

# JAPAN'S ENERGY 20 Questions

## INDEX

- Q1. How much energy can be self-supplied?
- Q2. What resources does Japan depend on?
- Q3. What countries does Japan import resources from?
- Q4. How are electric power costs changing?
- Q5. How much greenhouse gas is emitted?
- Q6. Are there advancements in research?
- Q7. Will hydrogen energy become popular?
- Q8. Why are energy efficiency measures important?
- Q9. How far have efforts for energy savings progressed?
- Q10. Why does renewable energy need to be promoted?
- Q11. Is renewable energy progressed in Japan?
- Q12. What kind of efforts are being made?
- Q13. Can we provide energy only by renewable energy?
- Q14. Is there progress in the decommissioning of nuclear power plants?
- Q15. Is there progress in the Fukushima F1?
- Q16. Is nuclear power generation necessary?
- Q17. How is radioactive waste produced?
- Q18. Is the safety of nuclear power plants improved?
- Q19. What are the basic policies of energy?
- Q20. What will be the composition of power supply?

# JAPAN'S ENERGY

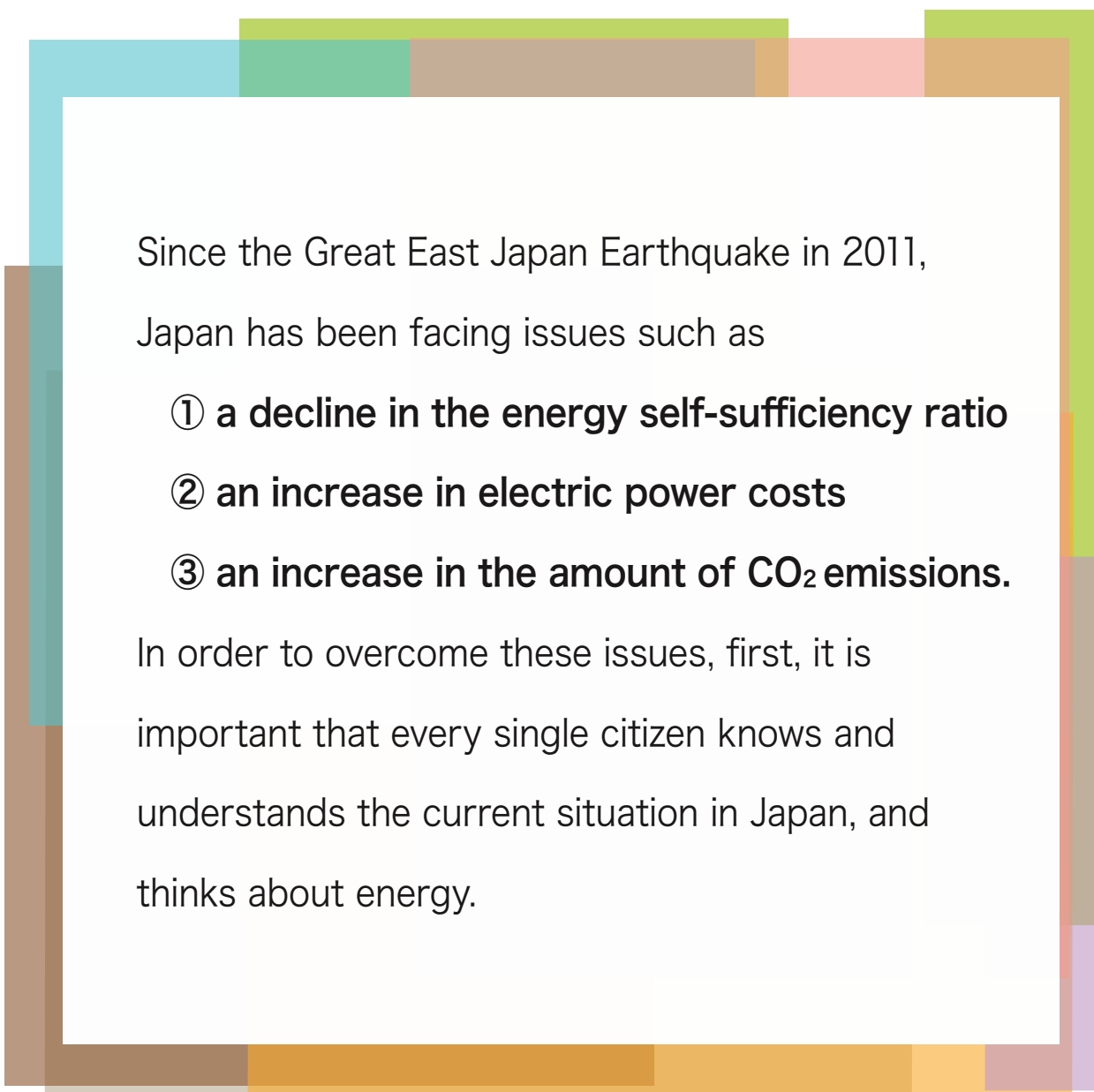
20 Questions to understand  
the current energy situation



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





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.

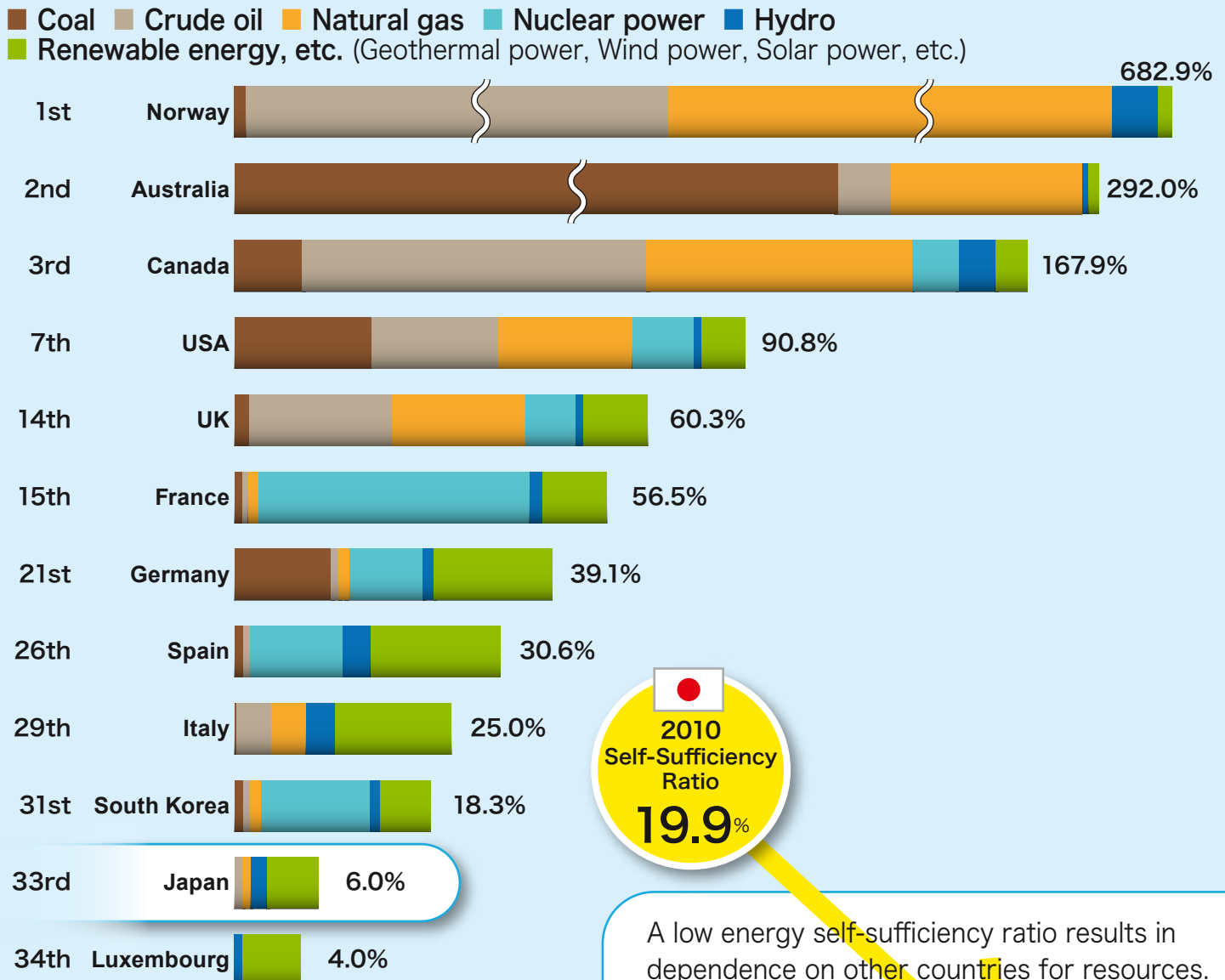
Q1

# 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 2014 was 6.0% which was a low level even compared to other OECD countries.

## Comparison of Primary Energy Self-Sufficiency Ratios of Major Countries (2014)



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 2016" \* The ranking in the table is the ranking of the 34 OECD countries.

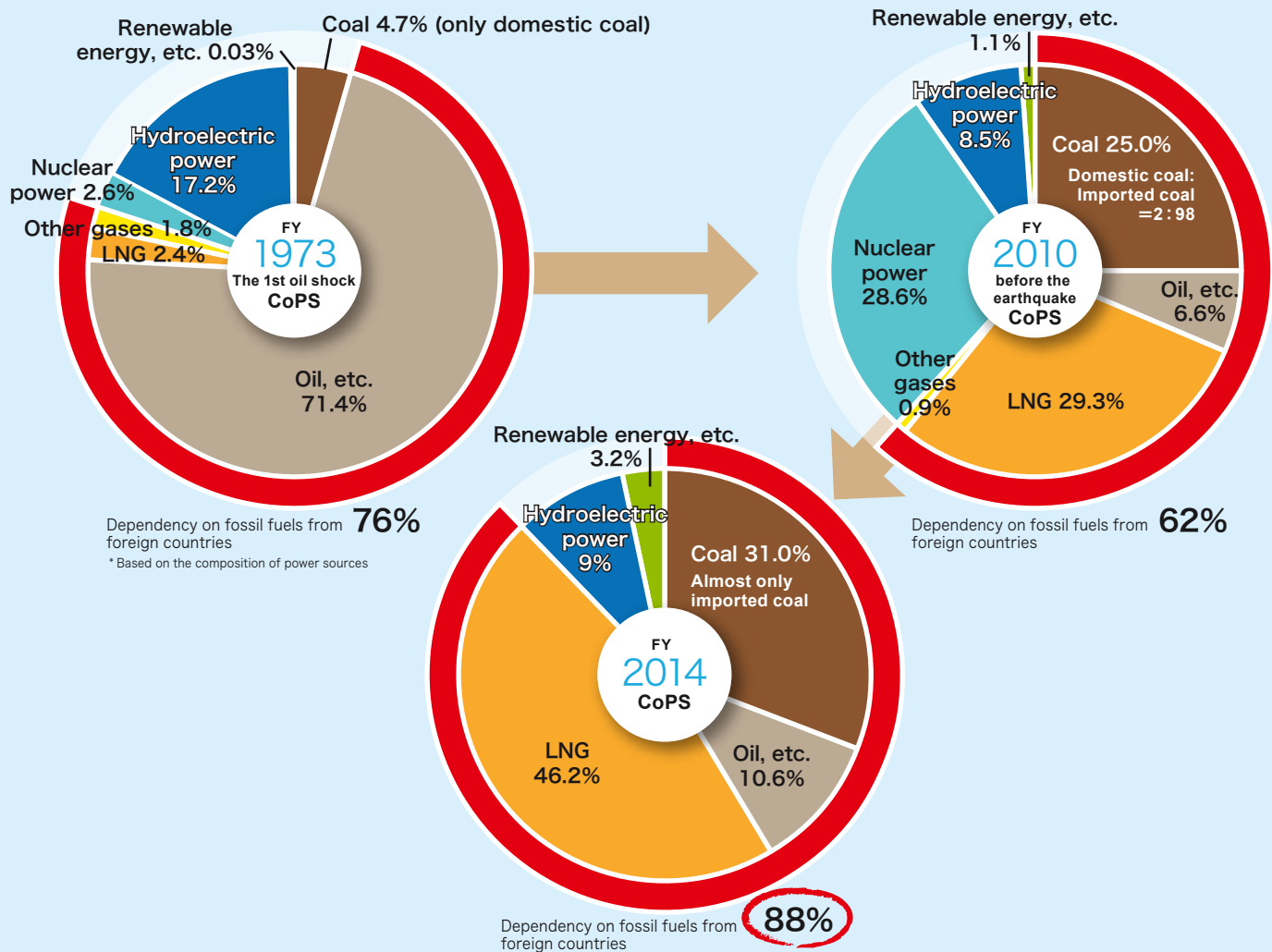
## Q2

## What resources does Japan depend on?

## A2

Japan depends on fossil fuels such as oil/coal/natural gas (LNG) imported from abroad. Dependency increased to 88% (based on the composition of power sources) in FY 2014, more than during the first oil shock.

## Trend of Japan's Composition of Power Sources (Energy Sources to Generate Electricity)



Source: Federation of Electric Power Companies of Japan (FEPC) "Composition ratio of generated electric power amount by power source," etc. : Calculated % by using generated electric power amounts. The "other gases" mainly indicates city gas, natural gas, and coke oven gas used for mixed combustion by general electricity utilities.\* The total amount expressed in % might not be 100% due to rounding.

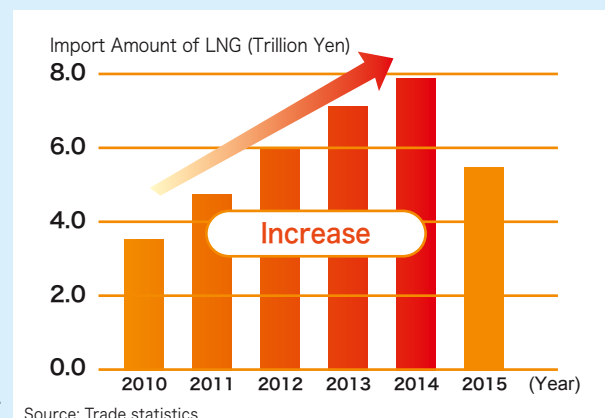
## An Increase in Imports of LNG

Since the Great East Japan Earthquake, due to shutdown of nuclear power plants, LNG-based thermal power plants generated more electric power for stable electric power supply. Therefore, a large amount of LNG was additionally imported. A trade deficit was recorded, which seemingly contributed to a deterioration in the current account balance. In 2015, the import amount was reduced due to a significant decline in the crude oil price.

## 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.

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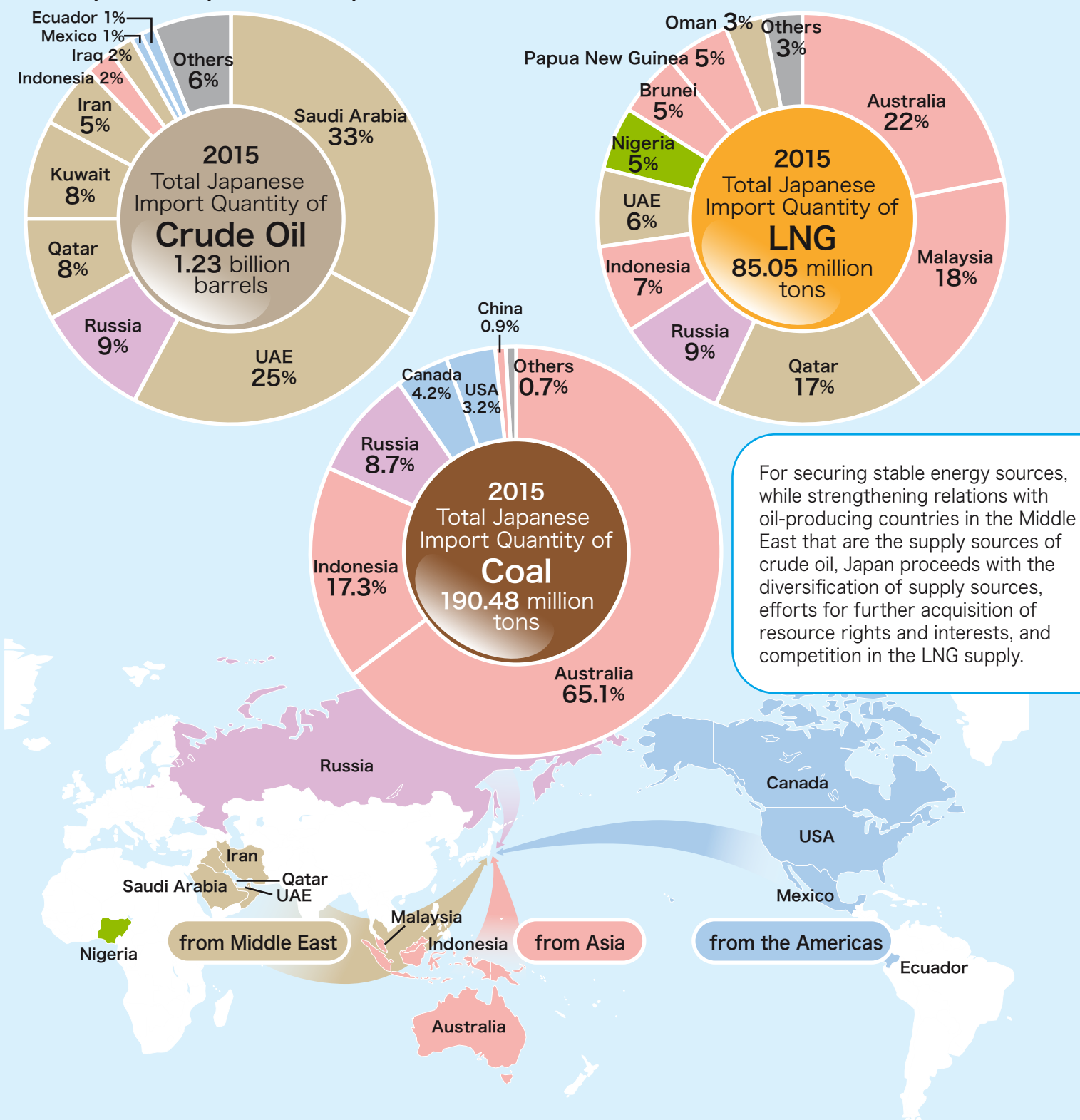
## Q3

## What countries does Japan import resources from?

## A3

Crude oil in Japan is mostly supplied by the Middle East such as Saudi Arabia or Iran, as well as Russia. Japan also mostly depends on imports from foreign countries for natural gas and coal.

## 2015 Japanese Import Counterparts of Fossil Fuels



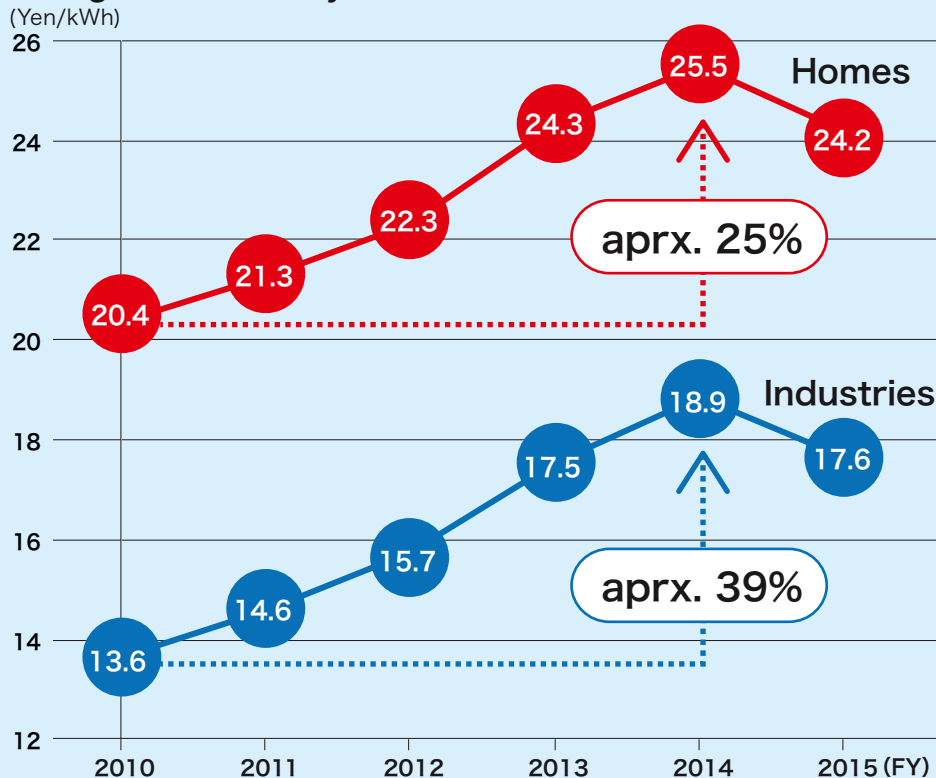
## Q4

## How are electric power costs changing?

## A4

Compared to FY 2010, in FY 2014, electricity rates for homes increased by approximately 25%, rates for industries increased by approximately 39%.

## Changes in Electricity Rates

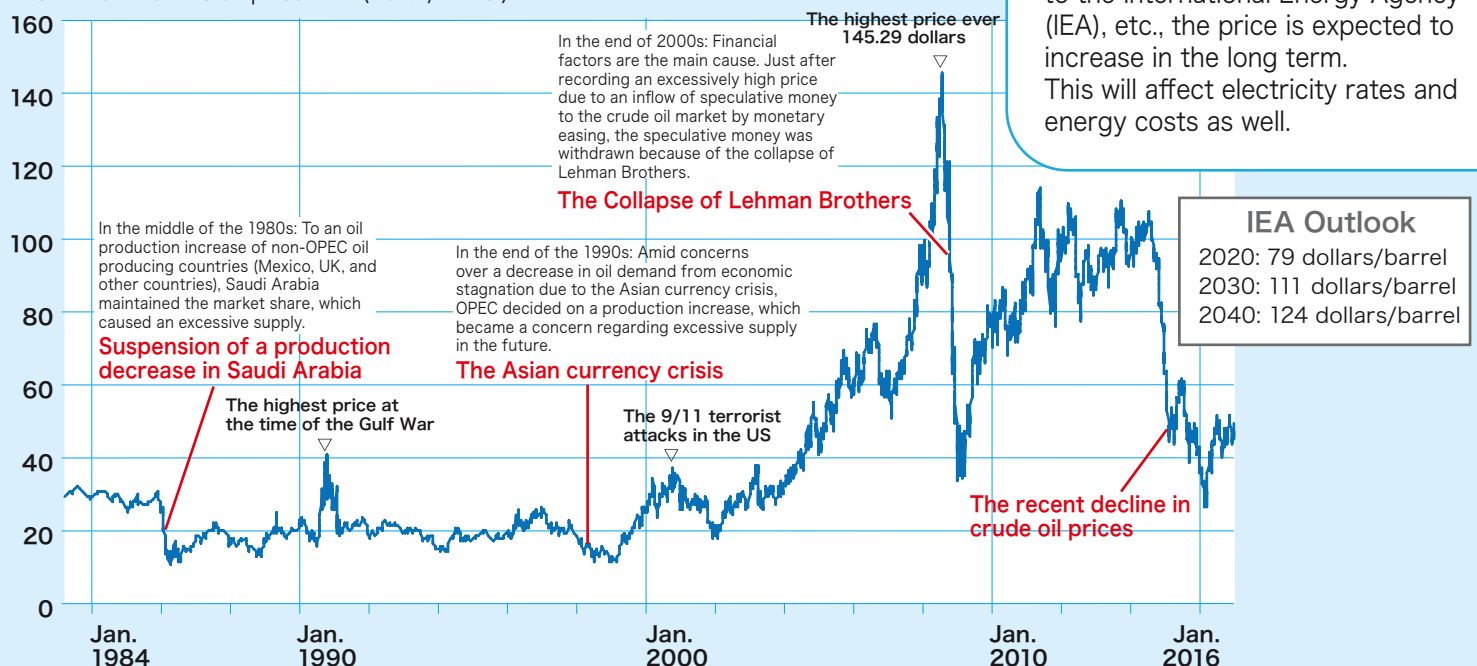


On the other hand, due to a significant decline in the crude oil price since the last half of 2014, in fiscal 2015, electricity rates for homes decreased by aprx. 5%, and the rates for industries decreased by aprx. 6%.

An increase in electricity rates of course affects household finances, and puts pressure on business operations of small and medium-sized enterprises. In addition, there is concern about the adverse effect on global competitiveness.

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

International crude oil price WTI (dollar/barrel)



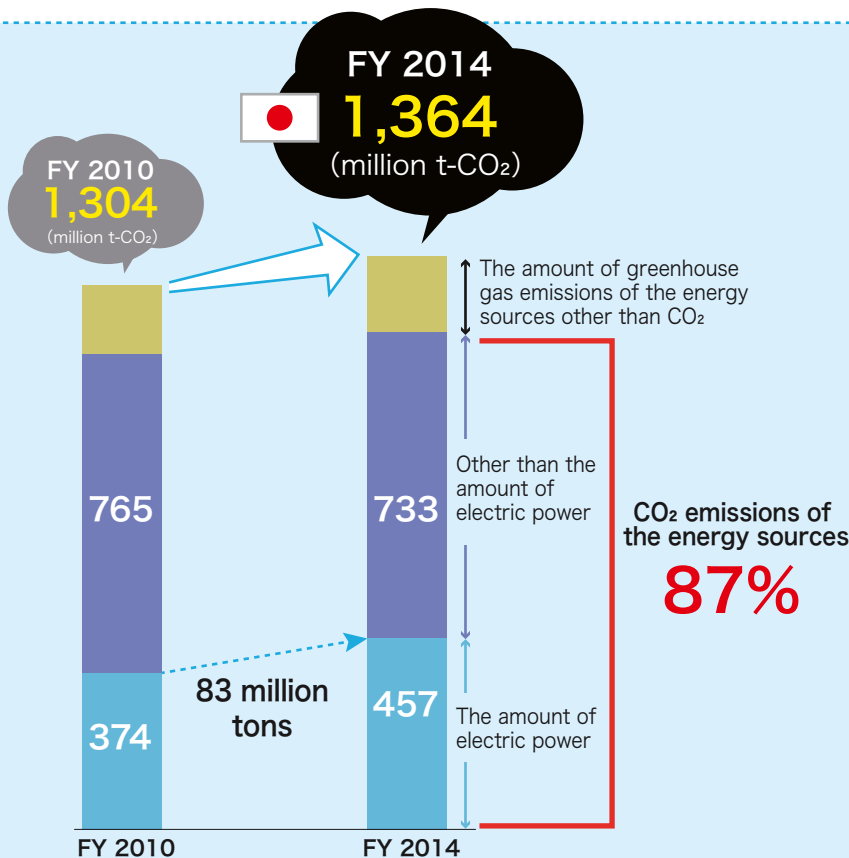


Q5

## 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 a historical high in fiscal 2013. In fiscal 2014, even though it decreased for the first time in 5 years, 1.364 billion tons of greenhouse gas were still emitted.



Since the earthquake, the amount of emissions in the electric power field increased by 83 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 approximately 6% of the amount of greenhouse gas emissions in Japan as a whole.

## Paris Agreement

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.

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

## 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, 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. In addition, the amount of CO<sub>2</sub> emissions of both countries has been significantly increasing.

Q6

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

A6

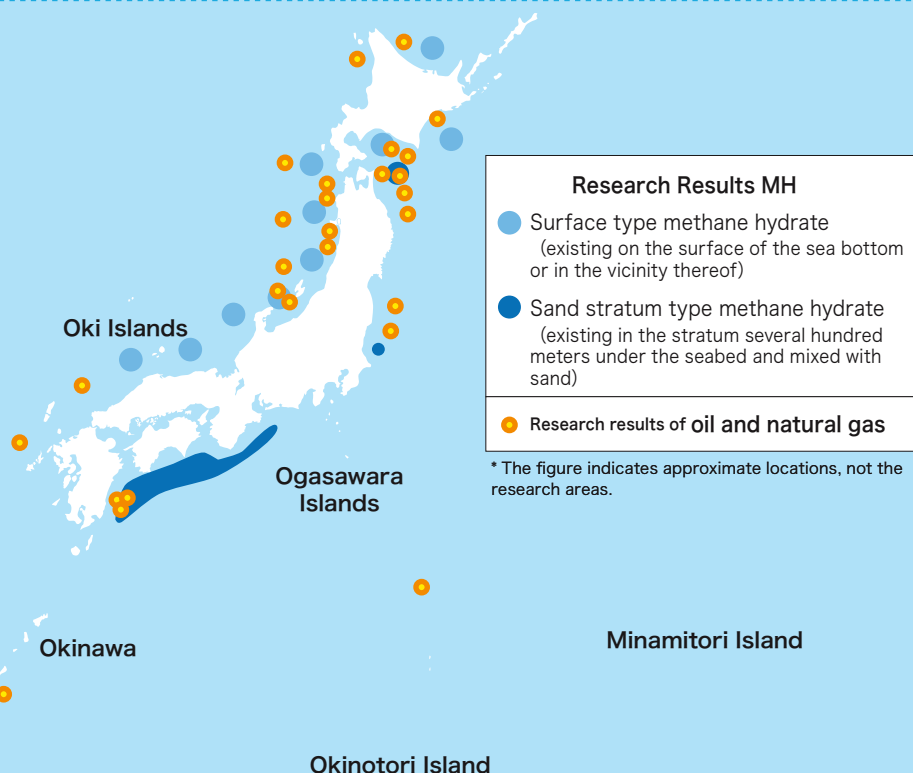
Japan is proceeding with research and development of non-conventional resources such as methane hydrate, in addition to oil and natural gas.

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. For this, R&D and technological demonstration are moving forward.

Now

Full-scale  
energy  
utilization

Residential fuel cell (ENE-FARM)

Sales began in 2009



Fuel cell vehicle (FCV)

Sales began in 2014

Future

Various  
usages

Portable FC



Hydrogen power generation/FC for business and industry



FC Bus



FC railroad vehicle



Hydrogen jet aircraft



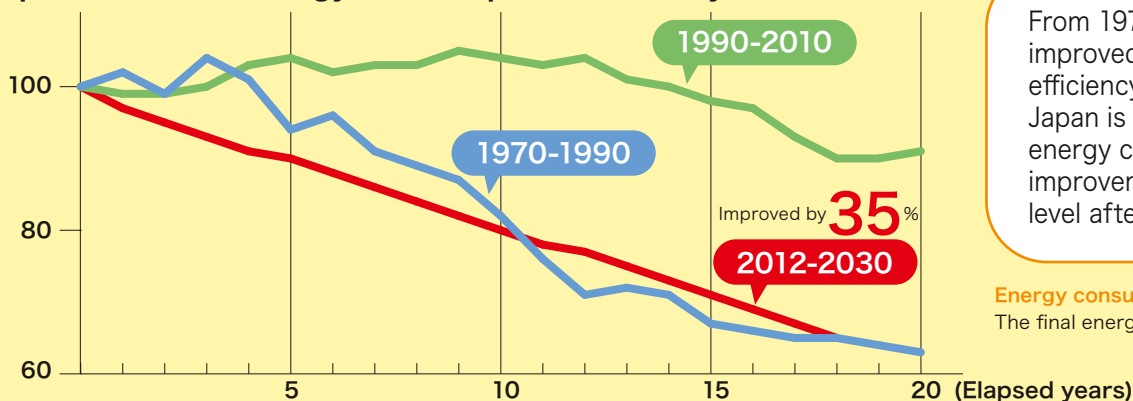
## Q8 Why are energy efficiency measures necessary?

**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.

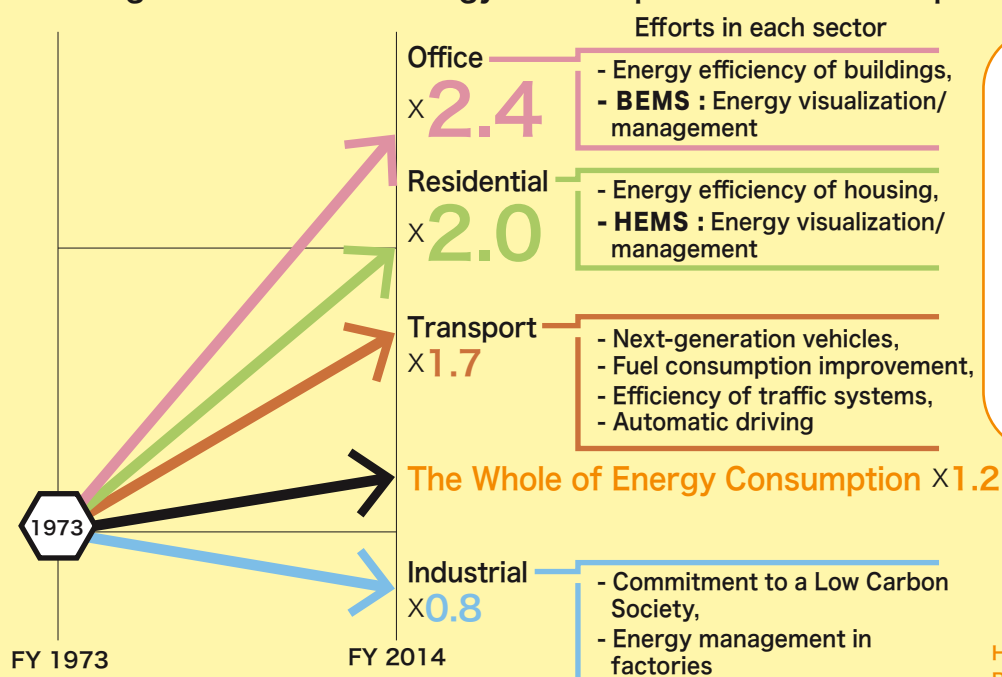
Improvement of Energy Consumption Efficiency



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 2.4 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

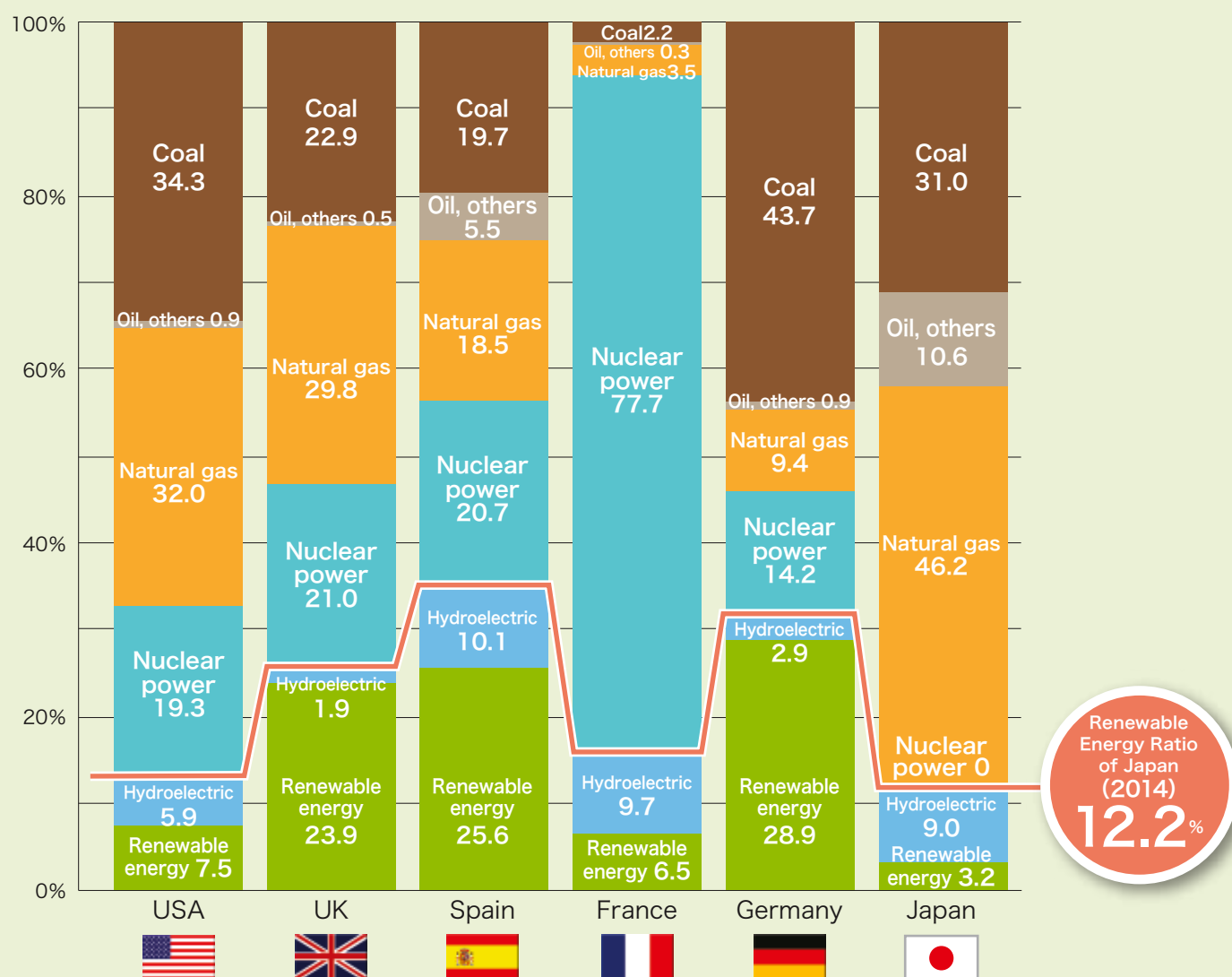
## Q10 Why does renewable energy need to be introduced?

**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 2014, the renewable energy ratio in the generated electric power amount of Japan is 12.2% (3.2% 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



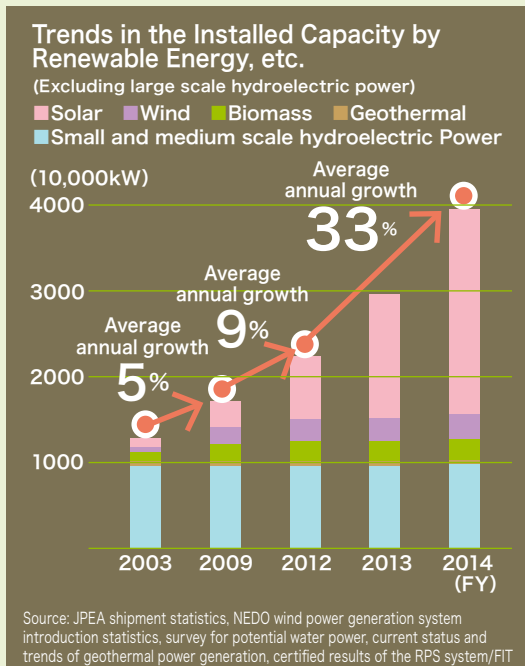
Source: [Other than Japan] Data of estimated figures in 2015, IEA Energy Balance of OECD Countries (2016 edition), [Japan] FEPC "Composition ratio of generated electric power amount by power source" \* Renewable Energy = Hydroelectric power is excluded

## Q12

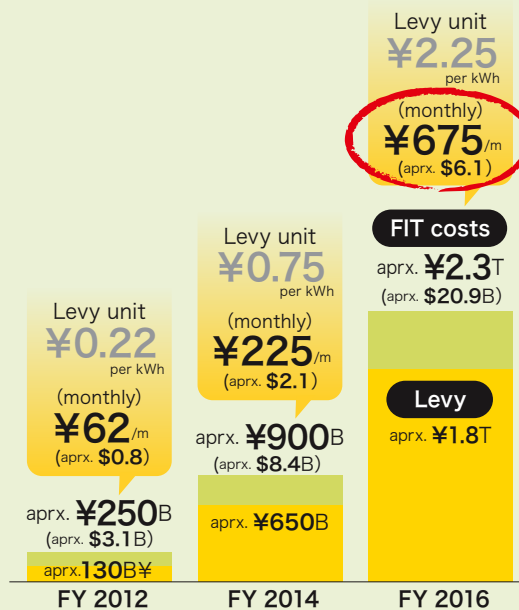
## What kind of efforts are being made for expanding the introduction of renewable energy?

## 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.



### Trends in Levy after Introducing the FIT



Thanks to the introduction FIT in 2012, the installed capacity of renewable energy is growing rapidly.

Meanwhile, the purchase costs reached 2.3 trillion yen (aprx. \$20.9 billion)\*, and the levy burden to average households amounts up to 675 yen/month (aprx. \$6.1)\*.

In order to maximize introduction of renewable energy while minimizing national burden, it is required to increase the introduction of renewable energy cost efficiently.

**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. Funding the costs as a levy from electricity users supports the introduction of renewable energy which is a high cost now. This system expanded the outlook for the possibility of funding expensive construction costs, and further spreading of renewable energy is expected.

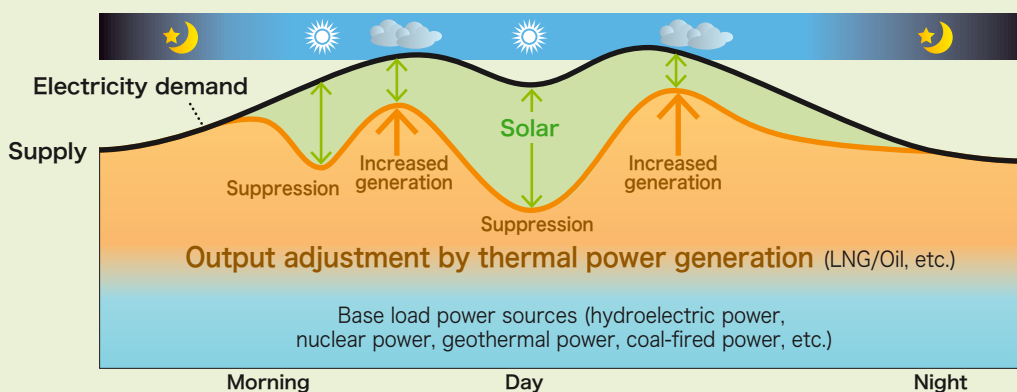
\* Calculated by Yearly-Average exchange rate.

## 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 order to keep stable use of electricity, the amount of supply needs to be the same as demand.

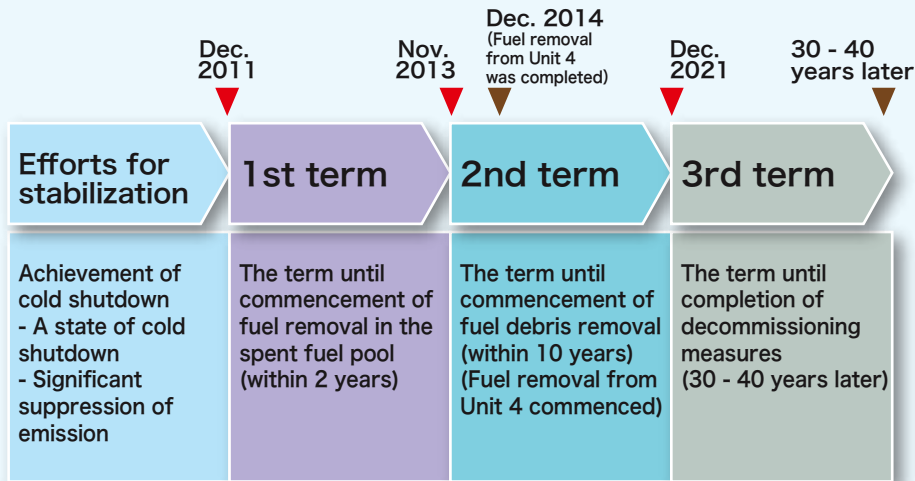
The power generation amount and consumption need to be balanced by thermal power, etc. that can respond to the fluctuation of renewable energy.

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 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 June 2015)

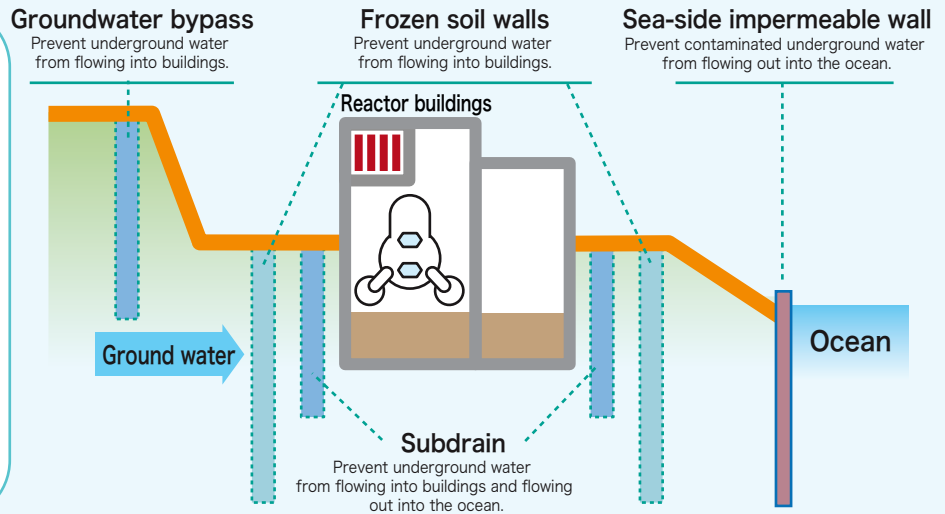


### Decommissioning Measures

In Unit 4, fuel removal of all 1,533 fuel assemblies from the pool was safely completed in December 2014. Regarding Units 1 to 3, preparations including removal of debris and decontamination are being steadily made. Additionally, concerning fuel debris removal, 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.

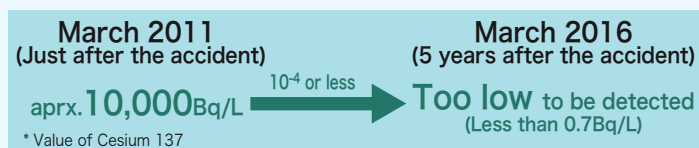
### Countermeasures for Contaminated Water

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. In order to solve contaminated water problems, preventative and multilevel countermeasures, such as enhancing the capability of groundwater pumping from the subdrain, continue to be implemented.



### Improvement in the Radioactive Material Concentration and Radiation Doses

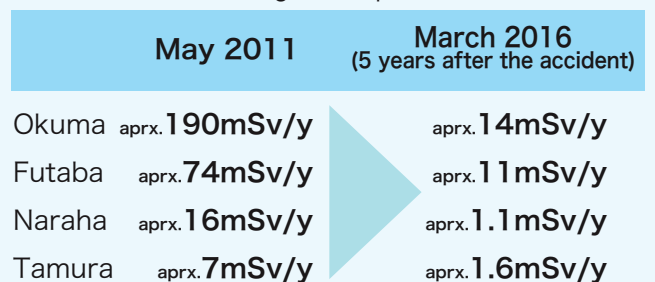
Radioactive material concentration in surrounding ocean areas of the Fukushima Daiichi Nuclear Power Plant



#### Evaluation by IAEA

- (Regarding radioactive material concentration) There is no rise in surrounding ocean areas or the open ocean, and it is within the range of the guidelines for drinking-water quality of the WHO. In addition, public safety is secured (December 2013)
- The level of radioactive materials in the marine environment is low and relatively stable (November 2016)

Change in radiation doses in surrounding municipalities



Just after the accident, the national government issued evacuation orders to the areas that were at risk of reaching or exceeding 20 mSv/year.

Source: Created from data in the websites of the Nuclear Regulation Authority

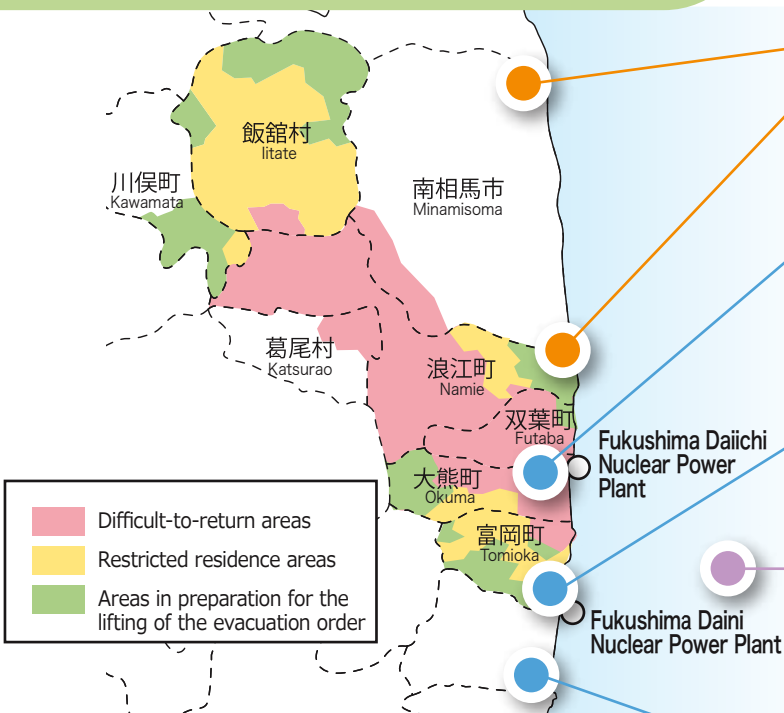


# Q15 Is there progress in the Fukushima Reconstruction?

**A15** Concerning the lifting of evacuation orders, decontamination and development of infrastructure/service are accelerating. Efforts toward revitalization are being taken through new technologies/industries.

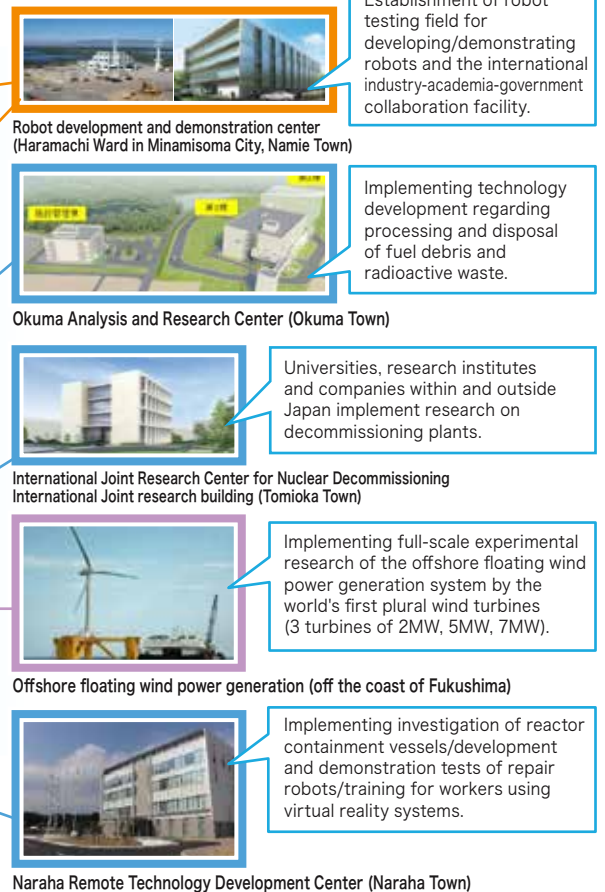
## Lifting of Evacuation Orders

Regarding restricted residence areas and areas in preparation for the lifting of the evacuation order, in order to lift the evacuation orders by March of next year, the environment is quickly being developed.  
Regarding difficult-to-return areas, systems for developing reconstruction bases are established.



## Fukushima Innovation Cost Scheme

Gathering wisdom from both within and outside Japan creates new technologies/industries from Hamadori which are proudly presented to the world.



## 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, Naraha town, Namie town and Soma city.

## Safety Measures for Food in Fukushima Prefecture

- Monitor inspections before shipping and publish the results of agriculture, forestry and fishery products.
- The products exceeded standard are shipping restricted, the products distributed in the market are safe.
- In recent years, the products that exceeded the standard limits have greatly decreased, and the restriction of distribution was lifted based on strict standards.
- As the world's first effort since 2012, inspection for all rice bags have been implemented.

### The situations in monitoring inspections of agricultural, forestry and fishery products

Classification	N/Inspections	Exceeded the Standard	
		Number	Ratio
Brown rice (produced in 2015)	aprx. 10.48 M	0	0.00%
Vegetables/fruits	1,200	0	0.00%
Animal products	1,060	0	0.00%
Cultivated mushrooms	111	0	0.00%
Marine products	2,316	0	0.00%
Edible wild plants/wild mushrooms	987	2	0.20%

Source: Reconstruction Agency

(Apr. 1, 2016 - Jun. 30, 2016)  
\* Aug. 20, 2015 - Mar. 31, 2016 only for "brown rice"

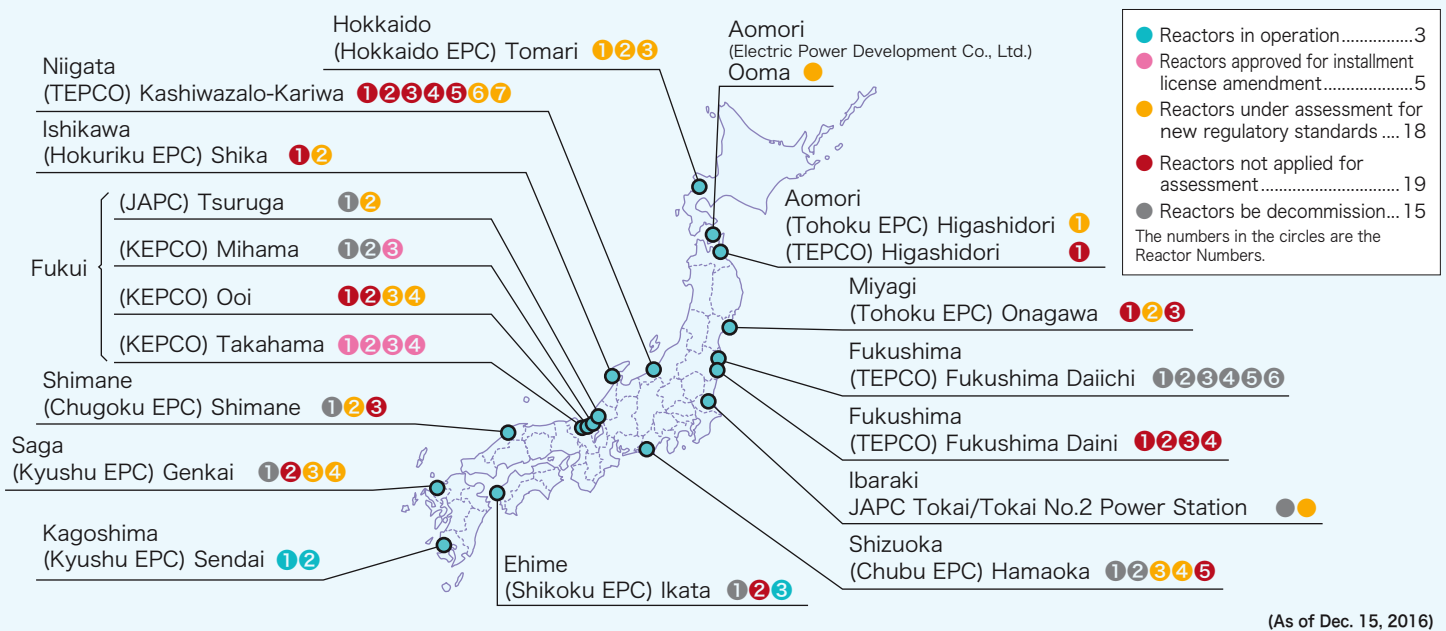
No products exceeded the standard limits

- Safely shipped
- Continue to investigate for lifting

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

## Q16 Is nuclear power generation necessary?

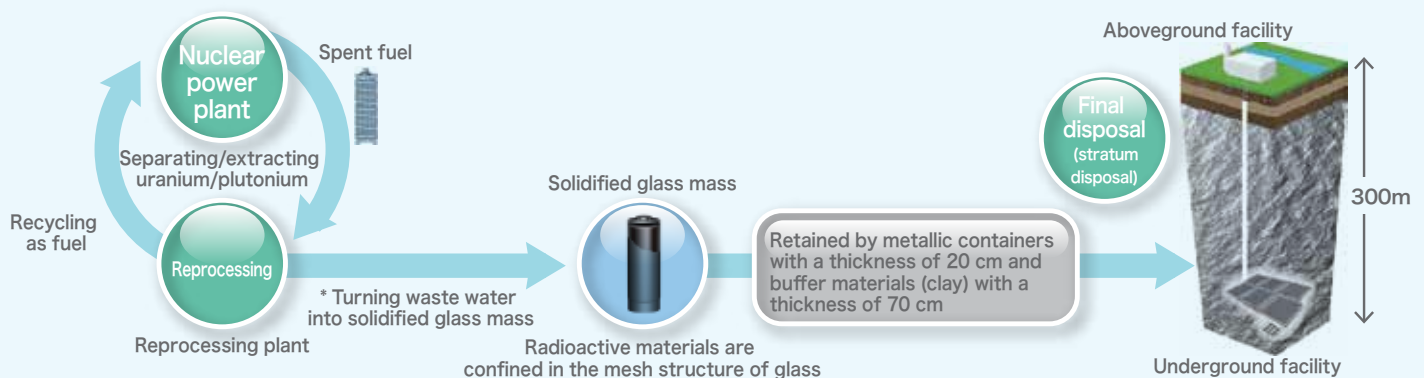
**A16** Nuclear power generation is indispensable power, in order to implement the below within poor resources ; ① securing a stable supply, ② reducing electric power costs, ③ suppressing CO<sub>2</sub> emissions. When restarting nuclear power plants, conforming to new regulatory standards that prioritize safety is required.



(As of Dec. 15, 2016)

## 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).



**High-level radioactive waste:** After separating/recovering uranium/plutonium from spent fuel, liquid waste is generated. This waste is called "high-level radioactive waste" because its radioactivity level is high, and is solidified after being mixed with glass (other radioactive waste is called "Low-level radioactive waste").



# 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.

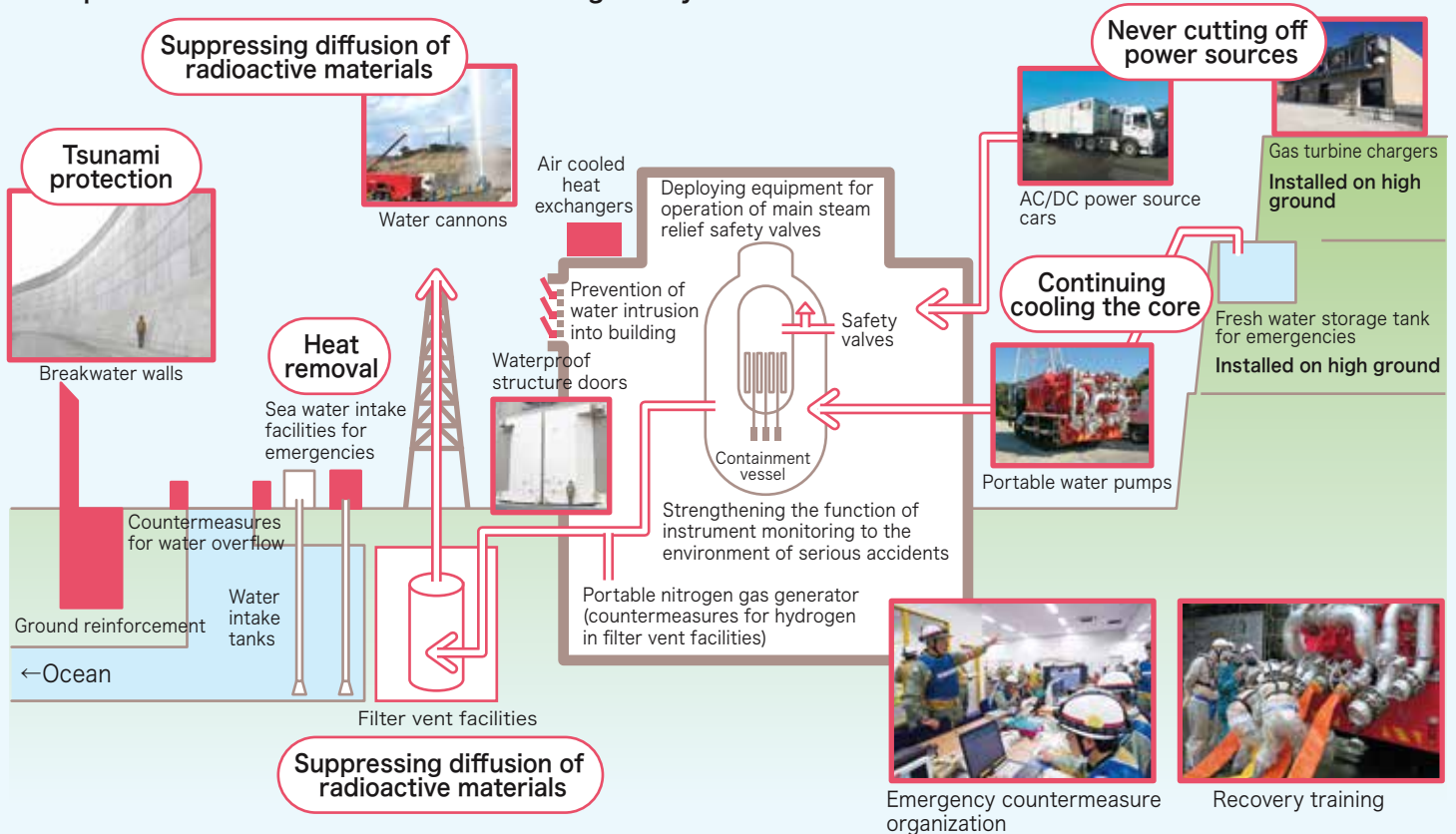
## Response to the New Regulatory Standards

### 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	Countermeasures for severe accidents (new establishment)
	Measure to prevent core damage (assuming failure of plural devices)	
	Consideration for water overflow inside a reactor (new establishment)	Enhancement or new establishment
	Consideration for natural phenomena (volcanoes/tornadoes/forest fires are newly established)	
	Consideration for fire	
	Reliability of power sources	
	Performance of other facilities	
	Aseismatic/tsunami-resistant performance	Enhancement

Source: Documents of the Nuclear Regulation Authority

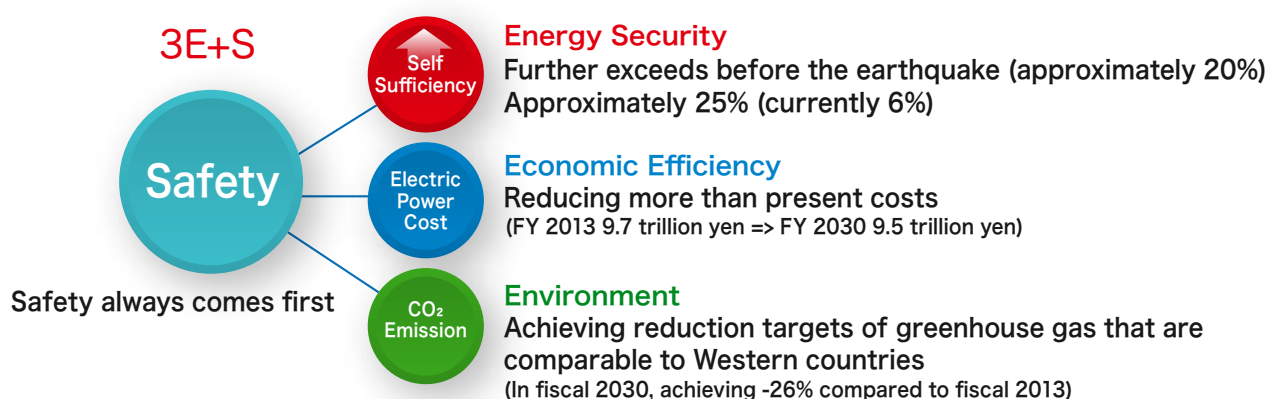
## Examples of Measures Based on the New Regulatory Standards



Photos courtesy of Chubu Electric Power Co., Inc.

## Q19 What are the basic policies of energy policies like?

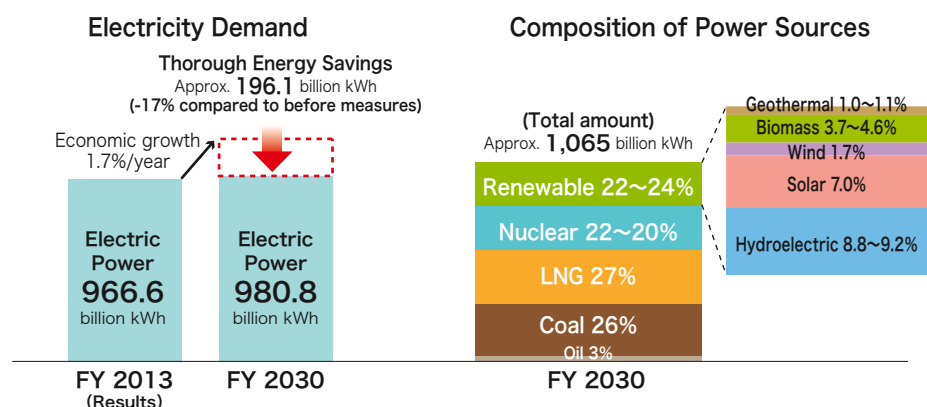
**A19** Keeping in mind that Safety always comes first, in order to simultaneously achieve improvement of Energy Security, Economic Efficiency, and Environment Suitability (3E+S), continuous efforts are being implemented. It is indispensable to implement the multi-layered energy supply structure where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



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