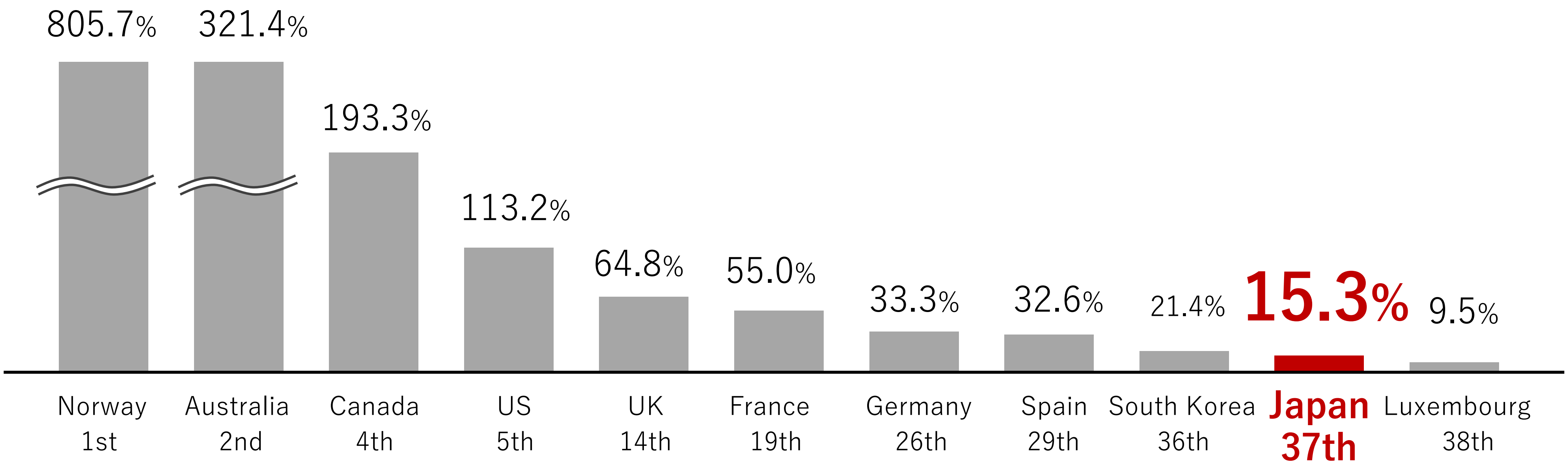
Ocean Power Grid
（海上パワーグリッド）

Energy Industry Landscape

Japan is Among the Least Energy Self-Sufficient Countries in the OECD

Japan's energy self-sufficiency ratio was **15.3% (37th)** as of 2023, which is extremely low among developed countries, and Japan relies heavily on energy imports.

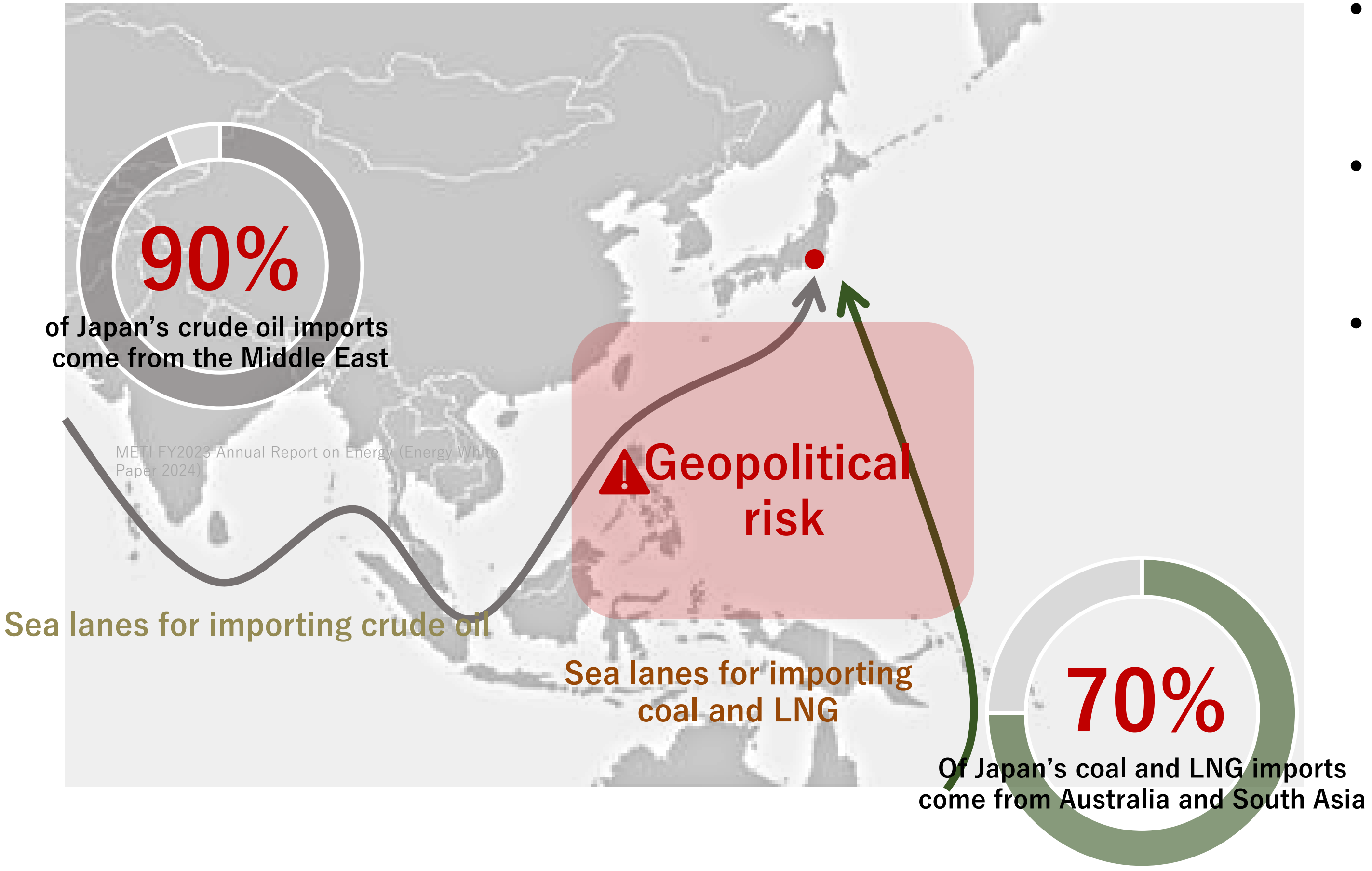
Energy Self-Sufficiency Ratios of Select OECD Countries (2023)



Source: Prepared based on World Energy Balances Highlights (International Energy Agency, October 2025).Energy self-sufficiency is calculated as domestic energy production (PJ) divided by total domestic energy supply (PJ).Japan's energy self-sufficiency ratio is sourced from the Comprehensive Energy Statistics (Final Time-Series Data for FY1990–FY2023) published by the Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry (METI).Note that there are minor differences between the energy self-sufficiency calculation methodologies used by the International Energy Agency and METI.

* Domestic energy refers to energy resources that can be secured domestically over the long term and the electricity generated using such resources. Japan relies heavily on imports for most of its energy resources. In particular, fossil fuels for thermal power generation (oil, natural gas, and coal) and uranium for nuclear power generation are almost entirely imported, which entails risks to the stability of energy supply. Accordingly, in Japan, "domestic energy" refers to renewable energy (solar, wind, hydro, geothermal, and biomass using sustainable feedstocks).

An Imported Energy Supply Chain Exposed to Energy Security Risks



METI FY2023 Annual Report on Energy (Energy White Paper 2024)

- Japan depends on the Middle East for **90%** of its **crude oil** supply
- **70%** of Japan's **coal and LNG** imports come from Australia and Southeast Asia
- Therefore, any rise in tensions around the South China Sea or waters near Taiwan poses a significant risk to the stable supply of energy to Japan.

Boosting energy self-sufficiency with domestic sources is an urgent priority

Mandated by the Japanese Government’s Strategic Energy Plan

In the 7th Strategic Energy Plan approved by Japan’s cabinet on Feb. 18th, 2025, the government projected that **renewable energy supply approximately 40% to 50% of total power by FY2040**, becoming the largest source. The plan highlights expected growth in battery storage demand and measures to enhance cybersecurity across all power sources, including batteries.

Key Points on Battery Storage in the Strategic Energy Plan *1

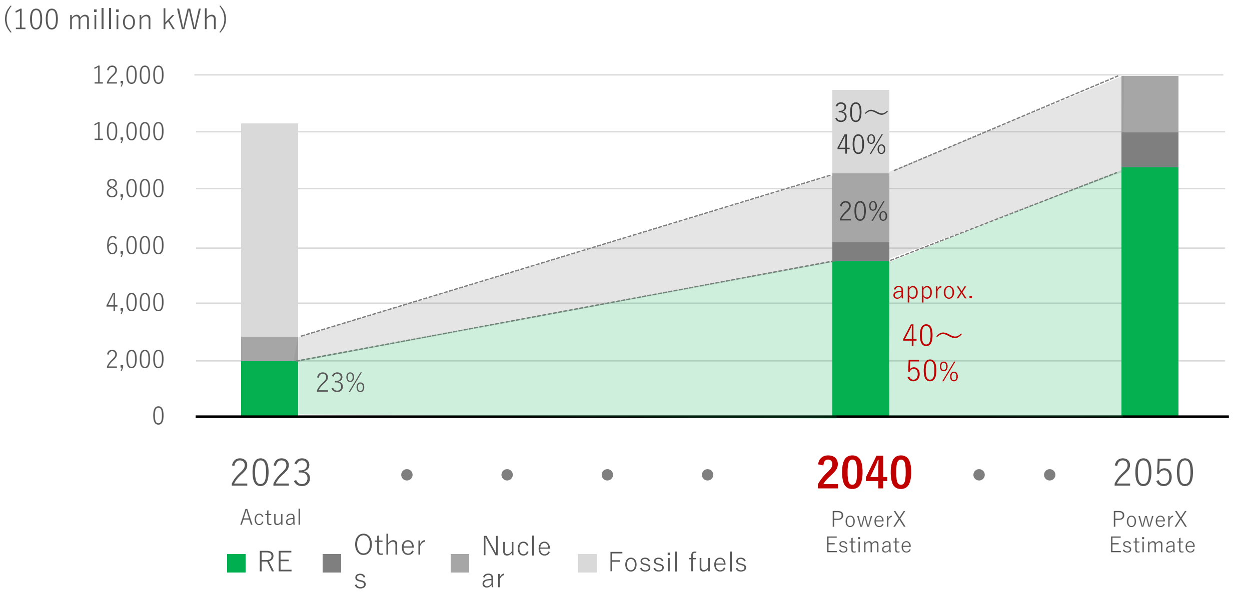
① Necessity of Batteries as a Core Power Source
The Plan identifies batteries as a central tool for managing renewable variability, while also supporting their use in disaster resilience, emergency power supply, and as resources under Japan’s Feed-in Premium (FIP) renewable scheme.

② Ongoing Support for Battery Storage Deployment
Government support will not rely on price competition alone, but will prioritize projects that guarantee safety, sustainability, and reliable long-term operations.

③ Strengthening Cybersecurity Across All Power Sources (Including Batteries)
The Plan highlights the need to strengthen cybersecurity measures across the entire power system, including battery assets.

④ Building International Competitiveness with a Global Supply Chain
The Plan promotes the development of both global and domestic supply chains for batteries, aiming to enhance international competitiveness while improving business stability and profitability.

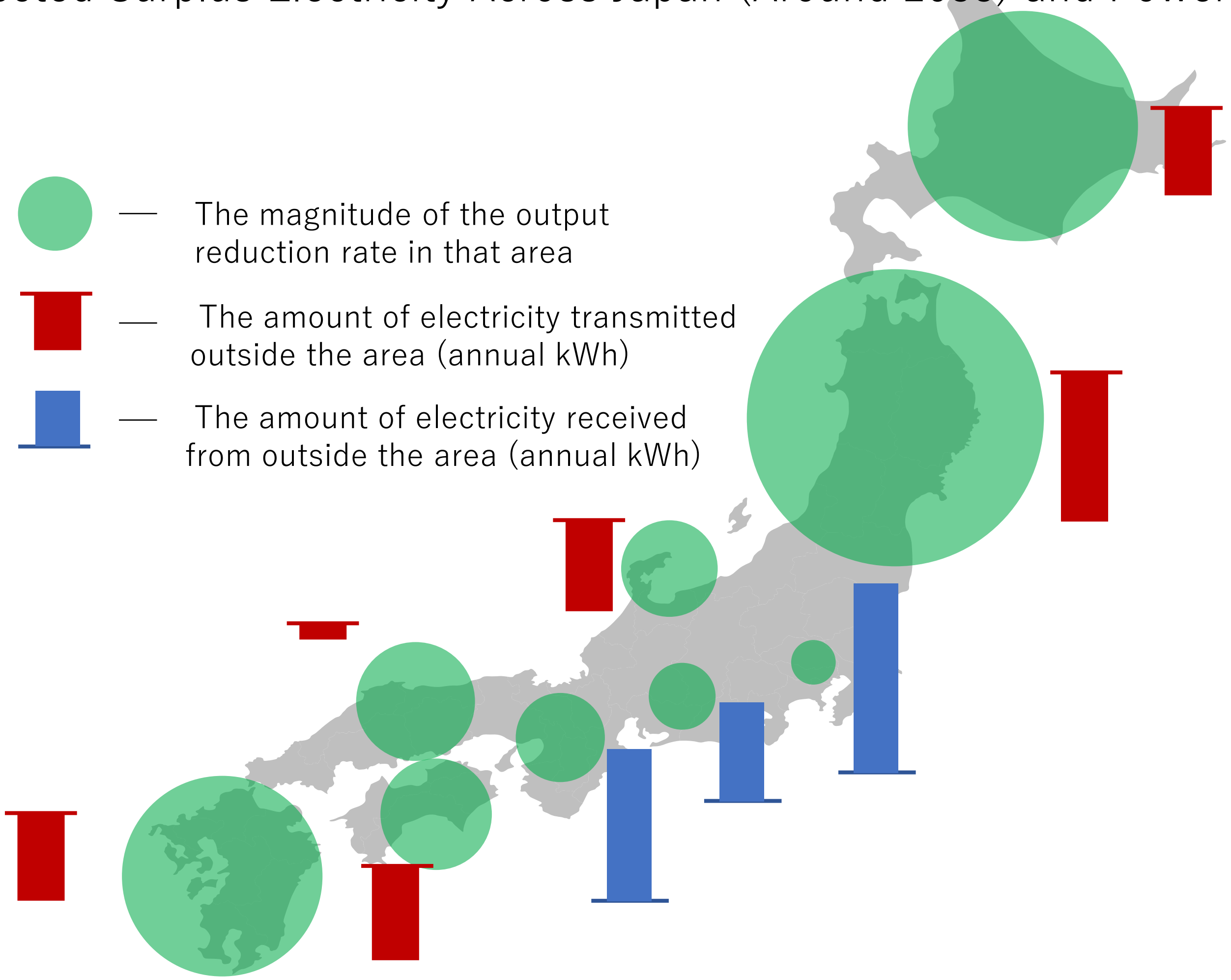
Estimated Balancing Capacity Required (Batteries) *4



*1 Source: Strategic Energy Plan (Agency for Natural Resources and Energy, February 2025).
*2 Power sources under the Feed-in Premium (FIP) scheme, in which renewable energy generators receive a premium subsidy in addition to market electricity prices.
*3 When supporting battery storage, requirements are defined for business schemes, technical specifications, safety standards, and long-term sustainability, with support prioritized based on economic viability.
*4 Except as noted, data are sourced from Japanese government publications, including METI and the Agency for Natural Resources and Energy. Figures for 2040 reflect government estimates in the 7th Strategic Energy Plan. Renewable energy for 2040 is estimated by applying these proportions to projected total generation. Renewable energy for 2050 is estimated based on government projections, adjusted under the assumption that a portion of CCS-based thermal generation is replaced by renewables, resulting in a 10–20% increase versus government estimates. Growth from 2040 to 2050 (excluding offshore wind) is estimated using historical growth rates, and absolute values are derived from projected total generation for 2050. See Appendix (p.51).

Mismatches in Supply-Demand Balance

Projected Surplus Electricity Across Japan (Around 2033) and Power Transmission and Reception via Interconnection Lines



- Areas for **power generation** and high **energy demand** are distant from one another, creating a structural “location mismatch” for electricity.
- Building new transmission lines or upgrading existing ones takes 10 to 20 years, making short-term solutions difficult.
- While storage batteries are effective for short-term supply-demand adjustments, they cannot serve as an alternative to long-distance power transmission.
- This is where the “Battery Tanker Model” and the “Watt-Bit” concept become important.

* Refer to the Agency for Natural Resources and Energy’s December 2, 2024, report “Long-Term Outlook for Renewable Energy Output Control, etc.” for the output control rates and interconnection line utilization (2033) by area. We have independently represented each area’s output control rate as the diameter of a circle, and the amount of power transmitted to and received from outside the area via interconnection lines is represented by the length of the bar graph.

Ocean Power Grid
Business Overview

Business Overview

Ocean Power Grid

Transport

Battery Tanker Business

Store and Use

Micro Grid for Remote Islands and Ports

Use

Remote Islands and Ocean Data Center-Related Business

Battery Tanker Business

Ocean Power Grid proposes a completely new method of electricity transmission that utilizes the ocean as a power grid.

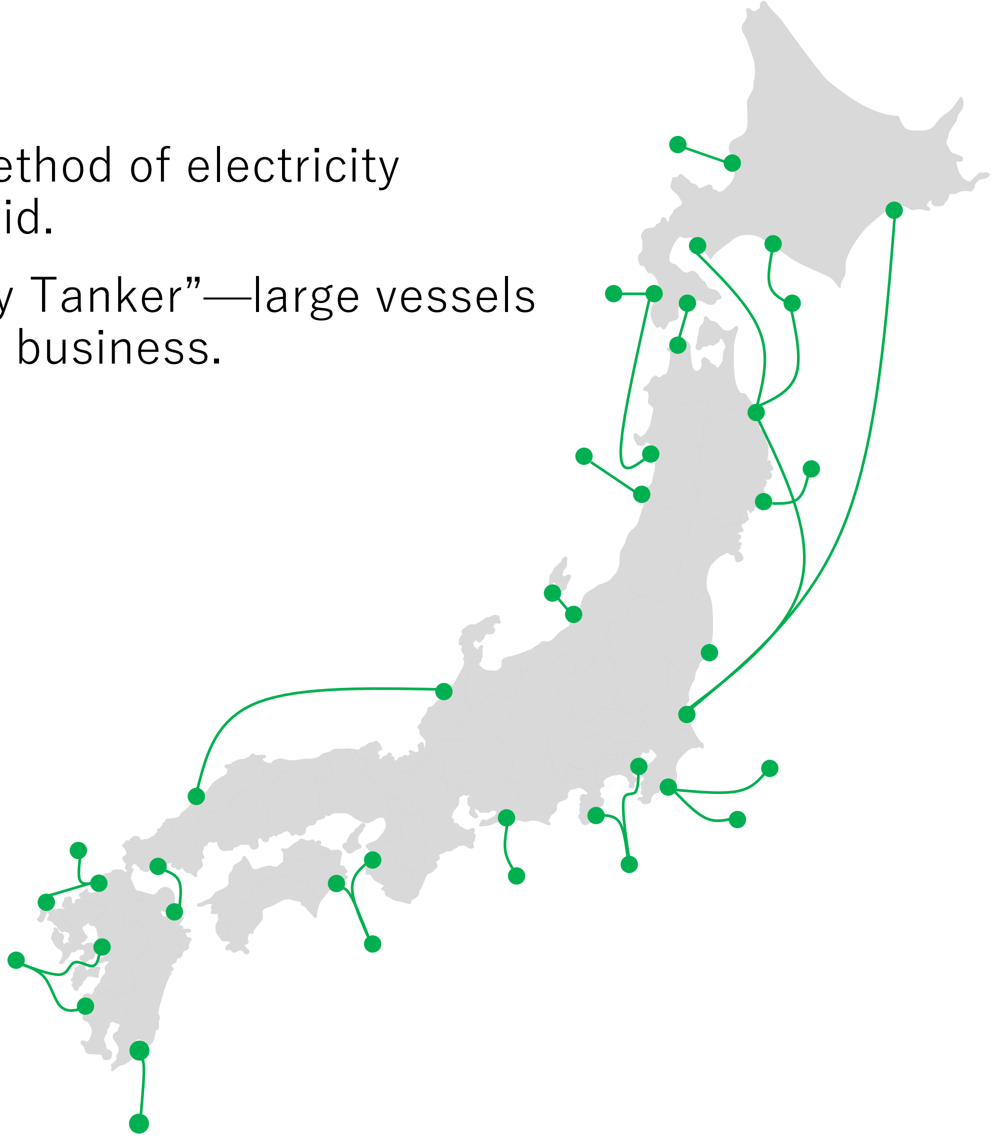
To make this a reality, we are developing “Battery Tanker”—large vessels that carry electricity as cargo—and expanding our business.

Power Grid

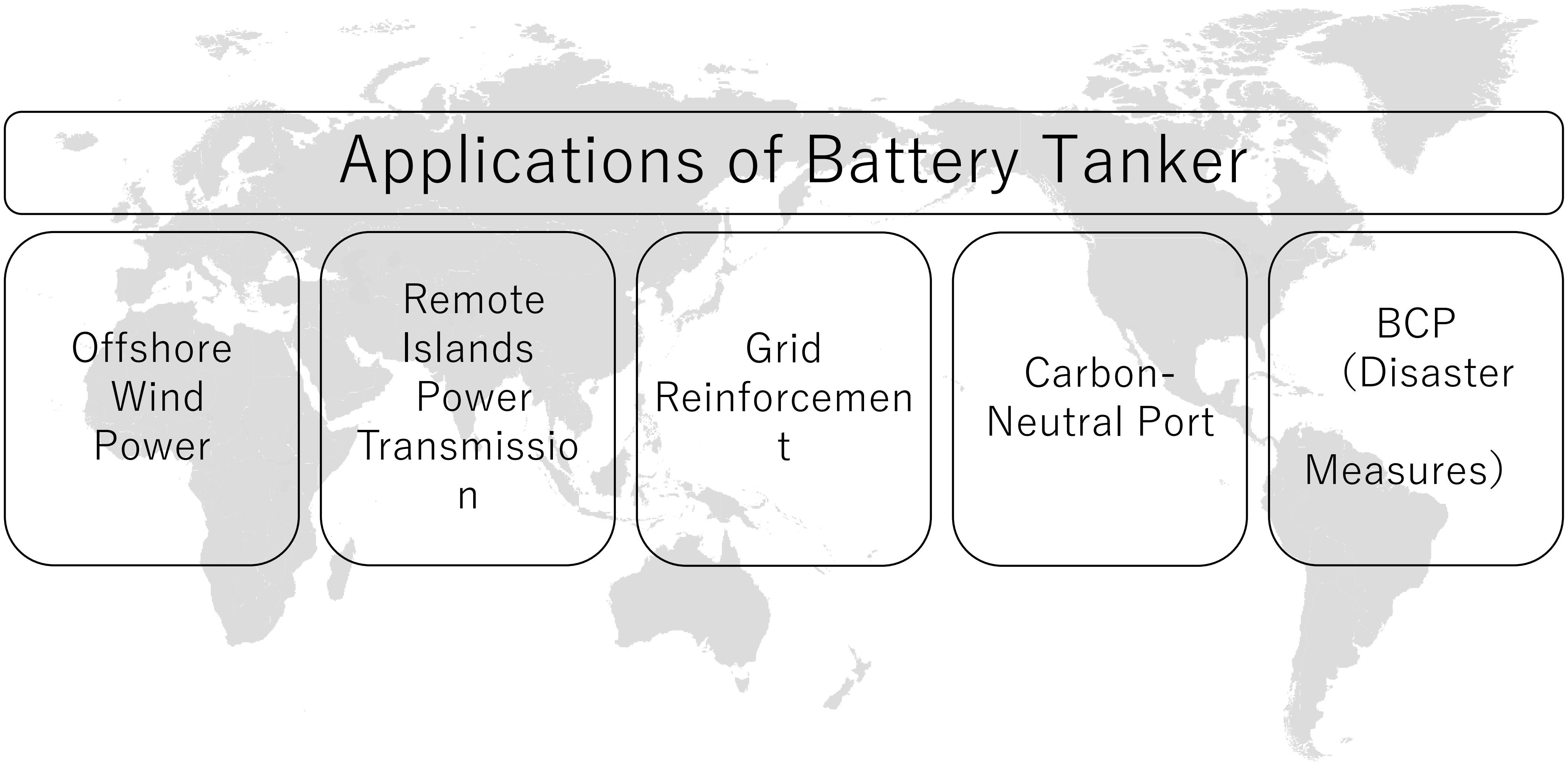
Creating a Power Grid at Sea

Electricity Carrier

Transporting Electricity by Ship



Battery Tanker Applications



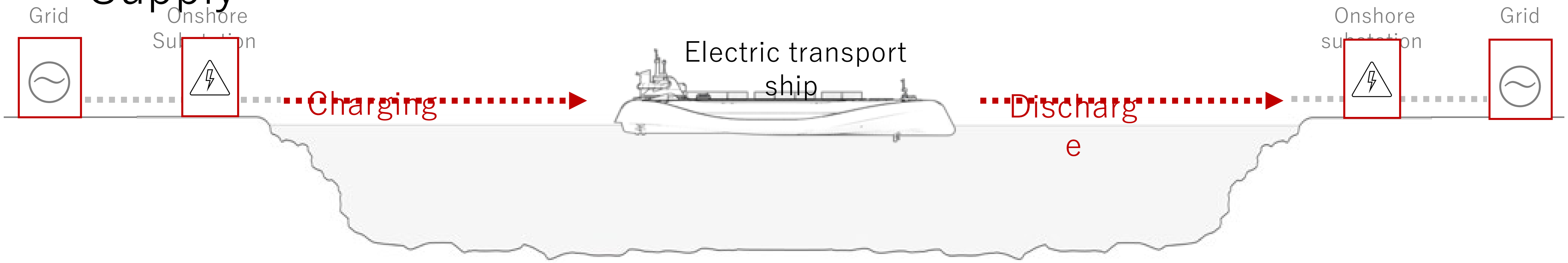
Battery Tanker – An Offshore Power Grid + Balancing Supply and Demand

Electric transport ships carry large quantities of batteries on board, enabling them to transport electricity as they sail.

This makes it possible to transport electricity from areas where it is available to areas where it is needed.

Available Power Supply

Electricity demand



Remote Island
Decarbonization Support

Wind Power
Electricity Business within the EEZ

Grid Reinforcement
Power Transmission Between Hokkaido and Honshu, etc.

BCP
Emergency Power Transmission to Disaster-Affected Areas

Electric Transport Ships & Electric Transport Barges

Battery Tanker

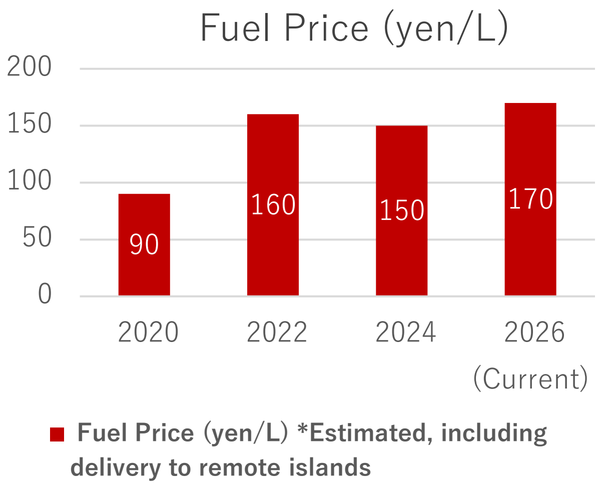
Battery Storage Barges

Remote Island Power Transmission Project

Circumstances surrounding remote islands
(islands not electrically connected to the mainland grid)

Rising Fuel Costs

Fuel prices are increasing year by year



- Fuel Reference Price: Calculated based on Kyushu Electric Power's published "January 20xx Universal Service Adjustment Rate for Remote Islands."
- Remote Island Delivery Expenses: Secondary transportation costs (equivalent to 25 yen/L) are included, based on the Agency for Natural Resources and Energy's "Petroleum Product Price Survey" and past interviews conducted on each remote island.

Aged power units

There are may OLD diesel generators on remote islands

Power Generation Efficiency and Fuel Costs
(Calculated at 170 yen/L)

Years of Operation	Generation Efficiency (L/kWh)	Fuel Cost (yen/kWh)
Up to 10 years	0.25–0.27	43–46 yen
11–20 years	0.28–0.30	48–51 yen
21–30 years	0.31–0.35	53–60 yen

- The deterioration in fuel consumption efficiency over time (0.25 → 0.32 L/kWh) takes into account not only the typical decline in thermal efficiency of internal combustion power generation facilities (equivalent to an annual rate of approximately 0.5–1.0%) but also the risk of efficiency loss associated with low-load operation specific to remote islands

Carbon neutrality

Concrete actions are needed to achieve the government's targets.

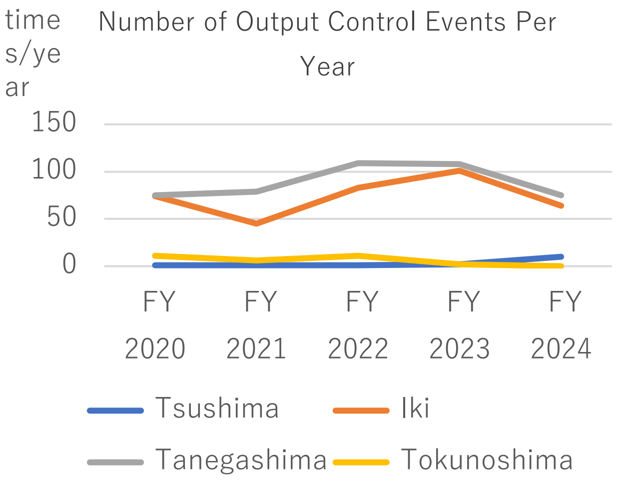
- FY 2030 Target:
  Reduce greenhouse gas emissions by **46%** compared to FY 2013 (and strive for a 50% reduction)
- Carbon Neutrality by 2050:
  Bring total greenhouse gas emissions to zero

The government's "Regional Decarbonization Roadmap" also positions remote islands as leading models for decarbonization

Situation surrounding remote islands (islands not connected to the mainland grid)

Curtailment of Power output

Surplus PV power generated during the day cannot be utilized. The following presents a case study from Kyushu



- Published data from Kyushu Electric Power Transmission & Distribution

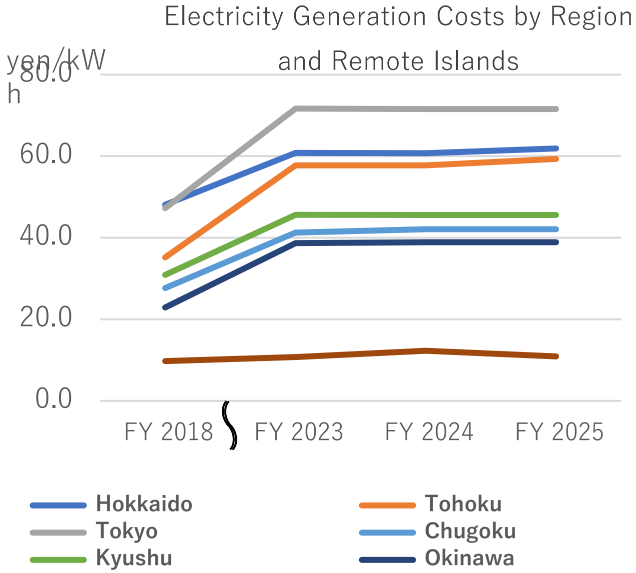
Resilience Vulnerabilities

Risk of power outages caused by disasters such as typhoons.

Risk	Mainland	Remote Islands
Power Source Diversity	Diversified across thermal, nuclear, and renewable energy sources	Over-reliance on diesel
Fuel Reserves	Many storage facilities; supply via land routes is also possible	Limited tank capacity; supply is by sea only
Restoration during power outages	Power can be supplied from neighboring municipalities	Power sharing is not possible (self-sufficient restoration is required)
Isolation during a disaster	Multiple supply routes exist	Completely cut off due to damage to ports and airports

High Cost Power Generation

Fuel and maintenance costs for diesel generators operating 24 hours a day



- Data sourced from the website of the Organization for the Promotion of Wide-Area Power System Operation

Japan's Remote Islands and Electricity Supply

Japan is an nation consisting of 14,125 islands. Of these, there are 14,120 islands excluding the mainland, and as many as 416 are inhabited.

Of these, approximately 274 internal combustion engines with a total capacity of 730 (MW) are in operation on the 85 islands not connected to the power grid, and their total annual power generation amounts to approximately 2,194 (GWh).

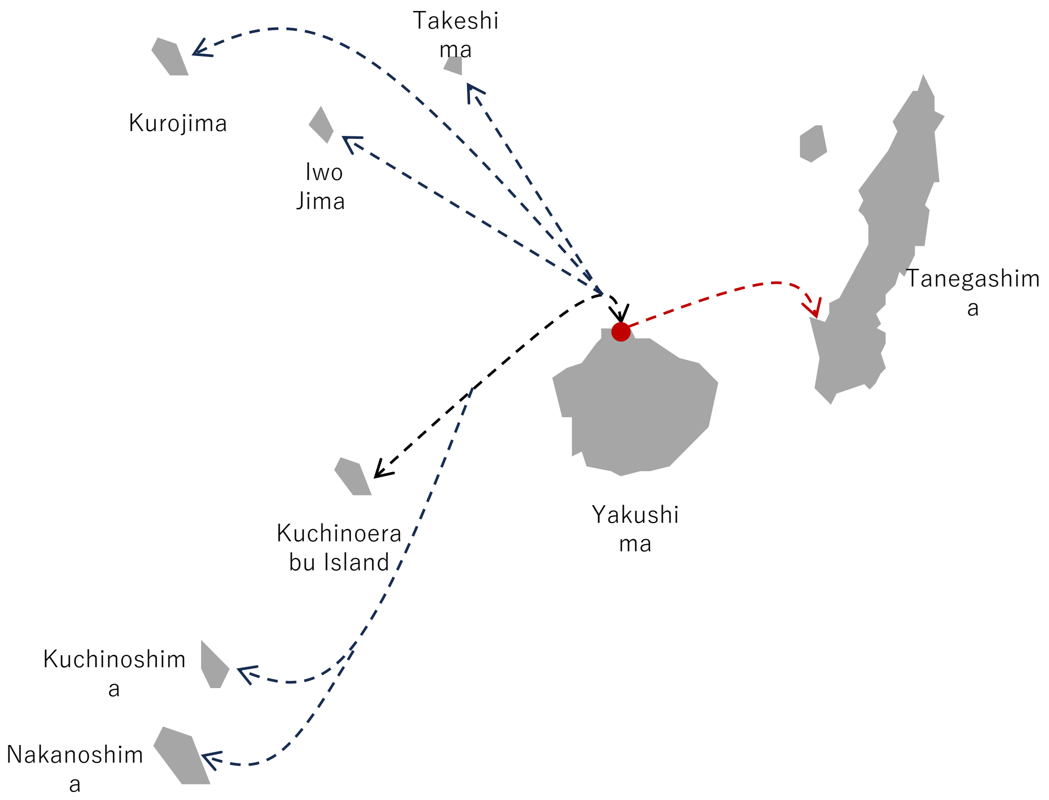
By supplying renewable energy to these islands via power transport ships, it is expected that CO_2 emissions from diesel generators—with an emission factor of 0.533 tCO_2/MWh ＝ 1,169,258 (t) of CO_2 emissions can be expected to be reduced annually.

Remote Islands with Highest Electricity Generation (Top 15 Islands)

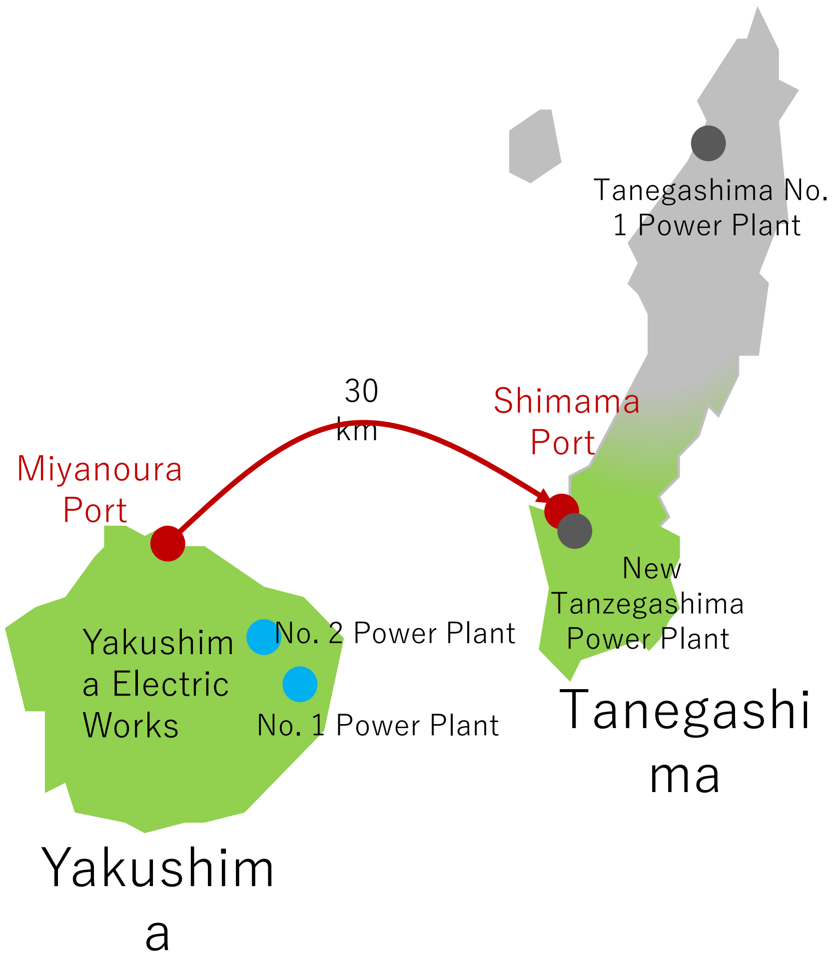
Joint Project Verification with Yakushima Denko

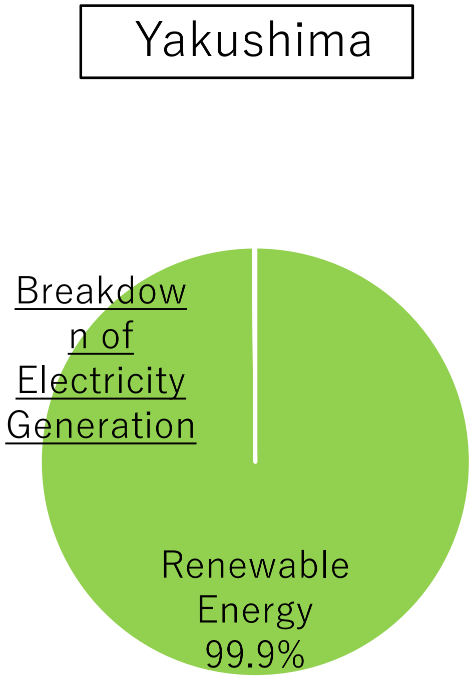
Taking advantage of its natural conditions—annual precipitation of approximately 8,000 mm and an average elevation of approximately 600 m—Yakushima possesses hydropower resources with a total installed capacity of 58,500 kW.

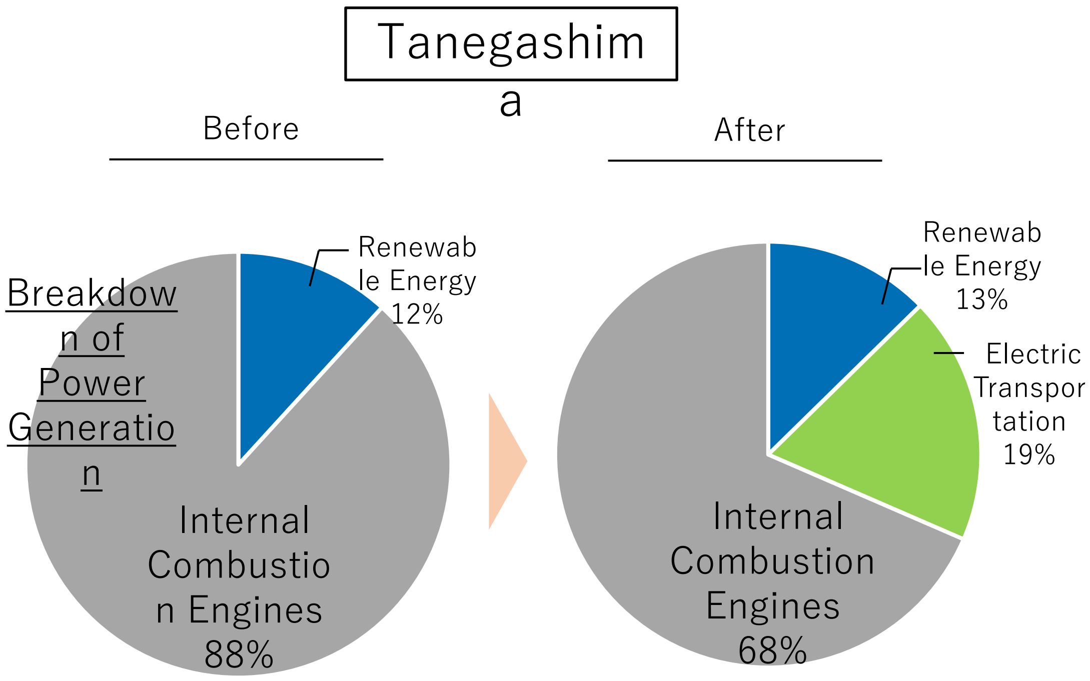
Decarbonization of Surrounding Islands Using Yakushima's Renewable Energy



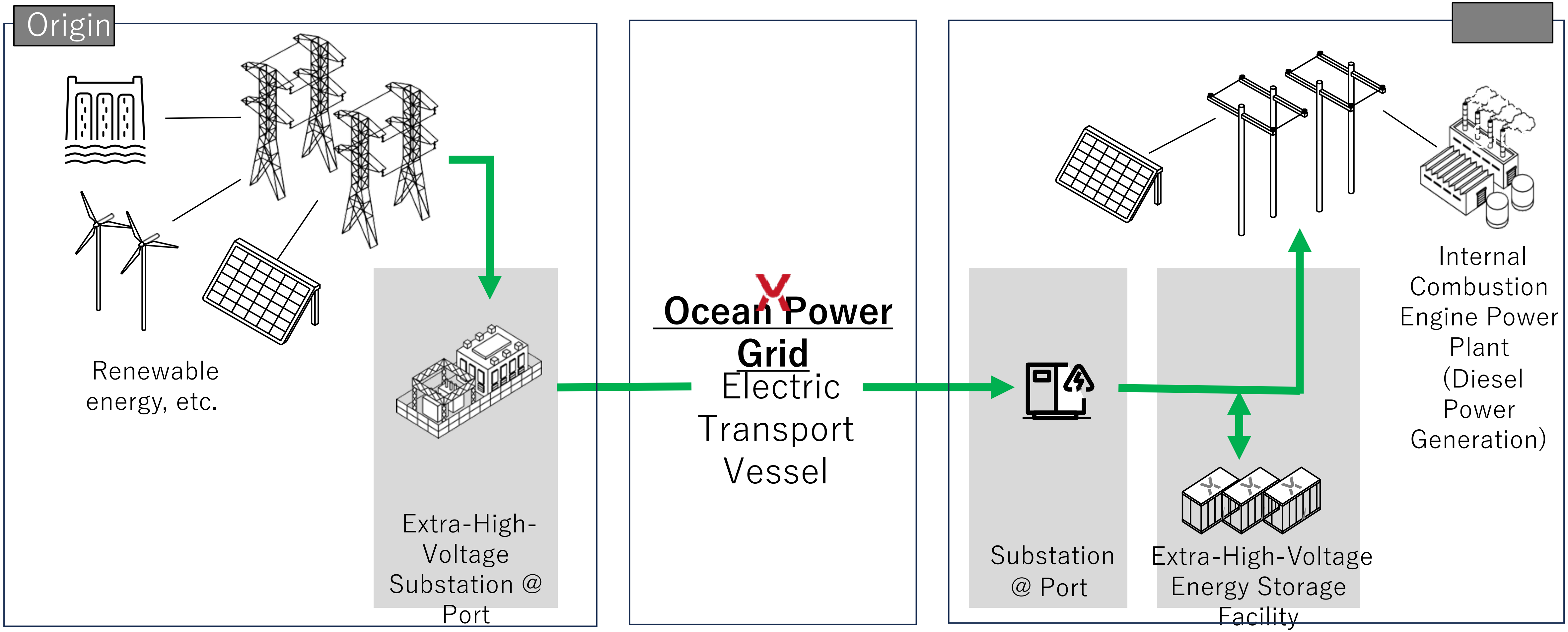
Project — Collaboration with Yakushima Denko —







A Generalized Remote Island Power Transmission Scheme

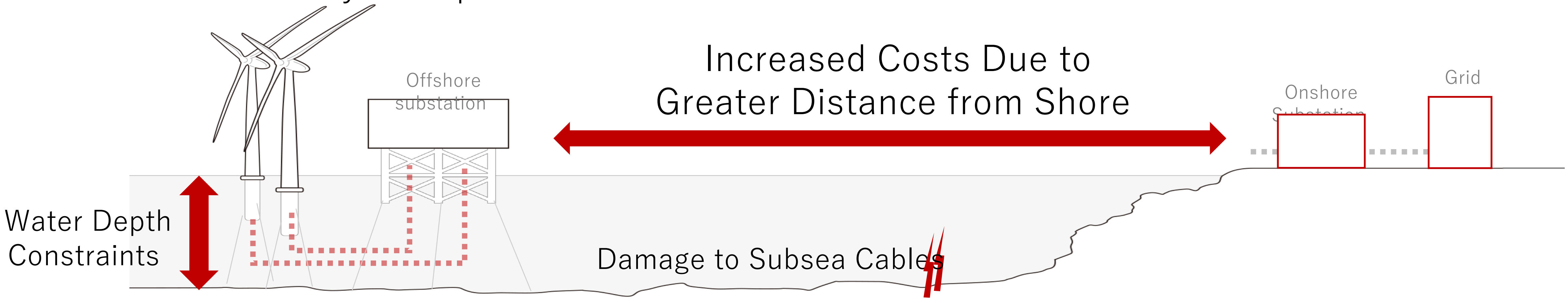


Offshore Wind Power Generation Business

—Why Use Electric Transport Ships?—

Challenges in the Development of Offshore Wind Farms

Since current offshore wind farms are designed with subsea cables in mind, they face the following challenges: (1) a depth limit of 300 meters; (2) the need for expensive HVDC equipment as the distance from shore increases; and (3) prolonged downtime due to damage to subsea cables caused by earthquakes.



Additional Challenges with Subsea cables

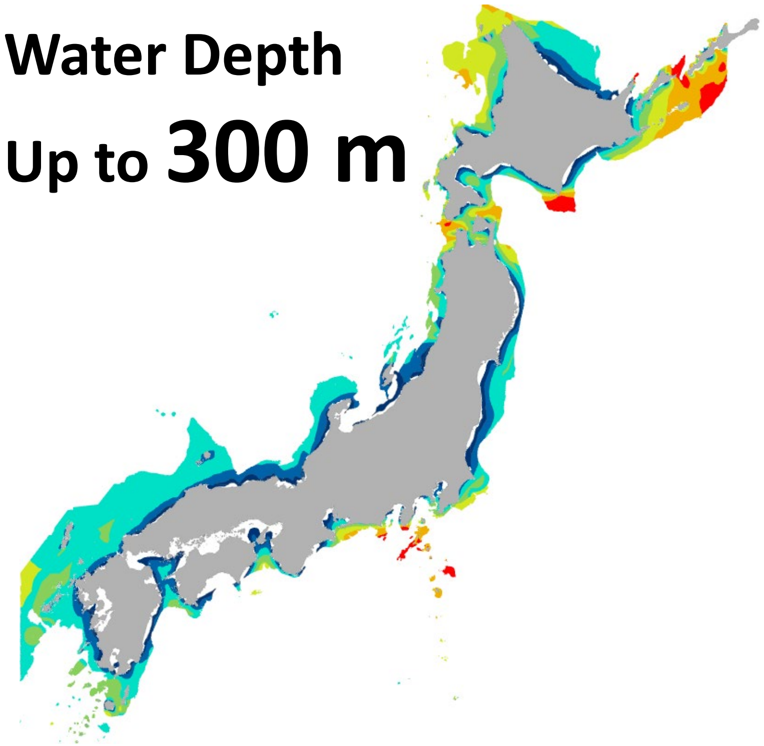
- Floating AC/DC Substation (under development)
- Scalability (Proto => GW)
- Agreement with fisherman (Fixed objects in the seas)
- Landing Locations (private transmission line)

Offshore Wind Power Potential — Expansion into the EEZ —

- Offshore wind potential was calculated based on areas with a water depth of up to 300 meters where subsea cables have been laid.
- Battery Tanker capable of navigating in areas deeper than 300 meters make it possible to harness wind power in high-potential areas with better wind conditions.

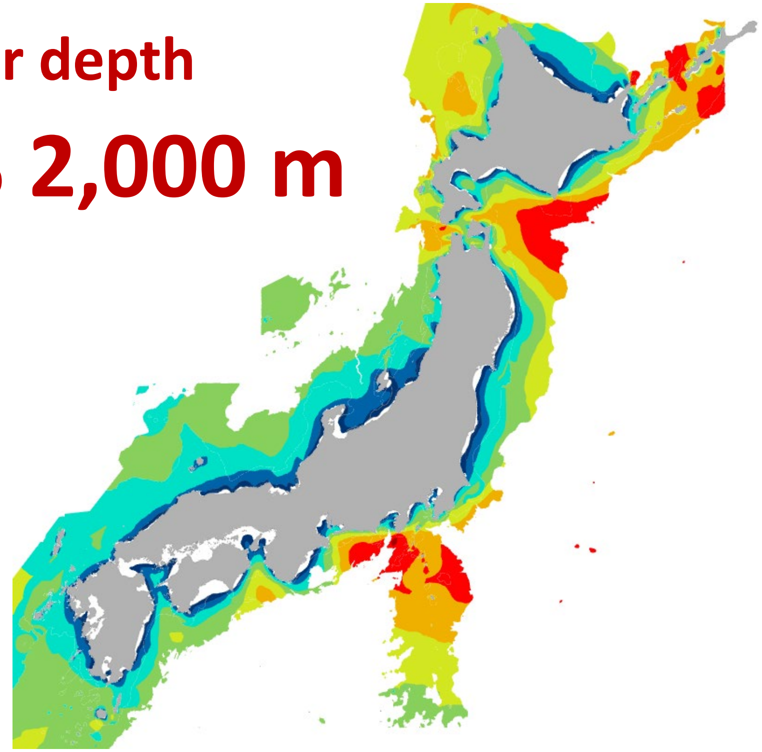
Water Depth

Up to 300 m



Water depth

Up to 2,000 m

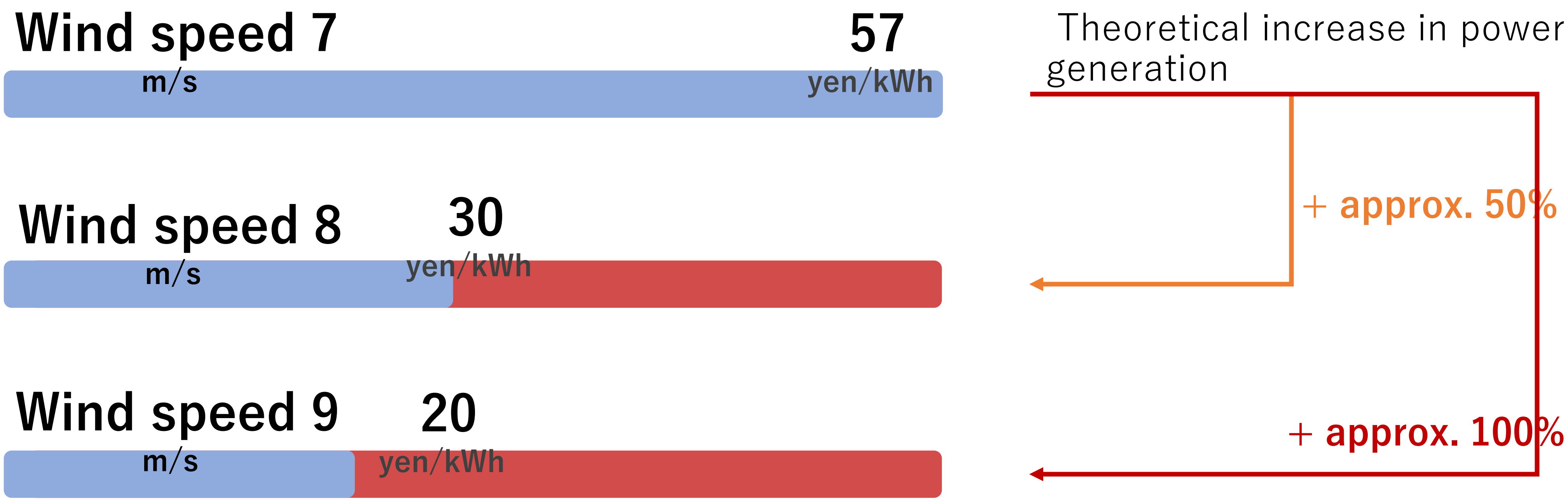


年平均風速 [m/s]

- 7.0-7.5
- 7.5-8.0
- 8.0-8.5
- 8.5-9.0
- 9.0-9.5
- 9.5-10.0
- 10.0-10.5
- 10.5-

*Created by PowerX using the NEDO Offshore Wind Conditions Map (altitude 140 m), the Japan Oceanographic Data Center's 500-meter mesh water depth data (J-EGG500), and the Ministry of Land, Infrastructure, Transport and Tourism's National Land Numerical Information (coastline data), among other sources. Conversion factors used: 6 MW/km^2 (0–50 m) and 3 MW/km^2 (50–2,000 m).

Offshore Wind Power Generations:
LCOE Comparison by Wind Conditions



Since the increase in average wind speed affects power generation according to the cube law (※), a significant reduction in LCOE can be expected

※ Kinetic energy of a fluid = 1/2 × density × area × $velocity^3$

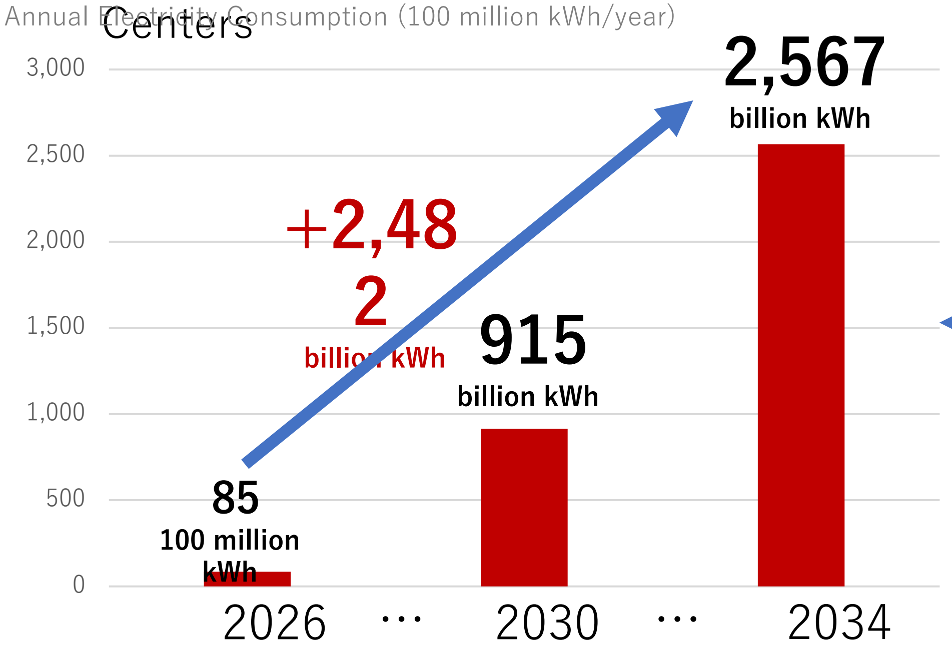
Source: NREL (2035 projection)
NREL (National Renewable Energy Laboratory): Annual Technology Baseline 2024 (ATB)
Exchange rate: Converted to yen at 150 yen/USD

Outlook for Offshore DC

Power demand at data centers is set to grow

- With the AI and IoT, both data center demand and electricity consumption are expected to increase.
- Cumulative electricity demand from 2026 to 2034 is expected to be equivalent to the total electricity consumption of Tokyo.

Forecast for the Increase in Electricity Consumption by Japanese Data Centers



Source: Calculated by our company as a cumulative total based on annual data center electricity demand figures listed separately in the "Demand Forecasts by Region and Supply Area (FY 2025)" published by the Organization for the Promotion of Wide-Area Electricity Operations on January 22, 2025.

■ The additional domestic data center electricity demand from 2026 to 2034 will be equivalent to Tokyo's current annual electricity consumption*1

By 2034
Power Required for Data Centers
required for data centers
248.2
billion kWh
≒

*1 Refer to the electricity demand figures by supply area in the "Demand Forecasts by Region and Supply Area (FY 2025)" published by the Organization for the Promotion of Wide-Area Electricity Operations on January 22, 2025. Tokyo's demand for FY 2025 is 260.3 billion kWh.

Idea of Watt - Bit

Suitable power generation sites

(e.g., Hokkaido, Kyushu)

\+

Optimizing time-shifting of surplus power, frequency regulation, and supply-demand balance using BESS's regulation capabilities

Expansion of interconnection lines and transmission grids

Expansion of Transmission Capacity

☐ Power transmission cables (HVDC between Hokkaido and Tokyo)*1 **500–920 million yen/km** (land routes: additional costs)

Demand Areas

(e.g., Tokyo, Kansai)

Computing Resources

Suitable Power Generation Sites

(e.g., Hokkaido and Kyushu)

Computing Resources

Using BESS and data centers to induce load fluctuations converting surplus power into computing resources on-site

Transmitting Bits (Value) via Fiber Optics

☐ Optical fiber cable (fiber-optic conversion of distribution networks)*2 **1.2–2.5 million yen per km**

☐ Submarine fiber-optic cables*2 Up to tens of millions of yen per km

Fiber-optic cables have lower construction costs than power transmission cables, and construction periods are relatively shorter

Demand Areas

(e.g., Tokyo, Kansai)

Challenges

- Excess electricity should be transmitted to areas of demand, but this is limited by constraints on interconnection lines and the power grid.
- Grid-side solutions face challenges in terms of both time (approximately 10 years) and cost

Solutions

- By installing data centers in areas suitable for power generation, and transmitting it via fiber-optic cables, we can resolve grid management challenges.
- Combining this with BESS will also enable load balancing
- The goal is to fully utilize any electricity remaining after grid stabilization measures have been implemented within the local area

*1 For information on transmission cables (HVDC between Hokkaido and Tokyo), refer to the 20th Meeting of the Committee on the Master Plan for Wide-Area Interconnection Systems and the Ideal Framework for Grid Utilization Rules, organized by the Organization for the Promotion of Wide-Area Power System Operation (https://www.occto.or.jp/assets/iinkai/masutapuran/2022/files/masuta_20_01_01.pdf).

*2 For information on optical fiber cables (the transition to fiber-optic power distribution networks), refer to the 24th Meeting of the Tariff System Expert Group of the Electricity and Gas Market Surveillance Commission (https://www.occto.or.jp/assets/iinkai/masutapuran/2022/files/masuta_20_01_01.pdf).For submarine optical cables, refer to the construction costs (https://cloudnetworks.co.jp/report/report.20140516.pdf) and distance (https://cloudnetworks.co.jp/aboutncs/cable.html) published for the Japan Sea Optical Submarine Cable System (NSC) Project. Based on the construction cost of 66 million USD ≒ approximately 10.3 billion yen (1 USD = 156 yen) and a distance of approximately 1,000 km, an estimate of about 13 million yen per km is possible; however, since construction costs vary by project, a range of several tens of millions of yen per km was applied.

Why Offshore Data Centers?

Challenges Facing Onshore Data Centers

- Soaring Land Acquisition and Construction Costs
- Strain on Power Grid Capacity
- Cooling Costs Account for 30–40% of Operating Expenses
- Delays of several years in grid connection work
- Difficulty in Meeting Decarbonization Requirements

The Potential of Offshore DC

- Offshore projects require no “land”
- Seawater cooling is expected to improve efficiency
- Rapid site selection through direct connection to renewable energy
- Relocation and repositioning are possible
- Easy to Combine with Renewable Energy

Watt-Bit — Remote Island and Offshore DC Business Concept

Island Data Center Model

Remote Islands Renewable Energy Generation (solar, wind, etc.) → Mega Power DC Islands Data Centers

▶Operates independently on 100% renewable energy even on remote islands not connected to the power grid. Sustainable digital infrastructure that maximizes the use of renewable energy resources on remote islands

Coastal Data Center Model

Renewable Energy Generation (solar, wind, etc.) → Mega Power DC Offshore Data Center

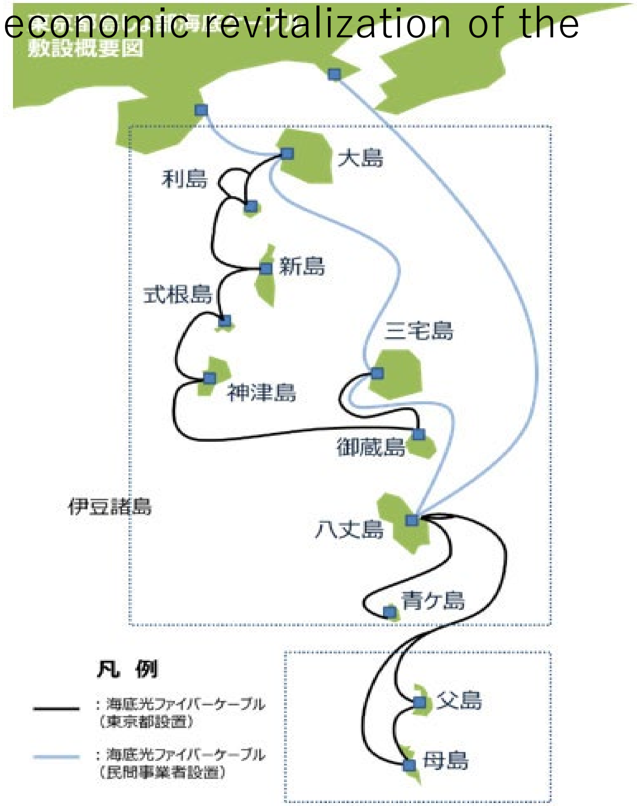
▶Deployed quickly and cost-effectively by utilizing existing infrastructure in ports and coastal areas. Enables improved PUE through seawater cooling and provides grid balancing capacity

Data Centers on Remote Islands in the Tokyo Archipelago

Thanks to the utilization of surplus electricity generated by offshore wind farms and the “TOKYO Data Highway” project—which leverages existing submarine fiber-optic cables—the Tokyo Islands region has the potential to become a leading candidate for future data center locations. Remote island data centers can contribute not only to the decentralization of data centers away from the city center but also to the economic revitalization of the islands.

Abundant electricity from offshore wind power

Data centers

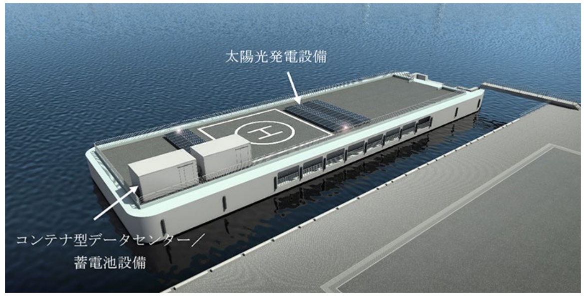


Well-developed submarine fiber-optic cable network

https://www.digitalservice.metro.tokyo.lg.jp/business/tokyo-data-highway/island

World’s First 100% Renewable Offshore Green Data

Nippon Yusen, NTT Facilities, Euras Energy Holdings, Mitsubishi UFJ Bank, and the City of Yokohama



A demonstration project for a 100% renewable energy-powered floating offshore data center—utilizing solar power and battery storage—will begin at Osanbashi Pier in **Yokohama City**, Kanagawa Prefecture.

This initiative aims to address three major barriers—"**land scarcity**," "**delays in securing power sources**," and ”**supports from resident**”.

1. Utilizing the “seawater” as a **cooling** and heating source to improve PUE (Power Usage Effectiveness)

2. Enables rapid commissioning and facility standardization, independent of “**ground conditions**” and “**location.**”

3. Generate power via offshore wind and **consume it on-site** at the data center.

4. The **ultimate BCP** (Business Continuity Plan) for Japan, where earthquakes and other disasters occur frequently

Source: https://www.ntt-f.co.jp/ntt-fjd/casestudy/023/

Thank You