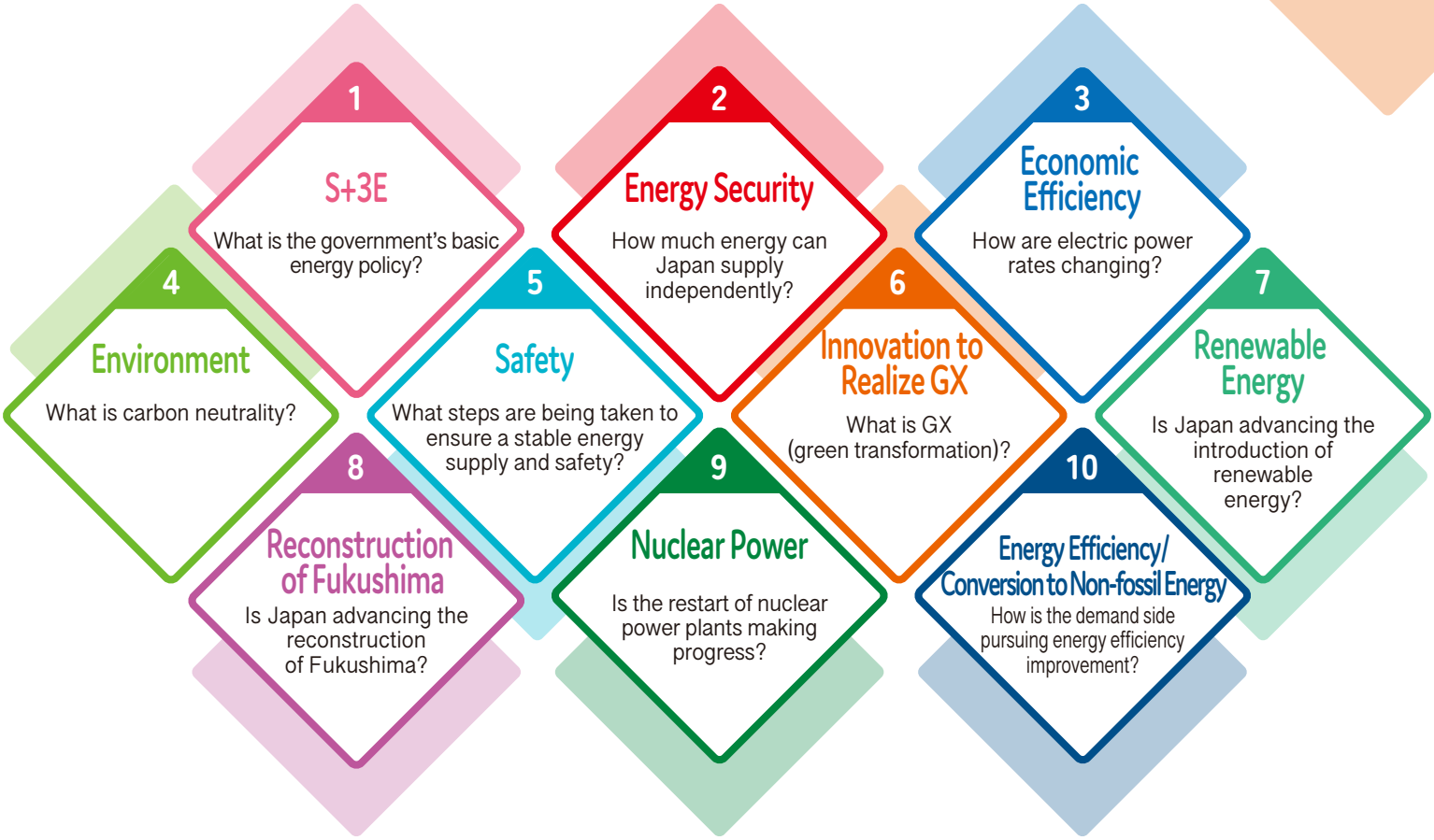
JAPAN'S ENERGY

10questions for understanding the current energy situation



METI
Agency for Natural Resources and Energy

Use this QR to view the article.

Issued: March 2025

1. S+3E

Basic Policy

Q **What is the government's basic energy policy?**

A On the major premise of Safety, we are making efforts to first of all achieve a stable supply of energy (Energy Security), along with improvements in Economic Efficiency and adaptability to the Environment (S + 3E).
Japan is a country with limited readily exploitable natural resources. This is due to its geological constraints, characterized by a geography of mountainous territory surrounded by deep waters. From the perspective of simultaneously achieving a stable supply of energy and decarbonization, we will promote the maximum introduction of renewable energy as a major power source, and also aim to create a well-balanced power source mix without over relying on any specific power source or fuel source.

Basic principles of S + 3E

Safety
Safety is the major premise.

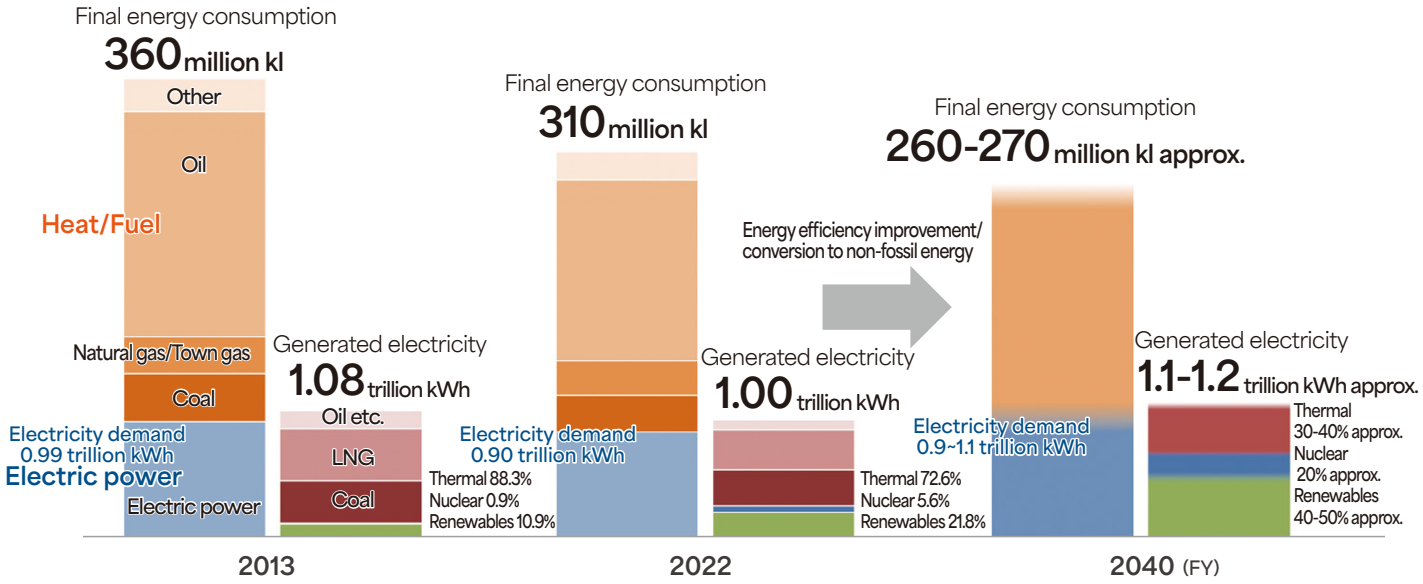
+

Energy Security
The energy self-sufficiency ratio is expected to be 30 to 40% in FY 2040. (12.6% in FY2022)

Economic Efficiency
Prices that are internationally compatible.

Environment
In pursuing efforts to be consistent with the global 1.5°C goal, we aim to achieve ambitious reduction targets, namely, reductions of 60% and 73% in FY2035 and FY2040, respectively, from FY2013 levels.

Energy supply and demand outlook

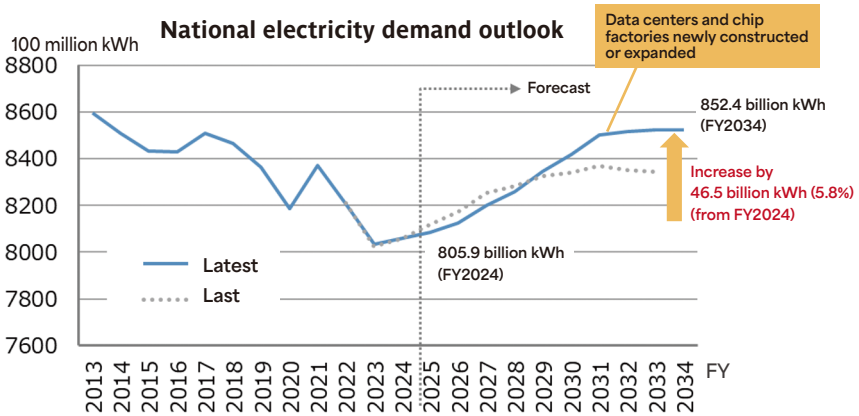


(Note) The column on the left indicates final energy consumption while the smaller column on the right indicates electricity generated. Electricity demand is calculated by subtracting transmission/distribution loss and electricity used at power stations from electricity generated.

Trends in electricity demand as digitalization progresses

Electricity demand in the household sector is in a downward trend due to falling population numbers and electricity conservation/energy efficiency improvement. On the other hand, a substantial increase will be seen in the industrial sector due to the new construction or expansion of data centers and chip factories. As a result, overall electricity demand is expected to take an upward turn despite the advancement of energy efficiency improvements.

National electricity demand outlook



*Applications for the construction and expansion of data centers and chip factories at the present time indicate that growth in electricity demand will slow down from 2031. However, this may change depending on the number of future applications for construction or expansion.
Source: "FY2025 Outlook for National and Regional Electricity Demand," The Organization for Cross-regional Coordination of Transmission Operators, Japan (OCCTO) website

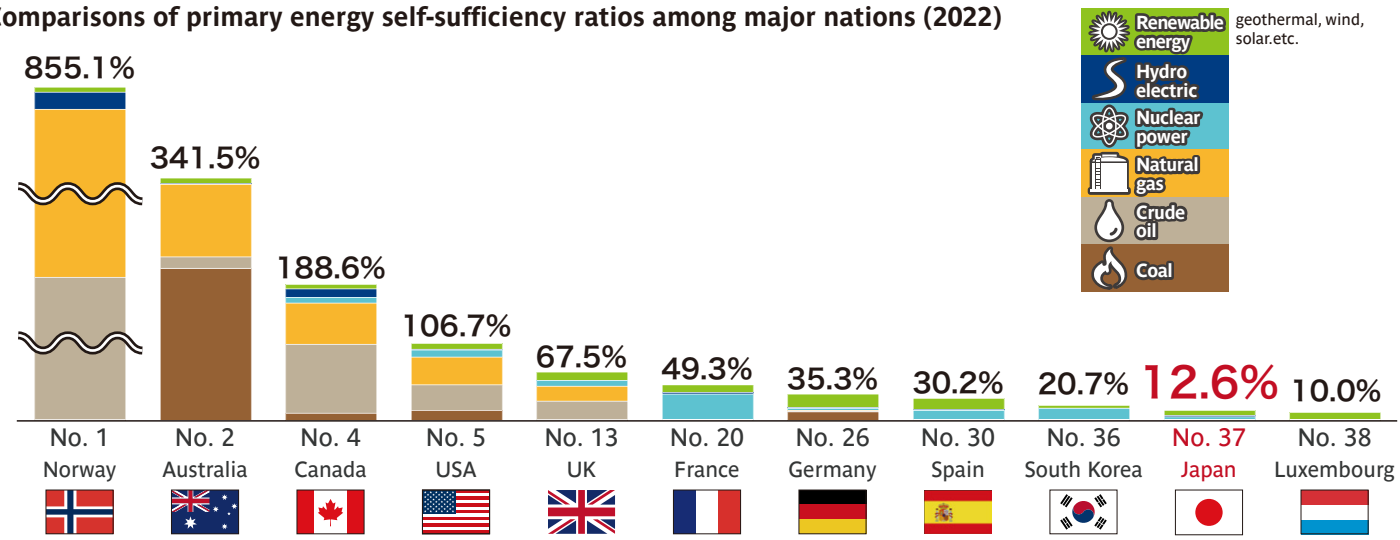
2. Energy Security

Changes in Energy Self-Sufficiency Ratio

Q How much energy can Japan supply independently from domestic resources?

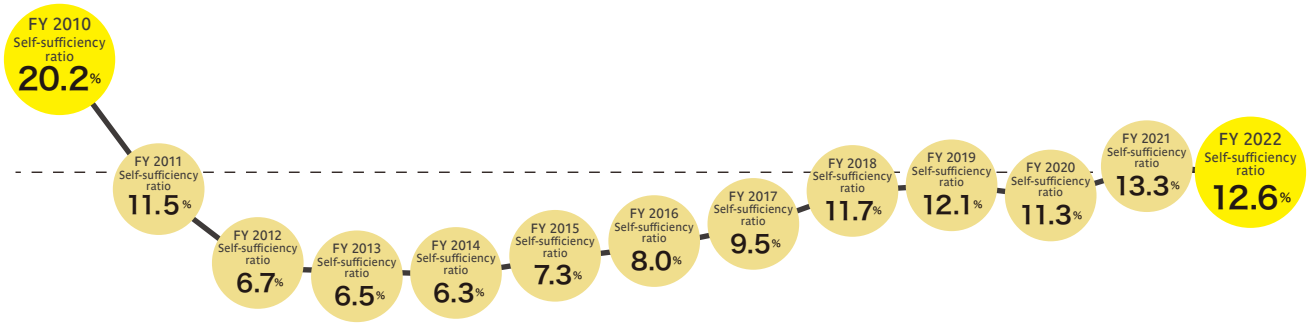
A In FY 2022, Japan's self-sufficiency ratio was 12.6% — lower than those of other OECD countries.

Comparisons of primary energy self-sufficiency ratios among major nations (2022)



Source: Estimates for 2022 from IEA "World Energy Balances 2023", except for data on Japan, which are confirmed values of FY 2022, derived from "Comprehensive Energy Statistics of Japan", published by the Agency for Natural Resources and Energy
* The ranks in the table are those of the 38 OECD member countries.

Energy self-sufficiency ratio in Japan

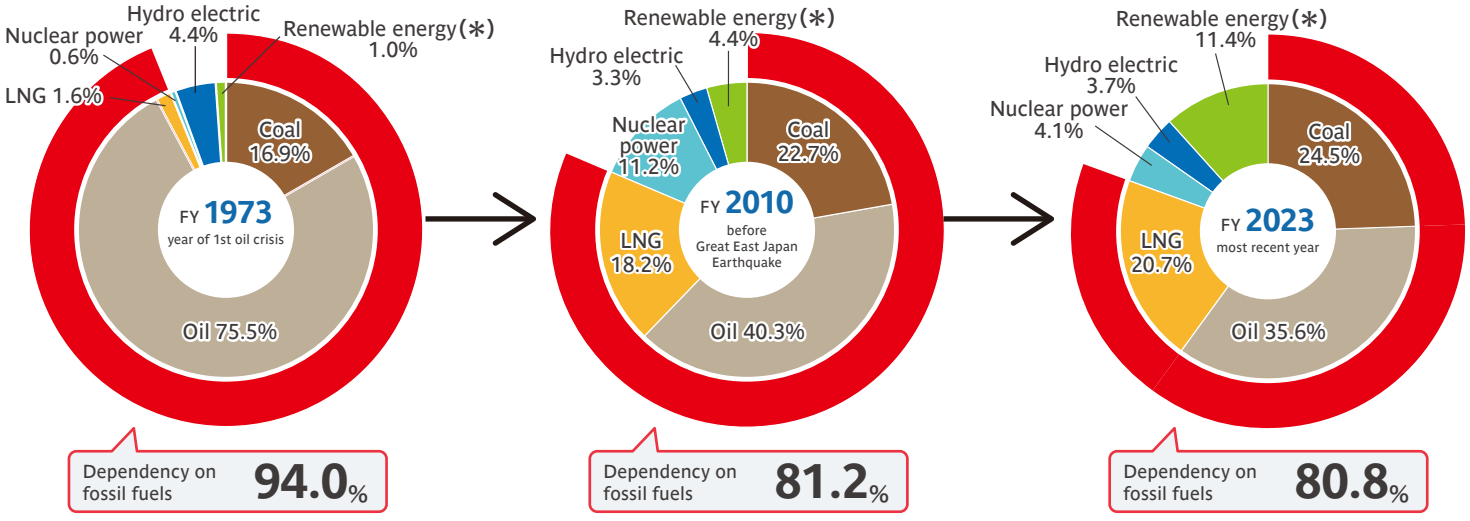


Primary energy sources : Primary forms of energy, including oil, natural gas, coal, nuclear power, solar power, and wind power.
Energy self-sufficiency rate : The percentage of the primary energy resources required for people's daily life and economic activities which can be produced or acquired in their own country.

Q What sources of energy does Japan depend on?

A Japan is largely dependent on oil, coal, natural gas (LNG), and other fossil fuels imports.

Trends in the mix of the primary energy supply in Japan



Source: preliminary values of FY 2023, derived from "Comprehensive Energy Statistics of Japan", published by the Agency for Natural Resources and Energy
* The sum of the values shown may not be 100% in some cases due to rounding of values.
* Renewable energy here, including geothermal power, wind power, and solar power, but not hydroelectric power, includes unused energy.

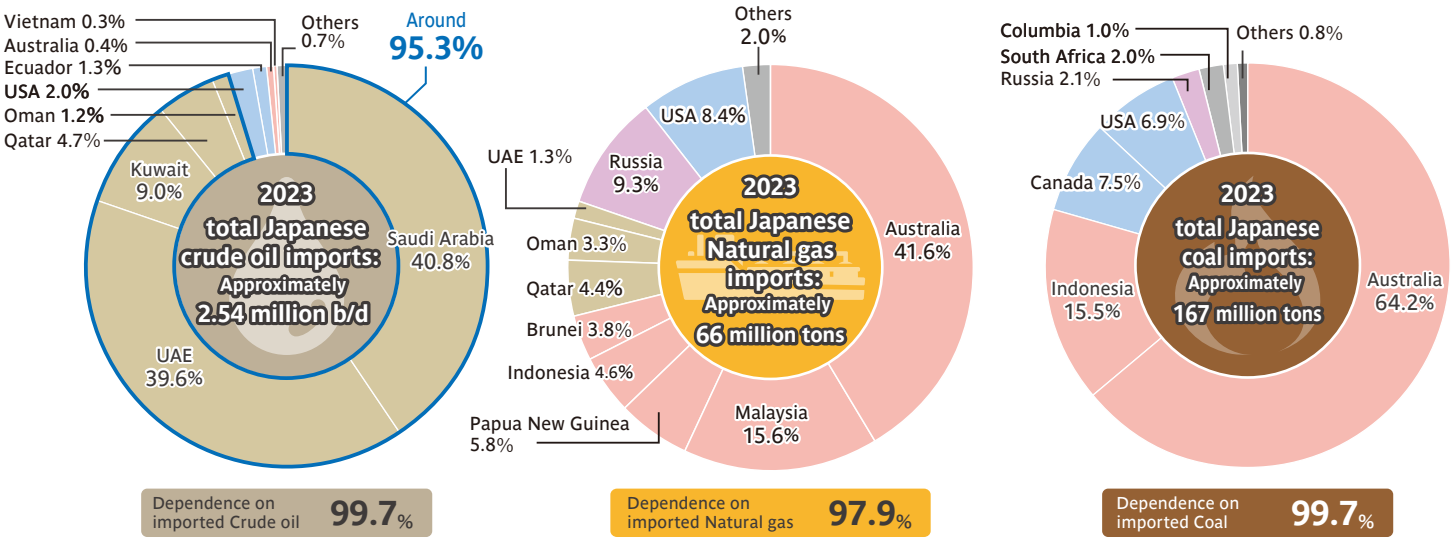
Resource Procurement Status

Q What countries does Japan import fossil fuels from?

A Japan depends on the Middle East for more than 90% of its crude oil imports. For LNG and coal, although dependence on the Middle East is low, Japan still relies on imports from Asia and other overseas sources.

Sources of Japanese fossil fuel imports (2023)

■ From Middle East ■ From Asia-Oceania ■ From Russia ■ From North and Central America ■ Others



Source: The Trade Statistics of Japan published by the Ministry of Finance (The degree of dependence on sources outside Japan on FY is derived from "Comprehensive Energy Statistics of Japan", published by the Agency for Natural Resources and Energy)

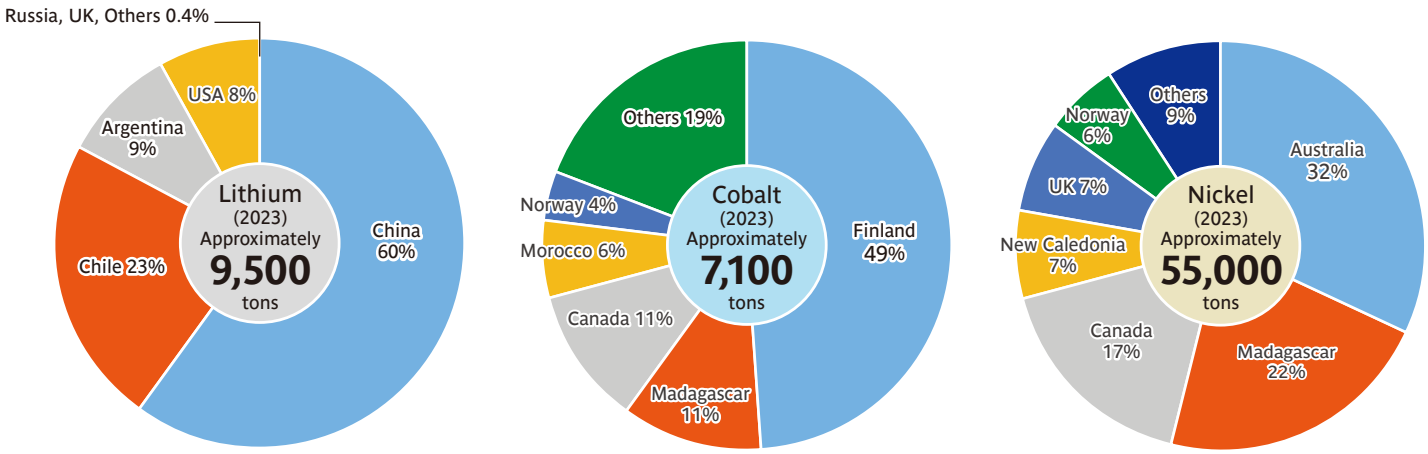
Efforts to secure a stable supply of fossil energy resources : For crude oil, Japan will strengthen relationships with countries in the Middle East that are the main suppliers. For LNG, Japan will diversify supply sources and work for further acquisition of interests in LNG projects. It will furthermore advance the development of domestic resources, such as methane hydrate, and consider measures to promote the securing of long-term LNG contracts. Japan has designated natural gas as one of its specified important goods based on the Economic Security Promotion Act, and will secure a surplus of LNG for strategic operation (Strategic Buffer LNG). The framework for interchanging LNG between businesses will be utilized in an emergency.

Q What kinds of mineral resources are used?

A As an example, the lithium-ion batteries that are used in electric vehicles require rare metals such as lithium, cobalt, and nickel. Japan depends almost 100% on imports for its mineral resources.

(Japan depends 100% on imports for the following 3 minerals.)

Annual import volume of major rare metals



Lithium, Li
It is the lightest metal in the periodic table and has high energy density. Due to those features, it is now a crucial raw material for producing lithium-ion batteries mounted in electric vehicles or as power sources for mobile devices, such as laptop computers.

Cobalt, Co
It is a ferromagnetic white metal, less susceptible to oxidation than iron, and stable with acids and alkali. It is most frequently used in positive electrodes of lithium-ion batteries installed in mobile phones, laptop computers, electric vehicles, and others.

Nickel, Ni
It is most commonly used in stainless steel and heat-resistant steel as an alloy combined with chrome or other metals, and is useful in a wide range of the industries from coins to electronics. A nickel compound is used in a positive electrode of nickel-hydrogen batteries and lithium-ion or other batteries.

Source: The Trade Statistics of Japan published by the Ministry of Finance
Lithium: Total of lithium carbonate and lithium hydroxide; Cobalt: Total of matte/clusters and oxide/hydroxide; Nickel: Total of base metal and ferronickel

Efforts to secure the stable supply of mineral resources: Based on the JOGMEC Act, investment in and loan guarantees for domestic smelting and refining businesses (midstream) have been added to risk money support services of JOGMEC (Japan Oil, Gas and Metals National Corporation). Based on the Economic Security Promotion Act, critical metals have been designated as specified important goods so that support will be provided. Furthermore, efforts will be made to develop domestic marine mineral resources.

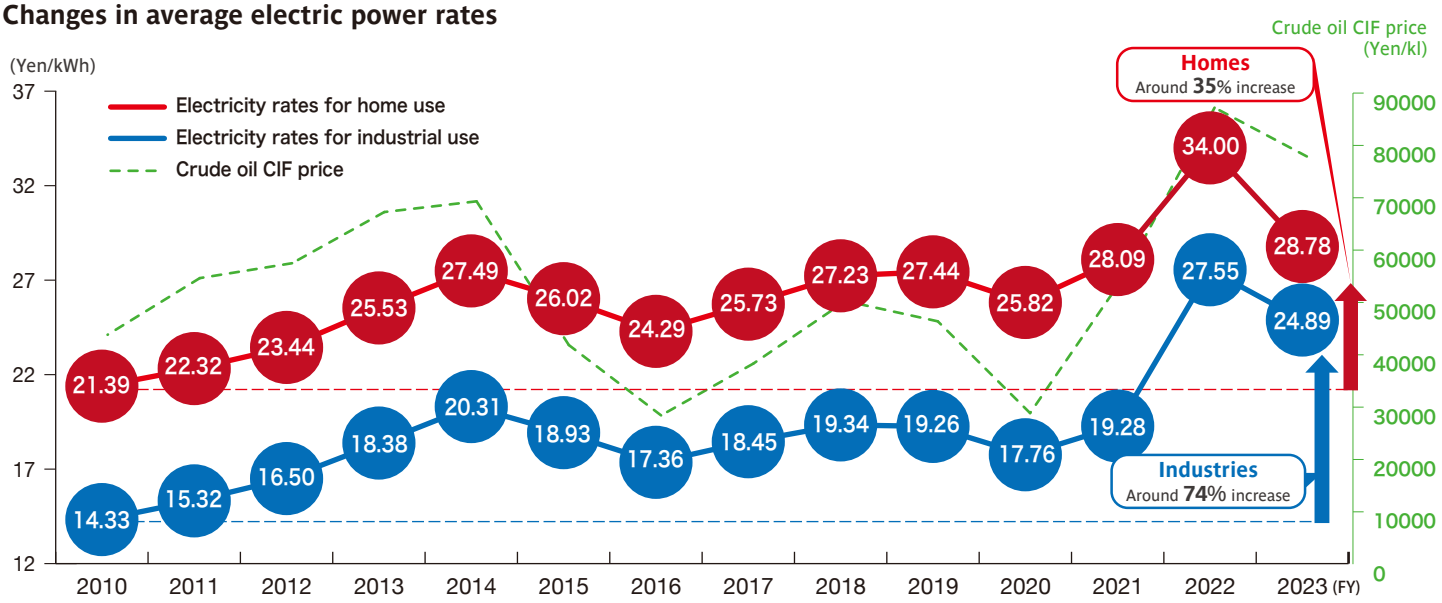
3. Economic Efficiency

Changes in Electric Power Rates

Q How are electric power rates changing?

A Electric power rates have been rising since the Great East Japan Earthquake. They rose in FY2022 due to price hikes for imported fuels. However, thanks to a decline in imported fuel prices thereafter, electric power rates in FY2023 were lower than those in FY2022.

Changes in average electric power rates

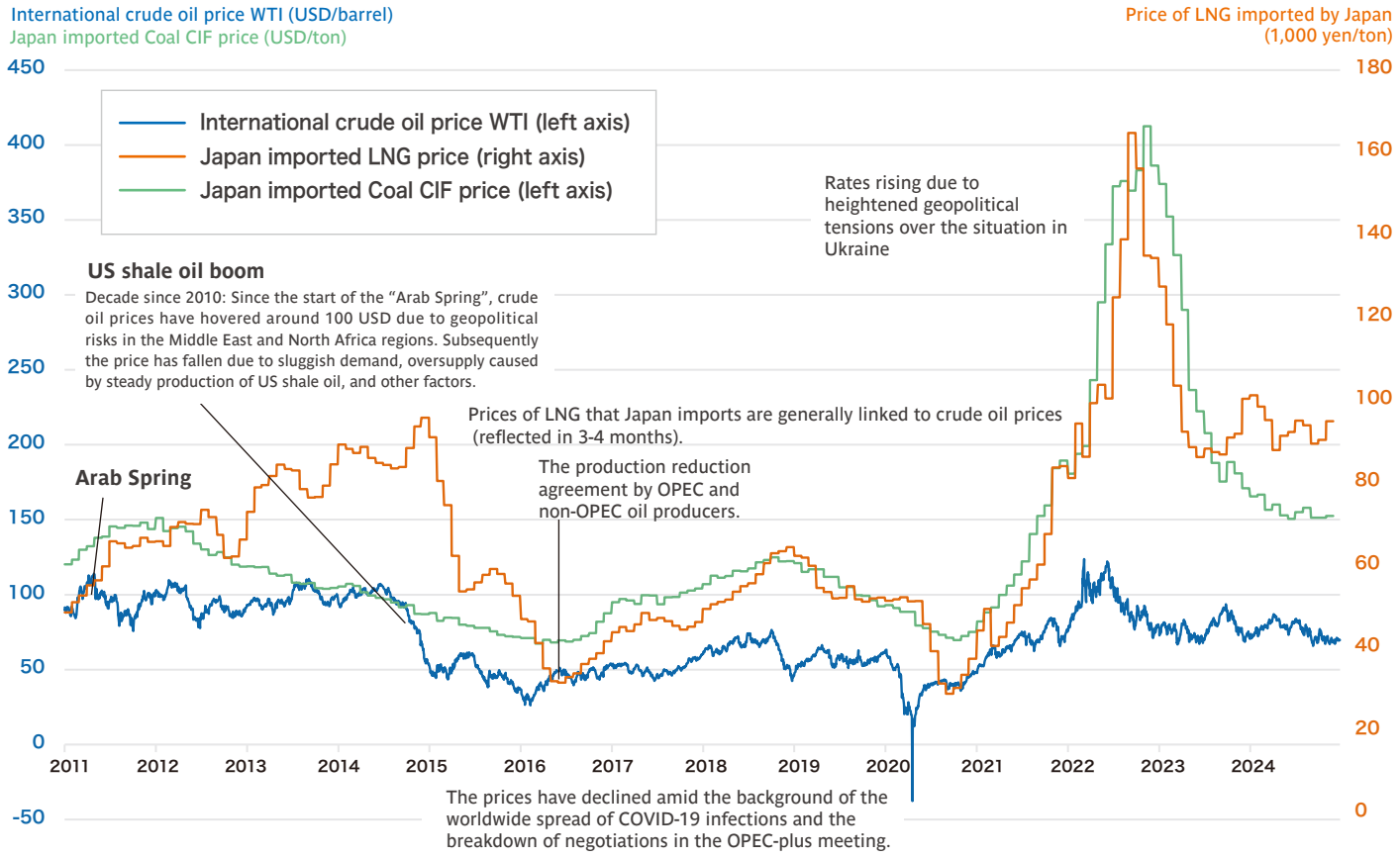


Source: Created based on monthly reports of generated and received electric power, financial materials of electric power companies, and power trading reports
Crude oil CIF price : Transaction price consisting of the import price plus related costs, such as transport cost and insurance cost.

Factor 1: Fuel Prices

Fuel prices have an effect on electric power rates and energy cost.

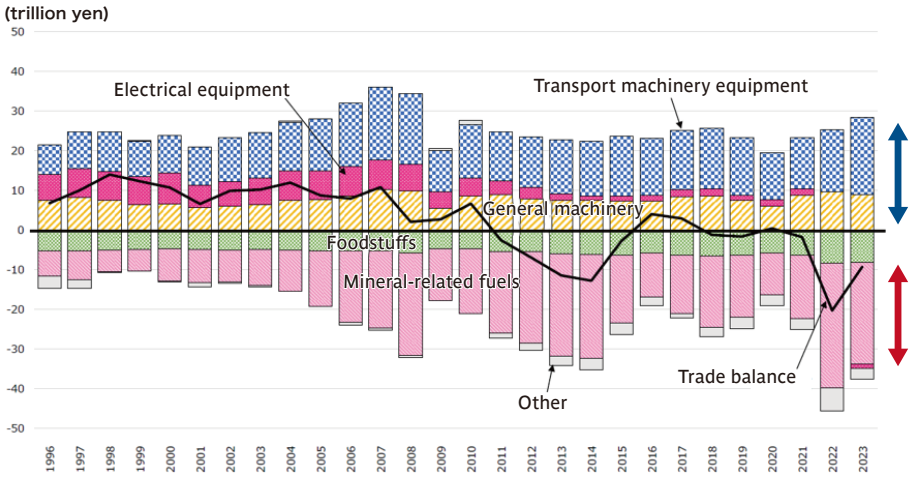
The past decline in crude oil prices and the current situation



Source: Created based on CME Nikkei and Trade Statistics published by the Ministry of Finance.

Changes in Japan's trade balance

Japan enjoys a trade surplus in exports of automobiles and semiconductor manufacturing equipment (approximately 28 trillion yen in 2023). On the other hand, Japan spends most of this surplus on imports of fossil fuels, such as crude oil and LNG (approximately 26 trillion yen in 2023). As Japan is heavily dependent on fossil fuel imports, it is vulnerable to uncertainties regarding energy supply stability as well as sharp price increases caused by a tight supply and demand balance.

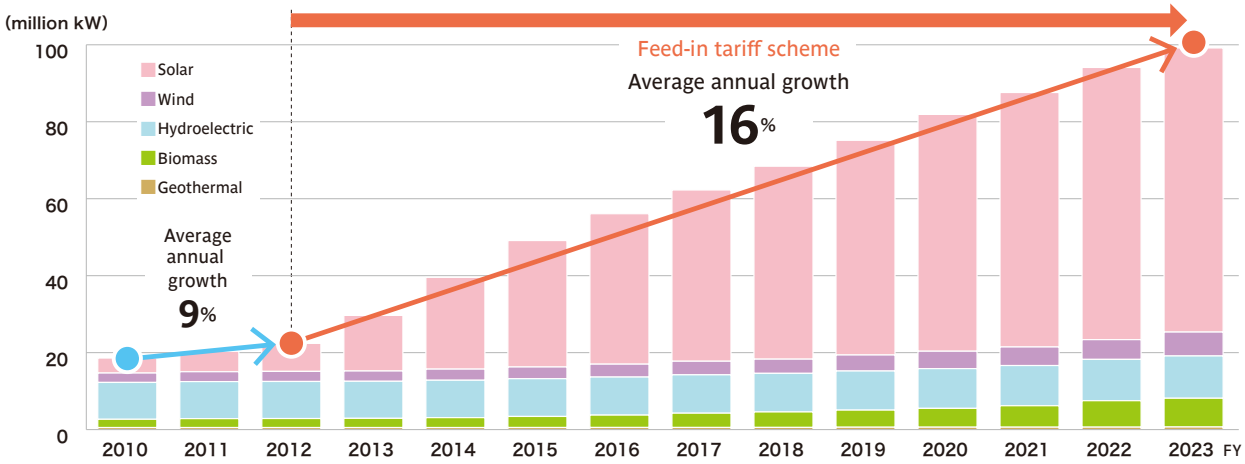


Source: Issues and Prescriptions for Japan's Economy from the Viewpoint of the Balance of Payments, taken from materials distributed at the first meeting hosted by the Ministry of Finance, with bold formatting added

Factor 2: Cost of Renewable Energy

Thanks to the introduction of the Feed-In Tariff (FIT) scheme in 2012, the installed capacity of renewable energy systems has been increasing rapidly. On the other hand, the purchase costs have reached 4.8 trillion yen, and the cost of the surcharge to an ordinary household consuming 400 kWh per month (based on the household research conducted by the Ministry of Internal Affairs and Communications) has risen to 1,396 yen per month. We are working to expand the introduction of renewable energy in a cost-efficient manner toward maximum utilization of it while curbing the financial burden on the people.

Changes in the installed capacity of renewable energy (excluding large-scale hydroelectric power)

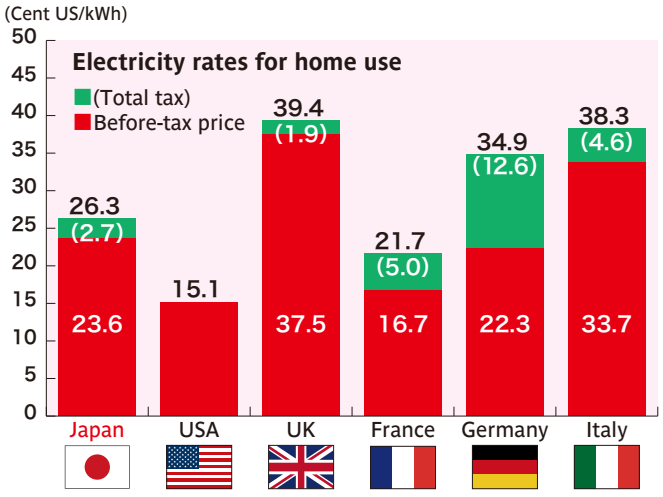


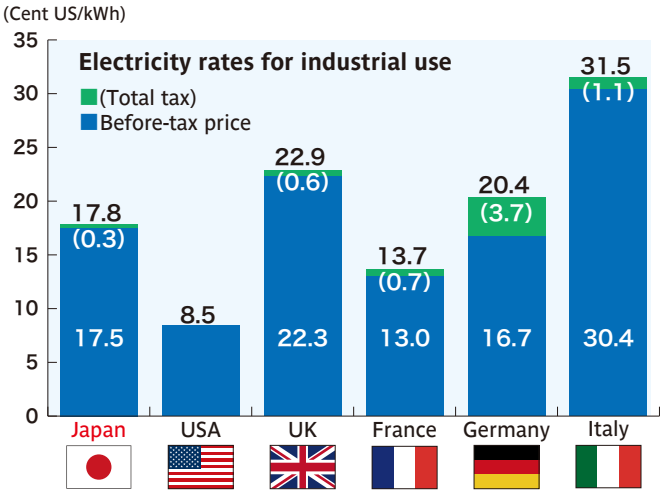
Source: Created by the Agency for Natural Resources and Energy based on JPEA solar panel shipment statistics, NEDO wind power capacity/generation statistics, surveys for potential waterpower, current status and trends of geothermal power generation, and certification results from the RPS system/FIT scheme.
Feed-In Tariff (FIT) scheme : In this scheme, the electricity generated by renewable energy is purchased by electric power companies at a fixed rate for a certain period. The electric power companies will cover the costs of purchasing the electric power from renewable energy through a surcharge that is paid by electricity users.

International comparison of electric power rates

The electric power rates in Japan were in a higher level for both home and industrial uses than other countries, but increasing burdens on the electric power companies overseas due to taxation and policies of promoting the introduction of renewable energy has reduced the gap in the rates between Japan and other countries.
We will have to continue efforts aimed at improving the efficiency of the electric power business and reducing electric power rates. On the other hand, we should be thoughtful of our country's specific conditions, meaning our issues related to resource supply. We should consider that most fuels and raw materials are largely dependent on imports from outside Japan, and thus it is critical for us to secure a stable supply of resources.

International comparison of electric power rates (2022)





Source: Created based IEA "Energy Prices and Taxes for OECD Countries 2022".
Note: The details of tax and before-tax prices are not known for the United States.

4. Environment

Global Warming Countermeasures: Carbon Neutrality

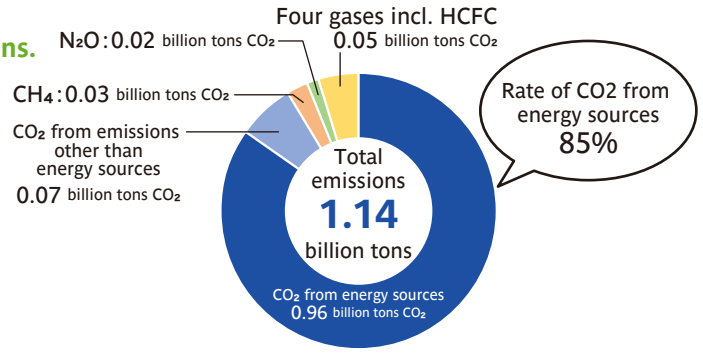
Q What is carbon neutrality?

A It refers to achieving net zero greenhouse gas emissions.

- "Greenhouse gas" covers not only CO_2 but all gases with a "greenhouse effect," including methane.
- "Net zero gas emissions" means balancing gas emissions with the absorbed amount through removing such gasses from the atmosphere, making the total gasses emitted to be equal to zero (net zero, or substantially zero).

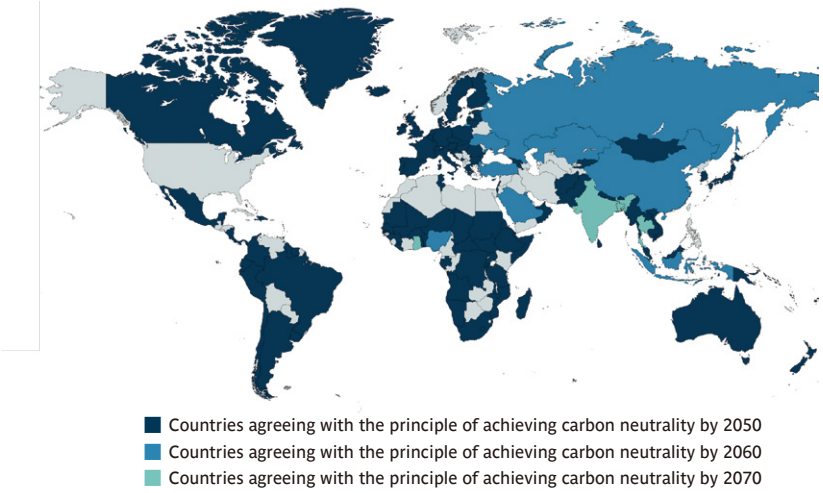
Greenhouse gases: There are 7 main gases: carbon dioxide, methane, dinitrogen oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride.

Greenhouse gas emissions in Japan (FY 2022)



Source: from GIO's "Data of Greenhouse Gas Emissions in Japan"
*The amounts for greenhouse gases other than CO_2 are converted to CO_2 equivalents.

Countries and regions that have agreed with the principle of achieving carbon neutrality



- Countries and regions that have declared intentions to achieve carbon neutrality (CN): 146 (*1)
- Approximately 70% of the world's total CO2 emissions (*2) are from these countries (2022 results)

*1 Counted by METI based on long-term strategies submitted to the UN by relevant countries and their CN declarations

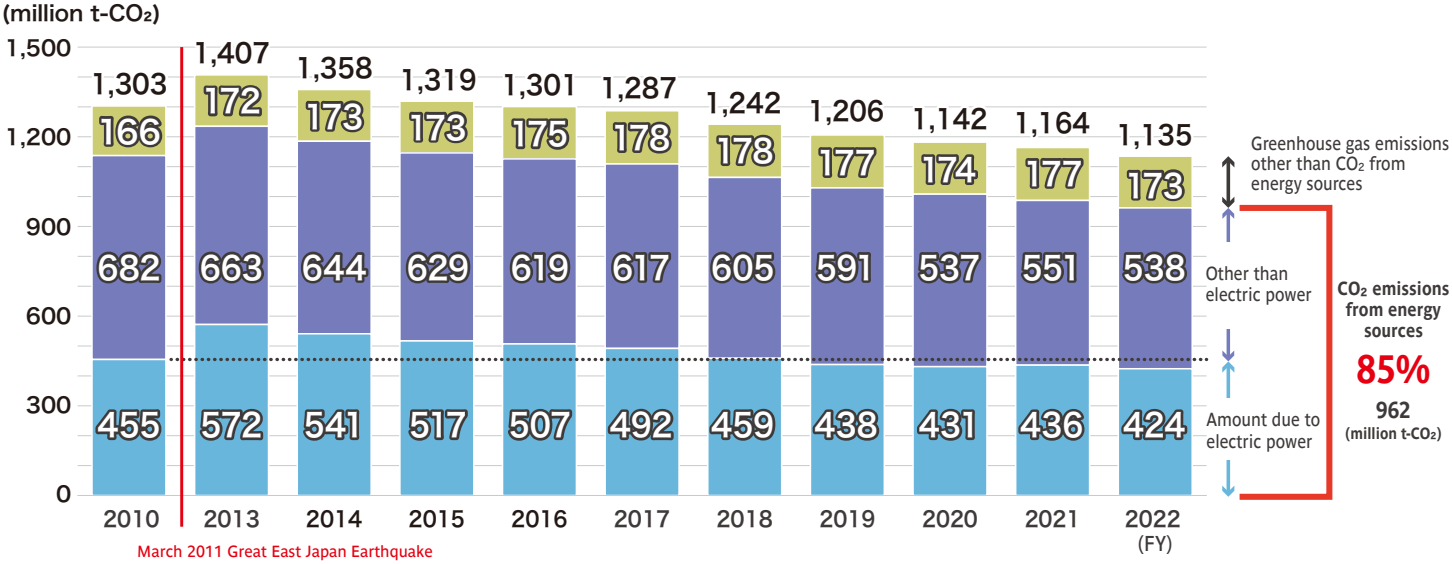
*2 Energy-related CO2 emissions are calculated based on the IEA Greenhouse Gas Emissions from Energy 2024

Greenhouse Gas Emittions

Q How much greenhouse gas is being emitted in Japan?

A The amount of greenhouse gas emissions in Japan increased after the Great East Japan Earthquake. However, in FY 2022, emissions dropped to 1.14 billion tons. Japan must continue working to reduce emissions.

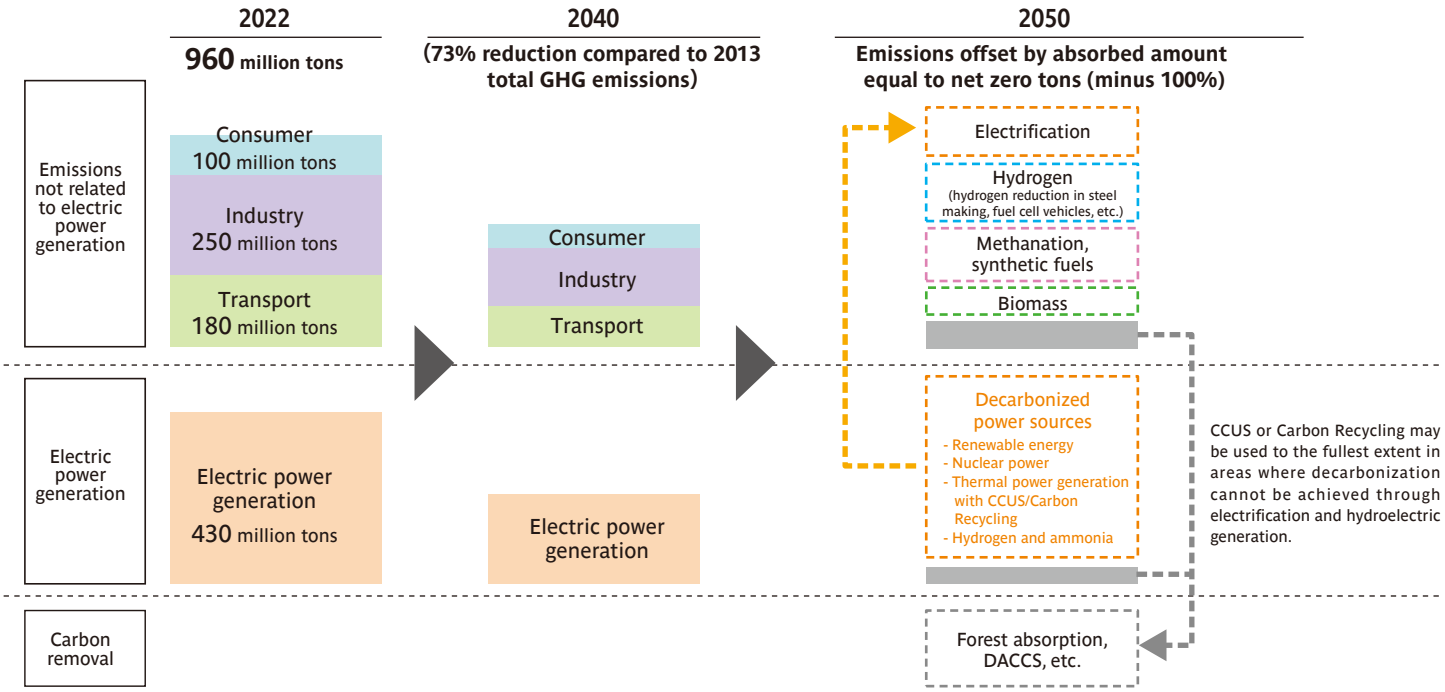
Changes in Japan's greenhouse gas emissions



Source: Created based on the "Comprehensive Energy Statistics of Japan", published by the Agency for Natural Resources and Energy and "Calculation results for the amount of greenhouse gas emissions in Japan", published by the Ministry of the Environment.

Direction Toward 2050 with Further Decarbonization

Image of transition to carbon neutrality

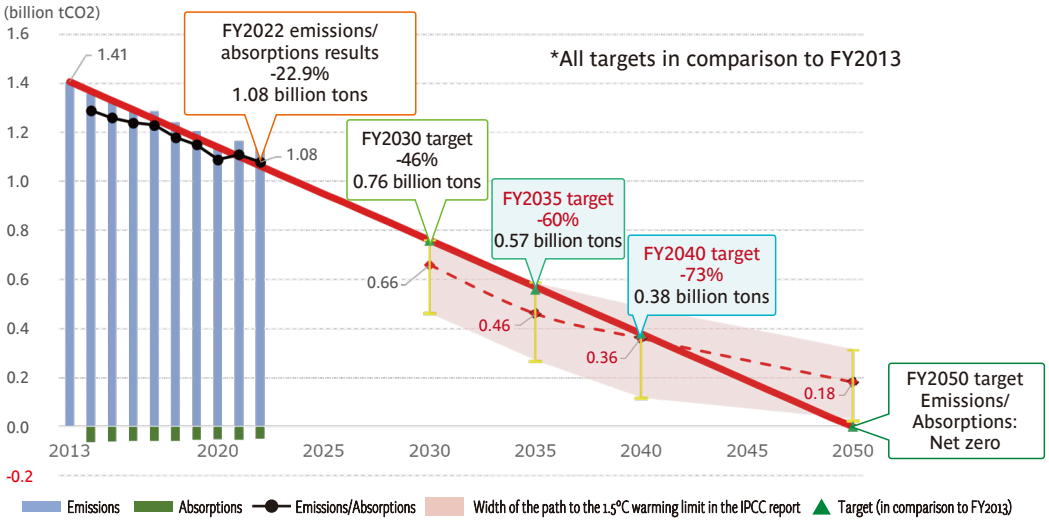


* Values shown are the amounts of CO_2 derived from energy

DACCS (direct air capture with carbon storage): A technology that directly captures and stores CO_2 that already exists in the atmosphere.

Japan's new greenhouse gas emission reduction targets (NDC)

Japan, like other nations, upholds an ambitious goal of achieving carbon neutrality by 2050, which is consistent with the 1.5°C threshold. To do this, we will advance green transformation (GX), an initiative that will heighten mid- to long-term predictability, contribute to the stable supply of energy and simultaneously achieve economic growth and decarbonization.

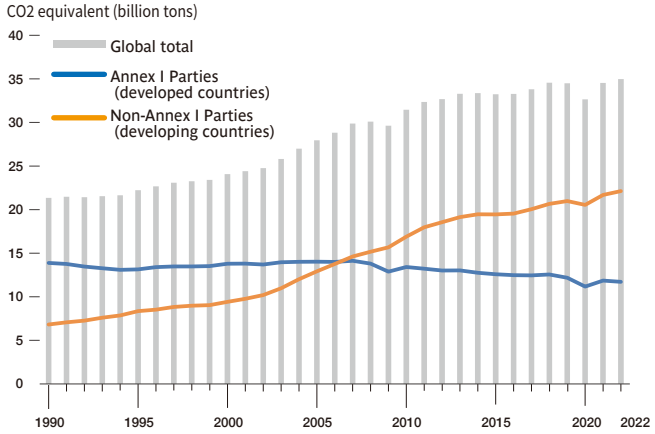


NDC: Nationally Determined Contribution

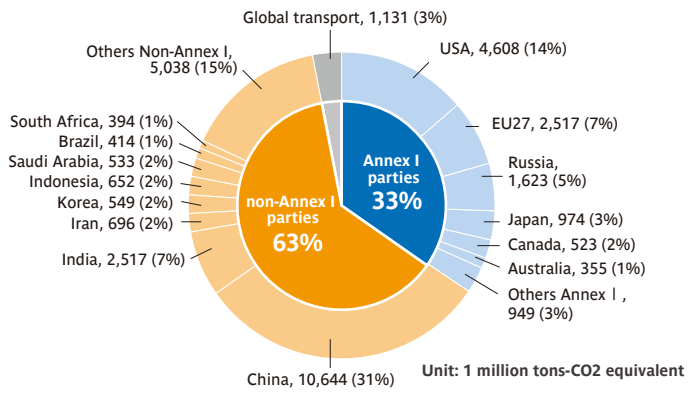
Column: Energy-related Greenhouse Gas Emissions

The recent increase in global energy-related greenhouse gas emissions has been driven by economic growth in emerging nations (emissions from non-Annex I parties (developing countries) more than tripled between 1990 and 2022). Japan accounts for about 3% of global emissions. It is believed that global emissions will not decline without emission reductions by emerging nations, not to mention those by developed countries.

Trends in energy-related greenhouse gas emissions



Energy-related greenhouse gas emissions in each country (2022)



Source: IEA "GHG Emissions from Fuel Combustion 2025"

5. Safety

Ensuring Safety

Q **What steps are being taken to ensure a stable supply of energy and safety in the face of intensifying natural disasters?**

A **To ensure a safe and stable supply of electricity, we are advancing measures such as making and implementing a contingency plan for mutual support and collaboration between power utilities in case of a natural disaster, thereby enhancing resilience.**
To ensure a stable supply of gas and its safety, we have taken measures such as making arrangements between general gas pipeline service providers for mutual collaboration in case of a natural disaster, imposing restrictions on gas consumption by large users in a tight supply/demand situation, and securing a surplus of LNG for an emergency (Strategic Buffer LNG).

Damage to the fuel and electric power infrastructure caused by typhoons, earthquakes and torrential rains

Damaged floating-type solar power generation facilities in Ichikawa City, Chiba Pref. (Due to a typhoon in September 2019)

Fallen utility poles (Due to the Noto Peninsula Earthquake in January 2024)
Source: Hokuriku Electric Power Transmission & Distribution Company

Flooded refinery facilities
(Due to a typhoon in October 2019)

Submerged tank lorries
(Due to torrential rain in July 2020)

Damage caused by tsunamis

TEPCO's Fukushima Daiichi Nuclear Power Station, which suffered a steam explosion due the effects of tsunamis following the Great East Japan Earthquake (March 2011)

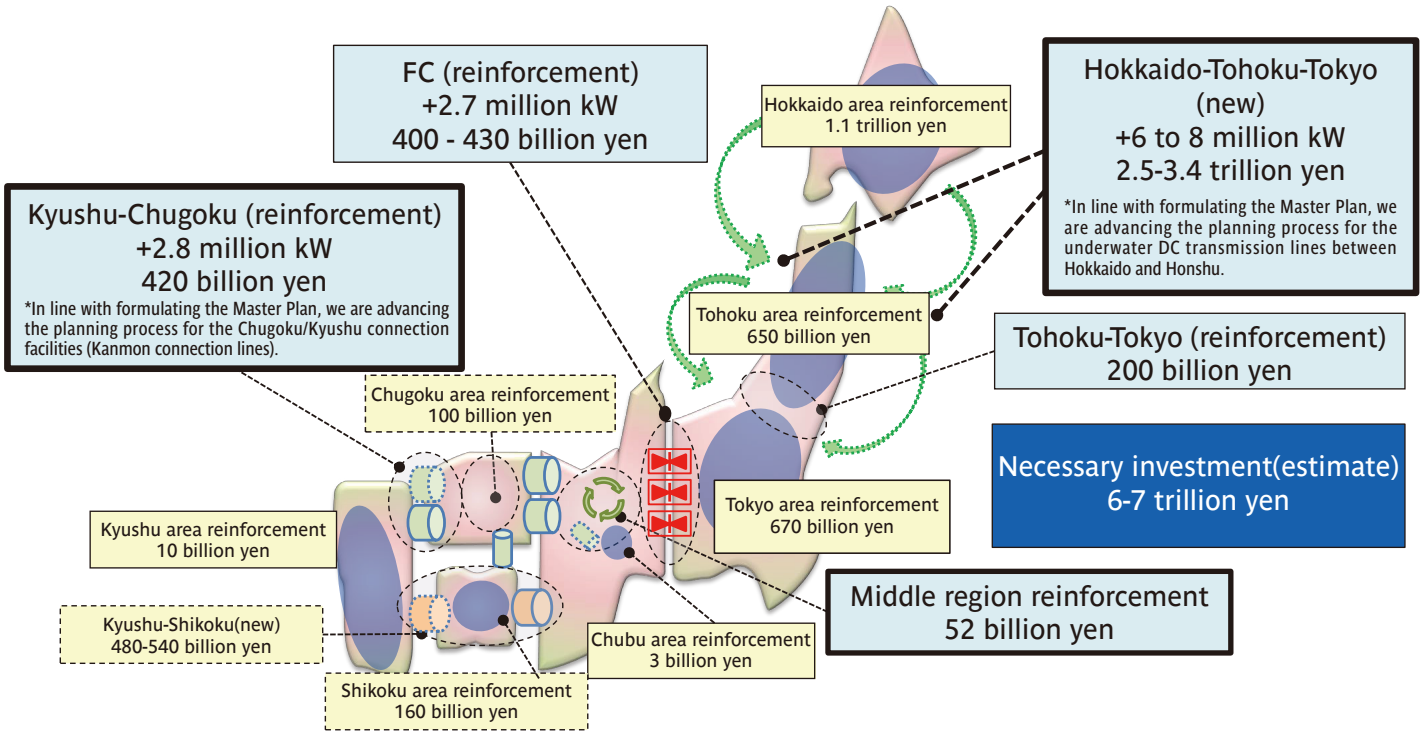
Photo : Tokyo Electric Power Company Holdings Photo & Video Library

The above measures are based on the following Acts:

- The Act of Partial Revision of the Electricity Business Act and Other Acts for Establishing Resilient and Sustainable Electricity Supply Systems, which was passed in June 2020.
- The Act of Partial Revision of High Pressure Gas Safety Act and Other Acts, which was passed in June 2022
- The Act of Partial Revision of the Gas Business Act and the JOGMEC Act, which was passed in November 2022
- The Economic Security Promotion Act, which was passed in May 2022

Effort 1: Enhancing the Resilience of Electric Power Infrastructure

We will advance grid reinforcement to expand the introduction of renewable energy and ensure a stable supply of electricity.
We will develop cross-regional transmission lines based on the Master Plan of Nationwide Power Transmission Networks to systematically respond to the introduction of renewable energy. We have introduced a mechanism to compensate for the reinforcement costs through the renewable energy surcharges and nationwide wheeling charges. Under this system, we aim to carry on projects including the construction of the underwater DC transmission lines between Hokkaido and Honshu, and the Chugoku/Kyushu connection facilities (Kanmon connection lines).

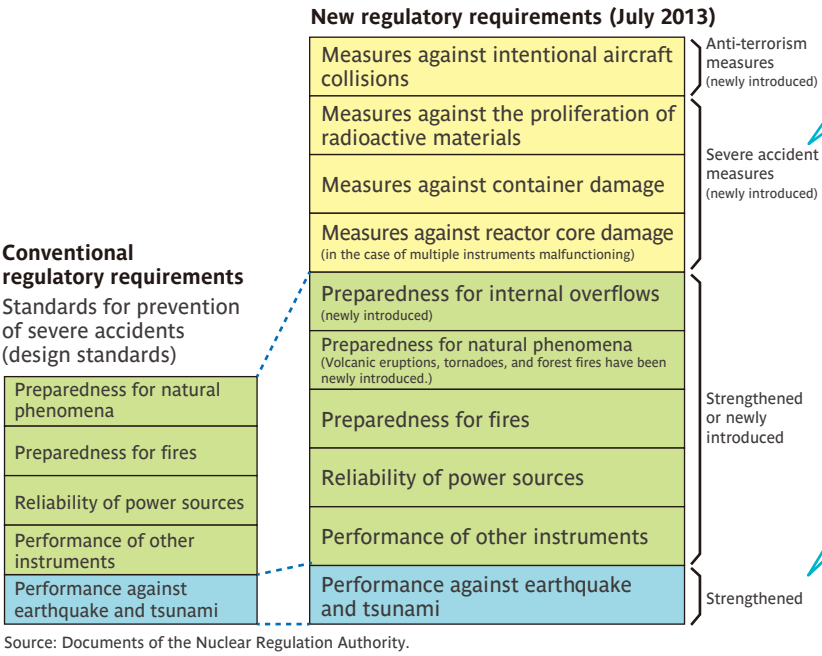


Source:Created from the base scenario in the Master Plan of Nation-wide Power Transmission Networks which the OCCTO published on March 29. 2023.

Resilience: means sturdiness, recuperative power or elasticity.

Effort 2: Conforming to New Regulatory Requirements for Higher Levels of Safety

When nuclear power plants are restarted, the Nuclear Regulation Authority will require them to conform to new regulatory requirements, which demand stricter accident-prevention measures than the former requirements. The power plants are also required to prepare provisions for contingencies and anti-terrorism measures.



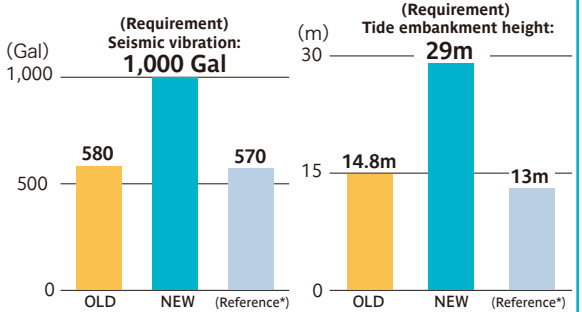
Source: Documents of the Nuclear Regulation Authority.

Example measures against severe accidents

In preparation for a serious incident in which vapor in the containment vessel must be discharged into the atmosphere to reduce the pressure in the containment vessel, the nuclear power plants must maintain systems that can limit the volume of discharge of radioactive substances to less than 1/1,000 and prevent hydrogen explosion.

Typical new requirements demanding stricter measures

Earthquakes: The reference value for seismic vibration has been revised from 580 Gal to 1,000 Gal.
Tsunamis: Based on the previous experience of earthquake disasters, potential tsunami height is estimated to be 23.1m and the required height of tide embankments has been revised from 14.8m to 29m.



Source: Tohoku Electric Power Company website

6. Innovation to Realize GX

GX (Green Transformation)

Q What is GX (green transformation)?

A GX refers to a program of social reform efforts to simultaneously achieve a stable supply of energy, economic growth and decarbonization (GHG emission reductions).

Q What innovation is Japan working on to achieve decarbonization?

A We are promoting next-generation renewable energy technologies, such as perovskite solar cells and floating-type offshore wind turbines. Other promising technologies include next-generation energy such as hydrogen, which is necessary for the conversion to non-fossil energy, and CCUS/Carbon Recycling to capture, utilize and store CO2.

Next-generation Renewable Energy

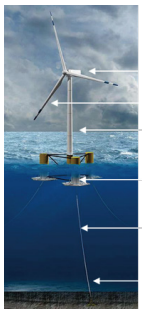
Perovskite solar cells

Perovskite solar cells use the chemical compound of this structure as power generation layers. Being light and flexible, they can be installed on building walls and other surfaces, which will create a variety of markets. The primary material for producing perovskite solar cells is iodine, of which Japan claims the second largest share (roughly 30%) of global production. Accordingly, Japan will be able to build an independent supply chain conducive to a stable supply of energy.

Floating-type offshore wind turbines

Unlike bottom-mounted offshore wind turbines, the base of this type of turbine floats on the surface of the sea. As there is no need to mount the base on the sea floor, floating-type offshore wind turbines can be installed in deep-sea areas.

Perovskite solar cells
Source:
Sekisui Chemical Co., Ltd.



Floating platform concepts
Source:
NREL Floats New Offshore Wind Cost Optimization Vision

Next-generation Energy Such as Hydrogen

Efforts for creating a hydrogen-based society

We are promoting the use of hydrogen in a wide variety of fields, including fuel cell vehicles and household fuel cells, in addition to the construction of supply chains aimed at enabling large-scale hydrogen supply and international trade in hydrogen.

Production

- Production of hydrogen from utility gas
- Surplus hydrogen collected from industrial processes

Domestic renewable energy

World's leading demonstration of producing hydrogen using electricity from solar power generation
(Source: Toshiba Energy Systems)

Transport and supply (supply chain)

Support for construction of hydrogen stations

(Source: Iwatani Corporation)

Use

Transport — Support for FCVs

MIRAI (Source: Toyota Motor Corporation)

SORA (Source: Toyota Motor Corporation)

Fuel cell small truck
(Source: Toyota Motor Corporation)

Fuel cell large truck
(Source: Toyota Motor Corporation)

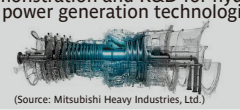
HYBARI
(Source: Toyota Motor Corporation)

General — Support for FC

ENE·FARM

Fuel cell combined power generation system [HYBRID-FC]
(Source: Mitsubishi Heavy Industries Ltd.)

Power gen. — Demonstration and R&D for hydrogen power generation technologies



(Source: Mitsubishi Heavy Industries, Ltd.)

Industry — Hydrogen utilization and development in industrial processes

Hydrogen-fired boiler
(Source: Miura Co., Ltd.)

Efforts for building an international hydrogen supply chain

Using liquefied hydrogen and several hydrogen carriers including MCH, technological development for building large-sized transport facilities and demonstrations of large-scale hydrogen transport have been completed.

Hydrogenation plant built in Brunei
(Source: AHEAD)

World's first hydrogen carrier "Suiso Frontier"
(Source: HySTRA)

Efforts toward public implementation of ammonia

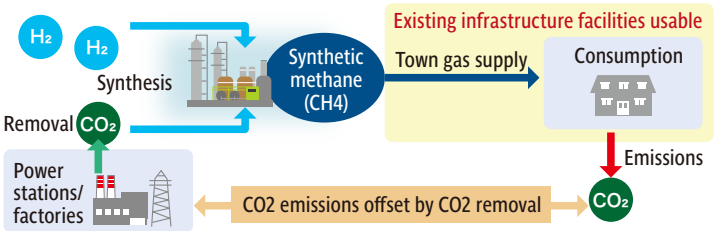
Ammonia can be used as a hydrogen carrier, and it can be produced and utilized at a lower cost than pure hydrogen since it can use existing infrastructure. As ammonia has a combustion speed close to that of coal, it is also attracting attention as a fuel for mixed combustion at coal-fired power stations and as a bunker fuel for international shipping. With regard to power generation, Japan has so far succeeded in the stable combustion and suppression of NOx (nitrogen oxide) emissions with 20% co-firing of ammonia. Going forward, we will advance technological development toward higher co-firing ratios and, ultimately, single-fuel firing.

Facility used to demonstrate mixed combustion
Source: JERA

Fuel ammonia ocean tanker (conceptual rendition)
Source: NYK Line

Synthetic methane (e-methane)

Synthetic methane, which is produced by synthesizing hydrogen (H2) and carbon dioxide (CO2), can use existing infrastructure and is therefore expected to contribute to the smooth decarbonization of town gas. Since CO2 emissions from the use of e-methane are offset by CO2 removal in the production process, CO2 in the atmosphere will not increase.



Source: Paraphrased from the Action Plan for Carbon Neutrality Challenge 2050 published by the Japan Gas Association

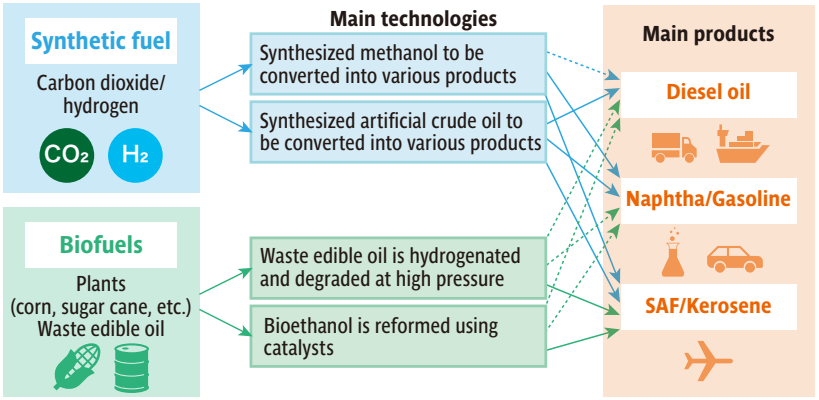
Synthetic fuel (e-fuel)

Synthetic fuel, which is also produced by synthesizing hydrogen (H2) and carbon dioxide (CO2), can use existing infrastructure. Having a high energy density comparable to fossil fuels is an advantage. E-fuel is expected to be utilized for automobiles (e-gasoline and e-diesel), ships (e-methanol) and aircraft (e-SAF).

Biofuels

Biofuels are produced from plants, waste edible oil and other waste. They are low-carbon fuels because raw materials such as plants absorb CO2 from the atmosphere while they are growing.

Production processes of synthetic fuel (e-fuel) and biofuel (SAF)

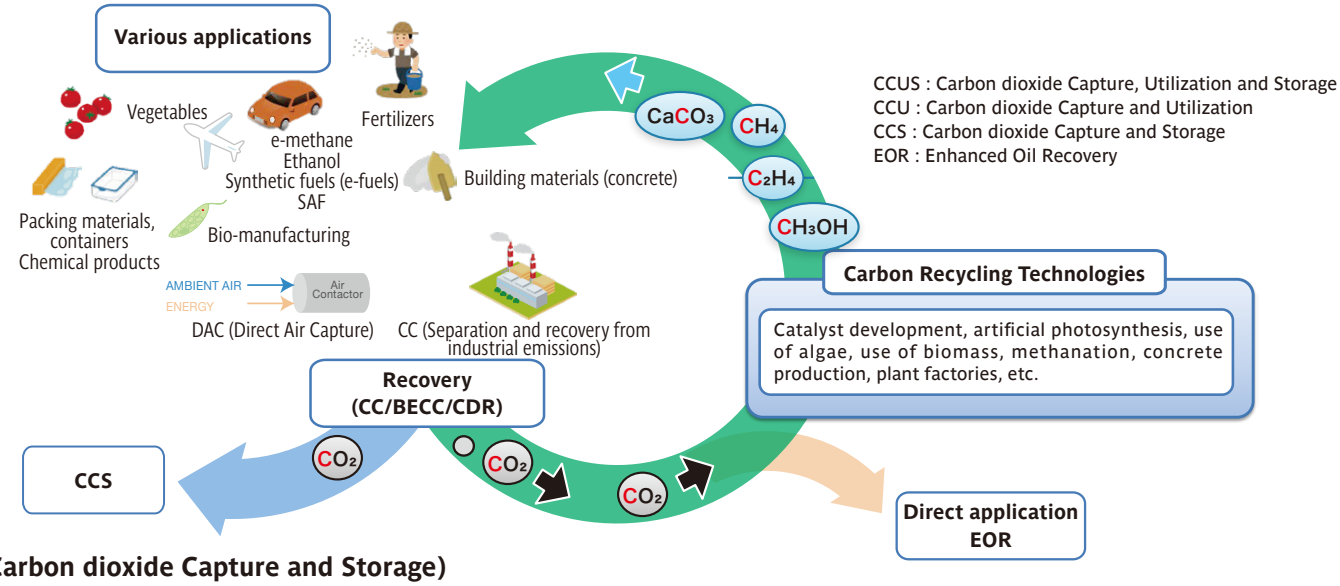


Technologies to Capture, Utilize and Store CO2

CCUS is a technology for capturing CO2 from industrial emissions for utilization or storage underground. It is targeted at industries that are hard to decarbonize, such as steelmaking, cement, chemicals and oil refining, as well as power stations. The technology is expected to realize decarbonization in sectors where conversion to non-fossil energy using electrification and hydrogen is difficult.

CCU/Carbon Recycling

Among CCU technologies, Carbon Recycling regards CO2 as a resource for reuse as material or fuel through mineralization and artificial photosynthesis. As Carbon Recycling contributes to curbing CO2 emissions, we will promote technological development, public implementation and international dissemination of this technology, along with the building of a CO2 supply chain.

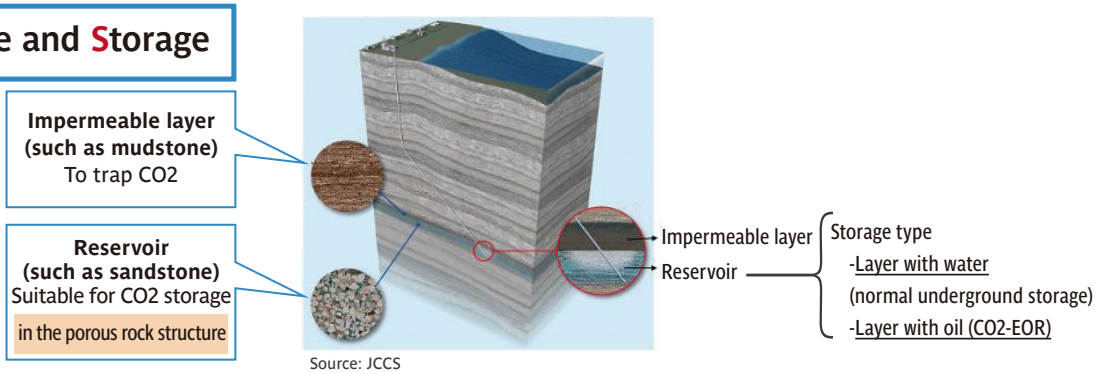


CCUS : Carbon dioxide Capture, Utilization and Storage
CCU : Carbon dioxide Capture and Utilization
CCS : Carbon dioxide Capture and Storage
EOR : Enhanced Oil Recovery

CCS (Carbon dioxide Capture and Storage)

CCS is a technology to separate and remove CO2 from industrial emissions such as those from power stations and chemical plants and inject the CO2 deep underground for storage. To implement CCS, there must be a rock formation with an underground reservoir where CO2 can be stored. Furthermore, the reservoir must be covered with an impermeable layer of cap-rock that traps CO2.
We support drilling to explore storage sites and the building of a supply chain, aiming to secure annual storage of 6 to 12 million tons by 2030.

Carbon dioxide Capture and Storage



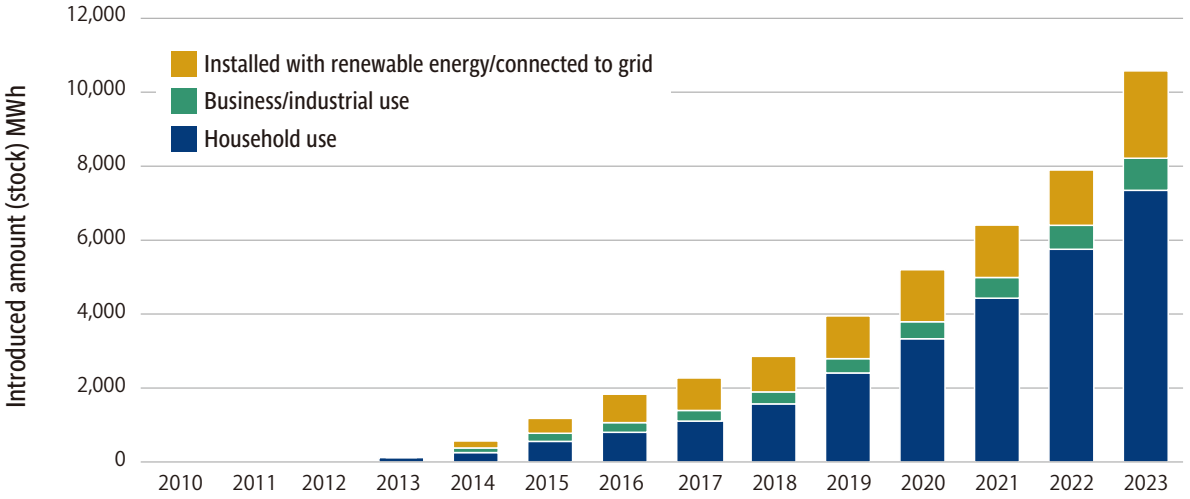
Source: JCCS

Practical Application of Innovation

Widespread use of power storage systems and fuel cells

The introduction of stationary power storage systems in Japan is increasing year by year. Furthermore, the use of fuel cells including Ene-Farm is expanding.

Stationary power storage systems introduced in Japan



Source: Created by Mitsubishi Research Institute based on the data published by Fuji Keizai

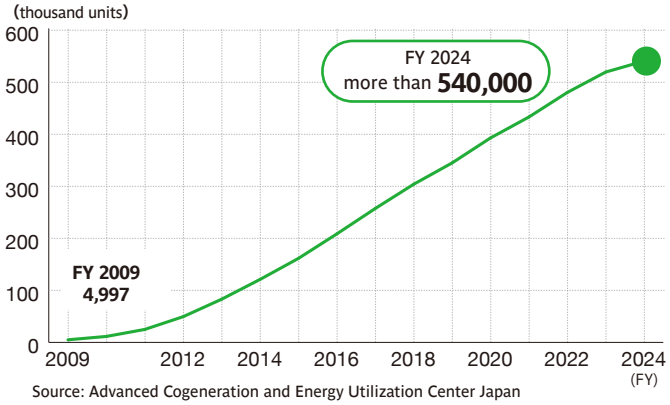
家庭用燃料電池コージェネレーションシステム

ENE・FARM

エネファーム

Ene-Farm, the worlds' first household fuel cell that utilizes hydrogen, was launched in Japan in 2009, and in FY2024, more than 540,000 units were in use.
Going forward, further technological development will take place to reduce the number of parts and pursue further cost reduction. Efforts will focus on ways to make the most of the potential of fuel cells, for instance verifying the feasibility of their use for supply capacity and adjustment power in the power grid. The goal is to support the improvement of the business environment for using this technology.

Number of Ene-Farms in Japan (cumulative)



Source: Advanced Cogeneration and Energy Utilization Center Japan

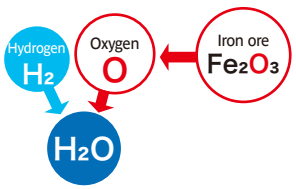
Practical use of various technologies can reduce CO2 emissions

Geothermal power generation

With nearly zero CO2 emissions, geothermal power generation is sustainable and stable. Taking advantage of Japan's tremendous potential, we will promote the development of geothermal power generation including a next-generation system.

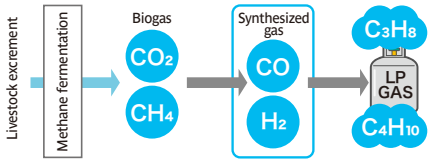
Steelmaking with hydrogen

Technological development that uses hydrogen to reduce iron ore.



Clean LPG

Aiming to achieve public implementation in the 2030s, we will conduct technological development of innovative catalysts and demonstrate a production process.



Producing raw materials for plastics using CO2 and other sources

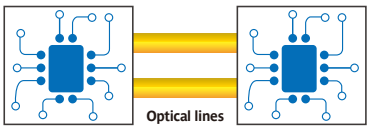
We will develop a technology for producing chemicals from waste plastics, waste rubber, CO2 and other sources as feedstock.

Producing materials such as concrete using captured CO2

Separating and collecting CO2 from emissions from thermal power plants or other facilities and recycling it into construction materials.

Photoelectric fusion

This is a technology used to replace electrical wiring of electronic devices with optical lines. It will bring about greater energy efficiency, larger capacities and lower latency, leading to a reduction in electricity consumption by the entire network system to one-hundredth of the previous level.



7. Renewable Energy

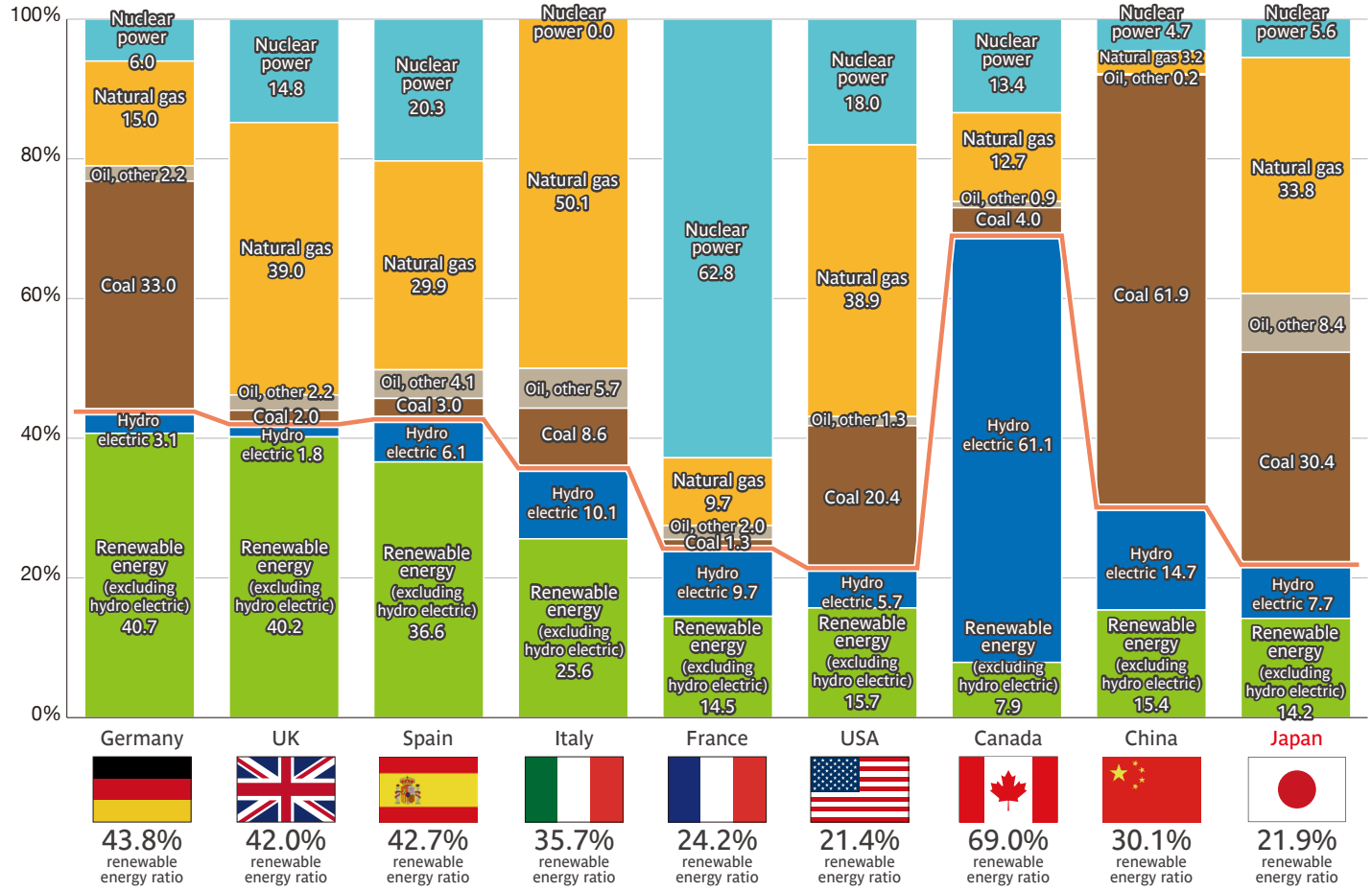
Introduction of Renewable Energy

Q **Is Japan advancing the introduction of renewable energy?**

A **The percentage of renewable energy power in Japan was 21.9% in FY2022. Japan ranks 6th in the world in terms of renewable energy power generation capacity, and 3rd in the world for solar power generation. The solar power generation capacity per unit of national land in Japan is one of the largest among major countries in the world.**

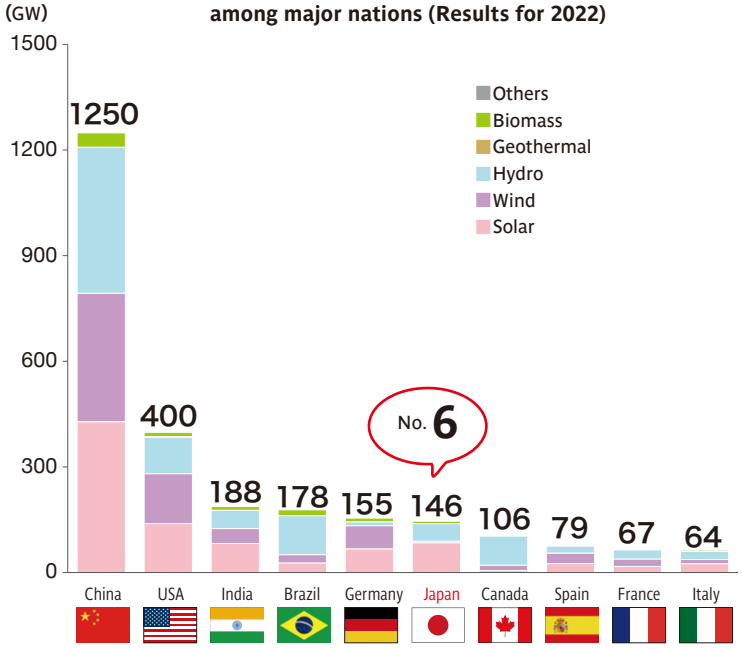
Comparison of percentages of renewable energy in total power generation in major nations

(Percentage of total generated power)

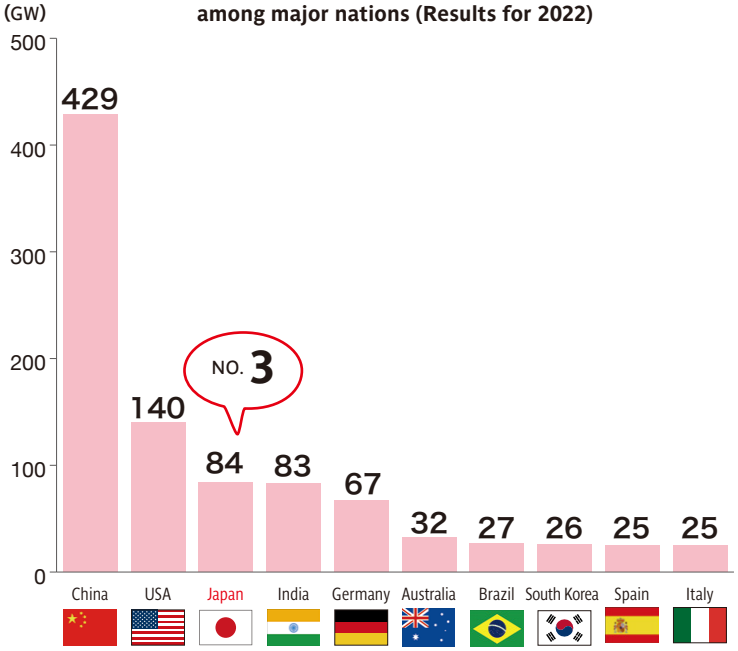


Source: Created by the Agency for Natural Resources and Energy based on the IEA "Market Report Series—Renewables 2023" (Power Generation in Each Country as of 2022), IEA database, and the Comprehensive Energy Statistics of Japan (FY2022 confirmed figures).

Renewable energy power generation capacity among major nations (Results for 2022)



Solar power generation capacity among major nations (Results for 2022)



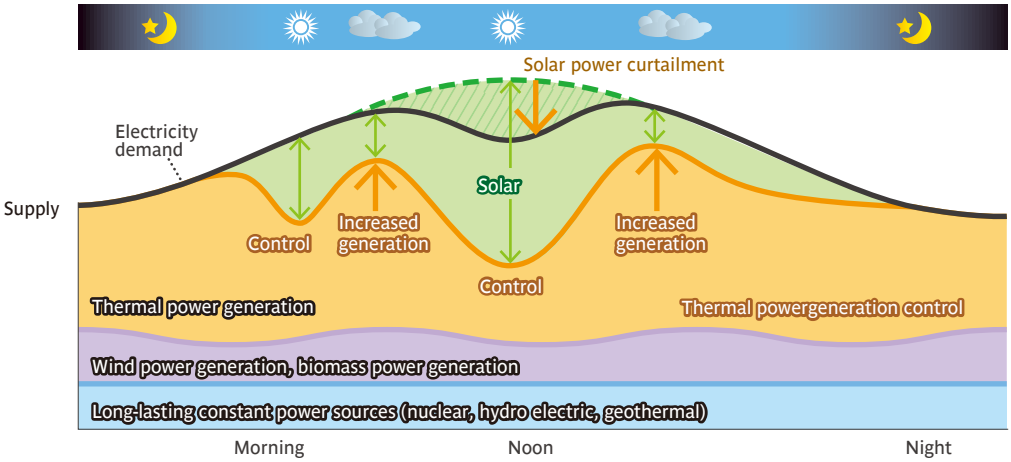
Source: Created by the Agency for Natural Resources and Energy based on the IEA "Renewables 2023"

Making Renewable Energy a Primary Source of Power

Q Is it possible to meet all demands of electric power only with renewable energy?

A The amount of electricity generated by renewable energy varies significantly depending on the weather and season. In order to ensure a stable supply, it is necessary to secure a method of energy storage to complement renewable energy in combination with flexible output power sources, such as thermal power generation and storage batteries.

Supply/demand situation on the lowest demand day (such as a sunny day in May)



The power generation (supply) should be balanced with consumption (demand) at all times to ensure stable access to electric power.
To this end, power sources with variable output such as thermal power generation are used to compensate for fluctuations in the output of renewable energy generation.

Q What are the policies being implemented by the government to make renewable energy a major power source?

A We will advance toward the maximum introduction of renewable energy while maintaining coexistence with local communities through strict business discipline, by enhancing the introduction of solar power to buildings, achieving the ZEH targets for newly built houses, forming projects for wind power generation, technological development of perovskite solar cells and offshore wind power, and grid reinforcement toward the expanded introduction of renewable energy.

Outlook for the introduction of renewable energy

			Ratios in FY2023	Prospects for FY2040
Ratios in total electricity generated	Renewables		22.9%	40–50% approx.
		Solar power	9.8%	23–29% approx.
		Wind power	1.1%	4–8% approx.
		Hydropower	7.6%	8–10% approx.
		Geothermal	0.3%	1–2% approx.
		Biomass	4.1%	5–6% approx.

Source: Created by the Agency for Natural Resources and Energy based on the Comprehensive Energy Statistics (FY2023 preliminary figures)

As more renewable energy is being introduced, concerns are raised in some communities on issues related to safety, disaster prevention, and the landscape. To properly address these concerns, business discipline will be enhanced through the amendment of the relevant act* to be enforced in April 2024. We will make efforts to maintain coexistence with local communities in introducing renewable energy.

*Act on Special Measures Concerning Procurement of Electricity from Renewable Energy Sources by Electricity Utilities

Examples of damage to solar power generation equipment caused by disasters

Cases affecting the landscape

Japan's strategy to expand renewable energy contributes to the world's efforts toward tripling renewable energy

This article shines light on Japan's policy regarding renewable energy. Japan's policy is also expected to contribute to global efforts toward tripling renewable energy generation capacity by 2030, to which the descision document adopted at COP28 calls on the Parties to contribute.

https://www.enecho.meti.go.jp/en/category/special/article/detail_198.html

Use this QR to view the article.

8. Reconstruction of Fukushima

Management of Decommissioning, Contaminated Water, and Treated Water at TEPCO's Fukushima Daiichi Nuclear Power Station (Fukushima Daiichi NPS)

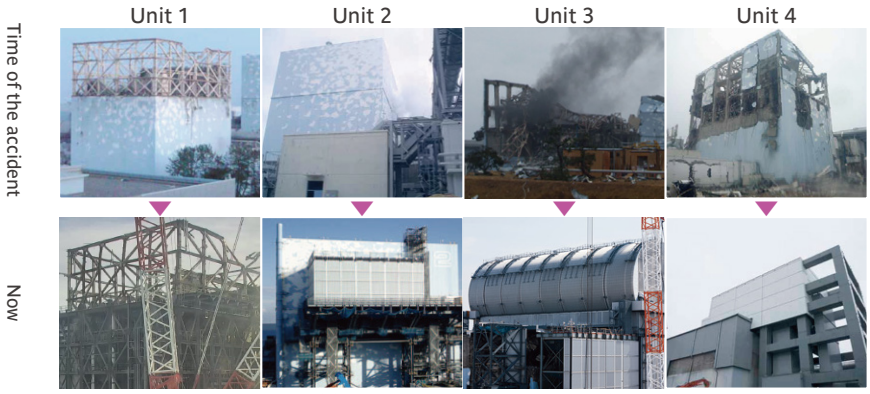
Q Are management of decommissioning, contaminated water, and treated water at TEPCO's Fukushima Daiichi NPS progressing?

A Although decommissioning contaminated water and treated water management are unprecedented challenges, measures are being implemented safely and steadily based on the "Mid-and-Long-Term Roadmap".

Decommissioning

All reactors are maintained kept in a stable condition, and rubble debris removal, decontamination, and other measures are being carried out toward fuel removal from the spent fuel pools.
In November 2024, the experimental retrieval of fuel debris from Unit 2 was completed using a telescopic device (an expandable device shaped like a fishing rod), and the analysis of the retrieved debris is currently underway. By employing the experience gained during the retrieval process and the insights obtained from the analysis, we will continue to tackle the challenging tasks fundamental to the decommissioning, such as fuel debris retrieval. We will advance the work steadily while making the utmost efforts to ensure safety.

(Current conditions of each reactor)

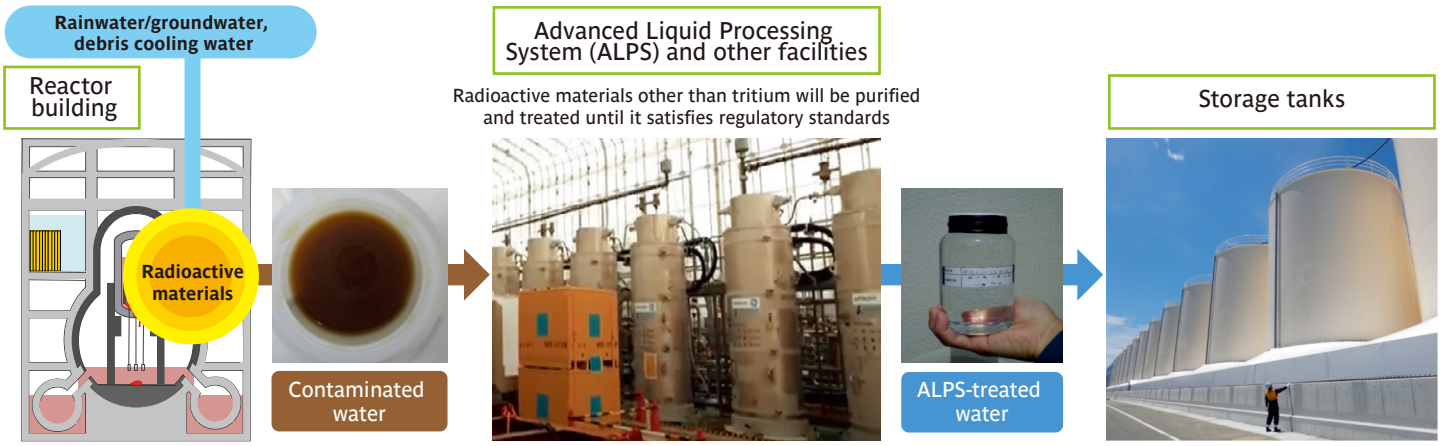


Status of fuel removal from the spent fuel pool

Unit 1	Unit 2	Unit 3	Unit 4
0/392 (Start from FY2027 - FY2028)	0/615 (Start from FY2024 - FY2026)	566/566 (Completed in Feb. 2021)	1535/1535 (Completed in Dec. 2014)

Management of Contaminated Water and Treated Water

The amount of contaminated water generated at the Fukushima Daiichi NPS has been reduced to around one-seventh of the initial amount through multi-layered countermeasures including frozen-soil walls. Contaminated water is treated using multiple purification facilities that remove radioactive materials other than tritium to satisfy regulatory standards before storage in tanks.
The discharge of ALPS treated water into the sea started in August 2023, and has been completed 11 times until March, 2025. The monitoring results and IAEA review missions have confirmed the safety of these discharge. We will continue to make every effort to ensure safety, take measures against adverse impact on reputation and provide support for continuation of livelihoods.



One year after the start of ALPS treated water discharge: How are safety and monitoring being ensured?

ALPS treated water has been discharged into the sea since August 2023. This link looks back on safety reviews and monitoring status, and explains how to interpret the sea area monitoring results.

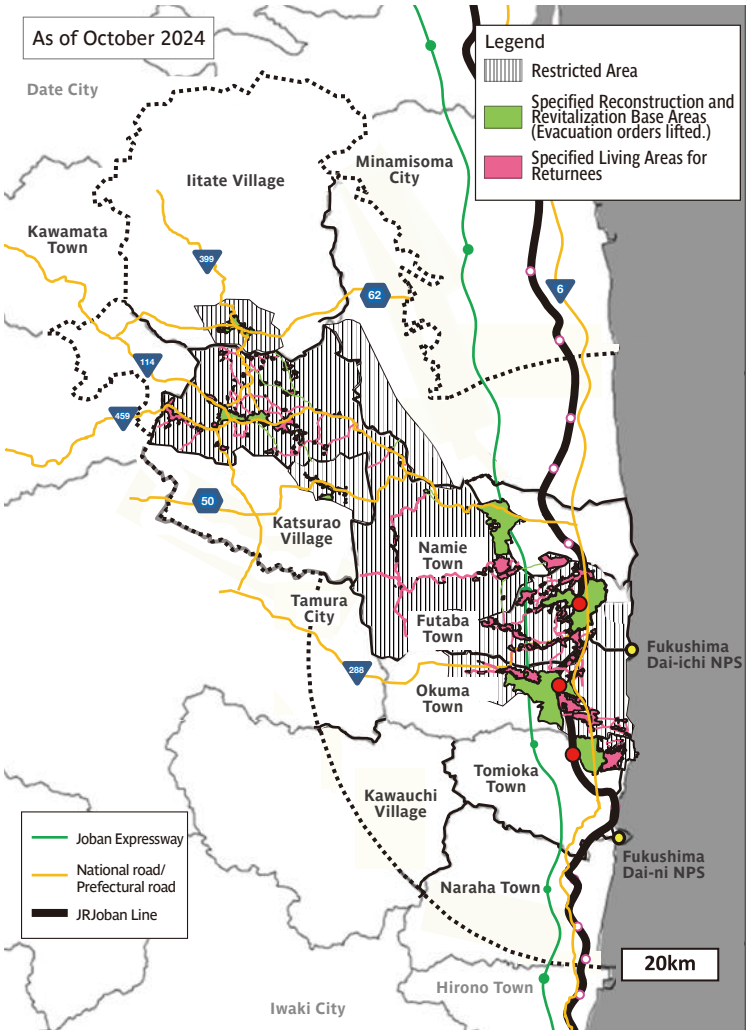
https://www.enecho.meti.go.jp/en/category/special/article/detail_205.html

Use this QR to view the article.

Reconstruction of Fukushima

Q Are steps progressing for lifting the evacuation orders in Fukushima?

A The evacuation order has been lifted on all regions except for the Restricted Area. Regarding the Restricted Area, the evacuation order around the railway station was first lifted in line with the reopening of the entire JR Joban Line in March 2020. Evacuation orders for the Specified Reconstruction and Revitalization Base Areas in six towns and villages were lifted in 2022 and 2023. (These six towns and villages are Katsurao Village, Okuma Town, Futaba Town, Namie Town, Tomioka Town and Iitate Village.)
Regarding the areas outside the Specified Reconstruction and Revitalization Base Areas, based on the government policy of August 2021, the Act on Special Measures for the Reconstruction and Revitalization of Fukushima was revised in 2023, to establish a system referred to as the Specified Living Areas for Returnees. This system, by lifting the evacuation order, aims to allow residents to return if they have the intention to do so, and rebuild their livelihoods after returning. We will take necessary action over the 2020s so that residents with the intention to return can do so.



Q What kind of initiatives are being taken to revitalize industry in Fukushima?

A In addition to rebuilding businesses and livelihoods, we will promote the Fukushima Innovation Coast Framework and the Fukushima Plan for a New Energy Society to promote new industrial clustering. The Fukushima Institute for Research, Education and Innovation (F-REI) has been established to promote R&D and human resource development. All these measures are being taken to support the regional revitalization of Fukushima.

Fukushima Innovation Coast Framework

Various efforts are underway to create new industries in order to achieve industrial restoration in the Hamadori and other areas of Fukushima Prefecture. With the Fukushima Robot Test Field as the core of an industrial cluster, 80 robot-related companies have entered the area since the earthquake.

Fukushima Robot Test Field (Minamisoma City, Namie Town):

This test field is one of the largest flight airspaces and runways in Japan for unmanned aerial vehicle. The research building is home to research and development of advanced technologies such as flying cars (opened in March 2020).

Fukushima Plan for a New Energy Society

In order to make Fukushima a pioneer of the new energy society of the future, efforts are being accelerated to further expand the introduction of renewable energy and realize a hydrogen-based society. These measures are being implemented to support the reconstruction from the energy field.

Fukushima Hydrogen Energy Research Field (FH2R):

Conducting demonstration projects for large-scale production of hydrogen from renewable energy using the world's leading 10,000 kW-class water electrolyzer (opened in March 2020).

The Fukushima Institute for Research, Education and Innovation (F-REI)

Aiming to become a world-renowned "central institute for creative reconstruction", F-REI conducts R&D in the following five fields:

1. Robotics
2. Agriculture, forestry and fisheries
3. Energy
4. Radiation science, medicine and drug development, & industrial applications for radiation
5. Collection and dissemination of data and knowledge on nuclear disasters

Food safety in Fukushima Prefecture

Agricultural, forestry and fishery products produced in Fukushima are tested for safety before shipment. Any items exceeding the radiation standards are restricted from shipment at each city, town, or village level; therefore, such items will not be distributed to the market.
No items exceeding the radiation standards were detected from March 1, 2023 to January 31, 2024.

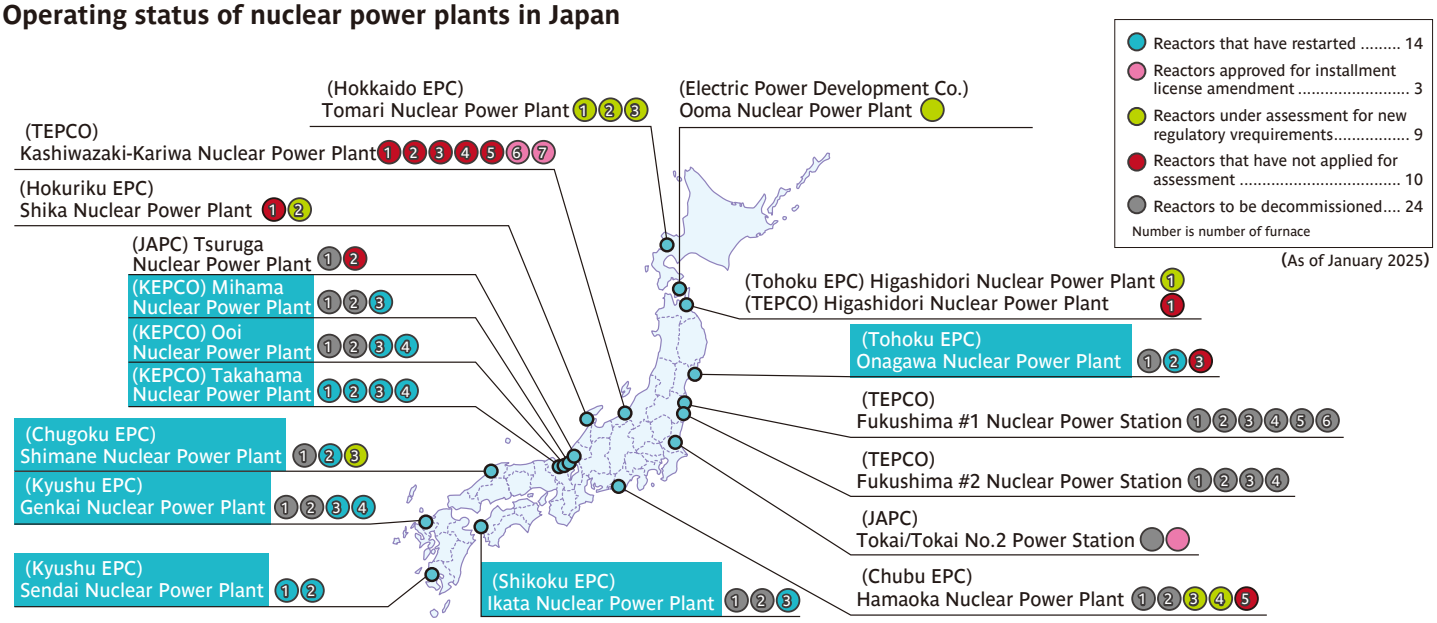
9. Nuclear Power

Operational Status of Nuclear Power Plants

Q **Is the restart of nuclear power plants making progress?**

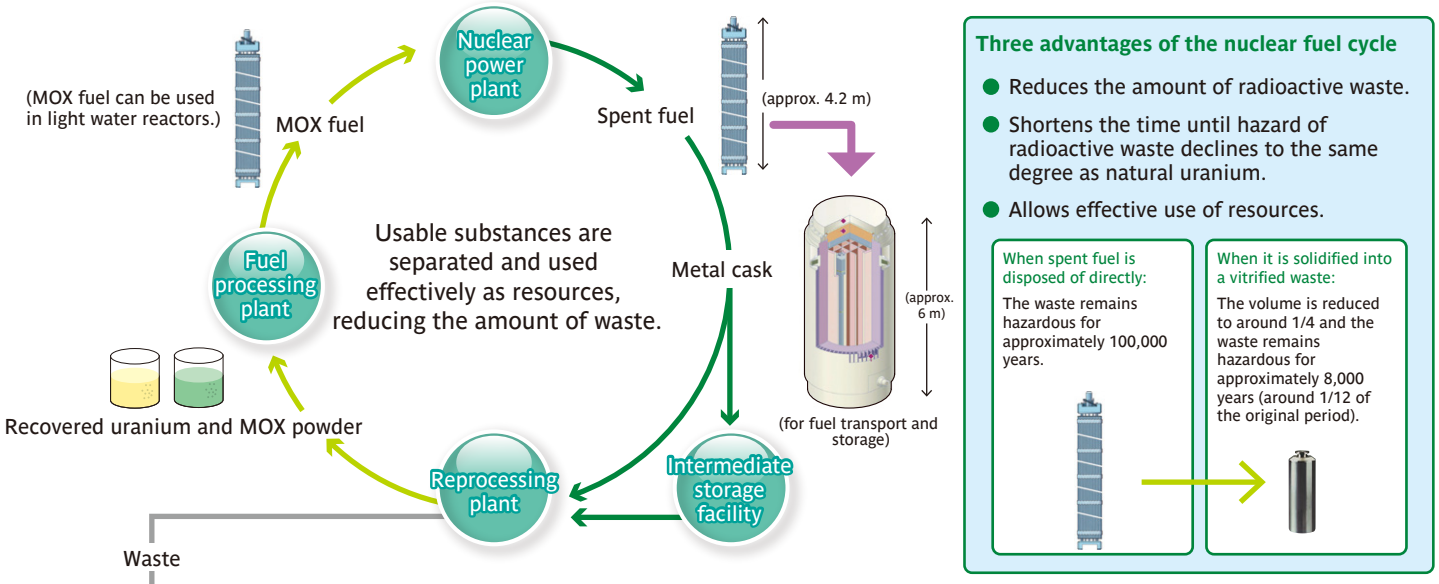
A **As of January 2025, fourteen reactors are operating nationwide. We will continue advancing the restart of nuclear power plants while obtaining understanding from the local communities, on the major premise of ensuring safety and on the condition that the Nuclear Regulation Authority recognizes that the plants conform with the new regulatory standards. By doing so, we will strive to simultaneously achieve a stable supply of energy and carbon neutrality.**

Operating status of nuclear power plants in Japan



Nuclear Fuel Cycle and High-level Radioactive Waste

Japan is advancing technologies for the "nuclear fuel cycle", in which spent fuel from nuclear reactors is reprocessed, the recovered uranium and plutonium are reused, and the volume of waste is reduced.



Three advantages of the nuclear fuel cycle

- Reduces the amount of radioactive waste.
- Shortens the time until hazard of radioactive waste declines to the same degree as natural uranium.
- Allows effective use of resources.

When spent fuel is disposed of directly:
The waste remains hazardous for approximately 100,000 years.

When it is solidified into a vitrified waste:
The volume is reduced to around 1/4 and the waste remains hazardous for approximately 8,000 years (around 1/12 of the original period).

Disposal of vitrified waste

Ninety-five percent of spent fuel from nuclear power stations can be reused after being reprocessed. The remaining 5% becomes liquid waste, which is melted into a raw glass material to create vitrified waste (high-level radioactive waste). The relevant law stipulates that the vitrified waste be buried deep underground in formations with high containment characteristics (geological disposal).

Source: Fuel assembly and metal cask: "Graphical Flip-chart of Nuclear & Energy Related Topics" , Japan Atomic Energy Relations Organization

Selection of Final Disposal Sites

The selection of final disposal sites for specified radioactive waste is a national challenge that must be resolved as Japan has been utilizing nuclear power for more than half a century and has accumulated high-level radioactive waste.
Literature surveys are being conducted at three municipalities* as the first stage of the selection process (as of February 2025).
*Suttu Town and Kamoenai Village in Hokkaido and Genkai Town in Saga Prefecture

To promote a better understanding of the mechanism of geological disposal and the geological environment of Japan, the Nationwide Map of Scientific Features was published in July 2017. Since then, public dialogue sessions with local people have been held throughout Japan.

Read more about the literature survey

Use this QR to view the article. (Japanese only)

Read more about the map

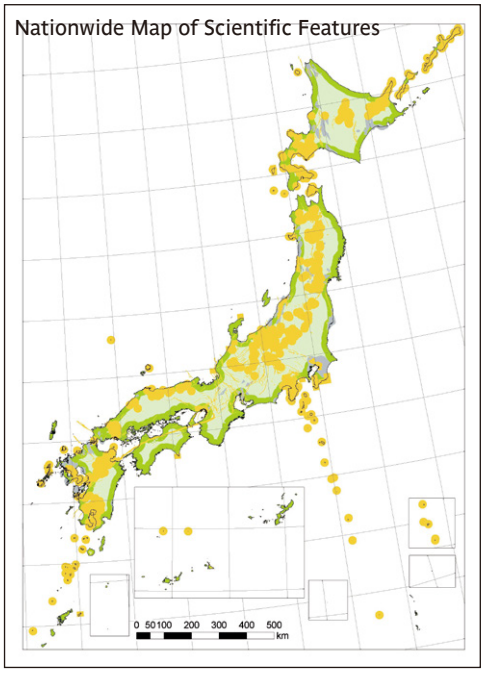
Use this QR to view the article.

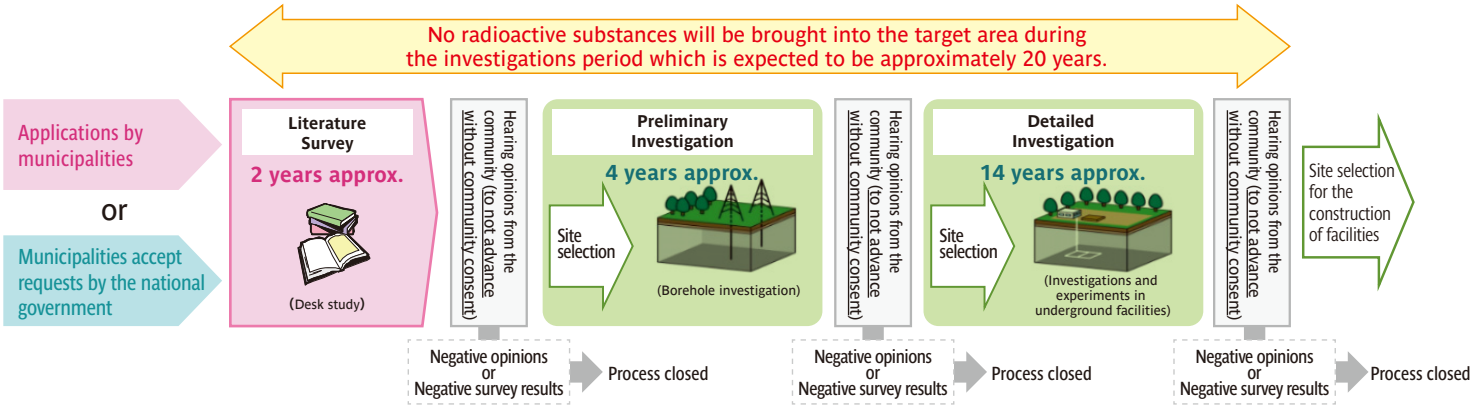
Classification of area into 4 colors based on scientific features

- Orange: Areas close to a volcano, active fault, etc.
- Silver: Areas with underground mineral resources
  (It must be noted that investigation may clarify areas where such mineral resources do not exist.)
- Green: Areas assumed to be favorable
- Dark green: Areas assumed to be preferable also from the viewpoint of safe waste transportation

*Even in the green areas, step-by-step investigations need to be conducted to confirm precisely whether a particular location satisfies the required conditions for geological disposal.

https://www.enecho.meti.go.jp/en/category/electricity_and_gas/nuclear/rwm/

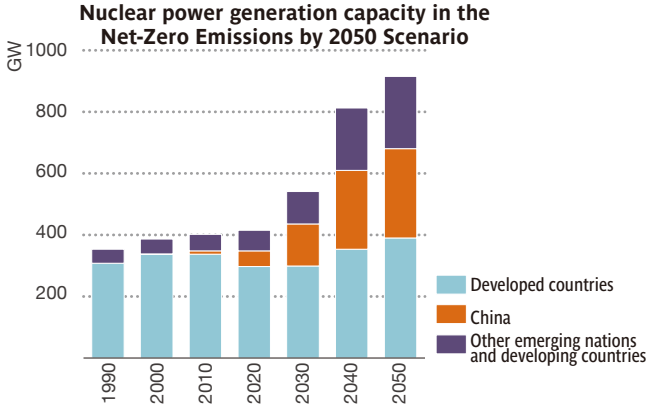




Column: Global outlook for nuclear power

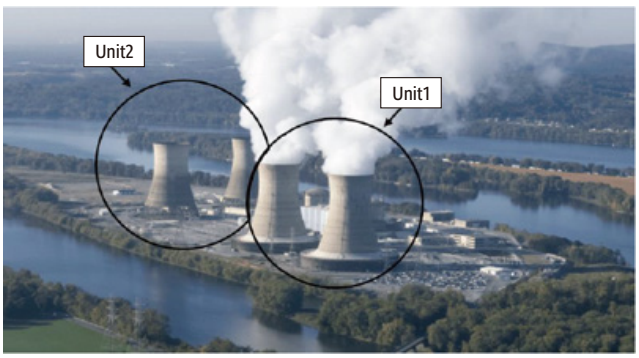
The International Energy Agency (IEA) forecasts that nuclear power generation capacity throughout the world will more than double to 916 GW by 2050 from the current level of 417 GW.
In particular, China, which is leading the expansion of nuclear power generation, will own one-third of the world's nuclear power plants by 2050.

Nuclear power generation capacity in the Net-Zero Emissions by 2050 Scenario



Source: IEA 2023 "Net Zero Roadmap: A Global Pathway to Keep the 1.5 ℃ Goal in Reach"

US tech giants, such as Amazon, Microsoft, Google and Meta, have successively announced their intention to utilize nuclear power generation based on the outlook for increasing power demand by data centers. For instance, Constellation, a power company in the United States, has announced the signing of a 20-year power purchase agreement with Microsoft and the restart of Three Mile Island Unit 1, which was shut down for economic reasons five years ago. Under the agreement, Microsoft will purchase all electricity generated by the renewed plant.



Three Mile Island Nuclear Generating Station (Source: The US Department of Energy website)

Nuclear energy utilization attracts global attention under the spotlight at COP28

COP28, which was held in the UAE in 2023, recognized the critical role of nuclear energy. This article sheds light on the latest movements in the world surrounding nuclear power generation.

https://www.enecho.meti.go.jp/en/category/special/article/detail_193.html

Use this QR to view the article.

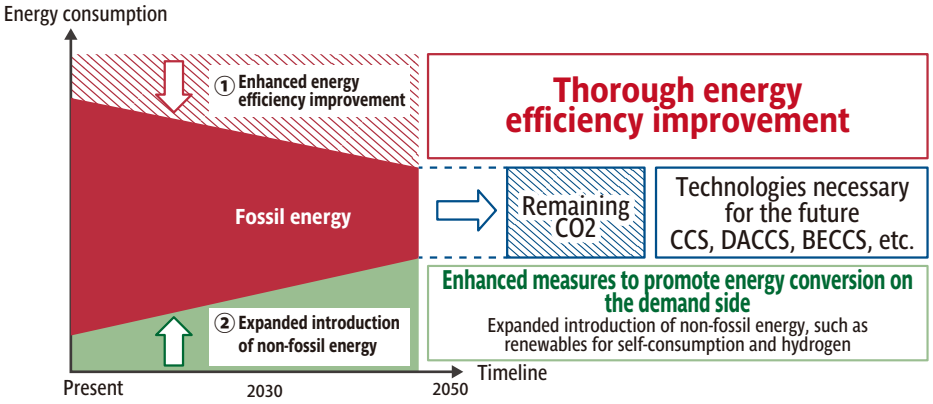
10. Energy Efficiency/Conversion to Non-fossil Energy

Improving Energy Efficiency/Conversion to Non-fossil Energy

Q How is the demand side pursuing energy efficiency improvement?

A **Since Japan fulfills most of its fossil fuel requirements with imports from overseas, the importance of energy efficiency improvement will remain unchanged. Going forward, in an effort to reduce emissions toward net zero by 2050, it is crucial to work not only on energy efficiency improvement but also on electrification and conversion to non-fossil energy.**

Conceptual timeline on the demand side toward net zero and directions of efforts



Efforts in the industrial sector

Fuel conversion, electrification and a shift to non-fossil energy are to be boldly advanced. To this end, we provide SMEs with expert consultation referred to as “energy efficiency diagnosis” and support for the installation of energy-efficient equipment. We will encourage efforts by SMEs and others to improve energy efficiency in cooperation with local financial institutions and organizations working to support energy efficiency improvement.

Visit this page for energy efficiency diagnosis as well as subsidies to encourage energy efficiency improvements or a shift to non-fossil energy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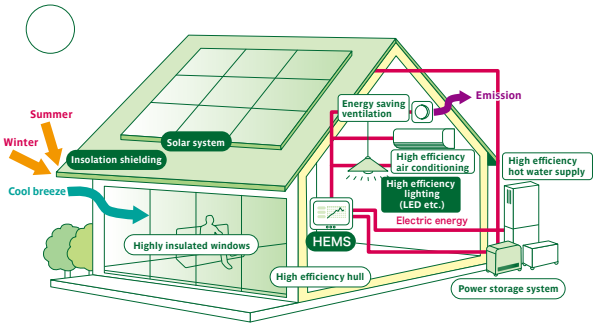
Scan the QR for detailed materials. (Japanese only)

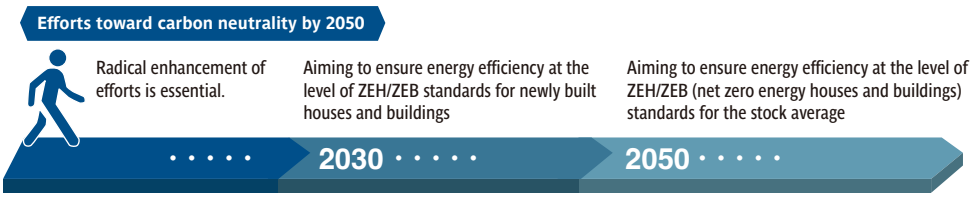
Efforts in the housing/building sector

As housing and other buildings remain in use for a long period of time once constructed, it is necessary to advance energy efficiency improvement, conversion to non-fossil energy including renewables and demand response (DR) in this sector. With the aim of ensuring energy efficiency at the level of ZEH/ZEB standards for newly built houses and buildings, efforts are underway to make energy efficiency standards mandatory and to raise those standard levels, with support measures in place.
We will also advance energy efficiency improvement at data centers and other facilities that are expected to proliferate as digitalization progresses.



ZEH (net Zero Energy Houses) are houses that make the balance of annual primary energy consumption net zero while maintaining indoor comfort levels. They achieve significant levels of energy efficiency by using high-performance heat insulation and adopting highly efficient equipment and systems, while also using renewable energy.

Direction of efforts in the housing/building sector



Plenty of information on energy efficiency improvement achievable at homes, selection of goods and more

We provide a program for supporting efforts made by businesses and households toward building an economy and society that are resilient against increasing energy costs.
Please visit the energy efficiency and conservation portal site for details of various measures including this program.

https://www.enecho.meti.go.jp/category/saving_and_new/saving/

Use this QR to view the web site. (Japanese only)

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