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RENEWABLE ENERGY INSTITUTE

Offshore Wind Power to Support Japan's Energy Needs

Institutions, Infrastructure and Industries for Large-Scale Deployment

March 2021

Acknowledgments

In preparing this report, we conducted interviews with energy experts at energy companies and overseas research institutes and received many helpful suggestions. We would like to thank them for their invaluable assistance.

This report is the reorganization and translation into English of Chapter 2 and following sections of the report "Offshore Wind Power to Support Japan's Energy - Institutions, Infrastructure and Industries for Large-Scale Deployment," written by the Renewable Energy Institute (REI) 's Offshore Wind Study Team.

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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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*Websites cited in this report were last accessed on November 30, 2020 unless otherwise noted.

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Introduction

Today, around the world, offshore wind power is being increasingly deployed on a large scale. Utilization of renewable energy is accelerating, and there are high expectations for the enormous potential and high generating capacity of offshore wind power. Technological innovations, such as increasing the size of wind turbines, have led to a virtuous cycle of decreasing costs and increasing adoption. On the global level, the cost of its generation is expected to be equivalent to that of fossil fuel power generation by 2030[1].

For Japan, surrounded by the sea, utilizing offshore wind power is highly significant and an urgent necessity. Deployment of renewables on a large scale is what will enable Japan to achieve carbon neutrality by 2050, the goal announced by the government in October 2020, and offshore wind power, which tends to be large in scale and have relatively high capacity factor will be one of Japan's primary energy power sources. Japan is second in the world in the deployment of solar PV (approx. 62 GW as of end-2019)[2], so wind power, which generates electricity whether day or night, needs to be accelerated to create a balanced renewable energy mix. The potential of the vast sea area around Japan can be exploited by the use of floating turbines which the foundations of the towers are moored to the seabed by chains or other means for deeper waters, in addition to the implantation turbines which the foundations are fixed to the seabed.

Large-scale deployment of offshore wind power will also have a major impact on domestic industry. Turbines are getting larger and they have many components, and because their construction is a major undertaking, local procurement can reduce transport costs. This is why power providers and turbine makers have an incentive to build local supply chains to reduce costs. The ports where turbines and platforms are assembled and taken out to sea also need to be further developed and reinforced, and vitalization of local industry can be expected with the development of ports. Even after the turbines are built, operations and maintenance (O&M) are needed to maintain capacity factor rate at high levels and must be carried out locally for the duration of the operating period (20 to 25 years). Offshore wind power, which can be expected to utilize domestic and regional resources, is part of the industrial policy of many countries.

Japan is finally now beginning to deploy offshore wind power on a large scale. This report is intended to indicate a direction for the steady deployment of offshore wind power as a form of energy that will support Japan into the future. Chapter 1 provides an overview of the current situation in Japan. A variety of systems and policies are currently being developed, making it difficult to summarize every program and initiative, so in this report we focus on the current state of sea area utilization rules, operator selection, electricity grids and other foundational systems. Chapter 2 looks at the characteristics of countries and regions leading the way in deployment of offshore wind power, in terms of both quantity and cost reductions, in order to clarify a direction forward for Japan.

After the Japanese version of this report was initially published, the "Offshore Wind Power Industry Vision (Ver. 1)" was released by the Public-Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power Generation in the Ministry of Economy, Trade and Industry (METI)[3]. A summary of the document is provided at the end of Chapter 2.

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1 International Renewable Energy Agency (IRENA), "Future of Wind," (October 2019), Figure 24, p.50. https://www.irena.org/publications/2019/Oct/Future-of-wind

2 IRENA "Renewable Energy Statistics 2020," (Jul. 2020), from p. 48-. https://www.irena.org/publications/2020/Jul/Renewable-energy-statistics-2020

3 Public-Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power Generation, "Offshore Wind Power Industry Vision (Ver. 1)" (December 15, 2020) https://www.meti.go.jp/shingikai/energy_environment/yojo_furyoku/pdf/002_02_02_01.pdf (accessed December 28, 2020)

Chapter 1: Current State of Offshore Wind Power in Japan

1. Government policy and deployment levels

Japan, as of September 2020, has deployed offshore wind power farms with capacity of approximately 20 MW. Most of these are government-led demonstration projects; there are just two commercially operating facilities that have completed testing and verification, and their capacity is around 4.5 MW. At the same time, the potential for offshore wind power in Japan is large, approximately 715 GW[4] according to estimates based on studies by the Ministry of the Environment (MOE).

Although the government's 5th Strategic Energy Plan, the current plan, established in 2018, evaluated the situation and states that "there have been no essential changes in technology trends anticipated for 2030 when the previous plan was established four years ago," and it did not change long-term energy supply and-demand projections for 2030, which were made in 2014[5]. It puts renewable energy (including large-scale hydropower)'s portion of the energy mix at around 22% to 24%, and wind power as a whole at around 1.7% (10 GW) including offshore wind, which is expected to be 0.82 GW, not even 10% of the wind power total[6] (as will be discussed below, the "Offshore Wind Power Industry Vision (Ver. 1)" released on December 15, 2020 by the Public-Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power Generation puts offshore wind power at 10 GW by 2030 and 30-45 GW by 2040).

On the other hands, policies which promote offshore wind deployment have also been promoted in recent 10 years. The Headquarters for Ocean Policy in the Cabinet Office, in its policy from 2012, has defined a series of issues related to the practical viability and commercialization of offshore wind power, including coordination with other stakeholders in sea area utilization, clarification of related utilization rules, appropriate environmental impact assessments, and cost reductions[7], and in its Basic Plan on Ocean Policy, specific government initiatives have been formulated[8]. Deficiencies in sea area utilization rules, and long-term occupancy rights in particular, were addressed through legislation, and for ports areas, the Port and Harbor Act was amended in 2016; and, for territorial sea areas other than port areas, a new framework was created that links long-term occupancy and the feed-in tariff system[9]. These moves by the government are steadily promoting investment in offshore wind power projects, and, as of June 2020, projects of around 18 GW (0.7 GW in port and harbor areas) are at the stage of environmental impact assessment[10]. Large-scale projects are concentrated in the waters off Akita and Aomori prefectures.

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4 Estimated by REI (based on commercial viability, 7.0 m/s or more from bottom-fixed and 7.5 m/s or more from floating) based on MOE, "Entrusted Work Concerning the Development and Disclosure of Basic Zoning Information Concerning Renewable Energies (FY2019)" (June 2020), Chapter 3.5, Table 3.5-4 ("Estimated Potential for Offshore Wind Power"). https://www.env.go.jp/earth/report/post_2.html

5 Strategic Energy Plan, Provisional Translation (Cabinet Decision of July 3, 2018), p. 4. https://www.enecho.meti.go.jp/en/category/others/basic_plan/5th/pdf/strategic_energy_plan.pdf

6 Agency for Natural Resources and Energy (ANRE), "Long-term Energy Supply and Demand Outlook Related Document" (July 2015), pp. 47, 67. https://www.enecho.meti.go.jp/committee/council/basic_policy_subcommittee/mitoshi/pdf/report_02.pdf

7 Headquarters for Ocean Policy, "Policy on Initiatives for Promoting Use of Marine Renewable Energy" (May 25, 2012) https://www8.cao.go.jp/ocean/policies/energy/pdf/houshin.pdf

8 "The Basic Plan on Ocean Policy," (Cabinet Decision No. 2 of April 26, 2013 and Cabinet Decision No. 3 of May 15, 2018) https://www8.cao.go.jp/ocean/policies/plan/plan.html

9 The Act on Promoting the Utilization of Sea Areas for the Development of Marine Renewable Energy Power Generation Facilities, drafted by the Cabinet Office's National Ocean Policy Secretariat, METI, and Ministry of Land, Infrastructure, Transport and Tourism (MLIT), was established in November 2018 and went into effect from April 2019. A bill of the same name was submitted to the Diet in March 2018 as well, but it was rejected.

10 REI research based on data from the MOE's Environmental Impact Assessment Network (http://assess.env.go.jp/).

2. Sea area occupancy procedures under the Act on Promoting the Utilization of Sea Areas for the Development of Marine Renewable Energy Power Generation Facilities

The Act on Promoting the Utilization of Sea Areas for the Development of Marine Renewable Energy Power Generation Facilities (hereinafter referred to as the "Renewable Energy Sea Area Utilization Act") establishes procedures for government designation of 'promotion zones' and selection of business operators by public tender[11]. Business operators that are selected receive FiT authorization under the feed-in tariff system, so the two systems are linked.

Zones expected to be eligible at an early stage for designation as promotion zones are first selected as 'promising areas[12].' Selection as a promising area is conditioned on being a promotion zone candidate and having identified stakeholders and obtained their agreement to start a council[13].

A 'council' is an organization for coordinating with stakeholders. It is organized by the Minister of Economy, Trade and Industry (METI), the Minister of Land, Infrastructure, Transport and Tourism (MLIT) and the relevant ministerial governors, and its members include the Minister of the Agriculture, Forestry and Fisheries, the mayors of related cities and towns, stakeholders and academic experts.[14]. The council serves as an important venue for forming relationships between local communities and the subsequent power project.

Zones for which a council has held discussions and a local sea area survey (wind conditions, geological features, etc.) has been completed by the government are designated as promotion zones.

After designation as a promotion zone, a business operator is selected through public tender. Conditions for selection are stated in the Guidelines for Public Tender of Exclusive Occupancy and Use, but the government is also obliged to provide operators with information closely related to the project to the extent possible[15]. In the examples to date (based on the Guidelines for four zones designated as promotion zones), occupancy and use fees and council conclusions have been stated in the Guidelines. At the same time, survey results on wind and water conditions and information on grid networks are provided only to prospective bidders that have met certain criteria, and, generally, they are not disclosed publicly[16]. In addition, procedures for environmental impact assessments are conducted by the operator separate from sea area occupancy procedures. Disclosure of access documents is mandated during the public notice and inspection period, but subsequent disclosure is voluntary, and there are no legal mandates on publicly releasing follow-up studies. Also, there have been no instances thus far of the government itself providing environmental impact assessment-related information.

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[11] The long-term occupancy system established first in the amended Port and Harbor Act sets forth the same procedures for operator selection by public tender as the Renewable Energy Sea Area Utilization Act.

[12] Promising area selection is an operational procedure based on guidelines that is intended to narrow down the zones where detailed investigations required for promotion zone designation can take place; it is the gateway to promotion zone designation. The selection process for promising zones involves hearing the opinions of a third-party committee that includes academic experts. ANRE, METI and MLIT, Ports and Harbours Bureau, "Promotion Zone Designation Guidelines for Development of Marine Renewable Energy Power Generation Facilities" (June 2019); see p. 11.

[13] Supra note 12, "Promotion Zone Designation Guidelines," p. 11.

[14] Supra note 12, "Promotion Zone Designation Guidelines," p. 12.

[15] ANRE, METI and MLIT, Ports and Harbours Bureau, "Interim Report of Joint Meeting of the Working Group on Promoting Offshore Wind Power Generation (under the Subcommittee on Mass Introduction of Renewable Energy and Next-Generation Electricity Networks, Committee on Energy Efficiency and Renewable Energy / Electricity and Gas Industry Committee, Advisory Committee for Natural Resources and Energy, METI) and the Subcommittee for Promoting Offshore Wind Power Generation, the Environment Committee, Harbor Committee, Transport Policies Council, MLIT" (April 2019), p. 32. https://www.meti.go.jp/shingikai/enecho/denryoku_gas/saisei_kano/yojo_furyoku/pdf/20190422_report.pdf

[16] Regarding the example of offshore Goto City, Nagasaki Prefecture, see "Got It! Renewable Energy: Offshore Wind Power Related Programs: About Operator Selection" on the website of the ANRE. https://www.enecho.meti.go.jp/category/saving_and_new/saiene/yojo_furyoku/index.html#sentei

Operators apply by submitting their exclusive occupancy and use plans for public tender. Assessments of plans are comprehensively evaluated based on the supply price, technical capabilities related to project execution, and coexistence in harmony with local communities (building connections with the community and local economic benefits)[17]. The Ministers of METI and MLIT hear the opinions of the prefectural governor related to benefits of the community, make references to the evaluation of the third-party committee, and select the operator based on these opinions. The tendered occupancy plan of the operator selected is effective for 30 years from its certification. The Minister of METI certifies the selected operator's project as a power project based on the feed-in tariff system, and the Minister of MLIT provides the operator a 30-year occupancy license for the promotion area (however, the license is limited to the effective period of the certified tendered plan).

The quantity and pace of promotion zone designation will have a major impact on the speed at which offshore wind power can be deployed. Since the law was enacted in April 2019, the two ministries, on two occasions, have announced the progress that has been made in designating promotion zones. In July 2019, 11 zones were announced as having progressed to a certain level of preparations and four of these have been identified as 'promising areas' (Figure1-1). Of these four, the sea area offshore from Goto City, Nagasaki Prefecture, was designated a promotion zone in December 2019 and an open call for operators was issued in June 2020. The remaining three zones (two Akita zones and one Chiba zone) were also designated promotion zones in July 2020, and an open call for operators was made that November[18]. In the July 2020 announcement, ten zones were indicated as having progressed to a certain level of preparations, and four of these were identified as 'promising areas.' At present, a total of 14 zones have been identified as promotion zones, promising areas or zones having progressed to a certain level of preparations.

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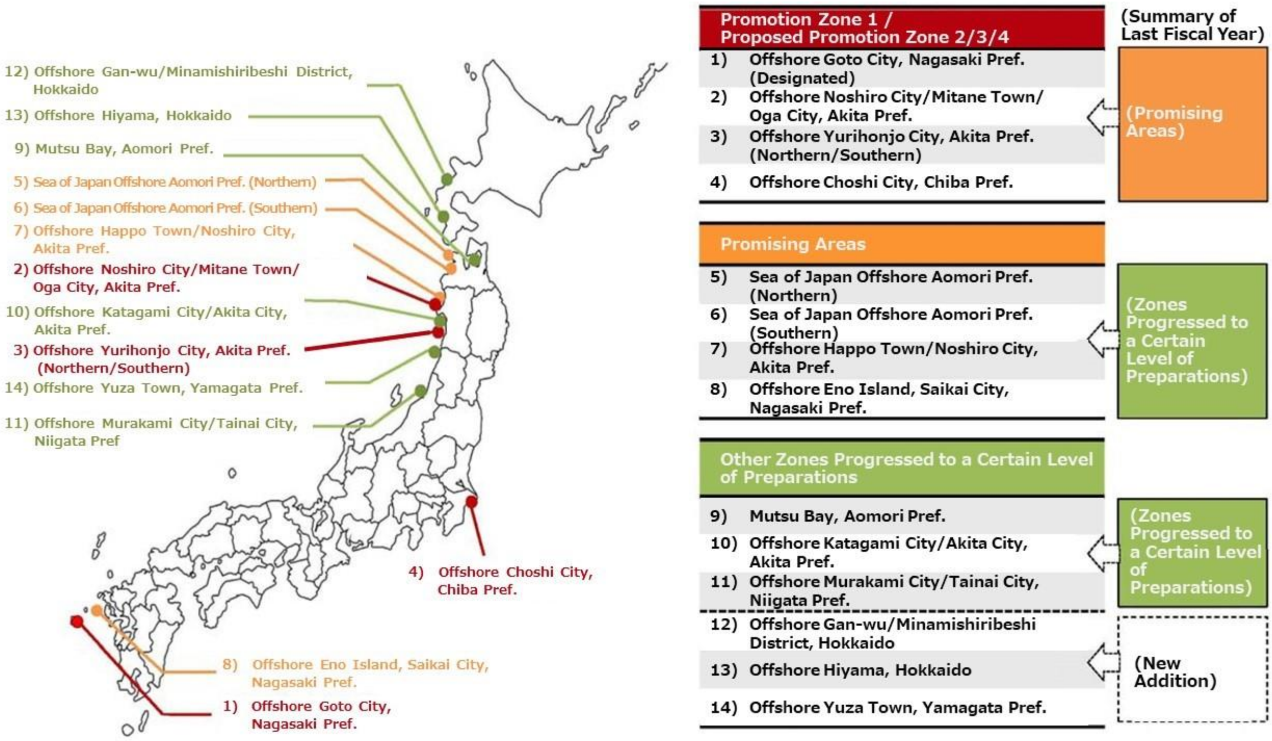
[17] Evaluation standards are stipulated in the Guidelines for Public Tender of Exclusive Occupancy and Use (Act Article 13.2.15). ANRE, METI and MLIT, Ports and Harbours Bureau, "Operating Guidelines for Public Bidding on Occupancy of General Sea Areas" (June 2019), from p. 8.

[18] Supra note 16, for information on the three zones, the "Got It! Renewable Energy: About Operator Selection" on the website of the ANRE.

Figure1-1 Promotion Zone Designation Under the Act



Source: METI and MLIT, "For Enhancement of Industrial Competitiveness for Offshore Wind Power Generation," Public-Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power Generation (First), Document 3 (July 17, 2020), p.7. https://www.enecho.meti.go.jp/category/saving_and_new/saiene/yojo_furyoku/dl/kassei/sangyou/01_docs03.pdf

Regarding the quantity and pace of promotion zone designation going forward, the government's policy on the matter currently is not altogether clear. In terms of numerical targets, the government sets a key performance indicator (KPI) to Renewable Energy Sea Area Utilization Act, which is five zones to start operation by 2030. However, as it is too small as a target, this is already close to being met as of 2020. The ways in which planned deployment will be promoted is also limited to the statement, 'needs to be considered'[19].

Additionally, the actual procedures for promotion zone designation are not entirely clear on how the scale of projects is determined or on the criteria used for selection[20]. As for selection of 'promising areas,' the gateway to designation as a promotion zone, the information provided by prefectures and other parties is not disclosed nor are the details of the selection process. For zones considered to have progressed to a certain level of preparations but which have not been made 'promising areas,' points requiring attention are indicated, but their details are unclear, and whether these points have been resolved when such zones are selected as promising areas the next fiscal year is also not disclosed. There is currently no clear direction for promotion zone designation going forward.

[19] Supra note 15, "Interim Report," p. 8. At the same time, in the interim report, it is also pointed out that there is no cap (upper limit) on potential deployment or the number of zones.

[20] Supra note 12. The Promotion Zone Designation Guidelines stipulates the non-disclosure of the names of members of the third-party committee and the selection process, see p. 11.

3. Current status of feed-in tariff system

A feed-in tariff classification was created for offshore wind power in fiscal 2014, and the purchase price was set at 36 JPY/kWh for both bottom-fixed and floating structures. Thereafter, in anticipation of the establishment of the Renewable Energy Sea Area Utilization Act, for bottom-fixed structures, it was decided that purchasing at the set price would be continued to fiscal 2019, and from fiscal 2020, the purchase price would be determined by bidding. Certified capacity of offshore wind power at the end of fiscal 2019 was 66.8 MW in total, and the 36 JPY/kWh purchase price applies to this amount. For projects under the Renewable Energy Sea Area Utilization Act in fiscal 2020 (three zones), a maximum price of 29 JPY/kWh was set[21].

The Procurement Price Calculation Committee explains, as follows, the reasons for switching to a bidding system from fiscal 2020 even for bottom-fixed projects outside the purview of the Renewable Energy Sea Area Utilization Act[22].

- There has recently been a sharp increase in projects undergoing environmental impact assessment procedures due to regulatory enhancements under the amended Port and Harbor Act and the Renewable Energy Sea Area Utilization Act (total of approx. 13 GW for territorial sea areas alone), and an adequately competitive environment has already been established for bottom-fixed wind power as a whole.
- There are no differences in specifications that would affect generating costs based only on whether or not the Renewable Energy Sea Area Utilization Act applies.
- If a bidding system is not used for projects that do not fall under the Act, operators will have an incentive to avoid projects to which the Act applies and which are subject to bidding, and this could negatively affect competition between operators by way of the Act.
- Overseas, nearly all FiT procurement prices are set via bidding, and this serves to reduce procurement prices, depending partly on how the system is designed.

In the first round of bidding, there was one bid for 4.8 MW out of the 120 MW of capacity made available, but it was higher than the ceiling price (34 JPY/kWh; undisclosed at the time of bidding), so there were no successful bidders[23].

A set price of 36 JPY/kWh has been maintained for floating offshore wind power until fiscal 2020. Prices for floating offshore wind power for the three years from fiscal 2021 to fiscal 2023 (outside the purview of the Renewable Energy Sea Area Utilization Act) will continue to use the assumptions used in fiscal 2020[24].

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21 As per the Guidelines for Public Tender of Exclusive Occupancy and Use for each of the three zones. Supra note 16.

22 Procurement Price Calculation Committee, "Opinion on FY2020 Procurement Prices, Etc." (February 4, 2020), from p. 51. https://www.meti.go.jp/shingikai/santeii/pdf/20200204001_1.pdf

23 Green Investment Promotion Organization, "Results of First Bidding (FY2020) for Bottom-Fixed Offshore Wind Power" (December 25, 2020) https://www.teitanso.or.jp/cms/wp-content/uploads/2020/12/tyakushoushikiyoujyoufuryoku_nyusatsukekka_dai1kai_20201225.pdf (accessed December 28, 2020)

24 As per the decision of the 63rd meeting of the Procurement Price Calculation Committee (November 27, 2020).

4. Connection to power grid

Potential of offshore wind power is located away from major consumption regions, in places like Hokkaido, northern Tohoku, and Kyushu. In order to utilize electricity from offshore wind power throughout Japan, not only are transmission lines needed from offshore wind farms to land but also it is essential that onshore transmission lines (the power grid) be used and enhanced efficiently. However, under Japan's current rules, power plants that are built first have the right to secure as much capacity on transmission lines as they need to stably supply their electricity (rule of first come, first served), and connecting new power plants requires transmission line enhancements. For this reason, the enormous cost of transmission line enhancements and the long ten-year timeframe have been significant issues. Transmission line enhancements are carried out by transmission companies on the request of power providers, and they are neither planned nor efficient; they are not based on an overarching vision of regional or national power grids that takes into account future power source distribution.

Take transmission line enhancements in northern Tohoku area, for example. Enhancement planning is taking place according to procedures referred to as the 'solicitation process' for power supply connection projects. These procedures are overseen by the Organization for Cross-regional Coordination of Transmission Operators (OCCTO). Potential power source connection projects in the vicinity are solicited and the grid is enhanced with multiple electricity providers jointly bearing construction costs. When this is completed, actual construction begins[25]. This process was started in October 2016, but the procedures have been prolonged due in part to some power providers pulling out of the process, and the process is expected to finally conclude around the end of February 2021[26]. According to the results of the solicitation process released in August 2019[27], offshore wind power accounts for around two-thirds (2.6 GW) of total interconnection capacity (approx. 3.9 GW).

The problem of connecting new power plants is a major problem for renewable energy, including offshore wind power, and the government is taking measures to address it.

First, for efficient operation of existing transmission lines, an initiative has started that uses output curtailment to handle cases in which generating output exceeds transmission capacity instead of operating transmission lines based on an annual (8,760 hours) output assumption instead of the plants' maximum capacity, and connecting new power plants to the extent possible. In Japan, TEPCO Power Grid began this on a trial basis in May 2019[28], and the aim is to expand it nationwide by the end of 2021.

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[25] Organization for Cross-regional Coordination of Transmission Operators, "Specific Procedures for the Power Supply Connection Project Solicitation Process" (April 2020)

[26] OCCTO, "Power Supply Connection Project Solicitation Process in the Northern Tohoku Area" (as per information updated on October 30, 2020) https://www.occto.or.jp/access/process/tohoku/tohoku_hokubu.html

[27] Tohoku Electric Power Co., Inc., "About the Handling of the Power Supply Connection Project Solicitation Process in the Northern Tohoku Area (March 10, 2020)," Ministry of Economy, Trade and Industry, Advisory Committee for Natural Resources and Energy, Committee on Energy Efficiency and Renewable Energy / Electricity and Gas Industry Committee, Working Group on Promoting Offshore Wind Power Generation (under the Subcommittee on Mass Introduction of Renewable Energy and Next-Generation Electricity Networks, Electricity and Gas Basic Policy Subcommittee, Grid Working Group No. 25, Document 3, p.3.

[28] TEPCO Power Grid, Inc., "Trial Initiative to Efficiently Expand Deployment of Renewable Energy in Chiba" (May 17, 2019) https://www.tepco.co.jp/pg/company/press-information/press/2019/1515133_8614.html

In order to conduct inter-regional grid planning on a nationwide scale that anticipates the distribution of power sources in the future, with a view to the mass deployment of renewable energy, a master plan is now being developed that considers grid enhancements that will be needed based on the potential of renewable energy. For inter-regional connection and core grid networks (transmission lines with voltage in the two highest classes in the region), cost-benefit analysis will be conducted and the need for enhancements determined. In conjunction with this, instead of procedures being initiated primarily by power generation companies, as has been done to date (the solicitation process), a mechanism has been put into place by which the government will estimate the level of deployment in promotion zones and make it possible to secure grid networks in advance (the 'integrated examination process'). However, looking at the first draft of the master plan, the amount of renewable energy to be deployed, which is one of the assumptions used for the plan, uses the total of figures in the current electricity supply plans of generators; the plan does not base its considerations on the mass deployment that is expected to be necessary in the future. Regarding the cost-benefit analyses conducted in the process of developing the master plan, a direction has been indicated; it follows the previous method of merely converting the considered benefits to a monetary value. It is therefore possible that the benefits of deploying renewable energy will not be adequately taken into account[29].

Additionally, in Japan, when connecting a new power plant requires that transmission lines be enhanced, an upper limit is placed on the costs borne by the transmission/distribution operator, and the remaining costs are the responsibility of the generators. The aforementioned solicitation process also determines this cost burden, so when generation businesses pull out of the process, these figures are left undecided, which is the situation that has occurred. Procedures can be delayed, and connection costs are sometimes excessive; the process is not necessarily predictable, and this has also been an issue.

5. Regional initiatives

Regional and local governments are taking an active stance to deployment especially in regions with a healthy amount of potential of offshore wind power. In Kyushu, Goto City in Nagasaki Prefecture and Kitakyushu City in Fukuoka Prefecture, where the government has conducted demonstration projects[30], are seeking to expand deployment upon receiving promotion zone designation under the Renewable Energy Sea Area Utilization Act, or further developing ports and harbors to serve as base ports for offshore wind power facilities while implementing related policies to promote industry in the region. Also, in the Tohoku region, Akita Prefecture has positioned offshore wind power as first priority for increased deployment of renewables, crafted a strategy for promoting deployment, and enhancing transmission networks, in port and harbor zones and territorial sea areas, and is continuing to promote widespread coordination, establishing a forum for related industries and having companies in the prefecture participate[31]. Further, study groups with academic experts and coordinating meetings to share information and opinions among related institutions and organizations are being held in various regions[32].

[29] In switching over to the new system, another issue is the conditions to transfer a grid connection right obtained by a generator through the previous solicitation process to an operator selected for promotion zone when the former business and the latter are not the same.

[30] Demonstration projects were conducted in port and harbor zones and general sea areas. The Port of Kitakyushu was designated as a base port for offshore wind power generation, joining the Port of Akita, Port of Noshiro and Port of Kagoshima. Ministry of Land, Infrastructure, Transport and Tourism, "Initial Designation of Base Ports for Offshore Wind Power (August 31, 2020)" https://www.mlit.go.jp/report/press/port06_hh_000207.html

[31] Akita Prefecture, "Second Phase Strategy of New Energy-related Industries in Akita" https://www.pref.akita.lg.jp/pages/archive/10638

[32] Some local governments are involved in zoning as a part of a demonstration project of the MOE of the Environment; since 2016, 15 local prefectures have been promoting this initiative.

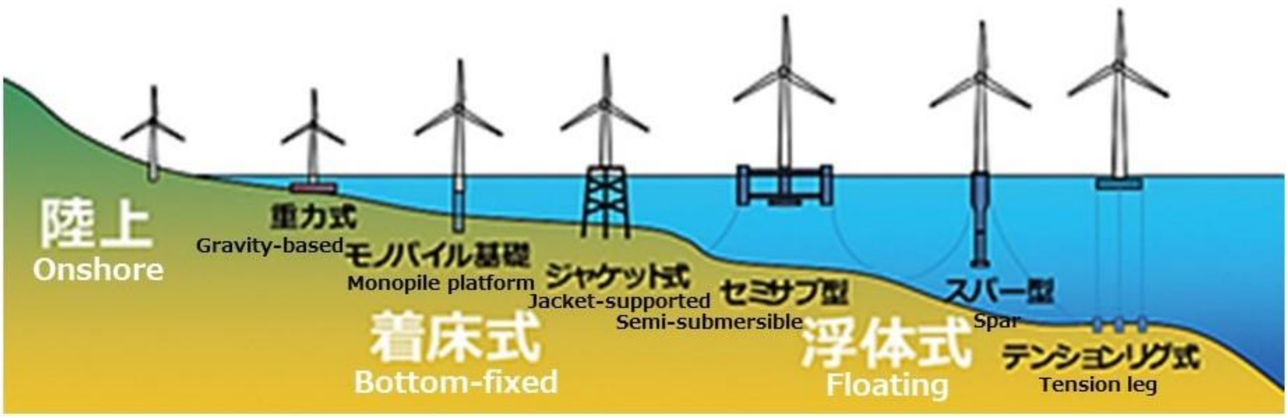
Coexistence in harmony with the fishing industry, an industry that also utilizes the ocean, is the most important issue that needs to be considered in the process of large-scale deployment of offshore wind power. Even in promotion zones already designated as such, concerns over the impact on the fishing industry, in terms of catch volume and operations, have been made clear at council meetings. At the same time, there are also cases of fishing reefs being formed by offshore wind power facilities, and this information being shared, and of offshore wind power projects and fishing industry participants coming to an understanding, through demonstration project initiatives that have already been conducted. And, even in zones without demonstration projects, study groups have been held prior to council meetings, and information shared on marine life ecosystems at the meetings. In addition, council reports, which are part of the Guidelines for Public Tender of Exclusive Occupancy and Use, include fishing industry impact studies and the creation of funds for coexistence with the fishing industry, and other initiatives are also being conducted for harmonizing offshore wind power and the fishing industry[33].

6. Major potential for floating offshore wind power

Japan's deployment potential

In Europe, development has taken place around the North Sea where there are expansive sea areas with relatively shallow depths (less than around 50 meters). In these sea areas, bottom-fixed assemblies are used in which turbine towers are supported by platforms directly connected to the seafloor. By contrast, Japan's coasts have many areas where the water gets deep almost immediately, and it is not easy to bottom-fix the platforms, or there is the potential for the seabed to be impacted by earthquakes, so given these constraints, floating platforms moored to the seabed with lines are expected to be utilized. There are various types of platforms technologies (Figure1-2). One is the spar platform currently used for commercially operating turbines offshore of Goto City, Nagasaki Prefecture. In recent years, demonstration projects have also been conducted using barge platforms, which are shaped like a barge and are lighter and less expensive than other options.

Figure1-2 Types of Platforms Used for Offshore Wind Power

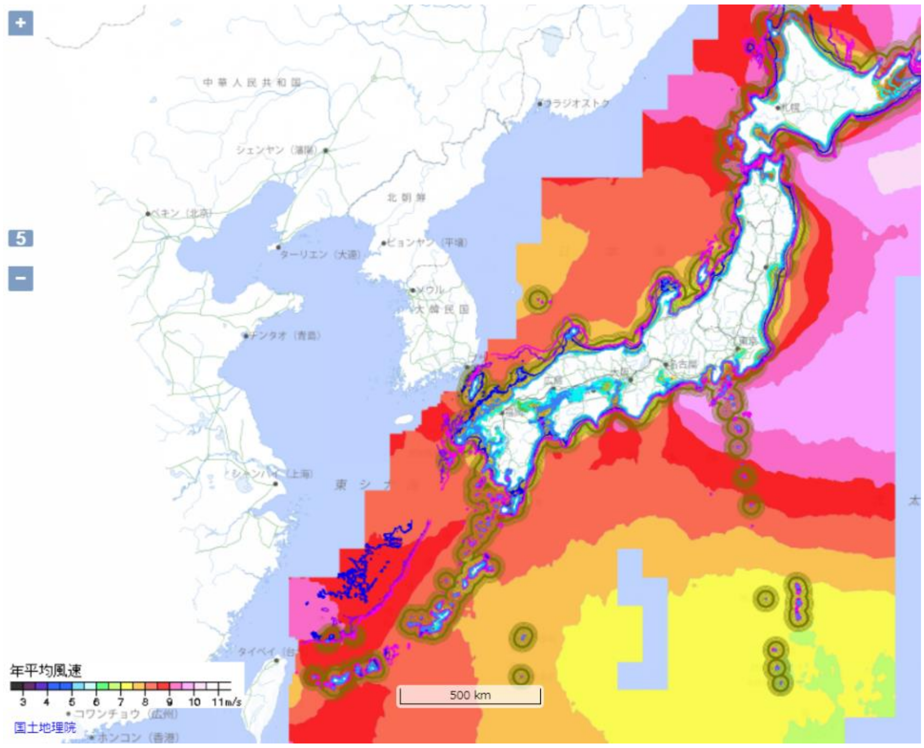


Source: Ueda, Yoshinori, "Recent Trends Regarding Offshore Floating Wind Turbines," website of The Ocean Policy Research Institute, "Ocean Newsletter," No. 421 (February 20, 2018), Diagram 1 https://www.spf.org/opri/newsletter/421_1.html

[33] Regarding the aforementioned, refer to council meeting documents and minutes from the four zones designated as promotion zones as of July 2020. "Got It! Renewable Energy: Offshore Wind Power Related Programs: Council" on the website of the ANRE https://www.enecho.meti.go.jp/category/saving_and_new/saiene/yojo_furyoku/index.html#kyougi

The technical potential of using floating platforms in deep sea areas (50-200 meters) less than 30 kilometers offshore is around 473 GW (1,315 TWh annually), which is nearly twice the potential of shallow sea areas where bottom-fixed assemblies can be utilized (approx. 242 GW, 749 TWh annually)[34]. Further, according to International Energy Agency (IEA) estimates, the technical potential of floating platforms in deep sea areas (60-2,000 meters) is 2,223 TWh annually in Japan's coastal waters (20-60 kilometers offshore) and 6,808 TWh annually further out (60-300 kilometers offshore)[35].

Figure1-3 Offshore Wind Power Potential Around Japan



Source: Created by REI based on wind condition maps from the New Energy and Industrial Technology Development Organization (NEDO)

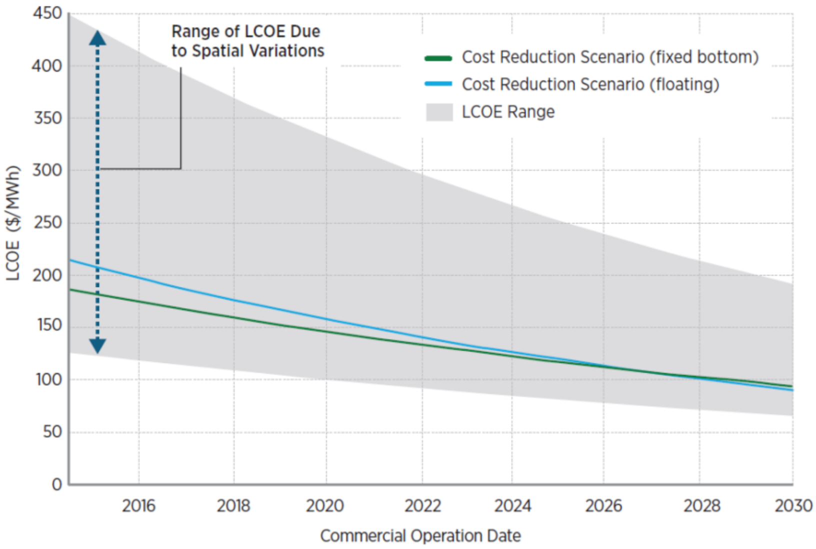
[34] Supra note 4. Estimated by REI based on the same conditions (taking into account commercial viability based on data from the MOE's "Estimated Potential for Offshore Wind Power").

[35] IEA, "Offshore Wind Outlook 2019," Table A.3, p.70. https://www.iea.org/reports/offshore-wind-outlook-2019

Reducing costs

Looking at global deployment of floating offshore wind power, as of 2019, there was 66 MW, 19 MW of it from Japan[36]. Floating offshore wind power is expected to come down in cost and increase in amount at an accelerating pace due to its characteristics[37], which include 1) the ability to be established in offshore areas with high wind speeds, 2) relatively low impact on use of other sea area utilization and the environment (scenery, etc.), and 3) ability to reduce costly marine operations because platforms can be assembled at port and transported out to sea. There are also projections showing costs coming down significantly. For example, according to a U.S. study, the generating costs (LCOE) of a certain pilot project are expected to decrease by half from 2019 to 2032[38]. Another study points to the possibility of costs equivalent to bottom-fixed platforms by 2030 (Figure1-4) [39].

Figure1-4 Projected Generating Costs (LCOE) for Offshore Wind Power in the U.S.



Source: Philipp Beiter et al., "A Spatial-Economic CostReduction Pathway Analysis for U.S. Offshore Wind Energy Development from 2015–2030,"(Footnote 39), Figure ES-3, p. xiii.

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36 Global Wind Energy Council (GWEC), "Global Offshore Wind Report 2020," p.12. https://gwec.net/global-offshore-wind-report-2020/

37 Garrett E. Barter et al., "A systems engineering vision for floating offshore wind cost optimization," Renewable Energy Focus, vol.34(Sep. 2020), pp.1-16.

38 From 107 USD/MWh in 2019 to 74 USD/MWh by 2027 and 57 USD/MWh by 2032. Walter Musial et al. "Cost of Floating Offshore Wind Energy Using New England Aqua Ventus Concrete Semisubmersible Technology" Table 8, p.22. https://www.nrel.gov/docs/fy20osti/75618.pdf

39 Philipp Beiter et al., "A Spatial-Economic Cost-Reduction Pathway Analysis for U.S. Offshore Wind Energy Development from 2015–2030," figure ES-3, p.xiii. https://www.nrel.gov/docs/fy16osti/66579.pdf

Project development going forward

Floating offshore wind power in Japan to date has consisted primarily of demonstration projects in Goto City, Nagasaki Prefecture (MOE project, 2MW), offshore Fukushima Prefecture (METI project, 2 MW, 5 MW, 7 MW)[40], and offshore Kitakyushu City, Fukuoka Prefecture (NEDO project, 3 MW)[41]. The turbines in Goto City, Nagasaki Prefecture, began operating commercially after the end of the demonstration project[42], and demonstration projects continue for the 2 MW (a commercialized turbine for onshore) and 5 MW (test turbine) offshore of Fukushima Prefecture and the 3 MW of Kitakyushu City. However, the 7 MW (test turbine) of Fukushima Prefecture has been removed because it was judged that commercial operations would not be feasible and has been decommissioned. This was due to the operating rate declining as a result of trouble with the facilities and components with very high wear being expensive, special-order products so that there were no real prospects for management and maintenance costs coming down[43].

At the same time, as demonstration projects have progressed, commercial projects have also started and are growing larger in scale. A promotion zone under the Renewable Energy Sea Area Utilization Act in Goto City, Nagasaki Prefecture, has made an open call for a floating wind farm up to 21 MW. Multiple other development projects using floating platform technologies have also been reported[44].

Various moves are also being made toward future project development. A number of technology development projects aimed at reducing costs have started in coordination with companies overseas[45].

In Europe, Hywind Scotland in the U.K., a 30 MW farm with five turbines (6 MW), has been operating commercially since 2017[46]. Other projects scheduled to begin operations in the next three years are shown in Table 1-1; many of the projects are in France[47].

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[40] Fukushima Offshore Wind Consortium, “Fukushima Floating Offshore Wind Farm Demonstration Project” http://www.fukushima-forward.jp/pdf/pamphlet.pdf

[41] NEDO, “Start of Demonstration Operations for Floating Offshore Wind Power System Offshore Kitakyushu City” (May 21, 2019) https://www.nedo.go.jp/news/press/AA5_101117.html

[42] Toda Corporation, “Vol. 2 Japan-First! Commercialization of Floating Offshore Wind Power Assembly” https://www.toda.co.jp/business/ecology/special/windmill_02.html

[43] Refer to Fukushima Floating Offshore Wind Farm Demonstration Project Review Committee, “FY2018 Fukushima Floating Offshore Wind Farm Demonstration Project Review Committee Report” (August 2018). https://www.enecho.meti.go.jp/category/saving_and_new/new/information/180824a/pdf/report_2018.pdf

It was reported in December 2020 that demonstration testing also ended on the 2 MW and 5 MW facilities and that they will be decomissioned. “All Offshore Wind Power in Fukushima Prefecture to be Decommissioned in FY2021,” Nikkei Online Edition (December 17, 2020) https://www.nikkei.com/article/DGXZQOFB1787A0X11C20A2000000

[44] Japan External Trade Organization (JETRO), “Iberdrola to Develop Large-Scale Offshore Wind Farm in Japan,” Business News (September 29, 2020)

[45] Including National Maritime Research Institute, FY2020 (20th) NMRI Research Presentation Meeting, “Future Vision for Floating Offshore Wind Power and NMRI Initiatives” (July 28, 2020) https://www.nmri.go.jp/event/presentation/R2/lecture_3.pdf and Tokyo Electric Power Company Holdings, “Engaging in Research and Development on Technologies to Lower the Cost of Floating Offshore Wind Turbines” (September 3, 2020) https://www.tepco.co.jp/press/release/2020/1551825_8710.html

[46] Equinor ASA The future of offshore wind is afloat. https://www.equinor.com/en/what-we-do/floating-wind.html

[47] WindEurope “Offshore Wind in Europe, Key trends and statistics 2019,” (Feb. 2020) p.21. https://windeurope.org/about-wind/statistics/offshore/european-offshore-wind-industry-key-trends-statistics-2019/

Table 1-1 Planned Floating Offshore Wind Power Projects in Europe

TABLE 4
Floating wind farms coming online in the next three years

COUNTRY	WIND FARM	CAPACITY (MW)	FLOATER TYPE	TURBINES NUMBER AND MODEL	EXPECTED COMMISSIONING DATE[5]
Portugal	Windfloat Atlantic Phase 1	25.0	Semi-sub	3 x V164-8.4 MW (MHI Vestas)	2020[6]
France	EolMed	24.0	Barge	4 x 6.2M152 (Senvion)	2021/2022
	Provence Grand Large	28.5	TLP	3 x V164-9.5MW (MHI Vestas)	2021
	EFGL	30.0	Semi-sub	3 x V164-10.0 MW (MHI Vestas)	2022
	Eoliennes Flottantes de Groix	28.5	TLP	3 x V164-9.5MW (MHI Vestas)	2022
UK	Kincardine	50.0[7]	Semi-sub	5 x V164-9.5MW (MHI Vestas)	2021
Norway	Hywind Tampen	88.0	Spar-buoy	11 x SG 8.0-167 DD (SGRE)	2022

Source: WindEurope

Source: WindEurope, "Offshore Wind in Europe, Key Trends and Statistics 2019" (Footnote 47), Table 4, p. 21

Approximately 229 MW is to be deployed around the world by 2023, and while these remain pilot projects, large-scale commercial projects are set to begin from 2024[48]. In Europe and the U.S., floating offshore wind power is still just beginning, so it is certainly possible for Japan to take the lead in the area of floating offshore wind power. In Asia as well, large-scale floating wind power projects are beginning in Taiwan, China and South Korea[49][50]. Initiatives in Japan need to progress quickly.

[48] NREL, "Floating Offshore Wind Turbines: utility scale by 2024?" energypost.eu (Apr.22 2020). https://energypost.eu/floating-offshore-wind-turbines-utility-scale-by-2024/

[49] Tom Russell, "South Korea reaffirms offshore wind goals," 4Coffshore (Jul.17, 2020). https://www.4coffshore.com/news/south-korea-reaffirms-offshore-wind-goals-nid17793.html

[50] Supra note 36, GWEC, "Global Offshore Wind Report 2020," p.66.

Chapter 2: Tackling Challenges

This chapter reviews the situation in Japan, as taken up in Chapter 1, from the standpoint of policy innovations in countries and regions advanced in offshore wind power, and indicates the direction Japan should take going forward.

1. Ambitious targets and medium/long-term deployment projections

In October 26, 2020, Japan declared its commitment to carbon neutrality by 2050. To ensure that the goals are achieved, it will be necessary to raise the proportion of renewable electricity to at least around 45% by 2030, as has been proposed by REI. Current projections for deployment of offshore wind power in Japan put it at 0.82 GW in 2030, but a target of 10 GW is thought to be necessary[51]. In the undermentioned "Offshore Wind Power Industry Vision (Ver. 1)," the figures are 10 GW in 2030 and 45 GW in 2040[52]. The predictability of this market expansion is critical, both for the continued investment of developers and supply chain industry in offshore wind power, and for promoting competition and lower costs through technology innovation and increased productivity. The government should make these figures the country's official targets.

According to IRENA estimates[53], in order to keep the average increase in global temperatures to an adequately low level of less than 2°C compared to pre-industrial levels (2°C target), it will be necessary to deploy offshore wind power of 228 GW by 2030 and 1,000 GW by 2050 on a worldwide basis. Looking at annual deployment, it can be calculated that a maximum of 28 GW will be deployed by 2030 and 45 GW by 2050. Also, in Europe, a target has been set for deployment of offshore wind power up to 450 GW by 2050, but to realize this, the current pace of 3 GW annually will have to be raised to at least 10 GW, and as high as 20 GW, starting in 2031[54]. To achieve this, supply chains will need to be strengthened, ports, transmission networks and other infrastructure reinforced, financing enhanced, and so on, and to achieve this at lower costs will require making it possible for multiple industries to utilize sea areas simultaneously; there needs to be change in the thinking about sea area utilization.

Further, offshore wind power projects span over 30 years, when considering the time from development to commercialization and the operating period. Moreover, each project has been over several hundred megawatts in scale, required large levels of investment, and has been deemed high risk. Research and development continue to be needed for technology innovation to further lower costs and reduce risk.

2. Enhancement and operation of power grids with a view to large-scale deployment of offshore wind power

If power grids are not enhanced, the electricity cannot be supplied, so it is no exaggeration to say that the fate of offshore wind power in large-scale deployment hinges on the content of the master plan currently being considered by the government. The U.S. state of Texas created a plan to build transmission lines in regions with renewable energy (onshore wind) potential and succeeded in deploying onshore wind power of 11 GW over a period of around 10 years.

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51 REI, "Proposal for 2030 Energy Mix in Japan (First Edition)" (August 2020)

52 In the undermentioned "Offshore Wind Power Industry Vision (Ver. 1) Summary" (December 15, 2020) of the Public-Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power Generation, a figure of 10 GW is stated for 2030. https://www.meti.go.jp/shingikai/energy_environment/yojo_furyoku/pdf/002_02_01_01.pdf

53 Supra note 1, IRENA, "Future of Wind," figure 19, p.43.

54 WindEurope, "Our energy, our future," (Nov. 2019), figure 8, p.30. https://windeurope.org/about-wind/reports/our-energy-our-future/

At present, the initial master plan is expected to be completed in fiscal 2022, but what is needed is a plan that sufficiently considers the potential and benefits of renewable energy, that enables participating generation businesses to secure predictability for their projects, and that presents a vision for the grid that includes large-scale deployment of offshore wind power in 10 years' time (and beyond). If instead of onshore inter-regional connection and onshore intra-regional grid enhancements, it proves to be more cost efficient to transmit power to demand regions directly via submarine transmission lines, then supplying electricity using high capacity submarine lines that span regions should also be considered[55].

Just as discussed, designation as a promotion zone under the Renewable Energy Sea Area Utilization Act is preconditioned on grid enhancement. To make it possible for businesses to predict the timing of grid connection and prevent grid enhancement delays from getting in the way of promotion zone designation, in regions where it is anticipated that there is major potential for deployment of offshore wind power, the government needs to actively initiate all processes, quickly start enhancement procedures, secure capacity and take other operational measures.

Japan, as was also discussed above, has a system by which generation companies bear a portion of the costs for onshore grid enhancements. So, from the additional standpoint of clarifying and reducing connection costs for generators, the cost burden for enhancement of the top two highest voltage onshore grid networks should be socialized (borne by end users). With the Act of Partial Revision of the Electricity Business Act and Other Acts for Establishing Resilient and Sustainable Electricity Supply Systems established in June 2020, enhancements to inter-regional connection and bulk transmission lines are to be subject to cost-benefit analysis, and the benefits of growth in renewable energy deployment in particular are to be borne nationally through the FiT surcharge. There needs to be a mechanism for strictly inspecting the appropriateness of enhancement costs as well as an appropriate system for distributing costs.

Introducing the Generation Side Basic Wheeling Charge, G-Charge, as a cost burden system for transmission grids has been debated, but careful considerations are needed in designing the system so that mass deployment of renewable energy and market competition are not hindered.

3. Enhancing the government's leadership

In the long-term sea area occupancy system under the Renewable Energy Sea Area Utilization Act, the government (METI and MLIT) coordinates the interests of stakeholders by providing information and holding joint committee meetings as part of the process for promotion zone designation. In that the government is responsible for conducting procedures that include coordination with related agencies and other bodies, it can be said that a foundation has been established that is close to the centralized method used in Europe.

At the same time, in Japan, the role of the government does not yet extend to leading the deployment of offshore wind power as seen in Europe.

First of all, selection of promotion zones at present is not done through active studies by the government; rather, it depends on proposals (information) from local governments and businesses. Very little time has passed since enactment of the Renewable Energy Sea Area Utilization Act, so to promote rapid deployment primarily by transferring projects already being formed, it would be rational to prioritize the intentions of regions where conditions are ripe as a result of initiatives to date. However, after this transitional period, the government needs to more actively conduct studies that cover all of Japan and move forward with designating promotion zones.

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[55] Regarding the demonstration project of Tokyo Electric Power Company Holdings, refer to the company's press release, "Regarding Implementation of Multi-Purpose, Multi-Terminal DC Transmission System Basic Technology Development Project" (July 14, 2020). In addition, in connection with utilization of submarine transmission lines for large-scale deployment of renewable energy, including offshore wind power, the Japan Wind Power Association has put forth its Japan Super Grid vision and the environmental NGO Environmental Watch Tokyo has published the Ryugu Power Transmission Plan. Moreover, the Asia Super Grid Study Group is considering routes for international connectors and domestic submarine transmission lines that assume domestic transmission of renewable energy, and is making related cost estimates.

Next, with respect to environmental impact assessments, the issues are reducing long-term risk and raising efficiency, and the limits of the provider-led system need to be overcome. Prolonged environmental impact assessments have also been problematic in connection with deployment of onshore wind power[56]. In advanced countries and regions for offshore wind power, to promote more efficient environmental impact assessments, government agencies actively disclose and share information, but as we have discussed, in Japan, this is limited. In the U.K., Germany and the U.S., where developers take the lead in conducting environmental impact studies, as is the case in Japan, strategic environmental assessments are conducted ahead of specific projects, but in Japan, such a system is not established by law and there is no system for disclosing or sharing information acquired through such process.

If environmental studies conducted by developers at their own expense can be integrated and the redundancies in studies performed by developers reduced, it would reduce overall costs related to development of the power plant. Like sea area designation in the U.K. and environmental impact assessments in Denmark and the Netherlands, the method needs to be adopted in which surveys are led by a government agency.

Additionally, the information disclosure and sharing is important not only before a project begins but also after it has been operating. The impact of offshore wind power projects on the natural environment and fishing industry has been subject to a host of studies already, but it has not yet been clarified adequately. Conducting surveys and studies based on a large amount of data could help clarify and sharpen future environmental impact studies for individual projects as well as help reduce the risk of the studies being prolonged and the cost to developers (and therefore to society in general). This would also make data-based dialogue with stakeholders possible, and, with this serving as a foundation for deepening understanding of offshore wind power, it would further facilitate project implementation. In Europe, studies are continued for a certain period of time after projects are completed and these studies are consciously compiled, but in Japan, though there have been efforts to compile and publish information from environmental impact assessments and post-project studies, they have been limited. Discussion and debate need to take place on compiling and sharing environmental impact information for offshore wind power[57][58].

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[56] In light of the awareness of this problem, operational improvements are being considered to shorten the period through demonstration projects and other means. The effectiveness of this will need to continue to be verified.

[57] METI, "Report of the Committee to Study Environmental Impact Assessment for Offshore Wind Power Facilities" (December 2018), p. 56, makes the following points. "Information related to environmental impact assessment reports is disclosed by MOE, MLIT, and some local governments, but nearly all the reports can only be viewed during the public notice and inspection period; after that they are not available and no information is shared." "The content included in environmental impact assessment reports is copyrighted by the provider, which creates the report, but because the reports constitute up-to-date environmental information, it is important from the standpoint of Japan's environmental protection for the information to be shared widely." "In the process of assessing environmental impact, a range of environmental information is acquired, so there needs to be a mechanism for sharing this information on the sea area environment and post-project study results. In addition, if this information is compiled and shared, it can help to improve predictive modeling technologies and can also be expected to promote consideration of more effective environmental protection measures." https://www.meti.go.jp/meti_lib/report/H30FY/000627.pdf. When providers make studies of sea areas, they must notify ANRE and MLIT in advance, but they are not required to report the study results (ANRE, Energy Efficiency and Renewable Energy Department, New and Renewable Energy Division, and MLIT, Ports and Harbours Bureau, Ocean and Environmental Policy Division, "Regarding Studies to Acquire Data on Wind Conditions, Sea Bed Terrain, etc. for Establishment of Offshore Wind Power Facilities" (2019)). https://www.enecho.meti.go.jp/category/saving_and_new/saiene/yojo_furyoku/dl/legal/kaiyou_research.pdf

[58] The deliberation process and member names of the third-party committee for zone selection and operator assessment in selection procedures are stipulated as not to be disclosed (ANRE, METI and MLIT, Ports and Harbours Bureau, "Promotion Zone Designation Guidelines for Development of Marine Renewable Energy Power Generation Facilities" (June 2019), p. 11, and, "Operating Guidelines for Public Bidding on Exclusive Occupancy and Use of Territorial Sea Areas" (June 2019), pp. 23-24, etc.). While considerations need to be given for the fair administration of third-party committees, from the standpoint of ensuring appropriate procedures, it is also important to maintain trust by having a system for verifying the fairness of the selection process after the fact. Appropriate information needs to be disclosed, include the names of committee members.

Councils can play a major role in coordinating with stakeholders. For sea area utilization, coordination with the fishing industry, recreational use and other local sectors is essential. Previous dialogue and coordination with stakeholders depended largely on a case-by-case response by the developer, but under the Renewable Energy Sea Area Utilization Act, the government also has a large role to play through council discussions and the creation of the Guidelines for Public Tender of Exclusive Occupancy and Use. Information disclosure and dialogue with stakeholders should not be left up to the developer; when the government takes the lead, trust shifts from individual project developers to the projects themselves. This means that, from the point of view of operators, they can expect to participate in projects with less risk related to stakeholder coordination because of the involvement of the government, and competition on the same level playing field becomes possible. As information disclosure and sharing progresses and a competitive environment is established, cost reductions can then become the aim.

In the four zones designated as promotion zones as of August 2020, it is thought that the councils proceeded relatively smoothly, and one factor for this was no doubt the advance coordination done by the operator. However, as promotion zone designations increase going forward, advance coordination by individual operators cannot necessarily be expected, and expecting such coordination would not be appropriate. The government should play an active role in councils.

Enhancing the leadership role played by the government reduces costs and drives the accelerated deployment of offshore wind power; this can be learned from the experience of Europe. Japan should also switch from the conventional operator-led scheme to a scheme led by the government[59].

4. Creating an environment for fair competition and stable projects

To secure a fair competitive environment, information disclosure and sharing is extremely important. With increased attention being given to the potential of Japan's market, not only in Japan domestically but around the world, promoting market participation and investment by many foreign and domestic project operators will lead to lower costs. The foundation for this is establishment of a fair competitive environment, and it will be important to actively promote information disclosure and sharing.

The importance of information-sharing, as stated above, is acknowledged in the government's design of the system[60]. Currently, information provided by the government, as of the formulation of the Guidelines for Public Tender of Exclusive Occupancy and Use, consists of weather forecasting data for wind conditions, data on marine phenomena and the seafloor. Information is also provided on onshore grid connection. In addition, regarding information related to councils that has an important impact even on the Guidelines for Public Tender of Exclusive Occupancy and Use, the council's discussions and summaries are disclosed, and opportunities for dialogue established between council members and operators interested in participating in the tender. However, with respect to the type of information shared, the conditions for accessing the information (nearly equivalent conditions to bidding requirements), and the timing for information-sharing beginning, it cannot be denied that the scope is narrower than that of offshore wind-developed countries and regions. Whether this environment is adequate will need to continue to be verified.

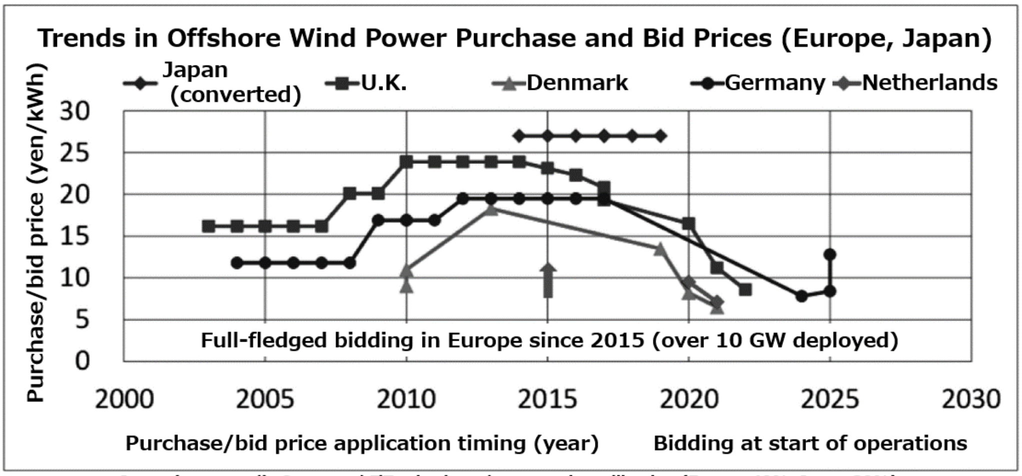
[59] This change should be made by around 2025. Germany decided to switch to a centralized system based on legal revisions made in 2017, and four years later, in 2021, bidding will begin under the new system.

[60] Supra note 15, "Interim Report," pp. 32, 37.

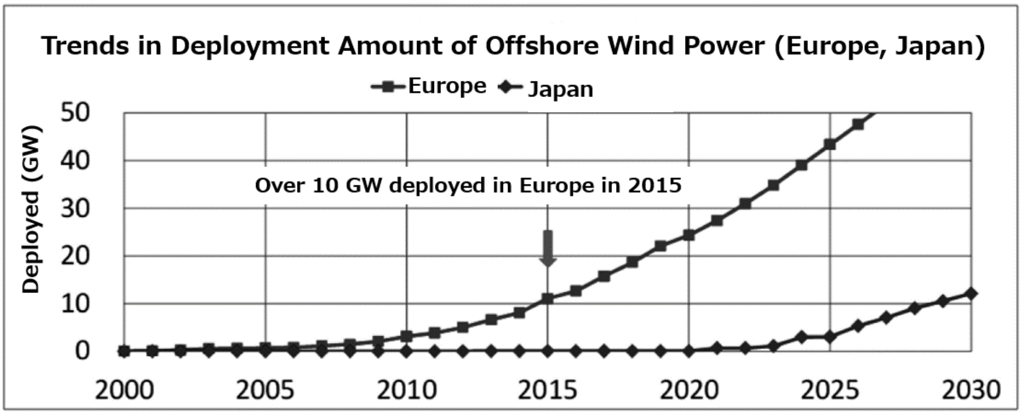
It is also essential to ensure the fairness of operator selection. Operator selection under the Renewable Sea Area Utilization Act, in the case of bottom-fixed platforms, involves an evaluation that puts highest priority on price, but there is also a comprehensive evaluation that looks at project execution ability, local coordination, and project ripple effects, so there is a strong need for transparency in the specific evaluation items and standards. Evaluation criteria and scoring are already disclosed, but attention needs to be paid to how this works going forward when actual evaluations are made. More information on the results of selection should also be made available to the extent that the interests of individual operators are not damaged.

In Japan, even though small-scale commercial projects have just gotten started, operators for bottom-fixed projects are already selected via competitive bidding. In most countries, competitive bidding is introduced only after projects of a certain scale have made progress and an adequately sized market has been established domestically (Figure2-1). If cost reductions are rushed and strict competition is enforced through setting a maximum price, Japan’s market could lose its appeal and investment could decline.

Figure2-1 Offshore Wind Power Deployment Volume and Acquisition and Bid Prices in Europe and Japan



Japan (converted): Converted FiT price based on capacity utilization (Europe 40%, Japan 30%)
27 yen/kWh=36×30/40



Source: Kaizu, Nobuhiro, “Offshore Wind Power Project Cost Issues and Forecasts,” Japan Wind Energy Association Journal Vol 42, No. 2 (2018), Diagram 5, p. 157https://www.jstage.jst.go.jp/article/jwea/42/2/42_154/_pdf

Globally it is true that power generation costs are reduced as offshore wind power begins to be deployed and turbines become larger. For bottom-fixed projects, generating costs were 16.9 USD/kWh in 2015 but 11.5 USD/kWh in 2019. Further, based on recent bidding and figures in power purchasing contracts, the average price at facilities to begin operations in 2023 will be 8.2 USD/kWh, so further price reductions are expected[61].

To make it possible to further reduce the cost of offshore wind power in Japan through the introduction of a bidding system will require a rationally designed system, as well as related regulations, rationalization of the approval process, and an ambitious long-term target to promote investment.

In recent years, there has been an increase in long-term supply contracts for electricity originating in renewable energy with end users interested in projects that use renewable energy (corporate PPA). There are already several examples of these contracts in Europe and Taiwan that use offshore wind power[62]. If offshore wind power providers can conclude corporate PPA with end users, it is possible to make projects stable while the risk of fluctuations in electricity sales revenue is avoided. Along with increasing demand by end users, designing a system that allows these contracts to be used is also important.

5. Building sustainable supply chains

In Japan, which does not have any turbine manufacturers, there are no manufacturing sites for turbines in the country, so most components have to be imported from other countries. Offshore wind turbines (nacelle, blade and platform) and submarine transmission facilities are large and costly to transport, so this situation could become a factor preventing lower costs for offshore wind power projects. If necessary machinery and components could be procured or assembled locally, costs could be reduced. Further, the supply chain is not only for turbines and their components. Turbine assembly, construction work for installation, and post-launch operations and maintenance (O&M) are indispensable to offshore wind power projects. A supply chain strategy is needed that considers enhancement of the supply chain in this broad sense (Table 2-1). Building a supply chain that Japanese companies take part in can be expected to have major economic ripple effects, create many new jobs[63] and benefit the local region[64].

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[61] IRENA, "Renewable Power Generation Costs in 2019," (Jun. 2020) p.75, p.84. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Jun/IRENA_Power_Generation_Costs_2019.pdf

[62] For examples in Europe, see John Parnell, "What Offshore Wind Can Bring to the Corporate PPA Party," GTM (Jun. 1 2020). https://www.greentechmedia.com/articles/read/what-offshore-wind-can-bring-to-the-corporate-ppa-party. In addition, the Taiwan example is a 20-year contract between Ørsted (approx. 900 MW project scheduled to begin operation around 2025) and TSMC.

[63] According to estimates made by JWPA in 2018, if 10 GW is deployed by 2030, it would mean direct investment of around 5.1-5.7 trillion yen, economic ripple effects of approximately 13-15 trillion yen, and new jobs for around 85,000 to 95,000 people as of 2030. JWPA, "For the Promotion of Offshore Wind Power Deployment: Particular Issues and Prospects Related to the New Offshore Wind Power Act" (March 16, 2018), Slide 28. http://jwpa.jp/k5u8z6e6/gfisf4vk/180316_offshore_request.pdf

[64] Akita Prefecture has estimated the economic ripple effects in the prefecture from the deployment of offshore wind power. If offshore wind power facilities are built in harbors and general sea areas (a total of six locations) in the prefecture, orders received by prefectural companies could total 269.1 billion yen (approximately 26% of the estimated project costs of 1,046.9 billion yen). Akita Prefecture, Department of Industry and Labor, "2020 First Regular Meeting (June Assembly), Industry and Tourism Committee/Subcommittee, Submitted Document," pp. 3-4. https://www.pref.akita.lg.jp/uploads/public/archive_0000051002_00/6%E6%9C%88%E6%89%80%E7%AE%A1.pdf

Table 2-1 Future Prospects for Wind Power-related Industries

Industry	Notes
Manufacturing	Wind turbines, components, and floating platforms
Construction	Installation, engineering (onshore), offshore engineering, transport (onshore and offshore), chartering
Maintenance	Onshore and offshore
Power providers	Generation and sale
Financers	Financing, funding, bonds
Power intermediaries	Power aggregation, wholesale electricity market
ESM and DSM	Power control for users, integrated control for supply-demand balance
Consulting	Design of maintenance parts related to turbines, power output prediction, marine consulting, repowering consulting
Other	Certification services

Source: JWPA, “JWPA Wind Vision Report” (February 2016), Table 4.5-1, p. 79
http://jwpa.jp/pdf/20160229-JWPA-WindVisionReport-ALL.pdf

Formation of industrial clusters and base ports

Offshore wind power is marked by high construction expenses and maintenance and management costs, and the key to reducing these costs is having a base port followed by a cluster of backing industries. Turbine components are brought to the base port for processing and assembly, and when they are ready, they are loaded onto ships and brought out to sea to build the facility. This allows turbine construction to take place over a short period of time. Shorter construction times will make it possible to reduce the risk of construction delays and lower chartering costs. Parts are kept in stock at the base port, so when the turbines need maintenance or repair, the parts are loaded at the port and repair work can be completed in a short amount of time[65]. This type of project management is enabled by appropriately developing an industrial cluster and base port.

The Japan Dredging and Reclamation Engineering Association estimates that to achieve deployments of 10 GW by 2030, it will require seven base ports (pre-assembly sites) nationwide, and to make possible the stable and planned deployment of 15 GW, it will require ten of these sites[66]. Developing ports and industrial clusters requires land, roads, and other infrastructure, so the initiative of local governments is indispensable. There are many examples of base ports overseas where testing facilities and research and educational institutions have been built. A plan for the integrated development of base ports and the building of supply chains needs to be carried out in concrete terms with the deep involvement of the central government, local government and industry.

[65] The information in this section makes reference to Iwamoto, Koichi, “Regional Promotion and Employment Creation from Formation of Offshore Wind Power Industry Base,” RIETI Policy Discussion Paper Series 16-P-004 (February 2016).

[66] Japan Dredging and Reclamation Engineering Association, “Issues in Offshore Wind Power Farm Construction and the Organization of Base Ports” (July 17, 2020), Public-Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power Generation, 1st meeting, Document 4-2, p. 8.
https://www.meti.go.jp/shingikai/energy_environment/yojo_furyoku/pdf/001_04_02.pdf

Technology development

High-quality components and new technologies will be capable of competing on the offshore wind power market not only in Japan but globally where market growth is accelerating. For existing technologies, supply chains have already been built and it may be difficult to compete in some cases. One of the goals then should be to develop future technologies and work to build new supply chains. There is a wide range of areas where technology innovation is needed (Table 2-2). It will be important to develop technologies to raise capacity factor and conduct operations monitoring, materials to increase the size of turbines and platforms and increase their durability, and also monitoring technologies for the marine environment to appropriately assess the impact of offshore wind power on the environment. Platform innovations are also needed for the mass deployment of floating assemblies.

Table 2-2 Technology Innovations to Reduce the Cost of Bottom-fixed Offshore Wind Power

Main category	Secondary category	Technology item
Site development	Studies	Seabed soil Remote sensing wind measurements (LIDAR) Advanced wake models Optimization of wind turbine layout
Construction	Turbine	Increase size Integrated design tools Longer lifetime Longer and slender blades Two bladed rotor Segmented blades Lighter nacelles Modulization Advanced inflow wind measurements (spinner LIDAR, etc.) Advanced control (wake load reduction, etc.)
	BOP	Advanced platform substructures Longer lifetime platforms Advanced/short timespan installation methods Installation vessels Offshore substations Submarine cables Optimization of cable positioning (ensure generating capacity when damaged) Scour protection
Operations	O&M	Smart maintenance (CMS, etc.) Automation (robots, AI, IoT, etc.) Reduced coating frequency for platform structures Crew transfer vessels Service operation vessels Detection of submarine cable damage position Scour monitoring
Decommissioning		Decommissioning methods

BOP: Balance of Plant

Source: Imamura, Hiroshi and Yuko Ueda, “Considerations on Technologies for Reducing Wind Power Costs,” Japan Wind Energy Association Journal Vol. 41, No. 4, Table 3, p. 636. https://www.jstage.jst.go.jp/article/jwea/41/4/41_633/_pdf

Technology development need not only be the initiative of individual operators; various companies could participate in joint R&D projects and widely share the results while receiving financial assistance from the government. Such joint industry programs are utilized in Europe for offshore wind power development[67]. Japan should also consider carrying out research and development on this model.

If entering the global market with a view to reducing costs through mass production of components, then standardization of parts and technologies becomes important. Deploying offshore wind power in Japan requires reliable machinery and technologies that match weather conditions in Japan, which differ from other regions, but it should be noted that emphasizing Japan's uniqueness and creating products and technologies tailored too specifically to Japan will result in higher costs and could narrow supply chain markets.

Human resources development

The development of human resources to support large-scale deployment of offshore wind power is an urgent task. Many people with different skills are involved in offshore wind power, from wind power farm planning to construction and operations[68], but for construction and installation, and for maintenance and management of facilities extending over 20 years, people are needed who are able to engage in work in high places out at sea. In Europe, skills acquired in the offshore oil and gas industry can be utilized in offshore wind power, but this industry does not exist on a large scale in Japan. For this reason, development of human resources becomes even more important, and it can also be expected to create job opportunities in a new category of employment. An estimated 2,150 people[69] with sufficient skills and training for building and installing offshore power facilities will be needed in Japan by 2024, and over 8,600[70] will be needed by 2030. In addition, with technology innovations (use of AI, etc.) in remote automated control systems used in maintenance and management, it will also be important to hire experts in data science, computer engineering, IT, and other areas[71]. To secure and develop these human resources, training schemes and educational organizations need to be created and related educational programs offered at higher education and research institutions, including colleges. This must be consciously undertaken through cooperation between the government and operators.

Nagasaki Ocean Academy opened on October 1, 2020, a human resources development institute related to marine energy, including offshore wind power[72]. The academy was founded by The Nippon Foundation, Nagasaki Marine Industry Cluster Promotion Association, Nagasaki Prefecture, Nagasaki University, and Nagasaki Institute of Applied Science. As Asia's first human resources development organization for marine energy, it provides an educational curriculum for marine energy like offshore wind power and aims to train 1,600 people over five years[73].

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67 TEPCO currently participates from Japan in R&D projects on floating offshore wind power conducted by Carbon Trust. Carbon Trust website, "Floating Wind Joint Industry Project."
https://www.carbontrust.com/our-projects/floating-wind-joint-industry-project

68 According to the American Wind Energy Association (AWEA), it involved 74 different occupations. AWEA, "U.S. Offshore Wind Power Economic Impact Assessment" (March 2020), p.4.
https://supportoffshorewind.org/wp-content/uploads/sites/6/2020/03/AWEA_Offshore-Wind-Economic-ImpactsV3.pdf

69 Assuming 2.5 people per 1 MW and 860 MW to be built by 2024. Global Wind Organization, GWEC, "Powering the Future, Global Offshore Wind Workforce Outlook 2020-2024," (April 2020), p.5. https://gwec.net/powering-the-future-report/

70 Estimated by The Nippon Foundation. On the establishment of Nagasaki Ocean Academy, on the Nagasaki Ocean Academy website https://noa.nagasaki.jp/about

71 Supra note 36, GWEC, "Global Offshore Wind Report 2020," p.29.

72 Nagasaki Ocean Academy website https://noa.nagasaki.jp/

73 The Nippon Foundation, "Classes Begin at Nagasaki Ocean Academy" (September 30, 2020)
https://www.nippon-foundation.or.jp/who/news/pr/2020/20200930-49758.html

Departments specializing in wind power might also be established at higher education institutes. In Europe, there is a wind energy department at the Delft University of Technology in the Netherlands[74], and four universities (TU Delft, Technical University of Denmark, Norwegian University of Science and Technology, University of Oldenburg) have jointly established the European Wind Industry Master degree program[75] to train specialists in the field. Establishing a similar department at Japanese universities are anticipated.

Establishment of cooperative relationship between the government and industry and a framework for strategic promotion

Building a sustainable supply chain in Japan is achievable. The government needs to indicate a direction for the future and provide required support to related industries, and industry needs to commit to this. The government should actively support technology development by universities and companies (including small and medium-sized companies). Also, industry needs to actively provide information on necessary components and technology trends and commit to procuring competitive parts and developing technologies in Japan.

The public-private council that was touched on previously (Chapter 1.1) has presented the results of the U.K.'s Offshore Wind Sector Deal as an example of a progressive government initiative, and also expressed the importance of government and industry addressing issues jointly. Specific policies need to be formed from the results of these deliberations and carried out accordingly. What is important is building a system for promoting strategy. When it formulated its offshore wind strategy in 2013, the U.K. established the Offshore Wind Industry Council (OWIC) with representatives from related government agencies and industry[76]. The council is a venue for dialogue between government and industry, and it also oversees progress on the strategy. Established at the same time were the Offshore Wind Programme Board for promoting policies aimed at cost reductions and the Offshore Renewable Energy Catapult for supporting R&D projects through coordinating government, industry and academic institutions and facilitating information-sharing between them, so in this way a framework was established for promoting the government's offshore wind power strategy. Under the Sector Deal of 2019, the OWIC is the promotion organization, and there is a system in place for coordinating with the government's Department for Business, Energy & Industrial Strategy. Japan should make its public - private council permanent and continue using it as venue for concretely analyzing its industry and integrating this into government policy. In addition, there is the need to establish a public-private consultative body to execute policy and conduct monitoring.

In East Asia, there are the major markets of Taiwan, South Korea, and China, and most countries have already started nurturing industries. The Japanese government needs to quickly develop specific policies to build a supply chain that is able to compete globally.

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[74] TU Delft "Wind Energy" https://www.tudelft.nl/en/ae/organisation/departments/aerodynamics-wind-energy-flight-performance-and-propulsion/wind-energy/

[75] European Wind Energy Master, Double Degree Joint Education Programme website. https://ewem.tudelft.nl/

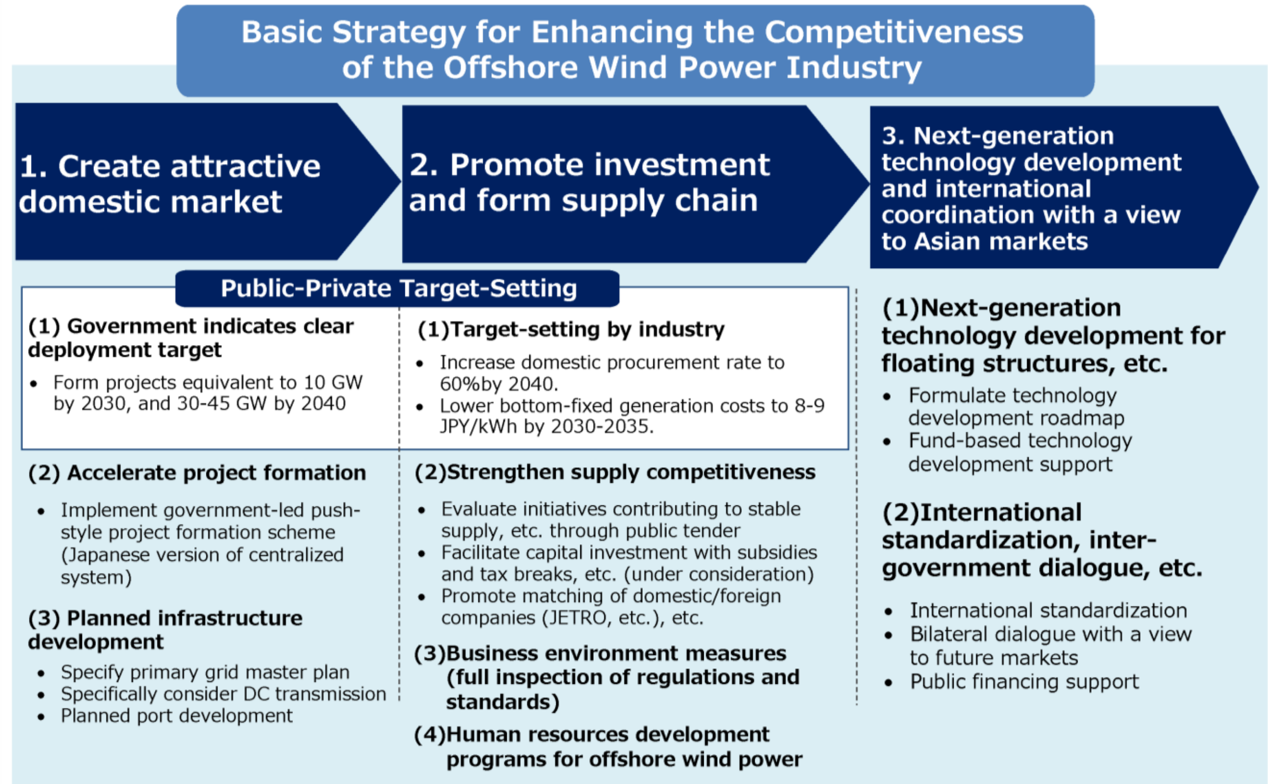
[76] Regarding the information in this paragraph, see "Offshore Wind Cost Reduction Task Force Report," (June 2012), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/66776/5584-offshore-wind-cost-reduction-task-force-report.pdf, HM Government, "Offshore Wind Industrial Strategy Business and Government Action," (August 2013). https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/243987/bis-13-1092-offshore-wind-industrial-strategy.pdf, and Department for Business, Energy & Industrial Strategy, "Offshore Wind Power Industry Policy" (translated by the British Embassy Tokyo) (2019) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/808640/Offshore_Wind_sector_deal_web_optimised_Ja.pdf

(Postscript)

On December 15, 2020, the Public-Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power Generation released the "Offshore Wind Power Industry Vision (Ver. 1)." The vision substantially raises the government's target for deployment of offshore wind power, sets cost reduction and domestic procurement rate targets for the industry, and comprehensively consider the major issues, including enhancing the business environment, strengthening supplier competitiveness, and developing technologies.

The government's target was increased significantly, to 10 GW in 2030 and 30-45 GW in 2040. It also calls for demonstration projects to be conducted in order to introduce a government-led project formation scheme (mechanism for more quickly and efficiently studying wind conditions and securing timely grid connection, with the involvement of central and local governments from the initial stage). In addition, the industry's generating cost target (bottom-fixed) is set at 8-9 JPY/kWh by 2030-2035. The domestic procurement rate, in terms of overall lifetime in Japan, is stated at 60% by 2040, and selection of operations through public tender is to take this rate into account.

Figure2-2 Summary of Basic Strategy in Offshore Wind Power Vision (Ver. 1)



Source: Public-Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power Generation, "Offshore Wind Industry Vision (Ver. 1) Summary" (December 15, 2020)
https://www.meti.go.jp/shingikai/energy_environment/yojo_furyoku/pdf/002_02_01_01.pdf

The announcement of this vision represents a major step forward in that the government and industry have cooperated to set a shared target and indicate a direction for promoting offshore wind power deployment. To ensure this vision does not come to naught, it will be important for the public and private sectors to cooperate in maintaining a framework for continued execution and monitoring of government policy.

Chapter 3: Conclusion

Natural disasters are becoming increasingly severe in Japan and around the world, due to the impact of climate crisis. This is becoming a grave problem that threatens people's lives. Many of the regular activities of society have been put on hold recently due to the COVID-19 pandemic, and this has alerted us again to the impact human activities of various kinds have on the environment while initiating and accelerating transformation to a new type of society with new lifestyles. When the regular activities of society resumes, we must not return to the status quo; we need to strive to build a better society, and in the energy sector, we must reaffirm the need to increase investment in the utilization of renewable energy.

Offshore wind power is one of the pillars that will support this new society. Its scale and stability as a power source will make it a pillar of energy supply and driver promoting the industry's conversion. This conversion from the offshore oil and gas industry, and the participation of material industries like steel and heavy industries like shipbuilding, will support offshore wind power in a broad industry. It can also be expected to help end industry's dependence on fossil fuels.

On October 26, 2020, the Japanese government declared it would set the policy target of net-zero greenhouse gas emissions by 2050. Offshore wind power is a key power source that will help the country achieve this goal, and whether it expands in any substantial way will depend on government policy over these next ten years.

Japan has taken its first step to propelling a new society with wind that blows freely on the sea. Now is the time to quicken the pace.

Offshore Wind Power to Support Japan's Energy Needs

Institutions, Infrastructure and Industries for Large-Scale Deployment

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