J-POWER “BLUE MISSION 2050”

EFFORTS TO REALIZE A CARBON-NEUTRAL AND HYDROGEN SOCIETY

Date: 2/26/2021 J-POWER

WELCOME

J-POWER “BLUE MISSION 2050”

We will continue to grow globally through our ingenuity by using our experience and technological capabilities to decarbonize energy, introduce the latest technologies, and take on the challenges of new business fields in order to provide constant energy supply and realize a sustainable society.

J-POWER's vision for 2050

Realization of Carbon Neutral and Hydrogen Society

- J-POWER has been engaged in hydroelectric, thermal, wind, and geothermal power generation, power transmission, and transformation projects* with a mission to contribute to the sustainable development of Japan and the world by continuously providing energy that people need. In order to achieve our mission, we will further develop our comprehensive technological capabilities and well-balanced portfolio that we have cultivated for a long time, and approach our mission from various angles.
- By 2050, we will take on the challenge of achieving carbon neutrality in our power generation business in stages. As a milestone, we will reduce CO_2 emissions by 40% in 2030.
- In order to achieve this goal, we need to steadily replace coal-fired power plants with CO_2-free hydrogen power generation ones. In doing so, we will also pursue the possibility of expanding our business domain by promoting to the use of hydrogen not only in power generation industry but also in other industries such as steel and chemicals.

* From the perspective of ensuring the neutrality of power transmission companies, the power transmission and transformation business will be handled by J-POWER Transmission Network Co., Ltd. (hereinafter referred to as J-POWER Transmission), which is J-POWER's wholly owned subsidiary established through a company split on April 1, 2020.

※J-POWER “BLUE MISSION 2050” is based on the further development of the power generation technology that J-POWER has cultivated to date, the image of sustainable management based on economic rationality, and consistency with the "Green Growth Strategy for Carbon Neutrality in 2050" outlined by the government.

※ In this document, the term "J-POWER" refers to the J-POWER Group.

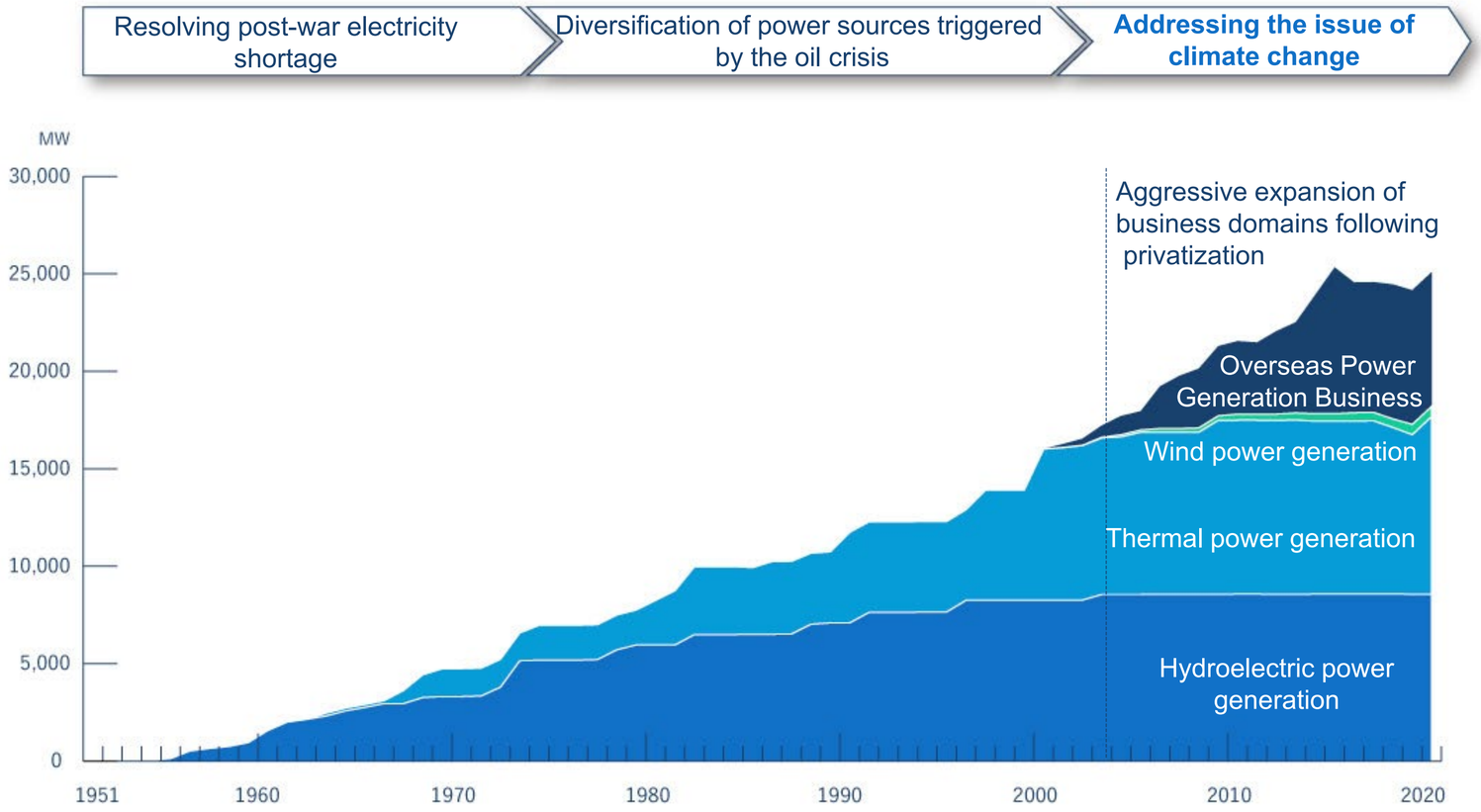
J-POWER'S CIRCUMSTANCE AND POSITION

COMPONENTS OF STRATEGY

SOLVING SOCIAL ISSUES OF THE TIMES THROUGH BUSINESS

Up until now, J-POWER has contributed to solving various energy-related issues of each era through its business. We have continued to expand our business and grow while constantly responding to changes in the world. From the early 2000s, we were among the first to respond to climate change issues. With the privatization of the company in 2004, we have been steadily expanding our business while rapidly developing overseas power generation and wind power generation businesses. J-POWER aims to achieve sustainable growth with an eye to the future, based on “coexistence of energy and the environment," by leveraging the technologies and achievements we have cultivated in Japan and around the world.

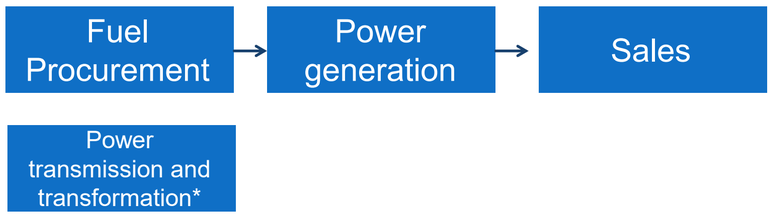
History: Solving Problems in Each Era

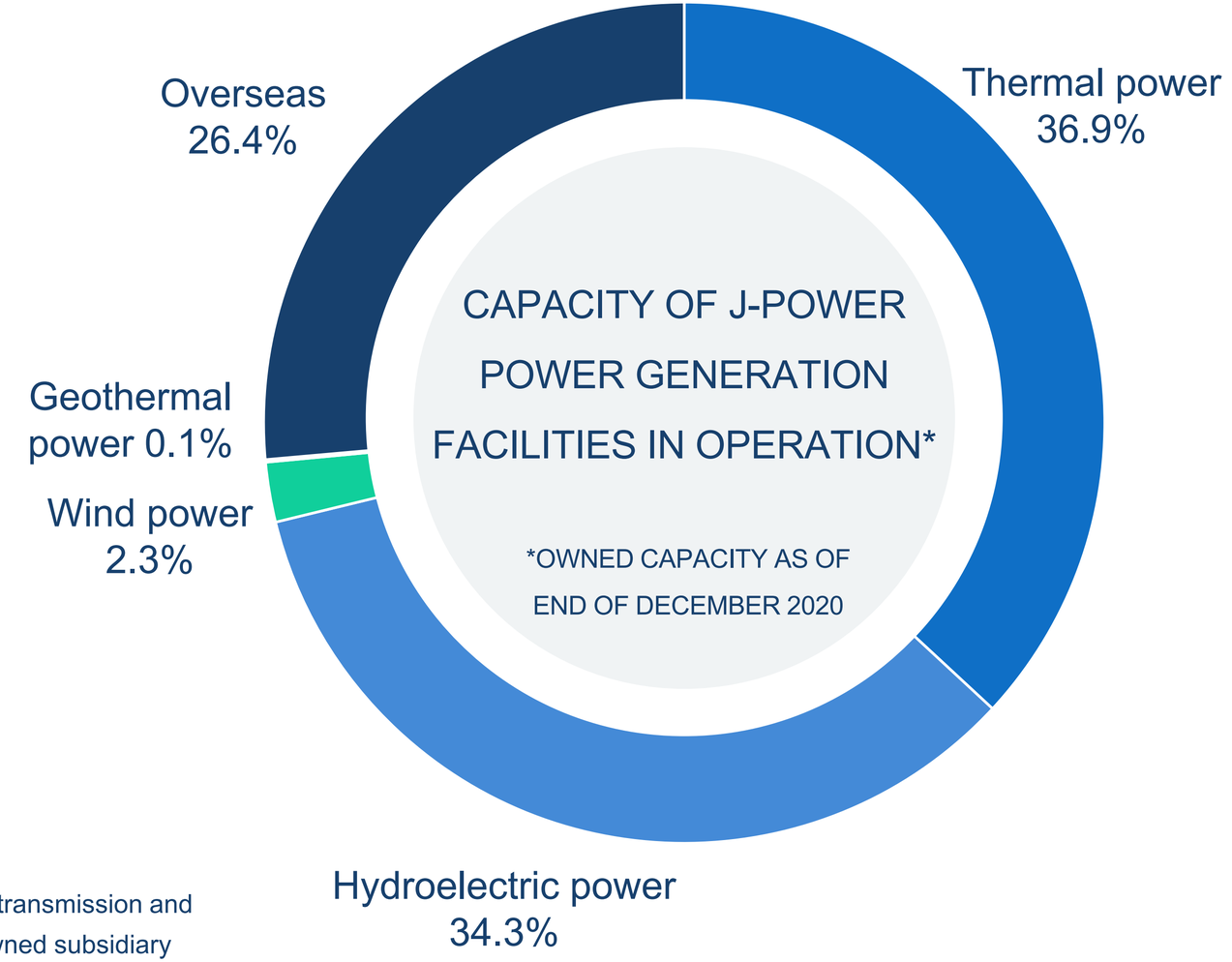


BALANCED PORTFOLIO

We have a well-balanced portfolio of power generation facilities, including water, fire, wind, and geothermal power generation facilities, as well as power transmission and transformation facilities*, and possess comprehensive technological capabilities ranging from fuel procurement to technologies for siting, construction, operation, and maintenance of the facilities. In addition, based on our achievements in Japan, we have been engaged in consulting and power generation businesses overseas for more than half a century.

J-POWER'S VALUE CHAIN





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ACHIEVEMENTS IN ORIGINAL PROJECT DEVELOPMENT AND TECHNOLOGY DEVELOPMENT

J-POWER has abundant technological capabilities backed by its long history of project development and technological development. Based on the comprehensive technological capabilities, we have been ready to provide practical solutions.

Japan's second-largest wind farm operator

J-POWER has been working on wind power generation at an early stage. As of February 26, 2021, J-POWER owns wind power generation facilities at 25 locations in Japan with a total capacity of 575,160 kW (equity basis), making it the second largest wind power generator in Japan.

Research and development of hydrogen production from coal

J-POWER has been conducting demonstration tests of coal gasification technology, those of CO_2 separation and capture, and research on effective utilization and storage of CO_2 for many years, with the aim of generating electricity from CO_2-free hydrogen. The CO_2-free hydrogen produced by our plant is expected to be used for power generation as well as in industrial fields such as steel.

CO_2-free nuclear power

J-POWER is promoting the Ohma Nuclear Power Plant Project with the highest priority on ensuring safety as a CO_2-free power source that can generate a large amount of electricity in a stable manner.

Facilities that contribute to the expansion of renewable energy

J-POWER Transmission owns submarine DC transmission lines, frequency conversion stations, and other power network facilities that are important for the spread of renewable energy and has a high level of technology and experience in construction and maintenance.

SPECIFIC SCENARIOS BASED ON MACRO-ENVIRONMENTAL ANALYSIS REQUIRED

Political Factor

In October 2020, the Japanese government declared its intention to reduce greenhouse gas emissions to zero overall and to achieve a carbon-neutral, decarbonized society by 2050. Around this time, specific policies such as the fade-out of inefficient coal-fired power plants and the Green Growth Strategy were released.

Economical Factor

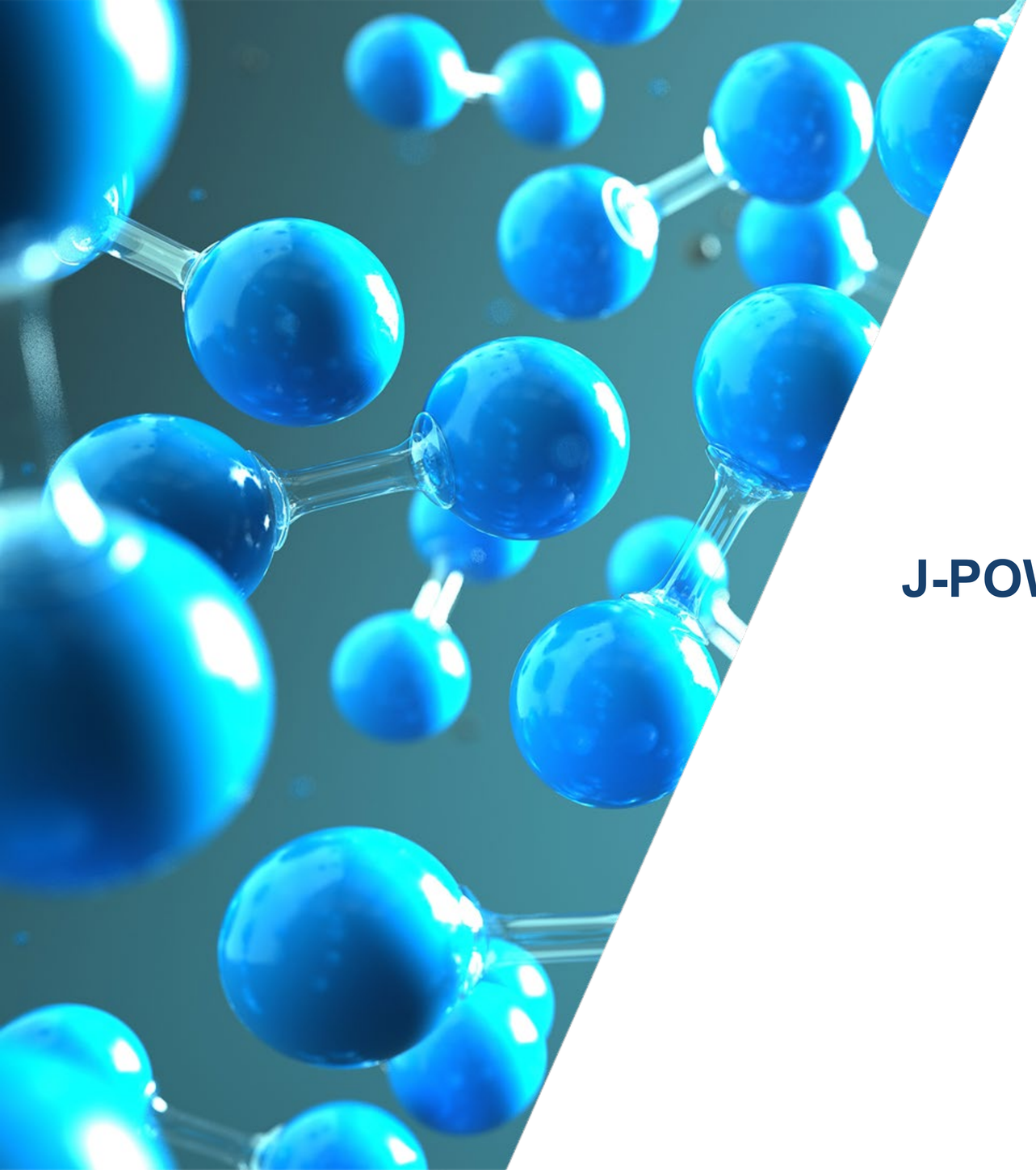
In Japan, a country with limited natural resources, inexpensive and stably procurable resources are essential as one of the primary energy sources to ensure a stable supply of electricity. Coal is the best resource for this purpose, but the conventional coal-fired power plants with high CO_2 emissions are expected to become less economically rational due to emission regulations, etc. The future of the local economic zone and the corporate assets that may become worthless are also issues to be addressed.

Social Factor

As the international community becomes increasingly concerned about the issue of climate change, proactive measures to reduce greenhouse gas emissions have become an urgent issue. In order to reduce greenhouse gas emissions, the expectation is increasing to promote electrification, expand the introduction of renewable energy sources, and utilize CO_2-free hydrogen in areas where electrification is difficult.

Technological Factor

In order to introduce a large amount of renewable energy, which is unstable due to the fact that the power generation depends on weather conditions, it is necessary to enhance CO_2-free adjustment power sources and power networks. In addition, there is a limit to the introduced amount of renewable energy due to location constraints, and in order to achieve zero emissions it is necessary to utilize CO_2-free hydrogen in various industrial fields including those where electrification is difficult.

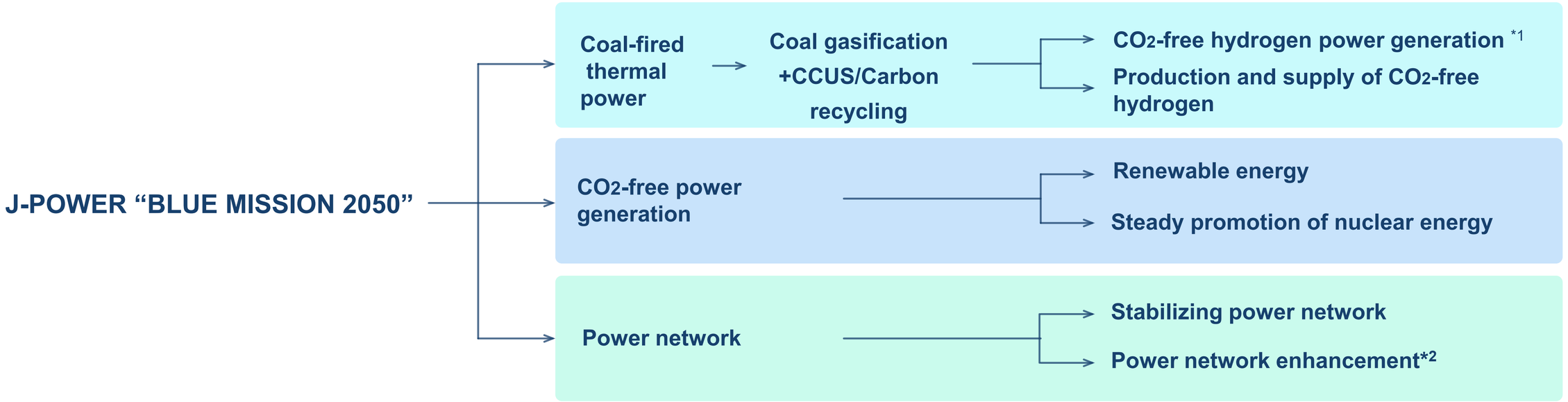


J-POWER “BLUE MISSION 2050” POLICIES

ACTION PLAN

CONCEPT

The J-POWER “BLUE MISSION 2050” is making an action plan based on the priorities of "acceleration" and "upcycle".



*1 Including the use of hydrogen extracted from ammonia for power generation, *2 The power network enhancement is an initiative of J-POWER Transmission.

Priorities for implementation (priority items)

Acceleration

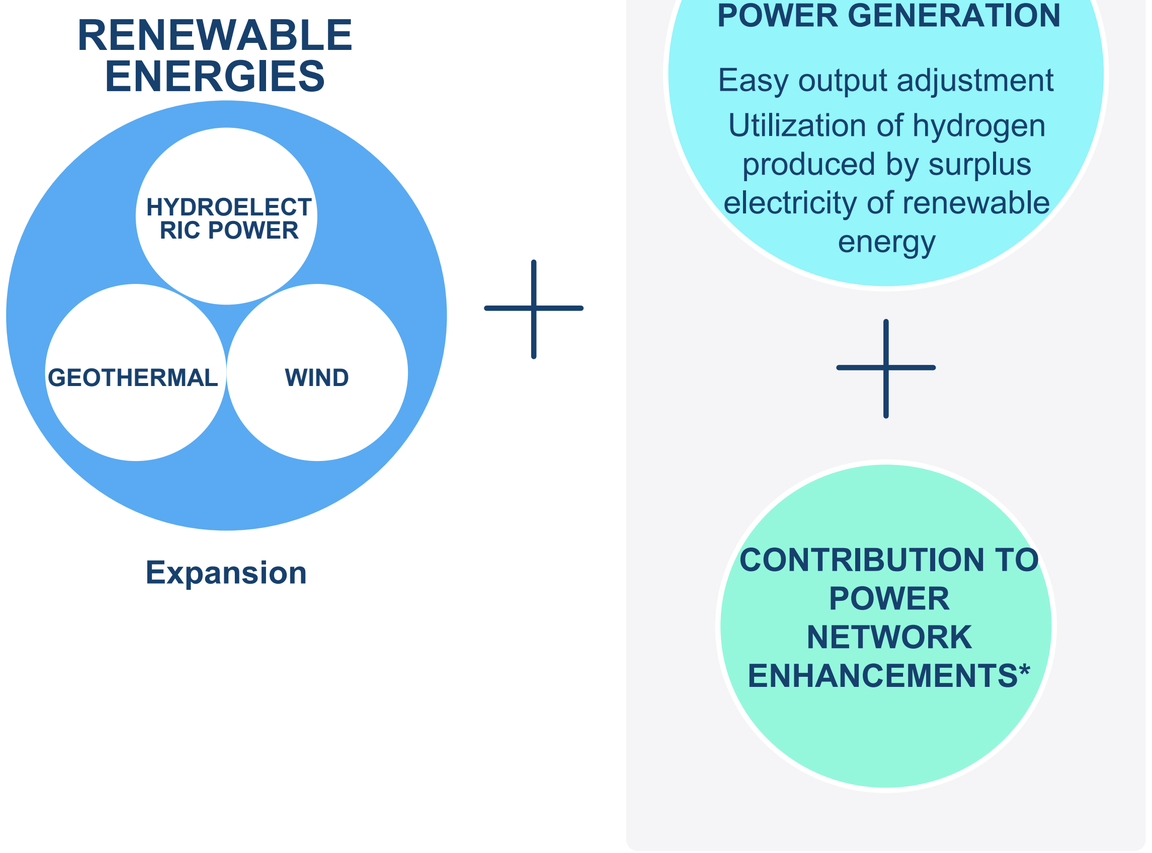
Upcycle

ACCELERATION TO REALIZE CARBON NEUTRALITY

Acceleration

Accelerating the Expansion of Renewable Energy with CO_2-Free Hydrogen Energy and Power Networks

We will further accelerate the expansion of renewable energies, including hydroelectric power, wind power, and geothermal power, which we have deployed nationwide to date.
In addition, CO_2-free hydrogen power generation can be easily adjusted in output, and store and utilize hydrogen produced by surplus electricity from renewable energy and mitigate the influence on the power network from fluctuation in the output of renewable energy, which depends on weather conditions. We will also contribute to the enhancement of the power network* for transporting electricity generated by renewable energy sources that are unevenly distributed in remote areas, to consumption areas, thereby helping to accelerate the expansion of renewable energy in Japan.



* The power network enhancement is an initiative of J-POWER Transmission.

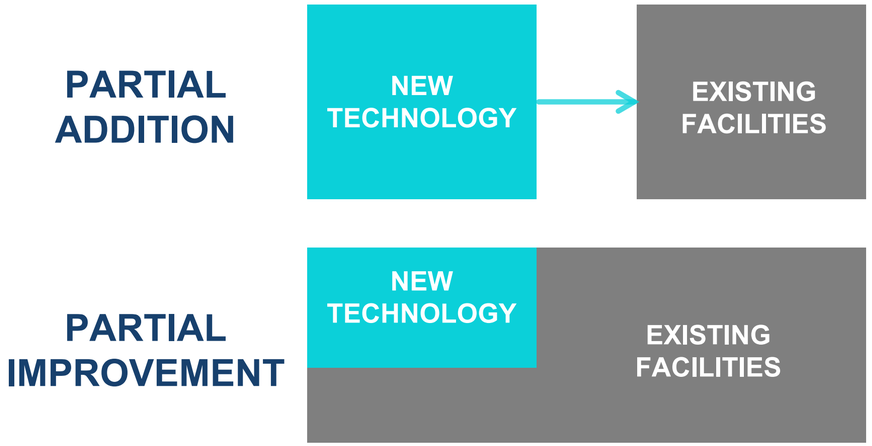
RAPID INNOVATION THROUGH UPCYCLING

Upcycle

Rebuilding the value of existing assets for rapid innovation

J-POWER “BLUE MISSION 2050” aims to apply new technologies at an early stage with economic rationality while reducing environmental impact, not only by introducing new facilities but also by upcycling (creatively converting) existing management resources into high value-added ones. In addition, we will formulate a roadmap so that innovations in technology can be quickly implemented in society, and we will move steadily forward with milestones.
For example, we will upcycle coal-fired power plants that are expected to phase out, by adding new technologies such as coal gasification and biomass-ammonia co-firing.

What is upcycling (creative value transformation)?

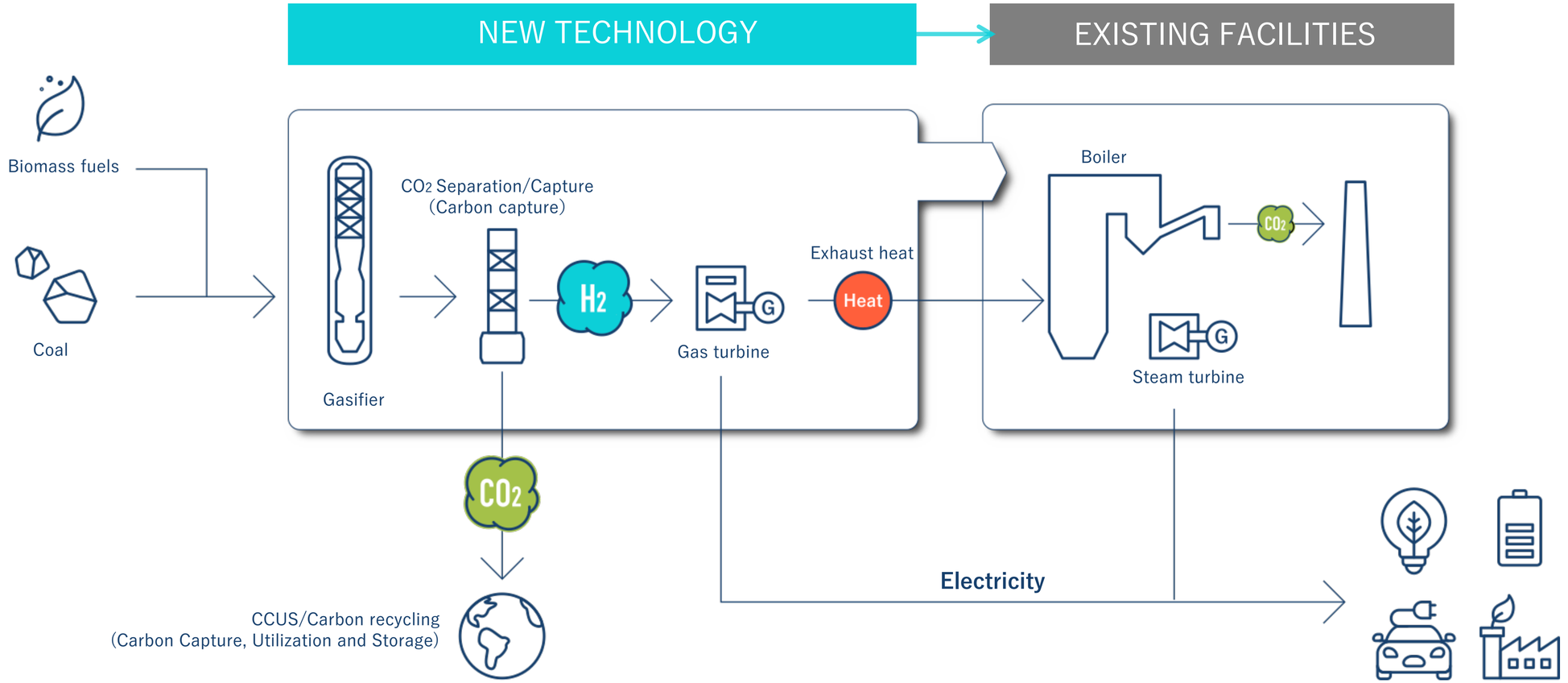


Advantages of Upcycling

REDUCTION OF ENVIRONMENTAL IMPACT
ECONOMIC RATIONALITY
EARLY START

UPCYCLING OF EXISTING FACILITIES

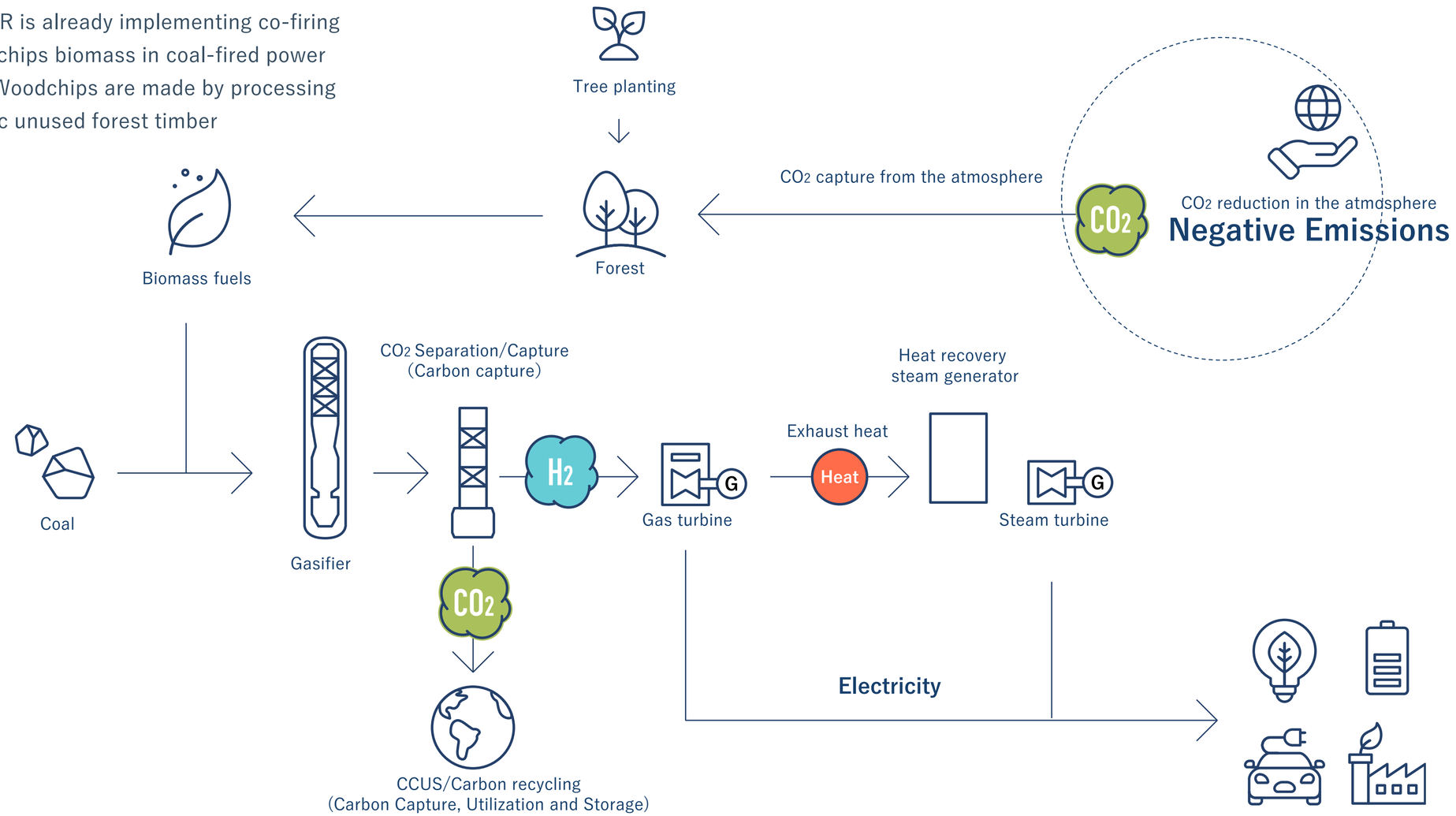
By upcycling existing power plants through adding the new technology, gasification and CO_2 separation and capture facilities to existing facilities, J-POWER will achieve CO_2-free hydrogen power generation in an economically rational and quick manner and maintain a stable supply of electricity while reducing the environmental impact.
J-POWER is steadily advancing its efforts to implement the new technology through the demonstration test projects to date.



NEGATIVE EMISSIONS THROUGH BIOMASS GASIFICATION

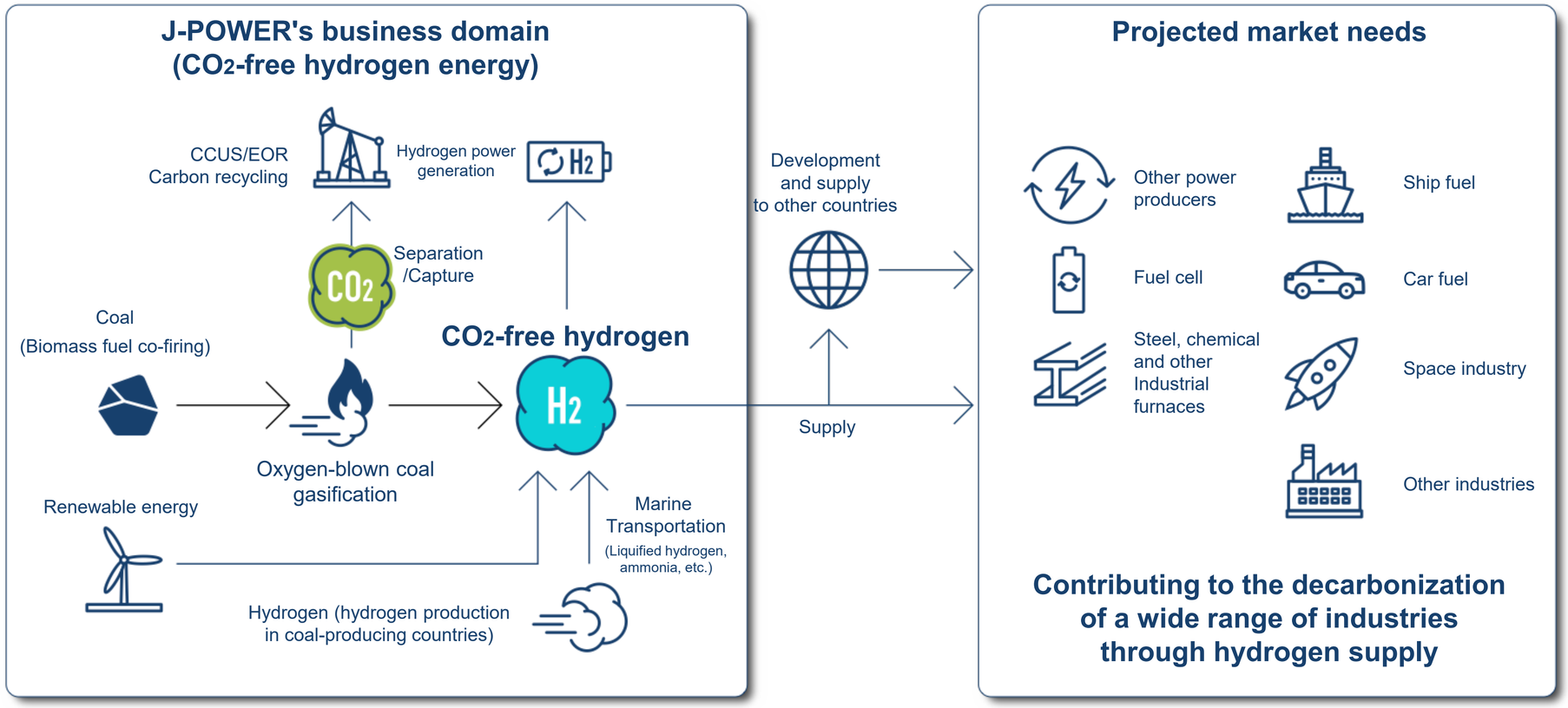
Negative emissions can be achieved by co-firing biomass with coal gasification.
It also contributes to the realization of a circular economy through the recycle of forest resources.

J-POWER is already implementing co-firing of woodchips biomass in coal-fired power plants. Woodchips are made by processing domestic unused forest timber



HYDROGEN SUPPLY CHAIN IN 2050

J-POWER has begun the transition from the previous coal-to-electricity conversion to CO_2-free hydrogen production using coal and hydrogen power generation. At the same time, J-POWER will pursue the possibility of expanding its business domain through supplying hydrogen to various uses.

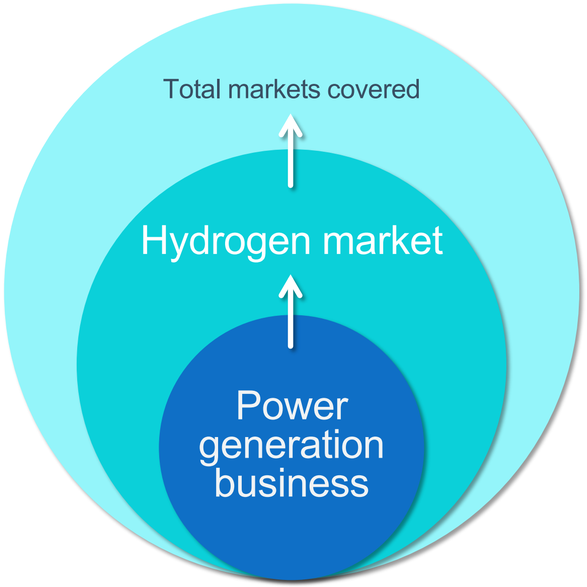


J-POWER aims to build an integrated value chain for electricity supply, from upstream fuel development, procurement, transportation, and storage to power generation, transmission/transformation, and retailing in collaboration with partners.

EXPANSION OF BUSINESS DOMAINS TOWARD 2050

Pursuing the possibility of expanding business domains by contributing broadly to the decarbonization of diverse industries

There is a high affinity between the government's "Green Growth Strategy for 2050" and J-POWER's proprietary technology development to date (CO_2-free hydrogen power generation combining coal gasification and CCUS). As the hydrogen industry expands in the future, it will be possible to develop not only the power generation business but also other applications and contribute to the carbon neutral society through supplying hydrogen to a wide range of industries. J-POWER's business domain, which is based on the power generation business, will also be able to expand into the hydrogen market.



Energy industries

- 1. Offshore wind power generation
- 2. Fuel ammonia industry
- 3. Hydrogen industry
- 4. Nuclear power industry

Transportation and manufacturing industries

- 5. Automobile and battery industry
- 6. Semiconductor, information and communication industry
- 7. Ship industry
- 8. Logistics, human flow, and civil engineering infrastructure industry
- 9. Food, agriculture, forestry and fisheries
- 10. Aircraft industry
- 11. Carbon recycling industry

Home and office industries

- 12. Housing and building industry
- 13. Resource recycling industry
- 14. Lifestyle industry

J-POWER “BLUE MISSION 2050” ROADMAP

CO_2 Reduction targets

-40% *1
-19 million tons
CO_2 emission from J-POWER’s domestic electric power business

Net emission 0
Realization of carbon neutral
CO_2 emission from J-POWER’s domestic electric power business

		2020	2030	2040	2050
	Coal-fired power plants in Japan	Phase out in order from aging/low carbonization (biomass/ammonia co-firing, etc.)			
CO_2-free hydrogen energy	Hydrogen power generation	Demonstration tests	Upcycle (adding gasifier to existing facilities)		CO_2-free hydrogen generation
	Fuel production (CO_2-free hydrogen)		Utilization in other industries		
CO_2-free generation	Renewable energy (hydro・wind・geothermal)	Approx. 1GW in new developments	Further new development, upcycling (replacement of existing facilities, repowering)		
	Nuclear power	Construction and operation of Ohma Nuclear Power Plant			
Power network	Stabilization	Expansion of hydroelectric power, oxygen-blown IGCC, and distributed energy services			
	Enhancement*2	Completion of expansion of New Sakuma Frequency Converter Station	Contribution to power network enhancement		

※ This roadmap will be updated and detailed as needed based on government policy conditions and the progress of industrial development. In addition, we will review the contents as the prerequisites change.

*1 Compared to the average results for three years from FY2017 to FY2019

*2 The power network enhancement is an initiative of J-POWER Transmission.

ACTION PLAN TOWARD 2030

CO_2 reduction target

-40% *1
-19 million tons
CO_2 emission from J-POWER's domestic electric power business

Net emission 0
Realization of carbon neutral
CO_2 emission from J-POWER's domestic electric power business

2030 — **2050**

1 Start of transition from coal to CO_2-free hydrogen power generation

For domestic coal-fired power plants, we will gradually phase out aging power plants, while adding gasification facilities to existing facilities to upcycle them as high-efficiency power generation systems using hydrogen, thereby reducing CO_2 emissions by 40% from the current level. By promoting the use of hydrogen, we will contribute to the realization of a new energy society in Japan.

2 Accelerating the development of renewable energy

We will promote new development and value enhancement for power generation, including offshore wind, by leveraging the knowledge we have gained through many years of development, maintenance and operation of renewable energies (hydroelectric power, onshore wind and geothermal). We will promote new development of about 1GW compared to FY2017 by FY2025 (globally expanding from 9.5GW to 10.5GW).

3 Nuclear power as CO_2-free power generation

We will promote the Ohma Nuclear Power Plant Project with the highest priority on ensuring safety to have an option for CO_2-free power generation. Since Ohma Nuclear Power Plant Project can use MOX fuel, which is recycled from spent fuel produced by nuclear power plants throughout Japan, we can contribute to CO_2 reduction through stable operation of the nuclear power plants in Japan.

4 Enhancement of power network as core infrastructure*2

In order to strengthen the backbone infrastructure that supports Japan's electric power network, we plan to complete the construction of a New Sakuma Frequency Conversion Station by fiscal 2027. In addition, we aim to contribute to projects to reinforce inter-regional connection lines and DC transmission lines, which will be necessary for the mass introduction of renewable energy in the future.

*1 Compared to the average results for the three years from FY2017 to FY2019 *2 The power network enhancement is an initiative of J-POWER Transmission.

TECHNOLOGY REALIZING J-POWER “BLUE MISSION 2050”

DEVELOPMENT ACHIEVEMENTS

Why coal?

Non-electrified sector needs large amounts of hydrogen

To achieve carbon neutrality, it is necessary to promote electrification, but a large amount of hydrogen is needed for decarbonization in sectors where electrification is difficult, such as transportation and steel manufacturing.

Limits to the amount of renewable energy installed

The production of CO_2-free hydrogen derived from renewable energy sources is limited in Japan due to geographical constraints, and CO_2-free hydrogen derived from fossil fuels is necessary to produce CO_2-free hydrogen in large quantities and in a stable manner.

Primary energy with low risk

For Japan, a country with small natural resources, coal, which is inexpensive, exists all over the world, has excellent storability, and poses little geopolitical risk, can be a suitable primary energy source for the large-scale and stable production of inexpensive CO_2-free hydrogen when the CO_2 generated is separated and captured.

Contributing to the reduction of atmospheric CO_2

Co-firing biomass during coal gasification can reduce atmospheric CO_2 (negative emissions) by combining CCUS/Carbon recycling.

2020	2030	2050
Demonstration test	**Transition period**	**CO_2 -free hydrogen**
Has conducted demonstration tests for hydrogen power generation by coal gasification for many years. Implementation of biomass co-firing at coal-fired power plants Conducted research/review on ammonia co-firing at coal-fired power plants	Will start hydrogen power generation as quickly as possible in a low-cost way. Example: Adding a gasifier to an existing coal-fired power plant The early introduction of hydrogen in large quantities at low cost will encourage the construction of the social infrastructure necessary for the future supply and use of CO_2 -free hydrogen.	Supplying CO_2 -free hydrogen and using it to generate electricity

Advantages of the J-POWER

Cost competitiveness

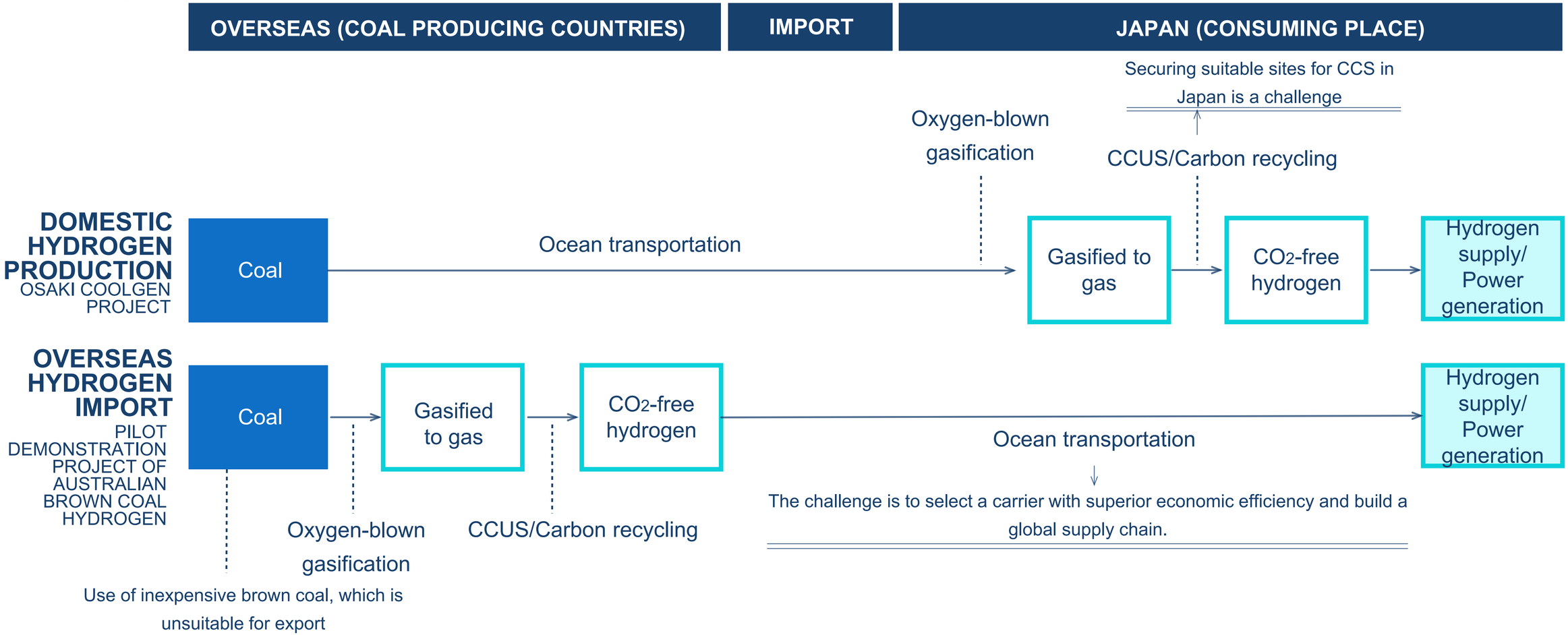
- It is aimed to make hydrogen production more cost competitive than water electrolysis by using inexpensive coal.
- Some of the land and facilities of existing coal-fired power plants can be used.

Technological strength

- The oxygen-blown coal gasification technology and CO_2 separation and capture technology required for hydrogen production from coal are already close to commercialization.
- We have a knowledge accumulated through demonstration tests and research on carbon recycling and CO_2 storage.

Two types of CO_2-free hydrogen production methods from coal

– In the production of CO_2-free hydrogen from coal, there are two possible methods: one is to import coal and produce CO_2-free hydrogen in Japan, and the other is to produce CO_2-free hydrogen in coal-producing countries and transport the hydrogen to Japan.
– Since each method has its own advantages and challenges, J-POWER will conduct demonstration tests for both methods to ensure the future production of CO_2-free hydrogen.



Osaki CoolGen Project

– The Osaki CoolGen Project*1 is currently conducting a demonstration test of a system that produces CO_2-free hydrogen from coal and uses it to generate electricity.
– The demonstration test is being conducted in three stages.

(Fiscal year)

2000 | 2010 | 2020 | 2030 | 2040

EAGLE Project 2002-2013
Demonstration test of oxygen-blown coal gasification and CO_2 separation and capture

→ **Osaki CoolGen Project** → To commercialization

Once the demonstration test in the Osaki CoolGen Project is completed, the next stage will be commercialization.

J-POWER's history of technological development in oxygen-blown coal gasification and CO_2 separation and capture dates back to the start of the EAGLE project in 2002, and the company is already at the forefront of the field with technologies accumulated over 18 years.

The Osaki CoolGen project is a demonstration test of a larger version of this project, also incorporating a fuel cell.

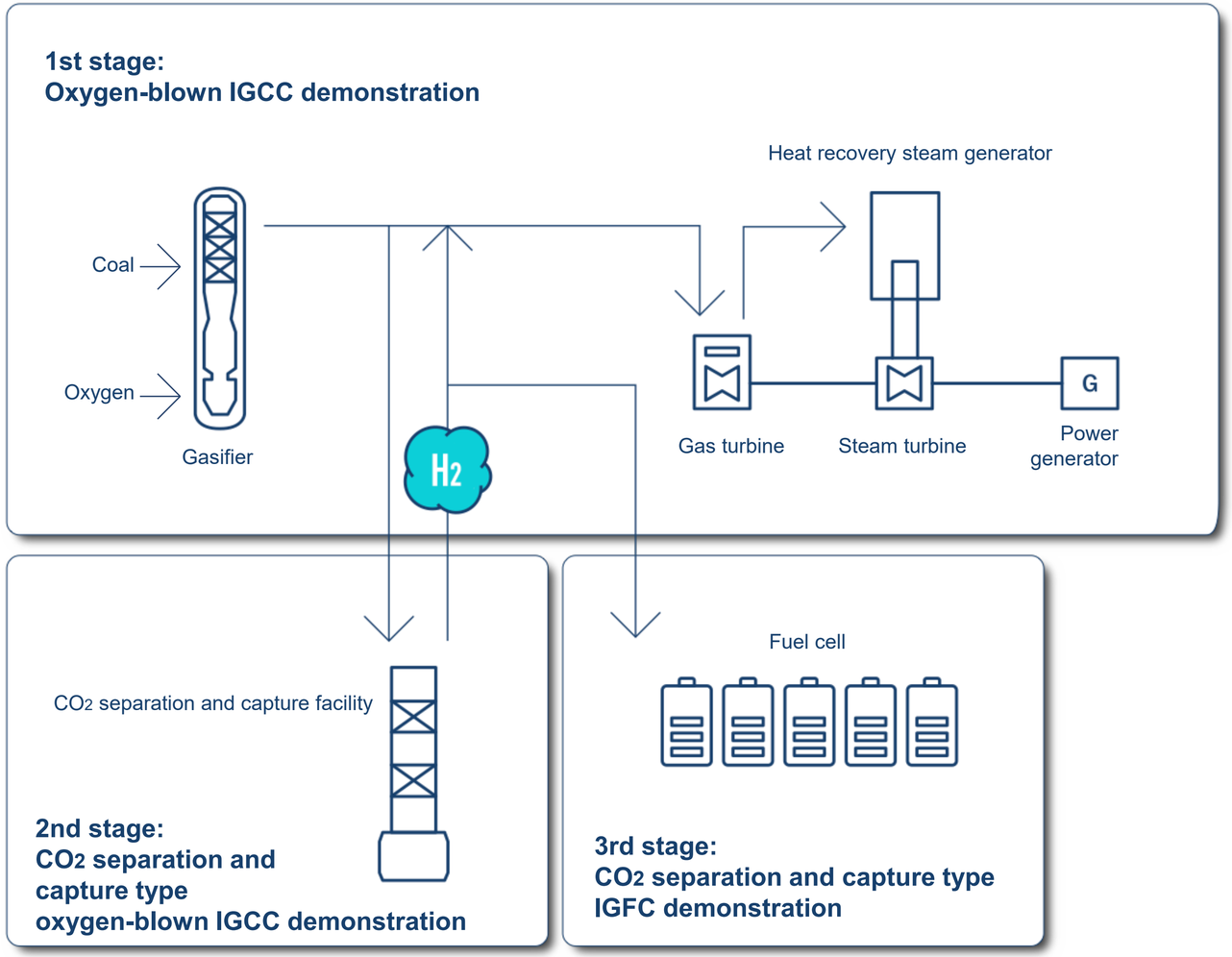
Phase 1 2016-2018
Oxygen-blown IGCC demonstration
Hydrogen of about 25%

Phase 2 2019-2020
CO_2 separation/capture + oxygen-blown IGCC demonstration
Hydrogen of about 85%*2
(High-purity hydrogen can be produced by refining)

Phase 3 2021-2022
CO_2 separation/capture + IGFC demonstration
Hydrogen of about 85%*2
(same as above)

*1 Jointly conducted with the Chugoku Electric Power Co., Ltd. as a project subsidized by the New Energy and Industrial Technology Development Organization (NEDO), a national research and development organization.
*2 Hydrogen concentration after CO_2 separation and capture. For power generation, the concentration will be lowered for burning due to restrictions on the capability of the turbine used in the demonstration test.

Osaki CoolGen Project (Details of the demonstration test)



– **IGCC (Integrated coal gasification combined cycle)**

This is a combined cycle power generation system with two types of power generation: a gas turbine that generates electricity by burning gas containing hydrogen generated from coal, and a steam turbine that generates electricity by using the exhaust heat of the gas turbine, etc.

There are two types of gasifiers for gasifying coal, oxygen-blown and air-blown types, and the oxygen-blown type enables generation of high concentrations of hydrogen in combination with CO_2 separation and capture facilities.

– **IGFC (Integrated coal gasification fuel cell combined cycle)**

This triple combined power generation system combines IGCC with a fuel cell that generates electricity from hydrogen. The power generation efficiency is higher than that of the oxygen-blown IGCC alone.

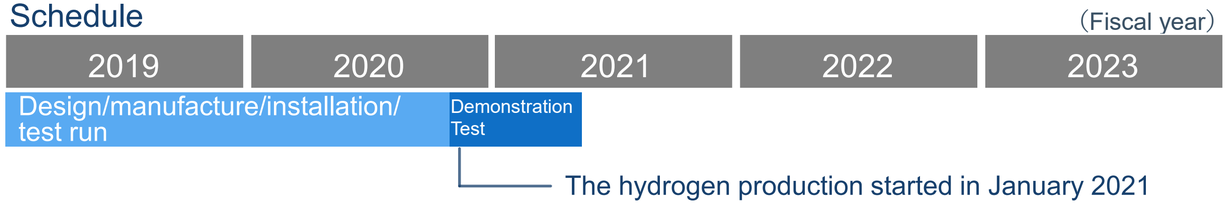
Australian Brown Coal Hydrogen Pilot Test Project

- J-POWER is participating in a pilot test project of constructing supply chain which produces hydrogen by gasifying brown coal in Australia and transports it to Japan.
- J-POWER has been in charge of gasification of the brown coal*1 and hydrogen refining facilities*2 utilizing its knowledge of coal gasification.
- The hydrogen production started in January 2021.
- When commercialized in the future, CO_2 free will be achieved by applying CCS*3 to store CO_2 generated in hydrogen production.

*1 Sponsored by the New Energy and Industrial Technology Development Organization (NEDO)
*2 Sponsored by the Australian federal government and the Victoria state government
*3 Planning to collaborate with the CarbonNet project being promoted by the Victoria State Government of Australia

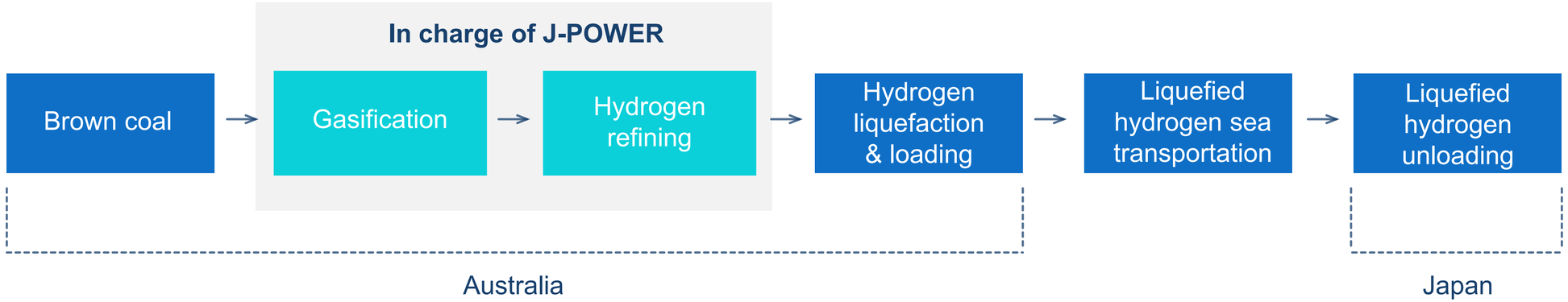
Brown coal gasification facility
Source: HySTRA

Schedule



<Overall View of the Global Hydrogen Supply Chain>

Benefits of using brown coal
- Unused
- Abundant resources
- Cheaper than coal



Carbon Recycling Demonstration Projects

Demonstration of carbon recycling by liquefying, transporting, and utilizing CO_2 captured by the Osaki Coolgen Project.

Company: Osaki CoolGen Corporation (Ownership: J-POWER 50%, Chugoku Electric Power Company 50%)
Demonstration Outline: Manufacturing liquefaction carbonic acid production 5ton-CO_2/day

Schedule (Fiscal year)

2020	2021	2022	2023	2024
Design/manufacture/ installation		Demonstration tests		

Osaki CoolGen

Oxygen-blown IGCC＋
CO_2 separation/capture process
demonstration facilities

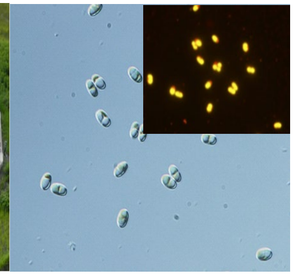
CO_2

Agricultural use
(Growth promotion)

Research on Carbon Recycling

We are developing bio-jet fuel production technology using marine microalgae.

40m open culture tank



Solaris Strain

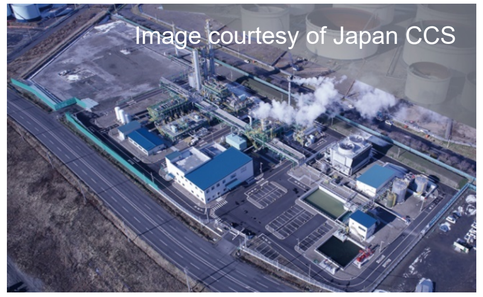
The Japanese Government Actions on Carbon Recycling

– The Japanese government formulates carbon recycling technology roadmap and promotes carbon recycling.

– Furthermore, Osakikamijima, where the Osaki Coolgen Project is being implemented, was established as a carbon recycling research base.

CO_2 Storage Demonstration and Technology Development Project

J-POWER has acquired knowledge of CO_2 storage through its participation in demonstration tests and technological development.

	CALLIDE OXYGEN COMBUSTION PROJECT	TOMAKOMAI CCS DEMONSTRATION TEST
Implemented by	Oxyfuel Technology Pty Ltd	Japan CCS Co., Ltd.
Location	Otway, Victoria, Australia	Tomakomai City, Hokkaido
CO_2 Press-in period	October to December 2014	April 2016 to November 2019
Press-in volume	21.1 tons	300,000 tons
Facility exterior	 View of CO_2 press and injection-in test	 Tomakomai CCS Demonstration Test Center

OTHERS

At the Gundih gas field in Indonesia, detailed plans are being developed from May 2020 for a CCS demonstration project to inject and store CO_2 underground, which is emitted from natural gas production.

Development of CO_2 storage technology is underway to solidify CO_2 (to hydrate) and store it in relatively shallow strata beneath the seafloor in order to increase storage capacity and reduce costs.

National movements on CO_2 storage

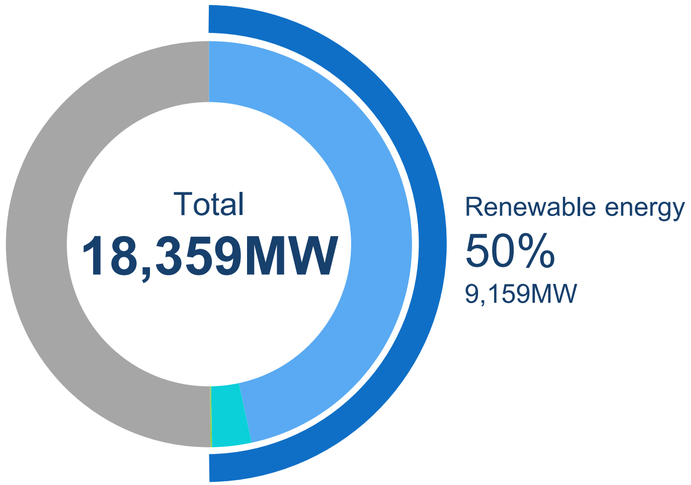
In 2005, the Research Institute of Innovative Technology for the Earth (RITE) estimated the CO_2 storage potential of Japan's coastal areas to be 146.1 billion tons.

→

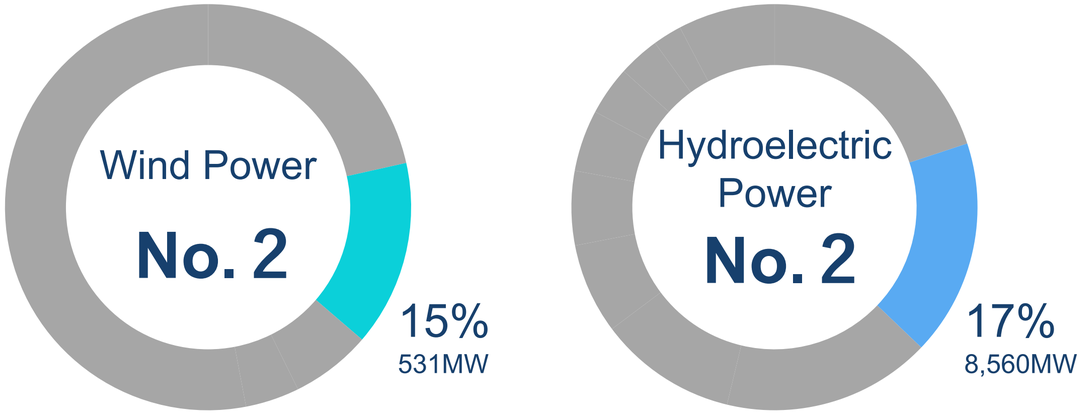
Currently, the Japanese government is conducting a survey of storage sites that are expected to store more than 100 million tons of CO_2 to identify promising storage sites.

Knowledge accumulated through 70-year history of development, construction, maintenance, and operation

J-POWER domestic power generation capacity*1



J-POWER domestic share*2

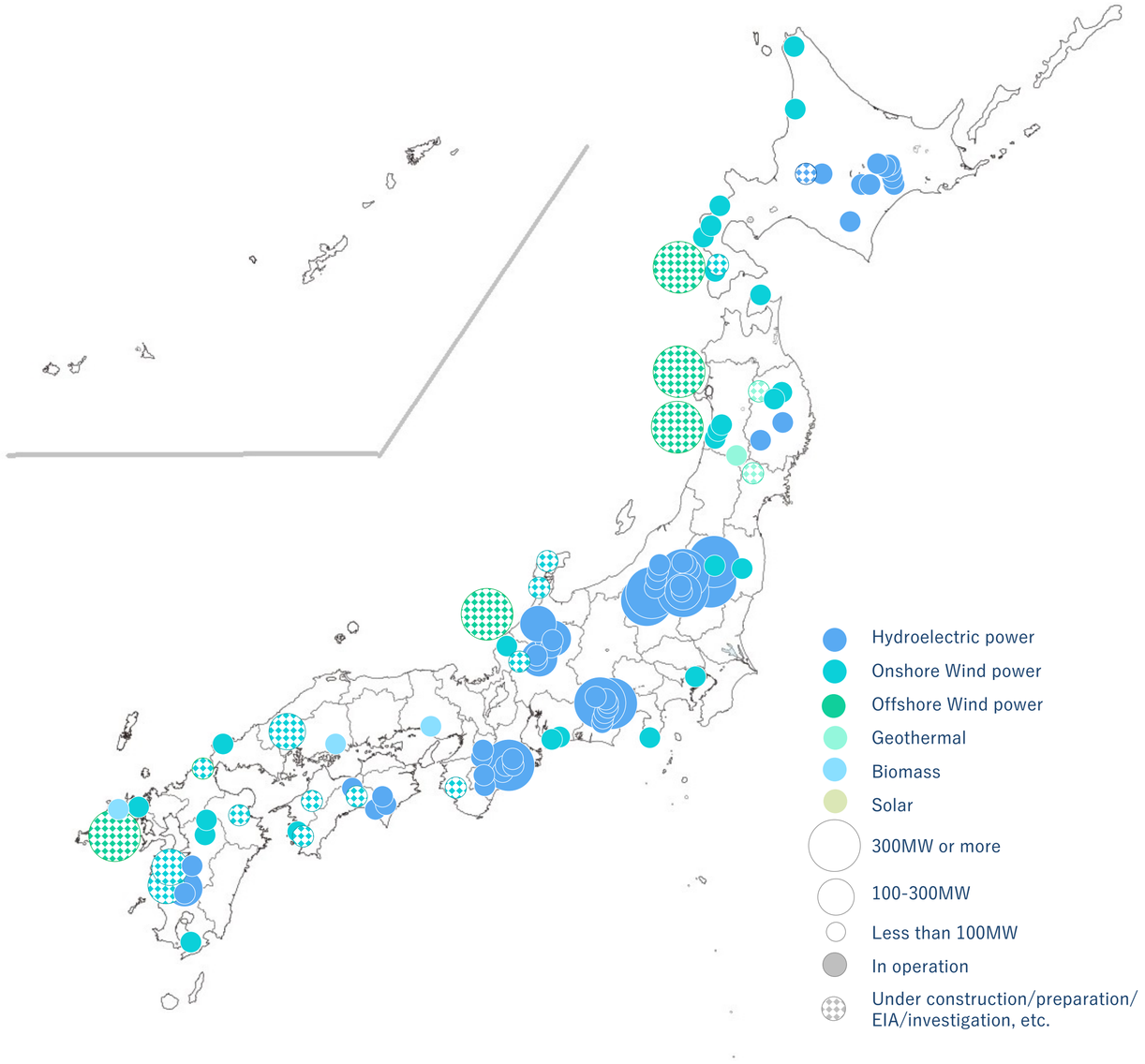


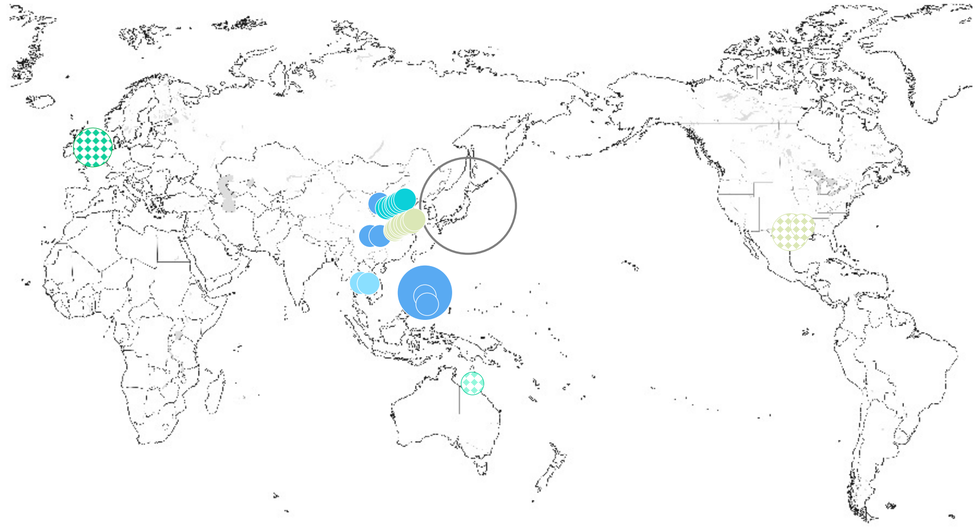
- J-POWER has a 70-year history of renewable energy development.
- J-POWER is one of Japan's leading renewable energy providers, with 50% of its domestic facilities capacity being from renewable energy sources.
- J-POWER has a great advantage in the form of extensive facilities and knowledge gained through years of construction, maintenance, and operation.
- J-POWER has this advantage to maximize the value of existing facilities while aiming for growth through new development.
- J-POWER allocates investment funds preferentially to renewable energies in the future.
- By FY2025, J-POWER will develop new facilities of 1GW (1,000 MW) compared to FY2017.

*1 As of December 31, 2020, owned capacity basis

*2 As of March 31, 2020, owned capacity basis

J-POWER Development status of renewable energy





	In operation	Research - construction phase
Hydroelectric	9,060MW	21MW
Wind power	591MW	Max. approx. 1,300MW A maximum of about 1,400 MW is under research for development at three sites in Japan's general sea area, and we formed consortium for development at one site.
Geothermal	23MW	17MW
Solar	22MW	188MW

Note:
*Owned capacity basis
*If the capacity is undecided, we used the estimated maximum owned capacity for calculation.
*The operator of offshore wind power in the general sea area is decided by bidding after designating the promotion area.
*In case of joint projects with other companies, we used estimated maximum capacity without considering equity for calculation.

Advantage and Future Development

Wind power

Know-how
Knowledge and experience gained from owning the facilities with the second largest market share in Japan

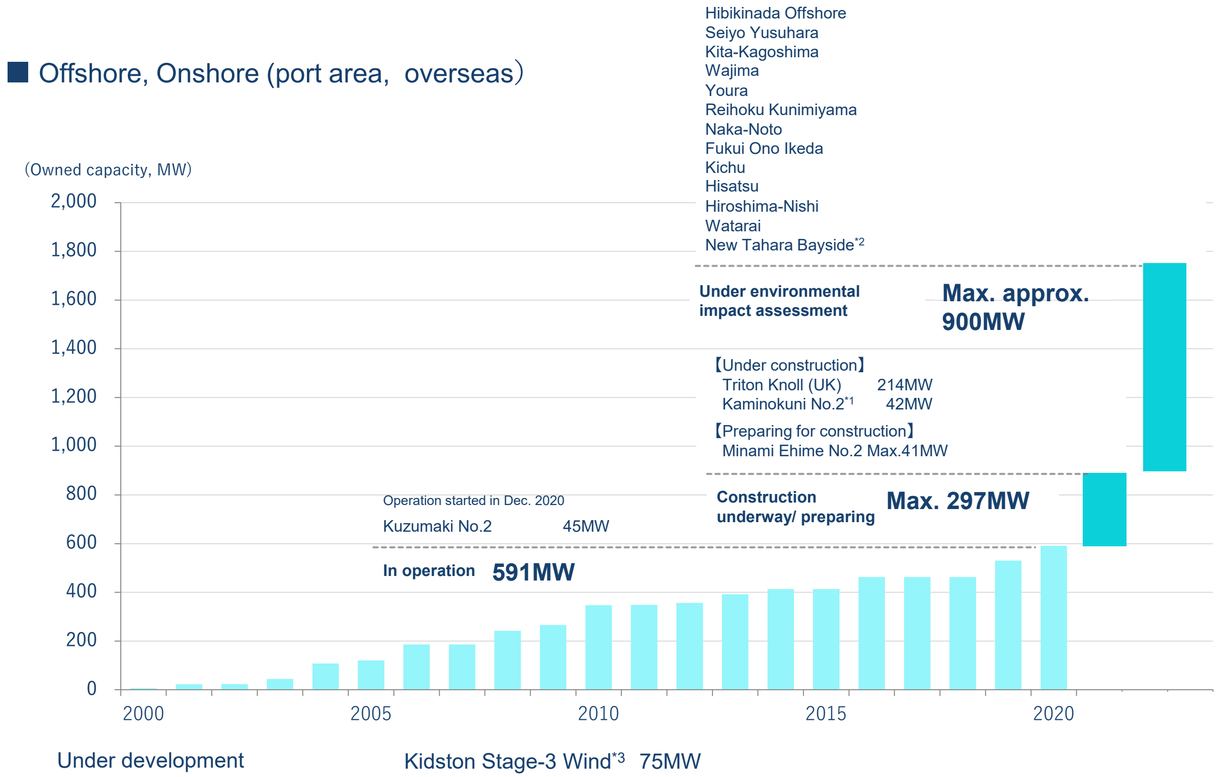
Engineering capability
Engineering capabilities to handle comprehensively from survey to construction, transmission line installation, operation and maintenance

Cost competitiveness
Efficient maintenance by a specialized wind power maintenance company within J-POWER

Strategy
– Promoting new development, both onshore and offshore
– Replacing aging wind power generation facility with larger, more efficient facility to increase the value of existing sites

Projects under development

■ Offshore, Onshore (port area, overseas)



Under development

Kidston Stage-3 Wind*3 75MW

■ Onshore (general sea area)

Under research for development	Saikai Offshore*4 Hiyama-area Offshore Awara Offshore*5	Max. approx. 1,400MW in total
Formed a consortium for business development*6	Off Akita pref.	

*1 Presents only phase 1 construction. Total plan amounts up to 120.4MW
*2 Estimated capacity increase with replacement
*3 Conducted jointly with Genex Power Limited
*4 Conducted jointly with SUMITOMO CORPORATION
*5 Conducted jointly with Mitsui Fudosan Co., Ltd.
*6 With JERA Co., Inc. and Equinor ASA

Advantage and Future Development

Hydroelectric Power

Large share

While there is no room for new large-scale hydroelectric power development in Japan, we have the second-largest facility in Japan

Low cost

Low power generation cost and high competitiveness due to advanced depreciation over the long period of time since the start of operation

Strategy

In addition to the development of small-scale hydroelectric power plants, in order to maximize the value of existing facilities, we increase volume of power generation through repowering (comprehensive renewal of major facilities) and maintain water reservoirs.

Projects under development

Projects	capacity	Note
Shinkatsurazawa/Kumaoi	17.0MW	Start of operation : FY2022 (planned)
Ashoro Repowering	-	Completion of construction : FY2022 (planned)
Ogamigo Repowering	20.0MW→21.3MW	Completion of construction : FY2023 (planned)
Nagayama Repowering	37.0MW→39.5MW	Completion of construction : FY2025 (planned)

Sakuma started operation in 1956

Okutadami, the largest capacity in Japan as a conventional hydroelectric power plant

Advantage and Future Development

Geothermal

Promote new development and replacement utilizing operational experience

Projects under development

Project	Capacity	Ownership	Owned capacity	Note
Onikobe Replacement	14.9MW	100%	14.9MW	Start of operation : April 2023 (planned)
Appi	14.9MW	15%	2.2MW	Start of operation : April 2024 (planned)
Takahinatayama-area	-	-	-	Under research for development

Wasabizawa started operation in 2019

Solar

Promote new development by utilizing the location, grid/market analysis, operation/sales know-how related to power plant construction accumulated within J-POWER

Projects under development

Project	Capacity	Ownership	Owned capacity	Note
Wharton (USA)	350MW	25%	87.5MW	Start of operation : 2022
Refugio (USA)	400MW	25%	100.0MW	Start of operation : 2023

The photo is a sample image

Promotion of the Ohma Nuclear Power Plant Project as CO_2-free energy

– Promote the Ohma Nuclear Power Plant Project with the highest priority on ensuring safety
– CO_2-free power source that can stably generate a large amount of power
– Contribution to stable operation of nuclear power plants throughout Japan by using MOX fuel

Location	Ohma-machi, Shimokita-gun, Aomori Prefecture
Capacity	1,383MW
Type of nuclear reactor	Advanced Boiling Water Reactor (ABWR)
Fuel	Enriched uranium and uranium-plutonium mixed oxide (MOX)
Started construction	May 2008
Commencement of operations	To be determined
Status	In December 2014, J-POWER submitted to NRA an application for permission for alteration of reactor installment license and an application for construction plan approval. We are undertaking review of compliance with the new safety standards.

Status of construction of the Ohma Nuclear Power Plant

The Ohma Nuclear Power Plant is the only nuclear power plant in Japan that can use MOX fuel, which is made by recycling spent fuel, in all of its reactor cores, leading to the reprocessing and reduction of spent fuel from nuclear power plants in Japan.
This will contribute to the stable operation of Japan's nuclear power plants, improve the energy self-sufficiency rate of Japan with few natural resources, and help reduction of CO_2 emissions.

Contributing to the expansion of renewable energy by stabilizing the power network

- In order to introduce a large amount of renewable energy throughout Japan, it is necessary to stabilize the power network by absorbing sudden fluctuations in output caused by weather conditions.
- As the introduction of renewable energies progresses, the value of output adjustment capability, which can adjust output quickly, will increase by contributing to the stabilization of power networks.
- J-POWER already possesses amount of output adjustment capability and has also conducted research and development for many years.
- J-POWER aims to leverage this advantage to grow by capturing the value recognized in power network stabilization.

Hydroelectric power
(Conventional hydroelectric power, Pumped storage)

- Quick output adjustment function contributes greatly to stabilization.
- Pumped storage power generation can absorb surplus power in the power network and has an even greater adjustment function.

< Strategy >

In addition to the development small-scale hydroelectric power plants, in order to maximize the value of existing facilities, we increase volume of power generation through repowering and maintain water reservoirs, etc.

Oxygen-Blown IGCC

- Quick output adjustment function contributes greatly to stabilization.

<Strategy>

Commercialization of oxygen-blown IGCC

Distributed Energy Services

- Stabilizing the power network by optimally selecting in-house consumption, power reception, and power transmission through the combination of renewable energy and batteries or through the VPP.

<Strategy>

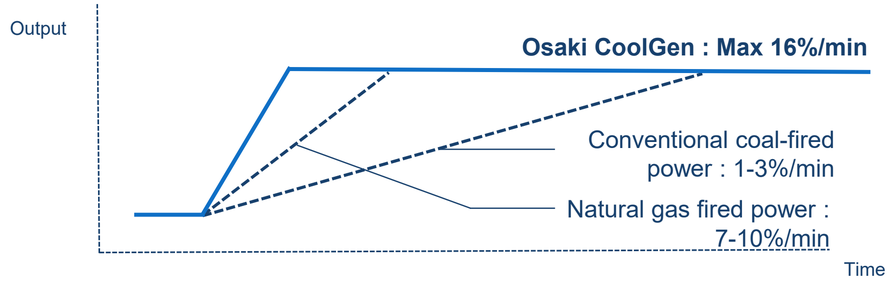
- Expansion of distributed energy services
- Already starting the VPP construction business*1

*1 Conducted at Suzuyo Power Co., Ltd., an affiliates accounted for by the equity method.

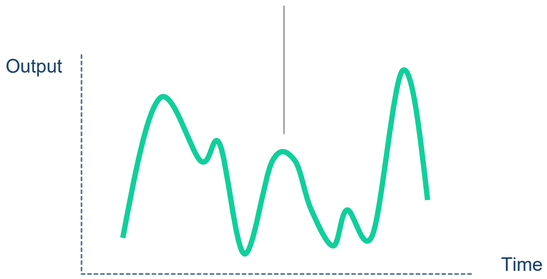
Power network stabilization

– The output of rapidly growing renewable energy sources, especially solar and wind power, fluctuates rapidly depending on weather conditions such as solar radiation and wind conditions.
– If left unchecked, this could lead to an imbalance between power supply and demand on the power network, resulting in large-scale blackouts.
– Therefore, it is necessary to remove output fluctuations of renewable energies by using power sources that can adjust output quickly
– For further renewable energy deployment, the value of power adjustment capability is taken account of in the growth process.

Speed of output adjustment of oxygen-blown IGCC **exceeds that of natural gas-fired power.**



Renewable energy



Renewable energy output fluctuates rapidly depending on weather conditions (solar radiation, wind conditions, etc.)

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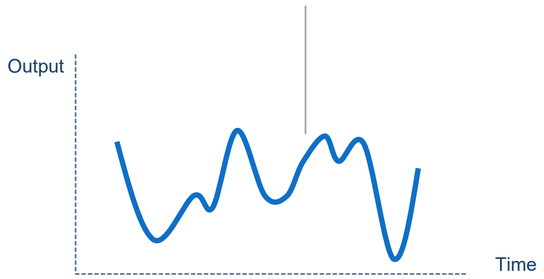
Hydroelectric power, oxygen-blown IGCC, distributed energy services



Adjusting the output of electric power sources quickly according to fluctuations in the output of renewable energy

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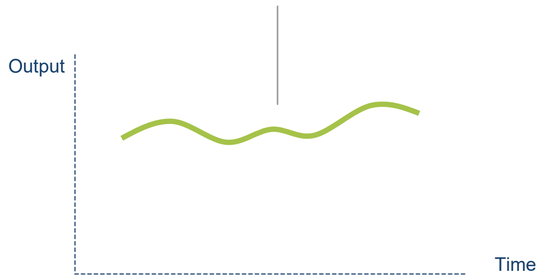
Leveling



Leveling the electricity flowing through the network

Contribution to power network enhancement*

*Contribution to the power network enhancement is an initiative of J-POWER Transmission.

– The optimal locations for renewable energy (Hokkaido, Tohoku, Kyushu) are far away from the power consumption areas (large cities).
– In order to expand the introduction of renewable energy, it is necessary to reinforce the power network to transport the electricity generated to the consumption areas.
– J-POWER Transmission owns and operates transmission and transformation facilities that utilize a wide range of technologies, including ordinary AC transmission lines, DC transmission lines, submarine cables, cables installed on bridges, and frequency conversion stations that enable the exchange of electricity between East and West Japan regions with different frequencies, and possesses technologies and knowledge necessary for expansion of the power network.
– Utilizing these technologies and experience, we contribute to power network enhancement by following initiatives.

Expansion of core transmission lines and inter-regional connection lines

Expansion of backbone transmission lines to transmit large amounts of electricity and inter-regional connection lines to transmit electricity across regions

– J-POWER Transmission owns a total of approximately 2,400 km*1 of transmission lines throughout Japan.

Expansion of DC transmission facilities

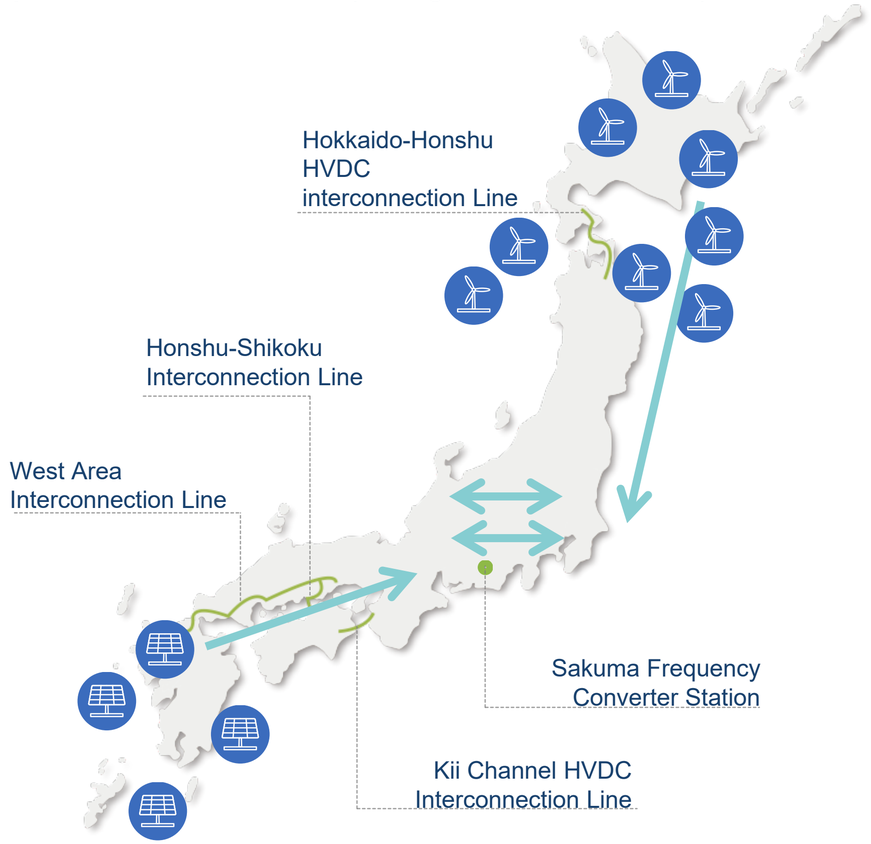
Installation of DC transmission lines (submarine cables) to transmit electricity generated by renewable energy to power consumption areas

– J-POWER Transmission owns DC interconnection facilities (submarine cable) for Hokkaido-Honshu HVDC Interconnection Line and Honshu-Shikoku Interconnection Line.
– J-POWER Transmission succeeded in constructing Japan's first ultra-high voltage DC power transmission facility and developing a DC CV cable.

Expansion of frequency conversion stations

Expansion of frequency conversion stations to exchange electricity between eastern Japan (50Hz) and western Japan (60Hz).

– J-POWER Transmission owns Sakuma Frequency Converter Station.
– New Sakuma Frequency Converter Station and replacement and expansion of related transmission lines are under construction.



*This diagram is an image. It is not intended to represent a real project.

*1 Including DC transmission lines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