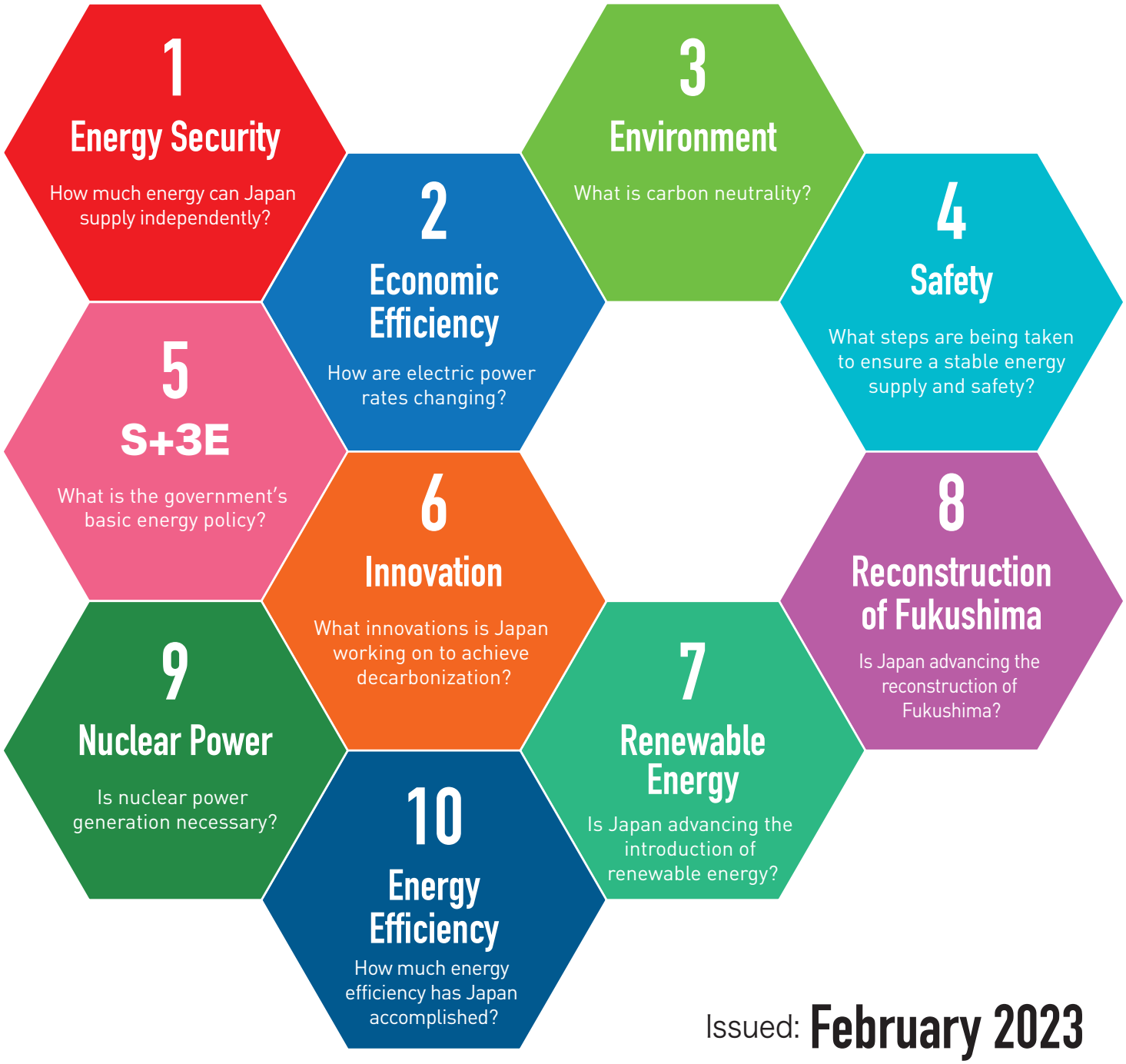
JAPAN'S ENERGY

10 questions for understanding the current energy situation



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経済産業省
資源エネルギー庁
Agency for Natural Resources and Energy

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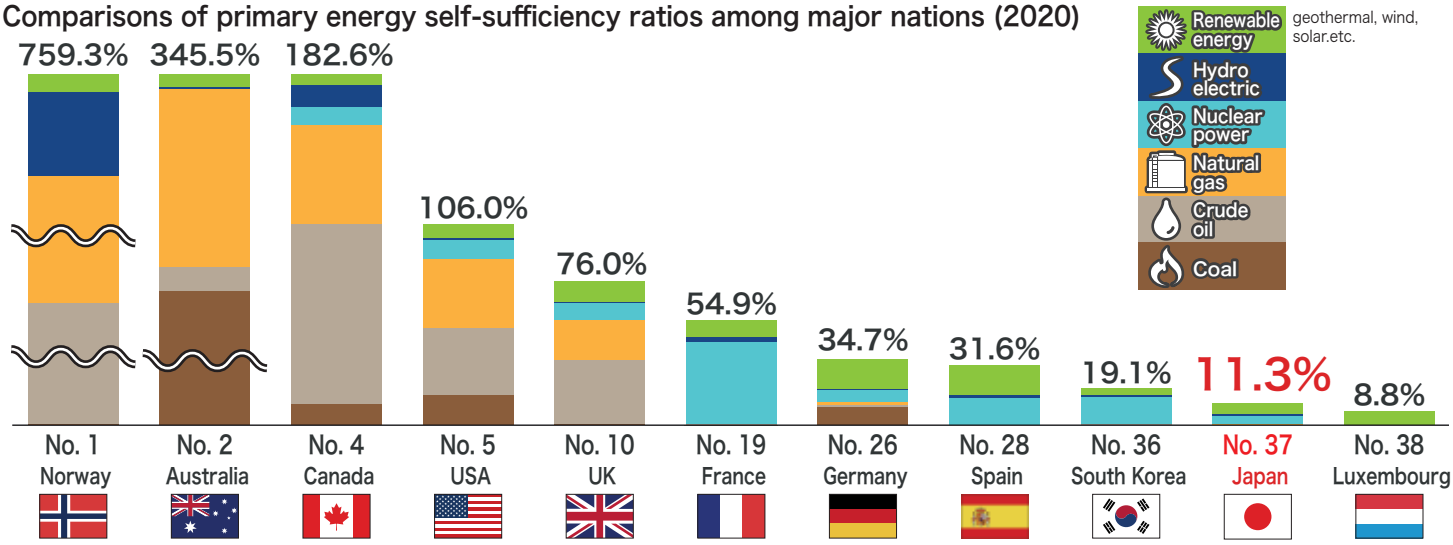
1. Energy Security

Changes in Energy Self-Sufficiency Ratio

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

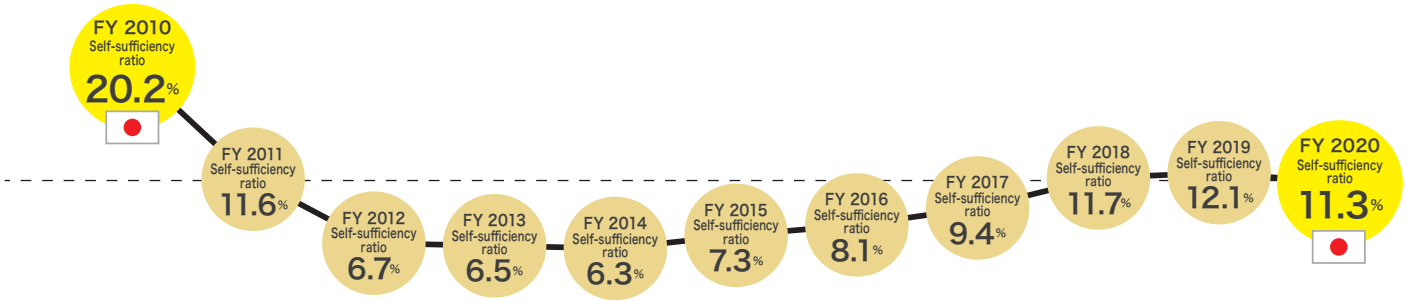
A In FY 2020, Japan's self-sufficiency ratio was 11.3% — lower than those of other OECD countries.

Comparisons of primary energy self-sufficiency ratios among major nations (2020)



Source: Estimates for 2020 from IEA "World Energy Balances 2021", except for data on Japan, which are confirmed values of FY 2020, 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

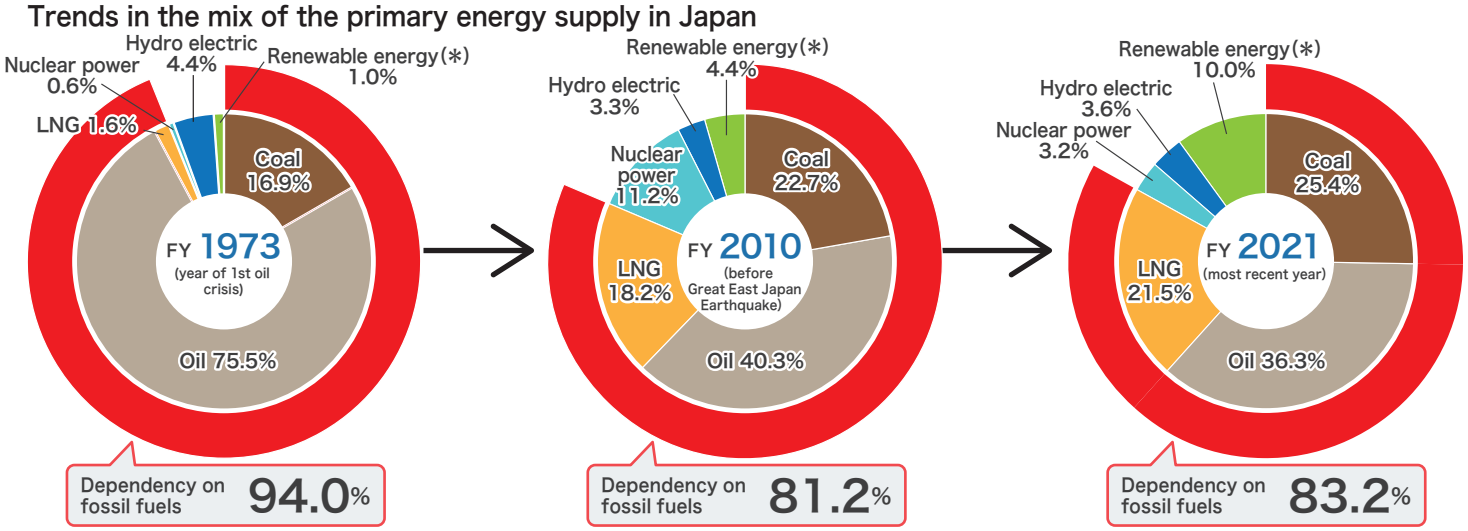


Primary energy sources: Primary forms of energy, including oil, natural gas, coal, nuclear power, solar power, and wind power.
Energy self-sufficiency rate: The percentage of the primary energy resources required for people's daily life and economic activities which can be produced or acquired in their 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 83.2% in FY 2021 in Japan.

Trends in the mix of the primary energy supply in Japan



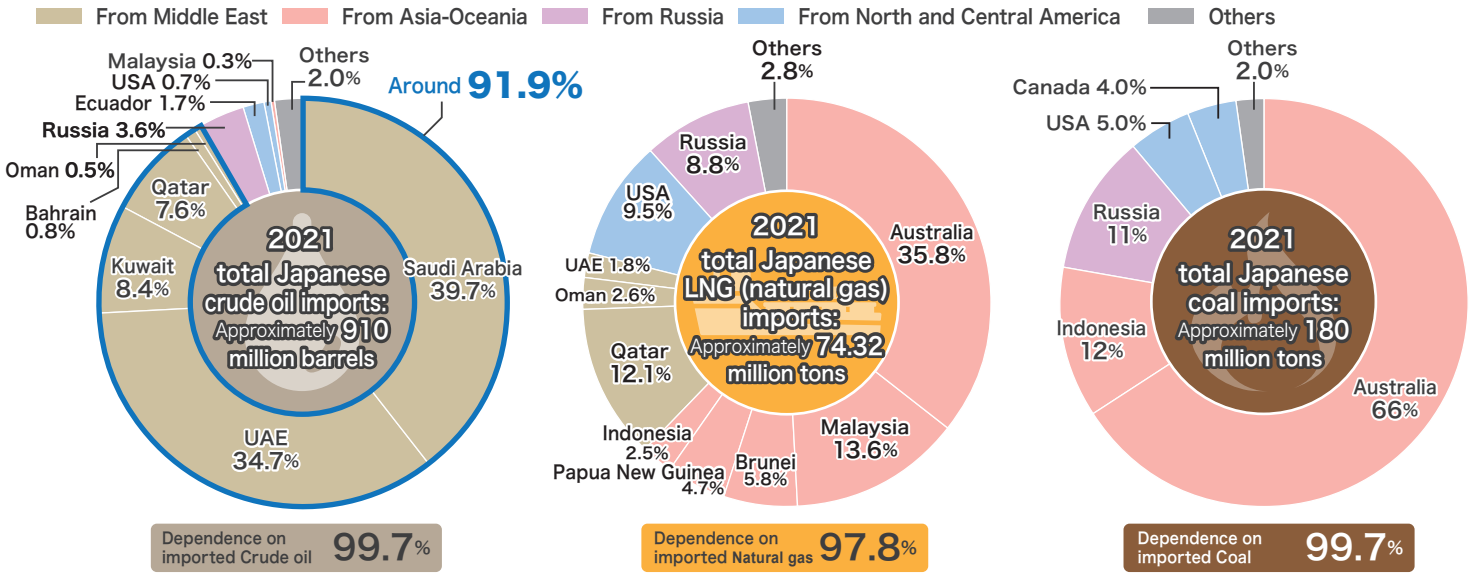
Source: preliminary values of FY 2021, derived from "Comprehensive Energy Statistics of Japan", published by the Agency for Natural Resources and Energy
* The sum of the values shown may not be 100% in some cases due to rounding of values.
* Renewable energy here, including geothermal power, wind power, 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 around 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 (2021)



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)

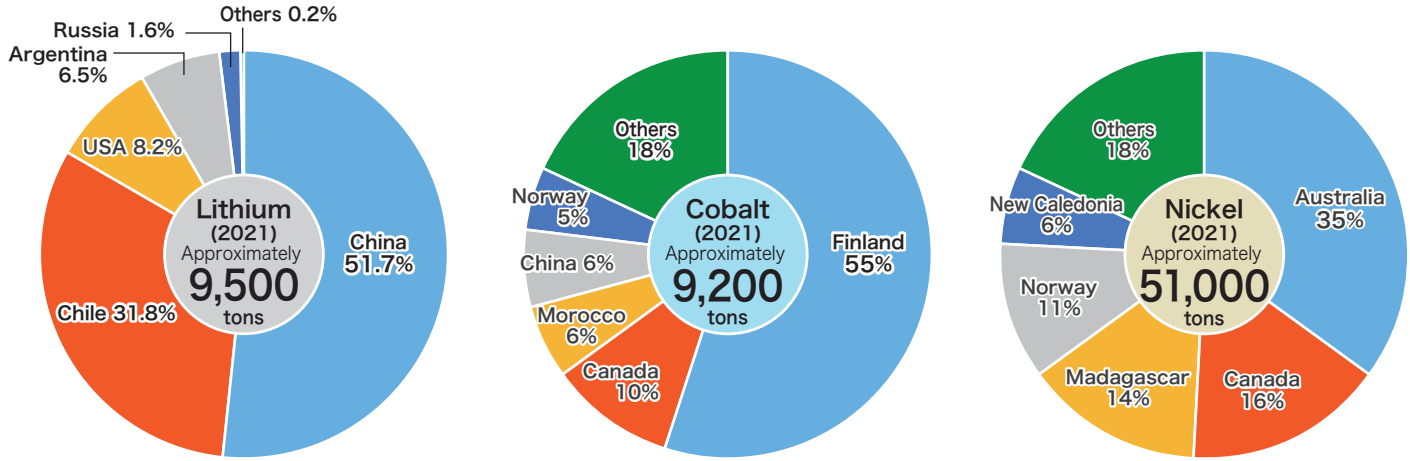
Efforts to secure the stable supply of resources: Japan is strengthening its relationships with the Middle East countries that are its main sources of crude oil. Aiming to increase the amount of LNG in the market, which is low compared to crude oil, Japan is also diversifying its supply sources, and working for further acquisition of resource rights and interests.

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 2022"
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: The JOGMEC Act has been revised to add investment in domestic smelting and refining businesses (midstream) and loan guarantee operations to JOGMEC risk money support services.
JOGMEC Act: This is the Act on the Japan Oil, Gas and Metals National Corporation, which stipulates the scope of business for the JOGMEC.

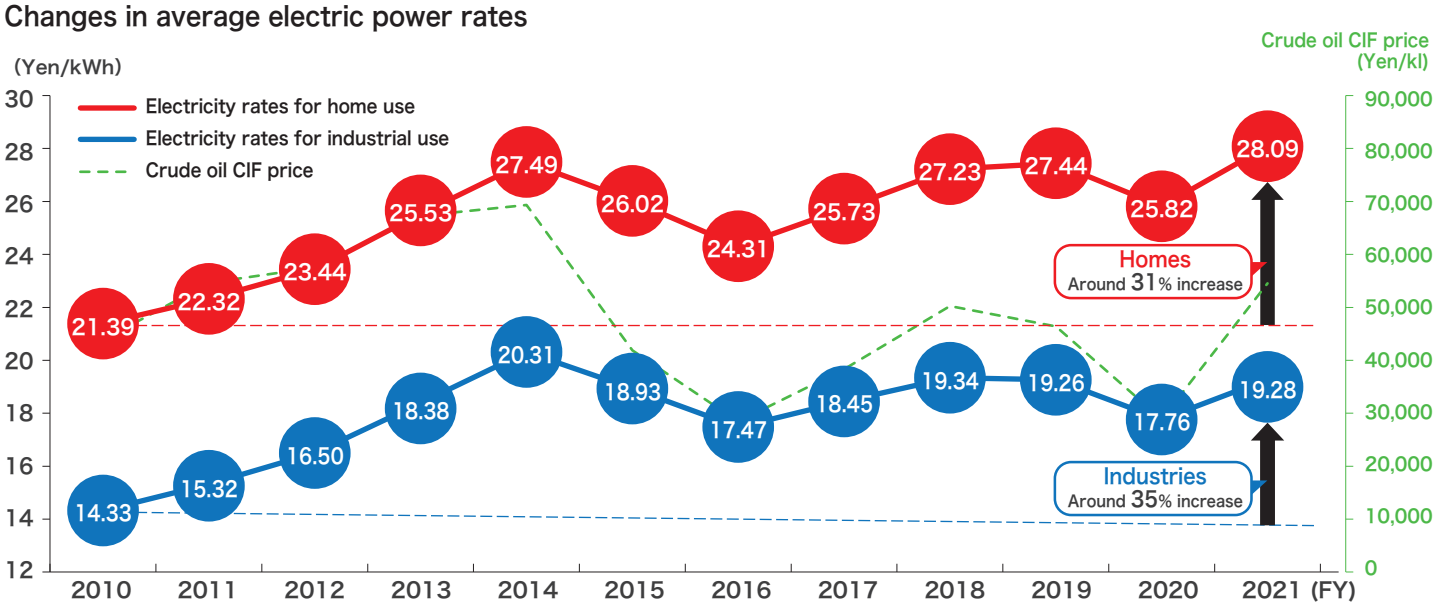
2. Economic Efficiency

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 declined from FY 2014 to 2016 as a result of falling oil prices, but they are rising again.

Changes in average electric power rates

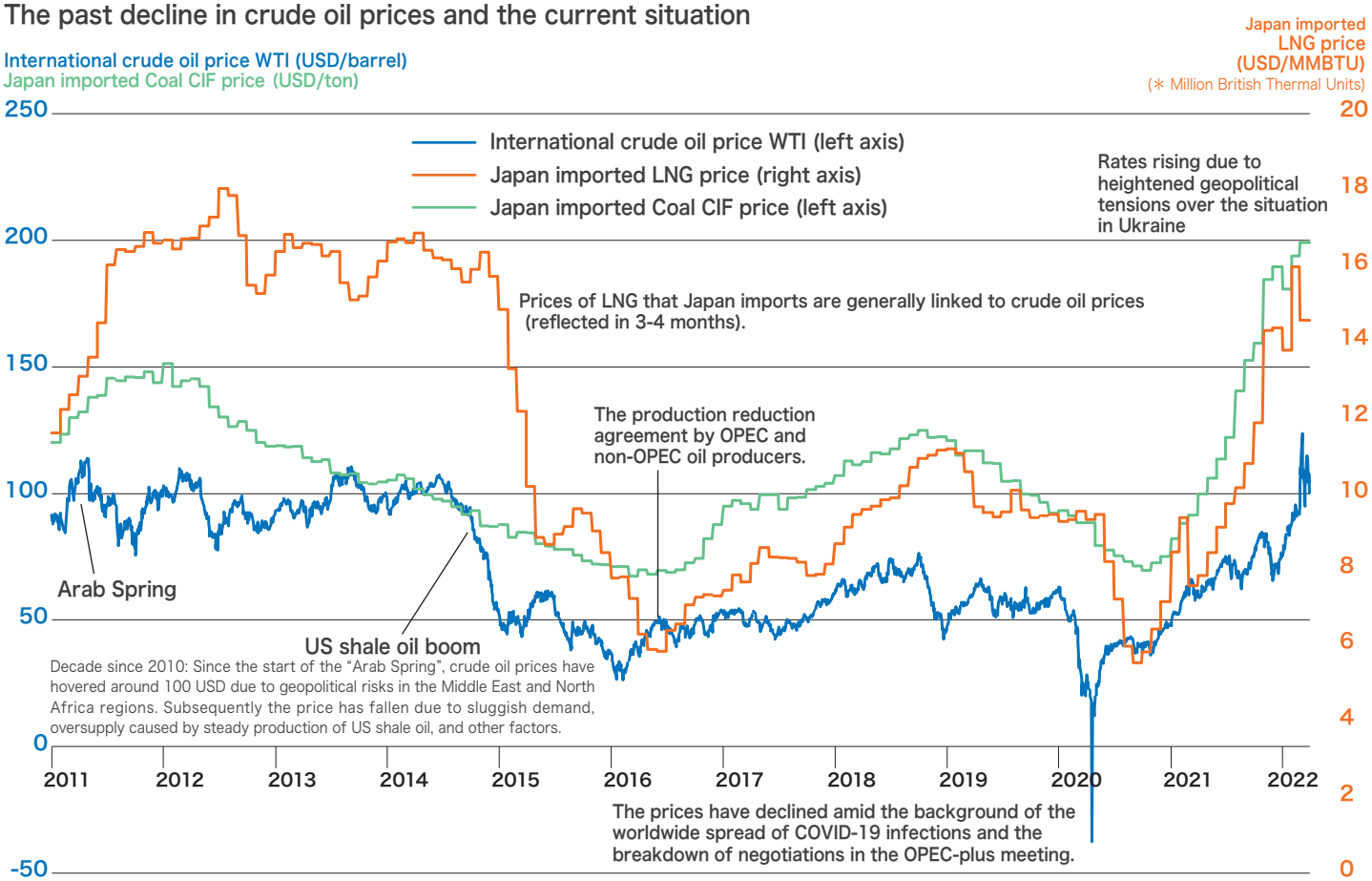


Source: Created based on monthly reports of generated and received electric power, financial materials of electric power companies, and power trading reports
Crude oil CIF price: Transaction price consisting of the import price plus related costs, such as transport cost and insurance cost.

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

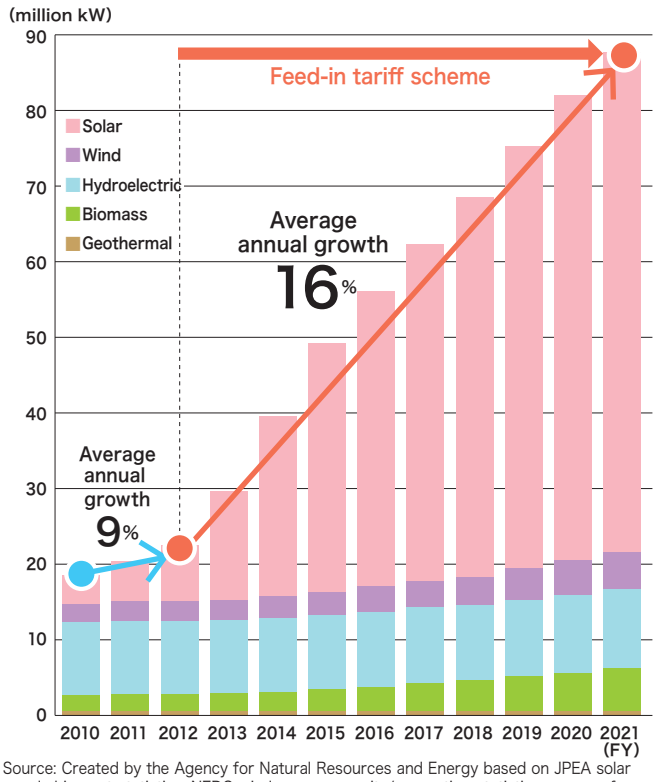


Source: Created based on CME Nikkei and Trade Statistics published by the Ministry of Finance.

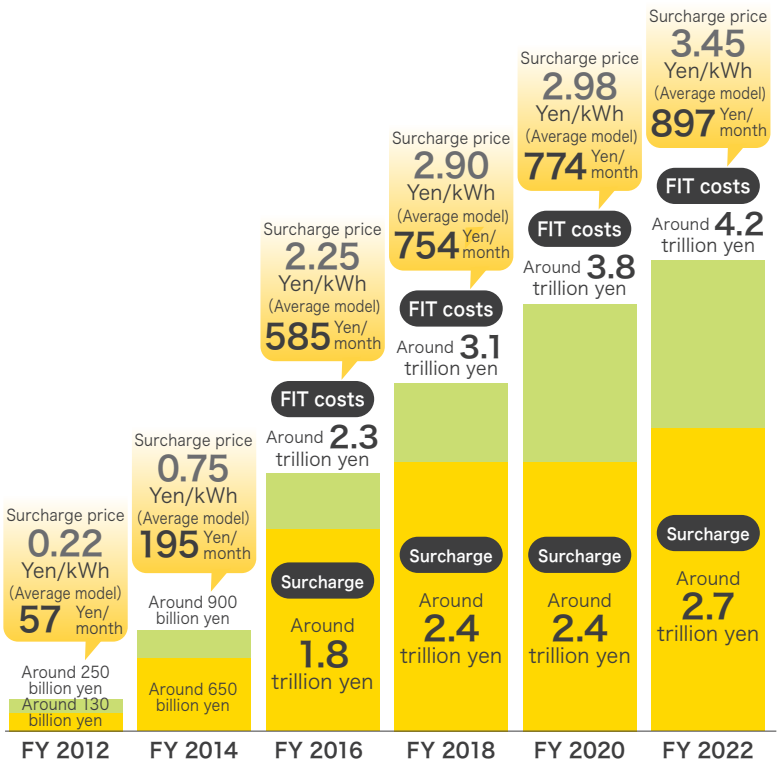
Factor 2: Cost of renewable energy

Thanks to the introduction of the Feed-In Tariff scheme (FIT) in 2012, the installed capacity of renewable energy systems is growing rapidly. On the other hand, the purchase costs have reached 4.2 trillion yen (approximately 32 billion USD), and the cost of the surcharge to ordinary households based on the average model (260 kWh/month) has risen to 897 yen/month. We are working to expand the introduction of renewable energy sources in a cost-efficient manner in order to maximize the use of renewable energy while decreasing the financial burden of doing so.

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



Changes in surcharges following the introduction of the FIT scheme



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.

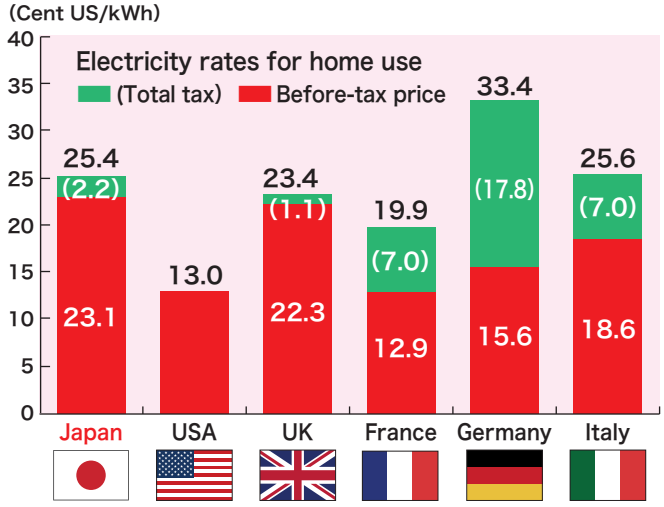
Feed-In Tariff (FIT) scheme: In this scheme, the electricity generated by renewable energy is purchased by electric power companies at a fixed rate for a certain period. The electric power companies will cover the costs of purchasing the electric power from renewable energy through a surcharge that is paid by electricity users.

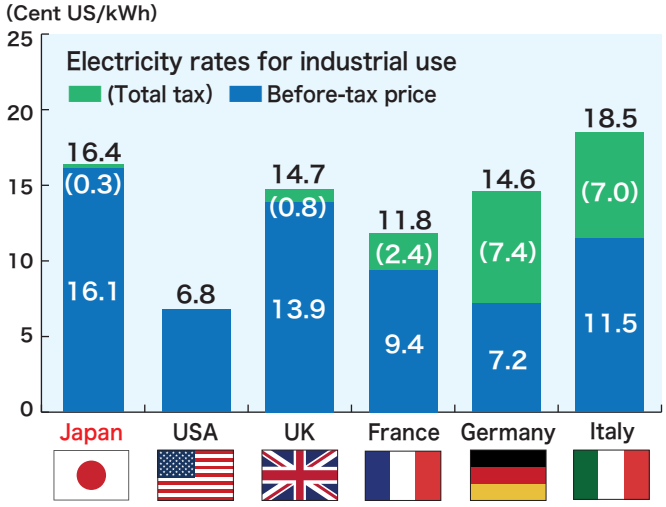
International comparison of electric power rates

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 (2019)





Source: Created based IEA "Energy Prices and Taxes for OECD Countries 2020".
Note: The details of tax and before-tax prices are not known for the United States.

3. Environment

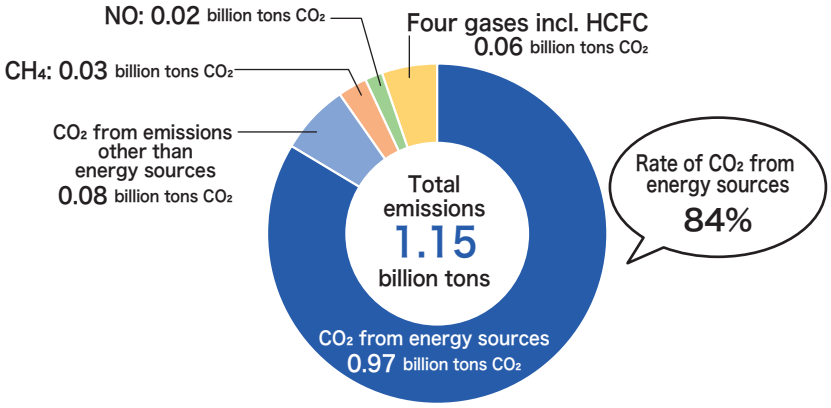
Global Warming Countermeasures: Carbon Neutrality

Q What is carbon neutrality?

A It refers to achieving net zero greenhouse gas emissions.

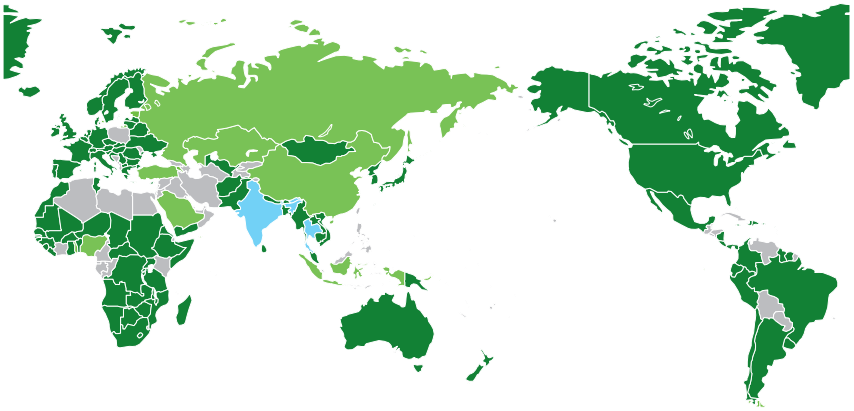
- "Greenhouse gas" covers **not only CO_2** but all gases with a "greenhouse effect," including methane.
- "Net zero gas emissions" means balancing gas emissions with the absorbed amount through removing such gases from the atmosphere, making **the total gases emitted to be equal to zero** (net zero,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

Greenhouse gas emissions in Japan (FY 2020)



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

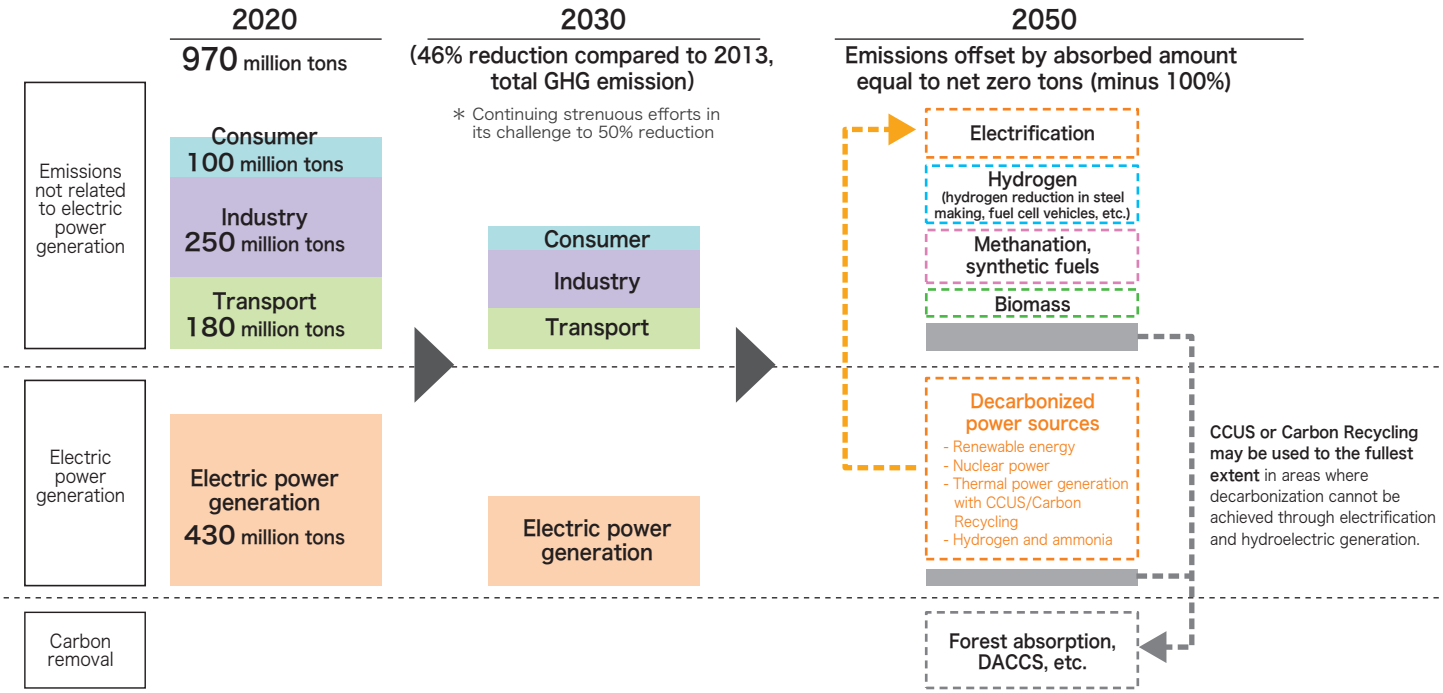


- Countries/regions working toward carbon neutrality (CN) by 2050*1:145
- 40.0% of the world's total CO_2 emissions are from these countries (2018 results*2)
- In addition, China (32.0%), Russia (2.5%), Indonesia (2.2%), and Saudi Arabia (2.0%) will join by 2060, and India (2.7%) will join by 2070. In this way, the movement to set carbon-neutral targets is expanding. (89.4% of the world's total CO_2 emissions are from these countries.)

■ Countries agreeing with the principle of achieving carbon neutrality by 2050 (145 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) 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 October 2022)
* 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



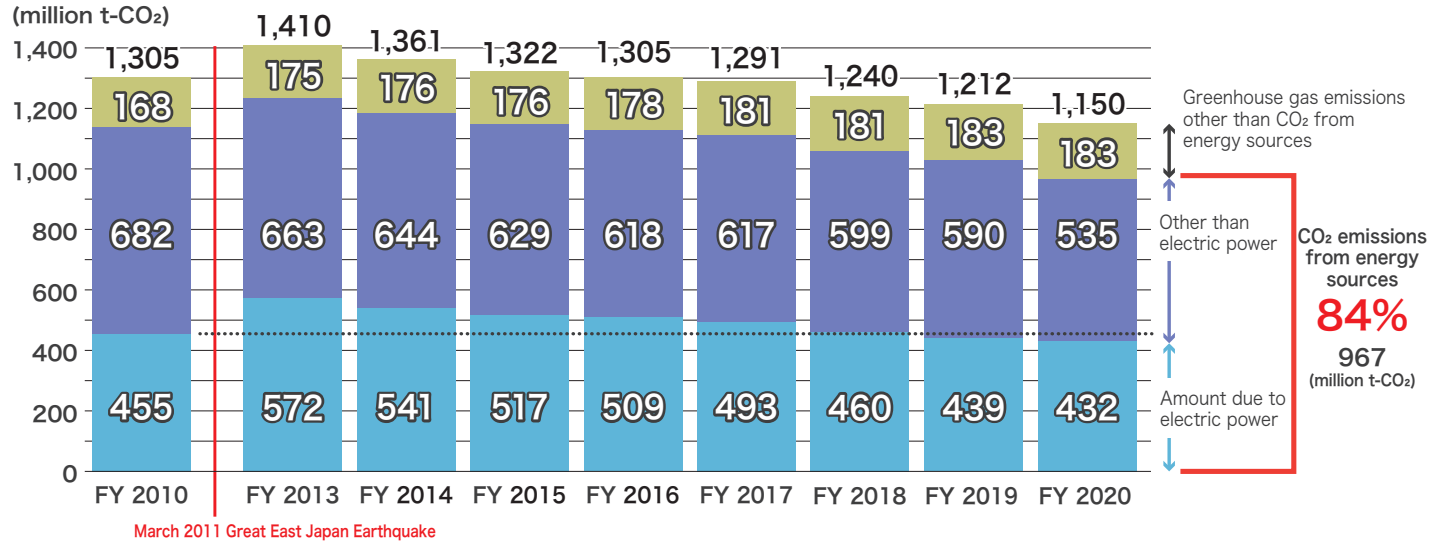
* Values shown are the amounts of CO_2 derived from energy
DACCS (direct air capture with carbon storage): A technology that directly captures and stores CO_2 that already exists in the atmosphere.

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 2020, emissions dropped to 1.15 billion tons. Japan must continue working to reduce emissions.

Changes in Japan's greenhouse gas emissions



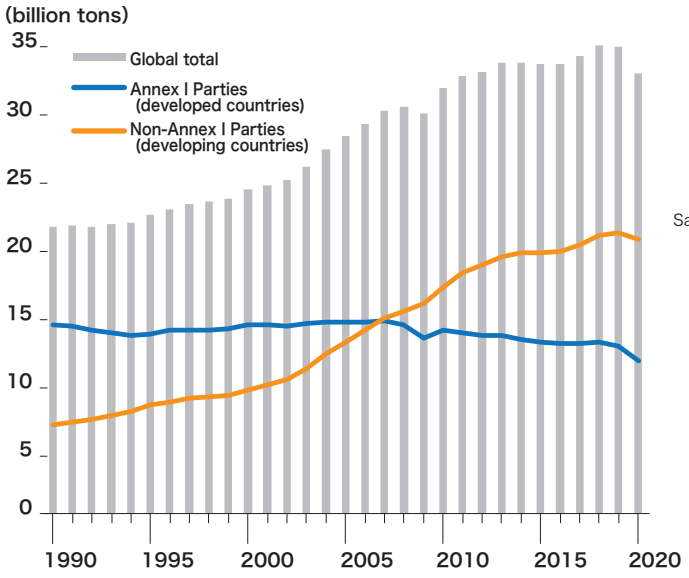
Source: Created based on the "Comprehensive Energy Statistics of Japan", published by the Agency for Natural Resources and Energy and "Calculation results for the amount of greenhouse gas emissions in Japan", published by the Ministry of the Environment.

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

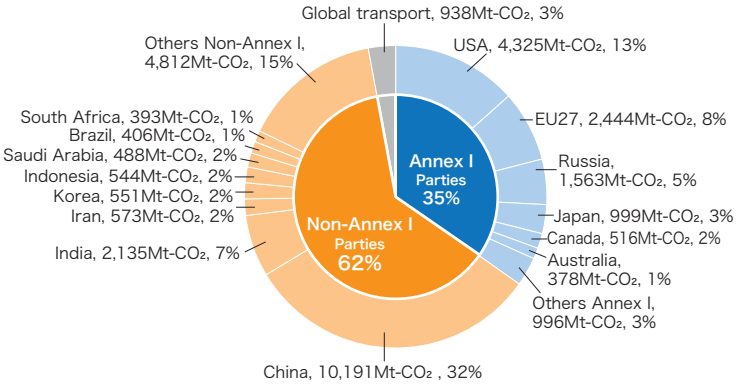
Column: Outlook for global CO_2 emissions

The recent increase in global 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 2020). Japan accounts for about 3% of global emissions. It is believed that global emissions will not improve 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 (2020)



Source: IEA "GHG Emissions from Energy 2022"

Aiming for carbon-neutral and environmentally friendly plastics

The issue of marine pollution resulting from improper disposal of plastics is drawing attention, and efforts are advancing to reduce the use of such plastics. Research and development are underway to address the environmental problems related to plastics.

https://www.enecho.meti.go.jp/about/special/johoteikyo/plastics_01.html

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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 In June 2020, a Cabinet decision was made to enact the Act of Enhancing Energy Supply Resilience, and a partial revision of the Electricity Business Act was made.
They will help to enhance collaborations in case of natural disasters, enhance resilience of the electricity transmission/distribution networks, and build disaster-resilient, distributed power systems.

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

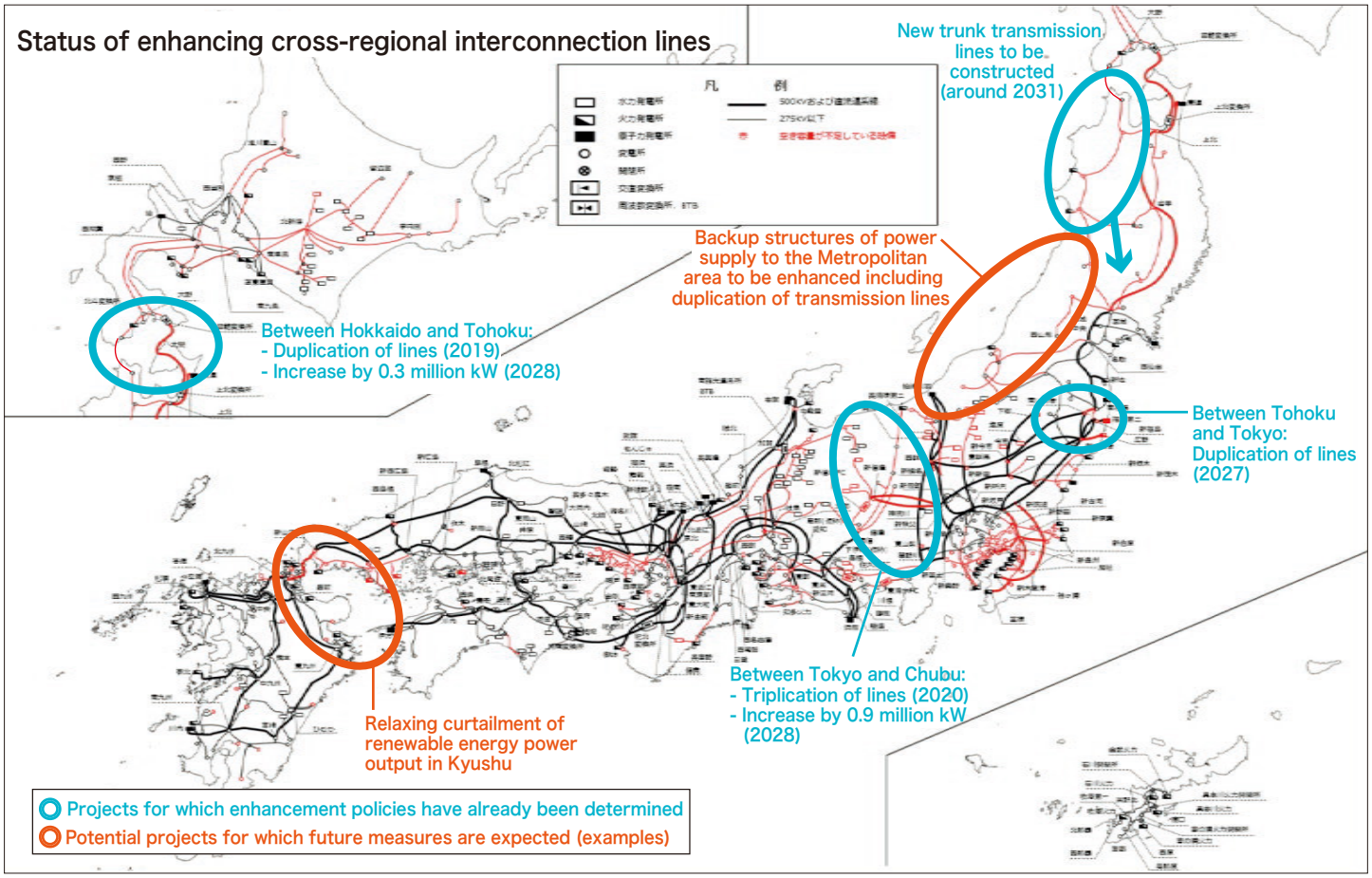
Act for Enhancing Energy Supply Resilience

The Act for Enhancing Energy Supply Resilience is formally named “the Act of Partial Revision of the Electricity Business Act and Other Acts for Establishing Resilient and Sustainable Electricity Supply Systems”. As stated in the name (“the Electricity Business Act and Other Acts”), this act contains partial revisions not only for the act governing the electricity business, which is called “the Electricity Business Act,” but also for “the Act on Special Measures Concerning Procurement of Electricity from Renewable Energy Sources by Electricity Utilities” (“the Act on Renewable Energy Special Measures”) and “the Act on the Japan Oil, Gas and Metals National Corporation” (“JOGMEC Act”).

The Electricity Business Act | The Act on Renewable Energy Special Measures | The JOGMEC Act

Effort 1: Enhancing the resilience of electric power infrastructure

In the context of potential risks of large-scale disasters, such as massive typhoons or earthquakes directly beneath the Tokyo Metropolitan Area, as well as increasing demands for decarbonization, it is essential to drastically enhance the resilience of electric power networks in Japan. There is also a high demand to make the transition to next-generation networks suitable for the introduction of large volumes of renewable energy. We will strive to duplicate the nationwide networks to enhance the backup structure for those systems and ensure the resilience of the power infrastructure.

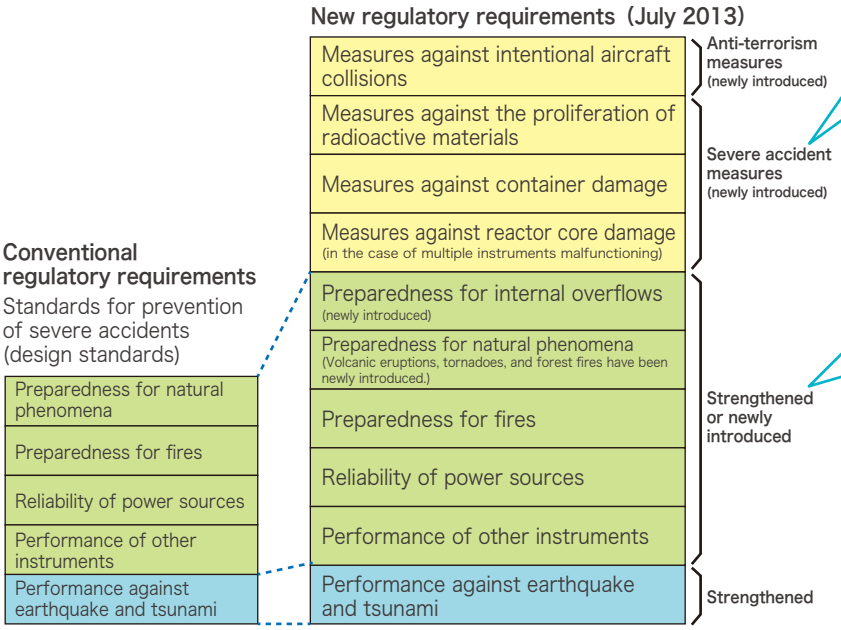


Source: Interim report for building next-generation power networks (Published on September 3, 2021)

Resilience: means sturdiness, recuperative power or elasticity.
Cross-regional interconnection lines: power transmission lines, frequency converters and AC/DC converters that connect different control areas, allowing the exchange of power across area borders.

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.



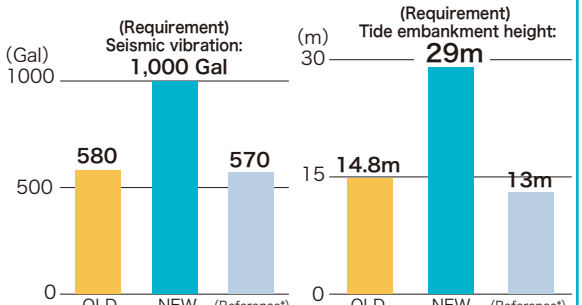
Source: Documents of the Nuclear Regulation Authority.

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 (11.3% in FY2020)

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.

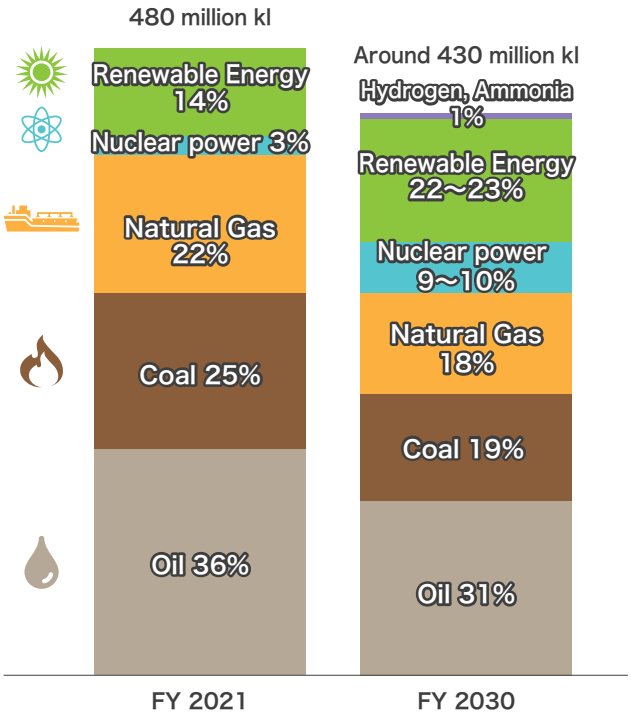
* Reduction target for all greenhouse gases including CO_2 from non-energy sources, etc.

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

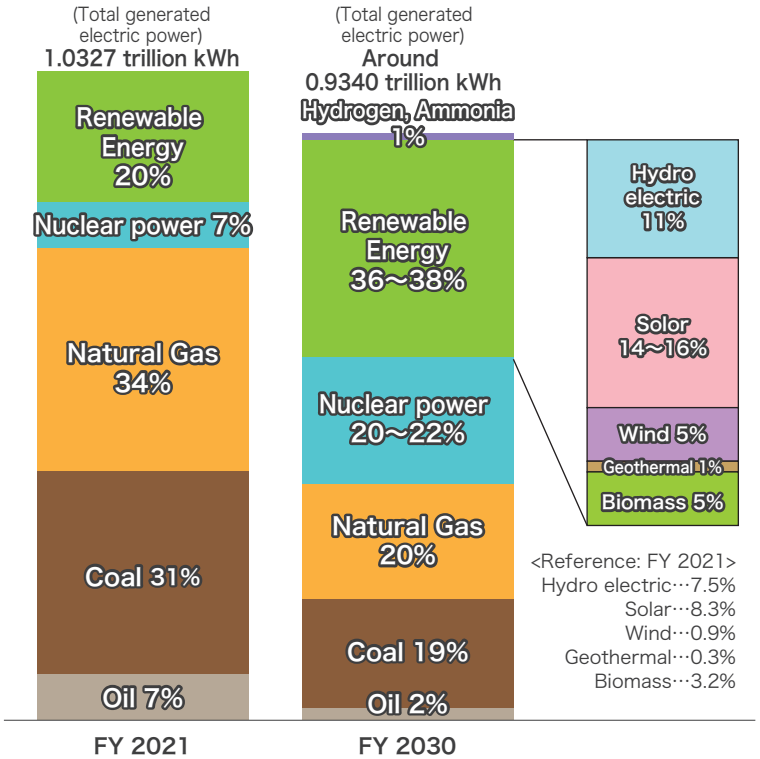
A The figure show the outlook for energy supply and demand* in FY 2030 (energy mix).

* 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



Source: "Comprehensive Energy Statistics of Japan"; 2021 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, Ammonia

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.

Production

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

Domestic renewable energy

Demonstrated production of hydrogen using electricity from solar power generation

(Source: Toshiba Energy Systems)

Import of hydrogen from outside Japan

Demonstration projects of hydrogen production from brown coal in Australia, marine transportation of liquefied hydrogen from Australia to Japan, and marine transportation from Brunei to Japan using the hydrogen carrier MCH

Japan-Brunei supply chain business unit: **AHEAD**

Japan-Australia supply chain business unit: **HySTRA**

Hydrogenation plant built in Brunei

World's first hydrogen carrier "Suiso Frontier"

Transport and supply (supply chain)

Support for construction of hydrogen stations

Use

Transport — Support for FCVs

General — Support for FC

ENE・FARM

Fuel cell combined power generation system [HYBRID-FC]

Power gen. — Consideration of hydrogen power

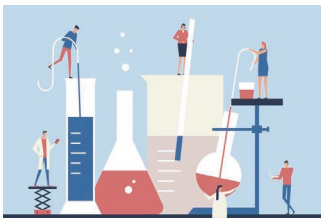
(Source: Mitsubishi Heavy Industries, Ltd.)

Industry — Hydrogen utilization and development in industrial processes

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



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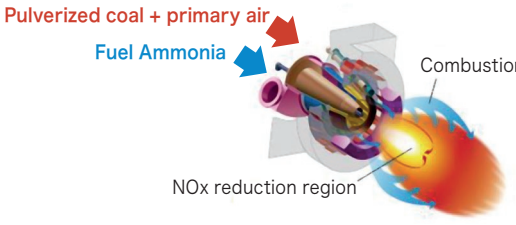
Efforts to utilize fuel ammonia

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 developing the only technology in the world 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 CO_2 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.

https://www.enecho.meti.go.jp/about/special/johoteikyo/ammonia_01.html

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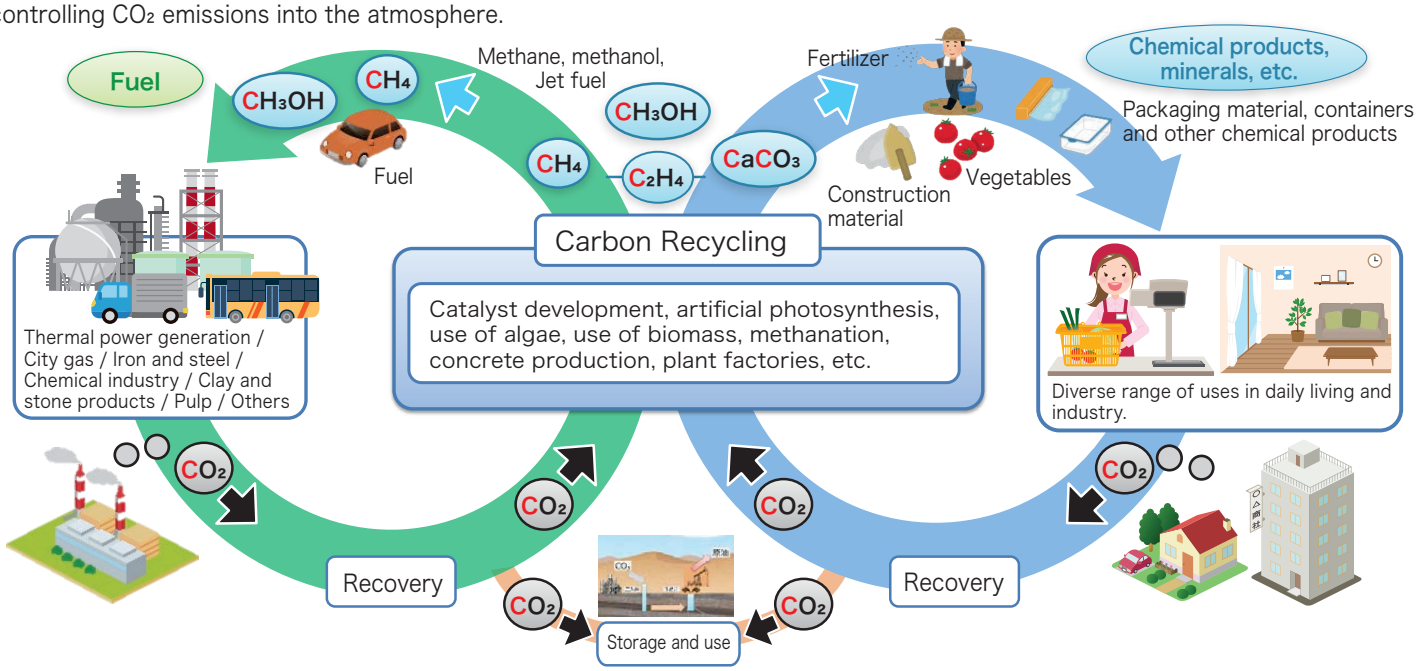
6. Innovation

Development of technology to reduce CO_2 emissions

Carbon Recycling (reuse of CO_2)

This is a technology used for capturing CO_2, and utilizing it as a raw material resource in concrete, plastics or others thereby controlling CO_2 emissions into the atmosphere.



Dream technology for CO_2 emissions reduction — Development and implementation of Carbon Recycling

"Carbon Recycling" technologies hold the key to achieving carbon neutrality. We are striving to quickly implement these technologies by carrying out intensive projects at the R&D and Demonstration Base for Carbon Recycling that was established in FY2022.

【What is Carbon Recycling?】

https://www.enecho.meti.go.jp/about/special/johoteikyo/carbon_recycling2021.html

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

【R&D and Demonstration Base for Carbon Recycling】

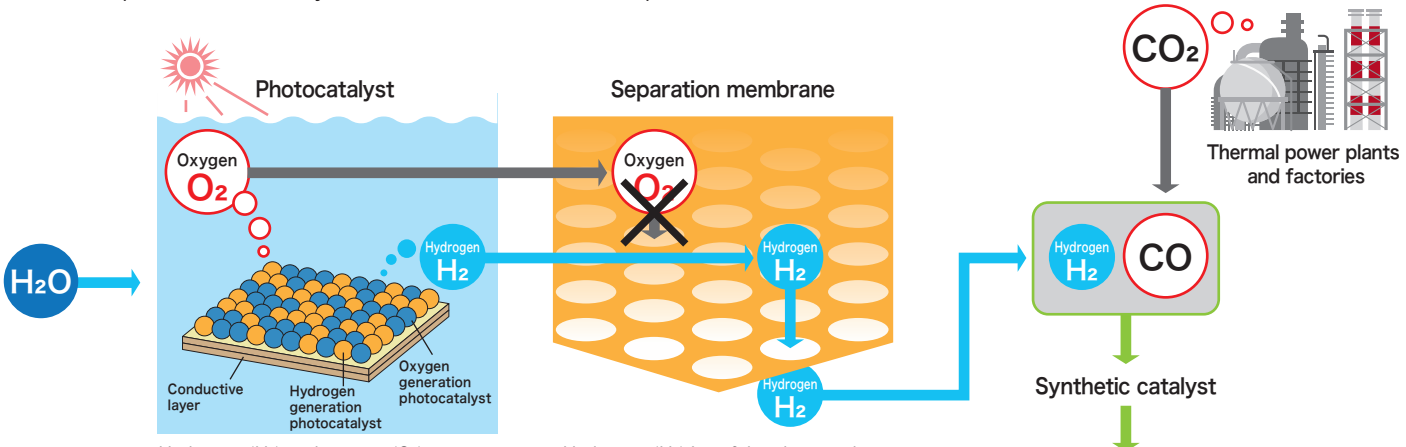
https://osakikamijima-carbon-recycling.nedo.go.jp

(Osaki-kamijima, Hiroshima Prefecture)

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

Artificial photosynthesis

This technology attempts to utilize CO_2 in the chemical industry, which manufactures raw materials for familiar products such as plastics. Japan leads the world in the technology of artificial photosynthesis using photocatalysts. This technology is currently under development via industry-academia collaboration in Japan.



Hydrogen (H_2) and oxygen (O_2) are produced with high efficiency by a photocatalyst that receives sunlight and decomposes water (H_2O).

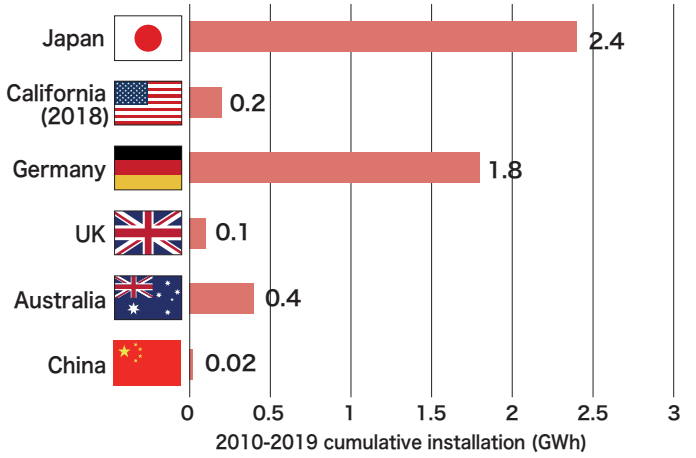
Hydrogen (H_2) is safely taken out by the separation membrane (using the difference in size between hydrogen and oxygen).

Practical Application of Innovation

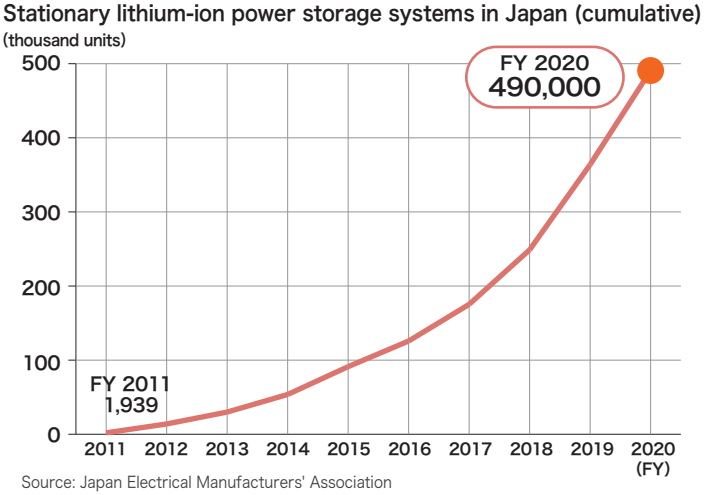
Widespread use of power storage systems

Japan is leading the way in technological development and dissemination of power storage systems in its efforts to expand the use of fuel cells and Ene-Farms.

Installation record of home power storage systems in major markets



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

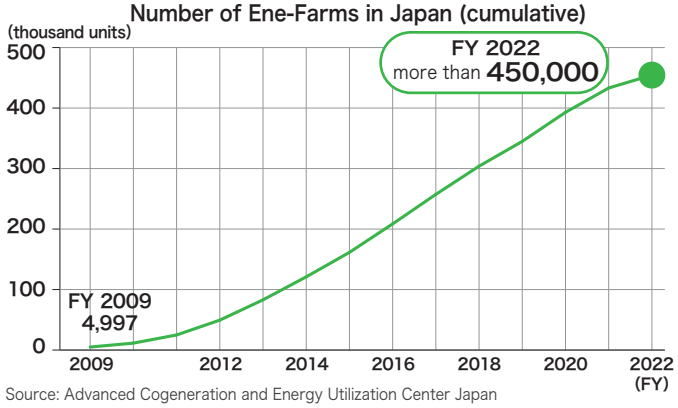
ENE・FARM

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 2022, more than 450,000 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.

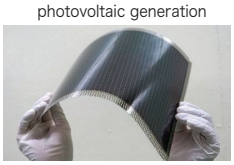
https://www.enecho.meti.go.jp/about/special/johoteikyo/nenryodenchi_01.html

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

Practical use of various technologies can reduce CO_2 emissions

Photovoltaic generation operable anywhere

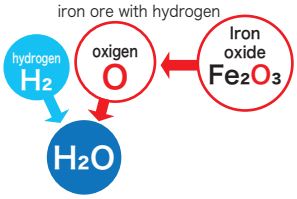
Flexible, lightweight, high-efficiency photovoltaic generation



Next-generation solar cells (perovskite solar cell)

Zero-Carbon steelmaking with CO_2-free hydrogen

Developing a technology for the reduction of iron ore with hydrogen

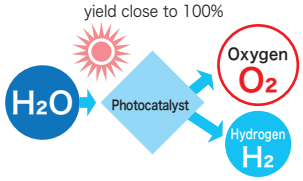


Producing materials such as concrete using captured CO_2

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

Artificial photosynthesis

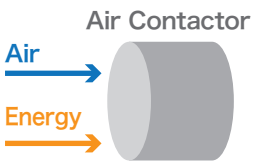
Developing the world's first photocatalyst that decomposes water with a quantum yield close to 100%



DAC

(Direct Air Capture of CO_2)

Developing technologies to capture CO_2 from the atmosphere and solidify it



Bio jet fuel

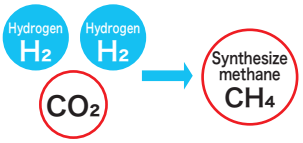
Developing next-generation electrified aircraft and establishing technologies to realize such aircraft

"CCS" to collect and bury CO_2

Demonstration test to be completed soon on using this technology to store CO_2 deep underground below the seabed

Methanation

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



7. Renewable Energy

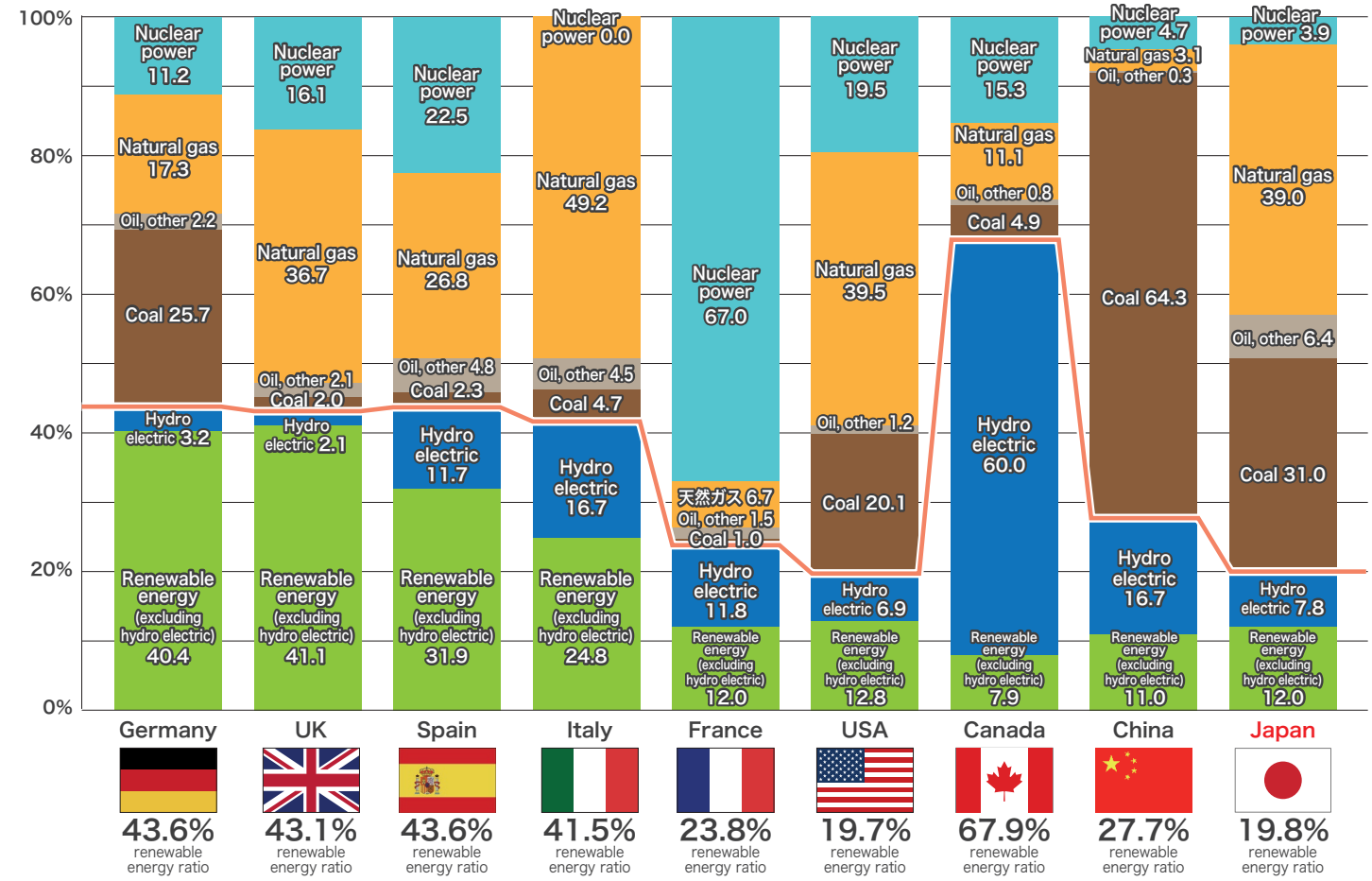
Introduction of Renewable Energy

Q Is Japan advancing the introduction of renewable energy?

A The percentage of renewable energy power in Japan was 19% in FY 2020.
Japan ranks 6th in the world in terms of renewable energy generation capacity, and 3rd in the world for solar power generation.

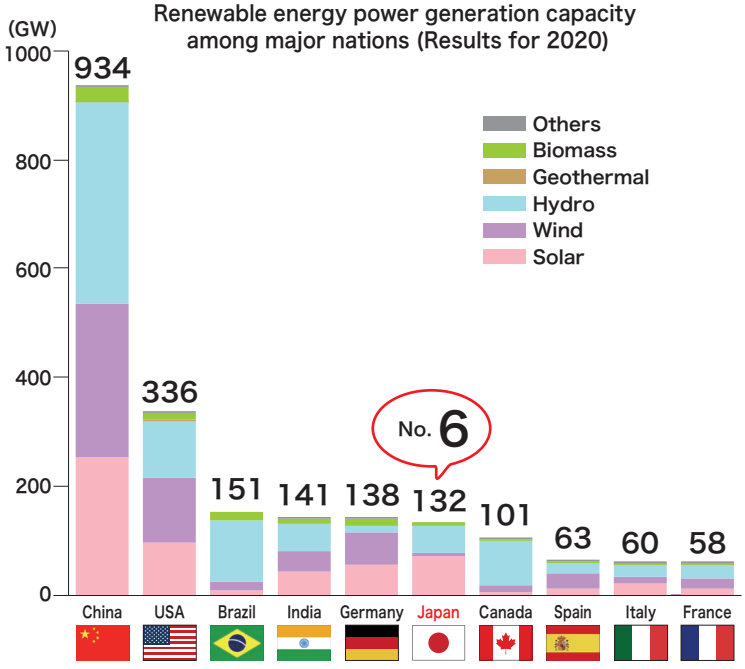
Comparison of percentages of renewable energy in total power generation in major nations

(Percentage of total generated power)

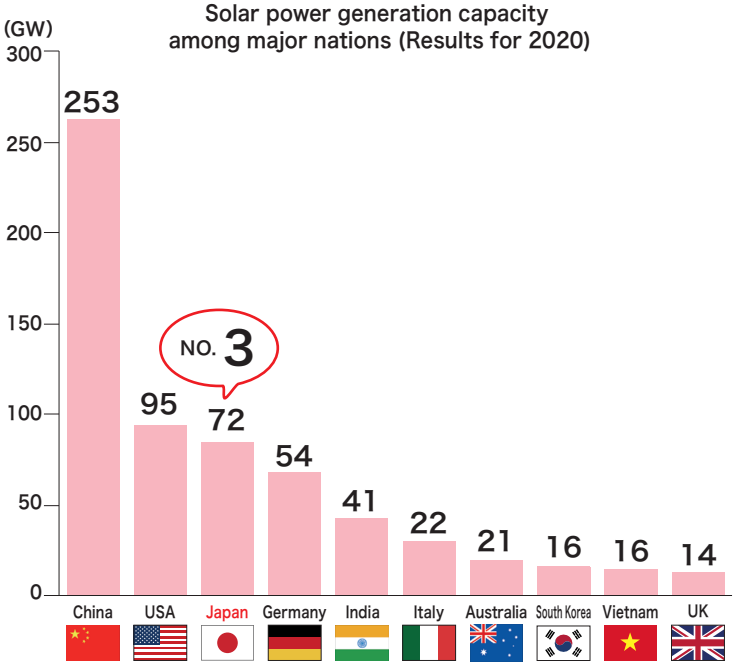


Source: Created by the Agency for Natural Resources and Energy based on the IEA "Market Report Series—Renewables 2021" (Power Generation in Each Country as of 2020), IEA database, and the Comprehensive Energy Statistics of Japan (FY2020 confirmed figures).

Renewable energy power generation capacity among major nations (Results for 2020)



Solar power generation capacity among major nations (Results for 2020)



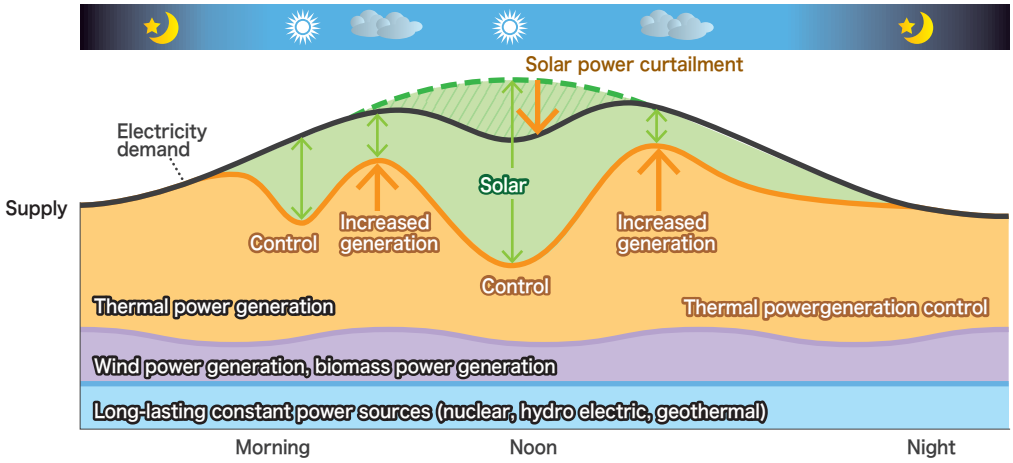
Source: Created by the Agency for Natural Resources and Energy based on the IEA "Renewables 2021"

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.

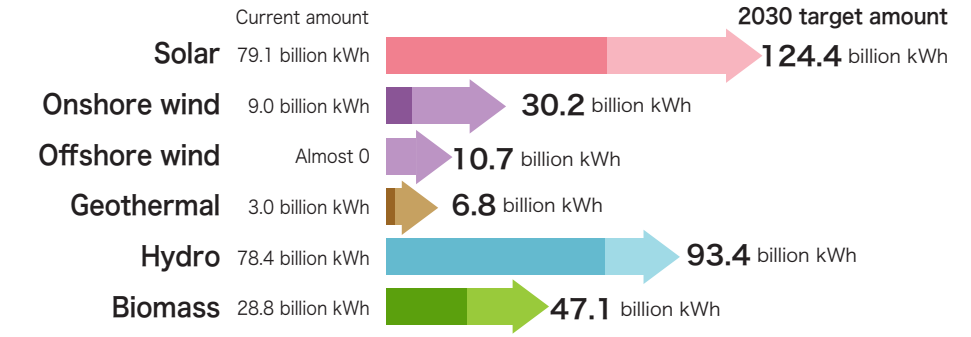
Supply/demand situation on the lowest demand day (such as a sunny day in May)



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 In the energy mix for 2030, the goal is to utilize renewable energy to contribute 330 to 350 billion kWh. While maximizing the introduction of renewable energy, such as utilizing not only solar power generation but also wind power generation and promoting the introduction of ZEH in newly built houses, policies will also be implemented to minimize safety concerns and environmental impacts.



+ Strengthening policies to promote introduction of renewable energy

- Introducing more wind power by reinforcing the networks
- Achieving ZEH targets for newly built houses, etc.

Regarding solar power, safety concerns about potential damage caused by disasters and issues related to the coordination with the local community regarding the impact on the landscape and environment have become apparent. As a result, there is a movement among some local municipalities to establish ordinances to require that notification be filed when developing systems larger than a certain size.


Examples of damage to solar power generation equipment caused by disasters

Cases affecting the landscape

Here's more about the 6th Strategic Energy Plan Renewable energy (1)–(5)

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/about/special/johoteikyo/energykihonkeikaku2021_kaisetu01.html

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

8. Reconstruction of Fukushima

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

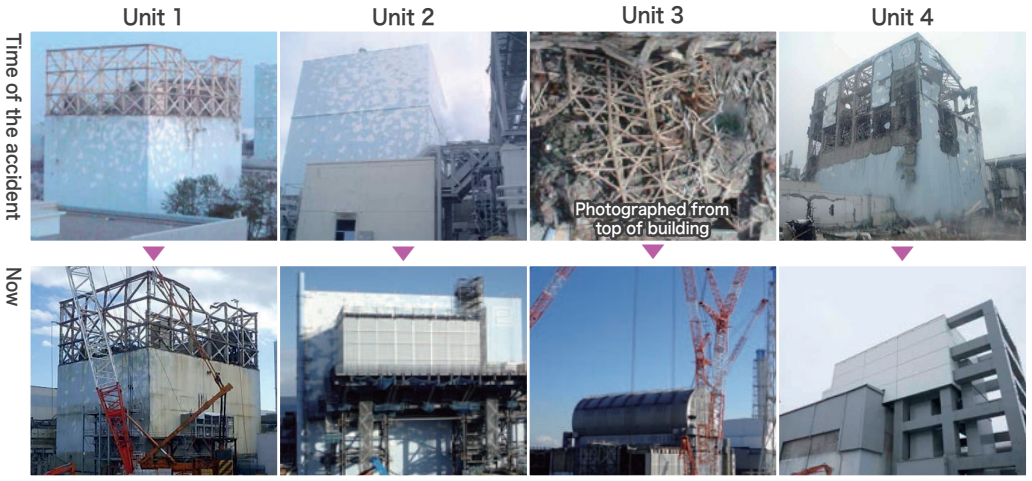
Q Are decommissioning contaminated water and treated water management at FDNPS progressing?

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 rubble removal, decontamination, and other measures are being carried out toward fuel removal from the spent fuel pools.
Japanese and UK companies are jointly developing a robot arm for retrieval of fuel debris (melted and solidified fuel). Starting in February 2022, they have been proceeding with equipment testing and operation training at a mock-up reactor simulation facility in Naraha, Fukushima Prefecture. In the future, as soon as preparations are complete, trial retrieval will start using a second unit to steadily expand the scale of the work.

(Current conditions of each reactor)

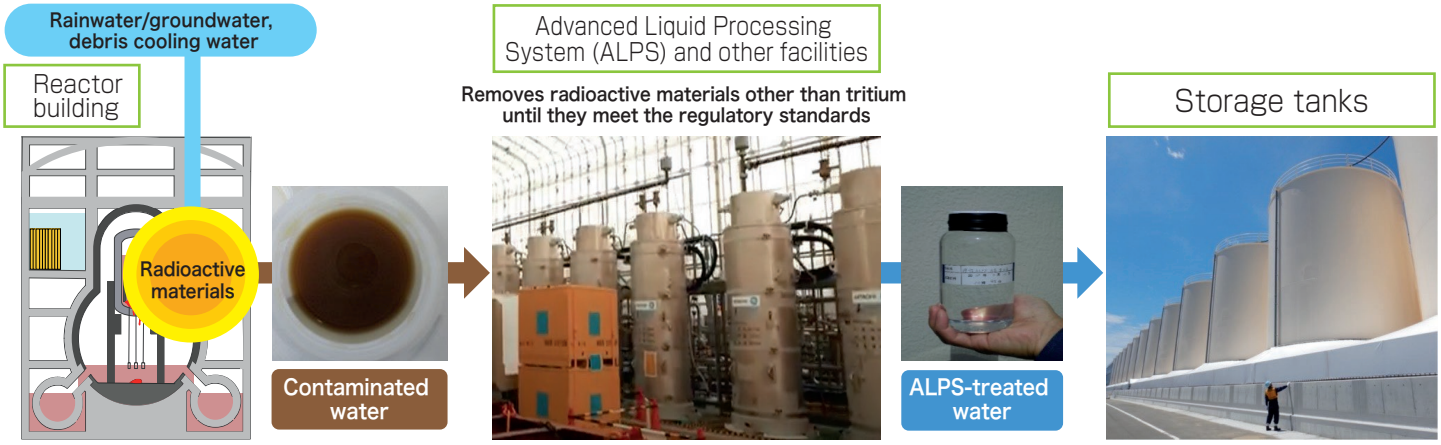


Status of fuel removal from the spent fuel pool

Unit 1	Unit 2	Unit 3	Unit 4
0/392 (Start from FY 2027 - FY 2028)	0/615 (Start from FY 2024 - FY 2026)	566/566 (Completed in Feb. 2021)	1535/1535 (Completed in Dec. 2014)

Countermeasures for contaminated water and treated water

The amount of contaminated water generated per day at the FDNPS has been reduced to around 1/4 of the initial amount through multi-layered countermeasures (such as frozen-soil walls). Contaminated water is treated using multiple purification facilities that remove as many of the radioactive materials as possible before the water is stored in tanks.
Currently, these tanks and their piping equipment occupy a large area of the site, and if this situation is not changed, they may become a major obstacle to the future decommissioning work. Under such circumstances, on April 2021, the Government of Japan announced its basic policy, based on which preparation will be started for discharging the ALPS treated water into the sea in about two years, on the premise that strict compliance with various laws and regulations is ensured and that all measures are taken to minimize adverse impacts on reputation. Going forward, the government as a whole will work to eliminate people’s concerns.



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

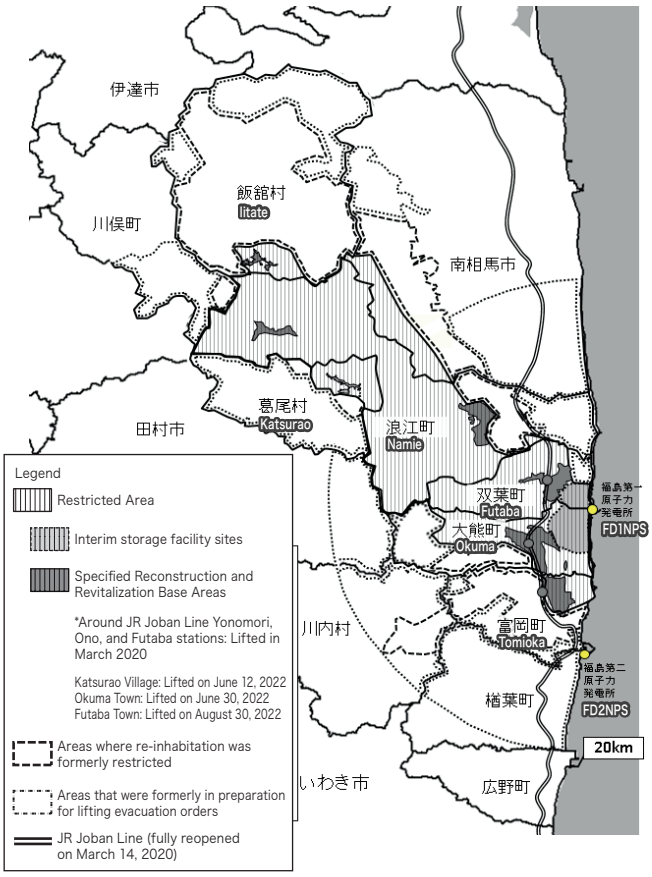
Use this QR code to view the article. (Japanese only)

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 stations was 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 Katsurao Village and Okuma Town were lifted in June 2022, and in Futaba Town in August 2022, which allowed residents of the Restricted Area return to their homes for the first time.
For the remaining Tomioka Town and Namie Town, and Iitate Village, preparations are underway with the goal of lifting evacuation orders around spring this year.
Also, for the areas outside the Reconstruction and Revitalization Base Areas, based on the government policy of August 2021, we will work to lift the evacuation orders over the 2020s, so that residents with the intention to return can do so.

Areas under evacuation orders (as of August 30, 2022)



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 and development. 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, 70 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	1,055	0	–
Vegetables /fruits	2,091	0	–
Livestock products	3,682	0	–
Cultivated plants /mushrooms	628	0	–
Marine seafood	3,956	1	0.03%
Fish from inland fisheries	46	0	–
Edible wild plants /mushrooms	664	0	–
Fish in rivers and lakes	401	2	0.5%

Status of monitoring inspections for agricultural, forestry and fishery products
(April 1, 2021 - March 31, 2022)

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. Fish in rivers and lakes that exceed the standard values are items for which the government has already imposed restrictions on shipment.

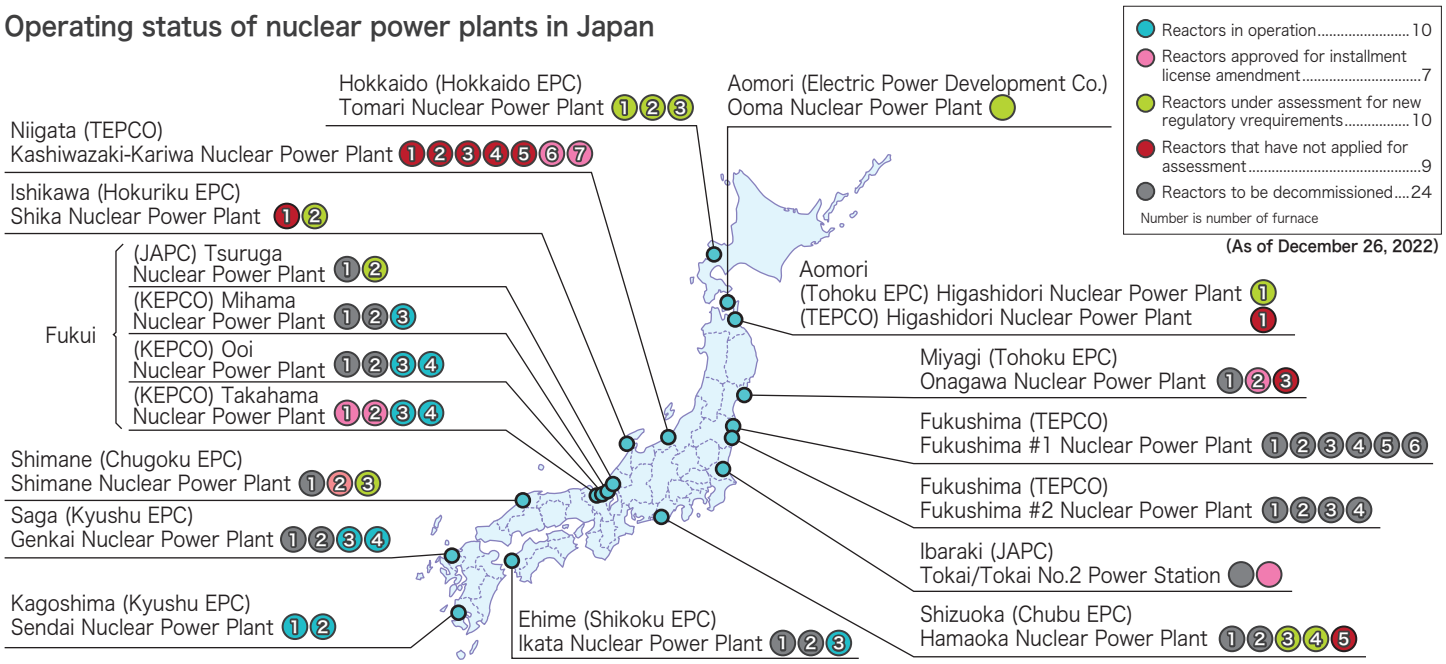
9. Nuclear Power

Operational Status of Nuclear Power Plants

Q Is nuclear power generation necessary?

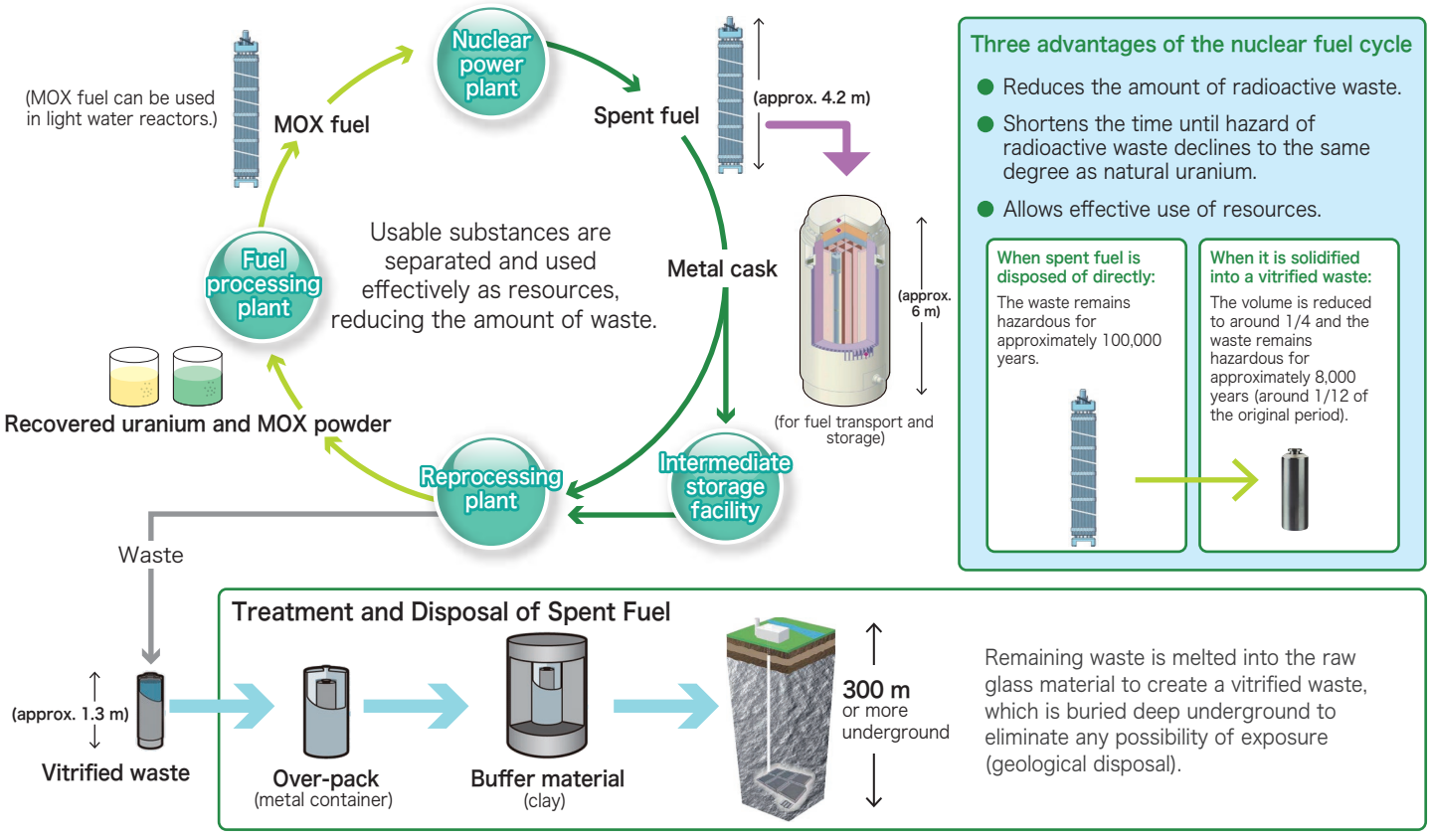
A For a country with limited natural resources, nuclear power generation is essential in order to achieve the following three objectives: (1) securing a stable supply of power; (2) curbing electric power costs; (3) reducing greenhouse gas emissions. In order for nuclear power plants to be restarted, they are required to conform with new regulatory requirements that prioritize safety.

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.

Classification of area into 4 colors based on scientific features

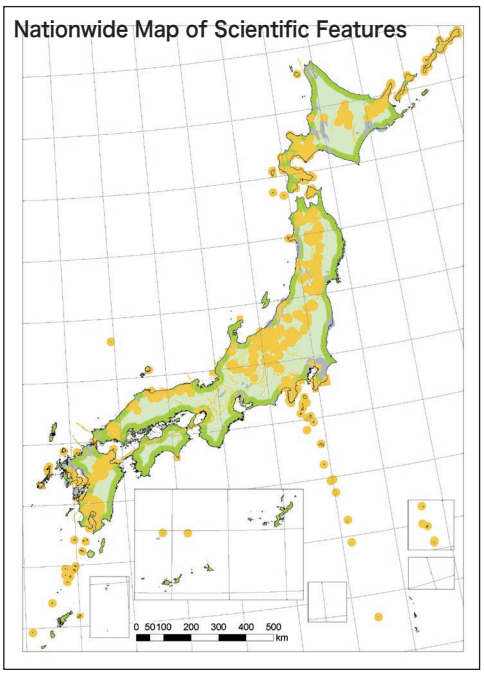
- Orange: Areas close to a volcano, active fault, etc.
- Silver: Areas with underground mineral resources
- Green: Areas assumed to be favorable
- Dark green: Areas assumed to be preferable also from the viewpoint of safe waste transportation

＊ 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.

Read more about a map

Use this QR code to view the article.

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



Read more about the literature survey

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

Since the Nationwide Map of Scientific Features was published, public dialogue sessions with local people have been held throughout Japan. Building on these past efforts, dialogues will continue to be held across Japan aiming to conduct literature survey in as many areas as possible.

No radioactive substances will be brought into the target area during the investigations period which is expected to be approximately 20 years.

- Nationwide Map of Scientific Features published (July 2017)
- Public dialogue sessions throughout Japan
- Provision of information to meet the needs of interested parties and stakeholders
- **Literature Survey**
  - Application by local governments or proposals from the national government accepted by local governments
  - (Desk study)
- Selecting sites for the preliminary investigation
- **Preliminary Investigation**
  - (Borehole investigation)
- Selecting sites for the detailed investigation
- **Detailed Investigation**
  - (Investigations and experiments in underground facilities)
- Selecting a planned site of facilities

Hearing of opinions from the community (not to advance without community consent))

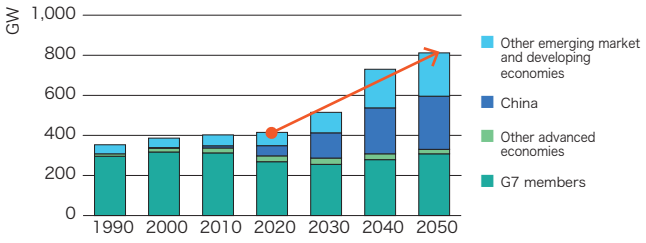
Hearing of opinions from the community (not to advance without community consent))

Hearing of opinions from the community (not to advance without community consent))

Column: Nuclear power perspectives in the world

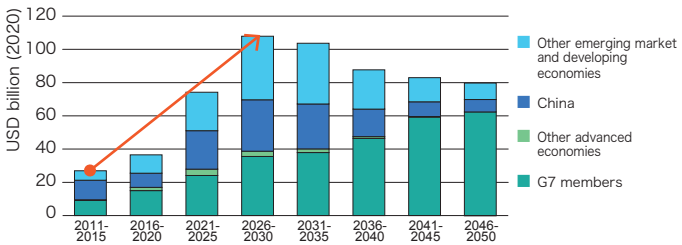
According to an analysis by the International Energy Agency (IEA), there will be an increasing need for constructing new nuclear power plants and expanding related investment in order to achieve net-zero emissions by 2050 in various countries and regions around the world.

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



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.

Global average annual investment in nuclear power in the Net-Zero Emissions by 2050 Scenario



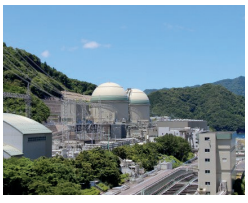
Global investment in nuclear power will surge from $30 billion in the 2010s to more than $100 billion in 2030. Developing countries will need investment until 2035. By 2050, investment will gradually shift to developed countries. Those developed countries will increase investment to extend the life of existing reactors and to build new reactors.

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

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/about/special/johoteikyo/energykihonkeikaku2021_kaisetu07.html



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

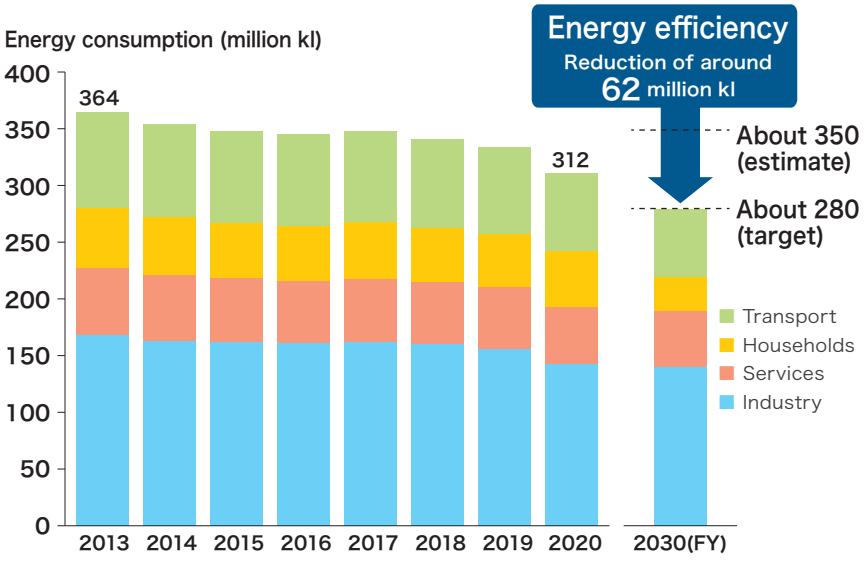
10. Energy Efficiency

Improving Energy Efficiency

Q How much energy efficiency has Japan accomplished?

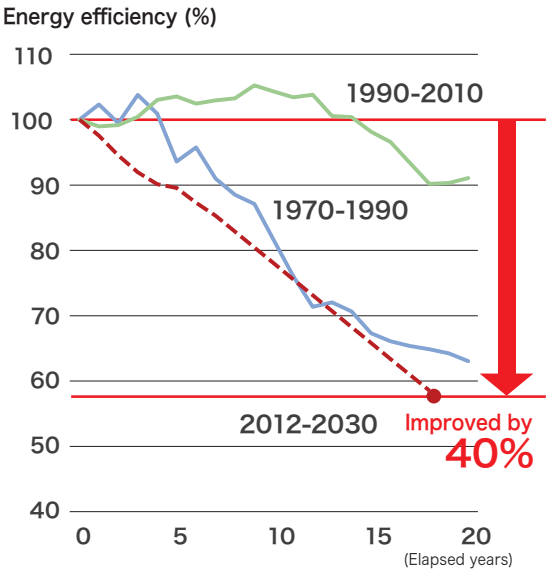
A Japan has strengthened its efforts to improve energy consumption efficiency and achieved a reduction in energy consumption by about 62 million kl crude oil equivalent.
The goal is to improve energy consumption efficiency by about 40%, to reach an all-time high level.

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

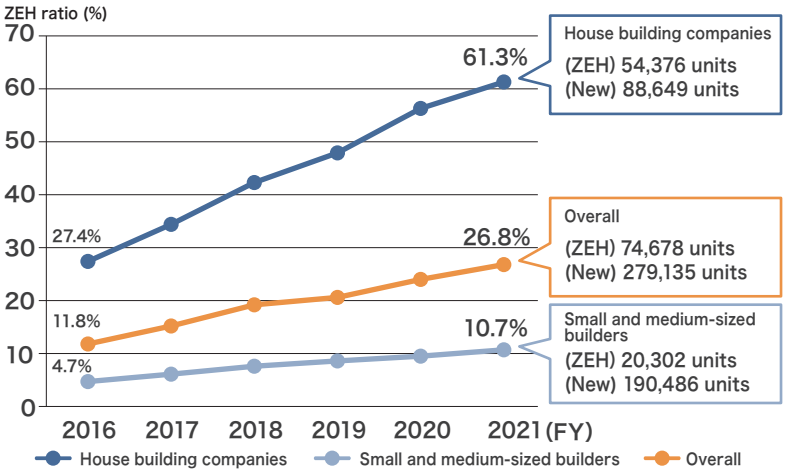


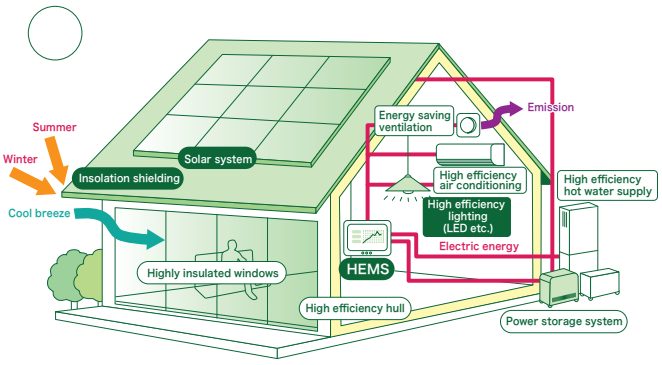
∗ Assuming energy efficiency in 1970, 1990, and 2012 to be 100
∗ Energy efficiency = Final energy consumption / Real GDP

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.

Energy conservation/efficiency improvement portal site

This special site introduces Japan's energy conservation/efficiency improvement policies, reference information, energy-saving practices that everyone can try at home, related subsidies, and information on how to choose products with improved energy efficiency.

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

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

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