Ministry of Economy, Trade and Industry
Agency for Natural Resources and Energy

JAPAN'S ENERGY SITUATION

27 July, 2015

Agency for Natural Resources and Energy
Ministry of Economy, Trade and Industry (METI) Japan

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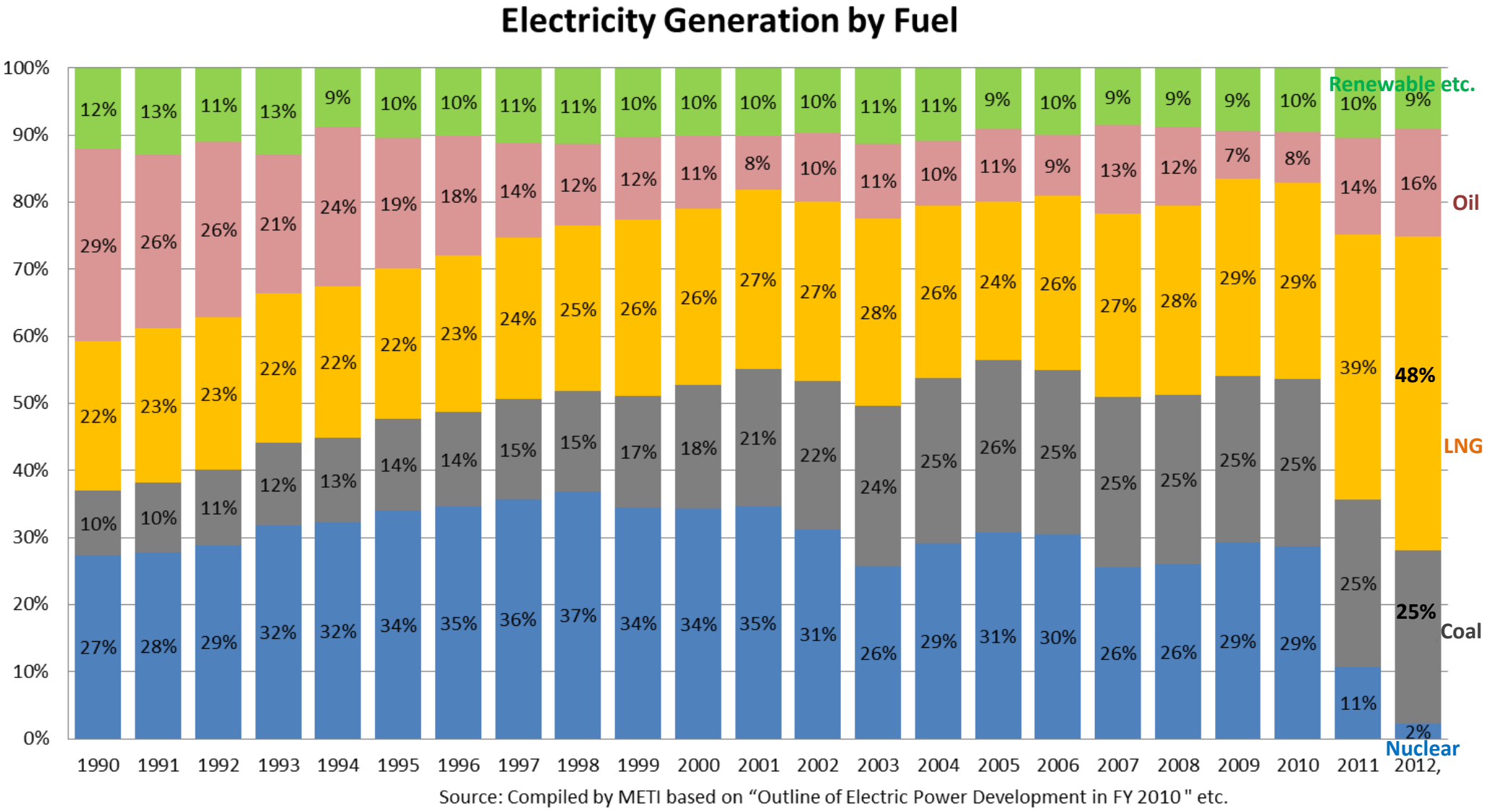
Current Energy Mix in Japan

Ministry of Economy, Trade and Industry
Agency for Natural Resources and Energy

LNG increase compensates for the decline of nuclear power.



Source: Compiled by METI based on “Outline of Electric Power Development in FY 2010 " etc.

Japan's Energy Supply Structure

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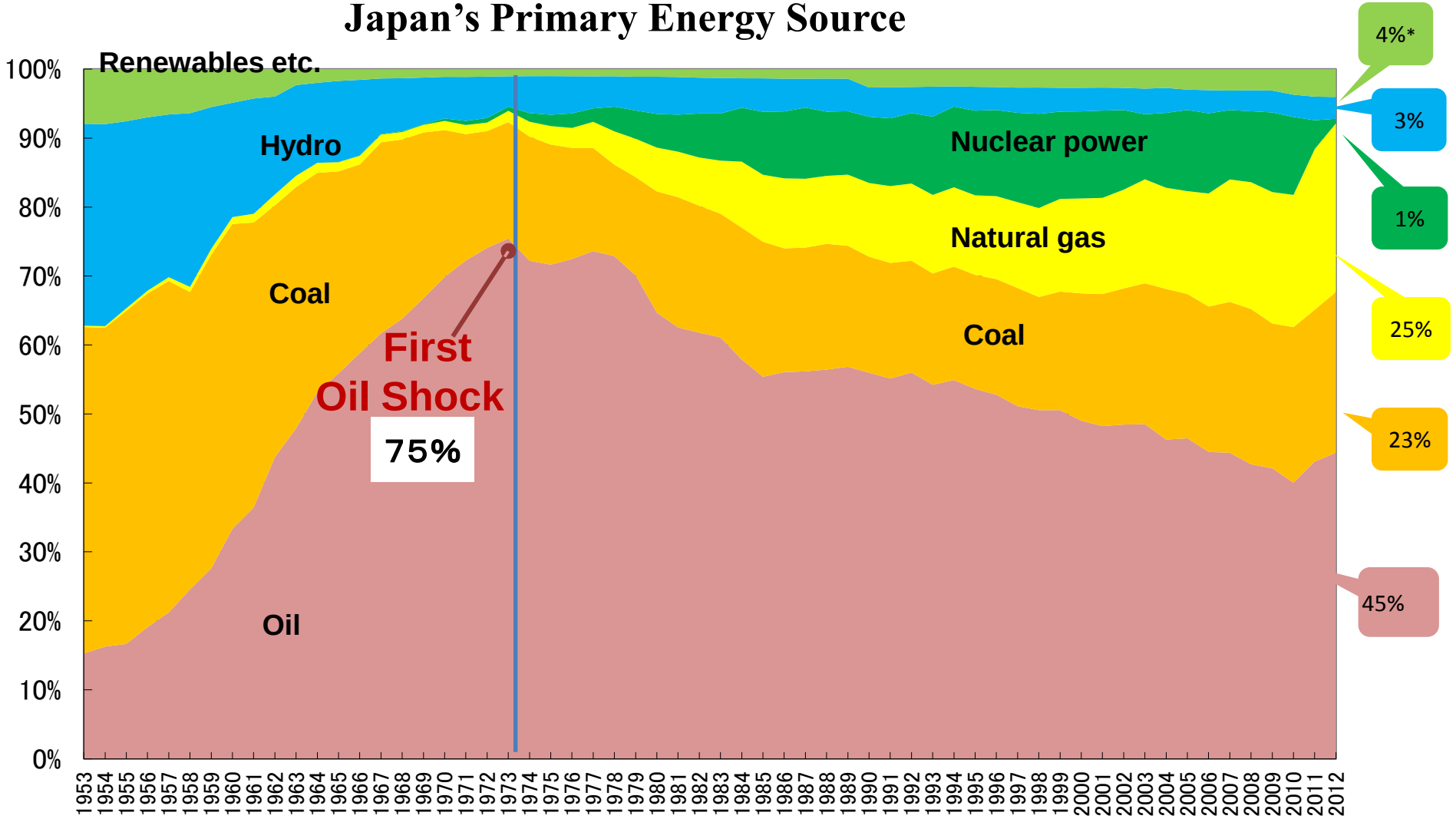
Agency for Natural Resources and Energy

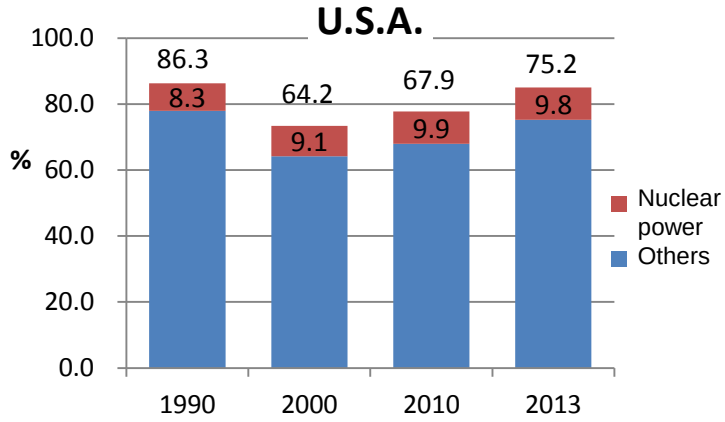
Japan's Primary Energy Source

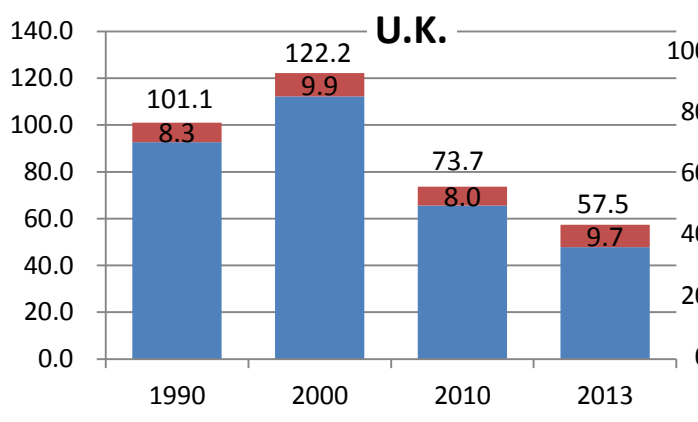


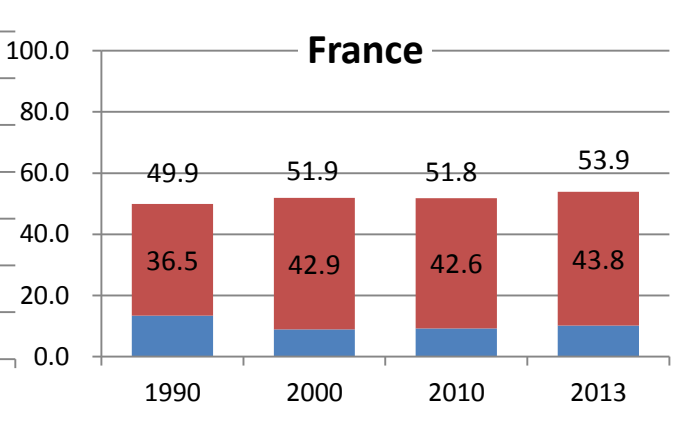
* "Renewables etc." consists of solar power (0.1%), wind power (0.2%), geothermal heat (0.1%), and biomass (3.3%).

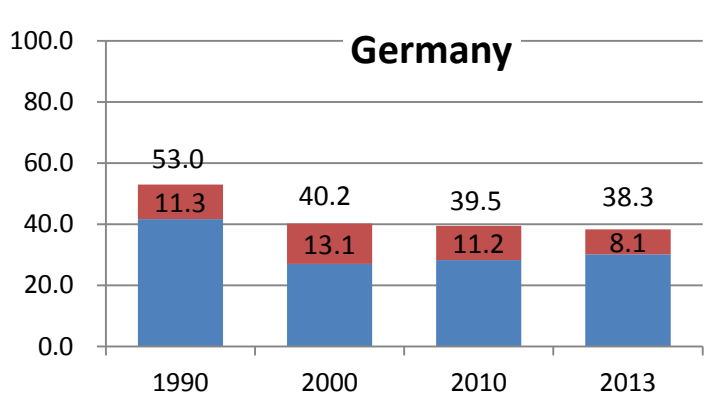
Source: Prepared based on "Comprehensive Energy Statistics (Preliminary Report for 2012)" issued by the Agency for Natural Resources and Energy."

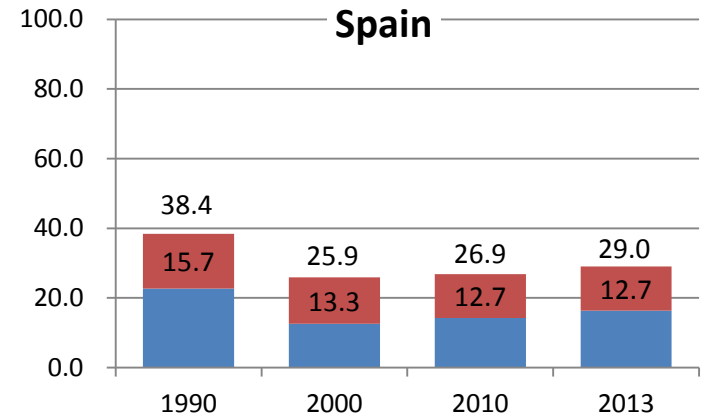
Changes in Primary Energy Self-Sufficiency Rate of Major Countries

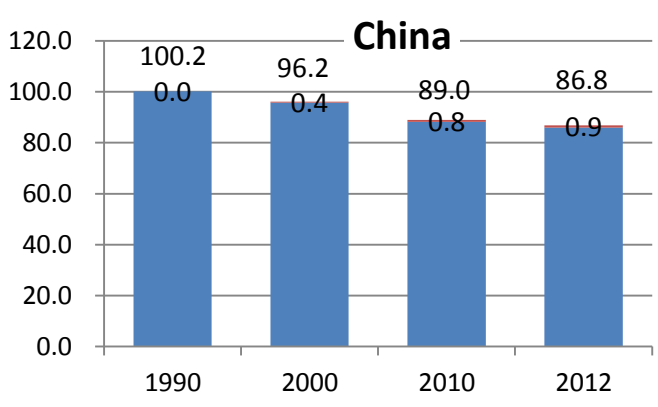


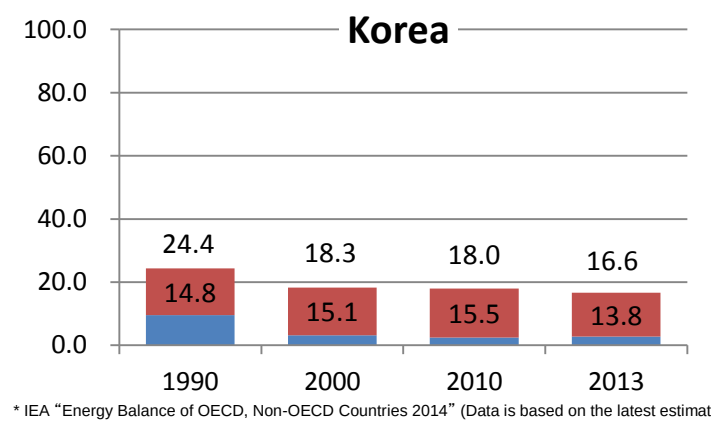


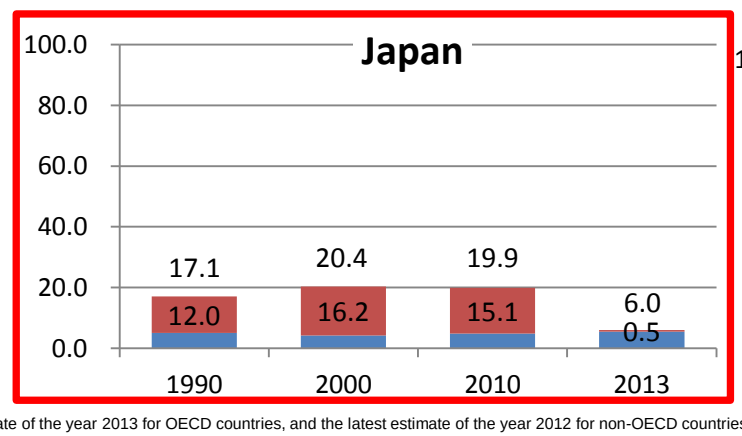


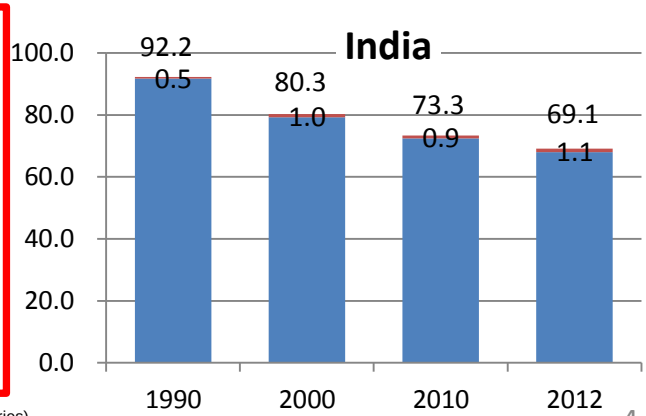








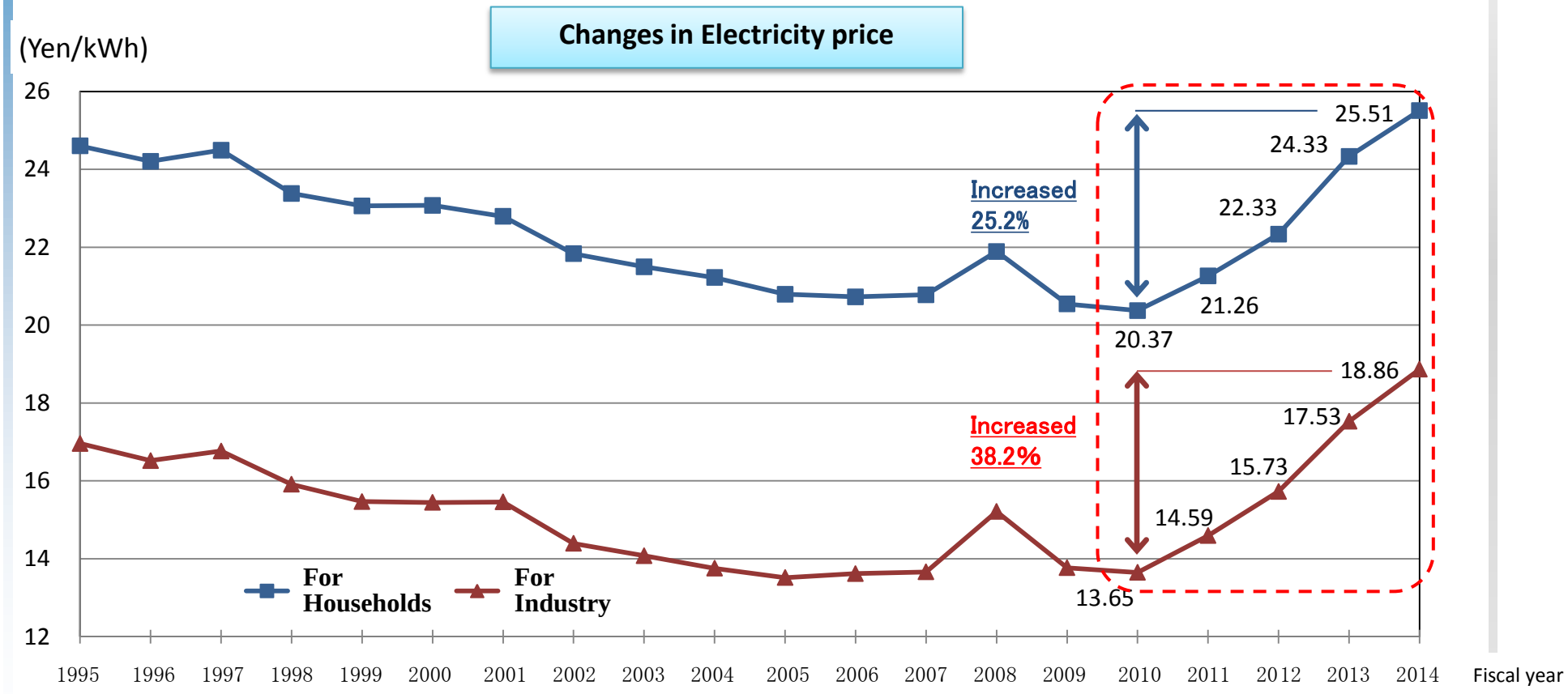




* IEA "Energy Balance of OECD, Non-OECD Countries 2014" (Data is based on the latest estimate of the year 2013 for OECD countries, and the latest estimate of the year 2012 for non-OECD countries).

Changes in Electricity price

◆ Since the Great East Japan Earthquake followed by the nuclear accident, the average electricity price rose by around 25% for households and around 40% for industry because of increasing fuel costs and so on.



[Source] Created based on the "Electricity Demand Report" (Federation of Electric Power Companies in Japan) and the materials concerning the power companies' final settlement reports, etc.

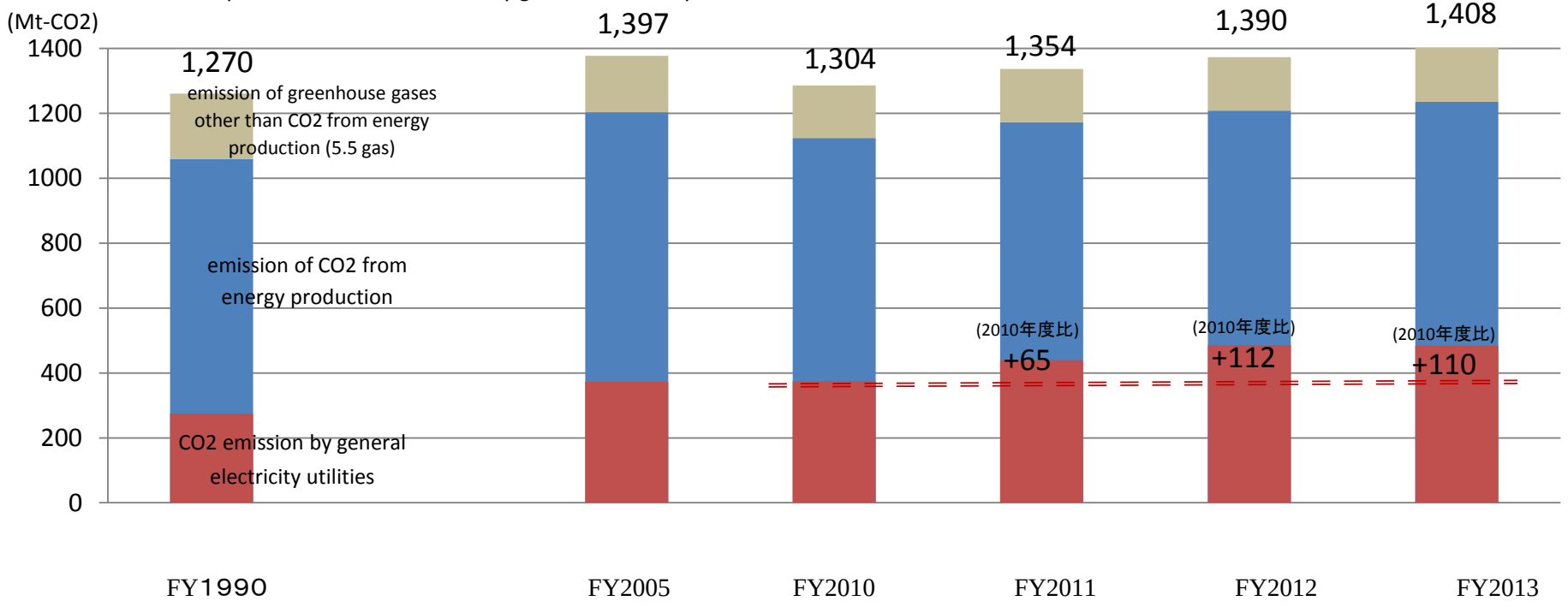
CO2 emission before and after the Great East Japan Earthquake

■ CO2 emission for FY2013 increased 101 million tons compared to FY2010.

■ Although emission except for electricity (*) are decreasing slightly, the emission from electricity production have increased by 110 million tons compared to FY2010, because of increased use of thermal power generation as this makes up for nuclear power.

(Million t-CO2)	1990	2005	2010	2011		2012		2013	
Greenhouse gas emission volume	1, 270	1, 397	1, 304	1, 354		1, 390		1, 408	
CO2 emission volume from energy production	1, 067	1, 219	1, 139	1, 188	(from FY2010)	1, 221	(from FY2010)	1, 235	(from FY2010)
Of which, for electricity*	275	373	374	439	+65	486	+112	484	+110
Of which, except for electricity	792	846	765	749	▲16	735	▲30	751	▲14

*Emission volume “for electricity” means emission volume by general electricity utilities.



1. Energy Policy

（The Fourth Strategic Energy Plan）

Principles of Energy Policy and Viewpoints for Reform

1. Principles of Energy Policy and Viewpoints for Reformation

(1) Confirmation of basic viewpoint of energy policies (3E + S)

Stable Supply (**E**nergy Security)

Cost Reduction (**E**conomic Efficiency)

Environment

Safety

+

Global Viewpoint

-Developing energy policies with international movement appropriately

-Internationalizing energy industries by facilitating business overseas.

Economic Growth

-Contribution to reinforce Japan's locational competitiveness.

-Activating Japan's energy market through energy system reform.

(2) Building multilayered and diversified flexible energy demand-supply structure

- Establishing resilient, realistic and multi-layered energy supply structure, where each energy source can exert its advantage and complement others' drawbacks.
- Creating a flexible and efficient supply/demand structure where various players can participate and various alternatives are prepared by system reforms.
- Improving self-sufficiency ratio by developing and introducing domestic resources to minimize influence from overseas' situation.

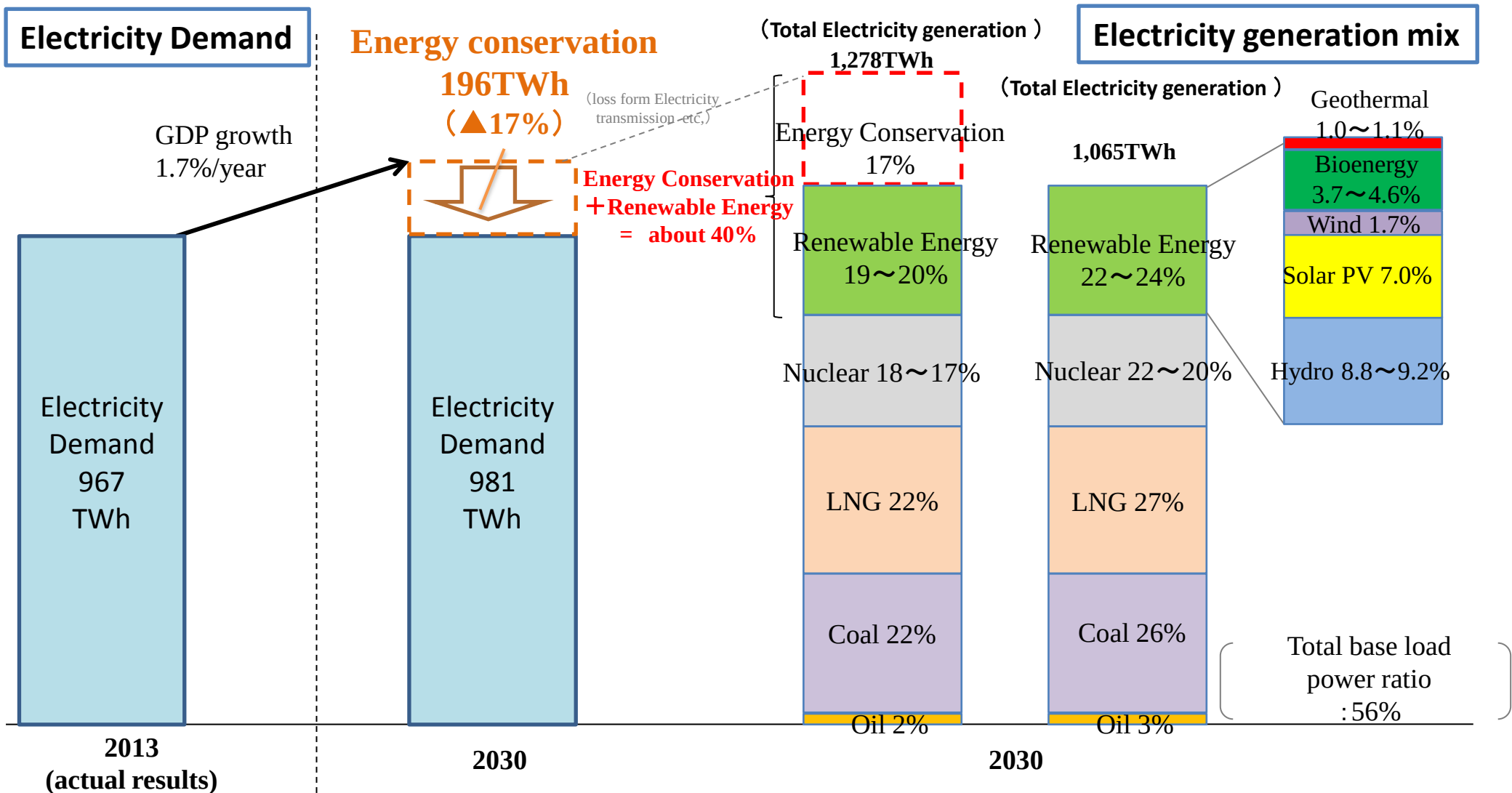
Japan's New Energy Mix

【Direction】

(1) To improve the self-sufficiency ratio to around 25% surpassing the level before the Earthquake.

(2) To reduce the electricity costs lower than today.

(3) To set a high-level GHG reduction goal compared with other developed countries to lead the world.

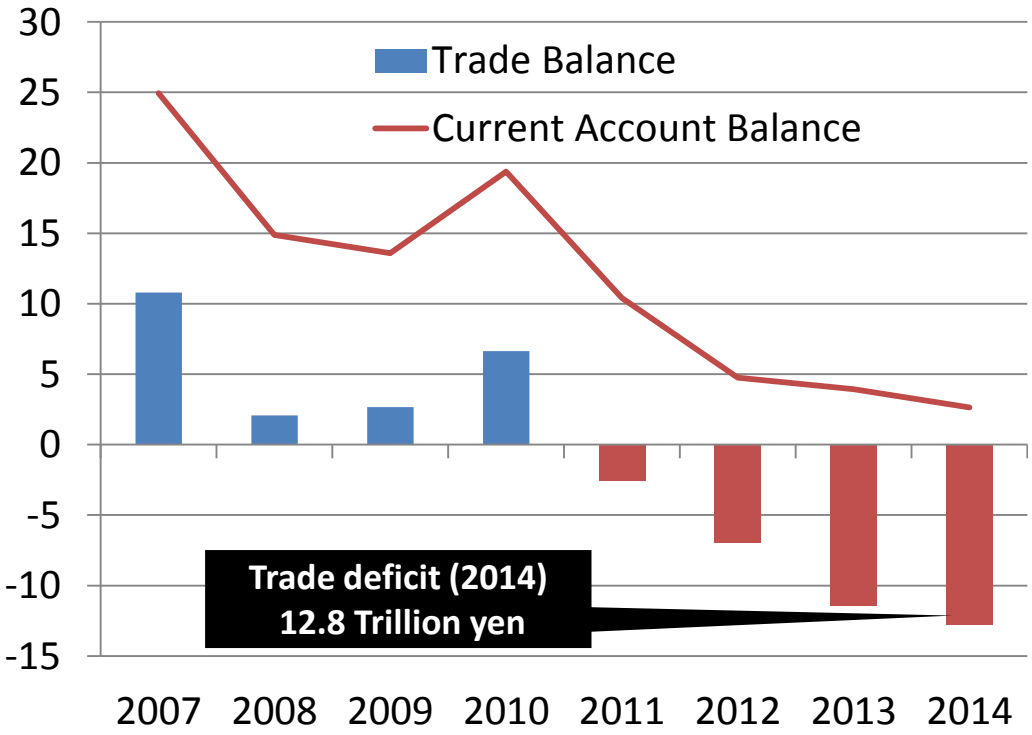


2. LNG

Japan Suffers Huge Trade Deficit

- The overall cost of LNG imports to Japan has increased from 3.5 trillion yen (2010) to around 8 trillion yen (2014).
- Japan recorded a trade deficit for the first time in 31 years in 2011. Trade deficit for 2014 was 12.8 trillion yen, which is not a sustainable level for Japan.

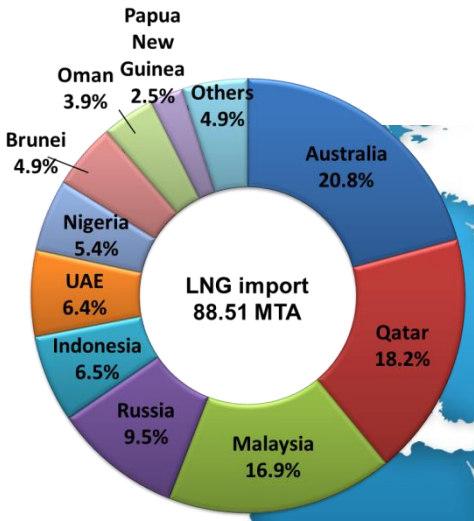
Changes in trade balance and current account balance（trillion yen）



	2010	2014	Difference
Trade Balance	6.6	- 12.8	- 19.5
Net Import Costs			
LNG	3.5	7.9	+4.4
Crude Oil	9.4	13.9	+4.5
Petroleum Products	2.5	3.1	+0.7
Coal	2.1	2.1	-0.0

Enhancing Gas Security – Diversifying Supply Sources

- Japan has mitigated supply disruption and secured stable supply by diversifying supply sources.
- Japan has a diversified portfolio with the largest supplier only accounting for 20% of total supply and the Middle East Dependency at 30%.



(Russia)
Yamal LNG Project
Vladivostok LNG Project
Far East LNG Project

(Canada)
LNG Canada Project
Pacific Northwest LNG Project
Kitimat LNG Project

(Southeast Asia)
Donggi Senoro Project
Abadi Project

(U.S.A)
Sabine Pass Project
Freeport Project
Cove Point Project
Cameron Project

(Mozambique)
Rovuma Area 1, Area 4 Project

(Australia)
Ichthys LNG Project
Wheatstone LNG Project

3. Methane Hydrate

Domestic resource development (Methane Hydrate)

Ministry of Economy, Trade and Industry

1. Deep Methane Hydrate

1. Offshore Production Test

- From March 12-18, 2013
- World's first experiment of methane hydrate gas production in a sea area using the depressurization method
- Total output: 120,000 cubic meters
  Ave. daily output: 20,000 cubic meters

Flare from offshore production test

2. Future plans

- Improve technologies for commercialization by 2018

3. Cooperation with USA

- Based on the Statement of Intent which singed in 2008, JOGMEC of Japan and NETL of the USA singed MOU concerning Japan-U.S. Collaboration on Methane Hydrate research activity in Alaska on Nov. 6, 2014.

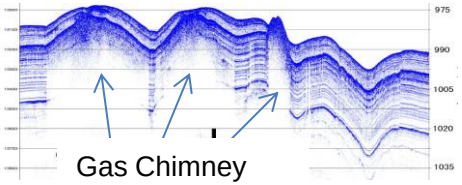
2. Shallow Methane Hydrate

1. Actions to understand resource reserves

- Shallow methane hydrates mainly exists in the Sea of Japan side
- Will conduct research starting in 2013 to 2016 in order to understand the resource reserve
- Conducted geological research in 2013 and 2014, discovered 971 areas where gas chimneys may exist
- Gathered shallow methane hydrate samples in 2014

2. Current Situations

- Conducted detailed and wide-area geological research and core sampling



Example of cross-section diagram of the sea bed

Gathered core samples bearing shallow methane hydrate

4. Coal

The Whole Concept of the Future Coal Policy (Interim Report)

Basic Understanding on Coal

1. Reserves of coal are abundant and coal is the low-cost energy source which is excellent in stable supply.
2. Coal demand has been increasing mainly in emerging countries. The price was doubled compared with the early 2000s; therefore, there is a risk that the price may go up in the mid-long-term.
3. The coal-fired power was re-evaluated as "a fuel for the base load power supply which is excellent in stable supply and economic efficiency" in the new Strategic Energy Plan.
4. Japanese power generating efficiency of the coal-fired power is at the highest level in the world. (If it is applied to the coal-fired power in the U.S., China, and India, 1.5 billion tons of CO_2 per year (= the amount of emissions in Japan as a whole) can be reduced)
5. Introduction of the Japanese highly-efficient coal-fired power will contribute to reduce the global environmental burden. It is also one of the important sectors in infrastructure export.

Issues on the supply side

- Lowering the import cost
- Excessive dependency on Australia and Indonesia (Over 80%)
- Lowering the supply risk such as weather, oligopolization, etc.

Issues on the utilization side

- Utilization of the coal-fired thermal power as a base load power supply
- Controlling CO_2 emissions from the coal-fired power

Issues in the overseas deployment

- Making more efficient the increasing coal-fired power generation in the world
- Response to the movements of controlling public support in the U.S.

Future direction of the measures

(1) Securing stable supply with low cost

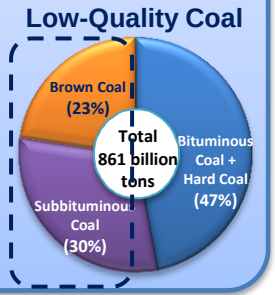
i. Examination of the diversification of suppliers, etc.

-Stable supply from major coal producing countries and re-evaluation in terms of costs

ii. Technology development to expand the use of low-quality coal

-Development of the technology to efficiently use the low-quality coal which had not been effectively used

-Development of the technology for reformed coal, SNG manufacturing technology, etc. for commercialization



(2) Promotion of the use of coal compatible with the environment

i. Technology development for highly-efficient use and low carbonization

-Practical use of A-USC and IGCC (in the 2020s)

-Practical use of IGFC that is more efficient and suitable for CO_2 capture (Around the 2030s)


Osaki Cool Gen Demonstration Project (IGCC and IGFC)

-Practical use of advanced IGCC and IGFC of which CO2 emissions are equivalent to the existing LNG thermal power (Around the 2040s)

ii. Technology development for capture and efficient use of CO_2

(3) Overseas deployment of Japanese low-carbon technologies

i. Contribution to reduce the global environmental burden by introducing the highly-efficient coal-fired power generation in emerging countries, etc.

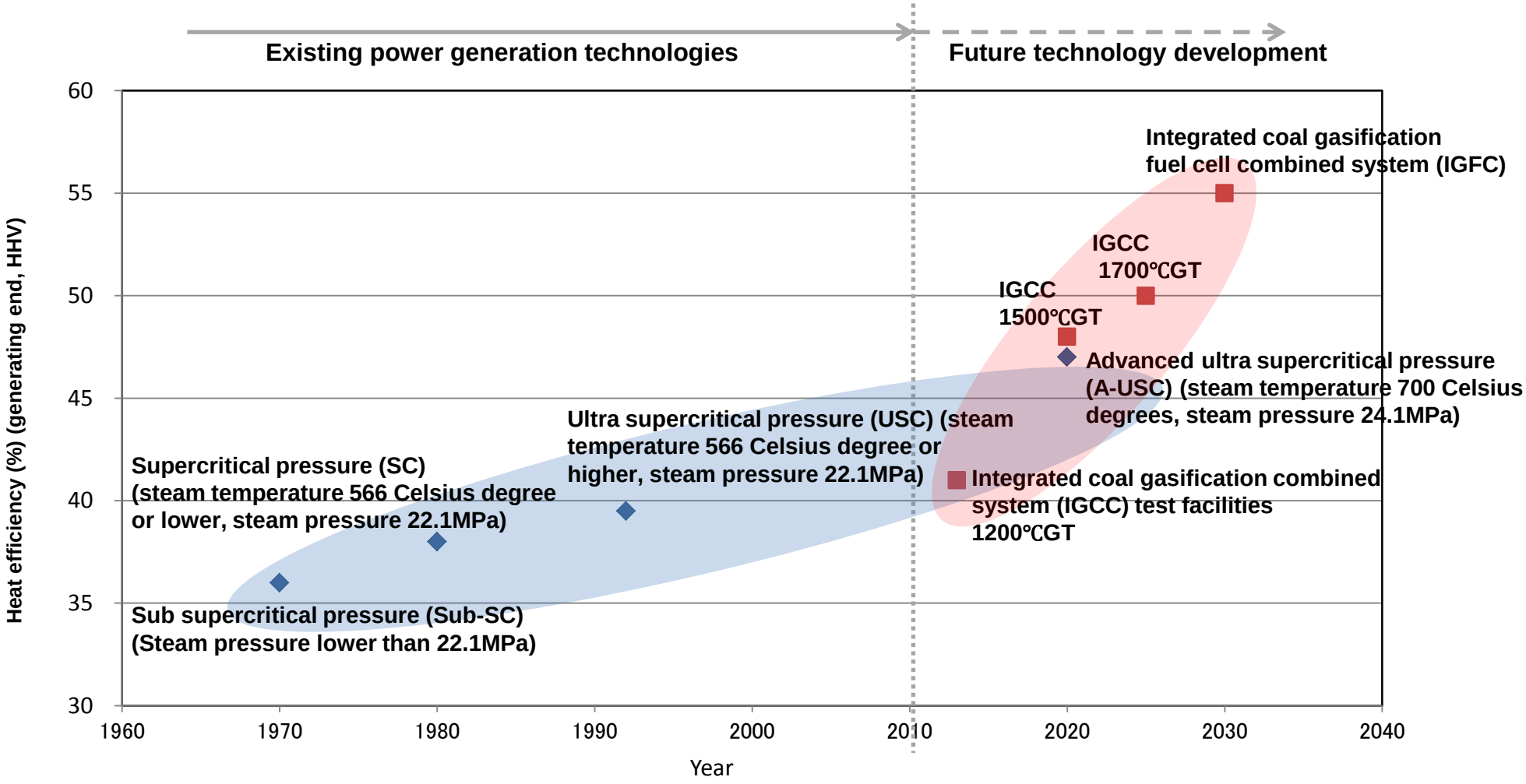
ii. Active promotion of infrastructure export for highly-efficient coal-fired power plants

iii. Projects to demonstrate low-carbon coal utilization technologies in foreign countries

Power generation efficiency and even higher efficiency of coal thermal power generation

For further improvement of coal thermal power generation efficiency, development of technologies such as Integrated coal Gasification Combined Cycle (IGCC), Integrated coal Gasification Fuel Cell combined Cycle (IGFC),Advanced Ultra SuperCritical pressure thermal power generation (A-USC) taking advantage of Japan's technologies is important.

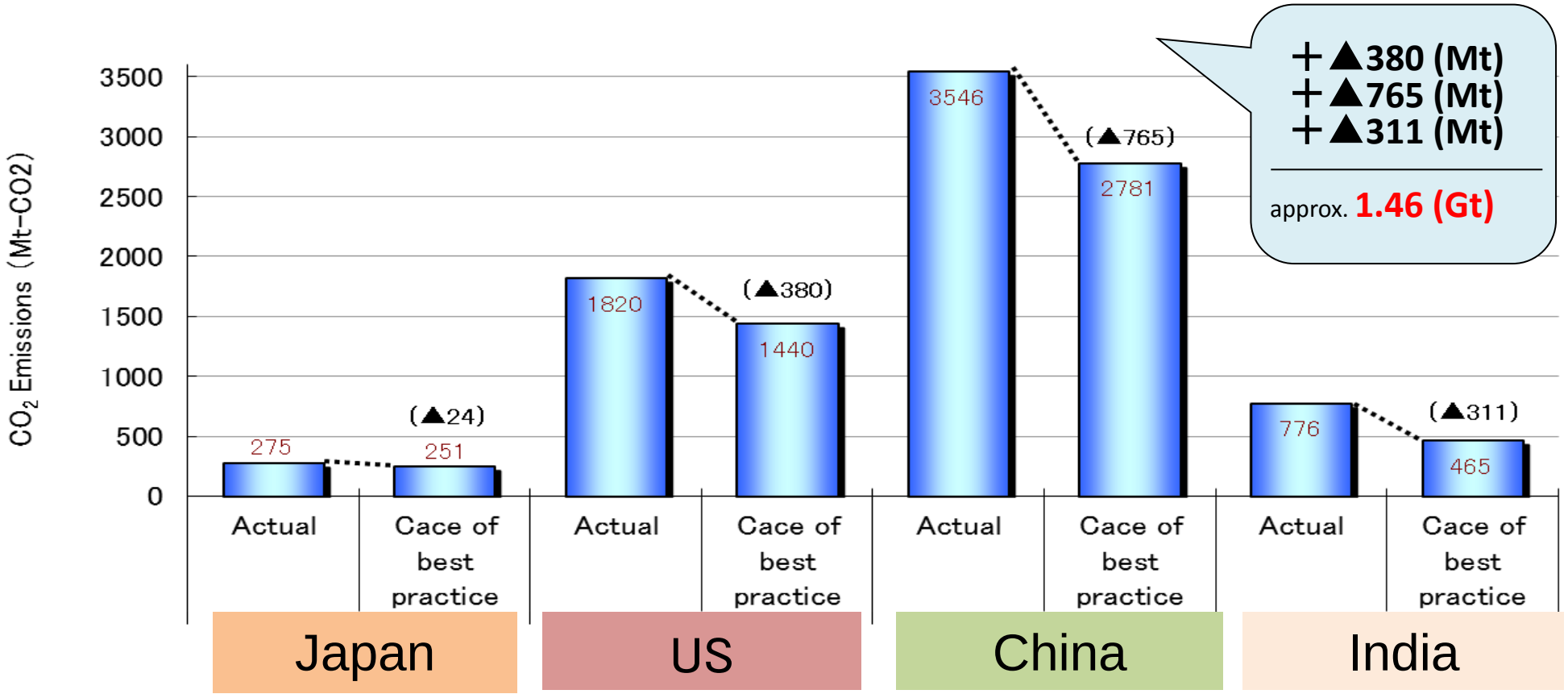
<Efficiency improvement of coal thermal power generation>



CO2 Emissions Reduction through Technological Transfer

○If the most advanced coal fired power technology is introduced to all the coal fired power plants in the US, China, and India, the CO2 reduction effect is estimated to be about 1,500 million tons, which is larger than the amount of total annual CO2 emissions in Japan

Actual CO2 Emissions from Coal Fired Power Generation (2010) and Case of Adopting currently Most Advanced Technology



Source: " IEA World Energy Outlook 2012 ", " Ecofys International Comparison of Fossil Power Efficiency and CO2 Intensity 2013 "

Coal Thermal Power generation (Promotion of Low-Carbon Technologies)

○Coal thermal power generation in Japan achieved the highest level of efficiency in the world.

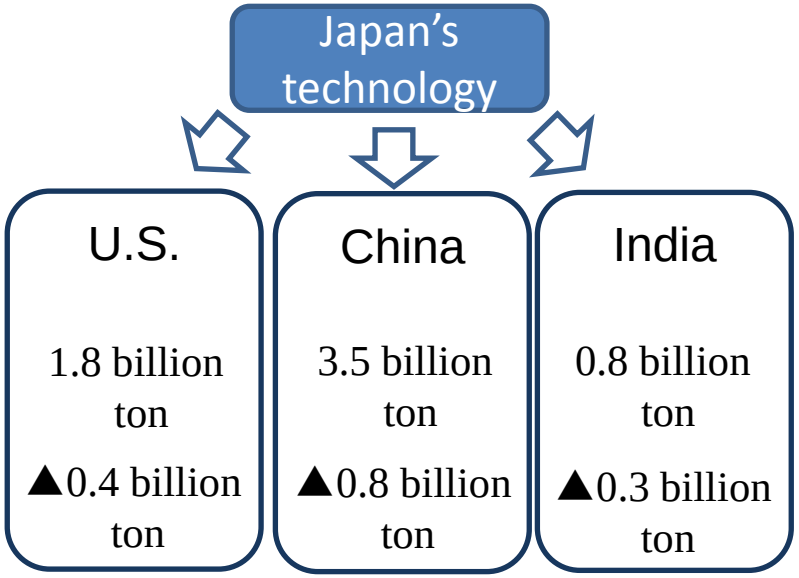
○If the most advanced technology in operation in Japan is applied to coal thermal power generation in the U.S. , China and India, it is estimated that CO2 emission could be reduced by about 1.5 billion tons.

The most advanced high efficiency coal thermal power generation

J-Power (Isogo Thermal Power Plant)

The estimation of CO2 reduction in case Japan's technology is applied

The effect of CO2 reduction from coal thermal power generation



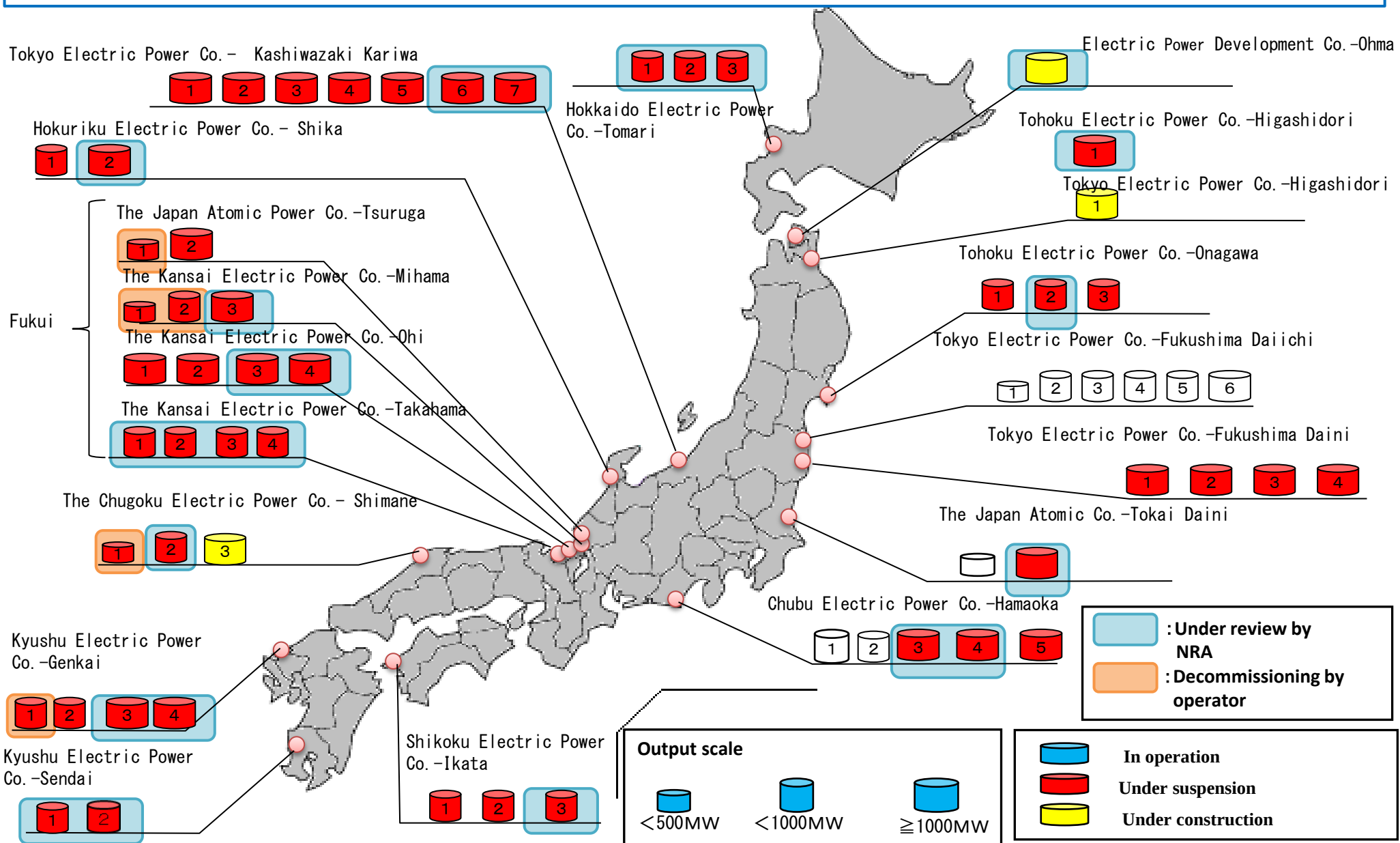
Total ▲1.5 billion ton
(The total emission in Japan: 1.3 billion ton)

5. Nuclear

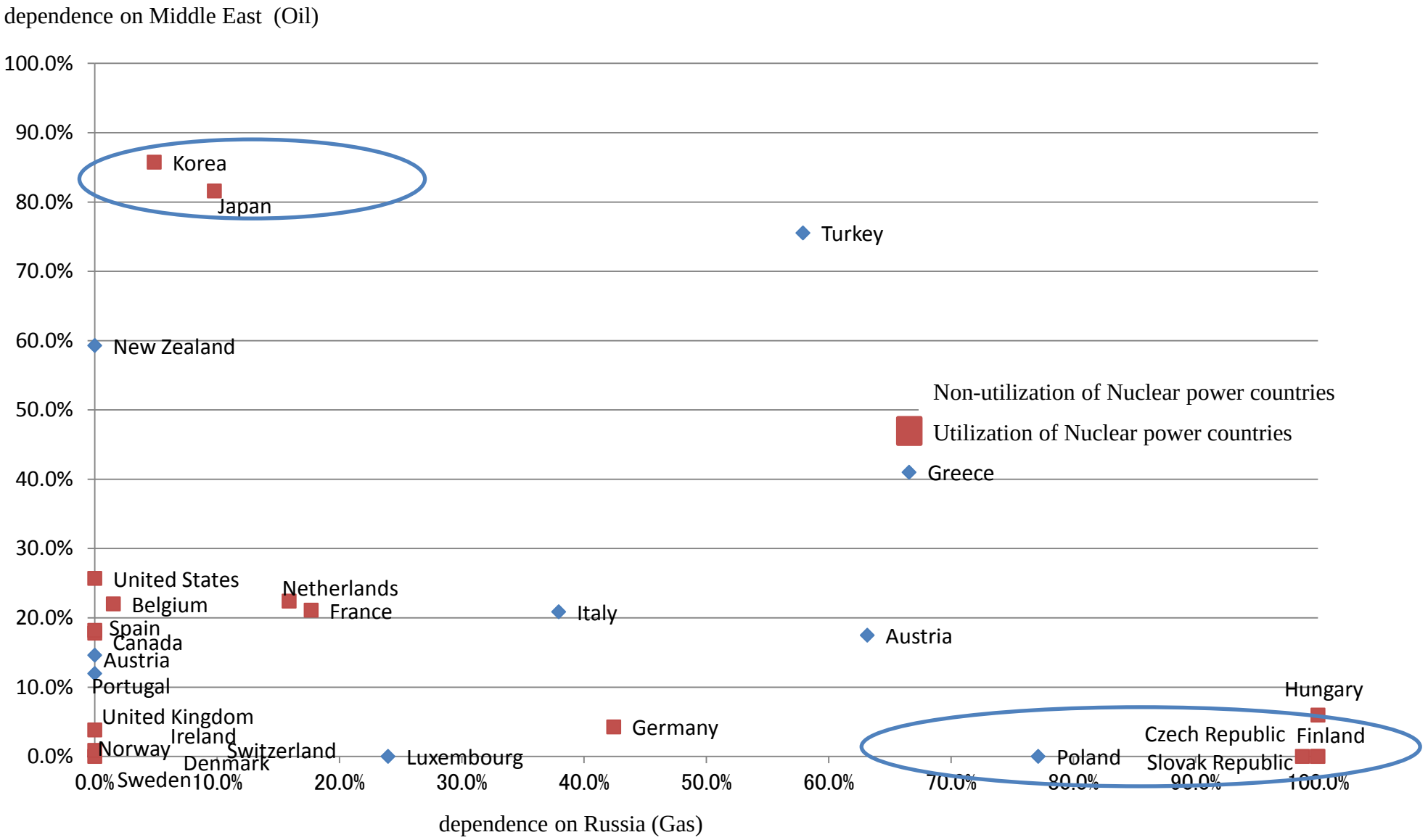
Nuclear Electric Power Plants in Japan (As of July 10th, 2015)

Agency for Natural Resources and Energy

25 units out of 15 sights are under review for restart by the Nuclear Regulation Authority (NRA) in accordance with its new safety regulations.



Relation between import of fossil fuel and utilization of nuclear power (2013)



OIL INFORMATION(IEA,2014) ,
NATURAL GAS INFORMATIONS(IEA,2014)

Examples of New Safety Requirements

Blue: Strengthening of Design Basis
Red: Severe accident measures

Reinforcement of AC power source
- Connect to two or more substations located in different places through two or more transmission lines
- Storage of fuel for emergency diesel generators for7 days

Emergency response center
- Secure earthquake protection by a seismic isolation function
- Secure safe habitability even if emissions of radioactive materials which is equivalent to those of 1F accidents occur

Measures to prevent containment vessel failure/Measures to prevent core damage
- Mobile water injection system

Addition of natural disasters to be assumed
- Include volcanic eruptions, tornadoes, and forest fires into design consideration

Water sources to prevent severe accidents
- Secure water sources

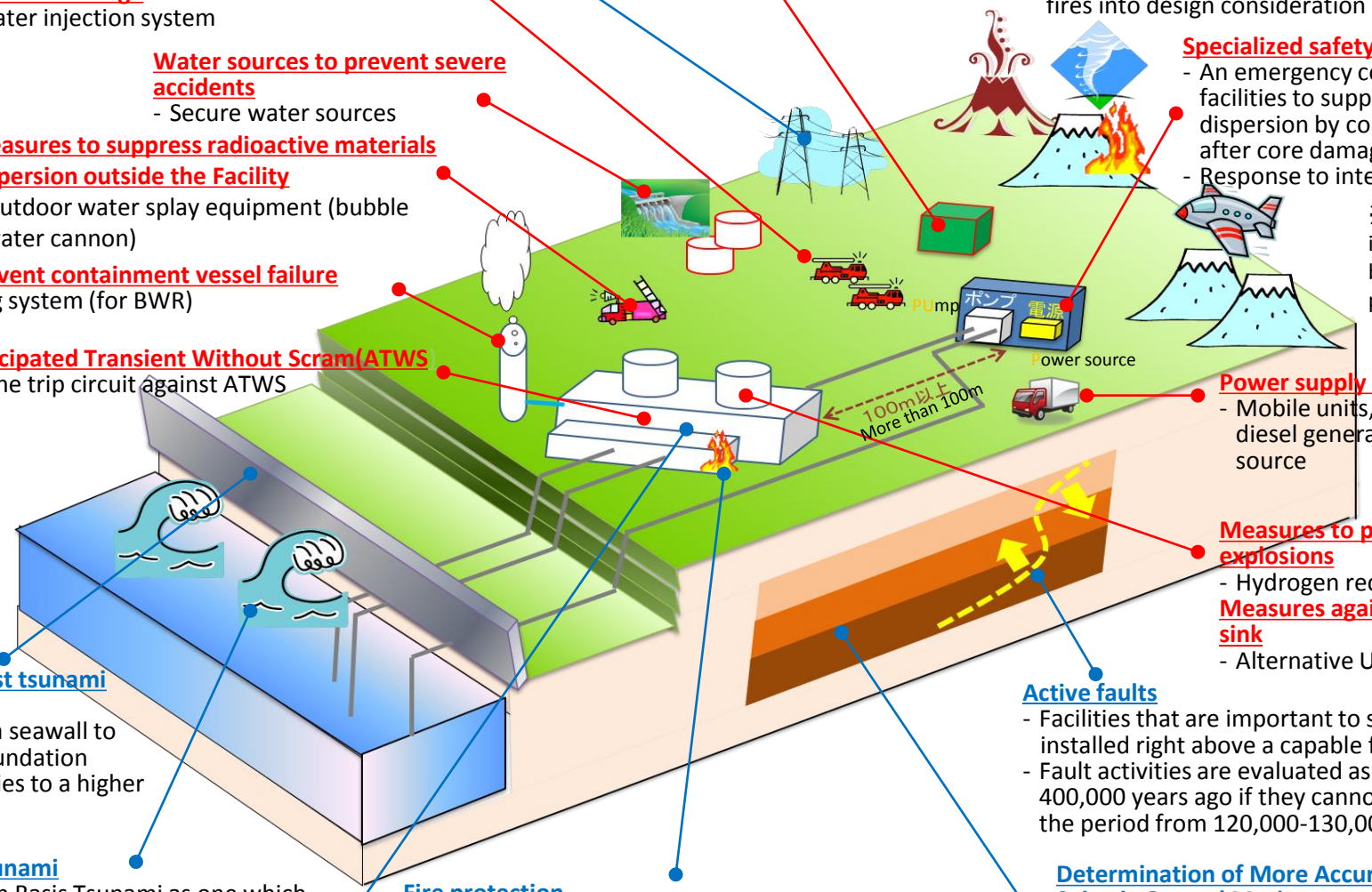
Specialized safety facility※
- An emergency control room back up facilities to suppress radioactive materials dispersion by containment vessel failure after core damage
- Response to intentional aircraft crashes

Measures to suppress radioactive materials dispersion outside the Facility
- Outdoor water splay equipment (bubble water cannon)

※Back-up facilities improving reliability shall be ready within a five year period

Measures to prevent containment vessel failure
- Filtered venting system (for BWR)

Measures of Anticipated Transient Without Scram(ATWS
- Additional turbine trip circuit against ATWS



Power supply against severe accidents
- Mobile units, another emergency diesel generator, the third DC power source

Measures to prevent hydrogen explosions
- Hydrogen recombiner

Measures against loss of final heat sink
- Alternative UHS system

Measures against tsunami inundation
- Installation of a seawall to prevent site inundation
- Relocate facilities to a higher place

Active faults
- Facilities that are important to safety cannot be installed right above a capable fault.
- Fault activities are evaluated as far back as approx. 400,000 years ago if they cannot be clearly denied during the period from 120,000-130,000 years ago up to now.

Design Basis Tsunami
- Define a Design Basis Tsunami as one which exceeds the largest ever recorded

Fire protection
- Protective measures of fire prevention, fire detection and extinguishment, and mitigation of fire effects in order not to spoil safety functions

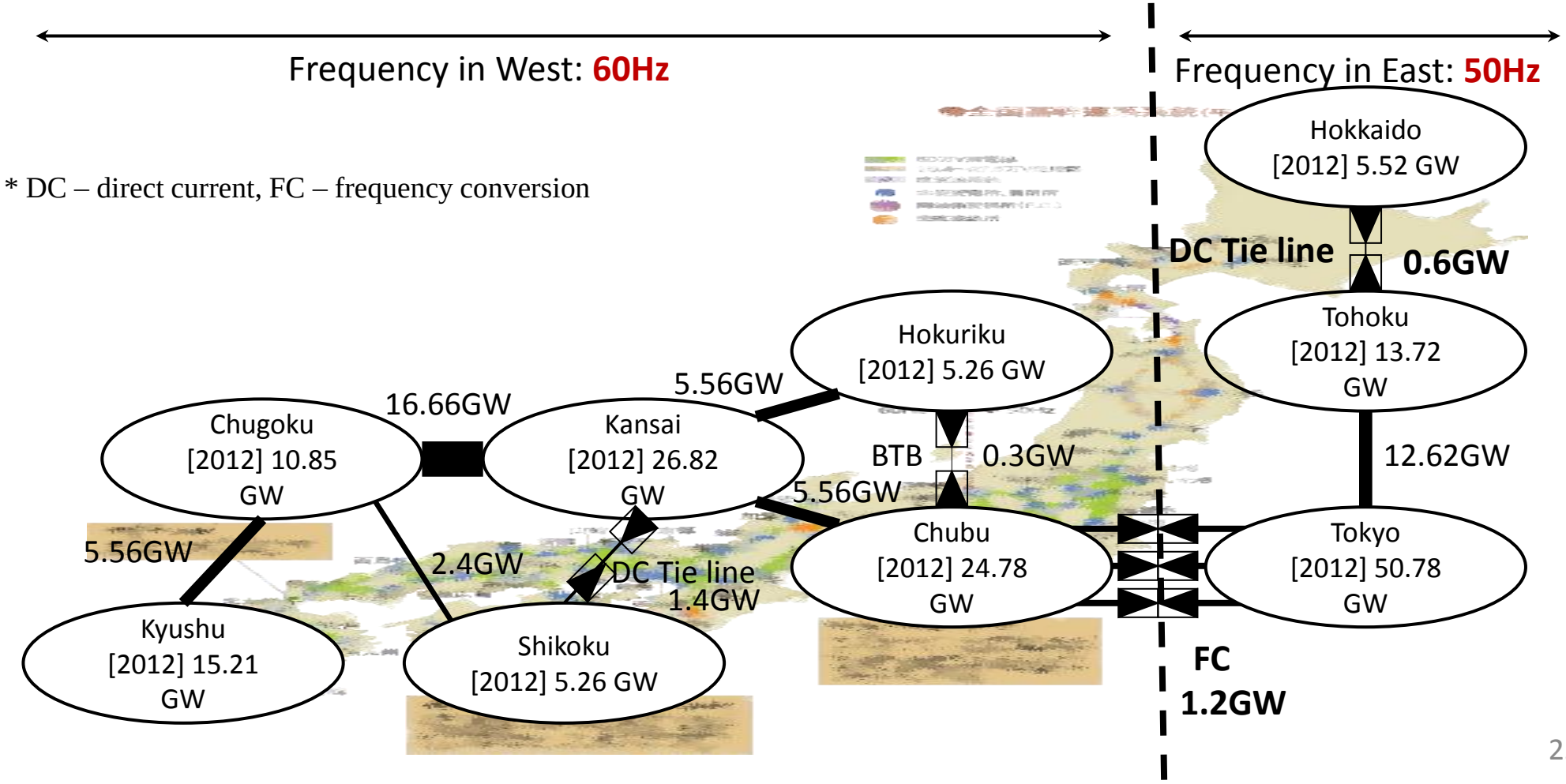
Determination of More Accurate Design Basis Seismic Ground Motions
- Three-dimensional evaluations of the subsurface structure
- A concept of ground motion without a specific seismic source

Internal flooding
- Introduce measures against internal flooding

6. Electricity System Reform

Problem revealed by 3.11

- Negative aspects of regional monopoly system with 10 big and vertically integrated EPCOs were revealed in the Great Earthquake on March 11, 2011:
  1. Lack of system to transmit electricity beyond regions
  2. Little competition and strong price control
  3. Limit in handling the change in energy mix including the increase in renewables

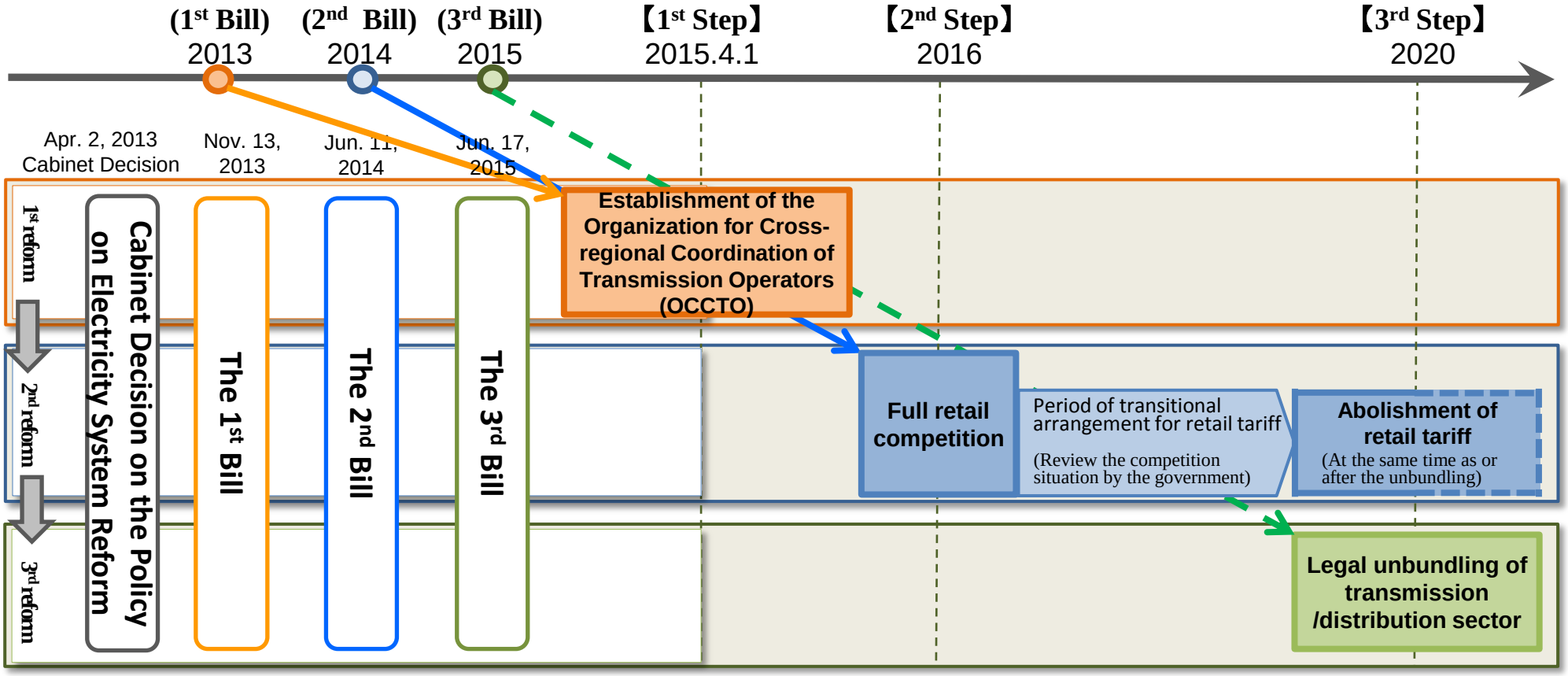


Electricity Market Reform in Japan: Roadmap

- April 2, 2013, Cabinet decided the “Policy on Electricity System Reform” to realize three objectives in Japan’s market with a three-step approach.

3 Objectives

(1) Securing a stable supply of electricity
(2) Suppressing electricity rates to the maximum extent possible
(3) Expanding choices for consumers and business opportunities

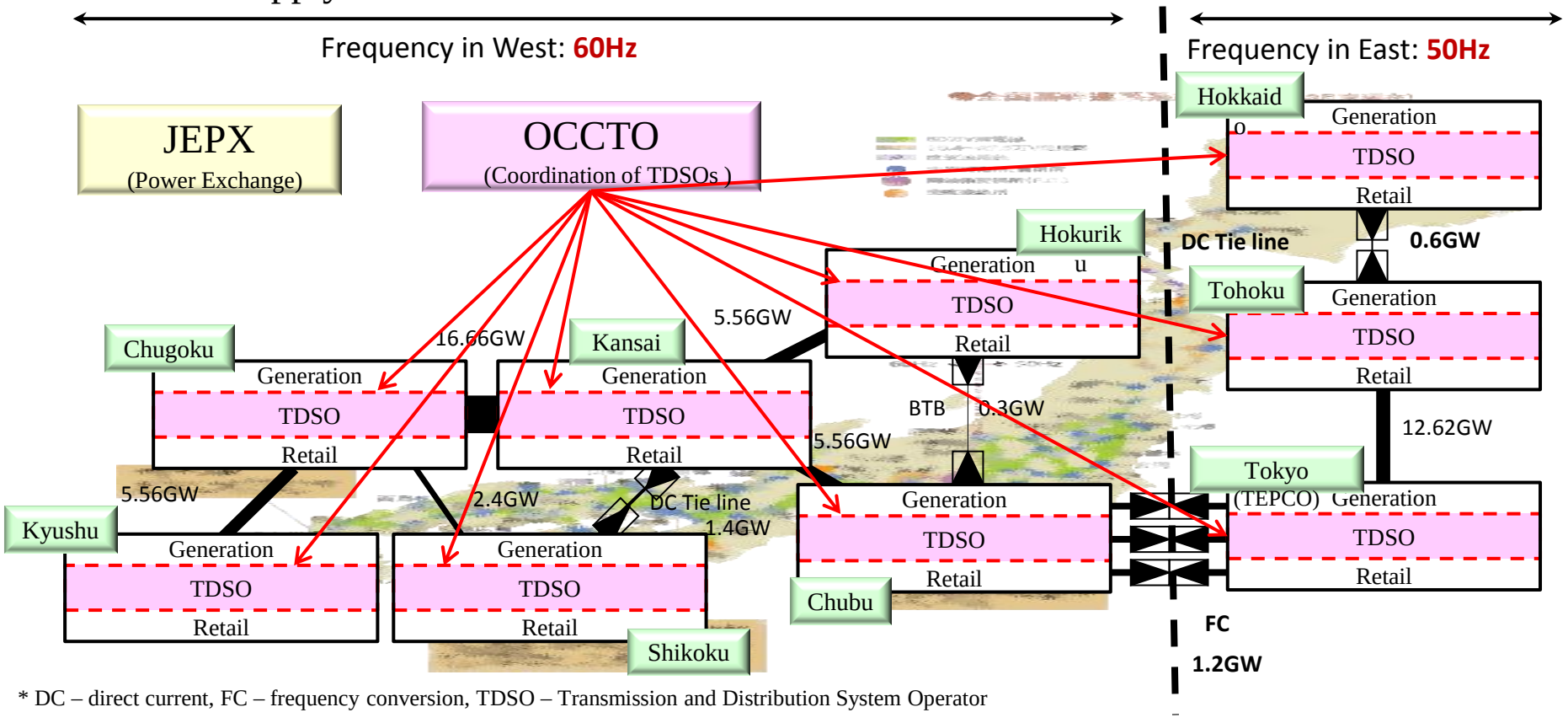


(※At around 2015:Transition to new regulatory organizations)

1st step: Establish the OCCTO

The 1st Bill

- Established the Organization for Cross-regional Coordination of Transmission Operators (OCCTO) in Apr. 2015
  - Main functions of OCCTO
    1. Aggregate and analyze the EPCO's supply-demand plans and grid plans, and order to change EPCO's plans such as tie lines construction
    2. Order EPCOs to reinforce generations and power interchanges under a tight supply-demand situation



* DC – direct current, FC – frequency conversion, TDSO – Transmission and Distribution System Operator

2nd step: Full Retail Competition

The 2nd Bill

- Expand retail competition to the residential sector in 2016, opening a new market
- Maintain regulated tariffs to 10 big EPCOs until the same time as or after the unbundling

Liberalized Sector
(50kW～)

Market Volume ; \10.1 trillion (=$ 84.2bn, € 74.8bn)

Share of total power supply : 62%

Large factory
Large building

Building
Medium factory

Small Factory

Regulated Sector
(～50kW)

Market Volume ; \8.1 trillion (=$ 67.5bn, € 60.0bn)
Number of contracts
Residential Customers : 77.3m
Small shops and offices: 7.3m

Share of total power supply : 38%

Small shop

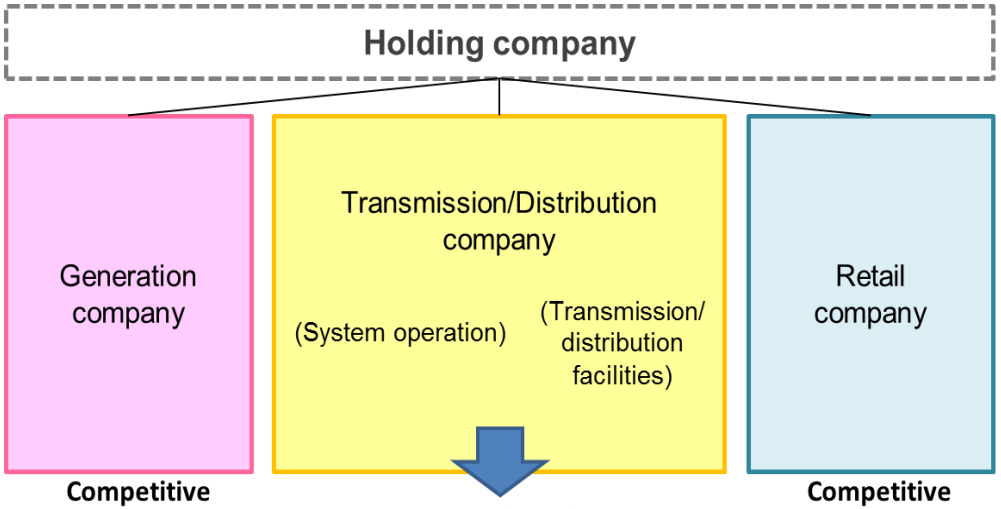
Residential Customer

3rd step: Unbundle the T/D sector

The 3rd Bill

- Unbundle the transmission/distribution sectors of big EPCOs by legal unbundling style in 2020

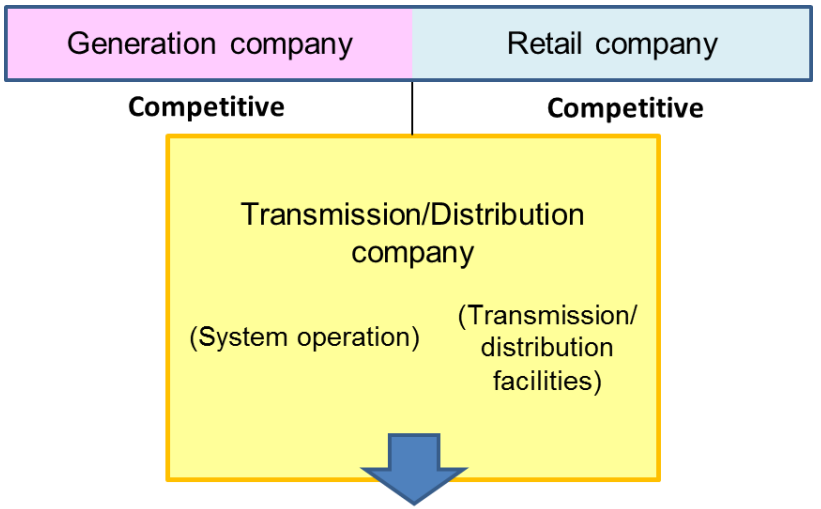
Holding company style



Regulated

- Regional monopoly
- Network tariff
- Responsibility for maintaining frequency & providing LR service
- Code of conduct

Affiliated company style



Regulated

- Regional monopoly
- Network tariff
- Responsibility for maintaining frequency & providing LR service
- Code of conduct

<Note>

✓ Big EPCOs will be required to unbundle transmission and distribution companies from generation ones or retail ones, in "legal unbundling."

✓ Both the holding company style and the affiliated company style, in which a generation and retail company has a transmission and distribution company as a subsidiary company ,are allowed.