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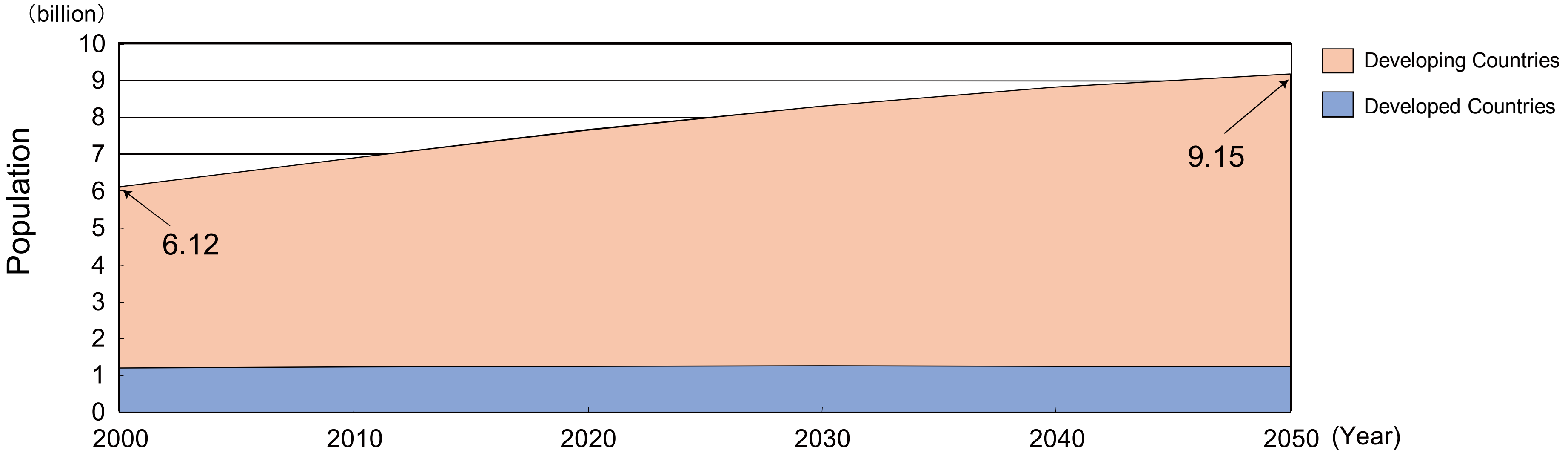
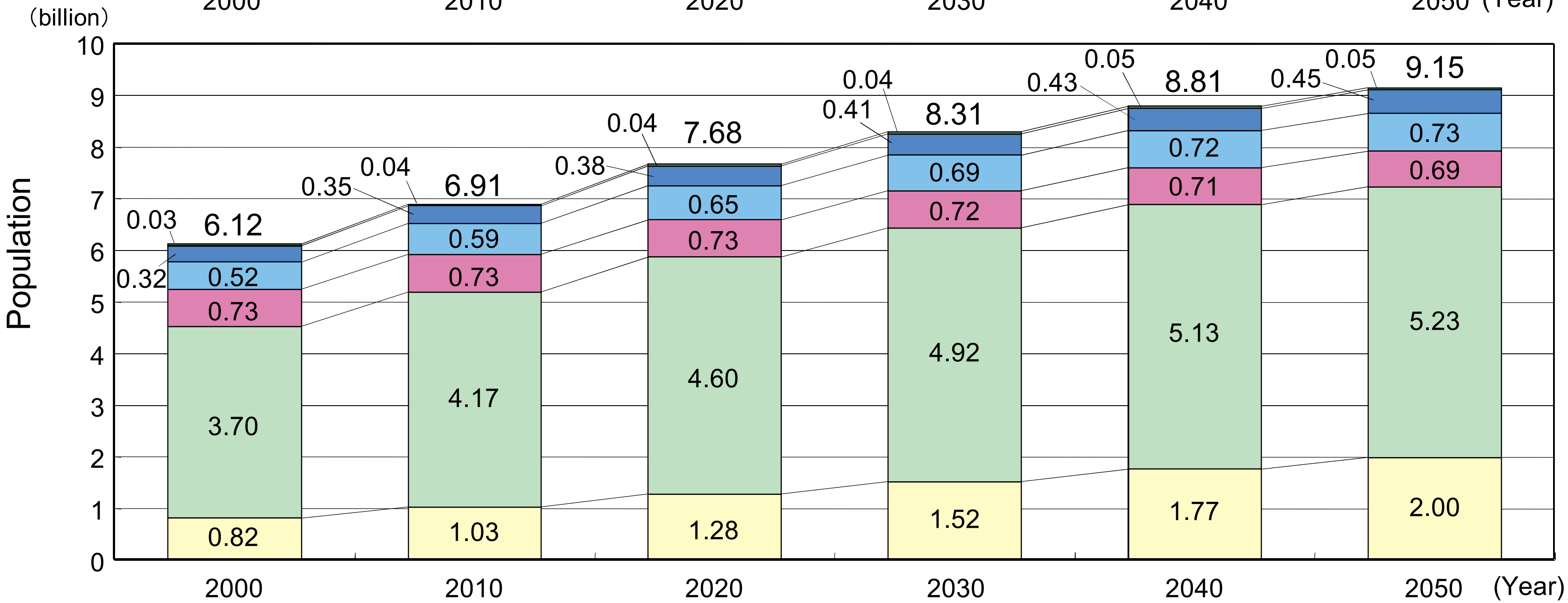
World Population Projections

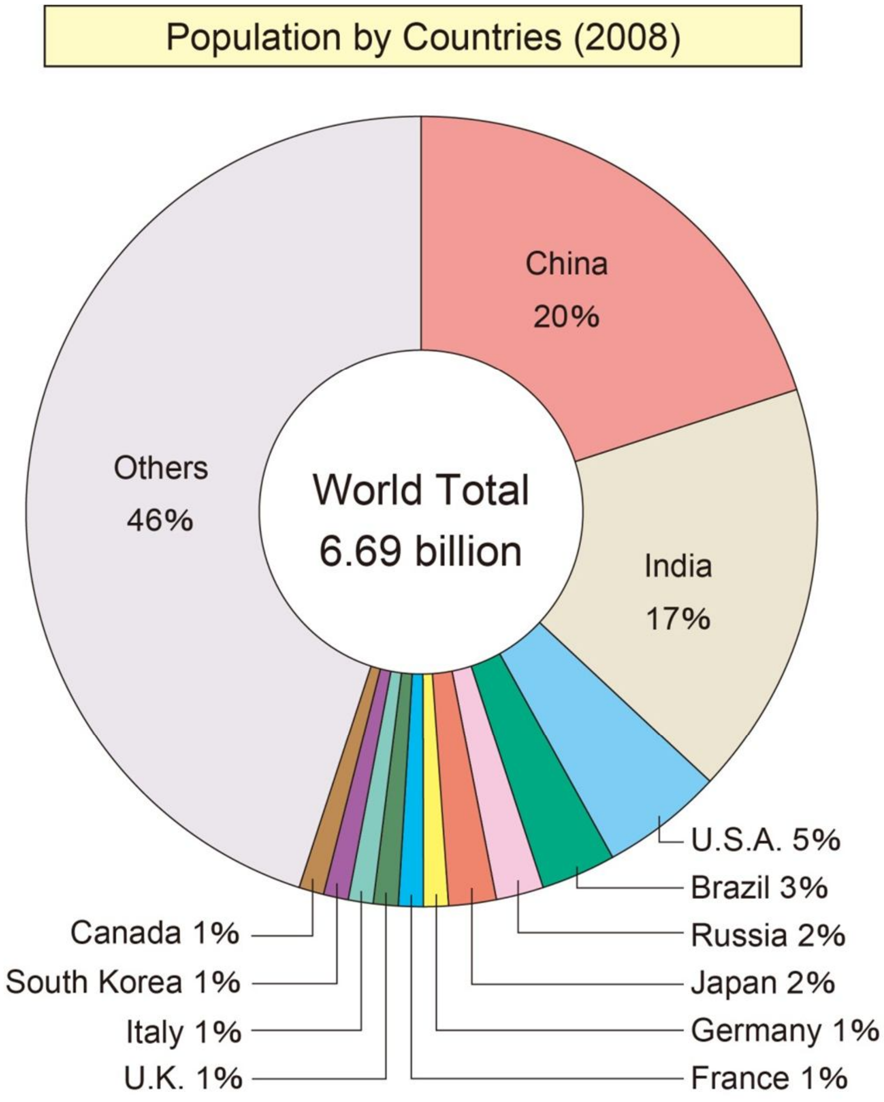


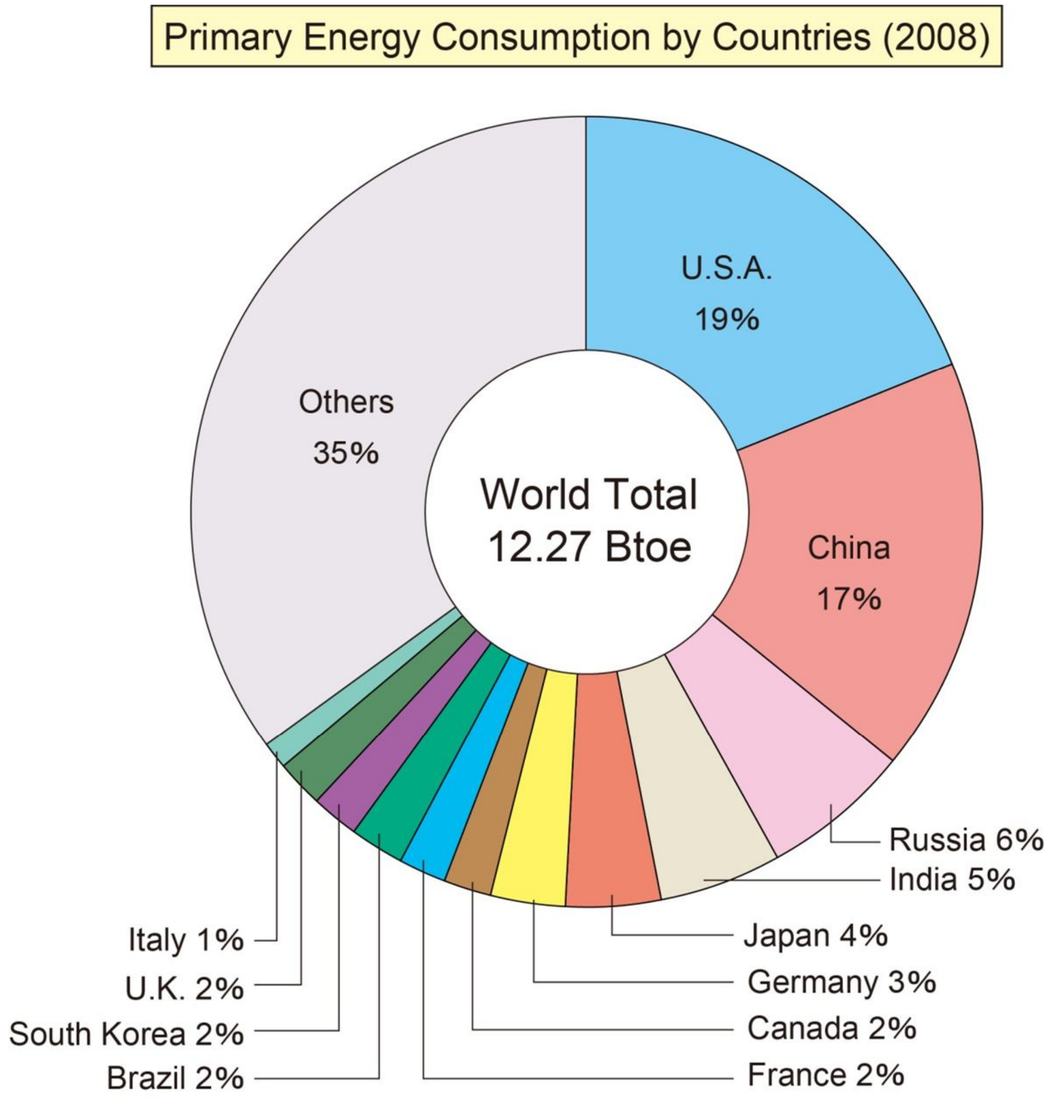


(Note) Figures may not add up to the totals due to rounding.

Source: World Population Prospects “The 2008 Revision Population Database (UN)”

World Population and Energy Consumption

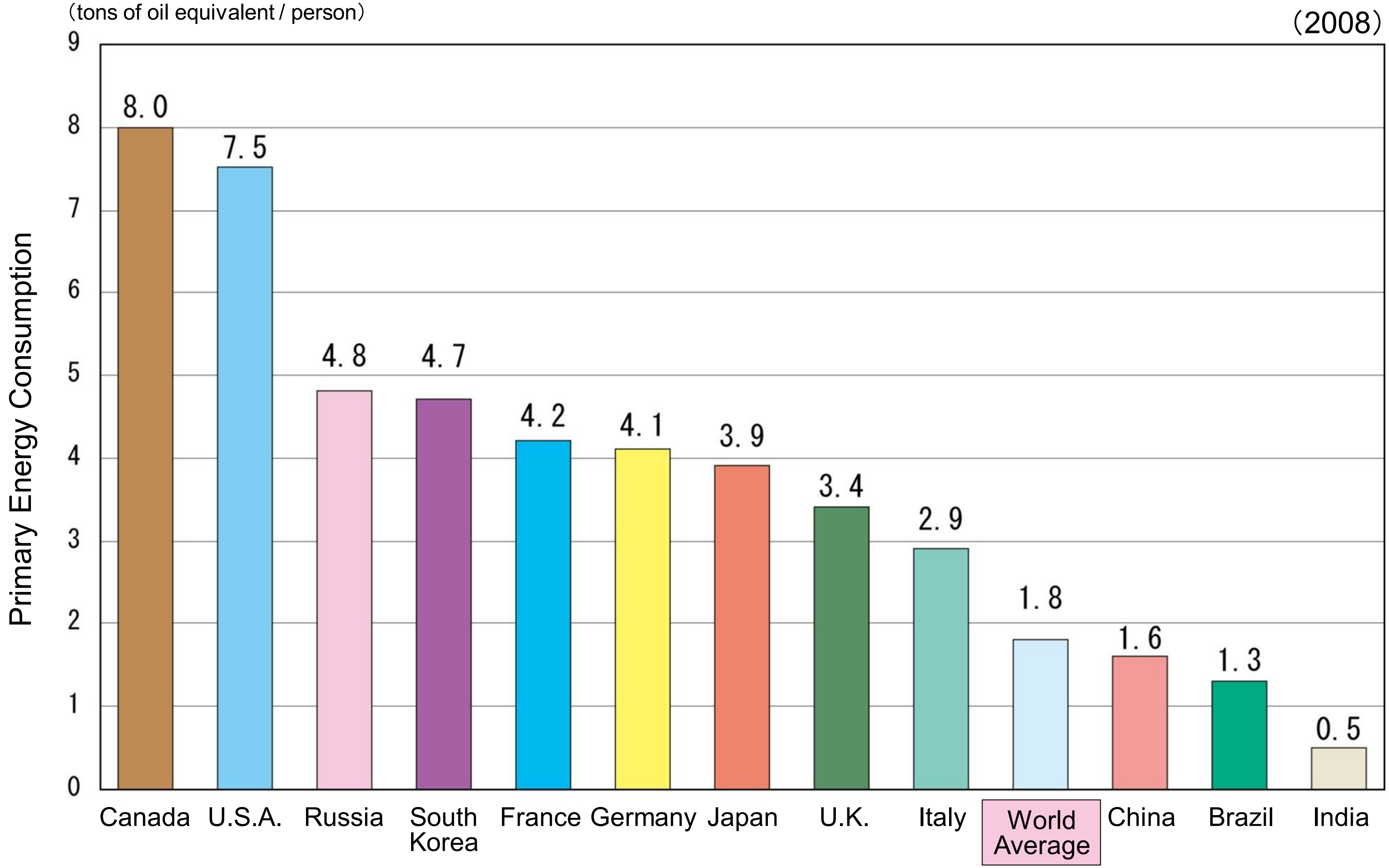




(Note) Figures may not add up to the totals due to rounding.
Btoe: billion tons of oil equivalent

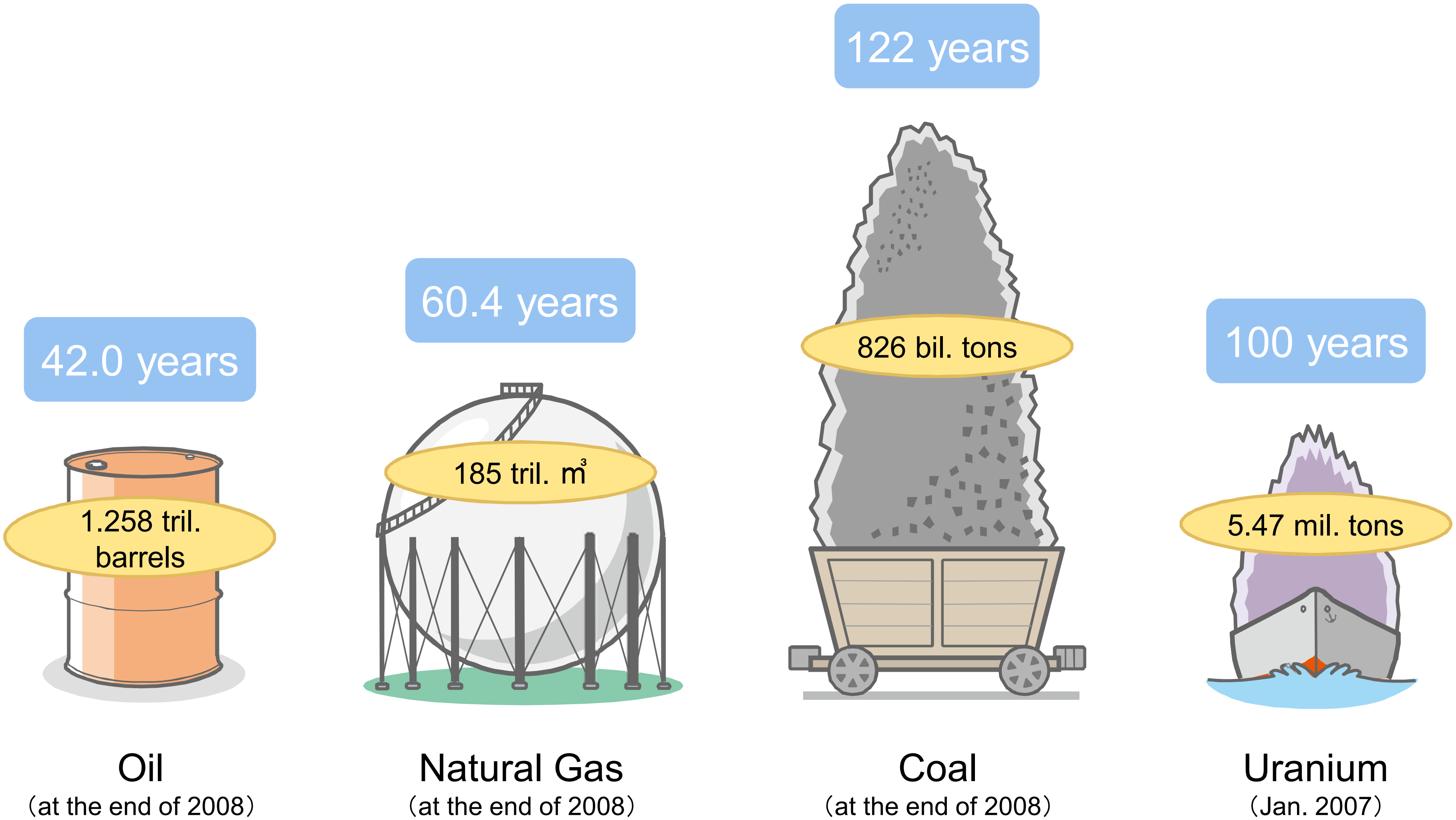
Source: IEA "ENERGY BALANCES OF OECD COUNTRIES (2010 Edition)" / "ENERGY BALANCES OF NON-OECD COUNTRIES (2010 Edition)"

Primary Energy Consumption per Capita



Source: IEA "ENERGY BALANCES OF OECD COUNTRIES (2010 Edition)" / "ENERGY BALANCES OF NON-OECD COUNTRIES (2010 Edition)"

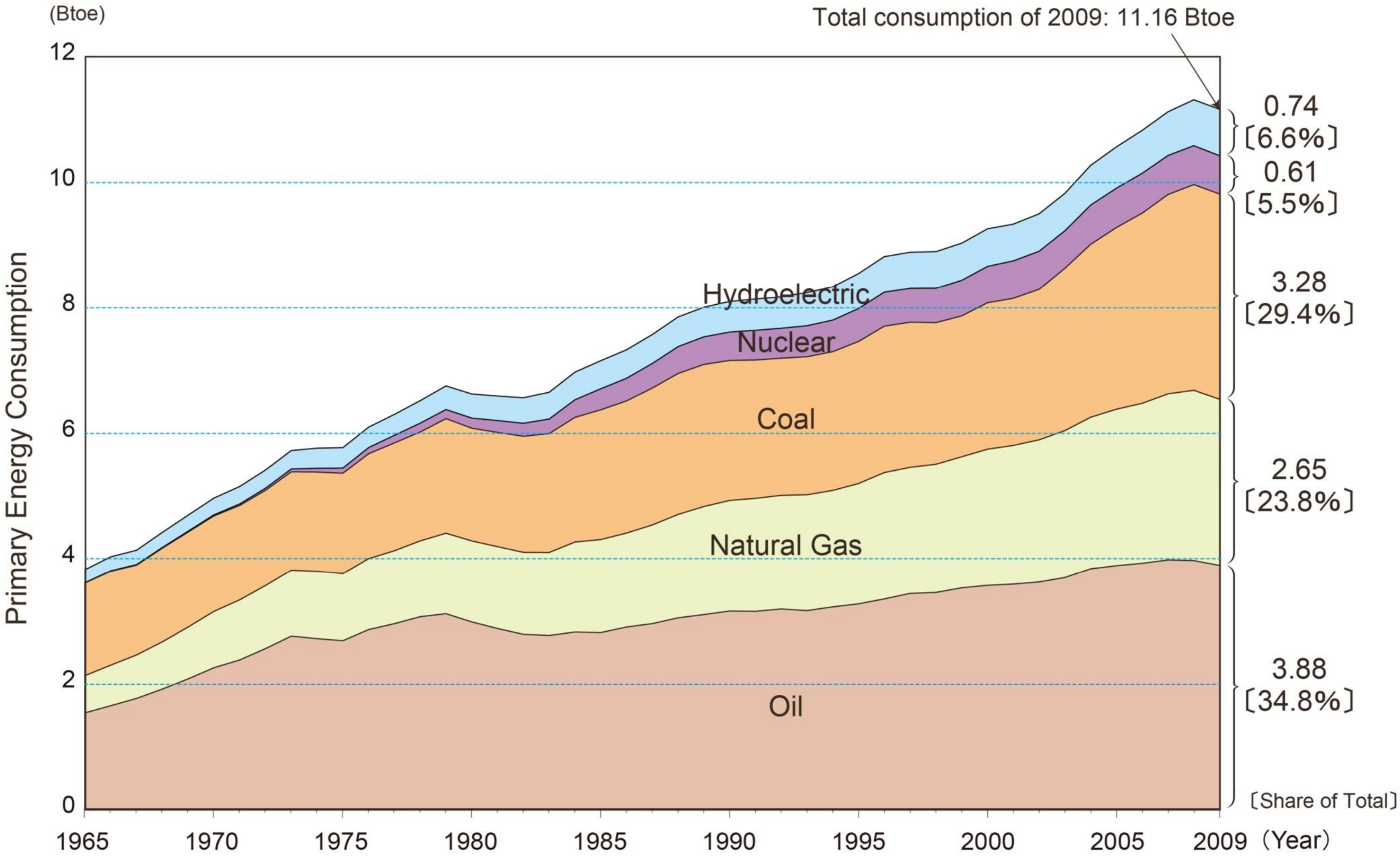
Proved Reserves of Energy Resources



Note1: Reserve-production ratio of oil, natural gas and coal = Reserves remaining at the end of the year / production in that year

Note2: Reserve-production ratio of uranium = Reserves remaining at the end of the year / Annual uranium consumption

The World's Primary Energy Consumption

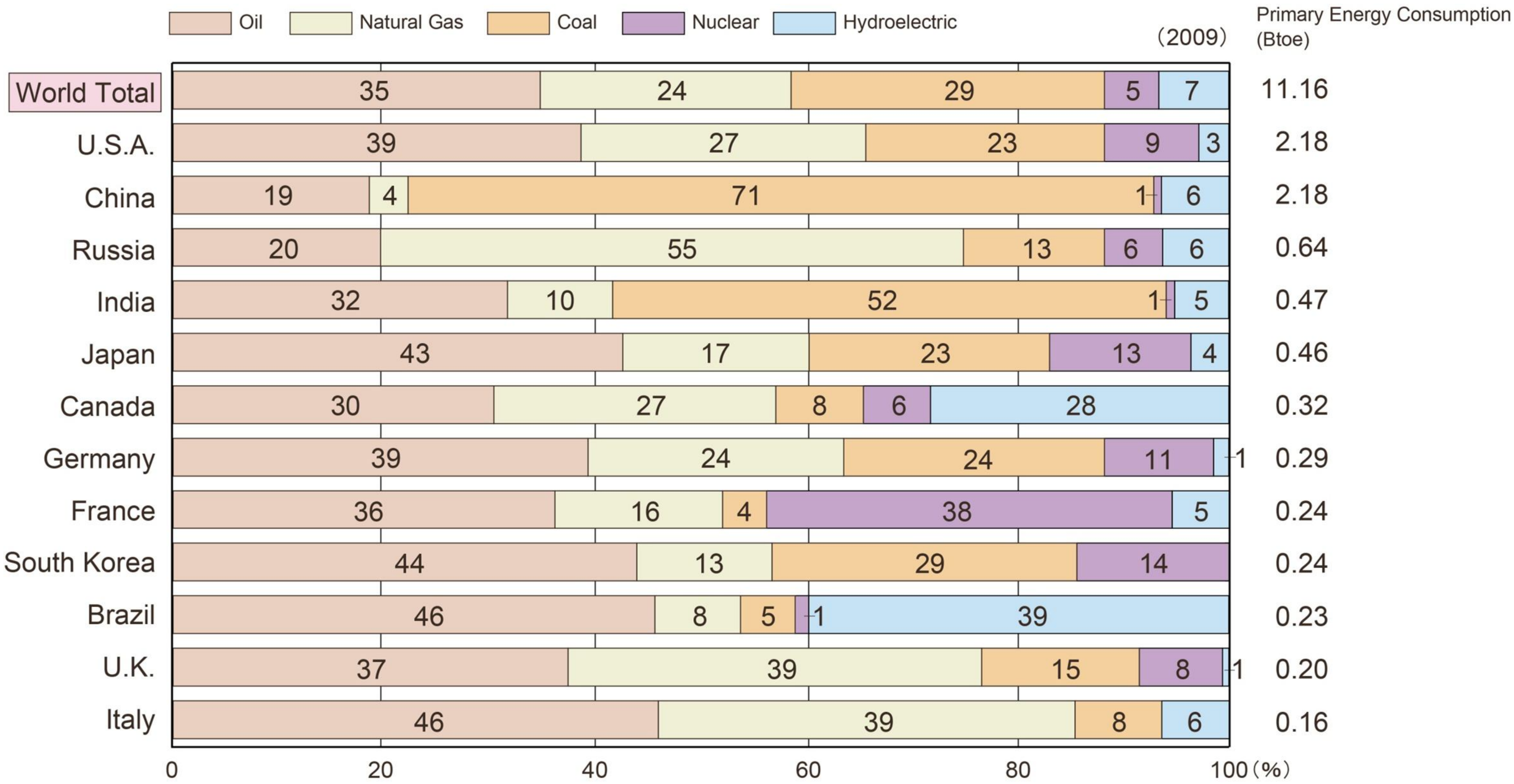


(Note) Figures may not add up to the totals due to rounding.

Btoe: billion tons of oil equivalent

Source: BP Statistical Review of World Energy June 2010

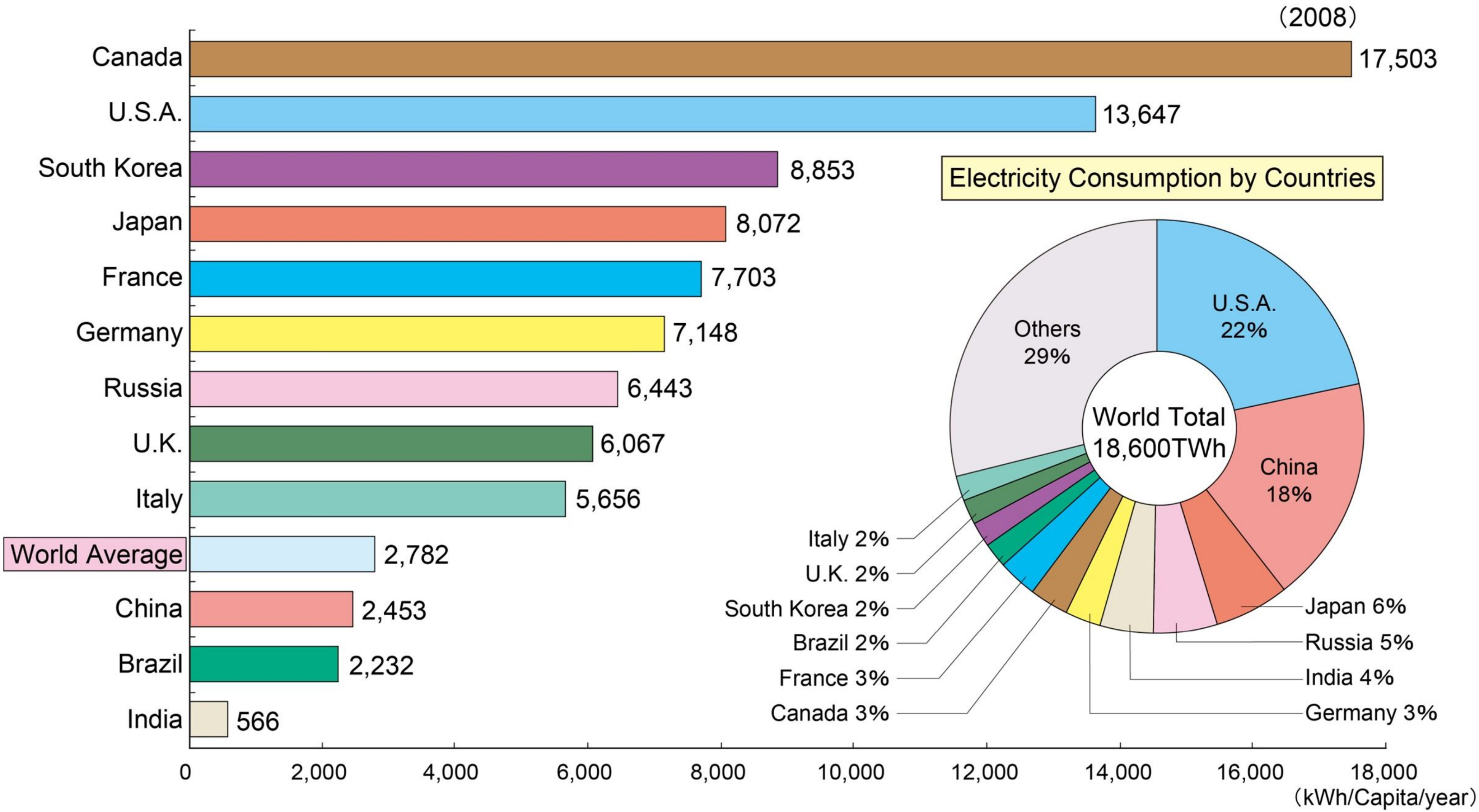
Primary Energy Consumption in Major Countries



(Note) Figures may not add up to the totals due to rounding.
Btoe: billion tons of oil equivalent

Source: BP Statistical Review of World Energy June 2010

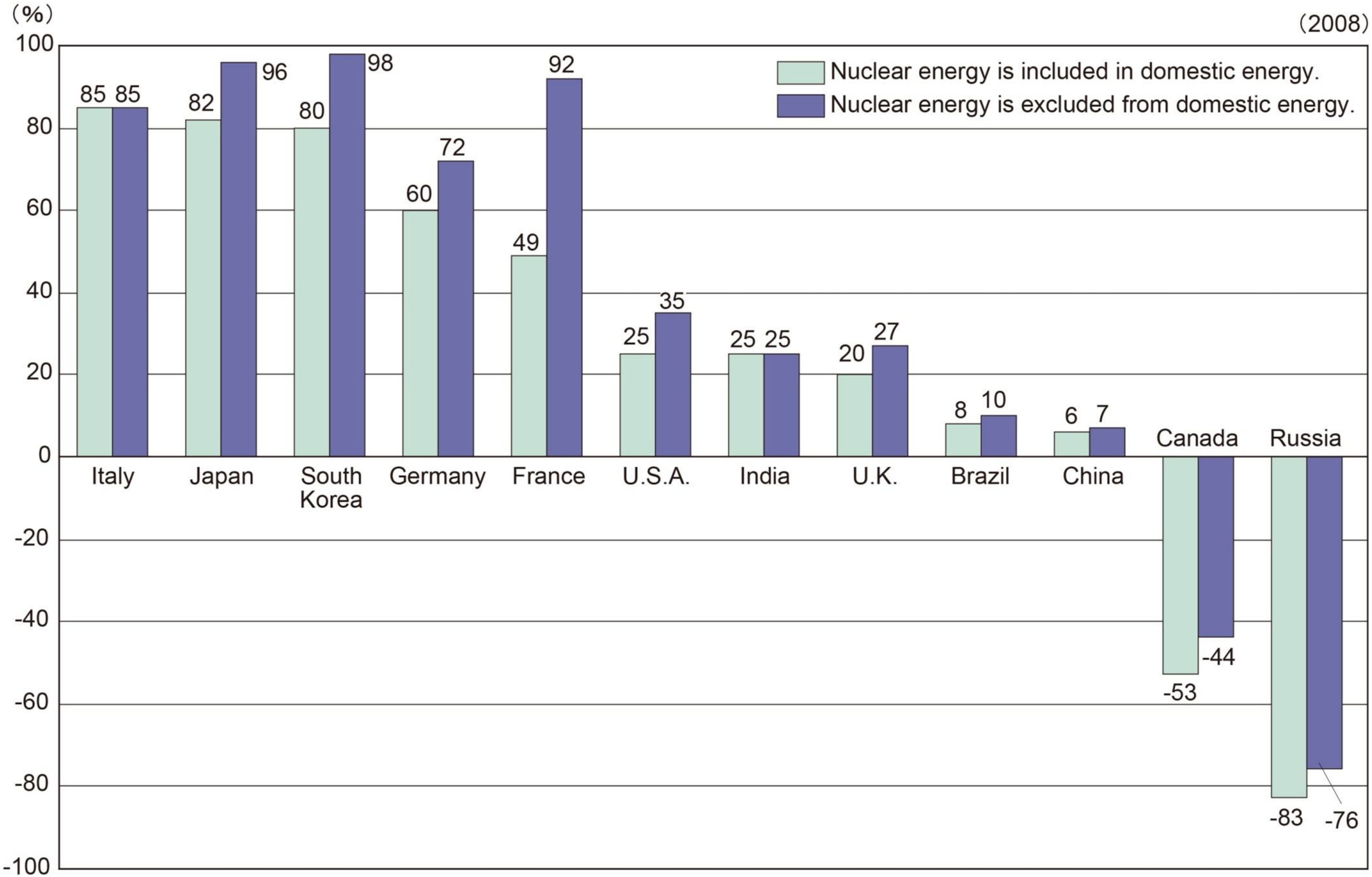
Electricity Consumption per Capita in Major Countries



(Note) Figures may not add up to the totals due to rounding.

Source: IEA "KEY WORLD ENERGY STATISTICS 2010"

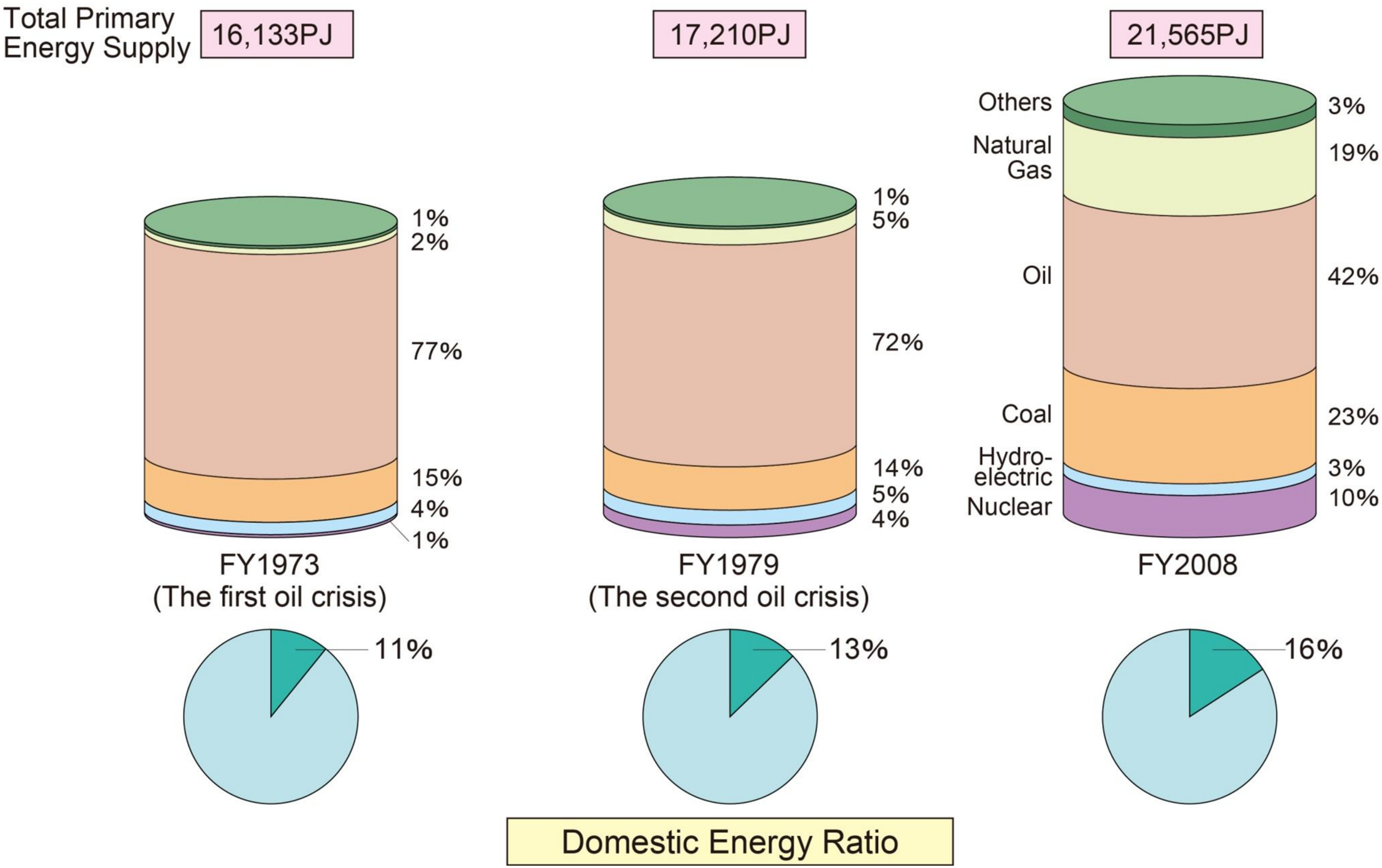
Dependence on Imported Energy Sources in Major Countries



(Note) Canada and Russia are net-exporting countries.

Source: IEA "ENERGY BALANCES OF OECD COUNTRIES (2010 Edition)" / "ENERGY BALANCES OF NON-OECD COUNTRIES (2010 Edition)"

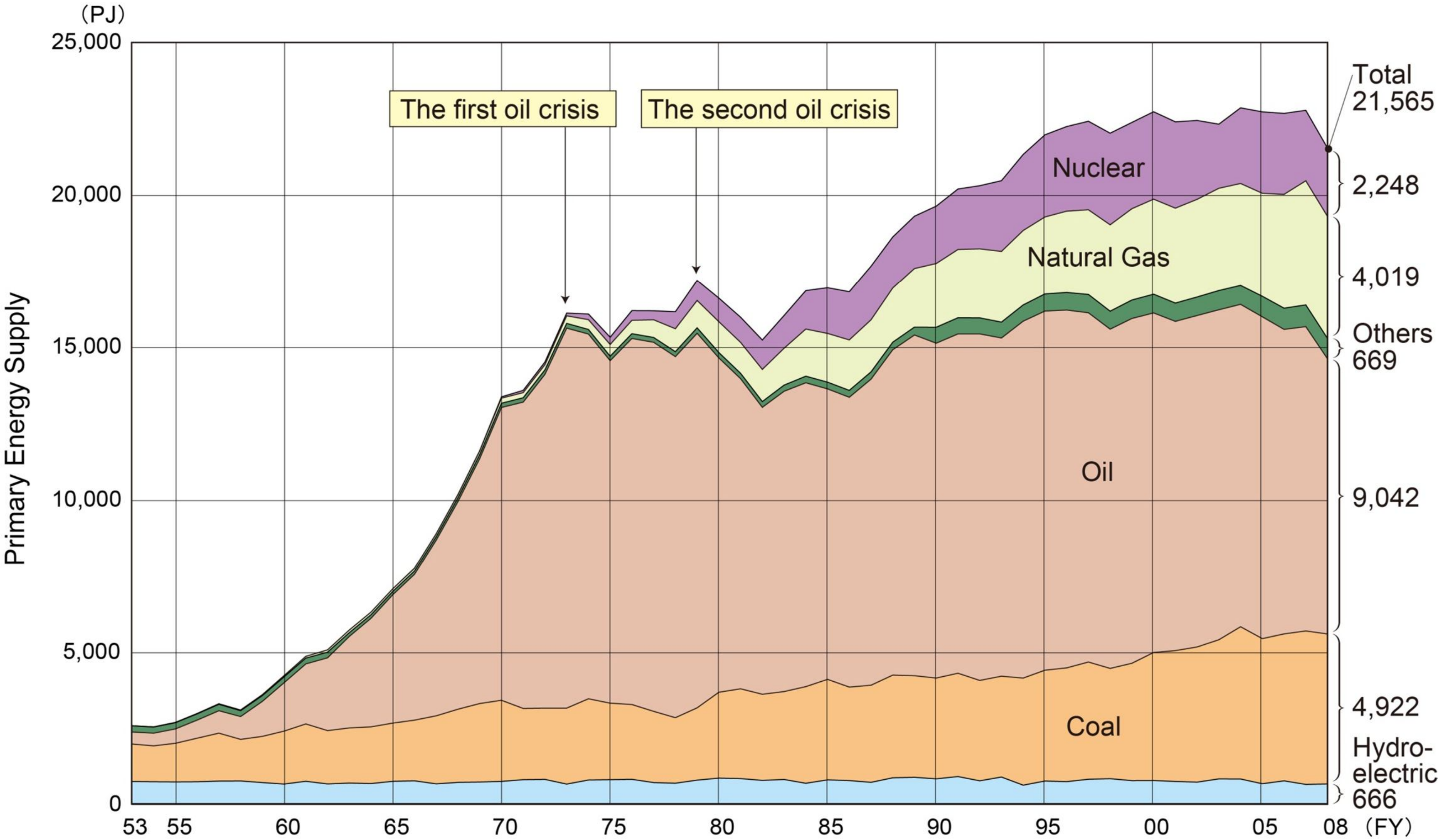
Changes of Japan's Primary Energy Supply Structure



(Note) Figures may not add up to the totals due to rounding.
1PJ (=10^{15}Joules) is equivalent to approx. 25,800 kiloliters of crude oil in calorie.
Nuclear energy is classified into semi-domestic energy due to its characteristic.

Source: Agency for Natural Resources and Energy "FY2008 Energy Supply & Demand Performance" etc.

Historical Trend of Japan’s Primary Energy Supply

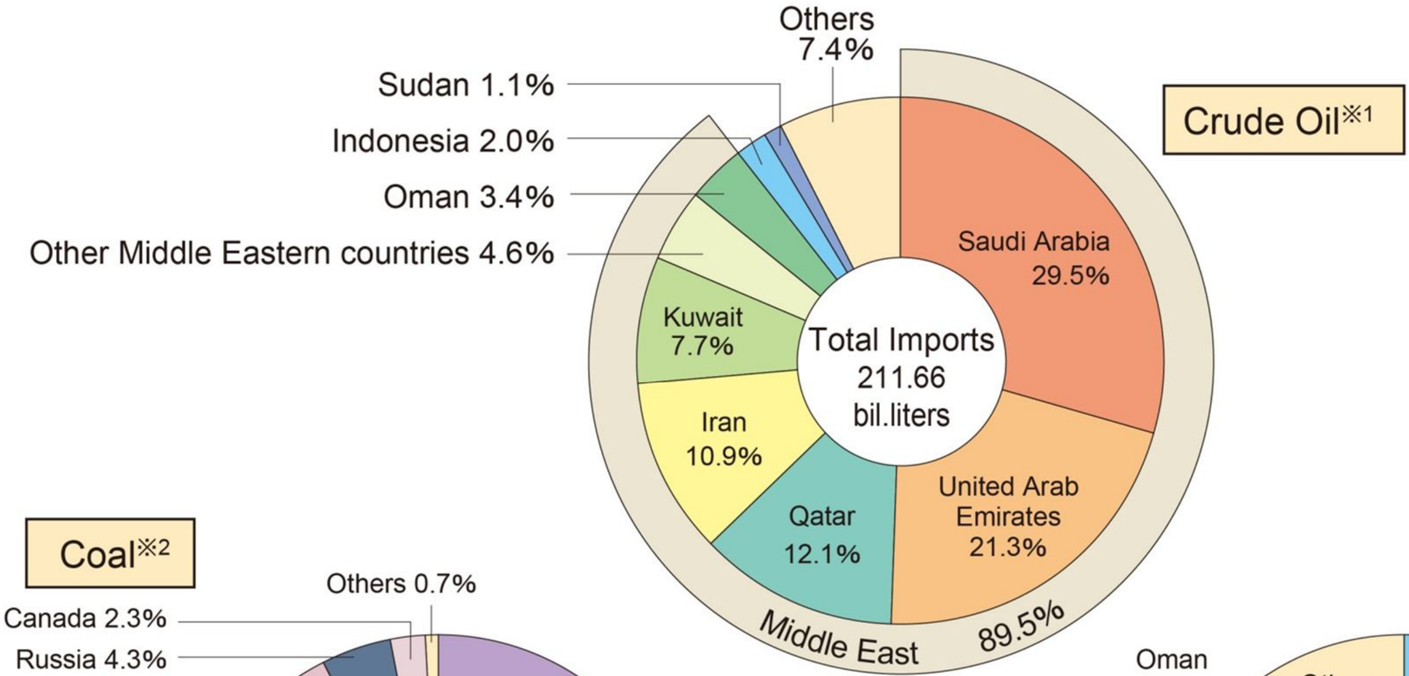


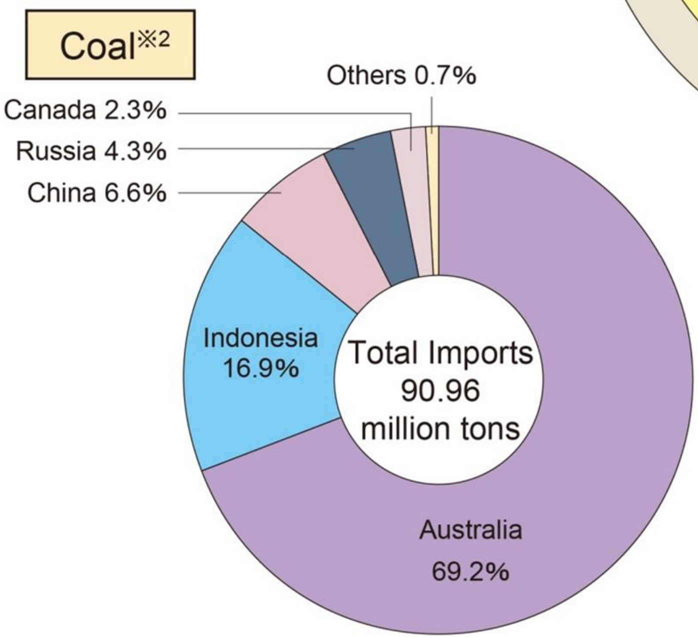
(Note) 1PJ (=10^{15}Joules) is equivalent to approx. 25,800 kiloliters of crude oil in calorie.

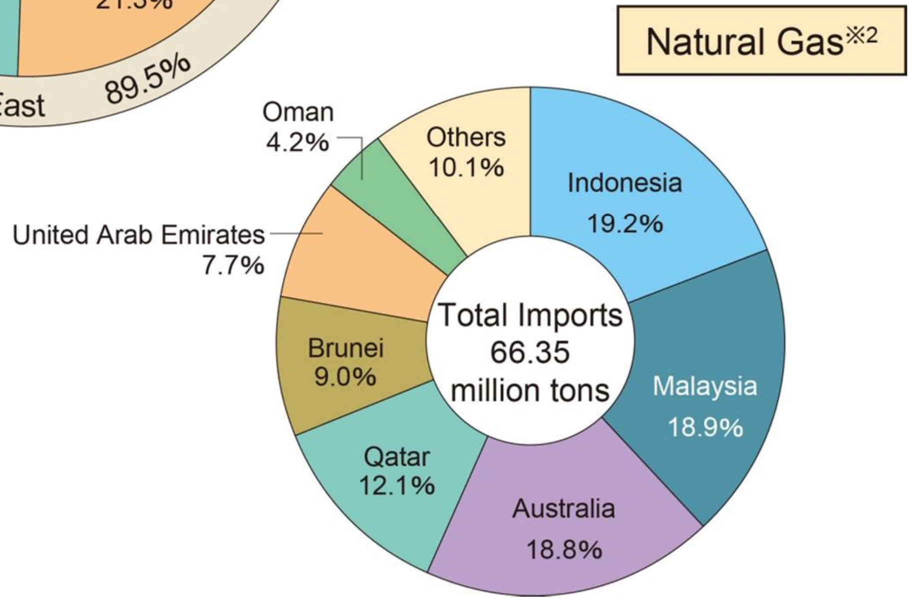
Source: Agency for Natural Resources and Energy “FY2008 Energy Supply & Demand Performance” etc.

Japan’s Fossil Fuel Imports by Country of Origin

FY 2009 result



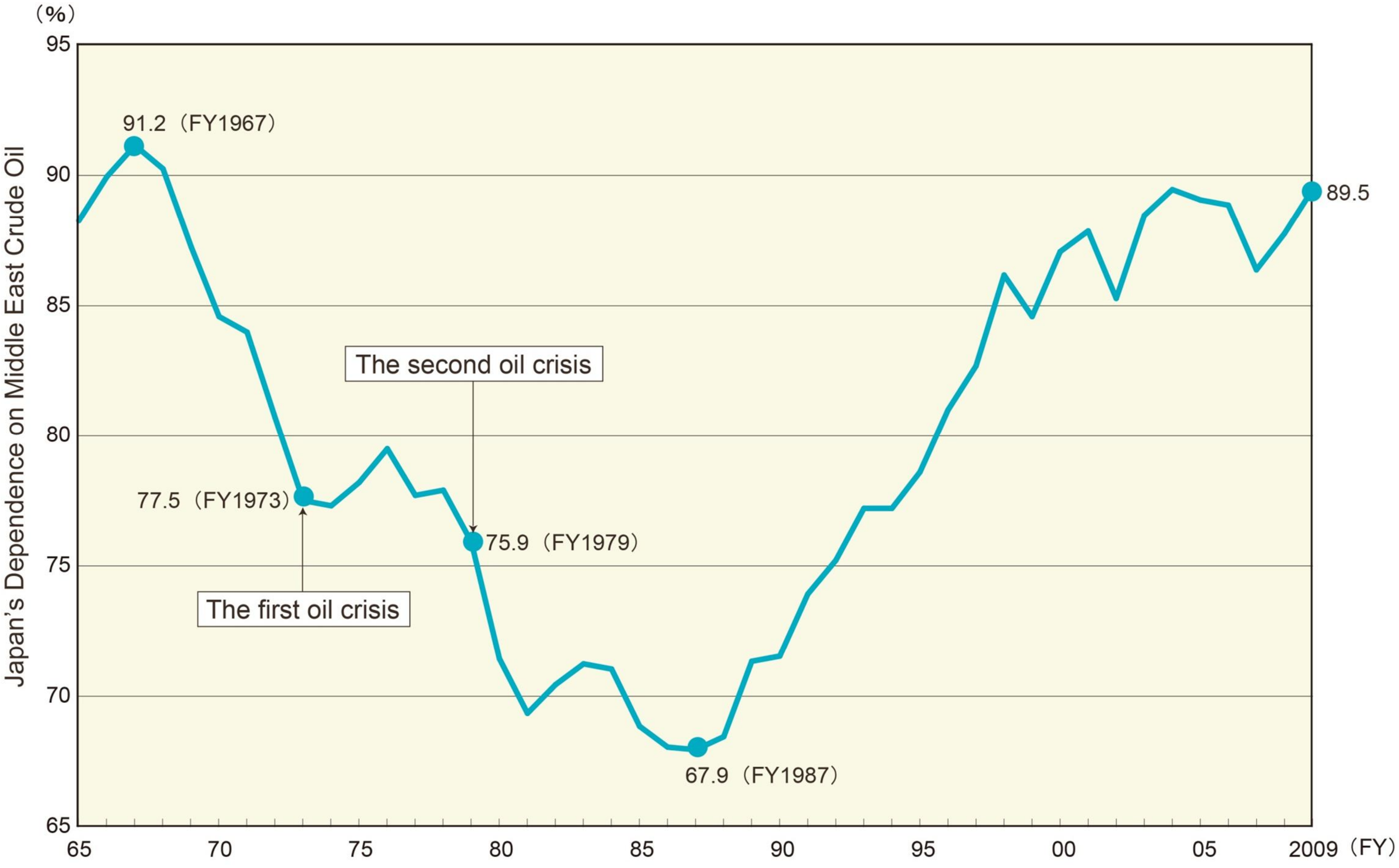




(Note) Figures may not add up to the totals due to rounding.

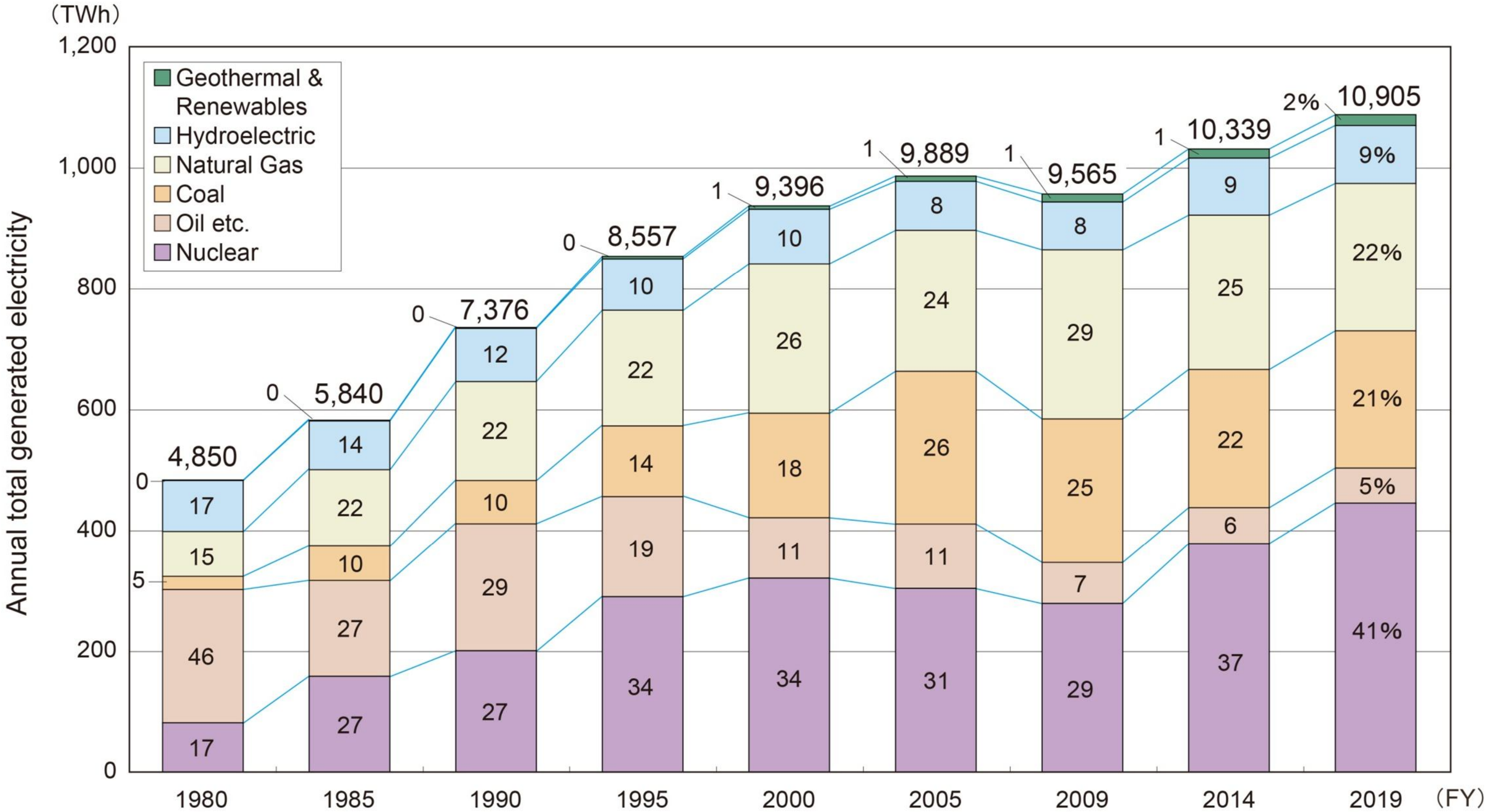
Source: ※1 Petroleum Association of Japan ※2 Trade Statistics of Japan

Japan’s Dependence on Middle East Crude Oil of Total Imports



Source: Petroleum Association of Japan

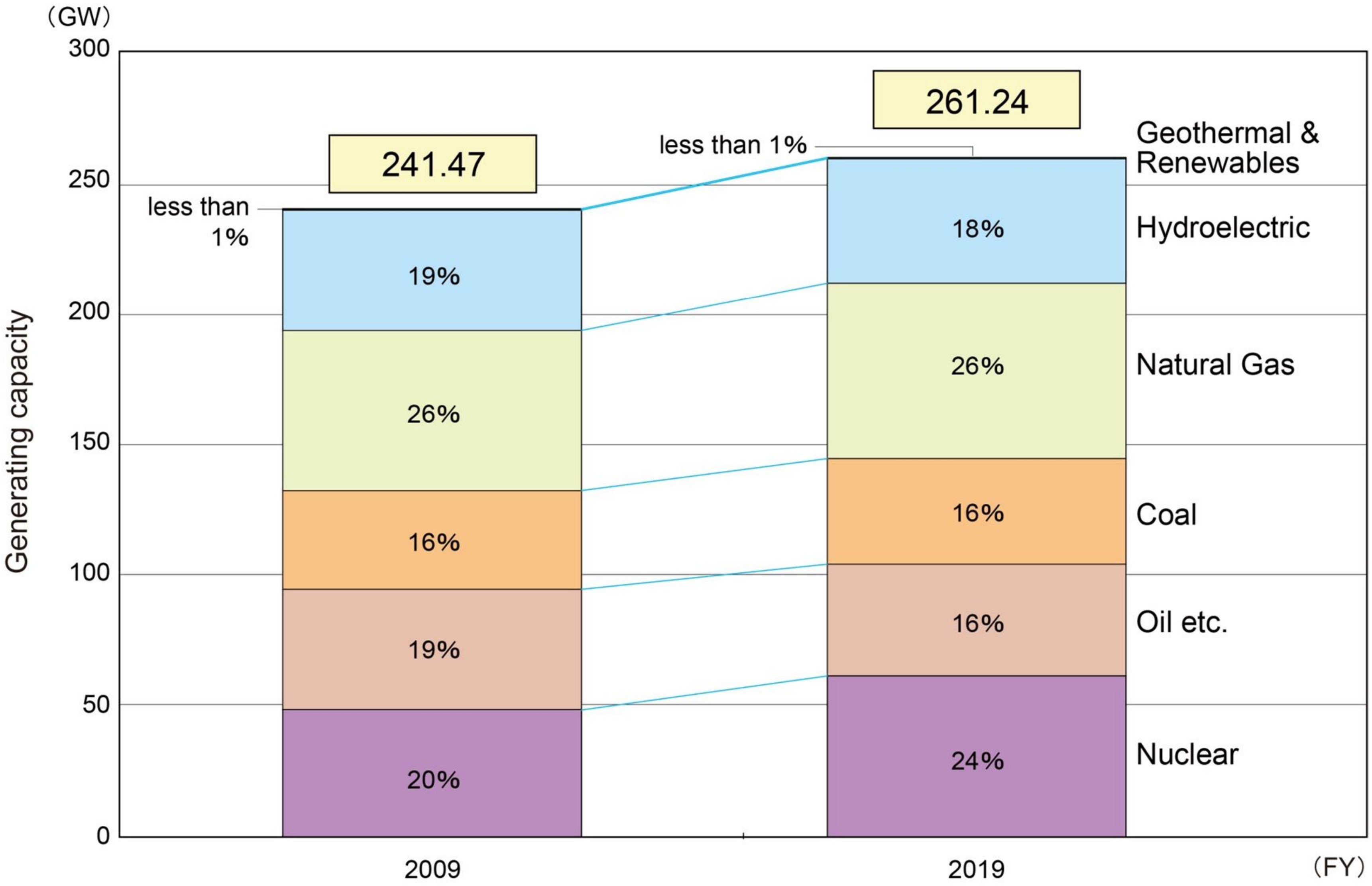
Japan’s Results and Prospects of Power Generation Volume by Source



(Note) Oil etc. includes LPG and other gases.
Figures may not add up to the totals due to rounding.
Total of 10 electric power companies and power purchased.
Figures within the graph represent the composition ratio.

Source: The Central Electric Power Council “Long Term Electric Power Facilities Development Plan, March 2010” etc.

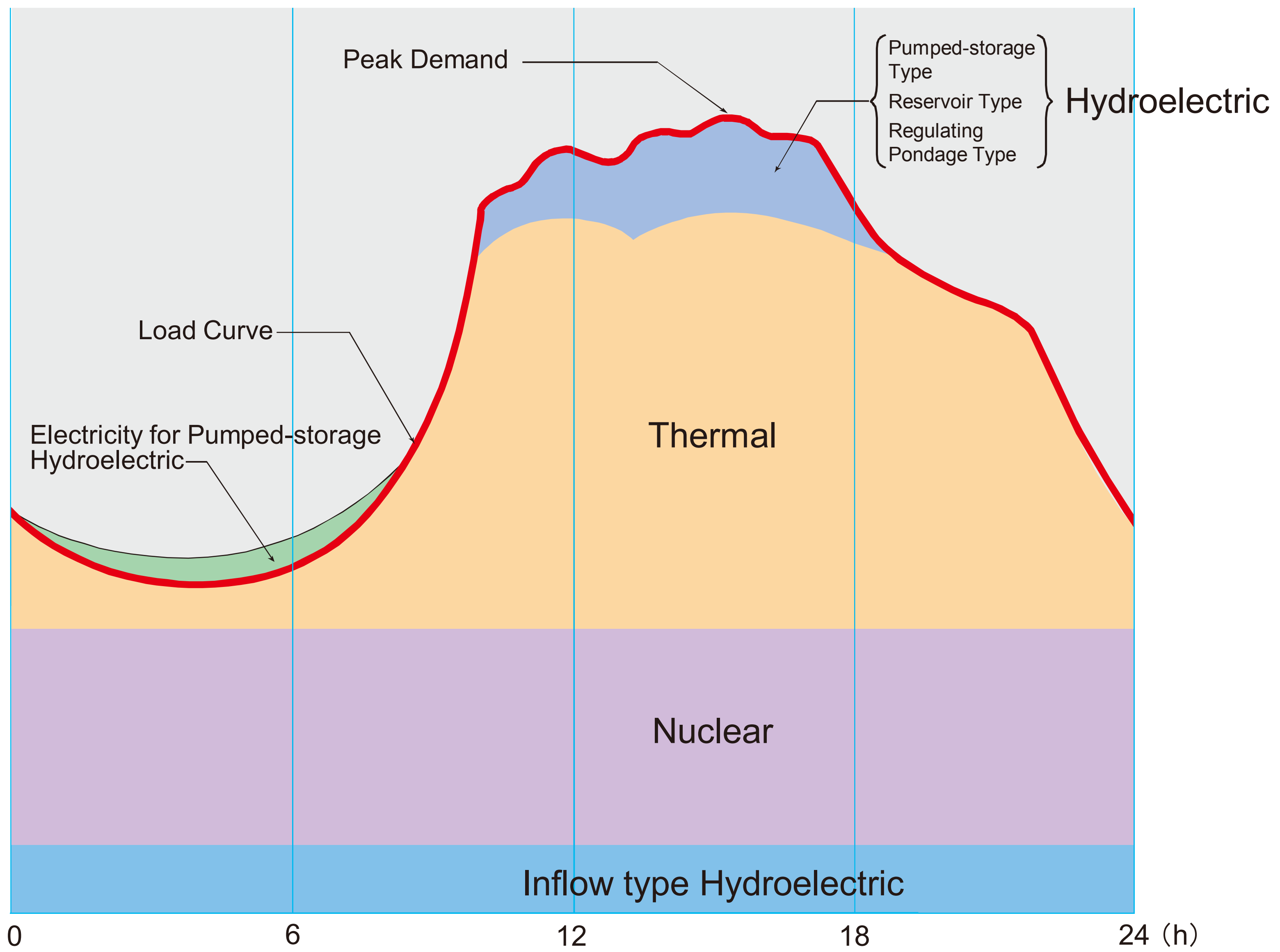
Power Facilities Development Plan



(Note) Figures may not add up to the totals due to rounding.

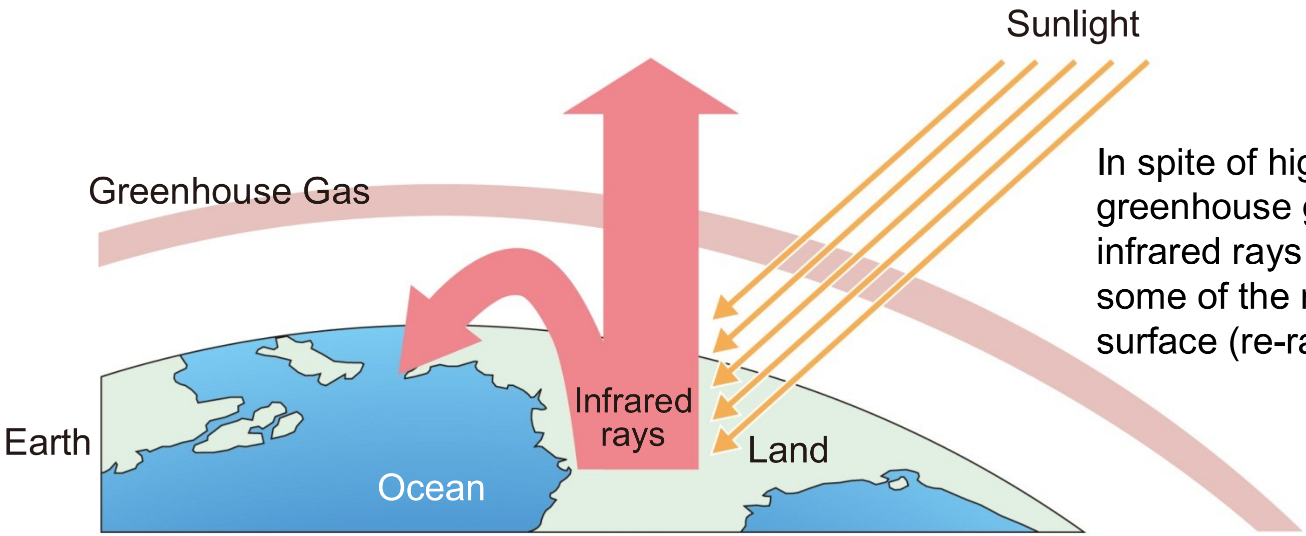
Source: The Central Electric Power Council "Long Term Electric Power Facilities Development Plan, March 2010", etc.

Optimal Combination of Power Sources



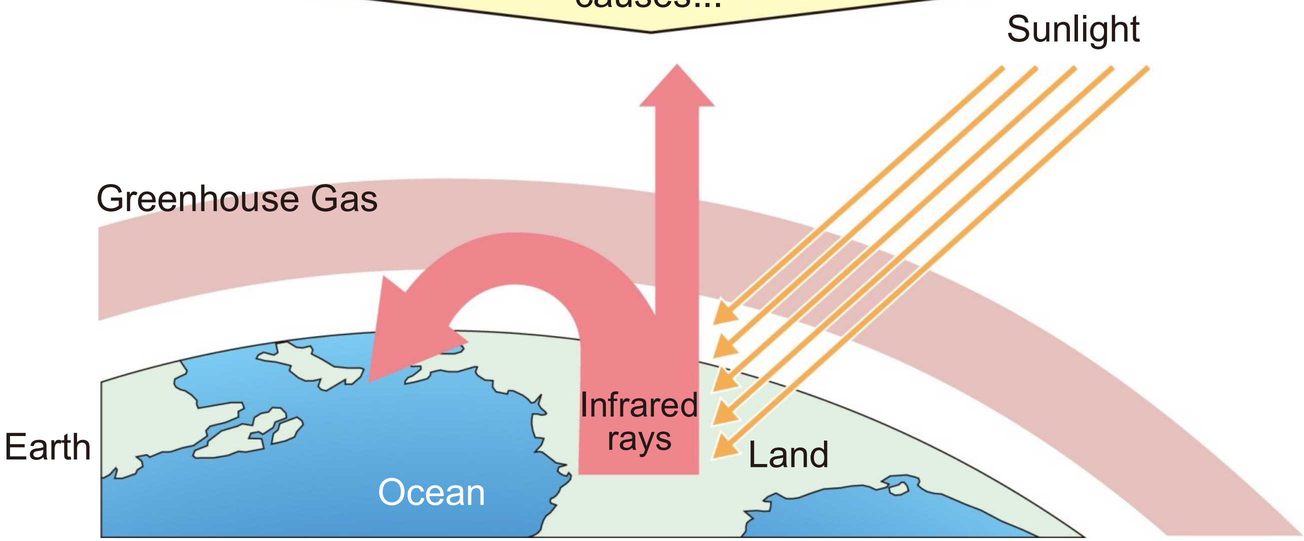
Source: Agency for Natural Resources and Energy “NUCLEAR ENERGY 2010”

Mechanism of Greenhouse Effect



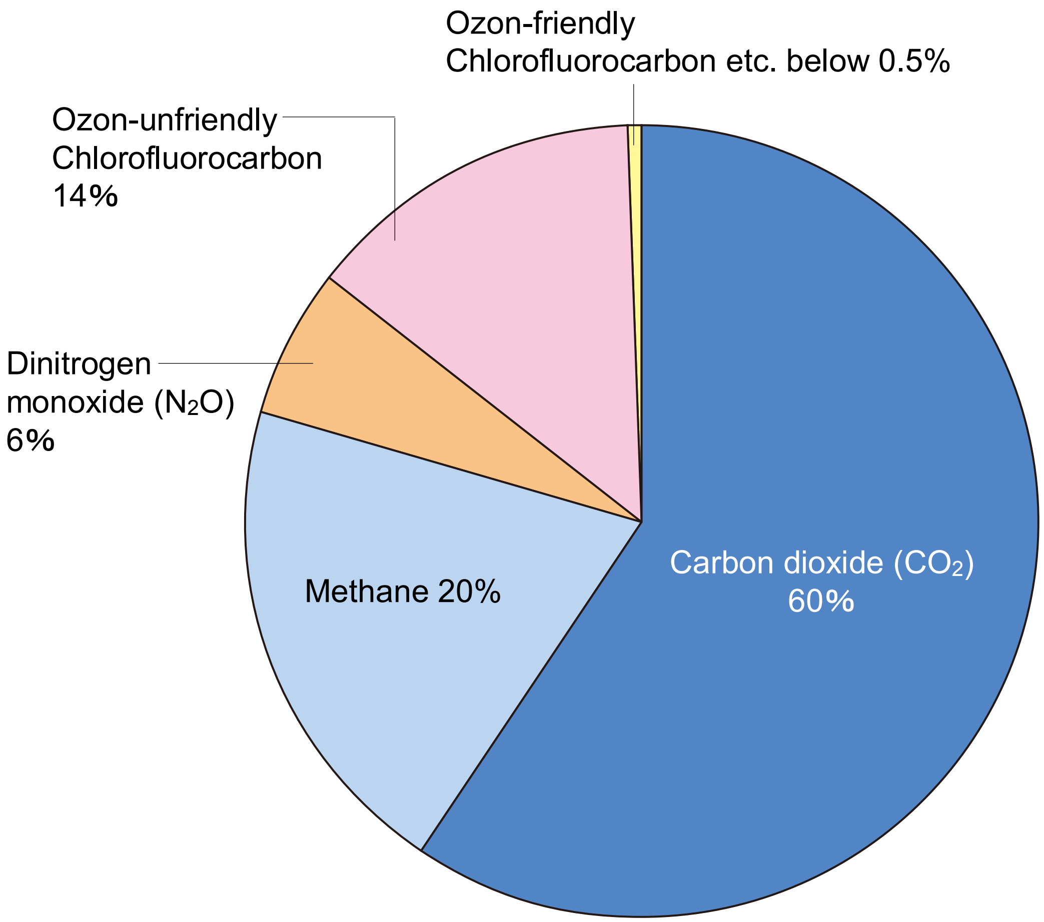
In spite of high light transmissivity, greenhouse gases such as CO_2 absorb infrared rays (heat) and then reflect some of the radiation to the earth's surface (re-radiation mechanism).

Further increase in greenhouse gas causes...

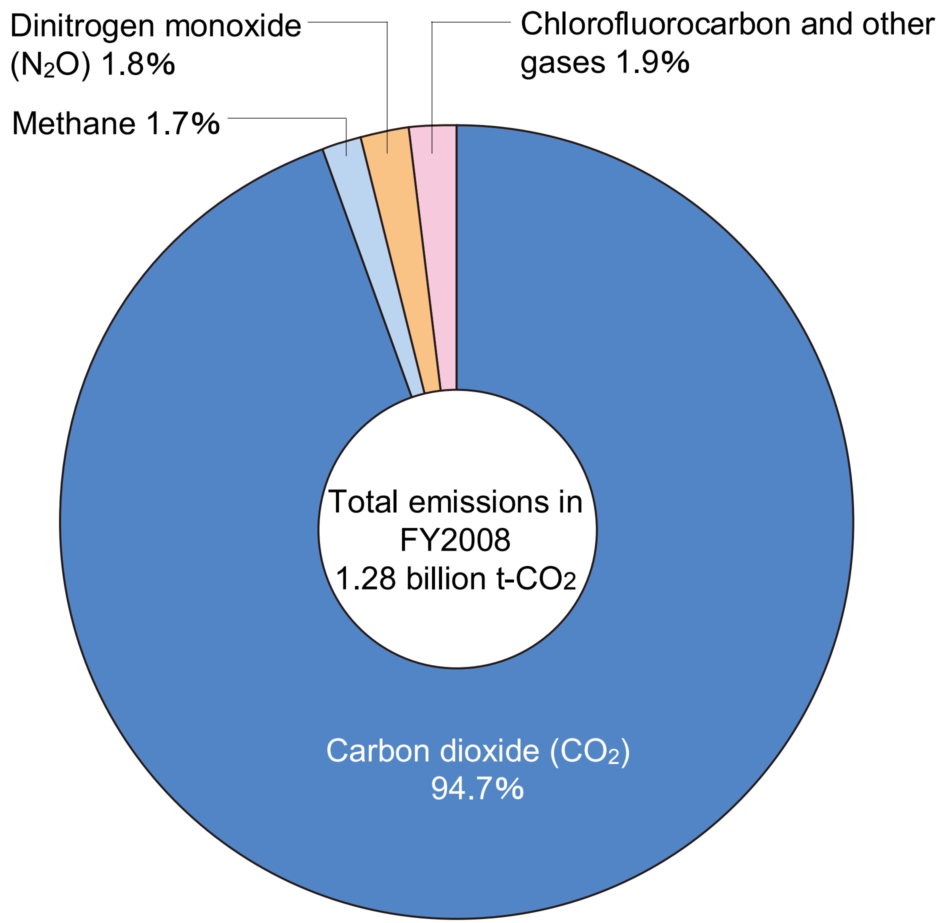


Contribution of Greenhouse Gases to Global Warming

Direct contribution to global warming of GHGs emitted by human activities after the Industrial Revolution



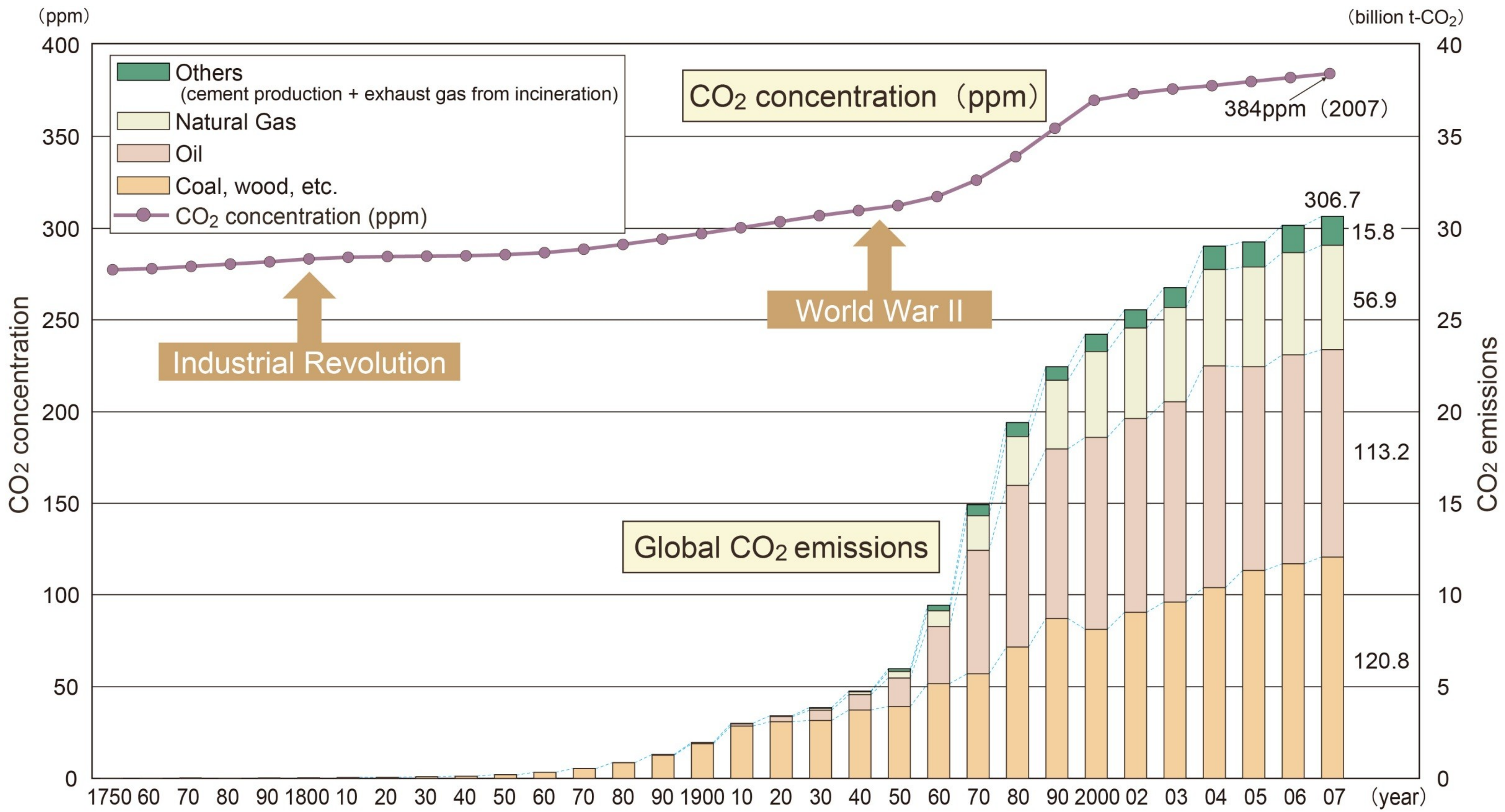
Direct contribution to global warming of GHGs emitted by Japan (for the single year of fiscal 2008)



(Note) Figures may not add up to the totals due to rounding.
GHGs: Greenhouse Gases

Source: "White Paper on the Environment, the Sound Material-Cycle Society and the Biodiversity 2010" etc.

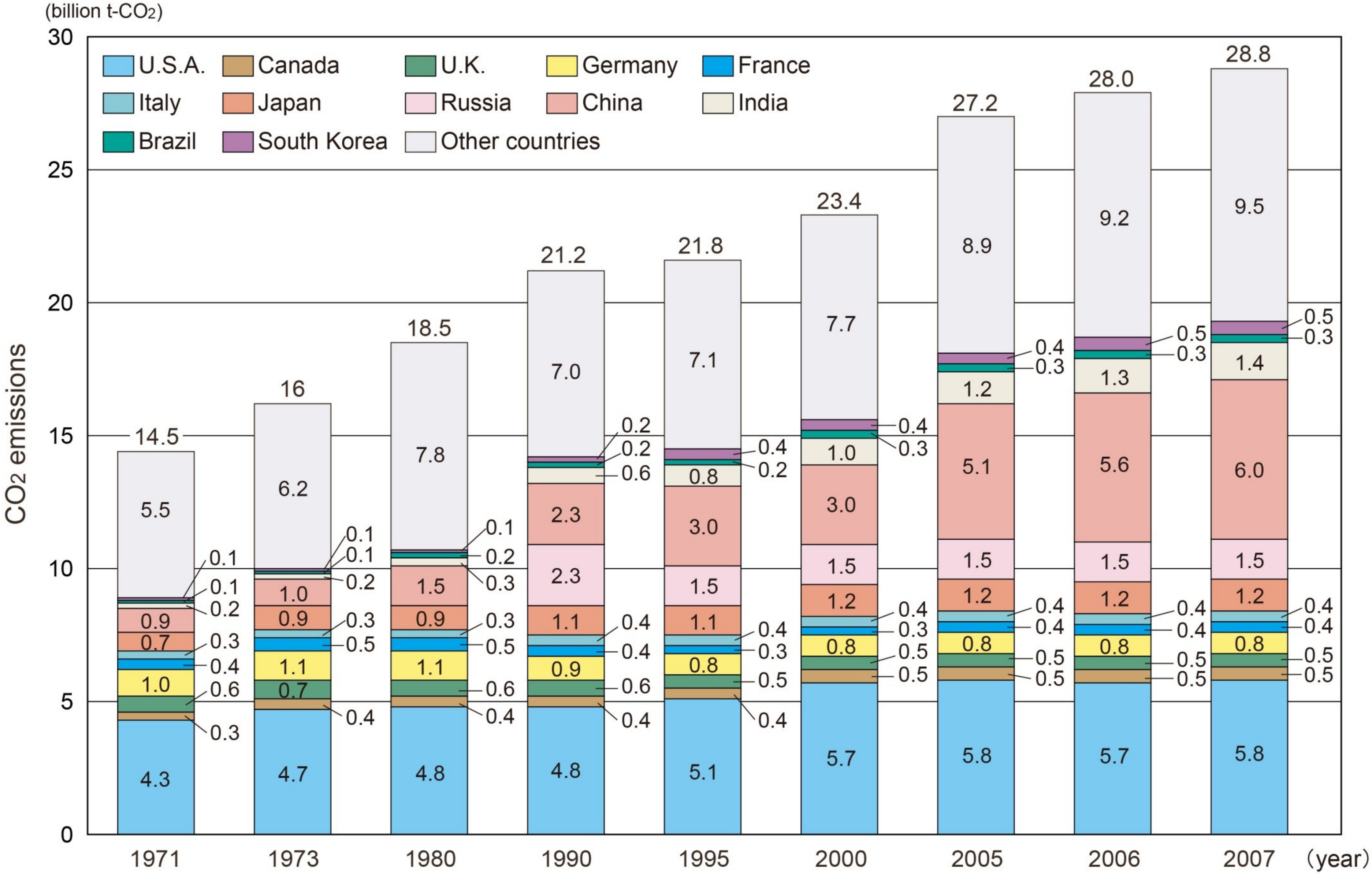
Changes in CO_2 Emissions from Fossil Fuels and Atmospheric CO_2 Concentration



(Note) Figures may not add up to the totals due to rounding.

Source: CDIAC "Global Fossil-Fuel Carbon Emissions"

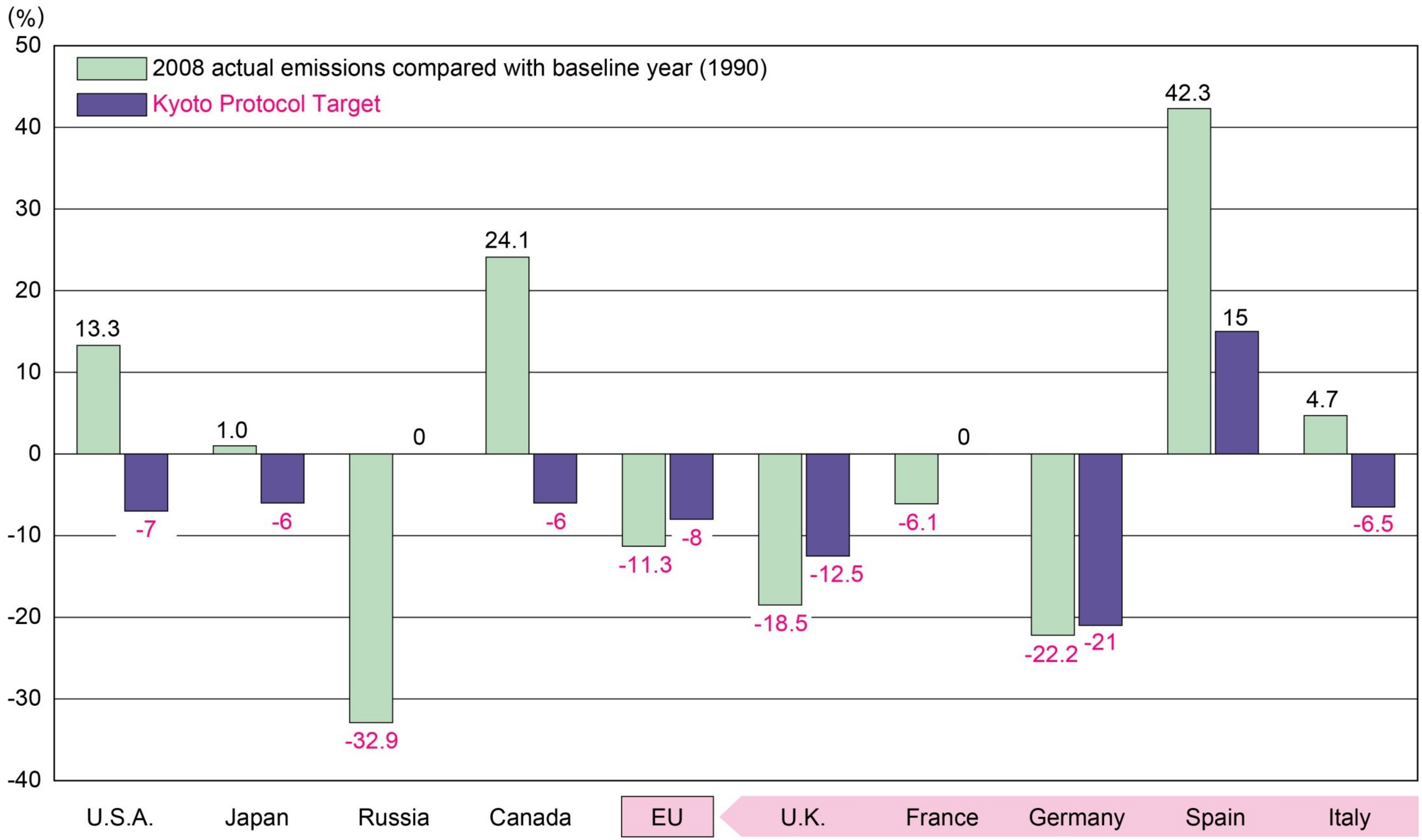
Historical Trends in World's CO_2 Emissions



(Note) Figures may not add up to the totals due to rounding.
Until 1990, Russia's CO_2 emissions are included in "Other countries".

Source: The Institute of Energy Economics, Japan "FY2010 Handbook of Energy & Economic Statistics in Japan"

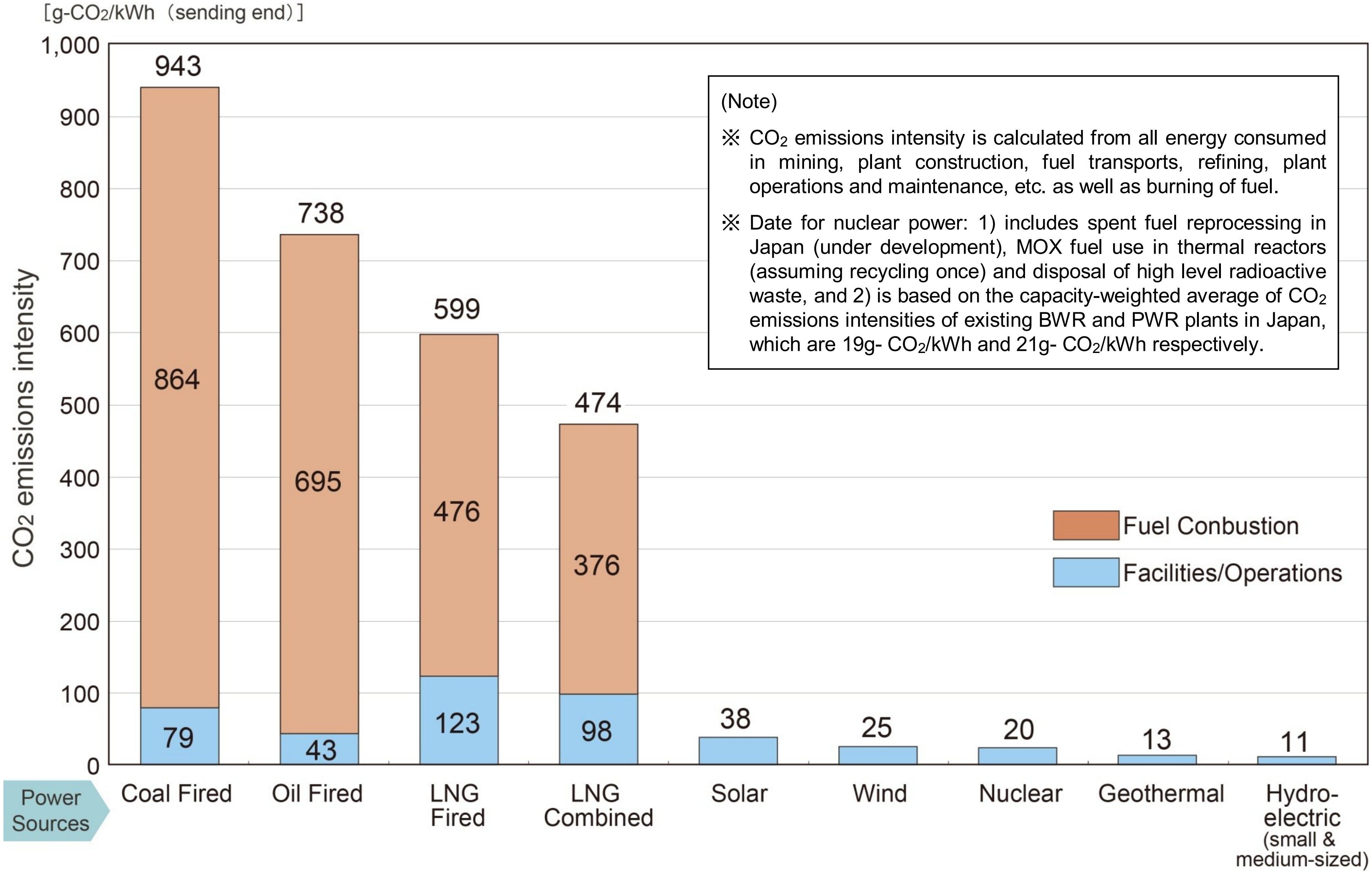
Kyoto Protocol Targets and Current Status of GHG Emissions



(Note) Numerical reduction target is not set for the developing countries such as China, India and Brazil

Source: Institute for Global Environmental Strategies “The GHGs Emissions Data”

Lifecycle Assessment CO_2 Emissions Intensity for Japan's Erergy Source



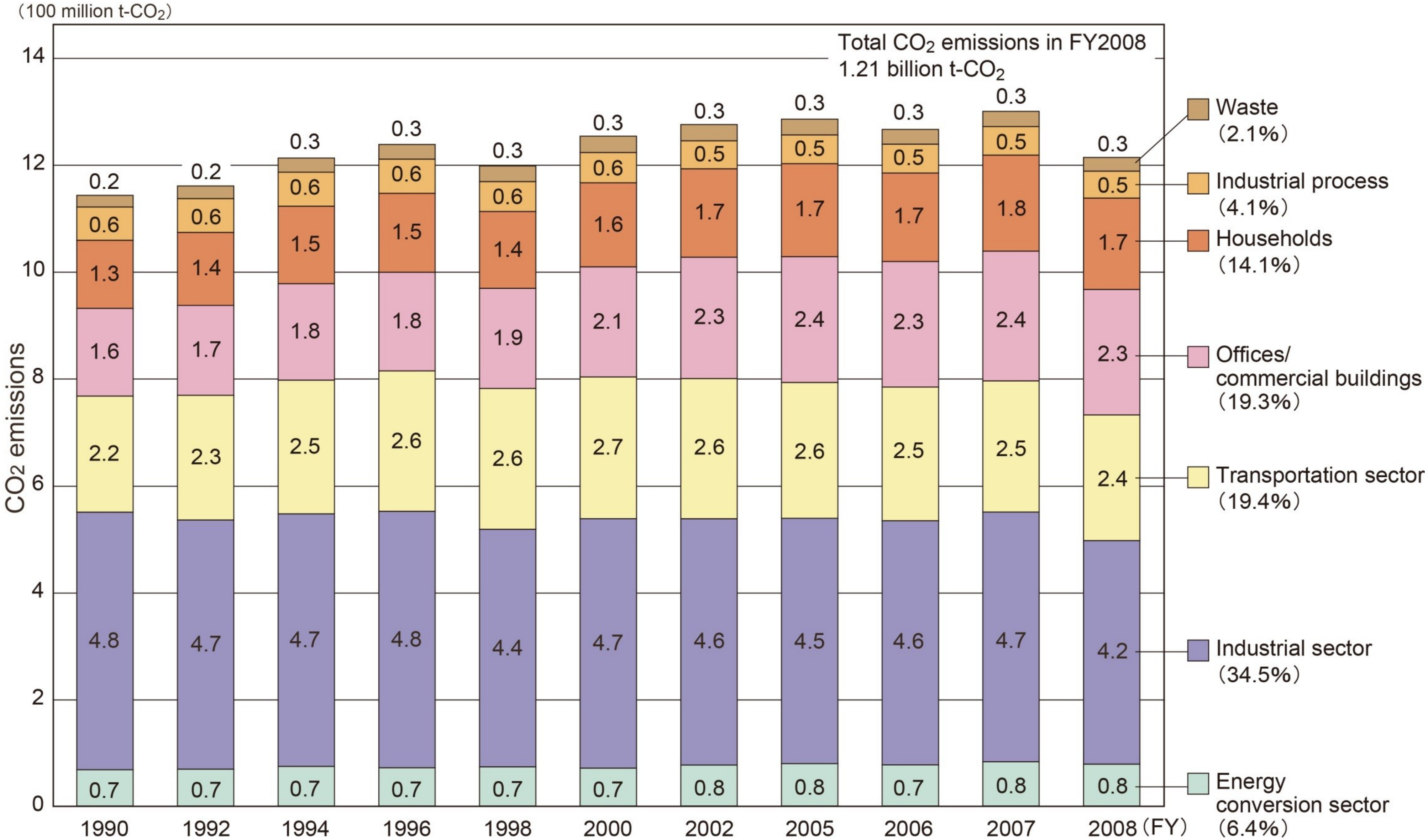
(Note)

※ CO_2 emissions intensity is calculated from all energy consumed in mining, plant construction, fuel transports, refining, plant operations and maintenance, etc. as well as burning of fuel.

※ Date for nuclear power: 1) includes spent fuel reprocessing in Japan (under development), MOX fuel use in thermal reactors (assuming recycling once) and disposal of high level radioactive waste, and 2) is based on the capacity-weighted average of CO_2 emissions intensities of existing BWR and PWR plants in Japan, which are 19g- CO_2/kWh and 21g- CO_2/kWh respectively.

Source: Central Research Institute of Electric Power Industry "Evaluation of Life Cycle CO_2 Emissiows of Power Genevations technologies (July 2010)"

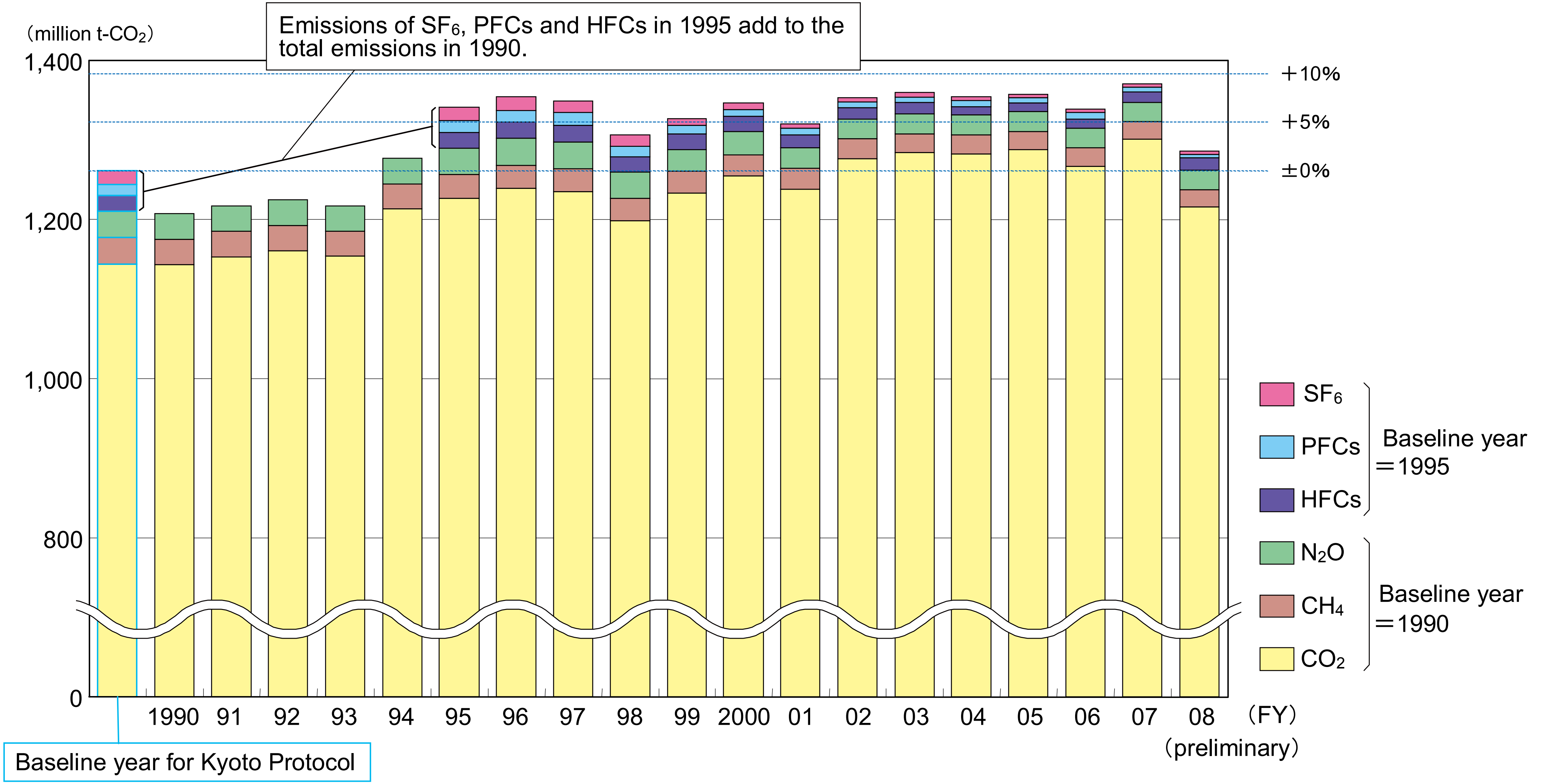
Japan's Changes in CO_2 Emissions by Sector



(Note) The numerical values show the indirect emissions (CO_2 emissions associated with power generation or heat generation are allocated to individual end demand sectors according to the electricity and heat consumption.)

Source: National Institute for Environmental Studies "Greenhouse gas emission (fixed annual) in FY2008"

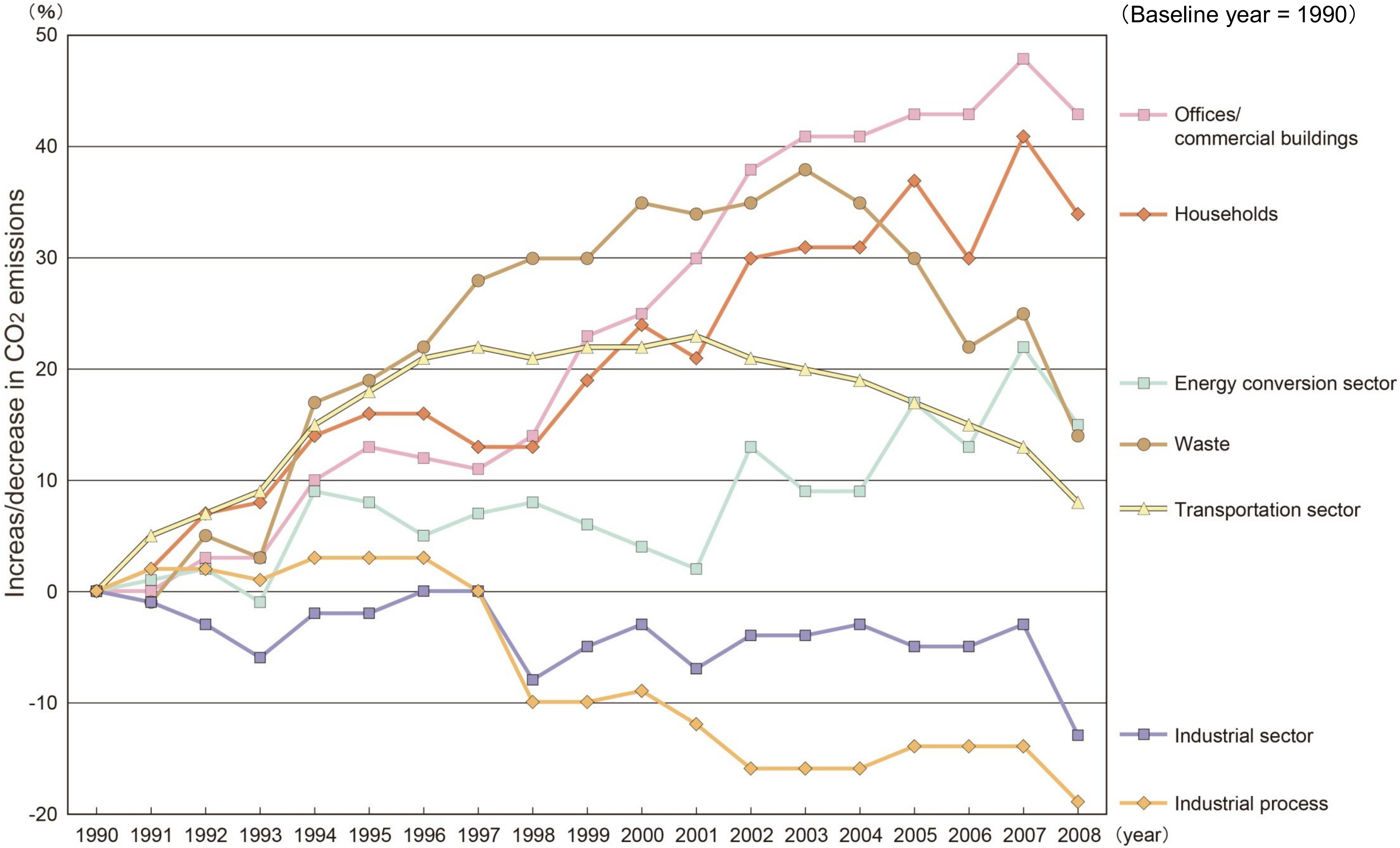
Changes in GHGs Emissions in Japan



(Note) Chlorofluorocarbon (HFCs、PFCs、SF_6)

Source: Greenhouse Gas Inventory Office of Japan

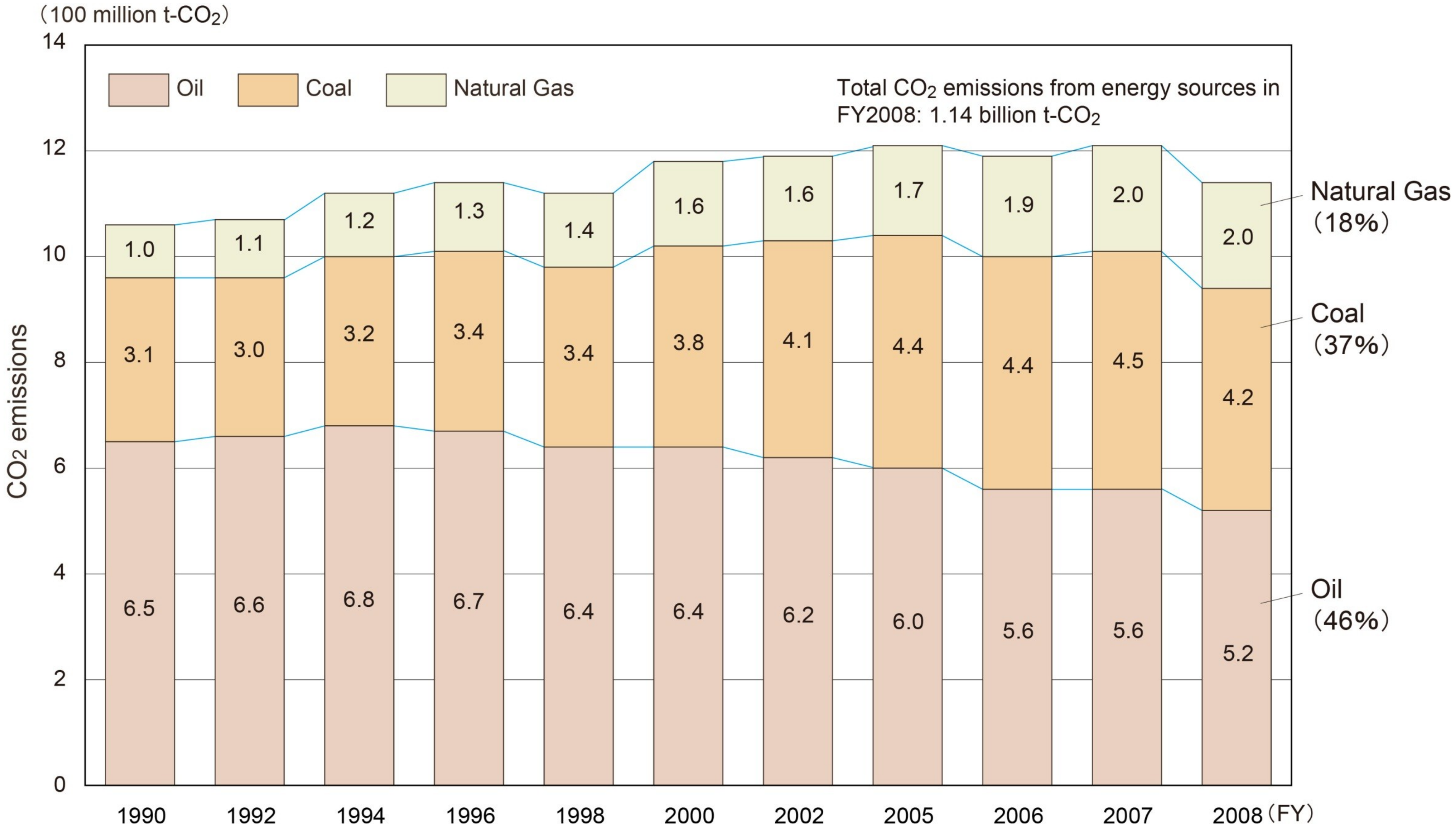
Increase/Decrease in CO_2 Emissions by Sector



(Note) The numerical values show the indirect emissions (CO_2 emissions associated with power generation or heat generation are allocated to individual end demand sectors according to the electricity and heat consumption.)

Source: National Institute for Environmental Studies "Greenhouse gas emission (fixed annual) in FY2008"

Changes in CO_2 Emissions by Energy Source



(Note) Figures may not add up to the totals due to rounding.

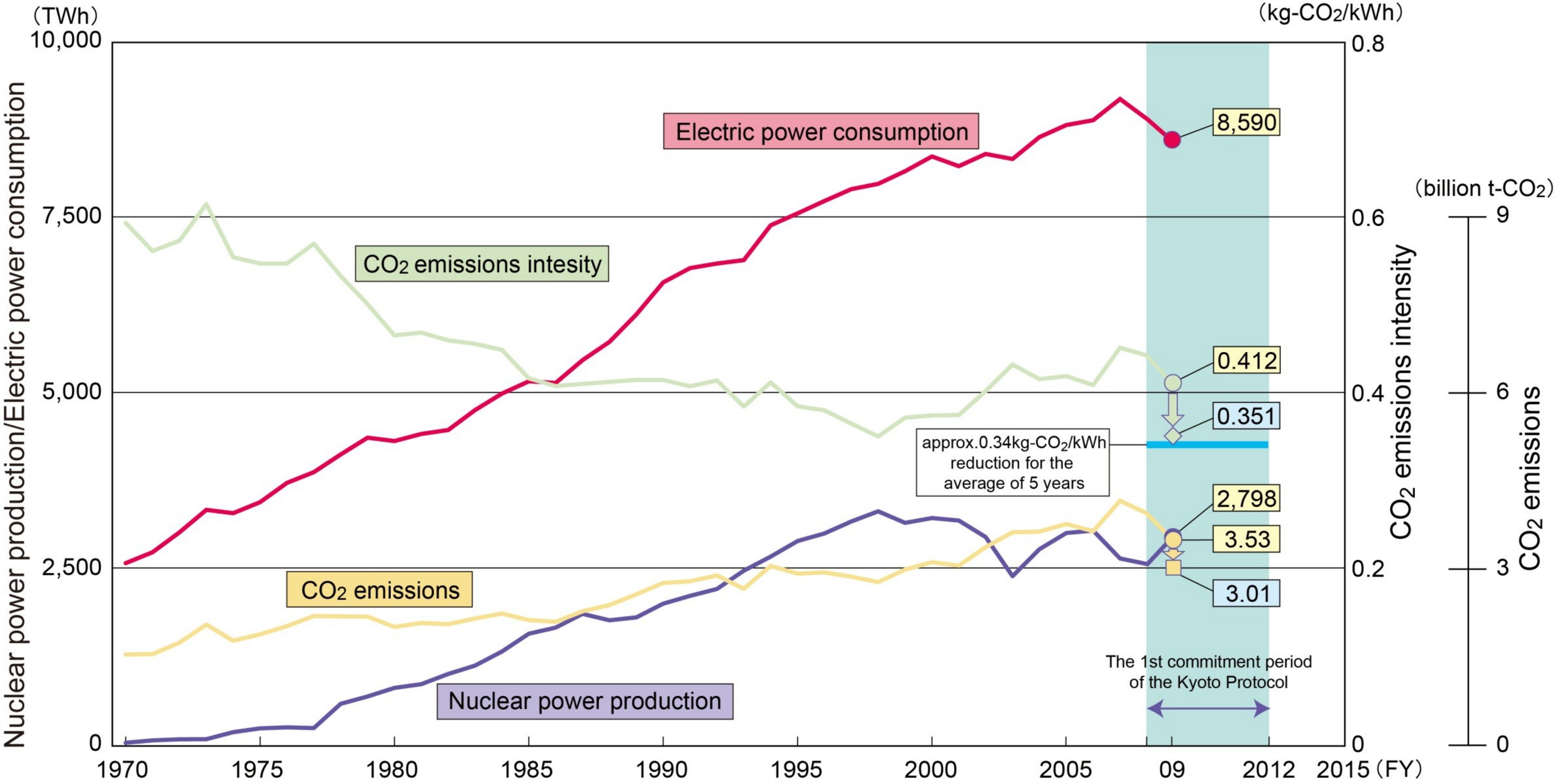
Source: Greenhouse Gas Inventory Office of Japan “National GHGs Inventory Report of JAPAN”

Measures by Japan's Electric Power Industry to Reduce CO_2 Emissions

- **Supply-side**
  - **Expanding use of non-fossil energy sources**
    - Promotion of nuclear power generation based on the premise safety assurance
    - Development and expansion of use of renewable energy sources
      Hydroelectric, geothermal, solar, wind, and biomass power generation
  - **Improving efficiency of electric power equipment**
    - Further improvement of thermal efficiency of thermal power plants
      Introduction of LNG combined-cycle power plant /Improvement of thermal efficiency of coal thermal power plants
    - Reduction of transmission and distribution loss
      High-voltage transmission, low-loss transformers
  - **International efforts**
    - Active utilization of the Kyoto Mechanisms
      Active utilization of the Clean Development Mechanisms & investment in Carbon Funds
    - Sectral approaches
      Participation in the Asia-Pacific Partnership [APP] (Peer Review Activities, etc.)
- **Demand-side**
  - **Energy conservation**
    - Electrification promotion, energy conservation and expansion of high efficiency electric equipment
      Heat pumps, heat storage air conditioning, electric vehicles, and others
      Participation in energy saving and CO_2 reduction activities by utilizing the domestic credit system
    - Utilization of untapped energy sources
      Heat recovery from river water, waste incineration facilities and substations
    - PR-activities and provision of information aimed at energy conservation and CO_2 reduction
      Household eco-account book, exhibitions on energy-saving appliances and seminars on energy-saving
    - Load leveling promotion such as heat pump & thermal storage systems
      Heat pumps & thermal storage type air conditioning / hot-water supply
  - **Efforts by electric utility industry as users**
    - Efforts in office-use energy conservation and the use of company-owned vehicles
      Reduction of amount of power
      Introduction of electric vehicles and fuel-efficient vehicles
- **Research and Development**
  - Supply-side: Clean Coal Technology, Next-generation electric power transmission and distribution technology (Smart Grid in Japan), CO_2 capture and storage technologies (CCS), and so on.
  - Demand-side: CO_2 refrigerant heat pump hot water heater, electric vehicles, and others

Source: The Federation of Electric Power Companies "Environmental Action Plan by the Japanese Electric Utility Industry"

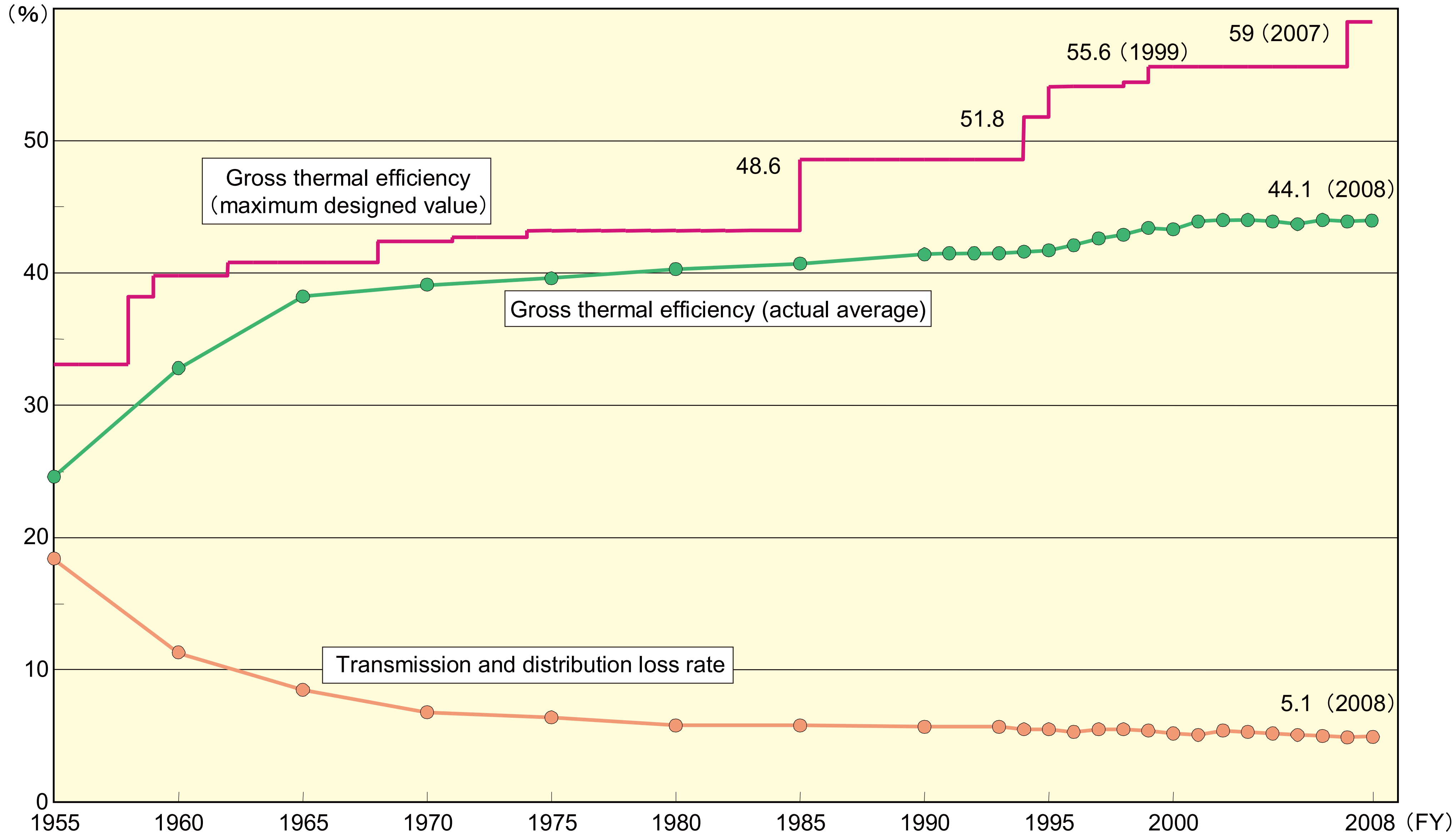
Historical Trends in CO_2 Emissions from Electricity Production in Japan



※ The marker (◇, □) indicates user-end CO_2 emissions intensity after the Kyoto Mechanism credit was reflected and CO_2 emissions after adjustment. The electric utility industry targets approximately 20% reduction (approx. 0.34kg-CO_2/kWh reduction) for the average of 5 years between fiscal 2008 and fiscal 2012, compared to 1990.

Source: The Federation of Electric Power Companies "Environmental Action Plan by the Japanese Electric Utility Industry"

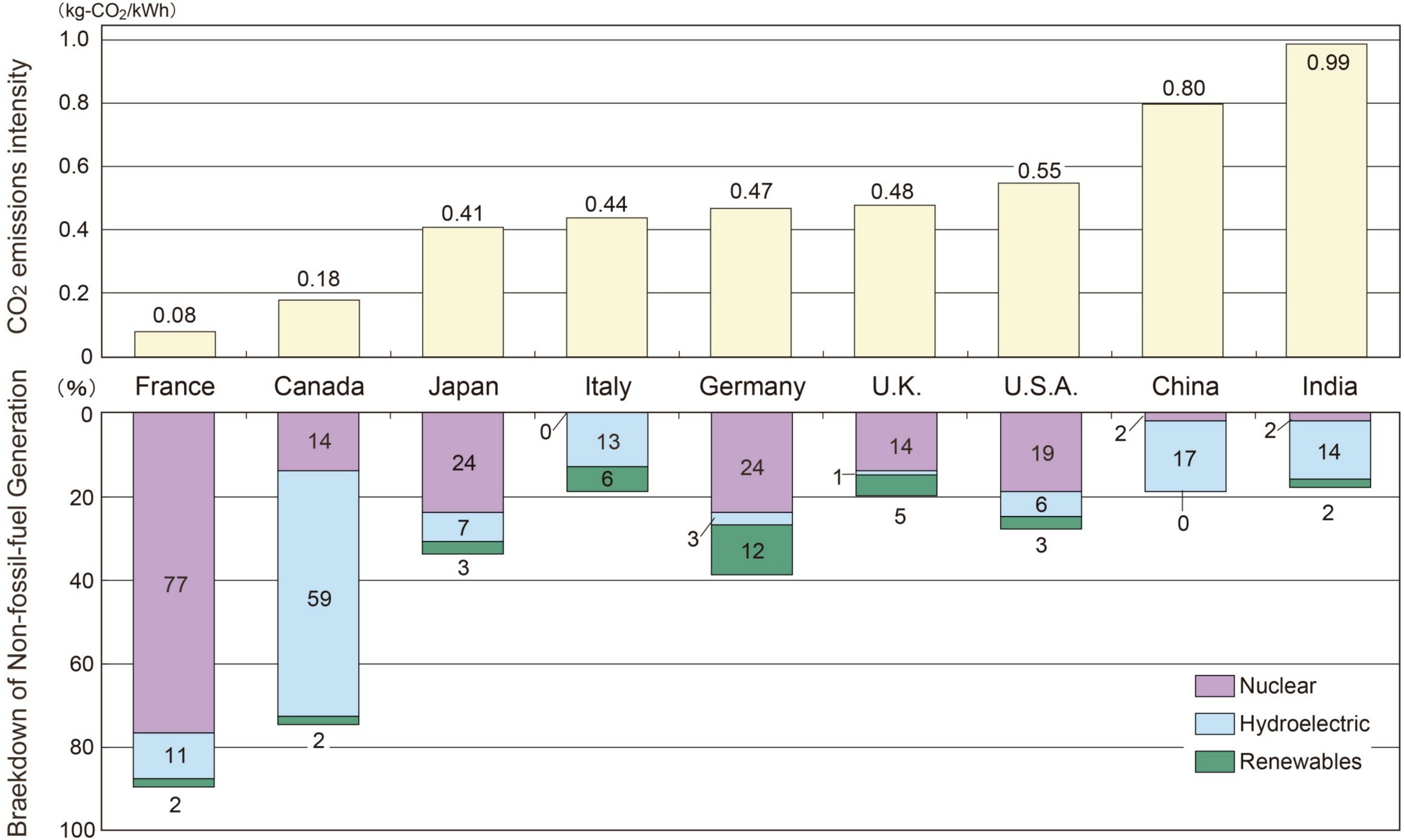
Thermal Efficiency and T&D Loss Factor in Japan



(Note) Lower Heating Value : Estimated from higher heating value standard based on the conversion factor of the comprehensive energy statistics (FY2007).

Source: Agency for Natural Resources and Energy “Japan Electric Utilities Handbook” etc.

Comparison of CO_2 Emissions Intensity by Country

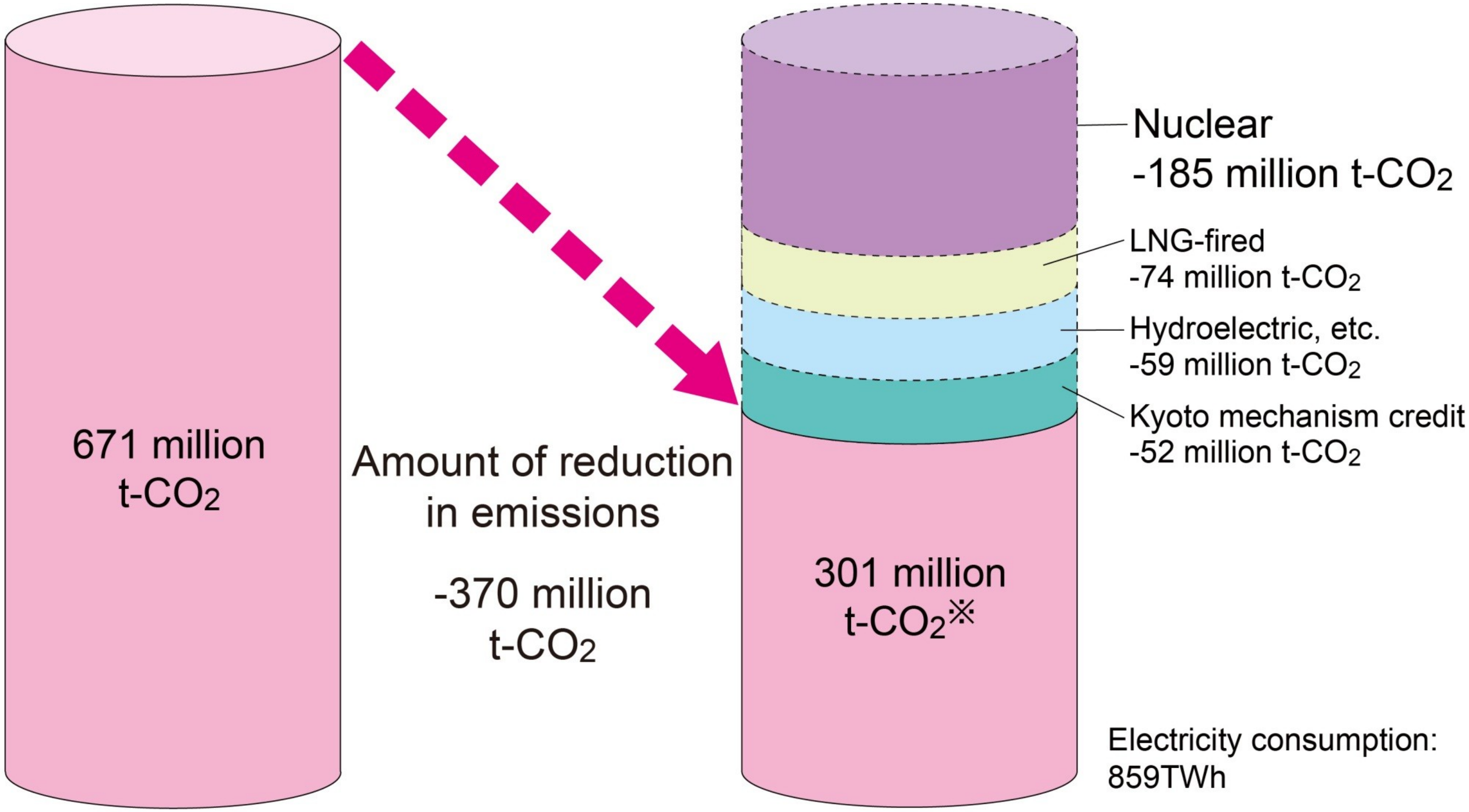


(Note) Fiscal 2008 figures. The figures contains Combined Heat and Power (CHP) plants. The figures of Japan contains non-utility generation facilities.

Source: IEA "ENERGY BALANCES OF OECD COUNTRIES (2010 Edition)" / "ENERGY BALANCES OF NON-OECD COUNTRIES (2010 Edition)"

Suppression Effect of CO_2 Emissions

(FY2009)



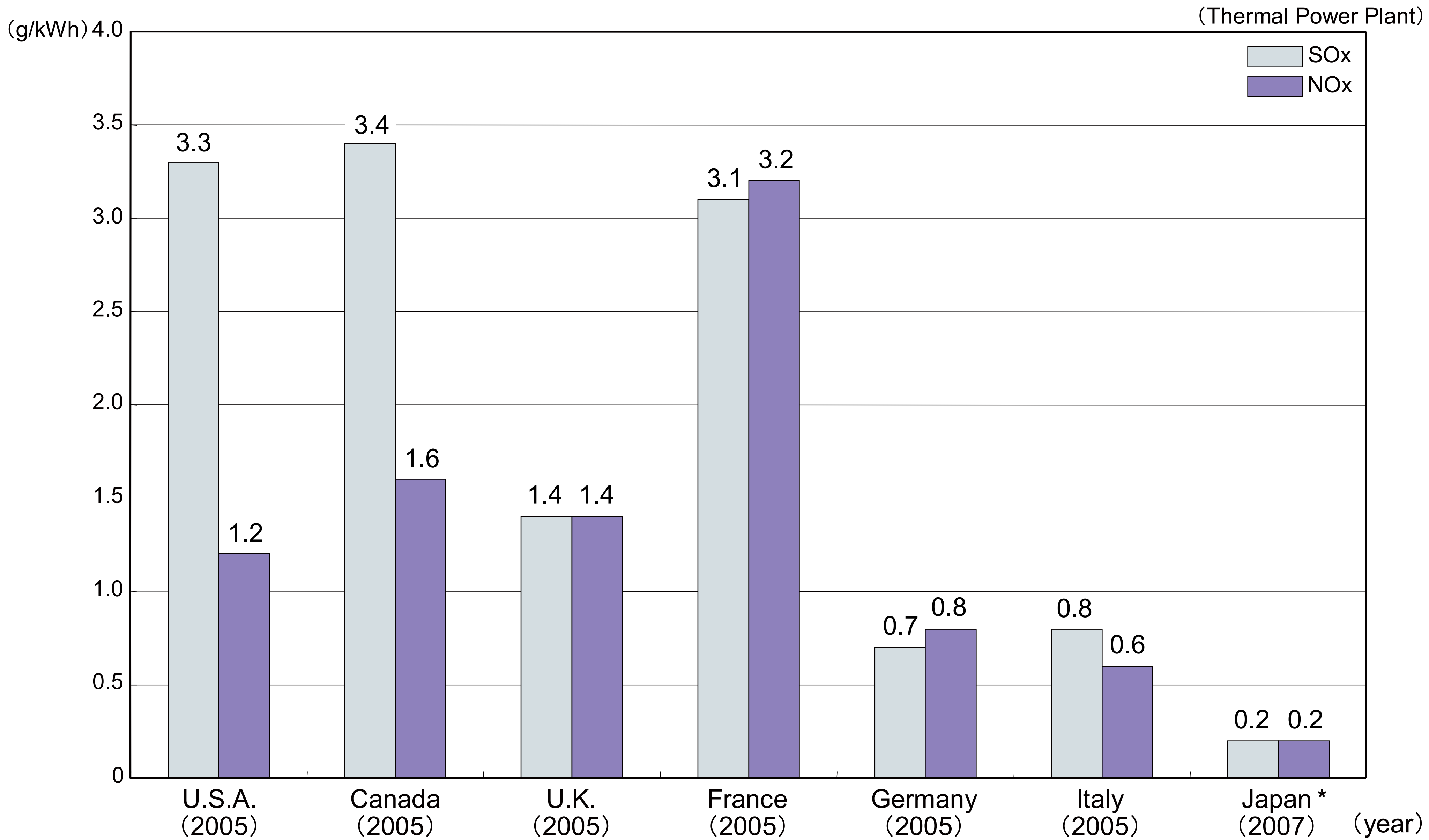
Total CO_2 emissions when it is assumed that all electricity is generated by oil-fired plant

Actual figures for CO_2 emissions

※total CO_2 emissions after offsetting Kyoto mechanism credit

Source: The Federation of Electric Power Companies "Environmental Action Plan by the Japanese Electric Utility Industry"

SOx and NOx Emissions per Unit of Electricity Generated in Major Countries



(Note) SOx: sulfur oxides NOx: nitrogen oxides

(*) 10 electric power companies and Electric Power Development Co. Ltd.

Source: Estimate based on IEA's "OECD Environmental Data compendium 2006/7" and "ENERGY BALANCES OF OECD COUNTRIES 2005-2006"

What is New Energy?

"New Energy" is one of the types of "renewable energies" generated from sun, wind, biomass, geothermal heat, hydroelectric power, etc., that is constantly replenished by processes derived from nature, and still needs assistance for dissemination of technologies to utilize them because of their high costs, nevertheless they are already well established technologies.

Renewable Energy

Large-scale hydroelectric

Geothermal
(excpt. Binary Power Generation)

New Energy

- Small & medium-scale hydroelectric Power Generation (1,000kW or less)
- Photovoltaic power generation
- Wind power generation
- Biomass Power Generation
- Biomass Fuel Fabrication (incl. Biomass-derived Waste)
- Geothermal heat (Binary Power Generation only)
- Utilization of solar thermal
- Use of Snow and Ice
- Biomass heat use
- Use of the heat from temperature differentials

（Wave Power Generation）

（Ocean Thermal Power Generation）

Source: Agency for Natural Resources and Energy "Energy in Japan"

Evaluation & Problems of New Energy

	Photovoltaic Power	Wind Power	Waste Power (Biomass Power)
Merits	○ No fear of exhaustion ○ Emit no CO_2 or other gases in the process of power generation ○ Due to neighboring the demand area, there is no transmission loss ○ Generate at daytime when the demand rises	○ No fear of exhaustion ○ Emit no CO_2 or other gases in the process of power generation	○ No additional CO_2 emission by power generation ○ Continuously supplied stable power source among new energies
Demerits	○ Due to low energy density, it needs much larger area than thermal and nuclear power generation for the same amount of power generation ○ Unstable due to no generation at night and low power output in rainy or cloudy days ○ High costs on facilities	○ Due to low energy density, it needs much larger area than thermal and nuclear power generation for the same amount of power generation ○ Unstable due to occasional and seasonal volatility in wind directions and speed ○ Makes noises when windmills rotate ○ Locations where the wind situation is good are unevenly distributed ○ High costs on facilities	○ Low generation efficiency ○ Needs further environmental loads reduction measures such as dioxin emission control measures and ash reduction
eneration cost	PY49/kWh	PY9-14/kWh	large-scale］JPY9-11/kWh

（Note） Generation costs are based on the calculation from the actual results (FY1999).
Energy density is the figure which shows the amount of generation in area.

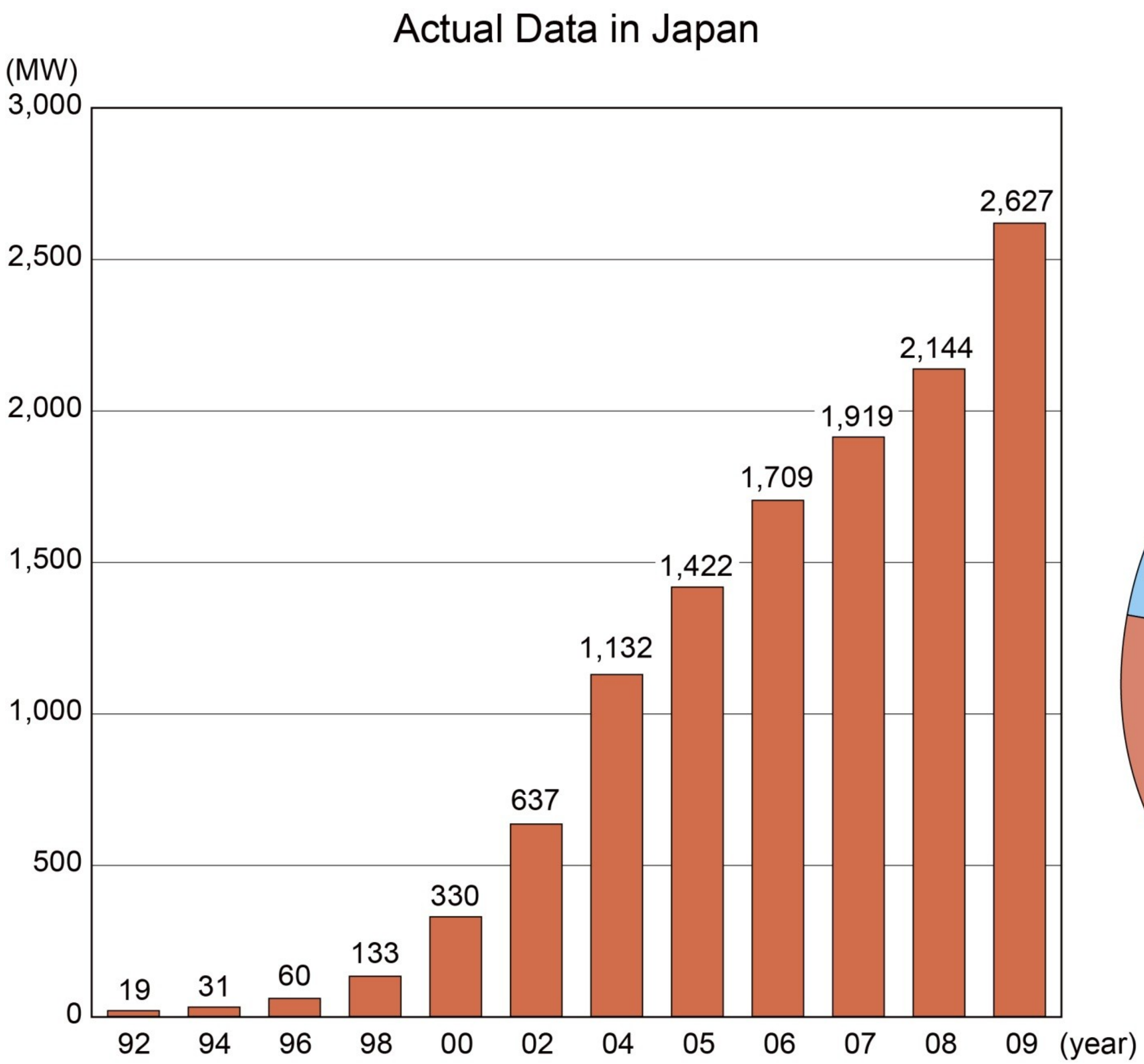
Source: Report of New and Renewable Energy Subcommittee, Advisory Agency for Natural Resources and Energy (August 2009)", etc.

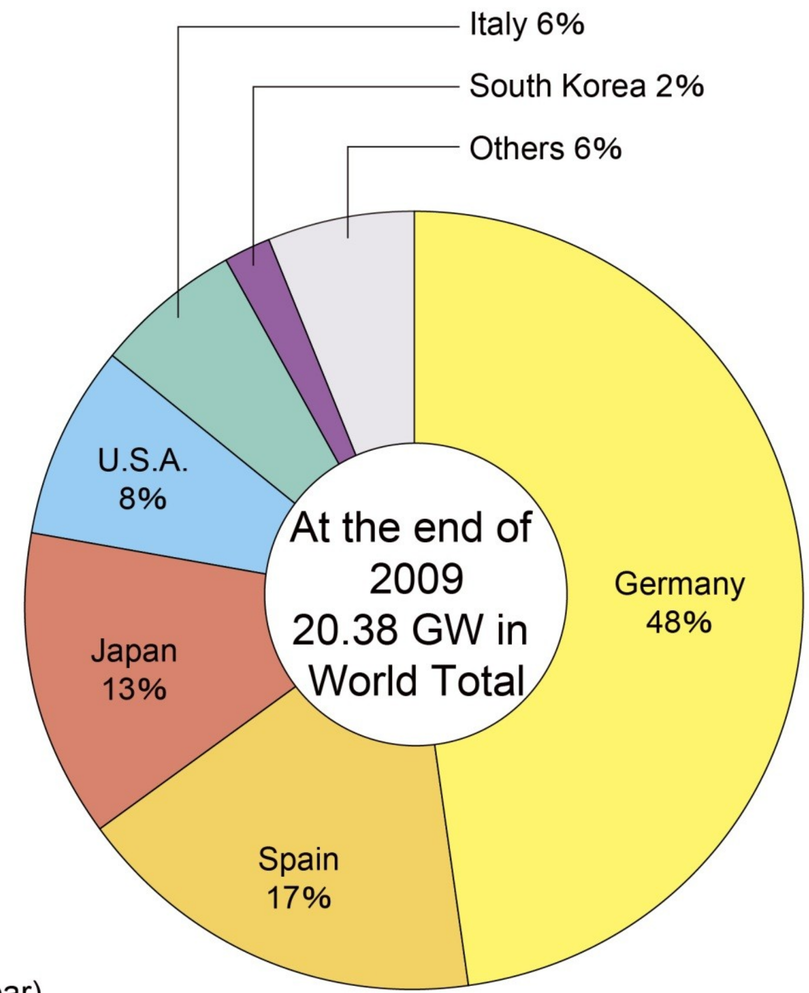
Current Status of Photovoltaic and Wind Power

	Photovoltaic Power	Wind Power
Power Generation Cost ※1	JPY 49/kWh	JPY 9 - 14/kWh
Necessary Site Area ※2	To substitute for a 1 GW class nuclear power plant	
	Approx. 58km^2	Approx. 214km^2
Operation Rate ※1 (Load Factor)	12%	20%

Source: ※1 Agency for Natural Resources and Energy "Energy in Japan" ※2 Study Group on Low Carbon Power Supply System (July 2008)

Photovoltaic Power Generation Capacity in Japan and the World

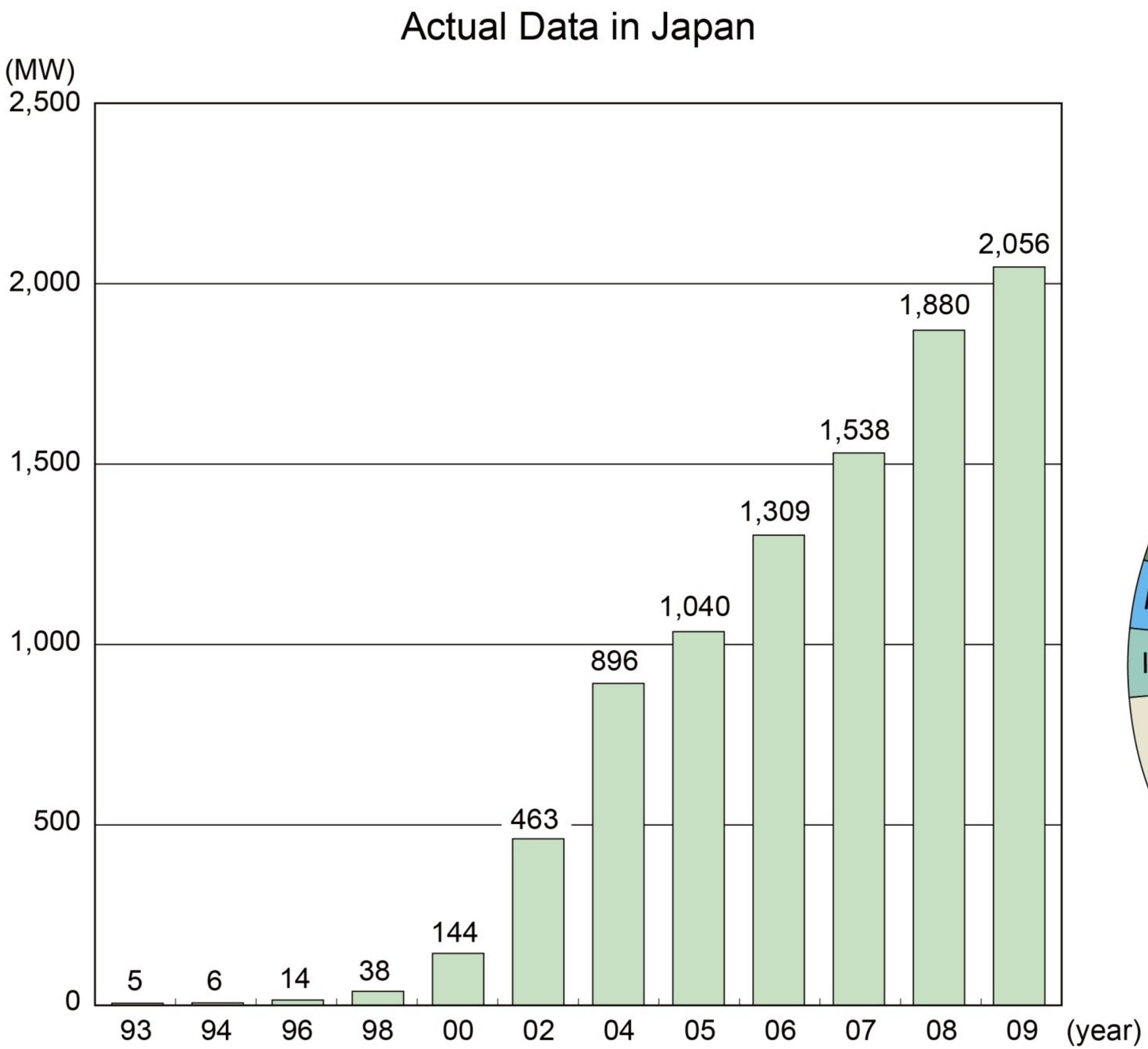


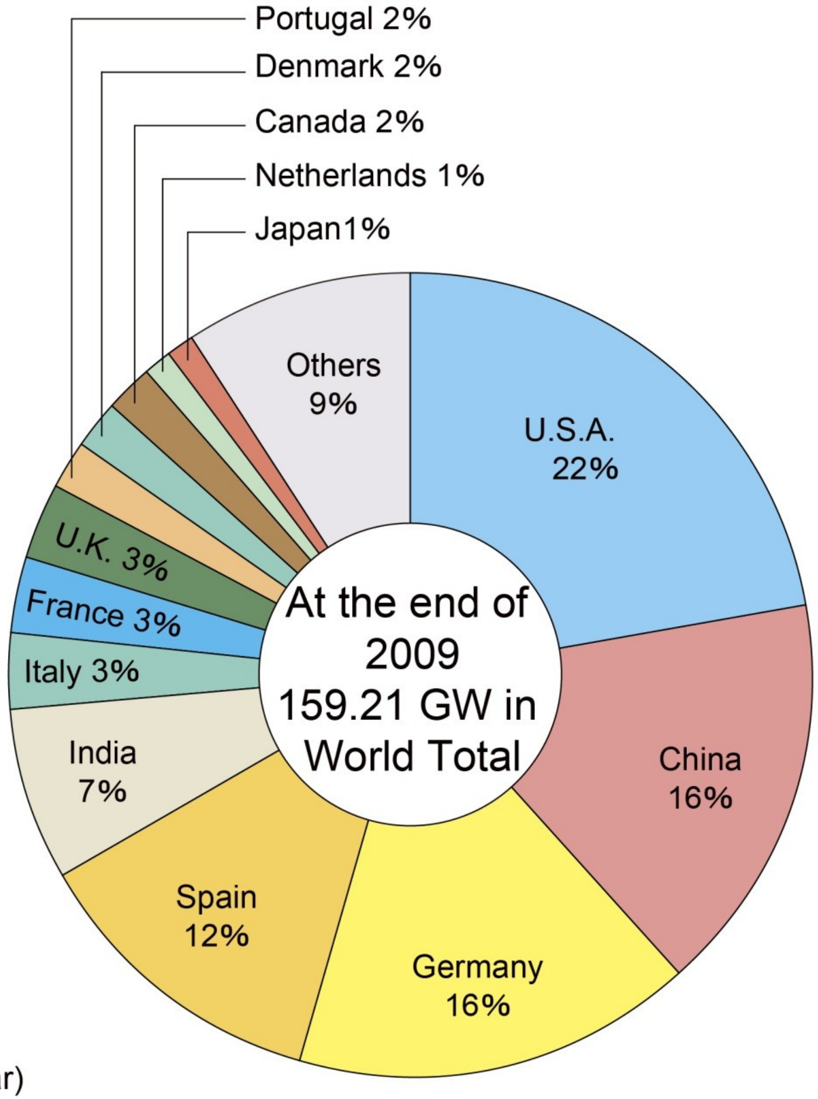


(Note) Figures may not add up to the totals due to rounding.

Source: International Energy Agency (IEA)

Wind Power Generation Capacity in Japan and the World



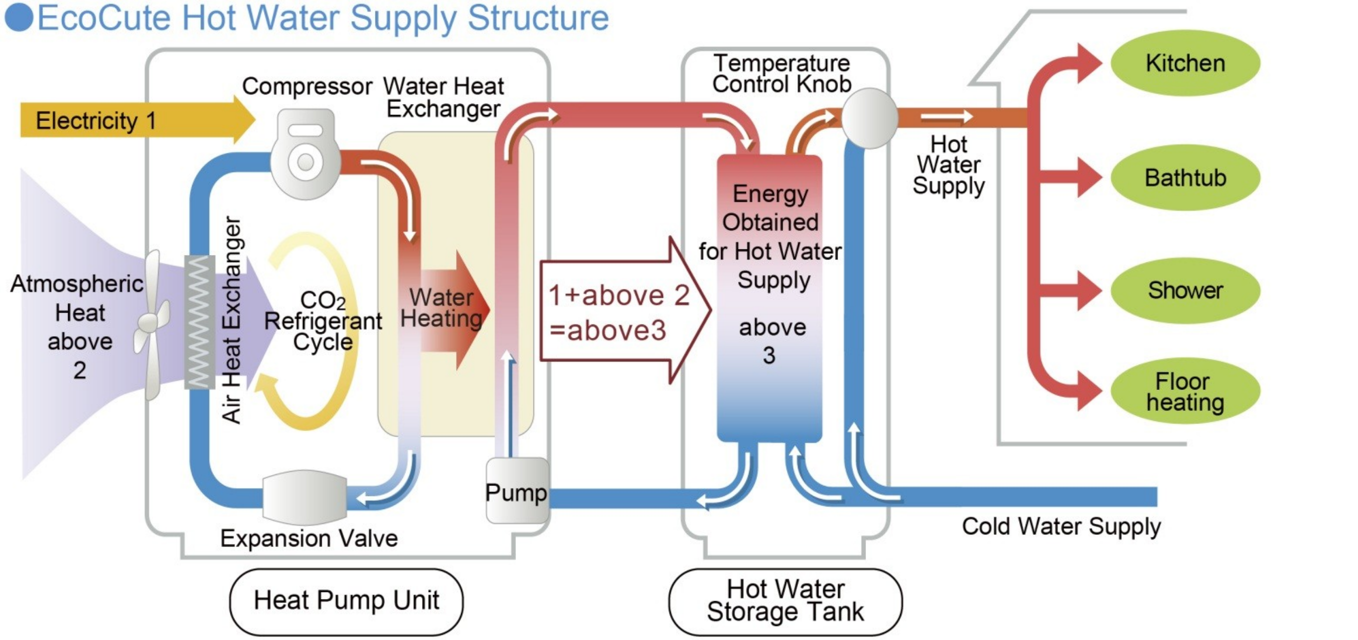


(Note) Figures may not add up to the totals due to rounding.

Sources: WWEA

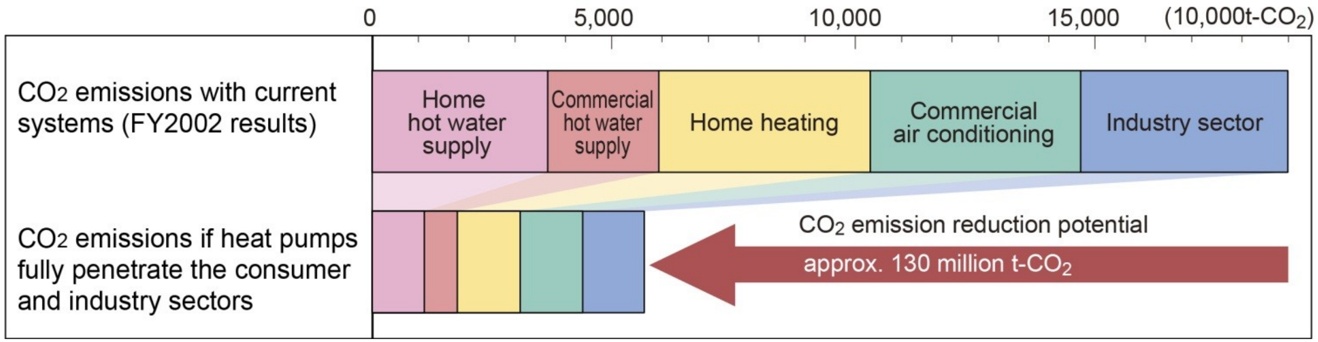
Mechanism of Heat Pump and its CO_2 Reduction Effect

●EcoCute Hot Water Supply Structure



1 Electricity Energy + above 2 Atomospheric Heat = above 3 Energy Obtained for Hot Water Supply

●CO_2 Reduction Effect of Heat Pump



Source: The Federation of Electric Power Companies "Environmental Action Plan by the Japanese Electric Utility Industry"

Mega Solar Power Generation Plant Projects in Japan

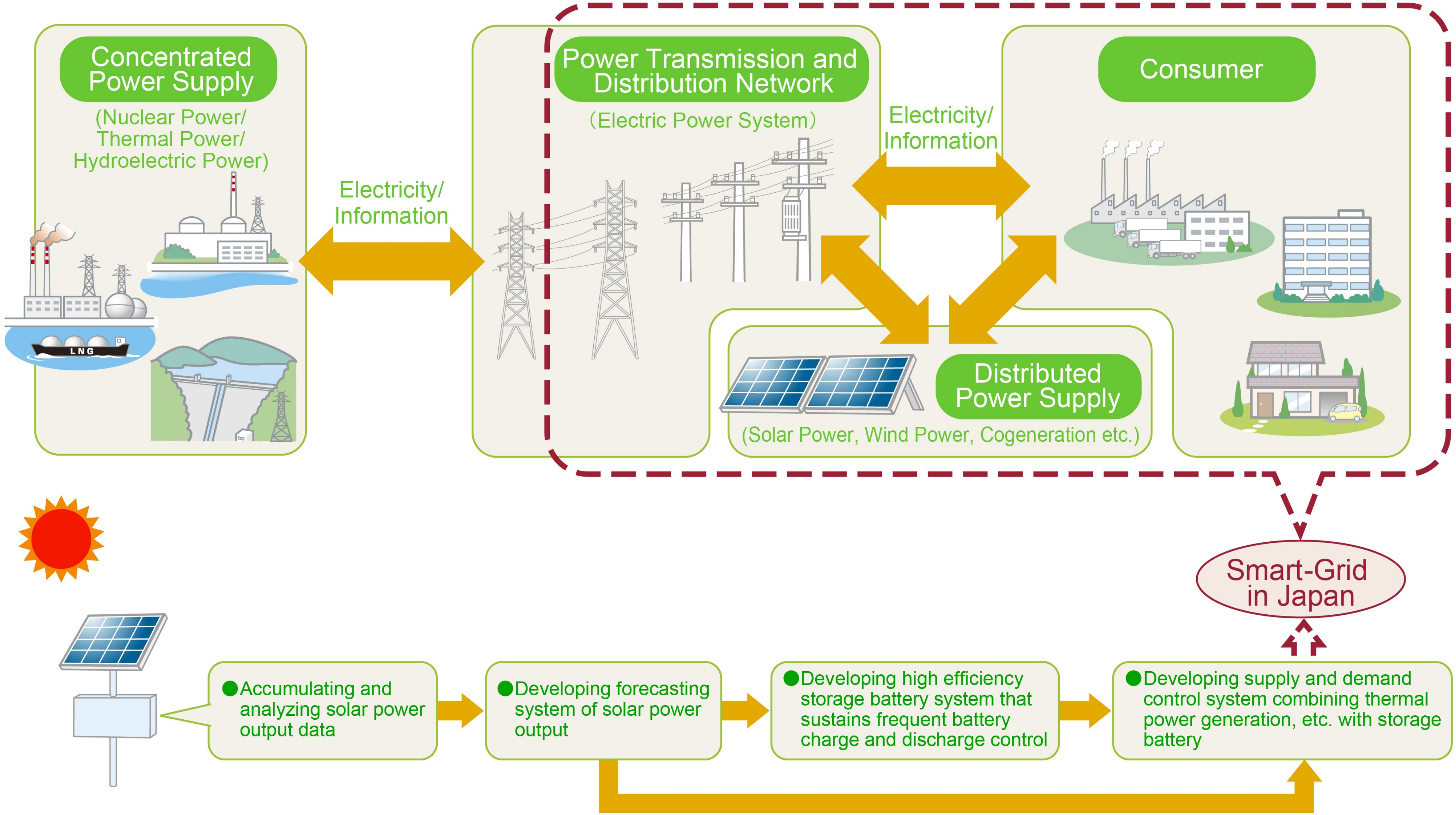
（as of October 31, 2010）

Company (EPCO)	Numbers	Cap （MW）	Expected COD	Location	Prefecture
Hokkaido	1	1	FY2011	Date Thermal Power Station site	Hokkaido
Tohoku	3	1.5	FY2011	Hachinohe Thermal Power Station site	Aomori
		2	FY2011	Sendai Thermal Power Station site	Miyagi
		1	FY2013	Haramachi Thermal Power Station site	Fukushima
Tokyo	3	7	FY2011	Kawasaki City property	Kanagawa
		13	FY2011	Tokyo EPCO property in Kawasaki City	Kanagawa
		10	FY2011	Yamanashi Pref. property in Kofu City	Yamanashi
Chubu	3	7.5	FY2011	Taketoyo Thermal Power Station site	Aichi
		1	FY2010	Iida City property	Nagano
		8	FY2014	Chubu EPCO property in Shizuoka City	Shizuoka
Hokuriku	4	1	FY2011	Hokuriku EPCO property in Shika Town	Ishikawa
		1	FY2011	Toyama City property	Toyoma
		1	FY2012	Hokuriku EPCO & Suzu City property	Ishikawa
		1	FY2012	Hokuriku EPCO property in Sakai City	Fukui
Kansai	2	10	FY2010※1 FY2011	Sakai City property	Osaka
		18	FY2010※2	Sharp Corp. property etc. in Sakai City	Osaka
Chugoku	1	3	FY2011	Chugoku EPCO property in Fukuyama City	Hiroshima
Shikoku	1	4.3※4	FY2010※3	Matsuyama Solar Power Station	Ehime
Kyushu	1	3	FY2010	Former Minato Power Station site	Fukuoka
Okinawa	1	4	FY2010※5	Miyakojima City property	Okinawa
Total	20	Approx.98.3			

※1 Partially commissioned in October 2010 (3MW)
※2 Partial commissioning is expected in FY2010 (9MW)
※3 Partial commissioning is expected in FY2010 (1.7MW)
Full commissioning is expected by FY2020 (4.3MW)
※4 Including existing facility (0.3MW, commissioned in March 1996)
※5 Construction completed in October 2010 and a series of demonstration examinations are being carried out.

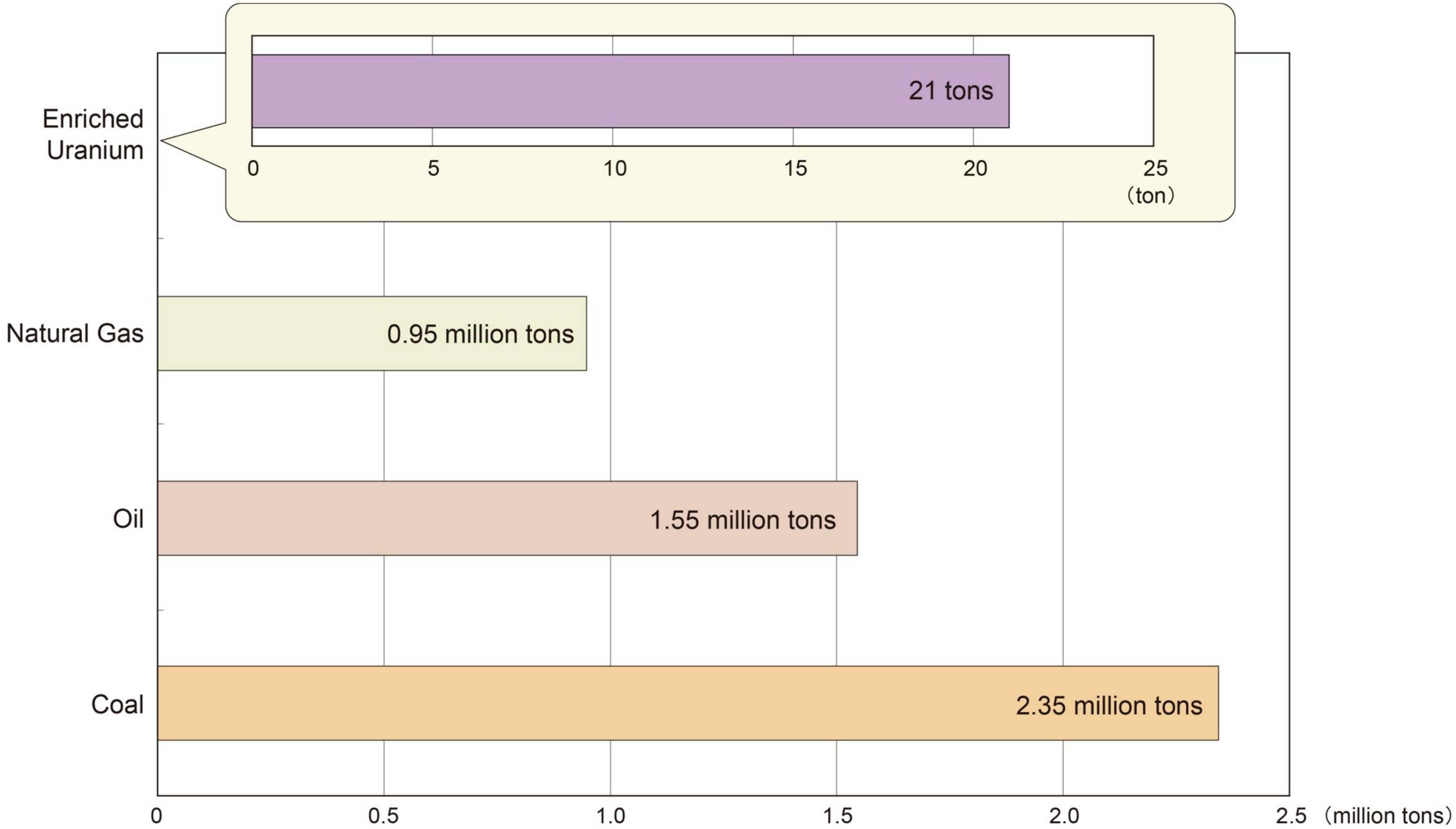
Source: The Federation of Electric Power Companies

Basic Concept of Smart-Grid in Japan



Source: The Federation of Electric Power Companies "Environmental Action Plan by the Japanese Electric Utility Industry"

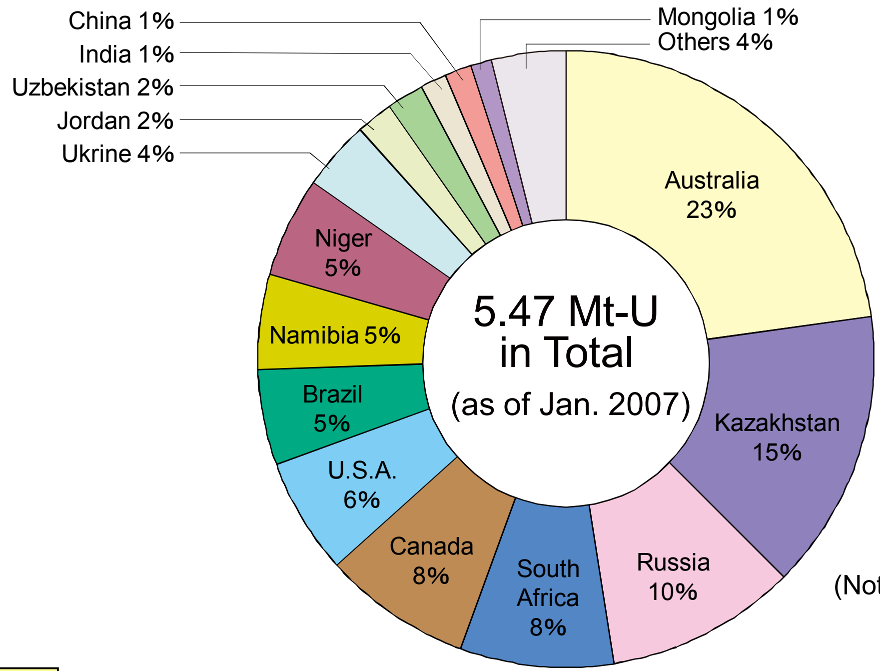
Comparison of Various Fuels Required to Operate a 1GW Power Plant per Year



Source: Agency for Natural Resources and Energy "NUCLEAR ENERGY 2010"

Proved Reserves and Japan's Procurement of Uranium

Proved Reserves of Uranium



(Note) Figures may not add up to the totals due to rounding.
t-U: tons of uranium

Japan's Procurement of Uranium

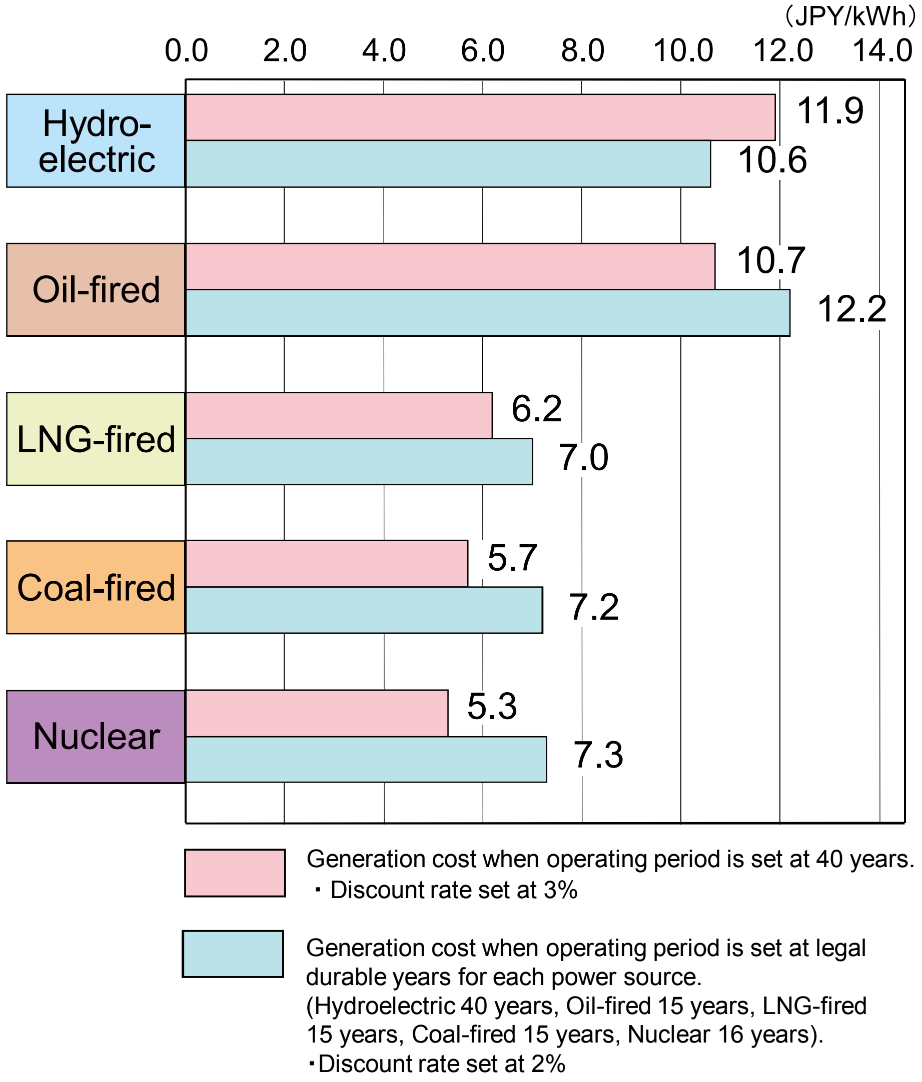
(as of Mar. 2009)

Contract type of Import	Supply countries	Contract quantity (in U_3O_8 short ton)
Long and short term contracts, and purchase of products	Canada, U.K., South Africa, Australia, France, U.S.A. and others	Approx. 341,800
Development and import scheme	Niger, Canada, Australia and Kazakhstan	Approx. 87,200
Total		Approx. 429,000

(Note) 1 short ton ＝ approx. 0.907 metric ton

Source: The Denki Shimbun “Nuclear Pocket Book FY2010”

Generation Costs per kWh (sending end)



＜Premises of trial calculation＞

Power Sources	Operating Period	Operation Rate	Output per unit
Hydroelectric	40y	45%	15MW
Oil-fired	40y	80%	400MW
LNG-fired	40y	80%	1,500MW
Coal-fired	40y	80%	900MW
Nuclear	40y	80%	1,300MW

- Based on the assumption that a plant started operation in FY2002
- Exchange rate (avg. in FY2002) 121.98 ¥/$
- Fuel prices (avg. in FY2002)
  Oil: 27.41$/bbl
  Coal: 35.5$/t
  LNG: JPY 28,090/t
- Fuel cost increase in oil, coal, & LNG
  IEA, "World Energy Outlook"

＜Breakdowns of nuclear fuel cycle costs＞※

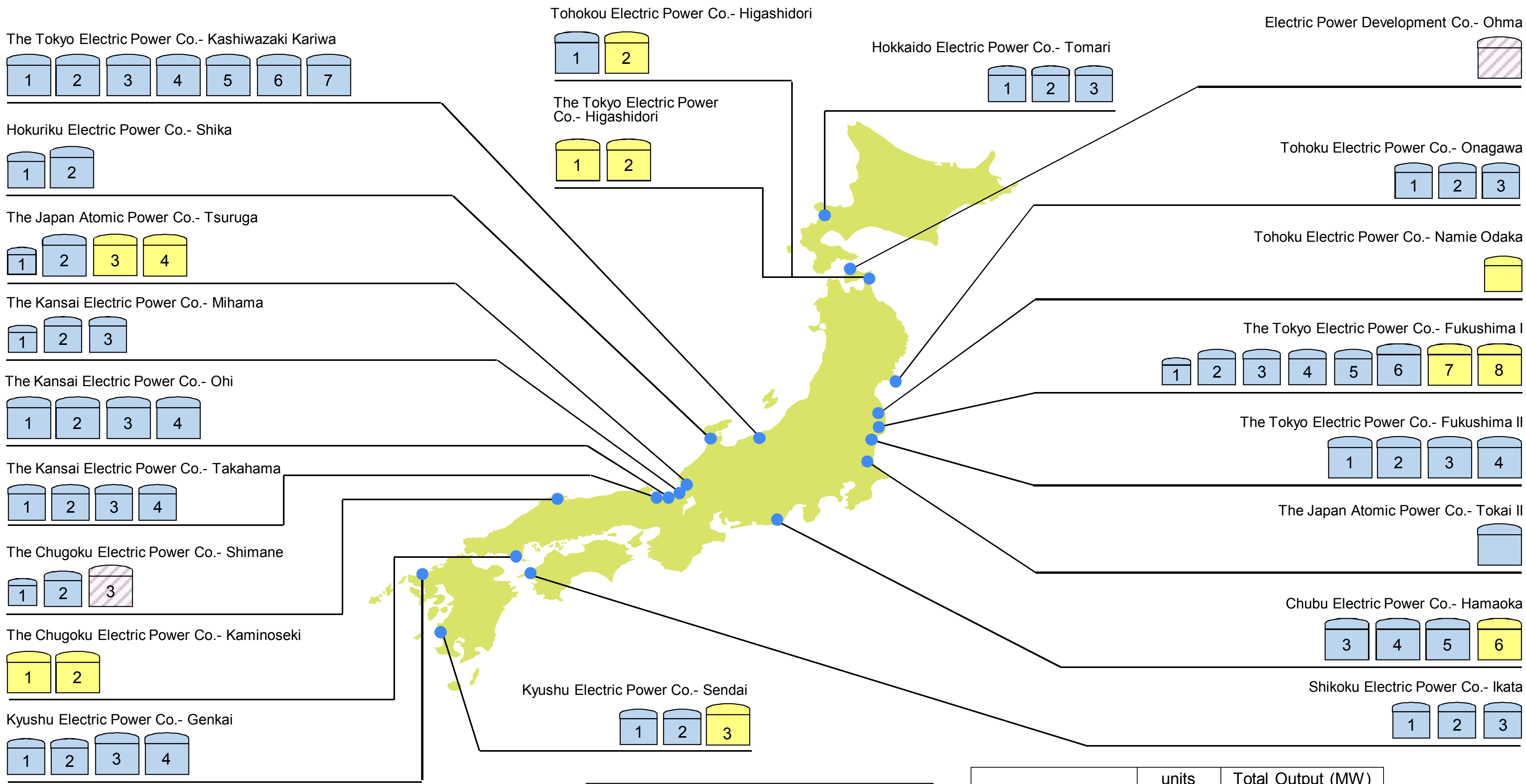
Nuclear fuel cycle costs	JPY 1.47/kWh
Front-end	JPY 0.66/kWh
Back-end	JPY 0.81/kWh
Reprocessing of spent fuel (fuel transports included)	JPY 0.50/kWh
Intermediate storage of spent fuel (fuel transports included)	JPY 0.04/kWh
HLW storage, transports, disposal	JPY 0.15/kWh
TRU processing, storage, disposal	JPY 0.09/kWh
Decommissioning of reprocessing facillities	JPY 0.03/kWh

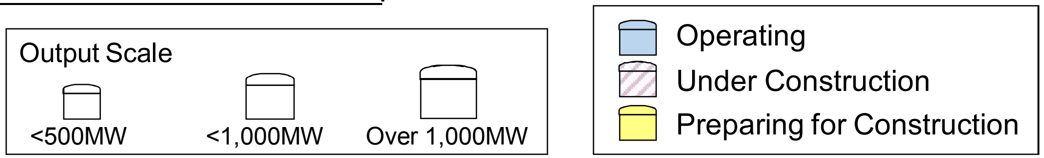
※Operating period set at 40 years.(Discount rate set at 3%)

Source: Electricity Industry Committee's Subcommittee to Study Costs and Other Issues (January 2004)

Nuclear Power Plants in Japan

(Commercial Plants, as of the end of March 2010)



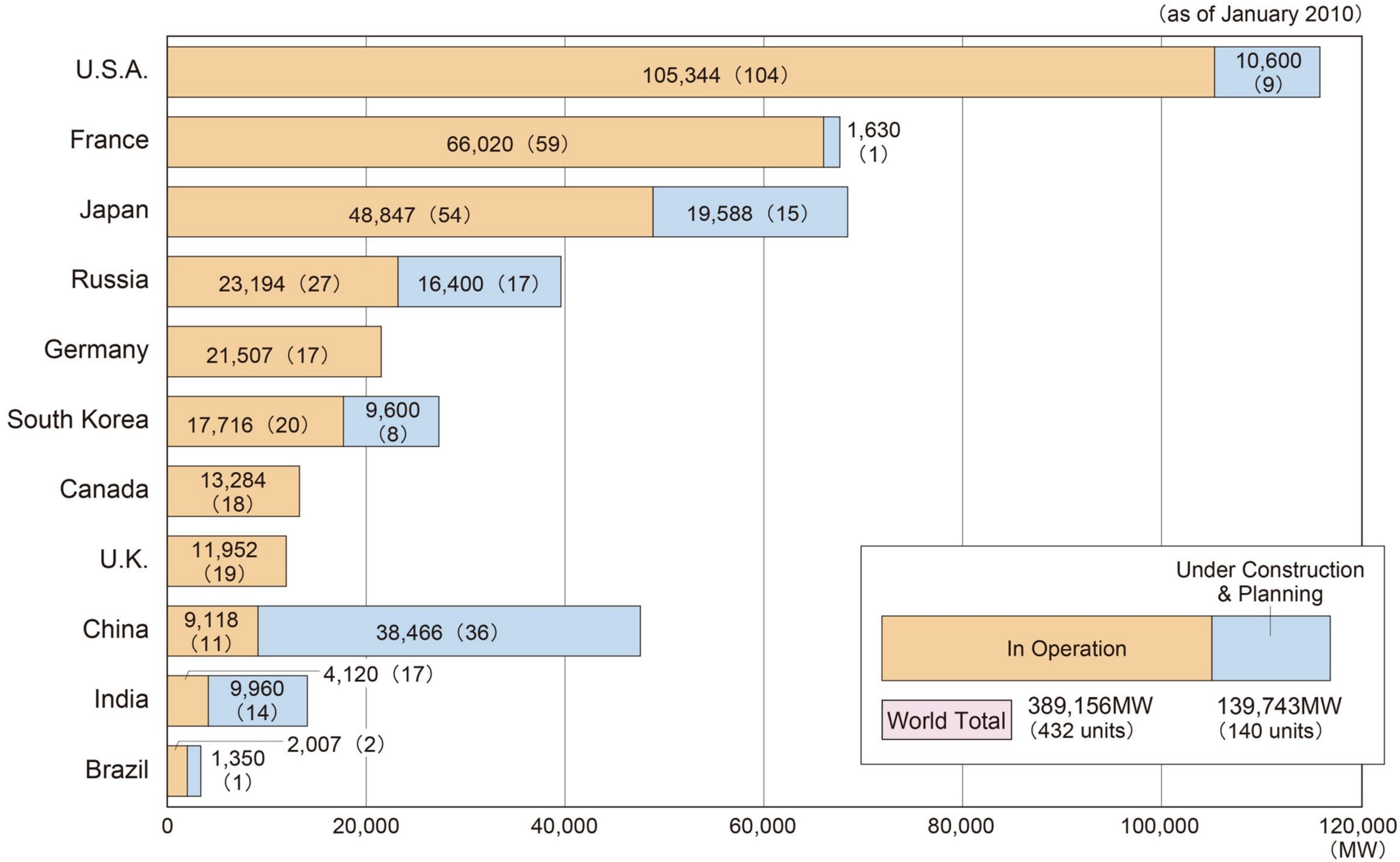


	units	Total Output (MW)
Operating	54	48,847
Under Construction	2	2,756
Preparing for Construction	12	16,552
Total	68	68,155

(Note) End of Operation: The Japan Atomic Power Co.- Tokai (March 31, 1998) / Chubu Electric Power Co.- Hamaoka reactors 1 and 2 (January 30, 2009)

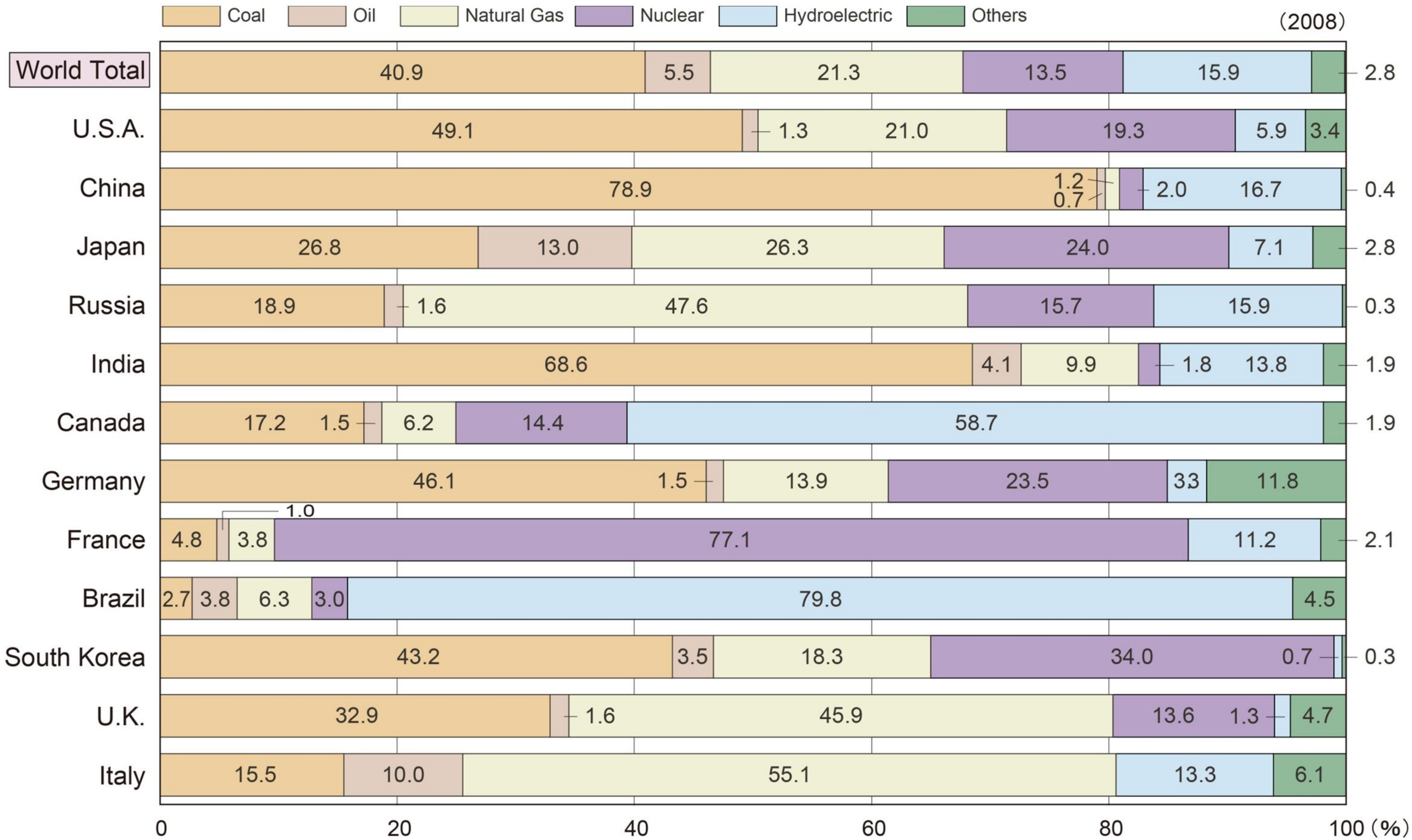
Source: Agency for Natural Resources and Energy “NUCLEAR ENERGY 2010”

Generating Capacity of Nuclear Power Plants in Major Countries



Source: Japan Atomic Industrial Forum, Inc. "World Nuclear Power Plants 2010" etc.

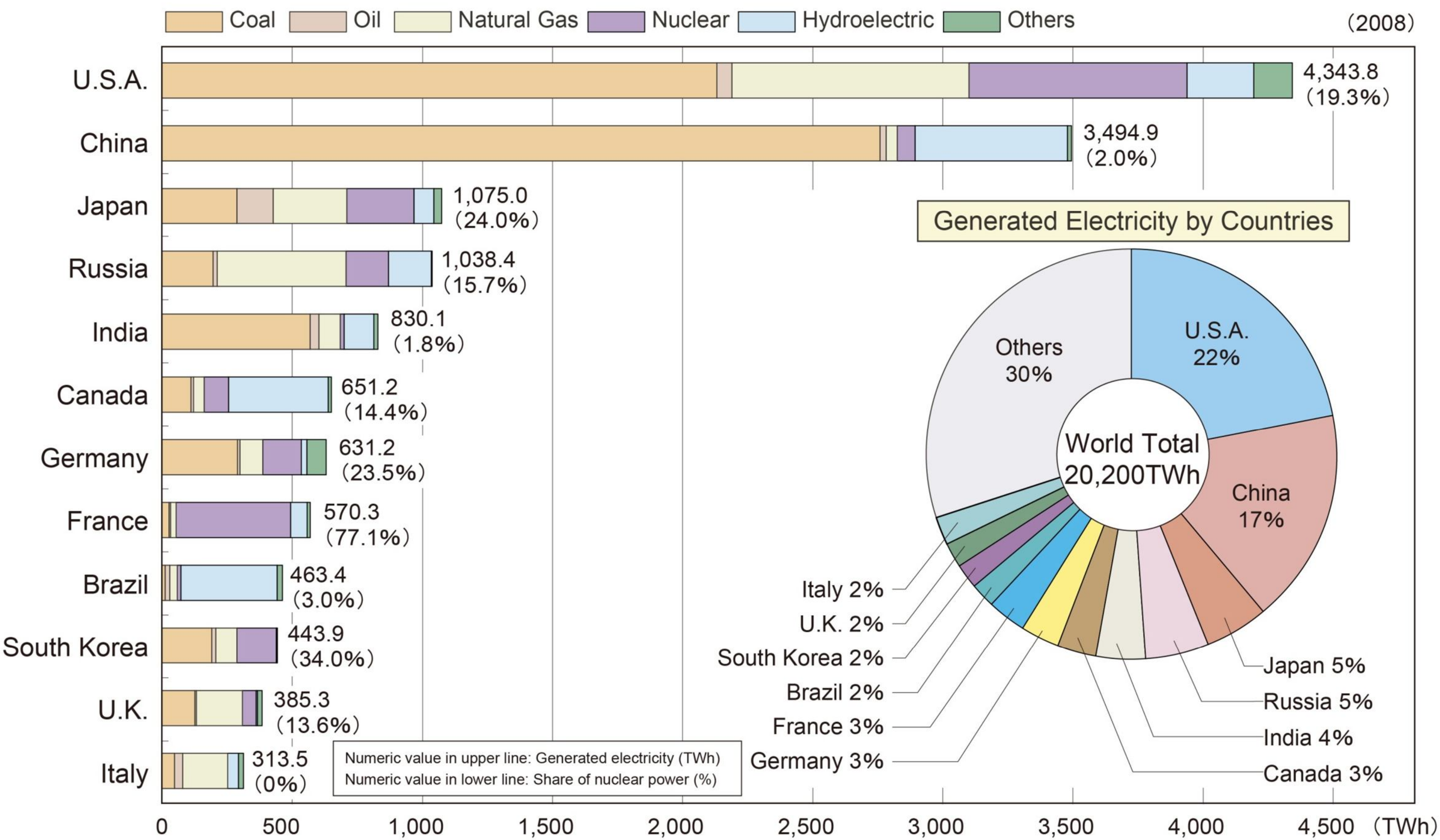
Power Generation Composition by Source in Major Countries



(Note) Figures may not add up to the totals due to rounding.

Source : IEA “ENERGY BALANCES OF OECD COUNTRIES (2010 Edition)”/ “ENERGY BALANCES OF NON-OECD COUNTRIES (2010 Edition)”

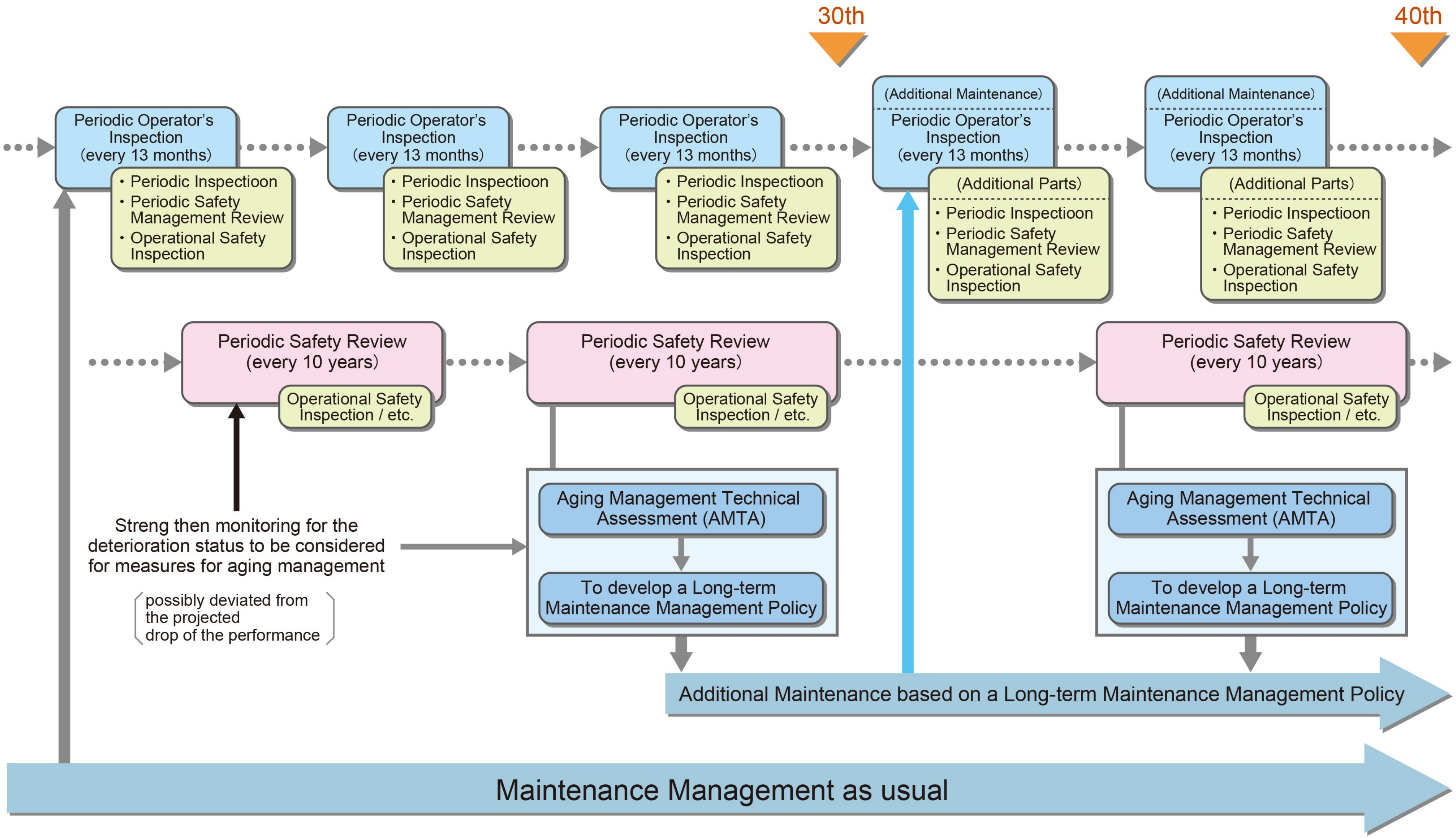
Electricity Generated and Share of Nuclear Power in Major Countries



(Note) Figures may not add up to the totals due to rounding.

Source : IEA "ENERGY BALANCES OF OECD COUNTRIES (2010 Edition)"/ "ENERGY BALANCES OF NON-OECD COUNTRIES (2010 Edition)"

Periodic Safety Review of Nuclear Power Plant and Measures for Aging Management



Source: White paper on Nuclear Energy 2009

Aseismic Measures Taken by Nuclear Power Plants

【8 key safety points】

Stages	Measures	Details
Assuring safety at the design stage	① Thorough investigation	Perform a detailed survey of active faults and past earthquakes at the site and its surrounding areas as well as the geology and geological structure of the site.
	② Seismic design considering even an extremely rare earthquake	Assure the seismic design to prevent safety-significant components and systems from losing their functions against ground motions both in the horizontal and vertical direction which are assumed to occur during the plant service life, even though the possibility is extremely low.
	③ Detailed analytical evaluation	Perform detailed analyses of possible complicated jolts to important buildings and components when a postulated earthquake hits the site using reliable computational codes to verify the seismic safety.
	④ Confirmation of safety of bearing ground and surrounding slopes	Perform tests and analyses to verify if the ground, on which the facilities important for seismic safety are to be built, has sufficient bearing resistance against earthquakes and confirm that assumed events accompanying an earthquake, such as the collapse of surrounding slopes, would not significantly influence the safety of reactor facilities.
	⑤ Confirmation of safety against tsunami	Investigating past tsunamis and performing detailed numerical simulations of tsunamis which are assumed to accompany earthquakes, etc, to confirm the safety of facilities.
Assuring safety at the construction and operation stages	⑥ Construction of a nuclear power plant on ground with sufficient bearing resistance	Build a nuclear power plant on ground that has a low amplitude of earthquake ground motion, sufficient bearing resistance, and no possibility of sliding or adverse subsidence.
	⑦ Automatic shutdown function	Install a system which can automatically shut the reactor immediately after jolts exceeding a certain level are detected.
	⑧ Demonstration of earthquake resistance and understanding of seismic limits using a shaking table and exciter	Demonstrate the earthquake resistance of nuclear facilities, understand the design margin and verify the validity of computational codes used in the maintenance and analysis of equipment functions by applying earthquake loads exceeding the design limit to the actual unit or a specimen equivalent to the actual unit by using a shaking table or exciter.

Source: Nuclear and Industrial Safety Agency "Seismic Safety of Nuclear Power Plants"

Revised Regulatory Guide for Reviewing Seismic Design of Nuclear Power Reactor Facilities

Former Guide

- Active faults to be considered
  : possibly active in last 50,000 years
- An epicentral earthquake of 6.5 on the Richter scale is should be uniformly considered

- Implement the research on active faults by literature, aerial photo, field survey, etc.

- Design Basis Earthquake Ground Motion in horizontal direction should be formulated.
- Earthquake ground motions shall be evaluated by empirical formulae based on the magnitude of earthquake and the distance of the epicenter. (Response spectra methodology)

More strict Level → More precise investigation → More advanced method

Revised Guide

Formulation of Design Basis Earthquake Ground Motion based on latest knowledge is required.

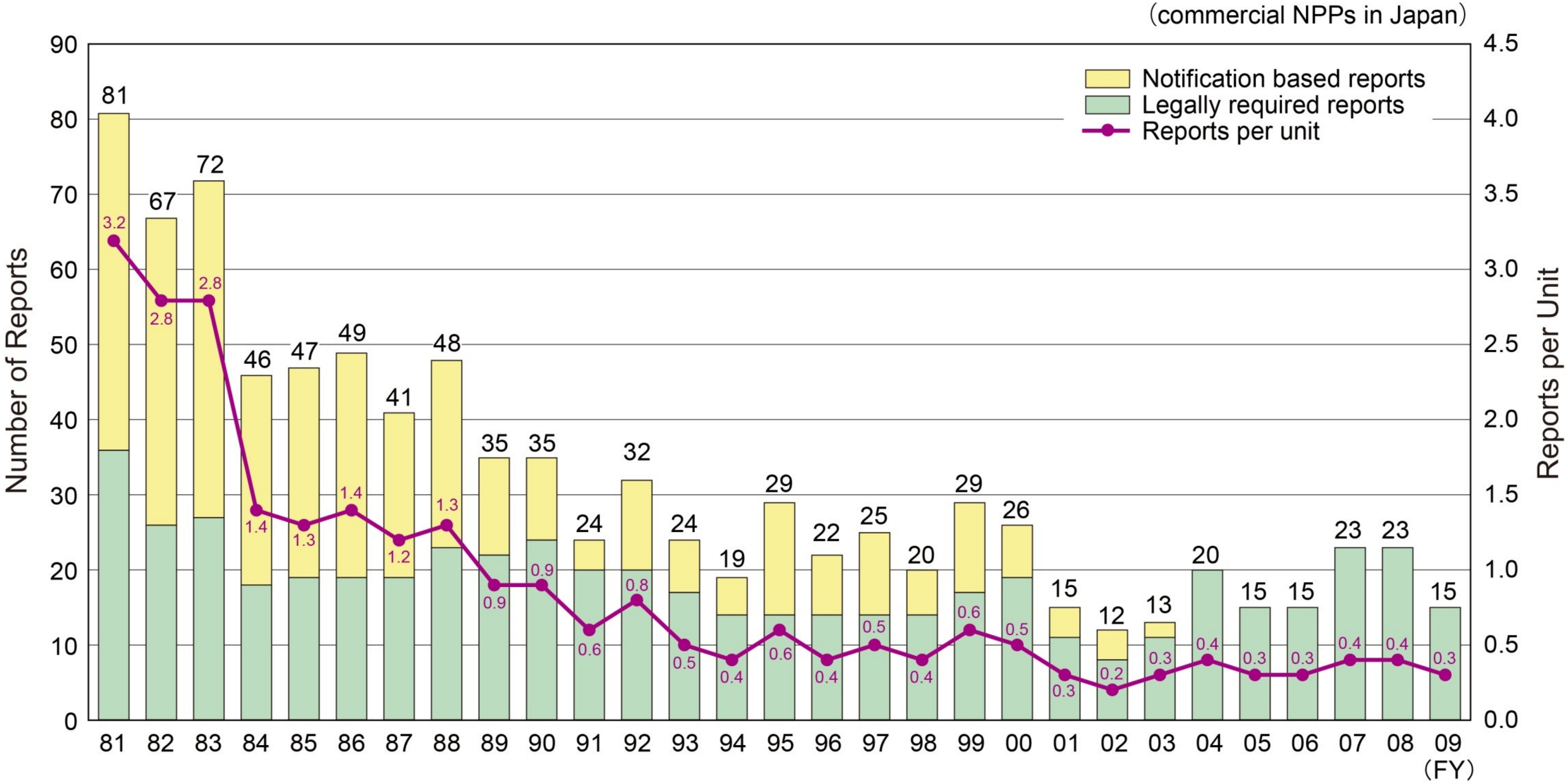
- Active faults to be considered
  : possibly active in last 120,000-130,000 years
- Instead of epicentral earthquake of 6.5 on the Richter scale, Earthquake ground motions with no specific epicenters shall be formulated by collecting observation records of the past earthquakes.

- In addition to conventional investigation, comprehensive survey including tectonic geomorphologic investigation should be made on the active faults in order to avoid overlooking indistinct ones.

- Design Basis Earthquake Ground Motion should be formulated both in horizontal and vertical directions.
- In addition to response spectra methodology, the fault model which can configure seisimogenic mechanisms in detail should be utilized.

Source: White Paper on Nuclear Energy 2009

Historical Trends in Reported Incidents and Failures at NPPs in Japan



(Note 1) The figures include the number of reports for plants under trial operation and construction.

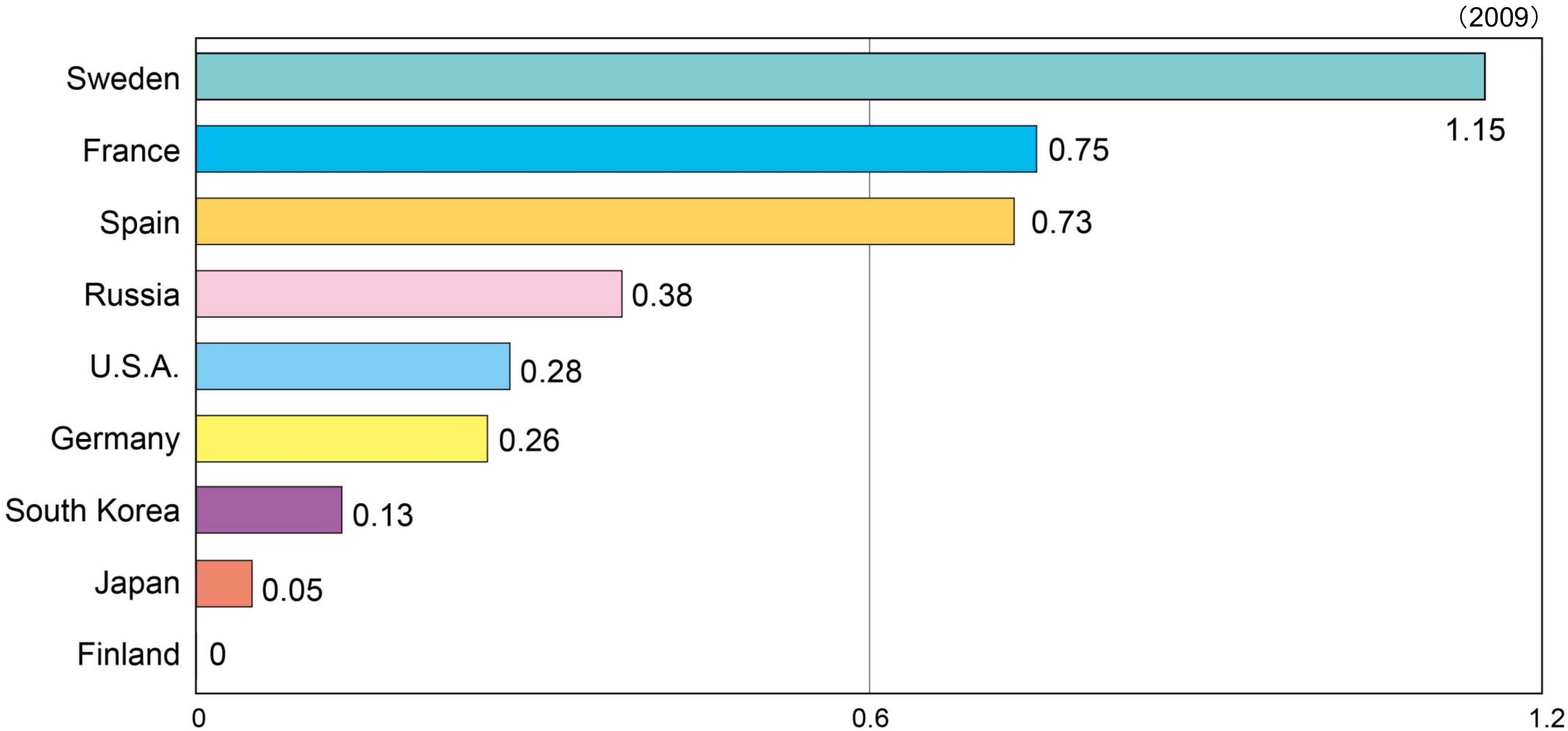
(Note 2)

$$\text{the figure of repots per unit} = \frac{\text{the Number of reports of commercial NPPs}}{\text{the number of operating units (as of the end of the FY)}}$$

(Note 3) Notification based reports are unified into legally required reports in accordance with the revision of the Nuclear Reactor Regulation Law in October 2003.

Source: Japan Nuclear Energy Safety Organization "Operational Status of Nuclear Facilities in Japan (2010)" etc.

Unplanned Automatic Scrams per 7,000 Hours Critical in Major Countries



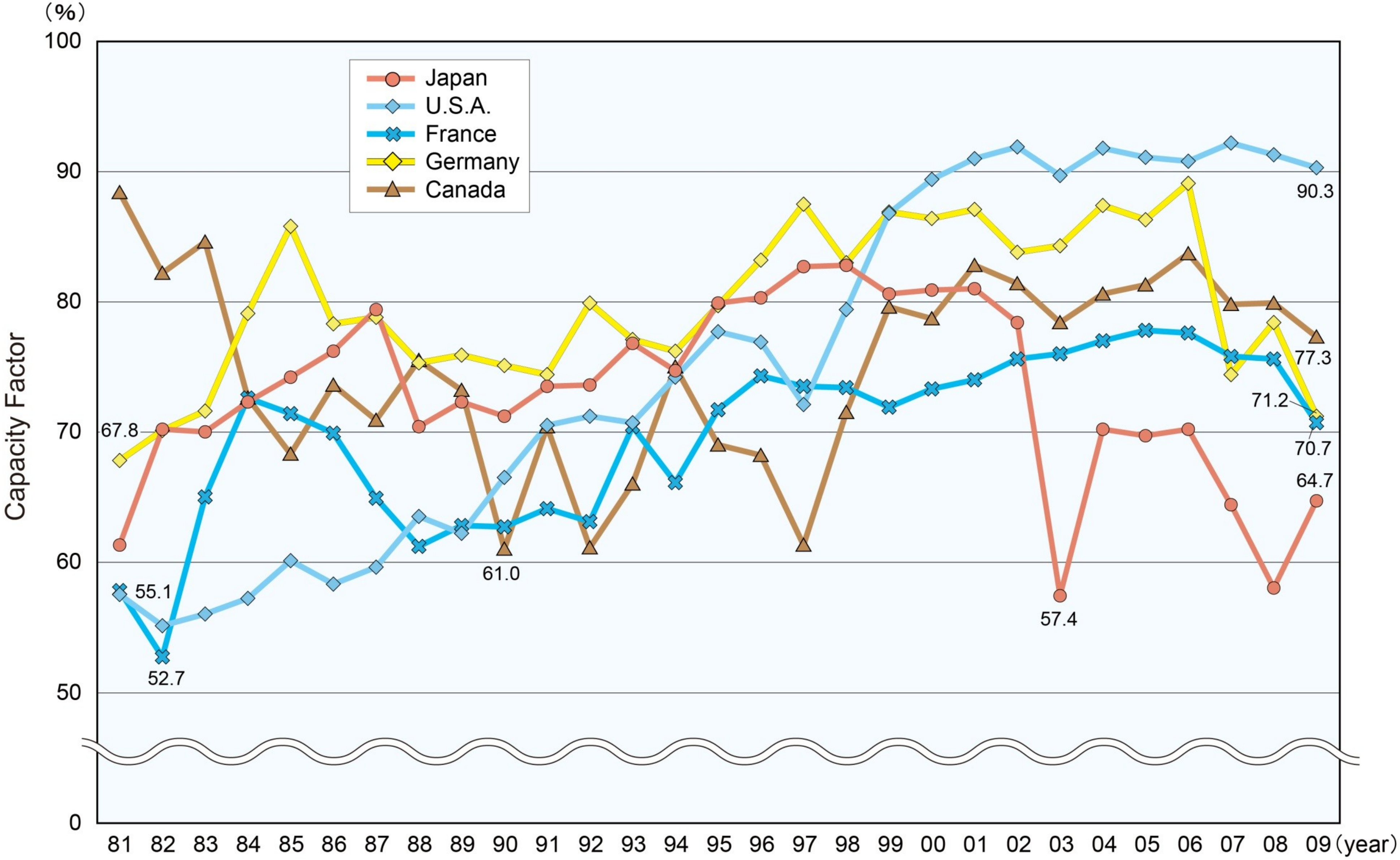
The unplanned automatic scrams per 7,000 hours critical (UA7)

$$\left(= \frac{\text{total unplanned scrams while critical in the previous 4 qtrs} \times 7{,}000 \text{ hrs}}{\text{total number of hours critical in the previous 4 qtrs}} \right)$$

(Note) Automatic Scram: Emergency shutdown of the reactor

Source: IAEA PRIS

Historical Trends in Capacity Factors of NPPs in Major Countries



Source: Japan Nuclear Energy Safety Organization "Operational Status of Nuclear Facilities in Japan (2010)"

Causes of the Accident at Chernobyl NPP

Lack of Safety Culture

Design Defects

- No Containment Vessel
- Designed to easily turn off safety equipment
- Positive void coefficient; during low power operation, the more voids (froths) in cooling water, the more output, etc.

Operators' Regulation Violation

- Withdrew control rods more than regulated
- Operated with Emergency Core Cooling System (ECCS) turned off
- Conducted a special test at lower power than planned

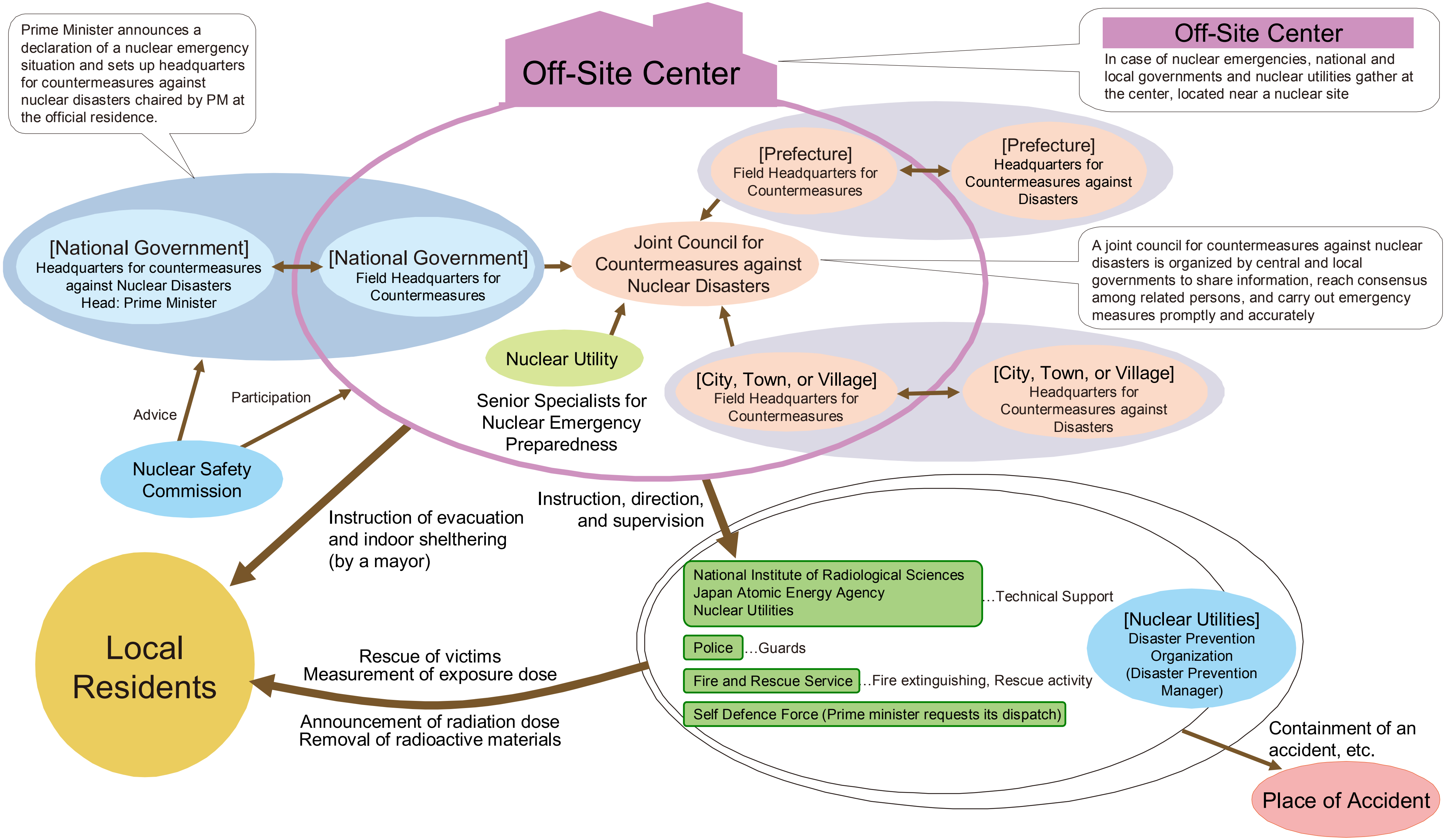
(Continuous operation was prohibited due to instability at low power range (less than 20% of total output), etc.)

Operational Mismanagement

- Managed by a non-reactor-specialist
- A special test was conducted without due processes or approval throughout the power plant
- Inadequate examinations on safety measures, etc.

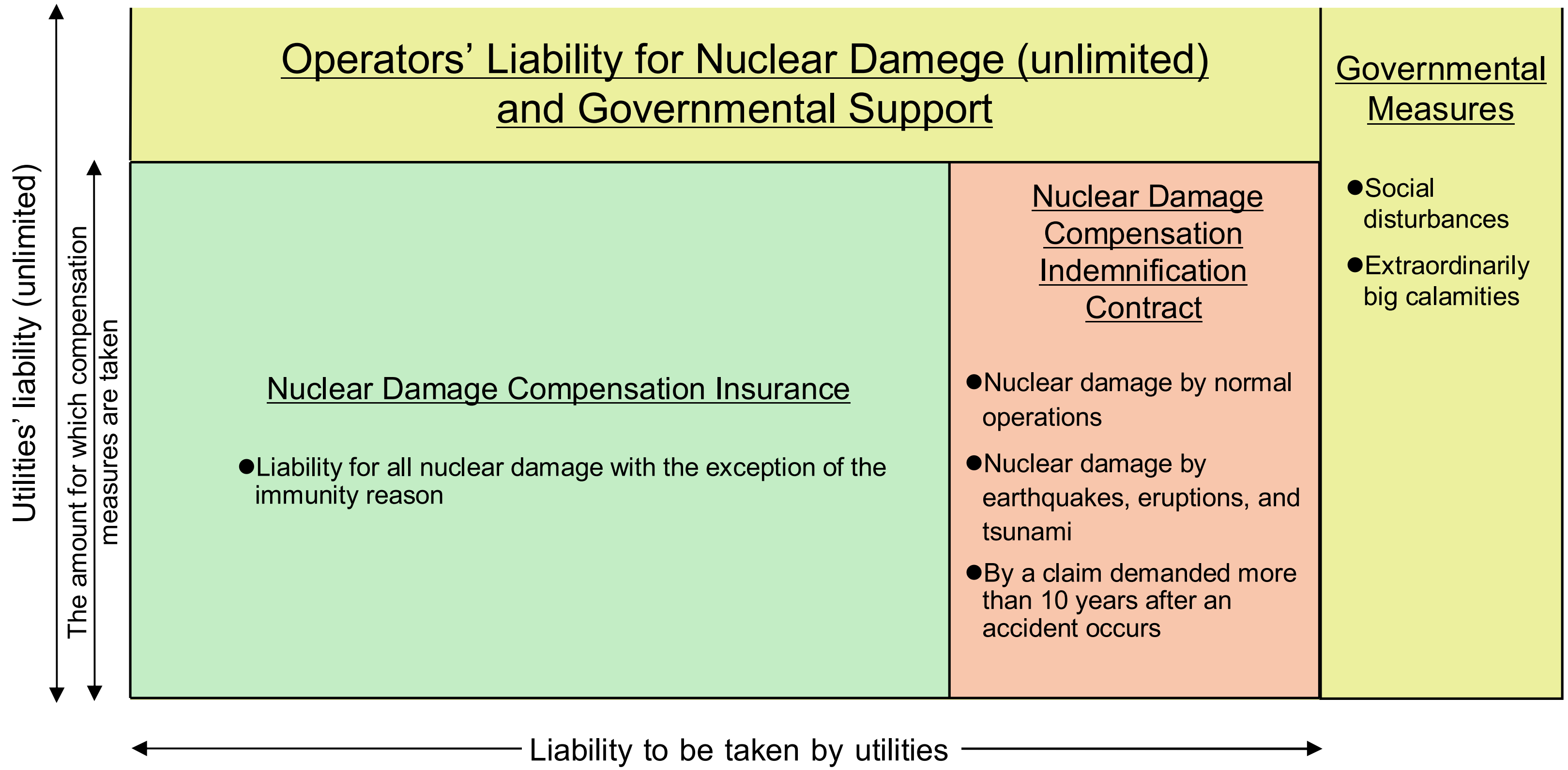
Source: Agency for Natural Resources and Energy

Disaster Prevention Systems during Nuclear Emergencies



Source: Agency for Natural Resources and Energy “NUCLEAR ENERGY 2010”

Nuclear Damage Compensation System

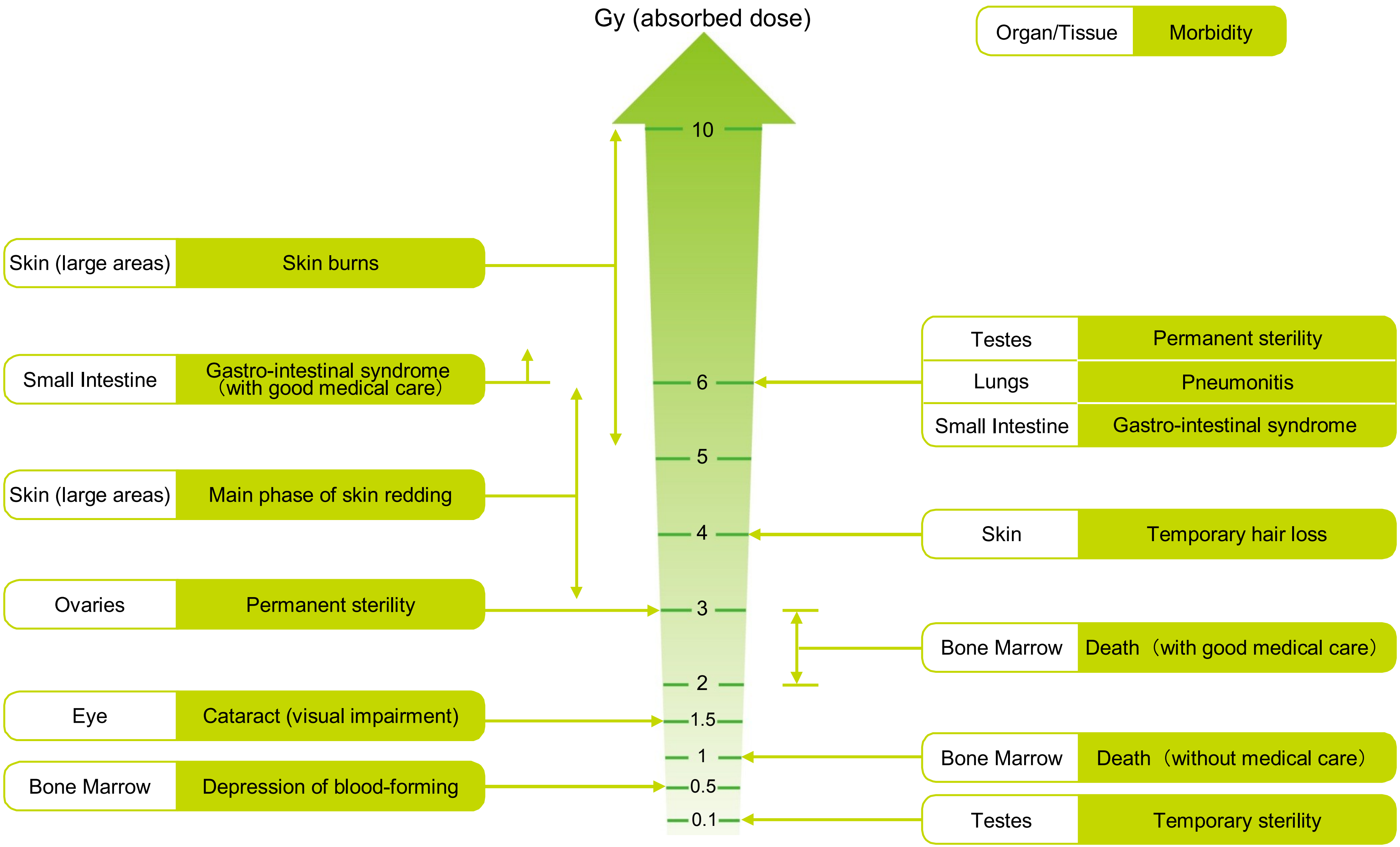


(Note) 1. Compensation depends on situations such as those of operations of nuclear reactors.
2. When compensation owed exceeds the amount for which compensation measures are taken, and if it is considered necessary to achieve the aim of the Law on Compensation for Nuclear Damage, governmental support is implemented pursuant to Diet resolution.
3. Government takes necessary measures against damages such as extraordinarily big natural calamities or social disturbances to which utilities are legally exempt from liability.

Source: The Denki Shimbun "Nuclear Pocket Book FY2010"

Acute Radiation Effects

Projected threshold※ estimates of the acute absorbed does for 1% incidence of morbidity and mortality.



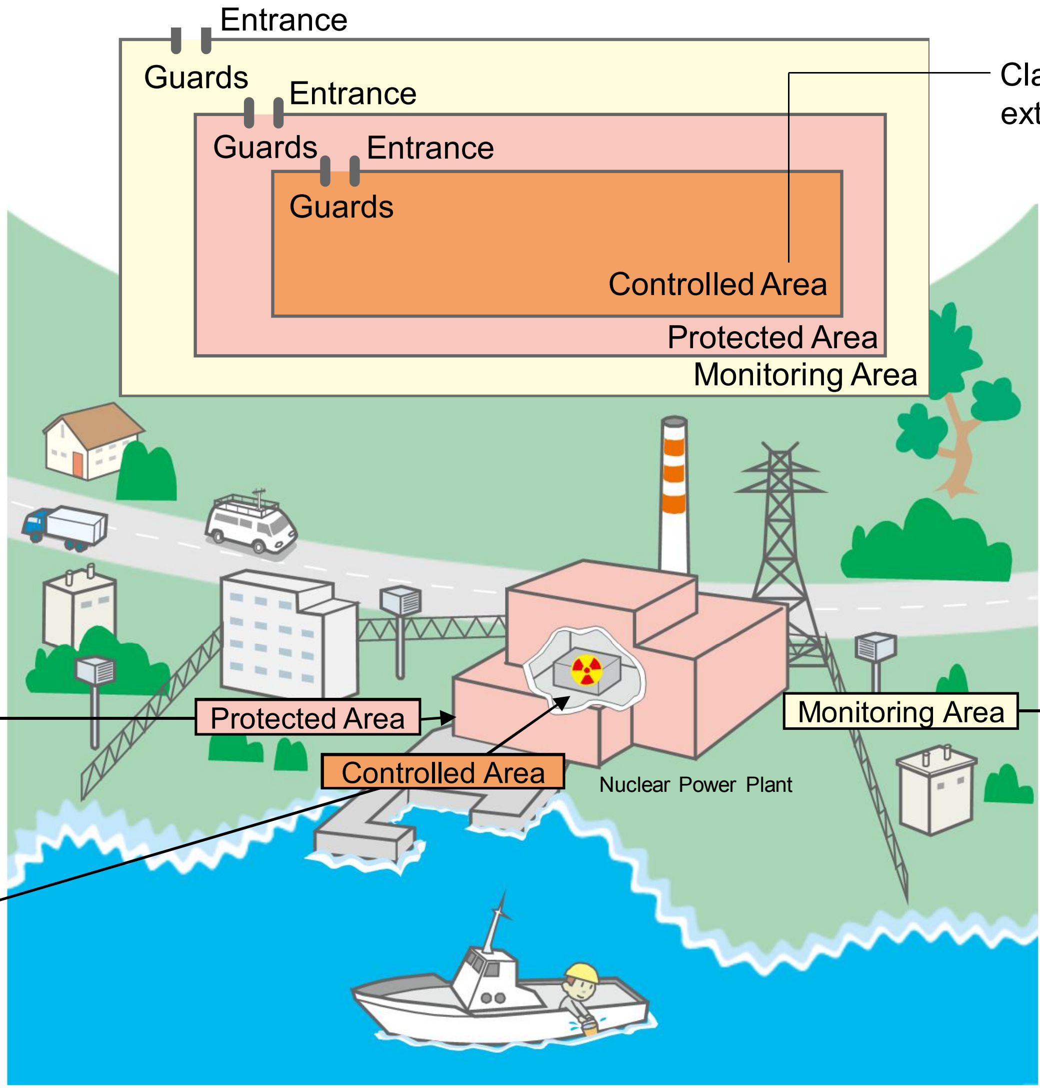
※Threshold：the maximum level of radiation considered to be acceptable or safe

Source: ICRP "Pub.103"

Controls in a Nuclear Power Plant by Area

Control is especially needed to preserve a nuclear power plant (except a controlled area).

Entry is restricted to prevent a damage by radiation and radioactive materials.



Classified in detail according to the extent of radiation or contamination

Within the area, unnecessary entry of the general public is restricted to prevent them from being exposed to more dose emitted from nuclear facilities than regulated by laws.

Source: Agency for Natural Resources and Energy, etc.

Radiation Exposure Control for Radiation Workers

Radiation Control Flow

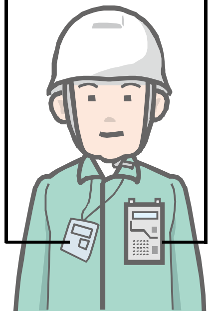
Radiation Workers
Medical examination / Education / Exposure records check
↓
Controlled-area entry permit
↓
Carrying a portable individual dosimeter
↓
To wear protective clothing (wearing a protective mask, if necessary)

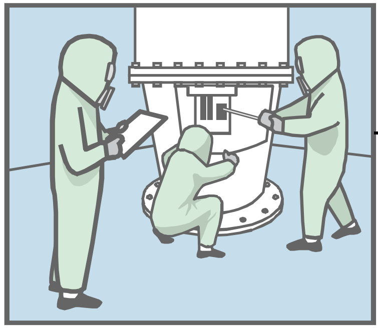
Section responsible for an assignment
Making a work plan
↓
Setting dose equivalent target

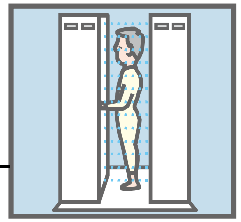
Experts in radiation Control
→ Making a work plan
↓
To instruct radiation protection

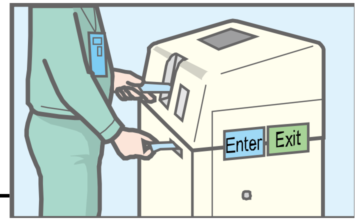
Making a work plan → Measures to reduce radiation exposure (ex. Installation of shields)

Setting dose equivalent target / Measures to reduce radiation exposure (ex. Installation of shields) / To instruct radiation protection
↓
Work within a controlled area
↓
Completion of work
↓
Surface contamination test
↓
To measure and evaluate individual effective dose
↓
Recording measurement results and notifying them to individuals
↓
Registering the data to the Radiation Dose Registration Center for Radiation Workers

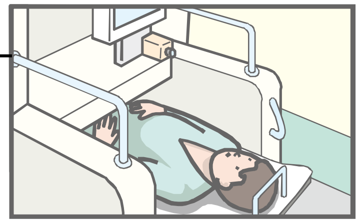

Left : Glass badge
Right : Alarm-equipped dosimeter


Employees with protective clothing are working


Surface contamination test to check workers' body

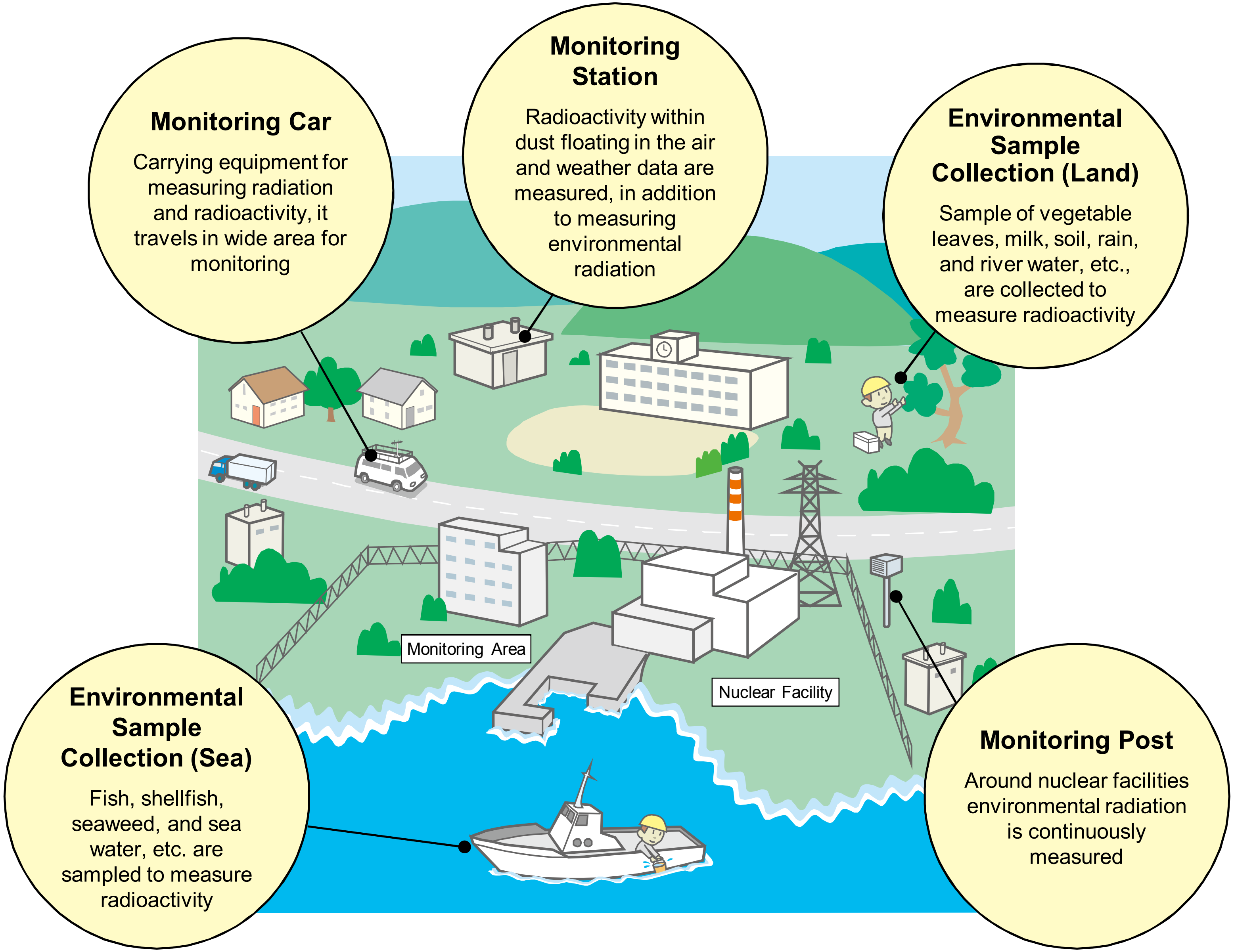


Individual effective dose is measured by the entrance and exit control equipment.


Radioactive materials in a body are periodically checked by a whole body counter.

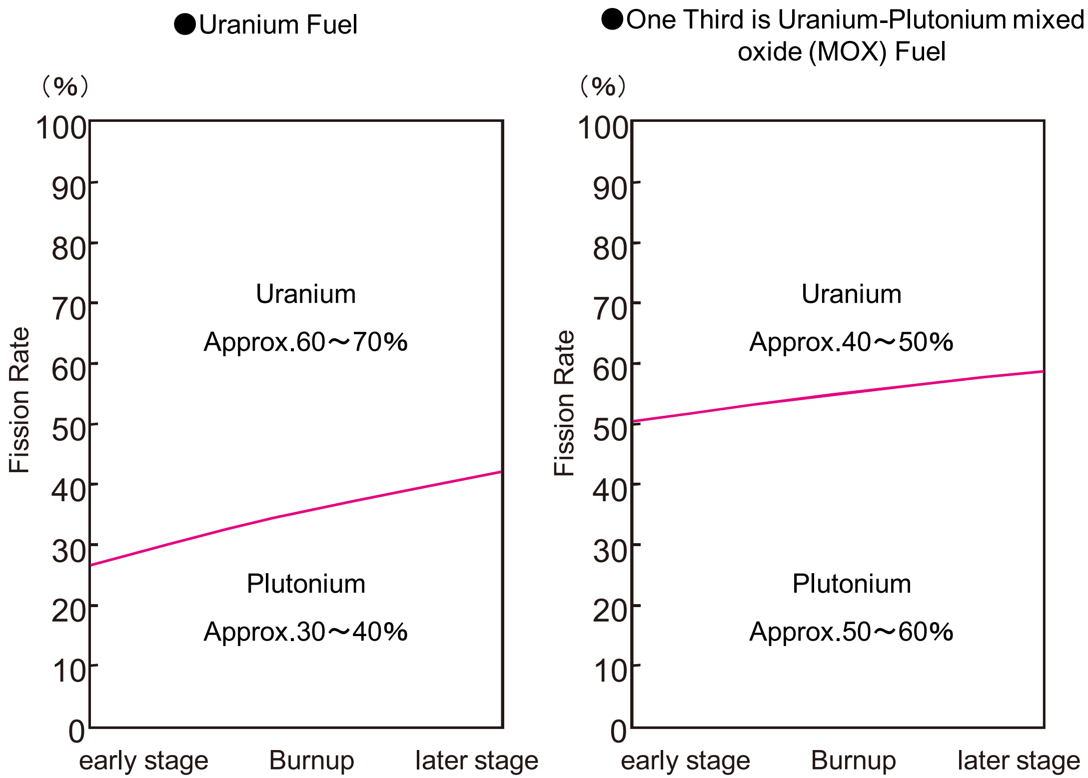
Source: Agency for Natural Resources and Energy, etc.

Environmental Radiation Monitoring around Nuclear Facilities

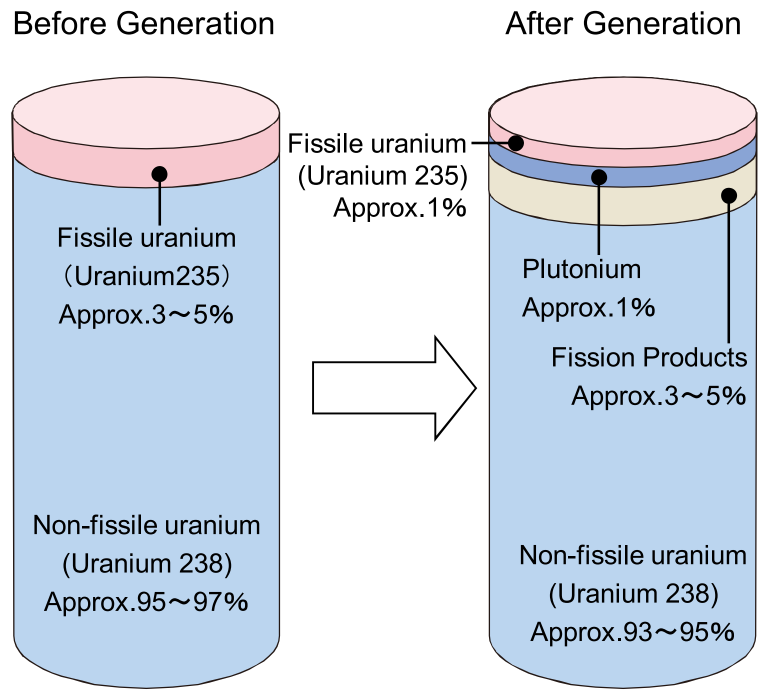


Nuclear Fission inside Light Water Reactors

①Fission Rate of Uranium and Plutonium in Reactor Core (BWR equilibrium core)

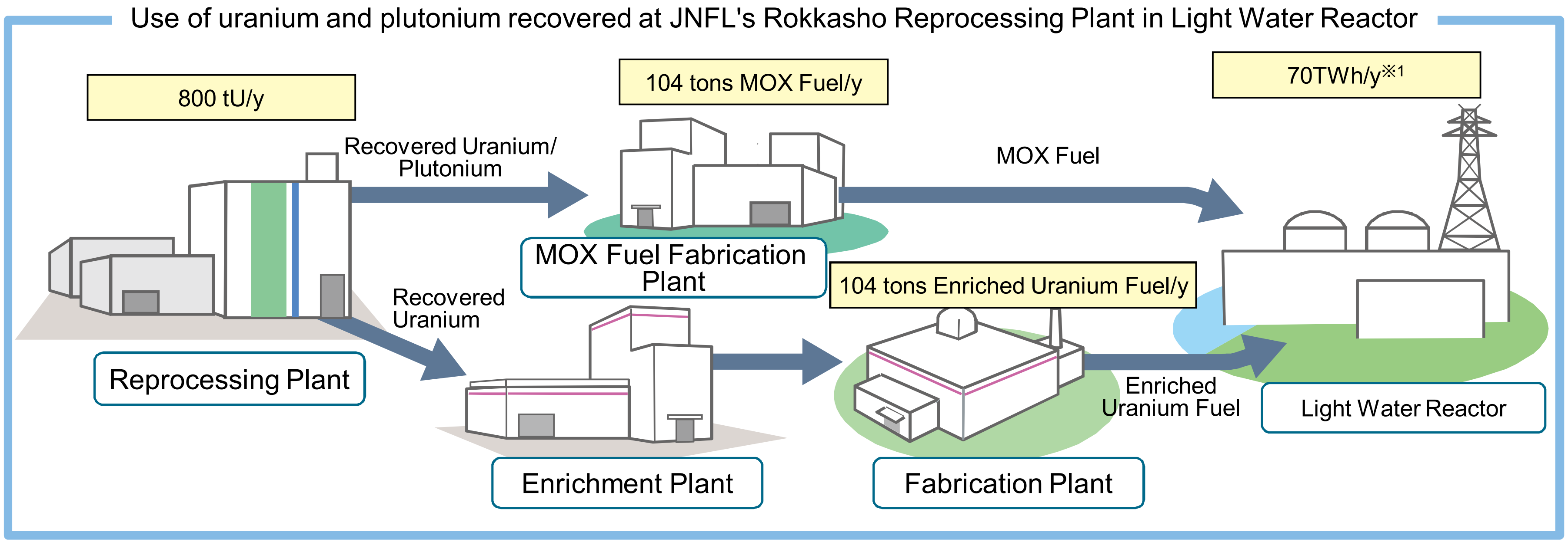


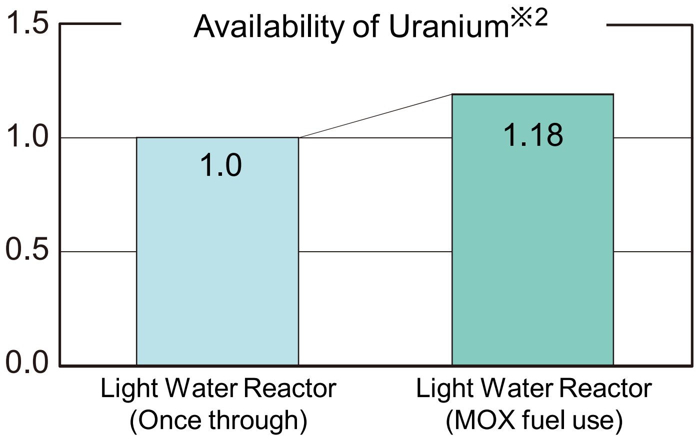
②(Ex.) Composition change of uranium fuel through generation



Source: Nuclear Safety Commission, Agency for Natural Resources and Energy

Utilization of Uranium Resources



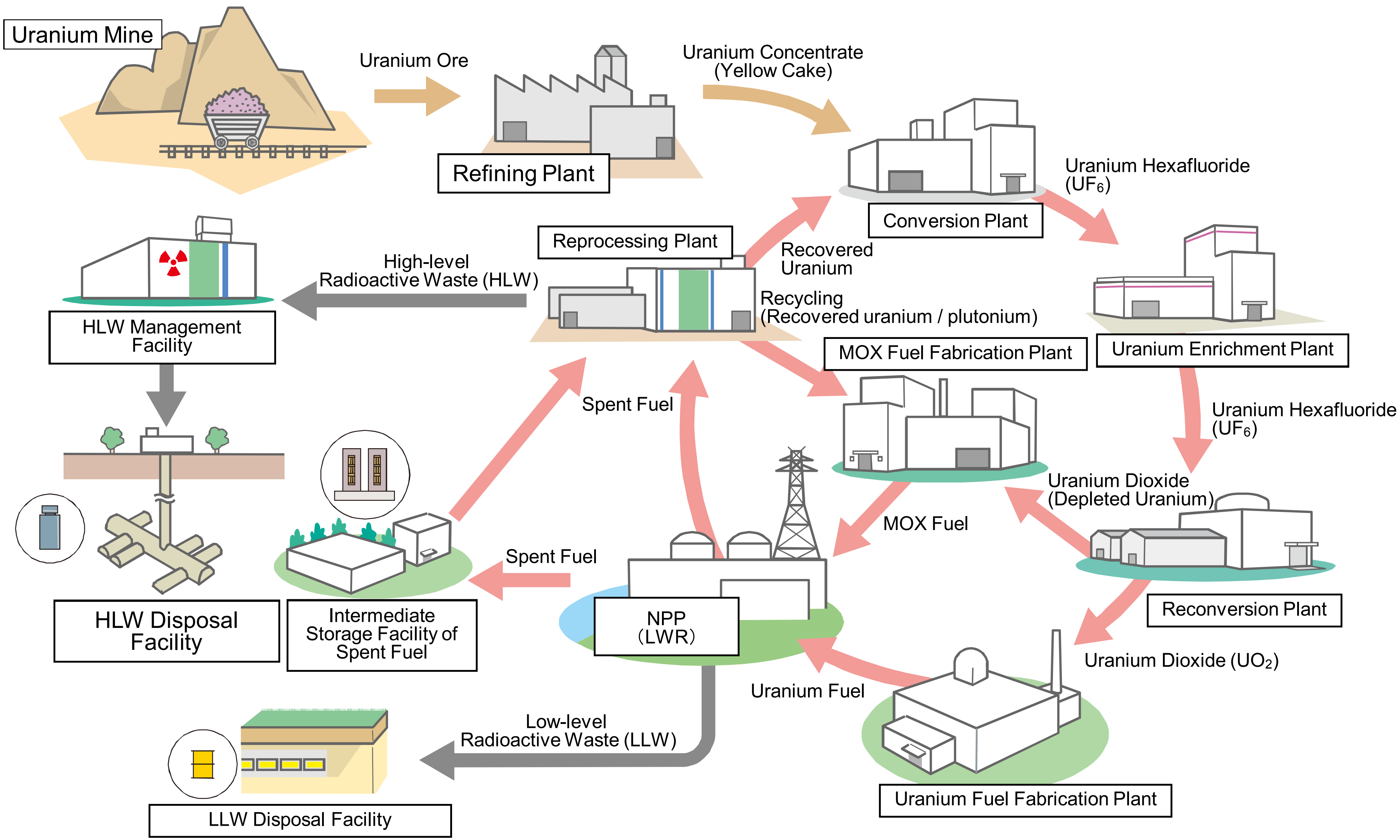


※1：70TWh is equivalent to annual output of ten 1GW capacity nuclear reactors. (1)

※2：Usage of plutonium can utilize the use of uranium by about 30 times when Fast Breeder Reactor came into practical use. (2)

Source: (1) Atomic Energy Commission of Japan (2004) (2) NEA "URANIUM2003"

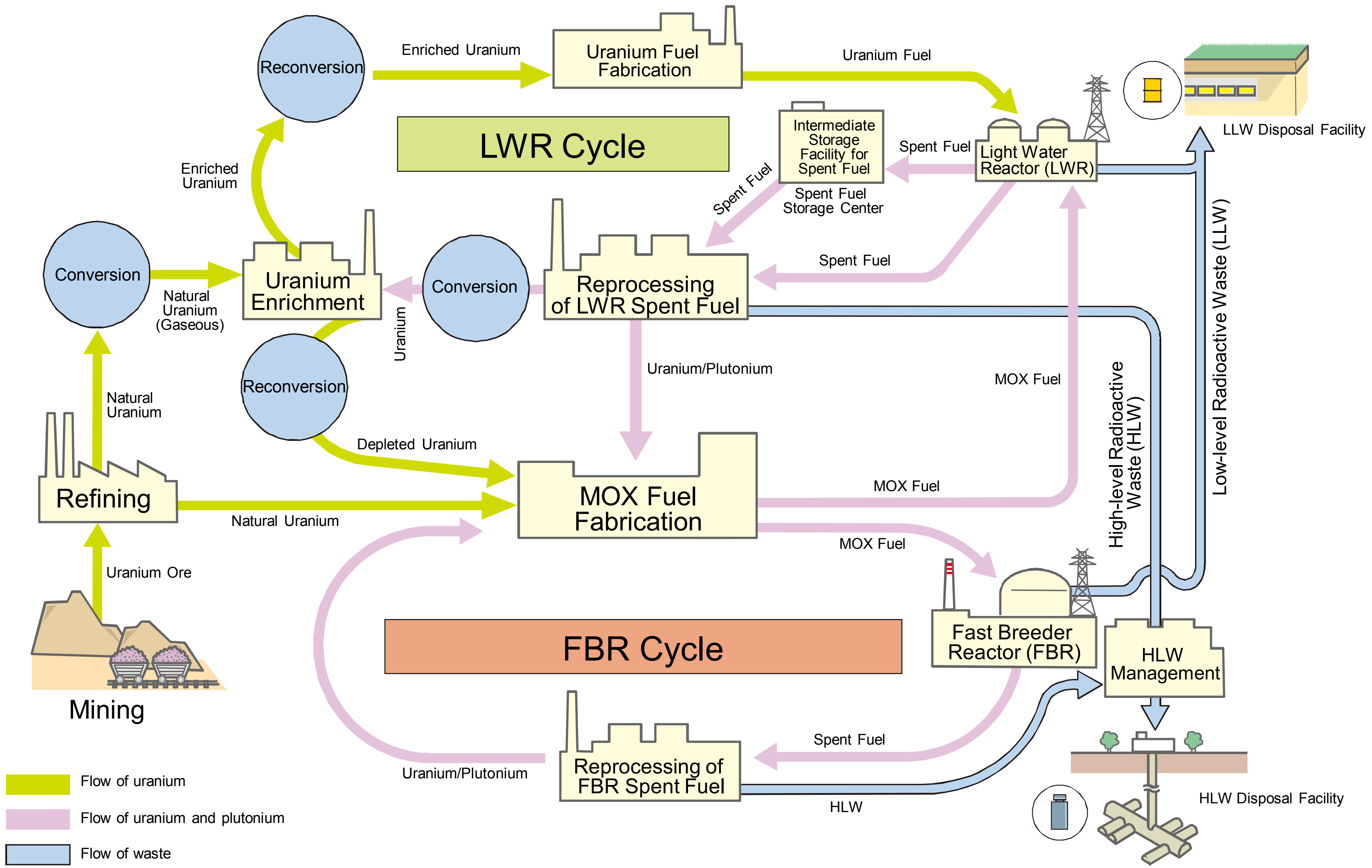
Nuclear Fuel Cycle



(Note) MOX Fuel: Uranium-Plutonium mixed oxide fuel

Source: Agency for Natural Resources and Energy “NUCLEAR ENERGY 2010”

Nuclear Fuel Cycle (Including FBR)



Source: Agency for Natural Resources and Energy “NUCLEAR ENERGY 2010”

Outline of JNFL's Nuclear Fuel Cycle Facilities

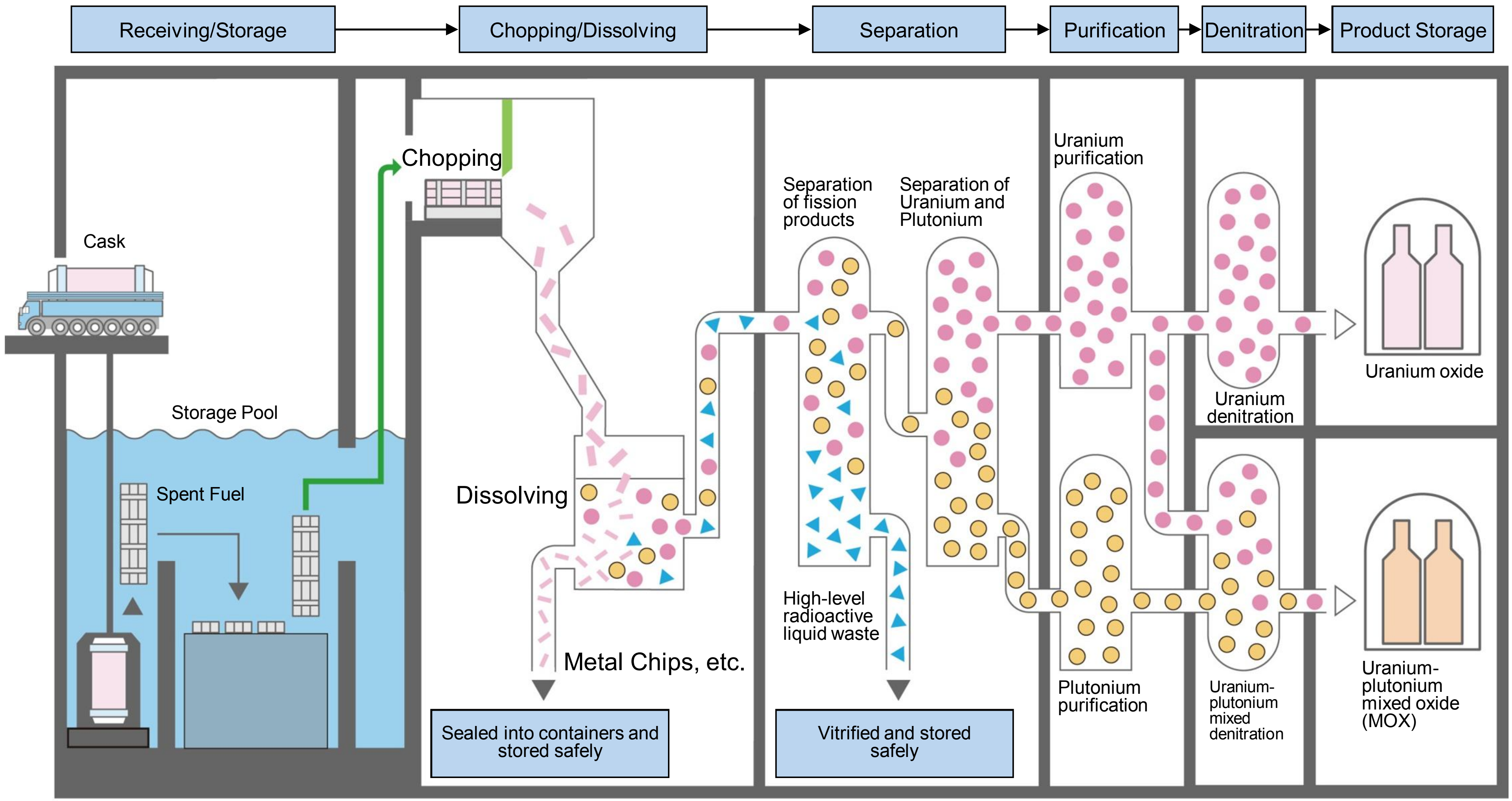
（as of October, 2010）

	Reprocessing Plant	MOX Fuel Fabrication Plant	Vitrified Waste Storage Center	Uranium Enrichment Plant	Low-level Radioactive Waste Disposal Center
Site	Iyasakatai, Rokkasho-mura, Aomori Prefecture			Oishitai, Rokkasho-mura, Aomori Prefecture	
Capacity	Maximum capacity: 800 t-U/y Storage capacity for spent fuel: 3,000 t-U	Maximum capacity: 130 t-HM/y※1	Storage capacity for wastes returned from oversea plants: 1,440 canistiers of vitrified waste Planned to be expanded to 2,880 canisters	1,050 t-SWU/y※2 Planned to be expanded to a maximum capacity of 1,500 t-SWU/year	Authorized capacity: 200,000m^3 (equivalent to 1 million 200 liter drums) Planned to be expanded to 600,000m^3 (equivalent to 3 million 200 liter drums)
Current Status	Under Construction	Applying for a business license	Cumulative number of stored canisters:1,310	Present capacity: 150 t-SWU/y	Cumulative number of stored drums: 213,331
Construction Cost	Approx. JPY2,193 billion	Approx. JPY190 billion	※3 Approx. JPY80 billion	Approx. JPY250 billion	※4 Approx. JPY160 billion
Schedule	Start of construction:1993 Commissioning: 2012 (planned)	Start of construction:2010 Commissioning: 2016 (planed)	Start of construction: 1992 Commissioning: 1995	Start of construction: 1988 Commissioning: 1992	Start of construction: 1990 Commissioning: 1992

※1 t-HM stands for "tons of heavy metal" which indicates the weight of plutonium and uranium metallic content in MOX.
※2 SWU：Separative work is measured in Separative work units SWU or kg SW
※3 Construction expense regarding 1,440 canisters of vitrified waste.
※4 Construction expense regarding 200,000m^3 low-level radioactive waste (equivalent to 1 million of 200 liter drums).

Source: Japan Nuclear Fuel Ltd., etc.

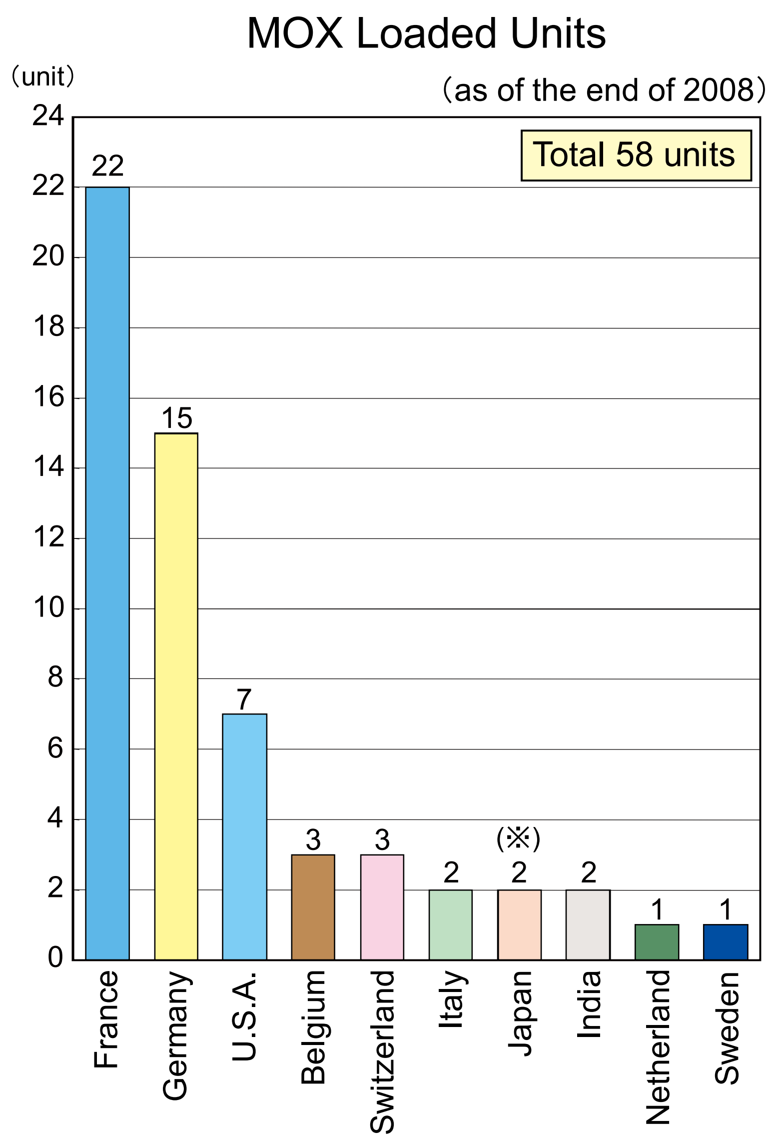
Flow of Reprocessing

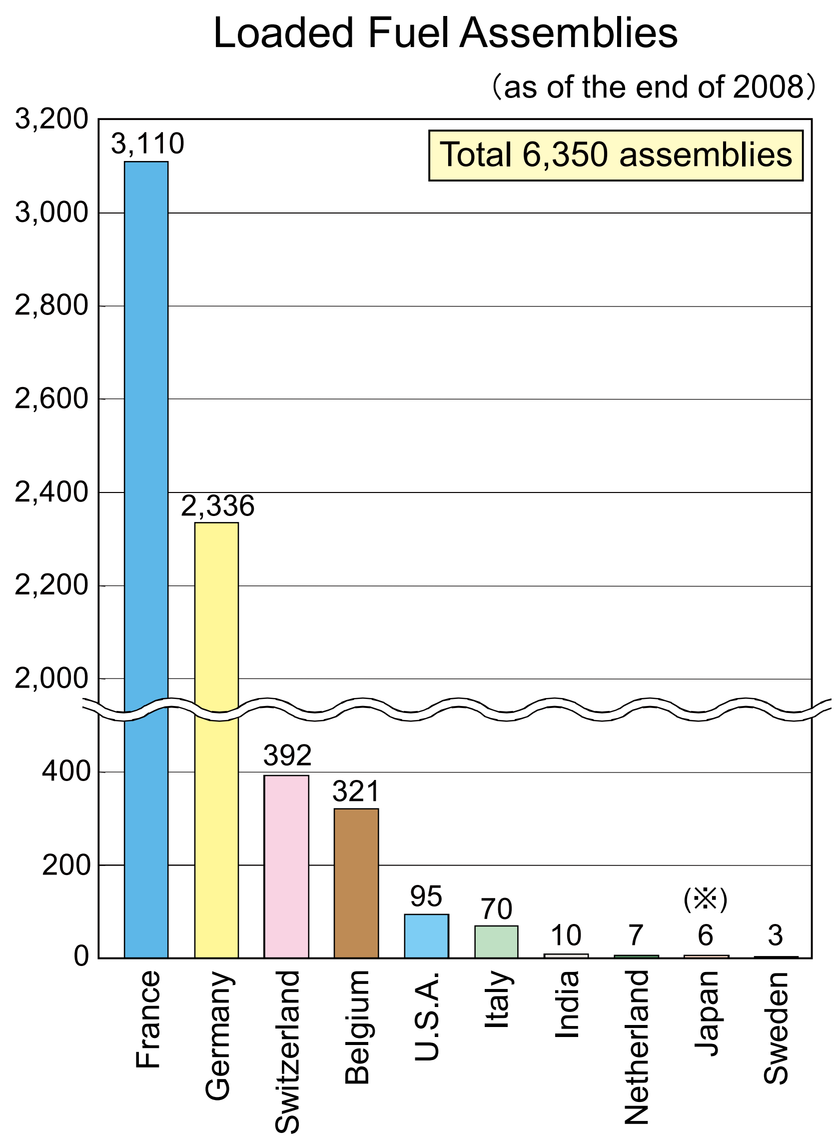


Uranium Plutonium Fission products (High-level radioactive wastes) Metal Chips, etc.

Source: Japan Nuclear Fuel Ltd.

MOX Fuel Use in LWRs in the World





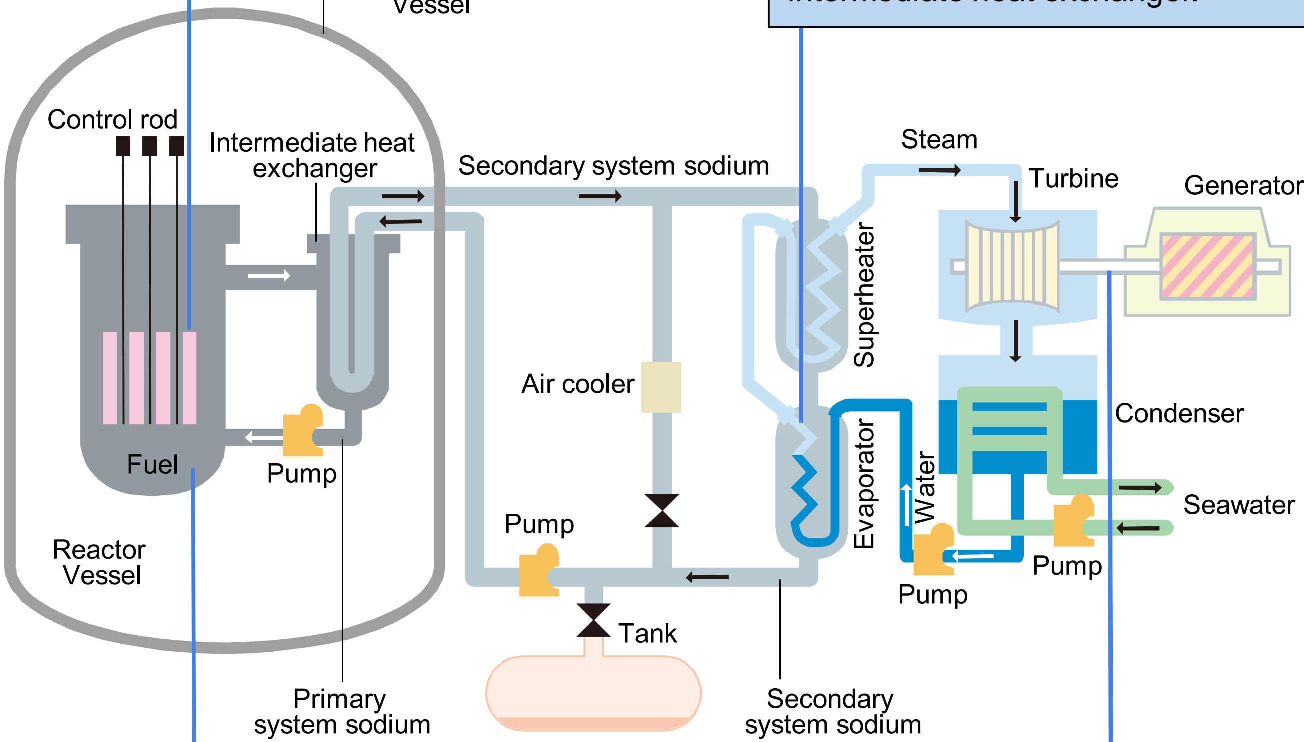
(Note) In Japan, Fugen, an advanced thermal reactor (ATR), loaded 772 MOX fuel assemblies. (Fugen was closed down in March 2003)
As of December 2008, MOX fuels were loaded in 21 plants in France, 10 plants in Germany, 3 plants in Switzerland, 2 plants in Belgium and 1 plant in U.S.A.
(※) Further total 64 MOX fuel assemblies have been loaded into 3 reactors on and after December 2009.

Source: Agency for Natural Resources and Energy "NUCLEAR ENERGY 2010" etc.

Mechanism of Fast Breeder Reactor (FBR)

Mixture of uranium and plutonium fuel is loaded in the reactor.

Heat generated in the reactor is transmitted to liquid metal sodium in the other system (secondary system sodium) via the intermediate heat exchanger.



FBR uses liquid metal sodium (primary system sodium) with high heat conductivity as the coolant.

Heat conducted by sodium converts water to steam which drives the turbine.

Source: Ministry of Education, Culture, Sports, Science and Technology

Amount of Spent Fuel to be stored

（unit: t-U）

Items / Period	FY1997-2010	FY2011-2020
Spent Fuel from NPPs（a）	14,000	13,500

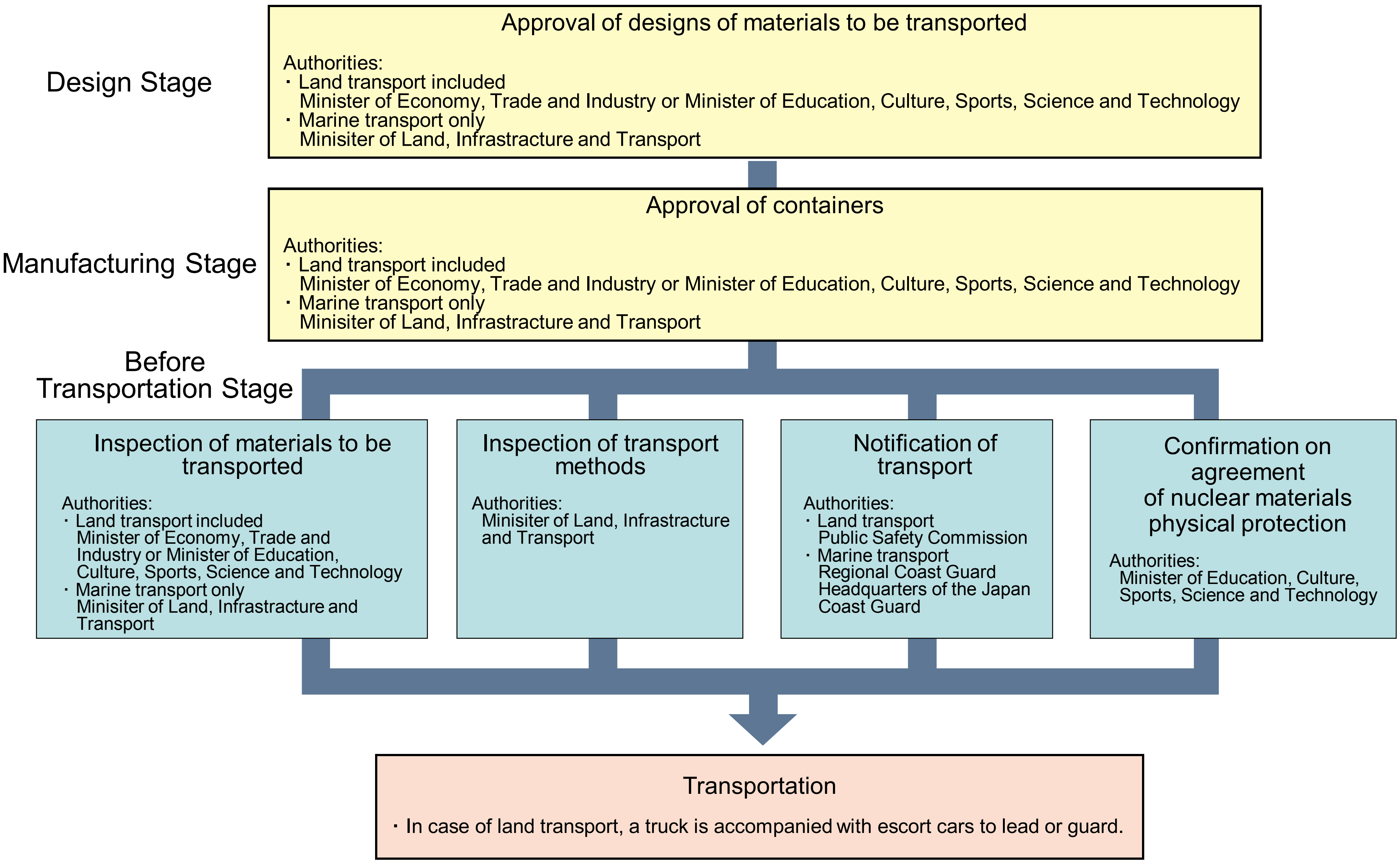
Shipped to the Rokkasho Reprocessing Plant（b）	6,700	8,000
Shipped to overseas countries（c）	70	0
On-site Storage（d）	2,900	2,800
Amount for which storage measures are needed（a-b-c-d）	4,400	2,700

Accumulated amount for which storage measures are needed	4,400	7,100

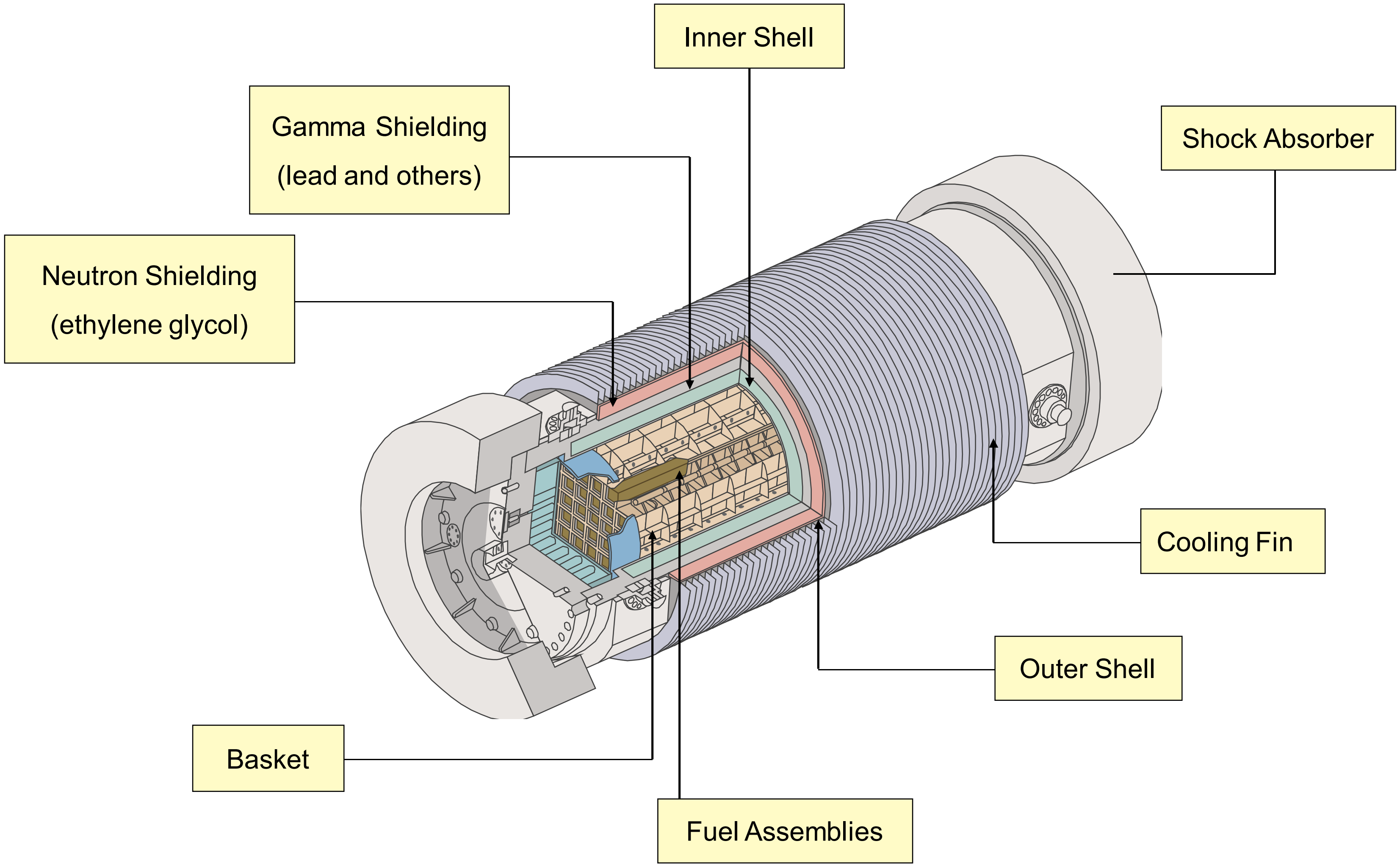
(Note) 1. Each entry represents a total during an indicated period.
2. Figures may not add up to the totals due to rounding.

Source: Agency for Natural Resources and Energy

Safety Regulation Flow of Nuclear Fuel Transport



Transport Casks for Spent Fuel



(Note) Figure shown is HZ used for domestic transport.

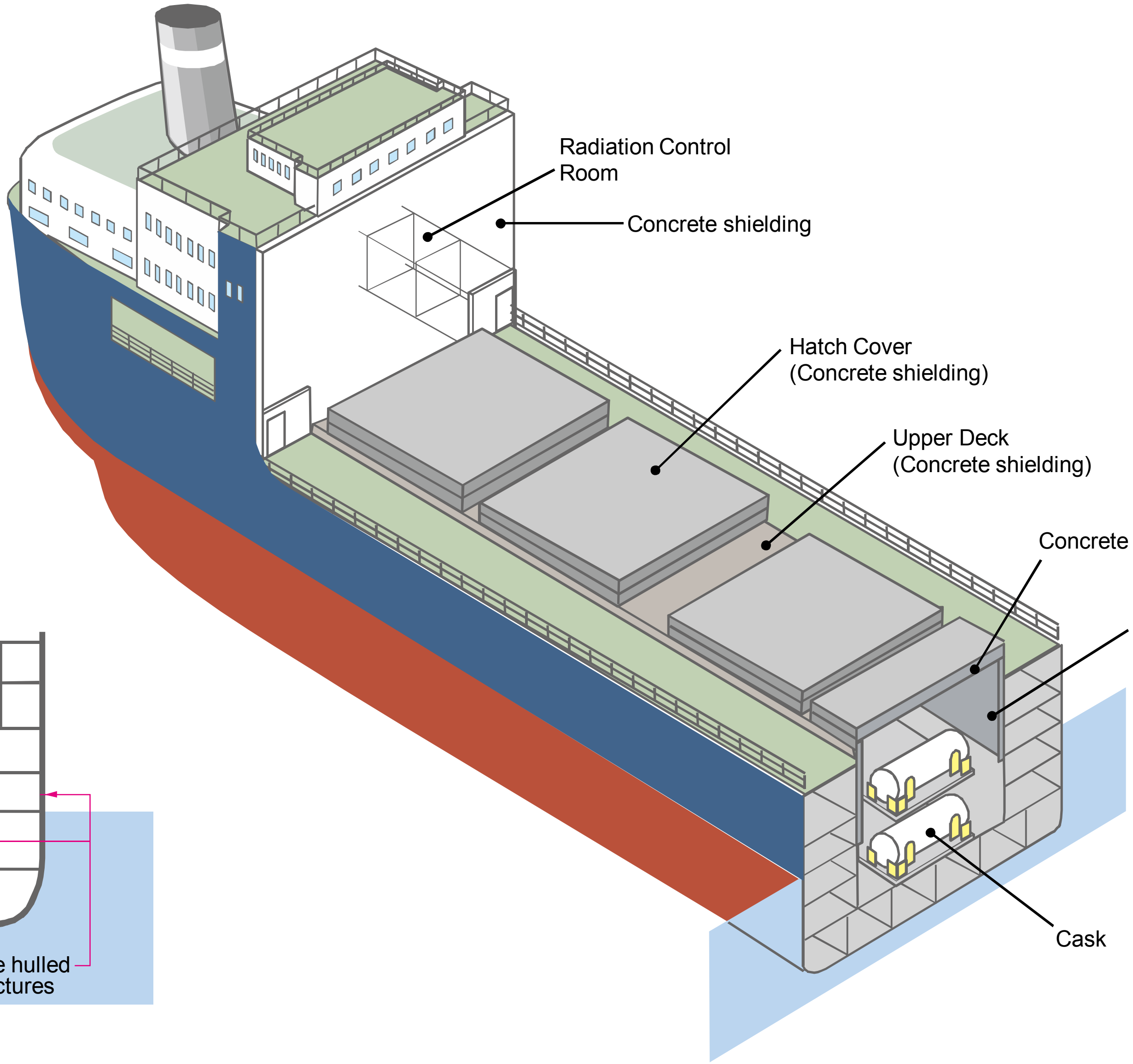
Source: Nuclear Fuel Transport Co., etc.

Transport Vessels for Spent Fuel

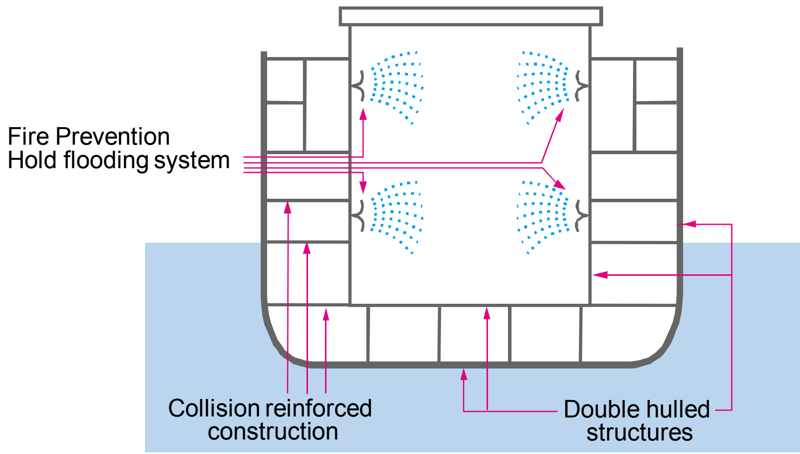
（1） Securing safe navigation
- Collision prevention radar, etc.

（2） Safe structure
- Double hulled structures
- Enhanced buoyancy

（3） Fire preventions
- Hold flooding system, etc.



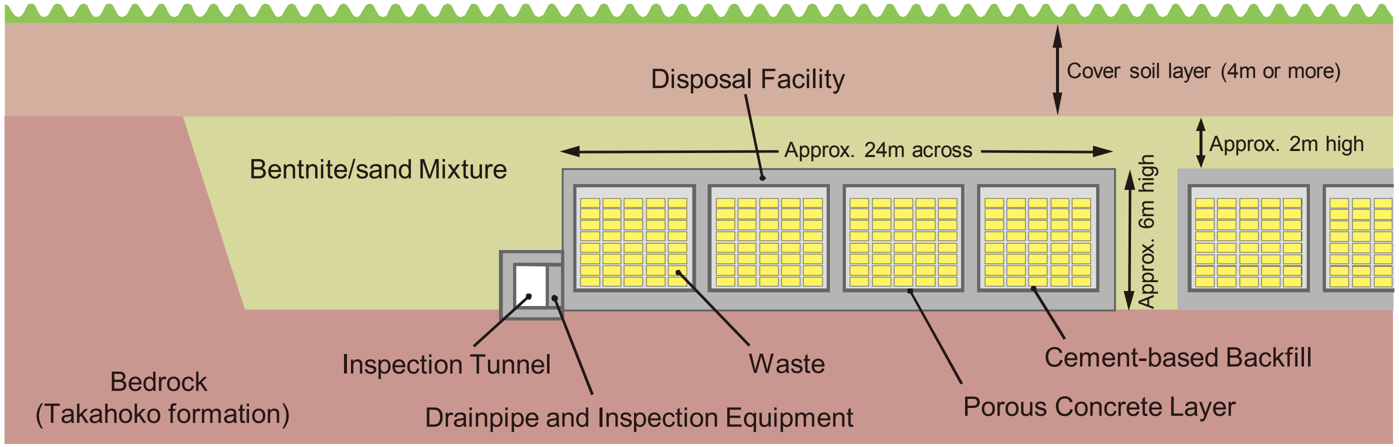
Cross Section



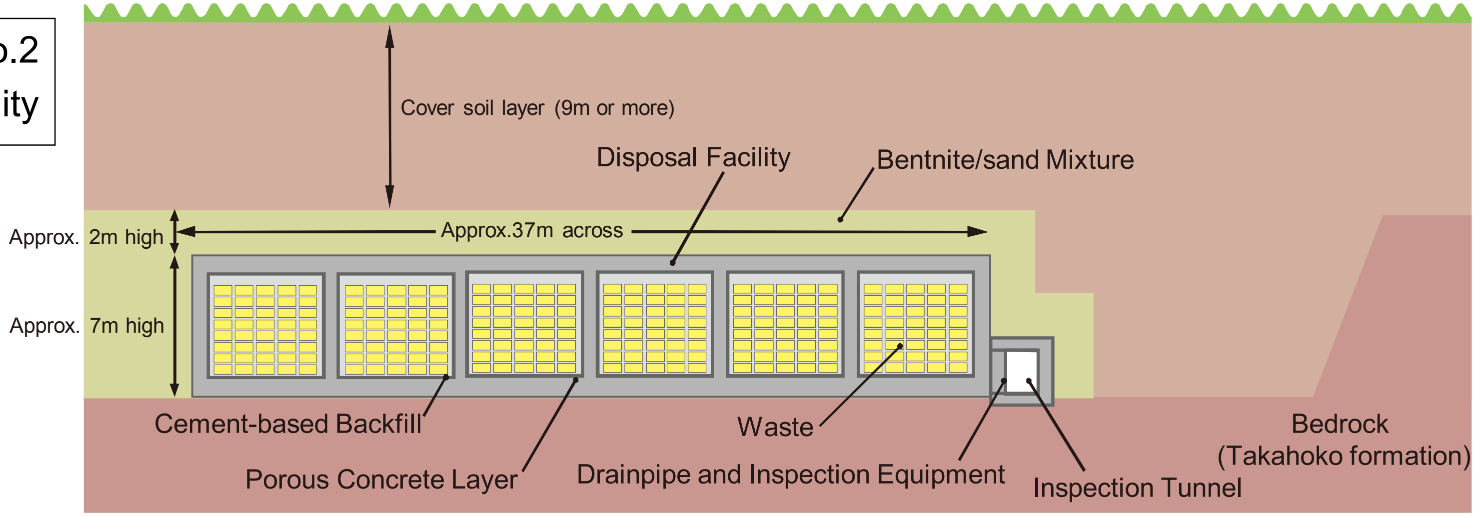
Source: Nuclear Fuel Transport Co.

Structure of Low-level Radioactive Waste Disposal Facility

Structure of No.1 Disposal Facility

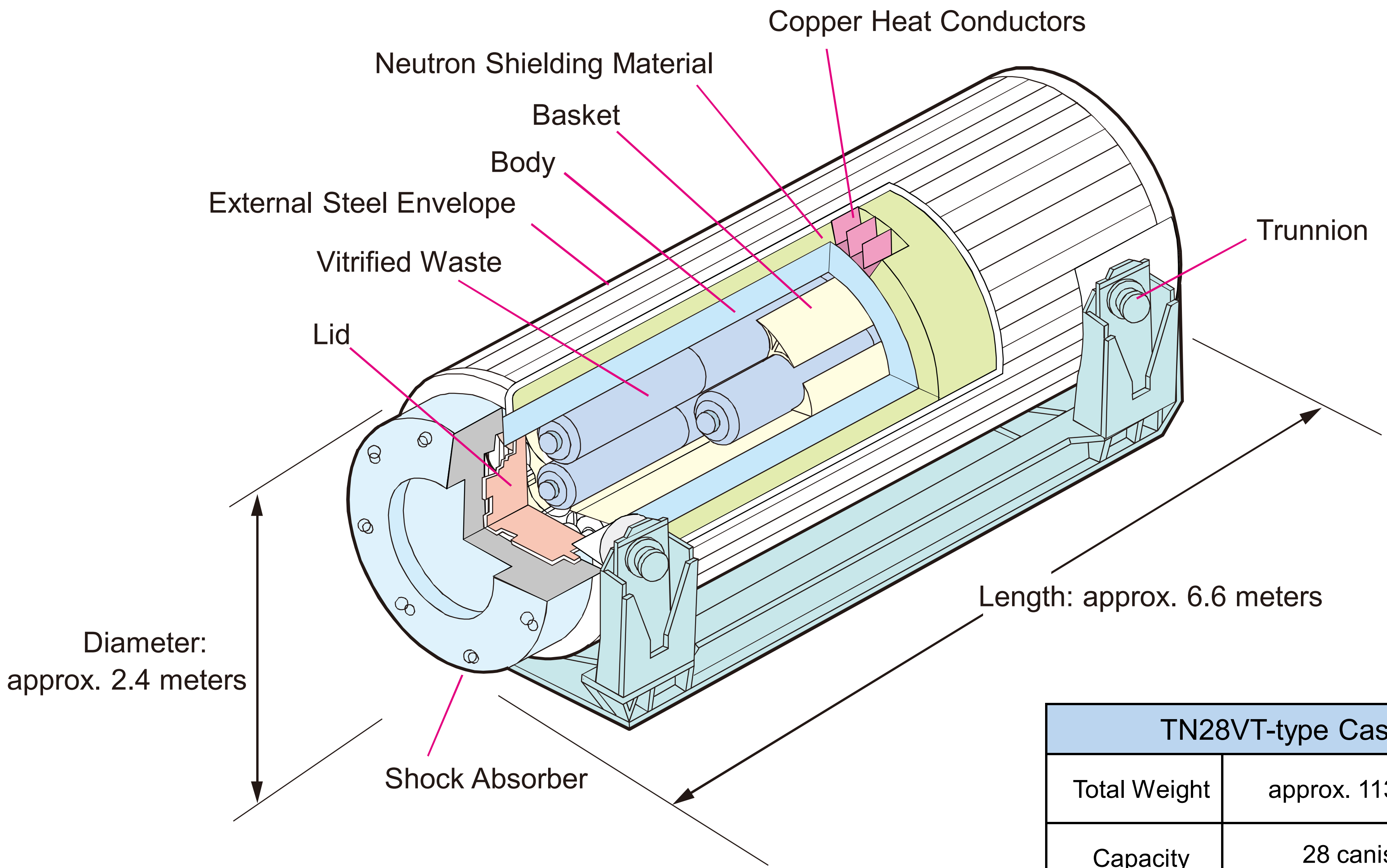


Structure of No.2 Disposal Facility



Source: Japan Nuclear Fuel Ltd.

Transport Casks for High-level Radioactive Waste (Vitrified Waste)



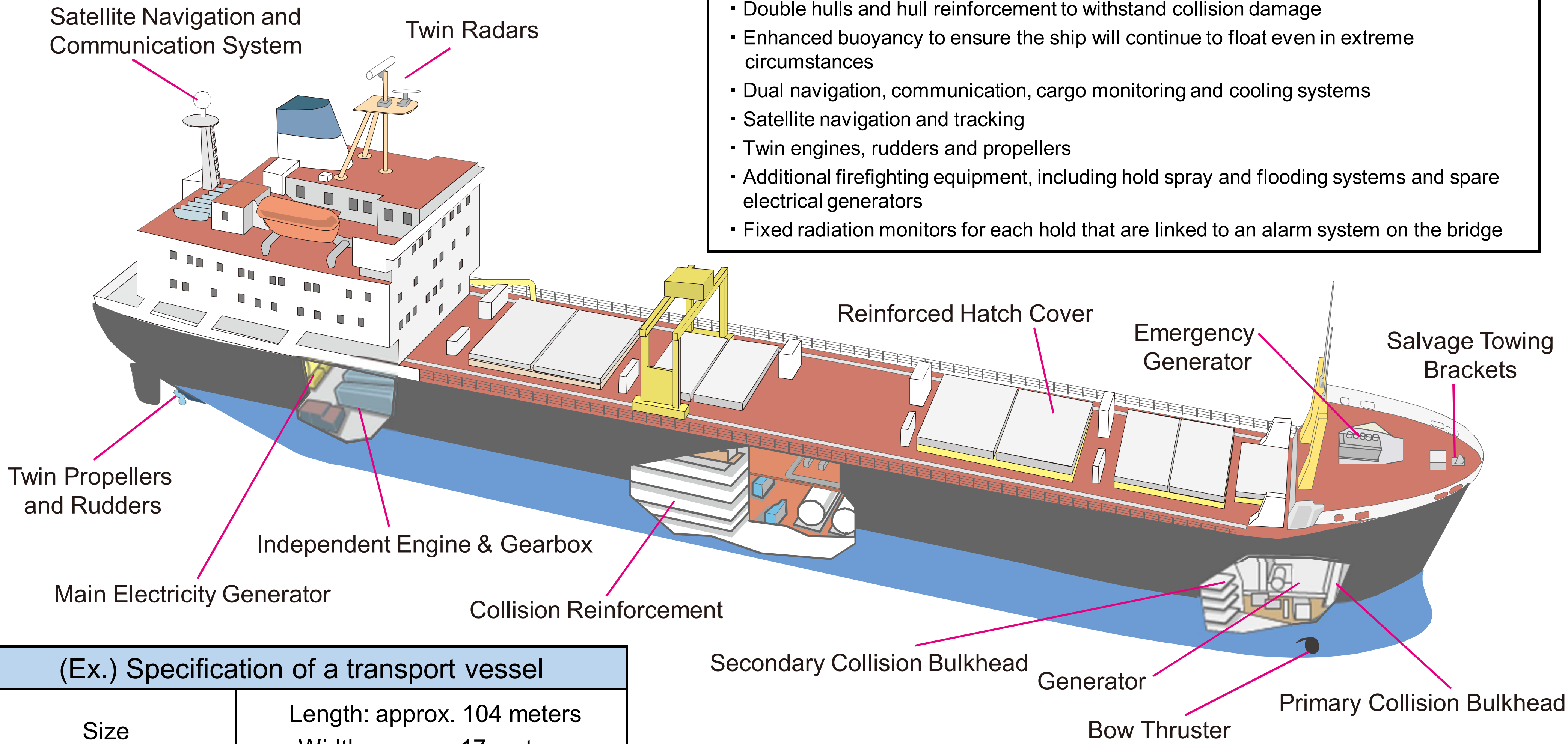
TN28VT-type Cask	
Total Weight	approx. 113.5 tons
Capacity	28 canisters

Source: The Federation of Electric Power Companies

Transport Vessels for High-level Radioactive Waste (Vitrified Waste)

Safety features of Transport Vessels for HLW (vitrified waste)

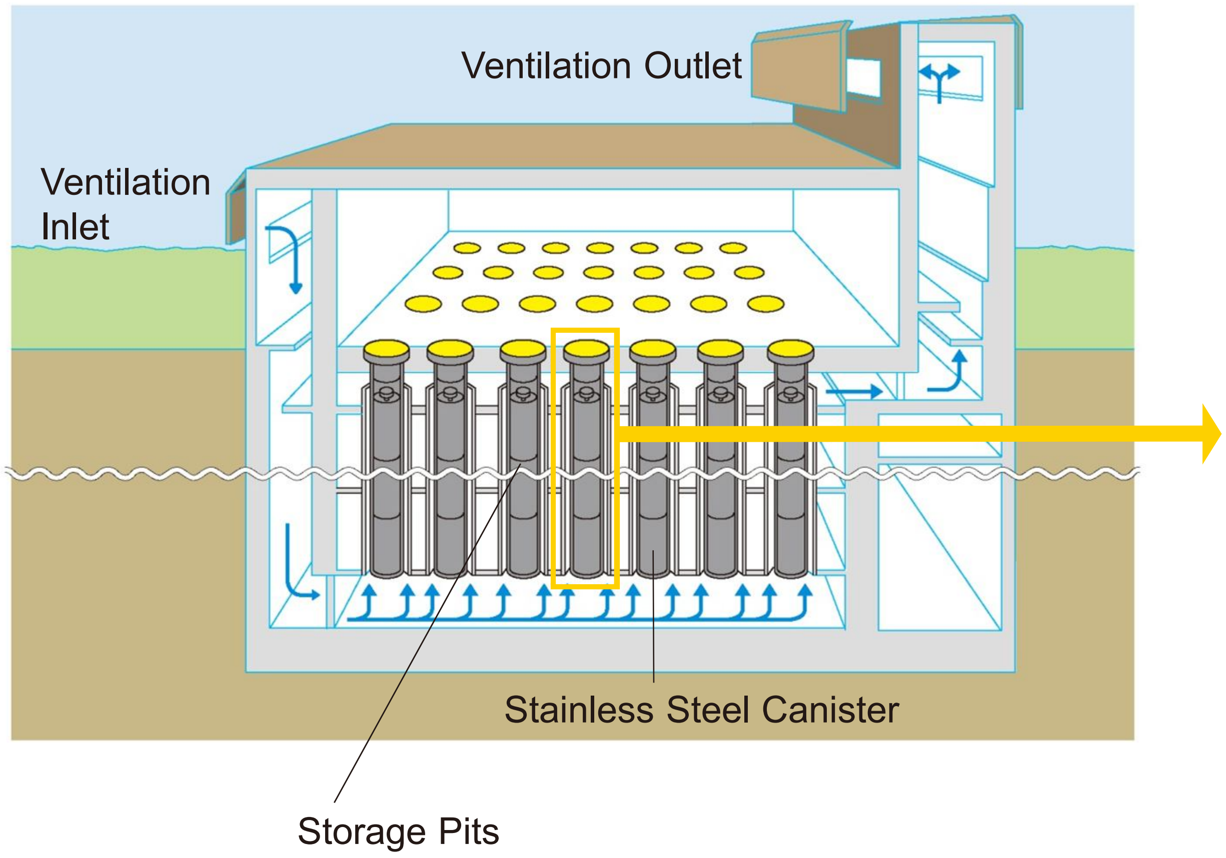
- Double hulls and hull reinforcement to withstand collision damage
- Enhanced buoyancy to ensure the ship will continue to float even in extreme circumstances
- Dual navigation, communication, cargo monitoring and cooling systems
- Satellite navigation and tracking
- Twin engines, rudders and propellers
- Additional firefighting equipment, including hold spray and flooding systems and spare electrical generators
- Fixed radiation monitors for each hold that are linked to an alarm system on the bridge



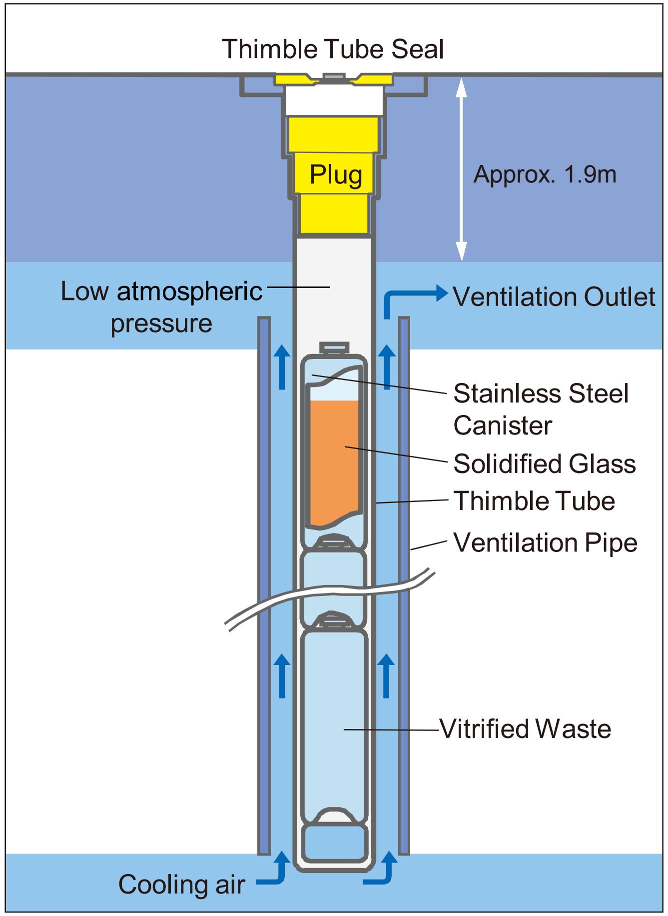
(Ex.) Specification of a transport vessel	
Size	Length: approx. 104 meters Width: approx. 17 meters
Gross Tonnage	approx. 5,000 tons
Deadweight	approx. 3,500 tons

Source: The Federation of Electric Power Companies

Temporary Storage for High-level Radioactive Waste (Vitrified Waste)



Enlarged image of storage pits



Source: Japan Nuclear Fuel Ltd.

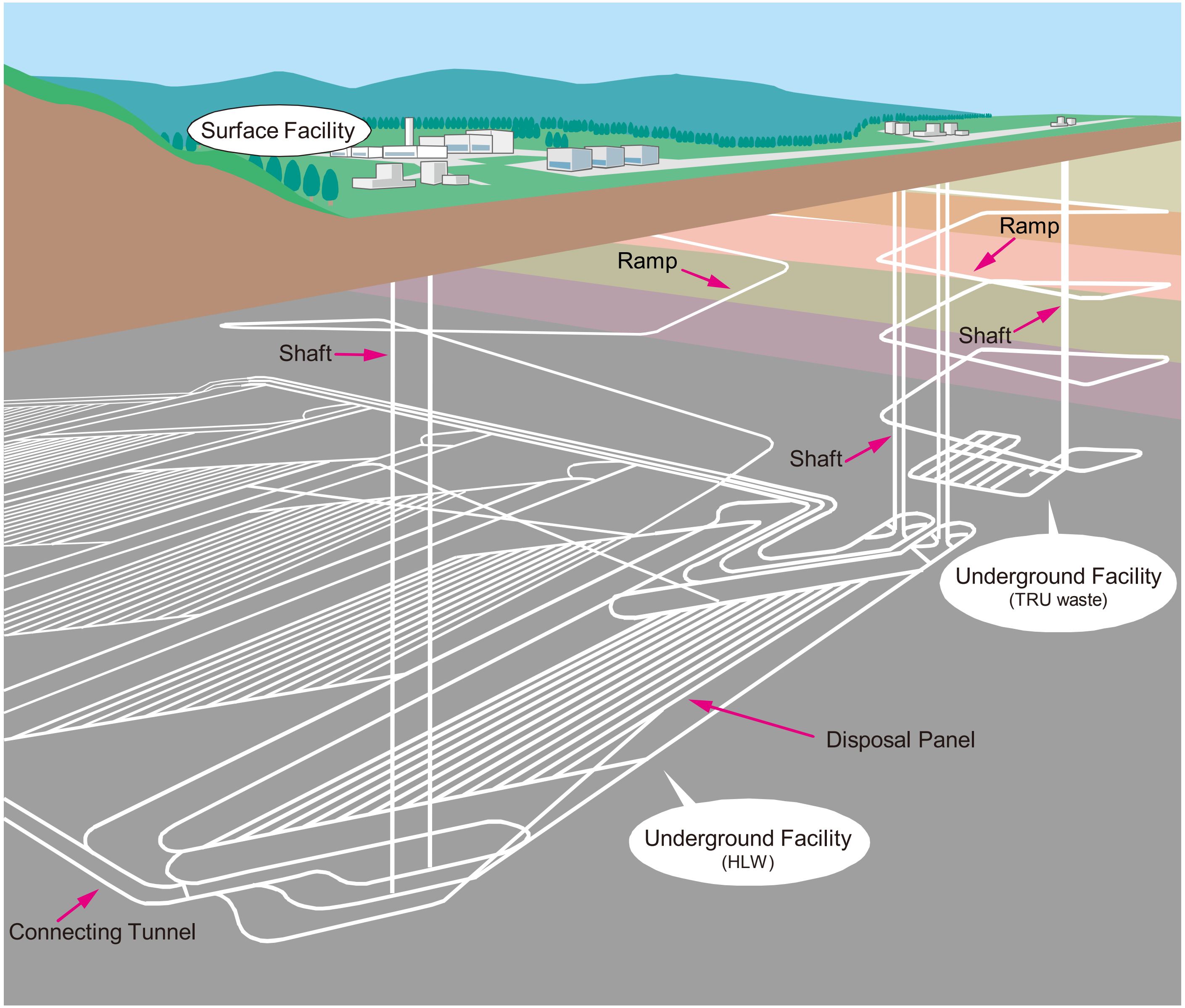
Geological Disposal of High-level Radioactive Waste

Example of layout in case of co-location with TRU waste* disposal facility

Example of specifications
(crystalline basement, depth of 1,000m)

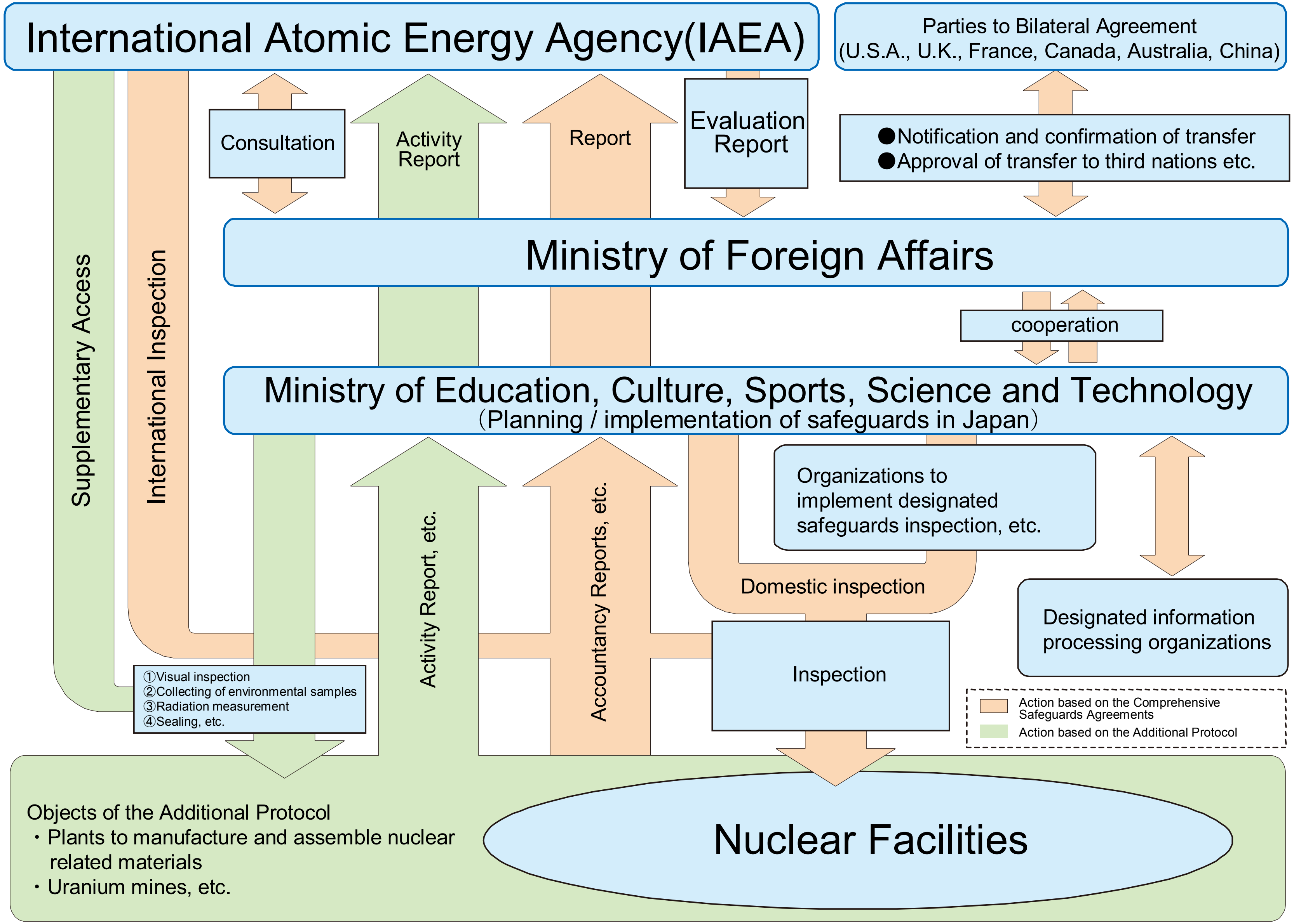
Surface Facility	Ground area: 1～2km²
Underground Facility for HLW	Disposal area: Approx. 3km x 2km
Underground Facility for TRU waste	Disposal area: Approx. 0.5km x 0.3km

(Note) * TRU waste: Low Level Radioactive Waste generated during reprocessing and MOX fabrication. HLW and some TRU waste require to be disposed in deep geological formation. "TRU" comes from transuranium elements, i.e. element with atomic numbers higher than that of uranium.



Source: Nuclear Waste Management Organization of Japan

Safeguards System in Japan



Source: Nuclear Material Control Center

Electric Power Development based on the Three Laws

①Law on Tax for Promotion of Electric Power Development

Tax rate
Until Sept.2003 JPY 0.445/kWh
Oct.2003 - Mar.2005 JPY 0.425/kWh
Apr.2005 - Mar.2007 JPY 0.40/kWh
Mar.2007 From JPY 0.375/kWh

①,② and ③ are called "Electric Power Development based on the Three Laws".

(Consumers)
↓
Electric Power Companies
↓
(Tax for Promotion of Electric Power Development)
JPY 330 billion ↓
General account
JPY 320.4 billion ↓

②Law on Special Accounts

Surplus from previous fiscal year, etc. → JPY 13.9 billion

Fund for developing surrounding areas → JPY 9.9 billion

Special Accounts for Energy Measures
Accounts for Promotion of Power Development
JPY 346.3 billion

Budget by Ministries
Ministry of Education, Culture, Sports, Science and Technology
JPY 141.1 billion
Ministry of Economy, Trade and Industry
JPY 205.1 billion

Measures for Electric Power Plant Location Accounts
JPY 0.19/kWh

- ○Development of power supply region
  - ・Development of infrastructure
  - ・Industrial development
- ○Emergency preparedness measures for power source region
- ○Promotion of public understanding of long-life fixed generation facilities
- ○Enhancement and strengthening of activities for harmonious coexistence in power supply regions
- ○Enhancement and strengthening of measures for nuclear emergency preparedness, environmental conservation and safety
- ○Measures for promotion of public understanding of nuclear power generation

Electric Power Generation Diversification Accounts
JPY 0.185/kWh

- ○Promotion of development of power generating facilities etc.
- ○Measures for smoother power supply
- ○Nuclear safety measures
- ○Promotion of research and development concerning the nuclear fuel cycle
- ○Promotion of advanced nuclear science and technology
- ○Securing the safety, and others

③Law on the Development of Areas Adjacent to Power Generating Facilities

Grant for to support power supply region

Financial support to smoothen construction and operation of power generation facilities

Grants for location electric power plants

Subsidy for supporting industrial development in power supply regions

Subsidy for development of power supply regions

and others

※ "Special Accounts for Promotion of Electric Power Development Acceleration Measures" and "Special Accounts for Petroleum and Sophisticated Structure of Energy Supply and Demand" were merged into "Special Accounts for Energy Measures" in FY2007. In that, "Accounts for Promotion of Electric power Development" succeed to the operation of "Special Account for Promotion of Electric Power Development Acceleration Measures ".
※ Since FY2007, the revenue from "Promotion of Power-resources Development Tax" has transferred to the annual revenue of general account. Necessary amount has been transferred from the general account to "Special Accounts for Energy Measures" each year.
※ The amounts are based on FY2010 budget.

Source: The Denki Shimbun "Nuclear Pocket Book FY2010"

Japan's Energy Policy

Outline of the "Basic Act on Energy Policy"

(enacted June 2002)

Provision of basic policies on energy supply and demand

1.Securing of stable supply (diversifying energy supply sources, increasing energy self-sufficiency ratio and achieving energy security)
2.Environmental suitability (preventing global warming, preserving local environment and achieving recycling-oriented society)
3.Utilization of market mechanisms (promoting deregulation measures while considering the above two political objectives)

Outline of "Basic Energy Plan"

(approved by the Cabinet and submitted to the Diet in October 2003)

1. Promotion of energy supply/demand measures
2. Development, introduction and utilization of diversified energy sources
   1) Development, introduction and utilization of nuclear energy
      - Nuclear power generation - to be promoted as the key power source
      - Promotion of nuclear fuel cycle - focusing on MOX fuel use in LWRs for the foreseeable future on condition of safety and nuclear nonproliferation
   2) Assurance of safety of and reliance on nuclear energy
   3), 4) and 5) Development, introduction and utilization of new energy sources, gas energy and coal
3. Assurance of stable oil supply, etc.

Revision of "Basic Energy Plan (the Strategic Energy Plan)" in 2010

(revised in March 2007 and in June 2010)

1. Basic Perspectives
   In addition to the three fundamental principles of national energy policy (energy security, environmental conservation and efficient supply), the Strategic Energy Plan of Japan focuses on new perspectives: economic growth based on energy and structural reform of the energy industry.

2. Targets for 2030
   1) To double the energy self-sufficiency ratio in energy supply and the self-developed fossil fuel supply ratio and, as a result, to raise the energy independence ratio from current 38% to about 70%
   2) To raise the zero-emission power source ratio from current 34% to about 70%
   3) To halve CO_2 emissions from the residential sector
   4) To maintain and to enhance energy efficiency in the industrial sector at the highest level in the world
   5) To maintain or to obtain top-class shares of global markets for energy-related products and systems

3. Specific measures to achieve the targets
   - Comprehensive efforts to secure resources and to enhance supply stability
   - Establishment of an independent and environmental-friendly energy supply structure
   - Establishment of a low carbon energy demand structure and building next-generation energy and social systems
   - Development and diffusion of innovative energy technologies
   - Promotion of international development in energy and environmental fields
   - Enhancement of international cooperation on energy
   - Promotion of mutual understanding with the public and development of human resources toward structural reform of the energy industry
   - Sharing roles among local governments, businesses and non-profit organizations, citizens' commitment, etc.

Source: Agency for Natural Resources and Energy, etc.

Outline of Basic Energy Plan (the Strategic Energy Plan)

Basic Perspectives

○The three fundamental principles of national energy policy (energy security, energy conservation and efficient supply)
○New perspective: economic growth based on energy and structural reform of the energy industry
○Fundamental changes in energy supply and demand system by 2030

Targets for 2030

1) To double the energy self-sufficiency ratio in energy supply and the self-developed fossil fuel supply ratio, and as a result to raise the energy independence ratio* from current 38% to about 70%

※ The "energy independence ratio" is an indicator that combines the self-sufficiency energy with the self-developed energy supply divided by total primary energy sources. An average energy self-sufficiency rate among the OECD countries is almost 70%.

2) To raise the zero-emission power source ratio from current 34% to about 70%
3) To halve CO_2 emissions from the residential sector
4) To maintain and to enhance energy efficiency in the industrial sector at the highest level in the world
5) To maintain or to obtain top-class shares of global markets for energy-related products and systems

Specific measures to achieve the targets

Comprehensive efforts to secure resources and to enhance supply stability

○Securing stable sources of energy supply
・Deepening strategic relationships with resource-rich countries through resource diplomacy by the prime minster and ministerial level and public-private partnership with the relevant industrial sectors
・Enhancing support for risk money for upstream concessions
・Raising self-sufficiency ratio of strategic rare metals (including recycling and alternative materials development) to more than 50%
○Maintaining domestic supply chain
○Strengthen contingency plans

Independent and environment-friendly energy supply structure

○Promoting nuclear power generation
・Building 9 new or additional nuclear plants (with the overall plant capacity utilization rate at about 85%) by 2020 and more than 14 (with the rate at about 90%) by 2030
・Improving the power source location subsidy system
・Achieving the nuclear fuel cycle establishment
○Expanding the introduction of renewable energy
・Expanding the feed-in tariff system
・R&D support, power grid stabilization and relevant deregulation
○Advanced utilization of fossil fuels
・Requiring to reduce CO_2 emissions of the plants to the IGCC plant levels in principle when planning to construct new coal fossil power plants
・Requiring new coal thermal plants for future planning to be CCS-ready
・Requiring coal thermal plants to be equipped with CCS technology by 2030, on the precondition of commercialization
○Enhancing electricity and gas supply systems
・Building the world's most advanced next-generation interactive grid network as early as possible in the 2020s
・Considering specific measures to double the electricity wholesale market in three years

Realization of a low carbon energy demand structure

○Industrial sector
・Enhancing the world's most advanced energy efficiency
・Promoting utilization of natural gas
○Residential sector (i.e. Households and Offices)
・Realizing net-zero-energy houses/buildings in average by 2030
・Replacing 100% of lights with highly-efficient lights (LED etc.) on a flow basis by 2020 and on a stock basis by 2030
○Transportation sector
・Raising next-generation vehicles' share of new vehicle's sales to up to 50% by 2020 and up to 70% by 2030
○Cross-sectional efforts
・Considering municipal-level energy use optimization policy measures etc.

Building next-generation energy and social systems

○Realizing the smart grid and smart communities by proceeding demonstration projects both home and abroad, promoting strategic international standardization and considering special zones（Realizing environmentally advanced city）
○Introducing smart meters and relevant energy management systems for all users, in principle, as early as possible in the 2020s
○Realizing a hydrogen-based society

Developing and diffusing innovative energy technologies

○Drafting a new energy innovation technology roadmap (within 2010) to accelerate the development of innovative energy technologies

Promotion of international development in energy and environmental fields

○Developing the public-private cooperation arrangements for supporting the international diffusion of highly efficient and low-carbon technologies
○Building a new mechanism to appropriately evaluate how Japan's international diffusion of its technologies, products and infrastructure contributes to reducing global greenhouse gas emissions

Enhancement of international cooperation on energy

Structural reform of the energy industry

Promotion of mutual understanding with the public and development of human resources

Sharing roles among local governments, businesses and non-profit organizations, citizens' commitment, etc.

Source: Agency for Natural Resources and Energy

Framework for Nuclear Energy Policy

Approved by Cabinet
in October 2005

〈Summary〉

Chapter 1

Basic Objectives

1. Strengthening the basic activities such as assurance of safety and guarantee of peaceful uses of nuclear energy
2. Contribution of nuclear power generation to the stable supply of energy and to measures against global warming
3. Contribution of radiation application technologies to the improvement of living standards of the people
4. Implementation of the most effective and efficient government initiatives

Common Principles of Future Approaches

1. Assurance of safety
2. Multilateral and comprehensive approaches
3. Simultaneous and parallel approaches: short-, medium-, and long-term
4. Emphasis on international partnership and cooperation
5. Emphasis on evaluation

Basic approach to the measures in each area

Chapter 3: Promotion of Utilization of Nuclear Energy

【Nuclear Power Generation】

Maintaining or increasing the current level of nuclear power generation (30-40% or more of the total electricity generation) even after 2030. In order to achieve this, the followings are set up as guidelines.

①Pursuing optimal utilization of existing NPPs and undertaking efforts in building new NPPs
②Preparing advanced models of the current LWRs for the replacement of existing NPPs
③Striving for the commercial use of FBRs from around 2050

【Nuclear Fuel Cycles】

Promoting the effective use of plutonium and uranium obtained by reprocessing spent fuel.
The surplus volume exceeding the capacity of the Rokkasho Reprocessing Plant will be stored at interim storage facilities.

【Utilization of Radiation】

Radiation application in the field of creation and production of new materials new and radiation therapy for cancer, etc.

Chapter 2 Strengthening the Basic Activities	Chapter 4 Promotion of R&D	Chapter 5 Promotion of International Approaches	Chapter 6 Improvement of Evaluations
○Assurance of safety ○Guarantee of peaceful uses ○Treatment and disposal of radioactive wastes ○Developing human resources ○Public hearing, public relations, coexistence with people/local community	○Promotion of research and development activities in different development stages in parallel. ○Selection and concentration	○Maintenance and strengthening of the nuclear non-proliferation regime ○International cooperation ○International development	○Evaluations of policies and responsibility of Japan Atomic Energy Commission

Source: Japan Atomic Energy Commission

Chart No.	Title	Summary of Contents
1-2	World Population Projections	World population in the year 2000 was 6.12 billion. It is forecast that the world's population will reach 9.15 billion by 2050, which is 1.5 times more than that of 2000, due primarily to the increase in developing countries.
1-3 1-4	World Population and Energy Consumption / Primary Energy Consumption per Capita	Although the population in China and India represented around 40% of the total world population in 2008, annual per capita primary energy consumption in both countries was below the global average. Japan with only 2% of the world's population consumed as much as 4% of the total primary energy used. Annual per capita energy consumption was equivalent to that in Europe.
1-6	Proved Reserves of Energy Resources	Considering the finite nature of energy resources and the future increase in energy consumption, securing energy resources remains a great challenge. With the intention of saving resources and energy, the prompt establishment of a nuclear fuel cycle to reuse plutonium and unburned uranium recovered from spent nuclear fuel is an important task.
1-7	The World's Primary Energy Consumption	Although world energy consumption is increasing as years go by, the growth in oil consumption has been moderated by positive use of alternative energy (nuclear energy and other forms) in advanced countries.
1-8	Primary Energy Consumption in Major Countries	The composition of primary energy consumption in major countries differs, depending on the situation in each country. Japan is one of the countries with a high dependence on crude oil. Another notable feature is that the composition of energy supplied from nuclear power is high (about 40%) in France.
1-10	Electricity Consumption per Capita in Major Countries	Per capita electricity consumption in Canada and the U.S.A. is high. Moreover, the U.S.A. & China consume approximately 40% of the world's total electricity.
1-11	Dependence on Imported Energy Sources in Major Countries	Compared to other major countries, Japan's energy supply structure is vulnerable because Japan imports approximately 80% of its energy resources (96% when nuclear energy is not included in domestic energy).
1-14	Changes of Japan's Primary Energy Supply Structure	Since the oil crisis in the 1970s, Japan has attempted to reduce its dependence on oil. However, oil still accounts for about 40% of the total primary energy supply. The increase in domestic energy ratio is covered largely by an increased use of nuclear energy.
1-15	Historical Trend of Japan's Primary Energy Supply	Japan's primary energy supply has been almost constant in recent years and heavily depended on oil even after the oil crises in the 1970s.
1-16	Japan's Fossil Fuel Imports by Country of Origin	Japan imports around 90% of its crude oil from Middle Eastern countries and imports coal mainly from Australia and liquefied natural gas (LNG) from Southeast Asian nations.
1-17	Japan's Dependence on Middle East Crude Oil of Total Imports	Japan's dependence on Middle Eastern crude oil had decreased to 67.9% in the late 1980s. However, since then it has increased and is now at the same level as prior to the oil crises in the 1970s.

Chart No.	Title	Summary of Contents
1-19	Japan's Results and Prospects of Power Generation Volume by Source	Power generation volume has been increasing year by year. Electric power companies have strived to meet power demand growth mainly by introducing nuclear energy and liquefied natural gas (LNG).
1-20	Power Facilities Development Plan	New power plants with a generation capacity of about 20GW will be required to meet power demand by 2019.
1-23	Optimal Combination of Power Sources	Because Japan imports most of its energy resources, it is crucial not to depend on any particular energy source, but to seek an optimal combination of power sources in order to make the best use of the characteristics of each power source. Electric power companies currently use nuclear power for their base-load, because it excels in stability of generation cost and fuel supply. Thermal and pumped storage hydroelectricity adjust the total supply to meet demand fluctuations.
2-1	Mechanism of Greenhouse Effect	Greenhouse gases such as CO_2 absorb infrared rays (heat) radiated from the ground and return part of the heat to the ground, while easily transmitting sunlight with short wavelengths. Accordingly, as CO_2 concentrations increase, infrared rays which cannot be released to outer space increase the ground temperature.
2-2	Contribution of Greenhouse Gases to Global Warming	Global warming is thought to be caused by increases in greenhouse gases generated from burning fossil fuels. In particular, increased CO_2 emissions have the highest contribution.
2-3	Changes in CO_2 Emissions from Fossil Fuels and Atmospheric CO_2 Concentration	Atmospheric CO_2 concentration has risen dramatically since the Industrial Revolution due to the burning of large volumes of fossil fuels.
2-4	Historical Trends in World's CO_2 Emissions	Worldwide CO_2 emissions in 2007 were about 2 times higher than they were in 1971. This increase of CO_2 emissions is mainly due to rapid emission growth in Asia (especially in China and India.). In Japan's case, CO_2 emissions in 2007 have increased 1.1-fold over 1990, the baseline year set in the Kyoto Protocol.
2-8	Kyoto Protocol Targets and Current Status of GHG Emissions	The Kyoto Protocol directed developed countries to reduce overall CO_2 equivalent emissions of greenhouse gases by at least 5% between 2008 and 2012 against 1990 level, and reduction target of each country was determined respectively.
2-9	Lifecycle Assessment CO_2 Emissions Intensity for Japan's Energy Source	Nuclear power emits less CO_2 per kWh than most of other energy sources, including renewable energy such as photovoltaic and wind power as well as coal, oil and LNG-fired plants.
2-11	Japan's Changes in CO_2 Emissions by Sector	The industrial and transportation sectors accounted for about 54% of Japan's CO_2 emissions in FY2008. The emissions from households and offices/commercial buildings (business sector) have increased from the 1990 level.
2-12	Changes in GHGs Emissions in Japan	Emissions (preliminary) of greenhouse gases in FY2008 exceeded approx. 2% in that of the 1990 level.

Chart No.	Title	Summary of Contents
2-13	Increase/Decrease in CO_2 Emissions by Sector	CO_2 emissions by the industrial process sector (cement manufacturing, etc.) and industrial sector have fallen below the 1990 level through continuous efforts to reduce emissions. Emissions from other sectors are increasing. In 2008, however, CO_2 emissions decreased from the previous year due to the decrease of energy demand following the economic recession.
2-14	Changes in CO_2 Emissions by Energy Source	Although CO_2 emissions from oil resources have decreased over 1990, they still accounted for about 46% of total emissions from energy sector in FY2008 in Japan.
2-15	Measures by Japan’s Electric Power Industry to Reduce CO_2 Emissions	In order to reduce CO_2 emissions, the electric power industry will actively takes various measures such as those on the electricity supply and demand sides in addition to R&D and international efforts.
2-16	Historical Trends in CO_2 Emissions from Electricity Production in Japan	The introduction of nuclear power has contributed to a decrease in CO_2 emissions intensity. In FY2009, increasing the availability factor of nuclear power facilities due to some units at the Kashiwazaki-Kariwa Nuclear Power Station reconnected to the grid, and decreasing of electricity demand caused of economic recession contributed to decrease total CO_2 emissions compared to those in FY2008.
2-17	Thermal Efficiency and T&D Loss Factor in Japan	In Japan, introduction of combined-cycle power generation and other efforts have improved thermal efficiency in order to reduce CO_2 emissions from thermal power plants. Japan’s electric power industry has been managing electric power facilites effectively. As a result, transmission and distribution loss have been decreasing year by year.
2-18	Comparison of CO_2 Emissions Intensity by Country	Those countries that utilize more hydroelectric and nuclear power emit less CO_2 from generation. This trend is especially significant in France where the composition of nuclear is high (about 80%).
2-19	Suppression Effect of CO_2 Emissions	In Japan, introduction of nuclear power has contributed to a CO_2 emissions reduction of about 30% (185/671 million tons of CO_2).
2-21	SOx and NOx Emissions per Unit of Electricity Generated in Major Countries	Compared to other nations, thorough combustion control at thermal power plants has made Japan’s SOx and NOx emissions per unit of electricity generated extremely low.
3-1	What is New Energy?	Renewable energy such as solar, wind, biomass, geothermal, and hydraulic is an energy derived from natural process and is supplied inexhaustibly. “NewEnergy” is defined as a part of renewable energy which needs support for the dissemination.
3-2	Evaluation & Problems of New Energy	Although new and renewable energy sources are inexhaustible as well as environmentally friendly, they have several drawbacks such as low energy density, instability of supply and uneconomical performances in comparison to conventional energy sources.

Chart No.	Title	Summary of Contents
3-3	Current Status of Photovoltaic and Wind Power	The costs of photovoltaic and wind power are currently high. In addition, due to a low energy density (requiring vast areas for large-volume generation), both power sources are not suitable for large-scale power generation but are usable as small-scale, dispersed power sources in remote areas.
3-5	Photovoltaic Power Generation Capacity in Japan and the World	More photovoltaic power has been introduced in Japan every year and Japan's share accounts nearly one eighth of the world's total capacity.
3-6	Wind Power Generation Capacity in Japan and the World	More wind power has been introduced in Japan every year.
3-8	Mechanism of Heat Pump and its CO_2 Reduction Effect	Heat pump is a system for gathering heat from the air utilizing the Boyle-Charle's law (the volume of gas is directly proportional to the absolute temperature and inversely proportional to the pressure). If heat pump systems are spread through air conditioning and hot water supplying in Commercial and Residential sector, and drying processes and air conditioning in Industrial sector, it would allow CO_2 emissions to be suppressed by max. 130 million t- CO_2 per year. This is equivalent to approx. 10% of Japan's total CO_2 emissions.
3-10	Mega Solar Power Generation Plant Projects in Japan	Mega solar is a large-scale solar power plants which has a capacity of 1,000-20,000kW. The 10 power companies released plans to build Mega Solar Power Plants with at a total capacity of about 140MW at around 30 sites throughout the country by 2020.
3-11	Basic Concept of Smart Grid in Japan	Smart Grid in Japan is a next-generation electric power transmission and distribution technology. With the high dissemination goals for photovoltaic generation by government aiming for the realization of a low-carbon society, the electric utility industry is advancing government-subsidized research on evaluation of the effect of the large-scale expansion of photovoltaic generation on the power system and measures to stabilize the power system using battery storage system.
4-1	Comparison of Various Fuels Required to Operate a 1GW Power Plant per Year	Nuclear power can generate a large amount of energy from a small amount of uranium fuel. It is also superior in terms of transportation and storage.
4-2	Proved Reserves and Japan's Procurement of Uranium	Uranium is superior in stability of supply because it is supplied mainly by politically stable countries.
4-3	Generation Costs per kWh (sending end)	Nuclear power generation is as economical as other sources.
4-4	Nuclear Power Plants in Japan	As of the end of March 2010, 54 commercial nuclear power reactors were in operation in Japan, with a total generation capacity of 48,847MW.
4-5	Generating Capacity of Nuclear Power Plants in Major Countries	As of January 1, 2010, 432 nuclear power plants were in operation, with an additional 140 planned or under construction. Japan has the world's third largest nuclear power capacity, following the U.S.A. and France.

Chart No.	Title	Summary of Contents
4-6	Power Generation Composition by Source in Major Countries	Each country has a different combination of power sources, depending on the abundance and type of domestic energy resources. Since Japan is deficient in energy self-sufficiency and is an island nation, it has tried to diversify power sources to improve its energy security.
4-7	Electricity Generated and Share of Nuclear Power in Major Countries	The U.S.A. generates the most electricity in the world. And also, the U.S.A. has 104 nuclear power plants in operation. China, the second place, generates more electricity from coal than total power output of the world's number three, Japan.
5-20	Periodic Safety Review of Nuclear Power Plant and Measures for Aging Management	Before 30 years after commissioning the nuclear power plant, the utility implements the technical review for plant life management and establishes 10-year maintenance plan. After national government approves the plan, the utility draws up the additional maintenance program based on the maintenance plan. The technical review and long term maintenance plan is revised every 10 years with introducing the up-to-date technical information.
5-21	Aseismic Measures Taken by Nuclear Power Plants	Sufficient safety measures are taken at every stage of design, construction and operation of nuclear power plants.
5-23	Revised Regulatory Guide for Reviewing Seismic Design of Nuclear Power Reactor Facilities	The Nuclear Safety Commission issued the revised "Regulatory Guide for Reviewing Seismic Design of Nuclear Power Facilities" on September 2006, which specified more detailed formulation of assumable ground motion as Design Base Earthquake Ground Motion (DBGM).
5-28	Historical Trends in Reported Incidents and Failures at NPPs in Japan	The number of reported incidents and failures of nuclear power plants in Japan has been decreasing since 1981. Due to the revision of the Law on the Regulation of Nuclear Source Material, Nuclear Fuels Material and Reactors in October 2003, quantification and clarification of reporting standard of incidents and failures have been reinforced and notification standards now comply with statutory standards.
5-30	Unplanned Automatic Scrams per 7,000 Hours Critical in Major Countries	Nuclear power plants in Japan have experienced fewer unplanned automatic scrams than those in other major countries.
5-31	Historical Trends in Capacity Factors of NPPs in Major Countries	Considering that Japanese nuclear power plants are required to undergo a government inspection almost once a year, capacity factor reflects good operational performance. In 2003, capacity factor decreased considerably due to longer shutdowns for inspection arising from maintenance problems at nuclear power plants. In addition, the interval of government inspection of each power plant can be set according to the characteristic of the plant since January 1, 2009.

Chart No.	Title	Summary of Contents
5-34	Causes of the Accident at Chernobyl NPP	The Chernobyl accident occurred due to various reasons, such as design defects, operators' violating regulations, and operational mismanagement. The lack of a safety culture is thought to be the basis of these problems. Safety culture is the philosophy that all individuals and organizations involved in the nuclear industry or studies should give top priority to safety.
5-45	Disaster Prevention Systems during Nuclear Emergencies	In response to the JCO's critical accident, a new law (Special Law of Emergency Preparedness for Nuclear Disaster) was enacted on June 16, 2000 to strengthen existing nuclear disaster prevention measures. The reinforced points of the new law are: (1) to establish a system by which central and local governments are unified to immediately cope with the situation; (2) to establish bases (off-site centers) where emergency measures can be taken in areas where nuclear power plants are located; and (3) to specify the role of nuclear operators in nuclear disaster prevention.
5-48	Nuclear Damage Compensation System	In principle, nuclear operators are liable for all damages caused by accidents in nuclear power plants. The operators are legally bound to have insurance to compensate for any damages suffered. If compensation needs exceed insurance cover, the government will extend aid, pursuant to a Diet resolution.
6-14	Acute Radiation Effects	When a person is exposed to a large amount of radiation at one time, the effects vary in proportion with the quantity of radiation received.
6-17	Controls in a Nuclear Power Plant by Area	The site of a nuclear power plant is legally classified into three distinct areas: a controlled area, a protected area and a monitoring area.
6-18	Radiation Exposure Control for Radiation Workers	Radiation exposure is rigorously controlled in accordance with the predefined procedures for radiation workers in controlled areas.
6-19	Environmental Radiation Monitoring around Nuclear Facilities	Nuclear operators monitor environmental radiation around their facility and radioactivity in environmental samples in order to confirm that there is no harmful effect on the surrounding environment.
7-3	Nuclear Fission inside Light Water Reactors	In light water reactors, not only uranium 235 but also uranium 238 undergoes fission. Plutonium 239 is produced as a result of uranium 238 absorbing neutrons. About 30-40% of power output is generated by plutonium in light water reactors and plutonium recovered from spent fuel can be reused as fuel.
7-4	Utilization of Uranium Resources	Uranium and plutonium obtained by reprocessing are classified as quasi-domestic energy resources. Japan, which has a scarcity of energy resources, needs to reprocess spent fuel to ensure effective use of uranium resources. When JNFL's Rokkasho reprocessing plant goes into full-scale operation and the recovered uranium and plutonium are used in light water reactors, it will correspond to 70TWh of electricity annually.

Chart No.	Title	Summary of Contents
7-5	Nuclear Fuel Cycle	Spent fuel from nuclear power plants contains unburned uranium and plutonium that are produced during power generation. Both resources are recovered and used as fuel again.
7-6	Nuclear Fuel Cycle (Including FBR)	Fast breeder reactors can generate more fuel than is consumed during power generation. While striving to put FBR into practical use, it is planned to use plutonium (MOX-fuel-use) in light water reactors to ensure effective utilization of uranium resources.
7-9	Outline of JNFL's Nuclear Fuel Cycle Facilities	Four different types of facilities are under construction or in operation at Rokkasho: reprocessing; high-level radioactive waste storage; uranium enrichment; and low-level radioactive waste underground disposal. The reprocessing plant will commission in 2012 and a MOX fuel fabrication plant is scheduled to start its operation in 2016.
7-17	Flow of Reprocessing	The purpose of reprocessing is to recover residual unburned uranium and newly produced plutonium that are left in spent fuel.
7-24	MOX Fuel Use in LWRs in the World	European countries such as France, Germany, Belgium and Switzerland have loaded nearly 6,350 MOX fuel assemblies into LWRs over the last 40 years. The U.S.A. recommenced MOX fuel usage in 2005. In Japan, an advanced thermal reactor, Fugen (closed down in March 2003), had safely consumed a total of 772 MOX fuel assemblies apart from light water reactors.
7-25	Mechanism of Fast Breeder Reactor (FBR)	Fast Breeder Reactors can generate more fuel than is consumed during power generation. The prototype reactor "Monju" in Japan is capable of generating about 1.2 times the amount of fuel (plutonium) consumed during power generation.
7-27	Amount of Spent Fuel to be stored	Spent fuel is a valuable recyclable resource, because uranium and plutonium recovered by reprocessing of spent fuel can be reused. Judging from the outlook for spent fuel and the capacity of the reprocessing plant, interim storage facilities to store spent fuel will be required until it can be reprocessed.
7-30	Safety Regulation Flow of Nuclear Fuel Transport	Nuclear fuel is packed in transport containers that have been inspected by the government. The containers are shipped safely only after being checked several times.
7-32	Transport Casks for Spent Fuel	Spent fuel is transported in exclusive-use casks. The casks possess the ability to shield radiation and prevent radioactive materials from escaping in cases of collision or fire.
7-33	Transport Vessels for Spent Fuel	Vessels used exclusively to transport spent fuel are equipped with ample safety measures including double-hulls and double-bottomed construction to prevent foundering, even in case of collision or stranding.
8-7	Structure of Low-level Radioactive Waste Disposal Facility	Metal drums containing LLW are emplaced in the facility with various barriers and under strict control.

Chart No.	Title	Summary of Contents
8-10	Transport Casks for High-level Radioactive Waste (Vitrified Waste)	High-level radioactive waste is transported in exclusive-use casks. The casks can shield radiation and are designed and built robustly in accordance with national standards to ensure reliability in cases of severe accidents such as fire, collision or sinking.
8-11	Transport Vessels for High-level Radioactive Waste (Vitrified Waste)	Vessels used to transport high-level radioactive waste (vitrified waste) have the following features: (1) a double-hulled structure; (2) wide-ranging fire fighting equipment; and (3) radar installation.
8-12	Temporary Storage for High-level Radioactive Waste (Vitrified Waste)	HLW (vitrified waste) storage pits have many thimble tubes. Each thimble tube can store 9 vitrified wastes. Indirect natural air cooling system is employed, and cooling air ventilate outside of the thimble tubes not to contact the vitrified waste directory.
8-15	Geological Disposal of High-level Radioactive Waste	HLW will be disposed of in a stable geological formation at a depth of more than 300 meters. All disposal tunnels will be backfilled at the end and sealed up completely.
9-4	Safeguards System in Japan	Under the Treaty on the Non-proliferation of Nuclear Weapons (NPT), all nuclear facilities in Japan receive inspections by the International Atomic Energy Agency (IAEA) as well as the Japanese government to ensure that nuclear energy is only used for peaceful purposes.
9-6	Electric Power Development based on the Three Laws	The three laws consist of 1) the Law on Tax for Promotion of Electric Power Development, 2) the Law on Special Accounts, and 3) the Law on the Development of Areas adjacent to Power Generating Facilities. These laws were enacted to develop public facilities and other facilities in order to boost local industries and provide infrastructure for the convenience of local communities where nuclear, thermal and hydro power generation facilities stand.
9-12	Japan’s Energy Policy	The Basic Energy Plan (the Strategic Energy Plan), which was approved by the Cabinet in October 2003, clearly showed Japan’s energy policy to advance nuclear power generation as the key power source in order to develop diversified energy sources as well as promoting the nuclear fuel cycle.
9-13	Outline of Basic Energy Plan (the Strategic Energy Plan)	Based on the “Basic Act on Enegy Policy”, the basic plan for energy supply & demand and other measures to achieve the targets are established.
9-14	Framework for Nuclear Energy Policy	The Atomic Energy Commission of Japan established the Fundamental Principles for Nuclear Energy Policy and the Cabinet approved it in October 2005. It specified that (1) nuclear power will contribute 30-40% or more of Japan’s total generated electricity beyond 2030, (2) nuclear fuel cycle will be promoted steadily, (3) various use of radiation, and so on.