Climate Change Scenario Analysis

In this section, we will introduce the J-POWER Group's climate change scenario analysis with reference to the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD).

Governance

The J-POWER Group is growing its business centered on the electric power generation business in Japan and overseas and recognizes that addressing climate change issues is inextricably intertwined with its business strategy. Accordingly, the Board of Directors **has positioned addressing climate change issues at the center of the management plan**, recognizing it as one of the Company's most important tasks, and is carefully monitoring progress in that direction. Furthermore, we have appointed a sustainability promotion manager who is a director and executive vice president to manage specific measures based on management plans.

▶ For information on the governance framework related to dealing with climate change, please refer to the sustainability promotion structures on page 40.

Strategy (1) Risks and Opportunities Related to Climate Change

The J-POWER Group's business could be strongly affected by climate change issues in terms of both risks and opportunities. Here we have compiled the main risks and opportunities related to climate change.

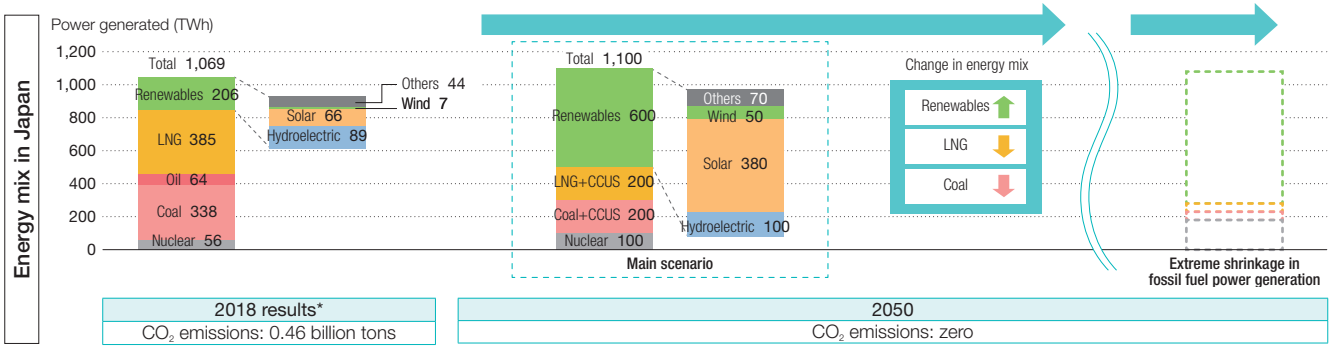
Risks and Opportunities	Category	Content	Period*		
			Short term	Medium term	Long term
Transition risks	Policy and legal	• Increasingly stringent regulations related to CO_2 emissions (phasing out coal-fired thermal power, introducing carbon pricing, strengthening 2°C/1.5°C goals) • Shrinking renewable energy purchase preferential programs	●	●	●
	Technology	• Falling utilization rates of thermal power plants due to the widespread introduction of renewable energy • Falling advantage of large-scale power generation due to the advancement of distributed power technologies • Increasing difficulty in connecting to the grid and securing land due to the widespread introduction of renewable energy		●	●
	Market	• Falling income from the thermal power business and difficulties in replacement of power plants due to a shift in preferences from fossil fuel to low-carbon power generation • Weakening competitiveness of thermal power business due to falling renewable energy and battery prices • Stagnation in renewable energy business due to intensifying competition and rising prices of scarce resources • Fuel supply capacity shortage for coal-fired thermal power due to falling coal prices and decreasing demand		●	●
	Reputation	• Falling corporate image due to CO_2 emissions • Declining investments and funding in fossil fuel businesses	●	●	●
Physical risks	Acute	• Damage of facilities due to extreme weather events, such as torrential rains, forest fires, cold snaps, and heat waves.		●	●
	Chronic	• Negative effects on facilities of the long-term rise in average temperatures, changing rainfall patterns, and rising sea levels			●
Opportunities	Resource efficiency	• Replacement of power plants to reduce fuel and water use • Wider use of high-efficiency thermal power that helps reduce CO_2 emissions and meets environmental requirements • Cost reductions through more efficient energy use at business sites and offices	●	●	●
	Energy source	• Expansion of low-carbon energy sources • Diversification of power sources that help ensure energy security • Expansion of needs for low-carbon technologies due to governmental carbon pricing incentives		●	●
	Products and services	• Development of technologies and products adapted to climate change • Providing services that can meet the changing needs of consumers and end users		●	●
	Markets	• Access to new energy sources • Expansion of electric power markets in emerging countries		●	●
	Resilience	• Expansion of renewable energy, distributed power sources, and demand-side businesses • Diversification of low-carbon fuels	●	●	●

* Short term: to 2025; medium term: to 2030; long term: to 2050

Strategy (2) Scenario Analysis (Formulation)

To achieve the 2°C goal set by the Paris Agreement, Japan needs to **eliminate CO_2 emissions from power generation no matter what the energy mix is in 2050**. This will require the expansion of renewable energy sources and use of carbon capture, utilization, and storage (CCUS) technologies to make fossil fuel power generation, such as coal-fired thermal power and LNG-fired thermal power, zero emission power generation. At the moment, we cannot accurately foresee what Japan's energy mix in 2050 will be.

The future energy mix will have a large impact on the J-POWER Group as power generation is its main business. The Group has formulated its own main scenario projection regarding Japan's energy mix in 2050. In addition, we have considered what would happen if fossil fuel power generation ultimately shrinks drastically as the increase in renewable energy usage and the decline in the use of fossil fuels accelerate further.



* Source: Power generated / IEA's "World Energy Outlook 2019" CO_2 emissions / Ministry of the Environment's "Fiscal 2018 Greenhouse Gas Emissions (Confirmed Figures)"

Strategy (2) Scenario Analysis (Assumptions)

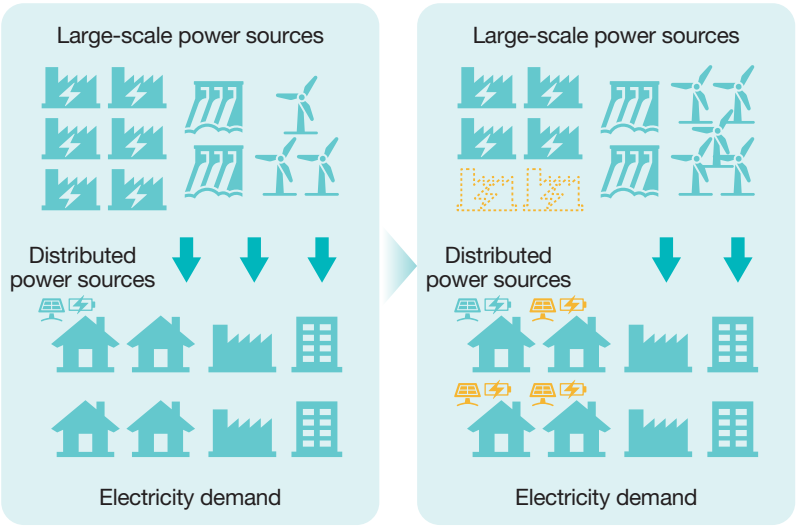
Assumptions behind Main Scenario

Electricity demand remains at the current level

Amount of energy consumed ↓ × Rate of electrification ↑ = Electricity demand →

Expanding decentralization and wider use of solar power and batteries

- Small-scale end users, especially households, are more decentralized, and low-voltage demand (around 35% of power demand) can be replaced with a combination of solar power and batteries.
- There is still a need for large-scale power sources (renewable energy, fossil fuels (+CCUS), nuclear power), especially in the industrial sector.



Scenario in which fossil fuel power generation shrinks drastically

The J-POWER Group considers **a scenario where fossil fuel power generation shrinks drastically to be unrealistic in Japan.**

This is because massive installations for carbon-free sources like renewable energy and nuclear power are restricted by the nature of the power sources themselves, and we think a certain amount of fossil fuel power sources will be necessary even in 2050.

Among the various fossil fuels, coal is very valuable in terms of energy security because its supply is stable and not exposed to geopolitical risks. In combination with CCUS technologies that suppress CO_2 emissions, it continues to be in demand.

Renewable Energy	☺	CO_2-free
	☹	Restrictions on sites and grid connections Unstable output due to natural fluctuations
LNG	☺	Lower CO_2 emissions than coal Easy adjustment of output
	☹	Greater geopolitical risks than coal in terms of supply, as 40% of reserves are in the Middle East Higher fuel costs than coal
Coal	☺	Stable supply due to insignificant geo-political risks Lower fuel costs than LNG
	☹	Larger CO_2 emissions
Nuclear Power	☺	CO_2-free Easy fuel stockpiling
	☹	Social acceptance

Risk Management

When formulating the scenarios, we focused on changes in Japan's energy mix. Here, we reassessed the main risks and opportunities (and resulting financial impacts) that could accompany those changes in the energy mix **if the J-POWER Group should fail to take any countermeasures related to climate change**.

As we move from the current situation and begin to face conditions like those outlined in the main scenario or the scenario in which fossil fuel power generation shrinks drastically, we believe the impact of associated risks and opportunities will get bigger.

Regardless of the type of power source, there will always be a risk that return on investment will stagnate amid future environmental changes (stranded asset risk). **We do not think that the stranded asset risk of coal-fired thermal power is higher** than that of gas-fired power, for which the fuel cost is higher, or that of renewables, the utilization rate of which is lower due to restrictions associated with weather and other natural conditions, as coal-fired thermal power is projected to have lower fuel costs* and a higher utilization rate.

	Risks and Opportunities	Content	Financial Impact
Coal-fired thermal power	Risks	Operation suspension order for coal-fired thermal power (phase out)	Decline in profit due to inability to operate
		Introduction of carbon pricing (carbon taxes, cap-and-trade, etc.)	Increase in power generation costs
		Lower utilization rates due to increase in renewables	Decline in profit due to lower utilization rates
		Expanding decentralization due to lower costs of renewables and batteries	
		Decline in demand for electricity derived from coal-fired thermal power	
		Fall in electricity market prices	Decline in profit due to lower sales prices
		Restrictions on investment and funding in coal-fired thermal power	Increase in difficulty procuring capital and stagnation of share prices
Renewables	Risks	Shrinking renewable energy preferential purchase programs aimed at limiting the increase in the burden on the public	Shrinking earnings opportunities for newly developed power sources
		Lower sales prices due to the intensifying competition among renewables	
		Increasing difficulty in connecting to the grid and securing land due to intensifying competition among renewables	Shrinking earnings opportunities due to stagnation of new development
	Opportunities	Expansion of renewable energy demand	Expanding earnings opportunities due to promotion of new development
		Stronger renewable energy expansion policies	
Distributed energy services	Opportunities	Expanding decentralization centered on renewable energy	Expanding earnings opportunities due to expansion of opportunities associated with distributed energy services

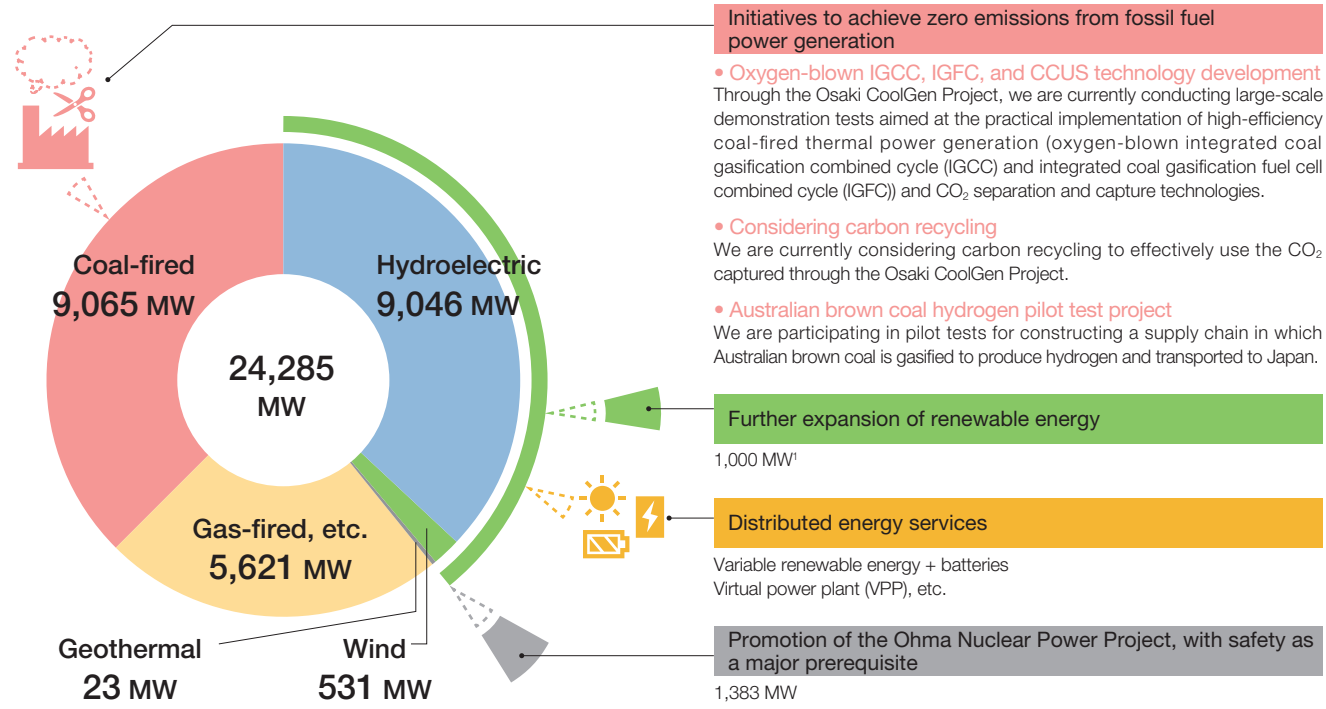
* Japan is not connected to any other country via gas pipeline and needs to import gas in the form of expensive LNG. This makes coal prices fundamentally lower than gas prices in Japan.

Metrics and Targets: Initiatives Aimed at Achieving Zero Emissions

Backed by a good balance of varied power sources, the J-POWER Group is leveraging its strengths to achieve **zero emissions through multifaceted initiatives that diversify risks associated with each power source**.

Initiatives to Achieve Zero Emissions	Targets	Deadline
Further expansion of renewable energy	Develop 1,000 MW of new capacity (0.3 billion kWh/year increase in hydroelectric, 2.5 billion kWh/year increase in wind power and others)[1]	FY2025
Initiatives to achieve zero emissions from fossil fuel power generation	Zero CO_2 emissions from fossil fuel power generation	2050
Promotion of the Ohma Nuclear Power Plant Project, with safety as a major prerequisite	Promote the construction of the Ohma Nuclear Power Plant (1,383 MW) with safety as a major prerequisite	Operation start date is to be determined

J-POWER Group's Global Capacity[2]



Initiatives to achieve zero emissions from fossil fuel power generation

- Oxygen-blown IGCC, IGFC, and CCUS technology development

Through the Osaki CoolGen Project, we are currently conducting large-scale demonstration tests aimed at the practical implementation of high-efficiency coal-fired thermal power generation (oxygen-blown integrated coal gasification combined cycle (IGCC) and integrated coal gasification fuel cell combined cycle (IGFC)) and CO_2 separation and capture technologies.

- Considering carbon recycling

We are currently considering carbon recycling to effectively use the CO_2 captured through the Osaki CoolGen Project.

- Australian brown coal hydrogen pilot test project

We are participating in pilot tests for constructing a supply chain in which Australian brown coal is gasified to produce hydrogen and transported to Japan.

Further expansion of renewable energy

1,000 MW[1]

Distributed energy services

Variable renewable energy + batteries
Virtual power plant (VPP), etc.

Promotion of the Ohma Nuclear Power Project, with safety as a major prerequisite

1,383 MW

1. Compared with FY2017
2. Capacity refers to owned capacity as of March 31, 2020

Metrics and Targets: Effects of Initiatives

Through initiatives aimed at achieving zero emissions, we made it possible to secure and enhance profit while suppressing risks associated with the changing energy mix in Japan.

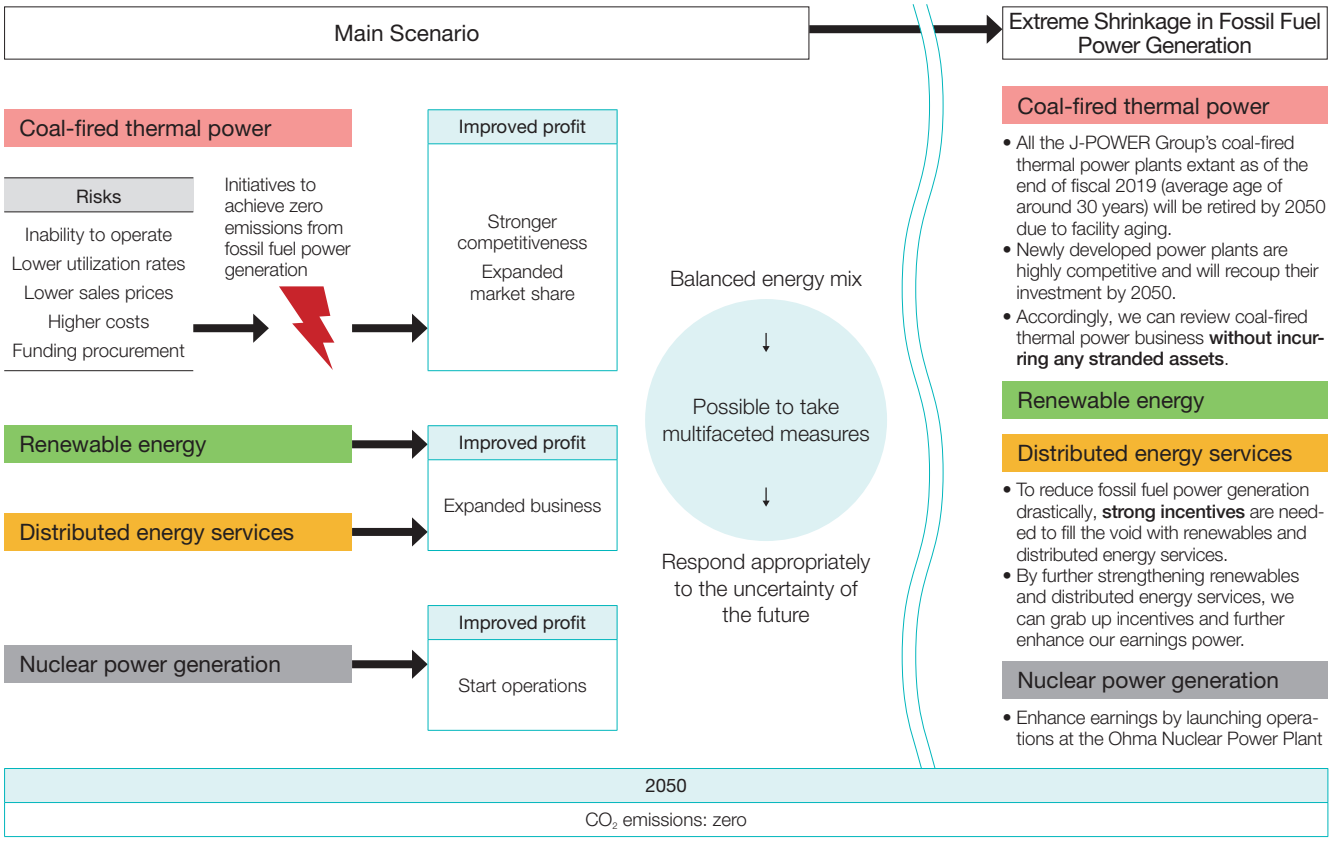
	Characteristics of Initiatives		Effects
Coal-fired thermal power	Reduction in CO_2 emissions	Achieving zero emissions in coal use through CCUS technology	• Circumvent demand decrease and operation suspension orders related to coal-fired thermal power • Avoid costs associated with carbon pricing, such as carbon taxes and cap-and-trade • Obviate reasons for restrictions on investment in and funding of coal-fired thermal power, facilitating smooth funding procurement and helping sustain and improve share prices
	Save on fuel costs	Oxygen-blown IGCC and IGFC are highly efficient, do not use much coal, and make it possible to use inexpensive, low-grade coal	• Because it is highly cost competitive, we expect demand to be higher than for conventional coal-fired thermal power • Even if electricity market prices fall due to the increase in renewables, it will be easy to secure profit
	Synthetic fuel ingredient production	Oxygen-blown IGCC and IGFC with CO_2 separation and capture can be used for manufacturing synthetic fuels and hydrogen in addition to generating electricity	• We expect them to contribute to profit through sales of synthetic fuel ingredients
	Superior load tracking capability	It is possible to adjust output in a shorter timeframe than conventional coal-fired thermal power	• Power can be quickly generated when renewable energy output falls due to weather and other natural circumstances, improving utilization rates and sales and helping further introduce renewables
	Competitive advantage	Oxygen-blown IGCC and IGFC are cutting-edge coal-fired thermal power generation technologies that can reduce CO_2 emissions	• By racing ahead of the competition to acquire and apply cutting-edge technologies, we expect to create barriers to entry and expand market share
Renewable energy			• By quickly developing new renewable projects, earnings opportunities can be realized before risks emerge
Distributed energy services			• As progress is made toward distributed energy services, earnings opportunities are realized
Nuclear power generation			• The start of operations at the Ohma Nuclear Power Plant will enable sales expansion without increasing CO_2 emissions

Metrics and Targets: Enhancing Corporate Value by Achieving Zero Emissions

By pursuing zero emissions initiative, the J-POWER Group will increase its competitiveness and expand its market share in the coal-fired thermal power market while improving profit through the expansion of renewable energy and distributed energy services. Further growth will follow the global roll out of these initiatives.

These efforts will ensure that the Group will strengthen its corporate value while realizing zero emissions, not only if our "main scenario" projection proves right and matches the actual 2050 energy mix, but in the event that renewables gain more ground and fossil fuel power generation declines.

However, in the event of a hypothetical, unrealistic scenario wherein by 2050 the use of fossil fuel power generation has drastically shrunk, we will strive to enhance corporate value by reviewing the coal-fired thermal power business and further expanding renewable energy, nuclear power, and distributed energy services.



For Reference: The increasing cost of renewable energy

Currently in Japan, renewable energy costs are decreasing due in large part to the mass production of renewable energy facilities and competition among manufacturers. Although this trend is expected to continue for some time, at some point it will reverse and **costs will rise as greater numbers of renewable energy facilities come on line**.

To install renewable energy facilities, wide swaths of land (or offshore areas) need to be secured and transmission lines (powerlines) need to be developed to connect the facilities with the closest transmission lines. As development proceeds first from on land (or offshore areas) that can be developed cheaply, renewable facilities developed later will incur higher costs related to the acquisition of land (or offshore area) or to powerline development. For example, even for offshore wind power generation, which is expected to become commonplace, Japan, unlike Europe where offshore wind power has already become widespread, is not surrounded by shallow waters. As development progresses, the wind turbines will need to be situated on deeper seabeds, increasing construction costs.

Furthermore, as the use of renewables increases in Japan, there will be a greater need to invest in electric storage and adjustment functions to absorb output variations caused by fluctuations in sunlight, wind, and other natural conditions. In addition, the trunk transmission lines that connect areas suitable for developing renewables with demand areas will need to be bolstered, or investment in energy-saving and distributed technologies will need to increase in order to accommodate the growing number of renewable power sources using only existing transmission lines.

Of course, technological advancements may help us to absorb those cost increases if new low-cost renewable technologies are widely adopted. In addition, we might be able to use inexpensive land or offshore areas overseas if we are connected with other countries through an international power grid. However, at present the feasibility of such projects remains unknown.

If we strive to meet the need for inexpensive and stable electric power while achieving zero emissions in Japan, **a strong choice will be coal-fired thermal power that achieves zero emissions through CCUS technology**. This is why the J-POWER Group is striving not only to expand renewable energy but also to achieve zero emissions from fossil fuel power generation.