



Report 2021 **Japan**

View from the sea at the demonstration test site of the floating offshore wind power generation system *Hibiki* manufactured by Hitachi Zosen Co., Ltd., installed 15 kilometres off the coast of Kitakyushu City

Author Yoshitomo Watanabe, Offshore Wind & Ocean Energy, New Energy Technology Department, New Energy and Industrial Technology Development Organization, Japan.

At the end of 2021, Japan's wind power capacity reached 4,581 MW (Figure 1). Most of the wind power installed in Japan is onshore wind power. The total number of wind turbines was 2,574, an increase of 87 in 2021.

The new single-year installation amount of wind power capacity in 2020 was the highest ever, but in 2021 it was 28% of that. This is because the number of large-scale projects carried out was low. In addition, decommissioned wind power generation capacity has increased to 68.2 MW. It is thought that this is due to the increase in the number of wind turbines that have been in operation for a long time. The national capacity

factor (average national capacity factor) was 21.5%, and the ratio of wind power to total electricity supply and demand in Japan was 1%.

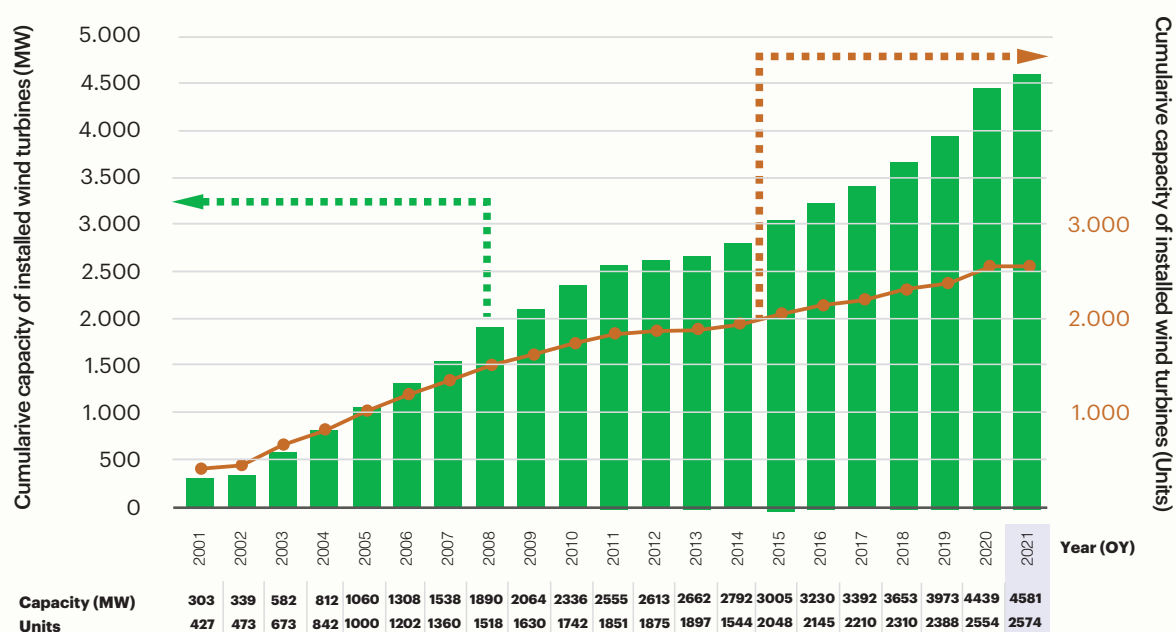


Figure 1: Deployment and installed capacity of wind power in Japan (Source: Japan Wind Power Association).

Table 1. Key Statistics 2021: Japan

Total (net) installed wind power capacity	4.58 GW
Total offshore capacity	0.05 GW
New wind power capacity installed	0.21 GW
Decommissioned capacity (in 2021)	0.07 GW
Total electrical energy output from wind	8.47 TWh
Wind-generated electricity as percentage of national electricity demand	0.97%
Average national capacity factor	21.5%
Target	10 GW of wind power capacity by 2030
National wind energy R&D budget	8.28 bil JPY; 74.5 mil USD

Introduction

The proportion of wind power is small, but it is increasing. In research and development, in order to promote offshore wind power, the New Energy and Industrial Technology Development Organization (NEDO) is

conducting several national projects with the aim of reducing the cost of offshore wind power. In addition to this, the Green Innovation Fund Project (GI Project) began in 2021, and specific projects will have been adopted and started by April 2022. Also, based on the Act of Promoting

Utilisation of Sea Areas in Development of Power Generation Facilities using Maritime Renewable Energy Resources (effective April 2019), companies were selected for offshore wind power generation projects with a total capacity of approximately 1.7 GW in four sea areas in 2021.

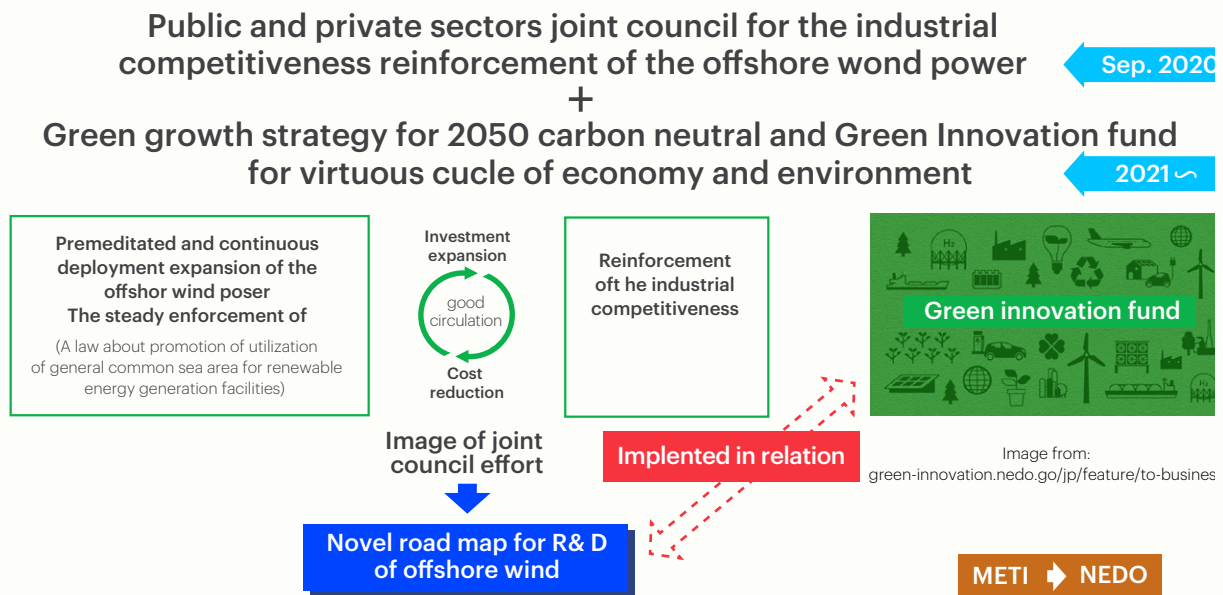


Figure 2: Cooperation between the public private sector's joint council and the Green Innovation Fund.

Highlight(s)

- Wind power generation in Japan is steadily increasing.
- Goal of 36-38% of renewable energy in the financial year 2030 toward carbon neutrality in 2050, and the Green Innovation Fund (GI Fund) was established in 2021.

Market Development

Targets and policy

Major policy measures were implemented in 2021 to connect wind energy supply to significant greenhouse gas emission reductions. In 2021, Japan announced a new greenhouse gas emission reduction target for the financial year 2030 (46% reduction compared to the financial year 2013), which is consistent with the 2050 carbon neutrality declared in 2020 and ambitious. In addition, the 6th Strategic Energy Plan, which sets an ambitious goal of 36-38% of renewable energy in the financial year 2030 toward carbon neutrality in 2050, and the Green Innovation

Fund (GI Fund) was established in 2021 for NEDO to support companies' ambitious goals. As part of the GI Fund, action plans have been formulated in 14 areas. One of these areas is renewable energy, including offshore wind power generation. Under the Green Growth Strategy, which is an industrial policy that creates a virtuous cycle between the economy and the environment, this fund supports companies and other entities for 10 years in areas ranging from research and development and demonstration to social implementation. The supported companies will demonstrate a commitment to specific goals and initiatives aimed at achieving them, especially in areas where policy effects are particularly large and long-term efforts are needed with an eye toward social implementation.

Research planning and social implementation utilising the GI Fund for offshore wind power generation will be implemented according to the roadmap considered by a public-private council for strengthening the industrial competitiveness of

offshore wind power started in 2020 (Figure 2).

In 2020, the public-private council was established to strengthen the competitiveness of the offshore wind power industry, and it has put together a vision for the offshore wind power industry. The government has set a target of 10 GW by 2030 and 30 to 45 GW of offshore wind power projects by 2040, and the industry has set targets for domestic procurement and cost reduction, aiming for a virtuous cycle of expanding the introduction of renewable energy and strengthening industrial competitiveness. In response to this, in April 2021, the public-private council and NEDO formulated a technology development roadmap to strengthen the competitiveness of the offshore wind power industry.

Also, in connection with the new law: the Act of Promoting Utilisation of Sea Areas in Development of Power Generation Facilities using Maritime Renewable Energy Resources that came into effect in April 2019, the establishment of promotion zones

and the selection of business operators made steady progress through bidding and other means. The promotion zones for which business operators have been selected are as follows:

- **Off the coast of Goto City, Nagasaki Prefecture**
The Ministry of Economy, Trade and Industry (METI) and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) publicly solicited and selected business operators (June 2021).
- **Three zones (off the coast of Noshiro City, Mitane Town, and Oga City, Akita Prefecture; off the coast of Yurihonjo City, Akita Prefecture; and off the coast of Choshi City, Chiba Prefecture)**
METI and MLIT publicly solicited and selected business operators (December 2021).

Progress and operational details

In 2021, Japan installed a new wind power capacity of 211 MW, most of which was onshore wind. Cumulative wind power capacity at the end of 2021 reached 4,581 MW with 2,574 turbines. Of this, offshore wind power generation capacity was 51.6 MW.

The national capacity factor (average national capacity factor) was 21.5%. The total amount of electricity generated by wind power generation in 2021 was about 8.47 TWh, which was 0.97% of the national electricity demand of 873.2 TWh.

Notably, the number of decommissioned wind turbines, with a capacity of 68.2 MW, increased remarkably in CY2021, compared to the previous year. This suggests that the number of wind turbines that are due for renewal is increasing.

Matters affecting growth and work to remove barriers

The Green Growth Strategy to support Japan's carbon neutrality by 2050 initiative was formulated in June 2021. The GI Fund was established for NEDO in connection with

this Green Growth Strategy. One of the fields under the Green Growth Strategy is renewable energy, of which offshore wind is attracting a lot of attention and expectation due to its huge potential.

The research plan and social implementation of offshore wind utilising the GI Fund were decided to be carried out according to a roadmap presented by NEDO at a public-private council meeting. In this roadmap, the importance of segmenting the supply chain into fields and developing the identified elemental technologies from the perspective of strengthening industrial competitiveness and reducing costs was stated, taking into account the characteristics of other countries and Japan in each field.

RD&D Activities

National research initiatives and results

Business promotion using the GI Fund has already begun toward the 2050 carbon-neutral target. As part of this promotion work, NEDO has decided to implement a technology development project related to reducing the cost of offshore wind power generation.

Specifically, in this NEDO project, the following four fields will be worked on first in order to promote the development of elemental technologies specified in the technology development roadmap:

- **Field 1:** Project for the development of next-generation wind turbine technology.
- **Field 2:** Development of low-cost technology for manufacturing and installation.
- **Field 3:** Development of offshore wind-related electrical system technology.
- **Field 4:** Project for upgrading offshore wind power operation and maintenance.

NEDO deliberates the proposals it receives and funds the ones adopted as NEDO projects. In this project, NEDO started a public solicitation in October 2021 and adopted 18 themes in 4 fields in January 2022. Actual technology development begins in calendar year 2022. In principle, the phase 1 of the project lasts for up to five years (theme 1) or three years (themes (2), (3) and (4)) starting in financial year 2021. The total budget for the entire period of this low-cost offshore wind power generation project (10 years for the phases 1 and 2) is planned to be 119.5 billion yen.

METI and NEDO have also used the traditional budget framework (METI to NEDO grants) to develop and manage the major wind power research and development programs in Japan. The offshore wind power generation technology research and development program (2018-2022) is focused on the following technology areas:

- **Barge-type floater:** NEDO developed and demonstrated a floating wind turbine that can be installed in seawater over 50 meters or deeper. In 2019, installation was completed at a depth of 50 meters, 15 km off the coast of Kitakyushu City, and a demonstration operation was started. Demonstration operation is currently being carried out (extended until the financial year 2022). This was conducted by a research consortium commissioned by NEDO.
- **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 drawn up 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.



Figure 3: Demonstration of base construction technology for suction buckets in actual sea area.

to 20 yen/kWh (0.16 EUR/kWh, 0.18 USD/kWh).

- 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 wind turbine utilisation 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.
- Fixed-bottom offshore wind power plant low-cost construction technology development: NEDO has developed low-cost construction technology for fixed-bottom 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 (Figure 3).

- NEDO supports the installation of fixed-bottom type offshore wind power generation. Support in harbour sea area began in 2013. NEDO has also been carrying out 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, and so on, necessary for installing offshore wind power generation facilities in general common sea areas (multiple actual sea areas) are being conducted. The results of these surveys will be published and will be made widely available to the public.
- NEDO has engaged in two research and development projects. 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, thereby improving the rate offshore wind turbines are installed in Japan.

METI has implemented a floating offshore wind power generation demonstration project (Fukushima FORWARD PJ). Until the end of 2021, METI evaluated offshore wind turbine removal technology at the 2 MW and 5 MW wind turbine demonstration sites.

Collaborative research

Japan participated in the following eight IEA Wind TCP tasks in 2021. Task 40, in which Japan serves as Operating Agent (OA) and Co-OA, began in 2018, the phases were summarized in 2021, and a report was prepared and completed in the spring of 2022.

- Task 11 Base Technology Information Exchange
- Task 25 Design & Operation of Energy Systems with Large Amounts of Variable Generation
- Task 26 Cost of Wind Energy
- Task 28 Social Science of Wind Energy Acceptance
- 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 as part of the IEC TC 88.

Impact of Wind Energy

Environmental impact

The amount of CO₂ reduced by wind power generation in 2021 was about 3.8 million tons-CO₂, which is equivalent to 0.39% of Japan's energy-derived CO₂ emissions. Last year it was 0.34%, so the degree of contribution is steadily improving, albeit little by little. Japan aims to reduce its energy-derived CO₂ emissions by 25% compared to 2013 by 2030, so further contributions from wind energy are expected.

Economic benefits and industry development

Many of the environmental measures that have been taken in the past have been regarded as costs for the companies and organisations that are working on them, which leads to growth constraints. However, in the

Carbon Neutrality by 2050 initiative, a change of mindset is mentioned, stressing the need to see these efforts as growth opportunities rather than costs. Proactive measures will bring about changes in industrial structure and social economics and will lead to future growth.

In order to realise carbon neutrality, it is necessary to drastically change conventional business models and company strategies, and the like. However, there are hurdles to realising carbon neutrality by 2050. To overcome these hurdles, it is necessary for the government to present as concrete a vision as possible, set high goals, and create an environment where private companies can easily take on challenges. Therefore, the Green Growth Strategy outlines 14 fields that are expected to grow in the future, sets ambitious goals to be aimed at in each field, and at the same time mobilises all policy tools such as budget, tax, regulation/standardisation, and private fund guidance. The Japanese Government will do its utmost to support companies' efforts. Through these efforts, Japan anticipates an annual economic boost of approximately 140 trillion yen in 2030 and approximately 290 trillion yen in 2050.

Next Term

Although the deployment of onshore wind power generation in the calendar year 2021 was less than in the calendar year 2020, onshore wind power generation projects are expected to steadily begin operations in the next few years, which will bring Japan's total wind power generation capacity to 16 GW or more. This increase will have an effect on the Japanese economy. Furthermore, future development of the domestic wind power generation industry will progress by strengthening the participation of the Japanese industry in offshore wind power development. Currently, there are many offshore wind projects envisioned. For offshore wind power generation, the number of operators in the promo-

tion zones (4 zones in total) has been decided, so it is expected to increase steadily.

NEDO recognises that reducing the cost of offshore wind is key to implementing offshore wind projects. Research and development for the GI fund phase 2 projects are scheduled to be considered after the phase 1 projects have progressed. NEDO will also consider projects from the next phase beginning the financial year 2023 under the existing budget framework. This way, NEDO will promote research and development and the revitalisation of domestic-related industries.

Reference

- [1] NEDO, Green Japan, Green Innovation
<https://green-innovation.nedo.go.jp/en/>