

The 32nd Clean Coal Day International Symposium (2023)
Featured Speech II



Towards Balancing Energy Security and the Environment

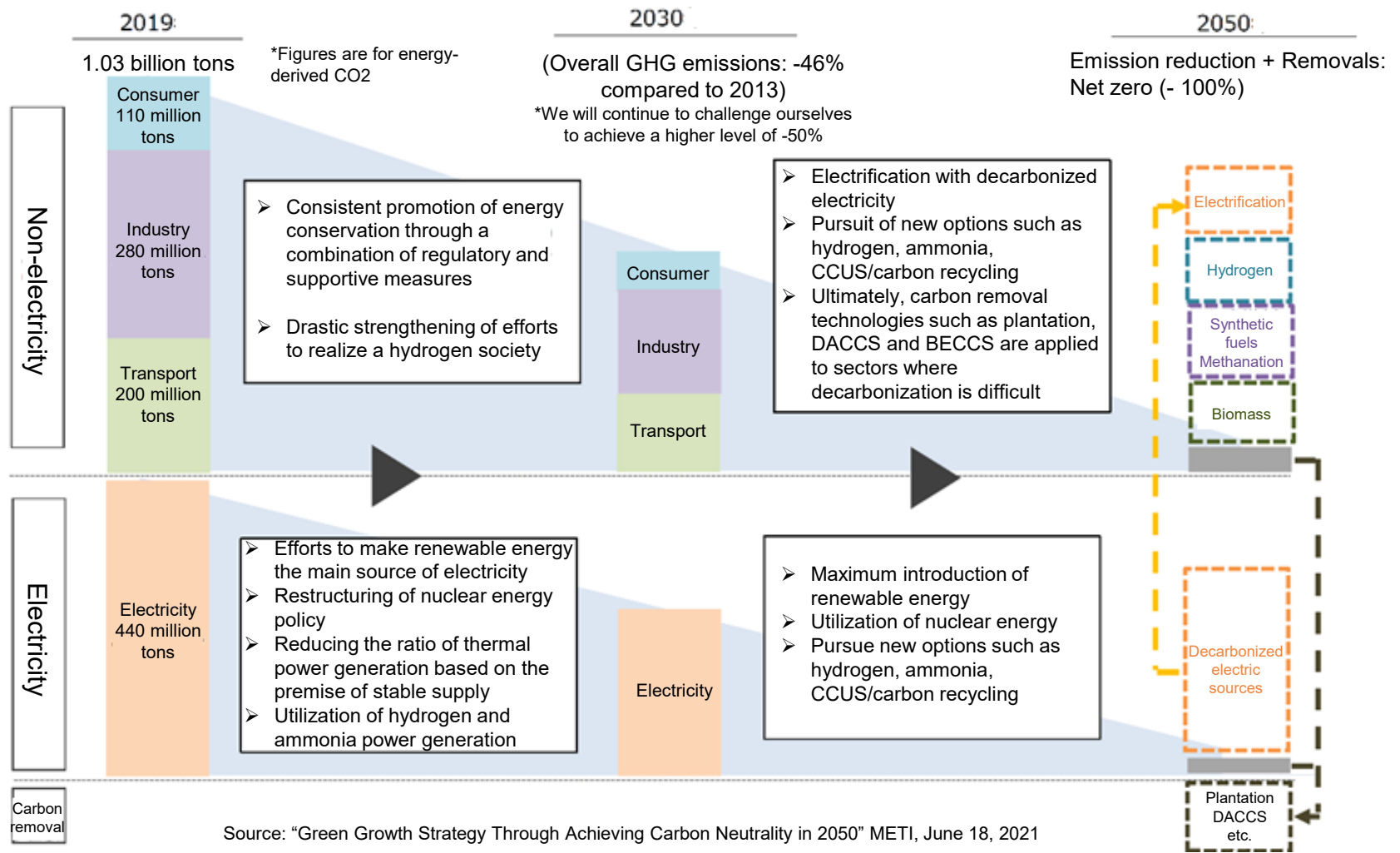
~J-POWER's Initiative: BLUE MISSION 2050~

September 5, 2023
J-POWER

Image of Achieving Carbon Neutrality in 2050

(Ministry of Economy, Trade and Industry (METI))

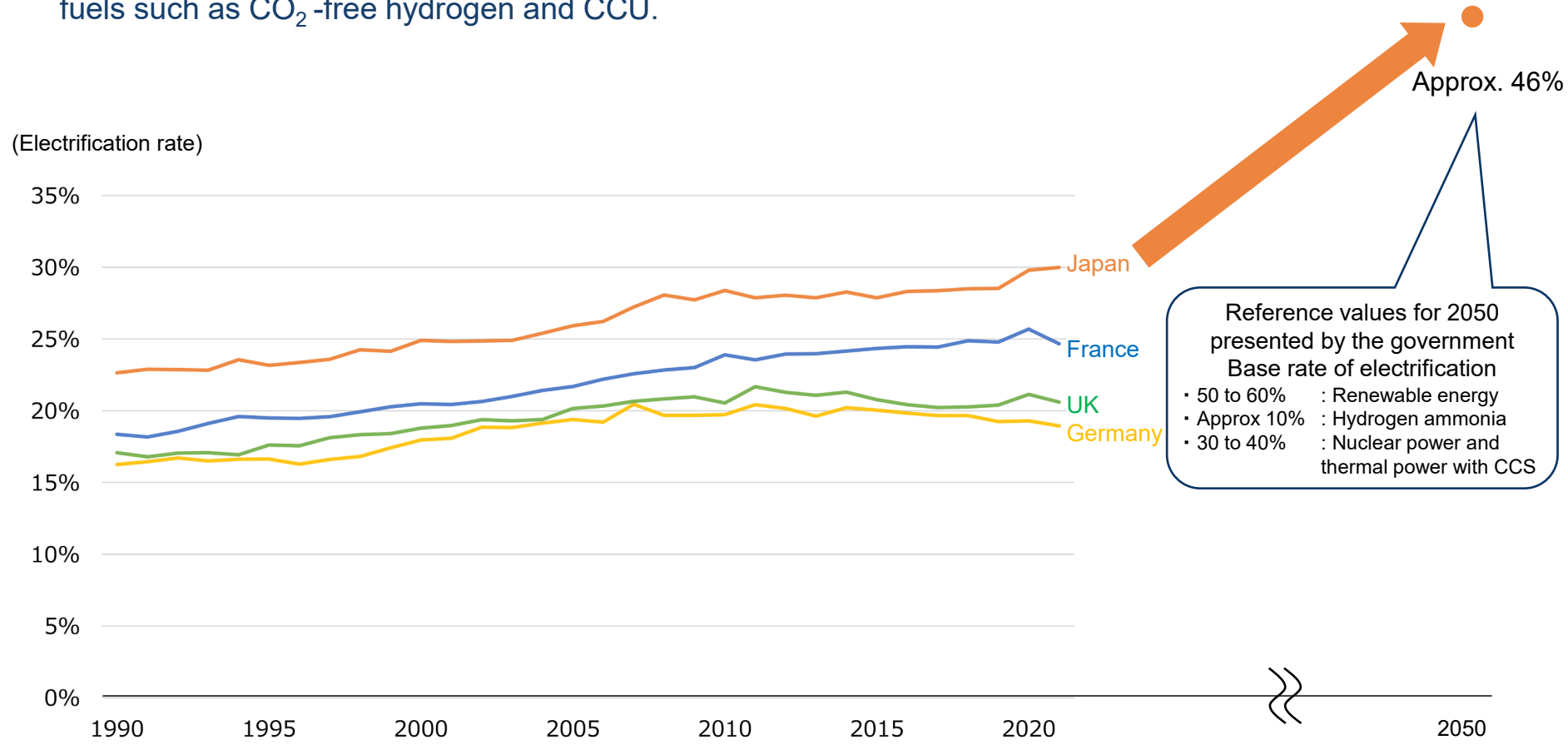
- Achieving carbon neutrality by 2050 requires decarbonization of the non-electricity sector, including electrification, in addition to decarbonization of the electricity sector.
- However, the electrification is difficult for many utilization form in the current non-electricity sector, and the introduction of carbon-neutral fuels and the utilization of carbon recycling are critical.



Source: "Green Growth Strategy Through Achieving Carbon Neutrality in 2050" METI, June 18, 2021

(Non-electricity Sector) Changes in Electrification Rate in Japan

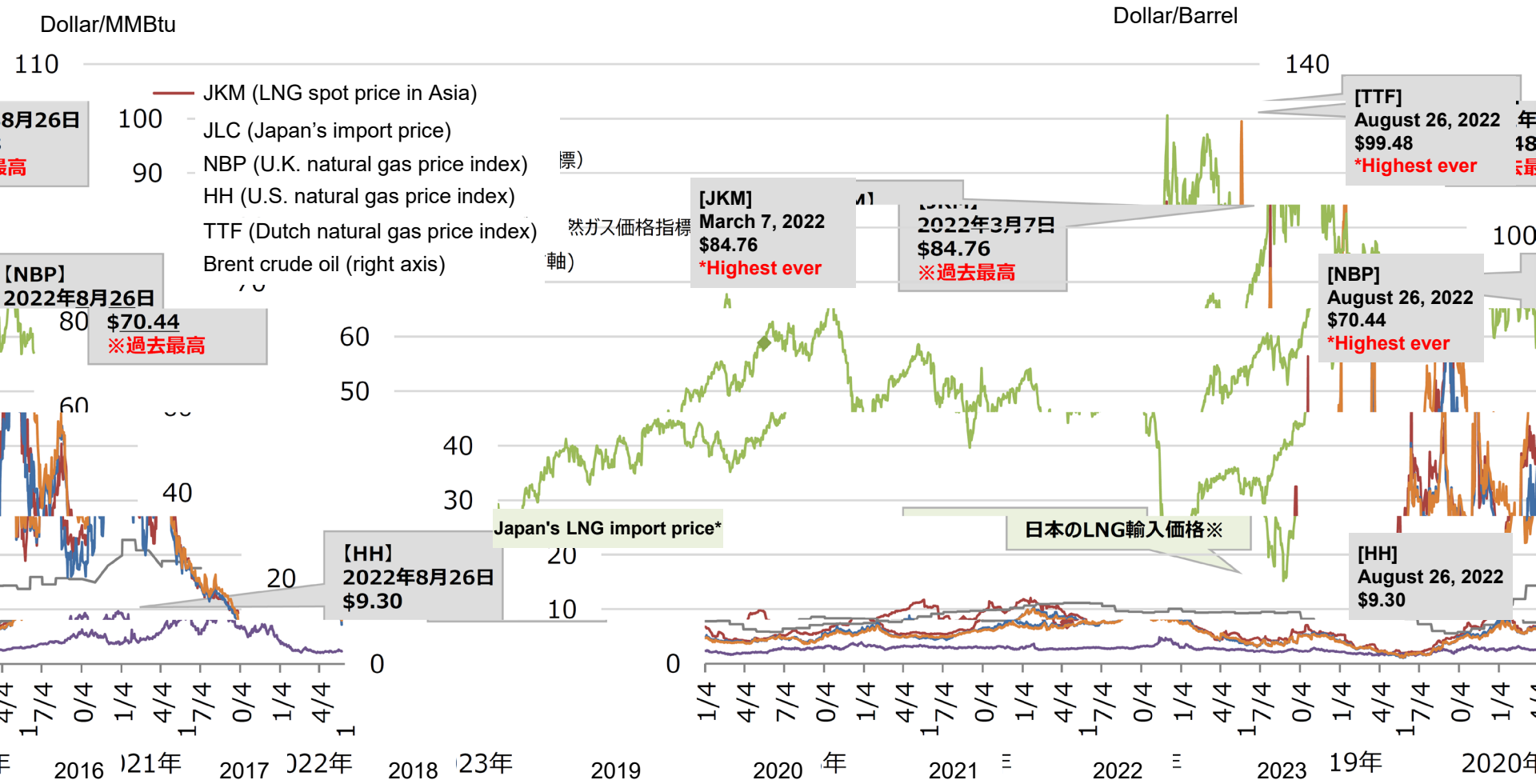
- Current electrification rate in Japan's non-electricity sector is around 30%, and it is only 46% according to the government's forecast for 2050.
- In sectors where electrification is difficult, it is important to promote the introduction of carbon neutral fuels such as CO₂-free hydrogen and CCU.



Source: Created by referencing Document 1 from The 53rd Strategic Policy Committee (June 28, 2023), and Document 1 from The 45th Strategic Policy Committee (July 13, 2021)

(Electricity Sector) Trend of Natural Gas Price (1/2)

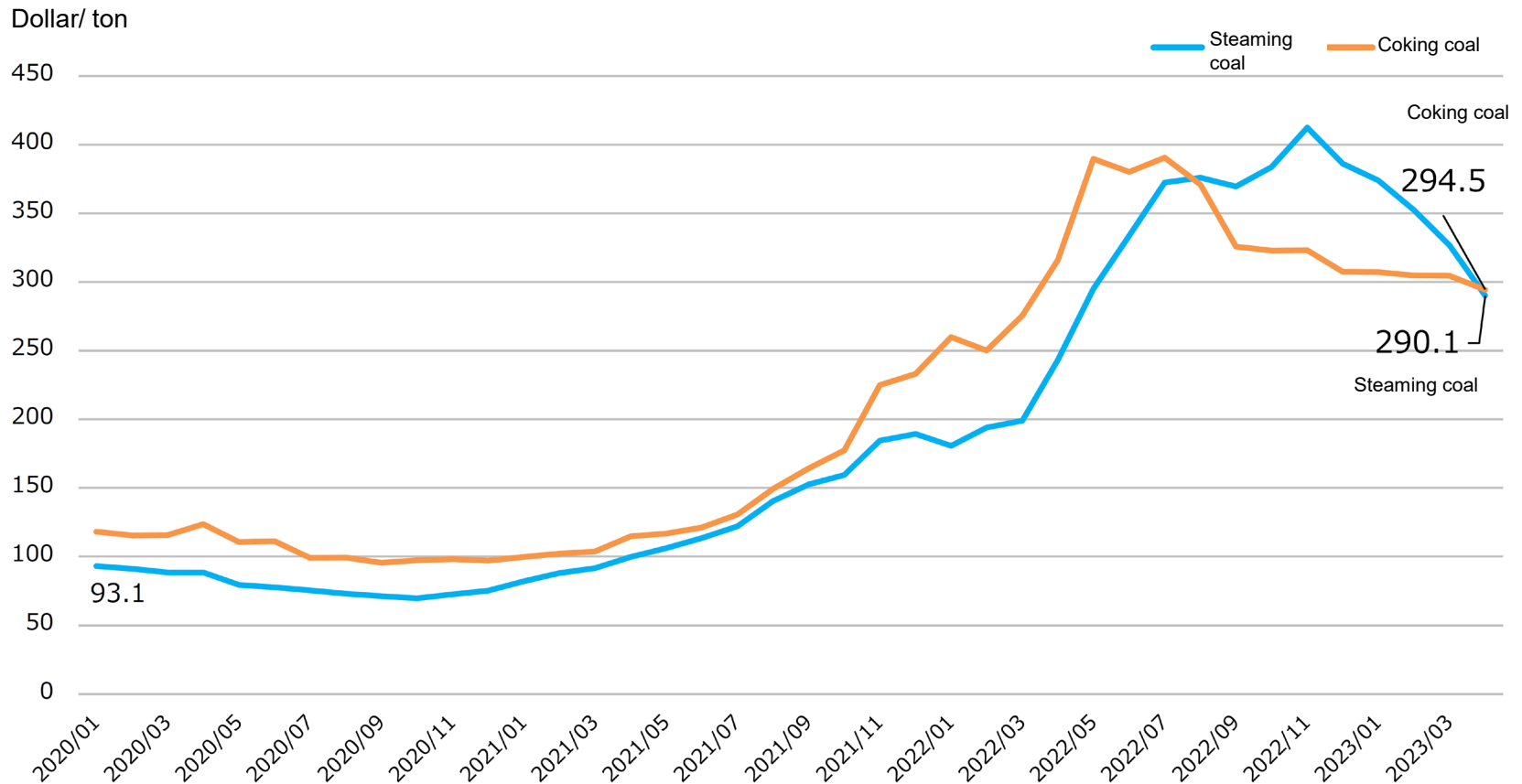
- The supply-demand balance for fossil resources has been severely disrupted by the unexpected world trends, such as the crisis in Ukraine.
- As a result, natural gas prices have fluctuated widely worldwide.



Source: Document 1 from The 53rd Strategic Policy Committee (June 28, 2023)

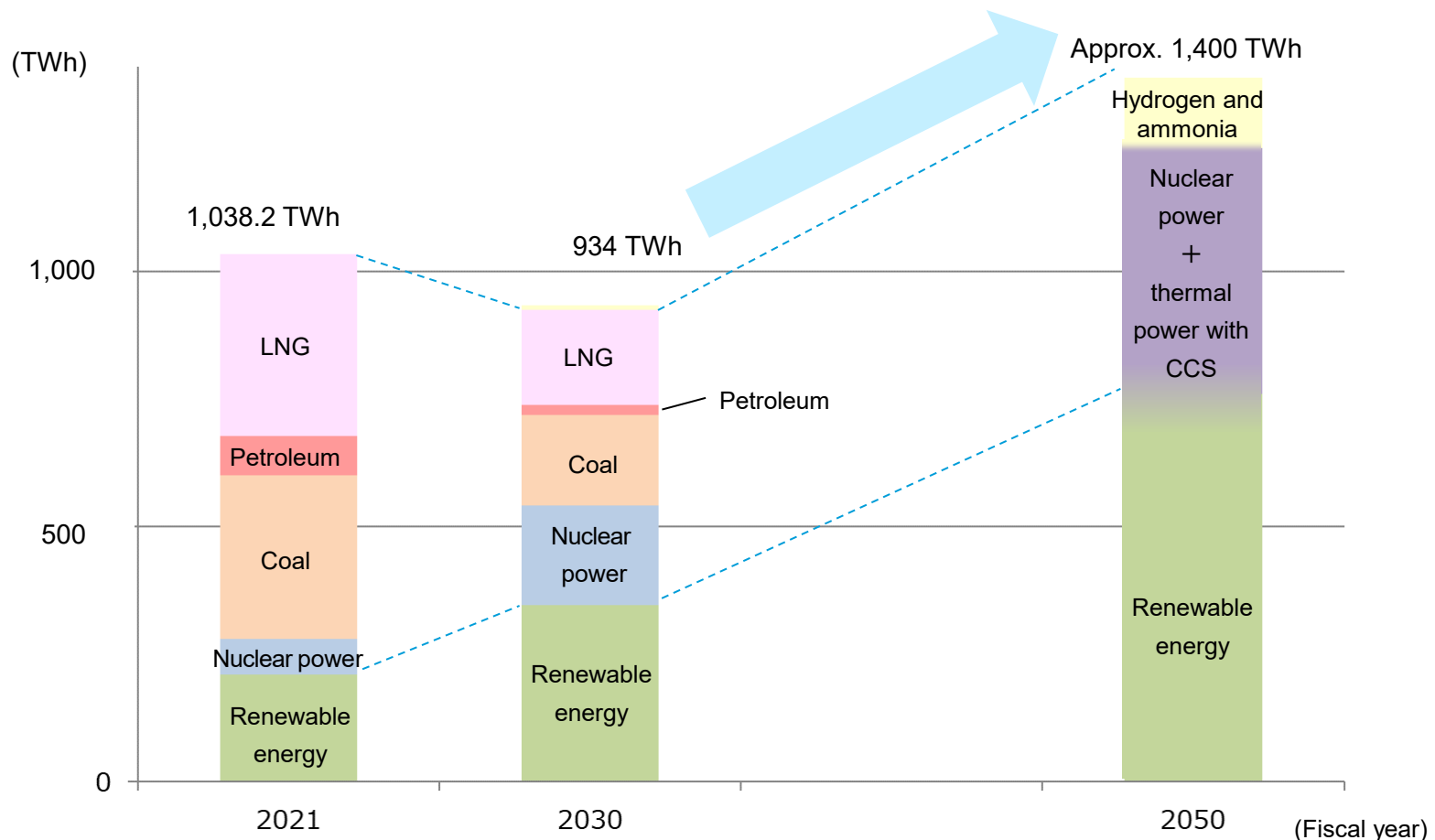
(Electricity Sector) Trend of Coal Price (2/2)

- Similarly, prices of steaming coal and coking coal have fluctuated widely.
- The important point in energy security is to retain various fossil resources as available options, rather than relying on specific resources.



(Electricity Sector) Amount of Power Generated and Power Composition in Japan

- Japan is largely dependent on imported fossil resources.
- Power demand is expected to increase in response to increased electrification and telecommunication capacity, the fulfilment of data centers, and other factors. Therefore, it is necessary to promote efforts to decarbonize fossil resources as well as the expansion of renewable energy in parallel.



Source: Created by referencing The 6th Strategic Energy Plan, Document 1 from The 45th Strategic Policy Committee (July 13, 2021), and Document 1 from The 53rd Strategic Policy Committee (June 28, 2023)

Approaches toward Carbon Neutrality

<WORLD TRENDS>

Climate change

Division of the world

Pandemic

Progress of DX

Fluctuations in resource prices

<JAPAN'S TRENDS>

Decarbonization of power sources

Decarbonization of the non-electricity sector

Utilization of nuclear power, renewable energy, hydrogen, and more

Promotion of electrification

Decarbonization of fossil resources

CCS

Utilization of hydrogen fuel, synthetic fuels, and more

To achieve carbon neutrality by 2050, it is important to take a diverse approach combining various resources and technologies

J-POWER contributes to the realization of a Carbon-neutral society through decarbonization of the non-electricity sector by producing CO₂-free hydrogen from fossil resources, and through power generation using the produced hydrogen.

J-POWER “BLUE MISSION 2050”

Towards a carbon-neutral and hydrogen energy society

We have developed the J-POWER “BLUE MISSION 2050” to achieve carbon neutrality by 2050.

- By combining our experience and integrated technologies, we aim to achieve zero CO₂ emissions from our power generation operations by 2050.
- As a milestone, we aim to reduce our CO₂ emissions by 40% (compared with the three-year average from 2017 to 2019) by 2030 *1. We will take up this challenge in stages.
- As one of these challenges, we will contribute to the realization of a hydrogen energy society by producing "CO₂-free hydrogen" from coal.

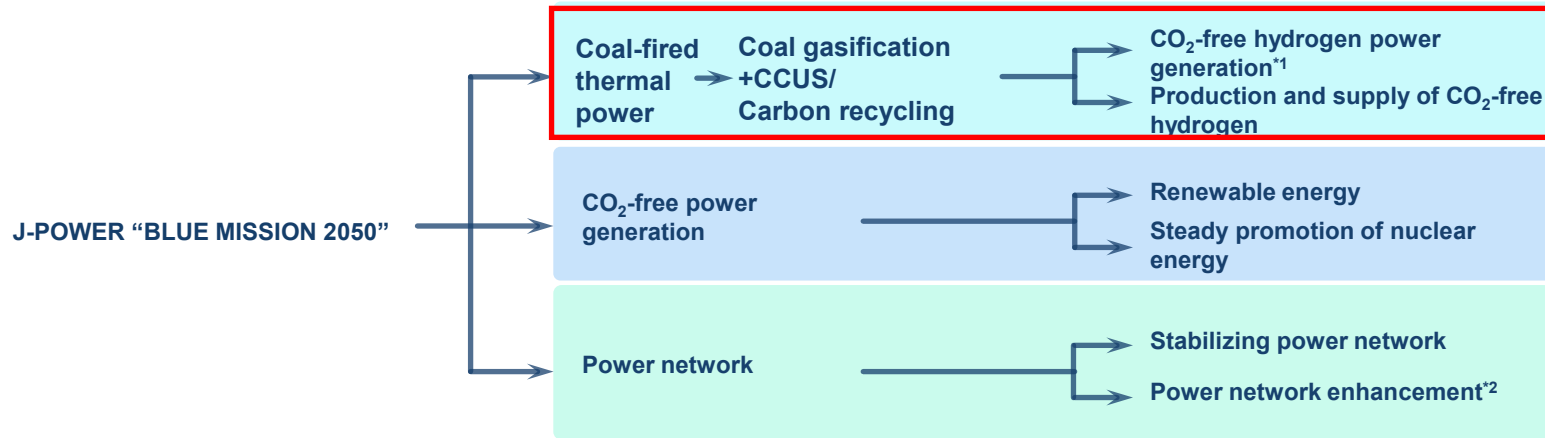
*1: 2030 target was renewed to 46% CO₂ reduction compared to FY2013, in line with Japanese Government policy



ACTION PLAN

CONCEPT

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



*1 Including the use of hydrogen extraction from ammonia for power generation

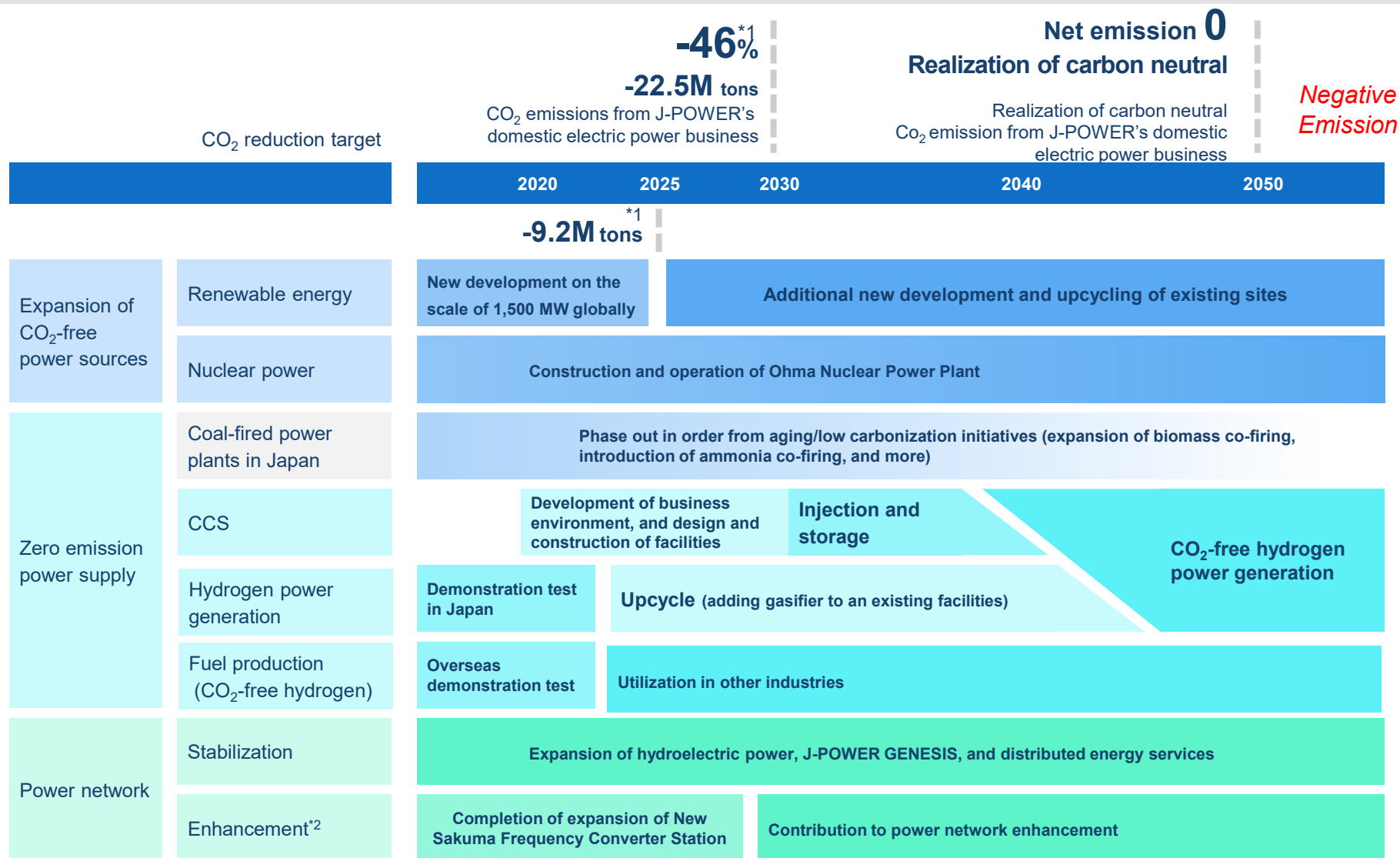
*2 The power network enhancement is an initiative for J-POWER transmission.

Priorities for implementation
(priority items)

Acceleration

Upcycle

J-POWER “BLUE MISSION 2050” Roadmap

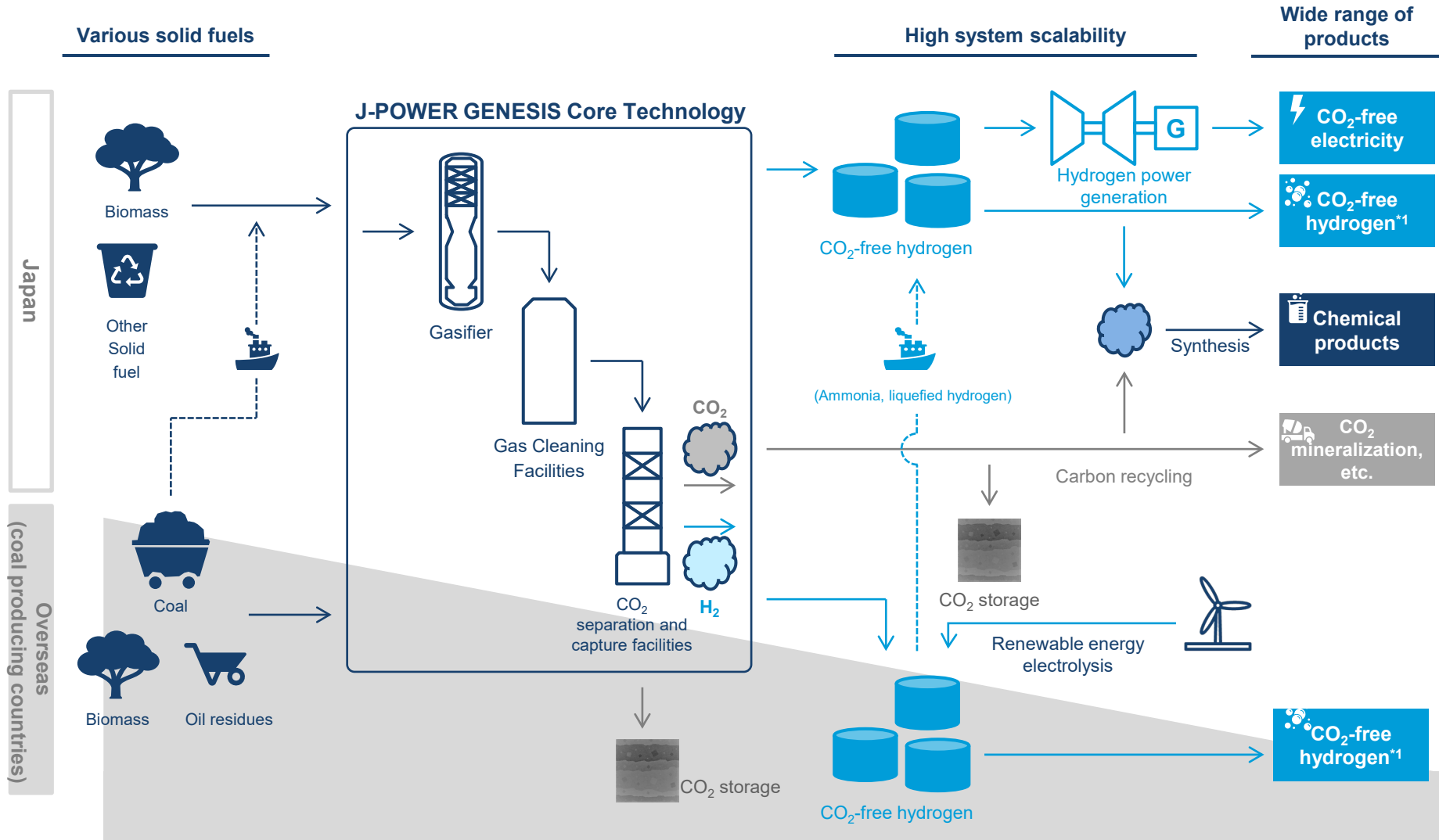


*1 Compared to FY2013 results *2 The power network enhancement is an initiative of J-POWER Transmission.

*The basis of the CO₂ emission reduction target has changed to FY2013 results from the average results for three years from FY2017 to FY2019. In comparison to the average results for three years from FY2017 to FY2019, the FY2025 target is -7 million tons, and the FY2030 target is -44%/-20.3 million tons.

*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.

J-POWER GENESIS Vision Overall Concept



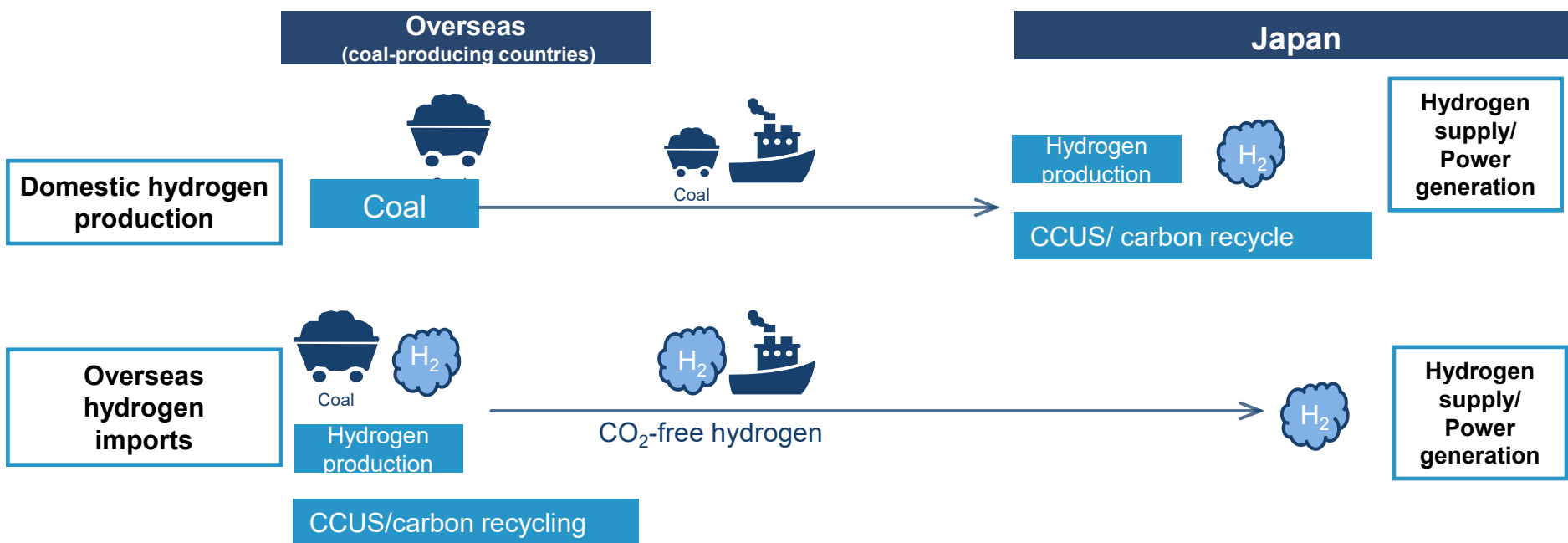
J-POWER GENESIS Gasification ENERgy & Sustainable Integrated System

*Trademark registered

*1: CO₂-free hydrogen including CO₂-free ammonia is a "sector-coupled energy" usable in various sectors such as industry and transportation.

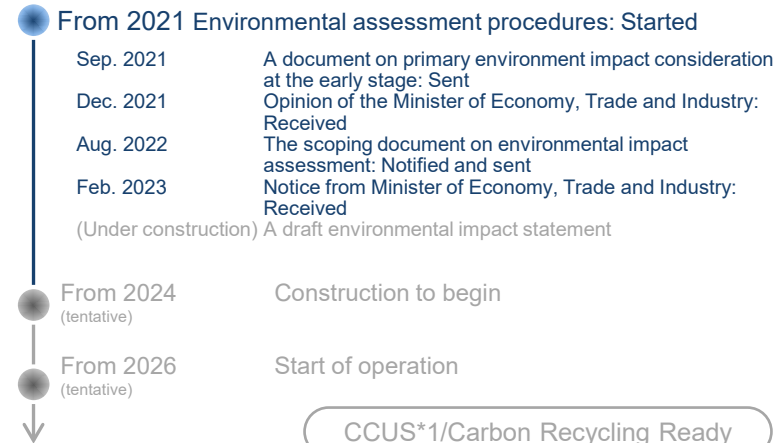
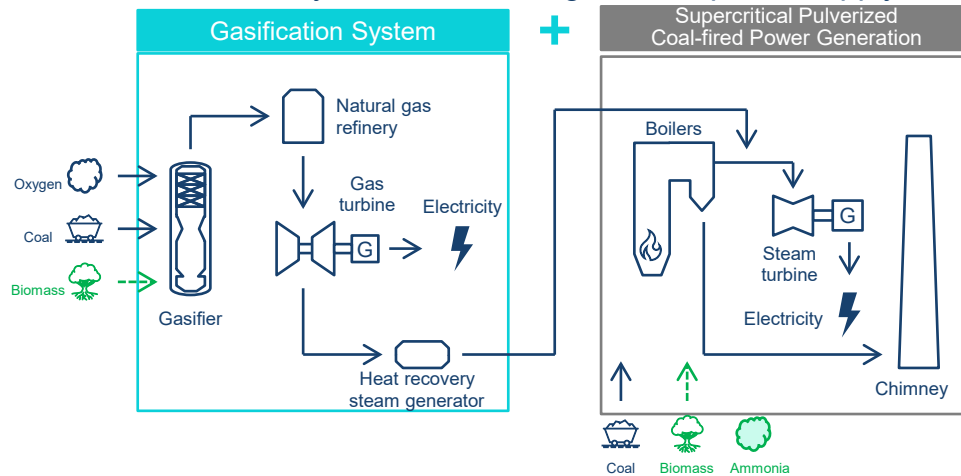
Two types of CO₂-free Hydrogen Production Methods from Coal

- Domestic hydrogen production: Import coal from overseas to produce hydrogen domestically and make it CO₂-free.
- Overseas hydrogen imports: CO₂-free hydrogen is produced in coal-producing countries and transported to Japan
 - ➔ Although each type of hydrogen production has its own advantages and challenges, such as the selection of suitable sites for CCS and economical transportation methods, J-POWER will conduct CO₂-free hydrogen production in the future through demonstration tests of two types of hydrogen production.



J-POWER GENESIS Vision (GENESIS Matsushima)

- J-POWER takes the first step toward CO₂-free hydrogen power generation at the Matsushima site, where we paved the way for the use of imported coal after the oil crisis.
- By applying the new technology to existing assets, J-POWER reduces the environmental burden at an early point with economic rationality while maintaining a stable power supply.



*1 CCUS: CO₂, Capture, Utilization and Storage

Flow of research & development on coal gasification technology

Wakamatsu Research Institute, Fukuoka



Demonstration test of oxygen-blown coal gasification and CO₂ separation and capture

Scaled up

Osaki CoolGen, Hiroshima



Operation of a larger gasifier (biomass-mixed) and demonstration test of gas turbine operation with high concentration of hydrogen

Commercialization

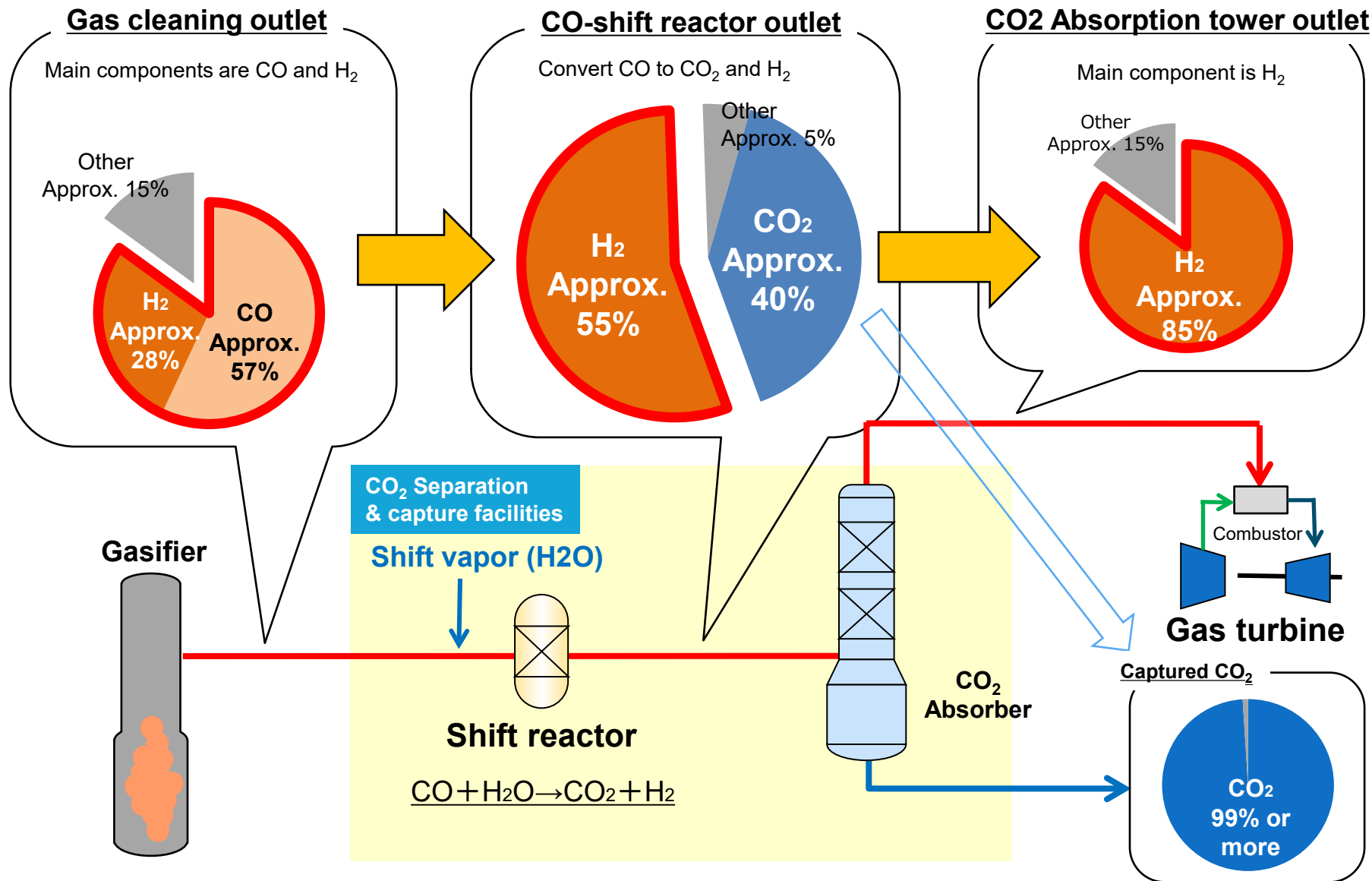
Matsushima Thermal Power Station, Nagasaki (current)



Aiming for CO₂-free hydrogen power generation in the future with coal gasification technology as a core technology

2002 **EAGLE Project** 2013 2016 **Osaki CoolGen Project** 2024 2026 **J-POWER GENESIS**

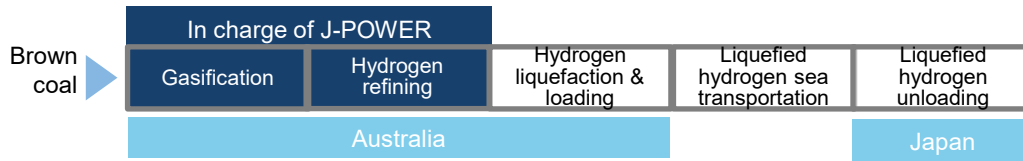
Change in Gas Composition due to CO₂ Separation and Capture



Outline of Australia-Japan Hydrogen Supply Chain 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 and hydrogen refining facilities*1 utilizing its knowledge of coal gasification. The hydrogen production started in January 2021 and J-POWER achieved 99.999% hydrogen purity in February. J-POWER conducted the demonstration test using multiple types of brown coal and biomass-mixed brown coal.
- In April 2022, the supply chain including hydrogen transportation and cargo handling to Japan was accomplished, progressing toward the realization of a society where hydrogen can be commonly used as an energy source.
- Utilizing the results of this demonstration test, J-POWER is currently studying the feasibility of commercialization.

<Overview of the Global Hydrogen Supply Chain>



Benefits of using brown coal

- Abundant resources
- Cheaper than coal

MOU on cooperation for the development of a hydrogen supply chain between Australia and Japan (AZEC Public-Private Investment Forum)

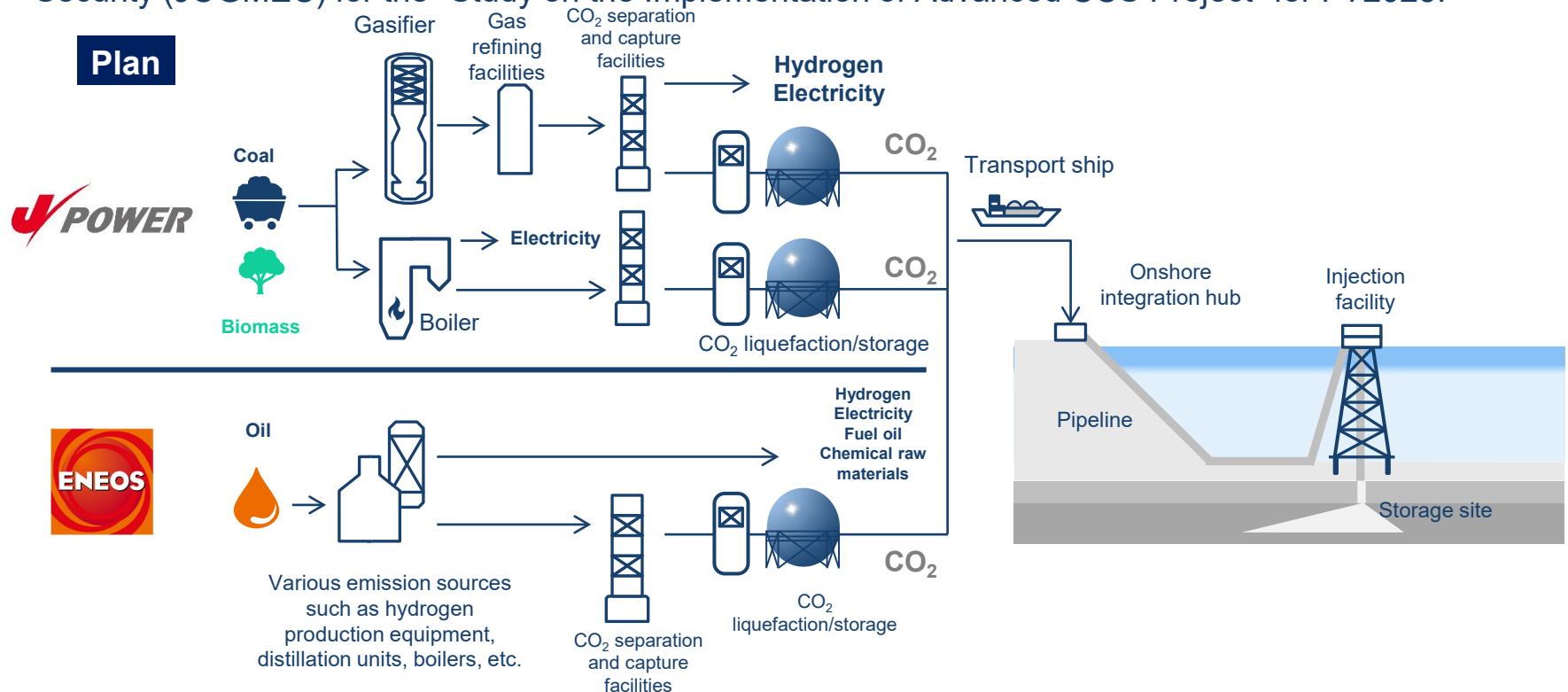


| Fiscal year | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|-----------------------------|--|------|--------------------|------|------|------|
| HESC demonstration schedule | Design/manufacture/ installation/test run | | Demonstration test | | | |

1 This demonstration test for brown coal was conducted as a project subsidized by the New Energy and Industrial Technology Development Organization (NEDO), a national research and development organization, while the test for hydrogen refining was sponsored by the Australian federal government and the Victoria state government. The participants for NEDO-subsidized project are Electric Power Development Co., Ltd.(J-POWER), Iwatani Corporation, Kawasaki Heavy Industries Ltd., Shell Japan Limited, Marubeni Corporation, ENEOS Corporation, and Kawasaki Kisen Kaisha, Ltd., while the Australian sponsored project was participated by Electric Power Development Co., Ltd.(J-POWER), JPLV, Iwatani Corporation, Kawasaki Heavy Industries Ltd., HEA, Marubeni Corporation, Sumitomo Corporation, and AGL Energy Ltd.
*J-Power Latrobe Valley

Feasibility Study on Large-scale CCS in Japan

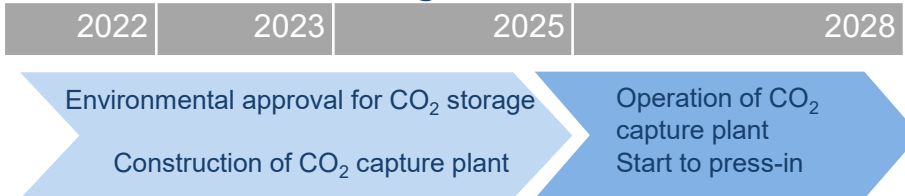
- J-POWER, ENEOS Corporation, and JX Petroleum Exploration Co., Ltd. have been studying the feasibility to commence a CCS project that separates, captures, transports, and stores CO₂ emitted from J-POWER's thermal power plants and ENEOS's refineries in western Japan by FY2030 .
- In February 2023, “West Japan Carbon dioxide Storage Survey Co., Ltd.,” was jointly established by the 3 parties, promoting to prepare for commercialization, including exploration and evaluation to select candidate sites for CO₂ storage.
- In August 2023, the 3 parties have jointly signed a contract with Japan Organization for Metals & Energy Security (JOGMEC) for the "Study on the Implementation of Advanced CCS Project" for FY2023.



Participation in CO₂ Capture, Transportation, and Storage Project in Queensland, Australia

- Participated in Glencore’s CTSCo*1 Carbon Capture and Storage (CCS) Project in Queensland, Australia, focusing on capturing CO₂ from coal fired power station, transporting and storing.
- Australia's first CCS project for coal fired power emissions, a demonstration project aimed at technical verification from CO₂ capture to storage. The Objective is to store up to 110,000 tCO₂ p.a. for 3 years starting from 2025.
- 500 million tons of CO₂ storage potential is available in the area. This project will contribute to economic development and job creation by creating new industries for blue hydrogen production in Australia.

Schedule to start storage in 2025



Rendered image of the proposed CO₂ capture plant and Millmerran Power Station in Queensland, Australia

Project partners



*1 Carbon Transport and Storage Company (CTSCo) is a Glencore wholly owned company. J POWER and Marubeni each funded A\$10 million in this project.



CO₂ injection site near Moonie Station in Queensland, Australia

Investment in Nippon Fiber Corporation KK (Ash-related)

- J-POWER has invested in Nippon Fiber Corporation KK, which has a technology to produce continuous filament yarn called "BASHFIBER®" from ash and slag generated from coal-fired power generation and integrated coal gasification combined cycle.
- BASHFIBER® has excellent strength, heat resistance and chemical resistance, with the potential to be used in a wide range of fields as a substitute for existing industrial fibers.
- BASHFIBER® is also expected to be used in the space industry, medical sector, and nuclear industries due to its resistance to radiation, being capable to add a radiation shielding function.



BASHFIBER®



BASHFIBER® processed into woven fabric

