JAPAN'S ENERGY 2019

10 questions 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
How much greenhouse gas is being emitted?

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

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

6 Innovation and Energy Efficiency
Are programs being implemented for research & development and energy efficiency?

7 Renewable Energy
Is progress being made in introducing renewable sources of energy?

8 Reconstruction of Fukushima
How is the progress of the reconstruction of Fukushima?

9 Nuclear Power
Is nuclear power generation necessary?

10 Mineral Resources
What kinds of mineral resources are used?

経済産業省
資源エネルギー庁
Ministry of Economy, Trade and Industry
Agency for Natural Resources and Energy

Use this QR code to view the article.

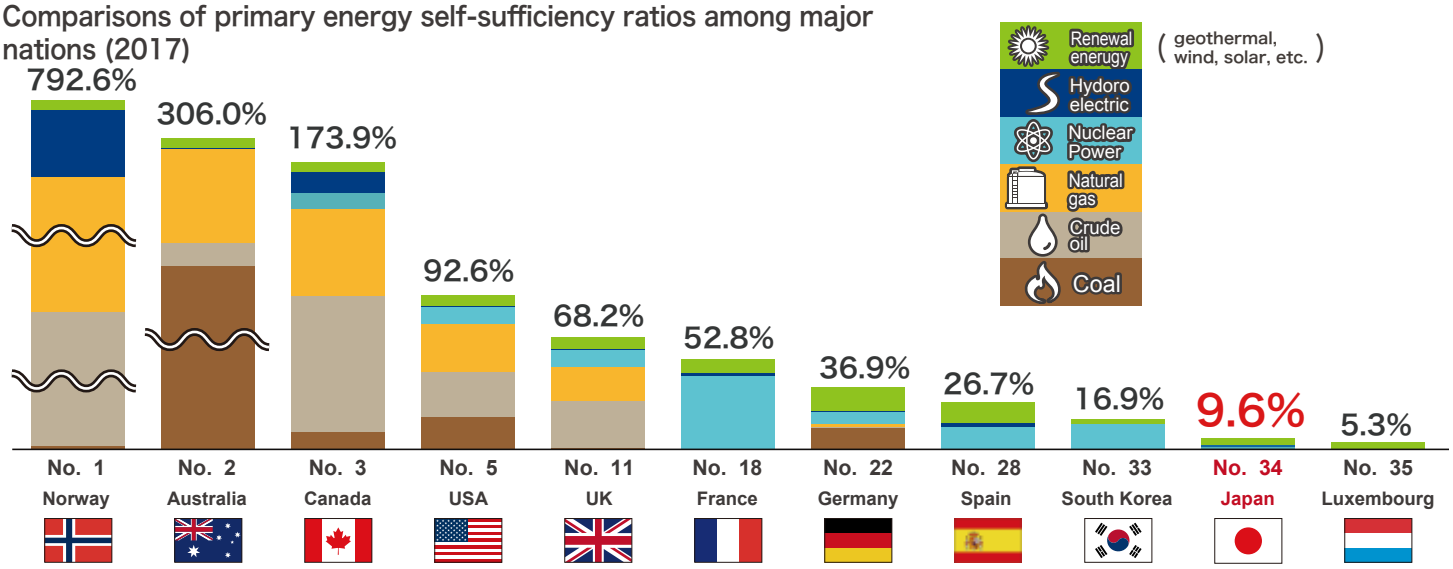
1. Energy Security

Changes in Energy Self-Sufficiency Ratio

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

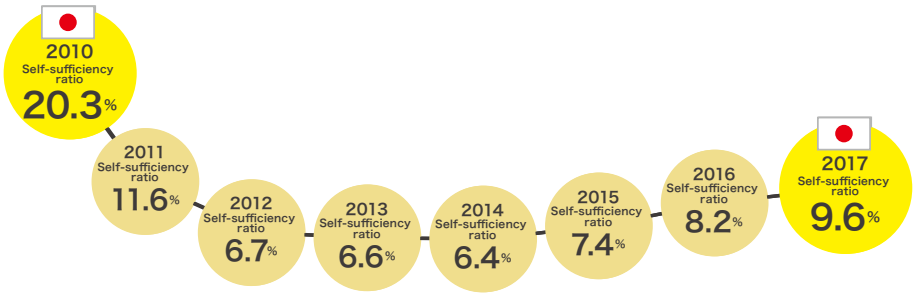
A In 2017, Japan's self-sufficiency ratio was 9.6% -- lower than other OECD countries.

Comparisons of primary energy self-sufficiency ratios among major nations (2017)



Source: 2017 estimates from IEA "World Energy Balances 2018". For Japan only, FY 2017 figures are from "Comprehensive energy statistics of Japan", Agency for Natural Resources and Energy. ＊The ranks in the table are those of the 35 OECD member countries.

Energy self-sufficiency ratio in Japan

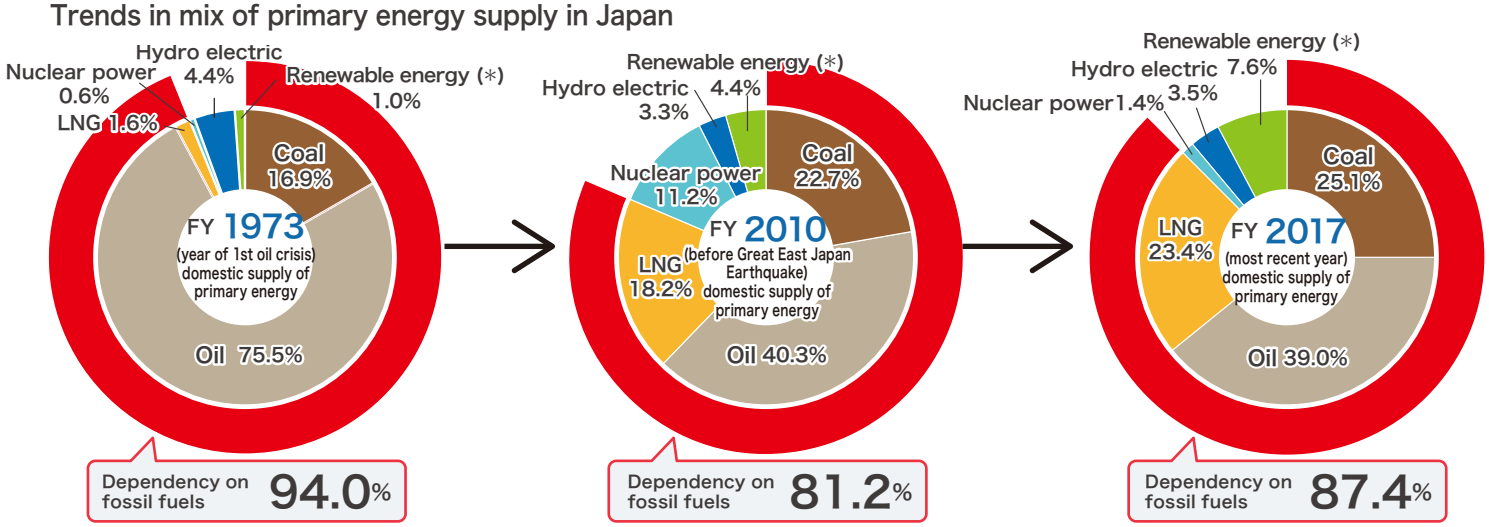


Primary energy sources: Oil, natural gas, coal, nuclear power, solar power, wind power, and other energy in their original forms.
Energy self-sufficiency ratio: Of the primary energy sources required for daily life and economic activity, this is the ratio that can be secured within one's own country.

Q What sources of energy does Japan depend on?

A Japan is largely dependent on oil, coal, natural gas (LNG), and other fossil fuels that are imported from overseas. Following the Great East Japan Earthquake, Japan's dependence on fossil fuels increased and was 87.4% in 2017.

Trends in mix of primary energy supply in Japan



Source: "Comprehensive energy statistics of Japan", Agency for Natural Resources and Energy
＊The total may not be 100% due to rounding.
＊Renewable energy here includes unused energy (geothermal power, wind power, solar power, and others, however, hydroelectric power is excluded).

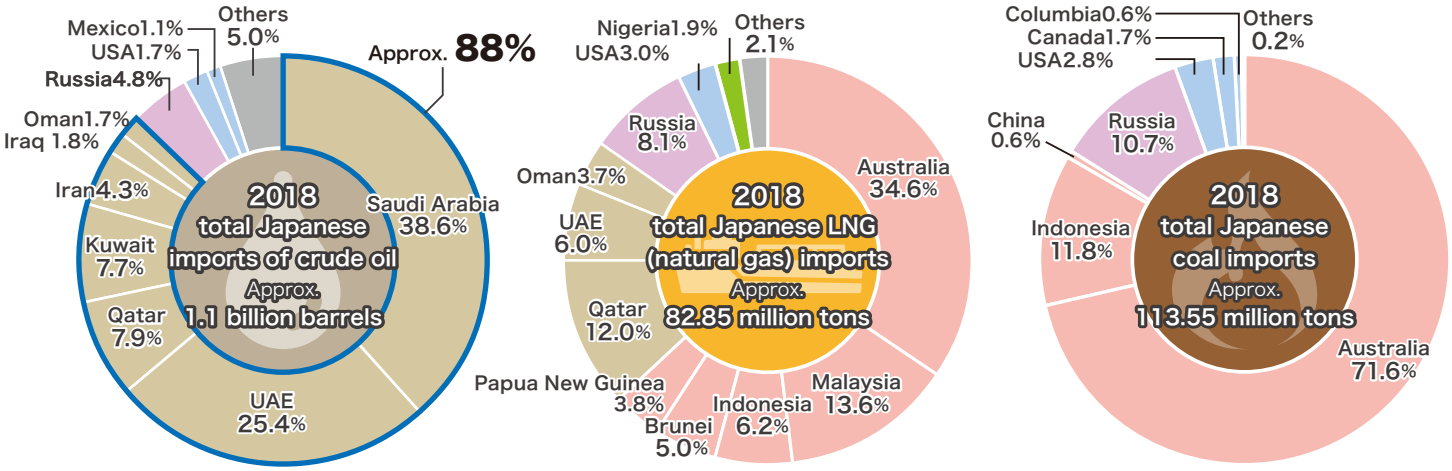
Resource Procurement Status

Q What countries does Japan import fossil fuels from?

A **Japan depends on the Middle East for around 88% 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 (2018)

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

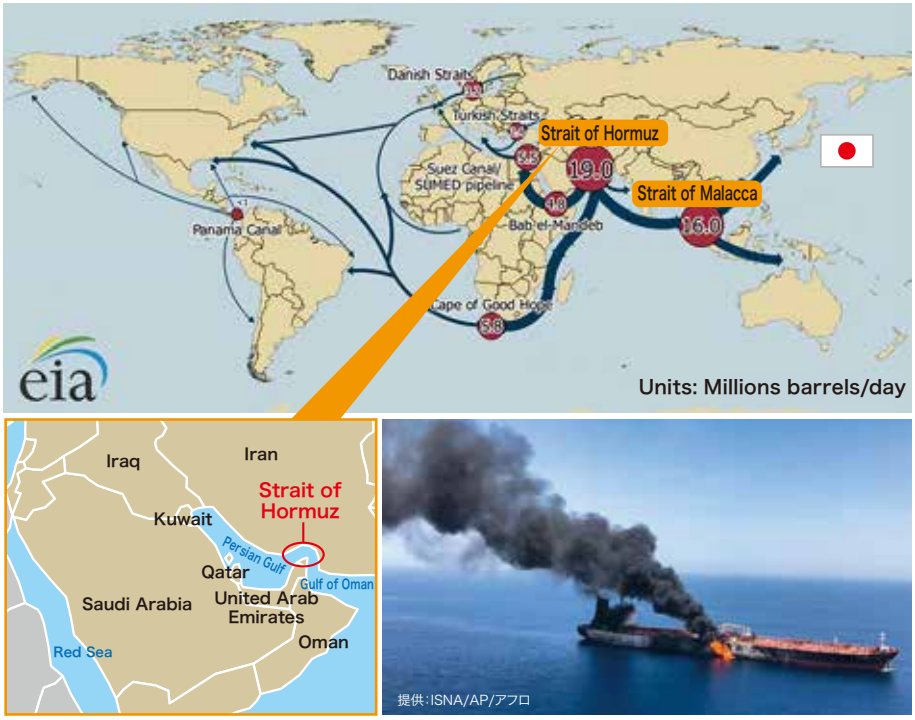


Source: "Trade statistics of Japan", Ministry of Finance (Dependence on overseas sources is from "Comprehensive energy statistics of Japan".)

Efforts to secure a 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.

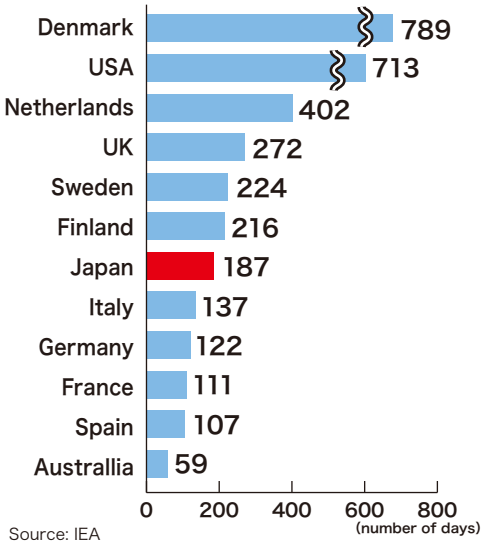
Column: Global crude oil trade and growing tensions in the Middle East

Global crude oil shipping routes and choke points (2016)



The Strait of Hormuz is an important shipping route. It is the largest single route for the transport of crude oil in the world, however, it is susceptible to the effects of Middle East tensions.
An oil tanker flying a Japanese flag was attacked in June 2019.

Oil stockpiling (number of days) of IEA member countries (2019)



Source: IEA
＊Numbers of days are calculated based on IEA standards. When calculated based on IEA standards, Japan's number of days is approximately 20% less than stipulated in the standards of the Oil Stockpiling Act. (Japan maintains a stockpile of 232 days when calculated based on the standards in the Oil Stockpiling Act.)

Oil is stockpiled in case it suddenly becomes difficult to obtain a supply of crude oil due to a destabilized political situation in the Middle East.

Crude oil choke points: These are key locations where large numbers of oil tankers pass through from countries all over the world pass through.
In the event that one of these points becomes impassable, global oil prices are expected to skyrocket.

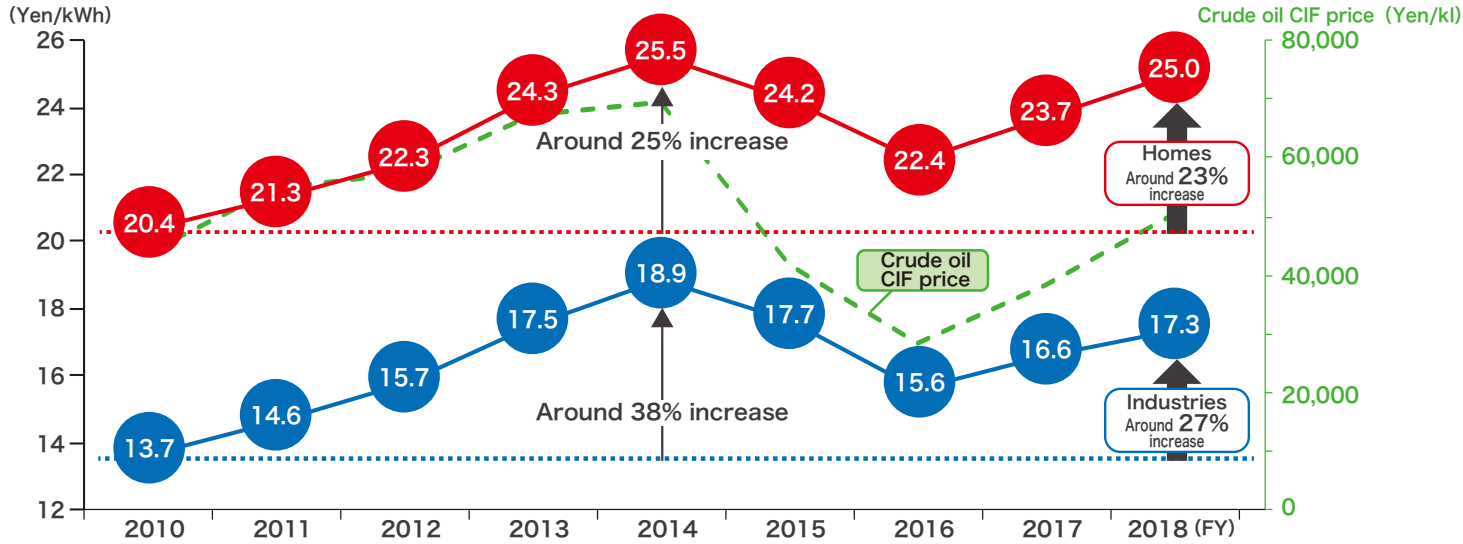
2. Economic Efficiency

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. Rates declined from FY 2014 to 2016 as a result of falling oil prices, but it is rising again.

Changes in average electric power rates



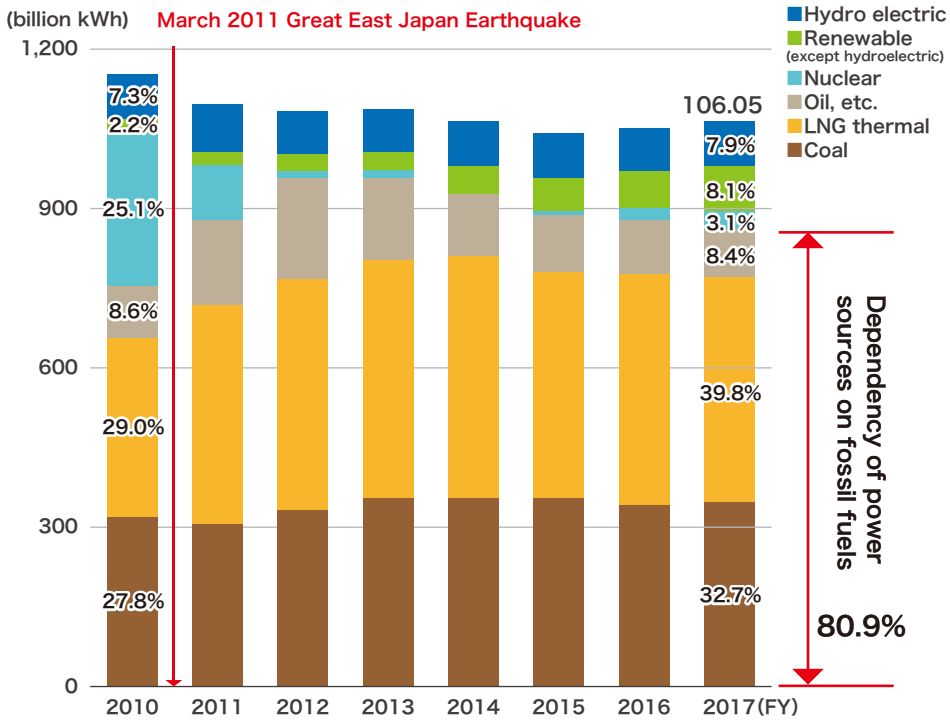
Source: Created based on monthly reports of generated and received electric power, and financial materials, of electric power companies.

Crude oil CIF price: Transaction price consisting of the import price plus related costs such as transport cost and insurance cost.

Changes in electric power rates

Compared with FY 2010 before the earthquake, electric power rates in FY 2014 showed a large increase of around 25% for homes and around 38% for industries. Aiming to increase the energy self-sufficiency ratio and create a mix of power sources that is resistant to changes in international oil prices, the government of Japan is working to stabilize electricity rates by various methods such as promoting competition between business operators through the full liberalization of the electricity retail market that was started in FY 2016, restarting nuclear power generation once safety has been ensured, and lowering the cost of renewable energy in order to increase its introduction.

Changes in the mix of power sources (supply) in Japan



Source: "Comprehensive energy statistics of Japan", Agency for Natural Resources and Energy

Global energy indicated by electric power rates

Energy is an important element that supports the lives and economic activities of the Japanese people. Electric power rates are one indicator when measuring economic efficiency.

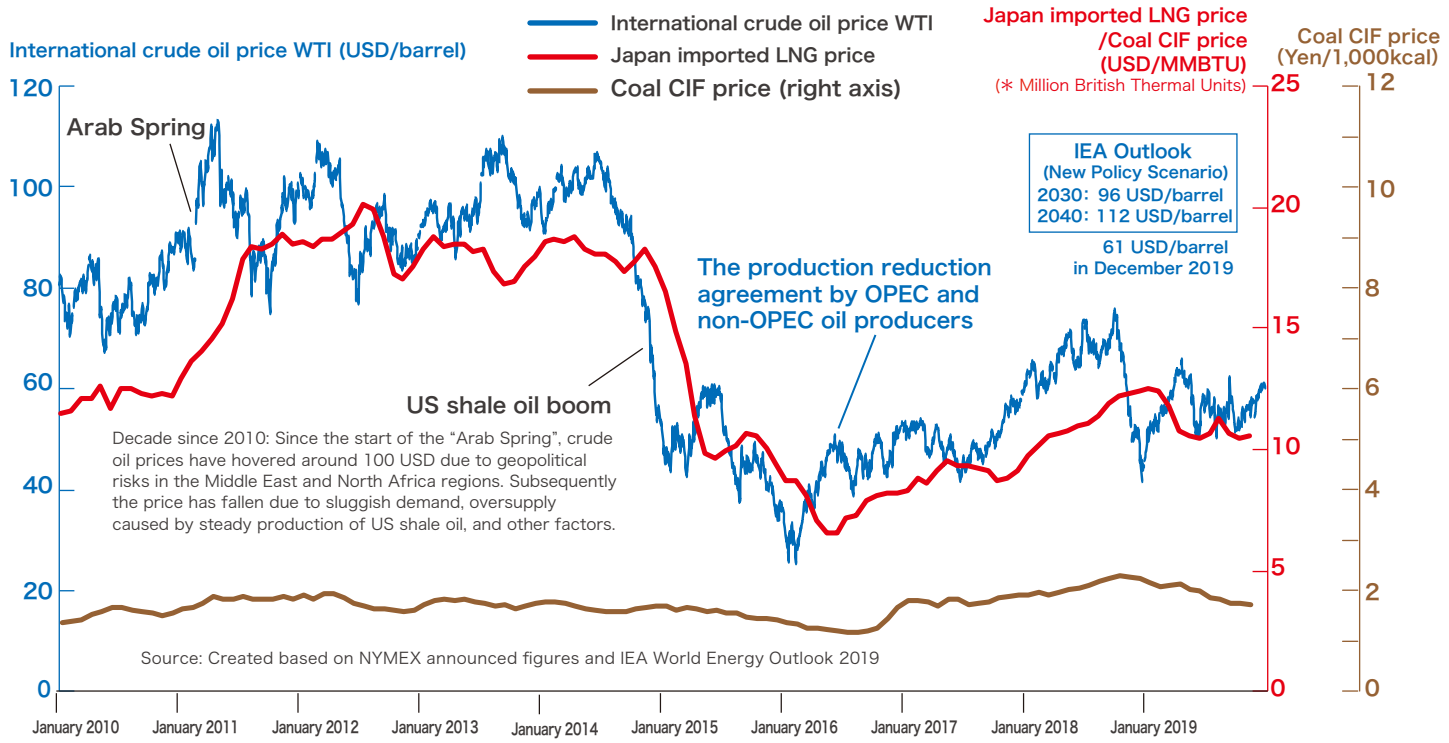
Reference: https://www.enecho.meti.go.jp/about/special/johoteikyo/3es_graph04.html

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

Factor1：Fuel prices

Fuel prices affect electric power rates and energy cost.

The past decline in crude oil prices and the current situation

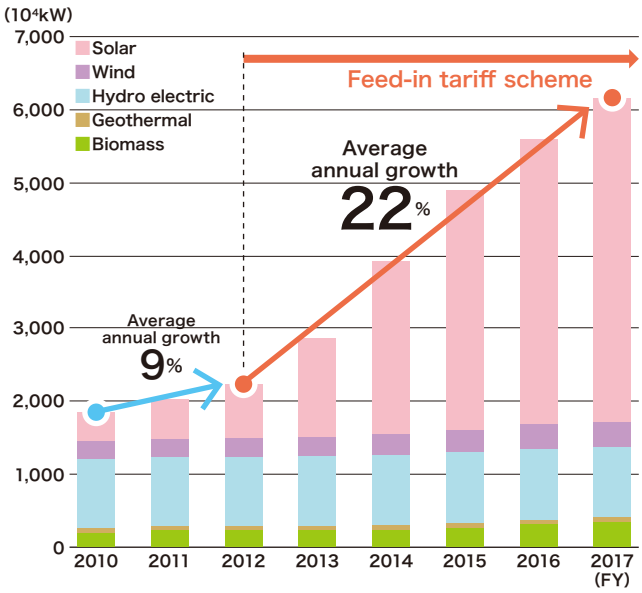


Source: Created based on NYMEX announced figures, IEA World Energy Outlook 2019, and average imported energy CIF prices (JPY).

Factor2:Cost of renewable energy

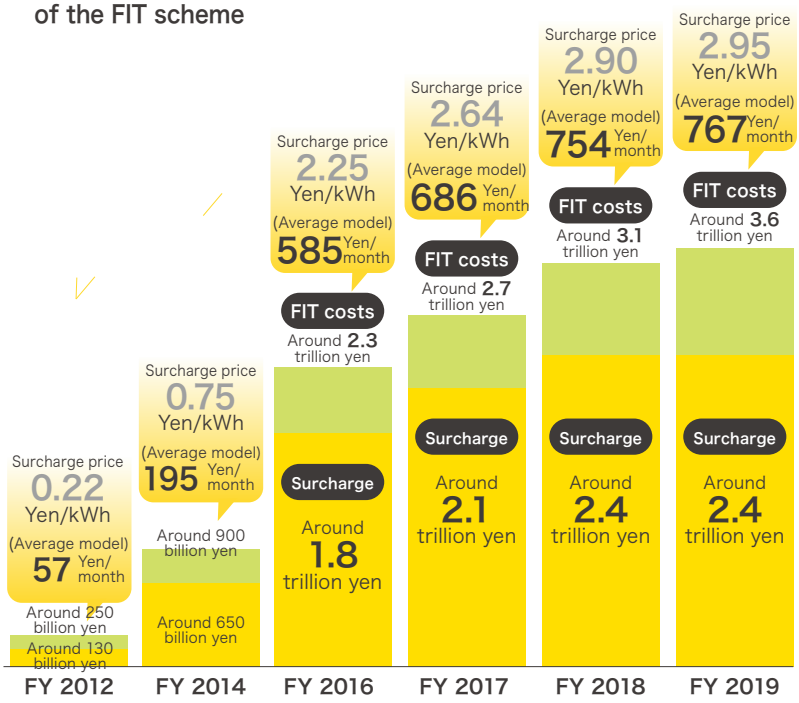
Thanks to the introduction of the Feed-In Tariff scheme (FIT) in 2012, the installed capacity of renewable energy systems is growing rapidly. On the other hand, the purchase costs have reached 3.6 trillion yen (approximately 33 billion USD), and the cost of the surcharge to ordinary households based on the average model (260 kWh/month) has risen to 767 yen/month.Japan is working to expand the cost-efficient introduction of renewable energy sources in order to maximize the use of renewable energy while also reducing the burden on the people.

Changes in installed capacity of renewable energy
(excluding large-scale hydro electric power)



Source: Created by the Agency for Natural Resources and Energy based on JPEA solar batteries shipment statistics, NEDO wind power capacity/generation statistics, surveys for potential water power, current status and trends of geothermal power generation, and certification results from the RPS system/FIT.

Changes in surcharges following introduction of the FIT scheme



Feed-In Tariff Scheme (FIT)： This is a system in which the electricity generated by renewable energy is purchased by electric power companies at a fixed rate for a certain period of time. The electric power companies collect the costs of purchasing this renewable energy by means of a surcharge that is paid by the electricity users.

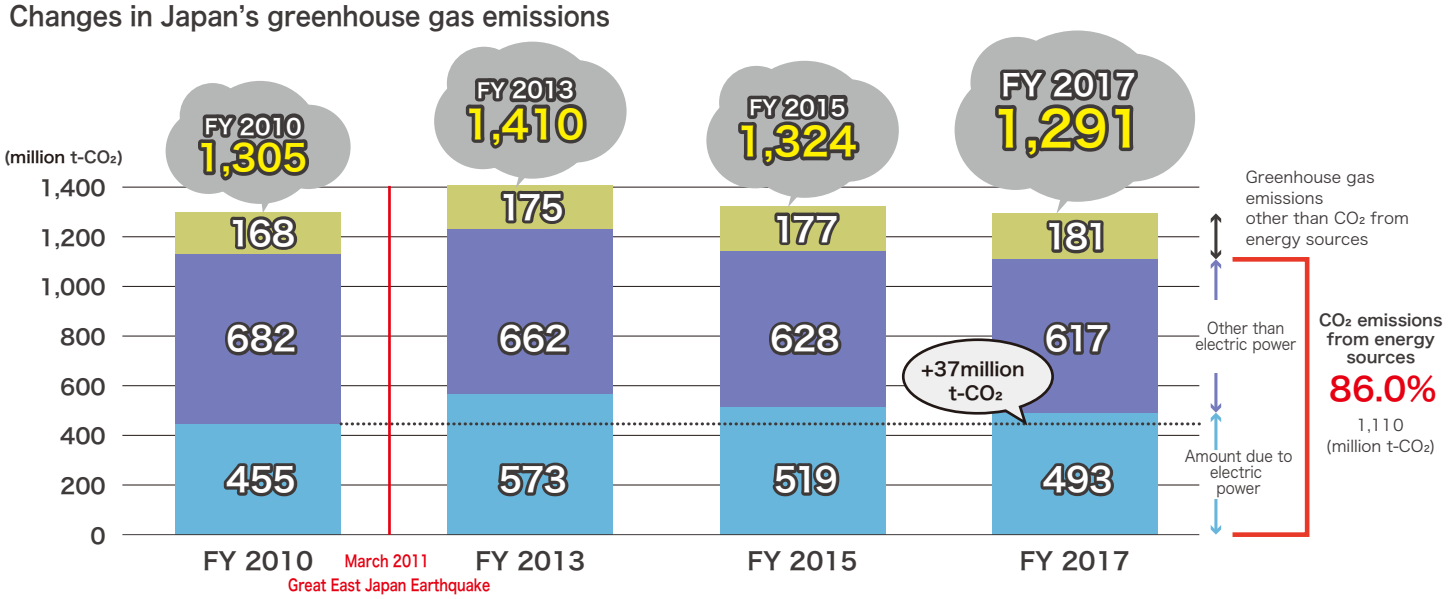
3. Environment

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 2017, emissions dropped to 1.29 billion tons. Japan must continue efforts at reducing emissions.

Changes in Japan's greenhouse gas emissions



Source: Created based on "Comprehensive energy statistics", "environmental action plans (FEPC)", and "calculation results for the amount of greenhouse gas emissions in Japan (Ministry of the Environment)"

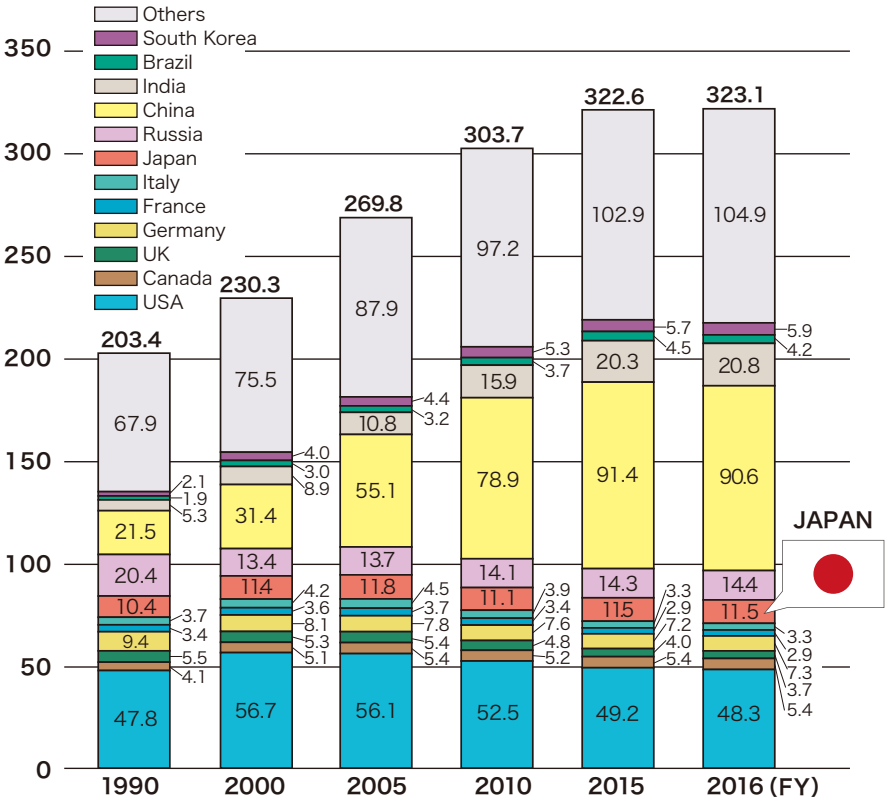
Greenhouse gases: There are 6 main greenhouse gases: carbon dioxide, methane, dinitrogen oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

Column - Outlook for global CO_2 emissions

Global CO_2 emissions are continuing to increase.The increase is particularly large in the rapidly-growing Asia region. Energy transition and decarbonization in Asia and other regions will be important.

Changes in global CO_2 emissions

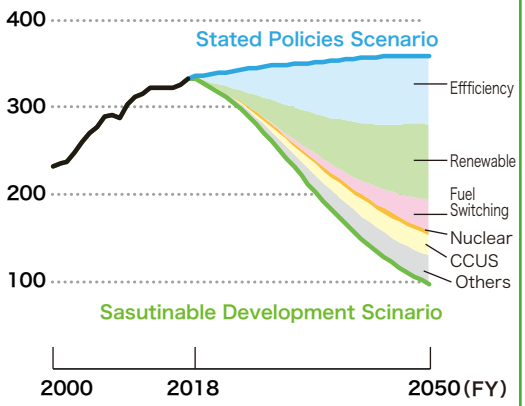
CO_2 emissions (10^8 tons)



Source : "Handbook of Japan's & World Energy & Economic Statistics 2019", The Institute of Energy Economics, Japan
＊The total values may not match due to rounding.

Outlook for CO_2 emissions

CO_2 emissions (10^8 tons)



Stated Policies Scenario…
Scenario incorporating the policies and plans presently announced by each country. Even if the targets are achieved, CO_2 emissions in 2050 are expected to reach **35 billion tons**.

Sustainable Development Scenario…
Scenario in which the Paris Agreement goals including limiting global warming to 1.5°C are achieved. Analysis shows that in order to eliminate the gap between the "ideal" of reducing CO_2 emissions to the level prescribed in the Paris Agreement (Sustainable Development Scenario) and the "reality" indicated by the Stated Policies Scenario, **implementation of all options will be required** including far-reaching programs for energy efficiency, introduction of renewable energy, reducing the use of fossil fuels, utilizing nuclear power, and CCUS (carbon capture, utilization, and storage).

Source : "World Energy Outlook 2019", IEA

Global Warming Countermeasures ～Paris Agreement～

Q What is the Paris Agreement?

A The key points of the Paris Agreement (adopted November 2015) are the following.

- The agreement was adopted at COP21 as a new framework for reducing greenhouse gases in and after 2020 to replace the Kyoto Protocol.
- All major emitting countries including developing countries, are obligated to take action.
- Efforts shall be made to limit global warming to 1.5°C, sufficiently below the level of ±2°C compared to before the industrial revolution.
- All signatory countries should submit reduction targets every 5 years.
- All signatory countries should create and communicate their long-term low greenhouse gas emissions development strategy (Long-term Strategy).

Q What is in Japan's long-term low greenhouse gas emissions development strategy, titled "The Long-term Strategy under the Paris Agreement"?

A The key points of The Long-term Strategy under the Paris Agreement (submitted to the UN in June 2019) are the following.

- Aim to accomplish a "decarbonized society", carbon neutrality throughout the world as early as possible in the second half of this century.
- Aiming to realize a virtuous cycle of environment and growth, carry out the following: ①Promotion of Innovation, ②Promotion of Green Finance, and ③Business-led Promotion of International Application and International Cooperation.

Greenhouse gas reduction targets of major nations

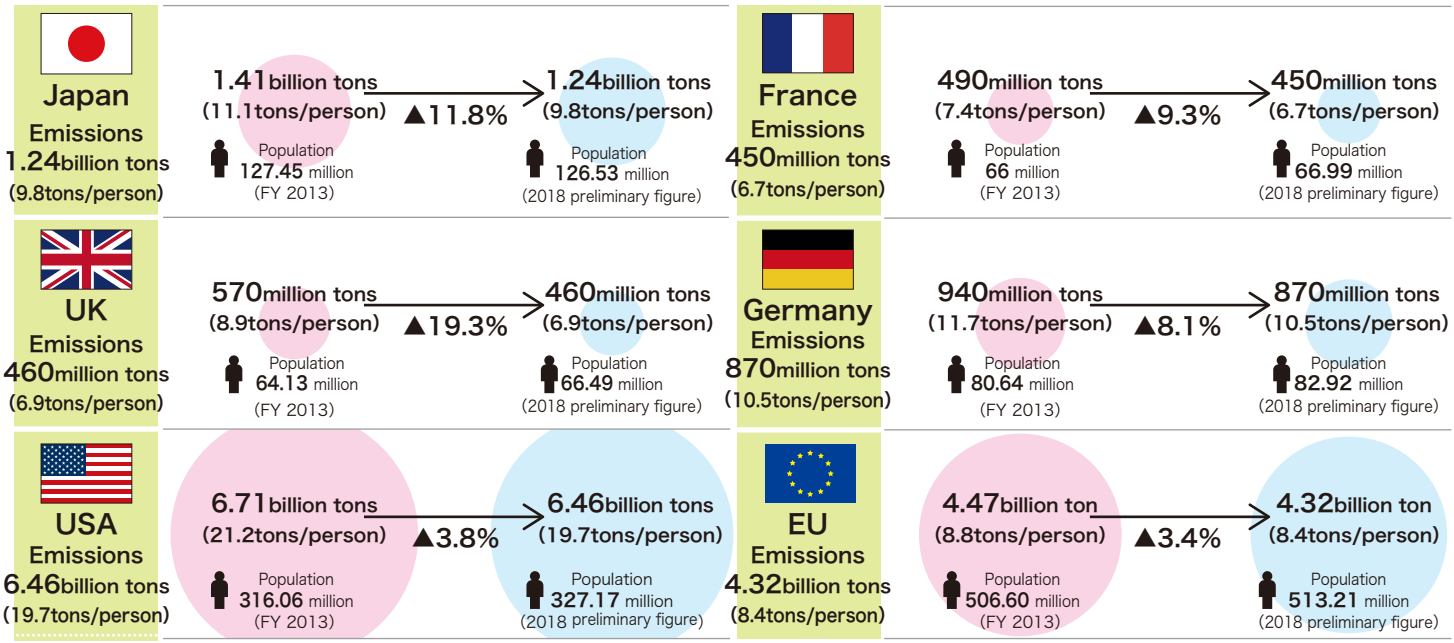
Country	Comparison to 1990	Comparison to 2005	Comparison to 2013
Japan＊	▲18.0%	▲25.4%	Reduction target ▲26.0% (by 2030)
USA	▲14～16%	Reduction target ▲26～28% (by 2025)	▲18～21%
EU	Reduction target ▲40% (by 2030)	▲35%	▲24%
China	・Reduce greenhouse gas **emissions by 60 - 65% per unit of GDP by 2030 compared with 2005 levels.** ・Reach peak greenhouse gas emissions in or around 2030.		
South Korea	・Reduce emissions by 37% by 2030 compared to expected 2030 levels with no measures taken.		

Japan reduction targets are in comparison with the 2013 level. USA targets are in comparison with the 2005 level. EU targets are in comparison with the 1990 level.
When the targets are all converted to comparison with 2013 levels, you can see that the target of Japan is high.

＊Only Japan uses fiscal years

Status of greenhouse gas reduction in major nations

Since FY 2014, Japan has reduced emissions for 5 consecutive years, and has already reduced emissions by approximately 12% compared to the reference level of FY 2013. This is the second largest reduction among G7 nations following the UK.



4. Safety

Natural Disasters

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

A Japan is constructing a disaster-resistant infrastructure and taking steps to ensure rapid recovery following a disaster.

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

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

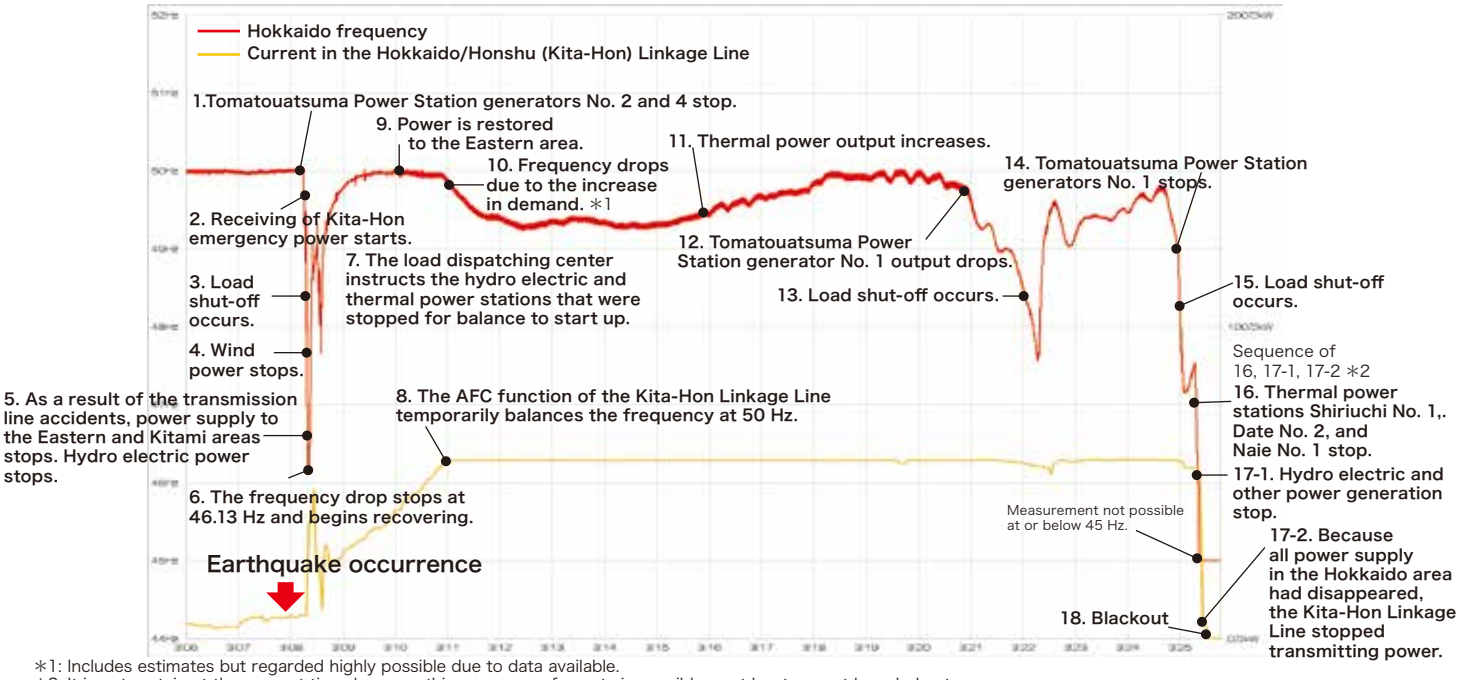
Damaged floating solar power plant
in Ichihara City, Chiba Prefecture
(September 2019 typhoon)

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

Large-scale blackout caused by an earthquake

Large-scale blackout in Hokkaido caused by Hokkaido Eastern Iburi Earthquake
(September 2018)

Following an earthquake in Hokkaido with a maximum seismic intensity of 7, Japan experienced its first-ever large-scale blackout affecting an entire region. The blackout resulted from a combination of factors, including stoppage of the No. 1, 2, and 4 generators at the Tomatouatsuma Power Station, and multiple hydro electric power generators that were forced offline by power transmission line accidents which affected 4 lines on 3 routes.



＊1: Includes estimates but regarded highly possible due to data available.
＊2: It is not certain at the present time, however this sequence of events is possible or at least cannot be ruled out.
Source: Created by the Agency for Natural Resources and Energy from the final report of the Verification Committee for the 2018 Hokkaido Eastern Iburi Earthquake.
Reference: https://www.occto.or.jp/iinkai/hokkaido_kensho/hokkaidokensho_saishuhoukoku.html

Damage caused by tsunami

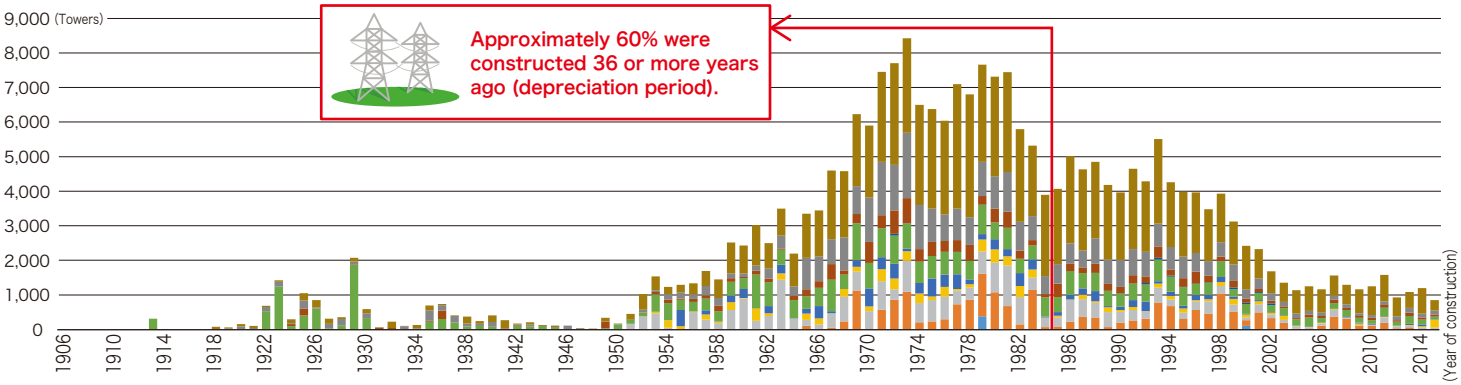
Fukushima Daiichi Nuclear Power Station, which suffered a steam explosion due the effects of a tsunami following the Great East Japan Earthquake(March 2011)

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

Program1：Renovating the electrical power network

Action① Updating technical standards for the power grid and replacing aging equipment

Numbers of power transmission towers constructed across Japan by year of construction

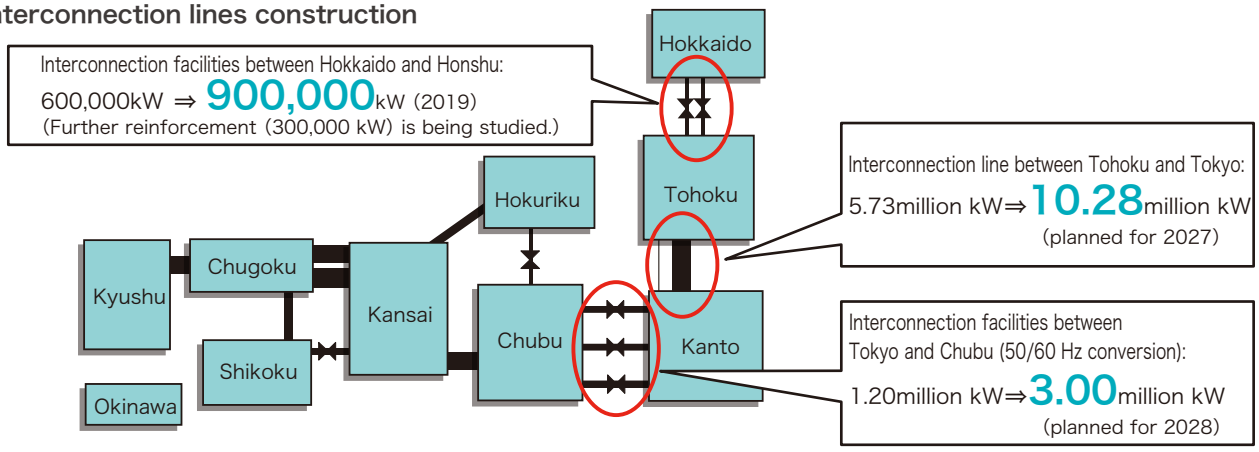


Source：Cross-regional Network Long-term Policy (Organization for Cross-regional Coordination of Transmission Operators, JAPAN, March 2017)

Voltage：DC250 500kV 275kV 220kV 187kV 154kV 132kV 110kV 77kV 66kV

Action② Reinforcing interconnection lines, and promoting expanded grid areas and interchanges

Status of interconnection lines construction

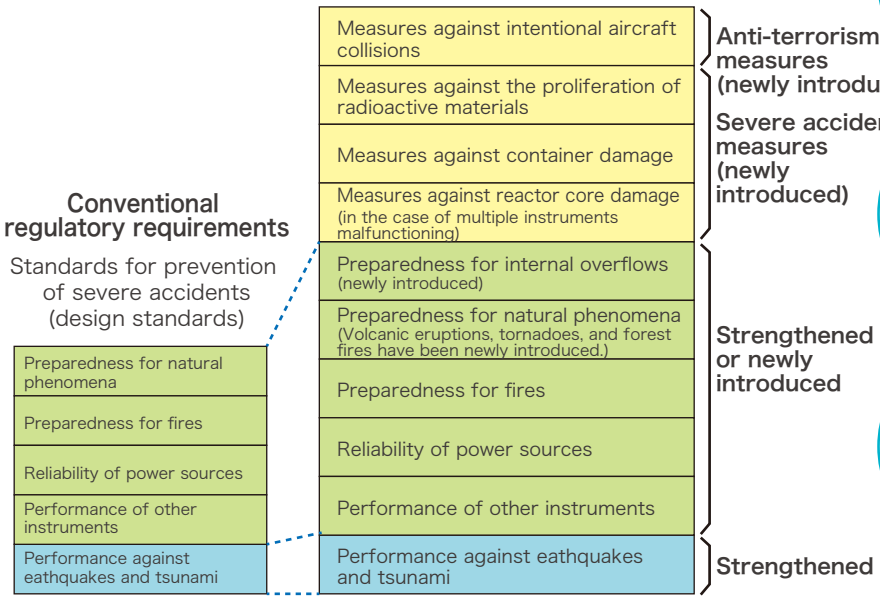


Interconnection lines: This refers to power transmission lines, frequency converter, and AC/DC converters that connect the power grid equipment in the supply areas of neighboring power companies, allowing the exchange of power across area borders.

Program2：Conforming to new regulatory requirements for higher levels of safety

When nuclear power plants are restarted, the Nuclear Regulation Authority requires conformance with new regulatory requirements. Accident prevention and response preparation measures are being reinforced.

New regulatory requirements (July 2013)



Source: Documents of the Nuclear Regulation Authority

Safety measures conforming to new regulatory requirements and their effects (examples)

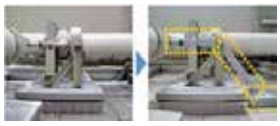
Countermeasures to ensure uninterrupted power supply

Installation of air-cooled emergency generators

Reduction in frequency of reactor core damage resulting from these measures＊

Approx. **1/19**

Earthquake countermeasures



Reinforcement of pipe systems

Approx. **1/3**

Tsunami countermeasures

Construction of seawalls

Approx. **1/250**

＊ Results of probabilistic risk assessment (PRA) (internal PRA, earthquake PRA, tsunami PRA) in the No. 1 Safety Improvement Assessment Report of the Kansai Electric Power Company Takahama No. 3 Reactor (submitted January 10, 2018)

5. 3E+S

Basic Policy

Q What is the government's basic energy policy?

A With the underlying premise that Safety is always the primary concern, programs are being carried out in order to simultaneously achieve improvement of Energy Security, Economic Efficiency, and Environmental Suitability (3E+S).
Japan is a country with very limited natural resources.There is no one source of energy that is superior in every way and in every circumstance.
It is essential to create a multi-layer energy supply structure where each power source delivers its maximum strength and complements the weaknesses of the others.

Energy Security (Self-sufficiency rate)
Exceed the level from before the Great East Japan Earthquake (approx. 20%).
Approx. 25% (currently 9.6%)

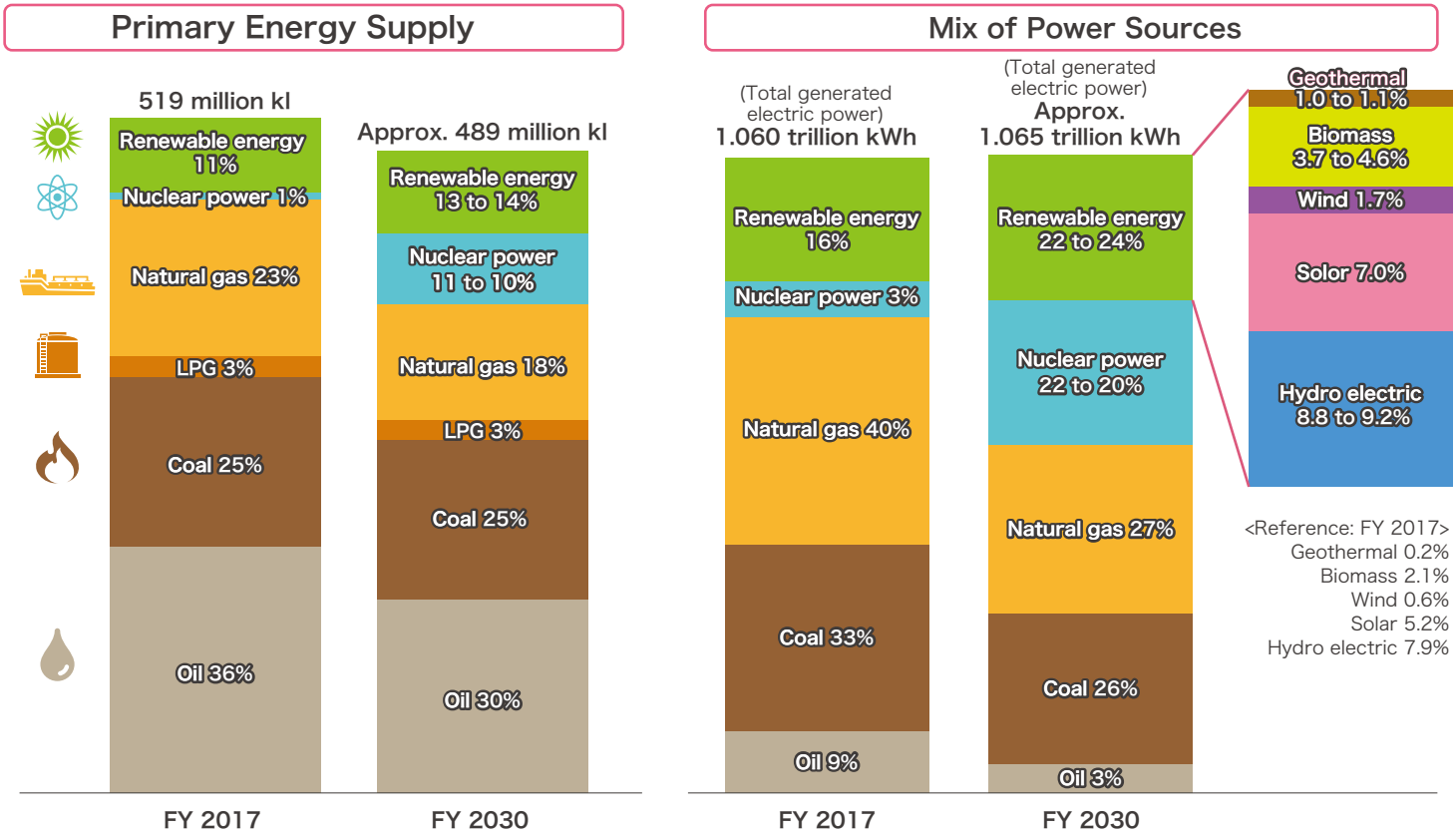
Economic Efficiency (Electricity cost)
Reduce costs from their current level.
(FY 2013 9.7 trillion yen ⇒FY 2030 9.5 trillion yen)

＊When formulating the energy mix

Environment (Greenhouse gas emissions)
Achieve targets for reduction in greenhouse gases that are comparable to Western countries.
(26% reduction from FY 2013 levels by FY 2030)

Q What will the future primary energy supply and mix of power sources look like?

A The figure below shows the ideal energy supply and demand structure (energy mix) for FY 2030 that will be realized by measures based on the government's basic energy policy.



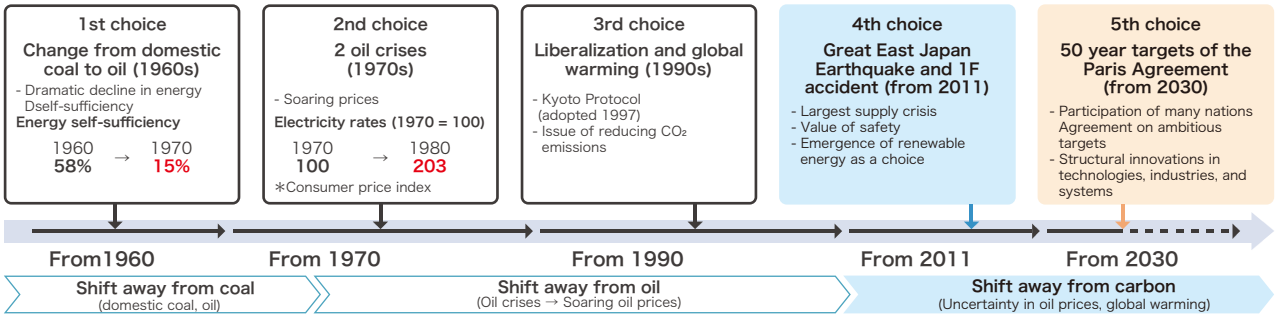
Accomplishing a “decarbonized society”

Q Is the accomplishment a “decarbonized society” possible?

A In order to accomplish a “decarbonized society”, Japan will explore every possible change to the energy supply structure and promote innovations.

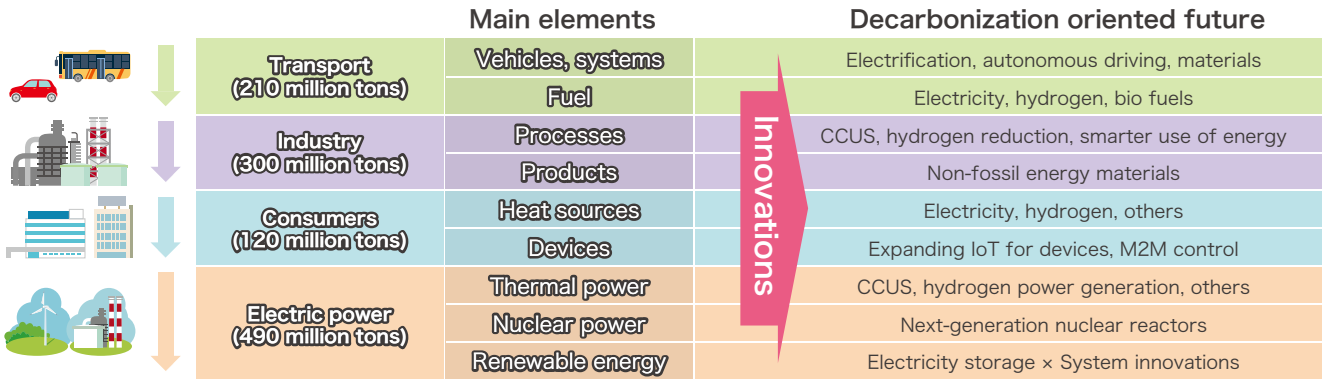
Flow of energy choice

Japan achieved economic growth through past policy choices to reduce dependence on coal and oil. The country is making steady progress towards achieving the target energy mix in 2030, decarbonization has become visible as a possible direction for 2050.



Innovations aimed at realizing decarbonization

In order to accomplish a “decarbonized society” as early as possible in the second half of this century, it will be necessary to realize a virtuous cycle of environment and growth through disruptive innovation.
We must gather wisdom of the world and move forward while exploring all possible options such as hydrogen, carbon recycling, renewable energy, batteries, and nuclear power.

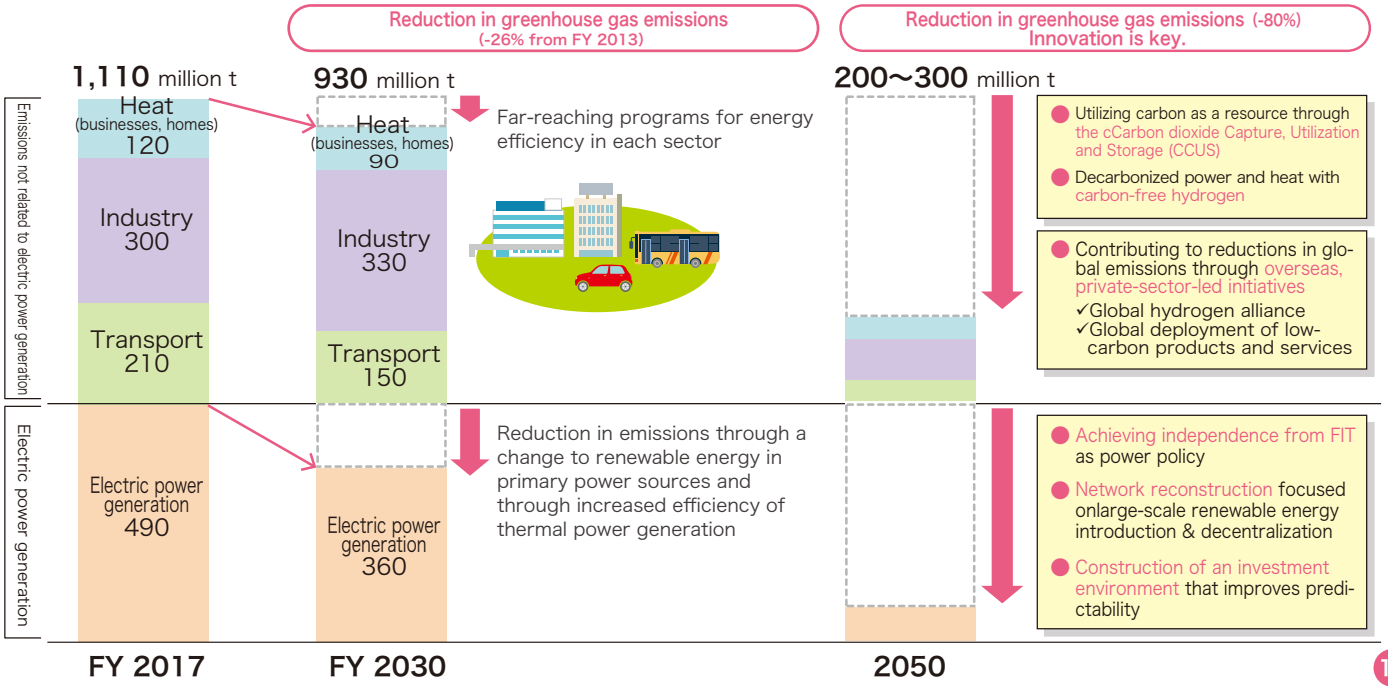


＊Figures in parentheses are 2017 emissions ＊CCUS: Carbon dioxide Capture, Utilization and Storage

Source: Created by the Agency for Natural Resources and Energy.

Actions for both the medium and long term

Large-scale reduction in greenhouse gas emissions through innovation and international collaboration will be essential for energy transition and decarbonization.



6. Innovation and Energy Efficiency

Hydrogen, Electricity Storage Technologies, and Carbon Recycling

Q What kinds of innovations lead to decarbonization?

A Possibilities include production of CO_2-free hydrogen from renewable energy sources, wide-ranging use of hydrogen in fuel cell vehicles and other equipment, and carbon recycling.

Programs for creating a hydrogen-based society

The use of hydrogen is being promoted in a wide variety of fields, including fuel cell vehicles and household fuel cells, through the construction of supply chains aimed at enabling large-scale hydrogen supply and international trade in hydrogen.

Production

Overseas unused energy

Brown coal → Gasification → CCS

Byproduct hydrogen

Overseas renewable energy → Water electrolysis

Renewable energy

Solar power / Wind power → Water electrolysis

＊Use of hydrogen as a means of energy storage (absorbing fluctuations in renewable energy output)

March 2020 demonstration project for large-scale hydrogen production using renewable energy - aiming for use during the Tokyo Olympics (Namie Town, Fukushima Prefecture)

Transport and supply (supply chain)

Nationwide promotion of hydrogen stations
(160 stations in 2020, 320 in 2025)

Large-scale network for maritime hydrogen transport
Launching ceremony for lliquefied hydrogen pilot carrier

Use

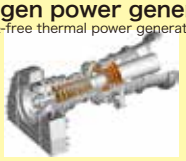
Transport sector — **Fuel cell vehicles** (FCV, FC buses, etc.)

Power generation sector — **Fuel cell cogeneration** (ENE-FARM, etc.)

Modification → ENE・FARM

Fuel cell combined power generation system [HYBRID-FC]

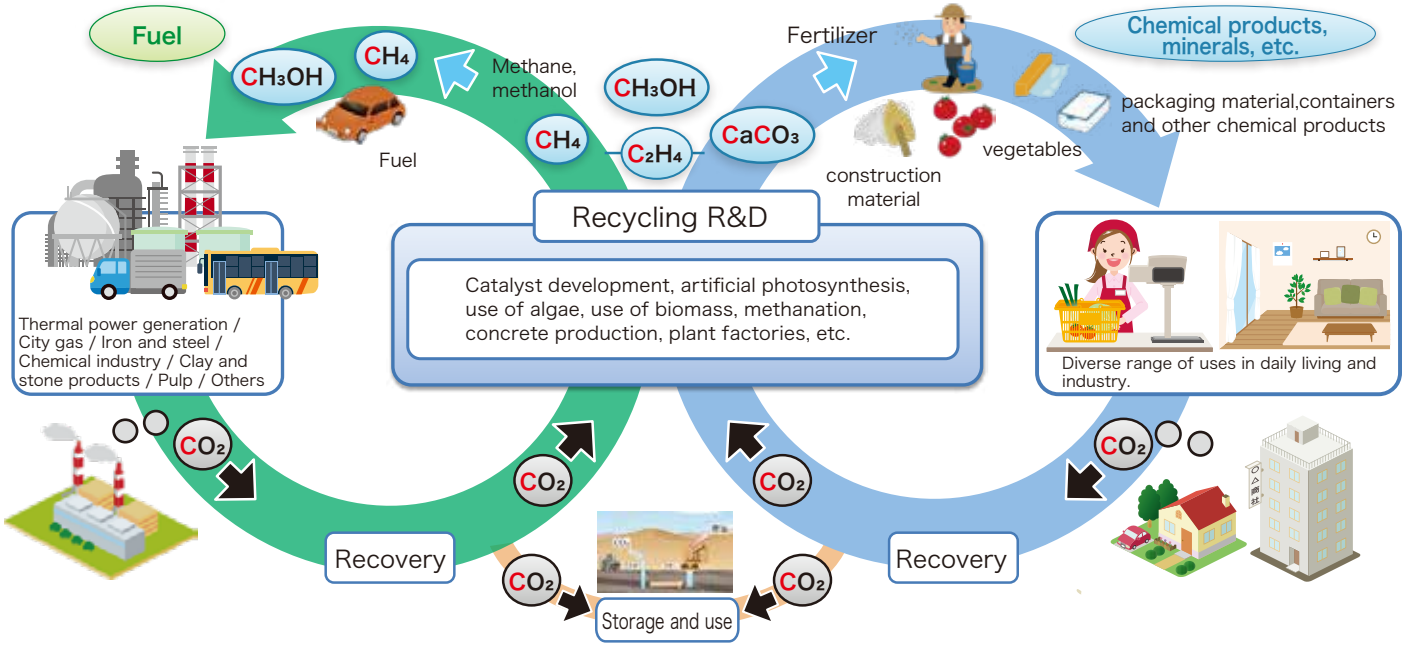
Hydrogen power generation
(CO_2-free thermal power generation)



Others
Use in the industry sector (Power-to-X)

Carbon Recycling (reuse of CO_2)

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



CO_2 may become useful in the future?!
"Carbon Recycling" to utilize CO_2 as a resource.

Research is proceeding into carbon recycling as an important means of reducing CO_2 in the atmosphere.
In June 2019, Japan formulated a roadmap for the possible uses of CO_2 and the technologies required to achieve them.

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

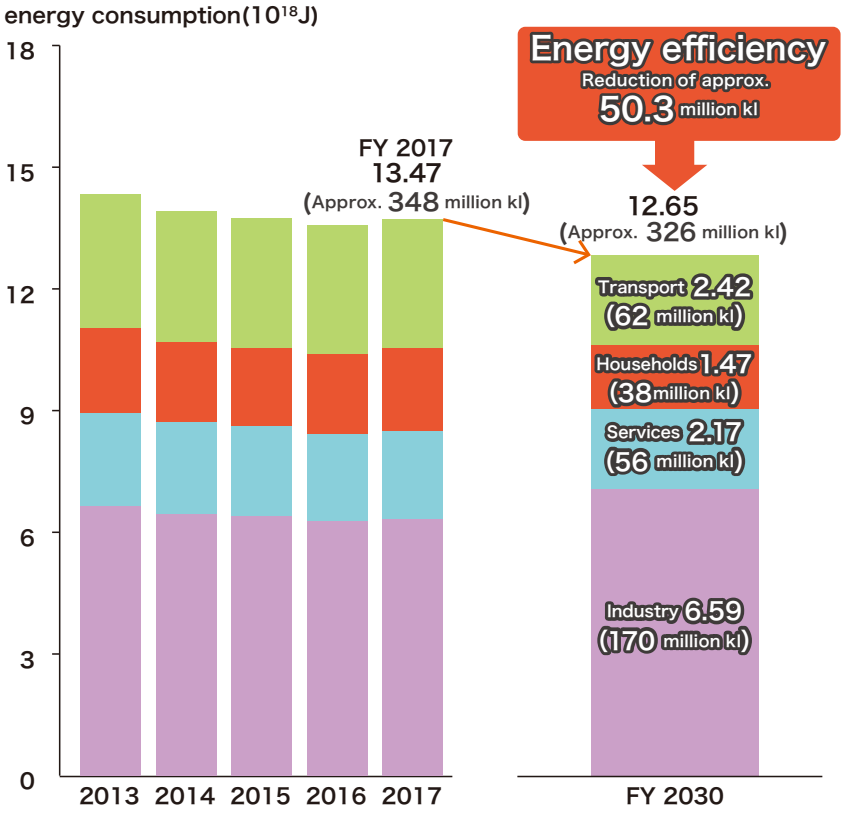
Use this QR code to view the article.

Energy Efficiency

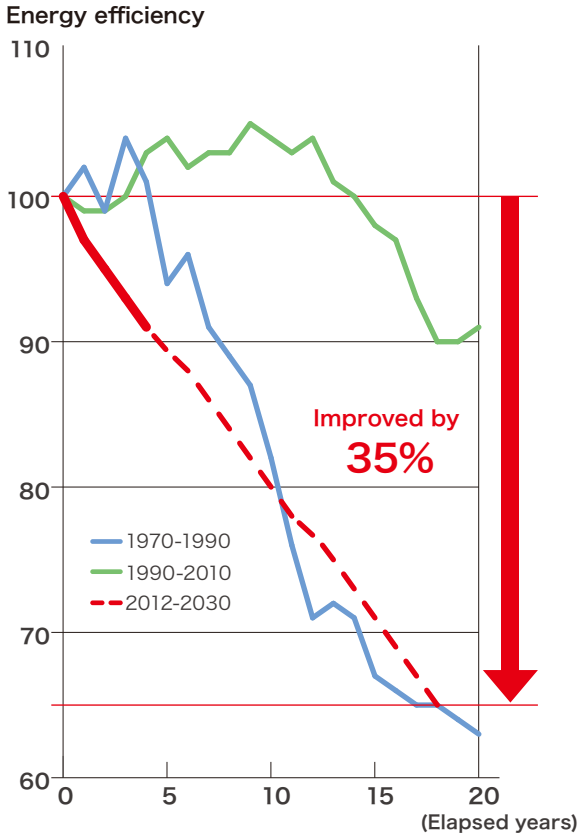
Q How much progress has Japan made in measures for energy efficiency?

A Japan is continuing with measures to increase energy efficiency. Improvements in energy efficiency is essential in order to achieve projected demand in FY 2030 with the energy mix.

Final energy demand with the energy mix



Energy efficiency improvements



Source: Created based on "Comprehensive energy statistics of Japan", Agency for Natural Resources and Energy; "System of National Accounts", Cabinet Office; and "Handbook of Japan's & World Energy & Economic Statistics", The Institute of Energy Economics, Japan.
* J (joules) are one of the unit indicating energy size.
* Figures in ( ) are energy values converted to crude oil units. Calculated using a crude oil conversion coefficient of 0. 0258 (kL/GJ).

* Using energy efficiency in 1970, 1990, and 2012 as 100
* Energy efficiency = Final energy consumption / Real GDP

Progress of measures to improve energy efficiency

Main measures to improve energy efficiency			FY 2017	FY 2030
All	LED	Adoption rate	Industry: Approx. 56% (580,000 kl) Services: Approx. 50% (1,160,000 kl) Households: Approx. 55% (1,150,000 kl)	All sectors 100% (5.38 million kl)
Industry	Top Runner Motors (Widespread use in pumps, fans, etc.)	Units in use	Approx. 2.07 million units (110,000 kl)	Approx. 31.2 million (5.38 million kl) Expected to replace half of all units in use (66 million units).
Services	Buildings	Rate of compliance with energy efficiency standards (Floor size basis)	Large scale: Approx. 100% (Mandatory) Medium scale: Approx. 91% Small scale: Approx. 75% (370,000 kl)	Almost 100% (3.32 million kl)
Households	High efficiency hot water systems	Units in use	Approx. 14.57 million (670,000 kl)	Approx. 46.3 million (2.69 million kl) Expected to increase to around 90% of the total (51.2 million households).
Transport	EV/PHV, FCV, and other next-generation automobiles	Percentage of new vehicle sales	Approx. 36% (part of 720,000 kl)	50 - 70% (part of 9.39 million kl) It is expected that EV/PHV will account for up to 20 - 30% of new vehicle sales (16% of all vehicles) while FCV will account for up to 3% (1% of all vehicles).

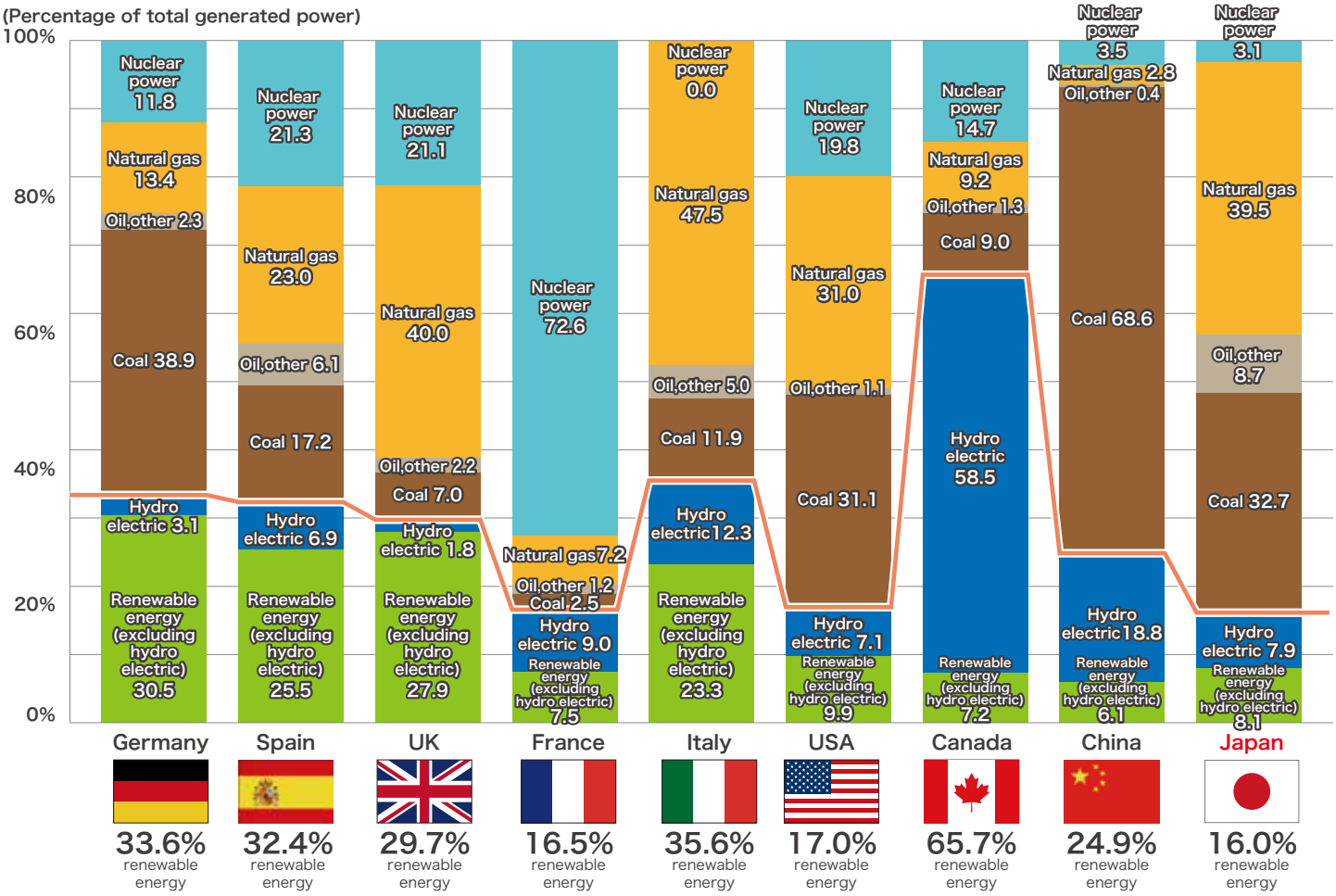
7. Renewable Energy

Introduction of Renewable Energy

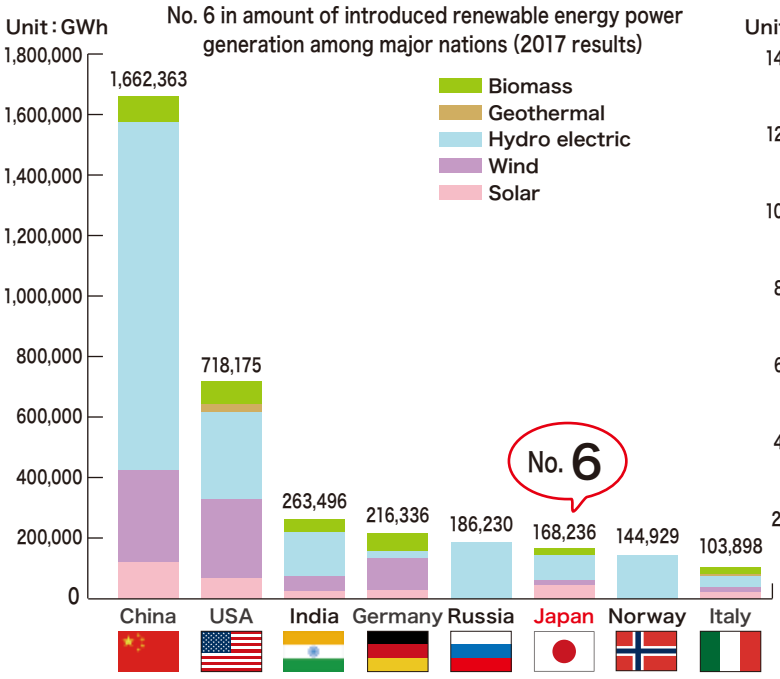
Q Is progress being made in introducing renewable sources of energy in Japan?

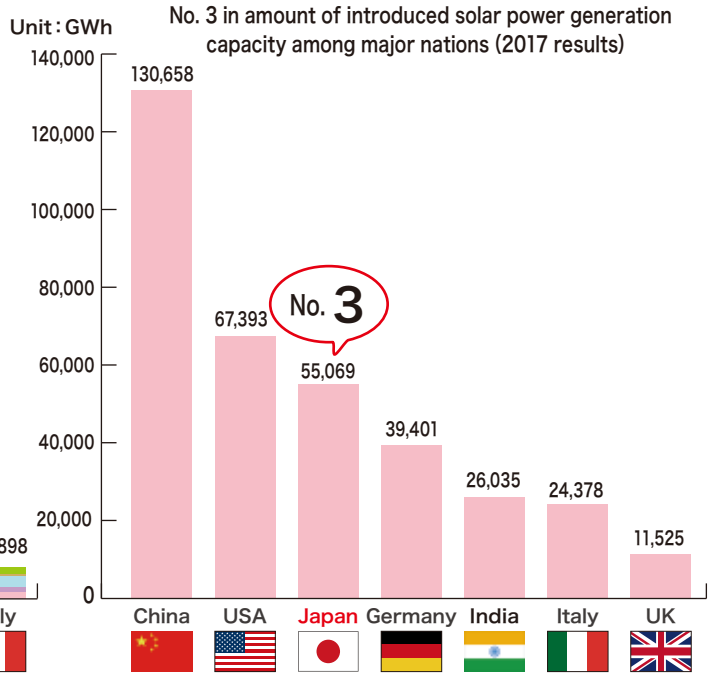
A The percentage of renewable energy power in Japan was 16.0% in 2017.
Japan is ranked No.6 in the world in terms of capacity of renewable energy generation capacity, and No.3 in the world for solar power generation.

Comparison of renewable energy percentages of total power generation in major nations (2017)



Source: Investigation by the Agency for Natural Resources and Energy





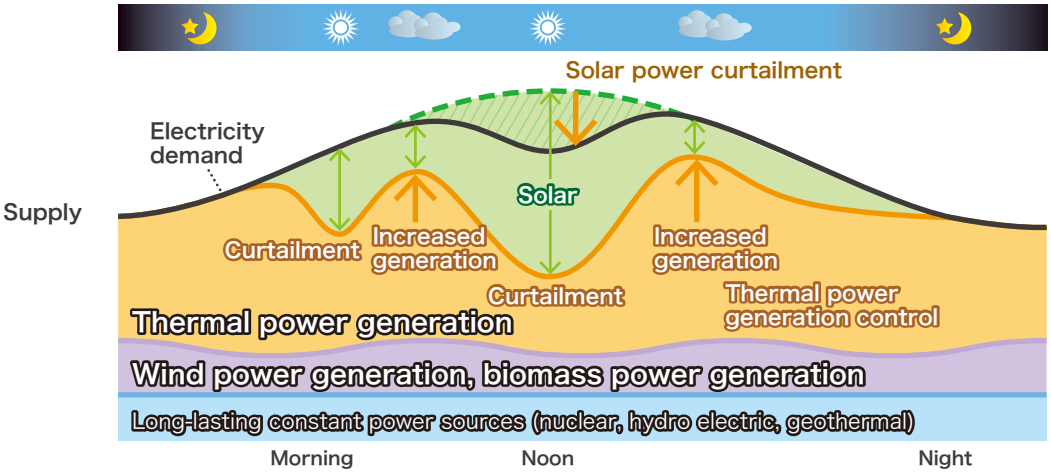
Source : Created by the Agency for Natural Resources and Energy based on the IEA database.

Making Renewable Energy a Primary Source of Power

Q Is it possible to supply electricity only from renewable sources?

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 means of energy storage by using renewable energy in combination with flexible output power sources such as thermal power generation and storage batteries.

Image of supply/demand situation on the lowest demand day (such as a sunny day in May)



It is necessary to maintain a balance between generation (supply) and consumption (demand) so that consumers can have stable access to electric power. To this end, flexible power sources such as thermal power generation are used to compensate for fluctuations in renewable energy output.

Q What kinds of government policies are being carried out in order to make renewable energy a major power source?

A Aiming to make renewable energy a primary source of power, studies are being carried out for a fundamental reform of the Feed-In Tariff system and reconstruction of renewable energy policies.

① Constructing a system that is tailored to the characteristics of the power sources

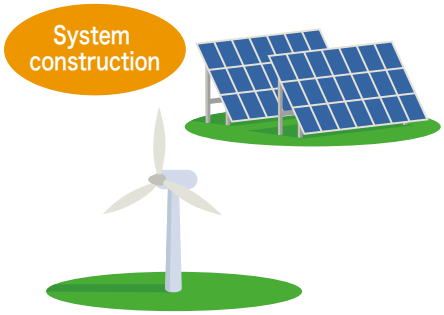
Japan will construct a system that can help further reduce the costs of competitive power sources (such as solar and wind), and strengthen the resilience (resistance to disasters and other events) of the power sources that can be used in each area.

② Ensuring suitable business regulations

Japan will construct a business environment that includes suitable business regulations for purposes including ensuring safety, coexisting in harmony with communities, and measures for suitable disposal of solar power generation equipment.

③ Creation of a next-generation electric power network that will support large-scale introduction of renewable energy

Japan will create a next-generation electric power network (push-based type) that can systematically support the large-scale introduction of renewable energy from a long-term perspective including technical potential for each power source.



Renewable energy and stable supplies: The necessary ability to continuously generate power

In July 2018, the cabinet of Japan approved "The 5th Strategic Energy Plan" as the basic direction for Japan's energy policies in the medium and long term. It sets out a plan for making renewable energy a major power source.

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

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

8. Reconstruction of Fukushima

Decommissioning and Contaminated Water Management of Fukushima Daiichi Nuclear Power Station

Q Are measures of decommissioning and Contaminated Water Management in Fukushima Daiichi Nuclear Power Station progressing?

A Although the decommissioning and contaminated water management are an unprecedented undertaking, continuous measures are being carried out safely and steadily based on the "Mid-and-Long-Term Roadmap"

Decommissioning

All reactors are being kept in stable conditions, and rubble removal, decontamination, and other measures are being carried out towards removing the fuel from the spent fuel pools.
Internal investigations of the containment vessels are being carried out in preparation for retrieving the fuel debris (fuel that melted and re-solidified). Based on the investigation results, trial retrieval will start at Unit 2 within 2021, and the scale of retrieval will be gradually increased.

(Current conditions of each reactor)

Unit 1

Unit 2

Unit 3 Photographed from top of building (at time of the accident)

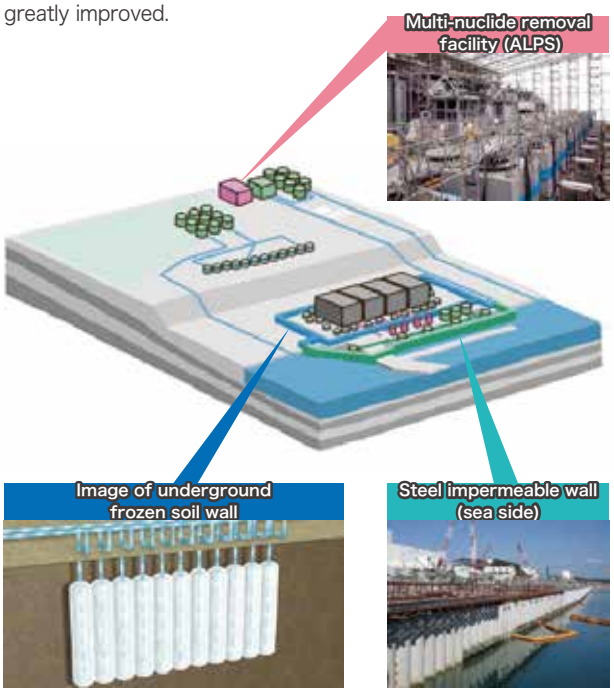
Unit 4

Investigation equipment

Previous investigations have identified the conditions inside the containment vessels, such as the distribution of fuel debris.
In the investigation at Unit 2, fuel debris-like deposit was successfully grasped and lifted up.

Contaminated water management

The amount of contaminated water generated at the Fukushima Daiichi Nuclear Power Station has been reduced to around one-third of the initial amount through multi-layered countermeasures (such as frozen-soil walls) compared to before the countermeasures.
Contaminated water is treated by multiple purification facilities to remove as much of the radioactive substances as possible before the water is stored in tanks.
The water quality in the surrounding sea areas has also been greatly improved.



<Changes in the concentration of radioactive substances in sea areas surrounding the Fukushima Daiichi Nuclear Power Station>

March 2011 (immediately after the accident) **Approx. 10,000 Bq/L** → November 2019 (nearly 8 years after the accident) **Less than 0.6 Bq/L**

Handling of the water stored in tanks

At present, the water in the tanks has been treated by multiple treatment facilities, and the concentration of radioactive substances has been reduced to around 1/1,000,000 of the original water. Because some of this water contains tritium and other nuclides which cannot be removed by purification facilities, deciding how to handle this water is an issue to be solved. Basics information and the latest information related to contaminated water management are available on the following website.

Contaminated water management in Fukushima: Top priority on safety and security

- Measure ① What is "ALPS treated water"? Is it true that it exceeds the standard?
- Measure ② What is "tritium"?
- Measure ③ Explanation of tritium and radiation exposure
- Measure ④ What are the regulatory standards for radioactive substances?
- Measure ⑤ Future measures for storage of ALPS treated water
- Measure ⑥ What are the effects of radiation by disposal of ALPS treated water?

Reference: https://www.enecho.meti.go.jp/about/special/johoteikyo/osensuitaisaku01.html
https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/index.html

Use this QR code to view the article.

(Japanese only)

Q How is the progress of the reconstruction of Fukushima?

A The evacuation orders will be lifted for parts of Futaba Town on March 4, 2020, Okuma Town on March 5, and Tomioka Town on March 10. As a result, the evacuation orders will have been lifted for all areas except for the designated the areas where returning is difficult. The JR Joban line will also resume full operation from March 14, 2020. The Specified Reconstruction and Revitalization Base in the areas where returning is difficult is also in construction for returning evacuees.
Efforts are also underway for restoring Fukushima communities through accelerating decontamination and construction of infrastructure/living environment services, rebuilding livelihoods, creating new industries, and promoting industrial clusters.

Fukushima Innovation Coast Framework

This project is aiming to construct a new industrial infrastructure to revitalize industries in the Hama-dori (coastal) area and other areas.

As of March 10, 2020

Fukushima Robot Test Field (Minamisoma City, Namie Town)

Consists of robot testing fields for development and demonstration of robots, and an international facility for collaboration by industry, academia, and government (partially opened in July 2018).

Fukushima Hydrogen Energy Research Field (Namie Town)

Conducting demonstration projects for large-scale production of hydrogen from renewable energy using the world's largest 10,000 kW class water electrolyzer.

Okuma Analysis and Research Center (Okuma Town)

Conducting analysis of low- and medium-dose radioactive rubble and fuel debris.

JAEA Collaborative Laboratories for Advanced Decommissioning Science (CLADS) International Research Building (Tomioka Town)

Universities, research institutes, and companies within and outside Japan have gathered in Fukushima and are conducting research related to decommissioning of nuclear reactors and other subjects.

Naraha Center for Remote Control Technology Development (Naraha Town)

Conducting investigations of reactor containment vessels, development and demonstration tests of repair robots, and training for workers using virtual reality systems.

The Fukushima Plan for a New Energy Society

The prefecture is creating a model for a future New Energy Society and promoting the "Fukushima Model" to the world.

Expanding the introduction of renewable energy

- Reinforcement of transmission lines for wind farms in the Abukuma and Futaba areas

Development of a model for realizing a "Hydrogen Society"

- Demonstration project for large-scale hydrogen production using renewable energy (Introduction of a 10,000 kW water electrolysis system - the largest in the world)
- Demonstration project for hydrogen transport and storage technologies (To be utilized during the 2020 Tokyo Olympics and Paralympics)

Creation of Smart Communities

- Support for construction of Smart Communities in some Fukushima regions including Shinchi Town, Soma City, Namie Town, Naraha Town and Katsurao Village

Food safety in Fukushima Prefecture

- Agricultural, forestry, and fishery products are subject to thorough monitoring inspections before shipping, and the results of these and other inspections are made public.
- There have been zero incidents of rice exceeding the standard since the 2015 crop.
- If food exceeding the standard is found, the necessary steps are taken to prevent it from reaching the market.

Status of monitoring inspections for agricultural, forestry and fishery products

(April 1, 2019 - May 31, 2019) ＊Aug. 21, 2018 - May. 31, 2019 for brown rice only

Classification	Number of inspections	Number exceeding standard	Percentage exceeding standard
Brown rice (produced in 2018)	Inspection of all bags	0	0.00%
Vegetables/fruits*	386	0	0.00%
Livestock products	667	0	0.00%
Cultivated plants/mushrooms	188	0	0.00%
Marine seafood	859	0	0.00%
Fish from inland fisheries	14	0	0.00%
Edible wild plants /mushrooms	416	0	0.00%
Fish in rivers and lakes	232	2	0.86%

Source: Created by the Reconstruction Agency based on "Progress of Fukushima Recovery (Ver. 26)"

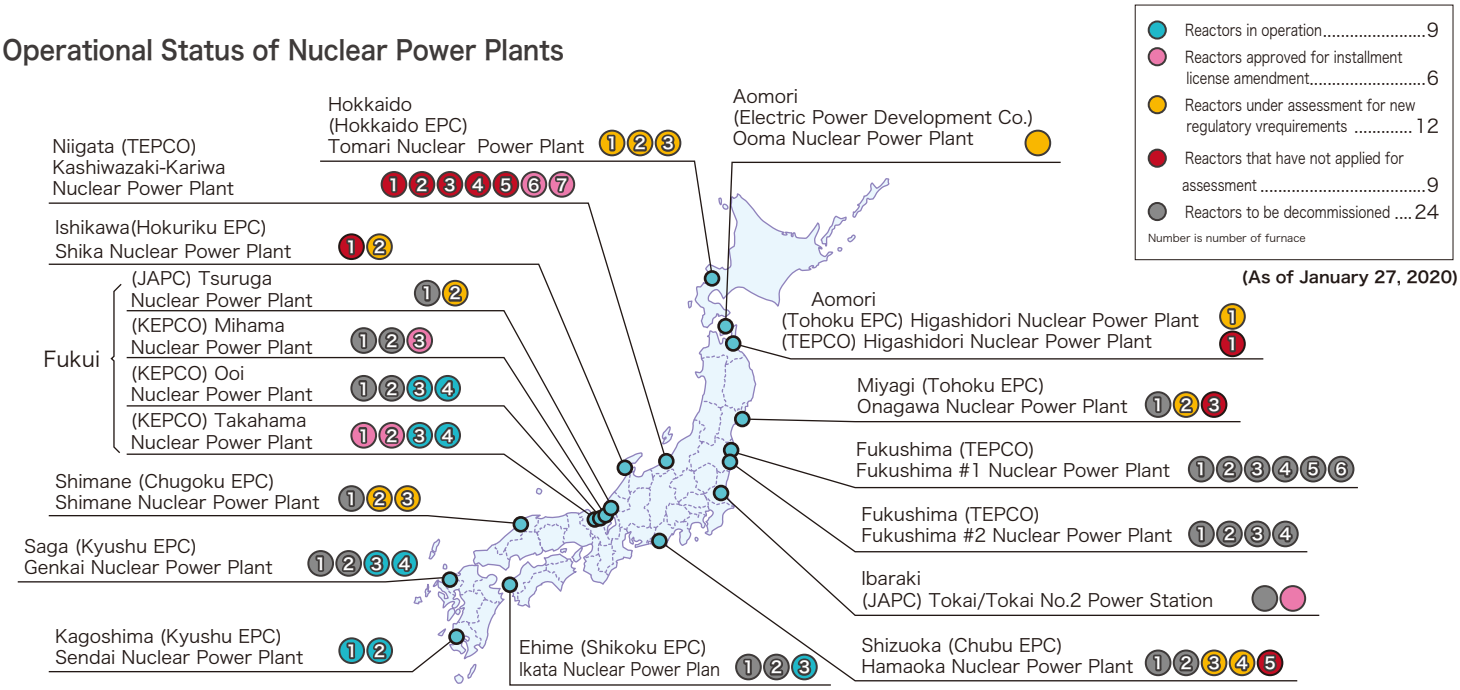
9. Nuclear Power

Operational Status of Nuclear Power Plants

Q Is nuclear power generation necessary?

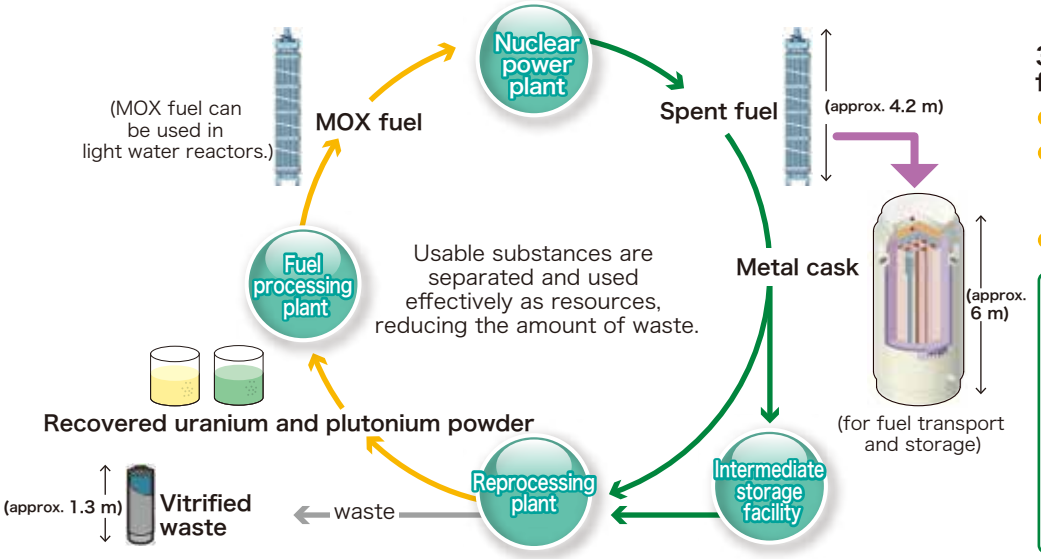
A For a country that lacks natural resources, nuclear power generation is essential in order to achieve the following 3 objectives: ① securing a stable supply of power, ② reducing electric power costs, ③ reducing greenhouse gas emissions. In order for nuclear power plants to be restarted, conformance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

Operational Status of Nuclear Power Plants



Nuclear Fuel Cycle

Japan maintains a "nuclear fuel cycle" which reprocesses spent fuel from nuclear reactors in order to reuse the recovered uranium and plutonium and reduce the generation of waste.

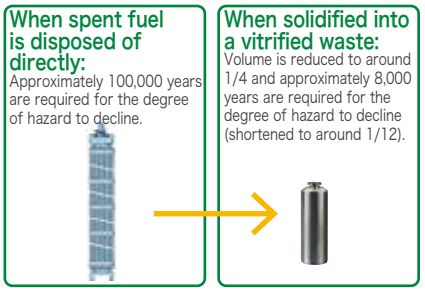


3 advantages of the nuclear fuel cycle

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

When spent fuel is disposed of directly: Approximately 100,000 years are required for the degree of hazard to decline.

When solidified into a vitrified waste: Volume is reduced to around 1/4 and approximately 8,000 years are required for the degree of hazard to decline (shortened to around 1/12).



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

Current state of spent fuel: Towards completion of a nuclear fuel cycle

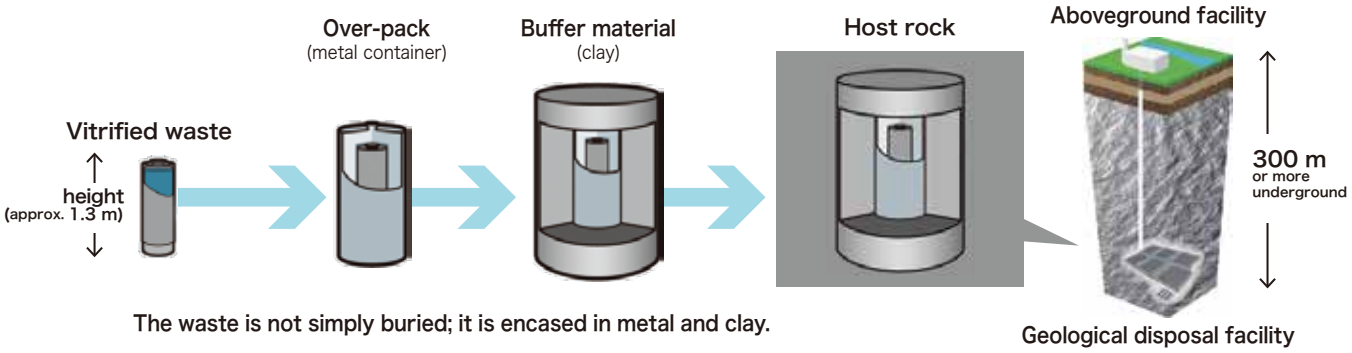
The Rokkasho Reprocessing Plant located in Aomori Prefecture is subject to the new regulatory standards for nuclear power facilities. Completion is expected in the first half of FY 2021. When it is completed, it is expected to have the capacity to process 800 tons of spent fuel per year.

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

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

Treatment and Disposal of Spent Fuel

Spent nuclear fuel that is produced by the operation of a nuclear power plant is recycled and reused as fuel. Raw glass material is melted into the remaining waste to create a solidified glass mass known as “vitrified waste”. This mass is disposed of by burying and isolating it deep underground (geological disposal).



The waste is not simply buried; it is encased in metal and clay.

Nationwide Map of Scientific Features

To deepen 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:** Close to a volcano, active fault, etc.
- **Silver:** Location of underground mineral resources
- **Green:** Assumed to be favorable
- **Dark green:** Green area located close to the coastline

Read more about a map

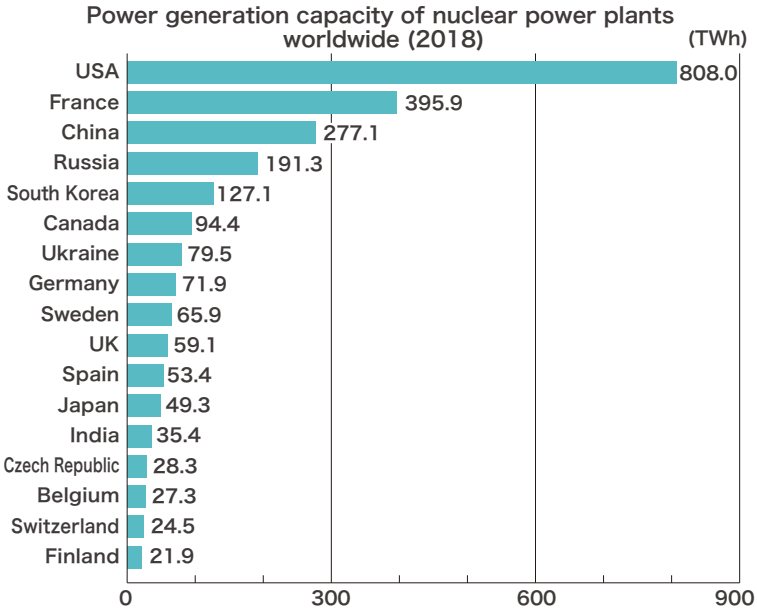
Use this QR code to view the article.

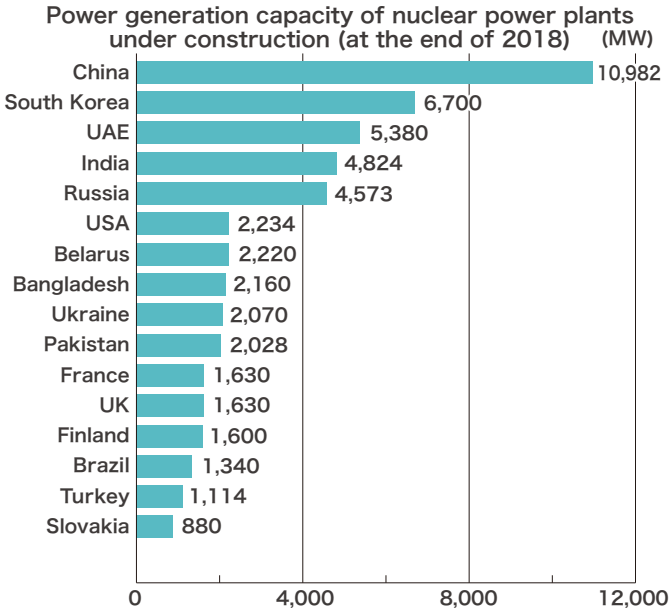
＊ Even in the green areas, a 3-stage disposal site selection investigation must be conducted to confirm precisely whether or not a particular location satisfies the required conditions for geological disposal.

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

Column: Global trends in nuclear power

Based on nuclear power generation results, the leading countries are, in order, the United States, France, China, Russia, and South Korea. However, the generation capacity of nuclear power plants under construction shows that China is constructing an extremely large number of plants.





Source：IAEA Energy, Electricity and Nuclear Power Estimates for the Period up to 2050 REFERENCE DATA SERIES No. 1 2019 Edition

10. Mineral Resources

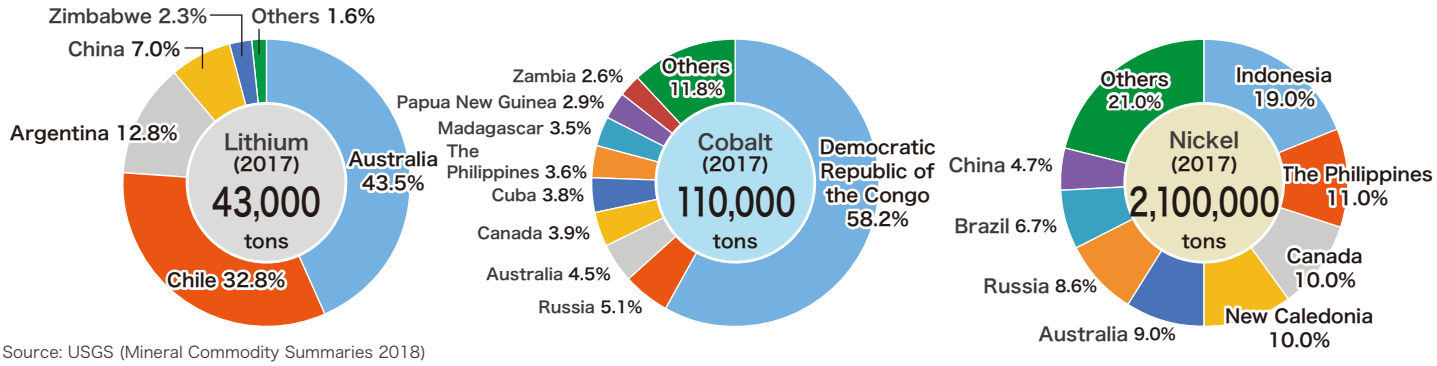
Mineral Resources

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.)

Global annual production of important rare metals

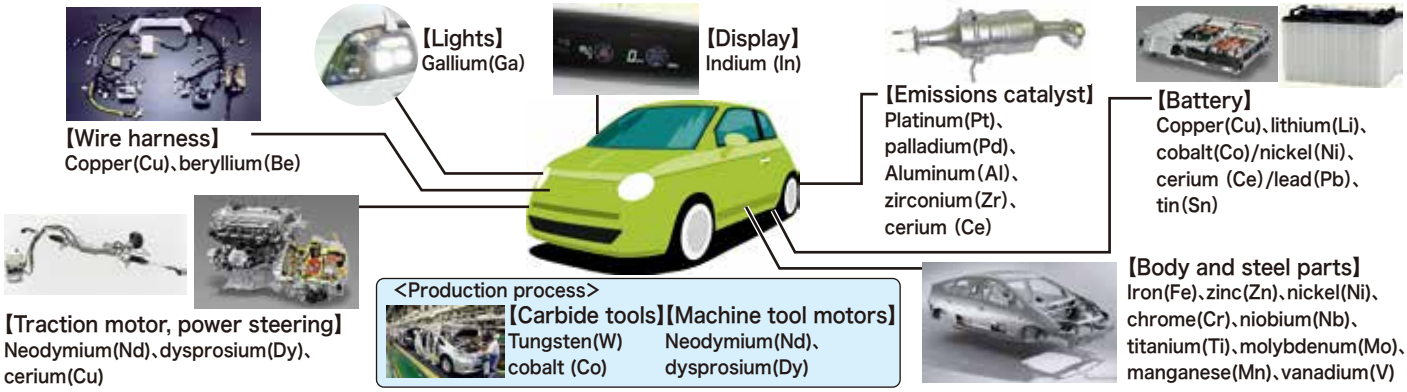


Source: USGS (Mineral Commodity Summaries 2018)

Japanese industry uses a wide range of mineral resources including iron, base metals (such as copper, lead, and zinc), as well as precious metals, rare-earth elements, and other rare metals (such as nickel and cobalt).The following example of an automobile uses many minerals in the materials of its components.

group of elements / period	I A	II A	III B	IV B	V B	VI B	VII B	VIII	I B	II B	III A	IV A	V A	VI A	VII A	O
1	1 H															2 He
2	3 Li	4 Be									5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg									13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe 27 Co 28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru 45 Rh 46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	57~71	72 Hf	73 Ta	74 W	75 Re	76 Os 77 Ir 78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	89~103	104 Rf	105 Db	106 Sg	107 Bh	108 Hs 109 Mt 110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og

Minerals used in an automobile



Column: Nobel Prize in Chemistry and lithium-ion batteries

The 2019 Nobel Prize in Chemistry was awarded to three scientists who invented the lithium-ion battery, including Asahi Kasei Honorary Fellow Dr. Akira Yoshino.
Lithium-ion batteries are used in all kinds of electronic devices such as mobile phones, notebook PCs, and electric vehicles.
Although renewable energy is considered unstable, using lithium-ion batteries for storing power in combination with a renewable energy source can help to stabilize the power supply.
Research into battery technologies is being conducted for resources that can replace lithium in order to make further improvements.
Mineral resources support global industry, and provide a pathway to the future.

Lecture by Asahi Kasei Honorary Fellow Akira Yoshino (November 2019)

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/

Please go to the below URL to see the electronic version (pdf) of this brochure.
https://www.enecho.meti.go.jp/en/category/brochures/

Japan's Energy 2019 Edition, Issued: March 2020

Click here if you would like to know more about energy!

Special contents
Various topics on energy

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

* For effective utilization of resources, this brochure uses recycled paper containing 80% used paper and vegetable oil ink