Climate Change Scenario Analysis

In February 2021, the J-POWER Group announced J-POWER "BLUE MISSION 2050," an initiative aimed at achieving a carbon-neutral and hydrogen society by 2050.[1]

Based on this initiative, we conducted a deeper 2050 scenario analysis[2] in line with the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) presented in last year's Integrated Report, and also conducted a scenario analysis for the midway point of 2030.

This scenario analysis can fluctuate depending on preconditions, they are the result of calculations made under certain assumptions and simplified for the purpose of assessing the scale of impact.

1. See pages 22-29 for information on J-POWER "BLUE MISSION 2050."
2. See pages 12-15 of the "J-POWER Group Integrated Report 2020" (link below) for information on the scenario analysis in the previous year.
https://www.jpower.co.jp/english/ir/pdf/2020.pdf

Note: For convenience, "coal" and "thermal power generation" in this scenario analysis include hydrogen power generation using hydrogen generated through coal gasification.

Scenario Analysis 2050 (1) Scenario Formulation

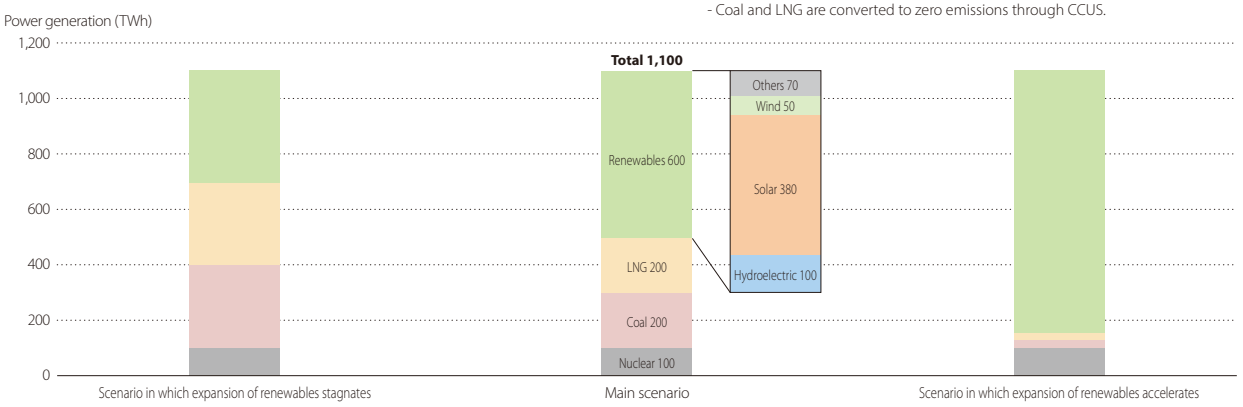
Whatever Japan's energy mix is in 2050, CO_2 emissions must be made net zero (i.e., carbon neutral). The J-POWER Group considers the main scenario to be one in which renewable energy (hereinafter "renewables"), thermal power generation with CCUS (coal and LNG), and nuclear power generation coexist in balance. In Japan, the mass adoption of renewables faces geographic and power network-related restrictions; furthermore, the capability for rapid adjustment of electricity output to regulate the balance of supply and demand in a power grid is necessary for mass adoption of renewables that are subject to output fluctuations. Accordingly, we believe that thermal power generation with CCUS will remain necessary.

However, although the main scenario contains certain assumptions concerning the environment surrounding the power generation business, these may differ from the actual environment in 2050.

Accordingly, we analyzed not only the main scenario but also scenarios with different preconditions for renewables and thermal power, which are thought to exert a large impact on the J-POWER Group.

Energy mix in Japan

- Coal and LNG include mixed combustion with biomass, ammonia, hydrogen, and mono combustion of hydrogen.
- Coal and LNG are converted to zero emissions through CCUS.



Assumptions

- Stagnation of expansion of power grid
- Insufficient locations for siting of renewables
- Rise in development cost of renewables
- Stagnation of offshore wind power development
- Stagnation of decentralization through solar power + storage batteries

- Progress of decentralization in small-scale demand (solar power + storage batteries)
- Expansion of power grid
- Sufficient locations for siting of renewables
- Achievement of CCUS at appropriate cost

- CCUS unachieved/costly
- Insufficient CO_2 storage sites
- Obstacles to fossil fuel procurement (supply chain collapse)
- Powerful policy incentives for renewables
- High carbon pricing

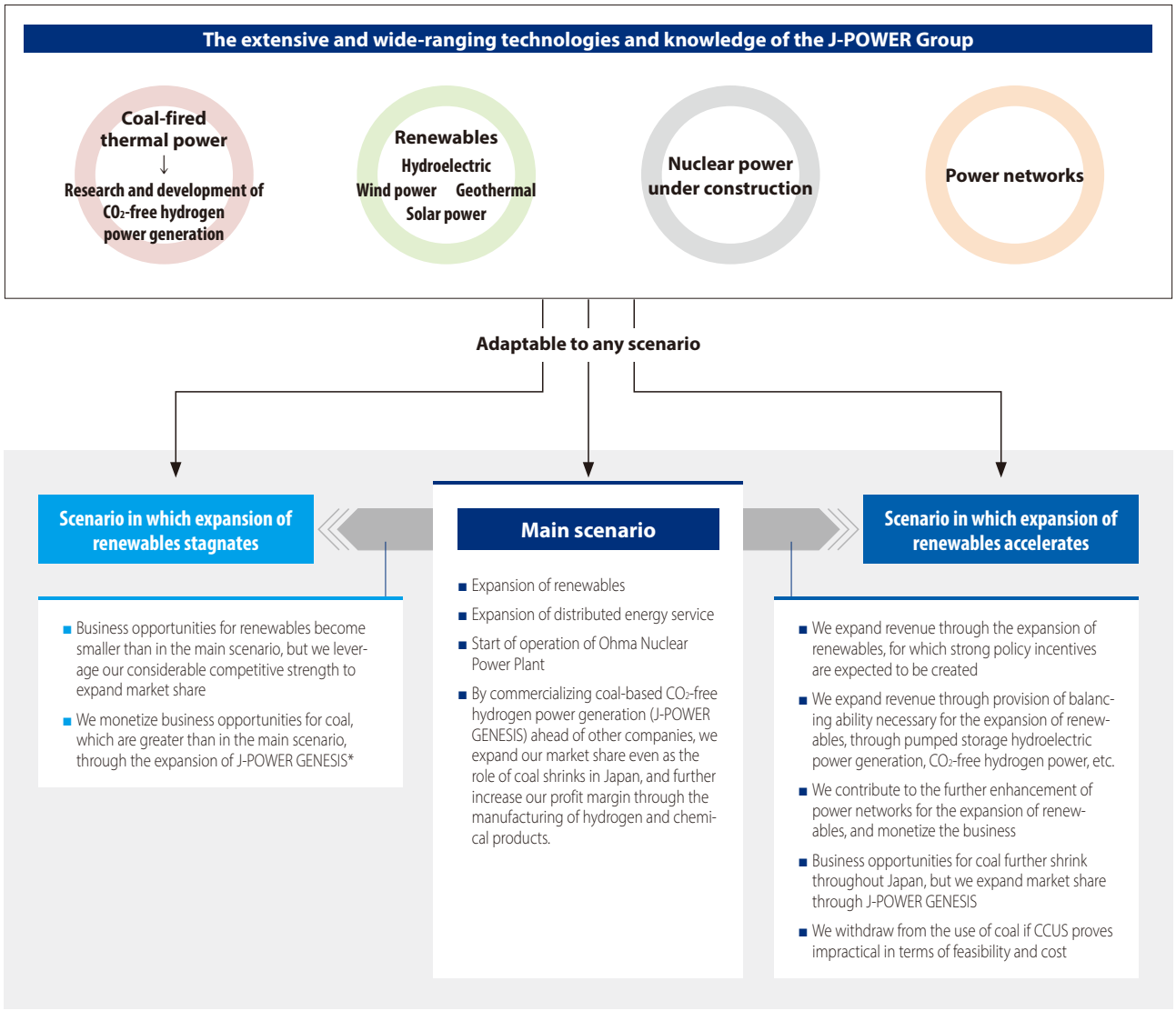
Scenario Analysis 2050 (2) Scenario Analysis

By 2050, a time 30 years from now, most existing power plants in Japan will face difficulties in operation and declining profitability due to aging. For that reason, not only the J-POWER Group but all companies that remain in the power generation business heading into 2050 will need to discontinue nearly all of their power plants and invest in new ones at some point.

This means that every company's power source portfolio will inevitably undergo reassessment as 2050 approaches. Accordingly, the power source portfolios that companies own at present will not directly work to their advantage or disadvantage in forming the CO_2-free power source portfolios of 2050. Rather, the technology and the knowledge of each company will greatly affect those portfolios.

The J-POWER Group has accumulated abundant and wide-ranging technologies and knowledge that extend to the formation and operation of a balanced power source portfolio, nuclear power plant construction, promotion of offshore wind power development, and research and development into CO_2-free hydrogen production and power generation. This allows us to flexibly select targets for investment.

Accordingly, as we are not forced to commit to specific types of power sources, we can adapt to any scenario for the year 2050 and can invest in the CO_2-free power sources that are expected to offer the highest return in each scenario. In addition, as many of our current facilities have undergone depreciation and will have completed their return on investment by 2050, we expect that these are unlikely to become stranded assets.



* See page 28 for information on J-POWER GENESIS.

Climate Change Scenario Analysis

Scenario Analysis 2030 (1) Scenario Formulation

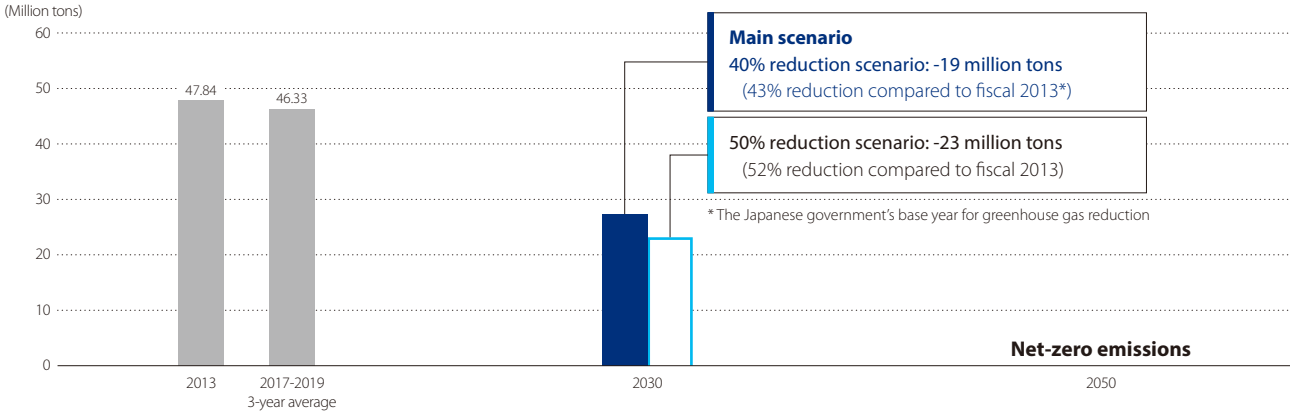
In the previous section, we analyzed the scenario associated with the change in energy mix when carbon neutrality is achieved by 2050.

However, regarding the pace at which CO_2 emissions must be reduced by 2050, a variety of scenarios can be considered, and each scenario has a different impact on the J-POWER Group.

Here we analyze the impacts of the CO_2 emissions reduction required for the J-POWER Group at a stage prior to 2050, taking 2030 as an example.

We also analyze a scenario in which further CO_2 emissions reduction is required, while maintaining the main scenario with its target of reducing CO_2 emissions from the domestic electric power business by 40% from the fiscal 2017-2019 three-year average in 2030, as outlined in J-POWER "BLUE MISSION 2050."

CO_2 emissions from the J-POWER Group's domestic electric power business



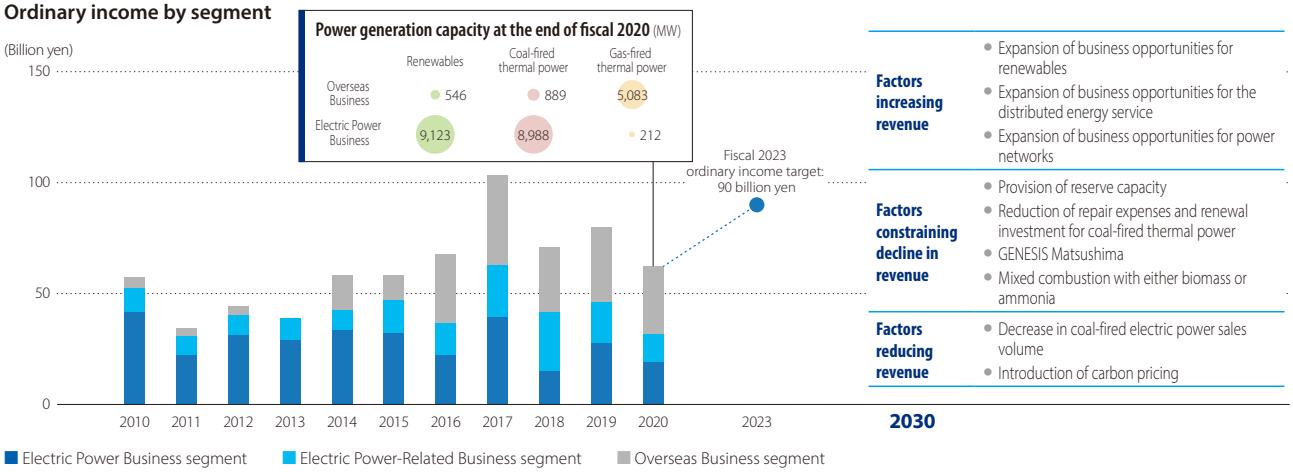
Scenario Analysis 2030 (2) Factors in Scenario Analysis

Given the considerable time constraints imposed by the nine-year period remaining until 2030, construction and replacement of power sources, commercialization of new technologies, enhancement of transmission lines as infrastructure, and so on are very likely to be limited. Our power source portfolio in 2030 will depend largely on our current power source portfolio.

Accordingly, when the J-POWER Group moves forward with the reduction of CO_2 emissions targeted for 2030, we will face limitations in avoiding adverse effects on profit and loss through changes in our portfolio.

To counter this, the J-POWER Group plans to capture new business opportunities in the reduction of CO_2 emissions and aim for monetization, working to mitigate adverse effects. In the case that Japan as a whole attempts to reduce CO_2 emissions rapidly by 2030, secondary changes will occur in the environment of the electric power business, which could have positive impacts on the profit and loss of the J-POWER Group.

Ordinary income by segment



Scenario Analysis 2030 (3) Effects on Renewables, etc.

Factors		Main Scenario (40% reduction scenario)	50% Reduction Scenario
Revenue expansion from renewable energy	Amid a decrease in thermal power sources and supply capacity in Japan overall, strong expectations are placed on the expansion of renewable energy. The foundation for business expansion will continue and improve through the avoidance of excessive competition among different forms of renewable energy and through the provision of policy incentives.	We have currently set a new generation capacity development target of 1,500 MW above our fiscal 2017 level by fiscal 2025, a target amount already exceeded by the total maximum estimated capacity of projects currently in stages from survey to construction. If all of these projects begin operation by 2030, income will increase by over 10 billion yen, assuming profitability in line with current FIT power sources. income will further increase if we succeed in bids for offshore wind power projects in domestic general sea areas, which are not included in targets. Taking development lead time into account, the number of new projects for which we can undertake development and begin operation by 2030 is limited by the time remaining. However, we will undertake as many projects as possible.	
	Renewable energy sales prices rise due to increase in demand for renewable energy.	Regarding approximately 10 billion kWh of hydroelectric power generation, which is not subject to FIT, the income increases by about 1 billion yen if its sales prices rise by 0.1 yen by the increase in contract sales prices and non-fossil fuel energy certificate sales.	
Expansion of business opportunities for the distributed energy services	Business opportunities for distributed energy services increase as the expansion of solar power generation and storage batteries in homes and buildings is essential for the mass introduction of renewable energy.	We aim to expand revenue by expanding our distributed energy service business implemented through affiliates.	
Revenue expansion in businesses related to power networks	We will expand revenue through provision of the balancing capability necessary for the expansion of renewable energy in Japan.	We aim to maximize the value of the balancing capabilities including pumped storage hydroelectric power generation.	
	We will acquire power network enhancement projects necessary for the expansion of renewable energy in Japan.	We aim to expand revenue by acquiring power network enhancement projects. Construction of the New Sakuma Frequency Converter Station and related transmission line enhancement and replacement work are already underway, with completion scheduled for 2027.	

Scenario Analysis 2030 (4) Effects on Coal-Fired Thermal Power Plants

Factors	Main Scenario (40% reduction scenario)	50% Reduction Scenario
Decrease in coal-fired electric power sales volume	Coal-fired thermal electric power sales volume decreases by about 40%; income decreases by about 10 billion yen on an ordinary income basis.	If we achieve a 50% reduction of CO_2 emissions through a decrease in electric power sales volume, coal-fired thermal electric power sales volume decreases by about 50% and income decreases by about 15 billion yen on an ordinary income basis.
Introduction of carbon pricing	—	Assuming the purchase of carbon credits for 10% of the CO_2 for which additional reduction beyond the main scenario is required, approximately 4 million tons of carbon credits will be necessary. Accordingly, if the cost of purchasing carbon credits cannot be passed on to the sales price, in terms of sensitivity, we will incur a burden of approximately 4 billion yen total, at a carbon credit price of 1,000 yen/ton, an additional factor behind the decrease in revenue from the main scenario. However, if a decrease in electric power sales volume means less decline in revenue, we will decrease electric power sales volume and the revenue decline impact will be at most 15 billion yen.
Provision of reserve capacity	While reducing electric power sales volume from coal-fired thermal power plants, we will retain facilities as reserve capacity for power generation only during peak demand, and will obtain income on the capacity market, etc. If we do not discontinue capacity corresponding to the decrease in electric power sales volume but provide it as reserve capacity, then in terms of sensitivity, we will realize annual income of approximately 40 billion yen under the main scenario and approximately 45 billion yen under the 50% reduction scenario, at 10,000 yen/kW-year. However, as expenses related to equipment maintenance costs will increase in comparison to the case in which we discontinue facilities, the revenue impact will be the amount obtained by deducting the facilities maintenance costs from the above income. If the current level of facilities maintenance costs remains, facilities maintenance costs will be approximately 40 billion yen under the main scenario and approximately 50 billion yen under the 50% reduction scenario. However, as the load factor will become significantly lower than its current level, some repair expenses and consignment expenses can be reduced (a total of approximately 20 billion yen out of approximately 40 billion yen under the main scenario and approximately 25 billion yen out of approximately 50 billion yen under the 50% reduction scenario).	
Reduction of repair expenses and renewal investment for coal-fired thermal power	Anticipating the constraint of operations from 2030, we will constrain repair expenses and renewal investment for coal-fired thermal power plants prior to that. Actual repair expenses for coal-fired thermal power will be approximately 45 billion yen per year and investment for renewal will be about 20 billion yen per year, some of which can be reduced.	
GENESIS Matsushima	We will reduce emission intensity through high-efficiency power generation from coal gasification-based hydrogen, and will constrain the decrease in electric power sales and the increase in power generation costs due to carbon pricing. Through upcycling of assets with advanced depreciation, the amount of capital expenditure will be low and the cost-effectiveness of CO_2 reduction will be high.	
Biomass/ammonia mixed combustion	We will reduce emission intensity through mixed combustion with either biomass or ammonia, and will constrain the decrease in electric power sales and the increase in power generation costs due to carbon pricing. There are issues to be solved such as procurement of biomass and ammonia, but we will work on them as much as possible.	