JAPAN'S ENERGY

10questions for understanding the current energy situation

1 **Energy Security**
How much energy can Japan supply independently?

2 **Economic Efficiency**
How are electric power rates changing?

3 **Environment**
What is carbon neutrality?

4 **Safety**
What steps are being taken to ensure a stable energy supply and safety?

5 **S＋3E**
What is the government's basic energy policy?

6 **Innovation**
What innovations is Japan working on to achieve decarbonization?

7 **Renewable Energy**
Is Japan advancing the introduction of renewable energy?

8 **Reconstruction of Fukushima**
Is Japan advancing the reconstruction of Fukushima?

9 **Nuclear Power**
Is the restart of nuclear power plants making progress?

10 **Energy Efficiency**
How much energy efficiency has Japan accomplished?

METI
Agency for Natural Resources and Energy

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Issued: February 2024

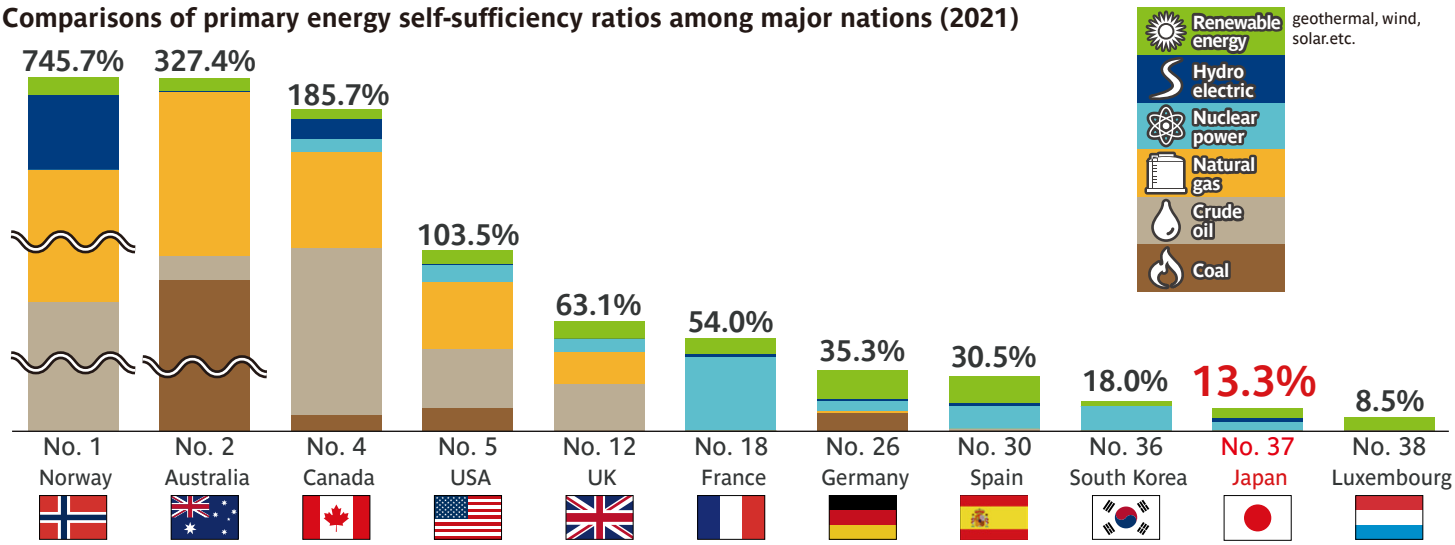
1. Energy Security

Changes in Energy Self-Sufficiency Ratio

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

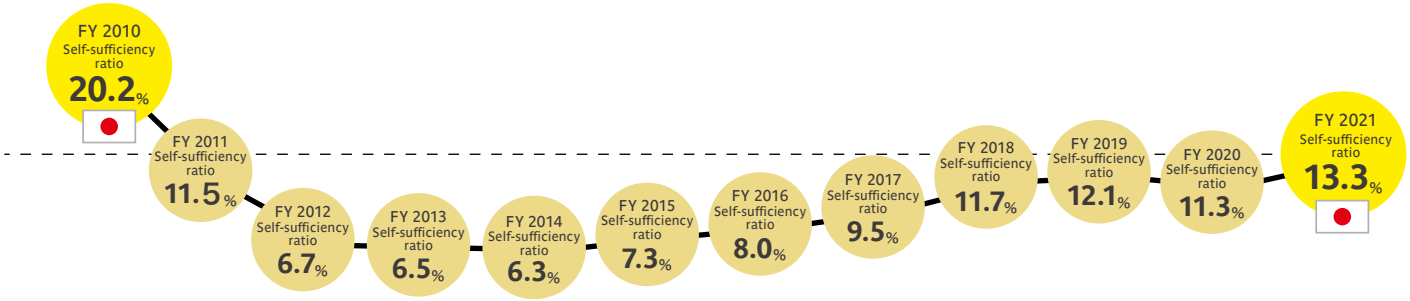
A In FY 2021, Japan's self-sufficiency ratio was 13.3% — lower than those of other OECD countries.

Comparisons of primary energy self-sufficiency ratios among major nations (2021)



Source: Estimates for 2021 from IEA "World Energy Balances 2022", except for data on Japan, which are confirmed values of FY 2021, 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

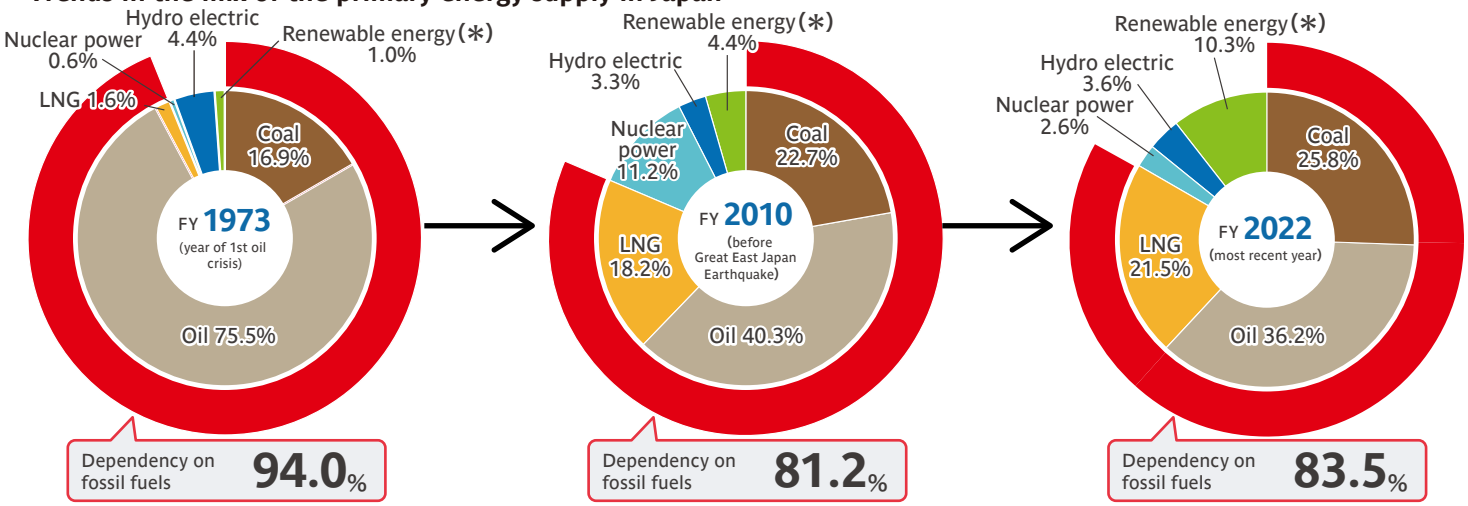


Primary energy sources : Primary forms of energy, including oil, natural gas, coal, nuclear power, solar power, and wind power.
Energy self-sufficiency rate : The percentage of the primary energy resources required for people's daily life and economic activities which can be produced or acquired in their 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. Following the Great East Japan Earthquake, the degree of dependence on fossil fuels has increased to 83.5% in FY 2022 in Japan.

Trends in the mix of the primary energy supply in Japan



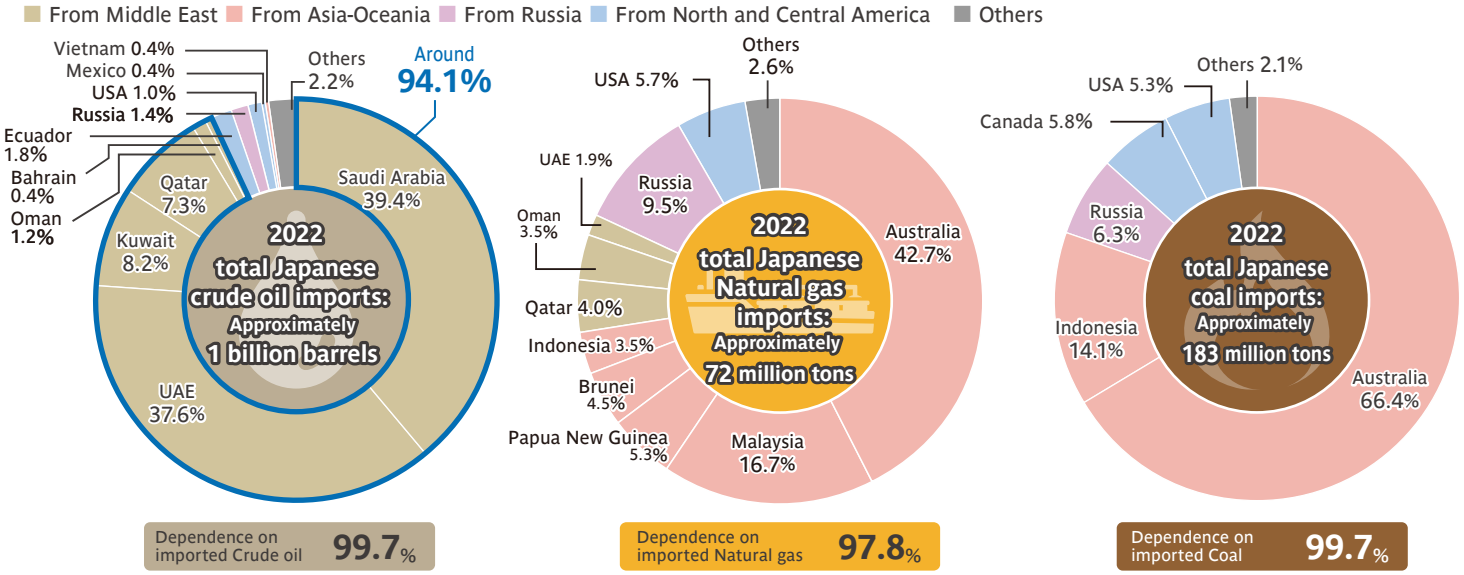
Source: preliminary values of FY 2022, derived from "Comprehensive Energy Statistics of Japan", published by the Agency for Natural Resources and Energy
* The sum of the values shown may not be 100% in some cases due to rounding of values.
* Renewable energy here, including geothermal power, wind power, 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 (2022)



Source: "Trade Statistics of Japan", 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)

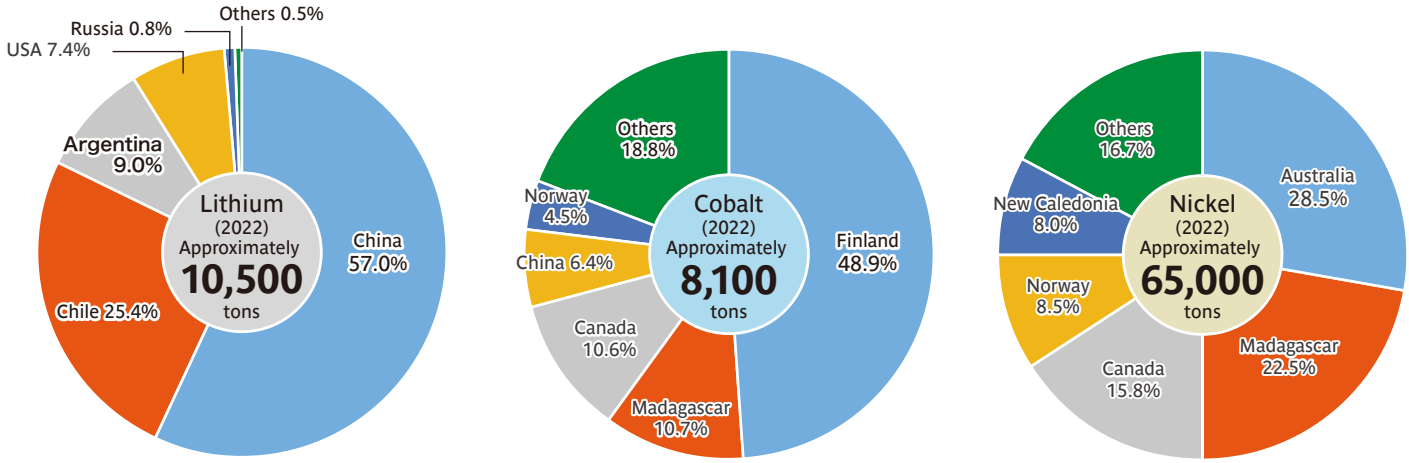
Efforts to secure a stable supply of fossil energy resources : for crude oil, Japan will strengthen relationships with countries in the Middle East that are the main suppliers. For LNG, Japan will diversify supply sources and work for further acquisition of interests in LNG projects. Japan has designated 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: USGS "Mineral Commodity Summaries 2023"
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.

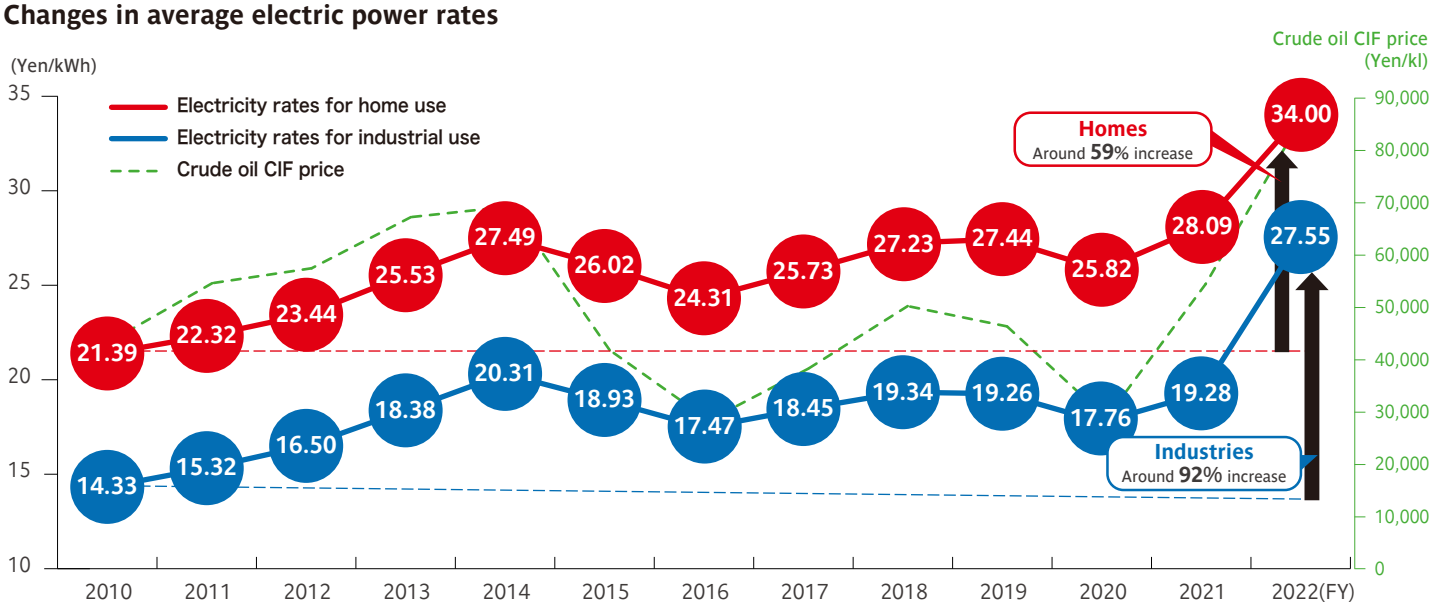
2. Economic Efficiency

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. The rates temporarily declined from FY2014 to 2016 due to falling crude oil prices, and in FY2020 due to the spread of COVID-19. However, they are rising again.

Changes in average electric power rates

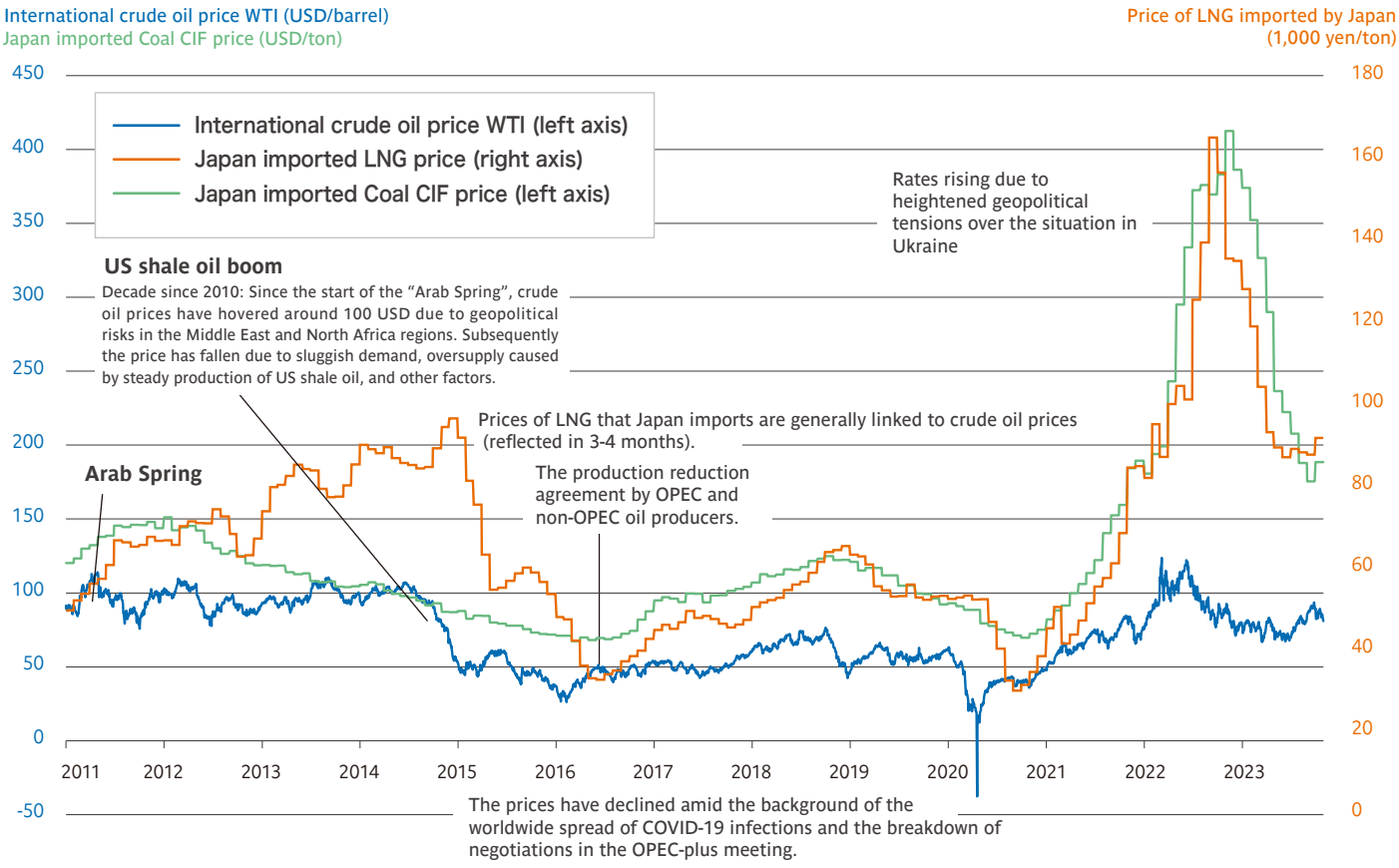


Source: Created based on monthly reports of generated and received electric power, financial materials of electric power companies, and power trading reports
Crude oil CIF price : Transaction price consisting of the import price plus related costs, such as transport cost and insurance cost.

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

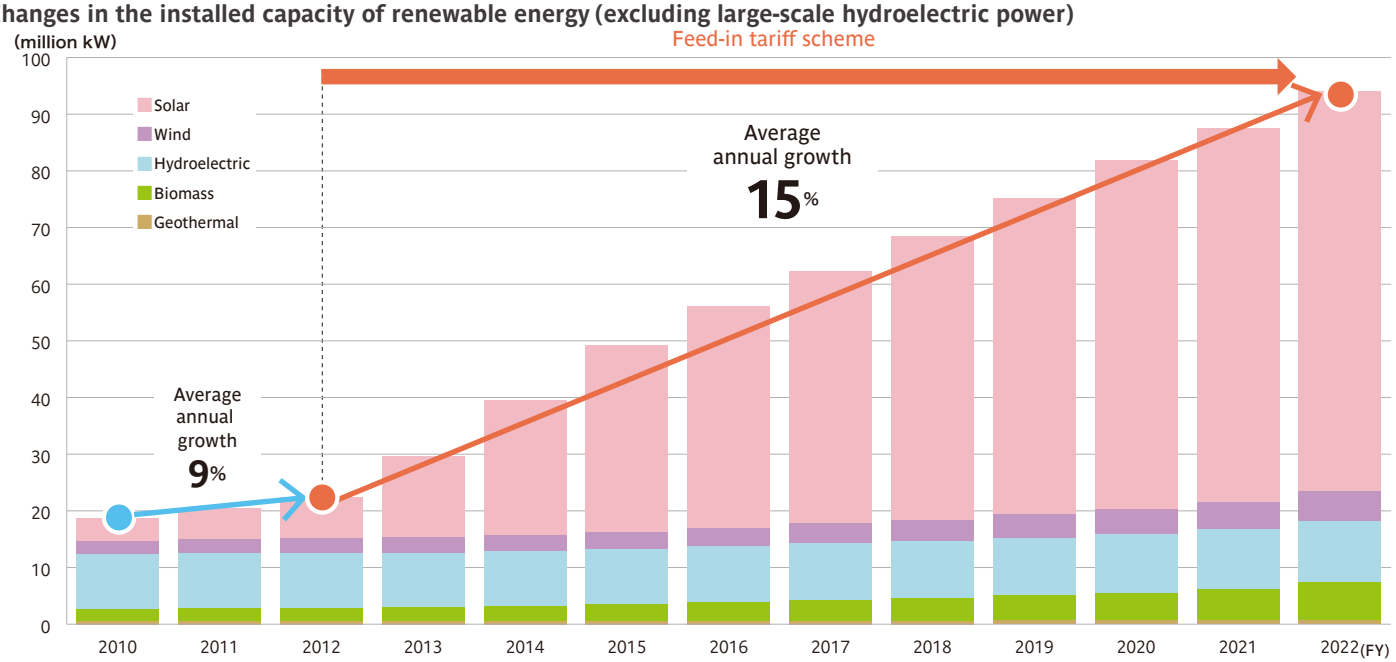


Source: Created based on CME Nikkei and Trade Statistics published by the Ministry of Finance.

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 4.7 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 560 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.

The Feed-in Premium (FIP) scheme started in April 2022 aiming to make renewable energy a primary source of power.

Toward achieving carbon neutrality by 2050, it is necessary to make renewable energy a primary source of power by expanding its introduction with priority to other sources. Visit the following website for details of the FIP scheme as a new means to this end.

https://www.enecho.meti.go.jp/about/special/johoteikyo/suiso_tukurikata.html

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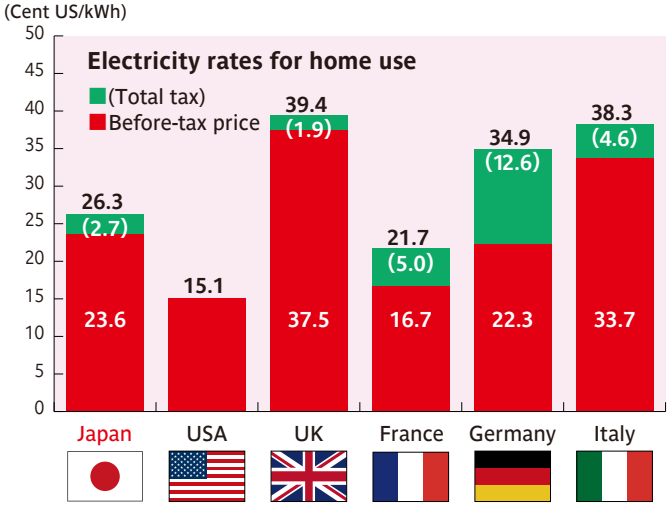
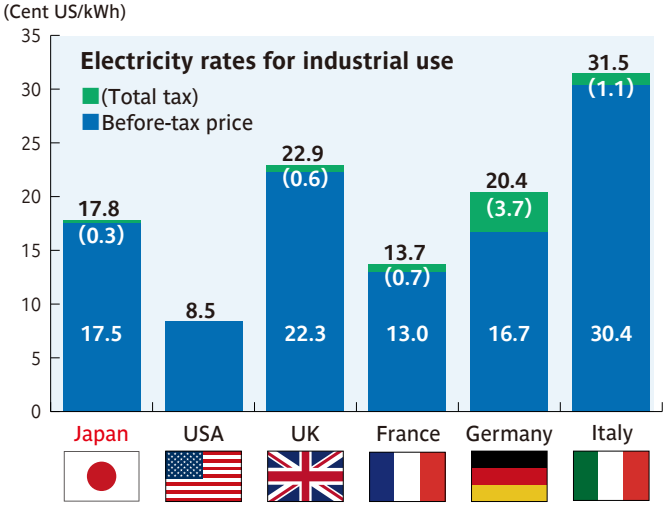
International comparison of electric power rates

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.

3. Environment

Global Warming Countermeasures: Carbon Neutrality

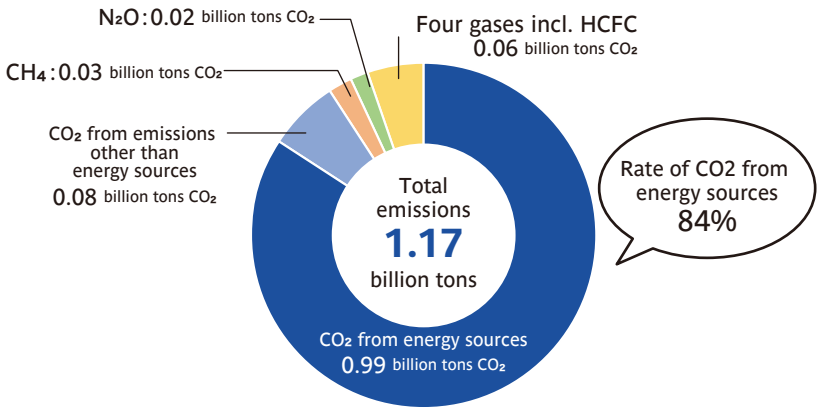
Q What is carbon neutrality?

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.)

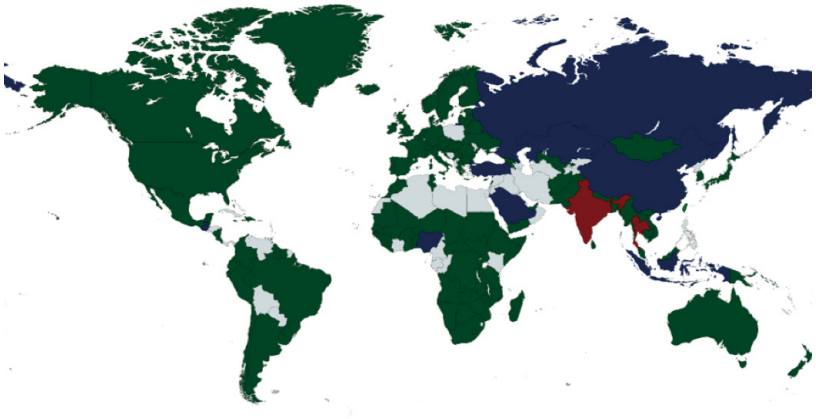
Greenhouse gases: There are 6 main gases: carbon dioxide, methane, dinitrogen oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

Greenhouse gas emissions in Japan (FY 2021)



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/regions that have agreed with the principle of achieving carbon neutrality

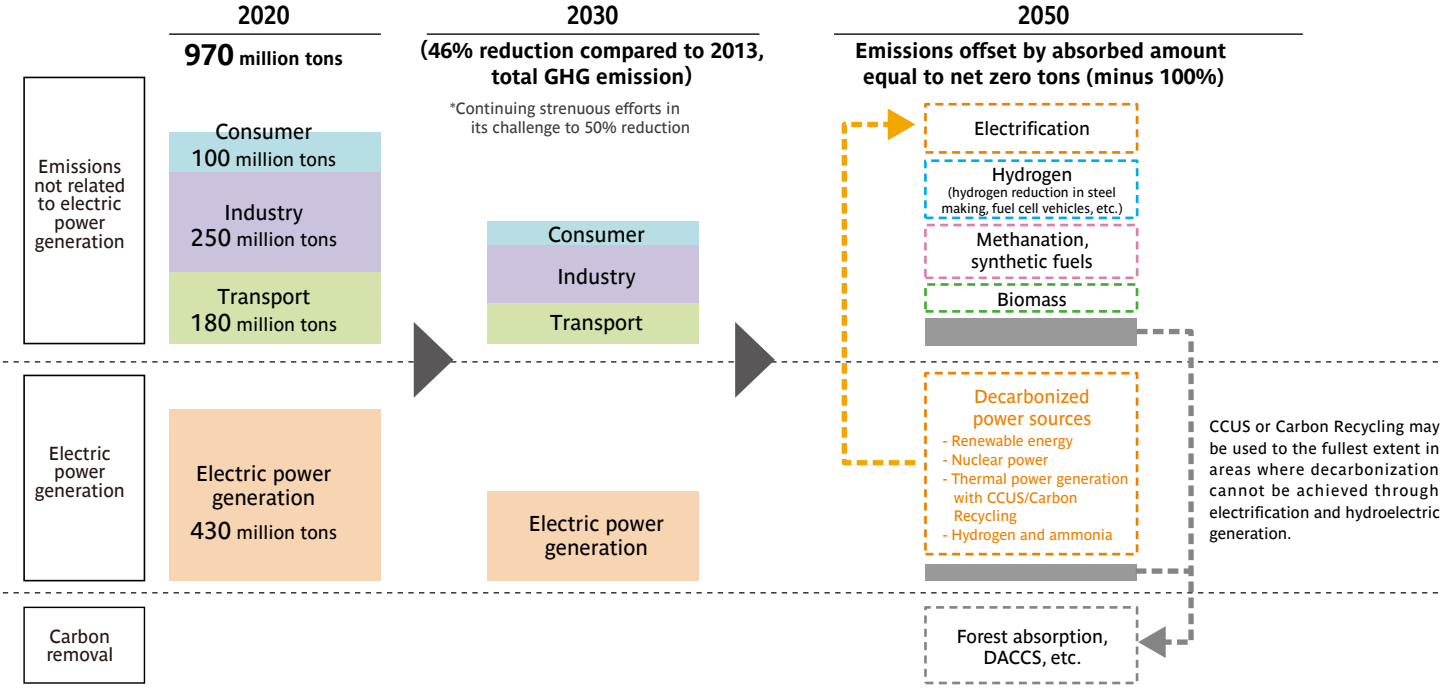


- Countries/regions working toward carbon neutrality (CN) by 2050*1 : 147
- 40% of the world's total CO_2 emissions are from these countries (2020 results*2)
- In addition, China (32%), Russia (5%), Indonesia (2%), and Saudi Arabia (1%) will join by 2060, and India (7%) will join by 2070. In this way, the movement to set carbon-neutral targets is expanding. (90% of the world's total CO_2 emissions are from these countries.)

■ Countries agreeing with the principle of achieving carbon neutrality by 2050 (147 countries including Japan)
■ Countries agreeing with the principle of achieving carbon neutrality by 2060
■ Countries agreeing with the principle of achieving carbon neutrality by 2070

*1 ① Countries participating in the Climate Ambitions Alliance; ② Countries that have submitted a long-term strategy to the United Nations and announced CN in 2050, and in April 2021 announced CN in 2050 at the Climate Summit COP26. Created by METI by counting countries (as of May 2023)
*2 GHG emissions are counted only for CO_2 emissions from energy sources, based on "CO_2 Emissions from Fuel Combustion (2020 data)" published by the IEA in 2022

Image of transition to carbon neutrality



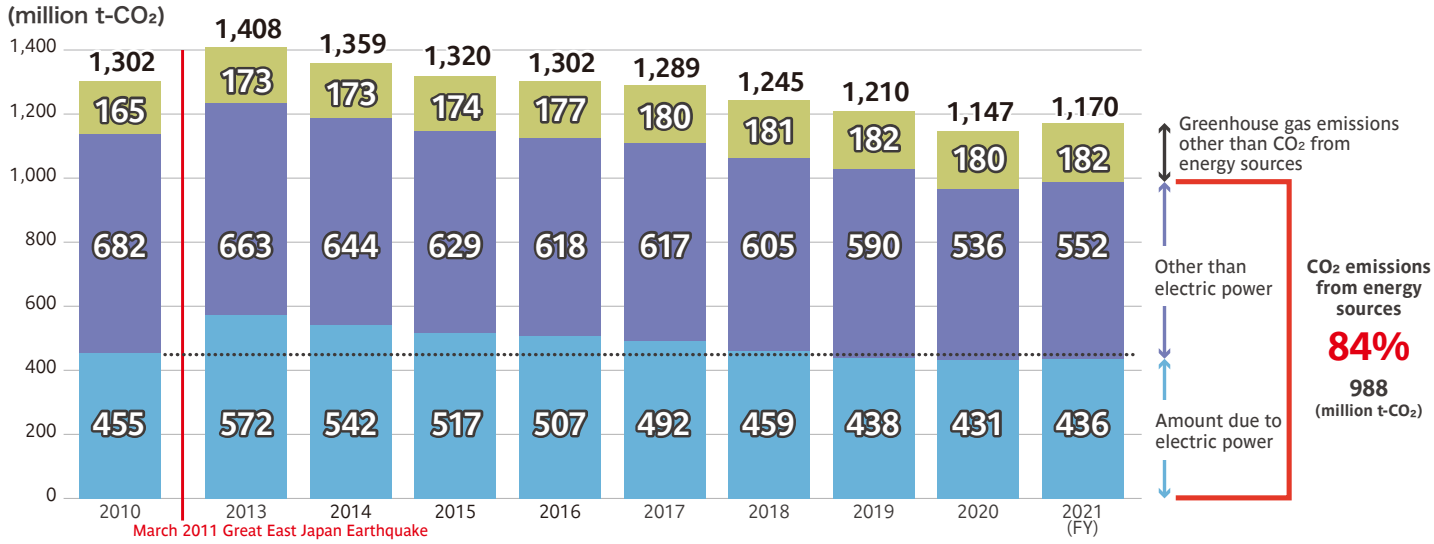
* Values shown are the amounts of CO_2 derived from energy
DACCS (direct air capture with carbon storage): A technology that directly captures and stores CO_2 that already exists in the atmosphere.

Emissions of Greenhouse Gases

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 2021, emissions dropped to 1.17 billion tons. Japan must continue working to reduce emissions.

Changes in Japan's greenhouse gas emissions

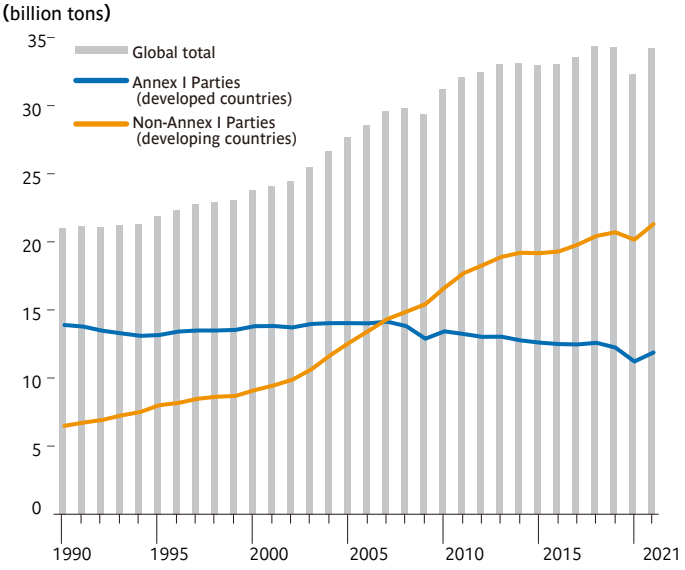


Source: Created based on the "Comprehensive Energy Statistics of Japan", published by the Agency for Natural Resources and Energy and "Calculation results for the amount of greenhouse gas emissions in Japan", published by the Ministry of the Environment.

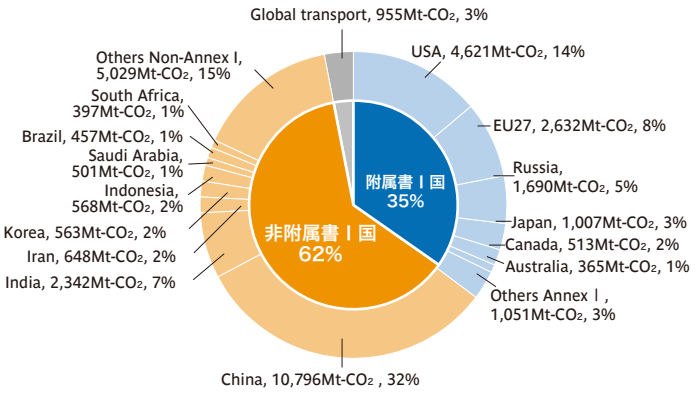
Column: Outlook for global CO_2 emissions

The recent increase in global energy-related greenhouse gas emissions has been driven by economic growth in emerging nations as emissions from non-Annex I parties (developing countries) more than tripled between 1990 and 2021. 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-derived greenhouse gas emissions



Energy-related greenhouse gas emissions in each country (2021)



Source: IEA "GHG Emissions from Energy 2023"

Japan's energy policy toward achieving GX (Part 1 and Part 2)

The Basic Policy for the Realization of GX was compiled in December 2022, depicting a roadmap covering the next 10 years toward simultaneously realizing a stable supply of energy, economic growth and decarbonization. Visit the following URLs for details.

Part 1: https://www.enecho.meti.go.jp/about/special/johoteikyo/gx_01.html
Part 2: https://www.enecho.meti.go.jp/about/special/johoteikyo/gx_02.html

Part 1 Part 2

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4. 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 stable supply of electricity and its safety, we are advancing measures such as making arrangements between power utilities for mutual collaboration in case of a natural disaster, enhancing the resilience of transmission/distribution networks, and building dispersed power systems resilient to natural disasters.**
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 and torrential rains

Collapsed wind turbine in Awaji City, Hyogo Prefecture (Due to a typhoon in August 2018)

Damaged floating solar power plant in Ichihara City, Chiba Prefecture (Due to a typhoon in September 2019)

Collapsed power transmission tower in Kimitsu City, Chiba Prefecture (Due to a typhoon in September 2019)

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

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

Damage caused by tsunamis

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

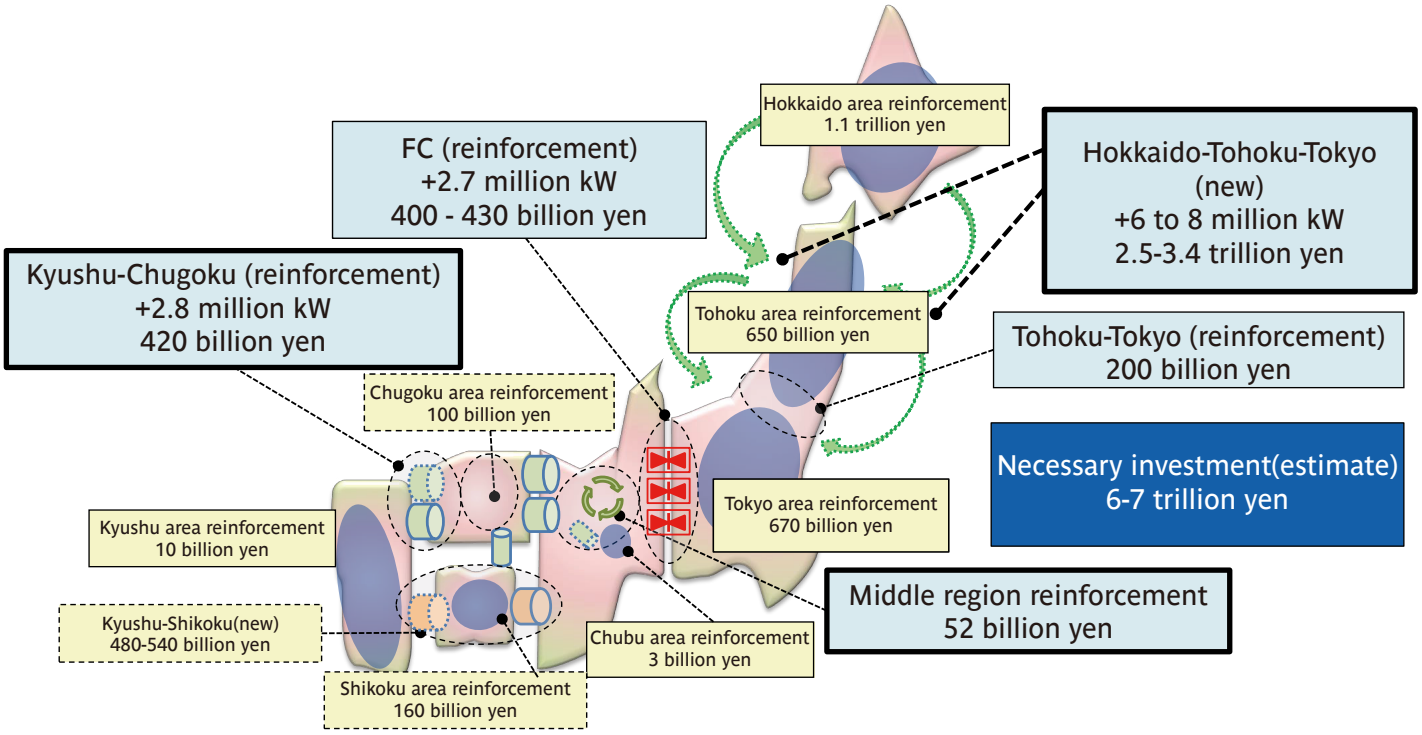
Photo : Tokyo Electric Power Company Holdings Photo & Video Library https://photo.tepco.co.jp

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

To introduce renewable energy extensively and make electric power infrastructure more resilient, the Organization for Cross-regional Coordination of Transmission Operators (OCCTO) formulated and published the Master Plan of Nation-wide Power Transmission Networks on March 29. 2023 with a view toward achieving carbon neutrality by 2050. At the same time, the OCCTO started studying specific plans for developing underwater direct-current transmission lines between Hokkaido and Honshu and other projects.

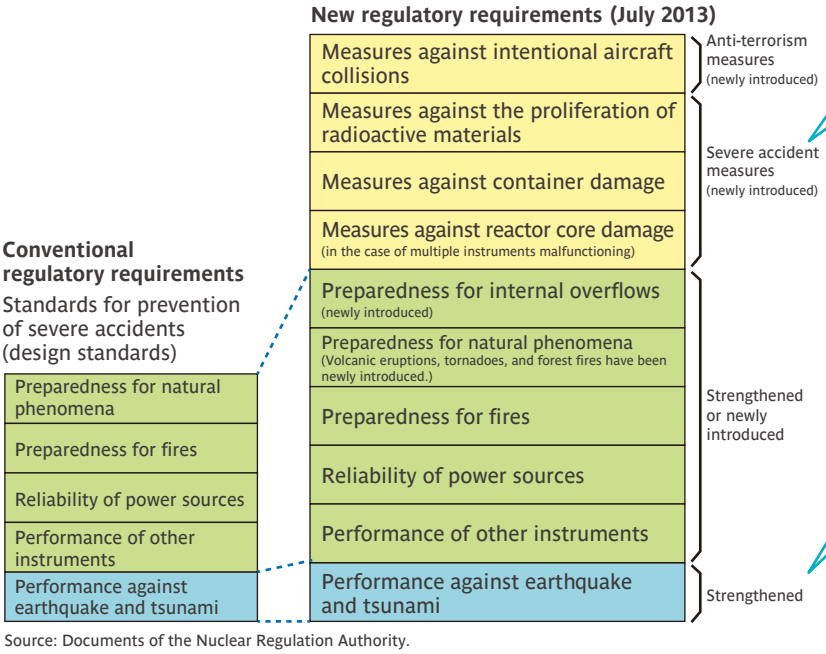


Source:Created from the base scenario in the Master Plan of Nation-wide Power Transmission Networks which the OCCTO published on March 29. 2023.

Resilience: means sturdiness, recuperative power or elasticity.

Effort 2: Conforming to new regulatory requirements for higher levels of safety

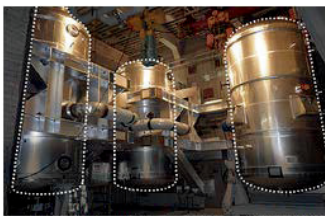
When nuclear power plants are restarted, the Nuclear Regulation Authority will require them to conform to new regulatory requirements, which demand stricter accident-prevention measures than the former requirements. The power plants are also required to prepare provisions for contingencies and anti-terrorism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



Source: Documents of the Nuclear Regulation Authority.

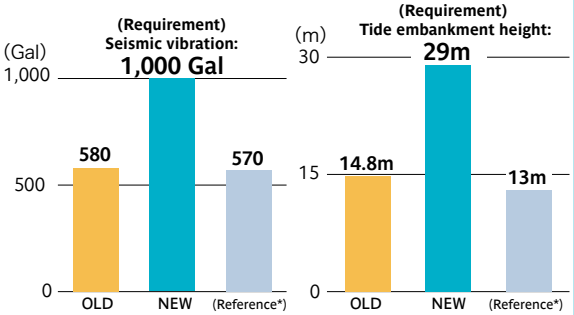
Example measures against severe accidents

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: TEPCO website

5. S+3E

Basic Policy

Q What is the government's basic energy policy?

A **On the premise of Safety, we are making efforts to simultaneously achieve Energy Security (self-sufficiency rate), Economic Efficiency, and Environment (S+3E).**
Japan is a country with limited natural resources. There is no one source of energy that is superior in every way. Therefore, it is essential to create a multi-layered energy supply structure where each energy resource is exploited fully for its best performance and compensates for disadvantages of other resources.

Energy Security (Self-sufficiency rate)

Exceed the level from before the Great East Japan Earthquake (around 20%).
Approximately 30% in FY 2030 (13.3% in FY2021)

Economic Efficiency (Electricity cost)

Expected to be 8.6 to 8.8 trillion yen in 2030, which is lower than 9.7 trillion yen in 2013

Environment (Greenhouse gas emissions)

Expected to be down by 46%* in FY2030 compared to FY2013, which is an ambitious reduction target consistent with 2050 carbon neutrality.

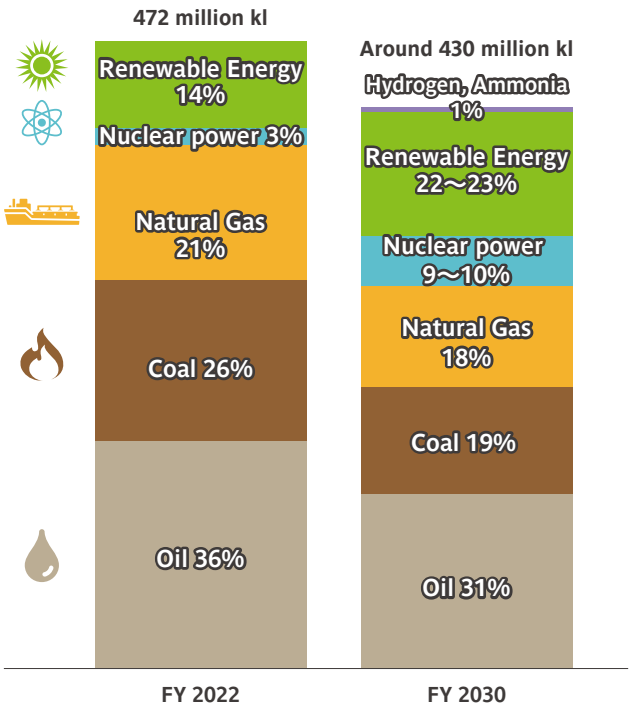
* Reduction target for all greenhouse gases including CO_2 from non-energy sources, etc.

Q What will the primary energy supply and the structure of power sources in the future be?

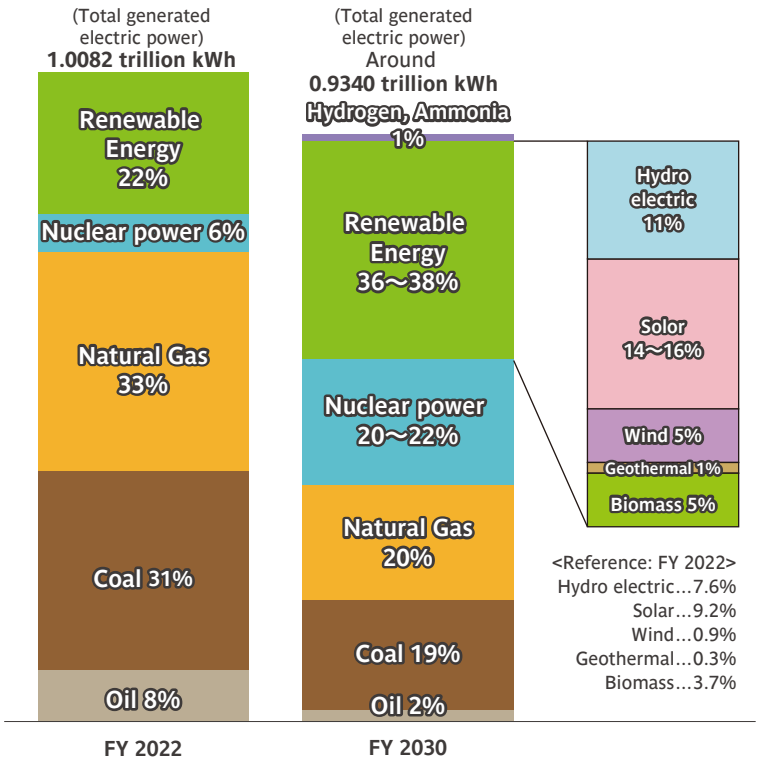
A **The figure show the outlook for energy supply and demand* in FY 2030 (energy mix).**

*In the light of new GHG emission reduction target in FY2030, this outlook shows energy supply and demand on the ambitious assumption that various challenges in both aspects of supply and demand in promoting thorough energy conservation and expansion of non-fossil energy will be overcome.

Primary Energy Supply



Power Generation Mix



<Reference: FY 2022>
Hydro electric…7.6%
Solar…9.2%
Wind…0.9%
Geothermal…0.3%
Biomass…3.7%

Source: "Comprehensive Energy Statistics of Japan"; 2022 preliminary figures published by the Agency for Natural Resources and Energy, outlook for energy supply and demand in FY2030 (related materials)
* The sum of the values shown may not be 100% in some cases for a reason of round values.
* Renewable energy here, including geothermal power, wind power, and solar power, but not hydroelectric power, includes unused energy.

6. Innovation

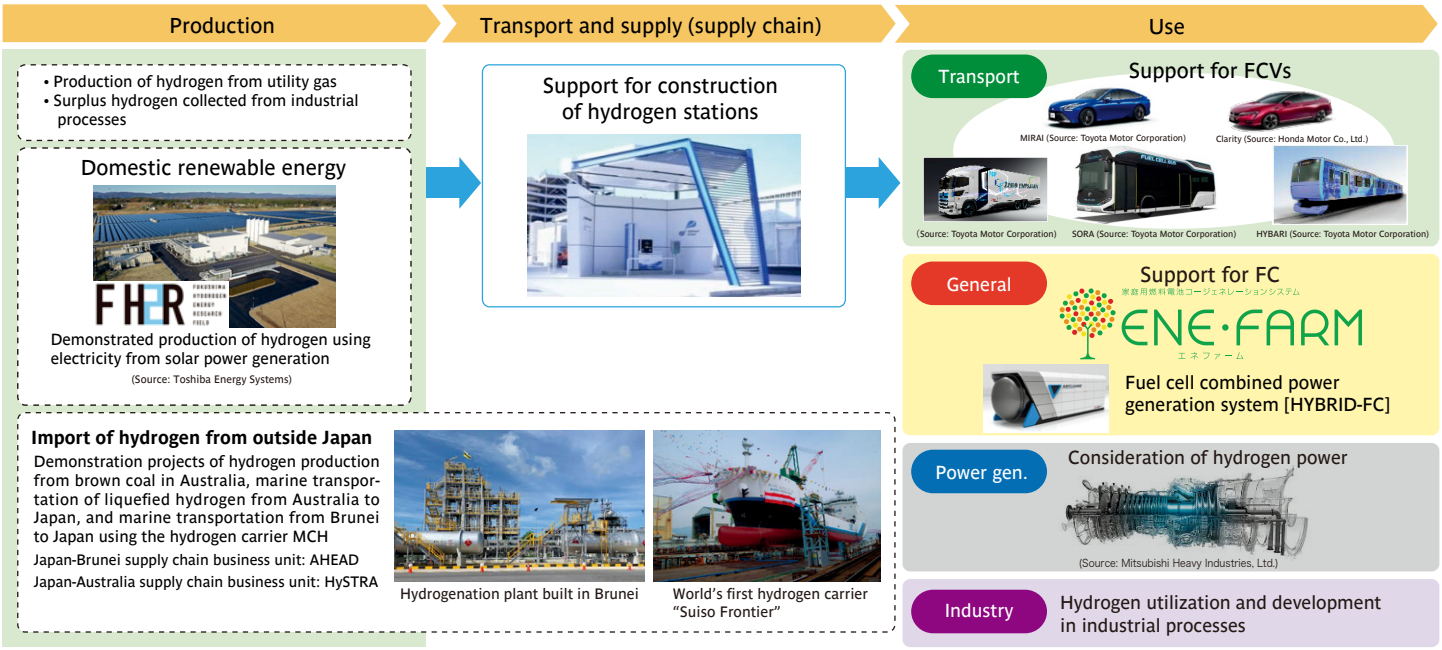
Hydrogen, other fuels and technologies for decarbonization

Q What innovations is Japan working on to achieve decarbonization?

A **For example, production of CO_2-free hydrogen from renewable energy sources, wide-ranging use of hydrogen in fuel cell vehicles and other equipment, fuel ammonia, and Carbon Recycling are promising.**

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.



How to produce hydrogen, a next-generation energy source

There are high hopes for hydrogen to become the next-generation energy as it does not emit CO_2. Also, hydrogen has a great advantage in that it can be made from various resources such as coal and gas, not to mention water. This section introduces how hydrogen is produced.

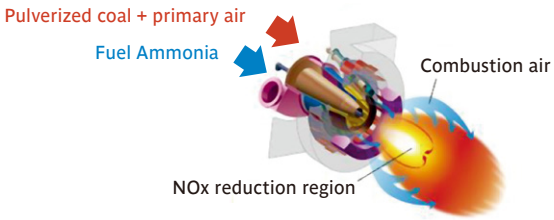
https://www.enecho.meti.go.jp/about/special/johoteikyo/suiso_tukurikata.html

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

Efforts to utilize fuel ammonia

Fuel ammonia can be used as a hydrogen carrier, and it can be manufactured and used at a lower cost than pure hydrogen since it can use existing infrastructure. In addition, fuel ammonia has a combustion speed close to that of coal, so it is suitable for use in coal-fired power generation.

Japan is leading the world in developing the technology to directly use fuel ammonia in thermal power generation facilities. Currently, Japan has succeeded in stable combustion and suppression of NOx (nitrogen oxide) emissions by co-firing fuel ammonia by 20%. By co-firing fuel ammonia at existing thermal power plants, it will be possible to generate thermal power with lower CO2 emissions.



Fuel ammonia mixed burner (image)

Facility used to demonstrate mixed combustion (JERA Hekinan Thermal Power Station)

Will ammonia really be available as "fuel" ? (Part 1 and Part 2)

When speaking of "ammonia," the image that comes to mind is "a toxic substance with a pungent odor." However, fuel ammonia has great potential as a next-generation energy source.

Part 1: https://www.enecho.meti.go.jp/en/category/special/article/detail_183.html
Part 2: https://www.enecho.meti.go.jp/en/category/special/article/detail_184.html

part 1 part 2

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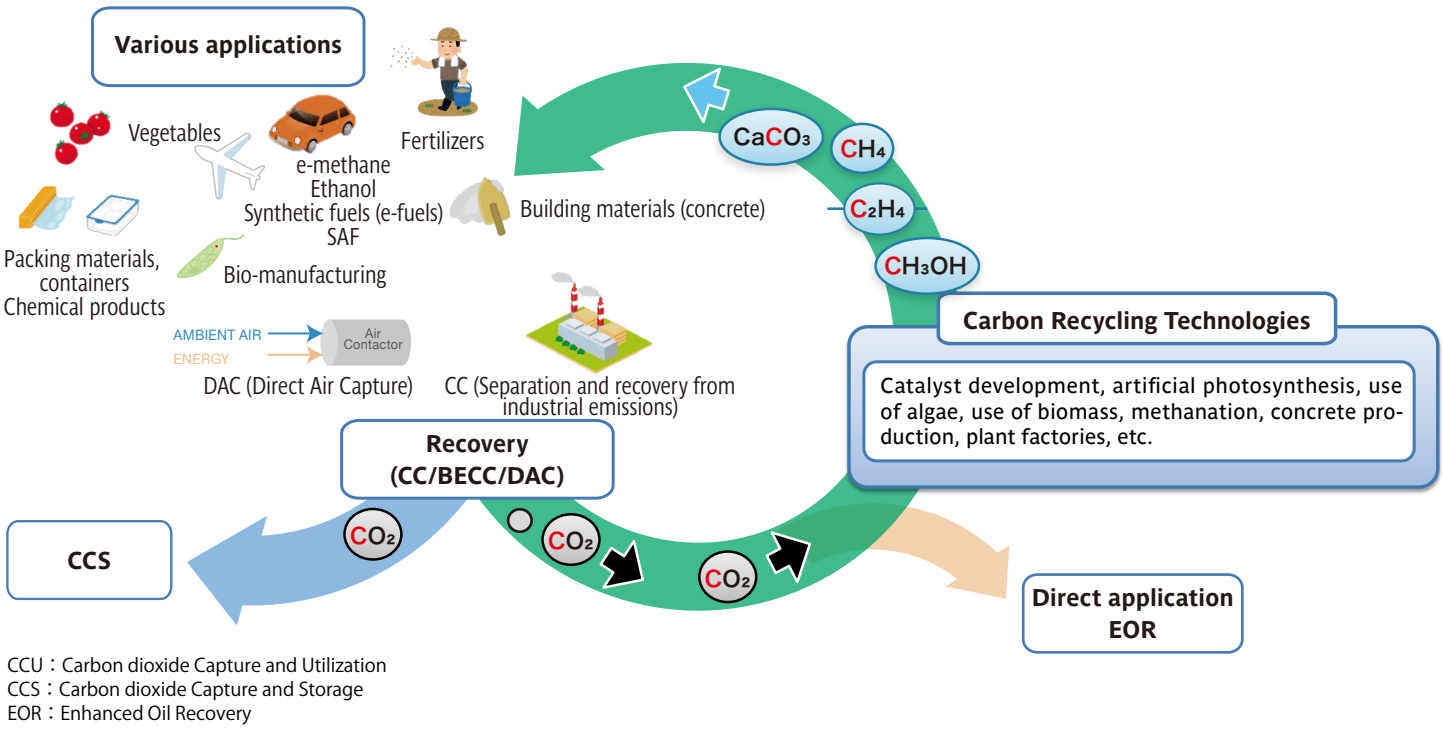
Development of technology to reduce CO_2 emissions

Carbon Recycling, CCUS (reuse of CO_2)

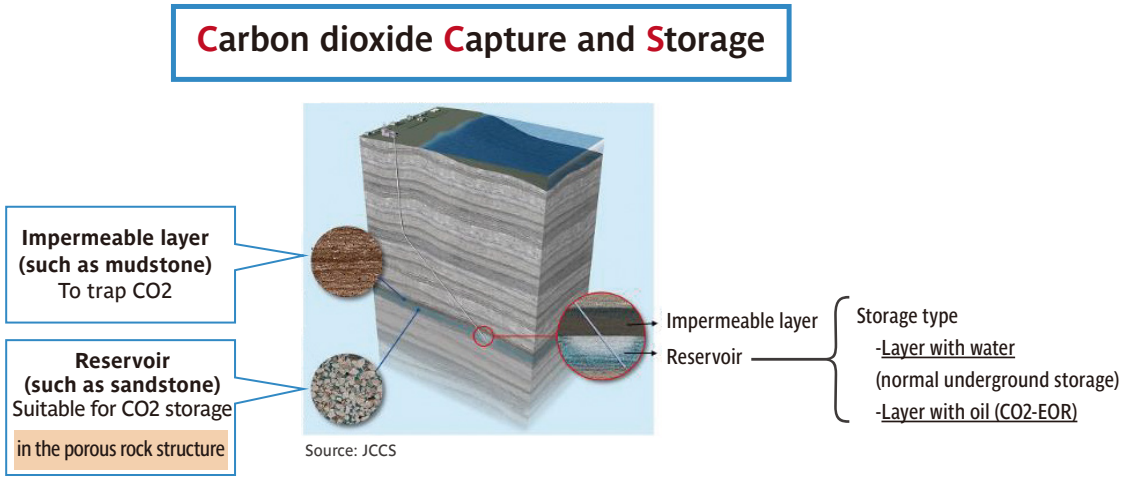
This is a technology used for capturing CO2, and utilizing it as a raw material resource in concrete, plastics or others thereby controlling CO2 emissions into the atmosphere.



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.



Perovskite solar cells

A perovskite solar cell is a type of solar cell that includes a perovskite-structured compound used in a power generation layer. Perovskite solar cells can be produced in a relatively simple production process without using polysilicon. They are light and flexible and can be attached to building walls or placed on roofs that cannot withstand heavy weight, showing great potential for popularization in various places for installation.

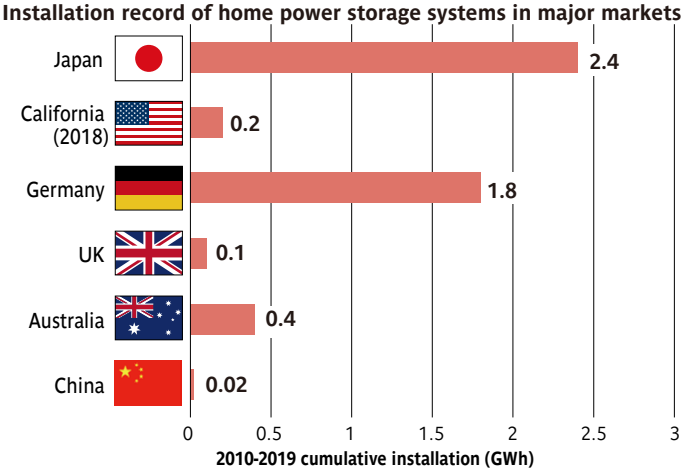
A representation of perovskite solar cells attached to a building wall

Practical Application of Innovation

Widespread use of power storage systems

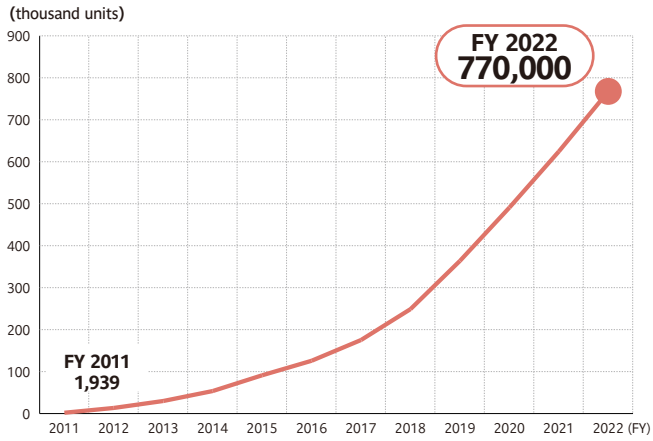
Japan is in the forefront in introducing power storage systems for household use. Furthermore, the use of fuel cells including Ene-Farm is expanding.

Installation record of home power storage systems in major markets



Source: Mitsubishi Research Institute, Inc.

Stationary lithium-ion power storage systems in Japan (cumulative)



Source: Japan Electrical Manufacturers' Association

家庭用燃料電池コージェネレーションシステム

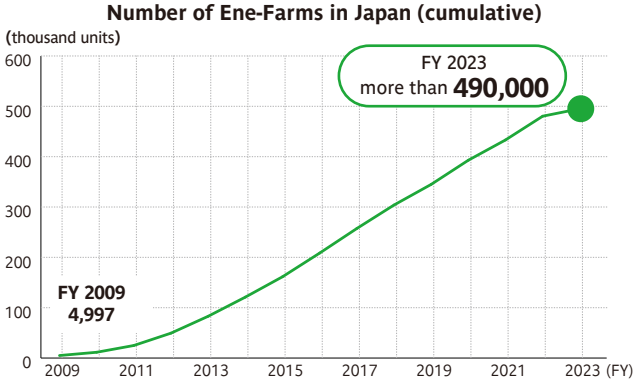
ENE・FARM

エネファーム

Ene-Farm, the worlds' first household fuel cell that utilizes hydrogen, was launched in Japan in 2009, and as of the end of September 2023, more than 490,000 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

The re-discovery of fuel cells

Taking the example of stationary fuel cells such as Ene-Farm, already a familiar item for many people, this section introduces the mechanism by which fuel cells generate electricity and heat.

https://www.enecho.meti.go.jp/about/special/johoteikyo/nenryodenchi_01.html

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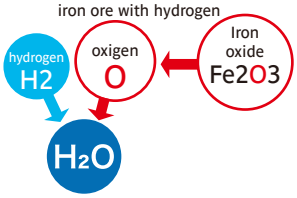
Practical use of various technologies can reduce CO_2 emissions

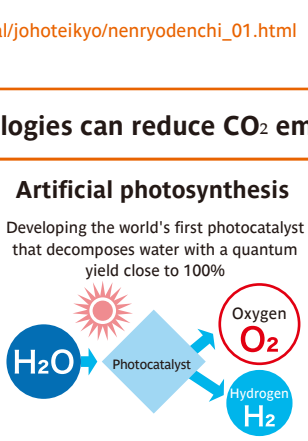
Zero-Carbon steelmaking with CO_2-free hydrogen

Developing a technology for the reduction of iron ore with hydrogen



Artificial photosynthesis

Developing the world's first photocatalyst that decomposes water with a quantum yield close to 100%



Offshore wind farm

Offshore wind power generation is the key to making renewable energy a major power source because of 1) mass introduction, 2) inexpensive electricity, and 3) large ripple effects.

Geothermal power generation

Geothermal power generation, with nearly zero CO2 emissions, enables sustainable power generation. We will advance technological development toward its introduction in collaboration with other ministries and agencies.

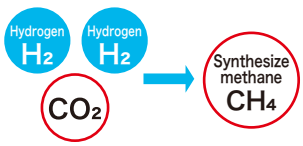
Sustainable Aviation Fuel

(SAF)

Development of jet fuel with CO_2 reduction effect produced from biomass and other materials

Methanation

Reacts hydrogen with CO_2 to synthesize methane (CH_4), which is the main component of natural gas.



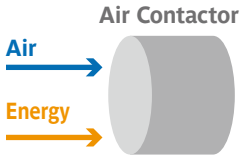
Producing materials such as concrete using captured CO_2

Separating and collecting CO_2 from emissions from thermal power plants or other facilities and recycling it into construction materials

DAC

(Direct Air Capture of CO_2)

Developing technologies to capture CO_2 from the atmosphere and solidify it



7. Renewable Energy

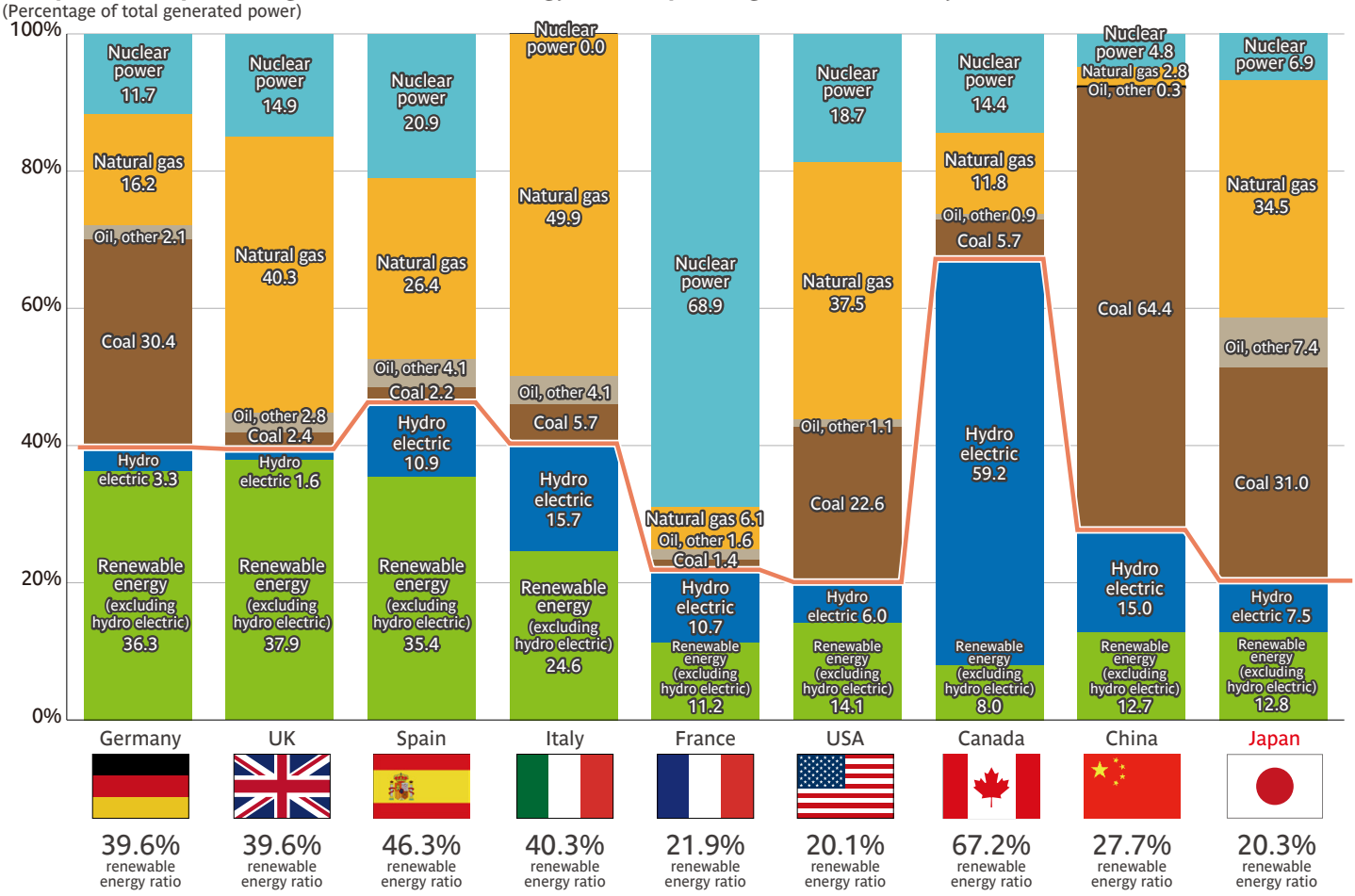
Introduction of Renewable Energy

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

A **The percentage of renewable energy power in Japan was 20.3% in FY2021.
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.**

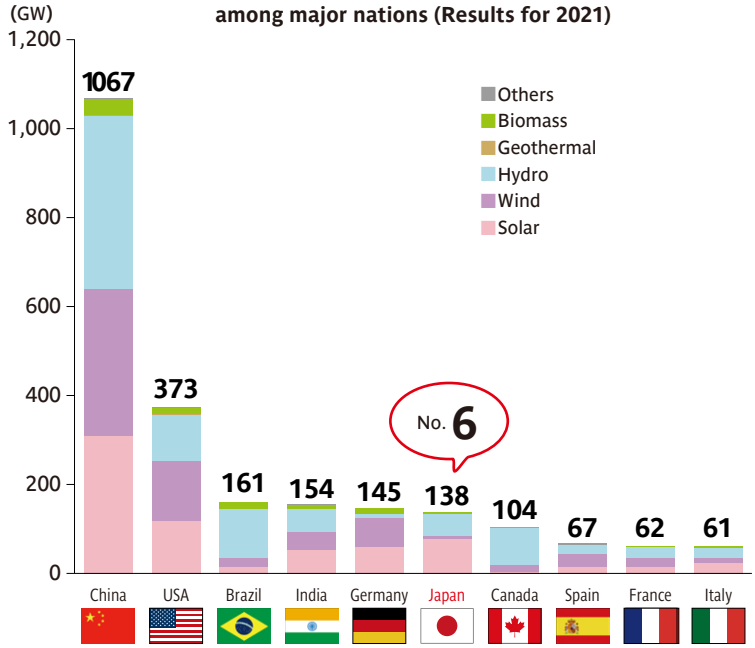
Comparison of percentages of renewable energy in total power generation in major nations

(Percentage of total generated power)

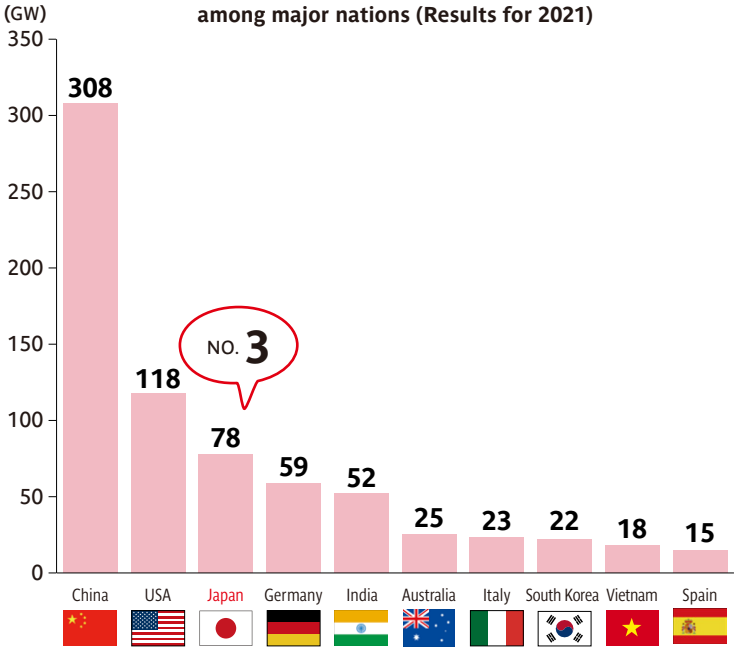


Source: Created by the Agency for Natural Resources and Energy based on the IEA "Market Report Series—Renewables 2022" (Power Generation in Each Country as of 2021), IEA database, and the Comprehensive Energy Statistics of Japan (FY2021 confirmed figures).

Renewable energy power generation capacity among major nations (Results for 2021)



Solar power generation capacity among major nations (Results for 2021)



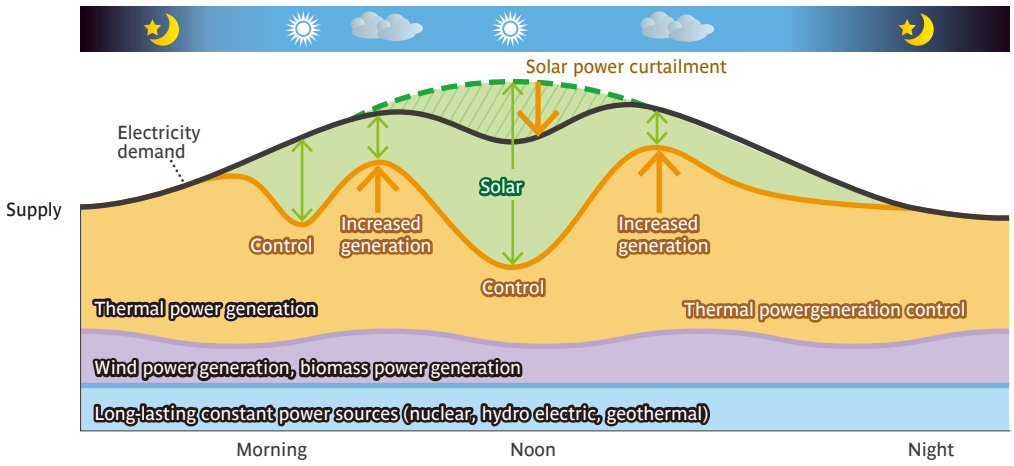
Source: Created by the Agency for Natural Resources and Energy based on the IEA "Renewables 2022"

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.**

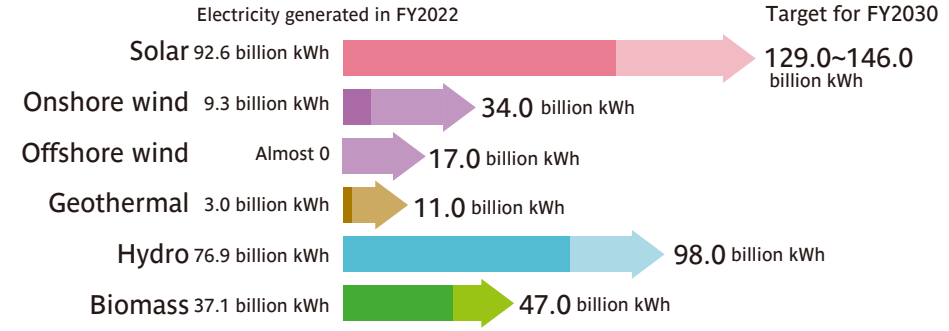
Supply/demand situation on the lowest demand day (such as a sunny day in May)



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, forming projects of wind power generation, and technological development of perovskite solar cells and offshore wind power.**



+ Strengthening policies to promote introduction of renewable energy

- Reinforcing the networks to expand renewable energy
- Achieving ZEH targets for newly built houses

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

Here's more about the 6th Strategic Energy Plan

A. Renewable energy expanding with cost reduction while promoting acceptance of local communities
B. Efforts to overcome "grid constraints" toward expanding the introduction of renewable energy

See details of the directions of renewable energy, which is positioned as a primary source of power generation of the future.

https://www.enecho.meti.go.jp/en/category/special/article/detail_173.html
https://www.enecho.meti.go.jp/en/category/special/article/detail_174.html

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8. Reconstruction of Fukushima

Decommissioning Contaminated Water and Treated Water Management of Fukushima Daiichi Nuclear Power Station (FDNPS)

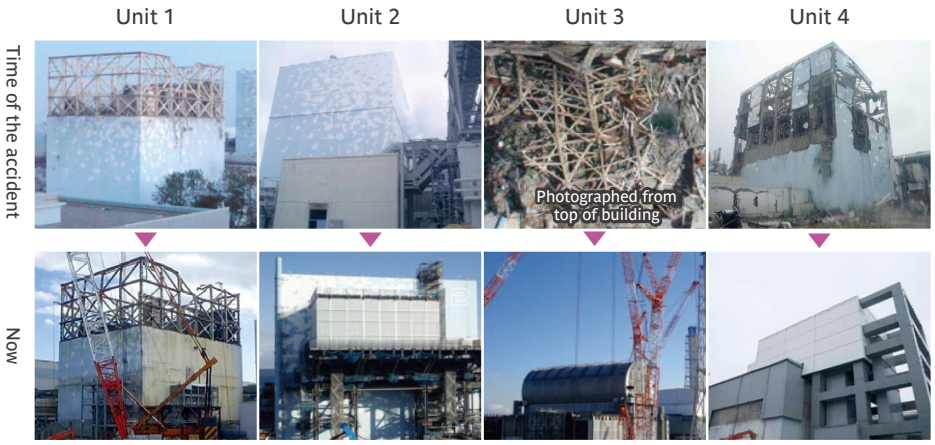
Q **Are decommissioning contaminated water and treated water management at FDNPS progressing?**

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 kept in stable condition, and debris removal, decontamination, and other measures are being carried out toward fuel removal from the spent fuel pools.
Toward the retrieval of fuel debris (melted and solidified fuel) investigation of the inside of the reactor containment vessel of Unit 1 was carried out from February 2022 to March 2023. Preparations are underway for experimental retrieval of fuel debris from Unit 2. A robot arm designed for fuel debris retrieval has been tested since February 2022 at a mock-up reactor simulation facility in Naraha Town in Fukushima Prefecture. In October 2023, the hatch of one of the penetrations leading to the inside of the reactor containment vessel was opened, and in January 2024, work to remove the sediment from inside the penetration started.

(Current conditions of each reactor)

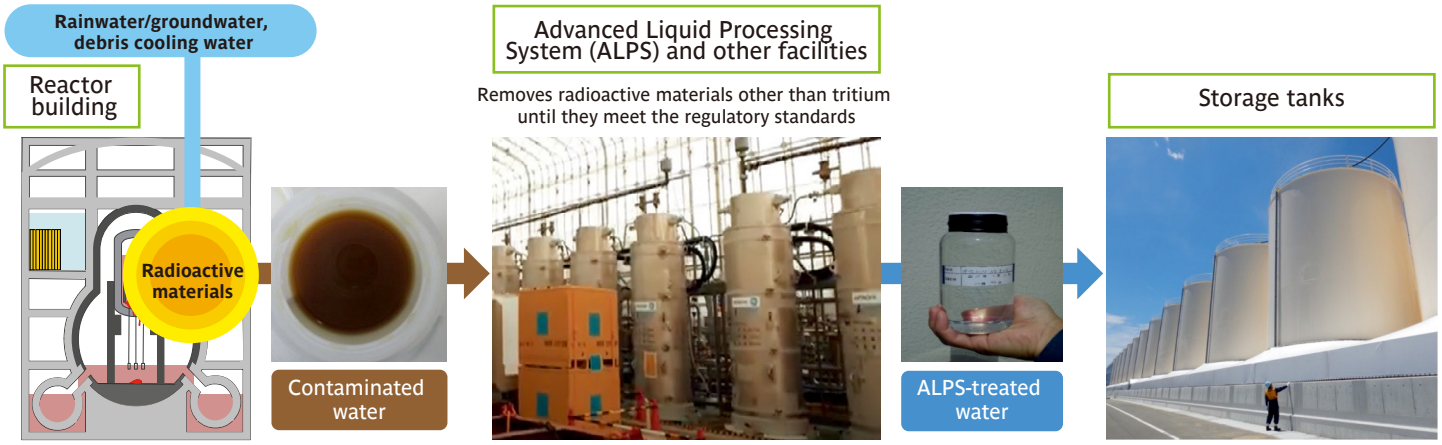


Status of fuel removal from the spent fuel pool

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 per day at the Fukushima Daiichi NPS has been reduced to around one-sixth of the initial amount through multi-layered countermeasures including frozen-soil walls. Contaminated water is treated using multiple purification facilities that remove as much of the radioactive material as possible before the water is stored in tanks.
Efforts are being made to further reduce the generation of contaminated water. However, an increasing number of these tanks occupy a large area of the site, and they may become an obstacle to future decommissioning work. Under such circumstances, in April 2021, the Government of Japan announced its basic policy for discharging ALPS treated water into the sea on the premise that strict compliance with relevant laws and regulations is ensured and that all measures are taken to minimize adverse impacts on reputation. Based on this basic policy, the discharge started in August 2023. The Government will continue to make all endeavors to ensure safety, take measures against reputational damage, and provide support for people's livelihoods.



The safe and secure disposal of treated water for reconstruction and decommissioning

1) The release of ALPS-treated water into the ocean and countermeasures against harmful rumors
2) What is the "secondary treatment" and what are "other nuclides" contained in the treated water?
3) Summary of immediate measures for the disposal of ALPS-treated water
4) The IAEA confirms the safety of ALPS-treated water

https://www.enecho.meti.go.jp/about/special/keyword/?k=廃炉

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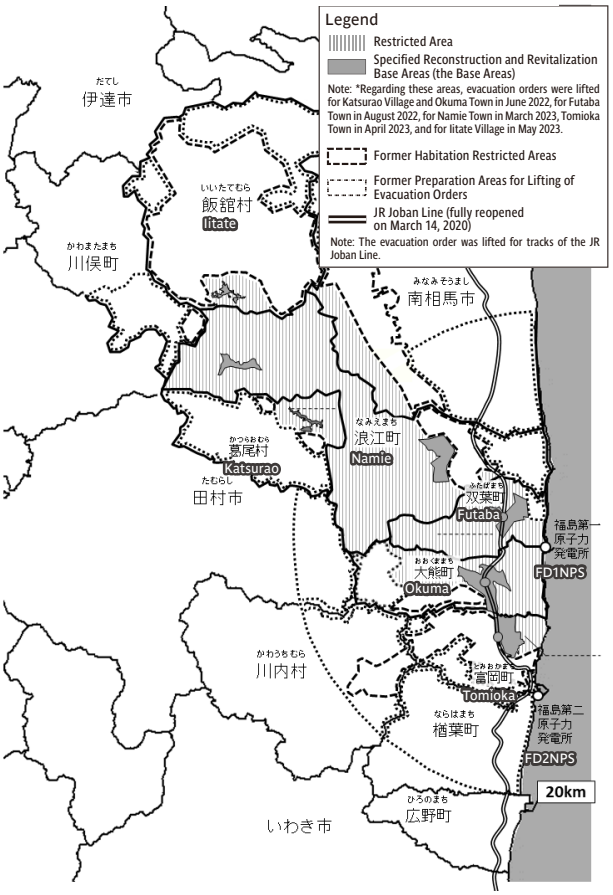
Reconstruction of Fukushima

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.

Areas under evacuation orders (as of May 1, 2023)



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. Efforts are also being made to ensure food safety. 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, 78 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).

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.

Classification	Number of inspections	Number exceeding standard	Percentage exceeding standard
Brown rice	1,062	0	—
Vegetables /fruits	2,071	0	—
Livestock products	1,701	0	—
Cultivated plants /mushrooms	594	0	—
Marine seafood	2,867	0	—
Fish from inland fisheries	22	0	—
Edible wild plants /mushrooms	477	0	—
Fish in rivers and lakes	145	0	—

Status of monitoring inspections for agricultural, forestry and fishery products
(April 1, 2022 - January 31, 2023)

Source: Created based on "Progress of Fukushima Recovery 31.1"

*Tests conducted by Fukushima Prefecture based on government guidelines. Items for shipping and sales are eligible.

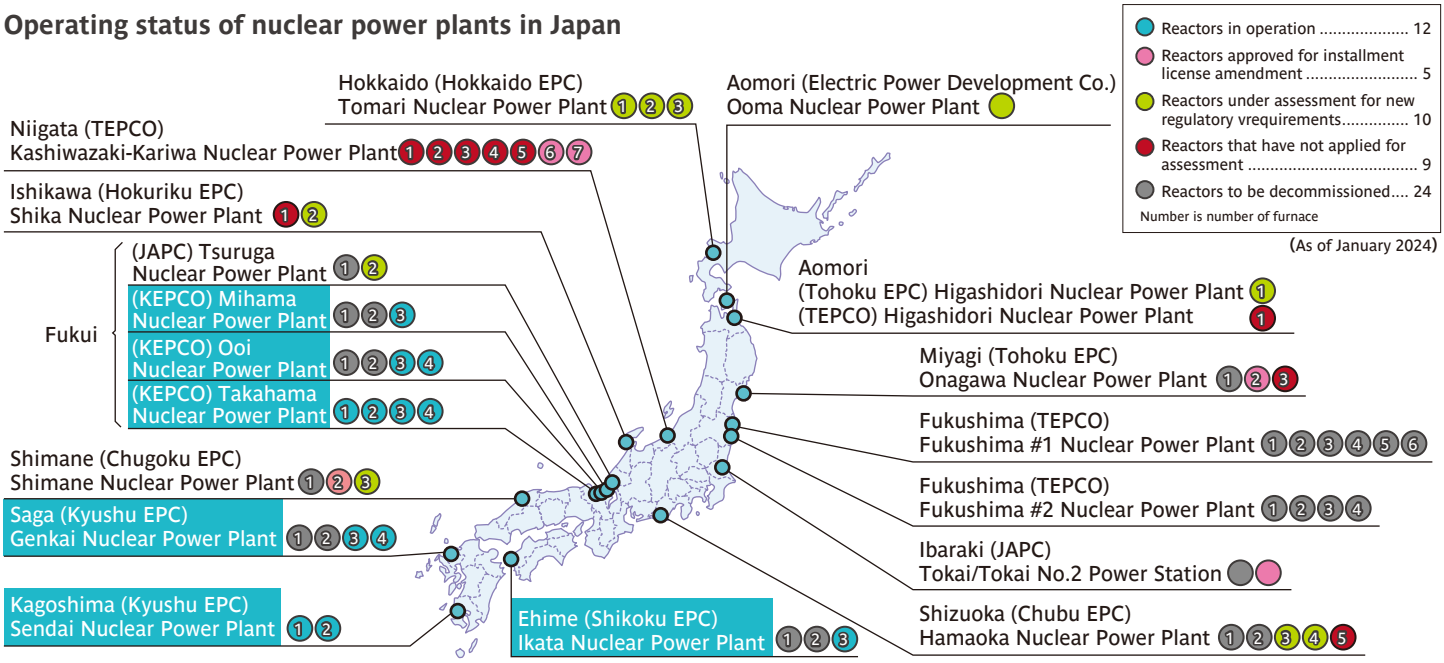
9. Nuclear Power

Operational Status of Nuclear Power Plants

Q Is the restart of nuclear power plants making progress?

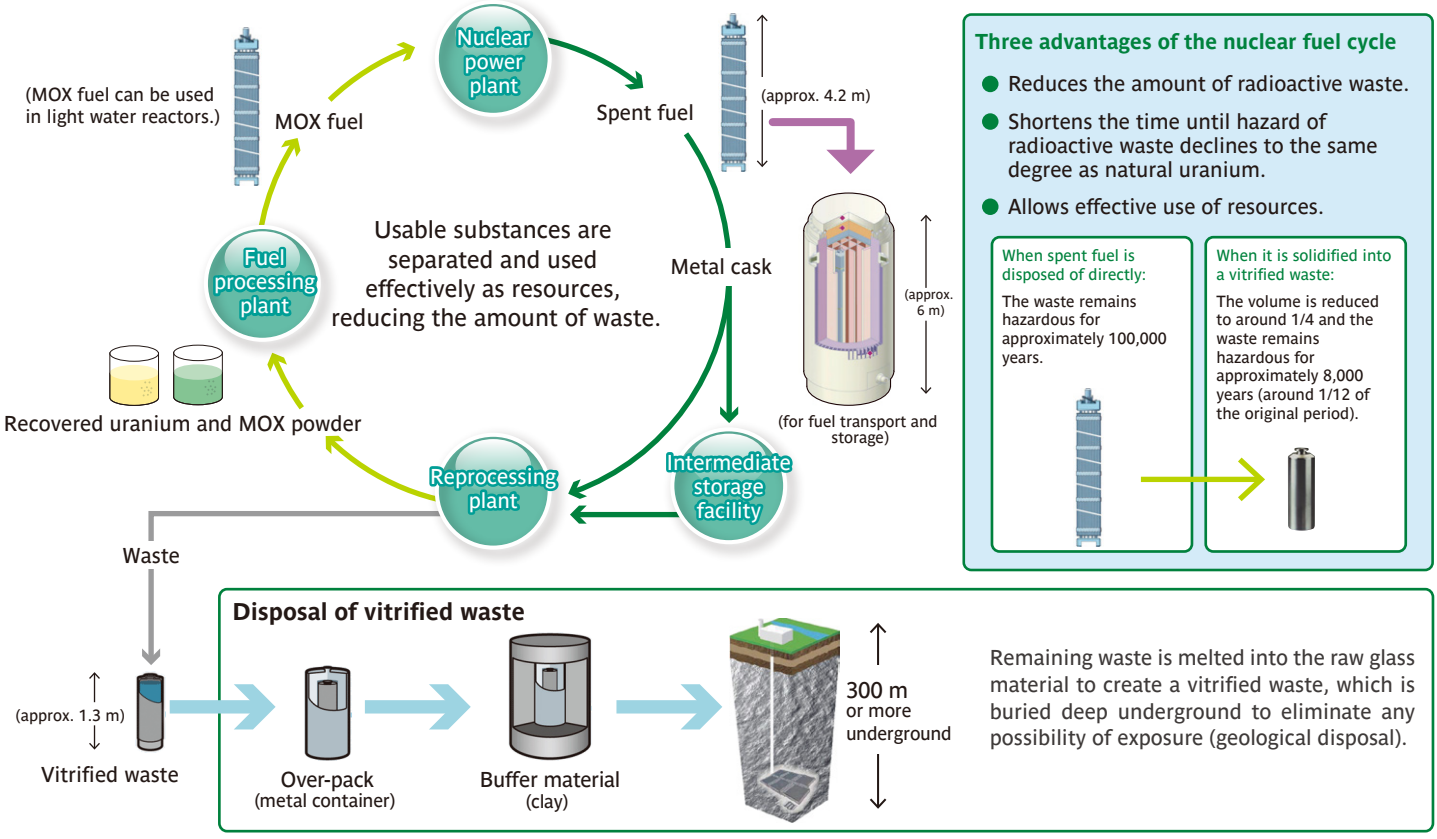
A **As of January 2024, twelve nuclear power plants are operating nationwide. We will continue advancing the restart of nuclear power plants while obtaining understanding from the local communities, on the major premise of ensuring safety and on the condition that the Nuclear Regulation Authority recognizes 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 Geological Disposal

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.



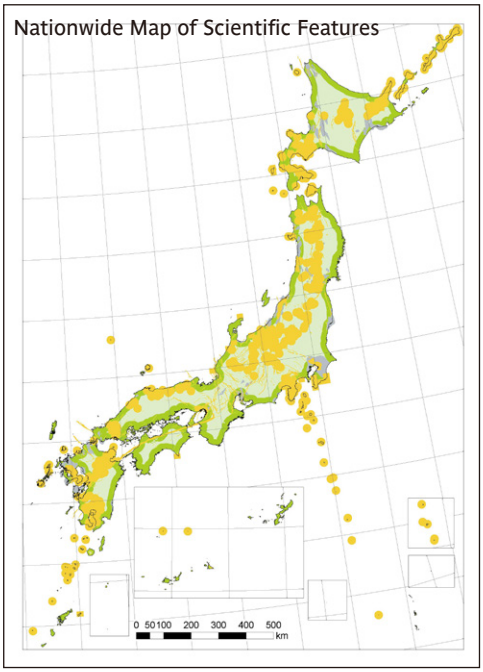
MOX: Mixed Oxide (Mixture of Uranium oxide and Plutonium oxide)
Fuel assembly and metal cask: "Graphical Flip-chart of Nuclear & Energy Related Topics", Japan Atomic Energy Relations Organization

Nationwide Map of Scientific Features and Literature Survey

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. In April 2023, the Basic Policy on the Final Disposal of Specified Radioactive Waste was revised to expand the locations for literature surveys. Based on the revised basic policy, we will undertake nationwide tours to respective local municipalities aiming to conduct literature surveys in as many areas as possible.

Read more about the literature survey

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



Classification of area into 4 colors based on scientific features

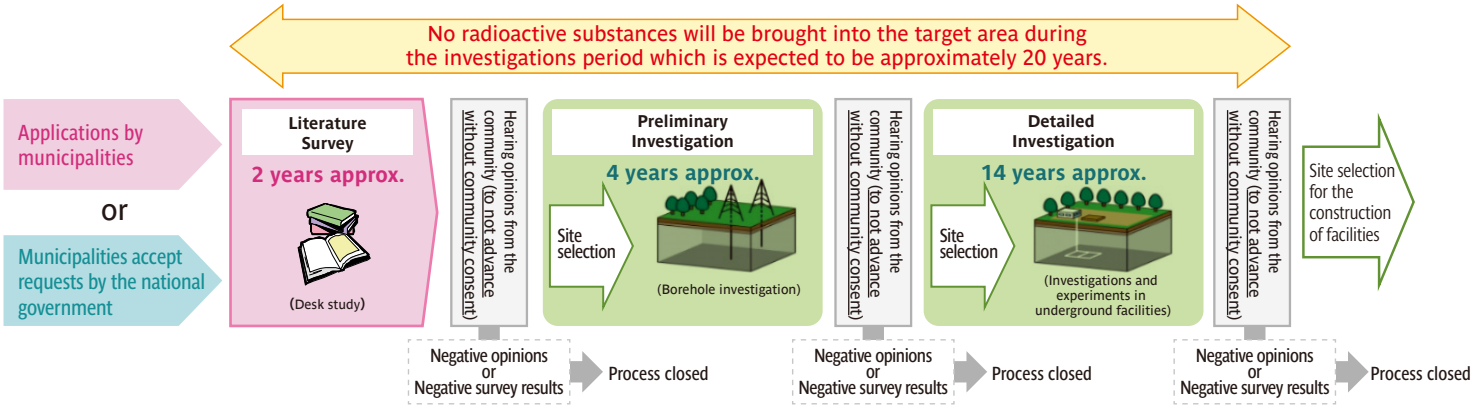
- Orange: Areas close to a volcano, active fault, etc.
- Silver: Areas with underground mineral resources
- Green: Areas assumed to be favorable
- Dark green: Areas assumed to be preferable also from the viewpoint of safe waste transportation

Read more about the map

Use this QR to view the article.

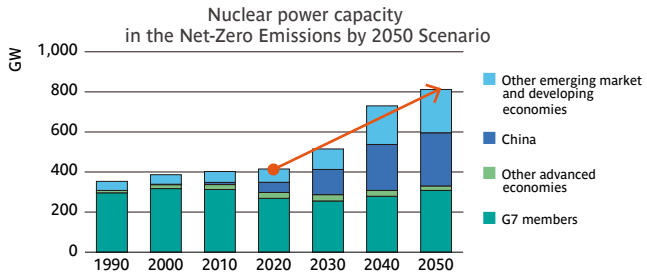
*Even in the green areas, step-by-step investigations need to be conducted to confirm precisely whether a particular location satisfies the required conditions for geological disposal.

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



Column: Nuclear power perspectives in the world

According to an analysis by the International Energy Agency (IEA), there will be an increasing need for constructing new nuclear power plants and expanding related investment in order to achieve net-zero emissions by 2050 in various countries and regions around the world.



Nuclear power generation capacity throughout the world will double by 2050 to 812 GW from the current level of 413 GW. Developed countries will shrink in their capacity by 2030 due to aging and decommissioning of nuclear reactors, but will recover by constructing new ones. China will become the world leader in nuclear power generation and will own one-third of the world's nuclear power plants by 2050.

Source: "Nuclear Power and Secure Energy Transitions: From Today's Challenges to Tomorrow's Clean Energy System" by IEA (2022)

COP28 was held from November 30 to December 13, 2023, in Dubai, the UAE. At the conference, the Global Stocktake (GST)* was conducted for the first time, and nuclear power was included in the outcome document as it contributes to global efforts that need to be advanced in pathways suited to respective countries in different national circumstances. According to the World Nuclear Association (WNA,) this was the first time that nuclear power had been officially specified as one of the solutions to climate change.

*The GST evaluates global progress toward meeting the goals of the Paris Agreement and suggests actions that need to be taken by respective countries. The GST is conducted every fifth year.

Source: COP28 website

Here's more about the 6th Strategic Energy Plan, nuclear power generation

The accident at the Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Station in 2011 must be remembered and reflected upon as the starting point our nuclear power policy. The Strategic Energy Plan states that the necessary scale of nuclear facilities should be maintained and utilized sustainably on the premise of ensuring safety.

https://www.enecho.meti.go.jp/en/category/special/article/detail_176.html

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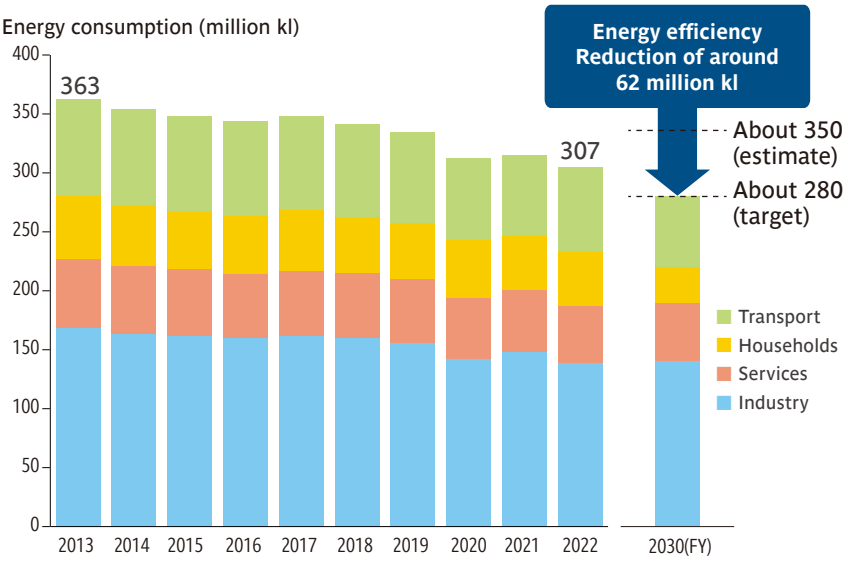
10. Energy Efficiency

Improving Energy Efficiency

Q How much energy efficiency has Japan accomplished?

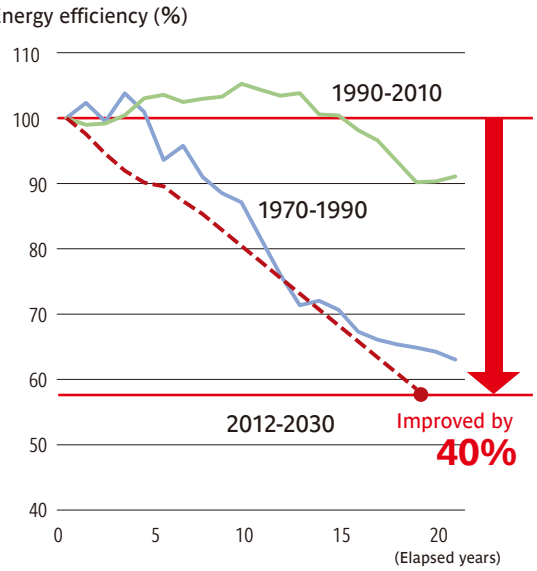
A **Japan has strengthened its efforts to improve energy consumption efficiency and achieved a reduction in energy consumption by about 62 million kl crude oil equivalent.**
The goal is to improve energy consumption efficiency by about 40%, to reach an all-time high level.

Final energy demand with the currently planned energy mix



Source: Created based on "Comprehensive Energy Statistics of Japan", published by the Agency for Natural Resources and Energy; "System of National Accounts", published by the Cabinet Office; and "Handbook of Japan's & World Energy & Economic Statistics", published by the Institute of Energy Economics, Japan.

Energy efficiency improvements

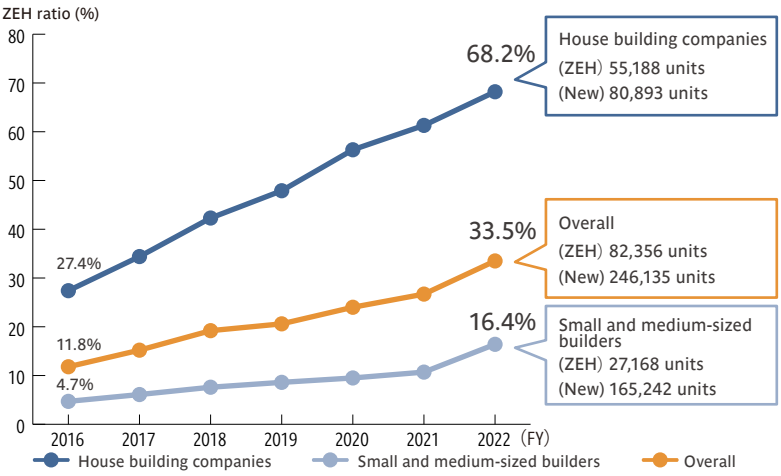


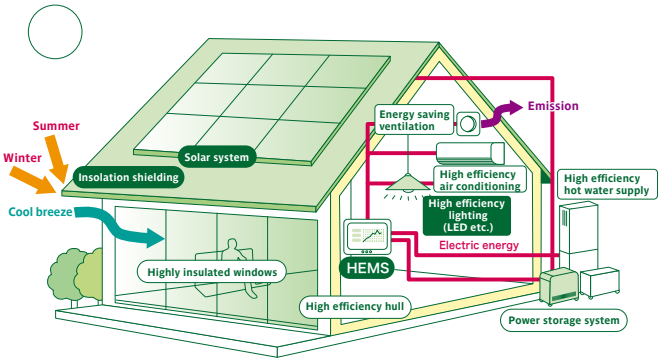
*Assuming energy efficiency in 1970, 1990, and 2012 to be 100
*Energy efficiency = Final energy consumption / Real GDP

Improvement of energy-saving efficiency performance of ZEH houses and buildings

In the business/housing sector, with the aim of ensuring energy efficiency at the level of ZEH/ZEB standards for new houses and buildings built after 2030, efforts are underway to make energy efficiency standards mandatory and raise those standard levels under the Act on the Improvement of Energy Consumption Performance of Buildings, as well as raise the "top-runner" standards in building materials and equipment.

Trends in the ZEH ratio of new custom-built homes





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 on the exterior of the homes and adopting highly efficient equipment and systems, while also using renewable energy.

Package of measures for supporting efforts to improve energy efficiency in response to increasing energy costs

Improving energy efficiency is becoming more important than ever from the perspectives of responding to sudden increases in energy prices and achieving carbon neutrality. We are enhancing a program for supporting efforts made by SMEs and households to improve energy efficiency.
Please visit the energy efficiency and conservation portal site for details of various measures including this package.
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Contact : **Research and Public Relations Office, General Policy Division, Director- General' s Secretariat, Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry**
1-3-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8931
TEL. +81-(0)3-3501-1511(main) https://www.enecho.meti.go.jp/

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