet Office or the Agency for Natural Resources and Energy, ANRE, should identify and publicize as soon as possible the sea areas that are sufficient for the installed capacity expected to start operation by 2035 in consideration of the potential (formulation of a regional version of MSP). In doing so, it goes without saying that identification of stakeholders and securing opportunities for their participation should be carefully promoted.

Furthermore, in the Fourth Basic Plan on Ocean Policy, the government positions efforts to designate areas under the Renewable Energy Sea Area Utilization Act as a form of MSP. However, when this is compared with the international guidance on MSP, it is pointed out that there is room for improvement from the perspective of stakeholder participation (see Appendix below). [33] Based on this plan, the government (Cabinet Office and ANRE) should proceed with improving the operation of sea area designation under the Renewable Energy Sea Area Utilization Act. At the same time, efforts should be immediately launched to promote the appropriate use of multiple sea areas.

[31] For a guide to the development of Marine Spatial Planning, see United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Oceanographic Commission (IOC), Marine spatial planning, *A Step-by-Step Approach toward Ecosystem-based Management*, 2009. An overview in Japanese is provided in the following: The University of Tokyo Ocean Alliance, "Guidelines for the Consensus Building Process for Ocean Use" (in Japanese), October 2017, Appendix A.

[32] The Fourth Basic Plan for Ocean Policy (in Japanese) (p.50) states, "With regard to Marine Spatial Planning, of which there are examples of introduction in other countries, efforts will be made to understand its actual status" (omitted) "and then, its deployment to other individual issues in the Exclusive Economic Zones, etc., and its application to the complex marine area use will be examined. (Cabinet Office, Ministry of Foreign Affairs, Ministry of Agriculture, Forestry and Fisheries, Ministry of Land, Infrastructure, Transport and Tourism)".

[33] Eka Higuchi, Validity of domestic legal system for sustainable utilization of the marine space: from the perspective of the international guidelines for marine spatial planning, Journal of Koeki Studies, Vol. 21, No. 1 (in Japanese), 2021, pp. 13-21.

(2) Shortening lead time and developing technical standards for FOW

Offshore wind projects are required to handled approval procedures and coordination across multiple ministries and agencies, namely, the Ministry of Economy, Trade and Industry, METI (tender, electricity business operation, financial support based on the Renewable Energy Special Measures Act, etc.), MLIT (tender, marine area occupancy permits, seabed surveys, etc.), and the Ministry of the Environment, MOE (environmental impact assessment, etc.) , the Fisheries Agency (fisheries-related), and the Ministry of Defense (exercises, defense facilities, etc.), making procedures related to lead time complex and inefficient.

By unifying the point of contact at the METI, procedures can be streamlined and made more efficient, and the role and responsibility of the government can be clarified and made more transparent from the perspective of businesses, local communities, and stakeholders. For the national government, it is also possible to centrally manage the progress of procedures through a single point of contact and to confirm and monitor the entire progress of permitting procedures, thereby establishing a system to eliminate duplication, identify regulations that are bottlenecks in the procedures, and make prompt improvements. Streamlining can also be aided by actively promoting digitalization.

At the same time, it is necessary to strengthen the national government structure to implement such a government role. The UK and the EU are also focusing on shortening lead times to accelerate offshore wind deployment.[34]

When constructing a power plant, it is required to comply with the technical standards set forth in the Electricity Business Act, the Port and Harbor Act, and the Ship Safety Act (for FOW) (Figure 9). METI and MLIT set the content of the standards according to the laws under their jurisdiction.

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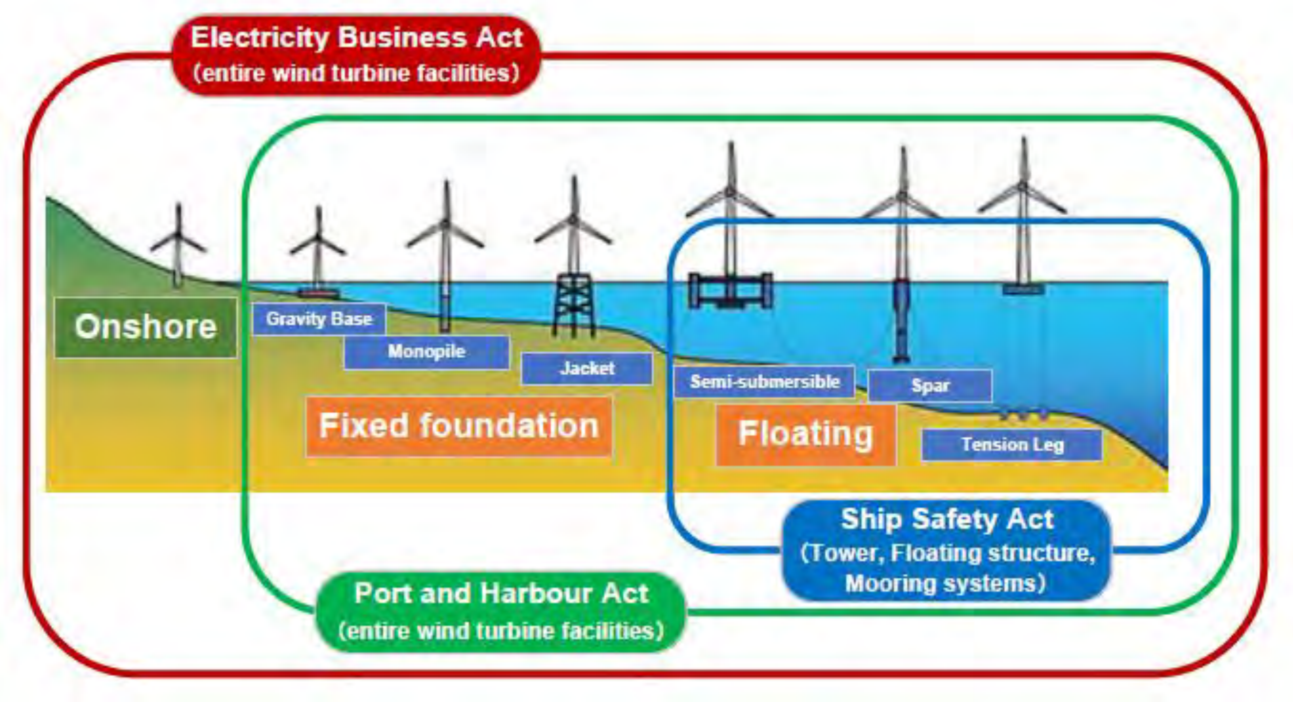
[34] UK：British Energy Security Strategy, April 2022

Europe：Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources, Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency (18.5.2022), COMMISSION RECOMMENDATION of 18.5.2022 on speeding up permit-granting procedures for renewable energy projects and facilitating Power Purchase Agreements

In addition, the International Renewable Energy Agency (IRENA) and GWEC have recommended various reforms to expand offshore wind deployment. Specifically, they have the following eight: (1) one-stop shop (a single contact point), (2) stakeholder consultation, (3) capping of lead time (about 3 years), (4) training for digitization, (5) digitized and searchable database, (6) alignment of land and ocean use, (7) emergency mechanism for quick dispute resolution, and (8) clear and consistent regulations. IRENA, GWEC, Enabling frameworks for offshore wind scale up: Innovations in permitting, September 2023

Figure 9. Technical standards set forth in the Electricity Business Act, the Port and Harbor Act, and the Ship Safety Act



Source: Created by Renewable Energy Institute, based on ClassNK, Wind Turbine Certification and Related Services, August 2021

International standards (IEC) and international certification systems are used to evaluate conformity to technical standards, but there are also unique evaluation standards that take into account Japan's geology, weather, and ocean conditions.[35] In addition, technologies and materials that have not been used in Japan before, such as the floating structures that form the foundation of FOW turbines and the synthetic fiber mooring ropes, are currently in the process of being tested in Japan and new standards are being established.

This situation could create a gap with international markets that are ahead in the manufacture, installation, and operation of wind turbines and floating structures, and could hinder development using internationally established technologies at reasonable cost and timeframes. In addition, with other countries raising their offshore wind deployment targets, and with the current situation pointing to supply chain manufacturing capacity as a potential bottleneck to accelerated deployment, it is easy to foresee how this could reduce the attractiveness of the Japanese market and slow the development of offshore wind in Japan.

Furthermore, conformity assessment of technical standards based on the Electricity Business Act, Port and Harbor Act, and Ship Safety Act are conducted by the registered bodies specified by each act, but some of them conduct assessments using advisory panels, which takes a long time. The number of registered bodies under the acts concerned is currently limited to one or two, respectively, becoming a bottleneck in the process.

[35] Furthermore, steel and other materials must be JIS-certified or individually inspected by METI's Electric Power Safety Division, etc.

Overseas, although it varies from country to country, international standards are being utilized to the maximum extent, and national technical standards are being aligned with international standards. At the same time, conformity assessment of technical standards are being streamlined by utilizing the international mutual recognition system of certification bodies that conform to international standards. Japan is also participating in the formulation and discussion of international standards, and should further promote the use of international standards and the international mutual recognition.

Specific points for improvement include the following.

First, it is important to use the internationally adopted IECRE OD-502 ED1 (2018) as the technical standards. Conformity assessments under the Electricity Business Act, Port and Harbor Act, and Ship Safety Act are required to be unified to those conducted by registered conformity verification bodies under the Electricity Business Act. Additionally, registered conformity verification bodies need to make efforts to publish the format of the application form that electric utilities submit when applying for certification, as well as sample entries for model plants. By implementing these measures, the assessment process will be streamlined and the time required for application and assessment will be shortened.

Furthermore, international mutual recognition should be utilized with certification bodies that are already certifying floating projects in South Korea, Europe, and the United States. By doing this, it will become possible to utilize the international certification process and improve efficiency.

Finally, it is important to urgently establish a positive list of steel materials, concrete materials used in the foundations of FOW power generation facilities, and synthetic fibers used in mooring lines. This makes it easier to select appropriate materials, and it is expected that conformity assessment will proceed efficiently.

(3) Improvement and simplification of offshore worker immigration control and vessel entry/exit procedures

Offshore wind development requires many different types of vessels for construction and maintenance. With the rapid technological innovation and increasing size of wind turbines, the ships needed, such as module ships for transporting parts and Wind Turbine Installation Vessels, WTIV, [36] and DP vessels[37] for fixed-bottom type construction, are also becoming larger. Although some have begun to be built in Japan and put into use, many of these specialized large vessels are operated in Europe. Since it is not realistic to build and operate all appropriate-sized vessels in Japan, the development of FOW power requires the rapid procurement of foreign-flagged vessels at a reasonable cost.

However, the regulation commonly known as the "cabotage rules"[38], which stipulates that the transportation of domestic cargo or passengers in territorial waters should be entrusted to vessels of national registry subject to the jurisdiction of the home country, in principle prevents the operation of foreign-flagged vessels. Currently, the proposed solution is to operate ships under a special permission issued by MLIT, or to have them registered in Japan.

Of these, the approach to get special permissions issued by MLIT is time-consuming because a special permission application is required for each individual navigation. Furthermore, the actual situation and specific requirements for special permissions have not been clarified, such as how many special permissions have been granted and for what kind of content, making it difficult to respond to the application process.

The process and requirements for changing a vessel's Japanese registry are not clear, and if a vessel's registry is changed, the vessel should be primarily used in Japanese waters, which is a hurdle for European and foreign offshore construction companies. In addition, the crews of Japanese-registered vessels must have a Japanese maritime license. The risk of entrusting the vessel to Japanese nationals unfamiliar with its operation also makes it difficult to change the ship's registry.[39] Furthermore, there are few Japanese with construction skills, and the majority of the workers are likely to be foreign nationals. Even if a ship is registered in Japan, it must call at a foreign port every certain period of time if it has foreign crew members or workers on board. Currently, the "60-day rule,"[40] which is said to be in light of purport of the Immigration Control and Refugee Recognition Act, is applied, but having to leave the country in the middle of the work is extremely inefficient in terms of schedule execution and cost.

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[36] In Japanese, WTIV is often called Self-Elevating Platform, SEP. It is used to transport the foundation and parts of the wind turbine to the installation site, and to perform installation work of foundation and wind turbine.

[37] A ship equipped with a device called Dynamic Positioning System that automatically controls the ship's position and heading using various sensor information.

[38] Article 3 of the Ship Act provides as follows: Only Japanese vessels may call at closed ports or transport goods or passengers between Japanese ports. However, this does not apply if a law or treaty provides otherwise, or when attempting to avoid marine casualties or capture, or when patented by MLIT.

[39] RWE Renewables Japan LLC, Issues in promoting offshore wind power (in Japanese), presented in the 16th meeting of Cabinet Office Comprehensive Inspection Task Force on Regulations Related to Renewable Energy, etc. September 21, 2021.

[40] Michio Aoki, Maritime Law in the Reiwa Era (23): Expectations and issues for the expansion of floating offshore wind power in Japan, and three issues including whether or not the Maritime Law is applicable (in Japanese), Nippon Kaiji Shimbun, March 30, 2023 (registration required)

As Japan continues to strictly apply cabotage rules, major overseas offshore wind industries may build offshore wind-related plants in other Asian countries near Japan to avoid the regulations, and processes and use of base ports that would normally take place in Japan's territorial waters may also be based overseas.

Specific measures for solving these problems, include the following.

Regarding the issue of ministerial special permissions, one possibility is to clarify the applicable requirements and at the same time establish "special permission" or "special zone" covering the entire designated sea area so that work vessels can function adequately.

With regard to the issues of ship registration changes and foreign sailors and workers, measures such as expanding the "60-day rule" to 120 days, along with measures to ease the qualifications of foreign sailors and workers, should be implemented.

If these measures were to be applied only to work vessels involved in offshore wind development in particular, it would be possible to adhere to the original purpose of securing national security while reasonably accelerating the development of offshore wind power and encouraging investment in Japan.

(4) Market design to maximize the use of electricity derived from offshore wind

The large amounts of electric power provided by offshore wind would not only replace the supply for the traditional demand that has been met with electric power derived from fossil fuels but would also have a wide range of uses, including supplying for new electricity demand (EVs, etc.), storing energy through hydrogen production (green hydrogen), and using green hydrogen in industries where decarbonization through electrification is difficult.

Demand for electricity derived from renewable energy is increasing in Japan, too. There are 84 Japanese companies (20% of the total 420 member companies) participating in the international initiative RE100.[41] However, the utilization rate of renewable energy-derived electricity by Japanese companies is considerably low compared to other major countries in the world (Table 1).

[41] RE100 is a global initiative of corporate consumers aiming to procure 100% renewable electricity. https://www.there100.org/

Table 1. Utilization rate of renewable energy-derived electricity by RE100 member companies in major countries (2021)

Country	Number of member companies (Head office location)	Number of member companies (Project implementation)	Power usage (TWh/year)	Renewable energy ratio
US	94	221	105	68 %
Japan	66	173	28	15 %
UK	46	183	12	99 %
Germany	15	165	12	85 %
China	6	211	30	32 %
Global	334	334	376	49 %

334 companies responded. Based on data from RE100 annual disclosure report 2022

Source: Renewable Energy Institute, Corporate PPA Practice Guidebook - Procurement methods of electricity with additionality- 2023 Edition (in Japanese), July 2023.

Companies around the world that are promoting decarbonization are demanding that their supply chains use renewable energy, which is a key means of decarbonization. Those that do not make progress in this area will be excluded from doing business with these companies. These companies will exit areas where the use of renewable energy cannot be advanced. If the situation in Japan continues to make it difficult to procure renewable energy within the country, Japan will be hit by a hollowing-out of industry.

Under these circumstances, offshore wind power is attracting attention. There is an urgent need to build a market where electricity and energy derived from offshore wind power can competitively reach consumers. Japan's current market, where carbon dioxide emissions are not properly assessed and existing power plants receive preferential treatment, requires further reform.

Although Japan has finally decided to introduce "carbon pricing," the emission quotas trading system proposed by the GX (Green Transformation) Strategy is voluntary, both in terms of participation and the setting of reduction targets. The effectiveness of this system is questionable, as the "emission quotas" trading will be phased in starting in FY2033, targeting only the electricity sector. The introduction of a carbon tax will be implemented as late as FY2028, and will only begin at a low level for fossil fuel importers and other entities.[42] It is essential to immediately introduce carbon pricing that is effective in reducing carbon emissions.

[42] METI, Environment and Economy Office, Towards the promotion of green transformation – Focusing on growth-oriented carbon pricing (in Japanese), May 29, 2023

Wholesale electricity market rules also need to be changed to allow formation of market prices that reflect appropriate fossil fuel costs and carbon prices, and determination of supply on a merit order basis. At the same time, the grid must be strengthened to enable such power supply. The review of the current "priority dispatching rule" and the elimination of unlimited curtailment of renewable electricity generation caused by "Non-firm access" are urgent issues. Unlimited curtailment reduces the business predictability for operators and has a significant impact on investment decisions. For this reason, for example, the introduction of compensation mechanism for the curtailment of more than 5% should be considered.

The number of consumers in Japan who conclude corporate PPAs to purchase electricity derived from renewable energy sources under long-term contracts is rapidly increasing. These consumers are looking for renewable electricity with additionality being effective in mitigating climate change, as well as price stability that is unaffected by fossil fuel import prices. Most of Japan's corporate PPAs are currently with electricity generated by solar PV, but there are growing expectations for offshore wind, which has great potential for dramatically expanding corporate PPAs in the future. To promote corporate PPAs for offshore wind, in addition to the generation cost reduction of offshore wind, the FIP mechanism should be revised to enable hedging against the risk of premium fluctuations.[43]

[43] Under the current FIP mechanism, the premium is affected by the previous year's market price, so it is not possible to bridge the gap between the actual market price and the FIP reference price. In the case where the FIP standard price is high (30 JPY/kWh), it is assumed that the decrease in income will be large when the market price rises (ANRE, Towards the start of the FIP system (in Japanese), February 14, 2022). There are two types of corporate PPAs: physical PPA (a contract that covers electricity and environmental value as a set) and virtual PPA (a contract that covers only environmental value). It is common for physical PPAs to have fixed contract prices, but offshore wind power generation has high power generation costs and the risk of premium fluctuations, making it difficult to apply the same fixed price as solar power. Even in virtual PPAs, consumers are exposed to the risk of premium fluctuations, so effective measures (such as hedging by purchasing electricity from the market) cannot be implemented with premiums that are not linked to actual market prices.

II. The potential of FOW and the possibility of accelerating its introduction in Japan

1. Potential of FOW

Japan's maritime jurisdiction, including its exclusive economic zone (EEZ), is vast. Its area is approximately 4.47 million km^2, making it the 6th largest in the world.[44] This is more than 10 times the size of the land, and FOW power, which can operate at deep water depths, is an important renewable energy resource that can be used on a large scale in the seas surrounding Japan. A study by the Ministry of the Environment calculated that there is a potential to install 783 GW of FOW power in areas with a distance of up to 30 km from shore, a water depth of 50-200 m, and a wind speed of 6.5 m/s or more, excluding national and quasi-national parks.[45]

The world is moving toward deeper waters, and as of 2023, the world's deepest floating offshore installation area is 300 m,[46] but the auction of offshore lease rights off the coast of California in the US, conducted in 2022,[47] includes areas with water depths deeper than 300 m. This means that there may be more locations for FOW in the relatively deep waters around the Japanese archipelago. Therefore, we decided to conduct a new analysis using publicly available wind data[48] and bathymetry data[49] to examine the potential of FOW in Japan.

Table 2 shows the calculation conditions.

Areas where feasibility would be difficult, such as areas with water depth of more than 1,000 m in the submarine cable laying route, are excluded. A roter swept area (wind receiving area) of the wind turbine was assumed to be 3.0 m^2/kW, this means that the rotor diameter is expected to be 196 m for 10 MW class, 240 m for 15 MW class, and 277 m for 20 MW class. The installed wind power generation capacity per unit area is assumed to be 8 MW/ km^2, which varies depending on the number of wind turbine arrays relative to the main wind direction, but assumes an arrangement of 10 rows and a margin in the orthogonal direction. This is equivalent to installing a maximum of 53 wind turbines of 15 MW class in a 100 km^2 (10 km x 10 km) sea area.

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44 National Ocean Policy Secretariat, Cabinet Office, Results of Survey and Confirmation of Sea Areas under Japan's Jurisdiction (Published on February 2, 2020) (in Japanese)

45 Ministry of the Environment, Commissioned work report on the preparation and publication of basic zoning information, etc. related to renewable energy in FY2019 (in Japanese).

46 Equinor Hywind Tampen

47 US Department of the Interior Press Release, "Biden-Harris Administration Announces Winners of California Offshore Wind Energy Auction", December 7, 2023.

48 National Research and Development Agency New Energy and Industrial Technology Development Organization (NEDO), NeoWinds (offshore wind conditions map) (in Japanese).

49 Japan Oceanographic Data Center (JODC), 500m Gridded Bathymetry Data (J-EGG500)

Table 2 FOW potential calculation conditions

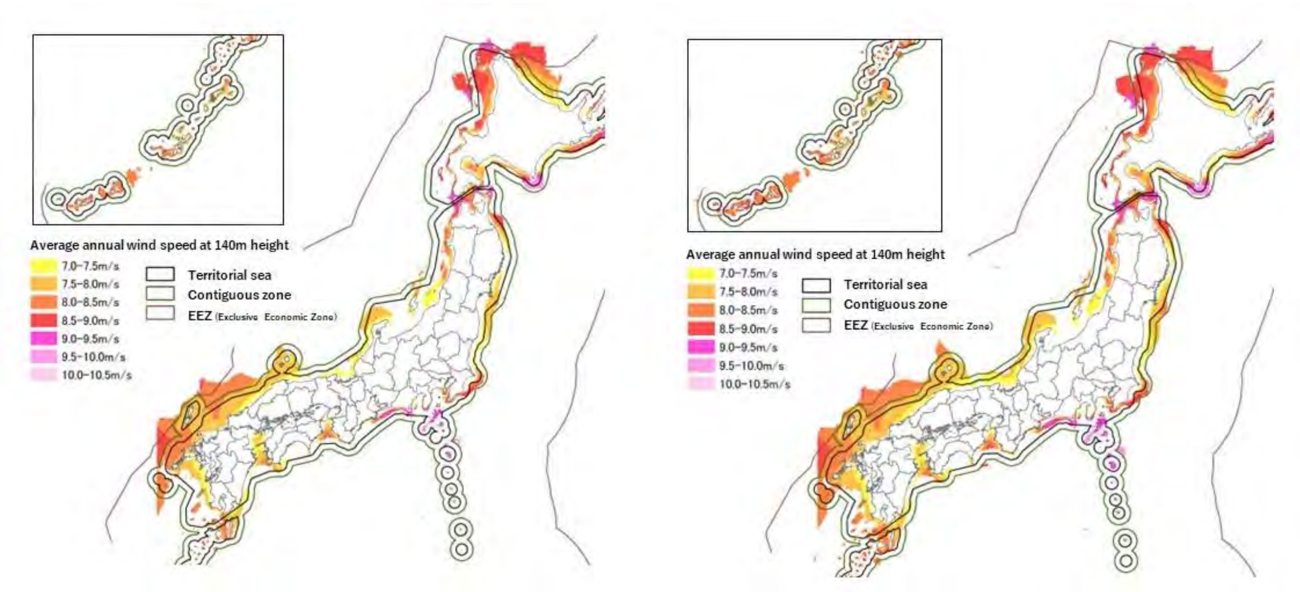
	Case 1 (water depth less than 200m)	Case 2 (water depth less than 300m)
Wind conditions	Annual average wind speed of 8.0 m/s or more at 140 m above sea level	
Water depth	50m or more, less than 200m	50m or more, less than 300m
Wind turbine	Roter swept area $3.0m^2/kW$	
Installation capacity	$8MW/km^2$	

Source: Created by Renewable Energy Institute

Figure 10 and Table 3 show the potential calculation results for FOW across Japan.

The left side of the potential map in Figure 10 shows Case 1 (water depth less than 200 m) and the right side shows Case 2 (water depth less than 300 m) shown in Table 3. For both areas below 200m and 300m depth, the potentials within the territorial waters account for about half of the total potentials including EEZ's. It was also found that the areas within 24 nautical miles from the territorial sea baselines, called contiguous zone, also account for more than 70% of the total potential including EEZ's. While it is important to consider the development of FOW in EEZ, it is expected that it will first to be developed within the territorial sea or to the extent that it is within the contiguous zone.s This study found that even within that range, there is potential for at least 500 GW or more.

Figure10. FOW potential map
(Left: Case 1, Right: Case 2)



Source: Created by Renewable Energy Institute. The outer boundary of the territorial sea was prepared based on the Japan Coast Guard's MSIL and the website, "Conceptual Map of Japan's Territorial Sea and Other Areas"(in Japanese).

Table 3. FOW potential calculation results

	Case 1 (Water depth 50m or more, less than 200m)	Case 2 (Water depth 50m or more, less than 300m)
Within territorial waters only (12 nautical miles*)	381 GW	470 GW
Territorial sea + EEZ contiguous zone only (24 nautical miles*)	542 GW	690 GW
Territorial sea + EEZ (200 nautical miles*)	733 GW	952 GW

*Distance from the baselines of territorial sea

Source: Created by Renewable Energy Institute

2. Candidate sea areas for the start of FOW operation by 2035

In order to achieve "at least 10 GW of operation by 2035," as indicated in Recommendation 1 of this report, the existing grid and port facilities need to be utilized to the maximum extent possible.[50] Therefore, it was decided to select candidate offshore areas for the introduction of FOW power over the next 10 years based on the selection criteria shown in Table 4.

Table 4 Conditions for selecting candidate offshore areas for FOW aiming to start commercial operation by 2035

Conditions for Selection of Candidate Sea Areas
1. There must be a transmission line of 500kV or 200kV or more with available capacity and a substation in the vicinity of the candidate sea area. 2. There must be a certain size of port in the vicinity of the candidate sea area. 3. A certain level of business feasibility is expected (average annual wind speed of 8.0 m/s is expected and the water depth is less than 200 m).

Source: Created by Renewable Energy Institute

The results are shown in Figure 11 and Table 5.

The 10 sea areas circled in green in Figure 11 satisfy the selection criteria in Table 4. Two areas in Hokkaido, two areas in Aomori prefecture, and one area each in Fukushima, Aichi, Wakayama, Fukuoka, Nagasaki, and Kagoshima prefectures were identified as candidates. The figures next to the prefecture names represent the capacity of FOW power[51] that could be installed in the next 10 years, and are the smaller of the potential value obtained from the grid capacity in the vicinity of the area or the total area of the installable sea areas.

[50] Such infrastructure facility enhancements generally require time in the order of 10 years. While it is necessary to proceed with future enhancement plans now, it is essential to use existing facilities in order to construct offshore wind farms and connect them to the grid without disturbing the realization of the target in the immediate year of 2035.

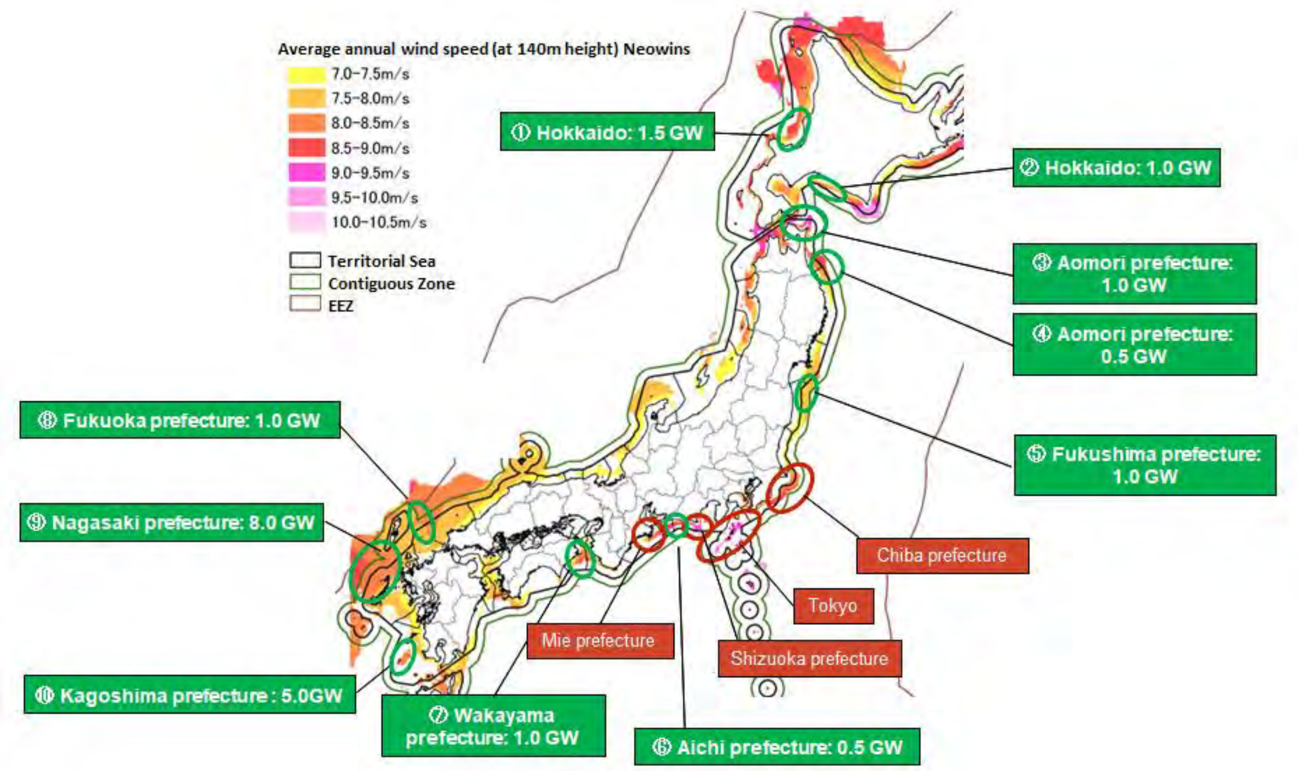
[51] These figures are based on the selection criteria and have not gained local consensus, etc.

Note that the power generation capacity described here does not consider the capacity limit of the inter-regional connection lines. For example, if 2 GW of FOW is installed in the Hokkaido area and 14 GW in the Kyushu area, it can be imagined that curtailment would occur frequently due to the facility constraints of the inter-regional connection lines, but this point is not considered.

Therefore, the candidate sea areas where only the installation of transmission lines into the sea area of FOW and no need to consider the reinforcement of inter-regional connection lines are separately shown circled in red. Specifically, those candidate sea areas are the Pacific side of Chiba prefecture, the Izu Islands in Tokyo, off the coast of Omaezaki in Shizuoka prefecture, and the Pacific side of Mie prefecture.

In particular, for example, the Pacific side of Chiba prefecture and the area around the Izu Islands in Tokyo have relatively good wind conditions, and are expected to be able to utilize the power in the demand area of Tokyo, if only a transmission line to land is constructed. The offshore area off Omaezaki in Shizuoka prefecture has not been determined to meet the selection criteria in Table 4 because the available capacity of the Hamaoka Nuclear Power Plant transmission line has not been specified, but if a connection to the transmission line was possible, it would be treated in the same category as the candidate sea area in the green circle.

Figure 11 Candidate areas for the introduction of FOW over the next 10 years with the aim of starting commercial operation by 2035



Source: Created by Renewable Energy Institute

Table 1 Results of evaluation of candidate sea areas based on the selection criteria

Prefectures	Average wind speed	Water depth	Maximum installation area (approximate)	Potential (estimate)	Major nearby ports	Candidate grid to connect	Installed grid capacity	Available grid capacity	Candidate connecting substations, etc.
① Hokkaido	8.5-9.0 m/s	50-150m	300 km²	2.5 GW	Ishikari Bay New Port (major port)	Do-o Kita Trunk Line (275kV)	1,809MW x 2 lines	1,727 MW	Nishitobetsu Substation
② Hokkaido	8.0-8.5 m/s	50-100m	200 km²	1.5 GW	Tomakomai Port (international hub port)	Tomato Atsuma Line (275kV)	not known	491 MW	Tomato Atsuma Substation
						Minamihayakita Line (275kV)	not known	528 MW	
③ Aomori prefecture	8.5-9.5 m/s	50-100m	150 km²	1.0 GW	Mutsu Ogawara Port (major port)	0001 Line (500kV)	not known	1,908 MW	Higashidori Nuclear Power Plant
④ Aomori prefecture	8.0-8.5 m/s	50-200m	800 km²	6.5 GW	Hachinohe Port (major port)	Gonohe Trunk Line (275kV)	9 04MW × 2 lines	898 MW	Gonohe Substation
⑤ Fukushima prefecture	8.0 m/s	50-200m	600 km²	5.0 GW	Soma/Onahama Port (major port)	Tomioka Line (500kV)	4,140MW x 2 lines	1,400 MW (When N-1 intertrip is applied)	Fukushima Daini Nuclear Power Plant/New Fukushima Substation
⑥ Aichi prefecture	8.5-9.5 m/s	50-200m	500 km²	4.0 GW	Mikawa Port (major port)	Taharakosai Line (275kV)	2,040MW x 2 lines	833 MW (When N-1 intertrip is applied)	Kosai Substation
⑦ Wakayama prefecture	8.0-8.5 m/s	50-150m	200 km²	1.5 GW	Wakayama Shimotsu Port (international hub port)	Gobo Trunk Line (500kV)	3,290MW x 2 lines	1,180 MW (When N-1 intertrip is applied)	Gobo Substation
⑧ Fukuoka prefecture	8.5-9.0 m/s	50-100m	1,000 km²	8.0 GW	Kitakyushu Port (renewable energy base port)	Wakamatsu Branch Line (220kV)	1,448MW x 2 lines	1,180 MW (When N-1 intertrip is applied)	Wakamatsu Substation
⑨ Nagasaki prefecture	8.0-8.5 m/s	50-100m	1,000 km²	8.0GW	Imari Port (major port)	Genkai Trunk Line 1 (500kV)	2,784MW x 1 line	1,505 MW	Genkai Nuclear Power Plant
						Genkai Trunk Line 2 North Line (500kV)	2,784MW x 1 line	1,132 MW	
						Genkai Trunk Line 2 South Line (500kV)	6,580MW x 1 line	5,034 MW	
						Genkai Nuclear Power Line (220kV)	1,224MW x 2 lines	1,041 MW (When N-1 intertrip is applied)	
⑩ Kagoshima prefecture	8.0-8.5m /s	50-200m	800 km²	6.5 GW	Sendai Port (major port)	Sendai Nuclear Power Line (500kV)	not known	2,883MW	Sendai Nuclear Power Plant
						New Kagoshima Line (220kV)	1,236MW x 2 lines	1,175MW (When N-1 intertrip is applied)	Former Sendai Power Plant

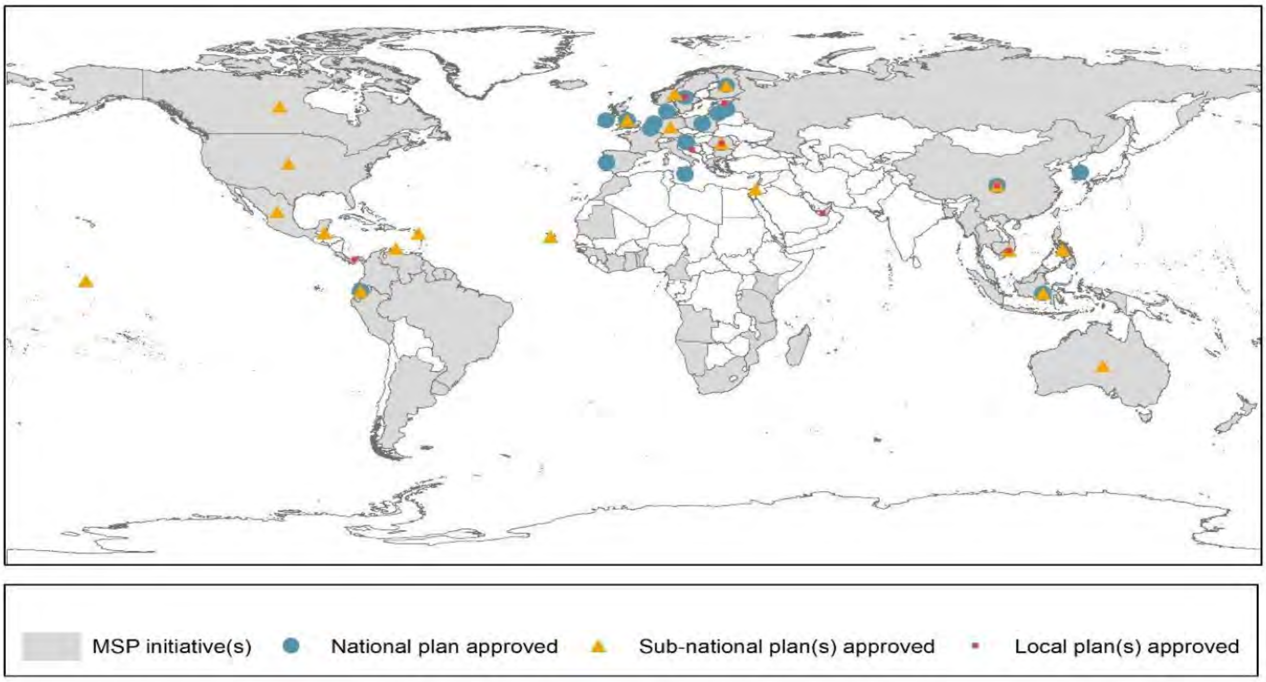
Note: Information on available grid capacity for each general power transmission and distribution utility as of the end of September 2023 is shown.

Source: Created by Renewable Energy Institute

Appendix: Marine Spatial Planning

Marine/Maritime Spatial Planning, MSP, is a public process to analyze and appropriately allocate the spatial and temporal distribution of human activities in the ocean to achieve ecological, economic, and social goals and objectives toward sustainable development.[52] MSP is a comprehensive and strategic process to minimize conflicts of interest and maximize benefits of human activities while maintaining the resilience of marine ecosystems.[53] The use of MSP has been promoted internationally since an international conference organized by the UNESCO Intergovernmental Oceanographic Commission (IOC-UNESCO) in 2006. Japan has been a member of IOC-UNESCO since its founding in 1960.[54] As of April 2022, 102 countries and regions around the world are involved in the initiative.

Figure 12. MSP status around the world as of April 2022



Source: IOC-UNESCO, State of the ocean report 2022: pilot edition, 2022, Figure 4.1

While the content of MSPs varies from country to country and region to region, and can be categorized according to their objectives (environmental protection, industrial use, multipurpose), implementation framework (guiding or legally binding), the degree of stakeholder participation, and scale (local, sub-national or national), etc.,[55] IOC-UNESCO has identified the following elements of effective planning.[56]

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[52] supra note 31: IOC-UNESCO, Marine spatial planning, *A Step-by-Step Approach toward Ecosystem-based Management*, p.18.

[53] IOC-UNESCO, the European Commission, MSPglobal International Guide on Marine/Maritime Spatial Planning, 2021, p.23.

[54] Yutaka Michida, professor at the University of Tokyo's Atmosphere and Ocean Research Institute, serves as the committee chair since June 2023.

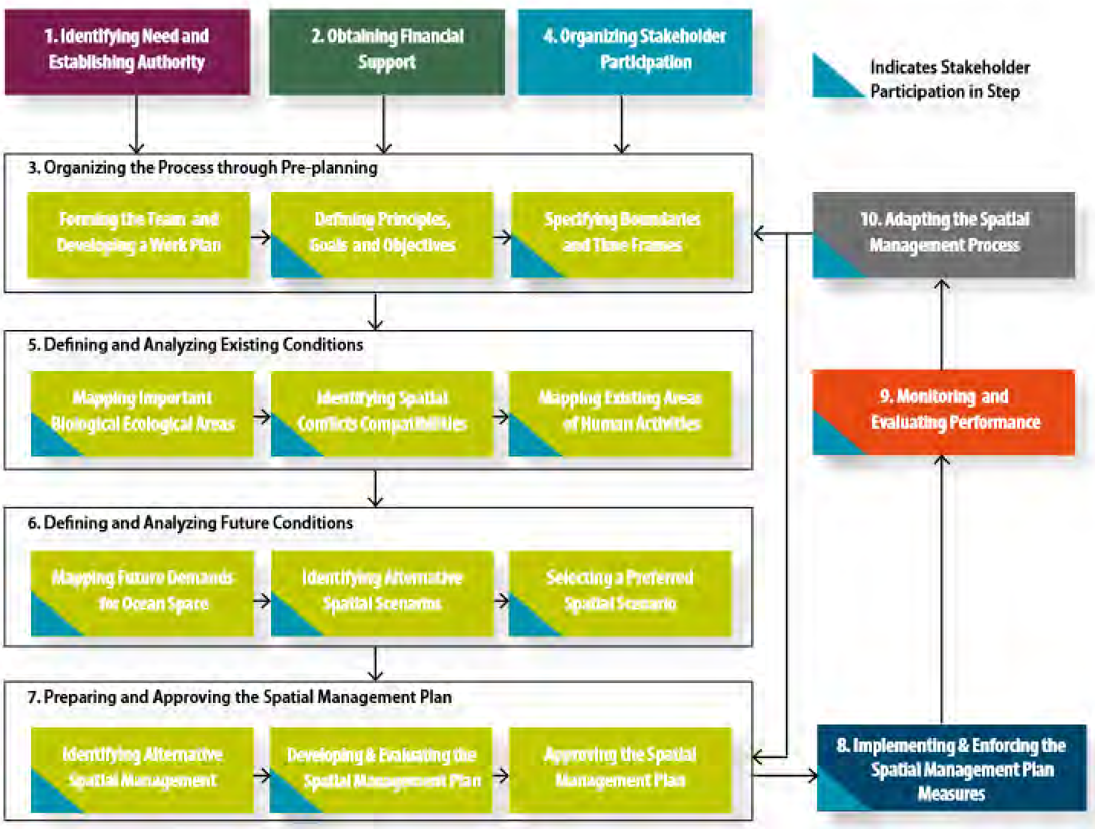
[55] IOC-UNESCO, Pilot State of the Ocean Report (Pilot StOR) Marine Spatial Plcaanning – Supplementary Material, 2022, IV. MSP typology

[56] supra note 31: IOC-UNESCO, Marine spatial planning, A Step-by-Step Approach toward Ecosystem-based Management, p.18, Box 4.
Yutaka Michida, Possibilities and Expectations for MSP in Japan (in Japanese), [Conference presentation]. "Unleashing Japan's Significant Offshore Wind Potential – Maritime Spatial Planning & Skills and Training" Tokyo, June 20, 2023.

- Ecosystem-based: Balancing ecological, economic, and social goals and objectives towards sustainable development (not aimed at protection of specific organisms or development of specific services)
- Integrated: Across sectors and agencies, and among levels of government
- Place-based or area-based:
- Adaptive: Capable of learning from experience
- Strategic and anticipatory: focused on the long term
- Participatory: stakeholders involved in the process

While the method of MSP development will be considered in accordance with the actual conditions of the country/region concerned, IOC-UNESCO has provided the following model (Figure 13). This model includes early stakeholder involvement, implementation and evaluation of the plan, and constant review of the plan. The MSP does not replace individual policy plans, and the plan and roadmap for promoting offshore wind development will be developed separately from the MSP.[57]

Figure 13. Marine spatial planning – A Step-by-Step Approach



Source: UNESCO-IOC, Marine spatial planning, A Step-by-Step Approach toward Ecosystem-based Management,Fig. 1.

[57] supra note 53: IOC-UNESCO, the European Commission, MSPglobal International Guide on Marine/Maritime Spatial Planning, p.24.

The need for MSP has long been debated in Japan. Based on the Basic Act on Ocean Policy, the government formulates and publishes every five years a "Basic Plan on Ocean Policy," which outlines basic policies concerning the ocean. The Third Basic Plan on Ocean Policy, formulated in 2018, stipulated that the Cabinet Office should study the actual status of MSPs in other countries, the necessity of introduction, issues and the possibility of utilization in Japan.

Third Basic Plan on Ocean Policy (Cabinet Decision, May 15, 2018) (Extract)
Chapter 2 Ocean Measures for Comprehensive and Systematic Implementation by the Government
6. Preserve Remote islands and Develop EEZ, etc.
(2) Promotion of Development of EEZ and Continental Shelves
b. Improving the Foundation and Environment to Promote the Effective Use of EEZ
○ (omitted)
With regard to Marine Spatial Planning (MSP), already introduced in several other countries, we will strive to understand the facts of MSP and we will study needs, issues, and feasibility in light of the reality of the use of Japan's ocean areas and the relationship with existing domestic laws and regulations. (Cabinet Office)

The Fourth Basic Plan on Ocean Policy, released five years later, also refers to Marine Spatial Planning. In its section on the promotion of digitalization. It states that "Japan will establish its own unique Marine Spatial Planning methodology," in the section on the promotion of digitalization, indicating that the focus is on data sharing, and less on the approach toward coordinating the use of marine areas. Still, the plan also states that "efforts will be made to promote more appropriate and effective use of complex maritime areas." It can be said that the foundation has been laid for the discussion to create a mechanism for the coordination across government ministries and agencies.

Fourth Basic Plan on Ocean Policy (Cabinet Decision on April 28, 2023) (Extract)
Chapter 1: The Nature of Ocean Policy
3-3. Basic Policy on Major Policies to be Steadily Promoted
(3) Promotion of DX in the ocean
b. Promotion of data sharing and utilization
(Omitted)
Additionally, through the sharing of oceanographic data, Japan's unique marine spatial planning methods will be established. In the process, efforts in promotion zones designated under the Renewable Energy Sea Area Utilization Act, etc., which have been carried out in various parts of Japan, will be appropriately positioned as a form of Marine Spatial Planning. Based on this, efforts will be made to promote multiple uses of sea areas more appropriately and effectively. In addition, from the perspective of unifying marine data, efforts will be made to further utilize and enhance the functionality of the MDA Situational Indication Lincages, MSIL, with a view to collaboration with Data Integration and Analysis System, DIAS, etc.

Chapter 2 Ocean Measures for Comprehensive and Systematic Implementation by the Government
3. Preserve Remote islands and Develop EEZ, etc.
(2) Promotion of Development of EEZ, etc.
A. Development of infrastructure and environment for promoting effective use of EEZ, etc.
○ (Omitted) Furthermore, efforts will be made to understand the actual status regarding Marine Spatial Planning, which has been introduced in other countries. At the same time, efforts will be made to promote the sharing and visualization of the actual status of regulations and sea area use under jurisdiction of each act, which has already been undertaken as part of Japan's Marine Spatial Planning, using the MDA Situational Indication Linkages, MSIL. Based on this, expanding to other individual issues in the exclusive economic zone, etc., and applying it to multiple sea area uses will be considered. (Cabinet Office, Ministry of Foreign Affairs, Ministry of Agriculture, Forestry and Fisheries, Ministry of Land, Infrastructure, Transport and Tourism)

It should be noted that while the plan states that efforts to designate areas under the Renewable Energy Sea Area Utilization Act are positioned as a form of MSP, it has been pointed out that there is room for improvement from the perspective of stakeholder participation when this is compared to the IOC-UNESCO guidance.[58]

[58] Eka Higuchi, Validity of domestic legal system for sustainable utilization of the marine space: from the perspective of the international guidelines for marine spatial planning(in Japanese), supra note 33.

Table 6 Comparison of the institutional framework of the Renewable Energy Sea Area Utilization Act and the IOC-UNESCO guidelines

UNESCO-IOC Guideline	Renewable Energy Sea Area Utilization Act	Basic policy	Guidelines for Area Designation	Operational guidelines for Public Tender	Environmental Impact Assessment Act (including Zoning Manual by MOE)
1.Identifying need and establishing authority	○	○	—	○	—
2. Obtaining financial support	—	—	—	○	—
3. Organizing the process through pre-planning					
Creating a project team and developing a work plan	○	○	○	—	—
Defining principles, objectives, etc.	○	○	○	—	—
Defining temporal and spatial scope	○	—	○	○	—
4. Organizing stakeholder participation	○	○	—		○
5.Defining and analyzing existing conditions					
Mapping important biological and ecological areas	○	○	○	○	○
Identifying spaces of contention	○	○	○	—	○
Mapping human activity areas	○	○	○	—	—
6. Defining and analyzing future conditions					
Mapping the future demand for that ocean space	○	○	○	—	○
Setting up multiple spatial scenarios	—	—	○	—	—
Selecting the preferred spatial sea use scenario	○	—	○	○	○
7. Preparing and approving the spatial management plan					
Setting up multiple spatial scenarios	○	○	—	—	—
Developing and evaluating spatial management plan	○	○	○	—	○
Approving the spatial management plan	○	○	○	○	—
8. Implementing and enforcing the spatial management plan	—	—	○	○	○
9. Monitoring and evaluating performance	○	○	○	○	○
10. Adapting the marine spatial management process	○	○	○	○	○

Note: ○ indicates whether the corresponding step exists, blue indicates the part where stakeholder participation is ensured, and red indicates the part where stakeholder participation is not ensured even though it is required by the IOC-UNESCO guidelines.

Source: Eka Higuchi, Validity of domestic legal system for sustainable utilization of the marine space: from the perspective of the international guidelines for marine spatial planning, supra note 33, Table 1 (Table design by Renewable Energy Institute)

Recommendations for
Accelerating the Commercialization of Floating Offshore Wind Power

December 2023

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