



FLOATING FORM WIND TURBINE HIBIKI MANUFACTURED BY HITACHI ZOSEN CO., LTD., INSTALLED 15 KILOMETERS OFFSHORE OF KITAKYUSHU CITY.

JAPAN

At the end of 2020, Japan's wind power capacity reached 4,439 MW (of which 57.6 MW is offshore wind). Most of the wind power installed in Japan is onshore wind power.

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The total number of wind turbines was 2526, an increase of 116 in 2020. The amount of wind capacity installed in 2020 was 1.9 times that of 2019, which is the largest new single-year installation

amount ever. The launch of several large-scale projects has contributed to this. The national capacity factor (average national capacity factor) was 20.8%, and the ratio of wind power to total electricity supply and demand in Japan was 0.89% (7.64/857.8 TWh). In research and development, in order to promote offshore wind power, the New Energy and Industrial

TABLE 1. KEY NATIONAL STATISTICS 2020: JAPAN

Total (net) installed wind power capacity*	4.44 GW
Total offshore capacity	0.06 GW
New wind power capacity installed	0.52 GW
Decommissioned capacity (in 2020)	0 GW
Total electrical energy output from wind	7.64 TWh
Wind-generated electricity as a percentage of national electricity demand	0.89%
Average national capacity factor**	20.8%
Target	10 GW of wind power capacity by 2030
National wind energy R&D budget	7.65 bil JPY; 76.5 mil USD

Technology Development Organization (NEDO) started a national project in 2020 to develop maintenance technology and wind turbine components to reduce the cost of offshore wind power.

Market Development

Targets and policy

The Ministry of Economy, Trade and Industry (METI)'s Fifth Energy Strategy aims to increase the ratio of renewable energy to power source composition as of 2030 from 22% to 24%, of which the ratio of wind power should be about 1.7%. In order to reach this target and in recognizing the importance of promoting offshore wind power, the government has enacted a new law: the Act of Promoting Utilization of Sea Areas in Development of Power Generation Facilities using Maritime Renewable Energy Resources (effective April 2019). This law stipulates how offshore wind power generation business should be conducted, and under it, the following process should be adhered to:

- The government will designate promotion areas and formulate guidelines for public offering occupancy plans.
- Businesses will then submit a public offering occupancy plan to the government (METI and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT)).
- The government will select the business operator with the most appropriate publicly offered occupancy plan and approve the plan.

Movements toward the designation of promotion areas by the end of calendar year 2020 are as follows:

In July 2019, the first announcement of areas considered to have progressed to a certain level of preparation suitable for starting projects (11 areas) and promising areas (4 areas) was made. In December 2020, (1) The area off the coast of Goto City, Nagasaki Prefecture, was designated as a promotion area out of 4 promising areas and started public offering for business operators. The ministry also unveiled plans to designate the remaining three areas.

The process of selecting a promotion area is expected to continue in the following order:

In 2020, Japan's wind power facilities increased by 516 MW (up 13.2% from the previous year), and this increase meant that power supply and demand from wind power generation grew nationwide from 0.76% the previous year to 0.89%. A public-private council has been launched to enhance the industrial competitiveness of offshore wind power. The targets for installing offshore wind power in 2030 and 2040 are summarized below.

Areas considered to have progressed to a certain level of preparation suitable for starting projects promising areas → promotion areas.

Progress and operational details

Japan installed a new wind power capacity of 516 MW in 2020, most of which was onshore wind. The number of wind turbines increased by 116. The amount of new wind power capacity installed in 2020 was 1.9 times that of 2019, which is the largest amount of new wind

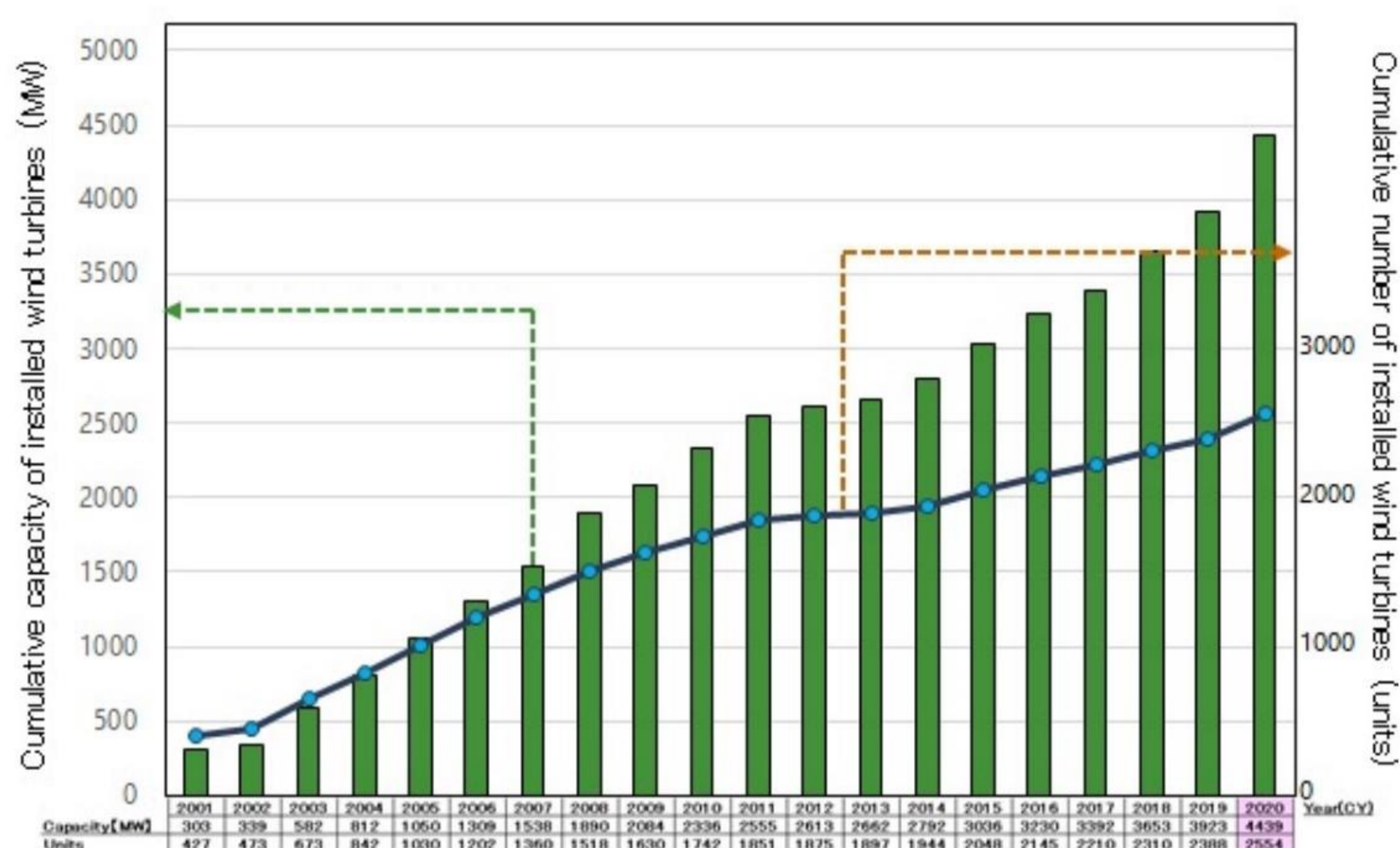


FIGURE 1. DEPLOYMENT AND INSTALLED CAPACITY OF WIND POWER IN JAPAN. SOURCE: JAPAN WIND POWER ASSOCIATION

power capacity installed in a single year ever. This is because eight years have passed since the enactment of environmental assessment legislation in 2012, and several large-scale projects have been launched since then. Cumulative wind power capacity at the end of 2020 reached 4,439 MW with 2,554 turbines (Figure 1), and the average size of newly built wind turbines increased to 2.7 MW.

The total amount of electricity generated by wind power in 2020 was about 7.64 TWh, which was 0.89% of the national electricity demand of 857.8 TWh.

Japan’s offshore wind capacity in 2020 was 67.6 MW. As part of NEDO’s Hibiki project, a barge-type floating wind turbine (3 MW) has been installed off the coast of Kitakyushu City and is undergoing demonstration operation.

Matters affecting growth and work to remove barriers

The government has established a public-private council to enhance the competitiveness of the offshore wind power industry in order to promote the cost reduction of offshore wind power in preparation for the mass installation of offshore wind power generation. The council’s first meeting was held on July 17, 20201 (https://www.meti.go.jp/shingikai/energy_environment/yojo_furyoku/001.html).

The following figure shows Japan’s approach to the competitiveness of its offshore wind industry (figure 2).

- To make offshore wind power a key power source, it is necessary to enhance the competitiveness of related industries and reduce costs.

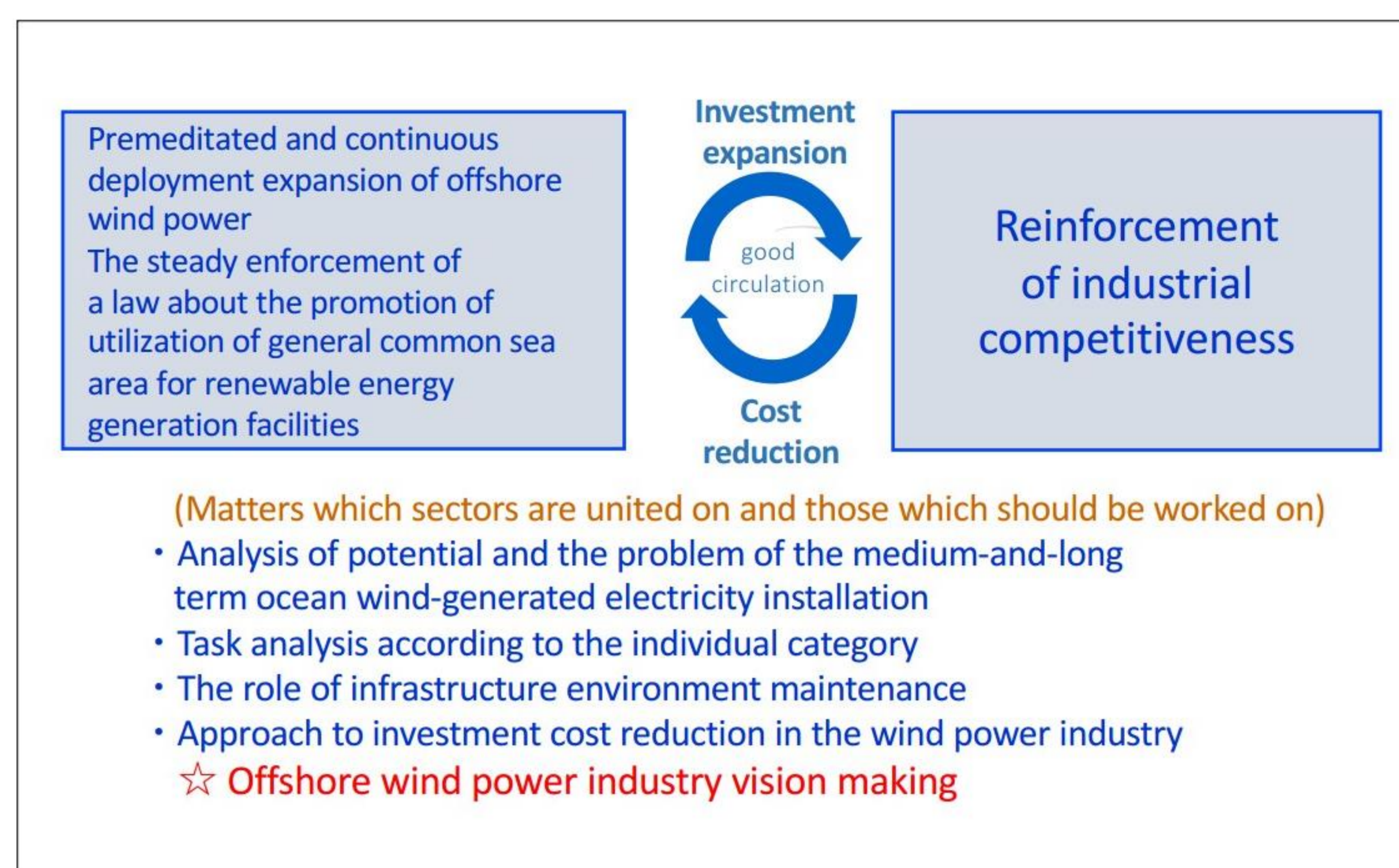


FIGURE 2. OUTLINE OF PUBLIC AND PRIVATE SECTORS JOINT COUNCIL EFFORT.

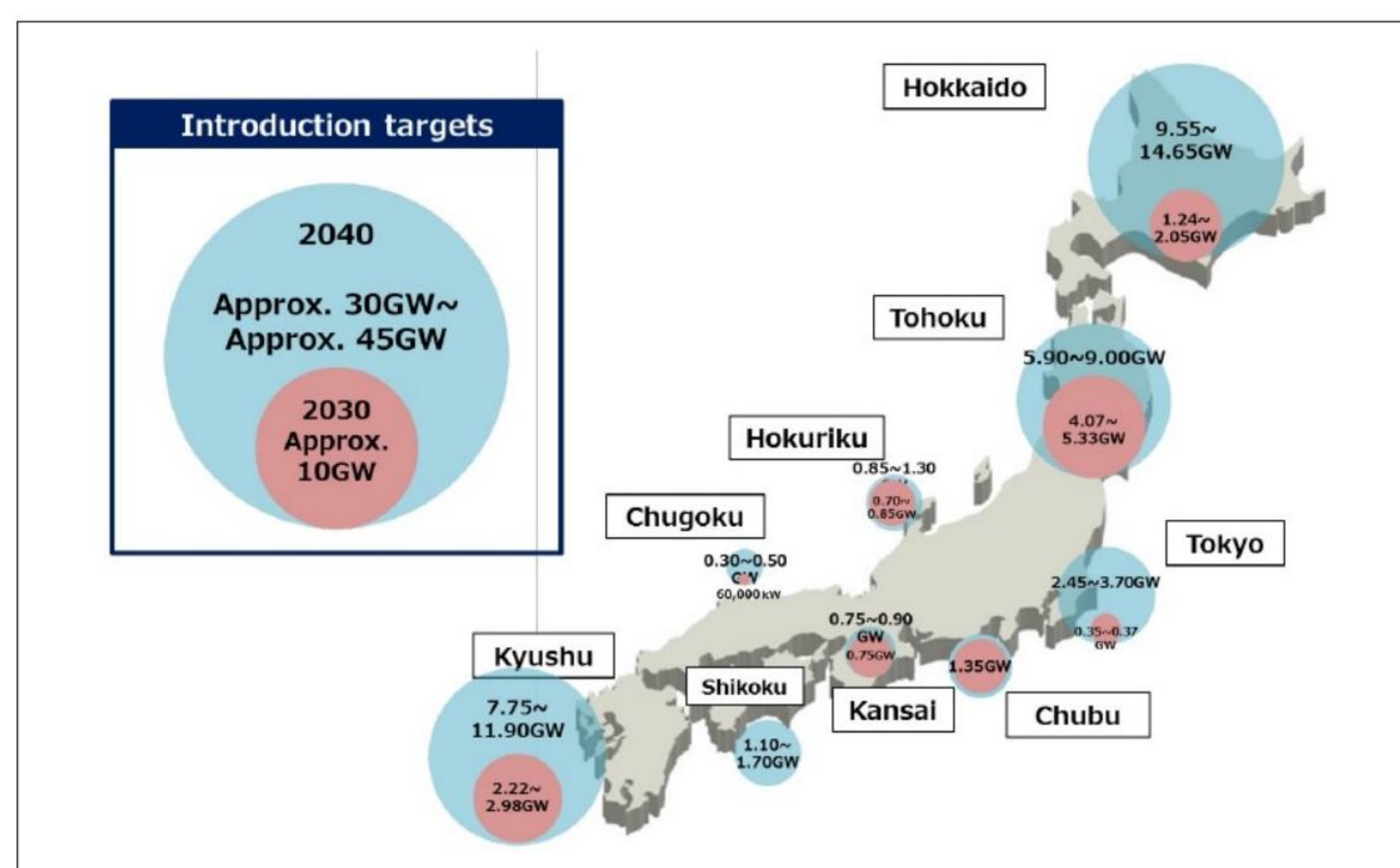


FIGURE 3. OFFSHORE WIND POWER GENERATION CAPACITY IN JAPAN ³⁾

- The key to enhancing competitiveness and reducing costs is expanding investment. Prospects for Japanese market expansion need to be shown.
- It is necessary to ensure the predictability of planned and continuous expansion of installation of wind power facilities, to enhance the competitiveness of related industries, and to reduce costs in a unified manner between the public and private sectors to create a mutual “virtuous cycle.”

Regarding the vision for the offshore wind industry, the initial vision was presented at the second meeting of the Offshore Wind Public-Private Council (December 15, 2020).

In it, the targets for introducing offshore wind power in 2030 and 2040 are summarized (Figure 3). Discussions with the public and private sectors will continue in order to make efforts toward realizing our vision. (https://www.meti.go.jp/shingikai/energy_environment/yojo_furyoku/pdf/002_02_e02_01.pdf)

RD&D Activities

National research initiatives and results

METI and NEDO manage major national wind power research and development programs in Japan. Many of these programs focus on reducing the levelized cost of energy of wind power, especially offshore wind.

Offshore wind power generation technology research and development (2018–2022) achieved the following results in 2020:

Barge type floater: NEDO developed and demonstrated a floating wind turbine that can be installed in seawater over 50 meters or deeper. In 2019, the installation was completed at a depth of 50 meters, 15 km off the coast of Kitakyushu City, and a demonstration operation was started. In 2020, continuing from the previous year, NEDO conducted a design verification based on floating body motion data measured using a demonstration turbine and obtained data that contributes to cost reduction by reviewing the design standards currently established for safety.

Newly designed floating body: NEDO has been working on the development of new elemental technology for floating offshore wind power generation systems. A survey was conducted in the latent sea area and various basic designs were made using advanced elemental technologies. NEDO also conducted a feasibility study to determine the content of the demonstration experiment and worked on the production of the demonstration turbine. The newly designed floating body aims to reduce the power generation cost after 2030 to 20 yen/kWh (0.16 EUR/kWh, 0.18 USD/kWh).

Another research and development program from METI and NEDO focuses on further reducing the cost of wind energy. The research and development program for advanced application technology for wind power generation (2013–2021, extended by one year due to the new coronavirus disease) includes the following:

Research and development on advanced operation of power turbines: NEDO is developing advanced operation support technology for wind turbines. The purpose is to reduce domestic wind turbine downtime by increasing the wind turbine utilization rate to over 97%. To that end, NEDO is developing a wind turbine operation and maintenance support system that can be used by domestic wind power generation companies. The support system consists of a platform and software and includes a wind turbine failure detection method using artificial intelligence and a failure evaluation method after a lightning strike on the wind turbine.

In 2020, NEDO worked on a demonstration test of the wind turbine operation and maintenance support system built in the previous year and verification of its effects.

Low-cost construction technology development: NEDO has developed low-cost construction technology for fixed-floor offshore wind power generation. Under the joint industrial program, based on a feasibility study on the development of cost reduction technology for foundation work, NEDO conducted a sea area selection survey and designed and produced equipment for demonstration in the test sea area.

NEDO supports the installation of fixed-bottom type offshore wind power generation. In the harbor sea area, support began in 2013, and from 2018 to 2020, NEDO supported an offshore wind power generation project in Kitakyushu City, Fukuoka Prefecture (support for sea area surveys, environmental impact surveys, detailed design, etc.). NEDO has also launched a feasibility study project for offshore wind power generation in the general common sea area. In this project, basic surveys of the seafloor, weather, sea conditions, etc., necessary for installing offshore wind power generation facilities in general common sea areas (actual sea areas, multiple areas) will be conducted. The results of these surveys will be compiled into materials and will be made widely available to the public. Publication of these research results will contribute to the expansion of offshore wind power generation and lead to public benefit.

NEDO started two research and development projects in 2020. One is the research and development of advanced wind turbine maintenance technology, and the other is the research and development of advanced wind turbine components technology. The purpose of the first research and development project is to develop technology that reduces downtime leading to a more stable electricity supply. This will contribute to enhancing the competitiveness of industries related to the maintenance of offshore wind turbines. The purpose of the second research and development project is to develop technology that will improve the technology available to domestic wind turbine components manufacturers and improve the rate offshore wind turbines are installed in Japan.

In 2020, NEDO designed the target offshore maintenance system, examined the feasibility, and manufactured the maintenance system. In addition, NEDO designed prototypes of the target wind turbine parts, examined their feasibility, and manufactured them.

METI implemented a floating offshore wind power generation demonstration project (Fukushima FORWARD PJ). METI continued the demonstration project on 2 MW and 5 MW wind turbines until the end of 2020 and evaluated it for commercialization verification. For the 7 MW wind turbine, METI conducted a demonstration of removal in FY2020.

Collaborative research

Japan participated in the following eight tasks in 2019. Task 40 began in 2018 with Japan serving as OA and Co-OA.

- Task 11 Base Technology Information Exchange
- Task 25 Design and Operation of Power Systems with Large Amounts of Wind Power
- Task 26 Cost of Wind Energy
- Task 28 Social Acceptance of Wind Energy Projects
- Task 30 Offshore Code Comparison Collaboration, Continued, with Correlation (OC6)
- Task 31 WAKEBENCH: Benchmarking of Wind Farm Flow Models
- Task 32 Lidar Systems for Wind Energy Deployment
- Task 40 Downwind Turbine Technologies

Japan also participates in many maintenance teams, project teams, and working groups in IEC TC 88.

Impact of Wind Energy

Environmental impact

The amount of CO₂ reduced by wind power generation in 2020 will be about 3.6 million tons-CO₂, which is equivalent to 0.34% of Japan's CO₂ emissions. Japan aims to reduce its energy-derived CO₂ emissions by 25% compared to 2013 by 2030. Wind energy contributes to some extent to achieving this goal, but its effectiveness is currently limited.

Economic benefits and industry development

Since 2000, Japan's wind energy industry has grown steadily and significantly, centered on equipment manufacturers and power generation companies. In the 2010s, the installation of onshore wind power progressed steadily, and the contribution to the domestic economy also progressed. On the other hand, due to the limitation of the development potential of suitable areas for onshore wind power

and the intensifying global competition of wind turbine manufacturers, expectations for offshore wind power development and its enhancement and the need to foster the offshore wind power industry are increasing. For these reasons, the establishment and implementation of the Renewable Energy Sea Area Utilization Law, the establishment of the Offshore Wind Power Public-Private Council, and the formulation and implementation of measures by the public and private sectors are in progress. It is expected that the future of economic benefits and industrial development will become clearer in the future.

Next Term

The onshore wind power project is expected to start operations steadily in the next few years, which will increase Japan's total power generation capacity by more than 16 GW, and this will have an impact on Japan's economy. Furthermore, by increasing the participation of Japanese industry in offshore wind power development, its future progress will be ensured. Currently, over 14 GW offshore wind projects are being envisioned. NEDO recognizes that reducing the cost of offshore wind power is the key to implementing offshore wind power projects, and from this perspective, NEDO will work on research and development and revitalization of domestic-related industries.

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