

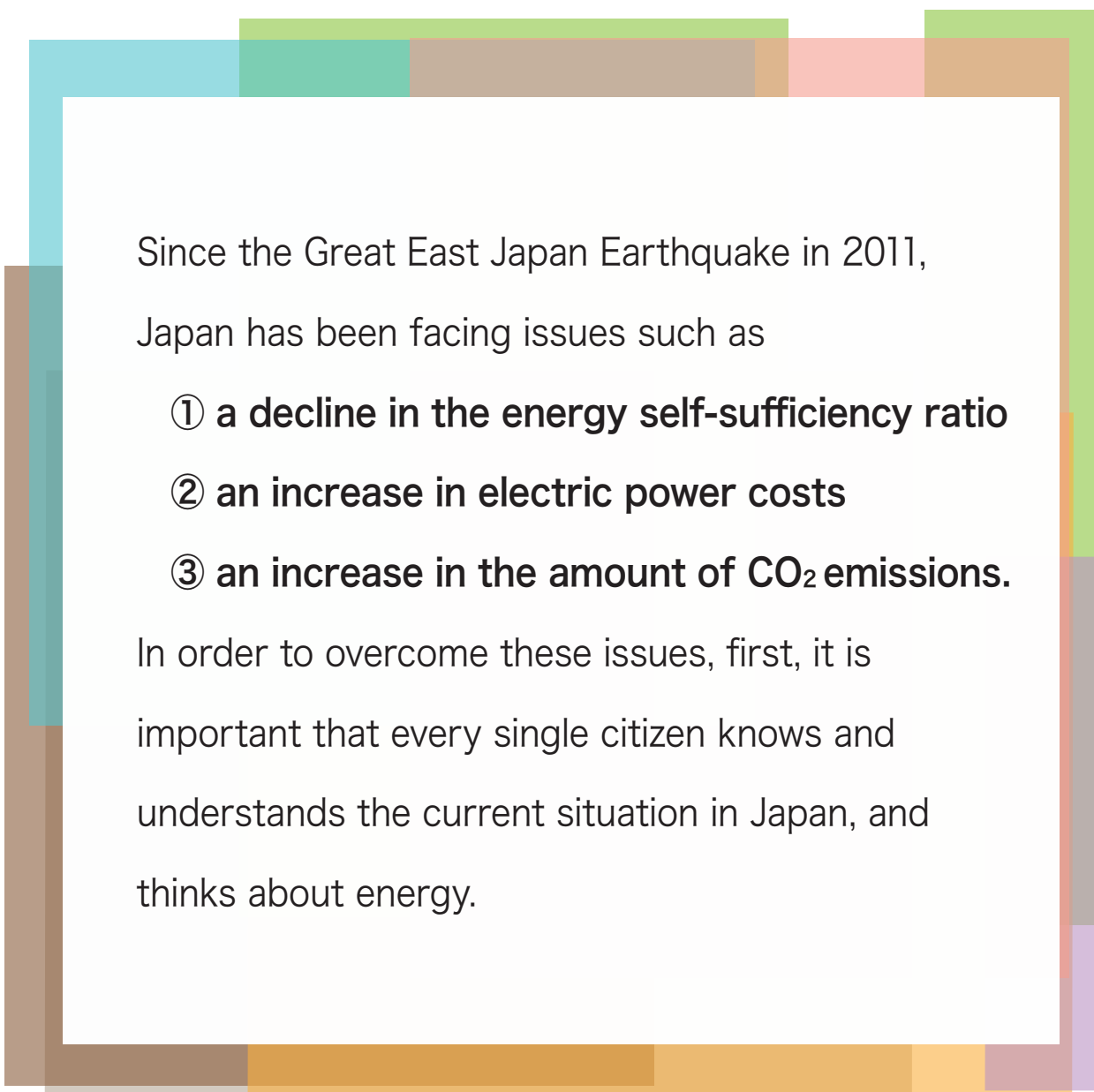
# JAPAN'S ENERGY

## 20 Questions to understand the current energy situation

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- Q2. What resources does Japan depend on?
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Since the Great East Japan Earthquake in 2011,  
Japan has been facing issues such as

- ① **a decline in the energy self-sufficiency ratio**
- ② **an increase in electric power costs**
- ③ **an increase in the amount of CO<sub>2</sub> emissions.**

In order to overcome these issues, first, it is  
important that every single citizen knows and  
understands the current situation in Japan, and  
thinks about energy.

(May 2018)

Based on final figures of the Comprehensive Energy Statistics of FY2016,  
some of the data in "Energy of Japan 2017" were revised back to 1990.

More detail information, please visit at

[http://www.enecho.meti.go.jp/statistics/total\\_energy/review.html](http://www.enecho.meti.go.jp/statistics/total_energy/review.html)

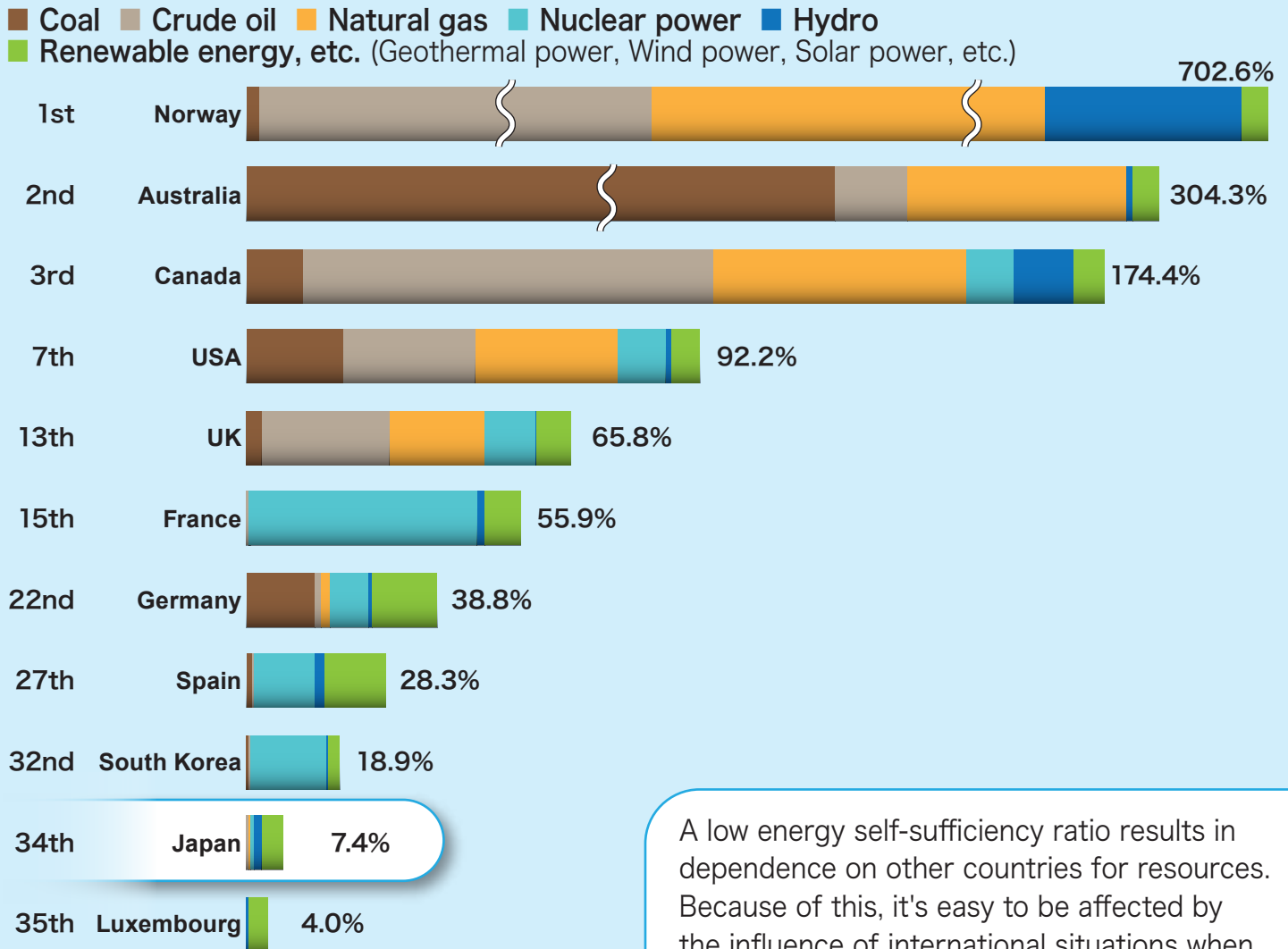
(Japanese only).

Q1

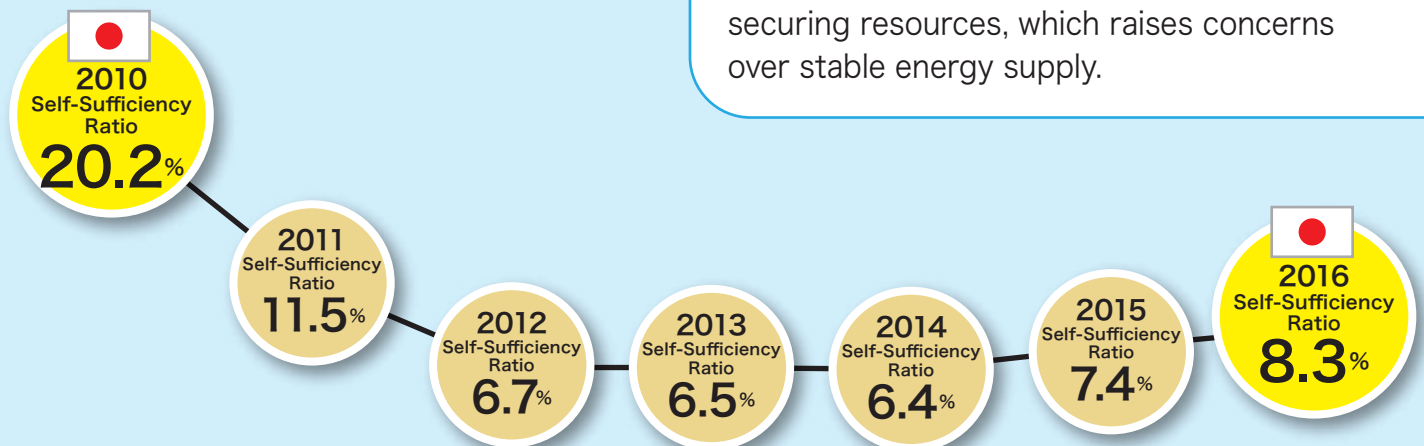
## How much energy can be self-supplied by domestic resources in Japan?

**A1** Originally, Japan is poor in resources such as oil and natural gas. The energy self-sufficiency ratio of Japan in 2015 was 7.4% which was a low level even compared to other OECD countries.

### Comparison of Primary Energy Self-Sufficiency Ratios of Major Countries (2015)



A low energy self-sufficiency ratio results in dependence on other countries for resources. Because of this, it's easy to be affected by the influence of international situations when securing resources, which raises concerns over stable energy supply.



**Energy self-sufficiency ratio:** In primary energies required for life and economic activity, the ratio that can be secured within one's own country.

Source: Created based on IEA "Energy Balance of OECD Countries 2017" \* The ranking in the table is the ranking of the 35 OECD countries. Japan based on Comprehensive energy statistics.

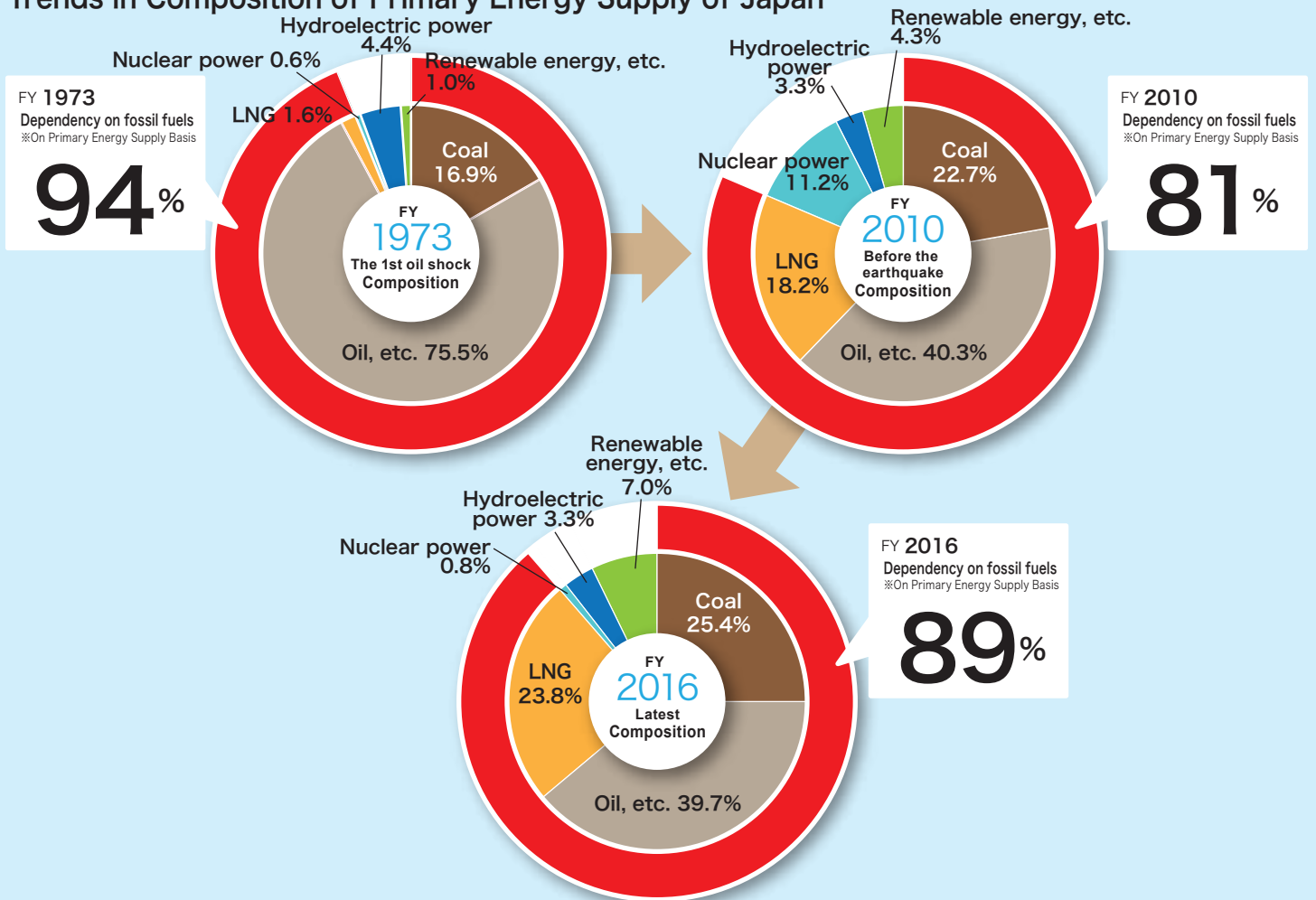
Q2

## What resources does Japan depend on?

A2

Japan depends on fossil fuels such as oil/coal/natural gas (LNG) imported from abroad. Before the earthquake, dependence was 81% on primary energy supply basis, but it is 89% in FY 2016 due to the generation by thermal power plants and the shutdown of nuclear power plants.

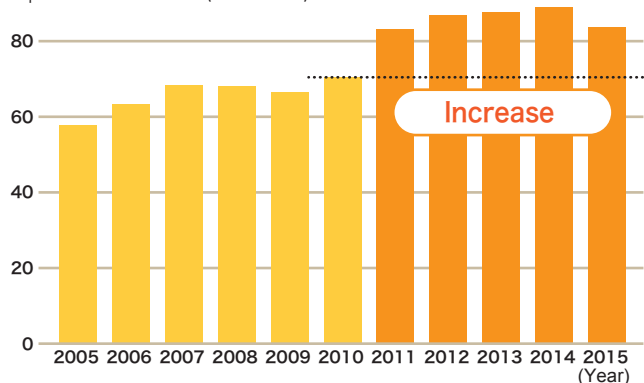
### Trends in Composition of Primary Energy Supply of Japan



Source: Comprehensive energy statistics.

\* The total amount expressed in % might not be 100% due to rounding.

Import Amount of LNG (Trillion Yen)



Source: Japan's Energy White Paper 2017 [213-1-9] Natural gas supply, Annual report on energy production · supply and demand statistics, Trade statistics

### An Increase in Imports of LNG

LNG (Liquefied Natural Gas) has expanded its role in recent years as a clean fossil fuel with the least emission of greenhouse gas. Even when the nuclear power plant shutdown after the Great East Japan Earthquake, LNG thermal power generation contributed to stable electric power supply. The stable supply of LNG will be increasingly demanded in the future.

#### What is LNG (Liquefied Natural Gas)?

Natural gas is produced from associated gas of oil fields or independent gas fields, comprised mainly of methane. Because it is in gaseous form at normal temperature/pressure, transported by pipeline in the gaseous form, or by tanker as LNG after becoming a liquid form by being cooled to  $-162^{\circ}\text{C}$ , either method of which is adopted. Natural gas is frequently used because it is relatively clean among the fossil fuels.

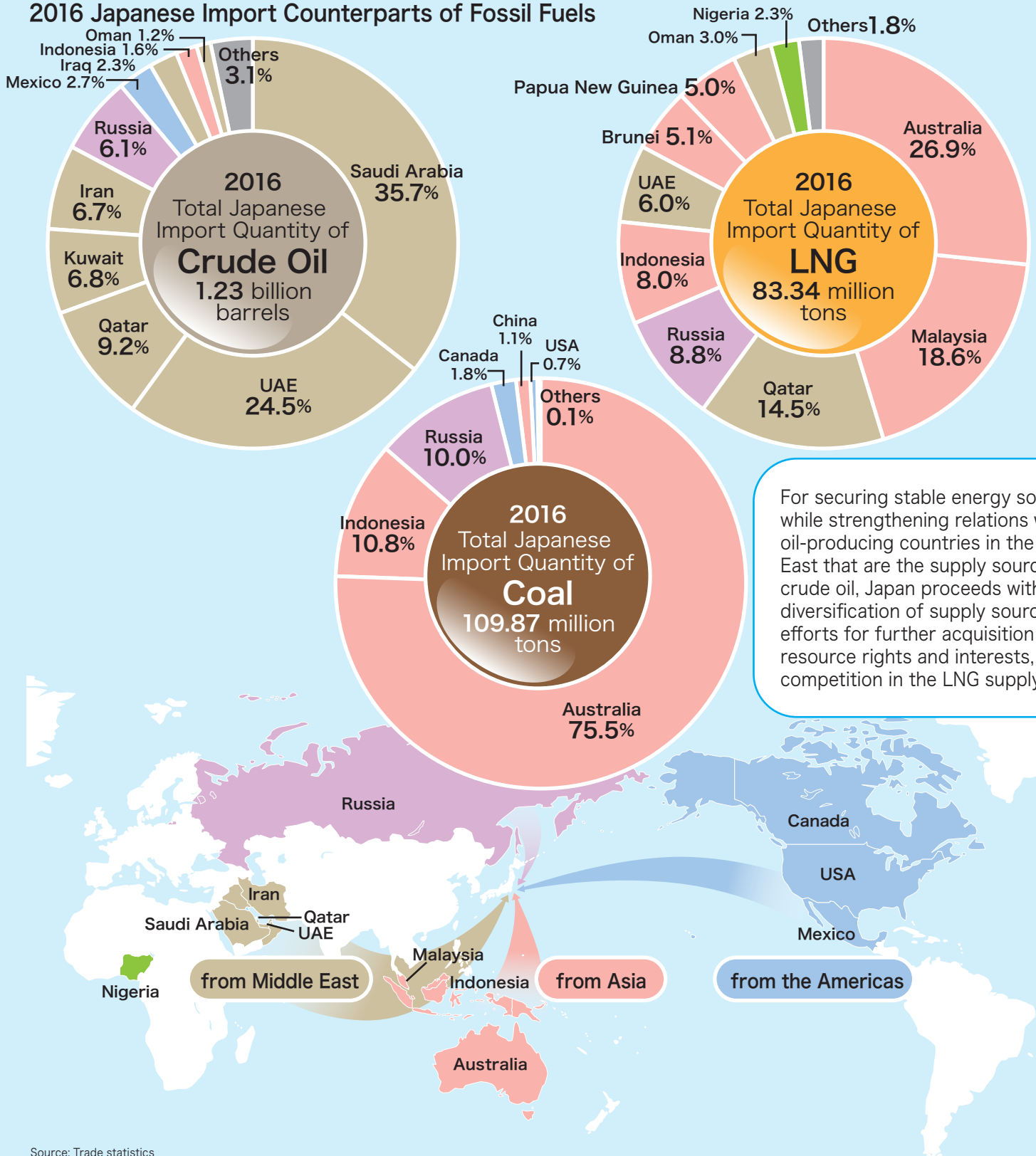
Q3

# What countries does Japan import resources from?

A3

Japan depends about 86% of crude oil on the Middle East such as Saudi Arabia or the United Arab Emirates etc. Japan also mostly depends on imports from foreign countries for natural gas and coal.

2016 Japanese Import Counterparts of Fossil Fuels



For securing stable energy sources, while strengthening relations with oil-producing countries in the Middle East that are the supply sources of crude oil, Japan proceeds with the diversification of supply sources, efforts for further acquisition of resource rights and interests, and competition in the LNG supply.

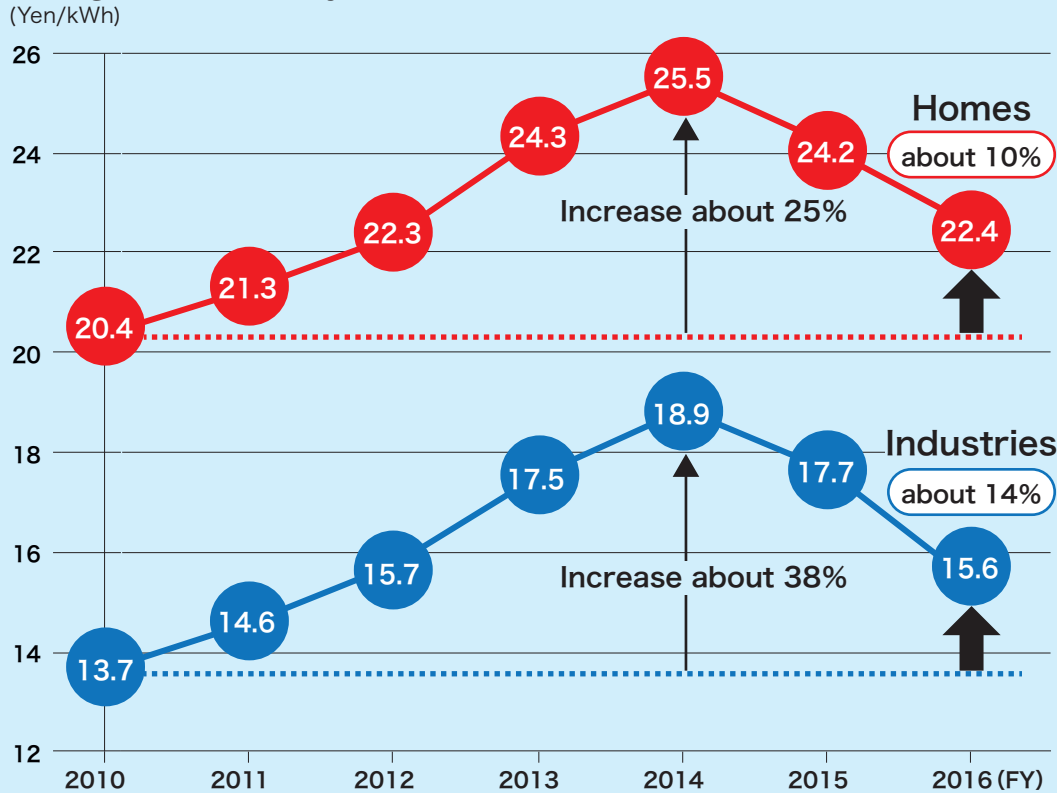
Source: Trade statistics

**Q4**

# How are electric power costs changing?

**A4** After the earthquake, the electricity rate increased, but it is on a downward trend since FY 2014 due to the subsequent decline in crude oil price etc.

## Changes in Electricity Rates

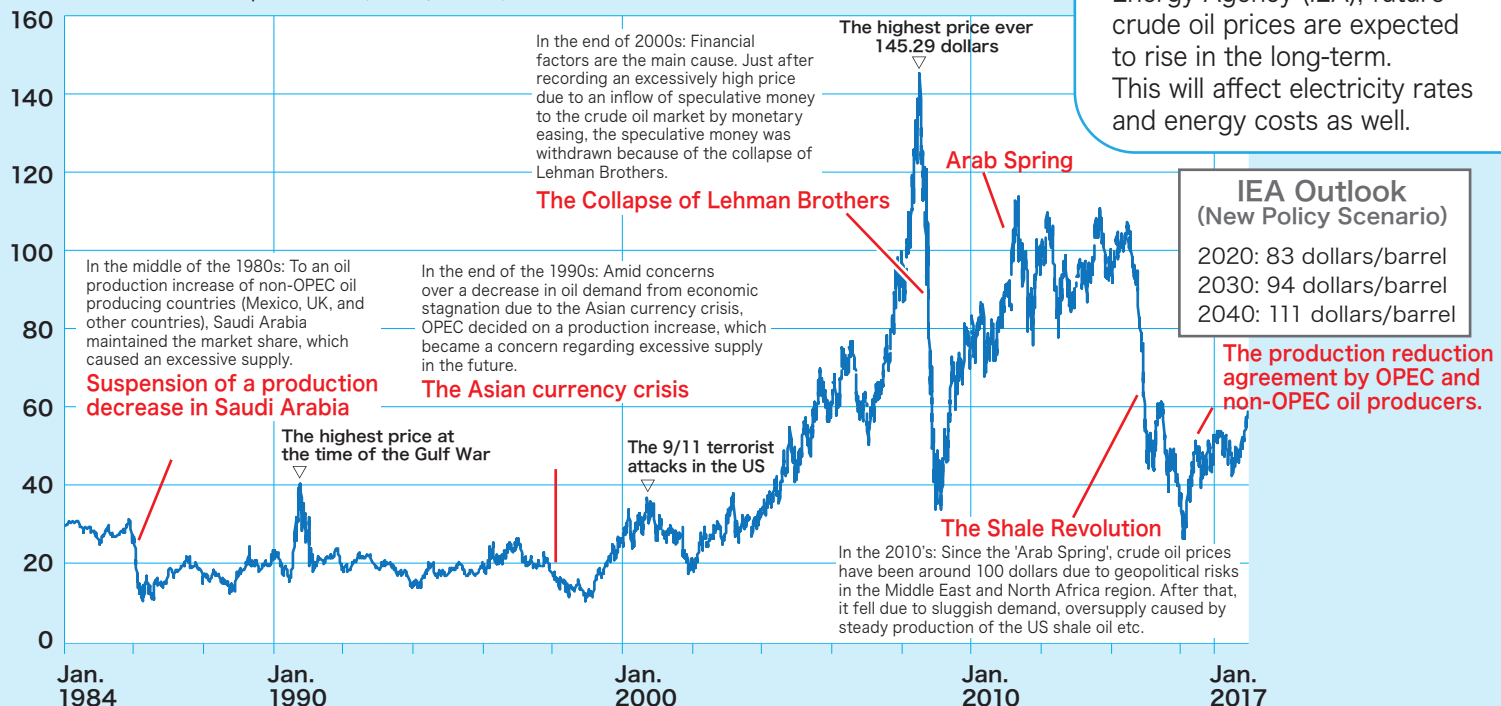


Compared with FY 2010 before the earthquake, in FY 2014, electricity rates for homes increased by about 25%, rates for industries increased by about 38%. Although it is on a downward trend since FY 2014, it is still at a high level of about 10% for homes and about 14% for industrial use.

Source: the reports of electricity demand (FEPC), and financial materials of each electric power company, etc.

## The Situation in the Past Where the Crude Oil Price Fell and the Current Situation

International crude oil price WTI (dollar/barrel)



The crude oil price was largely affected by international situations, and it has repeatedly violently fluctuated until now. According to the New Policy Scenario of the International Energy Agency (IEA), future crude oil prices are expected to rise in the long-term. This will affect electricity rates and energy costs as well.

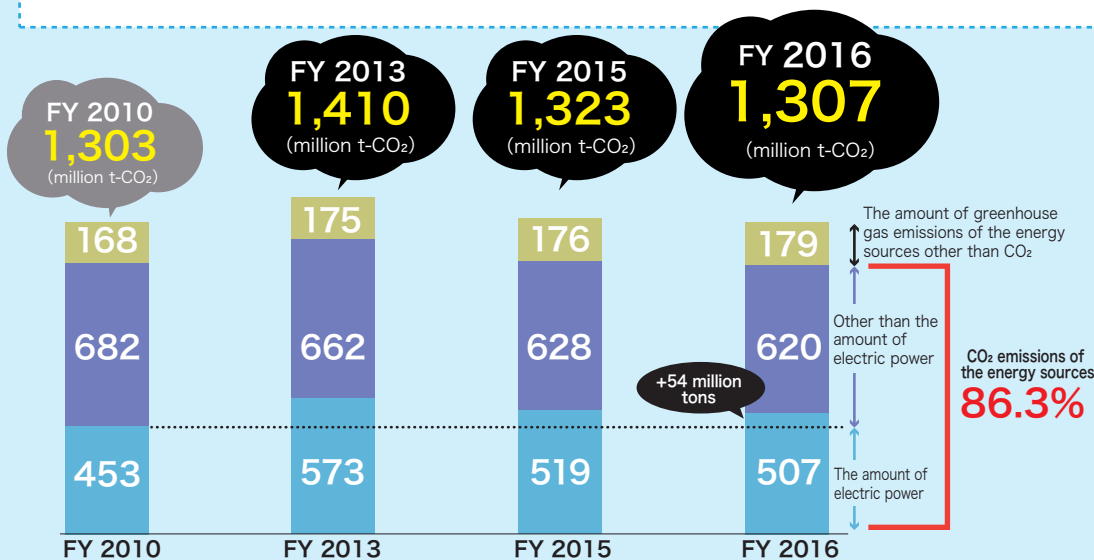
Source: NYMEX, IEA World Energy Outlook 2016

## Q5

## How much greenhouse gas is emitted in Japan?

## A5

Since the Great East Japan Earthquake, the amount of greenhouse gas emissions in Japan had been increasing, reaching 1.4 billion tons the highest ever in FY 2013. Although it started to decline after FY 2014, 1,307 million tons was still emitted in FY 2016. In the future, we must also make efforts to reduce it at levels comparable to those of other countries.



Since the earthquake, the amount of emissions in the electric power field increased by 54 million tons due to reasons including generation of more electric power by thermal power plants as a substitution for nuclear power. This is an increase of about 4% of the amount of greenhouse gas emissions in Japan as a whole.

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

## "Paris agreement" - what has been decided? What should we do?

In December 2015, the **Paris Agreement**, a new international framework in which all countries participate and which is fair and effective, was adopted. In the Paris Agreement, it was decided to make an effort to hold the increase in the global average temperature to well below 2°C compared to before industrialization, and to pursue efforts to limit the temperature to 1.5°C.

<http://www.enecho.meti.go.jp/about/special/tokushu/ondankashoene/pariskyotei.html>



more information  
(Japanese)



Photo: Cabinet Public Relations Office

## Energy Situations in Other Countries

- Germany: Even though renewable energy is expanding, the pace of CO<sub>2</sub> reduction is slow.**  
 Accompanying the expansion of renewable energy, electric power rates are increasing and the national burden is also expanding. In addition, even though the nuclear power ratio is decreasing, due to an increase of coal-fired power generation and operating rate of thermal power plants, the pace of CO<sub>2</sub> reduction is slow.
- UK: Renewable energy and nuclear power are being expanded.**  
 Renewable energy is being expanded together with the new establishment of nuclear power. Moreover, electricity rates also tend to be rising due to the influence of levies for renewable energy, etc.
- USA: Due to expanding the utilization of natural gas, etc., CO<sub>2</sub> emissions is decreasing.**  
 In addition to expansion of renewable energy and utilization of nuclear power, as a result of the shale revolution, utilization of natural gas including the electric power generation sector was expanded, which results in promoting CO<sub>2</sub> reduction.
- China/India: Accompanying economic growth, it is necessary to expand power supply capability.**  
 Currently, coal-fired power generation is the main power source (about 60% of world consumption in 2015), but they are trying to expand renewable energy and nuclear power in the future. Moreover, regarding coal-fired power generation, the policy of China is to suppress it, whereas that of India is to utilize it while improving efficiency. As of 2015, China is emitting 28% of the world CO<sub>2</sub> emissions, followed by the United States and India.

Source: : IEA "CO<sub>2</sub> EMISSIONS FROM FUEL COMBUSTION" 2017

Q6

## Are there advancements in research and development of domestic resources?

A6

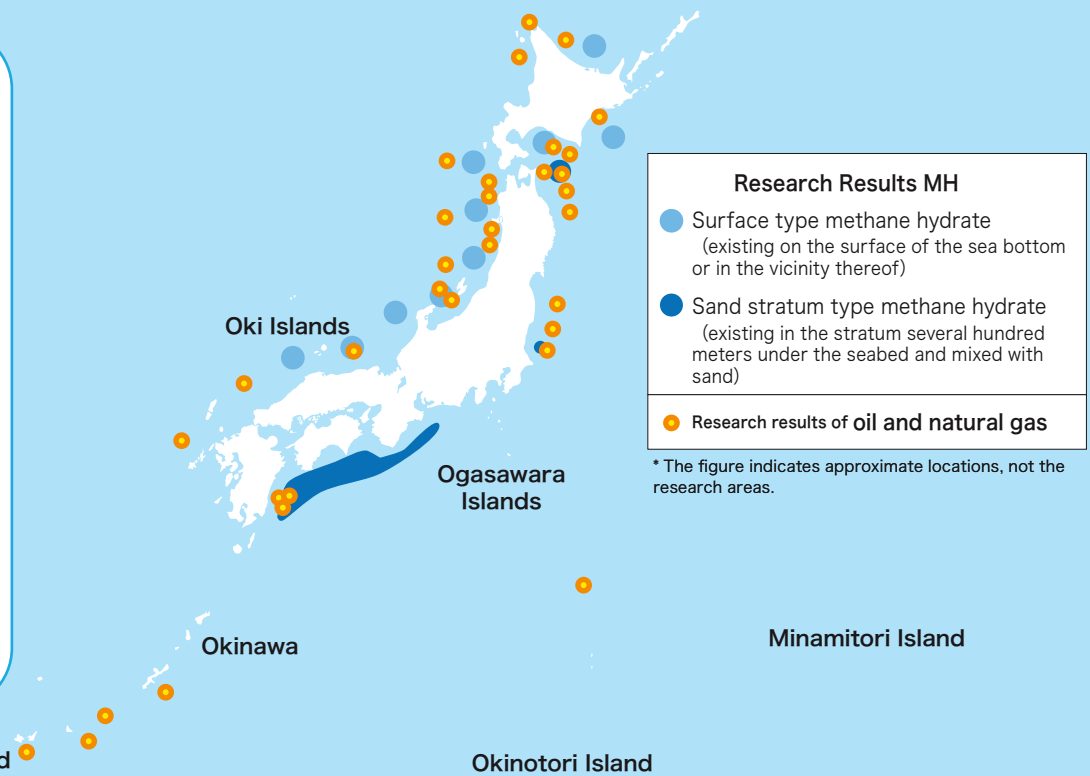
Japan is proceeding with research and development of non-conventional resources such as methane hydrate, in addition to oil and natural gas.

Along with research for grasping the amount of resources, techniques for recovery of methane hydrate are being developed for commercial projects.



### Methane Hydrate

An ice-like substance in which methane gas and water are combined under low temperature and high pressure conditions. It's called "burning ice."



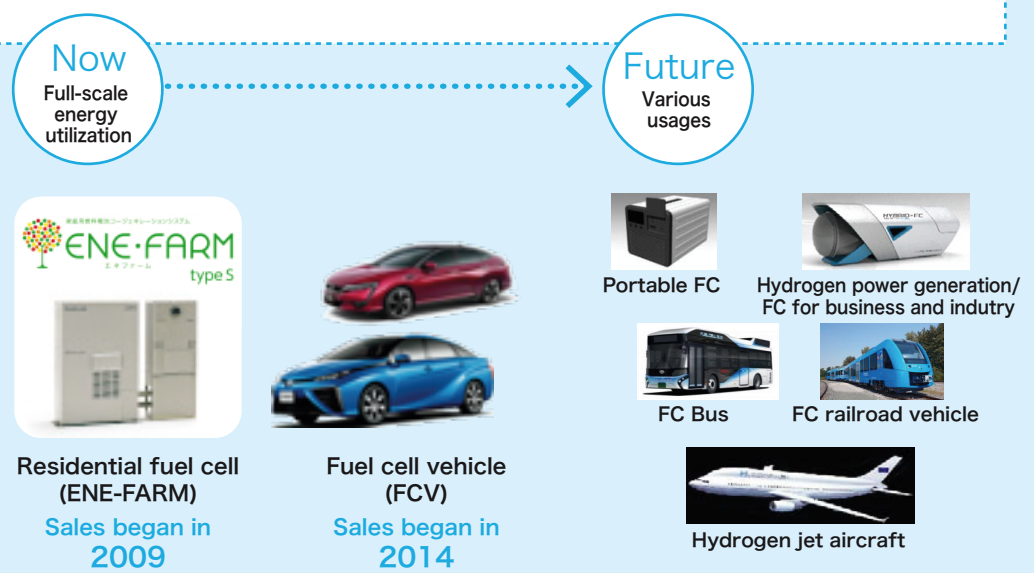
Q7

## Will hydrogen energy become popular in the future?

A7

From now, hydrogen energy is expected to be used for various purposes and to play a central role in replacing oil and other resources.

Hydrogen is expected to contribute to a low environmental burden, energy savings, and energy security by not emitting CO<sub>2</sub> when used, implementing higher energy efficiency by utilization of fuel cells, and being possible to be produced from various energy sources.





Q8

## Why are energy efficiency measures necessary?

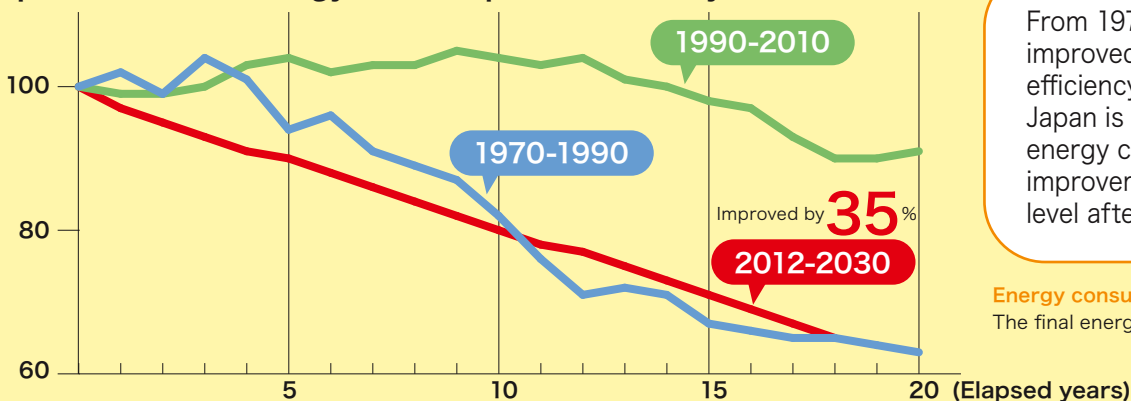
**A8** The reason is to effectively utilize limited resources. In addition, energy efficiency measures can suppress CO<sub>2</sub> emissions, which leads to solving global warming issues. Continuous efforts for energy efficiency measures are essential.

Q9

## How far have efforts for energy efficiency measures in Japan progressed?

**A9** Japan has excellent energy consumption efficiency and advanced energy efficiency measures. Improvement of consumption efficiency has been sluggish in recent years, so it is required to further advance energy efficiency measures.

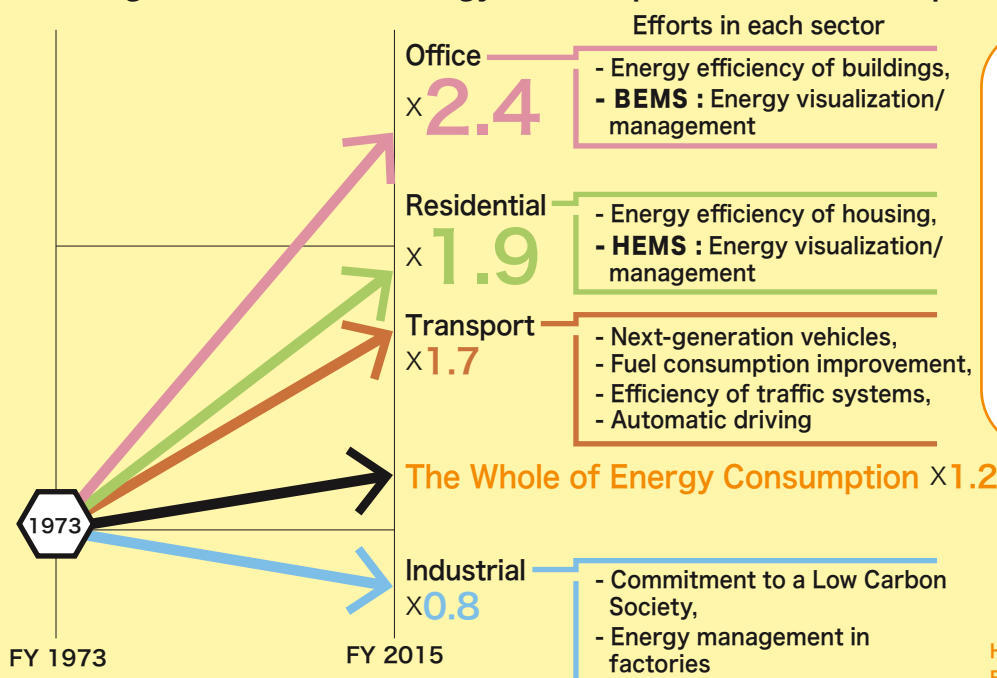
Improvement of Energy Consumption Efficiency



From 1970 to 1990, Japan largely improved energy consumption efficiency. With 2030 as a goal, Japan is aiming to achieve an energy consumption efficiency improvement of 35%, the same level after the oil crisis.

**Energy consumption efficiency:**  
The final energy consumption amount/Real GDP

The Change Ratio of Final Energy Consumption Amount of Japan (Comparison by Sector)



Compared to during the oil crisis, while the real GDP was increasing by 2.6 times, the increase in energy consumption remained at 1.2 times, which indicates that energy efficiency were promoted. However, the energy consumption amounts of the office sector and the residential sector are increasing, so it is required to promote energy efficiency measures.

**HEMS:** Home Energy Management System  
**BEMS:** Building Energy Management System

**Q10**

# Why does renewable energy need to be introduced?

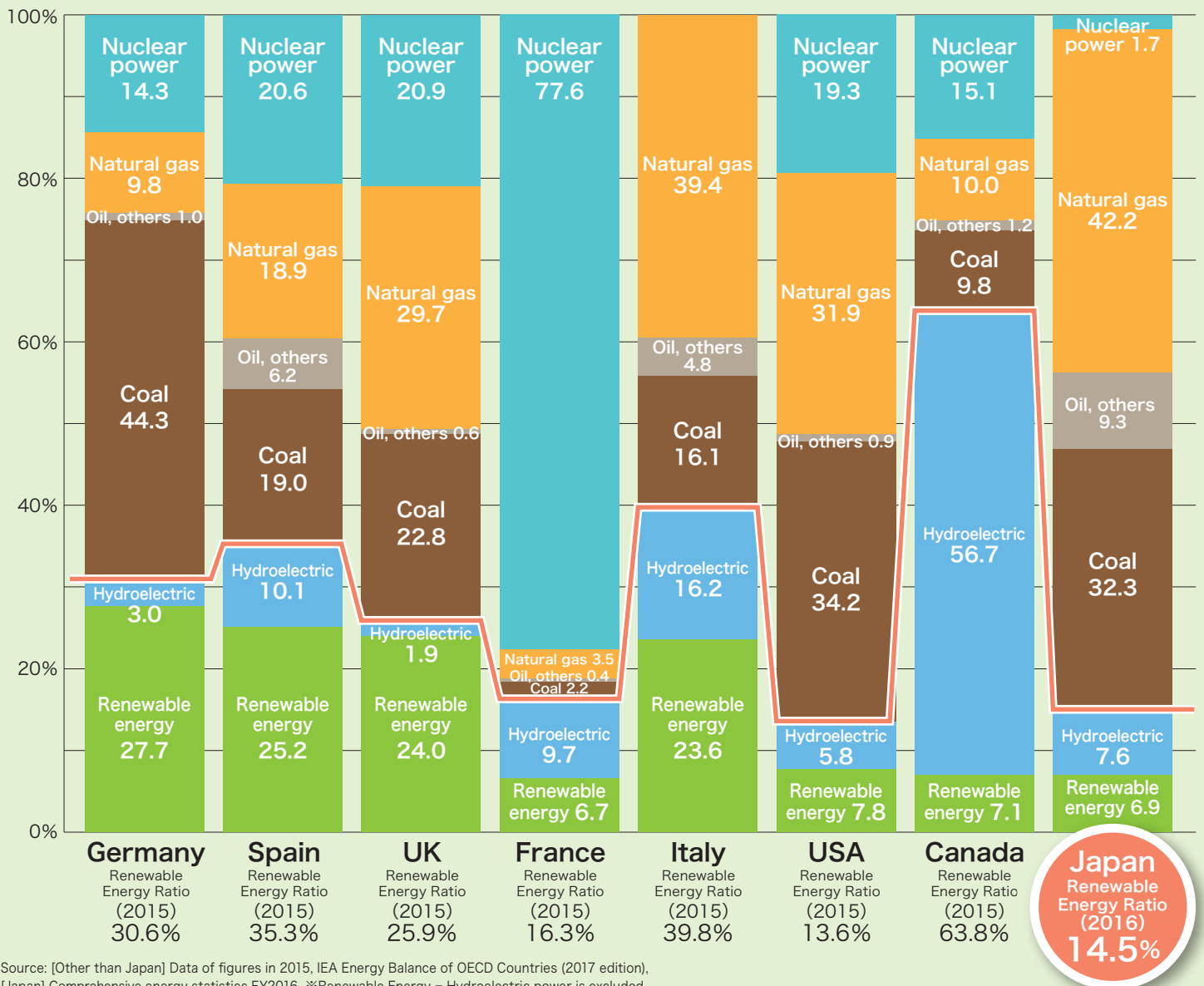
**A10** Renewable energy is an important energy that emits low CO<sub>2</sub> during electricity generation and contributes to energy self-sufficiency ratio.

**Q11**

# Is renewable energy progressed in Japan?

**A11** As of 2016, the renewable energy ratio in the generated electric power amount of Japan is 14.5% (6.9% if hydroelectric power is excluded). It seems low compared to major countries, so expanding further is required.

Comparison of the Renewable Energy Ratio in the Generated Electric Power Amount

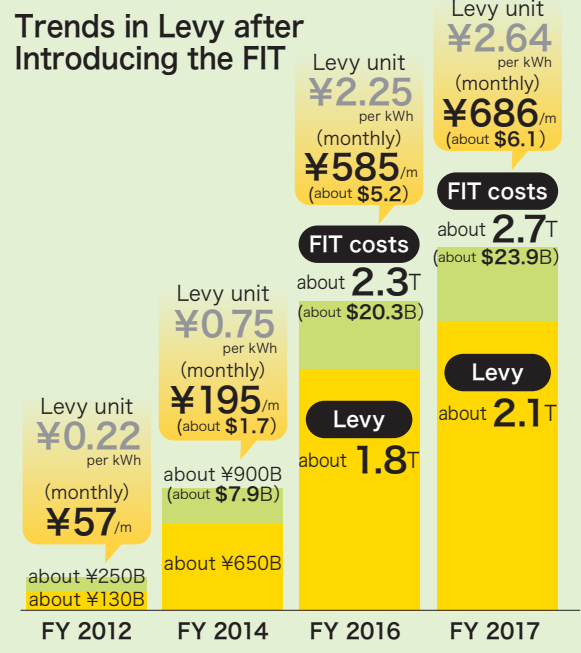
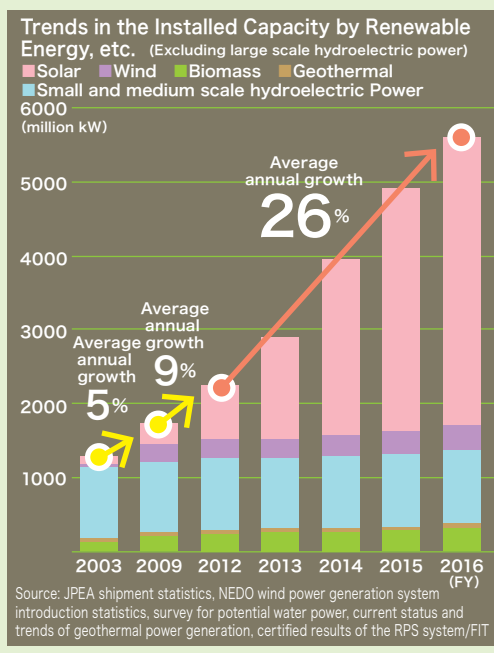


Source: [Other than Japan] Data of figures in 2015, IEA Energy Balance of OECD Countries (2017 edition), [Japan] Comprehensive energy statistics FY2016. ※Renewable Energy = Hydroelectric power is excluded

Q12

# What kind of efforts are being made for expanding the introduction of renewable energy?

**A12** The Feed-in Tariff Scheme (FIT) expands the introduction of renewable energy. Additionally, in order to reduce the cost of renewable energy, we are trying to accelerate R&D for renewable energy, such as offshore wind power generation and solar power generation.



Thanks to the introduction FIT in 2012, the installed capacity of renewable energy is growing rapidly. Meanwhile, the purchase costs reached 2.7 trillion yen (about \$23.9 billion)\*, and the levy burden to average households amounts up to 686 yen/month (about \$6.1)\*. In order to maximize introduction of renewable energy while minimizing national burden, we implemented the revised FIT Law incorporating a mechanism to encourage cost-effective introduction such as bidding systems etc.

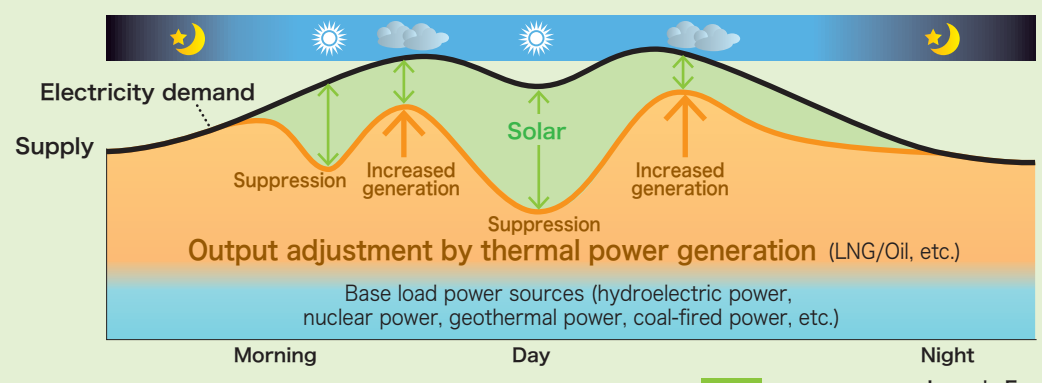
\* Calculated by Yearly-Average exchange rate.

**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 certain price. The costs are collected as a levy from electricity users.

Q13

# Can we provide energy only by renewable energy?

**A13** Renewable energy varies significantly depending on the condition of weather or season, and many kinds of renewable energy are not stable. Power sources that can adjust output such as thermal power need to be prepared as backup. In addition, issues such as the energy storage countermeasure and the method of power grid responding to massive introduction remain.



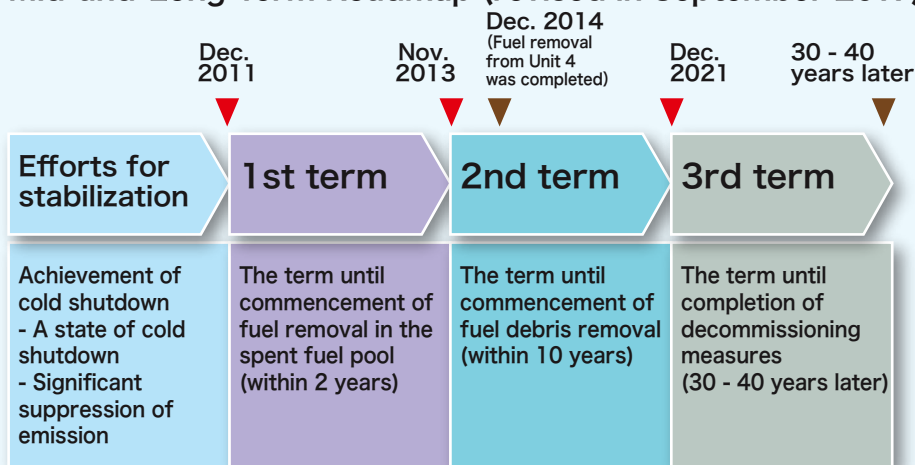
In order to keep stable use of electricity, the amount of supply needs to be the same as demand. The power generation amount and consumption need to be balanced by thermal power, etc. that can respond to the fluctuation of renewable energy.

Q14

## Is there progress in the decommissioning and contaminated water management at Fukushima Daiichi Nuclear Power Plant?

**A14** Although it's a difficult task, continuous efforts are being implemented safely and steadily based on the Roadmap revised at the end of September 2017 regarding the removal of spent fuel and fuel debris of Units 1 to 3, and countermeasures for contaminated water.

### Mid-and-Long-Term Roadmap (revised in September 2017)

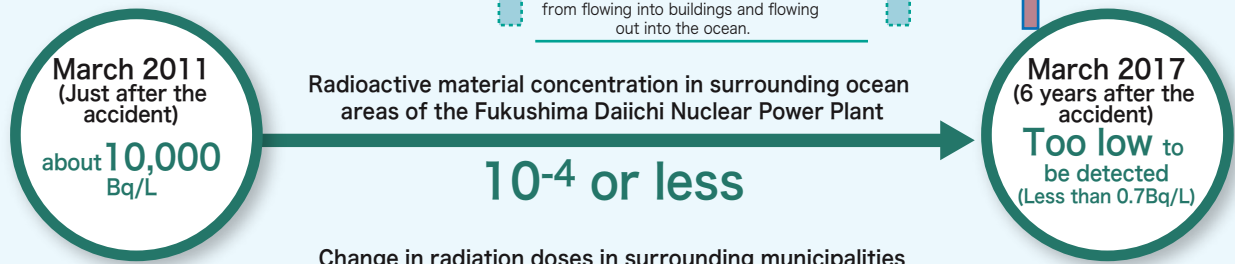
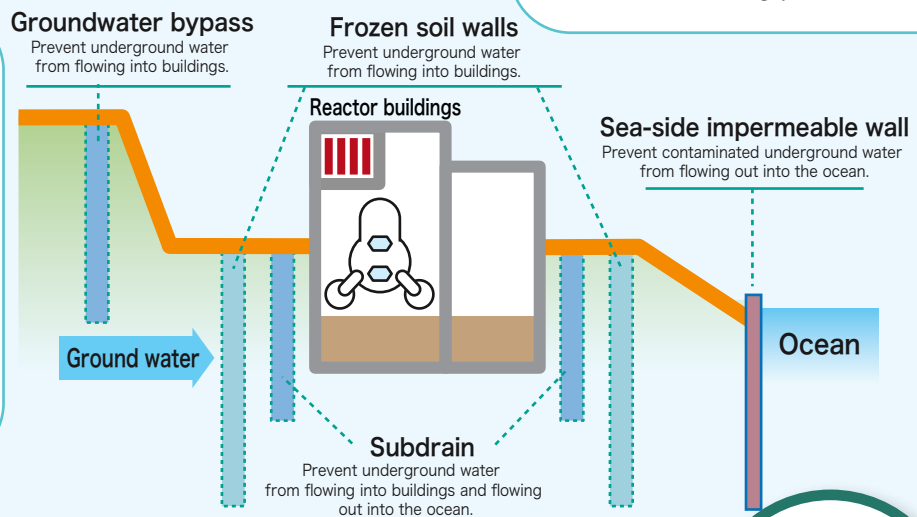


### Decommissioning Measures

In Unit 4, fuel removal from the pool was completed in December 2014. Regarding Units 1 to 3, preparations including removal of debris and decontamination are being steadily made, and it is planned to start removing fuel at Unit 3 in mid-2018. For the fuel debris removal, understanding of the conditions inside the reactor has progressed, and in September 2017, a policy on fuel debris removal was decided. Subsequently, by gathering wisdom from throughout the world, R&D for investigation inside the reactor containment vessel and development of fuel debris removal methods are being pursued.

### Countermeasures for Contaminated Water

Completion of sea-side impermeable walls further reduced the radioactive material concentration in surrounding ocean areas. The countermeasures are making steady progress. Frozen soil walls, started in March 2016 have been completed for the sea-side underground section in October 2016 and freezing of the mountain-side is in steady progress.



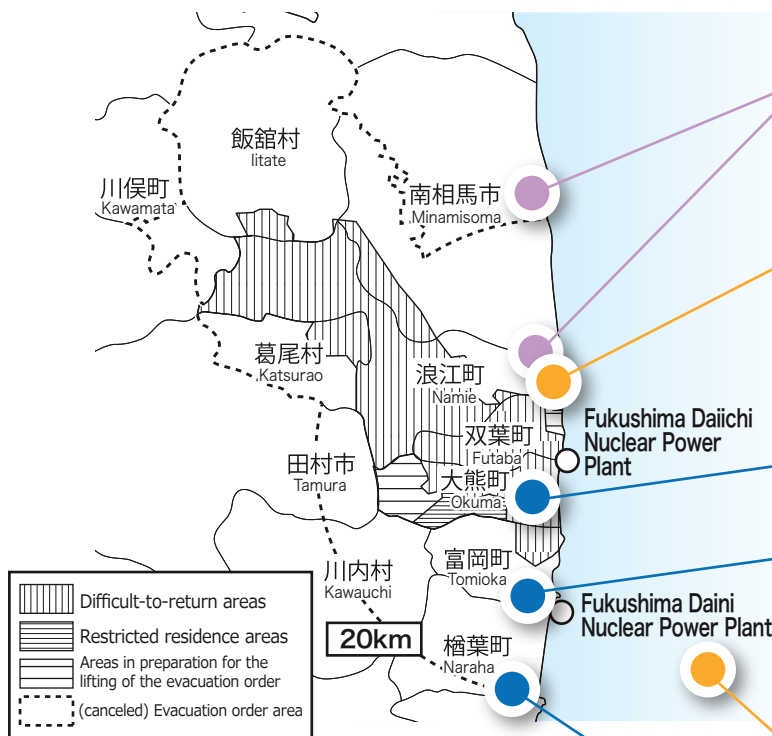
	May 2011	March 2016 (5 years after)	March 2017 (6 years after)
Namie	about <b>70mSv/y</b>	about <b>13mSv/y</b>	By the spring of 2017, all restricted residence areas and areas in preparation for the lifting of the evacuation order were lifted except Okuma and Futaba. ● Fukushima Innovation Coast Scheme ● Restructuring of business ● Dispelling of harmful rumors damage on food etc.
Tomioka	about <b>25mSv/y</b>	about <b>0.5mSv/y</b>	
Naraha	about <b>16mSv/y</b>	about <b>1.1mSv/y</b>	
Tamura	about <b>7mSv/y</b>	about <b>1.6mSv/y</b>	
	Physical decay + Effect of weathering + Decontamination		
	※Estimated on certain premise.		

# Q15 Is there progress in the Fukushima Reconstruction?

**A15** By the spring of 2017, all restricted residence areas and areas in preparation for the lifting of the evacuation order were lifted except Okuma and Futaba. For difficult-to-return areas, we are also working on the improvement of reconstruction bases. In addition, we are working on regeneration by accelerating decontamination and infrastructure/service development as well as creating new technologies/industries.

## Fukushima Innovation Coast Scheme

Aiming to build a new industrial base to restore industry in Hama-dori area etc.



### Fukushima Robot test field (Minamisoma City, Namie Town)



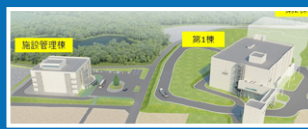
Establishment of robot testing field for developing/demonstrating robots and the international industry-academia-government collaboration facility.

### Large scale demonstration base of hydrogen production from renewable energy (Namie Town)



Implementing demonstration project to produce hydrogen from renewable energy on a large scale using the world's largest 10,000 kW class water electrolyzer.

### Okuma Analysis and Research Center (Okuma Town)



Implementing technology development regarding processing and disposal of fuel debris and radioactive waste.

### JAEA International Joint Research Center for Nuclear Decommissioning International Joint research building (Tomioka Town)



Universities, research institutes and companies within and outside Japan implement research on decommissioning plants.

### Offshore floating wind power generation (off the coast of Fukushima)



Implementing full-scale experimental research of the offshore floating wind power generation system by the world's first plural wind turbines (3 turbines of 2MW, 5MW, 7MW).

### Naraha Remote Technology Development Center (Naraha Town)



Implementing investigation of reactor containment vessels/development and demonstration tests of repair robots/training for workers using virtual reality systems.

## The Fukushima Plan for a New Energy Society

Creating a future model for a "new energy society" and promoting the "Fukushima Model" to the world.



### Expansion of introduction of renewable energy

- Supports for installation of transmission lines in the Abukuma and Futaba areas for building new wind farms.

### Development of a model for realizing a "Hydrogen Society"

- Producing green hydrogen from renewable energy (power-to-gas) on the largest scale in the world (10,000kW-class).
- Demonstration for transporting and storing hydrogen derived from renewable energy (utilizing hydrogen produced in Fukushima during 2020 Olympics and Paralympics in Tokyo).

### Creation of Smart Communities

- Demonstration projects of construction of a Smart Community in some regions across Fukushima, including Shinchi town, Soma city, Namie town, Naraha town and Katsurao Village.

## Safety Measures for Food in Fukushima Prefecture

- Monitor inspections before shipping and publish the results of agricultural, forestry and fishery products.
- Compared with just after the earthquake, products that exceeded the standard limits (100Bq/kg) have greatly decreased in recent years.
- Products that exceed the standard limits are subject to shipment restrictions, and products distributed in the market are safe.
- Shipment restrictions are lifted based on strict standards.

The situations in monitoring inspections of agricultural, forestry and fishery products (Apr. 1, 2016 - Mar. 31, 2017) \* Aug. 24, 2016 - Mar. 31, 2017 only for "Brown rice"

Classification	N/Inspections	Exceeded the Standard Ratio	
		Number	Ratio
Brown rice (produced in 2016)	about 10.24 M	0	0.00%
Vegetables/fruits	3,793	0	0.00%
Animal products	4,384	0	0.00%
Cultivated plants/mushrooms	1,049	0	0.00%
Marine seafood	8,766	0	0.00%
Edible wild plants/mushrooms	783	2	0.26%
Fish in rivers and lakes	621	4	0.64%

No products exceeded the standard limits

- Safely shipped
- Continue to investigate for lifting

Items that exceed the standard limits are subject to shipment restrictions for each production area

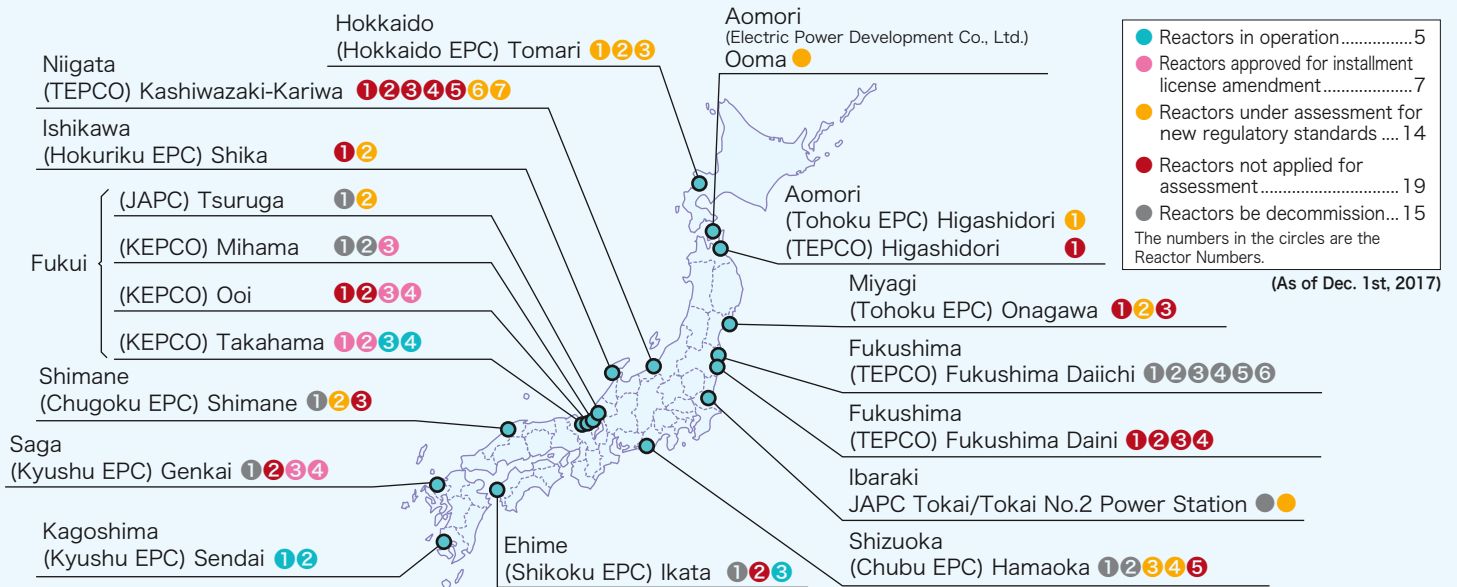
Source: Reconstruction Agency "Towards dispelling of harmful rumors - Recovery from nuclear disaster and progress of safety and regeneration in Fukushima -" (Oct. 2017)

**Q16**

**Is nuclear power generation necessary?**

**A16**

Nuclear power generation is indispensable power, in order to implement the below within poor resources ; ① securing a stable supply, ② reducing electric power costs, ③ suppressing CO<sub>2</sub> emissions. When restarting nuclear power plants, conforming to new regulatory standards that prioritize safety is required.

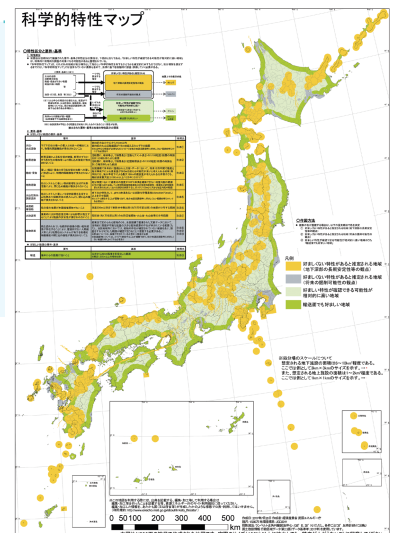
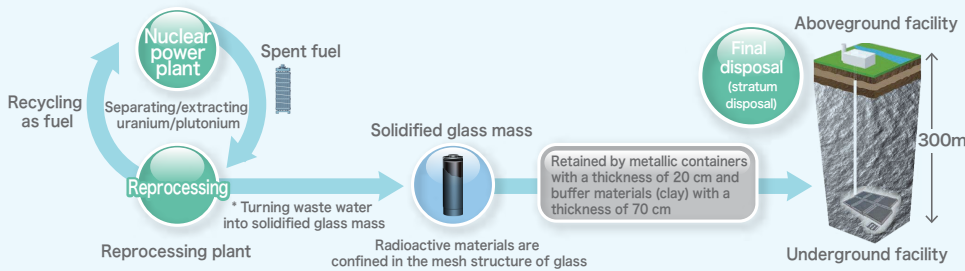


**Q17**

**How is radioactive waste produced by the operation of nuclear power plants disposed?**

**A17**

Along with recycling fuel, raw glass material is melted into the remaining waste water to become a solidified glass mass. The mass is disposed by burying it deep underground to be isolated (stratum disposal).



**Scientific characteristics map**

For your better understanding of the mechanism of stratum disposal and the geological environment in Japan, we published "Scientific Characteristics Map" in July 2017.

more information (Japanese)



[http://www.enecho.meti.go.jp/category/electricity\\_and\\_gas/nuclear/rw/kagakutekitokuseimap/maps/kagakutekitokuseimap.pdf](http://www.enecho.meti.go.jp/category/electricity_and_gas/nuclear/rw/kagakutekitokuseimap/maps/kagakutekitokuseimap.pdf)

**Q18**

# Is the safety of nuclear power plants secured?

**A18** Restarting nuclear power plants is required to conform to new regulatory standards by the Nuclear Regulation Authority, and enhancement of measures to prevent accidents and emergencies are performed.

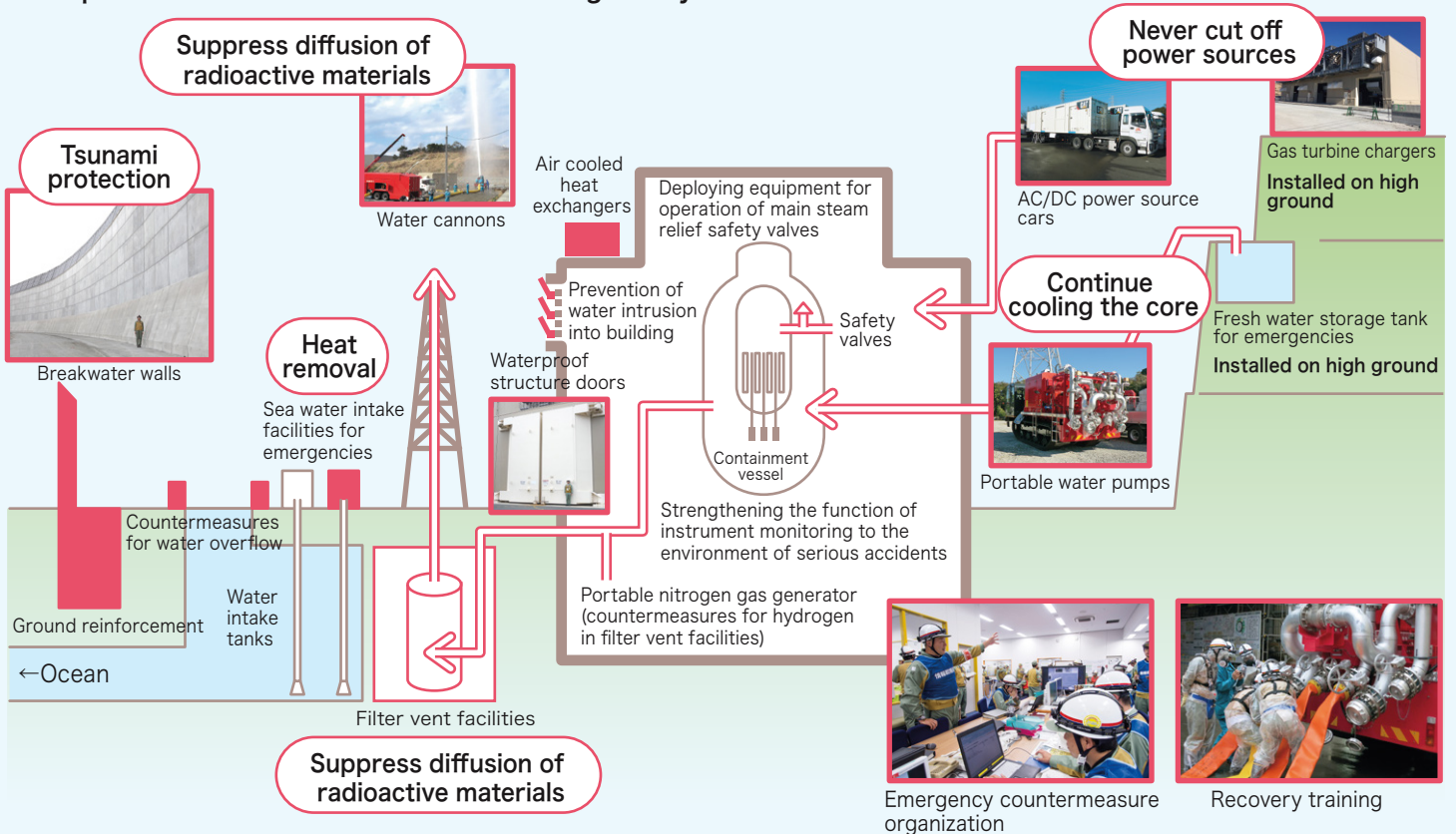
## Response to the New Regulatory Standards

### New regulatory standards (July 2013)

<b>Conventional Regulatory Standards</b> For preventing severe accidents (so-called design criteria)	Response to intentional airplane crash	Anti-terrorism measures (new establishment)
	Measures to suppress diffusion of radioactive materials	
	Measure to prevent breakage of containment vessels	
	Measure to prevent core damage (assuming failure of plural devices)	Countermeasures for severe accidents (new establishment)
	Consideration for water overflow inside a reactor (new establishment)	
	Consideration for natural phenomena (volcanoes/tornadoes/forest fires are newly established)	Enhancement or new establishment
	Consideration for fire	
	Reliability of power sources	
	Performance of other facilities	
	Aseismatic/tsunami-resistant performance	Aseismatic/tsunami-resistant performance

Source: Documents of the Nuclear Regulation Authority

## Examples of Measures Based on the New Regulatory Standards

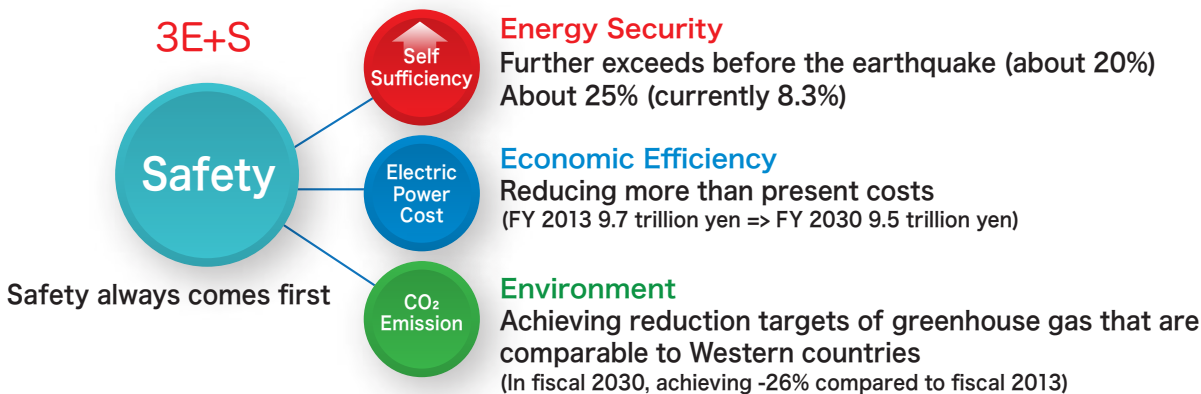


Photos courtesy of Chubu Electric Power Co., Inc.

Q19

# What are the basic policies of energy policies like?

**A19** Keeping in mind that Safety always comes first, in order to simultaneously achieve improvement of Energy Security, Economic Efficiency, and Environment Suitability (3E+S), continuous efforts are being implemented. It is indispensable to implement the multi-layered energy supply structure where each power source exhibits maximum performance and offsets weakness.

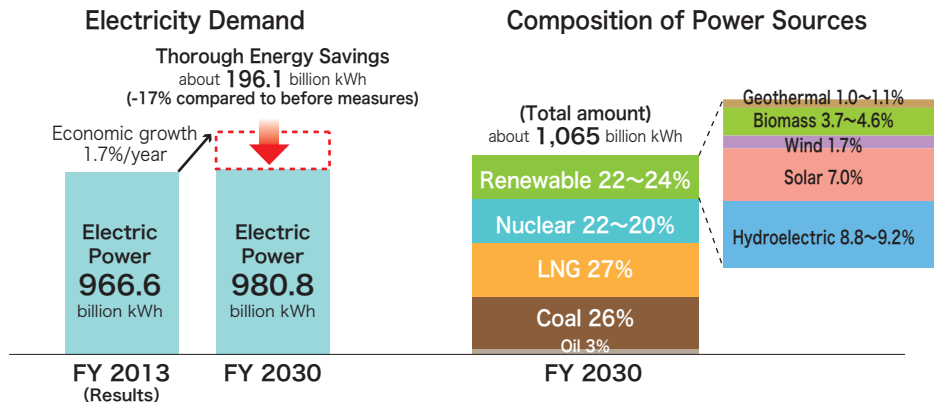


Q20

# What will be the composition of power sources?

**A20** The figure below shows the ideal compositions of power sources in the future (FY 2030) that will be realized when implementing policies in order to achieve 3E+S based on basic policies of energy.

While promoting thorough energy savings, maximum introduction of renewable energy, and efficiency improvement of thermal power generation, we will reduce dependence on nuclear power generation to the extent possible.



Contact :  
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