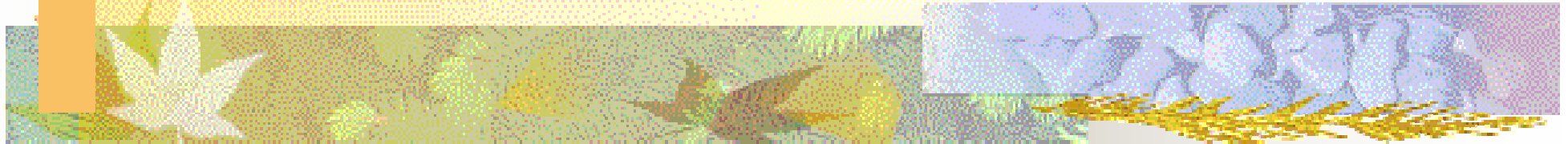




TOKYO ELECTRIC POWER COMPANY

# Electricity Market in Japan



July, 2004

Tokyo Electric Power Company (TEPCO)

for the Study Mission of the Japan Electric Association



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2. Electricity Liberalization
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# 1. Outline of Electricity Market in Japan

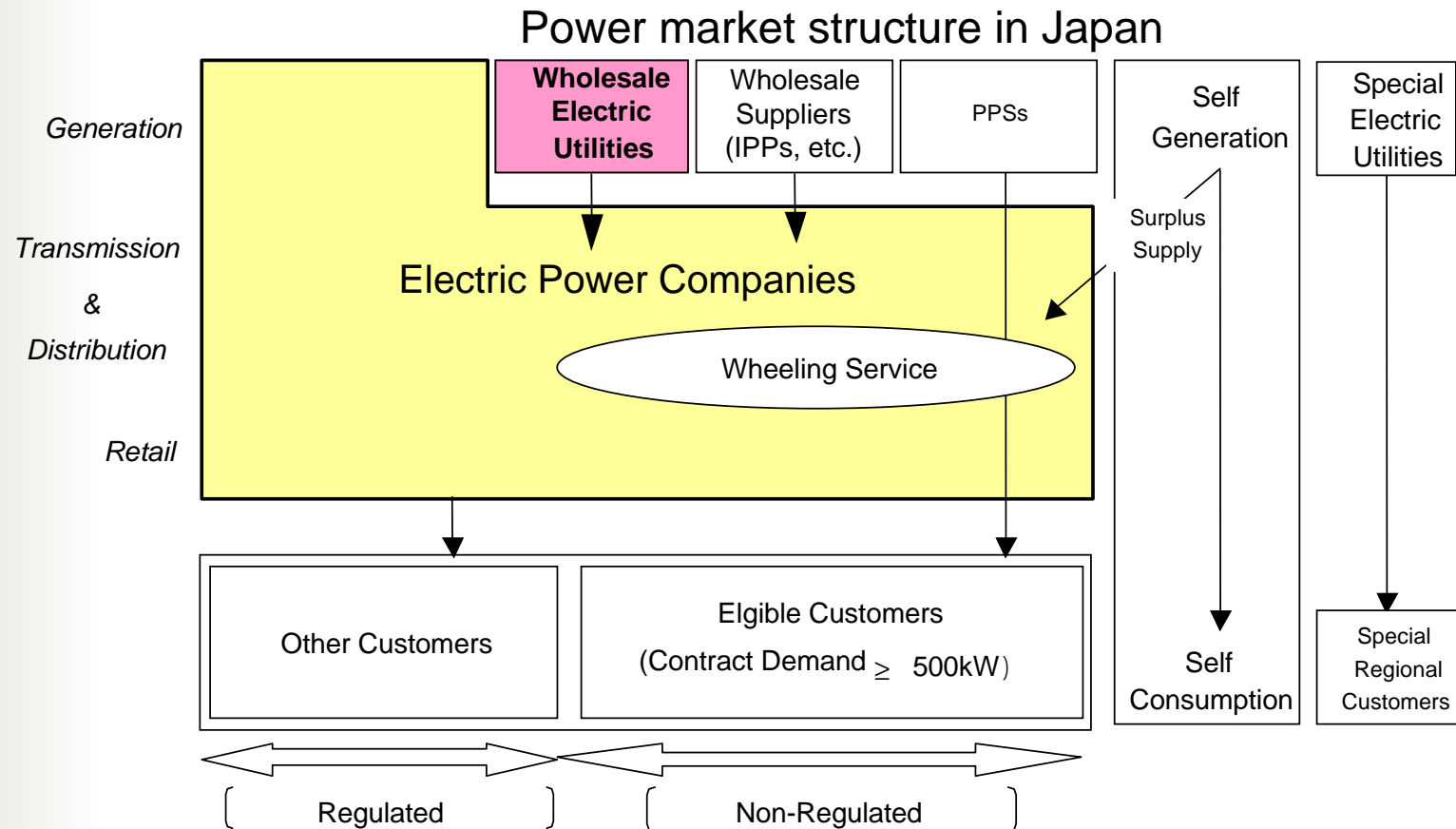
# The 10 Electric Power Companies & J-POWER

## ◆ 10 Power Electric Power Companies (EPCOs)

- Provide a retail supply through an integrated system including generation, transmission, and distribution.

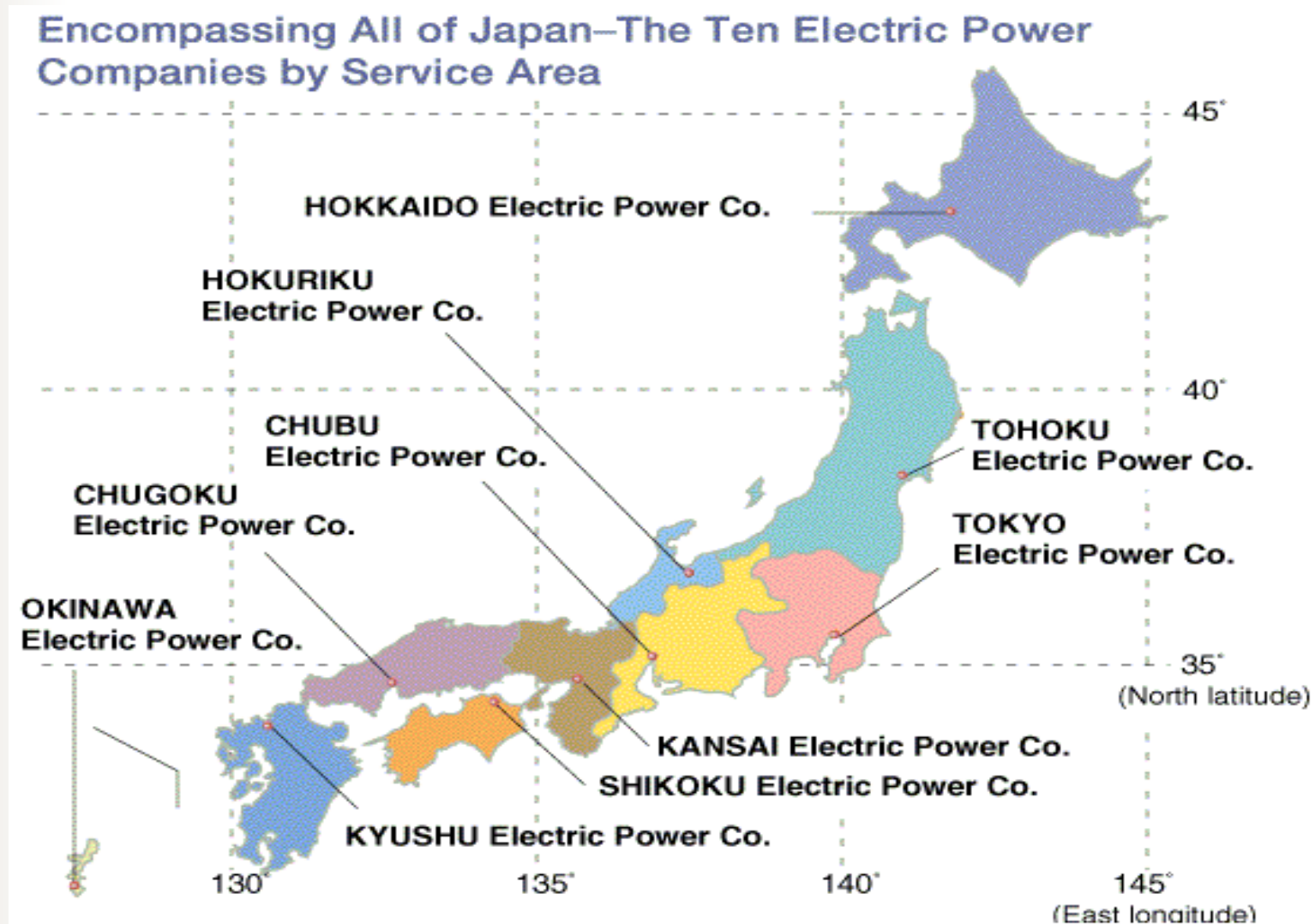
## ■ J-POWER

- Major Wholesale Electric Utility selling power on a wholesale basis to EPCOs.



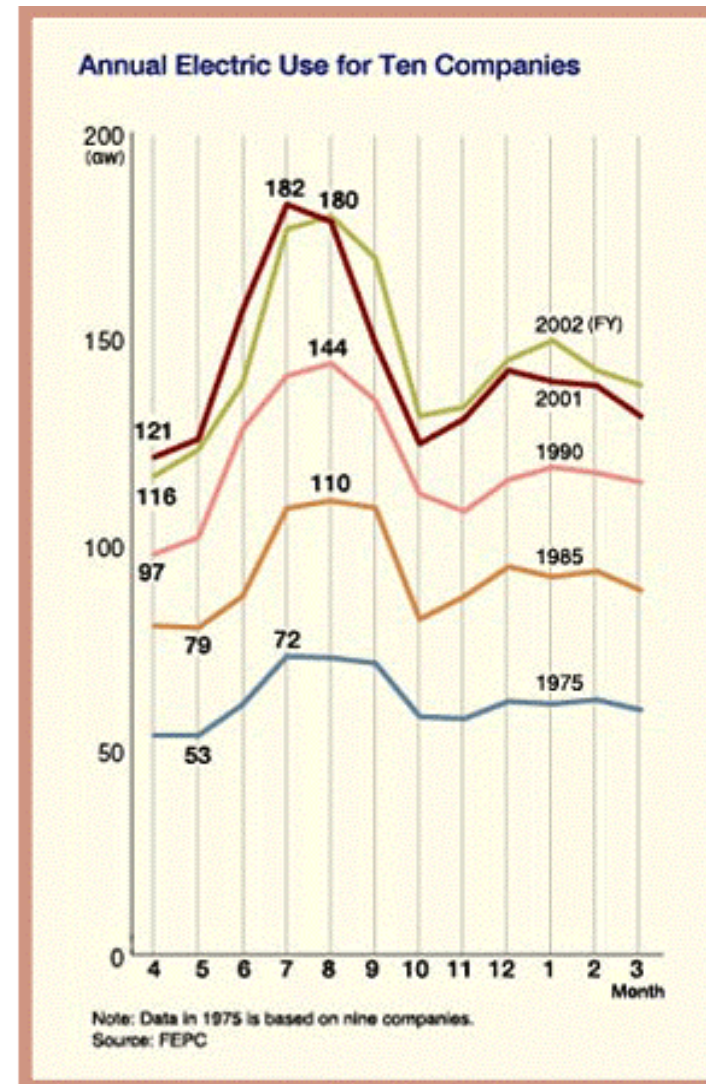
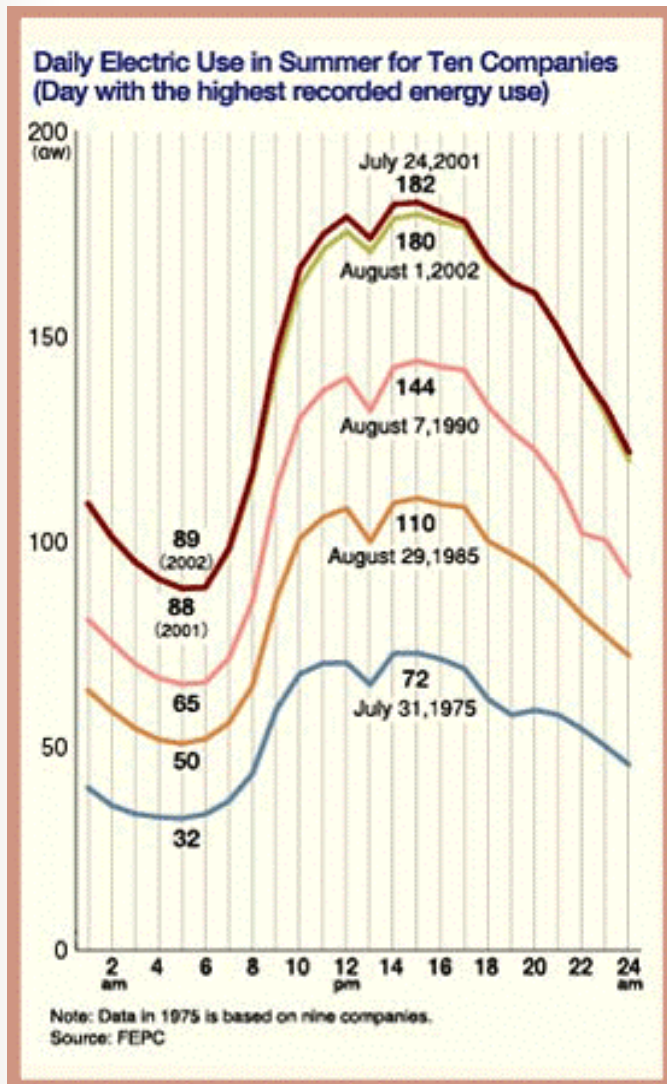
# The 10 Electric Power Companies

- ◆ System peak load (Total, FY2003): 167,267MW
- ◆ Electric energy sales (Total, FY2003): 834,305GWh.



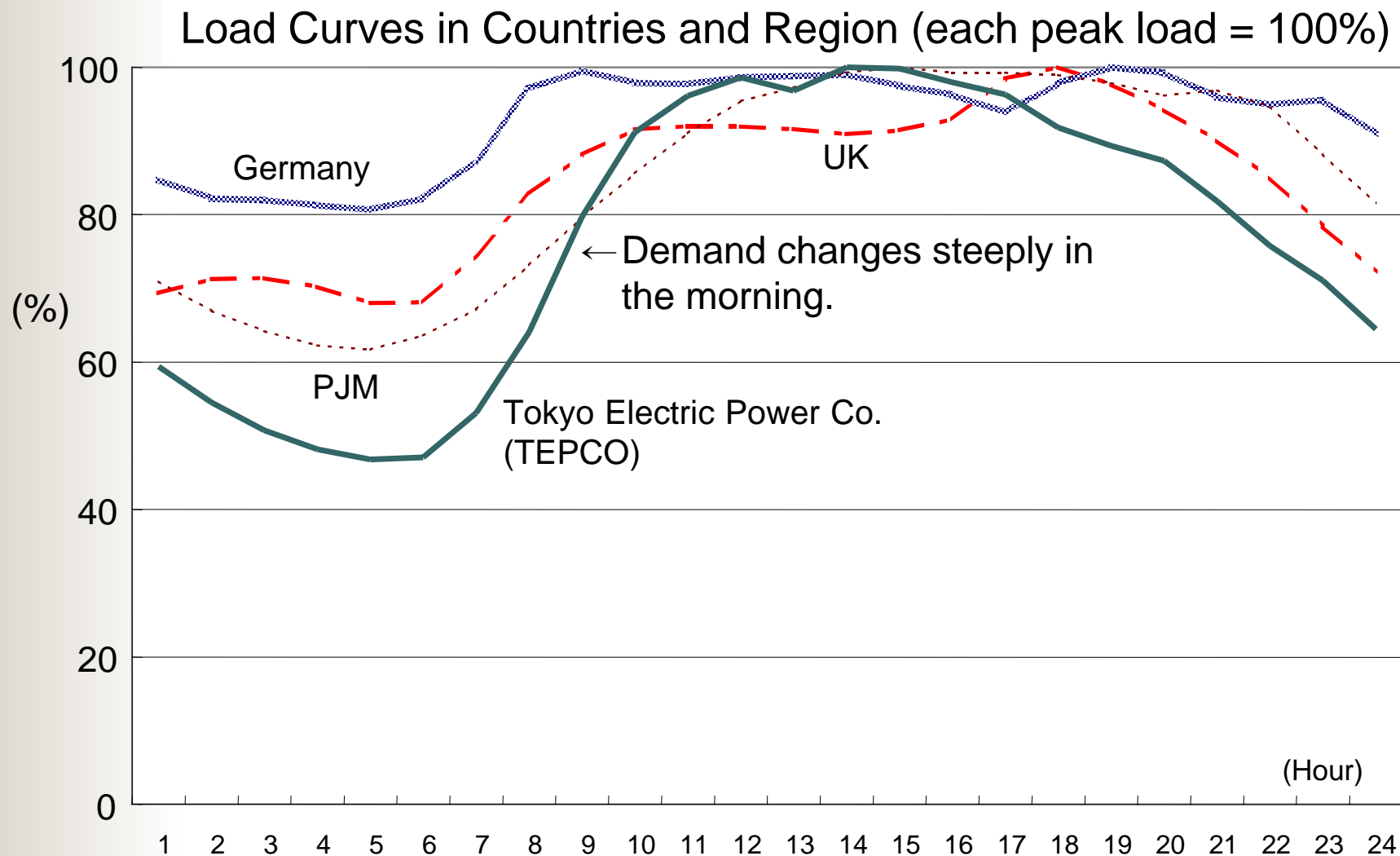
# Pattern of Electricity Usage

- ◆ Due to the demand for Air-conditioning, the Japanese power demand has its peak in summer.



## (Ref.) Electricity Supply-Demand Relationship in Japan

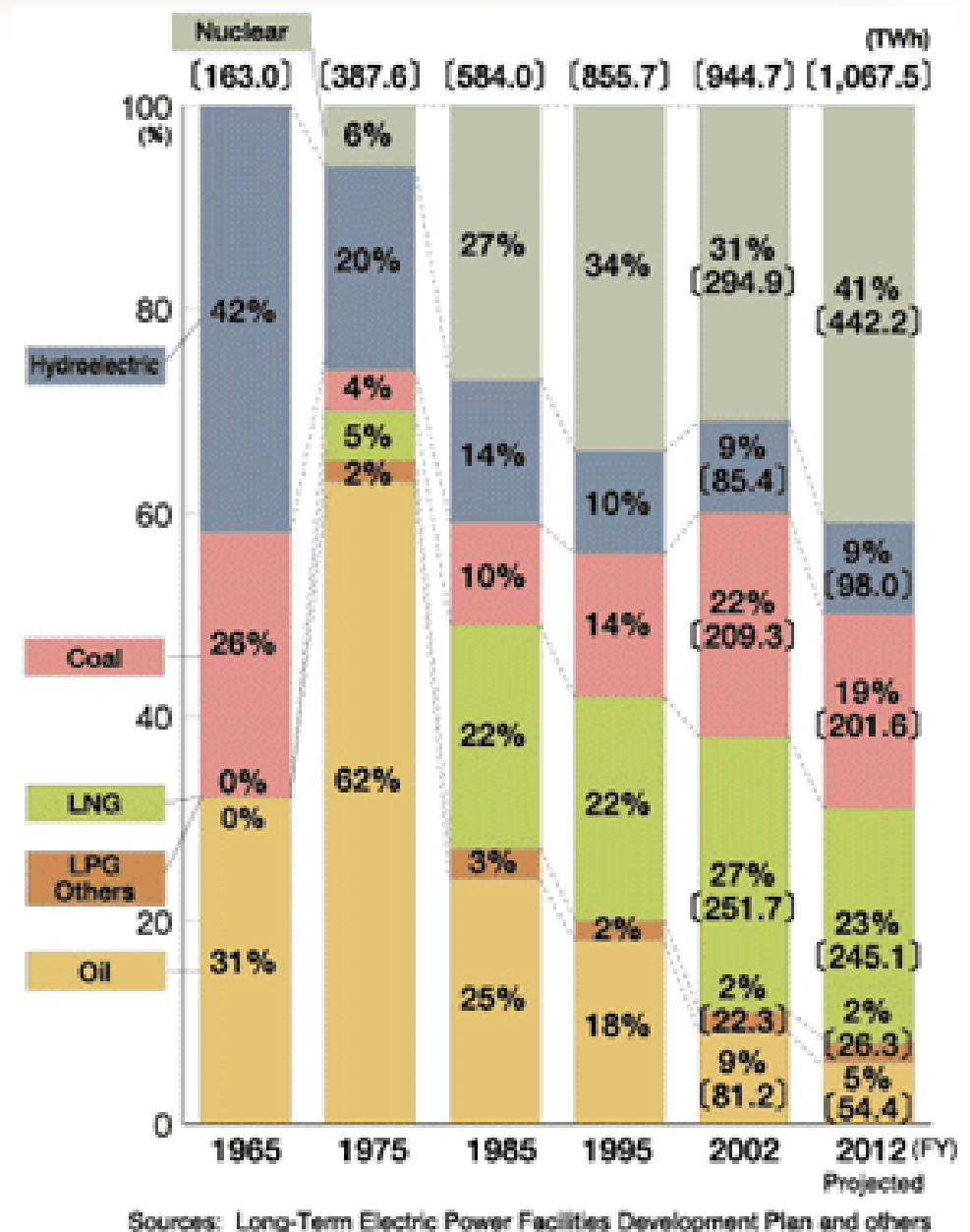
- ◆ Demand fluctuates more sharply as compared to other countries and regions.



(Source: TEPCO)

# Energy Source Power Output

- ◆ After facing two oil crisis in the 70's & 80's, Japan has diversified its energy sources for electricity.
  - Nuclear has served and will continued to serve as a key power source.



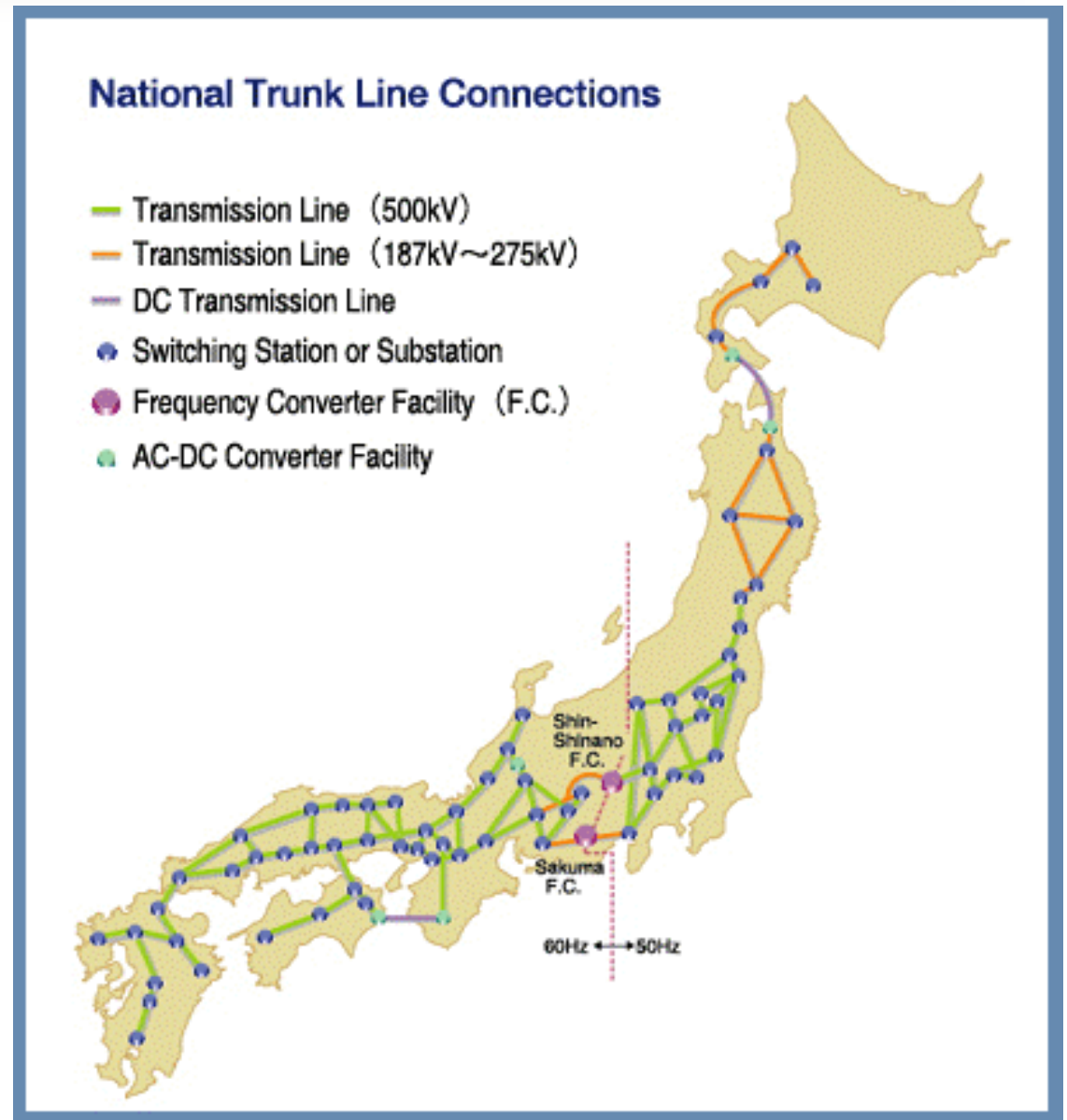


# Major Trunk Line Connections

◆ Transmission networks of electric companies are connected (except for Okinawa) to ensure a stable and efficient nationwide supply.

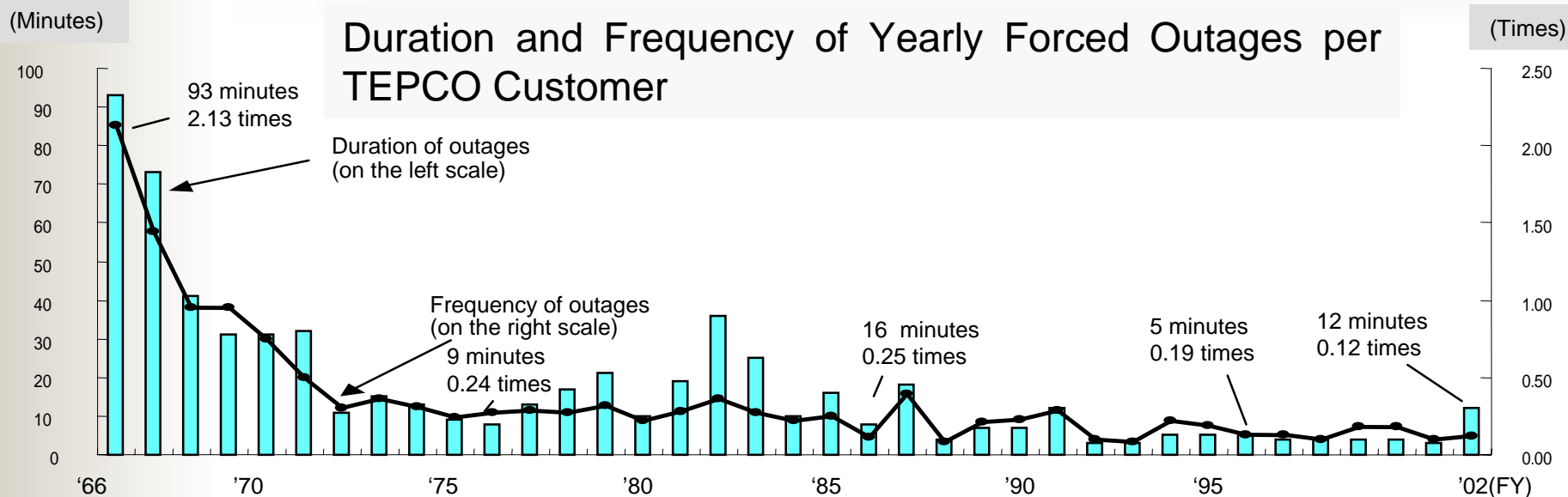
(e.g. emergency situations resulting from accidents, breakdowns, or summer peak demand)

- FC (Frequency Changes) stands between 50Hz- and 60Hz-zones.

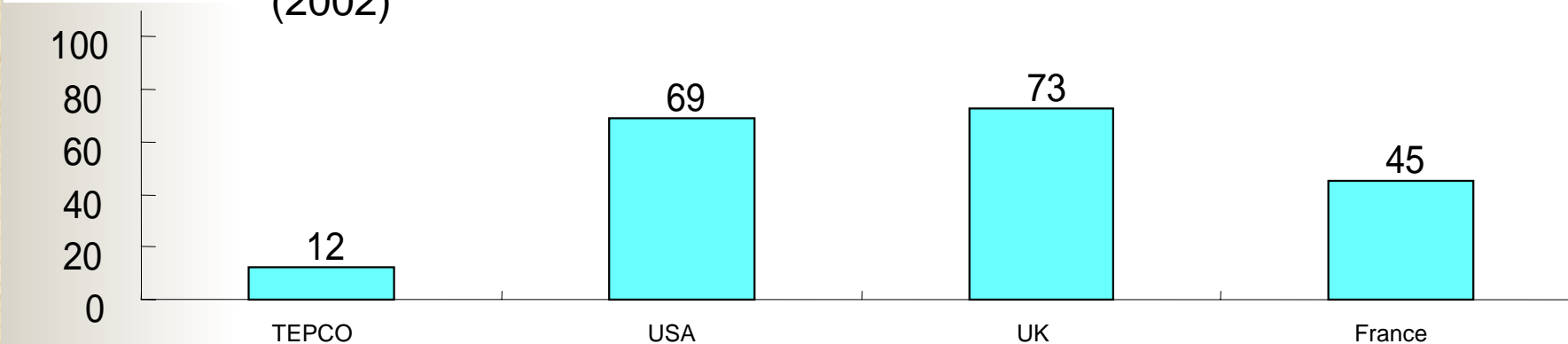


(Source: FEPC)

# (Ref.)Duration of Yearly Forced Outages per Customer (TEPCO's case)



**Duration of Yearly Forced Outages per Customer in Major Countries (2002)**



Source: USA: "SAIDI" (System Average Interruption Duration Index) average value of five US electric power companies—Consolidated Edison, Florida Power & Light, NStar (former Boston Edison), Pacific Gas & Electric, and Southern California Edison.  
 UK: "Ofgem Report on Distribution and Transmission Performance"  
 France: "EDF Annual Report"



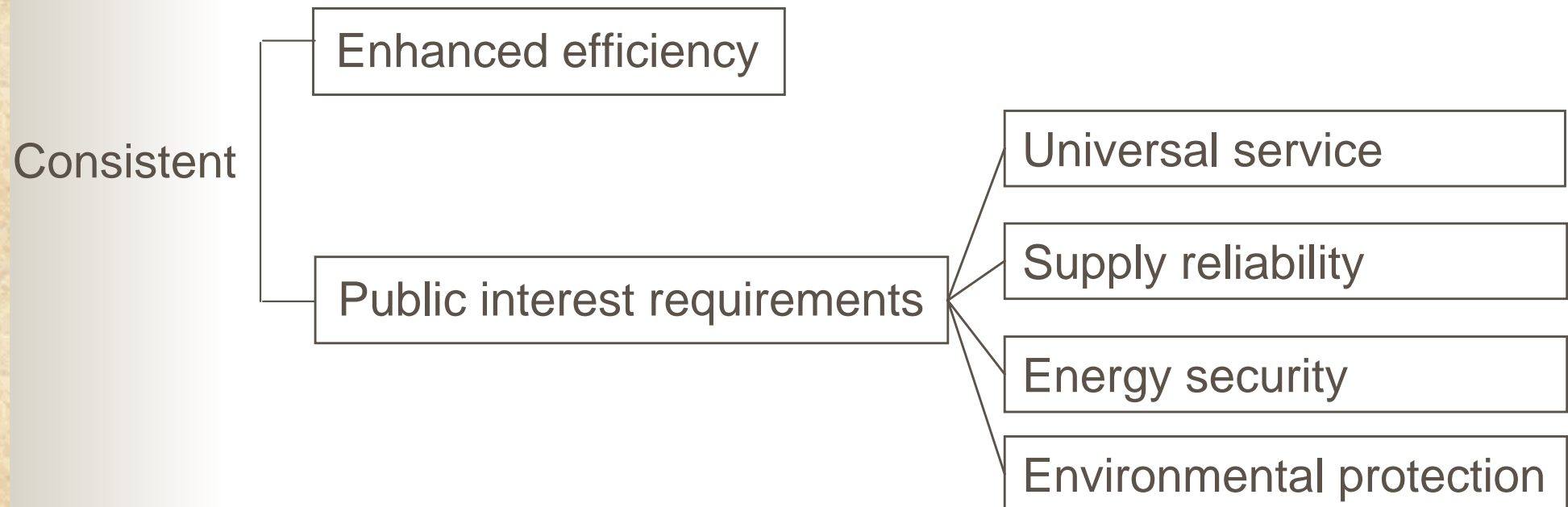
## 2. Electricity Liberalization

# Progress of Electricity Liberalization

- ◆ Discussion on electricity liberalization started early 1990s
  - Background: the high-cost structure in Japan, increasing demand for elimination of price variance between domestic and overseas markets, trend of sector reform in regulated industries (e.g. telecommunications and financial industries)
- ◆ In 1995: Amendment of the Electricity Utilities Industry Law (effective in December 1995)
  - Liberalization of **wholesale generation market** (Introduction of IPPs)
  - Introduction of wholesale power bidding system:
    - 6.66GW in total during 1996-99 was invited.
    - 28.341GW, fourfold of the invitation, was tendered, 7.38GW of which was successful.
- ◆ In 1999: Amendment of the Electricity Utilities Industry Law (effective in March 2000)
  - Introduction of **retail competition** for eligible customers of extra-high voltage
- ◆ In 2003: Amendment of the Electricity Utilities Industry Law (effective in April 2005)
  - Expansion of the liberalized market.

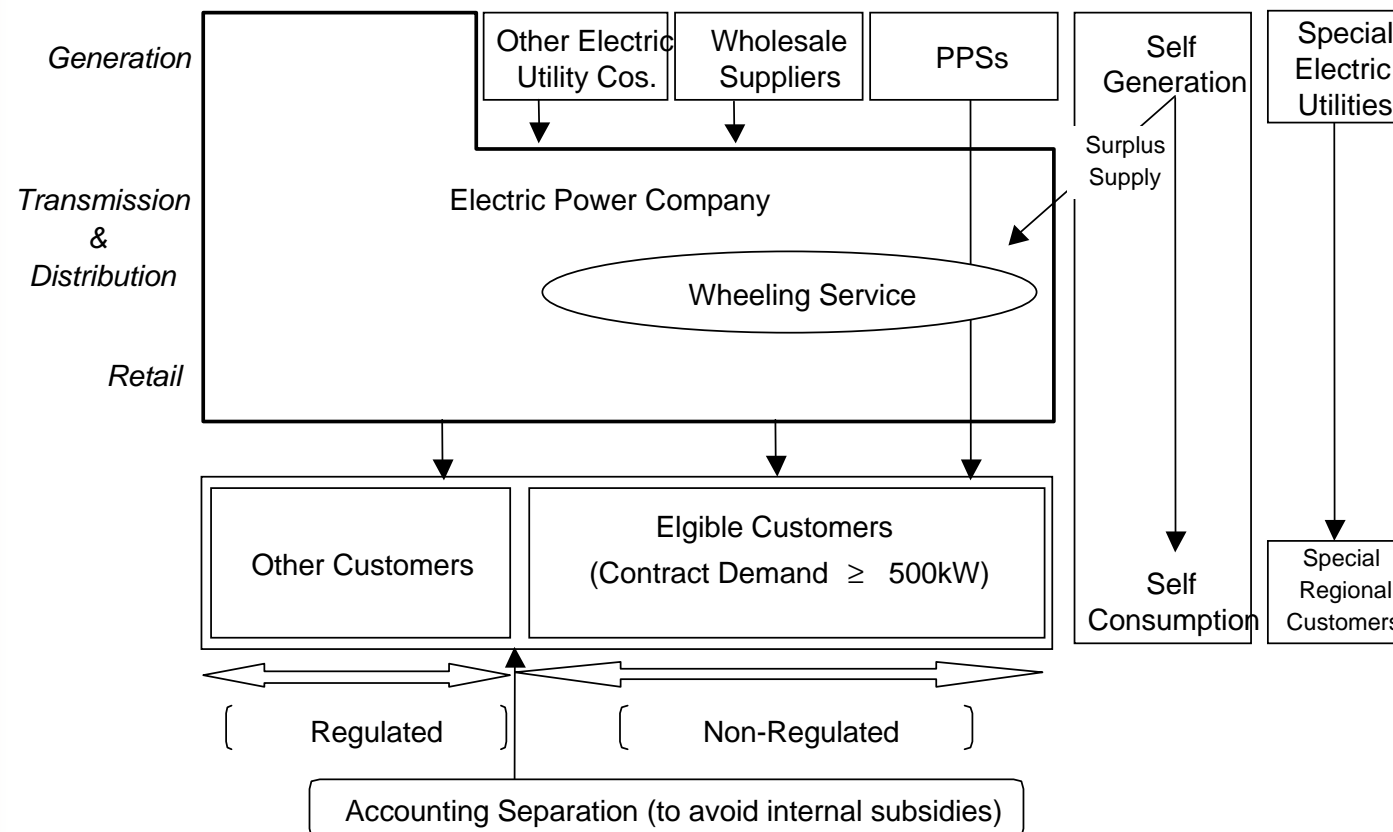
# Goals of Electricity Liberalization

- ◆ Promotion of public interests by providing *rate reductions and improving service level* through competition
- ◆ liberalization cannot be realized without compatibility between enhanced efficiency and protection of *public interest requirements*.



# Current Scheme

- ◆ Partial liberalization of the electricity retail market
  - Eligible Customers
    - Contract Demand: 2,000kW or more
    - Connected to an extra-high-voltage system of not less than 20 kV
    - About 30% of total electricity demand
- ◆ New Entrants (Power Producer and Supplier: PPS) became able to provide power to eligible customers by using “wheeling service,” offered by Electric Utility Companies, to transmit their electricity.



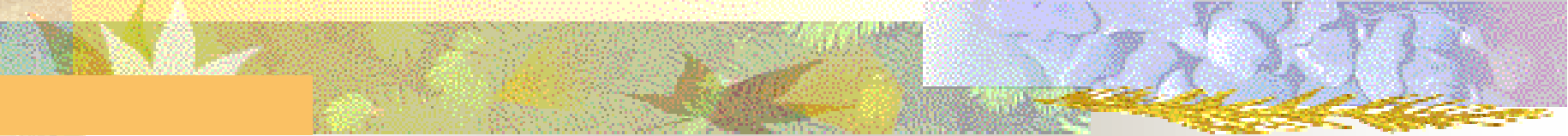
## Wheeling Service (Open access to transmission lines)

- ◆ Electric Utility Companies must accept application of new entrants for wheeling service.
  - Establishment of *Network service center*
- ◆ Rules of Wheeling Service ensure public interests and fairness
  - Electric Utility Companies are to:
    - *disclose* wheeling service-related information in advance.
    - *firewall* customer information.
    - operate dispatching control *non-discriminatively*.
  - New Entrants are to:
    - cope with the principle of “the same supply at the same time in 30 minute timeframe”
    - comply with dispatching order to maintain the network security
- ◆ In case of disputes, ex post regulation is exercised.

# New entrants (PPSs) to the market

- ◆ New entrants (as of July, 2004)
  - 15 “Power Producers & Suppliers (PPSs)”:  
Total capacity is 5.04GW
  
- ◆ The share of PPSs (as of July, 2004)
  - In TEPCO’s service area, 8 entities began operation, and have captured 372 customers and 1.21 GW.
  - The total share is only 4%, but *one quarter in the primary market for commercial customers*






### 3. Further Liberalization (Framework of New Institutional Arrangements)

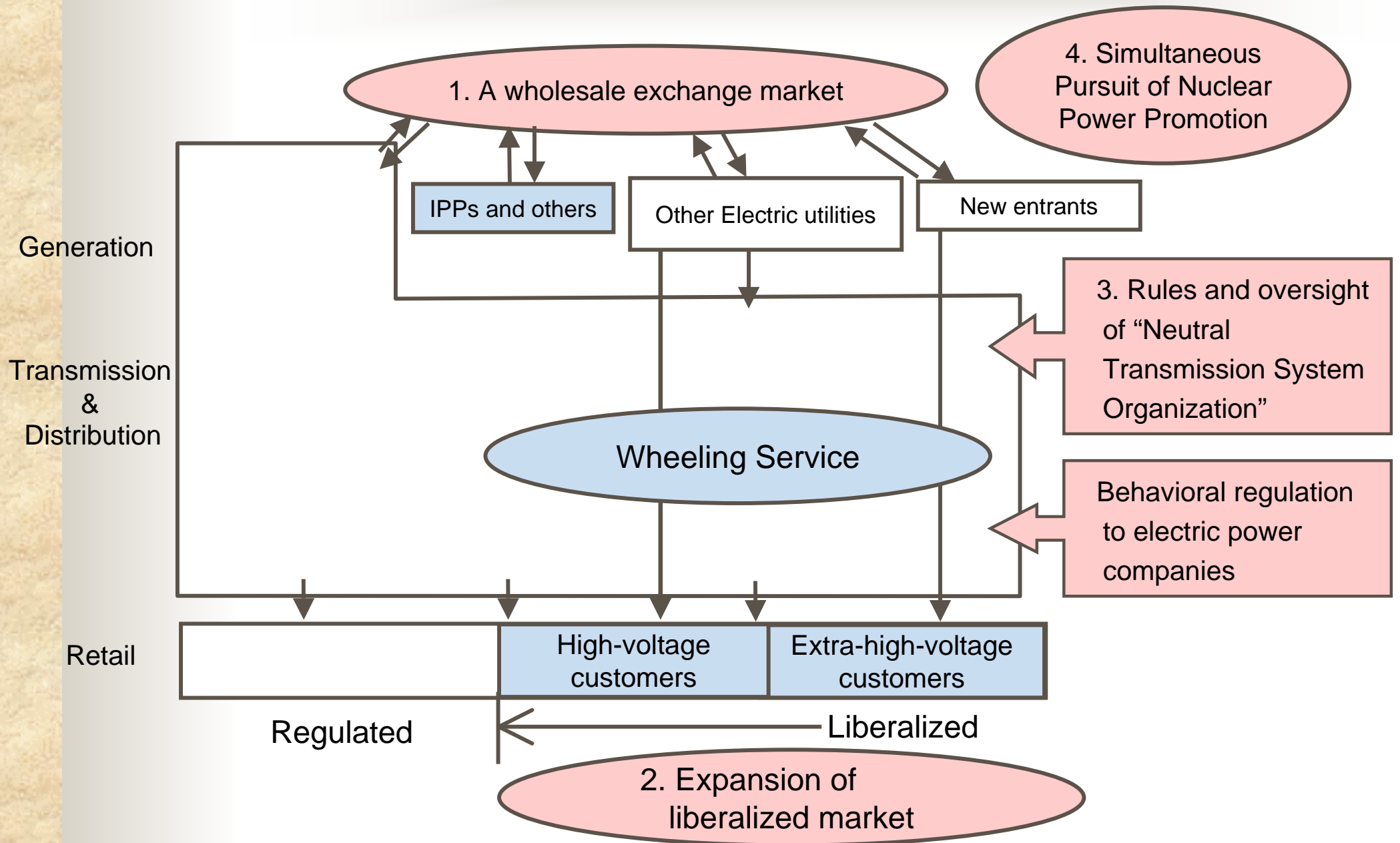
# Japanese own model: maintaining the vertically integrated system

- ◆ Characteristics of electricity
  - **Electricity cannot be stored**; therefore, supply and demand must be kept in balance in real-time.
  - **Power supply is less elastic.** Since it takes quite a long time to construct a power plant, additional supply capacity is not made available soon if there is a power shortage.
  - **Power demand is also less elastic.** Electricity is characterized by a lack of substitutability. Electricity is a necessity of life and economic activity. People find it difficult to refrain from buying electricity even if it is highly priced.

- ◆ Conditions Specific to Japan
  - Low self-sufficiency ratio in the energy supply
  - Sharp demand fluctuations
  - Long lead time for construction of facilities
  - Steady demand growth and the necessity of capacity expansion to meet it

- 
- ◆ Incumbent utilities should be maintained as a supplier with responsibility of supply security under the vertically integrated system from generation to retail. The utilities are particularly accounted for integral development and operation for generation and transmission facilities as well as promotion of nuclear power.
  - ◆ Under the current amendment of the Electricity Utilities Industry Law, the structural regulation (i.e. unbundling) is not adopted as long as the behavioral regulation is properly functioned.

# Key Points in the design of institutional arrangements

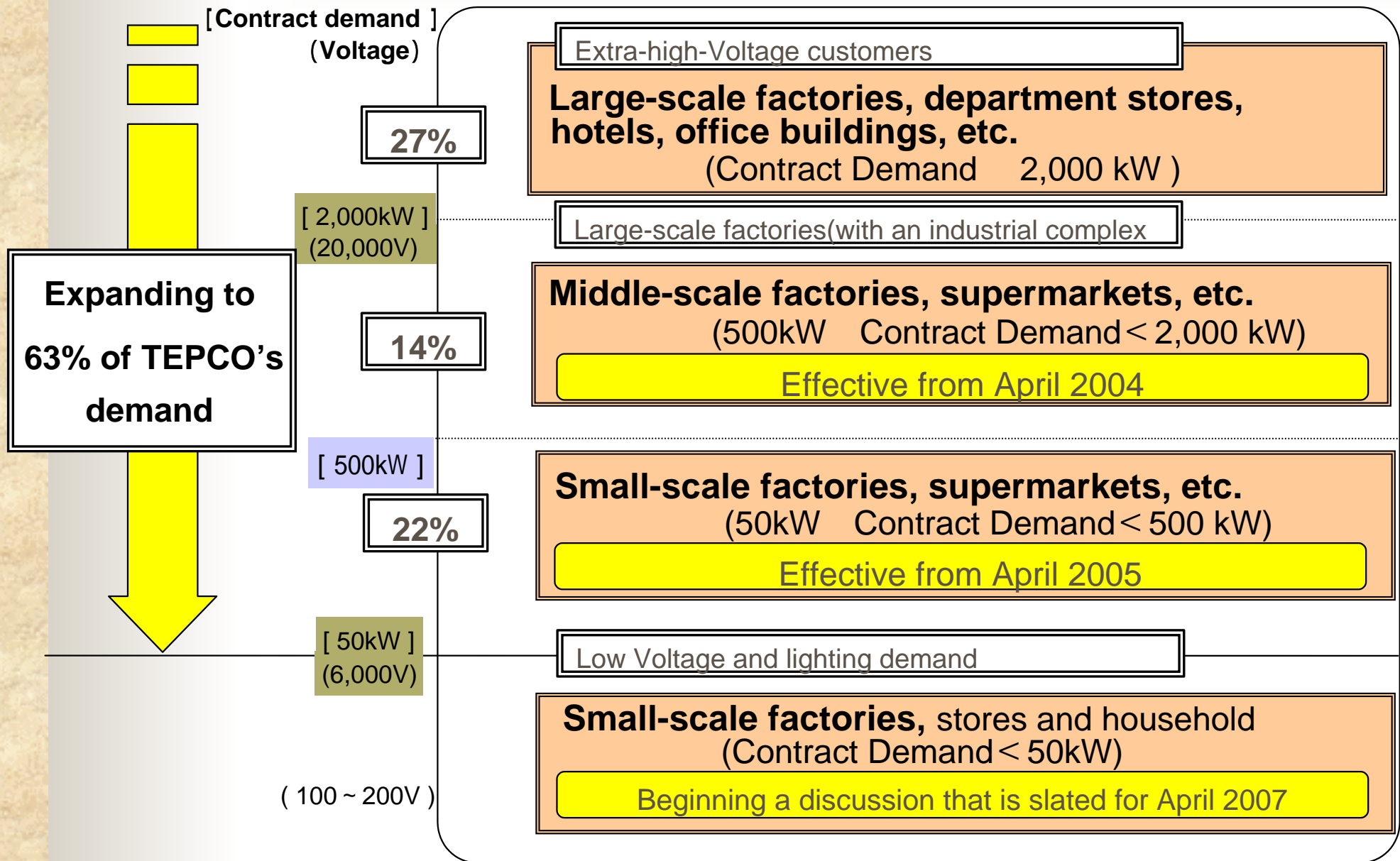


# 1. A wholesale exchange market

## ◆ Japan Electric Power Exchange (JEPX)

- Participation in exchange is voluntary, and not mandatory.
- A private non-profit organization
- Partners (investors):
  - ✓ A total of 21 investors as of now, including nine electric power companies plus the Electric Power Development Co., Ltd., 11 new entrants (PPS), and power generators. (as of July 2004)
- Members (participants):
  - ✓ Those firms that have either power generation capacity or retail demand, or agents who are employed by such firms.

# 2. Expansion of liberalized market

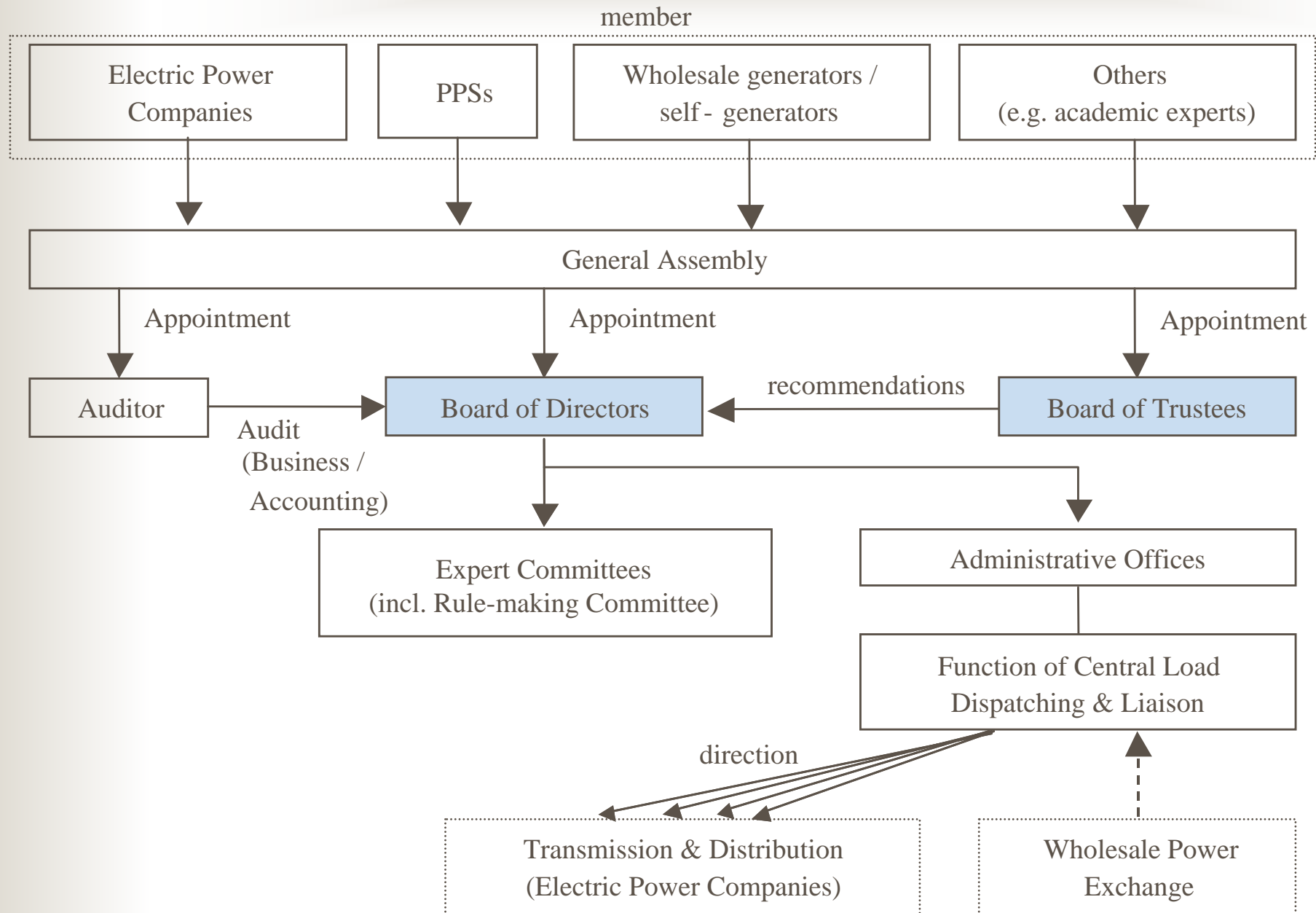


### 3. Rules and oversight of

#### “Neutral Transmission System Organization (NSO)”

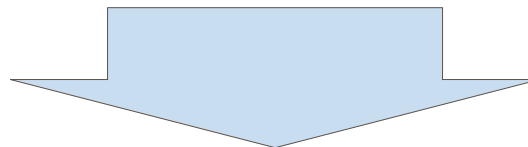
- ◆ NSO is a self-governing organization operated by private entities (e.g. EPCOs, PPSs), maintaining the process of neutrality.
  - In order to secure the fairness and transparency in transmission and distribution segments, NSO formulates basic rules (e.g. for development, access and operation of interconnection facilities) as well as implement market oversight and dispute-settlement.
    - ✓ T&D segments in electric power companies set forth and disclose a detail rules based on the rules formulated by NSO, and also disclose other rules on their own judgments.
  - “Electric Power System Council of Japan (ESCJ)” was designated as NSO in June 2004
    - ✓ 46 participants (including 10 EPCOs, as of 13 July, 2004)
  - Neutral-positioned academic experts are involved in decision-making process in addition to the market participants.
    - ✓ Voting power is proportionately allocated in order to secure neutrality as well as technicality.
- ◆ The government (i.e. METI) overseas the neutrality of decision-making process, leaving the operation of NSO itself to the initiative of NSO members.

# Organizational structure of ESCJ



## 4. Simultaneous Pursuit of Nuclear Power Promotion

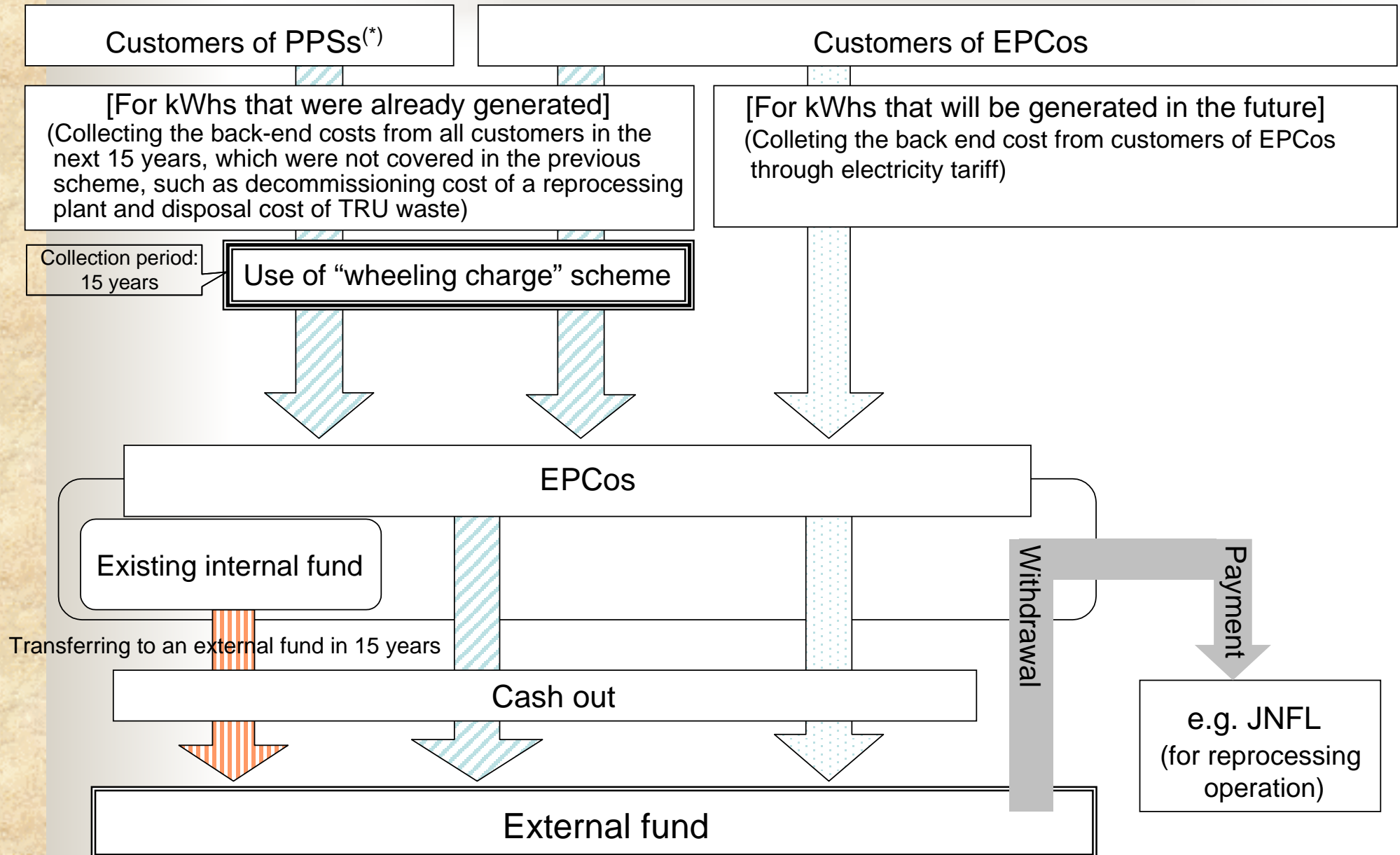
- ◆ Analysis and assessment of cost structure covering the back end of the nuclear industry and entire profitability of nuclear power
- ◆ Arrangement of sharing *roles between the government and private sector* will be made and consistent with the present system, based on the results of the analysis and assessment



- The concrete system and measures such as a financial scheme will be discussed by the end of 2004.



# Proposed Financial Scheme for Back-end Cost



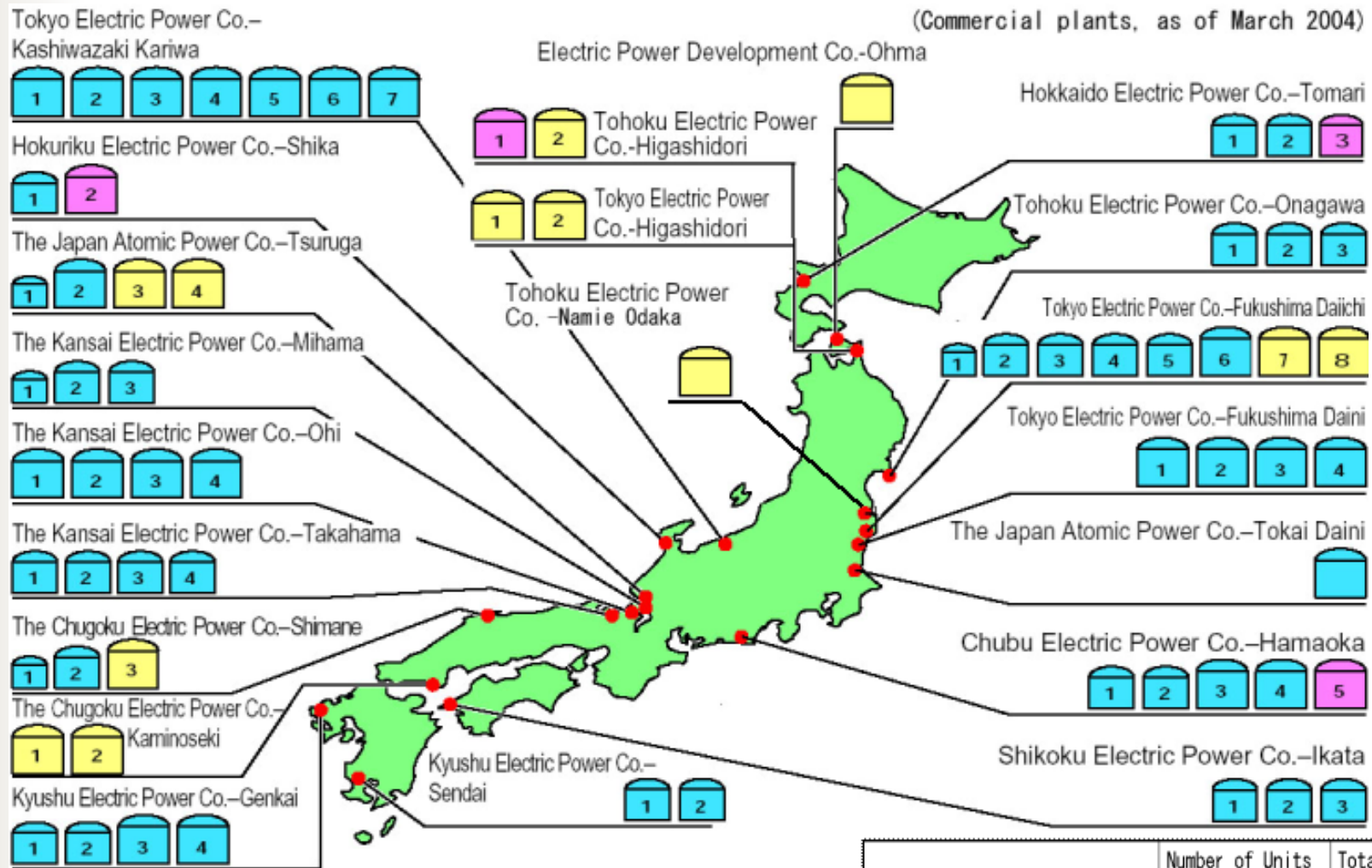
\*PPSs (Power Producers & Suppliers): Alternative suppliers, New market entrants



# 4. Nuclear Power and Fuel Cycle

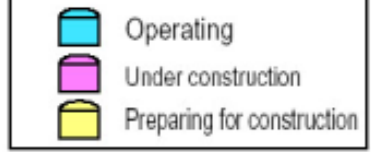
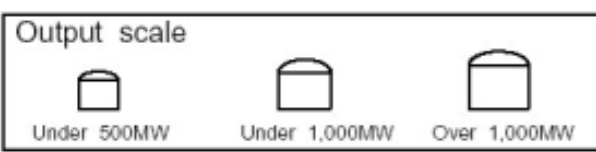
# Nuclear Power Plants in Japan

- ◆ 52 commercial nuclear reactors are in operation with a total generation capacity of 45,742 MW.



(Source: FEPC)

	Number of Units	Total Output (MW)
Operational	52	45,742
Under construction	4	4,750
Preparing for construction	12	16,318
<b>Total</b>	<b>68</b>	<b>66,810</b>

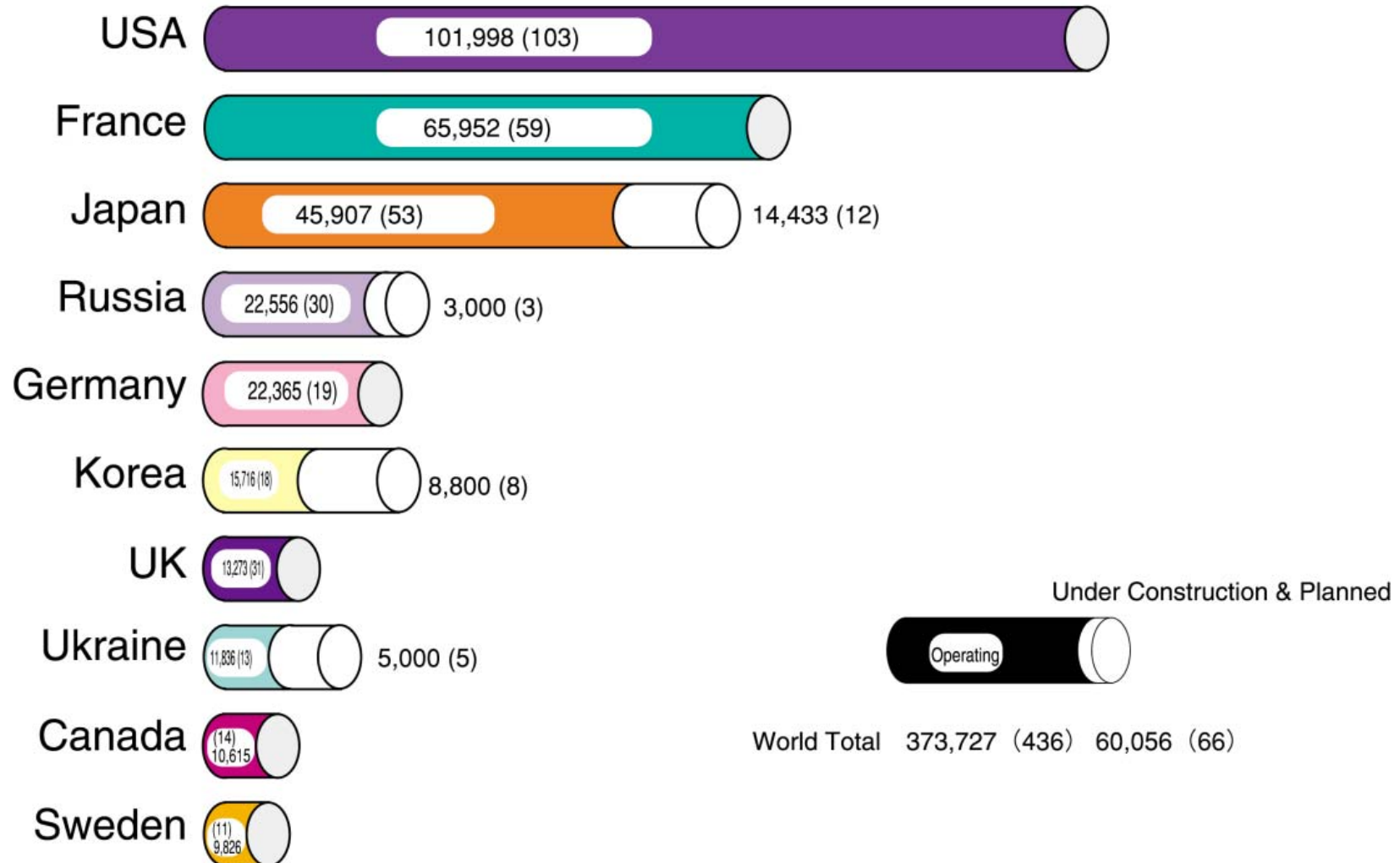


# International Comparison in Nuclear Power (1)

## Generating Capacity of Nuclear Power Plants in Major Countries

Unit: MW(Number of Units)

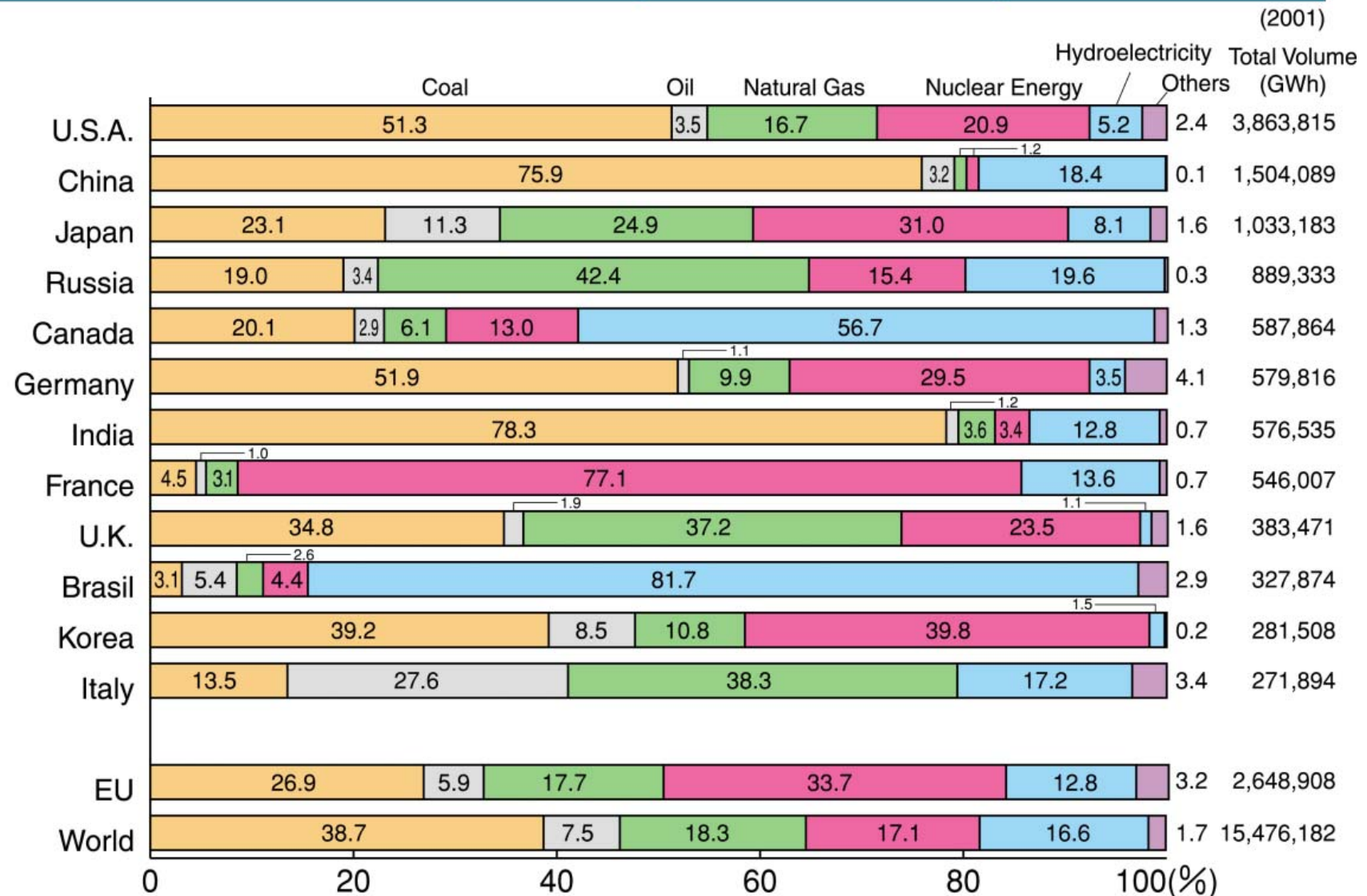
(As of Dec.31, 2002)



(Note) An advanced thermal reactor, "Fugen" and a prototype FBR, "Monju" are included in Japan.  
 (Source) Japan Atomic Industrial Forum

# International Comparison in Nuclear Power (2)

## Power Generation Volume by Source for Major Countries



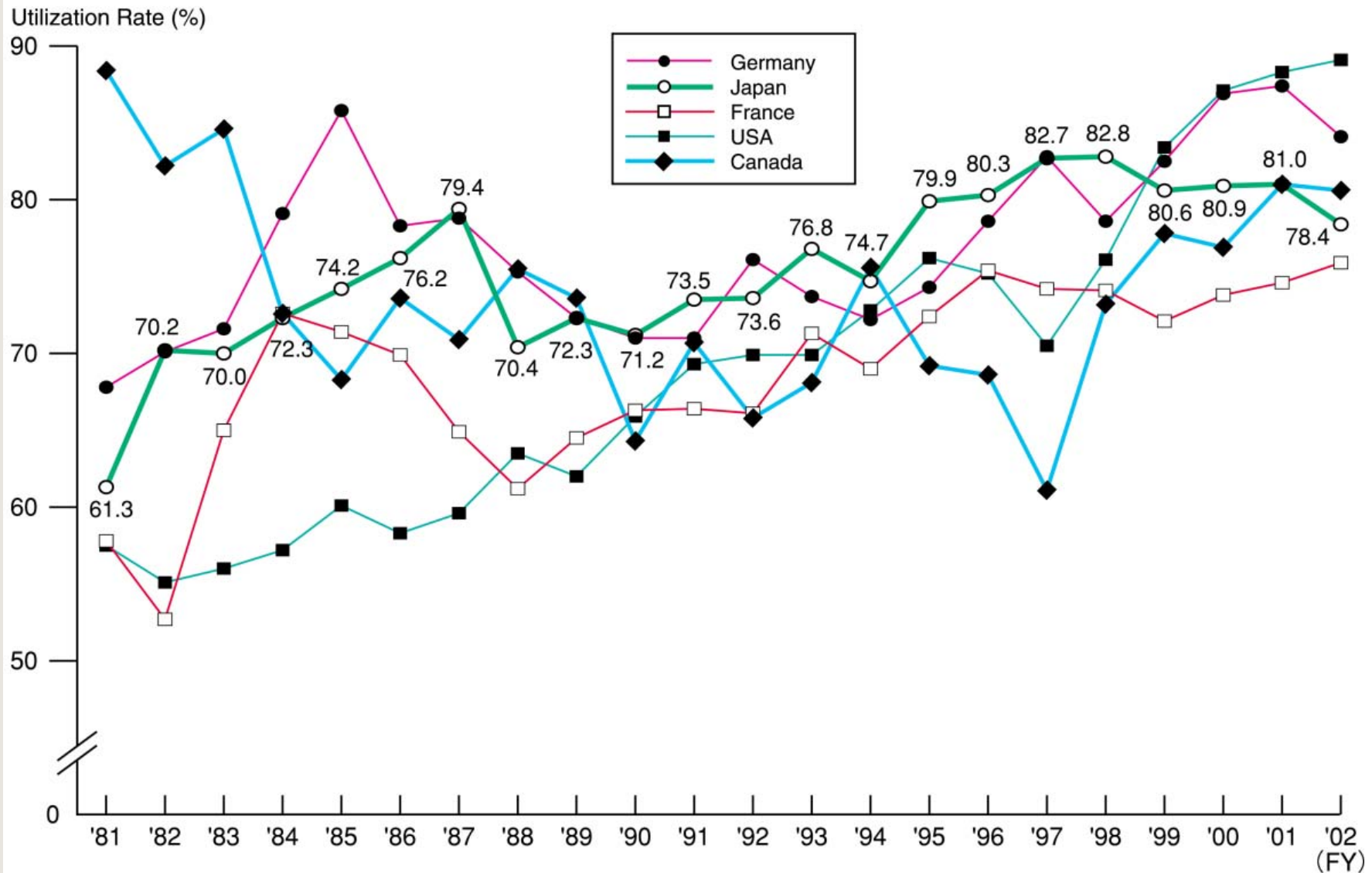
(Note) Figures do not necessarily total to 100% due to rounded numbers.

(Source) IEA, "Energy Balances of OECD Countries, 2000-2001"

IEA, "Energy Balances of Non-OECD Countries, 2000-2001"

# International Comparison in Nuclear Power (3)

## Utilization Rate of Nuclear Power Plants in Major Countries

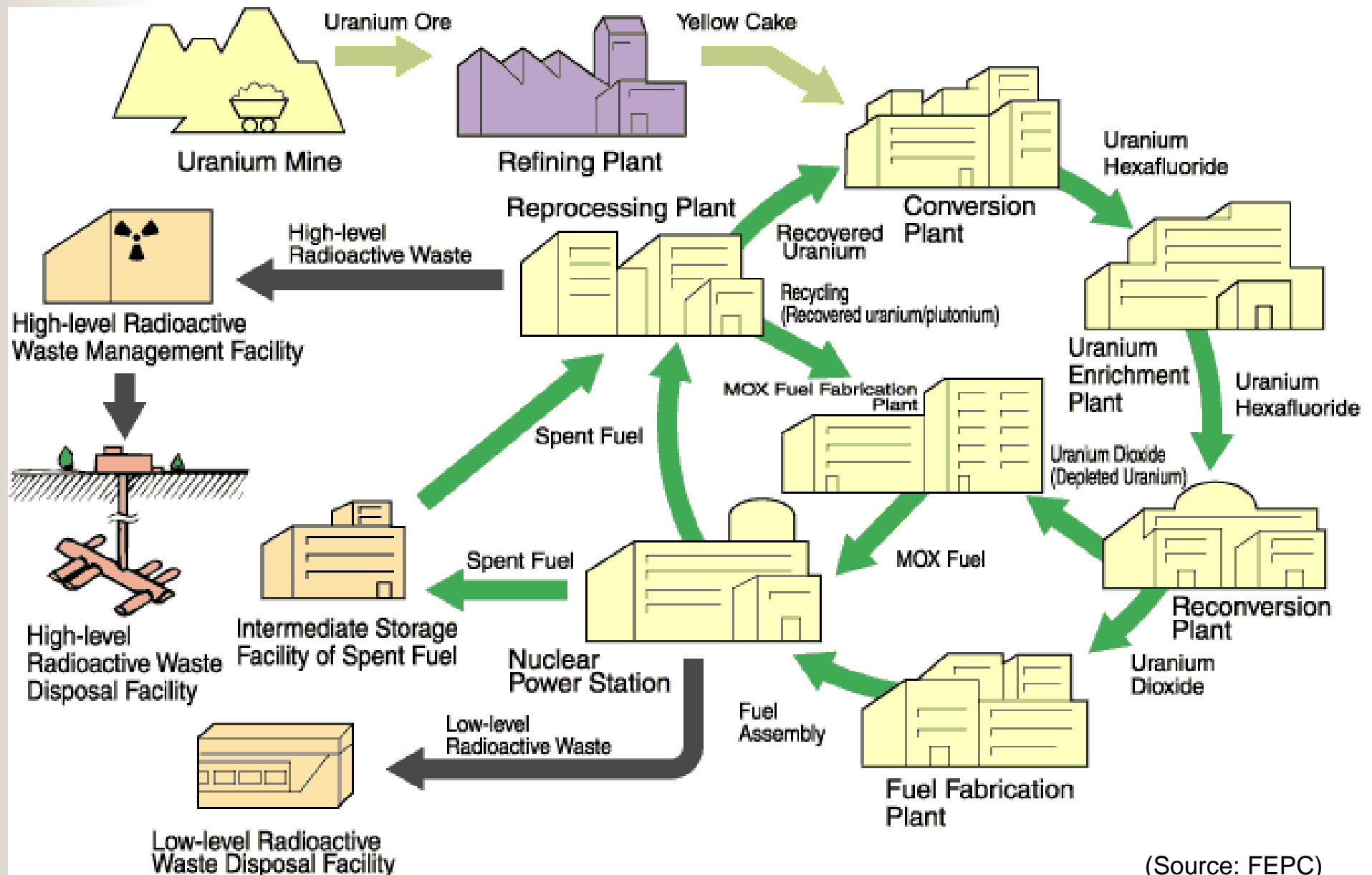


(Source) METI

# Nuclear Fuel Cycle Policy

- ◆ Japan has adopted a nuclear fuel cycle policy which offers lots of advantages.
  - Japan's spent fuel has been reprocessed in the U.K. and France. However, in order to further enhance energy security, Japan has turned to recycling spent fuel itself to establish nuclear power as a domestic energy source, because Japan has few natural resources.
  - In addition, it conserves uranium resources, and the volume of high level waste (HLW) is reduced to less than half by reprocessing spent fuel, which lightens the burden on final disposal of HLW.

# Nuclear Fuel Cycle Policy (contd.)



(Source: FEPC)



# Japan Nuclear Fuel Limited (JNFL)

- ◆ Owned in large part by EPCos, and operates 3 types of facilities:
  - the Uranium Enrichment Plant,
  - the Vitrified Waste Storage Center for high-level radioactive waste,
  - the Low-level Radioactive Waste Disposal Center.
- ◆ Preparing for overall operations at its large-scale Reprocessing Plant
- ◆ Planning to construct a MOX Fuel Fabrication Plant.

(As of the end of September 2003)

	Reprocessing Plant	Vitrified Waste Storage Center	Uranium Enrichment Plant	Low-level Radioactive Waste Disposal Center
Site	Iyasakatai, Rokkasho-mura, Kamikita-gun, Aomori Prefecture		Oishitai, Rokkasho-mura, Kamikita-gun, Aomori Prefecture	
Capacity	[Maximum processing capacity] 800 ton-U/year [Spent fuel storage capacity] 3,000 ton-U	Storage capacity for vitrified waste returned from overseas [Present] 1,440 canisters [Future] 2,880 canisters	[Initial operation] 150 ton-SWU/year [Planned] 1,500 ton-SWU/year (maximum capacity)	[Present] approx. 200,000m <sup>3</sup> equivalent to approx. one million 200 liter drums [Planned] approx. 600,000m <sup>3</sup> equivalent to approx. three million 200 liter drums
Current Status	Under construction	[Aggregate canisters received] 616	In operation with a capacity of 1,050 ton-scale-SWU/year	[Aggregate drums received] 143,755
Construction Cost	Approx. 2.14 trillion yen	80 billion yen <sup>(*)</sup>	Approx. 250 billion yen	Approx. 160 billion yen <sup>(**)</sup>
Schedule	Start of construction : 1993 Start of operation : 2006	Start of construction : 1992 Start of storage : 1995	Start of construction : 1988 Start of operation : 1992	Start of construction : 1990 Start of operation : 1992

(\*) Construction expense regarding 1,440 canisters of vitrified waste

(\*\*) Construction expense regarding 200,000m<sup>3</sup> low-level radioactive waste(equivalent to one million 200 liter drums)

(Source) JNFL's brochure and others